0.00.5em

0.0.00.5em

0.0.0.00.5em

0em

OpenCOBOL FAQ

Release 1.1

Brian Tiffin

October 19, 2013

CONTENTS

OpenCOBOL

Status

This is a 1.1 final of the OpenCOBOL FAQ. Sourced at ocfaq.rst. Courtesty of ReStructuredText, Sphinx and Pygments.
ocfaq.pdf is also available, using `rst2latex` and then `pdflatex`.
A Sphinx generated Portable Document Format version is stored http://opencobol.add1tocobol.com/OpenCOBOLFAQ.pdf
This FAQ is more than a FAQ and less than a FAQ.
Website favicon by Mark James, help.png from the FAMFAMFAM Silk icon set. http://creativecommons.org/licenses/by/2.5/
"COBOL Warriors" image Copyright © 2008 Robert Saczkowski. Banner courtesy of the GIMP, Copyright © 2008-2013 Brian Tiffin and both are licensed under Creative Commons Attribution-Share Alike 2.0 Generic License http://creativecommons.org/licenses/by-sa/2.0/
OpenCOBOL has been renamed to GNU Cobol and is now proudly a GNU free software project. http://savannah.gnu.org/projects/gnucobol

Authors

Brian Tiffin [btiffin]

Answers, quotes and contributions:

John Ellis [jrls_swla], Vincent Coen, Jim Currey, Bill Klein [wmklein], Ganymede, Simon Sobisch [human], Rildo Pragana, Sergey Kashyrin, Federico Priolo, Frank Swarbrick, Angus, DamonH, Parhs, Gerald Chudyk

Compiler by:

Roger While [Roger],
Keisuke Nishida [Keisuke],
(with the invaluable assistance of many others)

Special credits to

Gary Cutler author of the OpenCOBOL Programmers Guide
Joseph James Frantz for hosting and advocacy [aoirthoir]

Version 1.1, October 19th, 2013

Status Final. Superceded by GNU Cobol

ChangeLog ChangeLog

Note: Regarding COBOL Standards, Official COBOL Standards: There are many references to **standards** in this document. Very few of them are *technically* correct references. Apologies to all the hard working men and women of the technical committees for this unintentional slight. For specific details on what wordings should be used please see What are the Official COBOL Standards?

OpenCOBOL

Contents

OpenCOBOL FAQ

CHAPTER

ONE

1.1 WHAT IS OPENCOBOL?

OpenCOBOL is an open-source COBOL compiler. OpenCOBOL implements a substantial part of the COBOL 85 and COBOL 2002 standards, as well as many extensions of the existent COBOL compilers.

OpenCOBOL translates COBOL into C and compiles the translated code using the native C compiler. You can build your COBOL programs on various platforms, including Unix/Linux, Mac OS X, and Microsoft Windows.

The most excellent `OpenCOBOL Programmer's Guide` can be found at OpenCOBOL Programmers Guide.

CHAPTER

TWO

1.2 WHAT IS COBOL?

COBOL is an acronym for COmmon Business Oriented Language. This author has always thought of it as “Common Business” Oriented more than Common “Business Oriented”, but that emphasis is perhaps up to the reader’s point of view.

CHAPTER

THREE

1.3 HOW IS OPENCOBOL LICENSED?

The compiler is licensed under GNU General Public License.

The run-time library is licensed under GNU Lesser General Public License.

All source codes are copyright by the respective authors.

What that means, roughly, is:

```
You are allowed to write OpenCOBOL programs that use the libcob run time
library however you like.  Closed, proprietary, commercial use is allowed
and encouraged.  You can ship programs in binary form as you wish.

Modifications to the compiler itself, MUST provide access to source code and
be licensed under the GNU GPL.  This ensures that no one is allowed to call
modified sources their own, nor deny anyone else the chance to copy and
re-distribute the compiler source code, including your local changes.

Please note: any verion of the compiler that is configured to use Berkeley DB
beyond version 1.85 must abide by the Oracle license and sources of the
COBOL programs that use libdb must be shipped with any binaries.
```

OpenCOBOL is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

CHAPTER

FOUR

1.4 WHAT PLATFORMS ARE SUPPORTED BY OPENCOBOL?

OpenCOBOL 1.0 the current official release version, hosted on SourceForge.net, compiles on:

- All 32-bit MS Windows (95/98/NT/2000/XP)
- All POSIX (Linux/BSD/UNIX-like OSes)
- OS/X

OpenCOBOL 1.1, has been built on

- MS Windows native
- MS Windows with Cygwin
- GNU/Linux
- POSIX Systems including OpenSolaris
- OS/X
- AS/400
- HP Integrity HPUX 11.23
- RS600 AIX 5
- 390 Mainframe z/OS OMVS/USS
- others

CHAPTER

FIVE

1.5 ARE THERE PRE-BUILT OPENCOBOL PACKAGES

Yes. Debian APT, and RPM packages exist. Packages for NetBSD. Many. Google *opencobol packages* for any late breaking news.

A Debian Advanced Package Tool binary package exists for OpenCOBOL 1.0 as `open-cobol` and lists dependencies of

- libc6 (>= 2.7-1),
- libcob1,
- libcob1-dev (= 1.0-1),
- libdb4.5 (>= 4.5.20-3),
- libdb4.5-dev,
- libgmp3-dev,
- libgmp3c2,
- libltdl3-dev,
- libncurses5 (>= 5.6+20071006-3)

Thanks to the gracious efforts of Bart Martens, bartm on Debian's .org domain.

5.1 1.5.1 kiska.net repository

Also check out kiska.net for binary builds on various platforms. Thanks to Sergey Kashyrin.

5.2 1.5.2 sourceforge

There are OpenCOBOL links at http://cobol.sourceforge.net

In particular, http://sourceforge.net/projects/cobol/files/open-cobol/ can come in handy, with sources and MinGW binaries at a mininum. Maybe more as time goes on.

CHAPTER

SIX

1.6 WHAT IS THE MOST RECENT VERSION OF OPENCOBOL?

See What is the current version of OpenCOBOL?

CHAPTER

SEVEN

1.7 HOW COMPLETE IS OPENCOBOL?

OpenCOBOL 1.0 implements a substantial portion of COBOL 85, supports many of the advances and clarifications of COBOL 2002, and includes many extensions in common use from Micro Focus COBOL, ACUCOBOL and other existent compilers.

OpenCOBOL 1.1 implements a more substantial portion of the COBOL 85 Dialect, COBOL 2002 and a growing number of vendor extensions. Some proposed COBOL 20xx features have also been implemented. Compatibility support includes:

- MF for Micro Focus
- IBM for IBM compatibility
- MVS
- BS2000

OpenCOBOL also includes some advanced features allowing source code such as

```
CALL "cfunction" USING BY REFERENCE ADDRESS OF VAR-IN-LINKAGE-SECTION.
```

Passing the equivalent of char**, pointer to pointer to char. Just as a small example of the level of coverage and flexibility provided by OpenCOBOL.

```
DISPLAY
    FUNCTION UPPER-CASE(
        FUNCTION SUBSTITUTE(
            "This is the orginal string.";
            "original"; "new"; "string"; "text"
        )
    )
END-DISPLAY
```

To allow for substitution of mixed length strings, something not normally so easy in COBOL. The above will output:

```
THIS IS THE NEW TEXT.
```

Note: While OpenCOBOL can be held to a high standard of quality and robustness, the authors *DO NOT* claim it to be a "Standard Conforming" implementation of COBOL.

CHAPTER

EIGHT

1.8 WILL I BE AMAZED BY OPENCOBOL?

This author believes so. For an open source implementation of COBOL, OpenCOBOL may surprise you in the depth and breadth of its COBOL feature support, usability and robustness.

COBOL has historically been very secretive and low key. Its domain of use being very secretive and low key. COBOL programmers rarely work on systems that would allow for open internet chat regarding details, let alone *existence*. It is a tribute to the professionalism of these programmers that most people rarely, if ever, hear the name COBOL, a programming language with billions of lines of source code compiled and in production around the world over half a century.

OpenCOBOL is poised to change that historic trend, and allow for the long overdue sharing of wisdom that legions of COBOL developers have accumulated over 50 years of success and failure. The OpenCOBOL conversation may be more POSIX than mainframe, but there is now room to share, critique and pass on the hard lessons learned from critical systems computing. Given that millions of COBOL programmers kept billions of lines of COBOL source out of the press, surely some of the wisdom can be passed on in a way that keeps all the secrets secret while curious developers are exposed to COBOL outside the vaults.

CHAPTER

NINE

1.9 WHO DO I THANK FOR OPENCOBOL?

Many people. In particular **Keisuke Nishida** and **Roger While**.

See the THANKS file in the source code archive for more names of people that have worked on the OpenCOBOL project. Roger points out that the list is woefully incomplete. To quote:

```
The OC project would not have been where it is today without the
significant/enormous help from many-many persons. The THANKS
file does not even do justice to this.
```

CHAPTER

TEN

1.10 DOES OPENCOBOL INCLUDE A TEST SUITE?

Why yes it does. 74 syntax tests, 170 coverage tests, and 16 data representation tests in the February 2009 pre-release. 88 syntax, 253 coverage, and 22 data tests in a 2010 cut.

From the development tarball:

```
$ make check
```

will evaluate and report on the test suite. See make check listing for a current output listing of a test run.

CHAPTER

ELEVEN

1.11 DOES OPENCOBOL PASS THE NIST TEST SUITE?

The National Institute of Standards and Technology, NIST, maintains a COBOL 85 implementation verification suite of tests. An archive of the tests can be found at

http://www.itl.nist.gov/div897/ctg/cobol_form.htm

OpenCOBOL passes many of the tests included in the NIST sponsored COBOL 85 test suite. While it passes over 9000 of the tests, OpenCOBOL does not claim conformance to any level of COBOL *Standard*.

Instructions for use of the NIST suite is included in the build archive under:

`tests/cobol85/README`

Basically, it is a simple `uncompress` and `make` then sit back and relax. The scripts run OpenCOBOL over some 374 programs/modules and includes thousands of test passes.

```
Test Modules
------------

Core tests:

  NC - COBOL nucleus tests
  SM - COPY sentence tests
  IC - CALL sentence tests

File I-O tests:

  SQ - Sequential file I-O tests
  RL - Relative file I-O tests
  IX - Indexed file I-O tests
  ST - SORT sentence tests

Advanced facilities:

  IF - Intrinsic Function tests
```

With the addition of GLOBAL support, the OpenCOBOL 1.1 pre-release fails none of the attempted tests.

The summary.log from a run in February 2009:

```
------ Directory Information -------   --- Total Tests Information ---
Module Programs Executed Error Crash   Pass Fail Deleted Inspect Total
------ -------- -------- ----- -----  ----- ---- ------- ------- -----
NC           92       92     0     0   4363    0       6      11  4380
SM           15       15     0     0    290    0       3       1   294
IC           24       24     0     0    246    0       4       0   250
```

```
SQ            81        81      0      0    512     0        6       81   599
RL            32        32      0      0   1827     0        5        0  1832
IX            39        39      0      0    507     0        1        0   508
ST            39        39      0      0    278     0        0        0   278
SG             5         5      0      0    193     0        0        0   193
OB             5         5      0      0     16     0        0        0    16
IF            42        42      0      0    732     0        0        0   732
------ -------- -------- ----- -----  ----- ---- -------- -------- -----
Total        374       374      0      0   8964     0       25       93  9082
```

11.1 1.11.1 What's missing?

OpenCOBOL 1.1 does not include support for, or limits tests within the:

```
Advanced facilities:

  RW - REPORT SECTION tests
  CM - COMMUNICATION SECTION tests
  SG - Segment tests
  DB - Debugging facilities tests
  OB - Obsolete facilities tests
```

sections.

CHAPTER

TWELVE

1.12 WHAT ABOUT OPENCOBOL AND BENCHMARKS?

COBOL has a legacy dating back to 1959. Many features of the COBOL standard provide defaults more suitable to mainframe architecture than the personal computer a 3rd millennium OpenCOBOL developer will likely be using.

OpenCOBOL, by default, generates code optimized for big-endian hardware. Fairly dramatic speed improvements on Intel architecture can come from simple `USAGE IS COMPUTATIONAL-5` clauses in the DATA DIVISION.

12.1 1.12.1 telco billing

There is a benchmark posted at http://speleotrove.com/decimal/telco.html and thanks to Bill Klein [wmklein], there is a COBOL entry. From the source code at http://home.comcast.net/~wmklein/DOX/TELCO.txt you should only have to modify

```
Input-Output Section.
 File-Control.
    Select InFile  Assign to
         "C:\expon180.1e6".
    Select OutFile  Assign to
         "C:\TELCO.TXT"
                Line
                Sequential.
```

to point to the correct filename for your local copy of the benchmark million entry file and a suitable OutFile name for a clean compile and run.

In summary, the benchmark reads a large input file containing a suitably distributed list of telephone call durations (each in seconds). For each call, a charging rate is chosen and the price calculated and rounded to hundreths. One or two taxes are applied (depending on the type of call) and the total cost is converted to a character string and written to an output file. Running totals of the total cost and taxes are kept; these are displayed at the end of the benchmark for verification.

A run on an older pentium 4 and the million number file gave:

```
$ echo 'N' | time ./telco
Enter 'N' to skip calculations:
0.46user 1.08system 0:01.61elapsed 96%CPU (0avgtext+0avgdata 0maxresident)k
0inputs+134776outputs (0major+345minor)pagefaults 0swaps
$ echo '' | time ./telco
Enter 'N' to skip calculations:
11.37user 1.41system 0:12.95elapsed 98%CPU (0avgtext+0avgdata 0maxresident)k
24inputs+134776outputs (0major+360minor)pagefaults 0swaps
```

```
$ tail TELCO.TXT
    35    D  |         0.31         0.02         0.01 |         0.34
   193    D  |         1.73         0.11         0.05 |         1.89
   792    L  |         1.03         0.06              |         1.09
   661    D  |         5.91         0.39         0.20 |         6.50
    44    L  |         0.06         0.00              |         0.06
   262    L  |         0.34         0.02              |         0.36
-------------+-----------------------------------------+-------------
   Totals:   |   922,067.11    57,628.30    25,042.17 | 1,004,737.58
  Start-Time:09:37:23.93
    End-Time:09:37:36.83
```

A more recent 1.1 pre-release, on a dual quad-core Xeon box running Linux SLES 10 64-bit:

```
    35    D  |         0.31         0.02         0.01 |         0.34
   193    D  |         1.73         0.11         0.05 |         1.89
   792    L  |         1.03         0.06              |         1.09
   661    D  |         5.91         0.39         0.20 |         6.50
    44    L  |         0.06         0.00              |         0.06
   262    L  |         0.34         0.02              |         0.36
-------------+-----------------------------------------+-------------
   Totals:   |   922,067.11    57,628.30    25,042.17 | 1,004,737.58
  Start-Time:21:40:48.52
    End-Time:21:40:51.92
```

3.4 seconds cache-hot. Not bad.

CHAPTER

THIRTEEN

1.13 CAN OPENCOBOL BE USED FOR CGI?

Yes. Through standard IO redirection and the extended `ACCEPT ... FROM ENVIRONMENT ...` feature, OpenCOBOL is more than capable of supporting advanced Common Gateway Interface programming. See How do I use OpenCOBOL for CGI? for a sample *Hello Web* program.

For those developers looking to serve OpenCOBOL applications on hosted systems and no super user privileges, see How do I use LD_RUN_PATH with OpenCOBOL? for some pointers.

CHAPTER

FOURTEEN

1.14 DOES OPENCOBOL SUPPORT A GUI?

Yes, but not out of the box. There is not currently *(February 2013)* anything that ships with the product.

Third party extensions for Tcl/Tk and bindings for GTK+ do allow for graphical user interfaces. See Does OpenCOBOL support the GIMP ToolKit, GTK+? and Can OpenCOBOL interface with Tcl/Tk?.

14.1 1.14.1 GTK

The expectation is that GTK+ will be completely bound as a callable interface. That is currently *(February 2013)* not the case, with perhaps 2% of the GTK+ functionality wrapped (but with that 2%, fully functional graphical interfaces are possible).

14.2 1.14.2 Tcl/Tk

The Tcl/Tk engine is already quite complete but does place most of the burden of GUI development squarely on the Tk side.

14.3 1.14.3 Vala, WebKit

Vala will also open up a quick path to GUI development with OpenCOBOL. There is already an embedded web browser using the Vala bindings to WebKit. See Can OpenCOBOL interface with Vala? for a lot more details.

CHAPTER

FIFTEEN

1.15 DOES OPENCOBOL HAVE AN IDE?

Yes and no. There is no IDE that ships with the product. The add1tocobol team is currently *(February 2013)* at work creating extensions for the GNAT Programming Studio. This is working out quite nicely and will likely be the IDE of choice for the add1tocobol OpenCOBOL developers.

See Can the GNAT Programming Studio be used with OpenCOBOL? for more information.

There is also the Eclipse IDE and a major project for integrating COBOL but this will not be OpenCOBOL specific.

Many text editors have systems in place for invoking compilers. SciTE, Crimson Editor, vi and emacs to name but a few of the hundreds that support edit/compile/test development cycles.

See Does OpenCOBOL work with make? for some information on command line compile assistance.

CHAPTER

SIXTEEN

1.16 CAN OPENCOBOL BE USED FOR PRODUCTION APPLICATIONS?

Depends. OpenCOBOL is still in active development. Feature coverage is growing, and while the current implementation offers great coverage, applicability to any given situation would need to analyzed and risks evaluated before commitment to production use.

The licensing allows for commercial use, but OpenCOBOL also ships with notice of indemnity, meaning that there are no guarantees when using OpenCOBOL, directly or indirectly.

There may be a time when commercial support of OpenCOBOL is offered, but at the time of writing no known offering exists.

Search google just in case!

And yes, OpenCOBOL is used in production environments.

From [Roger]:

```
Incidentally, OC has been (and still is) used in production
environments since 2005.
(This includes projects that I personally worked on plus other
  projects reported to me; these worldwide)

The OC project would not have been where it is today without the
significant/enormous help from many-many persons. The THANKS
file does not even do justice to this.
```

16.1 1.16.1 Nagasaki Prefecture

Reported on opencobol.org, The Nagasaki Prefecture, population 1.44 million and 30,000 civil employees is using OpenCOBOL in support of its payroll management system. A team of 3 ported and maintain a suite of 200 COBOL programs, mingled with Perl and specialized reporting modules, running on Nec PX9000 big iron and Xeon servers.

16.2 1.16.2 Stories from Currey Adkins

Another post from opencobol.org in April 2009, *reprinted with permission*.

```
OpenCOBOL viability

For those concerned about the viability of OpenCOBOL in a production
environment, I offer our situation as an example.
```

```
We started loading OpenCOBOL to a Debian (Etch) Parisc box in mid March. With
some valuable help from this forum we were up and running in a few days.

We then explored the CGI capabilities and moved our home-brewed CGI handler
(written in HP3000 Cobol) over. We ended up changing only a few lines.

As Marcr's post indicates, we found a MySql wrapper and made some minor
changes to it.

Starting the second week in April we were in full development of new systems
for commercial use.

Please accept our congratulations to the community and our gratitude for the
help from the forum.

jimc
```

Another reference by Jim, some 6 months later in February 2010, which seems to be enough time for any rose-coloured glass effect to have worn off if it was going to.

```
For our part, the answer is yes.

You may want to read an earlier thread about this. Search on OpenCOBOL
viability.

Having worked with Cobol since the 1960's, my mindset is that no
conversion is automatic.

In our case we are not converting from a specific dialect like MF,
but instead are either writing entirely new systems or are changing
features (making them web based for example) in older systems.

There are some identified failures in OpenCOBOL execution that have
been discussed in this forum. We have found them to be inconsequential
and simply work around them. Then again I do not remember working with
a bug-free compiler.

Our environment is Debian Linux, OpenCOBOL 1.1, MySQL, ISAM (the one
provided with the 1.1 prerelease), HTML (via CGI) and a new PreProcessor
to relieve the tedium of writing SQL statements.

If you have some "nay sayers" in your organization and would like some
support I will be happy to speak with them.

jimc
```

I hope people don't mind a little advertising in this FAQ, but Jim has done a lot for OpenCOBOL and his company is a community minded company. http://www.curreyadkins.com

16.3 1.16.3 Public Accounting

Another from opencobol.org

```
As part of an initial study of COBOL compilers for finding an alternative to
that of MicroFocus, OpenCobol was selected to develop a model for the
compilation of a public accounting package (1.5 million lines).

The model had to validate this choice, including with the use of sequential
```

indexed files, with OpenCobol version 0.33 and small adjustments to the COBOL code (mainly using reserved keywords and keywords not implemented).

After the functional qualification of this model, the software is in production since July, 2011 under Linux RedHat Enterprise Linux 4 Advanced Server 32-bit virtualized environment VMWARE ESX - 4 GB of RAM - processor dual AMD Opteron 6176 (tm).

The software package is deployed for 650 users whose 150 connected simultaneously, at the peaks of activity and in comparison with the previous platform on AIX 4.3 and MicroFocus, performance gain is in a report, at best, 1-10 (batch of exploitation of entrustment), at worst, 1 to 4 (batch of recalculation).

With the rise of the package version, a functional validation is in progress since September 2011 with OpenCobol version 1.1 under Linux RedHat Enterprise Linux 5 Advanced Server 64-bit and dual Quad-Core AMD Opteron 8356 (tm) processor. No loss of performance related to the new version of OpenCobol (but related to the package of 10% to 20% loss) after campaign in the two environments.

CHAPTER

SEVENTEEN

1.17 WHERE CAN I GET MORE INFORMATION ABOUT COBOL?

The COBOL FAQ by William M Klein is a great place to start.

A google of the search words "COBOL" or "OpenCOBOL" are bound to lead to enough days worth of reading of in-depth articles, opinions and technical information to satisfy the greatest of curiosities.

The COBUG site *COBOL User Groups* is also a wonderful resource for OpenCOBOL developers.

This is highly subject to change, but currently *(February 2013)* a Draft of 20xx is available at http://www.cobolstandard.info/j4/index.htm and in particular http://www.cobolstandard.info/j4/files/std.zip

---

Note: While OpenCOBOL can be held to a high standard of quality and robustness, the authors *DO NOT* claim it to be a "Standard Conforming" implementation of COBOL.

CHAPTER

EIGHTEEN

1.18 WHERE CAN I GET MORE INFORMATION ABOUT OPENCOBOL?

Current project activities are at SourceForge. The opencobol.org website is probably a good place search as well. add1tocobol.com is a place to find out about a few of the fan initiatives. (An older archive has been stashed at http://oldsite.add1tocobol.com)

18.1 1.18.1 The OpenCOBOL Programmer's Guide

A very well written and masterful OpenCOBOL reference and COBOL development guide. By Gary Cutler, OpenCOBOL Programmers Guide.

CHAPTER

NINETEEN

1.19 CAN I HELP OUT WITH THE OPENCOBOL PROJECT?

Absolutely. Visit the opencobol.org website and either post a message asking what needs to be done, or perhaps join the development mailing list to find out the current state of development. See Is there an OpenCOBOL mailing list? for some details. OpenCOBOL is a GPL licensed open source project and while [Roger] is the lead developer he is quite open to code submissions. Having a central point of development allows for consistency and the very high level of quality control enjoyed by OpenCOBOL users.

19.1 1.19.1 Translation Efforts

A new project has started to see native language support in the `cobc` compile and run-time systems. Please see http://www.opencobol.org/modules/newbb/viewtopic.php?topic_id=1127&forum=1 for details if you think you can help.

```
Hi folks!

We're starting to translate upcoming versions into different
languages. The necessary code changes for OC 2.0 were already done.
Now we need translators.

Before posting every stuff here I want to gather the translators
here. Who is able and willing to translate the strings (currently 667)
into what language(s)
[or has somebody who does this]?

From the last discussions I remember people wanting to do this for
French, Italian, Spanish, German but I don't remember who exactly said
that he/she will help. We already have a Japanese translation, but
that needs an heavy update.

...
```

CHAPTER

TWENTY

1.20 IS THERE AN OPENCOBOL MAILING LIST?

Yes. Visit opencobol.org for details. The OpenCOBOL development mailing list is graciously hosted by SourceForge. The ML archive is available at http://sourceforge.net/mailarchive/forum.php?forum_name=open-cobol-list and once you have subscribed, the list will accept messages at the open-cobol-list email destination at lists.sourceforge.net.

CHAPTER

TWENTYONE

1.21 WHERE CAN I FIND MORE INFORMATION ABOUT COBOL STANDARDS?

The COBOL 85 standard is documented in

- ANSI X3.23-1985
- ISO 1989-1985
- ANSI X3.23a-1989
- ANSI X3.23b-1993

This is highly subject to change, but currently *(February 2013)* a Draft of 20xx is available at http://www.cobolstandard.info/j4/index.htm and in particular http://www.cobolstandard.info/j4/files/std.zip

---

Note: While OpenCOBOL can be held to a high standard of quality and robustness, the authors *DO NOT* claim it to be a "Standard Conforming" implementation of COBOL.

CHAPTER

TWENTYTWO

1.22 CAN I SEE THE OPENCOBOL SOURCE CODES?

Absolutely. Being an open source system, all sources that are used to build the compiler are available and free.

The *opencobol.org* site has links to release and pre-release archives. Most distributions of GNU/Linux will also have source code bundles. For example

```
$ apt-get source open-cobol
```

on Debian GNU/Linux will retrieve the most recent released package sources.

22.1 1.22.1 A ROBODoc experiment

A ROBODoc experimental project to document the source codes is hosted at ocrobo. See ROBODoc Support for a sample configuration file.

22.2 1.22.2 A Doxygen pass across the compiler source code

This is mentioned elsewhere, but the OpenCOBOL compiler source code bundle works beautifully with Doxygen. Mix application and compiler sources for overwhelmingly complete call graphs.

Is there OpenCOBOL API documentation?

Dimitri van Heesch's 1.7.4 release of Doxygen, http://www.doxygen.org was used to produce http://opencobol.add1tocobol.com/doxy/.

22.3 1.22.3 A Doxygen pass, application with compiler suite

Along with Gary's `OCic.cbl` http://opencobol.add1tocobol.com/doxyapp/ to demonstrate how easy it is to generate world class, audit friendly source code documentation, drilled right down to how the COBOL runtime is interacting with the operating system.

22.4 1.22.4 What was used to color the source code listings?

I wrote a Pygments lexer, mushed it into a local copy of Pygments and then call a rst2html-pygments.py program. Requires a fair amount of mucking about. See ReStructuredText and Pygments for some details.

As of January 2013, the COBOL lexer is in mainline Pygments. No more mucking about required. Georg Brandl did a wonderful job of refactoring the COBOL highlighter into his Pygments system. Many thanks to Georg, Tim and team Pocoo.

http://bitbucket.org/birkenfeld/pygments-main/pull-request/72/adding-an-opencobol-lexer

CHAPTER

TWENTYTHREE

1.23 WHAT HAPPENED TO OPENCOBOL.ORG?

Due to robot spam, new registrations on opencobol.org were disabled in 2012.

The active site is now hosted by SourceForge, at

https://sourceforge.net/projects/open-cobol/

CHAPTER

TWENTYFOUR

1.24 WHAT IS COBOL IN LATIN?

I came up with Publicus Negotiatio Cursus Lingua, and then smarter people suggested:

- negotium Orientatur lingua plebeius
- generalis negotium pertineo lingua
- de communi codice pro calculorum negotii
- codex communis pro calculorum negotii

I like the last one. ccpcn, pronounce that as kick-pickin'.

Thanks to Ray, Paul, and Daniel on LinkedIn.

CHAPTER

TWENTYFIVE

1.25 WHERE CAN I FIND OPEN COBOL SOURCE CODE?

Although open source COBOL is still rare, that is slowly changing. This entry will be a perpetually growing list, until the universe is at peace.

$$\lim_{\text{COBOL}\to\infty} f(\text{COBOL}) = 42^{42}$$

Last updated: June 11th, 2013. If you know of a worthy entry, drop me a note.

25.1 1.25.1 on SourceForge

OpenCOBOL is hosted on SourceForge at http://sourceforge.net/projects/open-cobol/

Other projects include:

- http://sourceforge.net/projects/cobcurses/ A curses screen design utility for OpenCOBOL
- http://sourceforge.net/projects/koopa/ a COBOL parser (generator)
- http://sourceforge.net/projects/cobol/ the open COBOL Utilities Project
- http://sourceforge.net/projects/record-editor/ which accepts COBOL copy books
- http://sourceforge.net/projects/cobol2html/ which auto documents COBOL
- http://sourceforge.net/projects/cobolxmlfilepar/ a one pass XML parser
- http://sourceforge.net/projects/acas/ Applewood Computers Accounting System
- http://sourceforge.net/projects/geekcode21gener/ Geekcode generator, written in COBOL
- http://sourceforge.net/projects/ocic-gui/ Gary Cutler's Compiler assistant, rewritten in a C# gui
- http://sourceforge.net/projects/apac-accounting/ a Business Management system

25.2 1.25.2 add1tocobol

The good folk that host this FAQ, also host http://oldsite.add1tocobol.com and http://add1tocobol.com

25.3 1.25.3 Stickleback

Wim Niemans' Project Stickleback. http://www.mycobol.net/ and http://stickleback.nlbox.com/

25.4 1.25.4 other places

- http://sites.google.com/site/cobolunit/ a Unit Testing framework for COBOL, written in COBOL

CHAPTER

TWENTYSIX

1.26 DO YOU KNOW ANY GOOD JOKES?

Maybe.

- A computer without COBOL and Fortran is like a piece of chocolate cake without ketchup or mustard.

  John Krueger

- A determined coder can write COBOL programs in any language.

  Author: unknown

- Rumour has it that the object oriented specification for COBOL was code named

  ADD 1 TO COBOL GIVING COBOL.

  Author: unknown

  A less verbose, more concise version; *very unCOBOL that*

  ADD 1 TO COBOL.

  Thanks to aoirthoir

  And, just because;

  ADD 1 TO COBOL GIVING OpenCOBOL

- A common disrepect of COBOL joke is that the acronym stands for:

  Completely Obsolete Business Oriented Language.

  Author unkown

  We know better. The reality is:

  Can't Obsolesce Because Of Legacy. *And why would you want to?*

  Brian Tiffin

- COBOL

  Certainly Old But Often Limber.

  Brian Tiffin

- Ruby on Rails? Don't forget COBOL ON COGS.

  http://www.coboloncogs.org/INDEX.HTM

- Eat COBOL, 200 billion lines can't be wrong.

  Brian Tiffin

- What did COBOL yell to the escaping thief?

  STOP RUN RETURNING NOW.

  Brian Tiffin

- A COBOL programmer's husband asks, "*Honey can you go to the store and get some milk. And if they have eggs, get a dozen*." After twenty minutes she returns and flops 12 bags of milk on the table. He looks at her curiously, "*Honey, why did you do that*?" She responds flatly, "**They had eggs**."

  Author unknown

- What did COBOL reply to the executive? *Yes, I can*

  PERFORM JUMPS THRU HOOPS.

  Brian Tiffin

- What did OpenCOBOL reply to the executive? *Sir, I can*

  PERFORM JUMPS THRU FLAMING-HOOPS UNTIL HELL-FREEZES-OVER.

  And being COBOL, I have to show you how little code it takes:

```
identification division.
program-id. freeze.

data division.
working-storage section.
01 hell                    pic 9.
   88 hell-freezes-over value 1.

procedure division.
perform jumps thru flaming-hoops until hell-freezes-over.
stop run.

jumps.
flaming-hoops.
divide 1 by 0 giving hell.
```

- Wrote COBOL all morning, all afternoon and into the night. *Another carpe*, **diem'ed**.

  Brian Tiffin, ripped from a meme, then farberized

26.1 1.26.1 Really?

Ok, sorry for the lame.

Here is a link to some actual humour; Bob the Dinosaur, thanks to Scott Adams.

http://dilbert.com/strips/comic/1997-11-04/

26.2 1.26.2 A 5-7-5 haiku?

How about a 5-7-5 haiku?

```
 program-id. one.
 procedure division. add
 1 to return-code.
```

btiffin

Compiles to a program that fails when run. Fails as poetry, fails as code. Your welcome.

One in cbrain

```
  72  .  65
.  73  .  75  .
  85  .  42
```

Displaying HAIKU and returning 42.

CHAPTER

TWENTYSEVEN

2 HISTORY

History

History

27.1 2.1 What is the history of COBOL?

Starting in 1959, a committee was formed under the sponsorship of the United States Department of Defense to recommend a short range option regarding business computing. The Conference on Data System Languages (CODASYL) led by Joe Wegstein of National Bureau of Standards (now National Institute of Standards and Technology) developed a new language, and created the first standardized business computer programming language.

The COmmon Business Oriented Language acronym was announced on September 18th, 1959.

Late in 1960, *essentially* the same COBOL program ran on two different hardware platforms, and stakeholders espied the potential for fulfilling the objective of industry wide, compatible business systems.

Admiral Grace Hopper is affectionately referred to as the *mother of the COBOL language* as she and her previous work with FLOW-MATIC greatly influenced the specifications of the first COBOL.

Standards have been published for:

- COBOL-68
- COBOL-74
- COBOL-85
- COBOL-2002
- Draft work for COBOL-20xx is currently *(February 2013)* underway

and these roughly correspond to the year they were produced. Note the y2k flavour of four digit naming occurred after the millennium change.

Estimates vary, but it is entirely reasonable to believe that of the some 300,000,000,000 (three hundred thousand million) lines of computer source code in production as of 1995, 200,000,000,000 (two hundred thousand million) lines were COBOL. A full 2/3rds of the world's source code at the time.

See the Wikipedia entry for COBOL for a lot more details.

27.2 2.2 What are the Official COBOL Standards?

Many thanks to William Klein, [wmklein] for details on what wordings are to be used when referencing COBOL Standards:

```
There are several references to "COBOL 85" and these are often
distinguished from "Intrinsic Functions".

The official (but really obscure) term that should be used is "Amended
Third Standard COBOL". The "clearer" (and IMHO better) term that should
be used is something like

 - "'85 Standard COBOL with its amendments"

By 1991 (actually 1993 for ISO rather than ANSI) there was no such thing
as "just '85 Standard COBOL". The only recognized Standard was the
"base" document (X3.23-1985) ALONG with its two amendments
 - Intrinsic Functions Module Amendment
 - Corrections Amendment

An interesting related fact is that the "Intrinsic Functions Module" was
OPTIONAL in the ANSI and ISO COBOL Standards but was REQUIRED (at the
HIGH level) for FIPS COBOL. As the "certification tests" were aimed at
getting US government contracts, most vendors (who were still doing
certification) actually treated Intrinsic Functions required not
optional for "High-level" certification. (They were NOT included in the
FIPS intermediate certification process).

Bottom-Line:
 Although some intrinsic functions were added in the '02 Standard (and
more are included in the draft revision), it is not proper (in my
opinion) to distinguish between supporting the '85 Standard and
supporting intrinsic functions.

P.S. The corrections amendment did make some technical changes but all
of these were included in the '02 Standard. Therefore, hopefully, what
it did won't impact OpenCOBOL much.
```

Note: While OpenCOBOL can be held to a high standard of quality and robustness, the authors *DO NOT* claim it to be a "Standard Conforming" implementation of COBOL.

27.3 2.3 What is the development history of OpenCOBOL?

OpenCOBOL was initially developed by Keisuke Nishida [Keisuke] from experience working on TinyCOBOL originally developed by Rildo Pragana.

The first public release was version 0.9.0 on January 25th, 2002.

Development continued apace, with version 0.30 released by Keisuke on August 8th, 2004.

Roger While [Roger] then took up the role as lead developer on October 30th, 2004.

Version 0.31 was released February 1st, 2005.

Version 0.32 was released May 12th, 2005.

Version 0.33 started on May 13th, 2005.

Version 1.0 was released on December 27th, 2007.

Version 1.1 was released on SourceForge on May 4th, 2012.

Version 1.1CE went into active development on May 4th, 2012.

27.4 2.4 What is the current version of OpenCOBOL?

OpenCOBOL 1.0 was released December 27th, 2007 by Roger While [Roger].

The decision to go 1.0 from the 0.33 version followed many incremental enhancements from 2005 through till late in 2007.

OpenCOBOL 1.1 pre-release became active on December 27th, 2007 and major developments occured publically until February, 2009. The pre-release source tar can be found at OpenCOBOL 1.1 with installer instructions at OpenCOBOL Install and in the INSTALLING text file of the sources.

The 1.1 pre-release of February 2009 was tagged as release on SourceForge in May of 2012. The 1.1 community edition is in development at http://sourceforge.net/projects/open-cobol

27.4.1 2.4.1 Building the current version

After a download and extract from http://sourceforge.net/projects/open-cobol/files/latest/download?source=files

```
$ tar xvf open-cobol-1.1.tar.gz
$ cd open-cobol-1.1
$ ./configure
$ make
$ make check
$ sudo make install
$ sudo ldconfig
```

will place a new set of binaries in `/usr/local`, ready to roll.

Be sure to see What are the configure options available for building OpenCOBOL? for all the available options for building from sources.

27.4.2 2.4.2 occurlrefresh

If you build a pre-release OC1.1, you will be able to compile the `occurlrefresh.cbl` (with `occurlsym.cpy`) application and an early `occurl.c` libCURL wrapper that allows file transfers off the Internet. `occurlrefresh` includes default filenames for retrieving the most recent pre-release source archive and only updates the local copy if there has been a newer upstream release.

Thanks to [aoirthoir] for hosting these; currently *(February 2013)* at

- occurlrefresh.cbl
- occurlsym.cpy

- occurl.c

and then simply

```
$ ./occurlrefresh
```

to download any new development archives. libCURL tests the modification timestamps, so this procedure is very resource efficient, only pulling from the server if there is something new. A `-b` option is accepted that will spawn off `tar`, `configure` and the `make` pass to compile a fresh copy. `-b` does not do an install, you'll still have to do that manually after verifying that everything is ok.

CHAPTER

TWENTYEIGHT

3 USING OPENCOBOL

Using OpenCOBOL

Using OpenCOBOL

28.1 3.1 How do I install OpenCOBOL?

Installation instructions can be found at OpenCOBOL Install.

28.1.1 3.1.1 From source with GNU/Linux

```
$ wget http://sourceforge.net/projects/open-cobol/files/open-cobol/1.1/open-cobol-1.1.tar.gz
$ tar xvf open-cobol-1.1.tar.gz
$ cd open-cobol-1.1
$ ./configure
```

```
$ make
$ make check
$ sudo make install
$ sudo ldconfig
```

28.1.2 3.1.2 Debian

The Debian binary package makes installing OpenCOBOL 1.0 a snap. From **root** or using sudo

```
$ apt-get install open-cobol
```

28.1.3 3.1.3 Fedora

From the main Fedora repositories

```
$ yum install open-cobol
```

28.1.4 3.1.4 Windows

Build from sources under Cygwin or MinGW. Follow the instructions from the site listed above, or read the OC_GettingStarted_Windows document by [wmklein] available online at

- http://opencobol.add1tocobol.com/oc_gettingstarted_windows.html
- http://opencobol.add1tocobol.com/OC_GettingStarted_Windows.pdf

Also see What is the current version of OpenCOBOL?.

28.1.5 3.1.5 Macintosh

From Ganymede on opencobol.org

HOWTO: Installling OpenCOBOL 1.0.0 (with BerkeleyDB) under Mac OS 10.5.x-10.6.x

```
On Mac OS X 10.5.x/10.6.x, I have successfully managed to compile and install
OpenCOBOL 1.0.0 (including libdb linking), and am now happily compiling
production systems with it. It's not *entirely* straightforward, as it involves
installing GMP via MacPorts -- the *only way* that GMP will install properly
because of some eccentricities in Apple's Xcode development tools (particularly
with relation to c99 in gcc), unless you are willing to patch things by hand.
In addition, the earlier BerkeleyDB versions (the 4.x.x ones available via
MacPorts) cause some strange ioctl errors at runtime under Mac OS X Leopard and
Snow Leopard when attempting certain types of ORGANIZATION IS INDEXED
operations; precisely what conditions causes this I am yet to fully ascertain.
The upshot of it is that in order to compile and run a complete OpenCOBOL 1.0.0
installation on Leopard and Snow Leopard, one has to 1) install GMP via
MacPorts; but 2) compile and install a recent version of BerkeleyDB natively.

Probably at some point, I'm going to package this into a pretty-pretty
precompiled .app and .dmg along with a rudimentary Cocoa compiler interface.
Until then, however -- my COBOL on Mac comrades! -- please do the following:

-- INSTALLATION STEPS (Tested on both 10.5.x and 10.6.x) --
1) Download an appropriate MacPorts distribution for your OS:
<http://distfiles.macports.org/MacPorts/>
If you want to use the installer:
* For 10.5.x: MacPorts-1.8.0-10.5-Leopard.dmg
```

```
* For 10.6.x: MacPorts-1.8.0-10.6-SnowLeopard.dmg
From source, MacPorts-1.8.0.tar.gz is confirmed to work on both versions.
NB: Make sure PATH is properly set by install in your active user's ~/.profile.
2) Update MacPorts: sudo port -d selfupdate
3) Install GMP with MacPorts: sudo port install gmp
4) Download the Oracle Berkeley DB 5.0.21 (or later) .tar.gz source:
<http://www.oracle.com/technology/products/berkeley-db/db/index.html>
5) Untar, cd to the Berkeley DB source folder, then:
cd /build_unix
6) Do the following to configure, make and install Berkeley DB:
../dist/configure
make
sudo make install
7) Download and untar OpenCOBOL 1.0.0, cd to directory
8) Run ./configure, setting CPPFLAGS and LDFLAGS as below (CHANGING ANY
VERSION-SPECIFIC PATHS TO WHAT YOU JUST INSTALLED) as follows:

./configure
CPPFLAGS="-I/opt/local/var/macports/software/gmp/5.0.1_0/opt/local/include/
-I/usr/local/BerkeleyDB.5.0/include/"
LDFLAGS="-L/opt/local/var/macports/software/gmp/5.0.1_0/opt/local/lib
-L/usr/local/BerkeleyDB.5.0/lib/"

9) Make and install:
make
sudo make install
10) Et voila! Try exiting the directory and invoking cobc.

-- YOU SHOULD THEN BE ABLE TO DO SOMETHING LIKE THIS: --

phrygia.ganymede-labs.com:bottles ganymede$ sw_vers
ProductName: Mac OS X
ProductVersion: 10.5.6
BuildVersion: 9G55
phrygia.ganymede-labs.com:bottles ganymede$ cobc -V
cobc (OpenCOBOL) 1.0.0
Copyright (C) 2001-2007 Keisuke Nishida
Copyright (C) 2007 Roger While
phrygia.ganymede-labs.com:bottles ganymede$ cobc -v -x bottles.cbl
preprocessing bottles.cbl into
/var/folders/KI/KI15WC0KGMmvvO980RztgU+++TI/-Tmp-//cob75450_0.cob translating
/var/folders/KI/KI15WC0KGMmvvO980RztgU+++TI/-Tmp-//cob75450_0.cob into
/var/folders/KI/KI15WC0KGMmvvO980RztgU+++TI/-Tmp-//cob75450_0.c
  gcc -pipe -c -I/usr/local/include
-I/opt/local/var/macports/software/gmp/5.0.1_0/opt/local/include/
-I/usr/local/BerkeleyDB.5.0/include/ -I/usr/local/include -O2 -Wno-unused
-fsigned-char -Wno-pointer-sign -o
/var/folders/KI/KI15WC0KGMmvvO980RztgU+++TI/-Tmp-//cob75450_0.o
/var/folders/KI/KI15WC0KGMmvvO980RztgU+++TI/-Tmp-//cob75450_0.c gcc -pipe
-L/opt/local/var/macports/software/gmp/5.0.1_0/opt/local/lib
-L/usr/local/BerkeleyDB.5.0/lib/ -o bottles
/var/folders/KI/KI15WC0KGMmvvO980RztgU+++TI/-Tmp-//cob75450_0.o
-L/opt/local/var/macports/software/gmp/5.0.1_0/opt/local/lib
-L/usr/local/BerkeleyDB.5.0/lib/ -L/usr/local/lib -lcob -lm -lgmp
-L/usr/local/lib -lintl -liconv -lc -R/usr/local/lib -lncurses -ldb


With lots of sloppy LINKAGE SECTION kisses,
-- Ganymede
```

28.2 3.2 What are the configure options available for building OpenCOBOL?

configure is a defacto standard development tool for POSIX compliant operating systems, in particular GNU/Linux. It examines the current environment and creates a Makefile suitable for the target computer and the package being built.

For OpenCOBOL, the `./configure` script accepts `--help` as a command line option to display all of the available configuration choices.

```
'configure' configures OpenCOBOL 1.1 to adapt to many kinds of systems.

Usage: ./configure [OPTION]... [VAR=VALUE]...

To assign environment variables (e.g., CC, CFLAGS...), specify them as
VAR=VALUE.  See below for descriptions of some of the useful variables.

Defaults for the options are specified in brackets.

Configuration:
  -h, --help              display this help and exit
      --help=short        display options specific to this package
      --help=recursive    display the short help of all the included packages
  -V, --version           display version information and exit
  ---quiet, --silent   do not print 'checking...' messages
      --cache-file=FILE   cache test results in FILE [disabled]
  -C, --config-cache      alias for '--cache-file=config.cache'
  -n, --no-create         do not create output files
      --srcdir=DIR        find the sources in DIR [configure dir or '..']

Installation directories:
  --prefix=PREFIX         install architecture-independent files in PREFIX
                          [/usr/local]
  --exec-prefix=EPREFIX   install architecture-dependent files in EPREFIX
                          [PREFIX]

By default, 'make install' will install all the files in
'/usr/local/bin', '/usr/local/lib' etc.  You can specify
an installation prefix other than '/usr/local' using '--prefix',
for instance '--prefix=$HOME'.

For better control, use the options below.

Fine tuning of the installation directories:
  --bindir=DIR           user executables [EPREFIX/bin]
  --sbindir=DIR          system admin executables [EPREFIX/sbin]
  --libexecdir=DIR       program executables [EPREFIX/libexec]
  --datadir=DIR          read-only architecture-independent data [PREFIX/share]
  --sysconfdir=DIR       read-only single-machine data [PREFIX/etc]
  --sharedstatedir=DIR   modifiable architecture-independent data [PREFIX/com]
  --localstatedir=DIR    modifiable single-machine data [PREFIX/var]
  --libdir=DIR           object code libraries [EPREFIX/lib]
  --includedir=DIR       C header files [PREFIX/include]
  --oldincludedir=DIR    C header files for non-gcc [/usr/include]
  --infodir=DIR          info documentation [PREFIX/info]
  --mandir=DIR           man documentation [PREFIX/man]

Program names:
  --program-prefix=PREFIX            prepend PREFIX to installed program names
  --program-suffix=SUFFIX            append SUFFIX to installed program names
```

```
  --program-transform-name=PROGRAM   run sed PROGRAM on installed program names

System types:
  --build=BUILD     configure for building on BUILD [guessed]
  --host=HOST       cross-compile to build programs to run on HOST [BUILD]

Optional Features:
  --disable-FEATURE       do not include FEATURE (same as --enable-FEATURE=no)
  --enable-FEATURE[=ARG]  include FEATURE [ARG=yes]
  --enable-maintainer-mode  enable make rules and dependencies not useful
                          (and sometimes confusing) to the casual installer
  --disable-dependency-tracking  speeds up one-time build
  --enable-dependency-tracking   do not reject slow dependency extractors
  --enable-experimental   (OpenCOBOL) enable experimental code (Developers only!)
  --enable-param-check    (OpenCOBOL) enable CALL parameter checking
  --enable-shared[=PKGS]
                          build shared libraries [default=yes]
  --enable-static[=PKGS]
                          build static libraries [default=yes]
  --enable-fast-install[=PKGS]
                          optimize for fast installation [default=yes]
  --disable-libtool-lock  avoid locking (might break parallel builds)
  --disable-rpath         do not hardcode runtime library paths
  --disable-nls           do not use Native Language Support

Optional Packages:
  --with-PACKAGE[=ARG]    use PACKAGE [ARG=yes]
  --without-PACKAGE       do not use PACKAGE (same as --with-PACKAGE=no)
  --with-cc=<cc>          (OpenCOBOL) specify the C compiler used by cobc
  --with-seqra-extfh      (OpenCOBOL) Use external SEQ/RAN file handler
  --with-cisam            (OpenCOBOL) Use CISAM for ISAM I/O
  --with-disam            (OpenCOBOL) Use DISAM for ISAM I/O
  --with-vbisam           (OpenCOBOL) Use VBISAM for ISAM I/O
  --with-index-extfh      (OpenCOBOL) Use external ISAM file handler
  --with-db1              (OpenCOBOL) use Berkeley DB 1.85 (libdb-1.85)
  --with-db               (OpenCOBOL) use Berkeley DB 3.0 or later (libdb)(default)
  --with-lfs64            (OpenCOBOL) use large file system for file I/O (default)
  --with-dl               (OpenCOBOL) use system dynamic loader (default)
  --with-patch-level      (OpenCOBOL) define a patch level (default 0)
  --with-varse         (OpenCOBOL) define variable sequential format (default 0)
  --with-gnu-ld           assume the C compiler uses GNU ld [default=no]
  --with-pic              try to use only PIC/non-PIC objects [default=use
                          both]
  --with-tags[=TAGS]
                          include additional configurations [automatic]
  --with-gnu-ld           assume the C compiler uses GNU ld default=no
  --with-libiconv-prefix[=DIR]  search for libiconv in DIR/include and DIR/lib
  --without-libiconv-prefix     don't search for libiconv in includedir and libdir
  --with-libintl-prefix[=DIR]  search for libintl in DIR/include and DIR/lib
  --without-libintl-prefix     don't search for libintl in includedir and libdir

Some influential environment variables:
  CC          C compiler command
  CFLAGS      C compiler flags
  LDFLAGS     linker flags, e.g. -L<lib dir> if you have libraries in a
              nonstandard directory <lib dir>
  CPPFLAGS    C/C++ preprocessor flags, e.g. -I<include dir> if you have
              headers in a nonstandard directory <include dir>
  CPP         C preprocessor
```

```
  CXXCPP      C++ preprocessor

Use these variables to override the choices made by 'configure' or to help
it to find libraries and programs with nonstandard names/locations.

Report bugs to <open-cobol-list@lists.sourceforge.net>.
```

28.3 3.3 Does OpenCOBOL have any other dependencies?

OpenCOBOL relies on a native C compiler with POSIX compatibility. GCC being a freely available compiler collection supported by most operating systems currently *(February 2013)* in use.

OpenCOBOL requires the following external libraries to be installed:

GNU MP (libgmp) 4.1.2 or later libgmp is used to implement decimal arithmetic. GNU MP is licensed under GNU Lesser General Public License.

GNU Libtool (libltdl) libltdl is used to implement dynamic CALL statements. GNU Libtool is licensed under GNU Lesser General Public License.

NOTE - Libtool is not required for Linux and Windows (including MinGW and Cygwin)

The following libraries are optional:

Berkeley DB (libdb) 1.85 or later libdb can be used to implement indexed file I/O and SORT/MERGE. Berkeley DB is licensed under the original BSD License (1.85) or their own open-source license (2.x or later). Note that, as of 2.x, if you linked your software with Berkeley DB, you must distribute the source code of your software along with your software, or you have to pay royalty to Oracle Corporation. For more information about Oracle Berkeley DB dual licensing go to : Oracle / Embedded / Oracle Berkeley DB

Ncurses (libncurses) 5.2 or later libncurses can be used to implement SCREEN SECTION. Ncurses is licensed under a BSD-style license.

28.4 3.4 How does the OpenCOBOL compiler work?

OpenCOBOL is a multi-stage command line driven compiler. Command line options control what stages are performed during processing.

1. Preprocess
2. Translate
3. Compile
4. Assemble
5. Link
6. Build

OpenCOBOL produces intermediate C source code that is then passed to a configured C compiler and other tools. the GNU C compiler, `gcc` being a standard.

The main tool, `cobc`, by default, produces modules, linkable shared object files.

28.4.1 3.4.1 Example of OpenCOBOL stages

Documenting the output of the various stages of OpenCOBOL compilation.

28.4.2 3.4.2 Original source code;

```
$ cat hello.cob

000100* HELLO.COB OpenCOBOL FAQ example
000200 IDENTIFICATION DIVISION.
000300 PROGRAM-ID. hello.
000400 PROCEDURE DIVISION.
000500     DISPLAY "Hello World!".
000600     STOP RUN.
```

28.4.3 3.4.3 Preprocess

```
$ cobc -E hello.cob
```

Preprocess only pass. One operation of the preprocessor is to convert FIXED format to FREE format. COPY includes are also read in along with REPLACE substitution. The above command displayed:

```
# 1 "hello.cob"

IDENTIFICATION DIVISION.
PROGRAM-ID. hello.
PROCEDURE DIVISION.
 DISPLAY "Hello World!".
 STOP RUN.
```

to standard out.

28.4.4 3.4.4 Translate

```
$ cobc -C hello.cob
```

Translate only; preprocesses and then translates the COBOL sources into C. You can examine these files to get a good sense of how the OpenCOBOL environment interacts with the native C facilities. OpenCOBOL 1.1 produced `hello.c.h` and `hello.c`.

28.4.5 3.4.5 hello.c.h

```
/* Generated by            cobc 1.1.0 */
/* Generated from          hello.cob */
/* Generated at            Oct 04 2008 00:19:36 EDT */
/* OpenCOBOL build date    Oct 01 2008 22:15:19 */
/* OpenCOBOL package date  Oct 01 2008 16:31:26 CEST */
/* Compile command         cobc -C hello.cob */

/* PROGRAM-ID : hello */

static unsigned char b_5[4] __attribute__((aligned));       /* COB-CRT-STATUS */
static unsigned char b_1[4] __attribute__((aligned));       /* RETURN-CODE */
static unsigned char b_2[4] __attribute__((aligned));       /* SORT-RETURN */
static unsigned char b_3[4] __attribute__((aligned));       /* NUMBER-OF-CALL-PARAMETERS */

/* attributes */
static cob_field_attr a_1   = {16, 4, 0, 0, NULL};
static cob_field_attr a_2   = {33, 0, 0, 0, NULL};

/* fields */
```

```
static cob_field f_5        = {4, b_5, &a_1};       /* COB-CRT-STATUS */

/* constants */
static cob_field c_1        = {12, (unsigned char *)"Hello World!", &a_2};

/* ---------------------------------------------- */
```

28.4.6 3.4.6 hello.c

```
/* Generated by            cobc 1.1.0 */
/* Generated from          hello.cob */
/* Generated at            Oct 04 2008 00:19:36 EDT */
/* OpenCOBOL build date    Oct 01 2008 22:15:19 */
/* OpenCOBOL package date  Oct 01 2008 16:31:26 CEST */
/* Compile command         cobc -C hello.cob */

#define  __USE_STRING_INLINES 1
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>
#include <libcob.h>

#define COB_SOURCE_FILE             "hello.cob"
#define COB_PACKAGE_VERSION "1.1"
#define COB_PATCH_LEVEL             0

/* function prototypes */
static int hello_ (const int);

int hello (void);


/* functions */

int
hello ()
{
  return hello_ (0);
}

/* end functions */

static int
hello_ (const int entry)
{

#include "hello.c.h"  /* local variables */

  static int initialized = 0;
  static cob_field *cob_user_parameters[COB_MAX_FIELD_PARAMS];
  static cob_module module = { NULL, NULL, &f_5, NULL, cob_user_parameters, 0, '.', '$', ',', 1, 1, 1


  /* perform frame stack */
  int frame_index;
  struct frame {
    int  perform_through;
```

```
  void *return_address;
} frame_stack[255];

/* Start of function code */

if (unlikely(entry < 0)) {
  if (!initialized) {
      return 0;
  }
  initialized = 0;
  return 0;
}

module.next = cob_current_module;
cob_current_module = &module;

if (unlikely(initialized == 0))
  {
    if (!cob_initialized) {
      cob_fatal_error (COB_FERROR_INITIALIZED);
    }
    cob_check_version (COB_SOURCE_FILE, COB_PACKAGE_VERSION, COB_PATCH_LEVEL);
    if (module.next)
      cob_set_cancel ((const char *)"hello", (void *)hello, (void *)hello_);
    (*(int *) (b_1)) = 0;
    (*(int *) (b_2)) = 0;
    (*(int *) (b_3)) = 0;
    memset (b_5, 48, 4);


    initialized = 1;
  }

/* initialize frame stack */
frame_index = 0;
frame_stack[0].perform_through = -1;

/* initialize number of call params */
(*(int *) (b_3))    = cob_call_params;
cob_save_call_params = cob_call_params;

goto l_2;

/* PROCEDURE DIVISION */


/* hello: */

l_2:;

/* MAIN SECTION: */

/* MAIN PARAGRAPH: */

/* hello.cob:5: DISPLAY */
{
  cob_new_display (0, 1, 1, &c_1);
}
/* hello.cob:6: STOP */
```

```
  {
    cob_stop_run ((*(int *) (b_1)));
  }

  cob_current_module = cob_current_module->next;
  return (*(int *) (b_1));

}

/* end function stuff */
```

28.4.7 3.4.7 Generate assembler

Using the -S switch asks `cobc` to ask the C compiler tool chain to not process farther than the assembler code generation phase.

```
$ cobc -S hello.cob
```

28.4.8 3.4.8 hello.s

```
    .file   "cob9141_0.c"
    .text
.globl hello
    .type   hello, @function
hello:
    pushl   %ebp
    movl    %esp, %ebp
    subl    $8, %esp
    movl    $0, (%esp)
    call    hello_
    leave
    ret
    .size   hello, .-hello
    .data
    .align 4
    .type   module.5786, @object
    .size   module.5786, 28
module.5786:
    .long   0
    .long   0
    .long   f_5.5782
    .long   0
    .long   cob_user_parameters.5785
    .byte   0
    .byte   46
    .byte   36
    .byte   44
    .byte   1
    .byte   1
    .byte   1
    .byte   0
    .local  cob_user_parameters.5785
    .comm   cob_user_parameters.5785,256,32
    .local  initialized.5784
    .comm   initialized.5784,4,4
    .section        .rodata
.LC0:
```

```
    .string "Hello World!"
    .data
    .align 4
    .type   c_1.5783, @object
    .size   c_1.5783, 12
c_1.5783:
    .long   12
    .long   .LC0
    .long   a_2.5781
    .align 4
    .type   f_5.5782, @object
    .size   f_5.5782, 12
f_5.5782:
    .long   4
    .long   b_5.5776
    .long   a_1.5780
    .align 4
    .type   a_2.5781, @object
    .size   a_2.5781, 8
a_2.5781:
    .byte   33
    .byte   0
    .byte   0
    .byte   0
    .long   0
    .align 4
    .type   a_1.5780, @object
    .size   a_1.5780, 8
a_1.5780:
    .byte   16
    .byte   4
    .byte   0
    .byte   0
    .long   0
    .local  b_3.5779
    .comm   b_3.5779,4,16
    .local  b_2.5778
    .comm   b_2.5778,4,16
    .local  b_1.5777
    .comm   b_1.5777,4,16
    .local  b_5.5776
    .comm   b_5.5776,4,16
    .section        .rodata
.LC1:
    .string "1.1"
.LC2:
    .string "hello.cob"
.LC3:
    .string "hello"
    .text
    .type   hello_, @function
hello_:
    pushl   %ebp
    movl    %esp, %ebp
    subl    $2072, %esp
    movl    8(%ebp), %eax
    shrl    $31, %eax
    testl   %eax, %eax
    je      .L4
```

```
    movl    initialized.5784, %eax
    testl   %eax, %eax
    jne     .L5
    movl    $0, -2052(%ebp)
    jmp     .L6
.L5:
    movl    $0, initialized.5784
    movl    $0, -2052(%ebp)
    jmp     .L6
.L4:
    movl    cob_current_module, %eax
    movl    %eax, module.5786
    movl    $module.5786, cob_current_module
    movl    initialized.5784, %eax
    testl   %eax, %eax
    sete    %al
    movzbl  %al, %eax
    testl   %eax, %eax
    je      .L7
    movl    cob_initialized, %eax
    testl   %eax, %eax
    jne     .L8
    movl    $0, (%esp)
    call    cob_fatal_error
.L8:
    movl    $0, 8(%esp)
    movl    $.LC1, 4(%esp)
    movl    $.LC2, (%esp)
    call    cob_check_version
    movl    module.5786, %eax
    testl   %eax, %eax
    je      .L9
    movl    $hello_, 8(%esp)
    movl    $hello, 4(%esp)
    movl    $.LC3, (%esp)
    call    cob_set_cancel
.L9:
    movl    $b_1.5777, %eax
    movl    $0, (%eax)
    movl    $b_2.5778, %eax
    movl    $0, (%eax)
    movl    $b_3.5779, %eax
    movl    $0, (%eax)
    movl    $4, 8(%esp)
    movl    $48, 4(%esp)
    movl    $b_5.5776, (%esp)
    call    memset
    movl    $1, initialized.5784
.L7:
    movl    $0, -4(%ebp)
    movl    $-1, -2044(%ebp)
    movl    $b_3.5779, %edx
    movl    cob_call_params, %eax
    movl    %eax, (%edx)
    movl    cob_call_params, %eax
    movl    %eax, cob_save_call_params
.L10:
    movl    $c_1.5783, 12(%esp)
    movl    $1, 8(%esp)
```

```
    movl    $1, 4(%esp)
    movl    $0, (%esp)
    call    cob_new_display
    movl    $b_1.5777, %eax
    movl    (%eax), %eax
    movl    %eax, (%esp)
    call    cob_stop_run
.L6:
    movl    -2052(%ebp), %eax
    leave
    ret
    .size   hello_, .-hello_
    .ident  "GCC: (Debian 4.3.1-9) 4.3.1"
    .section        .note.GNU-stack,"",@progbits
```

Produces `hello.s`.

28.4.9 3.4.9 Produce object code

```
$ cobc -c hello.cob
```

Compile and assemble, do not link. Produces `hello.o`.

28.4.10 3.4.10 Build modules

```
$ cobc -m hello.cob
```

Build dynamically loadable module. The is the *default behaviour*. This example produces `hello.so` or `hello.dll`.

```
$ cobc -b hello.cob
```

will do the same thing, but in this case, the extended Build is the same as the single Module build with `-m`. `-b` will build a dynamically loadable module that includes all of the entry points created from multiple command line inputs. It's fun; you can mix .cob, .c, and -l libs and OpenCOBOL does the right thing glueing it all together. `-b` Build is suited to Programming In The Large and using `cobcrun`.

28.4.11 3.4.11 Module run

```
$ cobcrun hello
Hello World!
```

Will scan the DSO hello.so, and then link, load, and execute hello.

28.4.12 3.4.12 Create executable

```
$ cobc -x hello.cob
```

Create an executable program. This examples produces `hello` or `hello.exe`.

This is important. *cobc* produces a *Dynamic Shared Object* by default. *To create executables*, you need to use `-x`.

```
$ ./hello
Hello World!
```

OpenCOBOL also supports features for multiple source, multiple language programming, detailed in the FAQ at Does OpenCOBOL support modules?.

28.4.13 3.4.13 sizes for hello on Fedora 16

The directory after using the various cobc options:

```
-rwxrwxr-x. 1 btiffin btiffin  9730 Apr 22 00:25 hello
-rw-rw-r--. 1 btiffin btiffin  2253 Apr 22 00:26 hello.c
-rw-rw-r--. 1 btiffin btiffin   835 Apr 22 00:26 hello.c.h
-rw-rw-r--. 1 btiffin btiffin   391 Apr 22 00:26 hello.c.l.h
-rw-rw-r--. 1 btiffin btiffin   181 Apr 22 00:24 hello.cob
-rw-rw-r--. 1 btiffin btiffin  3288 Apr 22 00:24 hello.o
-rw-rw-r--. 1 btiffin btiffin  2577 Apr 22 00:26 hello.s
-rwxrwxr-x. 1 btiffin btiffin  9334 Apr 22 00:27 hello.so
```

28.5 3.5 What is cobc?

`cobc` is the OpenCOBOL compiler. It processes source code into object, library or executable code.

See What compiler options are supported? for more information.

28.6 3.6 What is cobcrun?

`cobcrun` is the OpenCOBOL driver program that allows the execution of programs stored in OpenCOBOL modules.

The `cobc` compiler, by default, produces modules (the `-m` option). These modules are linkable dynamic shared objects (DSO). Using GNU/Linux for example

```
$ cobc -x hello.cob
$ ./hello
Hello World!
$ cobc hello.cob
$ cobcrun hello
Hello World!
```

The `cobc -x hello.cob` built an executable binary called hello. The `cobc hello.cob` produced a DSO hello.so, and cobcrun resolves the entry point and executes the code, right from the DSO.

`cobcrun` *is the compiler author's preferred way to manage OpenCOBOL development.* It alleviates knowing which source file needs `-x` while encouraging proper modular programming, a mainstay of OpenCOBOL.

28.7 3.7 What is cob-config?

`cob-config` is a program that can be used to find the C compiler flags and libraries required for compiling. Using GNU/Linux for example

```
$ cob-config
Usage: cob-config [OPTIONS]
Options:
        [--prefix[=DIR]]
        [--exec-prefix[=DIR]]
        [--version]
        [--libs]
        [--cflags]
$ cob-config --libs
-L/usr/local/lib -lcob -lm -lgmp -lncurses -ldb
$ cob-config --cflags
-I/usr/local/include
```

You may need to use these features during mixed source language development, usually by back-ticking the command output inline with other `gcc` commands.

28.8 3.8 What compiler options are supported?

The OpenCOBOL system strives to follow standards, yet also remain a viable compiler option for the many billions of existing lines of COBOL sources, by supporting many existing extensions to the COBOL language. Many details of the compile can be controlled with command line options. Please also see What are the OpenCOBOL compile time configuration files? for more details on this finely tuned control.

```
$ cobc -V
cobc (OpenCOBOL) 1.1.0
Copyright (C) 2001-2008 Keisuke Nishida / Roger While
Built    Oct 29 2008 16:32:02
Packaged Oct 28 2008 19:05:45 CET

$ cobc --help
Usage: cobc [options] file...

Options:
  --help                Display this message
  --version, -V         Display compiler version
  -v                    Display the programs invoked by the compiler
  -x                    Build an executable program
  -m                    Build a dynamically loadable module (default)
  -std=<dialect>        Compile for a specific dialect :
                          cobol2002   Cobol 2002
                          cobol85     Cobol 85
                          ibm         IBM Compatible
                          mvs         MVS Compatible
                          bs2000      BS2000 Compatible
                          mf          Micro Focus Compatible
                          default     When not specified
                        See config/default.conf and config/*.conf
  -free                 Use free source format
  -fixed                Use fixed source format (default)
  -O, -O2, -Os          Enable optimization
  -g                    Produce debugging information in the output
  -debug                Enable all run-time error checking
  -o <file>             Place the output into <file>
  -b                    Combine all input files into a single
                        dynamically loadable module
  -E                    Preprocess only; do not compile, assemble or link
  -C                    Translation only; convert COBOL to C
  -S                    Compile only; output assembly file
  -c                    Compile and assemble, but do not link
  -t <file>             Generate and place a program listing into <file>
  -I <directory>        Add <directory> to copy/include search path
  -L <directory>        Add <directory> to library search path
  -l <lib>              Link the library <lib>
  -D <define>           Pass <define> to the C compiler
  -conf=<file>          User defined dialect configuration - See -std=
  --list-reserved       Display reserved words
  --list-intrinsics     Display intrinsic functions
  --list-mnemonics      Display mnemonic names
  -save-temps(=<dir>)   Save intermediate files (default current directory)
  -MT <target>          Set target file used in dependency list
```

```
-MF <file>            Place dependency list into <file>
-ext <extension>      Add default file extension

-W                    Enable ALL warnings
-Wall                 Enable all warnings except as noted below
-Wobsolete            Warn if obsolete features are used
-Warchaic             Warn if archaic features are used
-Wredefinition        Warn incompatible redefinition of data items
-Wconstant            Warn inconsistent constant
-Wparentheses         Warn lack of parentheses around AND within OR
-Wstrict-typing       Warn type mismatch strictly
-Wimplicit-define     Warn implicitly defined data items
-Wcall-params         Warn non 01/77 items for CALL params (NOT set with -Wall)
-Wcolumn-overflow     Warn text after column 72, FIXED format (NOT set with -Wall)
-Wterminator          Warn lack of scope terminator END-XXX (NOT set with -Wall)
-Wtruncate            Warn possible field truncation (NOT set with -Wall)
-Wlinkage             Warn dangling LINKAGE items (NOT set with -Wall)
-Wunreachable         Warn unreachable statements (NOT set with -Wall)

-ftrace               Generate trace code (Executed SECTION/PARAGRAPH)
-ftraceall            Generate trace code (Executed SECTION/PARAGRAPH/STATEMENTS)
-fsyntax-only         Syntax error checking only; don't emit any output
-fdebugging-line      Enable debugging lines ('D' in indicator column)
-fsource-location     Generate source location code (Turned on by -debug or -g)
-fimplicit-init       Do automatic initialization of the Cobol runtime system
-fsign-ascii          Numeric display sign ASCII (Default on ASCII machines)
-fsign-ebcdic         Numeric display sign EBCDIC (Default on EBCDIC machines)
-fstack-check         PERFORM stack checking (Turned on by -debug or -g)
-ffold-copy-lower     Fold COPY subject to lower case (Default no transformation)
-ffold-copy-upper     Fold COPY subject to upper case (Default no transformation)
-fnotrunc             Do not truncate binary fields according to PICTURE
-ffunctions-all       Allow use of intrinsic functions without FUNCTION keyword
-fmfcomment           '*' or '/' in column 1 treated as comment (FIXED only)
-fnull-param          Pass extra NULL terminating pointers on CALL statements
```

28.9 3.9 What dialects are supported by OpenCOBOL?

Using the `std=<dialect>` compiler option, OpenCOBOL can be configured to compile using specific historical COBOL compiler features and quirks.

Supported dialects include:

- default
- cobol85
- cobol2002
- ibm
- mvs
- mf
- bs2000

For details on what options and switches are used to support these dialect compiles, see the `config/` directory of your OpenCOBOL installation. For Debian GNU/Linux, that will be `/usr/share/open-cobol/config/` if you used APT to install an OpenCOBOL package or `/usr/local/share/open-cobol/config/` after a build from the source archive.

For example: the *bs2000.conf* file restricts data representations to 2, 4 or 8 byte binary while *mf.conf* allows data representations from 1 thru 8 bytes. *cobol85.conf* allows debugging lines, *cobol2002.conf* configures the compiler to warn that this feature is obsolete.

28.10 3.10 What extensions are used if cobc is called with/without "-ext" for COPY

From Roger on opencobol.org

```
In the following order -
CPY, CBL, COB, cpy, cbl, cob and finally with no extension.

User specified extensions (in the order as per command line) are inspected
PRIOR to the above defaults.

ie. They take precedence.
```

28.11 3.11 What are the OpenCOBOL compile time configuration files?

To assist in the support of the various existent COBOL compilers, OpenCOBOL reads configuration files controlling various aspects of a compile pass.

Each supported dialect will also have a *.conf* file in the `config/` sub-directory of its installation. For Debian GNU/Linux, these will be in `/usr/share/open-cobol/config/` or `/usr/local/share/open-cobol/config` under default package and default *make* conditions.

For example, the default configuration, *default.conf* is:

```
# COBOL compiler configuration                                    -*- sh -*-

# Value: any string
name: "OpenCOBOL"

# Value: int
tab-width: 8
text-column: 72

# Value: 'cobol2002', 'mf', 'ibm'
#
assign-clause: mf

# If yes, file names are resolved at run time using environment variables.
# For example, given ASSIGN TO "DATAFILE", the actual file name will be
#  1. the value of environment variable 'DD_DATAFILE' or
#  2. the value of environment variable 'dd_DATAFILE' or
#  3. the value of environment variable 'DATAFILE' or
#  4. the literal "DATAFILE"
# If no, the value of the assign clause is the file name.
#
# Value: 'yes', 'no'
filename-mapping: yes

# Value: 'yes', 'no'
pretty-display: yes

# Value: 'yes', 'no'
```

```
auto-initialize: yes

# Value: 'yes', 'no'
complex-odo: no

# Value: 'yes', 'no'
indirect-redefines: no

# Value:         signed  unsigned  bytes
#                ------  --------  -----
# '2-4-8'         1 -  4                2
#                 5 -  9                4
#                10 - 18                8
#
# '1-2-4-8'       1 -  2                1
#                 3 -  4                2
#                 5 -  9                4
#                10 - 18                8
#
# '1--8'          1 -  2    1 -  2      1
#                 3 -  4    3 -  4      2
#                 5 -  6    5 -  7      3
#                 7 -  9    8 -  9      4
#                10 - 11   10 - 12      5
#                12 - 14   13 - 14      6
#                15 - 16   15 - 16      7
#                17 - 18   17 - 18      8
binary-size: 1-2-4-8

# Value: 'yes', 'no'
binary-truncate: yes

# Value: 'native', 'big-endian'
binary-byteorder: big-endian

# Value: 'yes', 'no'
larger-redefines-ok: no

# Value: 'yes', 'no'
relaxed-syntax-check: no

# Perform type OSVS - If yes, the exit point of any currently executing perform
# is recognized if reached.
# Value: 'yes', 'no'
perform-osvs: no

# If yes, non-parameter linkage-section items remain allocated
# between invocations.
# Value: 'yes', 'no'
sticky-linkage: no

# If yes, allow non-matching level numbers
# Value: 'yes', 'no'
relax-level-hierarchy: no

# not-reserved:
# Value: Word to be taken out of the reserved words list
# (case independent)
```

```
# Dialect features
# Value: 'ok', 'archaic', 'obsolete', 'skip', 'ignore', 'unconformable'
author-paragraph:                   obsolete
memory-size-clause:                 obsolete
multiple-file-tape-clause:          obsolete
label-records-clause:               obsolete
value-of-clause:                    obsolete
data-records-clause:                obsolete
top-level-occurs-clause:            skip
synchronized-clause:                ok
goto-statement-without-name:        obsolete
stop-literal-statement:             obsolete
debugging-line:                     obsolete
padding-character-clause:           obsolete
next-sentence-phrase:               archaic
eject-statement:                    skip
entry-statement:                    obsolete
move-noninteger-to-alphanumeric:    error
odo-without-to:                     ok
```

28.12 3.12 Does OpenCOBOL work with make?

Absolutely. Very well.

A sample `makefile`

```
# OpenCOBOL rules

COBCWARN = -W

# create an executable
%: %.cob
      cobc $(COBCWARN) -x $^ -o $@

# create a dynamic module
%.so: %.cob
      cobc $(COBCWARN) -m $^ -o $@

# create a linkable object
%.o: %.cob
      cobc $(COBCWARN) -c $^ -o $@

# generate C code
%.c: %.cob
      cobc $(COBCWARN) -C $^

# generate assembly
%.s: %.cob
      cobc $(COBCWARN) -S $^

# generate intermediate suitable for cobxref
%.i: %.cob
      [ -d tmps ] || mkdir tmps
      cobc $(COBCWARN) --save-temps=tmps -c $^

# hack extension; create an executable; if errors, call vim in quickfix
%.q: %.cob
      cobc $(COBCWARN) -x $^ 2>errors.err || vi -q
```

```
# hack extension; make binary; capture warnings, call vim quickfix
%.qw: %.cob
      cobc $(COBCWARN) -x $^ 2>errors.err ; vi -q

# run ocdoc to get documentation
%.html: %.cob
      ./ocdoc $^ $*.rst $*.html $*.css

# run cobxref and get a cross reference listing  (leaves tmps dir around)
%.lst: %.cob
      [ -d tmps ] || mkdir tmps
      cobc $(COBCWARN) --save-temps=tmps -c $^ -o tmps/$*.o && ~/writing/add1/tools/cobxref/cobxref t

# tectonics for occurlrefresh
occurlrefresh: occurl.c occurlsym.cpy occurlrefresh.cbl
      cobc -c -Wall occurl.c
      cobc -x -lcurl occurlrefresh.cbl occurl.o
```

And now to compile a small program called `program.cob`, just use

```
$ make program       # for executables
$ make program.o     # for object files
$ make program.so    # for shared library
$ make program.q     # create an executable and call vi in quickfix mode
```

The last rule, *occurlrefresh* is an example of how a multi-part project can be supported. Simply type

```
$ make occurlrefresh
```

and make will check the timestamps for occurl.c, occurlsym.cpy and occurlrefresh.cbl and then build up the executable if any of those files have changed compared to timestamp of the binary.

See Tectonics for another word to describe building code.

28.13 3.13 Do you have a reasonable source code skeleton for OpenCOBOL?

Maybe. Style is a very personal developer choice. OpenCOBOL pays homage to this freedom of choice.

Here is the FIXED form header that this author uses. It includes `ocdoc` lines.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ****************************************************************
      *><* ===========
      *><*
      *><* ===========
      *><* :Author:
      *><* :Date:
      *><* :Purpose:
      *><* :Tectonics: cobc
      *> ****************************************************************
       identification division.
       program-id. .

       environment division.
       configuration section.

       input-output section.
       file-control.
```

```
      *>   select
      *>   assign to
      *>   organization is
      *>   .

       data division.
       file section.
      *>fd .
      *>    01 .

       working-storage section.
       local-storage section.
       linkage section.
       screen section.

      *> ****************************************************************
       procedure division.

       goback.
       end program .
      *><*
      *><* Last Update: dd-Mmm-yyyy
```

Fill in the *program-id* and *end program* to compile. Fill in the ocdoc title for generating documentation. See What is ocdoc? for more information on *(one method of)* inline documentation.

Here are some templates that can cut and pasted.

Fixed form in lowercase

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ****************************************************************
      *> Author:
      *> Date:
      *> Purpose:
      *> Tectonics: cobc
      *> ****************************************************************
       identification division.
       program-id. .

       environment division.
       configuration section.

       input-output section.
      *> file-control.
      *>     select
      *>     assign to
      *>     organization is
      *>     .

       data division.
      *> file section.
      *> fd .
      *>     01 .

       working-storage section.

       local-storage section.

       linkage section.
```

```
       screen section.

      *> ****************************************************************
       procedure division.

       goback.
       end program .
```

Fixed form in UPPERCASE

```
OCOBOL >>SOURCE FORMAT IS FIXED
      ******************************************************************
      * Author:
      * Date:
      * Purpose:
      * Tectonics: cobc
      ******************************************************************
       IDENTIFICATION DIVISION.
       PROGRAM-ID. .

       ENVIRONMENT DIVISION.
       CONFIGURATION SECTION.

       INPUT-OUTPUT SECTION.
       FILE-CONTROL.
           SELECT
           ASSIGN TO
           ORGANIZATION IS
           .

       DATA DIVISION.
       FILE SECTION.
       FD .
           01 .

       WORKING-STORAGE SECTION.

       LOCAL-STORAGE SECTION.

       LINKAGE SECTION.

       SCREEN SECTION.

      ******************************************************************
       PROCEDURE DIVISION.

       GOBACK.
       END PROGRAM .
```

The OCOBOL "sequence number" can safely be removed. It is there to ensure proper alignment in the browser.

FREE FORM can be compiled with `cobc -free` or use the supported compiler directive:

```
>>SOURCE FORMAT IS FREE
```

the above line must start in column 7 unless `cobc -free` is used.

```
*> **  >>SOURCE FORMAT IS FREE
*> ****************************************************************
*> Author:
*> Date:
*> Purpose:
*> Tectonics: cobc -free
```

```
*> ****************************************************************
identification division.
program-id. .

environment division.
configuration section.

input-output section.
file-control.
    select
        assign to
        organization is
    .

data division.
file section.
fd .
    01 .

working-storage section.

local-storage section.

linkage section.

screen section.

procedure division.

goback.
end program .
```

These files can be downloaded from

- headfix.cob
- headfixuppper.cob
- headfree.cob

Note: There are tricks to ensure that FIXED FORMAT source code can be compiled in a FREE FORMAT mode. That includes using free form end of line comments, no sequence numbers, free form DEBUG line directives with the >>D starting in column 5 (so the D ends up in column 7).

28.14 3.14 Can OpenCOBOL be used to write command line stdin, stdout filters?

Absolutely. It comes down to SELECT name ASSIGN TO KEYBOARD for standard input, and SELECT name ASSIGN TO DISPLAY for standard out.

Below is a skeleton that can be used to write various filters. These programs can be used as command line pipes, or with redirections.

```
$ cat datafile | filter
$ filter <inputfile >outputfile
```

`filter.cob`. You'll want to change the 01-transform paragraph to do all the processing of each record. This skeleton simply copies stdin to stdout, *with a limit of 32K records* so that may need to be changed as well or tests made to ensure the default LINE SEQUENTIAL mode of KEYBOARD and DISPLAY are appropriate for the task at hand.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *><* ===========
      *><* filter
      *><* ===========
      *><* :Author:    Brian Tiffin
      *><* :Date:      20090207
      *><* :Purpose:   Standard IO filters
      *><* :Tectonics: cobc -x filter.cob
      *> ************************************************************
       identification division.
       program-id. filter.

       environment division.
       configuration section.

       input-output section.
       file-control.
           select standard-input assign to keyboard.
           select standard-output assign to display.

       data division.
       file section.
       fd standard-input.
           01 stdin-record     pic x(32768).
       fd standard-output.
           01 stdout-record    pic x(32768).

       working-storage section.
       01  file-status         pic x  value space.
           88 end-of-file             value high-value
              when set to false is         low-value.

      *> ************************************************************
       procedure division.
       main section.
       00-main.

       perform 01-open

       perform 01-read

       perform
            until end-of-file
                perform 01-transform
                perform 01-write
                perform 01-read
       end-perform
       .

       00-leave.
       perform 01-close
       .

       goback.
```

```
      *> end main

       support section.
       01-open.
       open input standard-input
       open output standard-output
       .

       01-read.
       read standard-input
            at end set end-of-file to true
       end-read
       .

      *> All changes here
       01-transform.
       move stdin-record to stdout-record
       .
      *>

       01-write.
       write stdout-record end-write
       .

       01-close.
           close standard-input
           close standard-output
       .

       end program filter.
      *><*
      *><* Last Update: dd-Mmm-yyyy
```

28.15 3.15 How do you print to printers with OpenCOBOL?

OpenCOBOL and COBOL in general does not directly support printers. That role is delegated to the operating system. Having said that, there are a few ways to get data to a printer.

28.15.1 3.15.1 printing with standard out

Writing directly to standard out, as explained in Can OpenCOBOL be used to write command line stdin, stdout filters? and then simply piping to `lpd` should usually suffice to get text to your printer.

```
$ ./cobprog | lp
$ ./yearend | lp -d $PRESIDENTSPRINTER
```

Don't try the above with the DISPLAY verb; use WRITE TO stdout, with stdout selected and assigned to the `DISPLAY` name.

28.15.2 3.15.2 calling the system print

Files can be routed to the printer from a running program with sequences such as

```
CALL "SYSTEM"
    USING "lp os-specific-path-to-file"
```

```
    RETURNING status
END-CALL
```

28.15.3 3.15.3 print control library calls

And then we open up the field of callable libraries for print support. Below is some template code for sending files to a local CUPS install.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ****************************************************************
      *> Author:    Brian
      *> Date:      10-Aug-2009
      *> Purpose:   CUPS quick print
      *> Tectonics: cobc -lcups -x cupscob.cob
      *> ****************************************************************
       identification division.
       program-id. cupscob.

       data division.
       working-storage section.
       01 result      usage binary-long.
       01 cupsError   usage binary-long.
       01 msgPointer  usage pointer.
       01 msgBuffer   pic   x(1024) based.
       01 msgDisplay  pic   x(132).

      *> ****************************************************************
       procedure division.
       call "cupsPrintFile"
         using
           "cupsQueue" & x"00"
           "filename.prn" & x"00"
           "OpenCOBOL CUPS interface" & x"00"
           by value 0
           by reference NULL
         returning result
       end-call

       if result equals zero
           call "cupsLastError" returning cupsError end-call
           display "Err: " cupsError end-display

           call "cupsLastErrorString" returning msgPointer end-call
           set address of msgBuffer to msgPointer
           string
               msgBuffer delimited by x"00"
             into msgDisplay
           end-string
           display function trim(msgDisplay) end-display
       else
           display "Job: " result end-display
       end-if

       goback.
       end program cupscob.
```

28.15.4 3.15.4 print to PDF with CUPS

As it turns out, the above code snippet can be used to print directly to a PDF defined cups-pdf printer. By

```
$ apt-get install cups cups-pdf
```

under Debian, you can then

```
call "cupsPrintFile"
    using
        "PDFer"       & x"00"
        "cupscob.cob" & x"00"
        "cupscob.pdf" & x"00"
        by value 0
        by reference NULL
    returning result
end-call
```

assuming `PDFer` is a Class or printer with a PDF member. A PDF version of the text in `cupscob.cob` will be placed in `~/PDF/` as `cupscob.pdf`.

Roger While added this wisdom:

```
Check if your particular distro has cups-pdf in
its repository. (eg. Using Yast with Suse).
If yes, install from there.
If no, use one of the RPM finders on the web to find
a version for your distro.
eg. www.rpmfind.com

The installation of cups-pdf should automatically set
up a dummy printer with the name "cups-pdf".
So you do not actually need to define a class.
You can print directly to "cups-pdf".
(Check defined printers with eg. "lpstat -t")

The output file location is dependent on the cups-pdf
configuration file normally located at /etc/cups/cups-pdf.conf.
So, eg. on my box the location is defined thus -
Out ${HOME}/Documents/PDFs
```

The code with a little more documentation, in case it turns out to be useful.

```
call "cupsPrintFile"              *> requires -lcups
    using
        "cups-pdf"    & x"00"         *> printer class
        "cupscob.cob" & x"00"         *> input filename
        "cupscob.pdf" & x"00"         *> title
        by value 0                    *> num_options
        by reference NULL             *> options struct <*
    returning result
    on exception
        display "hint: use -lcups for cupsPrintFile" end-display
end-call
```

28.15.5 3.15.5 Jim Currey's prtcbl

Jim kindly donated this snippet. One of his earliest efforts establishing a base of OpenCOBOL resources. prtcbl produces source code listing with results piped to a printer.

A few customizations. This version requires a change to a filename for printer control, location of copybooks, and possible changes to the system lp command line.

Stash a print setup string in the file so named. The program prompts for input, output and printer.

Jim pointed out that this was early attempts with OpenCOBOL as a tool to support better in house development, *and was nice enough to let me reprint it.*

```
OCOBOL IDENTIFICATION DIVISION.
       PROGRAM-ID. PRTCBL.
      *AUTHOR. J C CURREY.
      ************************************************************
      *      PRINTS A COBOL SOURCE FILE WITH IT'S COPY BOOKS     *
      *                                                          *
      *   VERSION 001--ORIGINAL VERSION                          *
      *                3/26/2009--J C CURREY                     *
      *                                                          *
      *           002--ADDS .CPY (CAPS) IF .cpy FAILS TO FIND    *
      *                  FILE AND EXPANDS INPUT TO 132 CHARACTERS*
      *                 4/09/2009--J C CURREY                    *
      *                                                          *
      *           003--ADDS NOLIST AND LIST SUPPORT (NOTE NOT    *
      *                  SUPPORTED BY OPENCOBOL COMPILER)        *
      *                  **NOLIST IN COL 7-14 TURNS OFF LISTING  *
      *                  **LIST IN COL 7-12 TURNS ON LISTING     *
      *                 4/22/2009--J C CURREY                    *
      *                                                          *
      *           004--ADDS SUPPORT FOR /testing-set-1/copybooks *
      *                Copybooks are searched for first in the   *
      *                local directory and if not found, then in *
      *                /testing-set-1/copybooks                  *
      *                 5/7/2009--J C CURREY                     *
      *                                                          *
      *           005--CORRECTS MISSING LINE ISSUE ON PAGE BREAKS*
      *                IN THE COPY FILE PRINTING SECTION.        *
      *                1285451--SANDY DOSS                       *
      *                06/19/2009--JEREMY MONTOYA                *
      *                                                          *
      *           006--USES EXTERNAL PCL CODE FILE TO INSERT PCL *
      *                CODE INTO PRINT FILE FOR FORMATTING.      *
      *                1330505--JIM CURREY                       *
      *                12/14/2009--PETE MCTHOMPSON               *
      ************************************************************
       ENVIRONMENT DIVISION.
       INPUT-OUTPUT SECTION.
       FILE-CONTROL.
121409     SELECT FORMAT-FILE ASSIGN TO WS-NAME-FORMAT-FILE
121409       ORGANIZATION IS LINE SEQUENTIAL.
           SELECT PRINT-FILE ASSIGN TO WS-NAME-PRINT-FILE
             ORGANIZATION IS LINE SEQUENTIAL.
           SELECT INPUT-FILE ASSIGN TO WS-NAME-INPUT-FILE
             ORGANIZATION IS LINE SEQUENTIAL
             FILE STATUS IS WS-INPUT-FILE-STATUS.
           SELECT COPY-FILE ASSIGN TO WS-NAME-COPY-FILE
             ORGANIZATION IS LINE SEQUENTIAL
             FILE STATUS IS WS-COPY-FILE-STATUS.
       DATA DIVISION.
       FILE SECTION.
      *
       FD  PRINT-FILE.
121409 01  FORMAT-LINE                        PIC X(140).
       01  PRINT-LINE.
           05  OR-LINE-NUMBER                 PIC Z(6).
```

```
           05  OR-FILLER-1                     PIC XX.
           05  OR-TEXT                         PIC X(132).
121409*
121409 FD  FORMAT-FILE.
121409 01  FORMAT-RECORD                       PIC X(140).
       *
        FD  INPUT-FILE.
        01  INPUT-RECORD.
            05  IR-BUFFER                     PIC X(132).

        FD  COPY-FILE.
        01  COPY-RECORD.
            05  CR-BUFFER                     PIC X(132).
       **NOLIST
       * THIS IS ANOTHER LINE
       **LIST
       *
        WORKING-STORAGE SECTION.
       ************************************************
       *   CONSTANTS, COUNTERS AND WORK AREAS         *
       ************************************************
        01  WS-NAME-PROGRAM                   PIC X(12) VALUE
121409                                            "prtcbl   006".
        01  WS-NO-PARAGRAPH                   PIC S9(4) COMP.
        01  WS-I                              PIC S9(4) COMP.
        01  WS-J                              PIC S9(4) COMP.
        01  WS-K                              PIC S9(4) COMP.
        01  WS-NAME-PRINT-FILE                PIC X(64) VALUE SPACES.
        01  WS-NAME-INPUT-FILE                PIC X(64) VALUE SPACES.
        01  WS-INPUT-FILE-STATUS              PIC XX VALUE "00".
050709 01  WS-NAME-COPY-FILE                 PIC X(128) VALUE SPACES.
050709 01  WS-HOLD-NAME-COPY-FILE            PIC X(128) VALUE SPACES.
121409 01  WS-NAME-FORMAT-FILE               PIC X(128) VALUE SPACES.
        01  WS-COPY-FILE-STATUS               PIC XX VALUE "00".
        01  WS-LINE-PRINTER-NAME              PIC X(16) VALUE SPACES.
        01  WS-LINE-NUMBER                    PIC S9(6) COMP
                                                  VALUE ZERO.
        01  WS-PAGE-LINE-COUNTER              PIC S9(4) COMP
                                                  VALUE 999.
        01  WS-PAGE-NUMBER                    PIC S9(4) COMP
                                                  VALUE ZERO.
        01  WS-PRINT-COMMAND                  PIC X(128).
       *
        01  WS-ESCAPE-CHARACTER               PIC X VALUE X"1B".
       *
        01  WS-HEADING-LINE                   PIC X(132).
        01  WS-CURRENT-DATE                   PIC X(21).
        01  WS-ED4S                           PIC ZZZZ-.
042209 01  WS-SWITCH-PRINT                   PIC X VALUE SPACE.
       ************************************************************
       *               PROCEDURE DIVISION                         *
       ************************************************************
        PROCEDURE DIVISION.
        0000-MAIN SECTION.
            PERFORM 1000-INITIALIZATION THRU 1990-EXIT.
            PERFORM 2000-PROCESS THRU 2990-EXIT.
            PERFORM 9000-END-OF-PROGRAM THRU 9990-EXIT.
            STOP RUN.
       ************************************************************
```

```
      *               INITIALIZATION                                  *
      ****************************************************************
       1000-INITIALIZATION.
           MOVE 1000 TO WS-NO-PARAGRAPH.
           DISPLAY "I) ", WS-NAME-PROGRAM, " BEGINNING AT--"
             FUNCTION CURRENT-DATE.
       1002-GET-INPUT-FILE.
           DISPLAY "A) ENTER INPUT-FILE NAME " WITH NO ADVANCING.
           ACCEPT WS-NAME-INPUT-FILE.
           OPEN INPUT INPUT-FILE.
           IF WS-INPUT-FILE-STATUS IS EQUAL TO 35
             DISPLAY "W) INPUT FILE NOT FOUND"
             GO TO 1002-GET-INPUT-FILE.
           DISPLAY "A) ENTER PRINT-FILE (WORK FILE) NAME "
             WITH NO ADVANCING.
           ACCEPT WS-NAME-PRINT-FILE.
           DISPLAY "A) ENTER PRINTER NAME " WITH NO ADVANCING.
           ACCEPT WS-LINE-PRINTER-NAME.
           OPEN OUTPUT PRINT-FILE.
121409     MOVE "laserjet_113D.txt" TO WS-NAME-FORMAT-FILE.
121409     OPEN INPUT FORMAT-FILE.
121409 1010-OUTPUT-PCL-CODES.
121409     READ FORMAT-FILE NEXT RECORD AT END GO TO 1020-FORMAT-EOF.
121409     MOVE FORMAT-RECORD TO FORMAT-LINE.
121409     WRITE FORMAT-LINE.
121409     GO TO 1010-OUTPUT-PCL-CODES.
121409 1020-FORMAT-EOF.
121409     CLOSE FORMAT-FILE.
       1990-EXIT.
           EXIT.
      ****************************************************************
      *                 DETAIL SECTION                                *
      ****************************************************************
       2000-PROCESS.
           MOVE 2000 TO WS-NO-PARAGRAPH.
           READ INPUT-FILE NEXT RECORD AT END GO TO 2990-EXIT.
           ADD 1 TO WS-LINE-NUMBER.
           IF WS-PAGE-LINE-COUNTER IS GREATER THAN 112
             PERFORM 2800-HEADINGS THRU 2890-EXIT.
           MOVE WS-LINE-NUMBER TO OR-LINE-NUMBER.
           MOVE SPACES TO OR-FILLER-1.
           MOVE INPUT-RECORD TO OR-TEXT.
042209     IF IR-BUFFER (7:6) IS EQUAL TO "**LIST"
042209       MOVE "Y" TO WS-SWITCH-PRINT.
042209     IF WS-SWITCH-PRINT IS EQUAL TO "N"
042209       THEN NEXT SENTENCE
042209       ELSE WRITE PRINT-LINE
042209            ADD 1 TO WS-PAGE-LINE-COUNTER.
042209      IF IR-BUFFER (7:8) IS EQUAL TO "**NOLIST"
042209       MOVE "N" TO WS-SWITCH-PRINT.
           IF IR-BUFFER (7:1) IS EQUAL TO "*" GO TO 2000-PROCESS.
           MOVE 1 TO WS-I.
       2010-COMPARE-LOOP.
           IF IR-BUFFER (WS-I:2) IS EQUAL TO "*>" GO TO 2090-ENDER.
           IF IR-BUFFER (WS-I:6) IS EQUAL TO " COPY " GO TO 2020-COPY.
           ADD 1 TO WS-I.
           IF WS-I IS LESS THAN 73 GO TO 2010-COMPARE-LOOP.
           GO TO 2000-PROCESS.
       2020-COPY.
```

```
           SUBTRACT 1 FROM WS-LINE-NUMBER.
           ADD 6 TO WS-I.
           MOVE 1 TO WS-J.
           MOVE SPACES TO WS-NAME-COPY-FILE.
       2022-MOVE-LOOP.
           IF IR-BUFFER (WS-I:1) IS EQUAL TO SPACE
             GO TO 2030-OPEN-COPYFILE.
           IF IR-BUFFER (WS-I:1) IS EQUAL TO "."
             MOVE ".cpy" to WS-NAME-COPY-FILE (WS-J:4)
               GO TO 2030-OPEN-COPYFILE.
           MOVE IR-BUFFER (WS-I:1) TO WS-NAME-COPY-FILE (WS-J:1).
           ADD 1 TO WS-I, WS-J.
           IF WS-I IS GREATER THAN 73
             OR WS-J IS GREATER THAN 64
               THEN MOVE "**PROBLEM WITH.COPY STATEMENT ABOVE**"
                      TO OR-TEXT
                    WRITE PRINT-LINE
                    ADD 1 TO WS-PAGE-LINE-COUNTER
                    GO TO 2000-PROCESS.
           GO TO 2022-MOVE-LOOP.
       2030-OPEN-COPYFILE.
           OPEN INPUT COPY-FILE.
           IF WS-COPY-FILE-STATUS IS NOT EQUAL TO "00"
040909       MOVE ".CPY" TO WS-NAME-COPY-FILE (WS-J:4)
040909       OPEN INPUT COPY-FILE
040909       IF WS-COPY-FILE-STATUS IS NOT EQUAL TO "00"
050709         MOVE WS-NAME-COPY-FILE TO WS-HOLD-NAME-COPY-FILE
050709         STRING "/testing-set-1/copybooks/"
050709           WS-HOLD-NAME-COPY-FILE
050709             INTO WS-NAME-COPY-FILE
      *     DISPLAY "D) AT.COPY FILE OPEN NAME=\", WS-NAME-COPY-FILE, "\"
050709         OPEN INPUT COPY-FILE
050709           IF WS-COPY-FILE-STATUS IS NOT EQUAL TO "00"
050709             ADD 25 TO WS-J
050709             MOVE ".cpy" TO WS-NAME-COPY-FILE (WS-J:4)
      *     DISPLAY "D) AT.COPY FILE OPEN NAME=\", WS-NAME-COPY-FILE, "\"
050709               OPEN INPUT COPY-FILE
050709               IF WS-COPY-FILE-STATUS IS NOT EQUAL TO "00"
050709                 MOVE "***COPY FILE ABOVE NOT FOUND***" TO OR-TEXT
050709                 WRITE PRINT-LINE
050709                 ADD 1 TO WS-LINE-NUMBER
050709                 ADD 1 TO WS-PAGE-LINE-COUNTER
050709                 GO TO 2000-PROCESS
050709               END-IF
050709           END-IF
040909       END-IF
040909     END-IF.
       2032-PRINT-LOOP.
           READ COPY-FILE NEXT RECORD AT END GO TO 2039-EOF.
           ADD 1 TO WS-LINE-NUMBER.
061909*    MOVE WS-LINE-NUMBER TO OR-LINE-NUMBER.
061909*    MOVE SPACES TO OR-FILLER-1.
061909*    MOVE COPY-RECORD TO OR-TEXT.
           IF WS-PAGE-LINE-COUNTER IS GREATER THAN 112
             PERFORM 2800-HEADINGS THRU 2890-EXIT.
061909     MOVE WS-LINE-NUMBER TO OR-LINE-NUMBER.
061909     MOVE SPACES TO OR-FILLER-1.
061909     MOVE COPY-RECORD TO OR-TEXT.
042209     IF CR-BUFFER (7:6) IS EQUAL TO "**LIST"
```

```
042209       MOVE "Y" TO WS-SWITCH-PRINT.
042209     IF WS-SWITCH-PRINT IS EQUAL TO "N"
042209       THEN NEXT SENTENCE
042209       ELSE WRITE PRINT-LINE
042209            ADD 1 TO WS-PAGE-LINE-COUNTER.
042209      IF CR-BUFFER (7:8) IS EQUAL TO "**NOLIST"
042209       MOVE "N" TO WS-SWITCH-PRINT.
           GO TO 2032-PRINT-LOOP.
       2039-EOF.
           CLOSE COPY-FILE.
042209     MOVE "Y" TO WS-SWITCH-PRINT.
       2090-ENDER.
           GO TO 2000-PROCESS.
      *
      *    PAGE HEADINGS
      *
       2800-HEADINGS.
           INITIALIZE PRINT-LINE.
           ADD 1 TO WS-PAGE-NUMBER.
           MOVE FUNCTION CURRENT-DATE TO WS-CURRENT-DATE.
           MOVE WS-NAME-INPUT-FILE TO PRINT-LINE.
           MOVE WS-PAGE-NUMBER TO WS-ED4S.
           MOVE "PAGE" TO PRINT-LINE (66:4).
           MOVE WS-ED4S TO PRINT-LINE (71:4).
           MOVE WS-CURRENT-DATE (5:2) TO PRINT-LINE (80:2).
           MOVE "/" TO PRINT-LINE (82:1).
           MOVE WS-CURRENT-DATE (7:2) TO PRINT-LINE (83:2).
           MOVE "/" TO PRINT-LINE (85:1).
           MOVE WS-CURRENT-DATE (1:4) TO PRINT-LINE (86:4).
           MOVE WS-CURRENT-DATE (9:2) TO PRINT-LINE (92:2).
           MOVE ":" TO PRINT-LINE (94:1).
           MOVE WS-CURRENT-DATE (11:2) TO PRINT-LINE (95:2).
           MOVE ":" TO PRINT-LINE (97:1).
           MOVE WS-CURRENT-DATE (13:2) TO PRINT-LINE (98:2).
           IF WS-PAGE-NUMBER IS EQUAL TO 1
             THEN WRITE PRINT-LINE
             ELSE WRITE PRINT-LINE AFTER ADVANCING PAGE.
           INITIALIZE PRINT-LINE.
           WRITE PRINT-LINE.
           MOVE 4 TO WS-PAGE-LINE-COUNTER.
       2890-EXIT.
           EXIT.
      *
      *    END OF JOB
      *
       2990-EXIT.
           EXIT.
      ****************************************************************
      *             TERMINATION                                      *
      ****************************************************************
       9000-END-OF-PROGRAM.
           MOVE 9000 TO WS-NO-PARAGRAPH.
           CLOSE INPUT-FILE.
           CLOSE PRINT-FILE.
121409*    STRING "lp -d " DELIMITED BY SIZE,
121409*      WS-LINE-PRINTER-NAME DELIMITED BY SIZE,
121409*      "-o sides=two-sided-long-edge " DELIMITED BY SIZE,
121409*      "-o lpi=11 -o cpi=18 -o page-left=34 " DELIMITED BY SIZE,
121409*      WS-NAME-PRINT-FILE DELIMITED BY SIZE
```

```
121409*         INTO WS-PRINT-COMMAND.
           STRING "lp -d " DELIMITED BY SIZE,
             WS-LINE-PRINTER-NAME DELIMITED BY SIZE,
             "-o raw " DELIMITED BY SIZE,
             WS-NAME-PRINT-FILE DELIMITED BY SIZE
               INTO WS-PRINT-COMMAND.
           CALL "SYSTEM" USING WS-PRINT-COMMAND.
           DISPLAY "I) " WS-NAME-PROGRAM " COMPLETED NORMALLY AT--"
               FUNCTION CURRENT-DATE.
       9990-EXIT.
           EXIT.
```

28.16 3.16 Can I run background processes using OpenCOBOL?

Absolutely. Using the `CALL "SYSTEM"` service. Some care must be shown to properly detach the input output handles, and to instruct the processes to ignore hangup signals along with the "run in a background subshell" control.

```
CALL "SYSTEM"
    USING
        "nohup whatever 0</dev/null 1>mystdout 2>mystderr &"
    RETURNING result
END-CALL
```

runs `whatever` in the background, detaches stdin, sends standard output to the file `mystdout` and standard error to `mystderr`.

The above example is for POSIX_ shell operating systems. As always, the commands sent through SYSTEM are VERY operating system dependent.

28.17 3.17 Is there OpenCOBOL API documentation?

Absolutely. Sort of. And it's beautiful, complete and awe inspiring.

Dimitri van Heesch's 1.7.4 release of Doxygen, http://www.doxygen.org was used to produce http://opencobol.add1tocobol.com/doxy/ and along with Gary's OCic.cbl http://opencobol.add1tocobol.com/doxyapp/ to highlight the absolutely beautiful compiler and application documentation available for OpenCOBOL now. These pages were produced with very little effort with only a few small tweaks to the Doxygen generated Doxyfile (to turn on all files, and to generate call graphs). The sample pass produces a 1400 page beauty of a reference manual in PDF generated from the Doxygen LaTex output. *2950 pages for the sample application run*.

OpenCOBOL ships as a developer tarball and Doxygen was let loose on the source tree after a ./configure and make pass. When the -C output of Gary Cutler's OCic.clb was placed into the tree, the output includes the call graphs that exercise some of the OpenCOBOL runtime library. This application level documentation is world class.

Regarding the above "sort of". This was a near effortless use of Doxygen. OpenCOBOL was not touched and the sources have no explicit Doxygen tags. It also excludes many of the automake, libtool, bison and flex source files. Even still, beautiful. The compiler API is now an easy grok, and application level documentation (doxyapp using OCic.cbl as a sample) should satisfy the world's most ruthless code auditor and meticulous development team lead.

See http://opencobol.add1tocobol.com/doxy/d2/dd4/structcb__field.html for a tantalizing sample of cb_field collaboration diagram and completeness of source code coverage. See http://opencobol.add1tocobol.com/doxyapp/d4/da8/OCic_8c.html for a view of how Doxygen handles the application level documentation. All for free.

28.18 3.18 How do I use LD_RUN_PATH with OpenCOBOL?

LD_RUN_PATH can be a saving grace for developers that want to build OpenCOBOL on hosted environments. LD_RUN_PATH is similar to LD_LIBRARY_PATH but builds the shared library path into cobc and then all of the binaries *compiled* with cobc. That means you can cherry pick the link loader paths when you build OpenCOBOL in a way that can add support for unsupported host features.

If you want a recent version of ncurses on your hosting service, but don't have root permissions, you can build it into one of your own directories then

```
EXPORT LD_RUN_PATH=mylibdir
./configure ; make ; make install
```

to build your OpenCOBOL. All compiles with cobc will now include mylibdir during compiles, and better yet, the binaries produced will also include mylibdir in the search path at runtime.

If you don't have *RECORD_PATH* in your cobc then you can simply compile with

```
LD_RUN_PATH=mylibdir cobc -x nextbigthing.cob
```

to achieve similar results.

With the CGI interface, see How do I use OpenCOBOL for CGI?, you can now build up a complete web side solution using OpenCOBOL with little worry about being stuck on link library depencencies or running scripts to setup any path variables before safely using your cgi-bin binaries.

LD_RUN_PATH is magical. It also avoids many security problems that can occur if you rely on LD_LIBRARY_PATH user environment settings. Your cobc will have **your** search path and not some /home/badusers trickery settings as LD_RUN_PATH searches come *before* LD_LIBRARY_PATH. Relying on LD_LIBRARY_PATH is deemed a **Don't do** by some experts. LD_RUN_PATH is a much safer bet.

28.19 3.19 What GNU build tool options are available when building OpenCOBOL?

The sources for the OpenCOBOL compiler follows GNU standards whenever possible. This includes being built around the GNU build system.

28.19.1 3.19.1 Basics

From an end-user perspective, what this means is that the source code distributions follow these basic steps:

```
tar xvf open-cobol-1.1.tar.gz
cd open-cobol-1.1
./configure
make
make check
sudo make install
sudo ldconfig
```

But that is just scratching the surface of the possibilities. See What are the configure options available for building OpenCOBOL? for the first steps with ./configure.

28.19.2 3.19.2 Out of tree builds

Next up, OpenCOBOL fully supports out-of-source-tree builds.

From Roger:

```
I mentioned in the past the preferred way of doing
a configure/build ie. Out-of-source-tree build.

eg.
We have OC 2.0 in /home/open-cobol-2.0

We want to test -
OC with BDB
OC with vbisam
OC without db (ISAM)

mkdir /home/oc20110710bdb
cd /home/oc20110710bdb
/home/open-cobol-2.0/configure --enable-debug
make
make check
cd tests
cd cobol85
# <Get newcob.val - per README>
make test

mkdir /home/oc20110710vbisam
cd /home/oc20110710vbisam
/home/open-cobol-2.0/configure --enable-debug --with-vbisam
make
make check
cd tests
cd cobol85
# <Get newcob.val - per README>
make test

mkdir /home/oc20110710nodb
cd /home/oc20110710nodb
/home/open-cobol-2.0/configure --enable-debug --without-db
make
make check
cd tests
cd cobol85
# <Get newcob.val - per README>
make test

For the last example both the OC and ANSI85 tests have been adjusted
to cater for lack of ISAM functionality.

To set your current environment to compile/execute from any of the above
(ie. without doing a "make install" from any directory), then
either "source" or execute as part of current environment
(with . ) the following files from the build directory -
tests/atconfig
tests/atlocal

(Note in that order)

So eg.
. /home/oc20110710vbisam/tests/atconfig
. /home/oc20110710vbisam/tests/atlocal

will set compiler/runtime to this environment in the current shell.
```

```
Note that both the OC tests and the ANSI85 tests do this internally
(Fairly obvious otherwise we would not be testing the right thing).

Of course, from any of the above example directories you can do
a final "make install".
```

28.19.3 3.19.3 Autotest options

By developing the OpenCOBOL system around the GNU build tools, developers receive a great many options *for free*.

`make check` can include TESTSUITEFLAGS.

The TESTSUITEFLAGS allows for options that include:

- `make check TESTSUITEFLAGS="--list"` to list the available tests and descriptions
- `"--verbose"` to show a little more information during the tests
- `"--jobs=n"` to run n tests in parallel. On multi core systems, the speed up is fairly dramatic. For 425 tests, normally 1 minute 22 seconds, `--jobs=4` ran in 36 seconds (on a small little AMD Athlon(tm) II X2 215 Processor). The more cores, the more dramatic the improvement.

28.20 3.20 Why don't I see any output from my OpenCOBOL program?

This is *actually* a frequently asked question, and it usually has the same answer.

OpenCOBOL uses the Curses and NCurses packages for advanced terminal features and SCREEN SECTION handling. This uses `stdscr` for input and output, and not the standard CONSOLE, SYSIN, SYSOUT character interface modes. One feature of the Curses handler is the concept of a secondary screen buffer, which is erased during initialization and then disappears at rundown. This can happen so fast on short display programs that it looks like nothing happens.

```
program-id. helloat.
DISPLAY "Hello, world" LINE 5 COLUMN 5 END-DISPLAY
goback.
```

will cause the Curses package to initialize a secondary buffer, display the Hello string, then immediately restore the primary buffer during `goback`. It will look like nothing is output when ./helloat is run. There are a few fixes for this.

- delay rundown with a `CALL "C$SLEEP" USING 5 END-CALL`
- `ACCEPT` an unused variable which will cause a wait for carriage return.
- or even better, dump the secondary buffer from all Curses screen handling.

The last option is discussed here.

28.20.1 3.20.1 SMCUP and RMCUP

https://blogs.oracle.com/samf/entry/smcup_rmcup_hate is a great article that discusses, and sledge-hammer fixes, the curses init screen clearing issue, leaving output on the stdout terminal, not an alternate screen.

First to find out the actual terminal capabilites, (and what control file is going to change):

```
$ infocmp | head -2
```

shows:

```
# Reconstructed via infocmp from file: /home/btiffin/.terminfo/x/xterm-256color
xterm-256color|xterm with 256 colors,
```

There is some voodoo with `infocmp` and `tic` to worry about. By default, infocmp reads local user files, but this change can also effect the entire system.

Using a super user context:

```
[btiffin@localhost junk]$ sudo infocmp | head -2
# Reconstructed via infocmp from file: /usr/share/terminfo/x/xterm-256color
xterm-256color|xterm with 256 colors,
```

gives us the system file.

After creating a *just in case* copy of `/usr/share/terminfo/x/xterm-256color` it is time to get rid of the alternate stdscr.

```
$ infocmp >xterm.terminfo
$ vi xterm.terminfo
$ # get rid of smcup= and rmcup= upto and including the comma
$ tic xterm.terminfo
```

in my case, the temporary *xterm.terminfo* looked like:

```
...
    rin=\E[%p1%dT, rmacs=\E(B, rmam=\E[?7l, rmcup=\E[?1049l,
    rmir=\E[4l, rmkx=\E[?1l\E>, rmm=\E[?1034l, rmso=\E[27m,
    rmul=\E[24m, rs1=\Ec, rs2=\E[!p\E[?3;4l\E[4l\E>, sc=\E7,
    setab=\E[4%p1%dm, setaf=\E[3%p1%dm,
    setb=\E[4%?%p1%{1}%=%t4%e%p1%{3}%=%t6%e%p1%{4}%=%t1%e%p1%{6}%=%t3%e%p1%d%;m,
    setf=\E[3%?%p1%{1}%=%t4%e%p1%{3}%=%t6%e%p1%{4}%=%t1%e%p1%{6}%=%t3%e%p1%d%;m,
    sgr=%?%p9%t\E(0%e\E(B%;\E[0%?%p6%t;1%;%?%p2%t;4%;%?%p1%p3%|%t;7%;%?%p4%t;5%;%?%p7%t;8%;m,
    sgr0=\E(B\E[m, smacs=\E(0, smam=\E[?7h, smcup=\E[?1049h,
...
```

and becomes:

```
...
    rin=\E[%p1%dT, rmacs=\E(B, rmam=\E[?7l,
    rmir=\E[4l, rmkx=\E[?1l\E>, rmm=\E[?1034l, rmso=\E[27m,
    rmul=\E[24m, rs1=\Ec, rs2=\E[!p\E[?3;4l\E[4l\E>, sc=\E7,
    setab=\E[4%p1%dm, setaf=\E[3%p1%dm,
    setb=\E[4%?%p1%{1}%=%t4%e%p1%{3}%=%t6%e%p1%{4}%=%t1%e%p1%{6}%=%t3%e%p1%d%;m,
    setf=\E[3%?%p1%{1}%=%t4%e%p1%{3}%=%t6%e%p1%{4}%=%t1%e%p1%{6}%=%t3%e%p1%d%;m,
    sgr=%?%p9%t\E(0%e\E(B%;\E[0%?%p6%t;1%;%?%p2%t;4%;%?%p1%p3%|%t;7%;%?%p4%t;5%;%?%p7%t;8%;m,
    sgr0=\E(B\E[m, smacs=\E(0, smam=\E[?7h,
...
```

`rmcup` and `smcup` edited out.

After the tic command completes, there is a shiny new local `/home/btiffin/.terminfo/x/xterm-256color` compiled terminfo file that has no alternate terminal screen capabilities.

As long as you don't run the *terminal info compiler*, `tic`, as *root*, the files in `/usr/share/terminfo/...` will still be the originals, and a new local copy is made. `tic` will overwrite the system file if it can, will move on and create a local compiled file if it can't.

The script in Sam's blog, mentioned above, will alleviate doing this manually every time the system updates the terminfo database.

So now, code like the following that displays data on line 2, column 12 and line 3, column 13

```
identification division.
program-id. helloscreen.
procedure division.
display "Hello, world" at 0212 end-display
display "Goodbye, smcup/rmcup" at 0313 end-display
goback.
end program helloscreen.
```

and then the command below; *which still blanks the screen, but now leaves output on the terminal after goback.*

```
[btiffin@home forum]$ ./helloscreen

       Hello, world
        Goodbye, smcup/rmcup
[btiffin@home forum]$
```

and OpenCOBOL displays things using advanced terminal capabilities, but leaves the data on screen after image exit.

Never worry about smcup/rmcup hate on curses init again. Not just OpenCOBOL and curses, but `vi`, `less`, `man` and any other alternate screen application. For the win. This change effects old school TE TI termcap calls too.

Curses will still play havoc with screen section programs in pipes; as stdin, stdout are a little special with curses involved. This is a minor annoyance that won't come up as often and piping screen interactive programs has always been laden in voodoo anyway.

CHAPTER

TWENTYNINE

4 RESERVED WORDS

COBOL Reserved Words

29.1 4.1 What are the OpenCOBOL RESERVED WORDS?

COBOL is a reserved word rich language. The OpenCOBOL compiler recognizes:

Reserved Words

Reserved Words

514 words in OC 1.1, 136 of which are marked not yet implemented. 378 functional reserved words, as of August 2008.

29.1.1 4.1.1 ACCEPT

Makes data available from the keyboard or operating system to named data items. OpenCOBOL supports both standard and extended `ACCEPT` statements.

Most extended `ACCEPT` statements will require an advanced terminal screen initialization, which can obscure `CONSOLE` input and output.

```
ACCEPT variable FROM CONSOLE.

ACCEPT variable FROM ENVIRONMENT "path".
ACCEPT variable FROM COMMAND LINE.

ACCEPT variable AT 0101.
ACCEPT screen-variable.

ACCEPT today FROM DATE.
ACCEPT today FROM DATE YYYYMMDD.
```

29.1.2 4.1.2 ACCESS

Defines a file's access mode. One of DYNAMIC, RANDOM, or SEQUENTIAL.

```
SELECT filename
    ASSIGN TO "filename.dat"
    ACCESS MODE IS RANDOM
    RELATIVE KEY IS keyfield.
```

29.1.3 4.1.3 ACTIVE-CLASS

Not yet implemented. Object COBOL feature.

29.1.4 4.1.4 ADD

Sums two or more numerics, with an eye toward financial precision and error detection.

```
ADD 1 TO cobol GIVING OpenCOBOL END-ADD.

ADD
    a b c d f g h i j k l m n o p q r s t u v w x y z
    GIVING total-of
    ON SIZE ERROR
        PERFORM log-problem
    NOT ON SIZE ERROR
        PERFORM graph-result
END-ADD
```

29.1.5 4.1.5 ADDRESS

Allows program access to memory address reference and, under controlled conditions, assignment.

```
SET pointer-variable TO ADDRESS OF linkage-store.

SET ADDRESS OF based-var TO ADDRESS OF working-var
```

29.1.6 4.1.6 ADVANCING

Programmer control of newline output and paging.

```
DISPLAY "Legend: " WITH NO ADVANCING END-DISPLAY.
WRITE printrecord AFTER ADVANCING PAGE END-WRITE.
```

29.1.7 4.1.7 AFTER

Nested PERFORM clause and can influence when loop conditional testing occurs.

```
PERFORM
    WITH TEST AFTER
    VARYING variable FROM 1 BY 1
        UNTIL variable > 10
        AFTER inner FROM 1 BY 1
            UNTIL inner > 4
            DISPLAY variable ", " inner END-DISPLAY
END-PERFORM.
```

Will display 55 lines of output. 1 to 11 and 1 to 5. Removing the *WITH TEST AFTER* clause would cause 40 lines of output. 1 to 10 and 1 to 4.

29.1.8 4.1.8 ALIGNED

Not yet implemented feature that will influence the internal alignment of not yet implemented USAGE `BIT` fields.

29.1.9 4.1.9 ALL

A multipurpose reserved in context word.

```
INSPECT variable REPLACING ALL "123" WITH "456".

MOVE ALL QUOTES TO var.
```

29.1.10 4.1.10 ALLOCATE

Allocates actual working storage for a BASED element.

```
ALLOCATE based-var INITIALIZED RETURNING pointer-var.
```

29.1.11 4.1.11 ALPHABET

```
* Set up for a mixed case SORT COLLATING SEQUENCE IS
 CONFIGURATION SECTION.
 SPECIAL-NAMES.
     ALPHABET name IS "AaBbCcDdEe..".
```

29.1.12 4.1.12 ALPHABETIC

One of the OpenCOBOL data class (*category*) tests.

```
IF variable IS ALPHABETIC
    DISPLAY "alphabetic" END-DISPLAY
END-IF
```

`ALPHABETIC` is defined as a data item that uses **only** `A` in the `PICTURE` clause. Finding examples of ALPHABETIC data use is difficult, which means this type is rarely used, favouring ALPHANUMERIC instead.

When tested, only data that are upper case `A to Z` and lower case `a to z` will return true, all others, including any digits `0 to 9` will return false.

29.1.13 4.1.13 ALPHABETIC-LOWER

One of the OpenCOBOL data class (*category*) tests.

```
IF variable IS ALPHABETIC-LOWER
    DISPLAY "alphabetic-lower" END-DISPLAY
END-IF
```

29.1.14 4.1.14 ALPHABETIC-UPPER

One of the OpenCOBOL data class (*category*) tests.

```
DISPLAY variable "alphabetic-upper " WITH NO ADVANCING
IF variable IS ALPHABETIC-UPPER
    DISPLAY "true A-Z, and nothing but A to Z" END-DISPLAY
ELSE
    DISPLAY "false A-Z, something else in here" END-DISPLAY
END-IF
```

29.1.15 4.1.15 ALPHANUMERIC

```
INITIALIZE data-record REPLACING ALPHANUMERIC BY literal-value
```

29.1.16 4.1.16 ALPHANUMERIC-EDITED

```
INITIALIZE data-record
    REPLACING ALPHANUMERIC-EDITED BY identifier-1
```

29.1.17 4.1.17 ALSO

A powerful, multiple conditional expression feature of EVALUATE.

```
EVALUATE variable ALSO second-test
    WHEN "A"      ALSO 1 THRU 5     PERFORM first-case
    WHEN "A"      ALSO 6            PERFORM second-case
    WHEN "A"      ALSO 7 THRU 9     PERFORM third-case
    WHEN OTHER                      PERFORM invalid-case
END-EVALUATE
```

29.1.18 4.1.18 ALTER

Obsolete and once unsupported verb that modifies the jump target for `GO TO` statements.

Yeah, just don't. Unless you are writing a state machine engine, maybe. `ALTER` should rarely be used in COBOL applications.

Rumour is, 1.1 may support this verb, to increase support for legacy code, and NOT as *homage to a good idea*. But to be honest, I do look forward to seeing the first OpenCOBOL Flying Spaghetti Monster for the giggles of righteous indignation.

Reality is, 2.0 does support ALTER. NIST Test Suite passes over 9,700 tests, up from just under 9,100 with 1.1.

29.1.19 4.1.19 ALTERNATE

Defines an ALTERNATE key for ISAM data structures.

```
SELECT file
    ASSIGN TO filename
    ACCESS MODE IS RANDOM
    RECORD KEY IS key-field
    ALTERNATE KEY IS alt-key WITH DUPLICATES.
```

29.1.20 4.1.20 AND

COBOL rules of precedence are; NOT, AND, OR.

```
IF field = "A" AND num = 3
    DISPLAY "got 3" END-DISPLAY
END-IF
```

COBOL also allows abbreviated combined relational conditions.

```
IF NOT (a NOT > b AND c AND NOT d)
   code
END-IF
```

is equivalent to

```
IF NOT (((a NOT > b) AND (a NOT > c)) AND (NOT (a NOT > d)))
    code
END-IF
```

29.1.21 4.1.21 ANY

Allows for any value is TRUE in an EVALUATE statement.

```
EVALUATE  TRUE  ALSO  TRUE
    WHEN a > 3  ALSO  ANY       *> b can be any value **
        PERFORM a-4-b-any
    WHEN a = 3  ALSO  b = 1
        PERFORM a-3-b-1
END-EVALUATE
```

29.1.22 4.1.22 ANYCASE

Not yet implemented. Will allow case insentive match of currency symbols with FUNCTION NUMVAL-C.

29.1.23 4.1.23 ARE

Allows for multiple conditional VALUES.

```
01 cond-1   PIC X.
   88 first-truth   VALUES ARE "A" "B" "C".
   88 second-truth  VALUES ARE "X" "Y" "Z".
```

29.1.24 4.1.24 AREA

Controls SORT, MERGE and RECORD data definitions.

```
I-O-CONTROL.
    SAME RECORD AREA FOR file1, file2.
```

29.1.25 4.1.25 AREAS

Plural readability option for AREA

```
SAME RECORD AREAS
```

29.1.26 4.1.26 ARGUMENT-NUMBER

Holds the number of OS parsed command line arguments, and can act as the explicit index when retrieving ARGUMENT-VALUE data. ARGUMENT-NUMBER can be used in ACCEPT FROM and DISPLAY UPON expressions.

```
ACCEPT command-line-argument-count FROM ARGUMENT-NUMBER END-ACCEPT

DISPLAY 2 UPON ARGUMENT-NUMBER END-DISPLAY
ACCEPT indexed-command-line-argument FROM ARGUMENT-VALUE END-ACCEPT
```

See COMMAND-LINE for more information on the unparsed command invocation string.

29.1.27 4.1.27 ARGUMENT-VALUE

Returns the next command line argument. This post from John on opencobol.org is an excellent idiom for parsing command line arguments without too much worry as to the order.

```
       >>source format is free
*>*****************************************************************
*> Author:    jrls (John Ellis)
*> Date:      Nov-2008
*> Purpose:   command line processing
*>*****************************************************************
identification division.
program-id. cmdline.
data division.
*>
working-storage section.
*>***************************************
01 argv                 pic x(100) value spaces.
   88 recv                        value "-r", "--recv".
   88 email                       value "-e", "--email".
   88 delivered                   value "-d", "--delivered".
01 cmdstatus            pic x    value spaces.
   88 lastcmd                    value "l".
```

```
01 reptinfo.
   05 rept-recv          pic x(30) value spaces.
   05 rept-howsent       pic x(10) value spaces.
*>
procedure division.
 0000-start.
*>
    perform until lastcmd
         move low-values         to argv
         accept argv             from argument-value
         if argv > low-values
            perform 0100-process-arguments
         else
            move "1"             to cmdstatus
         end-if
    end-perform
    display reptinfo.
    stop run.
*>
 0100-process-arguments.
*>
     evaluate true
         when recv
            if rept-recv = spaces
               accept rept-recv from argument-value
            else
               display "duplicate " argv
            end-if
         when email
            move "email"         to rept-howsent
         when delivered
            move "delivered"     to rept-howsent
         when other display "invalid switch: " argv
     end-evaluate.
```

Example run:

```
./cmdline --recv "john ellis" -e -f
invalid switch: -f
john ellis                    email
```

29.1.28 4.1.28 ARITHMETIC

Not yet implemented feature of the not yet implemented OPTIONS paragraph of the IDENTIFICATION DIVISION.

29.1.29 4.1.29 AS

```
PROGRAM-ID. program-name AS literal.
```

29.1.30 4.1.30 ASCENDING

COBOL table suport.

```
01 CLUBTABLE.
   05 MEMBER-DATA OCCURS 1 TO 6000000000 TIMES
        DEPENDING ON PEOPLE
        ASCENDING KEY IS HOURS-DONATED.
```

29.1.31 4.1.31 ASSIGN

Assign a name to a file or other external resource.

```
SELECT input-file
ASSIGN TO "filename.ext"
```

The actual filename used is dependent on a configuration setting. Under default configuration settings, `filename-mapping` is set to `yes`.

See What are the OpenCOBOL compile time configuration files? for details.

```
# If yes, file names are resolved at run time using
#   environment variables.
# For example, given ASSIGN TO "DATAFILE", the actual
#   file name will be
#  1. the value of environment variable 'DD_DATAFILE' or
#  2. the value of environment variable 'dd_DATAFILE' or
#  3. the value of environment variable 'DATAFILE' or
#  4. the literal "DATAFILE"
# If no, the value of the assign clause is the file name.
#
# Value: 'yes', 'no'
filename-mapping: yes
```

So, under GNU/Linux, bash shell

```
$ export DD_DATAFILE='/tmp/opencobol.dat'
$ ./myprog
```

the program will find the data in `/tmp/opencobol.dat`

```
$ export DD_DATAFILE='/tmp/other.dat'
$ ./myprog
```

this run of the same program will find the data in `/tmp/other.dat`

As shown in the sample .conf comments, the order of environment variable lookup proceeds through three enviroment variables before using a literal as the filename.

- DD_DATAFILE
- dd_DATAFILE
- DATAFILE
- and finally "DATAFILE"

where DATAFILE is the **name** used in

```
ASSIGN TO name
```

and can be any valid COBOL identifier, or string leading to a valid operating system filename.

29.1.32 4.1.32 AT

Controls position of ACCEPT and DISPLAY screen oriented verbs.

```
*> Display at line 1, column 4 <*
 DISPLAY "Name:" AT 0104 END-DISPLAY
*> Accept starting at line 1, column 10 for length of field <*
 ACCEPT name-var AT 0110 END-ACCEPT
```

29.1.33 4.1.33 ATTRIBUTE

Not yet implemented, but when it is, it will allow

```
SET screen-name ATTRIBUTE BLINK OFF
```

29.1.34 4.1.34 AUTO

Automatic cursor flow to next field in screen section.

29.1.35 4.1.35 AUTO-SKIP

Alias for AUTO

29.1.36 4.1.36 AUTOMATIC

LOCK MODE IS AUTOMATIC. See MANUAL and EXCLUSIVE for more LOCK options.

29.1.37 4.1.37 AUTOTERMINATE

Alias for AUTO

29.1.38 4.1.38 B-AND

Not yet implemented BIT field operation. See What STOCK CALL LIBRARY does OpenCOBOL offer? **CBL_AND** for alternatives allowing bitwise operations.

29.1.39 4.1.39 B-NOT

Not yet implemented BIT field operation. See What STOCK CALL LIBRARY does OpenCOBOL offer? **CBL_NOT** for alternatives allowing bitwise operations.

29.1.40 4.1.40 B-OR

Not yet implemented BIT field operation. See What STOCK CALL LIBRARY does OpenCOBOL offer? **CBL_OR** for alternatives allowing bitwise operations.

For example:

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20110626
      *> Purpose:   Demonstrate alternative for B-OR
      *> Tectonics: cobc -x bits.cob
      *> ************************************************************
       identification division.
       program-id. bits.

       data division.
```

```
       working-storage section.
       01 s1 pic 999 usage comp-5.
       01 t2 pic 999 usage comp-5.
       01 len   pic 9.
       01 result usage binary-long.

      *> ****************************************************************
       procedure division.
       move 2 to s1
       move 4 to t2
       move 1 to len

      *> CBL_OR takes source, target and length value  2 OR 4 is 6.    **
       call "CBL_OR" using s1 t2 by value len returning result end-call
       display s1 space t2 space len space result end-display

       goback.
       end program bits.
```

giving:

```
$ cobc -x bits.cob
$ ./bits
002 006 1 +0000000000
```

For a COBOL source code solution to BIT operations, Paul Chandler was nice enough to publish BITWISE.cbl and a full listing is included at BITWISE.

29.1.41 4.1.41 B-XOR

Not yet implemented BIT field operation. See What STOCK CALL LIBRARY does OpenCOBOL offer? **CBL_XOR** for alternatives allowing bitwise operations.

29.1.42 4.1.42 BACKGROUND-COLOR

```
05 BLANK SCREEN BACKGROUND-COLOR 7 FOREGROUND-COLOR 0.
```

29.1.43 4.1.43 BASED

```
01 based-var PIC X(80) BASED.
```

A sample posted by [human]

```
OCOBOL*-------------------------------------------------------------
       IDENTIFICATION DIVISION.
       PROGRAM-ID. 'MEMALL'.
       ENVIRONMENT DIVISION.
       CONFIGURATION SECTION.
       SPECIAL-NAMES. DECIMAL-POINT IS COMMA.
       INPUT-OUTPUT SECTION.
       FILE-CONTROL.
       DATA DIVISION.
       FILE SECTION.
      *
       WORKING-STORAGE SECTION.
      *
        77  mychar      pic x.
        01  REC-TEST BASED.
```

```
      03 REC-TEST-PART1 PIC X(5500000).
      03 REC-TEST-PART2 PIC X(0100000).
      03 REC-TEST-PART3 PIC X(1200000).
      03 REC-TEST-PART4 PIC X(1200000).
      03 REC-TEST-PART5 PIC X(1700000).
*-----------------------------------------------------------------
 LINKAGE SECTION.
*-----------------------------------------------------------------
 PROCEDURE DIVISION.
 declaratives.
 end declaratives.
*-----------------------------------------------------------------
 main section.
 00.
     FREE ADDRESS OF REC-TEST
     display 'MEMALL loaded and REC-TEST FREEd before ALLOCATE'
     accept   mychar
*
     IF ADDRESS OF REC-TEST = NULL
        display 'REC-TEST was not allocated before'
     ELSE
        display 'REC-TEST was allocated before'
     END-IF
     accept  mychar
*
     ALLOCATE  REC-TEST
     move all '9' to REC-TEST
     display 'REC-TEST allocated and filled with '
          REC-TEST (1:9)
     end-display
     accept  mychar
*
     IF ADDRESS OF REC-TEST = NULL
        display 'REC-TEST was not allocated before'
        ALLOCATE  REC-TEST
        display 'REC-TEST allocated again, filled with '
             REC-TEST (1:9)
        end-display
     ELSE
        display 'REC-TEST was allocated before'
     END-IF
     accept  mychar
*
*
     FREE ADDRESS OF REC-TEST
     display 'REC-TEST FREEd'
     accept  mychar
*
     stop run
*
     continue.
 ex. exit program.
*-----------------------------------------------------------------
*--- End of program MEMALL ---------------------------------------
```

29.1.44 4.1.44 BEEP

Ring the terminal bell during DISPLAY output. Alias for BELL

```
DISPLAY "Beeeeep" LINE 3 COLUMN 1 WITH BEEP END-DISPLAY.
```

29.1.45 4.1.45 BEFORE

Sets up a PERFORM loop to test the conditional before execution of the loop body. See AFTER for the alternative. BEFORE is the default.

```
MOVE 1 TO counter
PERFORM WITH TEST BEFORE
    UNTIL counter IS GREATER THAN OR EQUAL TO limiter
        CALL "subprogram" USING counter RETURNING result END-CALL
        MOVE result TO answers(counter)
        ADD 1 TO counter END-ADD
END-PERFORM
```

Also used with the WRITE verb.

```
WRITE record-name
    BEFORE ADVANCING some-number LINES
```

And to control how the INSPECT verb goes about its job.

```
INSPECT character-var TALLYING
   the-count FOR ALL "tests" BEFORE "prefix"
```

And not currently *(February 2013)* supported, in the declaratives for REPORT SECTION control.

```
USE BEFORE REPORTING
 ...
```

29.1.46 4.1.46 BELL

Ring the terminal bell during DISPLAY output. Alias for BEEP

```
DISPLAY "Beeeeep" LINE 3 COLUMN 1 WITH BELL END-DISPLAY.
```

29.1.47 4.1.47 BINARY

```
01 result PIC S9(8) USAGE BINARY
```

29.1.48 4.1.48 BINARY-C-LONG

With OpenCOBOL's tight integration with the C Application Binary Interface the compiler authors have built in support that guarantees a native system C *long* value being the same bit size between COBOL and C modules. This increases coverage of the plethora of open C library functions that can be directly used with the CALL verb. Including cases where callback functions that require *long* stack parameters (that can't as easily be wrapped in thin C code layers) can now be used more effectively and safely.

29.1.49 4.1.49 BINARY-CHAR

Defines an 8 bit usage item.

29.1.50 4.1.50 BINARY-DOUBLE

Defines a 64 bit usage item.

29.1.51 4.1.51 BINARY-LONG

32 bit native USAGE modifier. Equivalent to S9(8).

29.1.52 4.1.52 BINARY-SHORT

16 bit native USAGE. Equivalent to S9(5).

29.1.53 4.1.53 BIT

Not yet implemented. See What STOCK CALL LIBRARY does OpenCOBOL offer? for alternatives allowing bitwise operations.

29.1.54 4.1.54 BLANK

```
05 BLANK SCREEN BACKGROUND-COLOR 7 FOREGROUND-COLOR 0.
```

29.1.55 4.1.55 BLINK

Aaaaaah, my eyes!!

29.1.56 4.1.56 BLOCK

```
FD file-name
  BLOCK CONTAINS 1 TO n RECORDS
```

29.1.57 4.1.57 BOOLEAN

As yet unsupported modifier.

29.1.58 4.1.58 BOTTOM

A LINAGE setting.

```
FD  mini-report
      linage is 16 lines
          with footing at 15
          lines at top 2
          lines at bottom 2.
```

29.1.59 4.1.59 BY

```
PERFORM the-procedure
    VARYING step-counter FROM 1 BY step-size
    UNTIL step-counter > counter-limit
```

29.1.60 4.1.60 BYTE-LENGTH

Human inscisors average about 16mm.

More to the point, the BYTE-LENGTH returns the length, in bytes, of a data item. See FUNCTION BYTE-LENGTH

29.1.61 4.1.61 CALL

The OpenCOBOL CALL verb accepts literal or identifier stored names when resolving the transfer address. The USING phrase allows argument passing and OpenCOBOL includes internal rules for the data representation of the call stack entities that depend on the COBOL PICTURE and USAGE clauses. Return values are captured with RETURNING identifier. See What STOCK CALL LIBRARY does OpenCOBOL offer?.

For more information see http://www.opencobol.org/modules/bwiki/index.php?cmd=read&page=UserManual%2F2_3#content_1_0

CALL is the verb that opens up access to the plethora of C based ABI libraries. A **plethora**, *and the standard C library is accessible without explicit linkage* as a bonus.

One item of note is C pointers. Especially those passed around as handles. When calling a C routine that returns a handle, the RETURNING identifier will receive a C pointer. To use that handle in later CALLs, the argument from COBOL should usually by passed BY VALUE. This passes the C pointer, not the address of the COBOL identifier as the default BY REFERENCE argument handling would do.

Below is a sample that allows fairly carefree use of CBL_OC_DUMP during development. ON EXCEPTION CONTINUE.

```
OCOBOL*>>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20110701
      *> Purpose:   Try C library formatted printing, and CALL exception
      *> Tectonics: cobc -x callon.cob
      *>        or  cobc -x callon.cob CBL_OC_DUMP.cob
      *> ************************************************************
       identification division.
       program-id. callon.

       data division.
       working-storage section.
       01 result      usage binary-long.

       01 pie         usage float-short.
       01 stuff       pic x(12) value 'abcdefghijkl'.

      *> ************************************************************
       procedure division.
       move 3.141592654 to pie

      *> Get a dump of the memory at pie, but don't stop if not linked
       call "CBL_OC_DUMP" using pie 4 on exception continue end-call

      *> Call C's printf, abort if not available
```

```
       call static "printf" using
           "float-short: %10.8f" & x"0a00"
           by value pie
           returning result
       end-call
       display pie space length of pie space result end-display

      *> Get a dump of the memory used by stuff, don't stop if no link
       call "CBL_OC_DUMP" using stuff 12 on exception continue end-call

      *> Get a dump of the memory used by stuff, abort if not linked <*
       call "CBL_OC_DUMP" using stuff 12 end-call

       goback.
       end program callon.
```

See *What is CBL_OC_DUMP?* for details of the subprogram.

A runtime session shows:

```
$ cobc -x callon.cob
$ ./callon
float-short: 3.14159274
3.1415927 4 +0000000024
libcob: Cannot find module 'CBL_OC_DUMP'
$ cobc -x callon.cob CBL_OC_DUMP.cob
$ ./callon

Offset  HEX-- -- -- -5 -- -- -- -- 10 -- -- -- -- 15 --   CHARS----1----5-
000000  db 0f 49 40                                      ..I@............

float-short: 3.14159274
3.1415927 4 +0000000024

Offset  HEX-- -- -- -5 -- -- -- -- 10 -- -- -- -- 15 --   CHARS----1----5-
000000  61 62 63 64 65 66 67 68 69 6a 6b 6c               abcdefghijkl....


Offset  HEX-- -- -- -5 -- -- -- -- 10 -- -- -- -- 15 --   CHARS----1----5-
000000  61 62 63 64 65 66 67 68 69 6a 6b 6c               abcdefghijkl....
```

So, the first CALL to CBL_OC_DUMP doesn't 'fail' as the ON EXCEPTION CONTINUE traps the condition and lets the program carry on without a dump displayed. The last CALL does abend the program with 'Cannot find module' when CBL_OC_DUMP is not compiled in.

29.1.62 4.1.62 CANCEL

Virtual cancel of a module is supported. Physical cancel support is on the development schedule.

29.1.63 4.1.63 CD

A control clause of the as yet unsupported COMMUNICATION DIVISION.

29.1.64 4.1.64 CENTER

An as yet unsupported keyword.

29.1.65 4.1.65 CF

Shortform for CONTROL FOOTING, a clause used in REPORT SECTION.

29.1.66 4.1.66 CH

Shortform for CONTROL HEADING, a clause used in PAGE descriptors in the REPORT SECTION.

29.1.67 4.1.67 CHAIN

Invokes a subprogram, with no return of control implied. The chained program unit virtually becomes the main program within the run unit.

29.1.68 4.1.68 CHAINING

Passes procedure division data through WORKING-STORAGE and can be used for shell command line arguments as well, as in CALL "myprog" USING string END-CALL.

from opencobol.org by human

```
WORKING-STORAGE SECTION.
    01 cmd-argument.
      02 some-text pic x(256).

procedure division Chaining cmd-argument.

display 'You wrote:'
        '>"' function trim(some-text) '"'
        'from shell command line'
end-display
```

29.1.69 4.1.69 CHARACTER

```
PADDING CHARACTER IS
```

A soon to be obsolete feature.

29.1.70 4.1.70 CHARACTERS

A multi use keyword.

Used in SPECIAL-NAMES

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20101031
      *> Purpose:   Try out SYMBOLIC CHARACTERS
      *> Tectonics: cobc -x figurative.cob
      *> Rave:      OpenCOBOL is stone cold cool
      *> ************************************************************
       identification division.
       program-id. figurative.
```

```
       environment division.
       configuration section.
       special-names.
           symbolic characters TAB is 10
                               LF  is 11
                               CMA is 45.

       data division.
       working-storage section.
       01 a-comma pic x(1) value ",".
       01 lots-of-commas pic x(20).

      *> ************************************************************
       procedure division.
       display
           "thing" TAB "tabbed thing" LF
           "and" TAB "another tabbed thing" LF
           "other" CMA " things"
       end-display

       move a-comma to lots-of-commas
       display "MOVE a-comma : " lots-of-commas end-display

       move CMA to lots-of-commas
       display "MOVE symbolic: " lots-of-commas end-display

       goback.
       end program figurative.
```

Output:

```
$ cobc -x figuratives.cob
$ ./figuratives
thing   tabbed thing
and     another tabbed thing
other, things
MOVE a-comma : ,
MOVE symbolic: ,,,,,,,,,,,,,,,,,,,
```

Used in INSPECT

```
INSPECT str TALLYING tal FOR CHARACTERS
```

Used in a File Description FD

```
FD file-name
   BLOCK CONTAINS integer-1 TO integer-2 CHARACTERS
   RECORD IS VARYING IN SIZE FROM integer-5 TO integer-6 CHARACTERS
      DEPENDING ON identifier-1.
```

29.1.71 4.1.71 CLASS

Used to create alphabets in SPECIAL-NAMES.

```
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SPECIAL-NAMES.
CLASS octals IS '0' THRU '7'.

...

PROCEDURE DIVISION.
```

```
IF user-value IS NOT octals
    DISPLAY "Sorry, not a valid octal number" END-DISPLAY
ELSE
    DISPLAY user-value END-DISPLAY
END-IF
```

29.1.72 4.1.72 CLASS-ID

An as yet unsupported Object COBOL class identifier clause.

29.1.73 4.1.73 CLASSIFICATION

An as yet unsupported source code internationalization clause.

29.1.74 4.1.74 CLOSE

Close an open file. OpenCOBOL will implicitly close all open resources at termination of a run unit and will display a warning message stating so, and the danger of potentially unsafe termination.

```
CLOSE input-file
```

29.1.75 4.1.75 CODE

A syntactically recognized, but as yet unsupported clause of a report descriptor, RD.

29.1.76 4.1.76 CODE-SET

An as yet unsupported data internationalization clause.

29.1.77 4.1.77 COL

Alias for COLUMNS.

29.1.78 4.1.78 COLLATING

Allows definition within a program unit of a character set.

```
OBJECT-COMPUTER. name.
  PROGRAM COLLATING SEQUENCE IS alphabet-1.
```

29.1.79 4.1.79 COLS

Alias for COLUMNS.

29.1.80 4.1.80 COLUMN

1. A recognized but unsupported REPORT SECTION RD descriptor clause.
2. Also used for positional DISPLAY and ACCEPT, which implicitly uses SCREEN SECTION style ncurses screen IO.

```
DISPLAY var-1 LINE 1 COLUMN 23 END-DISPLAY
```

29.1.81 4.1.81 COLUMNS

A recognized but as yet unsupported RD clause.

29.1.82 4.1.82 COMMA

A SPECIAL-NAMES clause supporting commas in numeric values versus the default period decimal point. COBOL was way ahead of the internationization curve, *and this feature has caused compiler writers no little grief in its time, a challenge they rise to and deal with for the world's benefit*.

```
DECIMAL POINT IS COMMA
```

29.1.83 4.1.83 COMMAND-LINE

Provides access to command line arguments.

```
ACCEPT the-args FROM COMMAND-LINE END-ACCEPT
```

29.1.84 4.1.84 COMMIT

Flushes ALL current locks, synching file I/O buffers. OpenCOBOL supports safe transactional processing with ROLLBACK capabilities. *Assuming the ISAM handler configured when building the compiler can support LOCK_*

29.1.85 4.1.85 COMMON

```
PROGRAM-ID. CBL_OC_PROGRAM IS COMMON PROGRAM.
```

Ensures a nested sub-program is also available to other nested sub-programs with a program unit heirarchy.

29.1.86 4.1.86 COMMUNICATION

currently *(February 2013)* unsupported DIVISION, but see Does OpenCOBOL support Message Queues? for an alternative.

29.1.87 4.1.87 COMP

See COMPUTATIONAL

29.1.88 4.1.88 COMP-1

See COMPUTATIONAL-1

29.1.89 4.1.89 COMP-2

See COMPUTATIONAL-2

29.1.90 4.1.90 COMP-3

See COMPUTATIONAL-3

29.1.91 4.1.91 COMP-4

See COMPUTATIONAL-4

29.1.92 4.1.92 COMP-5

See COMPUTATIONAL-5

29.1.93 4.1.93 COMP-X

See COMPUTATIONAL-X

29.1.94 4.1.94 COMPUTATIONAL

Implementors choice; OpenCOBOL is a big-endian default. With most Intel personal computers and operating systems like GNU/Linux, COMPUTATIONAL-5 will run faster.

29.1.95 4.1.95 COMPUTATIONAL-1

Single precision float. Equivalent to FLOAT-SHORT.

29.1.96 4.1.96 COMPUTATIONAL-2

Double precision float. Equivalent to FLOAT-LONG.

29.1.97 4.1.97 COMPUTATIONAL-3

Equivalent to PACKED DECIMAL. Packed decimal is two digits per byte, always sign extended and influenced by a .conf setting *binary-size* COMPUTATIONAL-6 is UNSIGNED PACKED.

29.1.98 4.1.98 COMPUTATIONAL-4

Equivalent to BINARY.

29.1.99 4.1.99 COMPUTATIONAL-5

Native form.

29.1.100 4.1.100 COMPUTATIONAL-6

Unsigned packed decimal form, see COMPUTATIONAL-3.

29.1.101 4.1.101 COMPUTATIONAL-X

Native form.

29.1.102 4.1.102 COMPUTE

Computational arithmetic.

```
COMPUTE circular-area = radius ** 2 * FUNCTION PI END-COMPUTE
```

OpenCOBOL supports the normal gamut of arithmetic expressions.

- Add +
- Subtract -
- Multiply *
- Divide /
- Raise to power **

Order of precedence rules apply.

1. unary minus, unary plus
2. exponentiation
3. multiplication, division
4. addition, subtraction

Spaces and expressions

Due to COBOL allowing *dash* in user names, care must be taken to properly space arithmetic expressions.

Some examples of seemingly ambiguous and potentially dangerous code

```
OCOBOL*> ************************************************************
       identification division.
       program-id. computing.

       data division.
       working-storage section.
       01 answer pic s9(8).
       01 var    pic s9(8).

      *> ************************************************************
       procedure division.
       compute answer = 3*var-1 end-compute

       goback.
       end program computing.
```

That is NOT three times var *minus one*, OpenCOBOL will complain.

```
$ cobc -x computing.cob
computing.cob:18: Error: 'var-1' is not defined
```

whew, saved!

```
OCOBOL*> ****************************************************************
       identification division.
       program-id. computing.

       data division.
       working-storage section.
       01 answer pic s9(8).
       01 var    pic s9(8).
       01 var-1  pic s9(8).

      *> ****************************************************************
       procedure division.
       compute answer = 3*var-1 end-compute

       goback.
       end program computing.
```

With the above source, the compile will succeed.

```
$ cobc -x computing.cob
```

OpenCOBOL will (properly, according to standard) compile this as **three times var-1**. Not saved, if you meant 3 times var minus 1.

OpenCOBOL programmers are strongly encouraged to use full spacing inside COMPUTE statements.

```
OCOBOL*> ****************************************************************
       identification division.
       program-id. computing.

       data division.
       working-storage section.
       01 answer pic s9(8).
       01 var    pic s9(8).
       01 var-1  pic s9(8).

      *> ****************************************************************
       procedure division.
       compute
           answer = 3 * var - 1
           on size error
               display "Problem, call the ghost busters" end-display
           not on size error
               display "All good, answer is trustworthy" end-display
       end-compute

       goback.
       end program computing.
```

COMPUTE supports ON SIZE ERROR, NOT ON SIZE ERROR imperatives for safety, and the ROUNDED modifier for bankers.

29.1.103 4.1.103 CONDITION

As yet unsupported USE AFTER EXCEPTION CONDITION clause.

29.1.104 4.1.104 CONFIGURATION

A SECTION of the ENVIRONMENT DIVISION. Holds paragraphs for

- SOURCE-COMPUTER
- OBJECT-COMPUTER
- REPOSITORY
- SPECIAL-NAMES

29.1.105 4.1.105 CONSTANT

An extension allowing constant definitions

```
01 enumerated-value CONSTANT AS 500.
```

29.1.106 4.1.106 CONTAINS

An FD clause:

```
FD a-file RECORD CONTAINS 80 CHARACTERS.
```

29.1.107 4.1.107 CONTENT

A CALL clause that controls how arguments are passed and expected.

```
CALL "subprog" USING BY CONTENT alpha-var.
```

alpha-var will not be modifieable by subprog as a copy is passed.

See REFERENCE and VALUE for the other supported CALL argument control.

29.1.108 4.1.108 CONTINUE

A placeholder, no operation verb.

```
if action-flag = "C" or "R" or "U" or "D"
    continue
else
    display "invalid action-code" end-display
end-if
```

29.1.109 4.1.109 CONTROL

As yet unsupported REPORT SECTION clause for setting control break data fields.

29.1.110 4.1.110 CONTROLS

As yet unsupported REPORT SECTION clause for setting control break data fields.

29.1.111 4.1.111 CONVERTING

A clause of the INSPECT verb.

```
INSPECT X CONVERTING "012345678" TO "999999999".
```

29.1.112 4.1.112 COPY

The COBOL include pre-processor verb. Also see REPLACE and Does OpenCOBOL support COPY includes?.

29.1.113 4.1.113 CORR

Alias for CORRESPONDING.

29.1.114 4.1.114 CORRESPONDING

Move any and all sub fields with matching names within records.

```
01 bin-record.
   05 first-will usage binary-short.
   05 second-will usage binary-long.
   05 this-wont-move usage binary-long.
   05 third-will usage binary-short.
01 num-record.
   05 first-will pic 999.
   05 second-will pic s9(9).
   05 third-will pic 999.
   05 this-doesnt-match pic s9(9).

move corresponding bin-record to num-record
display
    first-will in num-record
    second-will in num-record
    third-will in num-record
end-display
```

29.1.115 4.1.115 COUNT

Sets the count of characters set in an UNSTRING substring.

From the OpenCOBOL Programmer's Guide's UNSTRING entry.

```
UNSTRING Input-Address
    DELIMITED BY "," OR "/"
    INTO
        Street-Address DELIMITER D1 COUNT C1
        Apt-Number DELIMITER D2 COUNT C2
        City DELIMITER D3 COUNT C3
        State DELIMITER D4 COUNT C4
        Zip-Code DELIMITER D5 COUNT C5
END-UNSTRING
```

29.1.116 4.1.116 CRT

```
SPECIAL-NAMES.
    CONSOLE IS CRT
    CRT STATUS is identifier-1.
```

CONSOLE IS CRT allows "CRT" and "CONSOLE" to be used interchangeably on DISPLAY but this is a default for newer OpenCOBOL implementations.

CRT STATUS IS establishes a PIC 9(4) field for screen ACCEPT status codes. There is also an implicit **COB-CRT-STATUS** register defined for all programs, that will be used if no explicit field is established.

29.1.117 4.1.117 CURRENCY

```
SPECIAL-NAMES.
    CURRENCY SIGN IS literal-1.
```

Default currency sign is the dollar sign "$".

29.1.118 4.1.118 CURSOR

Tracks the line/column location of screen ACCEPT.

```
SPECIAL-NAMES.
    CURSOR IS identifier-2.
```

identifier-2 is to be declared as PIC 9(4) or 9(6). If 4, the field is LLCC. With 9(6) it is LLLCCC where L is line and C is column, zero relative.

29.1.119 4.1.119 CYCLE

A clause that causes EXIT PERFORM to return to the top of a loop. See FOREVER for an example.

29.1.120 4.1.120 DATA

A magical DIVISION. One of COBOL's major strength is the rules surrounding the DATA DIVISION and pictorial record definitions.

29.1.121 4.1.121 DATA-POINTER

An as yet unsupported Object COBOL feature.

29.1.122 4.1.122 DATE

An ACCEPT source. 6 digit and 8 digit Gregorian dates.

1. ACCEPT ident-1 FROM DATE
2. ACCEPT ident-2 FROM DATE YYYYMMDD

```
 identification division.
 program-id. dates.

 data division.
 working-storage section.
 01 date-2nd
    03 date-yy   pic 9(2).
    03 date-mm   pic 9(2).
    03 date-dd   pic 9(2).
 01 date-3rd
    03 date-yyyy pic 9(4).
    03 date-mm   pic 9(2).
    03 date-dd   pic 9(2).

 procedure division.
 accept date-2nd from date end-accept

*> Just before the 3rd millennium, programmers admitted     <*
*>   that 2 digit year storage was a bad idea and ambiguous <*
 accept date-3rd from date yyyymmdd end-accept

 display date-2nd space date-3rd end-display

 goback.
 end program dates.
```

```
./dates
110701 20110701
```

29.1.123 4.1.123 DAY

An ACCEPT source. Access the current date in Julian form. Returns yyddd and yyyyddd formats.

1. ACCEPT ident-1 FROM DAY
2. ACCEPT ident-2 FROM DAY YYYYDDD

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      2011182 (July 01)
      *> Purpose:   Accept from day in Julian form
      *> Tectonics: cobc -x days.cob
      *> ************************************************************
       identification division.
       program-id. days.

       data division.
       working-storage section.
       01 julian-2nd.
          03 julian-yy   pic 9(2).
          03 julian-days pic 9(3).
       01 julian-3rd.
          03 julian-yyyy pic 9(4).
          03 julian-days pic 9(3).

       procedure division.
       accept julian-2nd from day end-accept

      *> Just before the 3rd millennium, programmers admitted     <*
```

```
      *> that 2 digit year storage was a bad idea and ambiguous   <*
       accept julian-3rd from day yyyyddd end-accept

       display julian-2nd space julian-3rd end-display

       goback.
       end program days.
```

```
$ make days
cobc -W -x days.cob -o days
$ ./days
11182 2011182
```

29.1.124 4.1.124 DAY-OF-WEEK

An ACCEPT source. Single digit day of week. 1 for Monday, 7 for Sunday.

```
accept the-day from day-of-week
```

29.1.125 4.1.125 DE

Report Writer shortcut for DETAIL. Recognized, but not yet implemented. This author found this type of shortcut very unCOBOL, until trying to layout a report, when it made a lot more practical sense *in FIXED form COBOL*.

29.1.126 4.1.126 DEBUGGING

A SOURCE-COMPUTER clause and DECLARATIVE phrase.

```
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER mine
  WITH DEBUGGING MODE.
```

DEBUGGING MODE can also be toggled on with the *-fdebugging-line* cobc option, and will compile in 'D' lines.

```
PROCEDURE DIVISION.
DECLARATIVES.
decl-debug section.
  USE FOR DEBUGGING ON ALL PROCEDURES
decl-paragraph.
  DISPLAY "Why is this happening to me?" END-DISPLAY
END DECLARATIVES.
```

USE FOR DEBUGGING sets up a section that is executed when the named section is entered. Powerful. It can also name a file, and the debug section is evaluated after open, close, read, start etc. Identifiers can be also be named and the debug section will trigger when referenced (usually after).

29.1.127 4.1.127 DECIMAL-POINT

Allows internationization for number formatting. In particular

```
IDENTIFICATION DIVISION.
PROGRAM-ID. 'MEMALL'.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SPECIAL-NAMES. DECIMAL-POINT IS COMMA.
```

will cause OpenCOBOL to interpret numeric literals along the lines of 123,45 as one hundred twenty three and forty five one hundreths.

DECIMAL-POINT IS COMMA, while world friendly, can be the cause of ambiguous parsing and care must be taken by developers that use comma to separate parameters to FUNCTIONs.

29.1.128 4.1.128 DECLARATIVES

An imperative entry that can control exception handling of file operations and turn on debug entry points.

```
procedure division.
declaratives.
handle-errors section.
    use after standard error procedure on filename-1.
handle-error.
    display "Something bad happened with " filename-1 end-display.
.
helpful-debug section.
    use for debugging on main-file.
help-me.
    display "Just touched " main-file end-display.
.
end declaratives.
```

29.1.129 4.1.129 DEFAULT

A multi-use clause used in

- CALL ... SIZE IS DEFAULT
- ENTRY ... SIZE IS DEFAULT
- INITIALIZE ... WITH ... THEN TO DEFAULT

29.1.130 4.1.130 DELETE

Allows removal of records from RELATIVE and INDEXED files.

```
DELETE filename-1 RECORD
  INVALID KEY
    DISPLAY "no delete" END-DISPLAY
  NOT INVALID KEY
    DISPLAY "record removed" END-DISPLAY
END-DELETE
```

4.1.130.1 OC 2.0

Allows file deletes.

```
DELETE FILE
    filename-1 filename-2 filename-3
END-DELETE
```

29.1.131 4.1.131 DELIMITED

A fairly powerful keyword used with the STRING and UNSTRING verbs. Accepts literals and the BY SIZE modifier.

```
STRING null-terminated
    DELIMITED BY LOW-VALUE
    INTO no-zero
END-STRING
```

29.1.132 4.1.132 DELIMITER

Tracks which delimiter was used for a substring in an UNSTRING operation.

From Gary's OCic.cbl

```
UNSTRING Expand-Code-Rec
    DELIMITED BY ". " OR " "
    INTO SPI-Current-Token
    DELIMITER IN Delim
    WITH POINTER Src-Ptr
END-UNSTRING
```

29.1.133 4.1.133 DEPENDING

Sets a control identifier for variable OCCURS table definitions.

```
01 TABLE-DATA.
   05 TABLE-ELEMENTS
       OCCURS 1 TO 100 TIMES DEPENDING ON crowd-size
       INDEXED BY cursor-var.
     10 field-1 PIC X.
```

29.1.134 4.1.134 DESCENDING

Controls a descending sort and/or retrieval order, with

- SORT filename ON DESCENDING KEY alt-key
- OCCURS 1 TO max-size TIMES DESCENDING KEY key-for-table

29.1.135 4.1.135 DESTINATION

Currently unsupported data descriptor. Part of VALIDATE.

29.1.136 4.1.136 DETAIL

A recognized but currently unsupported report descriptor detail line control clause.

29.1.137 4.1.137 DISABLE

An unsupported COMMUNICATION SECTION control verb.

29.1.138 4.1.138 DISK

A SELECT devicename phrase.

```
ASSIGN TO DISK USING dataname
```

Alternative spelling of **DISC** is allowed.

29.1.139 4.1.139 DISPLAY

A general purpose output verb.

- prints values to default console or other device
- set the current ARGUMENT-NUMBER influencing subsequent access ACCEPT FROM ARGUMENT-VALUE statements
- specify explicit COMMAND-LINE influencing subsequent access with ACCEPT FROM COMMAND-LINE, but not ARGUMENT-VALUE access
- sets enviroment variables, as part of a two step process. (Use the more concise SET ENVIRONMENT instead)
  1. DISPLAY "envname" UPON ENVIRONMENT-NAME
  2. DISPLAY "envname-value" UPON ENVIRONMENT-VALUE

```
DISPLAY "First value: " a-variable " and another string" END-DISPLAY

DISPLAY "1" 23 "4" END-DISPLAY
```

The setting of environment variables does not influence the owning process shell.

```
DISPLAY "ENVNAME" UPON ENVIRONMENT-NAME END-DISPLAY
DISPLAY "COBOL value" UPON ENVIRONMENT-VALUE
     ON EXCEPTION stop run
     NOT ON EXCEPTION continue
END-DISPLAY
CALL "SYSTEM" USING "echo $ENVNAME"
```

gives:

```
$ ENVNAME="parent shell value"
$ ./disps
COBOL value
$ echo $ENVNAME
parent shell value
```

29.1.140 4.1.140 DIVIDE

Highly precise arthimetic. Supports various forms:

- DIVIDE INTO
- DIVIDE INTO GIVING
- DIVIDE BY GIVING
- DIVIDE INTO REMAINDER
- DIVIDE BY REMAINDER

For example:

```
DIVIDE dividend BY divisor GIVING answer ROUNDED REMAINDER r
    ON SIZE ERROR
        PERFORM log-division-error
        SET division-error TO TRUE
    NOT ON SIZE ERROR
        SET division-error TO FALSE
END-DIVIDE
```

The 20xx draft standard requires conforming implementations to use 1,000 digits of precision for intermediate results. There will be no rounding errors when properly calculating financials in a COBOL program.

29.1.141 4.1.141 DIVISION

Ahh, sub-divisions. I think my favourite is the DATA DIVISION. It gives COBOL a distinctive and delicious flavour in a picturesque codescape.

Divisions must be specified in the order below within each source program unit.

1. IDENTIFICATION DIVISION.
2. ENVIRONMENT DIVISION.
3. DATA DIVISION.
4. PROCEDURE DIVISION.

A handy mnemonic may be *"I Enter Data Properly"*.

OpenCOBOL is flexible enough to compile files with only a PROCEDURE DIVISION, and even then it really only needs a PROGRAM-ID. See What is the shortest OpenCOBOL program? for an example.

29.1.142 4.1.142 DOWN

Allows decrement of an index control or pointer variable.

```
SET ind-1 DOWN BY 2
```

Also used for SCREEN SECTION scroll control.

```
SCROLL DOWN 5 LINES
```

29.1.143 4.1.143 DUPLICATES

Allows duplicate keys in indexed files.

```
SELECT filename
  ALTERNATE RECORD KEY IS altkey WITH DUPLICATES
```

Also for SORT control.

```
SORT filename ON DESCENDING KEY keyfield
  WITH DUPLICATES IN ORDER
  USING sort-in GIVING sort-out.
```

29.1.144 4.1.144 DYNAMIC

A file access mode allowing runtime control over SEQUENTIAL and RANDOM access for INDEXED and RELATIVE ORGANIZATION.

```
SELECT filename
  ORGANIZATION IS RELATIVE
  ACCESS MODE IS DYNAMIC
```

29.1.145 4.1.145 EBCDIC

Extended Binary Coded Decimal Interchange Code.

A character encoding common to mainframe systems, therefore COBOL, therefore OpenCOBOL. Different than ASCII and OpenCOBOL supports both through efficient mappings. See http://en.wikipedia.org/wiki/EBCDIC for more info.

ASCII to EBCDIC conversion the OpenCOBOL way

```
SPECIAL-NAMES.
ALPHABET ALPHA IS NATIVE.
ALPHABET BETA IS EBCDIC.

PROCEDURE DIVISION.
INSPECT variable CONVERTING ALPHA TO BETA
```

29.1.146 4.1.146 EC

An unsupported shortform for USE AFTER EXCEPTION CONDITION

29.1.147 4.1.147 EGI

An unsupported COMMUNICATION SECTION word.

29.1.148 4.1.148 ELSE

Alternate conditional branch point.

```
IF AGE IS ZERO
   DISPLAY "Cigar time" END-DISPLAY
ELSE
   DISPLAY "What is it with kids anyway?" END-DISPLAY
END-IF
```

For multi branch conditionals, see EVALUATE.

29.1.149 4.1.149 EMI

An unsupported COMMUNICATION SECTION word.

29.1.150 4.1.150 ENABLE

An unsupported COMMUNICATION SECTION control verb.

29.1.151 4.1.151 END

Ends things. Programs, declaratives, functions.

29.1.152 4.1.152 END-ACCEPT

Explicit terminator for ACCEPT.

29.1.153 4.1.153 END-ADD

Explicit terminator for ADD.

29.1.154 4.1.154 END-CALL

Explicit terminator for CALL.

29.1.155 4.1.155 END-COMPUTE

Explicit terminator for COMPUTE.

29.1.156 4.1.156 END-DELETE

Explicit terminator for DELETE.

29.1.157 4.1.157 END-DISPLAY

Explicit terminator for DISPLAY.

29.1.158 4.1.158 END-DIVIDE

Explicit terminator for DIVIDE.

29.1.159 4.1.159 END-EVALUATE

Explicit terminator for EVALUATE.

29.1.160 4.1.160 END-IF

Explicit terminator for IF.

29.1.161 4.1.161 END-MULTIPLY

Explicit terminator for MULTIPLY.

29.1.162 4.1.162 END-OF-PAGE

A LINAGE phrase used by WRITE controlling end of page imperative clause.

29.1.163 4.1.163 END-PERFORM

Explicit terminator for PERFORM.

29.1.164 4.1.164 END-READ

Explicit terminator for READ.

29.1.165 4.1.165 END-RECEIVE

Explicit terminator for RECEIVE.

29.1.166 4.1.166 END-RETURN

Explicit terminator for RETURN.

29.1.167 4.1.167 END-REWRITE

Explicit terminator for REWRITE.

29.1.168 4.1.168 END-SEARCH

Explicit terminator for SEARCH.

29.1.169 4.1.169 END-START

Explicit terminator for START.

29.1.170 4.1.170 END-STRING

Explicit terminator for STRING.

29.1.171 4.1.171 END-SUBTRACT

Explicit terminator for SUBTRACT.

29.1.172 4.1.172 END-UNSTRING

Explicit terminator for UNSTRING.

29.1.173 4.1.173 END-WRITE

Explicit terminator for WRITE.

29.1.174 4.1.174 ENTRY

Always for CALL entry points without being fully specified sub-programs. Great for defining callbacks required by many GUI frameworks.

See Does OpenCOBOL support the GIMP ToolKit, GTK+? for an example.

29.1.175 4.1.175 ENTRY-CONVENTION

An as yet unsupported clause.

29.1.176 4.1.176 ENVIRONMENT

Divisional name. And allows access to operating system environment variables. OpenCOBOL supports

- CONFIGURATION SECTION
- INPUT-OUTPUT SECTION

within the ENVIROMENT DIVISION.

Also a context sensitive keyword for access to the process environment variables.

- SET ENVIRONMENT "env-var" TO value
- ACCEPT var FROM ENVIRONMENT "env-var" END-ACCEPT

29.1.177 4.1.177 ENVIRONMENT-NAME

Provides access to the running process environment variables.

29.1.178 4.1.178 ENVIRONMENT-VALUE

Provides access to the running process environment variables.

29.1.179 4.1.179 EO

An unsupported shortform for USE AFTER EXCEPTION OBJECT

29.1.180 4.1.180 EOL

ERASE to End Of Line.

29.1.181 4.1.181 EOP

LINAGE clause shortform for END-OF-PAGE.

29.1.182 4.1.182 EOS

ERASE to End Of Screen.

29.1.183 4.1.183 EQUAL

Conditional expression to compare two data items for equality.

29.1.184 4.1.184 EQUALS

Conditional expression to compare two data items for equality.

29.1.185 4.1.185 ERASE

A screen section data attribute clause that can control which portions of the screen are cleared during DISPLAY, and ACCEPT.

```
01 form-record.
   02 first-field PIC xxx
      USING identifier-1
      ERASE EOL.
```

29.1.186 4.1.186 ERROR

A DECLARATIVES clause that can control error handling.

```
USE AFTER STANDARD ERROR PROCEDURE ON filename-1
```

Program return control.

```
STOP RUN WITH ERROR STATUS stat-var.
```

29.1.187 4.1.187 ESCAPE

Programmer access to escape key value during ACCEPT.

```
ACCEPT identifier FROM ESCAPE KEY END-ACCEPT
```

Data type is 9(4).

29.1.188 4.1.188 ESI

Unsupported COMMUNICATION SECTION control.

29.1.189 4.1.189 EVALUATE

A very powerful and concise selection construct.

```
EVALUATE a ALSO b ALSO TRUE
    WHEN 1 ALSO 1 THRU 9 ALSO c EQUAL 1 PERFORM all-life
    WHEN 2 ALSO 1 THRU 9 ALSO c EQUAL 2 PERFORM life
    WHEN 3 THRU 9 ALSO 1 ALSO c EQUAL 9 PERFORM disability
    WHEN OTHER PERFORM invalid
END-EVALUATE
```

29.1.190 4.1.190 EXCEPTION

Allow detection of CALL problem.

```
CALL "CBL_OC_DUMP" ON EXCEPTION CONTINUE END-CALL
```

29.1.191 4.1.191 EXCEPTION-OBJECT

Unsupport object COBOL data item reference.

29.1.192 4.1.192 EXCLUSIVE

Mode control for file locks.

29.1.193 4.1.193 EXIT

OpenCOBOL supports

- EXIT
- EXIT PROGRAM
- EXIT PERFORM [CYCLE]
- EXIT SECTION
- EXIT PARAGRAPH

Controls flow of the program. EXIT PERFORM CYCLE causes an inline perform to return control to the VARYING, UNTIL or TIMES clause, testing the conditional to see if another cycle is required. EXIT PERFORM without the CYCLE option causes flow to continue passed the end of the current PERFORM loop.

29.1.194 4.1.194 EXPANDS

Unsupported COMMUNICATION SECTION control.

29.1.195 4.1.195 EXTEND

Open a resource in an append mode.

29.1.196 4.1.196 EXTERNAL

Clause to specify external data item, file connection and program unit.

```
77 shared-var PIC S9(4) IS EXTERNAL AS 'shared_var'.
```

29.1.197 4.1.197 FACTORY

An unsupported object COBOL keyword.

29.1.198 4.1.198 FALSE

Logical false and conditional set condition.

```
01 record-1      pic 9.
   88 conditional-1 values 1,2,3 when set to false is 0.

set conditional-1 to true
display record-1 end-display

set conditional-1 to false
display record-1 end-display

if conditional-1
    display "BAD" end-display
end-if
```

Runs as:

```
$ ./conditionals
1
0
```

Also used in EVALUATE, inverting the normal sense of WHEN

```
evaluate false
    when 1 equal 1
        display "Not displayed, as 1 equal 1 is true" end-display
    when 1 equal 2
        display "This displays because 1 equal 2 is false" end-display
    when other
        display "the truest case, nothing is false" end-display
end-evaluate
```

29.1.199 4.1.199 FD

The record side of the COBOL file system. The File Descriptor. COBOL provides lots of control over file access. FD is part of that engine.

Sort files use SD

Some FD phrases are old, and their uses have been overtaken by features of modern operating systems.

- BLOCK CONTAINS
- RECORDING MODE IS

Others are pretty cool. LINAGE is one example. FD supports a mini report writer feature. Control over lines per page, heaVer, footer and a line counter, LINAGE IS, that is implicitly maintained by OpenCOBOL during file writes. These files are usually reports, but they don't have to be, LINAGE can be used for a simple step counter when you'd like progress displays of file updates.

Other recognized file descriptions include:

- RECORD IS VARYING IN SIZE FROM 1 TO 999999999 DEPENDING ON size-variable Record sizes need to fit in PIC 9(9), just shy of a thousand million.
- CODE-SET IS alphabet-name
- DATA RECORD IS data-name
- LABEL RECORDS ARE STANDARD (or OMITTED)
- RECORD CONTAINS 132 CHARACTERS

```
FD filename-sample
   RECORD IS VARYING IN SIZE FROM 1 TO 32768 CHARACTERS
     DEPENDING ON record-size-sample.
```

29.1.200 4.1.200 FILE

FILE is another multi use COBOL word.

- A SECTION of the DATA DIVISION.

The FILE section holds file description paragraphs and buffer layouts.

```
data division.
FILE section.
fd cobol-file-selector.
01 cobol-io-buffer        pic x(132).
```

- a context word for setting name for FILE STATUS fields in FILE-CONTROL paragraphs.

Some programmers don't like seeing COBOL code that does not verify and test FILE STATUS, so you should. See ISAM for the numeric codes supported.

```
environment division.
input-output section.
file-control.
   select optional data-file assign to file-name
       organization is line sequential
       FILE STATUS is data-file-status.
   select mini-report assign to "mini-report".
```

- a context word as part of the PROCEDURE DIVISION declarative statements allowing for out-of-band exception handling for file access.

Exception handling with declaratives can be powerful, but some programmers find the out of band nature of where the source code that caused a problem compared to where the error handler is, distasteful.

```
procedure division.
declaratives.

error-handling section.
    USE AFTER EXCEPTION FILE filename-maybe.
error-handler.
    display "Exception on filename" end-display
.
end declaratives.
```

Support for USE AFTER EXCEPTION FILE is a work in progress. Using DECLARATIVES forces use of section names in the PROCEDURE DIVISION.

- a context word as part of DELETE FILE filenames.

```
DELETE FILE file-selector-1 file-selector-2
```

DELETE FILE is supported in OpenCOBOL 2.0.

29.1.201 4.1.201 FILE-CONTROL

Files. The paragraph in the INPUT-OUTPUT section, in the ENVIRONMENT division. It's verbose, a little voodooey, and worth it.

```
environment division.
input-output section.
FILE-CONTROL.
  select optional data-file assign to file-name
      organization is line sequential
      file status is data-file-status.

  select mini-report assign to "mini-report".
```

29.1.202 4.1.202 FILE-ID

File naming clause. Assigned name may be device, FD clause specifies value of the file identifier.

```
VALUE OF FILE-ID IS file-ids in summary-array
```

more specifically

```
environment division.
input-output section.
file-control.
    select cobol-file-selector
    assign to disk
    organization            indexed
    access mode             dynamic
    record key              fd-key-field
    file status             file-status-field.

data division.
file section.
fd cobol-file-selector label record standard
    VALUE OF FILE-ID is "actual-filename.dat".
```

An alternative, and likely more common, method is to set the actual filename (*or the enviroment variable that references the actual filename*) in the `ASSIGN` clause. OpenCOBOL has a configuration setting to control how the actual filenames are mapped, see ASSIGN. `VALUE OF FILE-ID` is not ISO standard COBOL.

29.1.203 4.1.203 FILLER

Data division clause, for unnamed data allocations; filler, if you will.

```
01 the-record.
   05 first-field  pic x(10).
   05 filler       pic x(35) value "this space intentionally left blank".
   04 third-field  pic x(10).
```

`FILLER` is an optional word, and this code snippet is equivalent.

```
01 the-record.
    05 first-field  pic x(10).
    05             pic x(35) value "this space intentionally left blank".
    05 third-field  pic x(10).
```

Personal preference of this author is to explicitly type FILLER.

29.1.204 4.1.204 FINAL

Final. A recognized but currently not supported Report Writer feature.

29.1.205 4.1.205 FIRST

First. A recognized but currently not supported Report Writer feature.

29.1.206 4.1.206 FLOAT-EXTENDED

OpenCOBOL recognizes but does not yet support FLOAT-EXTENDED and will abend a compile.

29.1.207 4.1.207 FLOAT-LONG

OpenCOBOL supports floating point long.

```
identification division.
program-id. threes.

data division.
working-storage section.
01 fshort usage float-short.
01 flong  usage float-long.
01 fpic   pic   9v9(35).

procedure division.
compute fshort = 1 / 3 end-compute
display "as short " fshort end-display
compute flong = 1 / 3 end-compute
display "as long  " flong end-display
compute fpic = 1 / 6 end-compute
display "as pic   " fpic end-display
compute fpic rounded = 1 / 6 end-compute
display "rounded  " fpic end-display
goback.

end program threes.
```

displays:

```
$ ./threes
as short 0.333333343267440796
as long  0.333333333333333315
as pic   0.166666666666666666666666666666666666
rounded  0.166666666666666666666666666666666667
```

29.1.208 4.1.208 FLOAT-SHORT

OpenCOBOL supports short floating point.

29.1.209 4.1.209 FOOTING

A well supported LINAGE clause.

29.1.210 4.1.210 FOR

Recognized but unsupported Report Writer clause.

29.1.211 4.1.211 FOREGROUND-COLOR

Screen section foreground color control. See What are the OpenCOBOL SCREEN SECTION colour values?

29.1.212 4.1.212 FOREVER

Provides for infinite loops. Use EXIT PERFORM or EXIT PERFORM CYCLE to control program flow.

```
identification division.
program-id. foreverloop.

data division.
working-storage section.
01 cobol   pic 9 value 0.
01 c       pic 9 value 1.
01 fortran pic 9 value 2.

procedure division.

perform forever
    add 1 to cobol
    display "cobol at " cobol end-display

    if cobol greater than fortran
        exit perform
    end-if

    if cobol greater than c
        exit perform cycle
    end-if

    display "cobol still creeping up on c" end-display
end-perform

display "cobol surpassed c and fortran" end-display

goback.
end program foreverloop.
```

Which produces:

```
$ cobc -free -x foreverloop.cob
$ ./foreverloop
cobol at 1
cobol still creeping up on c
cobol at 2
cobol at 3
cobol surpassed c and fortran
```

I asked on opencobol.org for some input, and an interesting conversation ensued. I've included the forum thread archive, nearly in its entirety, to give a sense of various programmer styles and group thought processing. See Performing FOREVER?.

29.1.213 4.1.213 FORMAT

Source format directive.

```
123456 >>SOURCE FORMAT IS FIXED
```

29.1.214 4.1.214 FREE

Properly cleans up ALLOCATE alloted memory, and source format directive.

```
>>SOURCE FORMAT IS FREE

 01 var PIC X(1024) BASED.

 ALLOCATE var
 CALL "buffer-thing" USING BY REFERENCE var END-CALL
 MOVE var TO working-store
 FREE var
```

29.1.215 4.1.215 FROM

```
ACCEPT var FROM ENVIRONMENT "path"
    ON EXCEPTION
        DISPLAY "No path" END-DISPLAY
    NOT ON EXCEPTION
        DISPLAY var END-DISPLAY
END-ACCEPT
```

29.1.216 4.1.216 FULL

A screen section screen item control operator, requesting the normal terminator be ignored until the field is completely full or completely empty.

29.1.217 4.1.217 FUNCTION

Allows use of the many OpenCOBOL supported intrinsic functions.

```
DISPLAY FUNCTION TRIM("   trim off leading spaces" LEADING) END-DISPLAY.
```

See Does OpenCOBOL implement any Intrinsic FUNCTIONs? for details.

29.1.218 4.1.218 FUNCTION-ID

Not yet implemented, but it will allow for user defined FUNCTION.

29.1.219 4.1.219 GENERATE

Not yet implemented beyond simple parsing REPORT writer feature.

29.1.220 4.1.220 GET

Unsupported.

29.1.221 4.1.221 GIVING

Destination control for computations, and return value clause.

```
ADD 1 TO cobol GIVING OpenCOBOL.
```

29.1.222 4.1.222 GLOBAL

A global name is accessible to all contained programs.

29.1.223 4.1.223 GO

GO TO is your friend. Edsger was wrong. Transfer control to a named paragraph or section. See ALTER for details of monster goto power.

29.1.224 4.1.224 GOBACK

A return. This will work correctly for all cases. A return to the operating system or a return to a called program.

```
GOBACK.
```

29.1.225 4.1.225 GREATER

COBOL conditional expression, IF A GREATER THAN B, See LESS

29.1.226 4.1.226 GROUP

Recognized but unsupported Report Writer clauses.

29.1.227 4.1.227 GROUP-USAGE

An unsupported BIT clause.

29.1.228 4.1.228 HEADING

Recognized but unsupported Report Writer clauses.

29.1.229 4.1.229 HIGH-VALUE

A figurative ALPHABETIC constant, being the highest character value in the COLLATING sequence. It's invalid to MOVE HIGH-VALUE to a NUMERIC field.

29.1.230 4.1.230 HIGH-VALUES

Plural of HIGH-VALUE.

29.1.231 4.1.231 HIGHLIGHT

Screen control for field intensity.

29.1.232 4.1.232 I-O

An OPEN mode allowing for both read and write.

29.1.233 4.1.233 I-O-CONTROL

A paragraph in the INPUT-OUTPUT section, allowing sharing memory areas for different files.

```
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
I-O-CONTROL.
    SAME RECORD AREA FOR filename-1 filename-2.
```

29.1.234 4.1.234 ID

Shortform for IDENTIFICATION.

29.1.235 4.1.235 IDENTIFICATION

The initial division for OpenCOBOL programs.

```
IDENTIFICATION DIVISION.
PROGRAM-ID. sample.
```

Many historical paragraphs from the IDENTIFICATION DIVISION have been deemed obsolete. OpenCOBOL will treat these as comment paragraphs. Including

- AUTHOR
- DATE-WRITTEN
- DATE-MODIFIED
- DATE-COMPILED
- INSTALLATION
- REMARKS
- SECURITY

29.1.236 4.1.236 IF

Conditional branching. In COBOL, conditionals are quite powerful and there are many conditional expressions allowed with concise shortcuts.

```
IF A = 1 OR 2
    MOVE 1 TO B
END-IF
```

29.1.237 4.1.237 IGNORING

```
READ filename-1 INTO identifer-1 IGNORING LOCK END-READ
```

29.1.238 4.1.238 IMPLEMENTS

Unsupported Object COBOL expression.

29.1.239 4.1.239 IN

A data structure reference and name conflict resolution qualifier.

```
MOVE "abc" TO field IN the-record IN the-structure
```

Synonym for OF

29.1.240 4.1.240 INDEX

```
01 cursor-var USAGE INDEX.

SET cursor-var UP BY 1.
```

29.1.241 4.1.241 INDEXED

An ISAM file organization.

```
environment division.
input-output section.
file-control.
   select optional indexing
   assign to "indexing.dat"
   organization is indexed
   access mode is dynamic
   record key is keyfield of indexing-record
   alternate record key is splitkey of indexing-record
       with duplicates
   .
```

Sets an indexing control identifier for OCCURS data arrays.

```
01 TABLE-DATA.
   05 TABLE-ELEMENTS
       OCCURS 1 TO 100 TIMES DEPENDING ON crowd-size
       INDEXED BY cursor-var.
     10 field-1 PIC X.
```

29.1.242 4.1.242 INDICATE

GROUP INDICATE is an as yet unsupported REPORT SECTION RD clause that specifies that printable item is ouput only on the first occurrence of its report group for that INITIATE, control break, or page advance.

29.1.243 4.1.243 INHERITS

An unsupported Object COBOL clause.

29.1.244 4.1.244 INITIAL

A modifier for the PROGRAM-ID clause, that causes the entire DATA DIVISION to be set to an initial state each time the subprogram is executed by CALL.

```
ocobol >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20111226
      *> Purpose:   Small sample of INITIAL procedure division clause
      *> Tectonics: cobc -x -w -g -debug initialclause.cob
      *> ************************************************************
       identification division.
       program-id. initialclause.

      *> -*********-*********-*********-*********-*********-*********-**
       procedure division.
       call "with-initial" end-call
       call "without-initial" end-call
       call "with-initial" end-call
       call "without-initial" end-call
       call "without-initial" end-call
       goback.
       end program initialclause.


      *> -*********-*********-*********-*********-*********-*********-**
      *> -*********-*********-*********-*********-*********-*********-**
       identification division.
       program-id. with-initial is initial.

       data division.
       working-storage section.
       01 the-value pic 99 value 42.

      *> -*********-*********-*********-*********-*********-*********-**
       procedure division.
       display "Inside with-initial with   : " the-value end-display
       multiply the-value by 2 giving the-value
           on size error
               display "size overflow" end-display
       end-multiply
       goback.
       end program with-initial.


      *> -*********-*********-*********-*********-*********-*********-**
      *> -*********-*********-*********-*********-*********-*********-**
       identification division.
       program-id. without-initial.

       data division.
       working-storage section.
       01 the-value pic 99 value 42.

      *> -*********-*********-*********-*********-*********-*********-**
       procedure division.
       display "Inside without-initial with: " the-value end-display
       multiply the-value by 2 giving the-value
```

```
           on size error
               display "size overflow" end-display
       end-multiply
       goback.
       end program without-initial.
```

Gives:

```
[btiffin@home cobol]$ ./initialclause
Inside with-initial with   : 42
Inside without-initial with: 42
Inside with-initial with   : 42
Inside without-initial with: 84
size overflow
Inside without-initial with: 84
size overflow
```

INITIAL sets the-value to 42 upon each and every entry, without-initial multiplies through 42, 84, 168 (or would have).

29.1.245 4.1.245 INITIALIZE

A sample of the INITIALIZE verb posted to opencobol.org by human

```
OCOBOL*-------------------------------------------------------------
       IDENTIFICATION DIVISION.
       PROGRAM-ID. 'INITTEST'.
       ENVIRONMENT DIVISION.
       CONFIGURATION SECTION.
       SPECIAL-NAMES. DECIMAL-POINT IS COMMA.
       INPUT-OUTPUT SECTION.
       DATA DIVISION.
      *
       WORKING-STORAGE SECTION.
      *
        77  mychar      pic x.
        77  mynumeric   pic 9.
        01  REC-TEST BASED.
            03 REC-TEST-PART1 PIC X(10) value all '9'.
            03 REC-TEST-PART2 PIC X(10) value all 'A'.
        01  fillertest.
            03 fillertest-1 PIC 9(10) value 2222222222.
            03 filler       PIC X     value '|'.
            03 fillertest-2 PIC X(10) value all 'A'.
            03 filler       PIC 9(03) value 111.
            03 filler       PIC X     value '.'.
      *-------------------------------------------------------------
       LINKAGE SECTION.
      *-------------------------------------------------------------
       PROCEDURE DIVISION.
      *-------------------------------------------------------------
        Main section.
        00.
      *
            display 'fillertest '
                    'on start:'
            end-display
            display fillertest
            end-display
            accept  mychar
```

```
*
     initialize fillertest
     display 'fillertest '
             'after initialize:'
     end-display
     display fillertest
     end-display
     accept  mychar
*
     initialize fillertest replacing numeric by 9
     display 'fillertest '
             'after initialize replacing numeric by 9:'
     end-display
     display fillertest
     end-display
     accept  mychar
*
     initialize fillertest replacing alphanumeric by 'X'
     display 'fillertest '
             'after initialize replacing alphanumeric by "X":'
     end-display
     display fillertest
     end-display
     accept  mychar
*
     initialize fillertest replacing alphanumeric by all 'X'
     display 'fillertest '
             'after initialize replacing alphanumeric by all "X":'
     end-display
     display fillertest
     end-display
     accept  mychar
*
     initialize fillertest with filler
     display 'fillertest '
             'after initialize with filler:'
     end-display
     display fillertest
     end-display
     accept  mychar
*
     initialize fillertest all to value
     display 'fillertest '
             'after initialize all to value:'
     end-display
     display fillertest
     end-display
     accept  mychar
*
     ALLOCATE  REC-TEST
     display 'REC-TEST after allocating:'
     end-display
     display REC-TEST
     end-display
     accept  mychar
*
     initialize REC-TEST all to value
     display 'REC-TEST after initalize all to value:'
     end-display
```

```
           display REC-TEST
           end-display
           accept  mychar
       *
           stop run
       *
           continue.
        ex. exit program.
       *-----------------------------------------------------------------
       *--- End of program INITTEST ------------------------------------
```

Outputs:

```
fillertest on start:
2222222222|AAAAAAAAAA111.
fillertest after initialize:
0000000000|          111.
fillertest after initialize replacing numeric by 9:
0000000009|          111.
fillertest after initialize replacing alphanumeric by "X":
0000000009|X         111.
fillertest after initialize replacing alphanumeric by all "X":
0000000009|XXXXXXXXXX111.
fillertest after initialize with filler:
0000000000           000
fillertest after initialize all to value:
2222222222|AAAAAAAAAA111.
REC-TEST after allocating:

REC-TEST after initalize all to value:
9999999999AAAAAAAAAA
```

29.1.246 4.1.246 INITIALIZED

A modifier for the ALLOCATE verb, filling the target with a default value.

```
77 based-var   PIC X(9) BASED VALUE "ALLOCATED".
77 pointer-var USAGE POINTER.

ALLOCATE based-var
DISPLAY ":" based-var ":" END-DISPLAY
FREE based-var
ALLOCATE based-var INITIALIZED RETURNING pointer-var
DISPLAY ":" based-var ":" END-DISPLAY
```

displays:

```
:         :
:ALLOCATED:
```

29.1.247 4.1.247 INITIATE

Initialize internal storage for named REPORT SECTION entries.

Not currently *(February 2013)* supported.

29.1.248 4.1.248 INPUT

A mode of the OPEN verb for file access.

```
OPEN INPUT file
```

A SORT clause allowing programmer controlled input read passes where sortable records are passed to the sort algorithm using RELEASE.

```
procedure division.
sort sort-work
    on descending key work-rec
    collating sequence is mixed
    input procedure is sort-transform
    output procedure is output-uppercase.

display sort-return end-display.
goback.
```

29.1.249 4.1.249 INPUT-OUTPUT

A section in the ENVIRONMENT DIVISION of a COBOL source file containing FILE and I-O control paragraphs.

```
environment division.
input-output section.
file-control.
    select htmlfile
    assign to filename
    organization is record sequential.
```

OpenCOBOL supports

- FILE-CONTROL
- I-O-CONTROL

paragraphs within the INPUT-OUTPUT SECTION.

29.1.250 4.1.250 INSPECT

Provides very powerful parsing and replacement to COBOL and OpenCOBOL supports the full gamet of options.

```
ocobol identification division.
       program-id. inspecting.

       data division.
       working-storage section.
       01  ORIGINAL            pic XXXX/XX/XXBXX/XX/XXXXXXX/XX.
       01  DATEREC             pic XXXX/XX/XXBXX/XX/XXXXXXX/XX.

       procedure division.

       move function when-compiled to DATEREC ORIGINAL

       INSPECT DATEREC REPLACING ALL "/" BY ":" AFTER INITIAL SPACE

       display
           "Intrinsic function WHEN-COMPILED " ORIGINAL
       end-display
       display
```

```
           " after INSPECT REPLACING         " DATEREC
       end-display

       goback.
       end program inspecting.
```

Example output:

```
Intrinsic function WHEN-COMPILED 2010/03/25 23/05/0900-04/00
 after INSPECT REPLACING         2010/03/25 23:05:0900-04:00
```

29.1.251 4.1.251 INTERFACE

Unsupported.

29.1.252 4.1.252 INTERFACE-ID

An unsupported Object COBOL clause in the IDENTIFICATION division.

29.1.253 4.1.253 INTO

Division.

```
DIVIDE A INTO B GIVING C.
```

29.1.254 4.1.254 INTRINSIC

Used in REPOSITORY to allow the optional use of "FUNCTION" keyword.

```
environment division.
configuration section.
repository.
    function all intrinsic.
```

The source unit will now allow for program lines such as

```
move trim("  abc") to dest
move function trim("  abc") to dest
```

to compile the same code.

29.1.255 4.1.255 INVALID

Key exception imperative phrase.

```
READ filename-1
    INVALID KEY
        DISPLAY "Bad key"
    NOT INVALID KEY
        DISPLAY "Good read"
END-READ
```

29.1.256 4.1.256 INVOKE

Unsupported Object COBOL method call.

29.1.257 4.1.257 IS

Readability word. A IS LESS THAN B is equivalent to A LESS B.

29.1.258 4.1.258 JUST

Alias for JUSTIFIED.

29.1.259 4.1.259 JUSTIFIED

Tweaks storage rules in wierd JUST ways, lessening the voodoo behind MOVE instructions, *he said, sarcastically*.

```
77 str1 pic x(40) justified right.
```

29.1.260 4.1.260 KEY

Multi use, always means key:

```
- RELATIVE KEY IS
- ALTERNATE RECORD KEY IS
- NOT INVALID KEY
- SORT filename ON DESCENDING KEY keyfield
- START indexing KEY IS LESS THAN keyfield
```

29.1.261 4.1.261 KEYBOARD

A special value for Standard Input

```
file-control.
    select cgi-in
    assign to keyboard.
```

29.1.262 4.1.262 LABEL

A record label. As with most record labels, falling into disuse.

29.1.263 4.1.263 LAST

Used in START to prepare a read of the last record. A recognized but unsupported Report Writer clause.

```
START filename-1 LAST
    INVALID KEY
        MOVE ZERO TO record-count
        >>D DISPLAY "No last record for " filename-1 END-DISPLAY
END-START
```

29.1.264 4.1.264 LC_ALL

A reserved but unsupported category group. See Setting Locale. OpenCOBOL is 'locale' aware, but it is currently more *external* than in COBOL source. For now, it is safest to assume **LC_ALL=C**, but this can be configured differently when OpenCOBOL is built.

29.1.265 4.1.265 LC_COLLATE

A reserved but unsupported category name. Will be used with SET.

29.1.266 4.1.266 LC_CTYPE

A reserved but unsupported Locale category name. Will be used with SET.

29.1.267 4.1.267 LC_MESSAGES

A reserved but unsupported category name. See Setting Locale. OpenCOBOL is 'locale' aware, but it is currently more *external* than in COBOL source.

OpenCOBOL 2.0 extends locale support to the compiler messages.

```
$ export LC_MESSAGES=es_ES
$ cobc -x fdfgffd.cob
cobc: fdfgffd.cob: No existe el fichero o el directorio
```

29.1.268 4.1.268 LC_MONETARY

A reserved but unsupported Locale category name. Will be used with SET.

29.1.269 4.1.269 LC_NUMERIC

A reserved but unsupported Locale category name. Will be used with SET.

29.1.270 4.1.270 LC_TIME

A reserved but unsupported Locale category name. Will be used with SET.

29.1.271 4.1.271 LEADING

Multipurpose.

```
DISPLAY FUNCTION TRIM(var-1 LEADING) END-DISPLAY

INSPECT FUNCTION REVERSE(TEST-CASE)
    TALLYING B-COUNT
    FOR LEADING ' '.
DISPLAY B-COUNT.

INSPECT X REPLACING LEADING ZEROS BY SPACES.
```

as well as use in the COBOL preprocessor:

```
COPY "copy.inc"
    REPLACING LEADING ==TEST== BY ==FIRST==
              LEADING ==NORM== BY ==SECOND==.
```

29.1.272 4.1.272 LEFT

SYNCHRONIZED control.

29.1.273 4.1.273 LENGTH

A 'cell-count' length. Not always the same as BYTE-LENGTH.

29.1.274 4.1.274 LESS

A comparison operation.

```
IF requested LESS THAN OR EQUAL TO balance
    PERFORM transfer
ELSE
    PERFORM reject
END-IF
```

29.1.275 4.1.275 LIMIT

Recognized but unsupported Report Writer clause.

29.1.276 4.1.276 LIMITS

Recognized but unsupported Report Writer clause.

29.1.277 4.1.277 LINAGE

LINAGE is a *SPECIAL-REGISTER* supported by OpenCOBOL. A counter is maintained for file WRITE and can be used for pageing *and other* control.

```
COBOL ************************************************************
      * Example of LINAGE File Descriptor
      * Author: Brian Tiffin
      * Date:   10-July-2008
      * Tectonics: $ cocb -x linage.cob
      *            $ ./linage <filename ["linage.cob"]>
      *            $ cat -n mini-report
      ************************************************************
       IDENTIFICATION DIVISION.
       PROGRAM-ID. linage-demo.

       ENVIRONMENT DIVISION.
       INPUT-OUTPUT SECTION.
       FILE-CONTROL.
          select optional data-file assign to file-name
              organization is line sequential
              file status is data-file-status.
          select mini-report assign to "mini-report".

       DATA DIVISION.
       FILE SECTION.
       FD  data-file.
```

```
01  data-record.
   88 endofdata        value high-values.
   02 data-line        pic x(80).
FD  mini-report
   linage is 16 lines
       with footing at 15
       lines at top 2
       lines at bottom 2.
01  report-line         pic x(80).

WORKING-STORAGE SECTION.
01  command-arguments   pic x(1024).
01  file-name           pic x(160).
01  data-file-status    pic 99.
01  lc                  pic 99.
01  report-line-blank.
   02 filler           pic x(18) value all "*".
   02 filler           pic x(05) value spaces.
   02 filler           pic x(34)
       VALUE "THIS PAGE INTENTIONALLY LEFT BLANK".
   02 filler           pic x(05) value spaces.
   02 filler           pic x(18) value all "*".
01  report-line-data.
   02 body-tag         pic 9(6).
   02 line-3           pic x(74).
01  report-line-header.
   02 filler           pic x(6) VALUE "PAGE: ".
   02 page-no          pic 9999.
   02 filler           pic x(24).
   02 filler           pic x(5) VALUE " LC: ".
   02 header-tag       pic 9(6).
   02 filler           pic x(23).
   02 filler           pic x(6) VALUE "DATE: ".
   02 page-date        pic x(6).

01  page-count          pic 9999.

PROCEDURE DIVISION.

accept command-arguments from command-line end-accept.
string
   command-arguments delimited by space
   into file-name
end-string.
if file-name equal spaces
   move "linage.cob" to file-name
end-if.

open input data-file.
read data-file
   at end
       display
            "File: " function trim(file-name) " open error"
       end-display
       go to early-exit
end-read.

open output mini-report.
```

```
 write report-line
    from report-line-blank
 end-write.

 move 1 to page-count.
 accept page-date from date end-accept.
 move page-count to page-no.
 write report-line
    from report-line-header
    after advancing page
 end-write.

 perform readwrite-loop until endofdata.

 display
    "Normal termination, file name: "
    function trim(file-name)
    " ending status: "
    data-file-status
 end-display.
 close mini-report.

*> Goto considered harmful?  Bah!  :)
 early-exit.
 close data-file.
 exit program.
 stop run.

*****************************************************************
 readwrite-loop.
 move data-record to report-line-data
 move linage-counter to body-tag
 write report-line from report-line-data
    end-of-page
        add 1 to page-count end-add
        move page-count to page-no
        move linage-counter to header-tag
        write report-line from report-line-header
            after advancing page
        end-write
 end-write
 read data-file
    at end set endofdata to true
 end-read
 .

*****************************************************************
*> Commentary
*> LINAGE is set at a 20 line logical page
*>  16 body lines
*>   2 top lines
*>   A footer line at 15 (inside the body count)
*>   2 bottom lines
*> Build with:
*> $ cobc -x -Wall -Wtruncate linage.cob
*> Evaluate with:
*> $ ./linage
*> This will read in linage.cob and produce a useless mini-report
*> $ cat -n mini-report
```

```
      ****************************************************************
       END PROGRAM linage-demo.
```

Using

```
$ ./linage except.cob
```

Produces a *mini-report* of:

```
******************     THIS PAGE INTENTIONALLY LEFT BLANK     ******************
```

```
PAGE: 0001                          LC: 000000                          DATE: 090206
000001 IDENTIFICATION DIVISION.
000002 PROGRAM-ID. MINIPROG.
000003 ENVIRONMENT DIVISION.
000004 CONFIGURATION SECTION.
000005 SOURCE-COMPUTER. LINUX.
000006 OBJECT-COMPUTER. LINUX.
000007 SPECIAL-NAMES.
000008 INPUT-OUTPUT SECTION.
000009 FILE-CONTROL.
000010 SELECT PRINTFILE ASSIGN TO "XXRXWXX"
000011 FILE STATUS RXWSTAT.
000012 DATA DIVISION.
000013 FILE SECTION.
000014 FD PRINTFILE.
```

```
PAGE: 0002                          LC: 000015                          DATE: 090206
000001 01 PRINTREC PIC X(132).
000002 WORKING-STORAGE SECTION.
000003 01 RXWSTAT PIC XX.
000004 01 str     pic x(4).
000005 PROCEDURE DIVISION.
000006 A00-MAIN SECTION.
000007 001-MAIN-PROCEDURE.
000008 OPEN INPUT PRINTFILE.
000009 DISPLAY "File Status: " RXWSTAT.
000010 DISPLAY "EXCEPTION-FILE: " FUNCTION EXCEPTION-FILE.
000011 DISPLAY "Return Length: "
000012 FUNCTION LENGTH (FUNCTION EXCEPTION-FILE).
```

```
000013 DISPLAY "EXCEPTION-STATUS: " FUNCTION EXCEPTION-STATUS.
000014 DISPLAY "EXCEPTION-STATEMENT: " FUNCTION EXCEPTION-STATEMENT.
```

```
PAGE: 0003                          LC: 000015                          DATE: 090206
000001 STRING "TOOLONG" DELIMITED SIZE INTO RXWSTAT.
000002 DISPLAY "EXCEPTION-STATUS: " FUNCTION EXCEPTION-STATUS.
000003 DISPLAY "EXCEPTION-STATEMENT: " FUNCTION EXCEPTION-STATEMENT.
000004 DISPLAY "EXCEPTION-LOCATION: " FUNCTION EXCEPTION-LOCATION.
000005 STOP RUN.
```

See *except.cob* under the FUNCTION EXCEPTION-STATUS entry.

29.1.278 4.1.278 LINAGE-COUNTER

An internal OpenCOBOL noun, or *Special Register*. Value is readonly and is maintained during WRITEs to files that have a LINAGE clause. Useful for quick reports and logical page layouts.

29.1.279 4.1.279 LINE

LINE SEQUENTIAL files. Screen section line control.

29.1.280 4.1.280 LINE-COUNTER

Special register for the unsupported Report Writer.

29.1.281 4.1.281 LINES

Screen section line control, screen occurs control and area scrolling.

29.1.282 4.1.282 LINKAGE

A SECTION in the DATA DIVISION. Used for call frame data handling when the current run unit may not be in charge of the location of working storage. Defaults to uninitialized references which must be set with USING in a CALL or explicitly with SET ADDRESS. References without initialization will cause an addressing segfault.

29.1.283 4.1.283 LOCAL-STORAGE

A SECTION in the DATA DIVISION. Data defined in local storage will be local to the running module and re-entrant within subprogram call trees.

29.1.284 4.1.284 LOCALE

Unsupported in OpenCOBOL 1.1pre-rel. Support added in 2.0

A SPECIAL-NAMES entry giving OpenCOBOL an international flair.

```
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SPECIAL-NAMES.
    LOCALE spanish IS 'ES_es'.
```

29.1.285 4.1.285 LOCK

Record management.

```
SELECT filename-1 ASSIGN TO 'master.dat' LOCK MODE IS MANUAL.
```

29.1.286 4.1.286 LOW-VALUE

A figurative ALPHABETIC constant, being the lowest character value in the COLLATING sequence.

```
MOVE LOW-VALUE TO alphanumeric-1.

IF alphabetic-1 EQUALS LOW-VALUE
    DISPLAY "Failed validation" END-DISPLAY
END-IF.
```

It's invalid to MOVE LOW-VALUE to a numeric field.

29.1.287 4.1.287 LOW-VALUES

A pluralized form of LOW-VALUE. Equivalent.

```
MOVE LOW-VALUES TO alphanumeric-1.
```

29.1.288 4.1.288 LOWLIGHT

A screen attribute for DISPLAY and SCREEN SECTION fields.

```
SCREEN SECTION.
01 example.
    05 FILLER
        LINE 1 COLUMN 10
        VALUE IS "Example:"
        LOWLIGHT.
```

Will display the *Example:* legend in a dimmed video if supported with the current terminal settings.

29.1.289 4.1.289 MANUAL

LOCK MODE IS MANUAL WITH LOCK ON MULTIPLE RECORDS. See AUTOMATIC and EXCLUSIVE for more LOCK options.

29.1.290 4.1.290 MEMORY

An OBJECT-COMPUTER clause.

```
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
OBJECT-COMPUTER.
MEMORY SIZE IS 8 CHARACTERS.
```

29.1.291 4.1.291 MERGE

Combines two or more identically sequenced files on a set of specified keys.

```
MERGE sort-file
    ON DESCENDING KEY key-field-1
    WITH DUPLICATES IN ORDER
    COLLATING SEQUENCE IS user-alphabet
    USING filename-1 filename-2
    GIVING filename-3
```

29.1.292 4.1.292 MESSAGE

Unsupported Communication Section clause.

29.1.293 4.1.293 METHOD

Unsupported Object COBOL feature.

29.1.294 4.1.294 METHOD-ID

Unsupported Object COBOL feature.

29.1.295 4.1.295 MINUS

Screen section relative line and column control.

```
05 some-field pic x(16)
    line number is plus 1
    column number is minus 8
```

29.1.296 4.1.296 MODE

Locking mode. See MANUAL, AUTOMATIC, EXCLUSIVE.

29.1.297 4.1.297 MOVE

A workhorse of the COBOL paradigm. MOVE is highly flexible, intelligent, safe and sometimes perplexing data movement verb.

```
01 alphanum-3              PIC XXX.
01 num2                    PIC 99.

MOVE "ABCDEFG" TO xvar3
DISPLAY xvar3 END-DISPLAY

MOVE 12345 TO num2
DISPLAY num2 END-DISPLAY
```

displays:

```
ABC
45
```

Note the 45, MOVE uses a right to left rule when moving numerics.

Groups can be moved with

```
MOVE CORRESPONDING ident-1 TO ident-2
```

in which case only the group items of the same name will be transferred from the ident-1 group to the ident-2 fields.

29.1.298 4.1.298 MULTIPLE

```
LOCK MODE IS MANUAL WITH LOCK ON MULTIPLE RECORDS.
```

29.1.299 4.1.299 MULTIPLY

A mathematic operation.

```
MULTIPLY var-1 BY var-2 GIVING var-3
    ON SIZE ERROR
        SET invalid-result TO TRUE
END-MULTIPLY
```

29.1.300 4.1.300 NATIONAL

NATIONAL character usage. Not yet supported. OpenCOBOL does support PICTURE N.

29.1.301 4.1.301 NATIONAL-EDITED

Category.

29.1.302 4.1.302 NATIVE

Alphabet.

29.1.303 4.1.303 NEGATIVE

Conditional expression.

```
IF a IS NEGATIVE
    SET in-the-red TO TRUE
END-IF
```

29.1.304 4.1.304 NESTED

An unsupported program-protoype CALL clause.

29.1.305 4.1.305 NEXT

With READ, to read the next record, possibly by KEY. Also an obsolete control flow verb.

```
READ index-sequential-file NEXT RECORD INTO ident-1
```

```
IF condition-1
    NEXT SENTENCE
ELSE
    PERFORM do-something.
```

29.1.306 4.1.306 NO

Specify NO locks, NO sharing, NO rewind.

```
CLOSE filename-1 WITH NO REWIND
```

```
READ file-1 WITH NO LOCK
```

29.1.307 4.1.307 NONE

Unsupported DEFAULT IS NONE.

29.1.308 4.1.308 NORMAL

Program return control

```
STOP RUN WITH NORMAL STATUS status-val
```

See ERROR

29.1.309 4.1.309 NOT

Conditional negation. See AND, OR. Also used in operational declaratives such as NOT ON SIZE ERROR, *in which case the operation succeeded without overflowing the receiving data field*.

```
IF NOT testing
    CALL "thing"
        NOT ON EXCEPTION
            DISPLAY "Linkage to thing, OK" END-DISPLAY
    END-CALL
END-IF
```

29.1.310 4.1.310 NULL

Void. A zero address pointer. A symbolic literal.

```
CALL "thing" RETURNING NULL END-CALL
```

```
SET ADDRESS OF ptr TO NULL
```

```
IF ptr EQUAL NULL
    DISPLAY "ptr not valid" END-DISPLAY
END-IF
```

```
MOVE CONCATENATE(TRIM(cbl-string TRAILING) NULL) TO c-string
```

29.1.311 4.1.311 NULLS

Plural of NULL.

```
MOVE ALL NULLS TO var
```

29.1.312 4.1.312 NUMBER

Screen section LINE COLUMN control.

```
05 some-field pic x(16) LINE NUMBER 5.
```

29.1.313 4.1.313 NUMBERS

Plural of NUMBER.

29.1.314 4.1.314 NUMERIC

Category.

29.1.315 4.1.315 NUMERIC-EDITED

Category.

29.1.316 4.1.316 OBJECT

Unsupported Object COBOL feature.

29.1.317 4.1.317 OBJECT-COMPUTER

Environment division, configuration section run-time machine paragraph.

OpenCOBOL supports

```
OCOBOL identification division.
       program-id. runtime-computer.

       environment division.
       configuration section.
       object-computer.
           memory size is 8 characters
           program collating sequence is bigiron-alphabet
           segment-limit is 64
           character classificiation is spanish-locale.
       repository.
           function all intrinsic.
       special-names.
           alphabet bigiron-alphabet is ebcdic
           symbolic characters BS  is  9
                               TAB is 10
                               LF  is 11
                           NEWLINE is 11
```

```
                              CMA is 45
          locale spanish-locale is "es_ES".
```

29.1.318 4.1.318 OBJECT-REFERENCE

Unsupported Object COBOL feature.

29.1.319 4.1.319 OCCURS

Controls multiple occurances of data structures.

```
01 main-table.
   03 main-record occurs 366 times depending on the-day.
      05 main-field pic x occurs 132 times depending on the-len.
```

29.1.320 4.1.320 OF

A data structure reference and name conflict resolution qualifier.

```
MOVE "abc" TO the-field OF the-record OF the-structure
```

Synonym for IN

29.1.321 4.1.321 OFF

Turn off a switch. See ON.

```
SPECIAL-NAMES.
    SWITCH-1 IS mainframe
        ON STATUS IS bigiron
        OFF STATUS IS pc

...

SET mainframe TO OFF
```

29.1.322 4.1.322 OMITTED

Allows for placeholders in call frames and testing for said placeholders. Also allows for omitted label records, and void returns. OMITTED is only allowed with BY REFERENCE data.

```
CALL "thing" USING
    BY REFERENCE string-var
    BY VALUE number-var
    BY REFERENCE OMITTED
    GIVING NULL
END-CALL

...

PROGRAM-ID. thing.
DATA DIVISION.
WORKING-STORAGE SECTION.
77 default-float usage float-long.
```

```
LINKAGE-SECTION.
77 string-var pic x(80).
77 number-var pic 9(8).
77 float-var usage float-long.

PROCEDURE DIVISION
    USING
        BY REFERENCE OPTIONAL string-var
        BY VALUE number-var
        BY REFERENCE OPTIONAL float-var
    RETURNING OMITTED.

IF float-var IS OMITTED
    SET ADDRESS OF float-var TO default-float
END-IF
```

29.1.323 4.1.323 ON

Turn on a switch. See OFF.

```
SPECIAL-NAMES.
    SWITCH-1 IS mainframe
        ON STATUS IS bigiron
        OFF STATUS IS pc

...

SET mainframe TO ON
```

Starts declaratives.

```
ADD 1 TO wafer-thin-mint
    ON SIZE ERROR
        SET get-a-bucket TO TRUE
END-ADD
```

See SIZE, EXCEPTION.

29.1.324 4.1.324 ONLY

Sharing control. SHARING WITH READ ONLY

29.1.325 4.1.325 OPEN

Opens a file selector. Modes include INPUT, OUTPUT, I-O, EXTEND. May be OPTIONAL in the FD.

```
OPEN INPUT SHARING WITH ALL OTHER infile
OPEN EXTEND SHARING WITH NO OTHER myfile
```

29.1.326 4.1.326 OPTIONAL

Allows for referencing non-existent files. Allows for optionally OMITTED call arguments.

Code below shows optional file open and optional CALL arguments.

```
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT OPTIONAL nofile ASSIGN TO "file.not"
           ORGANIZATION IS LINE SEQUENTIAL.

...

DATA DIVISION.
LINKAGE SECTION.
77 arg PIC 99.

PROCEDURE DIVISION USING OPTIONAL arg

OPEN INPUT nofile
CLOSE nofile

IF arg IS OMITTED OR NOT NUMERIC
    MOVE 0 TO RETURN-CODE
ELSE
    MOVE arg TO RETURN-CODE
END-IF
GOBACK.
```

29.1.327 4.1.327 OPTIONS

A currently unsupported paragraph of the IDENTIFICATION division.

29.1.328 4.1.328 OR

Logical operation. See AND, NOT. OpenCOBOL supports COBOL's logical expression shortcuts. Order of precedence can be controlled with parenthesis, and default to NOT, AND, OR, right to left.

```
IF A NOT EQUAL 1 OR 2 OR 3 OR 5
    DISPLAY "FORE!" END-DISPLAY
END-IF
```

29.1.329 4.1.329 ORDER

Sort clause to influence how duplicates are managed.

```
sort sort-work
    ascending key work-rec with duplicates in order
    using  sort-in
    giving sort-out.
```

In 1.1pre-rel, WITH DUPLICATES IN ORDER is a default.

29.1.330 4.1.330 ORGANIZATION

Defines a file's storage organization. One of INDEXED, RELATIVE, SEQUENTIAL. OpenCOBOL also supports a LINE SEQUENTIAL structure.

29.1.331 4.1.331 OTHER

File sharing option, ALL OTHER, NO OTHER.

EVALUATE's else clause.

```
OCOBOL*> Here be dragons <*
       EVALUATE TRUE
           WHEN a IS 1
               PERFORM paragraph-1
           WHEN OTHER
               ALTER paragraph-1 TO paragraph-2
               PERFORM paragraph-3
       END-EVALUATE
```

29.1.332 4.1.332 OUTPUT

File OPEN mode. Procedure named in SORT

```
sort sort-work
    on descending key work-rec
    collating sequence is mixed
    input procedure is sort-transform
    output procedure is output-uppercase.
```

29.1.333 4.1.333 OVERFLOW

Declarative clause for STRING and UNSTRING that will trigger on space overflow conditions.

29.1.334 4.1.334 OVERLINE

A display control for SCREEN section fields.

29.1.335 4.1.335 OVERRIDE

Unsupportd Object COBOL METHOD-ID clause.

29.1.336 4.1.336 PACKED-DECIMAL

Numeric USAGE clause, equivalent to COMPUTATIONAL-3. Holds each digit in a 4-bit field.

From the opencobol-2.0 tarball testsuite

```
OCOBOL
       IDENTIFICATION   DIVISION.
       PROGRAM-ID.      prog.
       DATA             DIVISION.
       WORKING-STORAGE  SECTION.
       01 G-1.
         02 X-1         PIC 9(1) VALUE 1
                        PACKED-DECIMAL.
         02 FILLER      PIC X(18) VALUE SPACE.
       01 G-2.
         02 X-2         PIC 9(2) VALUE 12
                        PACKED-DECIMAL.
```

```
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-3.
  02 X-3          PIC 9(3) VALUE 123
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-4.
  02 X-4          PIC 9(4) VALUE 1234
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-5.
  02 X-5          PIC 9(5) VALUE 12345
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-6.
  02 X-6          PIC 9(6) VALUE 123456
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-7.
  02 X-7          PIC 9(7) VALUE 1234567
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-8.
  02 X-8          PIC 9(8) VALUE 12345678
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-9.
  02 X-9          PIC 9(9) VALUE 123456789
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-10.
  02 X-10         PIC 9(10) VALUE 1234567890
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-11.
  02 X-11         PIC 9(11) VALUE 12345678901
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-12.
  02 X-12         PIC 9(12) VALUE 123456789012
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-13.
  02 X-13         PIC 9(13) VALUE 1234567890123
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-14.
  02 X-14         PIC 9(14) VALUE 12345678901234
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-15.
  02 X-15         PIC 9(15) VALUE 123456789012345
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-16.
  02 X-16         PIC 9(16) VALUE 1234567890123456
                  PACKED-DECIMAL.
  02 FILLER       PIC X(18) VALUE SPACE.
01 G-17.
  02 X-17         PIC 9(17) VALUE 12345678901234567
```

```
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-18.
  02 X-18       PIC 9(18) VALUE 123456789012345678
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S1.
  02 X-S1       PIC S9(1) VALUE -1
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S2.
  02 X-S2       PIC S9(2) VALUE -12
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S3.
  02 X-S3       PIC S9(3) VALUE -123
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S4.
  02 X-S4       PIC S9(4) VALUE -1234
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S5.
  02 X-S5       PIC S9(5) VALUE -12345
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S6.
  02 X-S6       PIC S9(6) VALUE -123456
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S7.
  02 X-S7       PIC S9(7) VALUE -1234567
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S8.
  02 X-S8       PIC S9(8) VALUE -12345678
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S9.
  02 X-S9       PIC S9(9) VALUE -123456789
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S10.
  02 X-S10      PIC S9(10) VALUE -1234567890
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S11.
  02 X-S11      PIC S9(11) VALUE -12345678901
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S12.
  02 X-S12      PIC S9(12) VALUE -123456789012
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S13.
  02 X-S13      PIC S9(13) VALUE -1234567890123
                PACKED-DECIMAL.
  02 FILLER     PIC X(18) VALUE SPACE.
01 G-S14.
```

```
           02 X-S14        PIC S9(14) VALUE -12345678901234
                           PACKED-DECIMAL.
           02 FILLER       PIC X(18) VALUE SPACE.
         01 G-S15.
           02 X-S15        PIC S9(15) VALUE -123456789012345
                           PACKED-DECIMAL.
           02 FILLER       PIC X(18) VALUE SPACE.
         01 G-S16.
           02 X-S16        PIC S9(16) VALUE -1234567890123456
                           PACKED-DECIMAL.
           02 FILLER       PIC X(18) VALUE SPACE.
         01 G-S17.
           02 X-S17        PIC S9(17) VALUE -12345678901234567
                           PACKED-DECIMAL.
           02 FILLER       PIC X(18) VALUE SPACE.
         01 G-S18.
           02 X-S18        PIC S9(18) VALUE -123456789012345678
                           PACKED-DECIMAL.
           02 FILLER       PIC X(18) VALUE SPACE.
         PROCEDURE         DIVISION.
        *>   Dump all values <*
             CALL "dump" USING G-1
             END-CALL.
             CALL "dump" USING G-2
             END-CALL.
             CALL "dump" USING G-3
             END-CALL.
             CALL "dump" USING G-4
             END-CALL.
             CALL "dump" USING G-5
             END-CALL.
             CALL "dump" USING G-6
             END-CALL.
             CALL "dump" USING G-7
             END-CALL.
             CALL "dump" USING G-8
             END-CALL.
             CALL "dump" USING G-9
             END-CALL.
             CALL "dump" USING G-10
             END-CALL.
             CALL "dump" USING G-11
             END-CALL.
             CALL "dump" USING G-12
             END-CALL.
             CALL "dump" USING G-13
             END-CALL.
             CALL "dump" USING G-14
             END-CALL.
             CALL "dump" USING G-15
             END-CALL.
             CALL "dump" USING G-16
             END-CALL.
             CALL "dump" USING G-17
             END-CALL.
             CALL "dump" USING G-18
             END-CALL.
             CALL "dump" USING G-S1
             END-CALL.
```

```
CALL "dump" USING G-S2
END-CALL.
CALL "dump" USING G-S3
END-CALL.
CALL "dump" USING G-S4
END-CALL.
CALL "dump" USING G-S5
END-CALL.
CALL "dump" USING G-S6
END-CALL.
CALL "dump" USING G-S7
END-CALL.
CALL "dump" USING G-S8
END-CALL.
CALL "dump" USING G-S9
END-CALL.
CALL "dump" USING G-S10
END-CALL.
CALL "dump" USING G-S11
END-CALL.
CALL "dump" USING G-S12
END-CALL.
CALL "dump" USING G-S13
END-CALL.
CALL "dump" USING G-S14
END-CALL.
CALL "dump" USING G-S15
END-CALL.
CALL "dump" USING G-S16
END-CALL.
CALL "dump" USING G-S17
END-CALL.
CALL "dump" USING G-S18
END-CALL.
INITIALIZE X-1.
CALL "dump" USING G-1
END-CALL.
INITIALIZE X-2.
CALL "dump" USING G-2
END-CALL.
INITIALIZE X-3.
CALL "dump" USING G-3
END-CALL.
INITIALIZE X-4.
CALL "dump" USING G-4
END-CALL.
INITIALIZE X-5.
CALL "dump" USING G-5
END-CALL.
INITIALIZE X-6.
CALL "dump" USING G-6
END-CALL.
INITIALIZE X-7.
CALL "dump" USING G-7
END-CALL.
INITIALIZE X-8.
CALL "dump" USING G-8
END-CALL.
INITIALIZE X-9.
```

```
CALL "dump" USING G-9
END-CALL.
INITIALIZE X-10.
CALL "dump" USING G-10
END-CALL.
INITIALIZE X-11.
CALL "dump" USING G-11
END-CALL.
INITIALIZE X-12.
CALL "dump" USING G-12
END-CALL.
INITIALIZE X-13.
CALL "dump" USING G-13
END-CALL.
INITIALIZE X-14.
CALL "dump" USING G-14
END-CALL.
INITIALIZE X-15.
CALL "dump" USING G-15
END-CALL.
INITIALIZE X-16.
CALL "dump" USING G-16
END-CALL.
INITIALIZE X-17.
CALL "dump" USING G-17
END-CALL.
INITIALIZE X-18.
CALL "dump" USING G-18
END-CALL.
INITIALIZE X-S1.
CALL "dump" USING G-S1
END-CALL.
INITIALIZE X-S2.
CALL "dump" USING G-S2
END-CALL.
INITIALIZE X-S3.
CALL "dump" USING G-S3
END-CALL.
INITIALIZE X-S4.
CALL "dump" USING G-S4
END-CALL.
INITIALIZE X-S5.
CALL "dump" USING G-S5
END-CALL.
INITIALIZE X-S6.
CALL "dump" USING G-S6
END-CALL.
INITIALIZE X-S7.
CALL "dump" USING G-S7
END-CALL.
INITIALIZE X-S8.
CALL "dump" USING G-S8
END-CALL.
INITIALIZE X-S9.
CALL "dump" USING G-S9
END-CALL.
INITIALIZE X-S10.
CALL "dump" USING G-S10
END-CALL.
```

```
INITIALIZE X-S11.
CALL "dump" USING G-S11
END-CALL.
INITIALIZE X-S12.
CALL "dump" USING G-S12
END-CALL.
INITIALIZE X-S13.
CALL "dump" USING G-S13
END-CALL.
INITIALIZE X-S14.
CALL "dump" USING G-S14
END-CALL.
INITIALIZE X-S15.
CALL "dump" USING G-S15
END-CALL.
INITIALIZE X-S16.
CALL "dump" USING G-S16
END-CALL.
INITIALIZE X-S17.
CALL "dump" USING G-S17
END-CALL.
INITIALIZE X-S18.
CALL "dump" USING G-S18
END-CALL.
MOVE ZERO TO X-1.
CALL "dump" USING G-1
END-CALL.
MOVE ZERO TO X-2.
CALL "dump" USING G-2
END-CALL.
MOVE ZERO TO X-3.
CALL "dump" USING G-3
END-CALL.
MOVE ZERO TO X-4.
CALL "dump" USING G-4
END-CALL.
MOVE ZERO TO X-5.
CALL "dump" USING G-5
END-CALL.
MOVE ZERO TO X-6.
CALL "dump" USING G-6
END-CALL.
MOVE ZERO TO X-7.
CALL "dump" USING G-7
END-CALL.
MOVE ZERO TO X-8.
CALL "dump" USING G-8
END-CALL.
MOVE ZERO TO X-9.
CALL "dump" USING G-9
END-CALL.
MOVE ZERO TO X-10.
CALL "dump" USING G-10
END-CALL.
MOVE ZERO TO X-11.
CALL "dump" USING G-11
END-CALL.
MOVE ZERO TO X-12.
CALL "dump" USING G-12
```

```
END-CALL.
MOVE ZERO TO X-13.
CALL "dump" USING G-13
END-CALL.
MOVE ZERO TO X-14.
CALL "dump" USING G-14
END-CALL.
MOVE ZERO TO X-15.
CALL "dump" USING G-15
END-CALL.
MOVE ZERO TO X-16.
CALL "dump" USING G-16
END-CALL.
MOVE ZERO TO X-17.
CALL "dump" USING G-17
END-CALL.
MOVE ZERO TO X-18.
CALL "dump" USING G-18
END-CALL.
MOVE ZERO TO X-S1.
CALL "dump" USING G-S1
END-CALL.
MOVE ZERO TO X-S2.
CALL "dump" USING G-S2
END-CALL.
MOVE ZERO TO X-S3.
CALL "dump" USING G-S3
END-CALL.
MOVE ZERO TO X-S4.
CALL "dump" USING G-S4
END-CALL.
MOVE ZERO TO X-S5.
CALL "dump" USING G-S5
END-CALL.
MOVE ZERO TO X-S6.
CALL "dump" USING G-S6
END-CALL.
MOVE ZERO TO X-S7.
CALL "dump" USING G-S7
END-CALL.
MOVE ZERO TO X-S8.
CALL "dump" USING G-S8
END-CALL.
MOVE ZERO TO X-S9.
CALL "dump" USING G-S9
END-CALL.
MOVE ZERO TO X-S10.
CALL "dump" USING G-S10
END-CALL.
MOVE ZERO TO X-S11.
CALL "dump" USING G-S11
END-CALL.
MOVE ZERO TO X-S12.
CALL "dump" USING G-S12
END-CALL.
MOVE ZERO TO X-S13.
CALL "dump" USING G-S13
END-CALL.
MOVE ZERO TO X-S14.
```

```
           CALL "dump" USING G-S14
           END-CALL.
           MOVE ZERO TO X-S15.
           CALL "dump" USING G-S15
           END-CALL.
           MOVE ZERO TO X-S16.
           CALL "dump" USING G-S16
           END-CALL.
           MOVE ZERO TO X-S17.
           CALL "dump" USING G-S17
           END-CALL.
           MOVE ZERO TO X-S18.
           CALL "dump" USING G-S18
           END-CALL.
           STOP RUN.
```

With a support file to dump the first 10 bytes of each record

```
#include <stdio.h>
#ifdef  __INTEL_COMPILER
#pragma warning ( disable : 1419 )
#endif
int dump (unsigned char *data);
int dump (unsigned char *data)
{
  int i;
  for (i = 0; i < 10; i++)
    printf ("%02x", data[i]);
  puts ("");
  return 0;
}
/**/
```

Which captures:

```
1f202020202020202020
012f2020202020202020
123f2020202020202020
01234f20202020202020
12345f20202020202020
0123456f202020202020
1234567f202020202020
012345678f2020202020
123456789f2020202020
01234567890f20202020
12345678901f20202020
0123456789012f202020
1234567890123f202020
012345678901234f2020
123456789012345f2020
01234567890123456f20
12345678901234567f20
0123456789012345678f
1d202020202020202020
012d2020202020202020
123d2020202020202020
01234d20202020202020
12345d20202020202020
0123456d202020202020
1234567d202020202020
012345678d2020202020
```

```
123456789d2020202020
01234567890d20202020
12345678901d20202020
0123456789012d202020
1234567890123d202020
012345678901234d2020
123456789012345d2020
0123456789012345d20
1234567890123456d20
01234567890123456d
0f202020202020202020
000f2020202020202020
000f2020202020202020
00000f20202020202020
00000f20202020202020
0000000f202020202020
0000000f202020202020
000000000f2020202020
000000000f2020202020
00000000000f20202020
00000000000f20202020
0000000000000f202020
0000000000000f202020
000000000000000f2020
000000000000000f2020
0000000000000000f20
0000000000000000f20
00000000000000000f
0c202020202020202020
000c2020202020202020
000c2020202020202020
00000c20202020202020
00000c20202020202020
0000000c202020202020
0000000c202020202020
000000000c2020202020
000000000c2020202020
00000000000c20202020
00000000000c20202020
0000000000000c202020
0000000000000c202020
000000000000000c2020
000000000000000c2020
0000000000000000c20
0000000000000000c20
00000000000000000c
0f202020202020202020
000f2020202020202020
000f2020202020202020
00000f20202020202020
00000f20202020202020
0000000f202020202020
0000000f202020202020
000000000f2020202020
000000000f2020202020
00000000000f20202020
00000000000f20202020
0000000000000f202020
0000000000000f202020
```

```
000000000000000f2020
000000000000000f2020
0000000000000000f20
0000000000000000f20
00000000000000000000f
0c202020202020202020
000c2020202020202020
000c2020202020202020
00000c20202020202020
00000c20202020202020
0000000c202020202020
0000000c202020202020
000000000c2020202020
000000000c2020202020
00000000000c20202020
00000000000c20202020
0000000000000c202020
0000000000000c202020
000000000000000c2020
000000000000000c2020
0000000000000000c20
0000000000000000c20
00000000000000000000c
```

29.1.337 4.1.337 PADDING

Defines a character to use for short record padding.

```
ORGANIZATION IS LINE SEQUENTIAL PADDING CHARACTER IS '*'
```

29.1.338 4.1.338 PAGE

Write and Report writer clause.

```
WRITE theline AFTER ADVANCING PAGE
```

```
PAGE LIMITS ARE 66 LINES 132 COLUMNS
    HEADING iS 4 FIRST DETAIL IS 6
    LAST CONTROL HEADING IS 58
    LAST DETAIL IS 60
    FOOTING IS 62
```

29.1.339 4.1.339 PAGE-COUNTER

A special register, qualified by Report Name. Report Writer is recognized but not yet supported.

29.1.340 4.1.340 PARAGRAPH

An allowable EXIT point.

```
NAMED-PARAGRAPH.
    PERFORM FOREVER
        IF solution
            EXIT PARAGRAPH
        END-IF
```

```
        PERFORM solve-the-puzzle.
    END-PERFORM.
```

29.1.341 4.1.341 PERFORM

A COBOL procedural and inline control flow verb.

```
beginning.
    PERFORM FOREVER
        PERFORM miracles
    END-PERFORM
    GOBACK.

miracles.
    DISPLAY wonders END-DISPLAY.
```

29.1.342 4.1.342 PF

Report Writer alias for PAGE FOOTING.

29.1.343 4.1.343 PH

Report Writer alias for PAGE HEADING.

29.1.344 4.1.344 PIC

A commonly used shortform of PICTURE.

29.1.345 4.1.345 PICTURE

The PICTURE clause is easily one of COBOL's greatest strengths. Fully detailed pictorial data definitions. The internal complexity is left to compiler authors, while developers and management are free to describe data at a very high conceptual level.

The two most common picture characters are 9 and X, for numeric and alphanumeric data respectively. For alphbetic data, A can be used.

Aside from data storage pictures, a vast array of *edit* pictures are allowed for control of input and output formatting.

+, -, A, B, N, X, Z, "*", 'CR', 'DB', E, S, V, ., P, currency symbol

OpenCOBOL offers full standards support of all alpha, alphanumeric and numeric storage specifiers as well as full support for edit and numeric-edit clauses.

An example of some of the PICTURE options

```
*>>source format is free
*> ****************************************************************
*> Author:    jrls (John Ellis)
*> Date:      Oct-2008
*> Purpose:   formated output examples using pic strings.
*> ****************************************************************

identification division.
program-id. picstring.
```

```
data division.
working-storage section.
*><*

01  header.
    05  filler          pic xxx  value "ln".
    05  filler          pic x(11) value "    disp1".
    05  filler          pic x(11) value "    disp2".
    05  filler          pic x(11) value "    disp3".
    05  filler          pic x(11) value "    disp4".
    05  filler          pic x(12) value "    disp5".
    05  filler          pic x(9)  value "   an1".
    05  filler          pic x(14) value "      phone".
    05  filler          pic x(10) value "   date".
*><*
01  headerLines         pic x(90) value all "-".
*><*
01  displayformats.
    05  linenum         pic 99  value 1.
    05  disp1           pic zzz,zz9.99 value zero.
    05  filler          pic x value spaces.
    05  disp2           pic $zz,zz9.99 value zero.
    05  filler          pic x value spaces.
    05  disp3           pic ---,--9.99 value zero.
    05  filler          pic x value spaces.
    05  disp4           pic $-z,zz9.99 value zero.
    05  filler          pic x value spaces.
    05  disp5           pic -zz,zz9.zz- blank  zero value zero.
    05  filler          pic x value spaces.
*><*an1 is actually a string field because of the embedded blanks, thus you put value spaces.
    05  an1             pic 99b99b99    value spaces.
    05  filler          pic x value spaces.
    05  phone           pic bxxxbxxxbxxxx value spaces.
    05  filler          pic x value spaces.
    05  dispdate        pic 99/99/9999  value zero.
*><*

procedure division.
0000-start.
*><*
    display headerLines.
    display header.
    display headerLines.
*><**************************************************
    move 220.22         to disp1,
                           disp2.
    move -220.22        to disp3,
                           disp4,
                           disp5.

    inspect disp5 replacing first "-" by "(",
                            first "-" by ")".

    move 10122008       to dispdate.
*><**************************************************
*><*Please note the results of moving 'abcd' to an1.
*><*an1 will show up as 00 00 00 because alpha data was
*><*moved into instead of numeric data.
*><*
```

```
*><*The phone field will display " abc def ghij" because
*><*'b' in the pic string.
*><*************************************************
    move "abcd"         to an1.
    move "abcdefghij"   to phone.

    display displayformats.

    add 1               to linenum.
    move zero           to disp4,
                           disp5.
*><*************************************************
*><*Here after moving data to an1 and phone, I use the
*><*inspect statement to replace the blanks.
*><*************************************************
    move "123456"       to an1.
    move "5555551234"   to phone.

    inspect an1 replacing all " " by "-".

    inspect phone replacing first " " by "(",
                            first " " by ")",
                            first " " by "-".

    display displayformats.

    inspect phone converting "23456789" to "adgjmptw".
    display phone.

    perform 0010-endProgram.
*><*
0010-endProgram.
    stop run.
*><*
```

Outputs:

```
-------------------------------------------------------------------------------------------
ln     disp1      disp2      disp3      disp4      disp5      an1         phone       date
-------------------------------------------------------------------------------------------
01    220.22    $220.22    -220.22   $-220.22    (220.22) 00 00 00  abc def ghij 10/12/2008
02    220.22    $220.22    -220.22     $ 0.00             12-34-56 (555)555-1234 10/12/2008
(jjj)jjj-1adg
```

29.1.346 4.1.346 PLUS

Screen section relative line / column control during layout.

```
01 form-1 AUTO.
   05 LINE 01 COLUMN 01 VALUE "Form!".
   05 LINE PLUS 3 COLUMN 01 VALUE value-4.
```

29.1.347 4.1.347 POINTER

Allocates a restricted use variable for holding addresses.

```
01  c-handle        USAGE IS POINTER.

CALL "open-lib" RETURNING c-handle
```

```
    ON EXCEPTION
        DISPLAY "Can't link open-lib" END-DISPLAY
        STOP RUN RETURNING 1
END-CALL
IF c-handle EQUAL NULL
    DISPLAY "Can't open-lib" END-DISPLAY
    STOP RUN RETURNING 1
END-IF

CALL "use-lib" USING BY VALUE c-handle BY CONTENT "Hello" & x"00"
CALL "close-lib" USING BY VALUE c-handle

*> Interfacing with the C ABI is just a teenie-weenie bit of voodoo
*> Pass the REFERENCE or use RETURNING if C sets the value. Use
*>   VALUE when you want C to have its pointer, not the
*>   REFERENCE address of the COBOL POINTER.  So most inits are
*>   BY REFERENCE (or RETURNING) and most usage, including
*>   rundown of C ABI tools, is USING BY VALUE.
*> <*
```

29.1.348 4.1.348 POSITION

Alias for COLUMN in screen section layouts. Also an obsolete, recognized but not supported:

```
MULTIPLE FILE TAPE CONTAINS file-1 POSITION 1 file-2 POSITION 80
```

29.1.349 4.1.349 POSITIVE

Class condition.

```
IF amount IS POSITIVE
    DISPLAY "Not broke yet" END-DISPLAY
END-IF
```

29.1.350 4.1.350 PRESENT

Report Writer clause used for optional field and group output.

```
05 field PIC X(16) PRESENT WHEN sum > 0.
```

29.1.351 4.1.351 PREVIOUS

Previous key READ control for INDEXED files.

```
READ file-1 PREVIOUS RECORD
```

29.1.352 4.1.352 PRINTER

Special name.

```
SPECIAL-NAMES.
    PRINTER IS myprint

DISPLAY "test" UPON PRINTER END-DISPLAY
```

29.1.353 4.1.353 PRINTING

Report Writer declarative to SUPPRESS report printing.

29.1.354 4.1.354 PROCEDURE

The COBOL DIVISION that holds the executable statements. Also used with INPUT and OUTPUT sort procedures.

29.1.355 4.1.355 PROCEDURE-POINTER

Alias for PROGRAM-POINTER, capable of holding a callable address.

29.1.356 4.1.356 PROCEDURES

Debug module declarative clause.

```
USE FOR DEBUGGING ON ALL PROCEDURES
```

29.1.357 4.1.357 PROCEED

Used in ALTER.

```
ALTER paragraph-1 TO PROCEED TO paragraph-x
```

29.1.358 4.1.358 PROGRAM

An EXIT point.

```
EXIT PROGRAM.
```

29.1.359 4.1.359 PROGRAM-ID

The program identifier. Case sensitive, unlike all other OpenCOBOL identifiers. OpenCOBOL produces C Application Binary Interface linkable entities and this identifier must conform to those rules. Dashes in names are replaced by a hex string equivalent.

29.1.360 4.1.360 PROGRAM-POINTER

A data USAGE clause defining a field that can hold the executable address of a CALL routine.

```
77 callback USAGE PROGRAM-POINTER.
...
SET callback TO ENTRY a-program-id
CALL callback
```

29.1.361 4.1.361 PROMPT

Screen section input control.

```
PROMPT IS ':'
```

29.1.362 4.1.362 PROPERTY

Unsupported Object COBOL phrase.

29.1.363 4.1.363 PROTOTYPE

Unsupported Object COBOL phrase.

29.1.364 4.1.364 PURGE

Unsupported Communication Section clause.

29.1.365 4.1.365 QUEUE

Unsupported Communication Section clause.

29.1.366 4.1.366 QUOTE

A figurative constant representing “”.

```
DISPLAY QUOTE 123 QUOTE END-DISPLAY
```

Outputs:

```
"123"
```

29.1.367 4.1.367 QUOTES

A figurative constant representing “”.

```
01 var PICTURE X(4).

MOVE ALL QUOTES TO var
DISPLAY var END-DISPLAY
```

Outputs:

```
""""
```

29.1.368 4.1.368 RAISE

Exception handling. There IS support for exceptions in OpenCOBOL but it is currently fairly limited. See FUNCTION EXCEPTION-LOCATION for a sample. RAISE is not yet recognized.

29.1.369 4.1.369 RAISING

Exception handling. There IS support for exceptions in OpenCOBOL but it is currently limited. RAISING is not yet recognized.

29.1.370 4.1.370 RANDOM

A file access mode. RANDOM access allows seeks to any point in a file, usually by KEY.

29.1.371 4.1.371 RD

Report writer DATA division, REPORT section descriptor. Currently unsupported.

```
DATA DIVISION.
REPORT SECTION.
RD report-1
    PAGE LIMIT IS 66 LINES.
```

29.1.372 4.1.372 READ

A staple of COBOL. Read a record.

```
READ infile PREVIOUS RECORD INTO back-record
   AT END
       SET attop TO TRUE
   NOT AT END
       PERFORM cursor-calculator
END-READ
```

29.1.373 4.1.373 RECEIVE

An unsupported Communication Section clause.

29.1.374 4.1.374 RECORD

Multiple use phrase.

```
FD file
    RECORD IS VARYING IN SIZE FROM 1 TO 80 CHARACTERS
        DEPENDING ON size-field

SELECT file
    ASSIGN TO filename
    ACCESS MODE IS RANDOM
    RECORD KEY IS key-field
    ALTERNATE KEY IS alt-key WITH DUPLICATES.

READ infile NEXT RECORD INTO display-rec END-READ
```

29.1.375 4.1.375 RECORDING

An obsolete, recognized, but ignored file descriptor clause.

```
FD file
    RECORD IS VARYING IN SIZE FROM 1 TO 80 CHARACTERS
        DEPENDING ON size-field
    RECORDING MODE IS F.
```

29.1.376 4.1.376 RECORDS

Multiple use phrase.

```
UNLOCK file-1s RECORDS
```

29.1.377 4.1.377 RECURSIVE

Specifies a PROGRAM-ID as having the recursive attribute. Recursive sub programs can CALL themselves.

This qualifier has implications on how OpenCOBOL allocates storage. Normally storage is stacked, recursion can chew through stack space very quickly. Sub programs marked RECURSIVE are usually allocated using the memory heap.

```
PROGRAM-ID nextbigthing IS RECURSIVE.
```

29.1.378 4.1.378 REDEFINES

A very powerful DATA division control alllowing for redefinition of memory storage, including incompatible data by type.

```
IDENTIFICATION   DIVISION.
PROGRAM-ID.      prog.
DATA             DIVISION.
WORKING-STORAGE  SECTION.
01 X             PIC X.
01 G             REDEFINES X.
  02 A           PIC X.
  02 B           REDEFINES A PIC 9.
PROCEDURE        DIVISION.
    STOP RUN.
```

29.1.379 4.1.379 REEL

A tape device qualifier

```
CLOSE file REEL FOR REMOVAL
```

29.1.380 4.1.380 REFERENCE

The default COBOL CALL argument handler. CALL arguments can be

```
BY REFERENCE
BY CONTENT
BY VALUE
```

where by reference passes a reference pointer, allowing data modification inside sub programs.

29.1.381 4.1.381 RELATION

Unsupported.

29.1.382 4.1.382 RELATIVE

File organization where the position of a logical record is determined by its relative record number.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ****************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20110806
      *> Purpose:   RELATIVE file organization
      *> Tectonics: cobc -g -debug -W -x relatives.cob
      *> ****************************************************************
       identification division.
       program-id. relatives.

       environment division.
       configuration section.
       repository.
           function all intrinsic.

       input-output section.
       file-control.
           select optional relatives
               assign to "relatives.dat"
               file status is filestatus
               organization is relative
               access mode is dynamic
               relative key is nicknum.

       data division.
       file section.
       fd relatives.
          01 person.
             05 firstname      pic x(48).
             05 lastname       pic x(64).
             05 relationship   pic x(32).

       working-storage section.
       77 filestatus pic 9(2).
          88 ineof value 1 when set to false is 0.

       77 satisfaction pic 9.
          88 satisfied value 1 when set to false is 0.

       77 nicknum   pic 9(2).

       77 title-line pic x(34).
          88 writing-names value "Adding, Overwriting.  00 to finish".
          88 reading-names value "Which record?         00 to quit".
       77 problem   pic x(80).

       screen section.
       01 detail-screen.
          05           line 1 column 1  from title-line erase eos.
          05           line 2 column 1  value "Record: ".
          05 pic 9(2)  line 2 column 16 using nicknum.
          05           line 3 column 1  value "First name: ".
          05 pic x(48) line 3 column 16 using firstname.
          05           line 4 column 1  value "Last name: ".
          05 pic x(64) line 4 column 16 using lastname.
```

```
           05           line 5 column 1  value "Relation: ".
           05 pic x(32) line 5 column 16 using relationship.
           05 pic x(80) line 6 column 1  from problem.

       01 show-screen.
           05           line 1 column 1  from title-line erase eos.
           05           line 2 column 1  value "Record: ".
           05 pic 9(2)  line 2 column 16 using nicknum.
           05           line 3 column 1  value "First name: ".
           05 pic x(48) line 3 column 16 from firstname.
           05           line 4 column 1  value "Last name: ".
           05 pic x(64) line 4 column 16 from lastname.
           05           line 5 column 1  value "Relation: ".
           05 pic x(32) line 5 column 16 from relationship.
           05 pic x(80) line 6 column 1  from problem.

      *> -*********-*********-*********-*********-*********-*********-**
       procedure division.
       beginning.

      *> Open the file and find the highest record number
      *> which is a sequential read operation after START
           open input relatives

           move 99 to nicknum
           start relatives key is less than or equal to nicknum
               invalid key
                   move concatenate('NO START' space filestatus)
                     to problem
                   move 00 to nicknum
               not invalid key
                   read relatives next end-read
           end-start

      *> Close and open for i-o
           close relatives
           open i-o relatives

      *> Prompt for numbers and names to add until 00
           set writing-names to true
           set satisfied to false
           perform fill-file through fill-file-end
               until satisfied

           close relatives

      *> Prompt for numbers to view names of until 00
           open input relatives

           set reading-names to true
           set satisfied to false
           perform record-request through record-request-end
               until satisfied

           perform close-shop
       .
       ending.
           goback.
```

```
      *> get some user data to add
       fill-file.
           display detail-screen end-display.
           accept detail-screen end-accept.
           move spaces to problem
           if nicknum equal 0
               set satisfied to true
               go to fill-file-end
           end-if.
       .
       write-file.
           write person
               invalid key
                   move concatenate("overwriting: " nicknum) to problem
                   rewrite person
                       invalid key
                           move concatenate(
                               exception-location() space nicknum
                               space filestatus)
                           to problem
                   end-rewrite
           end-write.
           display detail-screen end-display

       .
       fill-file-end.
       .

      *> get keys to display
       record-request.
           display show-screen end-display
           accept show-screen end-accept
           move spaces to problem
           if nicknum equals 0
               set satisfied to true
               go to record-request-end
           end-if
       .

      *> The magic of relative record number reads
       read-relation.
           read relatives
               invalid key
                   move exception-location() to problem
               not invalid key
                   move spaces to problem
           end-read
           display show-screen end-display
       .

       record-request-end.
       .

      *> get out <*
       close-shop.
           close relatives.
           goback.
       .
       end program relatives.
```

with sample screens:

```
Adding, Overwriting.  00 to finish
Record:         04
First name:     Brad_____________________________________________
Last name:      Tiffin___________________________________________________________
Relation:       brother_____________________________
```

allowing for new record additions or overwrites of existing key numbers, and:

```
Which record?         00 to quit
Record:         03
First name:     Brian
Last name:      Tiffin
Relation:
```

where typing in a *nicknum* record number retrieves the relative record.

29.1.383 4.1.383 RELEASE

Release a record to a SORT. Used with INPUT PROCEDURE of SORT verb.

```
RELEASE record-1 FROM identifier-1
```

29.1.384 4.1.384 REMAINDER

Access to integer remainders during division.

```
DIVIDE
    hex-val BY 16 GIVING left-nibble REMAINDER right-nibble
END-DIVIDE
```

29.1.385 4.1.385 REMOVAL

A close clause.

```
CLOSE filename-1 REEL FOR REMOVAL
```

Specifies that the file is stored on multiple removable tapes/disks. Not all systems support such devices.

29.1.386 4.1.386 RENAMES

OpenCOBOL supports regrouping of level 02-49 data items with level 66 and RENAMES.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20110606
      *> Purpose:   Demonstration of 66-level datanames
      *> Tectonics: cobc
      *> ************************************************************
       identification division.
       program-id. sixtysix.

       data division.
       working-storage section.
       01 master.
          05 field-1 pic s9(9).
          05 field-2 pic x(16).
```

```
           05 field-3 pic x(4).
           05 field-4 pic s9(9).
        66 sixtysix renames field-2.
        66 group-66 renames field-2 through field-4.

      *> ************************************************************
        procedure division.
        move -66 to field-1
        move "sixtysix" to field-2
        move "ABCD" to field-3
        multiply field-1 by -1 giving field-4 end-multiply
        display "master  : " master end-display
        display "field-1 : " field-1 end-display
        display "sixtysix: " sixtysix end-display
        display "group-66: " group-66 end-display

        goback.
        end program sixtysix.
```

giving:

```
$ ./sixtysix
master  : 00000006vsixtysix        ABCD000000066
field-1 : -000000066
sixtysix: sixtysix
group-66: sixtysix        ABCD000000066
```

29.1.387 4.1.387 REPLACE

A COBOL text preprocessing operator.

```
REPLACE ==MARKER== BY ==DISPLAY "REPLACE EXAMPLE" END-DISPLAY==.
identification division.
program-id. prog.

procedure division.
MARKER
goback.
end program prog.
```

And then to see how that REPLACE is working, use *cobc* with the -E argument

```
# 1 "replacing.cob"

 identification division.
 program-id. prog.

 procedure division.
 DISPLAY "REPLACE EXAMPLE" END-DISPLAY
 goback.
 end program prog.
```

29.1.388 4.1.388 REPLACING

An INSPECT subclause. A COPY preprocessor clause.

29.1.389 4.1.389 REPORT

Unsupported Report Writer section and File descriptor clause.

29.1.390 4.1.390 REPORTING

Unsupported declarative for Report Writer.

29.1.391 4.1.391 REPORTS

Unsupported Report Writer file descriptor clause associating files with named reports.

29.1.392 4.1.392 REPOSITORY

A paragraph of the CONFIGURATION SECTION. OpenCOBOL supports the **FUNCTION ALL INTRINSIC** clause of the REPOSITORY. Allows source code to use intrinsic functions without the FUNCTION keyword.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20110213
      *> Purpose:   Demonstrate an intrinstric function shortcut
      *> Tectonics: cobc -x functionall.cob
      *> ************************************************************
       identification division.
       program-id. functionall.

       environment division.
       configuration section.
       repository.
           function all intrinsic.

      *> ************************************************************
       procedure division.
       display function pi space function e end-display
       display pi space e end-display

       goback.
       end program functionall.
```

Sample output:

```
$ cobc -x functionall.cob
$ ./functionall
3.14159265358979323846264338327950291 2.71828182845904523536028747135266625
3.14159265358979323846264338327950291 2.71828182845904523536028747135266625
```

Without the **repository** paragraph:

```
$ cobc -x functionall.cob
functionall.cob:19: Error: 'pi' undefined
functionall.cob:19: Error: 'e' undefined
```

29.1.393 4.1.393 REQUIRED

Recognized but ignored Screen section field attribute.

29.1.394 4.1.394 RESERVE

An unsupported SELECT clause.

29.1.395 4.1.395 RESET

Unsupported Report Writer data control field clause.

29.1.396 4.1.396 RESUME

Unsupported declarative control flow statement.

29.1.397 4.1.397 RETRY

Unsupported record locking wait and retry clause.

- RETRY n TIMES
- RETRY FOR n SECONDS
- RETRY FOREVER

29.1.398 4.1.398 RETURN

Return records in a SORT OUTPUT PROCEDURE.

29.1.399 4.1.399 RETURNING

Specify the destination of CALL results.

```
01 result PIC S9(8).

CALL "libfunc" RETURNING result END-CALL
```

Specify the return field for a sub-program.

```
PROCEDURE DIVISION USING thing RETURNING otherthing
```

29.1.400 4.1.400 REVERSE-VIDEO

SCREEN section field display attribute. Functionality dependent on terminal and operating system support and settings.

29.1.401 4.1.401 REWIND

A really cool lyric in the Black Eyed Peas song, “Hey Mama”.

29.1.402 4.1.402 REWRITE

Allow overwrite of records where primary key exists.

```
write person
    invalid key
        move concatenate("overwriting: " nicknum) to problem
        rewrite person
            invalid key
                move concatenate(
                    exception-location() space nicknum
                    space filestatus)
                to problem
        end-rewrite
end-write.
```

29.1.403 4.1.403 RF

Short form for unsupported REPORT FOOTING.

29.1.404 4.1.404 RH

Short form for unsupported REPORT HEADING.

29.1.405 4.1.405 RIGHT

Ignored SYNCHRONIZED clause.

29.1.406 4.1.406 ROLLBACK

Recognized but not fully supported revert of transactional revert of file writes. See COMMIT.

29.1.407 4.1.407 ROUNDED

Well defined rounding clause applied to arithmetic. Defined well enough for bank managers to feel comfortable handing their calculations over to a bunch of nerds.

```
COMPUTE total-value ROUNDED = 1.0 / 6.0 END-COMPUTE
```

29.1.408 4.1.408 RUN

A stopping point.

```
STOP RUN RETURNING 1
```

Terminates run regardless of nesting depth, returning control (and result) to operating system. See GOBACK and EXIT PROGRAM for other run unit terminations.

29.1.409 4.1.409 SAME

I-O-CONTROL clause for SAME RECORD AREA.

29.1.410 4.1.410 SCREEN

Screen section.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************ <*
      *> Author:    Brian Tiffin
      *> Date:      20110701
      *> Purpose:   Play with 2.0 screen section
      *> Tectonics: cobc
      *> ************************************************************ <*
       identification division.
       program-id. screening.

       data division.
       working-storage section.
       01 some-data pic s9(9).

       screen section.
       01 detail-screen.
          03 line 1 column 1 value "title line".
          03 line 2 column 1 value "field: ".
          03 line 2 column 16 using some-data.

      *> ************************************************************ <*
       procedure division.
       display detail-screen end-display
       accept detail-screen end-accept
       goback.

       end program screening.
```

being a poor representation of the plethora of field attribute control allowed in OpenCOBOL screen section.

Screen field attributes include:

- JUSTIFIED RIGHT
- BLANK WHEN ZERO
- OCCURS integer-val TIMES
- BELL, BEEP
- AUTO, AUTO-SKIP, AUTOTERMINATE
- UNDERLINE
- OVERLINE
- SECURE
- REQUIRED
- FULL
- PROMPT
- REVERSE-VIDEO
- BLANK LINE
- BLANK SCREEN
- ERASE EOL

- ERASE EOS
- SIGN IS LEADING SEPERATE CHARACTER
- SIGN IS TRAILING SEPERATE CHARACTER
- LINE NUMBER IS [PLUS] integer-val
- COLUMN NUMBER IS [PLUS] integer-val
- FOREGROUND-COLOR IS integer-val HIGHLIGHT, LOWLIGHT
- BACKGROUND-COLOR IS integer-val BLINK
- PICTURE IS picture-clause USING identifier
- PICTURE IS picture-clause FROM identifier, literal
- PICTURE IS picture-clause TO identifier
- VALUE is literal

During ACCEPT, USING fields are read/write, FROM fields are read and TO fields are write.

See What are the OpenCOBOL SCREEN SECTION colour values? for colour values.

29.1.411 4.1.411 SD

SORT file data descriptor.

```
SD sort-file-1
    RECORD CONTAINS 80 CHARACTERS.
```

29.1.412 4.1.412 SEARCH

A powerful table and file search verb. See Linear SEARCH for an example.

29.1.413 4.1.413 SECONDS

Clause of unsupported read/write RETRY on lock.

29.1.414 4.1.414 SECTION

COBOL source code is organized in DIVISION, SECTION, paragraphs and sentences. OpenCOBOL supports user named sections and recognizes the following list of pre-defined sections.

- CONFIGURATION
- INPUT-OUTPUT
- FILE
- WORKING-STORAGE
- LOCAL-STORAGE
- LINKAGE
- REPORT (recognized but unsupported)
- SCREEN

User defined sections provide for source code organization and use of PERFORM with THROUGH for tried and true COBOL procedural programming.

29.1.415 4.1.415 SECURE

SCREEN section field attribute. Displayed as asterisks.

29.1.416 4.1.416 SEGMENT

Unsupported Communication section clause.

29.1.417 4.1.417 SELECT

FILE-CONTROL phrase. Associates files with names, descriptors, and options.

```
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT fileresource
        ASSIGN TO external-name
        FILE STATUS IS identifier
        COLLATING SEQUENCE IS alphabet-name
        LOCK MODE IS MANUAL WITH LOCK ON MULTIPLE RECORDS
        RECORD DELIMITER IS STANDARD
        RESERVE num AREA
        SHARING WITH NO OTHER
        ORGANIZATION IS INDEX
            ACCESS MODE IS DYNAMIC
            RECORD KEY IS key-field
            ALTERNATE RECORD KEY IS key-field-2 WITH DUPLICATES
            ALTERNATE RECORD KEY IS key-field-3.
```

though, naming a quick file can be as simple as

```
SELECT myfile ASSIGN TO "name.txt".
```

which will be a default LINE SEQUENTIAL file.

29.1.418 4.1.418 SELF

Unsupported Object COBOL clause.

29.1.419 4.1.419 SEND

Unsupported Communication section verb.

29.1.420 4.1.420 SENTENCE

An obsolete control flow clause. CONTINUE is preferred to NEXT SENTENCE.

29.1.421 4.1.421 SEPARATE

Fine tuned control over leading and trailing sign indicator.

```
77 field-1 PICTURE S9(8) SIGN IS TRAILING SEPARATE.
```

29.1.422 4.1.422 SEQUENCE

Controls COLLATING sequence for character compares, by defining a character set.

29.1.423 4.1.423 SEQUENTIAL

OpenCOBOL supports both fixed length SEQUENTIAL and newline terminated LINE SEQUENTIAL file access.

29.1.424 4.1.424 SET

- SET ADDRESS OF ptr-var TO var.
- SET ENVIRONMENT "name" TO "value".
- SET cond-1 TO TRUE

That last one is pretty cool. An 88 level conditional set TRUE will cause the associated value to change to a value that satifies the condition as true.

```
01 field-1 pic 99.
   88 cond-1 value 42.

MOVE 0 TO field-1
DISPLAY field-1 END-DISPLAY
SET cond-1 TO TRUE
DISPLAY field-1 END-DISPLAY
```

00 and 42 are displayed.

29.1.425 4.1.425 SHARING

File sharing option.

- SHARING WITH NO OTHER
- SHARING WITH ALL OTHER
- SHARING WITH READ ONLY

Functionality dependent on build options and operating system running OpenCOBOL.

29.1.426 4.1.426 SIGN

Fine tuned control over leading and trailing sign indicator.

```
77 field-1 PICTURE S9(8) SIGN IS TRAILING SEPARATE.
```

29.1.427 4.1.427 SIGNED

OpenCOBOL supports the full gamut of COBOL numeric data storage. SIGNED and UNSIGNED being part and parcel.

29.1.428 4.1.428 SIGNED-INT

A native storage format NUMERIC data USAGE clause. Equivalent to BINARY-LONG, BINARY-LONG SIGNED, and SIGNED-LONG.

29.1.429 4.1.429 SIGNED-LONG

A native storage format NUMERIC data USAGE clause. Equivalent to BINARY-LONG, BINARY-LONG SIGNED, and SIGNED-INT.

29.1.430 4.1.430 SIGNED-SHORT

A native storage format NUMERIC data USAGE clause. Equivalent to BINARY-SHORT SIGNED.

29.1.431 4.1.431 SIZE

Multi purpose.

OpenCOBOL allows SIZE IS control on CALL arguments.

Arthimetic operations allow for declaritives on size errors.

```
ADD 1 TO ocobol
    ON SIZE ERROR
        SET erroneous TO TRUE
    NOT ON SIZE ERROR
        DISPLAY "Whee, ADD 1 TO COBOL" END-DISPLAY
END-ADD
```

STRING has a DELIMITED BY SIZE option to include entire fields.

29.1.432 4.1.432 SORT

OpenCOBOL supports USING, GIVING as well as INPUT PROCEDURE and OUTPUT PROCEDURE clauses for the SORT verb.

```
OCOBOL* OpenCOBOL SORT verb example using standard in and standard out
       identification division.
       program-id. sorting.

       environment division.
       input-output section.
       file-control.
           select sort-in
               assign keyboard
               organization line sequential.
           select sort-out
               assign display
               organization line sequential.
```

```
           select sort-work
               assign "sortwork".

       data division.
       file section.
       fd sort-in.
          01 in-rec         pic x(255).
       fd sort-out.
          01 out-rec        pic x(255).
       sd sort-work.
          01 work-rec       pic x(255).

       procedure division.
       sort sort-work
           ascending key work-rec
           using  sort-in
           giving sort-out.

       goback.
       exit program.
       end program sorting.
```

In the next sample, demonstrating INPUT PROCEDURE and OUTPUT PROCEDURE take note of the RETURN and RELEASE verbs as they are key to record by record control over sort operations.

Also, just to complicate things, this sample sorts using a mixed-case alphabet (but also places capital A out of order to demonstrate special cases that can codified in an ALPHABET).

```
OCOBOL >>SOURCE FORMAT IS FIXED
      ******************************************************************
      * Author:    Brian Tiffin
      * Date:      02-Sep-2008
      * Purpose:   An OpenCOBOL SORT verb example
      * Tectonics: cobc -x sorting.cob
      *     ./sorting <input >output
      *   or simply
      *     ./sorting
      *   for keyboard and screen demos
      ******************************************************************
       identification division.
       program-id. sorting.

       environment division.
       configuration section.
      * This sets up a sort order lower then upper except for A and a
       special-names.
           alphabet mixed is " AabBcCdDeEfFgGhHiIjJkKlLmMnNoOpPqQrRsStTu
      -"UvVwWxXyYzZ0123456789".

       input-output section.
       file-control.
           select sort-in
               assign keyboard
               organization is line sequential.
           select sort-out
               assign display
               organization is line sequential.
           select sort-work
               assign "sortwork".
```

```
data division.
file section.
fd sort-in.
   01 in-rec        pic x(255).
fd sort-out.
   01 out-rec       pic x(255).
sd sort-work.
   01 work-rec      pic x(255).

working-storage section.
01 loop-flag        pic x value low-value.

procedure division.
sort sort-work
    on descending key work-rec
    collating sequence is mixed
    input procedure is sort-transform
    output procedure is output-uppercase.

display sort-return end-display.
goback.

*****************************************************************
sort-transform.
move low-value to loop-flag
open input sort-in
read sort-in
    at end move high-value to loop-flag
end-read
perform
    until loop-flag = high-value
        move FUNCTION LOWER-CASE(in-rec) to work-rec
        release work-rec
        read sort-in
            at end move high-value to loop-flag
        end-read
end-perform
close sort-in
.

*****************************************************************
output-uppercase.
move low-value to loop-flag
open output sort-out
return sort-work
    at end move high-value to loop-flag
end-return
perform
    until loop-flag = high-value
        move FUNCTION UPPER-CASE(work-rec) to out-rec
        write out-rec end-write
        return sort-work
            at end move high-value to loop-flag
        end-return
end-perform
close sort-out
.

exit program.
```

```
       end program sorting.
```

Here is a snippet describing TABLE sorts by [jrls_swla]

```
table define

    01  nbr-of-columns  pic 9(4) value zero.
    01  tcindex2        usage is index.
    01  dbtables.
        03  tables-columns  occurs 1 to 1000 times
                depending on nbr-of-columns
                ascending key tcTable, tcColumn
                            indexed by tcindex.
        05  tcTable     pic x(64)   value spaces.
        05  tcColumn    pic x(64)   value spaces.
            05  tcAlias pic x(10)   value spaces.
        05  tcOrder pic 9(4)    value zero.
            05  tcType  pic x(10)   value spaces.
            05  tcMaxLen    pic 9(4)    value zero.
    *><*
    01  aliasName.
        05          pic x value "t".
        05 anVal        pic 9(3)    value zero.

     01 showdata.
        05  sdTable     pic x(17) value spaces.
        05  sdColumn    pic x(17) value spaces.
        05  sdType      pic x(10) value spaces.
        05  sdOrder     pic zzzzz-.
        05  sdMaxLen    pic zzzzz.

table load

   perform varying rows from 1 by 1
       until rows > dbNumRows
       call "dbNextRow"     using by value dbResult,
                                   by reference ColumnBuff,
                                   by reference CbuffDesc
            returning dbResult
       add 1            to nbr-of-columns
       set tcindex          up by 1
       move cbTable         to tcTable(tcindex)
       move cbColumn        to tcColumn(tcindex)
       move cbType          to tcType(tcindex)
       move cbOrder         to tcOrder(tcindex)
       move cbMaxLen        to tcMaxLen(tcindex)
       if nbr-of-columns = 1
          add 1         to anVal
       else
          set tcindex2      to tcindex
          set tcindex2      down by 1
          if cbTable <> tcTable(tcindex2)
             add 1          to anVal
          end-if
       end-if
       move aliasName       to tcAlias(tcindex)
   end-perform.


table sort
```

```
    sort tables-columns ascending key tcTable, tcColumn.

display table

    perform varying tcindex from 1 by 1
        until tcindex > nbr-of-columns
        move tcTable(tcindex)       to sdTable
        move tcColumn(tcindex)      to sdColumn
        move tcOrder(tcindex)       to sdOrder
        move tcType(tcindex)        to sdType
        move tcMaxLen(tcindex)      to sdMaxLen
        display showdata
    end-perform.
```

Excercise for the audience. Could the above code be simplified by using

```
MOVE CORRESPONDING cbRecord to table-columns(tcindex)
...
MOVE CORRESPONDING table-columns(tcindex) to showdata
```

with a few judicious field name changes?

4.1.432.1 An OCSORT support tool

There is an external sort utility referenced in What is ocsort?

29.1.433 4.1.433 SORT-MERGE

Used in an I-O-CONTROL paragraph with the SAME clause:

```
SAME SORT-MERGE AREA FOR filename-1.
```

The SORT-MERGE keyword and SORT keyword are equivalent in this case.

29.1.434 4.1.434 SORT-RETURN

A *SPECIAL-REGISTER* used by the OpenCOBOL SORT routines.

- +000000000 for success
- +000000016 for failure

A programmer may set SORT-RETURN in an INPUT PROCEDURE.

29.1.435 4.1.435 SOURCE

Compiler directive controlling source code handling.

```
>>SOURCE FORMAT IS FIXED
>>SOURCE FORMAT IS FREE
```

OpenCOBOL allows use of this directive at programmer whim. **cobc** defaults to FIXED format source handling, so the directive must occur beyond the sequence and indicator columns unless the **-free** compile option is used.

Split keys are a pending feature in OpenCOBOL.

```
SELECT ...
    RECORD KEY IS key-name SOURCE is dname-2 dname-3
```

Also a pending Report Writer data source clause.

29.1.436 4.1.436 SOURCE-COMPUTER

A paragraph of the IDENTIFICATION division. Treated as a comment.

29.1.437 4.1.437 SOURCES

Currently unsupported SOURCES ARE report writer clause.

29.1.438 4.1.438 SPACE

A figurative constant representing a space character.

29.1.439 4.1.439 SPACES

A figurative constant representing space characters.

29.1.440 4.1.440 SPECIAL-NAMES

OpenCOBOL supports a fair complete set of the SPECIAL-NAMES in common use.

- CONSOLE IS CRT
- SYSIN IS mnemonic-name-1
- SYSOUT IS
- SYSLIST IS
- SYSLST IS
- PRINTER IS
- SYSERR IS
- CONSOLE IS mnemonic-name-7
- SWITCH-1 IS mnemonic-name-n ON STATUS IS condition-name-1 OFF STATUS IS condition-name-2
- SWITCH-2
- ...
- SWITCH-8 IS ...
- C01 IS mnemonic-name-m
- ...
- C12 IS
- ALPHABET alphabet-name IS NATIVE, STANDARD-1, STANDARD-2, EBCDIC literal-1 THRU literal-2 [ALSO literal-3]
- SYMBOLIC CHARACTERS symbol-character IS integer-1 IN alphabet-name
- CLASS class-name IS literal THRU literal-2

- LOCALE locale-name IS identifier-1
- CURRENCY SIGN IS literal
- DECIMAL-POINT IS COMMA
- CURSOR IS identifier-1
- CRT STATUS IS identifier-1
- SCREEN CONTROL IS identifier-1 **PENDING**
- EVENT STATUS IS identifier-1 **PENDING**

29.1.441 4.1.441 STANDARD

- LABEL RECORDS ARE STANDARD

29.1.442 4.1.442 STANDARD-1

- ALPHABET IS STANDARD-1
- RECORD DELIMITER IS STANDARD-1

equivalent to ASCII

29.1.443 4.1.443 STANDARD-2

- ALPHABET IS STANDARD-1
- RECORD DELIMITER IS STANDARD-1

equivalent to ASCII

29.1.444 4.1.444 START

Sets internal file fields that will influence sequential READ NEXT and READ PREVIOUS for INDEXED files. Can also be used to seek to the FIRST or LAST record of a file for SEQUENTIAL access modes.

```
start indexing
   key is less than
       keyfield of indexing-record
   invalid key
       display
           "bad start: " keyfield of indexing-record
       end-display
       set no-more-records to true
   not invalid key
       read indexing previous record
           at end set no-more-records to true
       end-read
end-start
```

The conditionals are quite powerful.

```
KEY IS GREATER THAN
KEY IS >
KEY IS LESS THAN
KEY IS <
KEY IS EQUAL TO
KEY IS =

KEY IS NOT GREATER THAN
KEY IS NOT >
KEY IS NOT LESS THAN
KEY IS NOT <
KEY IS NOT EQUAL TO
KEY IS NOT =

KEY IS <>
KEY IS GREATER THAN OR EQUAL TO
KEY IS >=
KEY IS LESS THAN OR EQUAL TO
KEY IS <=
```

See Does OpenCOBOL support ISAM? for some example source code.

29.1.445 4.1.445 STATEMENT

Unsupported.

29.1.446 4.1.446 STATUS

Multi-purpose.

- CRT STATUS IS
- FILE STATUS IS
- EVENT STATUS IS
- SWITCH-1 IS thing ON STATUS IS conditional-1

29.1.447 4.1.447 STEP

Unsupported Report Writer OCCURS subclause.

29.1.448 4.1.448 STOP

End a run and return control to the operating system.

```
STOP RUN RETURNING 5.
```

Forms include:

- STOP RUN
- STOP RUN RETURNING stat
- STOP RUN GIVING stat
- STOP literal

- STOP RUN WITH ERROR STATUS stat
- STOP RUN WITH NORMAL STATUS stat

29.1.449 4.1.449 STRING

String together a set of variables with controlled delimiters.

```
01 var PICTURE X(5).

STRING
   "abc" DELIMITED BY "b"
   "def" DELIMITED BY SIZE
   "ghi" DELIMITED BY "z"
   INTO var
   ON OVERFLOW
       DISPLAY "var is full at" SPACE LENGTH OF var END-DISPLAY
END-STRING

DISPLAY var END-DISPLAY
```

Outputs:

```
var is full at 5
adefg
```

OpenCOBOL also fully supports the WITH POINTER clause to set the initial and track the position in the output character variable.

29.1.450 4.1.450 STRONG

Unsupported.

29.1.451 4.1.451 SUB-QUEUE-1

Unsupported Communication section clause.

29.1.452 4.1.452 SUB-QUEUE-2

Unsupported Communication section clause.

29.1.453 4.1.453 SUB-QUEUE-3

Unsupported Communication section clause.

29.1.454 4.1.454 SUBTRACT

Arithmetic operation.

```
SUBTRACT a b c FROM d ROUNDED END-SUBTRACT

SUBTRACT a FROM b GIVING c
    ON SIZE ERROR
        SET math-error TO TRUE
```

```
    NOT ON SIZE ERROR
        SET math-error TO FALSE
END-SUBTRACT

SUBTRACT CORRESPONDING record-a FROM record-b ROUNDED
    ON SIZE ERROR
        SET something-wrong TO TRUE
END-SUBTRACT
```

29.1.455 4.1.455 SUM

A REPORT SECTION control break summation field clause. Unsupported.

29.1.456 4.1.456 SUPER

Unsupported Object COBOL clause.

29.1.457 4.1.457 SUPPRESS

Unsupported declarative to suppress printing.

29.1.458 4.1.458 SYMBOL

Unsupported.

29.1.459 4.1.459 SYMBOLIC

SPECIAL-NAMES clause allowing user defined figurative constants.

29.1.460 4.1.460 SYNC

Alias for SYNCHRONIZED

29.1.461 4.1.461 SYNCHRONIZED

Control padding inside record definitions, in particular to match C structures.

```
01 infile.
   03 slice    occurs 64 times depending on slices.
      05 stext usage pointer synchronized.
      05 val   float-long    synchronized.
      05 ftext usage pointer synchronized.
```

29.1.462 4.1.462 SYSTEM-DEFAULT

OBJECT-COMPUTER clause for locale support.

```
CHARACTER CLASSIFICATION IS SYSTEM-DEFAULT
```

29.1.463 4.1.463 TABLE

Unsupported keyword, but OpenCOBOL fully supports tables, including SORT.

29.1.464 4.1.464 TALLYING

INSPECT clause for counting occurances of a literal.

```
INSPECT record-1 TALLYING ident-1 FOR LEADING "0"
```

29.1.465 4.1.465 TAPE

A device type used in ASSIGN.

29.1.466 4.1.466 TERMINAL

Unsupported Comminication section clause.

29.1.467 4.1.467 TERMINATE

Currently unsupported Report Writer verb to finish up a report. See INITIATE.

29.1.468 4.1.468 TEST

Allows control over when loop conditionals are tested. WITH TEST BEFORE is the default. WITH TEST AFTER will always evaluate the body of the loop at least once.

```
perform
    with test after
    varying x from 1 by xstep
    until x >= function e
        if x > function e
            move function e to x-value
        else
            move x to x-value
        end-if
        compute recip = 1 / x end-compute
        move recip to y-value
        write outrec end-write
end-perform
```

29.1.469 4.1.469 TEXT

Unsupported Communication section clause.

29.1.470 4.1.470 THAN

Part of the conditional clauses for readability.

```
IF A GREATER THAN 10
    DISPLAY "A > 10" END-DISPLAY
END-IF
```

29.1.471 4.1.471 THEN

A somewhat disdained keyword that is part of the IF THEN ELSE control structure.

```
IF A > 10 THEN
   DISPLAY "A GREATER THAN 10" END-DISPLAY
ELSE
   DISPLAY "A LESS THAN OR EQUAL TO 10" END-DISPLAY
END-IF
```

29.1.472 4.1.472 THROUGH

Used in definitions for alphabets in SPECIAL-NAMES and a procedural clause allowing PERFORM from one label THROUGH (inclusive) to another label and all paragraphs in between. Also used to specify grouping with RENAMES.

```
PERFORM 100-open-files THROUGH 100-files-end
```

29.1.473 4.1.473 THRU

Commonly used alias for THROUGH

29.1.474 4.1.474 TIME

An ACCEPT FROM source. Allows access to current clock.

```
01 current-time.
   05 ct-hours      pic 99.
   05 ct-minutes    pic 99.
   05 ct-seconds    pic 99.
   05 ct-hundredths pic 99.

ACCEPT current-time FROM TIME
```

29.1.475 4.1.475 TIMES

A counted loop.

```
PEFORM 5 TIMES
    DISPLAY "DERP" END-DISPLAY
END-PERFORM
```

29.1.476 4.1.476 TO

Multi-purpose destination specifier.

```
ADD 1 TO cobol GIVING OpenCOBOL
    ON SIZE ERROR
        DISPLAY "Potential exceeds expectations" END-DISPLAY
END-ADD
```

29.1.477 4.1.477 TOP

A LINAGE clause.

29.1.478 4.1.478 TRAILING

Multi-purpose. FUNCTION TRIM allows a TRAILING keyword. An INSPECT TALLYING subclause.

29.1.479 4.1.479 TRUE

A SET target. Used in EVALUATE to control when the operation succeeds. When used with a conditional 88 level name, will set the corresponding field to a listed VALUE.

```
01 field-1 pic x.
   88 cond-1 values 'a','b','c'.

SET cond-1 TO TRUE
DISPLAY field-1 END-DISPLAY
```

29.1.480 4.1.480 TYPE

An unsupported Report Writer report group clause. Also unsupported data description clause.

29.1.481 4.1.481 TYPEDEF

Unsupported data description clause that will allow user defined record layouts.

29.1.482 4.1.482 UCS-4

Currently unsupported Universal Character Set alphabet. UCS-4 would store international code points in 4 bytes.

29.1.483 4.1.483 UNDERLINE

SCREEN section field attribute.

29.1.484 4.1.484 UNIT

A close option, alias for REEL.

```
CLOSE file-1 UNIT WITH NO REWIND
```

29.1.485 4.1.485 UNIVERSAL

Unsupported Object COBOL exception object clause.

29.1.486 4.1.486 UNLOCK

Manual record unlock and buffer write sync.

```
UNLOCK filename-1 RECORDS
```

29.1.487 4.1.487 UNSIGNED

Usage clause specifing that a value will not include any sign and therefore can't be negative.

29.1.488 4.1.488 UNSIGNED-INT

A native storage format NUMERIC data USAGE clause. Equivalent to BINARY-LONG UNSIGNED and UNSIGNED-LONG.

29.1.489 4.1.489 UNSIGNED-LONG

A native storage format NUMERIC data USAGE clause. Equivalent to BINARY-LONG UNSIGNED and UNSIGNED-INT.

29.1.490 4.1.490 UNSIGNED-SHORT

A native storage format NUMERIC data USAGE clause. Equivalent to BINARY-SHORT UNSIGNED and UNSIGNED-SHORT.

29.1.491 4.1.491 UNSTRING

A powerful string decomposition verb.

```
UNSTRING Input-Address
    DELIMITED BY "," OR "/"
    INTO
        Street-Address DELIMITER D1 COUNT C1
        Apt-Number DELIMITER D2 COUNT C2
        City DELIMITER D3 COUNT C3
        State DELIMITER D4 COUNT C4
        Zip-Code DELIMITER D5 COUNT C5
    WITH POINTER ptr-1
    ON OVERFLOW
        SET more-fields TO TRUE
END-UNSTRING
```

29.1.492 4.1.492 UNTIL

Sets a loop conditional.

```
PERFORM VARYING ident-1 FROM 1 BY 1 UNTIL ident-1 > 10
    CALL "thing" USING BY VALUE ident-1 END-CALL
END-PERFORM
```

29.1.493 4.1.493 UP

Index and pointer modification.

```
SET ptr-1 UP BY 4
SET ind-1 UP BY 1
```

29.1.494 4.1.494 UPDATE

SCREEN section field attribute.

29.1.495 4.1.495 UPON

A DISPLAY destination clause.

29.1.496 4.1.496 USAGE

OpenCOBOL uses standard big-endian internal storage by default. USAGE clauses influence the data representation. The INTEL architecture uses little-endian form and OpenCOBOL programmers developing for this common chipset may need to pay heed to this for performance purposes. As per the standards, OpenCOBOL supports COMPUTATIONAL-5 native usage.

OpenCOBOL enables use of one to eight byte binary representations in both big and little endian forms.

Along with full support of all common COBOL PICTURE clauses both storage and display, OpenCOBOL supports USAGE clauses of:

- BINARY
- COMPUTATIONAL, COMP
- COMP-1
- COMP-2
- COMP-3
- COMP-4
- COMP-5
- COMP-X
- FLOAT-LONG
- FLOAT-SHORT
- DISPLAY
- INDEX
- PACKED-DECIMAL
- POINTER
- PROGRAM-POINTER
- SIGNED-SHORT
- SIGNED-INT
- SIGNED-LONG
- UNSIGNED-SHORT
- UNSIGNED-INT
- UNSIGNED-LONG
- BINARY-CHAR SIGNED

- BINARY-CHAR UNSIGNED
- BINARY-CHAR
- BINARY-SHORT SIGNED
- BINARY-SHORT UNSIGNED
- BINARY-SHORT
- BINARY-LONG SIGNED
- BINARY-LONG UNSIGNED
- BINARY-LONG
- BINARY-DOUBLE SIGNED
- BINARY-DOUBLE UNSIGNED
- BINARY-DOUBLE
- BINARY-C-LONG SIGNED
- BINARY-C-LONG UNSIGNED
- BINARY-C-LONG

29.1.497 4.1.497 USE

Sets up DECLARATIVES paragraphs.

- USE BEFORE DEBUGGING
- USE AFTER EXECEPTION

29.1.498 4.1.498 USER-DEFAULT

OBJECT-COMPUTER clause for locale support.

```
CHARACTER CLASSIFICATION IS USER-DEFAULT
```

29.1.499 4.1.499 USING

Specifies arguments to CALL and in PROCEDURE declarations.

- BY REFERENCE (default, pointer to modifiable data is passed)
- BY CONTENT (reference to a copy of the data)
- BY VALUE (actual dereferenced value is placed into call frame)

29.1.500 4.1.500 UTF-16

Unsupported internationalization clause.

29.1.501 4.1.501 UTF-8

Unsupported internationalization clause.

29.1.502 4.1.502 VAL-STATUS

Alias for the unsupported VALIDATE-STATUS clause of the VALIDATE statement.

29.1.503 4.1.503 VALID

Unsupported.

29.1.504 4.1.504 VALIDATE

Unsupported data validation verb.

29.1.505 4.1.505 VALIDATE-STATUS

Unsupported clause of the VALIDATE statement.

29.1.506 4.1.506 VALUE

An CALL frame argument modifier. Sets values in data descriptions as well as values used with 88 level conditional names.

29.1.507 4.1.507 VALUES

Plural of VALUE when more than one entry is used in an 88 conditional name.

29.1.508 4.1.508 VARYING

Sets a looping variable.

```
PERFORM VARYING loop-counter FROM 1 BY 1 UNTIL loop-counter > 10
    DISPLAY loop-counter END-DISPLAY
END-PERFORM
```

29.1.509 4.1.509 WHEN

A very powerful keyword used in EVALUATE phrases for specifying conditional expressions.

```
EVALUATE TRUE
    WHEN A = 10
        DISPLAY "A = 10" END-DISPLAY
    WHEN A = 15
        PERFORM A-IS-15
    WHEN B IS EQUAL 6
        PERFORM B-IS-6
    WHEN C IS GREATER THAN 5
        DISPLAY "C > 5" END-DISPLAY
    WHEN OTHER
        DISPLAY "Default imperative" END-DISPLAY
 END-EVALUATE
```

29.1.510 4.1.510 WITH

Multi-purpose.

- WITH LOCK
- DISPLAY WITH screen-attribute
- WITH ROLLBACK (pending)

29.1.511 4.1.511 WORKING-STORAGE

A DATA division section. Unless BASED, all fields are allocated and fixed in memory (for the running program within a module).

29.1.512 4.1.512 WRITE

Record write. Unlike READ that uses filenames syntax, WRITE uses record buffer syntax which must be related to the file through the FD file descriptor. OpenCOBOL supports LINAGE and WRITE has support for 'report' paging and line control.

```
WRITE record-buff END-WRITE

WRITE record-name-1 AFTER ADVANCING PAGE END-WRITE.

WRITE record-name-1
    AT END-OF-PAGE
        DISPLAY "EOP" END-DISPLAY
END-WRITE
```

29.1.513 4.1.513 YYYYDDD

Modifies ACCEPT var FROM DAY to use full 4 digit year for the Julian date retrieval.

```
ACCEPT date-var FROM DAY YYYYDDD
```

29.1.514 4.1.514 YYYYMMDD

Modifies ACCEPT var FROM DATE to use full 4 digit year.

```
ACCEPT date-var FROM DATE YYYYMMDD
```

29.1.515 4.1.515 ZERO

Figurative and numeric constant for the value 0.

29.1.516 4.1.516 ZEROES

Plural of ZERO.

29.1.517 4.1.517 ZEROS

Alternate spelling for ZEROES.

29.2 4.2 Does OpenCOBOL implement any Intrinsic FUNCTIONs?

Yes, many. As of the July 2008 1.1 pre-release

Intrinsic FUNCTION

```
ABS, ACOS, ANNUITY, ASIN, ATAN, BYTE-LENGTH, CHAR, CONCATENATE, COS,
CURRENT-DATE, DATE-OF-INTEGER, DATE-TO-YYYYMMDD, DAY-OF-INTEGER,
DAY-TO-YYYYDDD, E, EXCEPTION-FILE, EXCEPTION-LOCATION, EXCEPTION-STATEMENT,
EXCEPTION-STATUS, EXP, EXP10, FACTORIAL, FRACTION-PART, INTEGER,
INTEGER-OF-DATE, INTEGER-OF-DAY, INTEGER-PART, LENGTH, LOCALE-DATE,
LOCALE-TIME, LOG, LOG10, LOWER-CASE, MAX, MEAN, MEDIAN, MIDRANGE, MIN, MOD,
NUMVAL, NUMVAL-C, ORD, ORD-MAX, ORD-MIN, PI, PRESENT-VALUE, RANDOM, RANGE, REM,
REVERSE, SECONDS-FROM-FORMATTED-TIME, SECONDS-PAST-MIDNIGHT, SIGN, SIN, SQRT,
STANDARD-DEVIATION, STORED-CHAR-LENGTH, SUBSTITUTE, SUBSTITUTE-CASE, SUM, TAN,
TEST-DATE-YYYYMMDD, TEST-DAY-YYYYDDD, TRIM, UPPER-CASE, VARIANCE,
WHEN-COMPILED, YEAR-TO-YYYY
```

29.2.1 4.2.1 FUNCTION ABS

Absolute value of numeric argument

```
DISPLAY FUNCTION ABS(DIFFERENCE).
```

29.2.2 4.2.2 FUNCTION ACOS

The ACOS function returns a numeric value (in radians) that approximates the arccosine of the argument.

The domain of the arccosine function is -1 to +1. Domain errors return a result of 0. The inverse cosine function returns a range of 0 thru π

```
DISPLAY FUNCTION ACOS(-1).
```

29.2.3 4.2.3 FUNCTION ANNUITY

Compute the ratio of an annuity paid based on arguments of interest and number of periods.

```
WORKING-STORAGE SECTION.
77  INTEREST       PIC S9V9999 VALUE 0.08.
77  MONTHLY        PIC S9V9999 VALUE ZERO.
77  PERIODS        PIC 99      VALUE 36.
77  ANNUITY-VALUE  PIC S9V9999 VALUE ZERO.
PROCEDURE DIVISION.
   COMPUTE MONTHLY ROUNDED = INTEREST / 12
   COMPUTE ANNUITY-VALUE ROUNDED =
       FUNCTION ANNUITY (MONTHLY PERIODS)
   DISPLAY "Monthly rate: " MONTHLY
       " Periods: " PERIODS
       " Annuity ratio: " ANNUITY-VALUE
   END-DISPLAY.
```

Outputs:

```
Monthly rate: +0.0067 Periods: 36 Annuity ratio: +0.0314
```

29.2.4 4.2.4 FUNCTION ASIN

The ASIN function returns a numeric value (in radians) that approximates the arcsine of the argument.

The domain of the arcsine function is -1 to +1. Domain errors return a result of 0. The inverse sine function returns a range of -π/2 thru π/2

```
DISPLAY FUNCTION ASIN(-1).
```

29.2.5 4.2.5 FUNCTION ATAN

The ATAN function returns a numeric value (in radians) that approximates the arctangent of the argument.

The domain of the arctangent function is all real numbers. The inverse tangent function returns a range of -π/2 thru π/2

```
DISPLAY FUNCTION ATAN(1).
```

29.2.6 4.2.6 FUNCTION BYTE-LENGTH

The BYTE-LENGTH function returns an integer that is the internal storage length of the given argument.

```
COBOL  >>SOURCE FORMAT IS FIXED
      ************************************************************************
      * Purpose:   demonstrate intrinsic FUNCTION BYTE-LENGTH
      ************************************************************************
       identification division.
       program-id. bytelength.

       data division.
       working-storage section.
       01 char-var           usage binary-char.
       01 short-var          usage binary-short.
       01 long-var           usage binary-long.
       01 double-var         usage binary-double.

       01 num1-var           pic 9.
       01 num4-var           pic 99v99.
       01 num9-var           pic s9(9).
       01 num18-var          pic s9(18).
       01 num18c-var         pic s9(18) usage comp.
       01 num18p-var         pic s9(18) usage comp-3.
       01 edit-var           pic $zzzz9.99.

       01 string-var         pic x(10) value "abc".

       01 newline            pic x value x'0a'.

       procedure division.
       display
           "num1-var   len = " function byte-length(num1-var) newline
           "num4-var   len = " function byte-length(num4-var) newline
           "num9-var   len = " function byte-length(num9-var) newline
           "num18-var  len = " function byte-length(num18-var) newline
           "num18c-var len = " function byte-length(num18c-var) newline
           "num18p-var len = " function byte-length(num18p-var) newline
           "edit-var   len = " function byte-length(edit-var) newline

           "12         len = " function byte-length(12) newline
           "12.12      len = " function byte-length(12.12) newline
           "1234567890.123 = " function
               byte-length(1234567890.123) newline

           "string-var len = " function byte-length(string-var) newline
           "trim string    = " function
               byte-length(function trim(string-var)) newline

           "char-var   len = " function byte-length(char-var) newline
```

```
           "short-var  len = " function byte-length(short-var) newline
           "long-var   len = " function byte-length(long-var) newline
           "double-var len = " function byte-length(double-var)

       end-display
       goback.
       exit program.
```

Outputs:

```
num1-var   len = 1
num4-var   len = 4
num9-var   len = 9
num18-var  len = 18
num18c-var len = 8
num18p-var len = 10
edit-var   len = 9
12         len = 2
12.12      len = 4
1234567890.123 = 13
string-var len = 10
trim string    = 00000003
char-var   len = 1
short-var  len = 2
long-var   len = 4
double-var len = 8
```

29.2.7 4.2.7 FUNCTION CHAR

The CHAR function returns a ONE character alphanumeric field whose value is the character in the current collating sequence having the ordinal position equal to the value of the integer argument. The argument must be greater than 0 and less than or equal to the number of positions in the collating sequence. Errors in the argument range return 0 (the LOW-VALUE by default).

See ASCII or EBCDIC and details of the ALPHABET clause.

```
DISPLAY FUNCTION CHAR(66).
```

Would output **A** in the ASCII character set. Note this may be different than what some expect. OpenCOBOL CHAR is 1 thru 128 not 0 thru 127 as a C programmer may be used to.

And to add a little confusion, most personal computers use an extended character set, usually erroneously called ASCII with a range of 0 to 255. A more appropriate name may be ISO-8859-1 Latin 1. See ASCII for more accurate details. This author is often guilty of this misnomer of the use of the term ASCII.

29.2.8 4.2.8 FUNCTION COMBINED-DATETIME

Returns a common datetime form from integer date (years and days from 1600 to 10000) and numeric time arguments (seconds in day). Date should be from 1 to 3067671 and time should be from 1 to 86400. The character string returned is in the form 7.5.

```
DISPLAY FUNCTION COMBINED-DATETIME(1; 1) END-DISPLAY
```

Outputs:

```
0000001.00001
```

29.2.9 4.2.9 FUNCTION CONCATENATE

Concatenate the given fields. CONCATENATE is an OpenCOBOL extension.

```
MOVE "COBOL" TO stringvar
MOVE FUNCTION CONCATENATE("Open"; stringvar) TO goodsystem
DISPLAY goodsystem END-DISPLAY
```

29.2.10 4.2.10 FUNCTION COS

The COS function returns a numeric value that approximates the cosine of the argument (in radians).

The domain of the cosine function is all real numbers, with a nominal domain of 0 thru π with a zero returned at $\pi/2$. The cosine function returns a range of -1 thru +1.

```
DISPLAY FUNCTION COS(1.5707963267949).
```

29.2.11 4.2.11 FUNCTION CURRENT-DATE

Returns an alphanumeric field of length 21 with the current date, time and timezone information in the form YYYYMMDDhhmmsscc±tznn

```
DISPLAY FUNCTION CURRENT-DATE.
```

Example Output:

```
2008080921243796-0400
```

29.2.12 4.2.12 FUNCTION DATE-OF-INTEGER

Converts an integer date, days on the Gregorian since December 31 1600 to YYYYMMDD form

```
DISPLAY DATE-OF-INTEGER(1)
DISPLAY DATE-OF-INTEGER(50000)
```

Outputs:

```
16010101
17371123
```

50,000 days after December 31, 1600 being November 23rd, 1737.

29.2.13 4.2.13 FUNCTION DATE-TO-YYYYMMDD

Converts a two digit year date format to four digit year form using a sliding window pivot of the optional second argument. The pivot defaults to 50.

The OpenCOBOL implementation of DATE-TO-YYYYMMDD also accepts an optional third argument, replacing the default century value of 1900 and is treated as the years added to the given year portion of the first argument and modified by the sliding 100 window pivot.

Domain errors occur for year values less than 1600 and greater than 999,999. There is no validation of the input date.

Because of the sliding window, this function is dependent on the date of evaluation

```
DISPLAY FUNCTION DATE-TO-YYYYMMDD(000101)
DISPLAY FUNCTION DATE-TO-YYYYMMDD(500101)
DISPLAY FUNCTION DATE-TO-YYYYMMDD(610101)
DISPLAY FUNCTION DATE-TO-YYYYMMDD(990101)
```

```
DISPLAY FUNCTION DATE-TO-YYYYMMDD(990101, 50, 1900)
DISPLAY FUNCTION DATE-TO-YYYYMMDD(990101, -10, 1900)
DISPLAY FUNCTION DATE-TO-YYYYMMDD(990101, 50, 2000)
DISPLAY FUNCTION DATE-TO-YYYYMMDD(990101, 50, 2100)
```

When run in August, 2008 produces:

```
20000101
20500101
19610101
19990101
18990101
17990101
19990101
20990101
```

29.2.14 4.2.14 FUNCTION DAY-OF-INTEGER

Converts a Gregorian integer date form to Julian date form (YYYDDD) based on days since December 31, 1600. Errors return 0

```
DISPLAY FUNCTION DAY-OF-INTEGER(97336).
1867182
```

97,336 days after 16001231 being the 182nd day of the year 1867. Canada's date of Confederation and recognized birthday.

29.2.15 4.2.15 FUNCTION DAY-TO-YYYYDDD

Converts a Julian 2 digit year and three digit dat integer to a four digit year form. See FUNCTION DATE-TO-YYYYMMDD for some of the details of the calculations involved.

29.2.16 4.2.16 FUNCTION E

Returns Euler's number as an alphanumeric field to 34 digits of accuracy after the decimal. E forms the base of the natural logarithms. It has very unique and important properies such as:

- the derivative of e^x is e^x
- and the area below the curve of $y = 1/x$ for $1 <= x <= e$ is exactly 1.
- making it very useful in calculations of Future Value with compound interest.

```
DISPLAY FUNCTION E END-DISPLAY
```

outputs:

```
2.7182818284590452353602874713526625
```

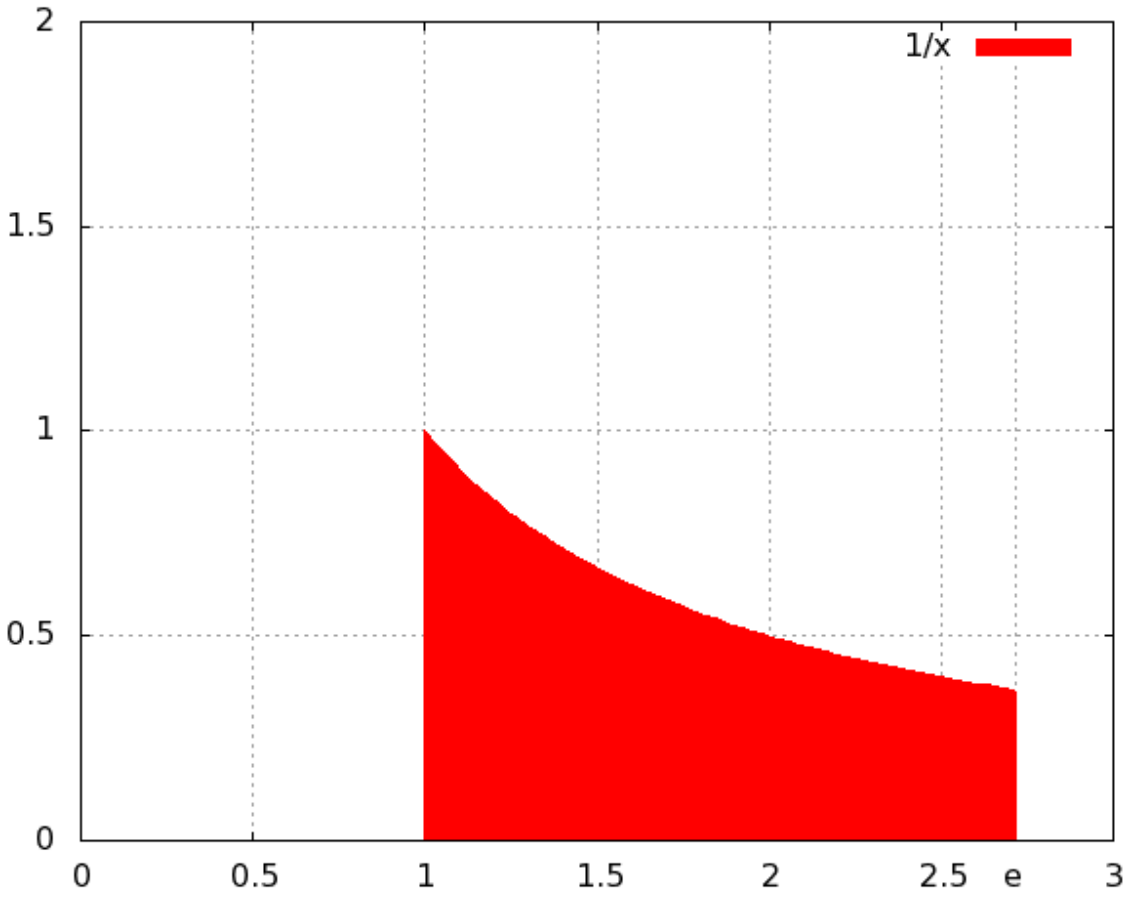
A small graph to show the magic area.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      29-May-2009, Modified 20110505 to add e tic mark
      *> Purpose:   Plot Euler's number (using integral of 1 over x)
      *> Tectonics: requires access to gnuplot. http://www.gnuplot.info
      *>            cobc -Wall -x ploteuler.cob
      *> OVERWRITES ocgenplot.gp, ocgpdata.txt and images/euler.png
      *> ************************************************************
       identification division.
```

```
       program-id. ploteuler.

       environment division.
       input-output section.
       file-control.
           select scriptfile
               assign to "ocgenplot.gp"
               organization is line sequential.
           select outfile
               assign to "ocgpdata.txt"
               organization is line sequential.

       data division.
       file section.
       fd scriptfile.
          01 gnuplot-command pic x(82).

       fd outfile.
          01 outrec.
             03 x-value   pic -z9.999.
             03 filler    pic x.
             03 y-value   pic -z9.999.

       working-storage section.
       01 xstep   pic 9v99999.
       01 x       pic 9v99999.
       01 recip   pic 9v99999.

      *> The plot command is xrange 0:3, y 0:2 data col 1 for x 2 for y
       01 gpcmds  pic x(400) value is
           "set style fill solid 1.0;                          " &
           "set grid;                                          " &
           "set xtics add ('e' 2.718281);                      " &
           "plot [0:3] [0:2] 'ocgpdata.txt' using 1:2 \        " &
           " with filledcurves below x1  title '1/x';          " &
           "set terminal png;                                  " &
           "set output 'images/euler.png';                     " &
           "replot                                             ".
       01 line-cnt pic 999.
       01 gptable.
          05 gpcmd pic x(50) occurs 8 times.

       01 gplot   pic x(40) value is 'gnuplot -persist ocgenplot.gp'.
       01 result  pic s9(9).

      *> **************************************************************
       procedure division.
       display function e end-display

      *><* Create the script to plot the area of Euler's number
       open output scriptfile.
       move gpcmds to gptable
       perform varying line-cnt from 1 by 1 until line-cnt > 8
           move gpcmd(line-cnt) to gnuplot-command
           write gnuplot-command end-write
       end-perform
       close scriptfile

      *><* Create the reciprocal data
```

```
open output outfile
move spaces to outrec
compute xstep = function e / 100 end-compute
perform
    with test after
    varying x from 1 by xstep
    until x >= function e
        if x > function e
            move function e to x-value
        else
            move x to x-value
        end-if
        compute recip = 1 / x end-compute
        move recip to y-value
        write outrec end-write
end-perform
close outfile

*><* Invoke gnuplot
call "SYSTEM" using gplot returning result end-call
if result not = 0
    display "Problem: " result end-display
    stop run returning result
end-if

goback.
end program ploteuler.
```

The area in red is exactly 1. *Well, not on this plot exactly, as it is somewhat sloppy with the xstep end case and the precisions.*



See Can OpenCOBOL be used for plotting? for some details on plotting.

29.2.17 4.2.17 FUNCTION EXCEPTION-FILE

This special-register holds the error number and name of the source file that caused an input output exception. See FUNCTION EXCEPTION-STATUS for an example.

29.2.18 4.2.18 FUNCTION EXCEPTION-LOCATION

This special-register can be queried for the location of the last exception. See FUNCTION EXCEPTION-STATUS for example source code. Note: This feature requires compilation with *-fsource-location* compiler switch. This option is also turned on with *-g* and *-debug* debugging info compiles. Information includes PROGRAM-ID, section and source line.

29.2.19 4.2.19 FUNCTION EXCEPTION-STATEMENT

This special-register holds the statement that was executing when the latest exception was raised. See FUNCTION EXCEPTION-STATUS for an example. Note: This feature requires compilation with *-fsource-location* compiler switch. This option is also turned on with *-g* debugging info compiles.

29.2.20 4.2.20 FUNCTION EXCEPTION-STATUS

This FUNCTION returns the current exception status. The example below is courtesy of Roger While, from a post he made announcing the *FUNCTION EXCEPTION-* features.

Source format is free, compile with *cobc -x -g -free except.cob*

```
IDENTIFICATION DIVISION.
PROGRAM-ID. MINIPROG.

ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER. LINUX.
OBJECT-COMPUTER. LINUX.
SPECIAL-NAMES.

INPUT-OUTPUT SECTION.
FILE-CONTROL.
SELECT PRINTFILE ASSIGN TO "XXRXWXX"
FILE STATUS RXWSTAT.

DATA DIVISION.
FILE SECTION.
FD PRINTFILE.
01 PRINTREC PIC X(132).

WORKING-STORAGE SECTION.
01 RXWSTAT PIC XX.

PROCEDURE DIVISION.
A00-MAIN SECTION.
001-MAIN-PROCEDURE.
OPEN INPUT PRINTFILE.
DISPLAY "File Status: " RXWSTAT.
DISPLAY "EXCEPTION-FILE: " FUNCTION EXCEPTION-FILE.
DISPLAY "Return Length: "
    FUNCTION LENGTH (FUNCTION EXCEPTION-FILE).
DISPLAY "EXCEPTION-STATUS: " FUNCTION EXCEPTION-STATUS.
DISPLAY "EXCEPTION-STATEMENT: " FUNCTION EXCEPTION-STATEMENT.
STRING "TOOLONG" DELIMITED SIZE INTO RXWSTAT.
DISPLAY "EXCEPTION-STATUS: " FUNCTION EXCEPTION-STATUS.
DISPLAY "EXCEPTION-STATEMENT: " FUNCTION EXCEPTION-STATEMENT.
DISPLAY "EXCEPTION-LOCATION: " FUNCTION EXCEPTION-LOCATION.

STOP RUN.
```

Example output:

```
File Status: 35
EXCEPTION-FILE: 35PRINTFILE
Return Length: 00000011
EXCEPTION-STATUS: EC-I-O-PERMANENT-ERROR
EXCEPTION-STATEMENT: OPEN
EXCEPTION-STATUS: EC-OVERFLOW-STRING
EXCEPTION-STATEMENT: STRING
EXCEPTION-LOCATION: MINIPROG; 001-MAIN-PROCEDURE OF A00-MAIN; 29
```

Tip: See the source file libcob/exception.def for a list of the plethora of run-time exceptions supported by OpenCOBOL.

29.2.21 4.2.21 FUNCTION EXP

Returns an approximation of Euler's number (see FUNCTION E) raised to the power of the numeric argument.

```
DISPLAY FUNCTION EXP(1) END-DISPLAY
```

outputs:

```
2.718281828459045091
```

Note: Be aware that this approximation seems accurate to "only" 15 decimal places. Diligent programmers need to be aware of the foibles of floating point mathematics and take these issues into consideration.

29.2.22 4.2.22 FUNCTION EXP10

Returns an approximation of the value 10 raised to the power of the numeric argument.

```
DISPLAY FUNCTION EXP10(1.0) END-DISPLAY
DISPLAY FUNCTION EXP10(1.2) END-DISPLAY
DISPLAY FUNCTION EXP10(10) END-DISPLAY
```

Outputs:

```
10.000000000000000000
15.848931924611132871
10000000000.000000000000000000
```

29.2.23 4.2.23 FUNCTION FACTORIAL

Computes the factorial of the integral argument. Valid Range of 0 to 19 with a domain of 1 to 121645100408832000.

```
OCOBOL*> ************************************************************
      *> Program to find range and domain of FUNCTION FACTORIAL
       identification division.
       program-id. fact.

       data division.
       working-storage section.
       01 ind pic 999.
       01 result pic 9(18).

      *> ************************************************************
       procedure division.
       perform varying ind from 0 by 1 until ind > 20
           add zero to function factorial(ind) giving result
               on size error
                   display "overflow at " ind end-display
           end-add
           display ind " = " function factorial(ind) end-display
       end-perform

       goback.
       end program fact.
```

Outputs:

```
000 = 000000000000000001
001 = 000000000000000001
002 = 000000000000000002
003 = 000000000000000006
```

```
004 = 000000000000000024
005 = 000000000000000120
006 = 000000000000000720
007 = 000000000000005040
008 = 000000000000040320
009 = 000000000000362880
010 = 000000000003628800
011 = 000000000039916800
012 = 000000000479001600
013 = 000000006227020800
014 = 000000087178291200
015 = 000001307674368000
016 = 000020922789888000
017 = 000355687428096000
018 = 006402373705728000
019 = 121645100408832000
overflow at 020
020 = 432902008176640000
```

Kind of the same thing, with some zero out formatting.

```
OCOBOL*> ****************************************************************
      *> Program to find range and domain of FUNCTION FACTORIAL
       identification division.
       program-id. fact.

       data division.
       working-storage section.
       01 ind                  pic 99.
       01 z-ind                pic z9.
       01 result               pic 9(18).
       01 pretty-result        pic z(17)9.

      *> ****************************************************************
       procedure division.
       perform varying ind from 0 by 1 until ind > 21
           add zero to function factorial(ind) giving result
               on size error
                   display
                       "overflow at " ind ", result undefined: "
                       function factorial(ind)
                   end-display
               not on size error
                   move ind to z-ind
                   move result to pretty-result
                   display
                       "factorial(" z-ind ") = " pretty-result
                   end-display
           end-add
       end-perform

       goback.
       end program fact.
```

Which outputs:

```
factorial( 0) =                  1
factorial( 1) =                  1
factorial( 2) =                  2
factorial( 3) =                  6
factorial( 4) =                 24
```

```
factorial( 5) =                120
factorial( 6) =                720
factorial( 7) =               5040
factorial( 8) =              40320
factorial( 9) =             362880
factorial(10) =            3628800
factorial(11) =           39916800
factorial(12) =          479001600
factorial(13) =         6227020800
factorial(14) =        87178291200
factorial(15) =      1307674368000
factorial(16) =     20922789888000
factorial(17) =    355687428096000
factorial(18) =   6402373705728000
factorial(19) = 121645100408832000
overflow at 20, result undefined, 4329020081766400000
overflow at 21, result undefined, 197454024290336768
```

29.2.24 4.2.24 FUNCTION FRACTION-PART

Returns a numeric value that is the fraction part of the argument. Keeping the sign.

```
DISPLAY FUNCTION FRACTION-PART(FUNCTION E) END-DISPLAY
DISPLAY FUNCTION FRACTION-PART(-1.5) END-DISPLAY
DISPLAY FUNCTION FRACTION-PART(-1.0) END-DISPLAY
DISPLAY FUNCTION FRACTION-PART(1) END-DISPLAY
```

Outputs:

```
+.718281828459045235
-.500000000000000000
+.000000000000000000
+.000000000000000000
```

29.2.25 4.2.25 FUNCTION INTEGER

Returns the greatest integer less than or equal to the numeric argument.

```
DISPLAY
    FUNCTION INTEGER (-3)      SPACE
    FUNCTION INTEGER (-3.141)
END-DISPLAY
DISPLAY
    FUNCTION INTEGER (3)       SPACE
    FUNCTION INTEGER (3.141)
END-DISPLAY
DISPLAY
    FUNCTION INTEGER (-0.3141) SPACE
    FUNCTION INTEGER (0.3141)  SPACE
    FUNCTION INTEGER (0)
END-DISPLAY
```

Outputs:

```
-000000000000000003 -000000000000000004
+000000000000000003 +000000000000000003
-000000000000000001 +000000000000000000 +000000000000000000
```

Note the -4, greatest integer **less than or equal to** the argument.

29.2.26 4.2.26 FUNCTION INTEGER-OF-DATE

Converts a date in the Gregorian calender to an integer form. Expects a numeric argument in the form *YYYYMMDD* based on years greater than or equal to 1601 and less than 10000. Month values range from 1 to 12. Days range from 1 to 31 and should be valud for the specified month and year. Invalid input returns unpredictable results and sets the exception EC-ARGUMENT-FUNCTION to exist. See FUNCTION DATE-OF-INTEGER for the converse function.

29.2.27 4.2.27 FUNCTION INTEGER-OF-DAY

Converts a Julian date of YYYYDDD to integer date form. See FUNCTION DAY-OF-INTEGER for the converse intrinsic function. Invalid arguments return an undefined result and set the exception EC-ARGUMENT-FUNCTION to exist.

29.2.28 4.2.28 FUNCTION INTEGER-PART

Returns the integer part of the numeric argument. Similar to FUNCTION INTEGER but returns different values for negative arguments.

```
DISPLAY
    FUNCTION INTEGER-PART (-3)      SPACE
    FUNCTION INTEGER-PART (-3.141)
END-DISPLAY
DISPLAY
    FUNCTION INTEGER-PART (3)       SPACE
    FUNCTION INTEGER-PART (3.141)
END-DISPLAY
DISPLAY
    FUNCTION INTEGER-PART (-0.3141) SPACE
    FUNCTION INTEGER-PART (0.3141)  SPACE
    FUNCTION INTEGER-PART (0)
END-DISPLAY
```

Outputs:

```
-00000000000000003 -00000000000000003
+00000000000000003 +00000000000000003
+00000000000000000 +00000000000000000 +00000000000000000
```

29.2.29 4.2.29 FUNCTION LENGTH

Returns an integer that is the length in character positions of the given argument.

```
working storage.
01 nat     pic n(10).
01 cha     pic x(10).
01 bin     constant as h'ff'.

01 num     pic s9(8)v9(8).
01 form    pic $-z(7)9.9(8).

procedure division.
display
    function length(nat) space
    function length(cha) space
    function length(bin)
end-display
```

```
display
    function length(num) space
    function length(form)
end-display
```

Outputs:

```
20 10 3
16 19
```

29.2.30 4.2.30 FUNCTION LOCALE-DATE

Returns a culturally appropriate date given an alphanumeric of 8 character positions in the form "YYYYMMDD" and an optional locale name that has been associted with a locale in the SPECIAL-NAMES paragraph.

See http://en.wikipedia.org/wiki/Locale for a start at the very detail rich computational requirements of LOCALE.

Will set EC-ARGUMENT-FUNCTION to exist for invalid input.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ****************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20120116
      *> Purpose:   Demonstrate locale functions
      *> Tectonics: cobc -x locales.cob
      *> ****************************************************************
       identification division.
       program-id. locales.

       environment division.
       configuration section.
       repository.
           function all intrinsic.

      *> -*********-*********-*********-*********-*********-*********-**
       procedure division.

      *> Display cultural norm date and times as set in environment.
      *>   Google LC_ALL.
      *> 20120622 represents June 22 2012
      *> 141516 represents 2pm (14th hour), 15 minutes, 16 seconds
      *> 39600 represents 11 hours in seconds

       display locale-date(20120622)            end-display
       display locale-time(141516)              end-display
       display locale-time-from-seconds(39600)  end-display

       goback.
       end program locales.
```

Which produced:

```
[btiffin@home cobol]$ cobc -x locales.cob
[btiffin@home cobol]$ ./locales
06/22/2012
02:15:16 PM
11:00:00 AM
```

I live in Canada, but usually run Fedora with LANG=en_US.utf8

and so

```
[btiffin@home cobol]$ export LANG='en_CA.utf8'
[btiffin@home cobol]$ ./locales
22/06/12
02:15:16 PM
11:00:00 AM
```

Boo, day month year form. Sad, 2 digit year? What kinda backwater land do I live in? Time to write strongly worded letters to some committees. :)

I just looked, and it seems Canada is listed as DD/MM/YY; I'm moving to Germany.

```
[btiffin@home cobol]$ export LANG=en_DK.utf8
[btiffin@home cobol]$ ./locales
2012-06-22
14:15:16
11:00:00
```

Joy. year month day. Hmm, what about Hong Kong?

```
[btiffin@home cobol]$ LANG=en_HK.utf8 ./locales
Sunday, June 22, 2012
02:15:16 EST
11:00:00 EST
```

Nice.

If you want to run your system through its locales, try

```
$ locs=( $(locale -a) )
$ for l in ${locs[@]}; do echo $l; LANG=$l ./locales; done
```

and expect some unicode in the output.

Oh, and along with FUNCTION EXCEPTION-STATUS you can detect invalid arguments.

```
000100 >>SOURCE FORMAT IS FIXED
000200*> ************************************************************
000300*> Author:    Brian Tiffin
000400*> Date:      20120116
000500*> Purpose:   Demonstrate locale function invalid arguments
000600*> Tectonics: cobc -x -g -debug locales.cob
000700*> ************************************************************
000800 identification division.
000900 program-id. locales.
001000
001100 environment division.
001200 configuration section.
001300 repository.
001400     function all intrinsic.
001500
001600*> -*********-*********-*********-*********-*********-*********-**
001700 procedure division.
001800
001900*> Display cultural norm date and times as set in environment.
002000*>   Google LC_ALL.
002100*> 20120622 represents June 22 2012
002200*> 141516 represents 2pm (14th hour), 15 minutes, 16 seconds
002300*> 39600 represents 11 hours in seconds
002400
002500 display locale-date(20120622)            end-display
002600 display locale-time(141516)              end-display
002700 display locale-time-from-seconds(39600)  end-display
002800
002900*> invalid arguments are detected through EXCEPTION-STATUS
```

```
003000 display locale-date(20120699)            end-display
003100 DISPLAY "EXCEPTION-STATUS: " EXCEPTION-STATUS
003200 DISPLAY "EXCEPTION-STATEMENT: " EXCEPTION-STATEMENT
003300 DISPLAY "EXCEPTION-LOCATION: " EXCEPTION-LOCATION
003400
003500 display locale-time(941516)               end-display
003600 DISPLAY "EXCEPTION-STATUS: " EXCEPTION-STATUS
003700 DISPLAY "EXCEPTION-STATEMENT: " EXCEPTION-STATEMENT
003800 DISPLAY "EXCEPTION-LOCATION: " EXCEPTION-LOCATION
003900
004000 display locale-time-from-seconds(-39600) end-display
004100
004200 goback.
004300 end program locales.
```

giving:

```
$ ./locales
06/22/2012
02:15:16 PM
11:00:00 AM

EXCEPTION-STATUS: EC-ARGUMENT-FUNCTION
EXCEPTION-STATEMENT: DISPLAY
EXCEPTION-LOCATION: locales; MAIN PARAGRAPH OF MAIN SECTION; 30

EXCEPTION-STATUS: EC-ARGUMENT-FUNCTION
EXCEPTION-STATEMENT: DISPLAY
EXCEPTION-LOCATION: locales; MAIN PARAGRAPH OF MAIN SECTION; 35
-11:00:00 AM
```

29.2.31 4.2.31 FUNCTION LOCALE-TIME

Returns a culturally appropriate date given an alphanumeric of 6 character positions in the form "HHMMSS" and an optional locale name that has been associted with a locale in the SPECIAL-NAMES paragraph. See http://en.wikipedia.org/wiki/Locale for a start at the very detail rich computational requirements of LOCALE.

Will set EC-ARGUMENT-FUNCTION to exist for invalid input.

See FUNCTION LOCALE-DATE.

29.2.32 4.2.32 FUNCTION LOCALE-TIME-FROM-SECONDS

Returns a culturally appropriate date given an alphanumeric number of seconds and an optional locale name that has been associted with a locale in the SPECIAL-NAMES paragraph.

See http://en.wikipedia.org/wiki/Locale for a start at the very detail rich computational requirements of LOCALE.

Will set EC-ARGUMENT-FUNCTION to exist for invalid input.

See FUNCTION LOCALE-DATE.

29.2.33 4.2.33 FUNCTION LOG

Returns an approximation of the natural logarithmic value of the given numeric argument. Uses a base of FUNCTION E.

```
DISPLAY FUNCTION LOG(100) END-DISPLAY
DISPLAY FUNCTION LOG(FUNCTION E) END-DISPLAY
```

gives:

```
4.60517018598809137
000000001
```

29.2.34 4.2.34 FUNCTION LOG10

Returns an approximation of the base-10 logarithmic value of the given numeric argument.

```
DISPLAY FUNCTION LOG10(100) END-DISPLAY
```

gives:

```
000000002
```

29.2.35 4.2.35 FUNCTION LOWER-CASE

Convert any uppercase character values (A-Z) in the argument to lowercase (a-z).

29.2.36 4.2.36 FUNCTION MAX

Returns the maximum value from the list of arguments.

```
DISPLAY FUNCTION MAX ( "def"; "abc";) END-DISPLAY
DISPLAY FUNCTION MAX ( 123.1; 123.11; 123) END-DISPLAY
```

Outputs:

```
def
123.11
```

29.2.37 4.2.37 FUNCTION MEAN

Returns the arithmetic mean (average) of the list of numeric arguments.

```
DISPLAY FUNCTION MEAN(1; 2; 3; 4; 5; 6; 7; 8; 9) END-DISPLAY
```

Outputs:

```
+5.00000000000000000
```

29.2.38 4.2.38 FUNCTION MEDIAN

Returns the middle value of the arguments formed by arranging the list in sorted order.

```
DISPLAY FUNCTION MEDIAN(1; 2; 3; 4; 5; 6; 7; 8; 9) END-DISPLAY
```

Outputs:

```
5
```

29.2.39 4.2.39 FUNCTION MIDRANGE

Returns the arithmetic mean (average) of the minimum and maximum argument from the list of numeric arguments.

```
DISPLAY FUNCTION MIDRANGE(1; 2; 3; 4; 5; 6; 7; 8; 9) END-DISPLAY
```

Outputs:

```
5.000000000000000000
```

29.2.40 4.2.40 FUNCTION MIN

Returns the minimum value from the list of arguments.

```
DISPLAY FUNCTION MIN ( "def"; "abc";) END-DISPLAY
DISPLAY FUNCTION MIN ( 123.1; 123.11; 123) END-DISPLAY
```

Outputs:

```
abc
123
```

29.2.41 4.2.41 FUNCTION MOD

Returns an integer value of that is the first-argument modulo second-argument.

```
DISPLAY FUNCTION MOD(123; 23) END-DISPLAY
```

Outputs:

```
+000000000000000008
```

29.2.42 4.2.42 FUNCTION NUMVAL

Returns the numeric value represented by the character string argument.

```
OCOBOL IDENTIFICATION   DIVISION.
       PROGRAM-ID.      prog.
       DATA             DIVISION.
       WORKING-STORAGE  SECTION.
       01  X   PIC   X(12) VALUE " -9876.1234 ".
       01  F   PIC   X(12) VALUE "B-9876.1234 ".
       PROCEDURE        DIVISION.
           DISPLAY FUNCTION NUMVAL ( X )
           DISPLAY FUNCTION NUMVAL ( F )
           END-DISPLAY.
           STOP RUN.
```

gives:

```
-09876.1234
000000000
```

The “B” in field F, breaks the numeric conversion. NUMVAL is actually fairly complicated and forgiving of inputs, but will return 0 on invalid numeric conversions.

OpenCOBOL 2 will also provide FUNCTION TEST-NUMVAL.

29.2.43 4.2.43 FUNCTION NUMVAL-C

Returns the numeric value represented by the culturally appropriate currency specification argument.

```
OCOBOL IDENTIFICATION   DIVISION.
       PROGRAM-ID.      prog.
       DATA             DIVISION.
       WORKING-STORAGE  SECTION.
       01  X   PIC   X(14) VALUE " % -9876.1234 ".
       PROCEDURE        DIVISION.
           DISPLAY FUNCTION NUMVAL-C ( X , "%" )
           END-DISPLAY.
           STOP RUN.
```

gives:

```
-09876.1234
```

in a LOCALE that uses the percent sign as a currency symbol.

OpenCOBOL 2 will also provide FUNCTION TEST-NUMVAL-C.

29.2.44 4.2.44 FUNCTION ORD

Returns the integer value that is the ordinal position of the character argument in the program's collating sequence. COBOL uses 1 as the lowest ordinal for character sequencing.

```
DISPLAY FUNCTION ORD("J") END-DISPLAY
```

Outputs (on an ASCII system with no ALPHABET clause):

```
00000075
```

Note that COBOL uses 1 as the first value for collating. So ASCII 74 is ORD 75 for "J".

29.2.45 4.2.45 FUNCTION ORD-MAX

Returns the integer that is the ordinal position of the maximum value of the given argument list.

```
DISPLAY ORD-MAX(9; 8; 7; 6; 5; 4; 3; 2; 1) END-DISPLAY
DISPLAY ORD-MAX('abc'; 'def'; 'ghi') END-DISPLAY
```

Outputs:

```
00000001
00000003
```

29.2.46 4.2.46 FUNCTION ORD-MIN

Returns the integer that is the ordinal position of the minimum value from the argument list.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20090531
      *> Purpose:   Demonstration of FUNCTION ORD-MIN and REPOSITORY
      *> Tectonics: cobc -x ordmin.cob
      *> ************************************************************
       identification division.
       program-id. ordmin.

       environment division.
```

```
       configuration section.
       repository.
           function all intrinsic.

       data division.
       working-storage section.
       01 posmin               pic 9(8).

      *> ************************************************************
       procedure division.
       move ord-min (9; 8; 7; 6; 5; 4; 3; 2; 1; 2; 3; 4; 5) to posmin
       display posmin end-display
       move ord-min ("abc"; "def"; "000"; "def"; "abc") to posmin
       display posmin end-display
       goback.
       end program ordmin.
```

Outputs:

```
00000009
00000003
```

Notice how ord-min did not require FUNCTION, as the REPOSITORY entry allows this to be skipped in the source codes.

29.2.47 4.2.47 FUNCTION PI

Returns an approximation of the ratio of the circumference by the diameter of a circle. It returns an alphanumeric with 34 digits after the decimal. Please be aware of the limitations of using these types of approximated values in computations.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20101030
      *> Purpose:   Demonstrate PI
      *> Tectonics: cobc -x pi-demo.cob
      *> ************************************************************
       identification division.
       program-id. pi-demo.

       data division.
       working-storage section.
       01 args pic x(80).
       01 diameter pic 999 value 1.
       01 show-diameter pic zz9.
       01 circumference usage float-long.
       01 plural pic xx.
       01 plural-length pic 9 value 1.
       01 newline pic x value x'0a'.

      *> ************************************************************
       procedure division.
       accept args from command-line end-accept
       if args not equal spaces
           move args to diameter
       end-if

       if diameter not equal 1
```

```
            move "s " to plural
            move 2 to plural-length
        else
            move "  " to plural
            move 1 to plural-length
        end-if
        move diameter to show-diameter

        display "FUNCTION PI is " function pi newline end-display

        compute circumference = function pi * diameter end-compute
        display
            "A wheel, " show-diameter " metre" plural(1:plural-length)
            "wide will roll, very close to but only approximately, "
            newline circumference " metres in ONE full rotation."
            newline
        end-display

        goback.
        end program pi-demo.
```

Outputs:

```
$ cobc -x pi-demo.cob && ./pi-demo && ./pi-demo 42
FUNCTION PI is 3.14159265358979323846264338327950 29

A wheel,   1 metre wide will roll, very close to but only approximately,
3.14159265358979312 metres in ONE full rotation.

FUNCTION PI is 3.14159265358979323846264338327950 29

A wheel,  42 metres wide will roll, very close to but only approximately,
131.946891450771318 metres in ONE full rotation.
```

29.2.48 4.2.48 FUNCTION PRESENT-VALUE

Returns an approximation of the present value from a discount rate and list of future period end amounts. It attempts to reflect the future value of $1.00 given time, inflation and interest.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20101030
      *> Purpose:   Demo of PRESENT-VALUE
      *> Tectonics: cobc -x present-value-demo.cob
      *> ************************************************************
       identification division.
       program-id. present-value-demo.

       data division.
       working-storage section.
       01 args pic x(80).
       01 newline pic x value x'0a'.
       01 rate pic s9v9999 value 0.7000.
       01 the-value pic s9(6)v99.

      *> ************************************************************
       procedure division.
       accept args from command-line end-accept
```

```
if args not equal to spaces
    move args to rate
end-if

compute the-value rounded =
    function present-value(rate; 1000, 1010, 1000, 1100)
end-compute
display
     "A discount rate of " rate " gives a PRESENT-VALUE of "
     the-value " given" newline
     "end-amounts of 1000, 1010, 1000 and 1100"
end-display

compute the-value rounded =
    function present-value(rate; 1000, 1000, 1000, 1000)
end-compute
display
     "A discount rate of " rate " gives a PRESENT-VALUE of "
     the-value " given" newline
     "end-amounts of 1000, 1000, 1000 and 1000"
end-display

goback.
end program present-value-demo.
```

Outputs:

```
$ ./present-value-demo
A discount rate of +0.7000 gives a PRESENT-VALUE of +001272.96 given
end-amounts of 1000, 1010, 1000 and 1100
A discount rate of +0.7000 gives a PRESENT-VALUE of +001257.53 given
end-amounts of 1000, 1000, 1000 and 1000
$ ./present-value-demo 0.333
A discount rate of +0.3330 gives a PRESENT-VALUE of +002089.18 given
end-amounts of 1000, 1010, 1000 and 1100
A discount rate of +0.3330 gives a PRESENT-VALUE of +002051.88 given
end-amounts of 1000, 1000, 1000 and 1000
$ ./present-value-demo 0.935
A discount rate of +0.9350 gives a PRESENT-VALUE of +001003.03 given
end-amounts of 1000, 1010, 1000 and 1100
A discount rate of +0.9350 gives a PRESENT-VALUE of +000993.23 given
end-amounts of 1000, 1000, 1000 and 1000
```

For details, talk to a professional.

rant Any COBOL programmer using financial functions for use by others **HAS** to attain some level of *domain expertise* in the mathematics at work, as well as a level of *technical competence* to read through and defend both the COBOL source code and the generated C code that OpenCOBOL emits before compiling. *rant over*

29.2.49 4.2.49 FUNCTION RANDOM

Returns a pseudo-random number given a numeric seed value as argument.

```
DISPLAY FUNCTION RANDOM(1) END-DISPLAY
DISPLAY FUNCTION RANDOM(1) END-DISPLAY
DISPLAY FUNCTION RANDOM() END-DISPLAY
```

Outputs:

```
+00000000.1804289383
+00000000.1804289383
+000000000.846930886
```

29.2.50 4.2.50 FUNCTION RANGE

Returns the value of the minimum argument subtracted from the maximum argument from the list of numeric arguments.

```
DISPLAY FUNCTION RANGE(1; 2; 3; 4; 5; 6; 7; 8; 9) END-DISPLAY
```

Outputs:

```
+000000000000000008
```

29.2.51 4.2.51 FUNCTION REM

Returns the numeric remainder of the first argument divided by the second.

```
DISPLAY FUNCTION REM(123; 23) END-DISPLAY
```

Outputs:

```
+000000000000000008
```

29.2.52 4.2.52 FUNCTION REVERSE

Returns the reverse of the given character string.

```
DISPLAY FUNCTION REVERSE("abc") END-DISPLAY
```

Outputs:

```
cba
```

29.2.53 4.2.53 FUNCTION SECONDS-FROM-FORMATTED-TIME

This function converts a time that is in a specified format to a numeric value representing the number of seconds after midnight.

```
OCOBOL IDENTIFICATION   DIVISION.
       PROGRAM-ID.      prog.
       DATA             DIVISION.
       WORKING-STORAGE  SECTION.
       01  X    PIC     X(6)    VALUE "hhmmss".
       01  Y    PIC     9(8)    COMP-5.
       01  Z    PIC     X(6)    VALUE "010203".
       PROCEDURE        DIVISION.
           MOVE FUNCTION SECONDS-FROM-FORMATTED-TIME (X, Z) TO Y.
           IF Y NOT = 3723
                   DISPLAY Y
                   END-DISPLAY
           END-IF.
           STOP RUN.
```

This test would fail if 01:02:03 was not returned as 3723 seconds past midnight.

Argumenent 1 takes the form *hhmmss* and expectes argument 2 to be a matching length numeric item, or 0 is returned.

29.2.54 4.2.54 FUNCTION SECONDS-PAST-MIDNIGHT

Returns the seconds past midnight from the current system time.

29.2.55 4.2.55 FUNCTION SIGN

Returns +1 for positive, 0 for zero and -1 for a negative numeric argument.

29.2.56 4.2.56 FUNCTION SIN

Returns an approximation for the trigonometric sine of the given numeric angle (expressed in radians) argument. See Can OpenCOBOL be used for plotting? for a sample graph using gnuplot.

29.2.57 4.2.57 FUNCTION SQRT

Returns an approximation of the square root of the given numeric argument.

```
DISPLAY FUNCTION SQRT(-1) END-DISPLAY
CALL "perror" USING NULL END-CALL
DISPLAY FUNCTION SQRT(2) END-DISPLAY
```

Outputs:

```
0.000000000000000000
Numerical argument out of domain
1.414213562373095145
```

Note: CALL "perror" reveals a bug in OpenCOBOL versions packaged before June 2009 where the stack will evetually underflow due to improper handling of the **void** return specification. Versions supporting RETURNING NULL fix this problem. An actual application that needed to verify the results of square roots or other numerical function would be better off placing a small C wrapper to set and get the global errno.

29.2.58 4.2.58 FUNCTION STANDARD-DEVIATION

Returns an approximation of the standard deviation from the given list of numeric arguments.

```
DISPLAY
    FUNCTION STANDARD-DEVIATION(1 2 3 4 5 6 7 8 9 10) SPACE
    FUNCTION STANDARD-DEVIATION(1 2 3 4 5 6 7 8 9 100)
END-DISPLAY
```

```
2.872281323269014308 28.605069480775604518
```

29.2.59 4.2.59 FUNCTION STORED-CHAR-LENGTH

Returns the numeric value of the internal storage length of the given argument in bytes, not counting spaces.

29.2.60 4.2.60 FUNCTION SUBSTITUTE

FUNCTION SUBSTITUTE is an OpenCOBOL extension to the suite of intrinsic functions.

```
DISPLAY
    FUNCTION SUBSTITUTE("this is a test",
        "this", "that",
        "is a", "was",
        "test", "very cool!")
END-DISPLAY
```

Will display:

```
that was very cool!
```

having changed *this* for *that*, *is a* for *was* and *test* with **very cool!**

The new intrinsic accepts:

```
SUBSTITUTE(subject, lit-pat-1, repl-1 [, litl-pat-2, repl-2, ...])
```

where lit-pat just means the scan is for literals, not that you have to use literal constants. WORKING-STORAGE identifiers are fine for any of the subject, the search patterns or the replacements.

As with all intrinsics, you receive a new field and the subject is untouched.

Note: The resulting field can be shorter, the same length or longer than the subject string.

This is literal character **global** find and replace, and there are no wildcards or other pattern expressions. Unlike INSPECT, this function **does not require same length** patterns and replacements. Each pattern replacement pair uses the original subject, not any intermediate in progress result.

As this is an alphanumeric operation, a reference modification is also allowed

```
MOVE FUNCTION SUBSTITUTE(subject, pat, repl)(2:4) TO xvar4
```

to result in 4 characters starting at the second position after the substitution.

29.2.61 4.2.61 FUNCTION SUBSTITUTE-CASE

Similar to SUBSTITUTE, but ignores upper and lower case of subject when matching patterns.

29.2.62 4.2.62 FUNCTION SUM

Returns the numeric value that is the sum of the given list of numeric arguments.

29.2.63 4.2.63 FUNCTION TAN

Returns an approximation for the trigonometric tangent of the given numeric angle (expressed in radians) argument. Returns ZERO if the argument would cause an infinity or other size error.

29.2.64 4.2.64 FUNCTION TEST-DATE-YYYYMMDD

Test for valid date in numeric yyyymmdd form.

29.2.65 4.2.65 FUNCTION TEST-DAY-YYYYDDD

Test for valid date in numeric yyyyddd form.

29.2.66 4.2.66 FUNCTION TRIM

Returns a character string that is the argument trimmed of spaces. Defaults to trimming both ends, but can be passed LEADING or TRAILING qualifier arguments.

```
DISPLAY '"' FUNCTION TRIM("   abc   ") '"' END-DISPLAY
DISPLAY '"' FUNCTION TRIM("   abc   " LEADING) '"' END-DISPLAY
DISPLAY '"' FUNCTION TRIM("   abc   " TRAILING) '"' END-DISPLAY
```

Outputs:

```
"abc"
"abc   "
"   abc"
```

29.2.67 4.2.67 FUNCTION UPPER-CASE

Returns a copy of the alphanumeric argument with any lower case letters replaced by upper case letters.

```
DISPLAY FUNCTION UPPER-CASE("# 123 abc DEF #") END-DISPLAY
```

Outputs:

```
# 123 ABC DEF #
```

29.2.68 4.2.68 FUNCTION VARIANCE

Returns the variance of a series of numbers. The variance is defined as the square of the FUNCTION STANDARD-DEVIATION

```
DISPLAY FUNCTION VARIANCE(1 2 3 4 5 6 7 8 9 100) END-DISPLAY.
+818.250000000000000
```

29.2.69 4.2.69 FUNCTION WHEN-COMPILED

Returns a 21 character alphanumeric field of the form YYYYMMDDhhmmsscc±zzzz e.g. 2008070505152000-0400 representing when a module or executable is compiled. The WHEN-COMPILED special register reflects when an object module was compiled

```
program-id. whenpart1. procedure division.
display "First part :" FUNCTION WHEN-COMPILED end-display.

program-id. whenpart2. procedure division.
display "Second part:" FUNCTION WHEN-COMPILED end-display.

program-id. whenshow. procedure division.
call "whenpart1" end-call.
call "whenpart2" end-call.
display "Main part  :" FUNCTION WHEN-COMPILED end-display.
```

For a test

```
$ cobc -c whenpart1.cob && sleep 15 && cobc -c whenpart2.cob &&
> sleep 15 && cobc -x whenshow.cob whenpart1.o whenpart2.o
$ ./whenshow
```

gives:

```
First part :2008082721391500-0400
Second part:2008082721393000-0400
Main part  :2008082721394500-0400
```

29.2.70 4.2.70 FUNCTION YEAR-TO-YYYY

Converts a two digit year to a sliding window four digit year. The optional second argument (default 50) is added to the date at execution time to determine the ending year of a 100 year interval.

29.3 4.3 Can you clarify the use of FUNCTION in OpenCOBOL?

Yes. This information is from [Roger], posted to the opencobol forums.

```
Just to clarify the use of FUNCTION.
(Applies to 0.33)
FUNCTION (generally speaking, there are exceptions) can
be used anywhere where a source item is valid.
It always results in a new temporary field.
This will have the desired characteristics dependant
on the parameters.
eg. FUNCTION MIN (x, y, z)
with x PIC 99
     y PIC 9(8) COMP
     z PIC 9(6)V99
will result in returning a field that has
at least 8 positions before the (implied) decimal
point and 2 after.

It does NOT ever change the contents of parameters
to the function.

FUNCTION's are nestable.
eg.

DISPLAY FUNCTION REVERSE (FUNCTION UPPER-CASE (myfield)).
```

One clarification to the above quote was pointed out by Roger. The line:

```
be used anywhere where a source item is valid.
```

should be:

```
be used anywhere where a sending field is valid.
```

29.4 4.4 What is the difference between the LENGTH verb and FUNCTION LENGTH?

From [Roger]:

```
The standard only defines FUNCTION LENGTH.
The LENGTH OF phrase is an extension (from MF)
```

29.5 4.5 What STOCK CALL LIBRARY does OpenCOBOL offer?

OpenCOBOL 1.0 ships with quite a few callable features. See CALL. Looking through the source code, you'll find the current list of service calls in:

```
libcob/system.def
```

With the 1.1 pre-release of July 2008, that list included

```
/* COB_SYSTEM_GEN (external name, number of parameters, internal name) */

COB_SYSTEM_GEN ("SYSTEM", 1, SYSTEM)
COB_SYSTEM_GEN ("CBL_ERROR_PROC", 2, CBL_ERROR_PROC)
COB_SYSTEM_GEN ("CBL_EXIT_PROC", 2, CBL_EXIT_PROC)
COB_SYSTEM_GEN ("CBL_OPEN_FILE", 5, CBL_OPEN_FILE)
COB_SYSTEM_GEN ("CBL_CREATE_FILE", 5, CBL_CREATE_FILE)
COB_SYSTEM_GEN ("CBL_READ_FILE", 5, CBL_READ_FILE)
COB_SYSTEM_GEN ("CBL_WRITE_FILE", 5, CBL_WRITE_FILE)
COB_SYSTEM_GEN ("CBL_CLOSE_FILE", 1, CBL_CLOSE_FILE)
COB_SYSTEM_GEN ("CBL_FLUSH_FILE", 1, CBL_FLUSH_FILE)
COB_SYSTEM_GEN ("CBL_DELETE_FILE", 1, CBL_DELETE_FILE)
COB_SYSTEM_GEN ("CBL_COPY_FILE", 2, CBL_COPY_FILE)
COB_SYSTEM_GEN ("CBL_CHECK_FILE_EXIST", 2, CBL_CHECK_FILE_EXIST)
COB_SYSTEM_GEN ("CBL_RENAME_FILE", 2, CBL_RENAME_FILE)
COB_SYSTEM_GEN ("CBL_GET_CURRENT_DIR", 3, CBL_GET_CURRENT_DIR)
COB_SYSTEM_GEN ("CBL_CHANGE_DIR", 1, CBL_CHANGE_DIR)
COB_SYSTEM_GEN ("CBL_CREATE_DIR", 1, CBL_CREATE_DIR)
COB_SYSTEM_GEN ("CBL_DELETE_DIR", 1, CBL_DELETE_DIR)
COB_SYSTEM_GEN ("CBL_AND", 3, CBL_AND)
COB_SYSTEM_GEN ("CBL_OR", 3, CBL_OR)
COB_SYSTEM_GEN ("CBL_NOR", 3, CBL_NOR)
COB_SYSTEM_GEN ("CBL_XOR", 3, CBL_XOR)
COB_SYSTEM_GEN ("CBL_IMP", 3, CBL_IMP)
COB_SYSTEM_GEN ("CBL_NIMP", 3, CBL_NIMP)
COB_SYSTEM_GEN ("CBL_EQ", 3, CBL_EQ)
COB_SYSTEM_GEN ("CBL_NOT", 2, CBL_NOT)
COB_SYSTEM_GEN ("CBL_TOUPPER", 2, CBL_TOUPPER)
COB_SYSTEM_GEN ("CBL_TOLOWER", 2, CBL_TOLOWER)
COB_SYSTEM_GEN ("\364", 2, CBL_XF4)
COB_SYSTEM_GEN ("\365", 2, CBL_XF5)
COB_SYSTEM_GEN ("\221", 2, CBL_X91)
COB_SYSTEM_GEN ("C$NARG", 1, cob_return_args)
COB_SYSTEM_GEN ("C$PARAMSIZE", 1, cob_parameter_size)
COB_SYSTEM_GEN ("C$MAKEDIR", 1, cob_acuw_mkdir)
COB_SYSTEM_GEN ("C$CHDIR", 2, cob_acuw_chdir)
COB_SYSTEM_GEN ("C$SLEEP", 1, cob_acuw_sleep)
COB_SYSTEM_GEN ("C$COPY", 3, cob_acuw_copyfile)
COB_SYSTEM_GEN ("C$FILEINFO", 2, cob_acuw_file_info)
COB_SYSTEM_GEN ("C$DELETE", 2, cob_acuw_file_delete)
COB_SYSTEM_GEN ("C$TOUPPER", 2, CBL_TOUPPER)
COB_SYSTEM_GEN ("C$TOLOWER", 2, CBL_TOLOWER)
COB_SYSTEM_GEN ("C$JUSTIFY", 1, cob_acuw_justify)
COB_SYSTEM_GEN ("CBL_OC_NANOSLEEP", 1, cob_oc_nanosleep)

/**/
```

Note the “SYSTEM”. This CALL sends a command string to the shell. It acts as a wrapper to the standard C library “system” call. “SYSTEM” removes any trailing spaces from the argument and appends the null terminator required for the C library “system” call. While shell access opens yet another powerful door for the OpenCOBOL programmer, diligent delevopers will need to pay heed to cross platform issues when calling the operating system.

29.5.1 4.5.1 A CBL_ERROR_PROC example

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *****************************************************************
      * OpenCOBOL demonstration
      * Author:  Brian Tiffin
```

```
* Date:    26-Jun-2008
* History:
*     03-Jul-2008
*     Updated to compile warning free according to standards
* Purpose:
*     CBL_ERROR_PROC and CBL_EXIT_PROC call example
*     CBL_ERROR_PROC installs or removes run-time error procedures
*     CBL_EXIT_PROC installs or removes exit handlers
*     Also demonstrates the difference between Run time errors
*     and raised exceptions.  Divide by zero is raises an
*     exception, it does not cause a run time error.
* NB:
*     Please be advised that this example uses the functional but
*     now obsolete ENTRY verb.  Compiling with -Wall will display
*     a warning.  No warning will occur using -std=MF
* Tectonics: cobc -x errorproc.cob
 identification division.
 program-id. error_exit_proc.

 data division.
 working-storage section.
* entry point handlers are procedure addresses
 01  install-address   usage is procedure-pointer.
 01  install-flag      pic 9 comp-x value 0.
 01  status-code       pic s9(9) comp-5.

* exit handler address and priority (prio is IGNORED with OC1.1)
 01  install-params.
     02 exit-addr      usage is procedure-pointer.
     02 handler-prio   pic 999 comp-x.

* indexing variable for back scannning error message strings
 01  ind               pic s9(9) comp-5.

* work variable to demonstrate raising exception, not RTE
 01  val               pic 9.

* mocked up error procedure reentrancy control, global level
 01  once              pic 9 value 0.
     88 been-here             value 1.

* mocked up non-reentrant value
 01  global-value      pic 99 value 99.

* LOCAL-STORAGE SECTION comes into play for ERROR_PROCs that
*   may themselves cause run-time errors, handling reentry.
 local-storage section.
 01  reenter-value     pic 99 value 11.

* Linkage section for the error message argument passed to proc
* By definition, error messages are 325 alphanumeric
 linkage section.
 01  err-msg           pic x(325).

* example of OpenCOBOL error and exit procedures
 procedure division.

* Demonstrate problem installing procedure
* get address of WRONG handler.  NOTE: Invalid address
```

```
 set exit-addr to entry "nogo-proc".

* flag: 0 to install, 1 to remove
 call "CBL_EXIT_PROC" using install-flag
                            install-params
                      returning status-code
 end-call.
* status-code 0 on success, in this case expect error.
 if status-code not = 0
     display
         "Intentional problem installing EXIT PROC"
         ", Status: " status-code
     end-display
 end-if.

* Demonstrate install of an exit handler
* get address of exit handler
 set exit-addr to entry "exit-proc".

* flag: 0 to install, 1 to remove
 call "CBL_EXIT_PROC" using install-flag
                            install-params
                      returning status-code
 end-call.
* status-code 0 on success.
 if status-code not = 0
     display
         "Problem installing EXIT PROC"
         ", Status: " status-code
     end-display
     stop run
 end-if.

* Demonstrate installation of an error procedure
* get the procedure entry address
 set install-address to entry "err-proc".

* install error procedure. install-flag 0 installs, 1 removes
 call "CBL_ERROR_PROC" using install-flag
                             install-address
                       returning status-code
 end-call.
* status-code is 0 on success.
 if status-code not = 0
     display "Error installing ERROR PROC" end-display
     stop run
 end-if.

* example of error that raises exception, not a run-time error
 divide 10 by 0 giving val end-divide.
* val will be a junk value, use at own risk

 divide 10 by 0 giving val
     on size error display "DIVIDE BY ZERO Exception" end-display
 end-divide.

* intentional run-time error
 call "erroneous" end-call.           *> ** Intentional error **
```

```
* won't get here.  RTS error handler will stop run
 display
     "procedure division, following run-time error"
 end-display.
 display
     "global-value: " global-value
     ", reenter-value: " reenter-value
 end-display.

 exit program.
****************************************************************

****************************************************************
* Programmer controlled Exit Procedure:
 entry "exit-proc".

 display
     "**Custom EXIT HANDLER (will pause 3 and 0.5 seconds)**"
 end-display.

* sleep for 3 seconds
 call "C$SLEEP" using "3" end-call.
* demonstrate nanosleep; argument in billionth's of seconds
*   Note: also demonstrates OpenCOBOL's compile time
*         string catenation using ampersand;
*         500 million being one half second
 call "CBL_OC_NANOSLEEP" using "500" & "000000" end-call.

 exit program.

****************************************************************
* Programmer controlled Error Procedure:
 entry "err-proc" using err-msg.

 display "**ENTER error procedure**" end-display.

* These lines are to demonstrate local and working storage
 display
     "global-value: " global-value
     ", reenter-value: " reenter-value
 end-display.
* As reenter-value is local-storage
*  the 77 will NOT display on rentry, while the global 66 will
 move 66 to global-value.
 move 77 to reenter-value.

* Process err-msg.
* Determine Length of error message, looking for null terminator
 perform varying ind from 1 by 1
     until (err-msg(ind:1) = x"00") or (ind = length of err-msg)
         continue
 end-perform.
 display err-msg(1:ind) end-display.

* demonstrate trapping an error caused in error-proc
 if not been-here then
     set been-here to true
     display "Cause error while inside error-proc" end-display
     call "very-erroneous" end-call        *> Intentional error
```

```
       end-if.

      * In OpenCOBOL 1.1, the return-code is local and does
      *   not influence further error handlers
      *move 1 to return-code.
       move 0 to return-code.

       display "**error procedure EXIT**" end-display.

       exit program.
```

with tectonics:

```
$ cobc -x errorproc.cob
$ ./errorproc
Intentional problem installing EXIT PROC, Status: -000000001
DIVIDE BY ZERO Exception
**ENTER error procedure**
global-value: 99, reenter-value: 11
Cannot find module 'erroneous'
Cause error while inside error-proc
**ENTER error procedure**
global-value: 66, reenter-value: 11
Cannot find module 'very-erroneous'
**error procedure EXIT**
libcob: Cannot find module 'very-erroneous'
**Custom EXIT HANDLER (will pause 3 and 0.5 seconds)**
```

29.5.2 4.5.2 Some stock library explanations

This small gem of a help file was written up by Vincent Coen, included here for our benefit.

Note: The code below is a work in progress. If you see this attention box; the file is not yet deemed complete.

```
System Calls v1.1.0 for OC v1.1  Author: Vincent B Coen  dated 12/01/2009

COB_SYSTEM_GEN ("CBL_ERROR_PROC", 2, CBL_ERROR_PROC):        Register error proc in Linux??? needs ch
   call using      install-flag   pic x comp-x    Indicates operation to be performed
                                                  (0 = install error procedure)
                                                  (1 = un-install error procedure)
                   install-addrs  Usage procedure pointer  Create by 'set install-addr to entry entry
                                                  (the address of error procedure to install or un-in

COB_SYSTEM_GEN ("CBL_EXIT_PROC", 2, CBL_EXIT_PROC)           Register closedown proc
   call using      install-flag   pic x comp-x    Indicate operation to be performed
                                                  (0 = install closedown proc. with default priority
                                                  (1 = un=install closedown proc.)
                                                  (2 = query priority of installed proc.)
                                                  (3 = install closedown proc. with given priority)
                   install-param  group item defined as:
                     install-addr  USAGE PROCEDURE POINTER (addr of closedown proc to install, uninst
                     install-prty  pic x comp-x    (when install-flag = 3, priority of proc. being in
      returning     status-code    (See section key).
   on exit           install-prty                   (when install-flag = 2, returns priority of select

COB_SYSTEM_GEN ("CBL_OPEN_FILE", 5, CBL_OPEN_FILE)           Open byte stream file
    call using     file-name      pic x(n)      space or null terminated
                   access-mode    pic x comp-5   (1 = read only, 2 = write only [deny must = 0]
```

```
                                                3 = read / write)
                  deny-mode      pic x comp-5   (0 = deny both, 1 = deny write, 2 = deny read
                                                3 = deny neither read nor write)
                  device         pic x comp-5   (must be zero)
                  file-handle    pic x(4)       (Returns a file handle for a successful open)
        returning  status-code    (See section key)

COB_SYSTEM_GEN ("CBL_CREATE_FILE", 5, CBL_CREATE_FILE)       Create byte stream file
    call using     file-name      pic x(n)      (space or null terminated)
                   access-mode    pic x comp-x  (1 = read only)
                                                (2 = write only (deny must be 0)
                                                (3 = read / write)
                   deny-mode      pic x comp-x  (0 = deny both read & write exclusive)
                                                (1 = deny write)
                                                (2 = deny read)
                                                (3 = deny neither read nor write)
                   device         pic x comp-x  (must be zero) (reserved for future use)
                   file-handle    pic x(4)      (Returns a file handle for a successful open)
         returning status-code     (See section key)

COB_SYSTEM_GEN ("CBL_READ_FILE", 5, CBL_READ_FILE)           Read byte stream file
    call using  file-handle     pic x(4)         (File handke returned when file opened)
                file-offset     pic x(8) comp-x  (offset in the file at which to read) (Max limit X"(
                byte-count      pic x(4) comp-x  (number of bytes to read. Poss limit x"00FFFF")
                flags           pic x comp-x     (0 = standard read, 128 = current file size returnec
                                                      file-offset field)
                buffer          pic x(n)
     returning status-code     (See section key)
      on exit:  file-offset                      (Current file size on return if flags = 128 on entry
                buffer          pic x(n)         (Buffer into which bytes are read. IT IS YOUR RESPON
                                                  TO ENSURE THAT THE BUFFER IS LARGE ENOUGH TO HOLD A
                                                  READ)
     Remarks:                  See Introduction to Byte Stream Routines as well as example code taker
                               from old version of CobXref

COB_SYSTEM_GEN ("CBL_WRITE_FILE", 5, CBL_WRITE_FILE)         Write byte stream file
    call using  file-handle     pic x(4)         (File handke returned when file opened)
                file-offset     pic x(8) comp-x  (offset in the file at which to write) (Max limit X"
                byte-count      pic x(4) comp-x  (number of bytes to write. Poss limit x"00FFFF")
                                                 Putting a value of zero here causes file to be tranc
                                                 to the size specified in file-offset)
                flags           pic x comp-x     (0 = standard write)
                buffer          pic x(n)         (Buffer into which bytes are writen from)
     returning status-code     (See section key)

     Remarks:                  See Introduction to Byte Stream Routines as well as example code taker
                               from old version of CobXref

COB_SYSTEM_GEN ("CBL_CLOSE_FILE", 1, CBL_CLOSE_FILE)         Close byte stream file
    call using file-handle       pic x(4)     on entry the file handle returned when file opened
         returning status-code   (see section key)

COB_SYSTEM_GEN ("CBL_FLUSH_FILE", 1, CBL_FLUSH_FILE)         ??????????????
    call using   ???????         pic ????       No Idea

COB_SYSTEM_GEN ("CBL_DELETE_FILE", 1, CBL_DELETE_FILE)       Delete File
    call using file-name         pic x(n)   file to delete terminated by space can contain path.
     returning status-code
```

```
COB_SYSTEM_GEN ("CBL_COPY_FILE", 2, CBL_COPY_FILE)           Copy file
      call using file-name1     (pic x(n)       File to copy, can contain path terniated by space
                 file-name2     (pic x(n)       File name of new file, can contain path termiated by
                                                For both, if no path current directory is assumed.
       returning status-code    (see section key)

COB_SYSTEM_GEN ("CBL_CHECK_FILE_EXIST", 2, CBL_CHECK_FILE_EXIST)     Check if file exists & return de
     Call using     file-name
                    file-details
       returning status-code

    file-name  pic x(n)
    file-details       Group item defined as:
       file-size        pic x(8) comp-x
     file-date
       day              pic x comp-x
       month            pic x comp-x
       year             pic xx comp-x

     file-time
       hours            pic x comp-x
       minutes          pic x comp-x
       seconds          pic x comp-x
       hundredths       pic x comp-x
     status-code    see section key

On entry: file-name     The file to look for. name can cotain path and is terminated by a space
                        If no path given current directory is assumed.
On Exit:  file-size     Size if file in bytes
          file-date     Date the file was created
          file-time     Time file created

COB_SYSTEM_GEN ("CBL_RENAME_FILE", 2, CBL_RENAME_FILE)        Rename file
    call using      old-file-name    pic x(n)     (file to rename can contain path terminated by spac
                    new-file-name    pic x(n)     (new file name  as above path must be same)
     returning status-code     (see section key)

COB_SYSTEM_GEN ("CBL_GET_CURRENT_DIR", 3, CBL_GET_CURRENT_DIR) Get details of current directory
     call using      ???        pic x(n)  ???
                     ???        pic x(n)  ???
      returning  status-code (see section key)

COB_SYSTEM_GEN ("CBL_CHANGE_DIR", 1, CBL_CHANGE_DIR)          Change current directory
     Call using     path-name   pic x(n) (relative or absolute terminated by x"00")
       returning  status-code (see section key)

COB_SYSTEM_GEN ("CBL_CREATE_DIR", 1, CBL_CREATE_DIR)          Create directory
     Call using     path-name   pic x(n)  (relative or absolute path-name terminate by x"00")
       returning  status-code  (see section key)

COB_SYSTEM_GEN ("CBL_DELETE_DIR", 1, CBL_DELETE_DIR)          Delete directory
     Call using path-name       pic x(n)  (relative or absolute name terminated by space or null [x"0
       returning status-code    (see section key)

COB_SYSTEM_GEN ("CBL_AND", 3, CBL_AND)                        logical AND
     Call using  source      (Any data item)
                 target      (Any data item)
        by value length      (numeric literal or pic x(4) comp-5
       returning status-code  (see section key)
```

```
COB_SYSTEM_GEN ("CBL_OR", 3, CBL_OR)                          logical OR
   call using    source      (Any data item)
                 target      (Any data item)
        by value length      (numeric literal or pic x(4) comp-5
      returning status-code  (see section key)

COB_SYSTEM_GEN ("CBL_NOR", 3, CBL_NOR)                        Logial Not OR ?
     Call using  source      (Any data item)
                 target      (Any data item)
        by value length      (numeric literal or pic x(4) comp-5
      returning status-code  (see section key)

COB_SYSTEM_GEN ("CBL_XOR", 3, CBL_XOR)                        logical eXclusive OR
     Call using  source      (Any data item)
                 target      (Any data item)
        by value length      (numeric literal or pic x(4) comp-5
      returning status-code  (see section key)


COB_SYSTEM_GEN ("CBL_IMP", 3, CBL_IMP)                        Logical IMPlies
    call using source        Any data item
               target        Any data Item
          by value length    Nuneric literal or pic x(4) comp-5
     returning status-code    (see section key)

COB_SYSTEM_GEN ("CBL_NIMP", 3, CBL_NIMP)                       Logical Not IMPlies
    call using source        Any data item
               target        Any data Item
          by value length    Nuneric literal or pic x(4) comp-5
     returning status-code    (see section key)

COB_SYSTEM_GEN ("CBL_EQ", 3, CBL_EQ)                          Logical EQUIVALENCE between bits of bot
     Call using  source      (Any data item)
                 target      (Any data item)
        by value length      (numeric literal or pic x(4) comp-5
      returning status-code  (see section key)

COB_SYSTEM_GEN ("CBL_NOT", 2, CBL_NOT)                        Logical NOT
   Call using target         Any data item
      by value length        numeric lit or pic x(4) comp-5

COB_SYSTEM_GEN ("CBL_TOUPPER", 2, CBL_TOUPPER)                Convert a string to Upper case
    Call using    string      pic x(n)          (The string to convert)
        by value  length      pic x(4) comp-5   (Number of bytes to change)
      returning status-code  (see section key)

COB_SYSTEM_GEN ("CBL_TOLOWER", 2, CBL_TOLOWER)                Convert a string to Lower case
    Call using    string      pic x(n)          (The string to convert)
        by value  length      pic x(4) comp-5   (Number of bytes to change)
      returning status-code  (see section key)

COB_SYSTEM_GEN ("\364", 2, CBL_XF4)
COB_SYSTEM_GEN ("\365", 2, CBL_XF5)
COB_SYSTEM_GEN ("\221", 2, CBL_X91)
COB_SYSTEM_GEN ("C$NARG", 1, cob_return_args)
COB_SYSTEM_GEN ("C$PARAMSIZE", 1, cob_parameter_size)
COB_SYSTEM_GEN ("C$MAKEDIR", 1, cob_acuw_mkdir)
COB_SYSTEM_GEN ("C$CHDIR", 2, cob_acuw_chdir)
```

```
COB_SYSTEM_GEN ("C$SLEEP", 1, cob_acuw_sleep)
COB_SYSTEM_GEN ("C$COPY", 3, cob_acuw_copyfile)
COB_SYSTEM_GEN ("C$FILEINFO", 2, cob_acuw_file_info)
COB_SYSTEM_GEN ("C$DELETE", 2, cob_acuw_file_delete)

COB_SYSTEM_GEN ("C$TOUPPER", 2, CBL_TOUPPER)                    Convert string to upper case
    see cbl_toupper  ???

COB_SYSTEM_GEN ("C$TOLOWER", 2, CBL_TOLOWER)                    Convert string to lower case
    see cbl_tolower  ???
COB_SYSTEM_GEN ("C$JUSTIFY", 1, cob_acuw_justify)
COB_SYSTEM_GEN ("CBL_OC_NANOSLEEP", 1, CBL_OC_NANOSLEEP)

Key:
  Option Returning clause will allow all routine to return a value showing result of the operation.
  Zero = success and nonzero failure. If this field is omitted the value should be returned in the
  special register RETURN-CODE..       Note that status-code must be capable of holding posative
                                       values from 0 to 65535 ie, pic xx comp-5.
```

And a sample program too

```
Introduction to Byte Streaming Routines.

The byte stream file routines enable you to read, write data files without the need to adhere to
Cobol record definitions.

For all of these routines, if the routine is successful the RETURN-CODE register is set to zero. If
it fails, the RETURN-CODE register contains a file status value which indicates the failure. This
file status  is always the standard ASNI '74 file status value. If no ANSI '74 file status is defined
for the error, an extended error status is returned (9/nnn) where nnn is the runtime error number).
           MAYBE need to speak to Roger. <<<<<<<<<<<<<<<<<<<<
```

An extract of a example of working Cobol code that shows usage of byte stream file handling

```
000100 Identification division.
000200 program-id.          cobxref.
...
...
104000 01  File-Handle-Tables.
104100     03  filler          occurs 0 to 99
104200                                depending on Fht-Table-Size.
104300       05 Fht-File-Handle  pic x(4).
104400       05 Fht-File-OffSet  pic x(8)       comp-x  value zero.
104500       05 Fht-File-Size    pic x(8)       comp-x  value zero.
104600       05 Fht-Block-OffSet pic x(8)       comp-x  value zero.
104700       05 Fht-Byte-Count   pic x(4)       comp-x  value 4096.
104800       05 Fht-CopyRefNo2   pic 9(6)               value zero.
104900       05 Fht-Pointer      pic s9(5)      comp    value zero.
105000       05 Fht-Copy-Line-End pic s9(5)     comp    value zero.
105100       05 Fht-Copy-Words   pic s9(5)      comp    value zero.
105200       05 Fht-sw-Eof       pic 9                  value zero.
105300        88 Fht-Eof                               value 1.
105400       05 Fht-Current-Rec  pic x(160)             value spaces.
105500       05 Fht-File-Name    pic x(256).
105600       05 Fht-Buffer       pic x(4097).
105700       05 filler           pic x                  value x"FF".
105800 01  Fht-Table-Size        pic s9(5) comp value zero.
105900*
106000 01  Cbl-File-Fields.
106100     03  Cbl-File-name     pic x(256).
```

```
106200     03  Cbl-Access-Mode   pic x          comp-x  value 1.
106300     03  Cbl-Deny-Mode     pic x          comp-x  value 3.
106400     03  Cbl-Device        pic x          comp-x  value zero.
106500     03  Cbl-Flags         pic x          comp-x  value zero.
106600     03  Cbl-File-Handle   pic x(4)               value zero.
106700     03  Cbl-File-OffSet   pic x(8)       comp-x  value zero.
106800*
106900 01  Cbl-File-Details.
107000     03  Cbl-File-Size     pic x(8)       comp-x  value zero.
107100     03  Cbl-File-Date.
107200         05  Cbl-File-Day  pic x          comp-x  value zero.
107300         05  Cbl-File-Mth  pic x          comp-x  value zero.
107400         05  Cbl-File-Year pic x          comp-x  value zero.
107500     03  Cbl-File-time.
107600         05  Cbl-File-Hour pic x          comp-x  value zero.
107700         05  Cbl-File-Min  pic x          comp-x  value zero.
107800         05  Cbl-File-Sec  pic x          comp-x  value zero.
107900         05  Cbl-File-Hund pic x          comp-x  value zero.
...
...
      ******************************************************************
      *
      * zz300, zz400, zz500 & zz600 all relate to copy files/libraries
      *   via the COPY verb
      *  As it is hoped to only use the filename.i via Open-Cobol
      * then this lot can be killed off as well as all the other related
      * code.
      * NOTE that the COPY verb is implemented in a very basic way despite
      *  the fact that this code allows for 99 levels of COPY, eg, there is
      *  NO replacing so hopefully I can remove it all after primary testing
      *  When it is built into cobc
      *
356400 zz300-Open-File.
356500****************
356600* Open a Copy file using CBL-OPEN-File
356700*  filename is using Cbl-File-name
356800*
356900     move     zero to Return-Code.
357000     if       Fht-Table-Size > 99
357100              move 24 to Return-Code
357200              display Msg11
357300              go to zz300-Exit.
357400*
357500* set up New entry in File Table
357600*
357700     add      1 to Fht-Table-Size.
357800     move     Fht-Table-Size to e.
357900     move     zeroes to Fht-File-OffSet (e) Fht-File-Size (e)
358000                        Fht-File-Handle (e) Fht-Block-OffSet (e)
358100                        Fht-CopyRefNo2 (e)  Fht-sw-Eof (e)
358200                        Fht-Copy-Line-End (e) Fht-Copy-Words (e).
358300     move     4096 to   Fht-Byte-Count (e).
358400     move     spaces to Fht-Current-Rec (e).
358500     move     1      to Fht-pointer (e).
358600*
358700     perform  zz400-Check-File-Exists thru zz400-Exit.
358800     if       Return-Code not = zero
358900              subtract 1 from Fht-Table-Size
359000              go to zz300-Exit.
```

```
359100*
359200     move     Fht-Table-Size to e.
359300     move     Cbl-File-Size to Fht-File-Size (e).
359400     move     Cbl-File-name to Fht-File-Name (e).
359500     move     1    to Cbl-Access-Mode
359600                     Cbl-Deny-Mode.
359700     move     zero to Cbl-Device
359800                     Cbl-File-Handle.
359900     move     zero to Return-Code.
360000     call     "CBL_OPEN_FILE" using
360100              Cbl-File-name
360200              Cbl-Access-Mode
360300              Cbl-Deny-Mode
360400              Cbl-Device
360500              Cbl-File-Handle.
360600     if       Return-Code not = zero
360700              display Msg12 cbl-File-name
360800              display "       This should not happen here"
360900              subtract 1 from Fht-Table-Size
361000              go to zz300-exit.
361100*
361200     move     Cbl-File-Handle to Fht-File-Handle (e).
361300     add      1 to Copy-Depth.
361400     move     1 to sw-Copy.
361500     move     zero to Fht-CopyRefNo2 (e)
361600                     Return-Code.
362000 zz300-Exit.
362100     exit.
362200/
362300 zz400-Check-File-Exists.
362400*
362500* check for correct filename and extention taken from COPY verb
362600*
362700*  input : wsFoundNewWord2
362800* Output : Return-Code = 0  : Cbl-File-Details & Cbl-File-name
362900*          Return-Code = 25 : failed fn in wsFoundNewWord2
363000*
363100     move     zero to e.
363200     inspect  wsFoundNewWord2 tallying e for all ".".
363300     if       e not zero
363400              go to zz400-Try1.
363500     perform  varying a from 1 by 1 until Return-Code = zero
363600              move   1 to e
363700              move   spaces to Cbl-File-name
363800              string wsFoundNewWord2 delimited by space
363900                                     into Cbl-File-name pointer e
364000              string File-Ext (a) delimited by size
364100                                     into Cbl-File-name pointer e
364200              move   zero to Return-Code
364300              call   "CBL_CHECK_FILE_EXIST" using
364400                     Cbl-File-name
364500                     Cbl-File-Details
364600              end-call
364700              if   Return-Code not = zero
364800               and a = 7
364900                     exit perform
365000              end-if
365100     end-perform
365200     if       Return-Code not = zero
```

```
365300              display "zz400A Check File exist err=" Return-Code
365400              display Msg13 wsFoundNewWord2
365500              move 25 to Return-Code
365600              go to zz400-Exit.
365700* ok file now found
365900     go       to zz400-Exit.
366000*
366100 zz400-Try1.
366200     move     wsFoundNewWord2 to Cbl-File-name.
366300     move     zero to Return-Code.
366400     call     "CBL_CHECK_FILE_EXIST" using
366500              Cbl-File-name
366600              Cbl-File-Details.
366700     if       Return-Code not = zero
366800              move function lower-case (wsFoundNewWord2) to
366900                    Cbl-File-name
367000              go to zz400-Try2.
367100* ok file now found
367200     go       to zz400-exit.
367300*
367400 zz400-Try2.
367500     move     zero to Return-Code.
367600     call     "CBL_CHECK_FILE_EXIST" using
367700              Cbl-File-name
367800              Cbl-File-Details.
367900     if       Return-Code not = zero
368000              display "zz400C Check File exist err=" Return-Code
368100              display Msg13 wsFoundNewWord2 " or " Cbl-File-name
368200              move 25 to Return-Code
368300              go to zz400-Exit.
368400*
368500* ok file now found
368600*
368700 zz400-Exit.
368800     exit.
368900/
369000 zz500-Close-File.
369100     call     "CBL_CLOSE_FILE" using
369200              Fht-File-Handle (Fht-Table-Size).
369300     if       Return-Code not = zero
369400              display Msg14
369500                      Cbl-File-name.
369800     subtract 1 from Fht-Table-Size.
369900*
370000     if       Fht-Table-Size = zero
370100              move zero to sw-Copy.
370200     subtract 1 from Copy-Depth.
370300     move     zero to Return-Code.
370400     go       to zz500-Exit.
370500*
370600 zz500-Exit.
370700     exit.
370800/
370900 zz600-Read-File.
371000****************
371100* called using file-handle
371200*  returning   CopySourceRecin1  size 160 chars
371300* If buffer enpty read a block
371400*    and regardless, move record terminated by x"0a"
```

```
371500* to Fht-Current-Rec (Fht-Table-Size)
371600*
371700     if       Fht-Eof (Fht-Table-Size)
371800              perform zz500-Close-File
371900              go to zz600-Exit.
372000*
372100     if       Fht-File-OffSet (Fht-Table-Size) = zero
372200         and  Fht-Block-OffSet (Fht-Table-Size) = zero
372300              perform zz600-Read-A-Block
372400              go to zz600-Get-A-Record.
372500*
372600 zz600-Get-A-Record.
372700******************
372800* Now to extract a record from buffer and if needed read a block
372900*         then extract
373000*
373100     move     spaces to Fht-Current-Rec (Fht-Table-Size).
373200     add      1 to Fht-Block-OffSet (Fht-Table-Size) giving g.
373300*
373400* note size is buffer size + 2
373500*
373600     unstring Fht-Buffer (Fht-Table-Size) (1:4097)
373700                delimited by x"0A" or x"FF"
373800                into         Fht-Current-Rec (Fht-Table-Size)
373900                delimiter    Word-Delimit3
374000                pointer      g.
374100*
374200* Get next Block of data ?
374300*
374400     if       Word-Delimit3 = x"FF"
374500          and g not < 4097
374600              add Fht-Block-OffSet (Fht-Table-Size)
374700                                to Fht-File-OffSet (Fht-Table-Size)
374800              perform zz600-Read-A-Block
374900              go to zz600-Get-A-Record.
375000* EOF?
375100     move     1 to Fht-Pointer (Fht-Table-Size).
375200     if       Word-Delimit3 = x"FF"
375300              move 1 to Fht-sw-Eof (Fht-Table-Size)
375400              go to zz600-Exit.
375500* Now so tidy up
375600     subtract 1 from g giving Fht-Block-OffSet (Fht-Table-Size).
375700     go       to zz600-exit.
375800*
375900 zz600-Read-A-Block.
      ******************
376000     move     all x"FF" to Fht-Buffer (Fht-Table-Size).
376100*     if       Fht-File-Size (Fht-Table-Size) < 4096 and not = zero
376200*              move Fht-File-Size (Fht-Table-Size)
376300*                                to Fht-Byte-Count (Fht-Table-Size).
376400     call     "CBL_READ_FILE" using
376500              Fht-File-Handle (Fht-Table-Size)
376600              Fht-File-OffSet (Fht-Table-Size)
376700              Fht-Byte-Count (Fht-Table-Size)
376800              Cbl-Flags
376900              Fht-Buffer (Fht-Table-Size).
377000     if       Return-Code not = zero
377100              display Msg15 Return-Code
377200              go to zz600-Exit.
```

```
377300* just in case all ff does not work
377400     move     x"FF" to Fht-Buffer (Fht-Table-Size) (4097:1).
377500     move     zero to Fht-Block-OffSet (Fht-Table-Size).
377600     subtract Fht-Byte-Count (Fht-Table-Size)
377700                             from Fht-File-Size (Fht-Table-Size).
377800 zz600-Exit.
377900     exit.
```

29.6 4.6 What are the XF4, XF5, and X91 routines?

From opencobol.org

```
The CALL's X"F4", X"F5", X"91" are from MF.
You can find them in the online MF doc under
Library Routines.

F4/F5 are for packing/unpacking bits from/to bytes.
91 is a multi-use call. Implemented are the subfunctions
get/set cobol switches (11, 12) and get number of call params (16).

Roger
```

Use

```
CALL X"F4" USING
               BYTE-VAR
               ARRAY-VAR
           RETURNING STATUS-VAR
```

to pack the last bit of each byte in the 8 byte ARRAY-VAR into corresponding bits of the 1 byte BYTE-VAR.

The X"F5" routine takes the eight bits of byte and moves them to the corresponding occurrence within array.

X"91" is a multi-function routine.

```
CALL X"91" USING
               RESULT-VAR
               FUNCTION-NUM
               PARAMETER-VAR
           RETURNING STATUS-VAR
```

As mentioned by Roger, OpenCOBOL supports FUNCTION-NUM of 11, 12 and 16.

11 and 12 get and set the on off status of the 8 (eight) run-time OpenCOBOL switches definable in the SPECIAL-NAMES paragraph. 16 returns the number of call parameters given to the current module.

29.7 4.7 What is CBL_OC_NANOSLEEP OpenCOBOL library routine?

CBL_OC_NANOSLEEP allows (upto) nanosecond sleep timing. It accepts a 64 bit integer value which may be in character or numeric data forms.

```
CALL "CBL_OC_NANOSLEEP" USING 500000000
                        RETURNING STATUS
END-CALL
```

Would wait one-half second. *It may be easier to grok if the source code uses string catenation; "500" & "000000" for example.*

29.8 4.8 How do you use C$JUSTIFY?

The C$JUSTIFY sub program can centre, or justify strings left or right.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      01-Jul-2008
      *> Purpose:   Demonstrate the usage of OpenCOBOL call library
      *>            C$JUSTIFY, C$TOUPPER, C$TOLOWER
      *> Tectonics: Using OC1.1 post 02-Jul-2008, cobc -x -Wall
      *> History:   02-Jul-2008, updated to remove warnings
      *> ************************************************************
       identification division.
       program-id. justify.

       environment division.
       configuration section.
       source-computer. IBMPC.
       object-computer. IBMPC.

       data division.
       WORKING-STORAGE section.
       01 source-str           pic x(80)
           value "    this is a test of the internal voice communication
      - " system".
       01 just-str             pic x(80).
       01 justification        pic x.
       01 result               pic s9(9) comp-5.

       procedure division.
       move source-str to just-str.

      *> Left justification
       move "L" to justification.
       perform demonstrate-justification.

      *> case change to upper, demonstrate LENGTH verb
       call "C$TOUPPER" using just-str
                        by value function length( just-str )
                        returning result
       end-call.

      *> Centre
       move "C" to justification.
       perform demonstrate-justification.

      *> case change to lower
       call "C$TOLOWER" using just-str
                            by value 80
                        returning result
       end-call.

      *> Right, default if no second argument
       call "C$JUSTIFY" using just-str
                        returning result
       end-call.
       move "R" to justification.
       perform show-justification.
```

```
           exit program.
           stop run.

          *> ************************************************************
           demonstrate-justification.
           call "C$JUSTIFY" using just-str
                                  justification
                            returning result
           end-call
           if result not equal 0 then
               display "Problem: " result end-display
               stop run
           end-if
           perform show-justification
           .

          *> ************************************************************
           show-justification.
           evaluate justification
               when "L"   display "Left justify" end-display
               when "C"   display "Centred (in UPPERCASE)" end-display
               when other display "Right justify" end-display
           end-evaluate
           display "Source:    |" source-str "|" end-display
           display "Justified: |" just-str "|" end-display
           display space end-display
           .
```

Producing:

```
$ ./justify
Left justify
Source:    |    this is a test of the internal voice communication system                  |
Justified: |this is a test of the internal voice communication system                      |

Centred (in UPPERCASE)
Source:    |    this is a test of the internal voice communication system                  |
Justified: |           THIS IS A TEST OF THE INTERNAL VOICE COMMUNICATION SYSTEM           |

Right justify
Source:    |    this is a test of the internal voice communication system                  |
Justified: |                       this is a test of the internal voice communication system|
```

29.9 4.9 What preprocessor directives are supported by OpenCOBOL?

OpenCOBOL 1.1 supports a limited number of **directives**.

- >>D for conditional debug line compilation
- >>SOURCE for changing fixed and free format preprocessing modes
- *> for inline comments, column 1+ in free form, column 7+ in fixed

OpenCOBOL 2.0 supports a much wider subset of standard directives and existent extensions. Some are only recognized and will be ignored with a warning until implemented.

- >>D
- >>SOURCE

- >>DEFINE
- >>DISPLAY
- >>IF
- >>ELSE
- >>ELIF
- >>ELSE-IF
- >>END-IF
- >>SET
- >>LEAP-SECOND
- >>TURN

29.9.1 4.9.1 >>D

Debug line control. OpenCOBOL only compiles these lines if the **-fdebugging-line** command line is used.

29.9.2 4.9.2 >>SOURCE

OpenCOBOL fully supports FREE and FIXED format source. The compiler defaults FIXED form sources, so this directive is usually placed at column 8 or beyond. The command line arguments **-free** and **-fixed** controls the default for the *first line* of source.

See What source formats are accepted by OpenCOBOL? for more details.

29.9.3 4.9.3 >>DEFINE

Define a compile time symbol.

- >>DEFINE identifier AS literal
- >>DEFINE identifier AS literal OVERRIDE
- >>DEFINE identifier OFF
- >>DEFINE identifier PARAMETER
- >>DEFINE identifier CONSTANT
- >>DEFINE identifier working-variable

The -D command line option can be used to define symbols.

29.9.4 4.9.4 >>IF

Conditional compile directive. Will include source lines upto >>END-IF, an >>ELSE-IF or >>ELSE clause if condition is true.

- >>IF identifier DEFINED
- >>IF conditional-expression

29.9.5 4.9.5 >>ELSE-IF

Allows for multiple conditions in a conditional compile sequence.

29.9.6 4.9.6 >>ELIF

Alias for >>ELSE-IF.

29.9.7 4.9.7 >>ELSE

Compiles in source lines upto an >>END-IF if the previous >>IF or >>ELSE-IF conditions test false.

29.9.8 4.9.8 >>END-IF

Terminates a conditional compile block.

29.9.9 4.9.9 >>SET

Allows modification of compiler source text handling behaviour.

- >>SET CONSTANT
- >>SET SOURCEFORMAT
- >>SET FOLDCOPYNAME | FOLD-COPY-NAME
- >>SET NOFOLDCOPYNAME | NOFOLD-COPY-NAME
- >>SET AS
- >>SET literal
- >>SET {SET_PAREN_LIT}
- >>SET working-store-var

29.9.10 4.9.10 >>LEAP-SECOND

Ignored.

29.9.11 4.9.11 >>TURN

Will allow modification of exception code handling, when implemented.

CHAPTER

THIRTY

5 FEATURES AND EXTENSIONS

OpenCOBOL Features

OpenCOBOL Features

30.1 5.1 How do I use OpenCOBOL for CGI?

OpenCOBOL is more than capable of being a web server backend tool.

- One of the tricks is assigning an input stream to KEYBOARD when you need to get at POST data.
- Another is using the ACCEPT var FROM ENVIRONMENT feature.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      ******************************************************************
      * Author:    Brian Tiffin, Francois Hiniger
      * Date:      30-Aug-2008
      * Purpose:   Display the CGI environment space
      * Tectonics: cobc -x cgienv.cob
      *   Move cgienv to the cgi-bin directory as cgienv.cgi
      *   browse http://localhost/cgi-bin/cgienv.cgi or cgienvform.html
      ******************************************************************
       identification division.
       program-id. cgienv.

       environment division.
       input-output section.
       file-control.
           select webinput assign to KEYBOARD.

       data division.
       file section.
       fd webinput.
          01 postchunk       pic x(1024).

       working-storage section.
       78 name-count      value 34.
       01 newline         pic x   value x'0a'.
       01 name-index      pic 99 usage comp-5.
       01 value-string    pic x(256).
       01 environment-names.
          02 name-strings.
             03 filler    pic x(20) value 'AUTH_TYPE'.
             03 filler    pic x(20) value 'CONTENT_LENGTH'.
             03 filler    pic x(20) value 'CONTENT_TYPE'.
             03 filler    pic x(20) value 'DOCUMENT_ROOT'.
             03 filler    pic x(20) value 'GATEWAY_INTERFACE'.
             03 filler    pic x(20) value 'HTTP_ACCEPT'.
             03 filler    pic x(20) value 'HTTP_ACCEPT_CHARSET'.
             03 filler    pic x(20) value 'HTTP_ACCEPT_ENCODING'.
             03 filler    pic x(20) value 'HTTP_ACCEPT_LANGUAGE'.
             03 filler    pic x(20) value 'HTTP_COOKIE'.
             03 filler    pic x(20) value 'HTTP_CONNECTION'.
             03 filler    pic x(20) value 'HTTP_HOST'.
             03 filler    pic x(20) value 'HTTP_REFERER'.
             03 filler    pic x(20) value 'HTTP_USER_AGENT'.
             03 filler    pic x(20) value 'LIB_PATH'.
             03 filler    pic x(20) value 'PATH'.
             03 filler    pic x(20) value 'PATH_INFO'.
             03 filler    pic x(20) value 'PATH_TRANSLATED'.
             03 filler    pic x(20) value 'QUERY_STRING'.
```

```
           03 filler     pic x(20) value 'REMOTE_ADDR'.
           03 filler     pic x(20) value 'REMOTE_HOST'.
           03 filler     pic x(20) value 'REMOTE_IDENT'.
           03 filler     pic x(20) value 'REMOTE_PORT'.
           03 filler     pic x(20) value 'REQUEST_METHOD'.
           03 filler     pic x(20) value 'REQUEST_URI'.
           03 filler     pic x(20) value 'SCRIPT_FILENAME'.
           03 filler     pic x(20) value 'SCRIPT_NAME'.
           03 filler     pic x(20) value 'SERVER_ADDR'.
           03 filler     pic x(20) value 'SERVER_ADMIN'.
           03 filler     pic x(20) value 'SERVER_NAME'.
           03 filler     pic x(20) value 'SERVER_PORT'.
           03 filler     pic x(20) value 'SERVER_PROTOCOL'.
           03 filler     pic x(20) value 'SERVER_SIGNATURE'.
           03 filler     pic x(20) value 'SERVER_SOFTWARE'.
       02 filler redefines name-strings.
           03 name-string   pic x(20) occurs name-count times.

       procedure division.

      * Always send out the Content-type before any other IO

       display
           "Content-type: text/html"
           newline
       end-display.
       display
           "<html><body>"
       end-display.
       display
           "<h3>CGI environment with OpenCOBOL</h3>"
       end-display.
       display
           '<a href="/cgienvform.html">To cgienvform.html</a>'
           "<p><table>"
       end-display.
      * Accept and display some of the known CGI environment values
       perform varying name-index from 1 by 1
           until name-index > name-count
               accept value-string from environment
                   name-string(name-index)
               end-accept
               display
                   "<tr><td>"
                   name-string(name-index)
                   ": </td><td>"
                   function trim (value-string trailing)
                   "</td></tr>"
               end-display
               if (name-string(name-index) = "REQUEST_METHOD")
                  and (value-string = "POST")
                       open input webinput
                       read webinput
                           at end move spaces to postchunk
                       end-read
                       close webinput
                       display
                           '<tr><td align="right">'
                           "First chunk of POST:</td><td>"
```

```
                        postchunk(1:72)
                        "</td></tr>"
                    end-display
                end-if
        end-perform.
        display "</table></p></body></html>" end-display.
COOL    goback.
```

Once compiled and placed in an appropriate cgi-bin directory of your web server, a simple form can be used to try the example.

cgienvform.html

```
<html><head><title>OpenCOBOL sample CGI form</title></head>
<body>
<h3>OpenCOBOL sample CGI form</h3>
<form action="http://localhost/cgi-bin/cgienv.cgi" method="post">
    <p>
    Text: <input type="text" name="text"><br>
    Password: <input type="password" name="password"><br>
    Checkbox: <input type="checkbox" name="checkbox"><br>
    <input type="radio" name="radio" value="ONE"> One<br>
    <input type="radio" name="radio" value="TWO"> Two<br>
    <input type="submit" value="Send"> <input type="reset">
    </p>
</form>
</body>
</html>
```

30.1.1 5.1.1 AJAX

From a post on opencobol.org by DamonH:

```
As promised, here is the html for AJAX to use the cgenv.cgi example from the FAQ.
You need not change anything with the cobol code.
```

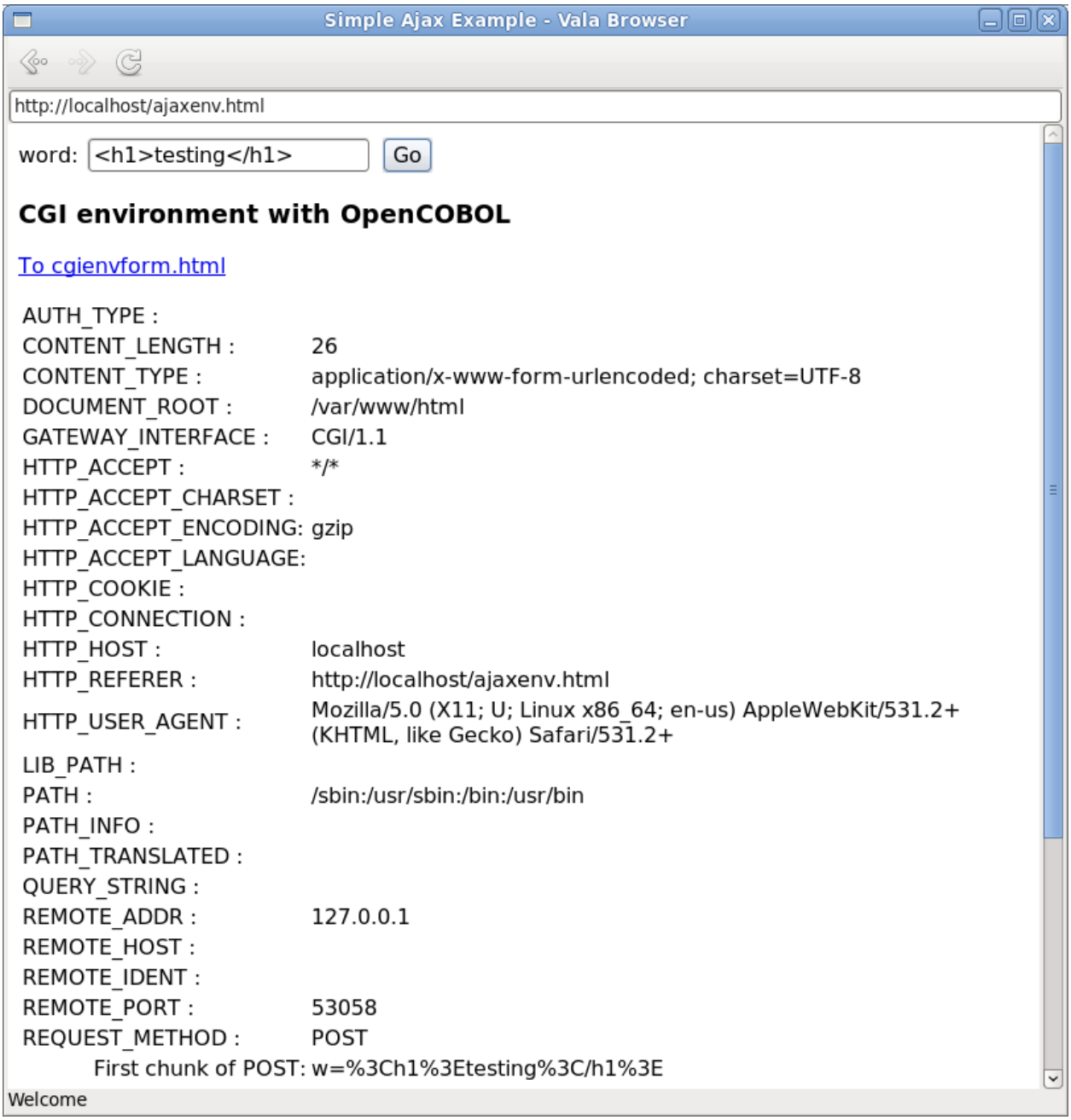
ajax.html

```
<html>
<head>
<title>Simple Ajax Example</title>
<script language="Javascript">
function xmlhttpPost(strURL) {
    var xmlHttpReq = false;
    var self = this;
    // Mozilla/Safari
    if (window.XMLHttpRequest) {
        self.xmlHttpReq = new XMLHttpRequest();
    }
    // IE
    else if (window.ActiveXObject) {
        self.xmlHttpReq = new ActiveXObject("Microsoft.XMLHTTP");
    }
    self.xmlHttpReq.open('POST', strURL, true);
    self.xmlHttpReq.setRequestHeader('Content-Type', 'application/x-www-form-urlencoded');
    self.xmlHttpReq.onreadystatechange = function() {
        if (self.xmlHttpReq.readyState == 4) {
            updatepage(self.xmlHttpReq.responseText);
        }
    }
    self.xmlHttpReq.send(getquerystring());
```

```
}

function getquerystring() {
    var form     = document.forms['f1'];
    var word = form.word.value;
    qstr = 'w=' + escape(word);  // NOTE: no '?' before querystring
    return qstr;
}

function updatepage(str){
    document.getElementById("result").innerHTML = str;
}
</script>
</head>
<body>
<form name="f1">
  <p>word: <input name="word" type="text">
  <input value="Go" type="button" onclick='javascript:xmlhttpPost("/cgi-bin/cgienv.cgi")'></p>
  <div id="result"></div>
</form>
</body>
</html>
```

A quick screenshot from the Vala WebKit called from OpenCOBOL sample. *To be clear, this is a screenshot of an OpenCOBOL application that includes an embedded brower, displaying AJAX invoked OpenCOBOL CGI binaries (installed on the host without superuser access).* Take this one step further, and the browser application could utilize libSOUP and be its own webserver.

Sometimes, just wow. Ok, feel the need for marketing speak. "Moving beyond COBOL? Why? Move COBOL beyond."



For those developers looking to serve OpenCOBOL applications on hosted systems and no super user privileges, see How do I use LD_RUN_PATH with OpenCOBOL? for some pointers on local library linkage.

30.2 5.2 What is ocdoc?

ocdoc is a small utility used to annotate sample programs and to support generation of Usage Documentation using COBOL sourced ReStructuredText extract lines.

ocdoc.cob

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
```

```
*><* ====================
*><* ocdoc.cob usage guide
*><* ====================
*><* .. sidebar:: Table of Contents
*><*
*><*     .. contents:: :local:
*><*
*><* :Author:    Brian Tiffin
*><* :Date:      30-Sep-2008
*><* :Rights:    Copyright (c) 2008, Brian Tiffin.
*><*              GNU FDL License.
*><* :Purpose:   Extract usage document lines from COBOL sources.
*><*              Using OpenCOBOL 1.1pr.  OpenCOBOL is tasty.
*><* :Tectonics: cobc -x ocdoc.cob
*><* :Docgen:    $ ./ocdoc ocdoc.cob ocdoc.rst ocdoc.html skin.css
*> ************************************************************
*><*
*><* ------------
*><* Command line
*><* ------------
*><* *ocdoc* runs in two forms.
*><*
*><* Without arguments, *ocdoc* will act as a pipe filter.
*><* Reading from standard in and writing the extract to standard
*><+  out.
*><*
*><* The *ocdoc* command also takes an input file, an extract
*><+  filename, an optional result file (with optional
*><+  stylesheet) and a verbosity option *-v* or a
*><+  special *-fixed* flag (to force skipping sequence numbers).
*><* If a result file is given, ocdoc will automatically
*><* run an *rst2html* command using the SYSTEM service.
*><*
*><* Due to an overly simplistic argument handler, you can only
*><+  turn on verbosity or -fixed when using all four filenames.
*><*
*><* Examples::
*><*
*><*   $ cat ocdoc.cob | ocdoc >ocdoc.rst
*><*   $ ./ocdoc ocdoc.cob ocdoc.rst
*><*   $ ./ocdoc ocdoc.cob ocdoc.rst
*><+  ocdoc.html skin.css -fixed
*><*   ...
*><*   Input  : ocdoc.cob
*><*   Output : ocdoc.rst
*><*   Command: rst2html --stylesheet=skin.css
*><+  ocdoc.rst ocdoc.html
*><*
*><* -----------------
*><* What is extracted
*><* -----------------
*><* - Lines that begin with \*><\* *ignoring spaces*, are
*><+  extracted.
*><*
*><* - Lines that begin with \*><+ are appended to the
*><+  previous output line.  As lines are trimmed of trailing
*><+  spaces, and *ocdoc* removes the space following the
*><+  extract triggers, you may need two spaces after an
*><+  ocdoc append.
```

```
*><*
*><* - Lines that begin with \*><[ begin a here document
*><+  with lines that follow extracted as is.
*><*
*><* - Lines that begin with \*><] close a here document.
*><+  Here document start and end lines are excluded from the
*><+  extract.
*><*
*><* -----------
*><* Source code
*><* -----------
*><* `Download ocdoc.cob
*><+  <http://opencobol.add1tocobol.com/ocdoc.cob>`_
*><* `See ocdocseq.cob
*><+  <http://opencobol.add1tocobol.com/ocdocseq.html>`_
*><*
*><! This is not extracted. Reminder of how to include source
*><! .. include:: ocdoc.cob
*><!    :literal:
*><*
*><* ----------------------
*><* identification division
*><* ----------------------
*><*
*><* ::
*><*
*><[
 identification division.
 program-id. OCDOC.

 environment division.
 input-output section.
 file-control.
     select standard-input assign to KEYBOARD.
     select standard-output assign to DISPLAY.

     select source-input
     assign to source-name
     organization is line sequential
     .
     select doc-output
     assign to doc-name
     organization is line sequential
     .
*><]
*><*
*><* -------------
*><* data division
*><* -------------
*><*
*><* ::
*><*
*><[
 data division.
 file section.
 fd standard-input.
    01 stdin-record      pic x(256).
 fd standard-output.
    01 stdout-record     pic x(256).
```

```
 fd source-input.
    01 source-record     pic x(256).
 fd doc-output.
    01 doc-record        pic x(256).

 working-storage section.
 01 arguments            pic x(256).
 01 source-name          pic x(256).
 01 doc-name             pic x(256).
 01 result-name          pic x(256).
 01 style-name           pic x(256).
 01 verbosity            pic x(9).
    88 verbose           values "-v" "--v" "-verbose" "--verbose".
    88 skipseqnum        values "-fix" "-fixed" "--fix" "--fixed".
 01 usagehelp            pic x(6).
    88 helping           values "-h" "--h" "-help" "--help".
 01 filter-flag          pic x value low-value.
    88 filtering         value high-value.

 01 line-count           usage binary-long.
 01 line-display         pic z(8)9.

*><]
*><*
*><* Note the conditional test for end of here doc
*><*
*><* ::
*><*
*><[
 01 trimmed              pic x(256).
    88 herestart         value "*><[".
    88 hereend           value "*><]".

 01 hereflag             pic x value low-value.
    88 heredoc           value high-value.
    88 herenone          value low-value.

*><]
*><*
*><* Note the here-record adds an ocdoc extract to lines that
*><+  follow.
*><*
*><* ::
*><*
*><[
 01 here-record.
    02 filler            pic x(5) value "*><* ".
    02 here-data         pic x(251).

 01 seq-record.
    02 filler            pic x(7) value "       ".
    02 seq-data          pic x(249).

 01 doc-buffer           pic x(256).
 01 buffer-offset        pic 999 usage comp-5 value 1.
 01 buffer-flag          pic x value low-value.
    88 buffer-empty      value low-value.
    88 buffered-output   value high-value.
```

```
 01 counter              pic 999 usage comp-5.
 01 len-of-comment       pic 999 usage comp-5.

 01 first-part           pic x(8).
    88 special           values "*><*" "*><+".
    88 autodoc           value "*><*".
    88 autoappend        value "*><+".

 01 rst-command          pic x(256).
 01 result               usage binary-long.
*><]
*><*
*><* ------------------
*><* procedure division
*><* ------------------
*><*
*><* ::
*><*
*><[
*> ***************************************************************
 procedure division.

*><]
*><*
*><* Accept command line arguments.  See if help requested.
*><*
*><* ::
*><*
*><[
 accept arguments from command-line end-accept

 move arguments to usagehelp
 if helping
     display
         "$ ./ocdoc source markover [output [skin [--fixed]]]"
     end-display
     display "$ ./ocdoc" end-display
     display
         "    without arguments extracts stdin to stdout"
     end-display
     goback
 end-if

*><]
*><*
*><* Either run as filter or open given files.  Two filenames
*><+  will generate an extract.  Three will run the extract
*><+  through *rst2html* using an optional fourth filename
*><+  as a stylesheet.
*><*
*><* ::
*><*
*><[
*> Determine if this is running as a filter
 if arguments not equal spaces
     unstring arguments delimited by all spaces
         into source-name doc-name
              result-name style-name
```

```
                verbosity
    end-unstring

    open input source-input
    open output doc-output
else
    set filtering to true

    open input standard-input
    open output standard-output
end-if

*><]
*><*
*><* Initialize the output buffer, and line count.
*><*
*><* ::
*><*
*><[
set buffer-empty to true
move 1 to buffer-offset
move spaces to doc-record
move 0 to line-count

*><]
*><*
*><* The read is either from file or stdin.  Start with the
*><+  first record.
*><*
*><* ::
*><*
*><[
*> filtering requires different reader loop
if filtering
    read standard-input
        at end move high-values to stdin-record
    end-read
    move stdin-record to source-record
else
    read source-input
        at end move high-values to source-record
    end-read
end-if

*><]
*><*
*><* The main loop starts here, having done a pre-read to start
*><+  things off.
*><*
*><* ::
*><*
*><[
perform until source-record = high-values
    add 1 to line-count

*><]
*><*
*><* Small wrinkle if processing fixed form with sequence numbers,
*><+  as the heredoc end marker needs to be recognized
```

```
*><+  but we still want the sequence numbers in the heredoc.
*><*
*><* So files processed --fixed play some data shuffling games.
*><*
*><* ::
*><*
*><[
     if skipseqnum
         if heredoc
             move source-record(7 : 248) to trimmed
             move source-record to seq-data
             move seq-record to source-record
         else
             move source-record(7 : 248) to source-record
             move source-record to trimmed
         end-if
     else
         move function trim(source-record leading) to trimmed
     end-if

*><]
*><*
*><* First to check for here doc start and end, setting flag
*><+  if trimmed conditional the heredoc start or heredoc end
*><+  strings.
*><*
*><* ::
*><*
*><[
     if herestart
         set heredoc to true
     end-if

     if hereend
         set herenone to true
     end-if

*><]
*><*
*><* Inside the loop, we skip over heredoc entries.
*><+  If it is normal, than check for heredoc and include
*><+  source lines that follow, by prepending the extract tag
*><*
*><* ::
*><*
*><[
     if (not herestart) and (not hereend)
         if heredoc
             move source-record to here-data
             move here-record to trimmed
         end-if

*><]
*><*
*><* Unstring the line, looking for special tags in the first
*><+  part.
*><*
*><* ::
*><*
```

```
*><[
         unstring trimmed delimited by all spaces
             into first-part
                 count in counter
         end-unstring

*><]
*><*
*><* If special, we either buffer or append to buffer
*><*
*><* ::
*><*
*><[
         evaluate true when special
             if autoappend and buffer-empty
                 move spaces to doc-record
                 move 1 to buffer-offset
             end-if

             if autodoc and buffered-output
                 if filtering
                     move doc-record to stdout-record
                     write stdout-record end-write
                 else
                     write doc-record end-write
                 end-if
                 if verbose
                     display
                         function trim(doc-record trailing)
                     end-display
                 end-if
                 move spaces to doc-record
                 set buffer-empty to true
                 move 1 to buffer-offset
             end-if

*><]
*><*
*><* Skip over where the tag was found plus an extra space.
*><* Adding 2 skips over the assumed space after a special tag
*><*
*><* ::
*><*
*><[
             add 2 to counter
             compute len-of-comment =
                 function length(trimmed) - counter
             end-compute

             if len-of-comment > 0
                 move trimmed(counter : len-of-comment)
                     to doc-buffer
             else
                 move spaces to doc-buffer
             end-if

*><]
*><*
*><* Buffer the line, either to position 1 or appending to last.
```

```
*><*
*><* ::
*><*
*><[
                string
                    function trim(doc-buffer trailing)
                        delimited by size
                    into doc-record
                    with pointer buffer-offset
                    on overflow
                        move line-count to line-display
                        display
                            "*** truncation *** reading line "
                            line-display
                        end-display
                end-string
                set buffered-output to true
            end-evaluate
        end-if

*><]
*><*
*><* Again, we either read the next record from file or stdin.
*><*
*><* ::
*><*
*><[
        if filtering
            read standard-input
                at end move high-values to stdin-record
            end-read
            move stdin-record to source-record
        else
            read source-input
                at end move high-values to source-record
            end-read
        end-if
    end-perform

*><]
*><*
*><* We may or may not end up with buffered data
*><*
*><* ::
*><*
*><[
    if buffered-output
        set buffer-empty to true
        move 1 to buffer-offset
        if filtering
            move doc-record to stdout-record
            write stdout-record end-write
        else
            write doc-record end-write
        end-if
        if verbose
             display
                function trim(doc-record trailing)
             end-display
```

```
            end-if
            move spaces to doc-record
        end-if

       *><]
       *><*
       *><* Close the OpenCOBOL files
       *><*
       *><* ::
       *><*
       *><[
        if filtering
            close standard-output
            close standard-input
        else
            close doc-output
            close source-input
        end-if

        if verbose
            display "Input  : " function trim(source-name) end-display
            display "Output : " function trim(doc-name) end-display
        end-if

       *><]
       *><*
       *><* If we have a result file, use the SYSTEM service to
       *><+  generate an HTML file, possibly with stylesheet.
       *><*
       *><* ::
       *><*
       *><[
       *> pass the extract through a markover, in this case ReST
        move spaces to rst-command
        if result-name not equal spaces
            if style-name equal spaces
                string
                    "rst2html " delimited by size
                    doc-name delimited by space
                    " " delimited by size
                    result-name delimited by space
                    into rst-command
                end-string
            else
                string
                    "rst2html --stylesheet=" delimited by size
                    style-name delimited by space
                    " " delimited by size
                    doc-name delimited by space
                    " " delimited by size
                    result-name delimited by space
                    into rst-command
                end-string
            end-if

            if verbose
                display
                    "Command: "
                    function trim(rst-command trailing)
```

```
            end-display
        end-if

        call "SYSTEM"
            using rst-command
            returning result
        end-call

        if result not equal zero
            display "HTML generate failed: " result end-display
        end-if
    end-if

*><]
*><*
*><* And before you know it, we are done.
*><*
*><* ::
*><*
*><[
    goback.

    end program OCDOC.
*><]
*><*
*><* Don't forget to visit http://opencobol.org
*><*
*><* Cheers
*><*
*><* *Last edit:* 03-Oct-2008
```

30.2.1 5.2.1 ocdoc generated ocdoc documentation

See ocdoc.html for the output from processing *ocdoc.cob* with **ocdoc** using the tectonics listed in the source. skin.css ends up embedded in the html.

```
$ cobc -x ocdoc.cob
$ ./ocdoc ocdoc.cob ocdoc.rst ocdoc.html skin.css
```

30.3 5.3 What is CBL_OC_DUMP?

CBL_OC_DUMP is somewhat of a community challenge application to allow for runtime data dumps. Multiple postings to opencobol.org has refined the hex display callable to:

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *-----------------------------------------------------------------
      * Authors:   Brian Tiffin, Asger Kjelstrup, human
      * Date:      27-Jan-2010
      * Purpose:   Hex Dump display
      * Tectonics: cobc -c CBL_OC_DUMP.cob
      *     Usage: cobc -x program.cob -o CBL_OC_DUMP
      *            export OC_DUMP_EXT=1 for explanatory text on dumps
      *            (memory address and dump length)
      *            export OC_DUMP_EXT=Y for extended explanatory text
      *            (architecture   and endian-order)
      *-----------------------------------------------------------------
       identification division.
```

```
 program-id. CBL_OC_DUMP.
*
 ENVIRONMENT      DIVISION.
 CONFIGURATION    SECTION.
*
 data division.
 working-storage section.
 77  addr                           usage pointer.
 77  addr2addr                      usage pointer.
 77  counter              pic 999999 usage comp-5.
 77  byline               pic 999    usage comp-5.
 77  offset               pic 999999.
 01  some                 pic 999    usage comp-5.
     88 some-is-printable-iso88591
        values 32 thru 126, 160 thru 255.
     88 some-is-printable-ebcdic
        values 64, 65, 74 thru 80, 90 thru 97,
               106 thru 111, 121 thru 127, 129 thru 137, 143,
               145 thru 153, 159, 161 thru 169, 176,
               186 thru 188, 192 thru 201, 208 thru 217, 224,
               226 thru 233, 240 thru 249.
 77  high-var             pic 99     usage comp-5.
 77  low-var              pic 99     usage comp-5.
*
 01  char-set             pic x(06).
     88 is-ascii          value 'ASCII'.
     88 is-ebdic          value 'EBCDIC'.
     88 is-unknown        value '?'.
 01  architecture         pic x(06).
     88 is-32-bit         value '32-bit'.
     88 is-64-bit         value '64-bit'.
 01  endian-order         pic x(10).
     88 is-big-endian-no   value 'Little-Big'.
     88 is-big-endian-yes  value 'Big-Little'.
*
 77  hex-line             pic x(48).
 77  hex-line-pointer     pic 9(02) value 1.
*
 77  show                 pic x(16).
 77  dots                 pic x value '.'.
 77  dump-dots            pic x.
*
 77  hex-digit            pic x(16)  value '0123456789abcdef'.
 01  extended-infos       pic x.
     88 show-extended-infos      values '1', '2', 'Y', 'y'.
     88 show-very-extended-infos values '2', 'Y', 'y'.
*
 77  len                  pic 999999 usage comp-5.
 77  len-display          pic 999999.
*
 linkage section.
 01  buffer               pic x       any length.
 77  byte                 pic x.
*-----------------------------------------------------------------
 procedure division using buffer.
*
 MAIN SECTION.
 00.
     perform starting-address
```

```
*
     perform varying counter from 0 by 16
             until   counter  >=   len
        move counter to offset
        move spaces  to hex-line, show
        move '-'     to hex-line (24:01)
        move 1       to hex-line-pointer
        perform varying byline from 1 by 1
                until   byline  >  16
           if (counter + byline) > len
              if byline < 9
                 move space to hex-line (24:01)
              end-if
              inspect show (byline:) replacing all spaces by dots
              exit perform
           else
              move buffer (counter + byline : 1) to byte
              perform calc-hex-value
              if ((some-is-printable-iso88591 and is-ascii) or
                  (some-is-printable-ebcdic   and is-ebdic)   )
                 move byte to show (byline:1)
              else
                 move dots to show (byline:1)
              end-if
           end-if
        end-perform
        display offset '  ' hex-line '  ' show
        end-display
     end-perform
     display ' '
     end-display
*
     continue.
 ex. exit program.
*-----------------------------------------------------------------
 CALC-HEX-VALUE SECTION.
 00.
     subtract 1 from function ord(byte) giving some
     end-subtract
     divide   some by 16 giving high-var remainder low-var
     end-divide
     string hex-digit (high-var + 1:1)
            hex-digit (low-var  + 1:1)
            space
            delimited by size
            into hex-line
            with pointer hex-line-pointer
     end-string
*
     continue.
 ex. exit.
*-----------------------------------------------------------------
 STARTING-ADDRESS SECTION.
 00.
* Get the length of the transmitted buffer
     CALL 'C$PARAMSIZE' USING 1
        GIVING len
     END-CALL
* If wanted, change the dots to something different than points
```

```
      accept dump-dots from environment 'OC_DUMP_DOTS'
        not on exception
            move dump-dots to dots
      end-accept
*
      perform TEST-ASCII
      perform TEST-ENDIAN
      set addr      to address of buffer
      set addr2addr to address of addr
*
      if len > 0
* To show hex-address, reverse if Big-Little Endian
         if is-big-endian-yes
            set addr2addr up   by LENGTH OF addr
            set addr2addr down by 1
         end-if
         move 1 to hex-line-pointer
         perform varying byline from 1 by 1
                 until byline > LENGTH OF addr
            set address of byte to addr2addr
            perform calc-hex-value
            if is-big-endian-yes
               set addr2addr down by 1
            else
               set addr2addr up   by 1
            end-if
         end-perform
      end-if
*
* Get and display characteristics and headline
      accept extended-infos from environment 'OC_DUMP_EXT'
      end-accept
      if show-extended-infos
         display ' '
         end-display
         if len > 0
            end-display
            display 'Dump of memory beginning at Hex-address: '
                     hex-line (1 : 3 * (byline - 1) )
            end-display
         end-if
         move len to len-display
         display 'Length of memory dump is: ' len-display
         end-display
         if show-very-extended-infos
            perform TEST-64bit
            display 'Program runs in '
                    architecture ' architecture. '
                    'Char-set is '
                    function trim (char-set) '.'
            end-display
            display 'Byte order is ' endian-order
                    ' endian.'
            end-display
         end-if
      end-if
*
* Do we have anything to dump?
      if len > 0
```

```
* Ensure that the passed size is not too big
        if len > 999998
           move 999998 to len, len-display
           display 'Warning, only the first '
                   len-display  ' Bytes are shown!'
           end-display
        end-if
        display ' '
        end-display
        display 'Offset  '
                'HEX-- -- -- -5 -- -- -- -- 10 '
                '-- -- -- -- 15 -- '
                '  '
                'CHARS----1----5-'
        end-display
     else
        display ' '
        end-display
        display 'Nothing to dump.'
        end-display
     end-if
*
     continue.
 ex. exit.
*-----------------------------------------------------------------
 TEST-ASCII SECTION.
*Function: Discover if running Ascii or Ebcdic
 00.
     evaluate space
        when x'20'
           set  is-ascii   to true
        when x'40'
           set  is-ebdic   to true
        when other
           set  is-unknown to true
     end-evaluate
*
     continue.
 ex. exit.
*-----------------------------------------------------------------
 TEST-64BIT SECTION.
*Function: Discover if running 32/64 bit
 00.
*    Longer pointers in 64-bit architecture
     if function length (addr) <= 4
        set  is-32-bit to true
     else
        set  is-64-bit to true
     end-if
*
     continue.
 ex. exit.
*-----------------------------------------------------------------
 TEST-ENDIAN SECTION.
 00.
*    Number-bytes are shuffled in Big-Little endian
     move 128 to byline
     set address of byte to address of byline
     if function ord(byte) > 0
```

```
            set  is-big-endian-yes to true
         else
            set  is-big-endian-no  to true
         end-if
      *
         continue.
       ex. exit.
      *-----------------------------------------------------------------
       end program CBL_OC_DUMP.
```

Example displays:

```
Alpha literal Dump

Offs  HEX-- -- -- 5- -- -- -- -- 10 -- -- -- -- 15 -- CHARS----1----5-
0000  61 62 63 64 65 66 67 68 69 6a 6b 6c 6d 6f 70 71 abcdefghijklmopq
0016  72                                             r...............

Integer Dump: +0000000123

Offs  HEX-- -- -- 5- -- -- -- -- 10 -- -- -- -- 15 -- CHARS----1----5-
0000  7b 00 00 00                                    {...............
```

Or with OC_DUMP_EXT enviroment variable set to Y:

```
Numeric Literal Dump: 0

Dump of memory beginning at Hex-address: bf 80 fc e4
Program runs in 32-bit architecture. Char-set is ASCII .
Byte order is Big-Little endian.

Offs  HEX-- -- -- 5- -- -- -- -- 10 -- -- -- -- 15 -- CHARS----1----5-
0000  00                                             ................
```

30.3.1 5.3.1 Update to OC_CBL_DUMP

human posted a new version that displays the dump upon SYSERR. Goes to show the activity that can spring forth from a keen and engaged community.

Edit 19-Oct-2010: Put all dump-outputs to syserr. Removed unused paragraphs and minor beauty changes.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *-----------------------------------------------------------------
      * Authors:   Brian Tiffin, Asger Kjelstrup, Simon Sobisch
      * Date:      19-Oct-2010
      * Purpose:   Hex Dump display
      * Tectonics: cobc -c CBL_OC_DUMP.cob
      *     Usage: export OC_DUMP_EXT=1 for explanatory text on dumps
      *            (memory address and dump length)
      *            export OC_DUMP_EXT=Y for extended explanatory text
      *            (architecture   and endian-order)
      *-----------------------------------------------------------------
       IDENTIFICATION DIVISION.
       PROGRAM-ID. CBL_OC_DUMP.
      *
       ENVIRONMENT      DIVISION.
       CONFIGURATION    SECTION.
      *
       DATA DIVISION.
       WORKING-STORAGE SECTION.
       77  addr                              usage pointer.
```

```
 77  addr2addr                       usage pointer.
 77  counter              pic 999999 usage comp-5.
 77  byline               pic 999    usage comp-5.
 77  offset               pic 999999.
 01  some                 pic 999    usage comp-5.
     88 some-is-printable-iso88591
        values 32 thru 126, 160 thru 255.
     88 some-is-printable-ebcdic
        values 64, 65, 74 thru 80, 90 thru 97,
               106 thru 111, 121 thru 127, 129 thru 137, 143,
               145 thru 153, 159, 161 thru 169, 176,
               186 thru 188, 192 thru 201, 208 thru 217, 224,
               226 thru 233, 240 thru 249.
 77  high-var             pic 99     usage comp-5.
 77  low-var              pic 99     usage comp-5.
*
 01  char-set             pic x(06).
     88 is-ascii          value 'ASCII'.
     88 is-ebdic          value 'EBCDIC'.
     88 is-unknown        value '?'.
 01  architecture         pic x(06).
     88 is-32-bit         value '32-bit'.
     88 is-64-bit         value '64-bit'.
 01  endian-order         pic x(10).
     88 is-big-endian-no  value 'Little-Big'.
     88 is-big-endian-yes value 'Big-Little'.
*
 77  hex-line             pic x(48).
 77  hex-line-pointer     pic 9(02) value 1.
*
 77  show                 pic x(16).
 77  dots                 pic x value '.'.
 77  dump-dots            pic x.
*
 77  hex-digit            pic x(16)  value '0123456789abcdef'.
 01  extended-infos       pic x.
     88 show-extended-infos      values '1', '2', 'Y', 'y'.
     88 show-very-extended-infos values '2', 'Y', 'y'.
*
 77  len                  pic 999999 usage comp-5.
 77  len-display          pic 999999.
*
 LINKAGE SECTION.
 01  buffer               pic x       any length.
 77  byte                 pic x.
*-----------------------------------------------------------------
 PROCEDURE DIVISION USING buffer.
*
*MAIN SECTION.
*00.
     perform starting-address
*
     perform varying counter from 0 by 16
             until   counter  >=   len
        move counter to offset
        move spaces  to hex-line, show
        move '-'     to hex-line (24:01)
        move 1       to hex-line-pointer
        perform varying byline from 1 by 1
```

```
                until   byline  >  16
            if (counter + byline) > len
               if byline < 9
                  move space to hex-line (24:01)
               end-if
               inspect show (byline:) replacing all spaces by dots
               exit perform
            else
               move buffer (counter + byline : 1) to byte
               perform calc-hex-value
               if ((some-is-printable-iso88591 and is-ascii) or
                    (some-is-printable-ebcdic   and is-ebdic)   )
                  move byte to show (byline:1)
               else
                  move dots to show (byline:1)
               end-if
            end-if
         end-perform
         display offset '  ' hex-line '  ' show
                 upon SYSERR
         end-display
      end-perform
      display ' '
              upon SYSERR
      end-display
*
      exit program.
*-----------------------------------------------------------------
 CALC-HEX-VALUE SECTION.
*00.
      subtract 1 from function ord(byte) giving some
      end-subtract
      divide   some by 16 giving high-var remainder low-var
      end-divide
      string hex-digit (high-var + 1:1)
             hex-digit (low-var  + 1:1)
             space
             delimited by size
             into hex-line
             with pointer hex-line-pointer
      end-string
*
      exit section.
*-----------------------------------------------------------------
 STARTING-ADDRESS SECTION.
*00.
* Get the length of the transmitted buffer
      CALL 'C$PARAMSIZE' USING 1
         GIVING len
      END-CALL
* If wanted, change the dots to something different than points
      accept dump-dots from environment 'OC_DUMP_DOTS'
        not on exception
            move dump-dots to dots
      end-accept
*
      perform TEST-ASCII
      perform TEST-ENDIAN
      set addr      to address of buffer
```

```
           set addr2addr to address of addr
      *
           if len > 0
      * To show hex-address, reverse if Big-Little Endian
              if is-big-endian-yes
                 set addr2addr up   by LENGTH OF addr
                 set addr2addr down by 1
              end-if
              move 1 to hex-line-pointer
              perform varying byline from 1 by 1
                      until byline > LENGTH OF addr
                 set address of byte to addr2addr
                 perform calc-hex-value
                 if is-big-endian-yes
                    set addr2addr down by 1
                 else
                    set addr2addr up   by 1
                 end-if
              end-perform
           end-if
      *
      * Get and display characteristics and headline
           accept extended-infos from environment 'OC_DUMP_EXT'
           end-accept
           if show-extended-infos
              display ' '
                      upon SYSERR
              end-display
              if len > 0
                 display 'Dump of memory beginning at Hex-address: '
                          hex-line (1 : 3 * (byline - 1) )
                          upon SYSERR
                 end-display
              end-if
              move len to len-display
              display 'Length of memory dump is: ' len-display
                       upon SYSERR
              end-display
              if show-very-extended-infos
                 perform TEST-64bit
                 display 'Program runs in '
                         architecture ' architecture. '
                         'Char-set is '
                         function trim (char-set) '.'
                         upon SYSERR
                 end-display
                 display 'Byte order is ' endian-order
                         ' endian.'
                         upon SYSERR
                 end-display
              end-if
           end-if
      *
      * Do we have anything to dump?
           if len > 0
      * Ensure that the passed size is not too big
              if len > 999998
                 move 999998 to len, len-display
                 display 'Warning, only the first '
```

```
                    len-display  ' Bytes are shown!'
                    upon SYSERR
              end-display
           end-if
           display ' '
                   upon SYSERR
           end-display
           display 'Offset  '
                   'HEX-- -- -- -5 -- -- -- -- 10 '
                   '-- -- -- -- 15 -- '
                   '  '
                   'CHARS----1----5-'
                   upon SYSERR
           end-display
        else
           display ' '
                   upon SYSERR
           end-display
           display 'Nothing to dump.'
                   upon SYSERR
           end-display
        end-if
*
        exit section.
*-----------------------------------------------------------------
 TEST-ASCII SECTION.
*Function: Discover if running Ascii or Ebcdic
*00.
        evaluate space
           when x'20'
              set  is-ascii   to true
           when x'40'
              set  is-ebdic   to true
           when other
              set  is-unknown to true
        end-evaluate
*
        exit section.
*-----------------------------------------------------------------
 TEST-64BIT SECTION.
*Function: Discover if running 32/64 bit
*00.
*    Longer pointers in 64-bit architecture
        if function length (addr) <= 4
           set  is-32-bit to true
        else
           set  is-64-bit to true
        end-if
*
        exit section.
*-----------------------------------------------------------------
 TEST-ENDIAN SECTION.
*00.
*    Number-bytes are shuffled in Big-Little endian
        move 128 to byline
        set  address of byte to address of byline
        if function ord(byte) > 0
           set  is-big-endian-yes to true
        else
```

```
           set  is-big-endian-no  to true
       end-if
*
       exit section.
*-----------------------------------------------------------------*
 end program CBL_OC_DUMP.
```

30.4 5.4 Does OpenCOBOL support any SQL databases?

Yes. There are embedded SQL engines for OpenCOBOL and PostgreSQL, Oracle, and Firebird.

30.4.1 5.4.1 OCESQL

Brought to us by the developers behind the Open Source COBOL Consortium in Japan. It may require a pass through Google Translate, but see

http://www.osscons.jp/osscobol/download/

and look to **DB interface tool (Open COBOL ESQL) v1.0.0**

Coded for `./configure; make; make check && sudo make install`

Will require PostgreSQL as well as the development headers.

While you on the site, you may want to look at the UTF-8 and SJIS character set versions of the OpenCOBOL compiler.

30.4.2 5.4.2 Firebird gpre

The good folk at IBPheonix have modified the Firebird `gpre` COBOL preprocessor slightly and it now integrates well with OpenCOBOL. The Firebird database has been in use in production (orginally as InterBase) since 1981. Firebird started with a fork of the open source InterBase 6.0. Instructions on getting the COBOL `gpre` command to link with embedded Firebird is documented at http://www.ibphoenix.com/resources/documents/how_to/doc_382

30.4.3 5.4.3 Oracle

Oracle's **procob** preprocessor generates code that can be compiled with OpenCOBOL

- as reported on opencobol.org the **procob 10.2 Oracle** preprocessor produces code that compiles and executes just fine with OpenCOBOL 1.1 See note about data sizes and the *binary-size:* configuration below.

30.4.4 5.4.4 Other SQL engines

Along with the OpenCOBOL specific `ocesql` pre processor, `procob` and `gpre`, there are are *at least* two usable CALL extensions. There are currently *(February 2013)* quite a few active developments for easing SQL engine access.

- There are workable prototypes for SQLite at ocshell.c
  - with a sample usage program at sqlscreen.cob
  - and supporting documentation at sqlscreen.html
- The SQLite extension comes in two flavours; a shell mode discussed above and a direct API interface housed at ocsqlite.c

- A libdbi (generic database access) extension is also available. See cobdbi for full details.
- Efforts toward providing a preprocessor for EXEC are underway.
- Jim Currey's team has kindly posted an ease-of-use MySQL preprocessing layer.
  - http://svn.wp0.org/add1/libraries/mysql4Windows4OpenCobol/
- Rumours of a potential Postgres layer have also been heard.
  - Not a rumour anymore. Work on a nicely complete PostgreSQL binding was posted by gchudyk to
  - http://www.opencobol.org/modules/newbb/viewtopic.php?topic_id=868&forum=1&post_id=4142
- **AND** as a *thing to watch for*, one of the good people of the OpenCOBOL communinity has written a layer that converts READ and WRITE verbage to SQL calls *at run time*. More on this as it progresses.

30.4.5 5.4.5 Oracle procob and binary data sizes

Details of the configuration setting for proper Oracle procob processing.

From Angus on opencobol.org

```
Hi

I had some trouble with Oracle procob 10.2 and OpenCobol 1.1 with std=mf.
For PIC S9(2) COMP, procob seems to use 2 bytes, and OpenCobol only one.
It doesn't work well. It comes from the parameter binary-size in the
mf.conf, which seems to tell to opencobol the larger of comp type
I modify to binary-size: 2-4-8 and it works (same as the mvs.conf)
Our application works with Microfocus / Oracle, and microfocus use 2 bytes,
like Oracle. Perhaps because we have the mvs toggle

Except for this thing, opencobol and oracle work like a charm,
on a debian 32bit.

Regards,
Angus
```

30.4.6 5.4.6 Direct PostgreSQL Sample

Nowhere near as complete as the binding that Gerald later posted to opencobol.org, the example below was a starting point.

See http://www.opencobol.org/modules/newbb/viewtopic.php?topic_id=868&forum=1#forumpost4142

Note that the PostgreSQL runtime library is **libpq**, *ending in q not g*.

```
OCOBOL*> *************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20091129
      *> Purpose:   PostgreSQL connection test
      *> Tectonics: cobc -x -lpq pgcob.cob
      *> *************************************************************
       identification division.
       program-id. pgcob.

       data division.
       working-storage section.
       01 pgconn usage pointer.
       01 pgres  usage pointer.
```

```
 01 resptr usage pointer.
 01 resstr pic x(80) based.
 01 result usage binary-long.
 01 answer pic x(80).

*> ************************************************************
 procedure division.
 display "Before connect:" pgconn end-display

 call "PQconnectdb" using
     by reference "dbname = postgres" & x"00"
     returning pgconn
 end-call
 display "After connect: " pgconn end-display

 call "PQstatus" using by value pgconn returning result end-call
 display "Status:         " result end-display

 call "PQuser" using by value pgconn returning resptr end-call

 set address of resstr to resptr
 string resstr delimited by x"00" into answer end-string
 display "User:           " function trim(answer) end-display

 display "call PQexec" end-display
 call "PQexec" using
     by value pgconn
     by reference "select version();" & x"00"
     returning pgres
 end-call
 display pgres end-display

*> Pull out a result. row 0, field 0 <*
 call "PQgetvalue" using
     by value pgres
     by value 0
     by value 0
     returning resptr
 end-call
 set address of resstr to resptr
 string resstr delimited by x"00" into answer end-string
 display "Version:        " answer end-display

 call "PQfinish" using by value pgconn returning null end-call
 display "After finish:   " pgconn end-display

 call "PQstatus" using by value pgconn returning result end-call
 display "Status:         " result end-display

*> this will now return garbage  <*
 call "PQuser" using by value pgconn returning resptr end-call
 set address of resstr to resptr
 string resstr delimited by x"00" into answer end-string
 display "User after:     " function trim(answer) end-display

 goback.
 end program pgcob.
```

Run from a user account that has default PostgreSQL credentials:

```
$ cobc -x -lpq pgcob.cob
$ ./pgcob
Before connect:0x00000000
After connect: 0x086713e8
Status:        +0000000000
User:          brian
call PQexec
0x08671a28
Version:       PostgreSQL 8.3.7 on i486-pc-linux-gnu, compiled by GCC gcc-4.3.real (Debian 4.3.
After finish:  0x086713e8
Status:        +0000000001
User after:    PostgreSQL 8.3.7 on i486-pc-linux-gnu, compiled by GCC gcc-4.3.real (Debian 4.3.
```

Note that *User after* is not the valid answer, shown on purpose. The connection had been closed and the status was correctly reported as non-zero, being an error, but this example continued through as a demonstration.

30.5 5.5 Does OpenCOBOL support ISAM?

Yes. The official release used Berkeley DB, but there are also experimental configurations of the compiler that use VBISAM, CISAM, DISAM or other external handlers. See What are the configure options available for building OpenCOBOL? for more details about these options. The rest of this entry assumes the default Berkeley database.

ISAM is an acronymn for Indexed Sequential Access Method.

OpenCOBOL has fairly full support of all standard specified ISAM compile and runtime semantics.

For example

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *><* ================
      *><* indexing example
      *><* ================
      *><* :Author:    Brian Tiffin
      *><* :Date:      17-Feb-2009
      *><* :Purpose:   Fun with Indexed IO routines
      *><* :Tectonics: cobc -x indexing.cob
      *> ************************************************************
       identification division.
       program-id. indexing.

       environment division.
       configuration section.

       input-output section.
       file-control.
          select optional indexing
          assign to "indexing.dat"
          organization is indexed
          access mode is dynamic
          record key is keyfield of indexing-record
          alternate record key is splitkey of indexing-record
              with duplicates
          .

      *> ** OpenCOBOL does not yet support split keys **
      *>  alternate record key is newkey
      *>      source is first-part of indexing-record
      *>                last-part of indexing-record
```

```
*>      with duplicates

 data division.
 file section.
 fd indexing.
 01 indexing-record.
    03 keyfield          pic x(8).
    03 splitkey.
       05 first-part     pic 99.
       05 middle-part    pic x.
       05 last-part      pic 99.
    03 data-part         pic x(54).

 working-storage section.
 01 display-record.
    03 filler            pic x(4)  value spaces.
    03 keyfield          pic x(8).
    03 filler            pic xx    value spaces.
    03 splitkey.
       05 first-part     pic z9.
       05 filler         pic x     value space.
       05 middle-part    pic x.
       05 filler         pic xx    value all "+".
       05 last-part      pic z9.
    03 filler            pic x(4)  value all "-".
    03 data-part         pic x(54).

*> control break
 01 oldkey               pic 99x99.

*> In a real app this should well be two separate flags
 01 control-flag         pic x.
    88 no-more-duplicates          value high-value
       when set to false is              low-value.
    88 no-more-records             value high-value
       when set to false is              low-value.

*> *************************************************************
 procedure division.

*> Open optional index file for read write
 open i-o indexing

*> populate a sample database
 move "1234567800a01some 12345678 data here" to indexing-record
 perform write-indexing-record
 move "8765432100a01some 87654321 data here" to indexing-record
 perform write-indexing-record
 move "1234876500a01some 12348765 data here" to indexing-record
 perform write-indexing-record
 move "8765123400a01some 87651234 data here" to indexing-record
 perform write-indexing-record

 move "1234567900b02some 12345679 data here" to indexing-record
 perform write-indexing-record
 move "9765432100b02some 97654321 data here" to indexing-record
 perform write-indexing-record
 move "1234976500b02some 12349765 data here" to indexing-record
 perform write-indexing-record
```

```
 move "9765123400b02some 97651234 data here" to indexing-record
 perform write-indexing-record

 move "1234568900c13some 12345689 data here" to indexing-record
 perform write-indexing-record
 move "9865432100c13some 98654321 data here" to indexing-record
 perform write-indexing-record
 move "1234986500c13some 12349865 data here" to indexing-record
 perform write-indexing-record
 move "9865123400c13some 98651234 data here" to indexing-record
 perform write-indexing-record

*> close it ... not necessary, but for the example
 close indexing

*> clear the record space for this example
 move spaces to indexing-record

*> open the data file again
 open i-o indexing

*> read all the duplicate 00b02 keys
 move 00 to first-part of indexing-record
 move "b" to middle-part of indexing-record
 move 02 to last-part of indexing-record

*> using read key and then next key / last key compare
 set no-more-duplicates to false
 perform read-indexing-record
 perform read-next-record
     until no-more-duplicates

*> read by key of reference ... the cool stuff
 move 00 to first-part of indexing-record
 move "a" to middle-part of indexing-record
 move 02 to last-part of indexing-record

*> using start and read next
 set no-more-records to false
 perform start-at-key
 perform read-next-by-key
     until no-more-records

*> read by primary key of reference
 move "87654321" to keyfield of indexing-record

*>
 set no-more-records to false
 perform start-prime-key
 perform read-previous-by-key
     until no-more-records

*> and with that we are done with indexing sample
 close indexing

 goback.
*> ****************************************************************

*><* Write paragraph
```

```
 write-indexing-record.
   write indexing-record
       invalid key
           display
               "rewrite key: " keyfield of indexing-record
           end-display
             rewrite indexing-record
                 invalid key
                     display
                         "really bad key: "
                         keyfield of indexing-record
                     end-display
             end-rewrite
   end-write
 .

*><* read by alternate key paragraph
 read-indexing-record.
     display "Reading: " splitkey of indexing-record end-display
     read indexing key is splitkey of indexing-record
   invalid key
       display
          "bad read key: " splitkey of indexing-record
       end-display
         set no-more-duplicates to true
     end-read
 .

*><* read next sequential paragraph
 read-next-record.
     move corresponding indexing-record to display-record
     display display-record end-display
     move splitkey of indexing-record to oldkey

     read indexing next record
         at end set no-more-duplicates to true
         not at end
             if oldkey not equal splitkey of indexing-record
                 set no-more-duplicates to true
             end-if
     end-read
 .

*><* start primary key of reference paragraph
 start-prime-key.
     display "Prime < " keyfield of indexing-record end-display
     start indexing
        key is less than
            keyfield of indexing-record
        invalid key
            display
                "bad start: " keyfield of indexing-record
            end-display
            set no-more-records to true
        not invalid key
            read indexing previous record
                at end set no-more-records to true
            end-read
     end-start
```

```
       .

      *><* read previous by key of reference paragraph
       read-previous-by-key.
           move corresponding indexing-record to display-record
           display display-record end-display

           read indexing previous record
               at end set no-more-records to true
           end-read
       .
      *><* start alternate key of reference paragraph
       start-at-key.
           display "Seeking >= " splitkey of indexing-record end-display
           start indexing
              key is greater than or equal to
                  splitkey of indexing-record
              invalid key
                  display
                      "bad start: " splitkey of indexing-record
                  end-display
                  set no-more-records to true
              not invalid key
                  read indexing next record
                      at end set no-more-records to true
                  end-read
           end-start
       .

      *><* read next by key of reference paragraph
       read-next-by-key.
           move corresponding indexing-record to display-record
           display display-record end-display

           read indexing next record
               at end set no-more-records to true
           end-read
       .
       end program indexing.
      *><*
      *><* Last Update: 20090220
```

which outputs:

```
Reading: 00b02
    12345679   0 b++ 2----some 12345679 data here
    97654321   0 b++ 2----some 97654321 data here
    12349765   0 b++ 2----some 12349765 data here
    97651234   0 b++ 2----some 97651234 data here
    12345679   0 b++ 2----some 12345679 data here
    97654321   0 b++ 2----some 97654321 data here
    12349765   0 b++ 2----some 12349765 data here
    97651234   0 b++ 2----some 97651234 data here
    12345679   0 b++ 2----some 12345679 data here
    97654321   0 b++ 2----some 97654321 data here
    12349765   0 b++ 2----some 12349765 data here
    97651234   0 b++ 2----some 97651234 data here
Seeking >= 00a02
    12345679   0 b++ 2----some 12345679 data here
    97654321   0 b++ 2----some 97654321 data here
```

```
    12349765   0 b++ 2----some 12349765 data here
    97651234   0 b++ 2----some 97651234 data here
    12345679   0 b++ 2----some 12345679 data here
    97654321   0 b++ 2----some 97654321 data here
    12349765   0 b++ 2----some 12349765 data here
    97651234   0 b++ 2----some 97651234 data here
    12345679   0 b++ 2----some 12345679 data here
    97654321   0 b++ 2----some 97654321 data here
    12349765   0 b++ 2----some 12349765 data here
    97651234   0 b++ 2----some 97651234 data here
    12345689   0 c++13----some 12345689 data here
    98654321   0 c++13----some 98654321 data here
    12349865   0 c++13----some 12349865 data here
    98651234   0 c++13----some 98651234 data here
    12345689   0 c++13----some 12345689 data here
    98654321   0 c++13----some 98654321 data here
    12349865   0 c++13----some 12349865 data here
    98651234   0 c++13----some 98651234 data here
    12345689   0 c++13----some 12345689 data here
    98654321   0 c++13----some 98654321 data here
    12349865   0 c++13----some 12349865 data here
    98651234   0 c++13----some 98651234 data here
Prime < 87654321
    87651234   0 a++ 1----some 87651234 data here
    12349865   0 c++13----some 12349865 data here
    12349765   0 b++ 2----some 12349765 data here
    12348765   0 a++ 1----some 12348765 data here
    12345689   0 c++13----some 12345689 data here
    12345679   0 b++ 2----some 12345679 data here
    12345678   0 a++ 1----some 12345678 data here
```

on any first runs, where **indexing.dat** does not exist. Subsequent runs have the same output with:

```
rewrite key: 12345678
rewrite key: 87654321
rewrite key: 12348765
rewrite key: 87651234
rewrite key: 12345679
rewrite key: 97654321
rewrite key: 12349765
rewrite key: 97651234
rewrite key: 12345689
rewrite key: 98654321
rewrite key: 12349865
rewrite key: 98651234
```

prepended, as the WRITE INVALID KEY clause triggers a REWRITE to allow overwriting key and data.

30.5.1 5.5.1 FILE STATUS

Historically, the condition of a COBOL I/O operation is set in an identifier specified in a *FILE STATUS IS* clause.

John Ellis did us the favour of codifying the OpenCOBOL FILE STATUS codes See ISAM for the details.

30.6 5.6 Does OpenCOBOL support modules?

Yes. Quite nicely in fact. Dynamically! COBOL modules, and object files of many other languages are linkable. As OpenCOBOL uses intermediate C, linkage to other languages is well supported across many platforms. The OpenCOBOL CALL instruction maps COBOL USAGE to many common C stack frame data representations.

Multipart, complex system development is well integrated in the OpenCOBOL model.

```
$ cobc -b hello.cob goodbye.cob
```

Combines both source files into a single dynamically loadable module. Example produces **hello.so**.

Using the **-l** link library option, OpenCOBOL has access to most shared libraries supported on its platforms.

```
$ cobc -x -lcurl showcurl.cob
```

Will link the /usr/lib/libcurl.so (*from the cURL project*) to showcurl. The OpenCOBOL CALL verb will use this linked library to resolve calls at runtime.

Large scale systems are at the heart of COBOL development and OpenCOBOL is no exception.

For more information, see What is COB_PRE_LOAD?.

30.7 5.7 What is COB_PRE_LOAD?

COB_PRE_LOAD is an environment variable that controls what dynamic link modules are included in a run.

For example:

```
$ cobc occurl.c
$ cobc occgi.c
$ cobc -x myprog.cob
$ export COB_PRE_LOAD=occurl:occgi
$ ./myprog
```

That will allow the OpenCOBOL runtime link resolver to find the entry point for CALL "CBL_OC_CURL_INIT" in the occurl.so module. *Note:* the modules listed in the COB_PRE_LOAD environment variable DO NOT have extensions. OpenCOBOL will do the right thing on the various platforms.

If the DSO files are not in the current working directory along with the executable, the COB_LIBRARY_PATH can be set to find them.

See What is COB_LIBRARY_PATH? for information on setting the module search path.

30.8 5.8 What is the OpenCOBOL LINKAGE SECTION for?

Argument passing in COBOL is normally accomplished through the **LINKAGE SECTION**. This section does not allocate or initialize memory as would definitions in the WORKING-STORAGE SECTION.

Care must be taken to inform COBOL of the actual source address of these variables before use. Influences CHAINING and USING phrases. See CALL for more details.

30.9 5.9 What does the -fstatic-linkage OpenCOBOL compiler option do?

Under normal conditions, the *LINKAGE SECTION* is unallocated and uninitialized. When a LINKAGE SECTION variable, that is not part of the *USING* phrase (not a named calling argument), any memory that has been addressed becomes unaddressable across calls. *-fstatic-linkage* creates static addressing to the LINKAGE SECTION.

From [Roger]:

```
This relates to LINKAGE items that are NOT referred
to in the USING phrase of the PROCEDURE DIVISION.
It also only has relevance when the program is CALL'ed
from another prog.
This means that the addressability of these items must
be programmed (usually with SET ADDRESS) before reference.

Per default, the item loses its addressability on exit
from the program. This option causes the module to retain
the item's address between CALL invocations of the program.
```

With some rumours that this may become the default in future releases of OpenCOBOL, and the *-fstatic-linkage* option may be deprecated.

30.10 5.10 Does OpenCOBOL support Message Queues?

Yes, but not out of the box. A linkable POSIX message queue layer is available.

```
/* OpenCOBOL access to POSIX Message Queues                */
/* Author: Brian Tiffin                                    */
/* Date:   August, 2008                                    */
/* Build:  gcc -c ocmq.c                                   */
/* Usage:  cobc -x -lrt program.cob ocmq.o                 */

#include <fcntl.h>          /* For O_* constants */
#include <sys/stat.h>       /* For mode constants */
#include <errno.h>          /* Access to error values */
#include <mqueue.h>         /* The message queues */
#include <signal.h>         /* for notification */
#include <time.h>           /* for the timed versions */
#include <stdio.h>
#include <string.h>         /* For strerror */

#include <libcob.h>         /* for cob_resolve */

/* Forward declarations */
static void ocmq_handler(int, siginfo_t *, void *);
static void (*MQHANDLER)(int *mqid);

/* Return C runtime global errno */
int ERRORNUMBER() {
    return errno;
}

/* Load a COBOL field with an error string */
int ERRORSTRING(char *errbuff, int buflen) {
    void *temperr;

    temperr = strerror(errno);
    memcpy((void *)errbuff, temperr, buflen);
    return strlen(temperr);
}

/*

/* Open Message Queue */
```

```
int MQOPEN(char *mqname, int oflags) {
    mqd_t mqres;

    errno = 0;
    mqres = mq_open(mqname, oflags);
    return (int)mqres;
}

/* Creating a queue requires two extra arguments, permissions and attributes */
int MQCREATE(char *mqname, int oflags, int perms, char *mqattr) {
    mqd_t mqres;

    errno = 0;
    mqres = mq_open(mqname, oflags, (mode_t)perms, (struct mq_attr *)mqattr);
    return (int)mqres;
}

/* Get current queue attributes */
int MQGETATTR(int mqid, char *mqattr) {
    mqd_t mqres;

    errno = 0;
    mqres = mq_getattr((mqd_t)mqid, (struct mq_attr *)mqattr);
    return (int)mqres;
}

/* Set current queue attributes */
/*   only accepts mqflags of 0 or MQO-NONBLOCK once created */
int MQSETATTR(int mqid, char *mqattr, char *oldattr) {
    mqd_t mqres;

    errno = 0;
    mqres = mq_setattr((mqd_t)mqid, (struct mq_attr *)mqattr, (struct mq_attr *)oldattr);
    return (int)mqres;
}

/* Send a message to the queue */
int MQSEND(int mqid, char *message, int length, unsigned int mqprio) {
    mqd_t mqres;

    errno = 0;
    mqres = mq_send((mqd_t)mqid, message, (size_t)length, mqprio);
    return (int)mqres;
}

/* Read the highest priority message */
int MQRECEIVE(int mqid, char *msgbuf, int buflen, int *retprio) {
    ssize_t retlen;

    errno = 0;
    retlen = mq_receive((mqd_t)mqid, msgbuf, buflen, retprio);
    return (int)retlen;
}

/* Timeout send */
int MQTIMEDSEND(int mqid, char *message, int length, unsigned int mqprio, int secs, long nanos) {

    mqd_t mqres;
    struct timespec mqtimer;
```

```
    struct timeval curtime;

    /* Expect seconds and nanos to wait, not absolute.  Add the OpenCOBOL values */
    gettimeofday(&curtime, NULL);
    mqtimer.tv_sec = curtime.tv_sec + (time_t)secs;
    mqtimer.tv_nsec = nanos;

    errno = 0;
    mqres = mq_timedsend((mqd_t)mqid, message, (size_t)length, mqprio, &mqtimer);
    return (int)mqres;
}

/* Read the highest priority message */
int MQTIMEDRECEIVE(int mqid, char *msgbuf, int buflen, int *retprio, int secs, long nanos) {
    ssize_t retlen;
    struct timespec mqtimer;

    struct timeval curtime;

    /* Expect seconds and nanos to wait, not absolute.  Add the OpenCOBOL values */
    gettimeofday(&curtime, NULL);
    mqtimer.tv_sec = curtime.tv_sec + (time_t)secs;
    mqtimer.tv_nsec = nanos;

    errno = 0;
    retlen = mq_timedreceive((mqd_t)mqid, msgbuf, buflen, retprio, &mqtimer);
    return (int)retlen;
}


/* Notify of new message written to queue */
int MQNOTIFY(int mqid, char *procedure) {
    struct sigevent ocsigevent;
    struct sigaction ocsigaction;

    /* Install signal handler for the notify signal - fill in a
     * sigaction structure and pass it to sigaction(). Because the
     * handler needs the siginfo structure as an argument, the
     * SA_SIGINFO flag is set in sa_flags.
     */
    ocsigaction.sa_sigaction = ocmq_handler;
    ocsigaction.sa_flags = SA_SIGINFO;
    sigemptyset(&ocsigaction.sa_mask);

    if (sigaction(SIGUSR1, &ocsigaction, NULL) == -1) {
        fprintf(stderr, "%s\n", "Error posting sigaction");
        return -1;
    }

    /* Set up notification: fill in a sigevent structure and pass it
     * to mq_notify(). The queue ID is passed as an argument to the
     * signal handler.
     */
    ocsigevent.sigev_signo      = SIGUSR1;
    ocsigevent.sigev_notify     = SIGEV_SIGNAL;
    ocsigevent.sigev_value.sival_int = (int)mqid;

    if (mq_notify((mqd_t)mqid, &ocsigevent) == -1) {
        fprintf(stderr, "%s\n", "Error posting notify");
```

```
        return -1;
    }
    return 0;
}

/* Close a queue */
int MQCLOSE(int mqid) {
    mqd_t mqres;

    errno = 0;
    mqres = mq_close((mqd_t)mqid);
    return (int)mqres;
}

/* Unlink a queue */
int MQUNLINK(char *mqname) {
    mqd_t mqres;

    errno = 0;
    mqres = mq_unlink(mqname);
    return (int)mqres;
}

/* The signal handling section */
/* signal number */
/* signal information */
/* context unused (required by posix) */
static void ocmq_handler(int sig, siginfo_t *pInfo, void *pSigContext) {
    struct sigevent ocnotify;
    mqd_t mqid;

    /* Get the ID of the message queue out of the siginfo structure.     */
    mqid = (mqd_t) pInfo->si_value.sival_int;

    /* The MQPROCESSOR is a hardcoded OpenCOBOL resolvable module name */
    /*   It must accept an mqd_t pointer  */
    cob_init(0, NULL);
    MQHANDLER = cob_resolve("MQPROCESSOR");
    if (MQHANDLER == NULL) {
        /* What to do here? */
        fprintf(stderr, "%s\n", "Error resolving MQPROCESSOR");
        return;
    }

    /* Request notification again; it resets each time a notification
     * signal goes out.
     */
    ocnotify.sigev_signo = pInfo->si_signo;
    ocnotify.sigev_value = pInfo->si_value;
    ocnotify.sigev_notify = SIGEV_SIGNAL;

    if (mq_notify(mqid, &ocnotify) == -1) {
        /* What to do here? */
        fprintf(stderr, "%s\n", "Error posting notify");
        return;
    }

    /* Call the cobol module with the message queue id */
    MQHANDLER(&mqid);
```

```
    return;
}
/**/
```

With a sample of usage. Note the linkage of the rt.so realtime library.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      ******************************************************************
      * Author:    Brian Tiffin
      * Date:      August 2008
      * Purpose:   Demonstration of OpenCOBOL message queues
      * Tectonics: gcc -c ocmq.c
      *            cobc -Wall -x -lrt mqsample.cob ocmq.o
      ******************************************************************
       identification division.
       program-id. mqsample.

       data division.
       working-storage section.
      * Constants for the Open Flags
       01 MQO-RDONLY           constant as 0.
       01 MQO-WRONLY           constant as 1.
       01 MQO-RDWR             constant as 2.
       01 MQO-CREAT            constant as 64.
       01 MQO-EXCL             constant as 128.
       01 MQO-NONBLOCK         constant as 2048.
      * Constants for the protection/permission bits
       01 MQS-IREAD            constant as 256.
       01 MQS-IWRITE           constant as 128.

      * Need a better way of displaying newlines
       01 newline              pic x value x'0a'.

      * Message Queues return an ID, maps to int
       01 mqid                 usage binary-long.
       01 mqres                usage binary-long.
      * Queue names end up in an mqueue virtual filesystem on GNU/Linux
       01 mqname.
          02 name-display      pic x(5) value "/ocmq".
          02 filler            pic x value x'00'.
       01 mqopenflags          usage binary-long.
       01 mqpermissions        usage binary-long.

       01 default-message      pic x(20) value 'OpenCOBOL is awesome'.
       01 user-message         pic x(80).
       01 send-length          usage binary-long.

       01 urgent-message       pic x(20) value 'Urgent OpenCOBOL msg'.

      * Data members for access to C global errno and error strings
       01 errnumber            usage binary-long.
       01 errstr               pic x(256).
      * legend to use with the error reporting
       01 operation            pic x(7).

       01 loopy                pic 9.

      * Debian GNU/Linux defaults to Message Queue entry limit of 8K
       01 msgbuf               pic x(8192).
       01 msglen               usage binary-long value 8192.
```

```
* Priorities range from 0 to 31 on many systems, can be more
 01 msgprio              usage binary-long.
* MQ attributes.  See /usr/include/bits/mqueue.h
 01 mqattr.
    03 mqflags           usage binary-long.
    03 mqmaxmsg          usage binary-long.
    03 mqmsgsize         usage binary-long.
    03 mqcurmsqs         usage binary-long.
    03 filler            usage binary-long occurs 4 times.
 01 oldattr.
    03 mqflags           usage binary-long.
    03 mqmaxmsg          usage binary-long.
    03 mqmsgsize         usage binary-long.
    03 mqcurmsqs         usage binary-long.
    03 filler            usage binary-long occurs 4 times.

 procedure division.
* The ocmq API support MQCREATE and MQOPEN.
* This example uses non blocking, non exclusive create
*   read/write by owner and default attributes
 compute
     mqopenflags = MQO-RDWR + MQO-CREAT + MQO-NONBLOCK
 end-compute.
 compute
     mqpermissions = MQS-IREAD + MQS-IWRITE
 end-compute.

* Sample shows the two types of open, but only evaluates create
 if zero = zero
 call "MQCREATE" using mqname
                       by value mqopenflags
                       by value mqpermissions
                       by value 0
                  returning mqid
 end-call
 else
 call "MQOPEN" using mqname
                     by value mqopenflags
                  returning mqid
 end-call
 end-if.
 move "create" to operation.
 perform show-error.

* Show the attributes after initial create
 perform show-attributes.

* Register notification
 call "MQNOTIFY" using by value mqid
                       mqname
                       returning mqres
 end-call.
 move "notify" to operation.
 perform show-error.

* Create a temporary queue, will be removed on close
* call "MQUNLINK" using mqname
*                 returning mqres
* end-call.
```

```
      * move "unlink" to operation.
      * perform show-error.

      * Use the command line arguments or a default message
       accept user-message from command-line end-accept.
       if user-message equal spaces
           move default-message to user-message
       end-if.
       move function length
            (function trim(user-message trailing))
           to send-length.

      * Queue up an urgent message (priority 31)
       call "MQSEND" using by value mqid
                           by reference urgent-message
                           by value 20
                           by value 31
       end-call.
       move "send-31" to operation.
       perform show-error.

      * Queue up a low priority message (1)
       call "MQSEND" using by value mqid
                           by reference user-message
                           by value send-length
                           by value 1
                      returning mqres
       end-call.
       move "send-1" to operation.
       perform show-error.

      * Queue up a middle priority message (16)
       inspect urgent-message
           replacing leading "Urgent" by "Middle".
       call "MQSEND" using by value mqid
                           by reference urgent-message
                           by value 20
                           by value 16
                      returning mqres
       end-call.
       move "send-16" to operation.
       perform show-error.

      * Redisplay the queue attributes
       perform show-attributes.

      * Pull highest priority message off queue
       call "MQRECEIVE" using by value mqid
                              by reference msgbuf
                              by value msglen
                              by reference msgprio
                         returning mqres
       end-call.
       display
           newline "receive len: " mqres " prio: " msgprio
       end-display.
       if mqres > 0
           display
               "priority 31 message: " msgbuf(1:mqres)
```

```
            end-display
        end-if.
        move "receive" to operation.
        perform show-error.

      * Pull the middling priority message off queue
        call "MQRECEIVE" using by value mqid
                               by reference msgbuf
                               by value msglen
                               by reference msgprio
                         returning mqres
        end-call.
        display
            newline "receive len: " mqres " prio: " msgprio
        end-display.
        if mqres > 0
            display
                "priority 16 message: " msgbuf(1:mqres)
            end-display
        end-if.
        move "receive" to operation.
        perform show-error.

      * ** INTENTIONAL ERROR msglen param too small **
      * Pull message off queue
        call "MQRECEIVE" using by value mqid
                               by reference msgbuf
                               by value 1024
                               by reference msgprio
                         returning mqres
        end-call.
        display
            newline "receive len: " mqres " prio: " msgprio
        end-display.
        if mqres > 0
            display
                "no message: " msgbuf(1:mqres)
            end-display
        end-if.
        move "receive" to operation.
        perform show-error.

      * Pull the low priority message off queue, in blocking mode
        move MQO-NONBLOCK to mqflags of mqattr.
        call "MQSETATTR" using by value mqid
                               by reference mqattr
                               by reference oldattr
                         returning mqres
        end-call
        move "setattr" to operation.
        perform show-error.
        perform show-attributes.

        call "MQRECEIVE" using by value mqid
                               by reference msgbuf
                               by value msglen
                               by reference msgprio
                         returning mqres
        end-call.
```

```
display
    newline "receive len: " mqres " prio: " msgprio
end-display.
if mqres > 0
    display
        "priority 1 message: " msgbuf(1:mqres)
    end-display
end-if.
move "receive" to operation.
perform show-error.

perform varying loopy from 1 by 1
    until loopy > 5
        display "Sleeper call " loopy end-display
        call "CBL_OC_NANOSLEEP" using 50000000000
                                returning mqres
        end-call
end-perform.

* Close the queue.  As it is set unlinked, it will be removed
call "MQCLOSE" using by value mqid
               returning mqres
end-call.
move "close" to operation.
perform show-error.

* Create a temporary queue, will be removed on close
call "MQUNLINK" using mqname
                returning mqres
end-call.
move "unlink" to operation.
perform show-error.

goback.

*****************************************************************
* Information display of the Message Queue attributes.
show-attributes.
call "MQGETATTR" using by value mqid
                       by reference mqattr
                 returning mqres
end-call
move "getattr" to operation.
perform show-error.

* Display the message queue attributes
display
    name-display " attributes:"       newline
    "flags:    " mqflags   of mqattr  newline
    "max msg:  " mqmaxmsg  of mqattr  newline
    "mqs size: " mqmsgsize of mqattr  newline
    "cur msgs: " mqcurmsqs of mqattr
end-display
.

* The C global errno error display paragraph
show-error.
    call "ERRORNUMBER" returning mqres end-call
    if mqres > 0
```

```
            display
                operation " errno: " mqres
            end-display
            call "ERRORSTRING" using errstr
                                     by value length errstr
                                returning mqres end-call
            if mqres > 0
                display
                    "     strerror: " errstr(1:mqres)
                end-display
            end-if
        end-if
    .
    end program mqsample.

    ******************************************************************
    * Author:    Brian Tiffin
    * Date:      August 2008
    * Purpose:   Demonstration of OpenCOBOL message queue notification
    * Tectonics: gcc -c ocmq.c
    *            cobc -Wall -x -lrt mqsample.cob ocmq.o
    ******************************************************************
    identification division.
    program-id. MQSIGNAL.

    data division.
    working-storage section.
    01 msgbuf pic x(8192).
    01 msglen usage binary-long value 8192.
    01 msgprio usage binary-long.
    01 mqres  usage binary-long.

    linkage section.
    01 mqid usage binary-long.

    procedure division using mqid.

    display "in MQSIGNAL".
    display "In the COBOL procedure with " mqid end-display.
    perform
        with test after
        until mqres <= 0

        call "MQRECEIVE" using by value mqid
                               by reference msgbuf
                               by value msglen
                               by reference msgprio
                          returning mqres
        end-call
        display
            "receive len: " mqres " prio: " msgprio
        end-display
        if mqres > 0
            display
                "priority 31 message: " msgbuf(1:mqres)
            end-display
        end-if
    end-perform.
```

```
       goback.
       end program MQSIGNAL.
```

30.11 5.11 Can OpenCOBOL interface with Lua?

Yes. Lua can be embedded in OpenCOBOL applications.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *><* ======================
      *><* OpenCOBOL Lua Interface
      *><* ======================
      *><*
      *><* .. sidebar:: Contents
      *><*
      *><*     .. contents::
      *><*         :local:
      *><*         :depth: 2
      *><*         :backlinks: entry
      *><*
      *><* :Author:    Brian Tiffin
      *><* :Date:      28-Oct-2008
      *><* :Purpose:   interface to Lua scripting
      *><* :Rights:    | Copyright 2008 Brian Tiffin
      *><*             | Licensed under the GNU General Public License
      *><*             | No warranty expressed or implied
      *><* :Tectonics: | cobc -c -I/usr/include/lua5.1/ oclua.c
      *><*             | cobc -x -llua5.1 luacaller.cob oclua.o
      *><*             | ./ocdoc luacaller.cob oclua.rst oclua.html ocfaq.css
      *><* :Requires:  lua5.1, liblua5.1, liblua5.1-dev
      *><* :Link:      http://www.lua.org
      *><* :Thanks to: The Lua team, Pontifical Catholic University
      *><*             of Rio de Janeiro in Brazil.
      *><*             http://www.lua.org/authors.html
      *><* :Sources:   | http://opencobol.add1tocobol.com/luacaller.cob
      *><*             | http://opencobol.add1tocobol.com/oclua.c
      *><*             | http://opencobol.add1tocobol.com/oclua.lua
      *><*             | http://opencobol.add1tocobol.com/oclua.rst
      *><*             | http://opencobol.add1tocobol.com/ocfaq.rss
      *><*
      *> ***************************************************************
       identification division.
       program-id. luacaller.

       data division.
       working-storage section.
       01 luastate              usage pointer.
       01 luascript             pic x(10) value 'oclua.lua' & x"00".
       01 luacommand            pic x(64).
       01 luaresult             pic x(32).
       01 lualength             usage binary-long.

       01 items                 pic 9 usage computational-5.
       01 luastack.
          03 luaitem            pic x(32) occurs 5 times.
       01 depth                 usage binary-long.

      *> ***************************************************************
```

```
procedure division.

call "OCLUA_OPEN" returning luastate end-call

move 'return "OpenCOBOL " .. 1.0 + 0.1' & x"00" to luacommand
call "OCLUA_DOSTRING"
    using
        by value luastate
        by reference luacommand
        by reference luaresult
        by value function length(luaresult)
    returning depth
end-call
display
    "OpenCOBOL displays: " depth " |" luaresult "|"
end-display

call "OCLUA_DOFILE"
    using
        by value luastate
        by reference luascript
        by reference luaresult
        by value 32
    returning depth
end-call
display
    "OpenCOBOL displays: " depth " |" luaresult "|"
end-display

call "OCLUA_DOFILE"
    using
        by value luastate
        by reference luascript
        by reference luaresult
        by value 32
    returning depth
end-call
display
    "OpenCOBOL displays: " depth " |" luaresult "|"
end-display

call "OCLUA_DEPTH"
    using
        by value luastate
    returning depth
end-call
display "Lua depth: " depth end-display

perform varying items from 1 by 1
    until items > depth
        call "OCLUA_GET"
            using
                by value luastate
                by value items
                by reference luaresult
                by value 32
            returning lualength
        end-call
        move luaresult to luaitem(items)
```

```
end-perform

perform varying items from 1 by 1
    until items > depth
        display
            "Item " items ": " luaitem(items)
        end-display
end-perform

call "OCLUA_POP"
    using
        by value luastate
        by value depth
    returning depth
end-call

call "OCLUA_DEPTH"
    using
        by value luastate
    returning depth
end-call

display "Lua depth: " depth end-display

call "OCLUA_CLOSE" using by value luastate end-call

goback.
end program luacaller.
*> ****************************************************************
*><* ++++++++
*><* Overview
*><* ++++++++
*><* The OpenCOBOL Lua interface is defined at a very high level.
*><*
*><* The objective is to provide easy access to Lua through
*><* script files or strings to be evaluated.
*><*
*><* Command strings and script file names passed to Lua MUST be
*><* terminated with a null byte, as per C Language conventions.
*><*
*><* A Lua engine is started with a call to OCLUA_OPEN, which
*><* returns an OpenCOBOL POINTER that is used to reference
*><* the Lua state for all further calls.
*><*
*><* A Lua engine is run down with a call to OCLUA_CLOSE.
*><*
*><* .. Attention::
*><*   Calls to Lua without a valid state will cause
*><*   undefined behaviour and crash the application.
*><*
*><* Lua uses a stack and results of the Lua RETURN reserved
*><* word are placed on this stack.  Multiple values can be
*><* returned from Lua.
*><*
*><* The developer is responsible for stack overflow conditions
*><* and the size of the stack (default 20 elements) is
*><* controlled with OCLUA_STACK using an integer that
*><* determines the numbers of slots to reserve.
*><*
```

```
*><* Requires package installs of:
*><*
*><* * lua5.1
*><* * liblua5.1
*><* * liblua5.1-dev
*><*
*><* +++++++++++++++++
*><* OpenCOBOL Lua API
*><* +++++++++++++++++
*><* ----------
*><* OCLUA_OPEN
*><* ----------
*><* Initialize the Lua engine.
*><*
*><* ::
*><*
*><*   01 luastate USAGE POINTER.
*><*
*><*   CALL "OCLUA_OPEN" RETURNING luastate END-CALL
*><*
*><* -----------
*><* OCLUA_STACK
*><* -----------
*><* Check and possibly resize the Lua data stack.  Returns 0 if
*><* Lua cannot expand the stack to the requested size.
*><*
*><* ::
*><*
*><*   01 elements USAGE BINARY-LONG VALUE 32.
*><*   01 result   USAGE BINARY-LONG.
*><*
*><*   CALL "OCLUA_STACK"
*><*       USING
*><*           BY VALUE luastate
*><*           BY VALUE elements
*><*       RETURNING result
*><*   END-CALL
*><*
*><* --------------
*><* OCLUA_DOSTRING
*><* --------------
*><* Evaluate a null terminated alphanumeric field as a Lua program
*><* producing any top of stack entry and returning the depth of
*><* stack after evaluation.
*><*
*><* Takes a luastate, a null terminated command string,
*><* a result field and length and returns an integer depth.
*><*
*><* .. Attention::
*><*   The Lua stack is NOT popped while returning the top of stack entry.
*><*
*><* ::
*><*
*><*   01 luacommand pic x(64).
*><*   01 luaresult  pic x(32).
*><*   01 depth      usage binary-long.
*><*
*><*   move 'return "OpenCOBOL " .. 1.0 + 0.1' & x"00" to luacommand
*><*   call "OCLUA_DOSTRING"
```

```
*><*       using
*><*           by value luastate
*><*           by reference luacommand
*><*           by reference luaresult
*><*           by value function length(luaresult)
*><*       returning depth
*><*   end-call
*><*   display
*><*       "OpenCOBOL displays: " depth " |" luaresult "|"
*><*   end-display
*><*
*><* Outputs::
*><*
*><*   OpenCOBOL displays: +0000000001 |OpenCOBOL 1.1                    ||
*><*
*><* ------------
*><* OCLUA_DOFILE
*><* ------------
*><* Evaluate a script using a null terminated alphanumeric field
*><* naming a Lua program source file, retrieving any top of
*><* stack entry and returning the depth of stack after evaluation.
*><*
*><* Takes a luastate, a null terminated filename,
*><* a result field and length and returns an integer depth.
*><*
*><* .. Attention::
*><*   The Lua stack is NOT popped while returning the top of
*><*   stack entry.
*><*
*><* ::
*><*
*><*   01 luascript  pic x(10) value 'oclua.lua' & x"00".
*><*   01 luaresult  pic x(32).
*><*
*><*   call "OCLUA_DOFILE"
*><*       using
*><*           by value luastate
*><*           by reference luascript
*><*           by reference luaresult
*><*           by value function length(luaresult)
*><*       returning depth
*><*   end-call
*><*   display
*><*       "OpenCOBOL displays: " depth " |" luaresult "|"
*><*   end-display
*><*
*><* Given oclua.lua::
*><*
*><*   -- Start
*><*   -- Script: oclua.lua
*><*   print("Lua prints hello")
*><*
*><*   hello = "Hello OpenCOBOL from Lua"
*><*   return math.pi, hello
*><*   -- End
*><*
*><* Outputs::
*><*
*><*   Lua prints hello
```

```
*><*   OpenCOBOL displays: +0000000002 |Hello OpenCOBOL from Lua        ||
*><*
*><* and on return from Lua, there is *math.pi* and the
*><* Hello string remaining on the Lua state stack.
*><*
*><* -----------
*><* OCLUA_DEPTH
*><* -----------
*><* Returns the current number of elements on the Lua stack.
*><*
*><* ::
*><*
*><*   call "OCLUA_DEPTH"
*><*       using
*><*           by value luastate
*><*       returning depth
*><*   end-call
*><*   display "Lua depth: " depth end-display
*><*
*><* ---------
*><* OCLUA_GET
*><* ---------
*><* Retrieves values from the Lua stack, returning the length
*><* of the retrieved item.
*><*
*><* An example that populates and displays an OpenCOBOL table::
*><*
*><*   01 items                pic 9 usage computational-5.
*><*   01 luastack.
*><*      03 luaitem           pic x(32) occurs 5 times.
*><*
*><*   perform varying items from 1 by 1
*><*       until items > depth
*><*           call "OCLUA_GET"
*><*               using
*><*                   by value luastate
*><*                   by value items
*><*                   by reference luaresult
*><*                   by value function length(luaresult)
*><*               returning lualength
*><*           end-call
*><*           move luaresult to luaitem(items)
*><*   end-perform
*><*
*><*   perform varying items from 1 by 1
*><*       until items > depth
*><*           display
*><*              "Item " items ": " luaitem(items)
*><*           end-display
*><*   end-perform
*><*
*><* Lua numbers the indexes of stacked items from 1, first
*><* item to n, last item (current top of stack). Negative
*><* indexes may also be used as documented by Lua, -1 being
*><* top of stack.
*><*
*><* Sample output::
*><*
*><*   Item 1: OpenCOBOL 1.1
```

```
      *><*   Item 2: 3.1415926535898
      *><*   Item 3: Hello OpenCOBOL from Lua
      *><*   Item 4: 3.1415926535898
      *><*   Item 5: Hello OpenCOBOL from Lua
      *><*
      *><* ---------
      *><* OCLUA_POP
      *><* ---------
      *><* Pops the given number of elements off of the Lua stack
      *><* returning the depth of the stack after the pop.
      *><*
      *><* Example that empties the Lua stack::
      *><*
      *><*   call "OCLUA_POP"
      *><*       using
      *><*           by value luastate
      *><*           by value depth
      *><*       returning depth
      *><*   end-call
      *><*
      *><* -----------
      *><* OCLUA_CLOSE
      *><* -----------
      *><* Close and free the Lua engine.
      *><*
      *><* .. Danger::
      *><*    Further calls to Lua are unpredictable and may well
      *><*    lead to a SIGSEGV crash.
      *><*
      *><* ::
      *><*
      *><*   call "OCLUA_CLOSE" using by value luastate end-call
      *><*
```

With usage document at oclua.html

The above code uses a wrapper layer of C code

```
/* OpenCOBOL Lua interface */
/* tectonics: cobc -c -I/usr/include/lua5.1 oclua.c */

#include <stdlib.h>
#include <stdio.h>
#include <string.h>

/* Include the Lua API header files. */
#include <lua.h>
#include <lauxlib.h>
#include <lualib.h>

/* Open the Lua engine and load all the default libraries */
lua_State *OCLUA_OPEN() {
    lua_State *oclua_state;
    oclua_state = lua_open();
    luaL_openlibs(oclua_state);
    return oclua_state;
}

int OCLUA_DO(lua_State *L, int which, const char *string, unsigned char *cobol, int coblen) {
    int result;
```

```
    int stacked;
    const char *retstr;
    int retlen;

    memset(cobol, ' ', coblen);
    result = ((which == 0) ? luaL_dostring(L, string) : luaL_dofile(L, string));
    if (result == 1) {
    /* error condition */
    return -1;
    } else {
    stacked = lua_gettop(L);
    if (stacked > 0) {
        /* populate cobol field with top of stack */
        retstr = lua_tolstring(L, stacked, &retlen);
        memcpy(cobol, retstr, (coblen > retlen) ? retlen : coblen);
    }
    /* return number of items on the stack */
    return stacked;
    }
}

/* by filename */
int OCLUA_DOFILE(lua_State *L, const char *filename, unsigned char *cobol, int coblen) {
    return OCLUA_DO(L, 1, filename, cobol, coblen);
}

/* by string */
int OCLUA_DOSTRING(lua_State *L, const char *string, unsigned char *cobol, int coblen) {
    return OCLUA_DO(L, 0, string, cobol, coblen);
}

/* retrieve stack item as string */
int OCLUA_GET(lua_State *L, int element, unsigned char *cobol, int coblen) {
    const char *retstr;
    int retlen;

    /* populate cobol field with top of stack */
    memset(cobol, ' ', coblen);
    retstr = lua_tolstring(L, element, &retlen);
    if (retstr == NULL) {
    return -1;
    } else {
    memcpy(cobol, retstr, (coblen > retlen) ? retlen : coblen);
    return retlen;
    }
}

/* check the stack, resize if needed, returns false if stack can't grow */
int OCLUA_STACK(lua_State *L, int extra) {
    return lua_checkstack(L, extra);
}

/* depth of Lua stack */
int OCLUA_DEPTH(lua_State *L) {
    return lua_gettop(L);
}

/* pop elements off stack */
int OCLUA_POP(lua_State *L, int elements) {
```

```
    lua_pop(L, elements);
    return lua_gettop(L);
}

/* close the engine */
void OCLUA_CLOSE(lua_State *L) {
    lua_close(L);
}

/**/
```

and this sample Lua script **oclua.lua**

```
-- Start
-- Script: oclua.lua
print("Lua prints hello")

hello = "Hello OpenCOBOL from Lua"
return math.pi, hello
-- End
```

30.12 5.12 Can OpenCOBOL use ECMAScript?

Yes. Using the SpiderMonkey engine. See Can OpenCOBOL use JavaScript?

30.13 5.13 Can OpenCOBOL use JavaScript?

Yes. A wrapper for the SpiderMonkey engine allows OpenCOBOL access to core JavaScript.

```
/* OpenCOBOL with embedded spidermonkey javascript */
/*   cobc -c -I/usr/include/smjs ocjs.c
 *   cobc -x -lsmjs jscaller.cob
 *   some people found mozjs before smjs
 */
#include <stdio.h>
#include <string.h>

/* javascript api requires an environment type */
#define XP_UNIX

#if (defined(XP_WIN) || defined(XP_UNIX) || defined(XP_BEOS) || defined(XP_OS2))
#include "jsapi.h"
#else
#error "Must define one of XP_BEOS, XP_OS2, XP_WIN or XP_UNIX"
#endif

/* Error codes */
#define OCJS_ERROR_RUNTIME  -1
#define OCJS_ERROR_CONTEXT  -2
#define OCJS_ERROR_GLOBAL   -3
#define OCJS_ERROR_STANDARD -4
#define OCJS_ERROR_EVALUATE -5

/* OpenCOBOL main CALL interface */
/* javascript layer requires
 *   a runtime per process,
```

```
 *   a context per thread,
 *   a global object per context
 * and will initialize
 *   standard classes.
 */
static JSRuntime *rt;
static JSContext *cx;
static JSObject *global;
static JSClass global_class = {
    "global",0,
    JS_PropertyStub,JS_PropertyStub,JS_PropertyStub,JS_PropertyStub,
    JS_EnumerateStub,JS_ResolveStub,JS_ConvertStub,JS_FinalizeStub
};

/* Initialize the engine resources */
int ocjsInitialize(int rtsize, int cxsize) {
    JSBool ok;

    /* on zero sizes, pick reasonable values */
    if (rtsize == 0) { rtsize = 0x100000; }
    if (cxsize == 0) { cxsize = 0x1000; }

    /* Initialize a runtime space */
    rt = JS_NewRuntime(rtsize);
    if (rt == NULL) { return OCJS_ERROR_RUNTIME; }
    /* Attach a context */
    cx = JS_NewContext(rt, cxsize);
    if (cx == NULL) { return OCJS_ERROR_CONTEXT; }
    /* And a default global */
    global = JS_NewObject(cx, &global_class, NULL, NULL);
    if (global == NULL) { return OCJS_ERROR_GLOBAL; }
    /* Load standard classes */
    ok = JS_InitStandardClasses(cx, global);

    /* Return success or standard class load error */
    return (ok == JS_TRUE) ? 0 : OCJS_ERROR_STANDARD;
}

/* Evaluate script */
int ocjsEvaluate(char *script, char *result, int length) {
    jsval rval;
    JSString *str;
    int reslen = OCJS_ERROR_EVALUATE;

    JSBool ok;

    /* filename and line number, not reported */
    char *filename = NULL;
    int lineno = 0;

    /* clear the result field */
    memset(result, ' ', length);

    /* Evaluate javascript */
    ok = JS_EvaluateScript(cx, global, script, strlen(script), filename, lineno, &rval);

    /* Convert js result to JSString form */
    if (ok == JS_TRUE) {
        str = JS_ValueToString(cx, rval);
```

```
        reslen = strlen(JS_GetStringBytes(str));
        if (length < reslen) { reslen = length; }
        /* convert down to char and move to OpenCOBOl result field */
        memcpy(result, JS_GetStringBytes(str), reslen);
    }
    return reslen;
}

/* Evaluate script from file */
int ocjsFromFile(char *filename, char *result, int length) {
    FILE *fin;
    int bufsize = 10240;
    char inbuf[bufsize];
    int reslen;

    fin = fopen(filename, "r");
    if (fin == NULL) { return OCJS_ERROR_EVALUATE; }
    //while (fread(inbuf, sizeof(char), bufsize, fin) > 0) {
    if (fread(inbuf, 1, bufsize, fin) > 0) {
        reslen = ocjsEvaluate(inbuf, result, length);
    }
    return reslen;
}

/* release js engine */
int ocjsRunDown() {
    if (cx != NULL) { JS_DestroyContext(cx); }
    if (rt != NULL) { JS_DestroyRuntime(rt); }
    JS_ShutDown();
    return 0;
}

/* Quick call; start engine, evaluate, release engine */
int ocjsString(char *script, char *result, int length) {
    int reslen;

    reslen = ocjsInitialize(0, 0);
    if (reslen < 0) { return reslen; }
    reslen = ocjsEvaluate(script, result, length);
    ocjsRunDown();
    return reslen;
}
/**/
```

A sample OpenCOBOL application:

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *>*****************************************************************
      *>Author:    Brian Tiffin
      *>Date:      11-Sep-2008
      *>Purpose:   Embed some javascript
      *>Tectonics: cobc -c -I/usr/include/smjs ocjs.c
      *>           cobc -x -l/smjs jscaller.cob ocjs.o
      *>*****************************************************************
       identification division.
       program-id. jscaller.

       data division.

       working-storage section.
```

```
 78 ocjs-error-runtime  value -1.
 78 ocjs-error-context  value -2.
 78 ocjs-error-global   value -3.
 78 ocjs-error-standard value -4.
 78 ocjs-error-evaluate value -5.

 78 newline              value x"0a".
 01 source-data          pic x(40)
      value "----+----1----+-$56.78 90----3----+----4".
 01 result               pic s9(9).
 01 result-field         pic x(81).

 01 javascript           pic x(1024).
 01 safety-null          pic x value x"00".

*>*****************************************************************
*><* Evaluate spidermonkey code, return the length of js result
 procedure division.

 display "js> " with no advancing end-display
 accept javascript end-accept
 call "ocjsString"
     using javascript
         result-field
         by value function length(result-field)
     returning result
 end-call
 display "OpenCOBOL result-field: " result-field end-display
 display "OpenCOBOL received    : " result newline end-display

*><* Initialize the javascript engine
 call "ocjsInitialize"
     using by value 65536
         by value 1024
     returning result
 end-call
 if result less 0
     stop run returning result
 end-if

*><* find (zero offest) dollar amount, space, number
 move spaces to javascript
 string
     "pat = /\$\d+\.\d+\s\d+/; "
     'a = "' delimited by size
     source-data delimited by size
     '"; ' delimited by size
     "a.search(pat); " delimited by size
     x"00" delimited by size
     into javascript
 end-string

 display
     "Script: " function trim(javascript, trailing)
 end-display

 call "ocjsEvaluate"
     using javascript
         result-field
```

```
            by value function length(result-field)
        returning result
    end-call
    display "OpenCOBOL result-field: " result-field end-display
    display "OpenCOBOL received    : " result newline end-display

   *><* values held in js engine across calls
    move spaces to javascript
    string
        'a;' delimited by size
        x"00" delimited by size
        into javascript
    end-string

    display
        "Script: " function trim(javascript, trailing)
    end-display

    call "ocjsEvaluate"
        using javascript
            result-field
            by value function length(result-field)
        returning result
    end-call
    display "OpenCOBOL result-field: " result-field end-display
    display "OpenCOBOL received    : " result newline end-display

   *><* erroneous script
    move spaces to javascript
    string
        'an error of some kind;' delimited by size
        x"00" delimited by size
        into javascript
    end-string

    display
        "Script: " function trim(javascript, trailing)
    end-display

    call "ocjsEvaluate"
        using javascript
            result-field
            by value function length(result-field)
        returning result
    end-call
    if result equal ocjs-error-evaluate
        display " *** script problem ***" end-display
    end-if
    display "OpenCOBOL result-field: " result-field end-display
    display "OpenCOBOL received    : " result newline end-display

   *><* script from file
    move spaces to javascript
    string
        'ocjsscript.js' delimited by size
        x"00" delimited by size
        into javascript
    end-string
```

```
display
    "Script: " function trim(javascript, trailing)
end-display

call "ocjsFromFile"
    using javascript
        result-field
        by value function length(result-field)
    returning result
end-call
if result equal ocjs-error-evaluate
    display " *** script problem ***" end-display
end-if
display "OpenCOBOL result-field: " result-field end-display
display "OpenCOBOL received    : " result newline end-display

*><* Rundown the js engine
call "ocjsRunDown" returning result

*><* take first name last name, return last "," first
move spaces to javascript
string
    "re = /(\w+)\s(\w+)/; " delimited by size
    'str = "John Smith"; ' delimited by size
    'newstr = str.replace(re, "$2, $1"); ' delimited by size
    "newstr;" delimited by size
    x"00" delimited by size
    into javascript
end-string

display
    "Script: " function trim(javascript, trailing)
end-display

call "ocjsString"
    using javascript
        result-field
        by value function length(result-field)
    returning result
end-call
display "OpenCOBOL result-field: " result-field end-display
display "OpenCOBOL received    : " result newline end-display

*><* split a string using numbers return array (as js string form)
move spaces to javascript
string
    'myString = "Hello 1 word. Sentence number 2."; '
        delimited by size
    'splits = myString.split(/(\d)/); ' delimited by size
    'splits;'  delimited by size
    x"00" delimited by size
    into javascript
end-string

display
    "Script: " function trim(javascript, trailing)
end-display

call "ocjsString"
```

```
           using javascript
               result-field
               by value function length(result-field)
           returning result
       end-call
       display "OpenCOBOL result-field: " result-field end-display
       display "OpenCOBOL received    : " result newline end-display

      *><* Get javascript date
       move "new Date()" & x"00" to javascript

       display
           "Script: " function trim(javascript, trailing)
       end-display

       call "ocjsString"
           using javascript
               result-field
               by value function length(result-field)
           returning result
       end-call
       display "OpenCOBOL result-field: " result-field end-display
       display "OpenCOBOL received    : " result end-display

       goback.
       end program jscaller.
```

And with a sample script:

ocjsscript.js

```
var x = 2
var y = 39
var z = "42"
// boths line evaluate to 42
eval("x + y + 1")
eval(z)
```

Sample output:

```
js> 123 * 456 + 789
OpenCOBOL result-field: 56877
OpenCOBOL received    : +000000005

Script: pat = /\$\d+\.\d+\s\d+/; a = "----+----1----+-$56.78 90----3----+----4"; a.search(pat);
OpenCOBOL result-field: 16
OpenCOBOL received    : +000000002

Script: a;
OpenCOBOL result-field: ----+----1----+-$56.78 90----3----+----4
OpenCOBOL received    : +000000040

Script: an error of some kind;
 *** script problem ***
OpenCOBOL result-field:
OpenCOBOL received    : -000000005

Script: re = /(\w+)\s(\w+)/; str = "John Smith"; newstr = str.replace(re, "$2, $1"); newstr;
OpenCOBOL result-field: Smith, John
OpenCOBOL received    : +000000011
```

```
Script: myString = "Hello 1 word. Sentence number 2."; splits = myString.split(/(\d)/); splits;
OpenCOBOL result-field: Hello ,1, word. Sentence number ,2,.
OpenCOBOL received    : +000000036

Script: new Date()
OpenCOBOL result-field: Mon Sep 15 2008 04:16:06 GMT-0400 (EDT)
OpenCOBOL received    : +000000039
```

30.14 5.14 Can OpenCOBOL interface with Scheme?

Yes, directly embedded with Guile and libguile.

callguile.cob

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20090215
      *> Purpose:   Demonstrate libguile Scheme interactions
      *> Tectonics: cobc -x -lguile callguile.cob
      *> ************************************************************
       identification division.
       program-id. callguile.

       data division.
       working-storage section.
       01 tax-scm              usage pointer.
       01 shipping-scm         usage pointer.
       01 scm-string           usage pointer.
       01 radix-scm            usage pointer.

       01 subtotal             pic 999v99 value 80.00.
       01 subtotal-display     pic z(8)9.99.
       01 weight               pic 99v99  value 10.00.
       01 weight-display       pic Z9.99.
       01 breadth              pic 99v99  value 20.00.
       01 breadth-display      pic Z9.99.

       01 answer               pic x(80).
       01 len                  usage binary-long.

       01 tax                  pic 9(9)v9(2).
       01 tax-display          pic z(8)9.9(2).
       01 shipping             pic 9(9)v9(2).
       01 shipping-display     pic z(8)9.9(2).
       01 invoice-total        pic 9(9)v9(2).
       01 invoice-display      pic $(8)9.9(2).

      *> ************************************************************
       procedure division.

       display "OC: initialize libguile" end-display
       call "scm_init_guile" end-call

       display "OC: load scheme code" end-display
       call "scm_c_primitive_load" using "script.scm" & x"00" end-call
       display "OC:" end-display
```

```
display "OC: evaluate one of the defined functions" end-display
call "scm_c_eval_string" using "(do-hello)" & x"00" end-call
display "OC:" end-display

display "OC: perform tax calculation" end-display
move subtotal to subtotal-display
move weight to weight-display
move breadth to breadth-display
call "scm_c_eval_string"
    using
        function concatenate(
            "(compute-tax "; subtotal-display; ")"; x"00"
        )
    returning tax-scm
end-call

display "OC: perform shipping calculation" end-display
display "OC: " function concatenate(
                    "(compute-shipping "; weight-display; " ";
                    breadth-display; ")"; x"00"
                )
end-display
call "scm_c_eval_string"
    using
        function concatenate(
            "(compute-shipping "; weight-display; " ";
            breadth-display; ")"; x"00"
        )
    returning shipping-scm
end-call

display "OC: have guile build a scheme integer 10" end-display
call "scm_from_int32"
    using by value size is 4 10 returning radix-scm
end-call

display "OC: have guile convert number, base 10" end-display
call "scm_number_to_string"
    using
        by value tax-scm by value radix-scm
    returning scm-string
end-call

display "OC: get numeric string to COBOL" end-display
call "scm_to_locale_stringbuf"
    using
        by value scm-string
        by reference answer
        by value 80
    returning len
end-call
display "OC: tax as string: " answer end-display
move answer to tax

call "scm_number_to_string"
    using
        by value shipping-scm by value radix-scm
    returning scm-string
end-call
```

```
        call "scm_to_locale_stringbuf"
            using
                by value scm-string
                by reference answer
                by value 80
            returning len
        end-call
        display "OC: shipping as string: " answer end-display
        move answer to shipping

        compute invoice-total = subtotal + tax + shipping end-compute

        move subtotal to subtotal-display
        move tax to tax-display
        move shipping to shipping-display
        move invoice-total to invoice-display
        display "OC:" end-display
        display "OC: subtotal   " subtotal-display end-display
        display "OC: tax        " tax-display end-display
        display "OC: shipping   " shipping-display end-display
        display "OC: total:     " invoice-display end-display
        goback.
        end program callguile.
```

script.scm

```
(define (do-hello)
  (begin
    (display "Welcome to Guile")
    (newline)))

(define (compute-tax subtotal)
  (* subtotal 0.0875))


(define (compute-shipping weight length)

  ;; For small, light packages, charge the minimum
  (if (and (< weight 20) (< length 5))
      0.95

      ;; Otherwise for long packages, charge a lot
      (if (> length 100)
          (+ 0.95 (* weight 0.1))

          ;; Otherwise, charge the usual
          (+ 0.95 (* weight 0.05)))))

(display "Loaded script.scm")(newline)
```

Outputs:

```
OC: initialize libguile
OC: load scheme code
Loaded script.scm
OC:
OC: evaluate one of the defined functions
Welcome to Guile
OC:
OC: perform tax calculation
```

```
OC: perform shipping calculation
OC: (compute-shipping 10.00 20.00)
OC: have guile build a scheme integer 10
OC: have guile convert number, base 10
OC: get numeric string to COBOL
OC: tax as string: 7.0
OC: shipping as string: 1.45
OC:
OC: subtotal          80.00
OC: tax                7.00
OC: shipping           1.45
OC: total:           $88.45
```

Of course using Scheme for financial calculations in an OpenCOBOL application would not be a smart usage. This is just a working sample.

30.15 5.15 Can OpenCOBOL interface with Tcl/Tk?

Yes. OpenCOBOL supports the Tcl/Tk embedding engine developed by Rildo Pragana as part of the TinyCOBOL project. We have been given permission by Rildo to embed his engine in OpenCOBOL.

See http://ww1.pragana.net/cobol.html for sources.

A working sample

```
OCOBOL IDENTIFICATION DIVISION.
       PROGRAM-ID.    tclgui.
       AUTHOR. Rildo Pragana.
      *> REMARKS.
      *>    Example tcl/tk GUI program for Cobol.
      *>
       ENVIRONMENT DIVISION.
       DATA DIVISION.
      *>
       WORKING-STORAGE SECTION.
       01 DATA-BLOCK.
          05 NAME           PIC X(40).
          05 W-ADDRESS      PIC X(50).
          05 PHONE          PIC X(15).
          05 END-PGM          PIC X.
                05 QUICK-RET      PIC X.
       01 SITE-INFO.
          05  TITLE       PIC X(20).
          05  URL         PIC X(50).
       77 GUI-01          PIC X(64) VALUE "formA.tcl".
       77 GUI-02          PIC X(64) VALUE "formB.tcl".
       77 END-OF-STRING   pic X value LOW-VALUES.
       77 T-SCRIPT              PIC X(128).
       77 T-RESULT              PIC X(80).
       01 dummy                 pic X value X"00".

       PROCEDURE DIVISION.

       CALL "initTcl"

      *> test for stcleval function
       string "expr 12 * 34" END-OF-STRING into T-SCRIPT
       call "stcleval" using T-SCRIPT T-RESULT
```

```
       display "eval by tcl: |" T-SCRIPT "| returned " T-RESULT

       MOVE "Your name here" to NAME
       MOVE "Your address" TO W-ADDRESS
       MOVE "Phone number" to PHONE
      *> this variable tells Cobol that the user required an exit
       MOVE "0" to END-PGM
       MOVE "1" to QUICK-RET
       MOVE "Afonso Pena" to NAME
      *> now we may have the script name as a variable, terminated by a space
       CALL "tcleval" USING DATA-BLOCK "./formA.tcl "
       MOVE "Deodoro da Fonseca" to NAME
       CALL "tcleval" USING DATA-BLOCK GUI-01
       MOVE "Rui Barbosa" to NAME
       CALL "tcleval" USING DATA-BLOCK GUI-01
       MOVE "Frei Caneca" to NAME
       CALL "tcleval" USING DATA-BLOCK GUI-01

       MOVE "0" to QUICK-RET
       MOVE "Your name here" to NAME.
       100-restart.
      *> call C wrapper, passing data block and size of data
       CALL "tcleval" USING DATA-BLOCK GUI-01

       DISPLAY "Returned data:"
       DISPLAY "NAME    [" NAME "]"
       DISPLAY "ADDRESS [" W-ADDRESS "]"
       DISPLAY "PHONE   [" PHONE "]"
      *> if not end of program required, loop
       if END-PGM = 0
           go to 100-restart.
      *> to start a new GUI (graphical interface), call this first
       call "newGui"
       MOVE "Title of the site" to TITLE
       MOVE "URL (http://..., ftp://..., etc)" to URL
      *> now we may draw other main window...
       CALL "tcleval" USING SITE-INFO GUI-02
       DISPLAY "Returned data:"
       DISPLAY "TITLE   [" TITLE "]"
       DISPLAY "URL     [" URL "]"

       STOP RUN.
```

Which uses two Tcl/Tk scripts

```
#!/bin/sh
# the next line restarts using wish\
exec wish "$0" "$@"

if {![info exists vTcl(sourcing)]} {

    package require Tk
    switch $tcl_platform(platform) {
      windows {
            option add *Button.padY 0
      }
      default {
            option add *Scrollbar.width 10
            option add *Scrollbar.highlightThickness 0
            option add *Scrollbar.elementBorderWidth 2
```

```
            option add *Scrollbar.borderWidth 2
      }
    }

}

###############################################################################
# Visual Tcl v1.60 Project
#


#################################
# VTCL LIBRARY PROCEDURES
#

if {![info exists vTcl(sourcing)]} {
#############################################################################
## Library Procedure:  Window

proc ::Window {args} {
    ## This procedure may be used free of restrictions.
    ##    Exception added by Christian Gavin on 08/08/02.
    ## Other packages and widget toolkits have different licensing requirements.
    ##    Please read their license agreements for details.

    global vTcl
    foreach {cmd name newname} [lrange $args 0 2] {}
    set rest    [lrange $args 3 end]
    if {$name == "" || $cmd == ""} { return }
    if {$newname == ""} { set newname $name }
    if {$name == "."} { wm withdraw $name; return }
    set exists [winfo exists $newname]
    switch $cmd {
        show {
            if {$exists} {
                wm deiconify $newname
            } elseif {[info procs vTclWindow$name] != ""} {
                eval "vTclWindow$name $newname $rest"
            }
            if {[winfo exists $newname] && [wm state $newname] == "normal"} {
                vTcl:FireEvent $newname <<Show>>
            }
        }
        hide    {
            if {$exists} {
                wm withdraw $newname
                vTcl:FireEvent $newname <<Hide>>
                return}
        }
        iconify { if $exists {wm iconify $newname; return} }
        destroy { if $exists {destroy $newname; return} }
    }
}
#############################################################################
## Library Procedure:  vTcl:DefineAlias

proc ::vTcl:DefineAlias {target alias widgetProc top_or_alias cmdalias} {
    ## This procedure may be used free of restrictions.
    ##    Exception added by Christian Gavin on 08/08/02.
```

```
    ## Other packages and widget toolkits have different licensing requirements.
    ##    Please read their license agreements for details.

    global widget
    set widget($alias) $target
    set widget(rev,$target) $alias
    if {$cmdalias} {
        interp alias {} $alias {} $widgetProc $target
    }
    if {$top_or_alias != ""} {
        set widget($top_or_alias,$alias) $target
        if {$cmdalias} {
            interp alias {} $top_or_alias.$alias {} $widgetProc $target
        }
    }
}
###############################################################################
## Library Procedure:  vTcl:DoCmdOption

proc ::vTcl:DoCmdOption {target cmd} {
    ## This procedure may be used free of restrictions.
    ##    Exception added by Christian Gavin on 08/08/02.
    ## Other packages and widget toolkits have different licensing requirements.
    ##    Please read their license agreements for details.

    ## menus are considered toplevel windows
    set parent $target
    while {[winfo class $parent] == "Menu"} {
        set parent [winfo parent $parent]
    }

    regsub -all {\%widget} $cmd $target cmd
    regsub -all {\%top} $cmd [winfo toplevel $parent] cmd

    uplevel #0 [list eval $cmd]
}
###############################################################################
## Library Procedure:  vTcl:FireEvent

proc ::vTcl:FireEvent {target event {params {}}} {
    ## This procedure may be used free of restrictions.
    ##    Exception added by Christian Gavin on 08/08/02.
    ## Other packages and widget toolkits have different licensing requirements.
    ##    Please read their license agreements for details.

    ## The window may have disappeared
    if {![winfo exists $target]} return
    ## Process each binding tag, looking for the event
    foreach bindtag [bindtags $target] {
        set tag_events [bind $bindtag]
        set stop_processing 0
        foreach tag_event $tag_events {
            if {$tag_event == $event} {
                set bind_code [bind $bindtag $tag_event]
                foreach rep "\{%W $target\} $params" {
                    regsub -all [lindex $rep 0] $bind_code [lindex $rep 1] bind_code
                }
                set result [catch {uplevel #0 $bind_code} errortext]
                if {$result == 3} {
```

```
                    ## break exception, stop processing
                    set stop_processing 1
                } elseif {$result != 0} {
                    bgerror $errortext
                }
                break
            }
        }
        if {$stop_processing} {break}
    }
}
#############################################################################
## Library Procedure:  vTcl:Toplevel:WidgetProc

proc ::vTcl:Toplevel:WidgetProc {w args} {
    ## This procedure may be used free of restrictions.
    ##    Exception added by Christian Gavin on 08/08/02.
    ## Other packages and widget toolkits have different licensing requirements.
    ##    Please read their license agreements for details.

    if {[llength $args] == 0} {
        ## If no arguments, returns the path the alias points to
        return $w
    }
    set command [lindex $args 0]
    set args [lrange $args 1 end]
    switch -- [string tolower $command] {
        "setvar" {
            foreach {varname value} $args {}
            if {$value == ""} {
                return [set ::${w}::${varname}]
            } else {
                return [set ::${w}::${varname} $value]
            }
        }
        "hide" - "show" {
            Window [string tolower $command] $w
        }
        "showmodal" {
            ## modal dialog ends when window is destroyed
            Window show $w; raise $w
            grab $w; tkwait window $w; grab release $w
        }
        "startmodal" {
            ## ends when endmodal called
            Window show $w; raise $w
            set ::${w}::_modal 1
            grab $w; tkwait variable ::${w}::_modal; grab release $w
        }
        "endmodal" {
            ## ends modal dialog started with startmodal, argument is var name
            set ::${w}::_modal 0
            Window hide $w
        }
        default {
            uplevel $w $command $args
        }
    }
}
```

```
###############################################################################
## Library Procedure:  vTcl:WidgetProc

proc ::vTcl:WidgetProc {w args} {
    ## This procedure may be used free of restrictions.
    ##    Exception added by Christian Gavin on 08/08/02.
    ## Other packages and widget toolkits have different licensing requirements.
    ##    Please read their license agreements for details.

    if {[llength $args] == 0} {
        ## If no arguments, returns the path the alias points to
        return $w
    }

    set command [lindex $args 0]
    set args [lrange $args 1 end]
    uplevel $w $command $args
}
###############################################################################
## Library Procedure:  vTcl:toplevel

proc ::vTcl:toplevel {args} {
    ## This procedure may be used free of restrictions.
    ##    Exception added by Christian Gavin on 08/08/02.
    ## Other packages and widget toolkits have different licensing requirements.
    ##    Please read their license agreements for details.

    uplevel #0 eval toplevel $args
    set target [lindex $args 0]
    namespace eval ::$target {set _modal 0}
}
}


if {[info exists vTcl(sourcing)]} {

proc vTcl:project:info {} {
    set base .top43
    namespace eval ::widgets::$base {
        set set,origin 1
        set set,size 1
        set runvisible 1
    }
    namespace eval ::widgets::$base.lab44 {
        array set save {-disabledforeground 1 -font 1 -text 1}
    }
    namespace eval ::widgets::$base.cpd45 {
        array set save {-disabledforeground 1 -font 1 -text 1}
    }
    namespace eval ::widgets::$base.cpd46 {
        array set save {-disabledforeground 1 -font 1 -text 1}
    }
    namespace eval ::widgets::$base.che47 {
        array set save {-disabledforeground 1 -font 1 -text 1 -variable 1}
    }
    namespace eval ::widgets::$base.but48 {
        array set save {-command 1 -disabledforeground 1 -font 1 -text 1}
    }
    namespace eval ::widgets::$base.ent49 {
```

```
        array set save {-background 1 -insertbackground 1 -textvariable 1}
    }
    namespace eval ::widgets::$base.cpd50 {
        array set save {-background 1 -insertbackground 1 -textvariable 1}
    }
    namespace eval ::widgets::$base.cpd51 {
        array set save {-background 1 -insertbackground 1 -textvariable 1}
    }
    namespace eval ::widgets::$base.lis43 {
        array set save {-background 1 -listvariable 1}
    }
    namespace eval ::widgets::$base.lab45 {
        array set save {-disabledforeground 1 -font 1 -text 1}
    }
    namespace eval ::widgets::$base.but47 {
        array set save {-command 1 -disabledforeground 1 -text 1}
    }
    namespace eval ::widgets::$base.but51 {
        array set save {-command 1 -disabledforeground 1 -text 1}
    }
    set base .top47
    namespace eval ::widgets::$base {
        set set,origin 1
        set set,size 1
        set runvisible 1
    }
    namespace eval ::widgets::$base.ent48 {
        array set save {-background 1 -disabledforeground 1 -insertbackground 1 -textvariable 1}
    }
    namespace eval ::widgets::$base.but49 {
        array set save {-command 1 -disabledforeground 1 -text 1}
    }
    namespace eval ::widgets::$base.but50 {
        array set save {-command 1 -disabledforeground 1 -text 1}
    }
    namespace eval ::widgets_bindings {
        set tagslist _TopLevel
    }
    namespace eval ::vTcl::modules::main {
        set procs {
            init
            main
            cobol_update
        }
        set compounds {
        }
        set projectType single
    }
}
}

###################################
# USER DEFINED PROCEDURES
#
#############################################################################
## Procedure:  main

proc ::main {argc argv} {
global cobol_fields widget
```

```
set cobol_fields {
    name        40
    address     50
    phone       15
    endpgm      1
    quickret      1
}

global nomes_anteriores
if {![info exists nomes_anteriores]} {
      set nomes_anteriores {}
}

#bind all <Return> do_exit
}

proc ::cobol_preprocess {args} {
      global quickret
      if {$quickret} {
              do_exit
      }
}
################################################################################
## Procedure:  cobol_update

proc ::cobol_update {} {
global widget
global nomes_anteriores name

#puts "tcl-TC LOG: lappend nomes_anteriores $name"
lappend nomes_anteriores $name
focus $widget(nome_entry)

}

################################################################################
## Initialization Procedure:  init

proc ::init {argc argv} {

}

init $argc $argv

###################################
# VTCL GENERATED GUI PROCEDURES
#

proc vTclWindow. {base} {
    if {$base == ""} {
        set base .
    }
    ###################
    # CREATING WIDGETS
    ###################
    wm focusmodel $top passive
    wm geometry $top 1x1+0+0; update
    wm maxsize $top 1265 994
```

```
    wm minsize $top 1 1
    wm overrideredirect $top 0
    wm resizable $top 1 1
    wm withdraw $top
    wm title $top "vtcl.tcl"
    bindtags $top "$top Vtcl.tcl all"
    vTcl:FireEvent $top <<Create>>
    wm protocol $top WM_DELETE_WINDOW "vTcl:FireEvent $top <<DeleteWindow>>"

    ####################
    # SETTING GEOMETRY
    ####################

    vTcl:FireEvent $base <<Ready>>
}

proc vTclWindow.top43 {base} {
    if {$base == ""} {
        set base .top43
    }
    if {[winfo exists $base]} {
        wm deiconify $base; return
    }
    set top $base
    ####################
    # CREATING WIDGETS
    ####################
    vTcl:toplevel $top -class Toplevel \
        -highlightcolor black
    wm focusmodel $top passive
    wm geometry $top 570x523+318+169; update
    wm maxsize $top 1265 994
    wm minsize $top 1 1
    wm overrideredirect $top 0
    wm resizable $top 1 1
    wm deiconify $top
    wm title $top "New Toplevel 1"
    vTcl:DefineAlias "$top" "Toplevel1" vTcl:Toplevel:WidgetProc "" 1
    bindtags $top "$top Toplevel all _TopLevel"
    vTcl:FireEvent $top <<Create>>
    wm protocol $top WM_DELETE_WINDOW "vTcl:FireEvent $top <<DeleteWindow>>"

    label $top.lab44 \
        -disabledforeground #a1a4a1 -font {helvetica 18 bold} -text Nome:
    vTcl:DefineAlias "$top.lab44" "Label1" vTcl:WidgetProc "Toplevel1" 1
    label $top.cpd45 \
        -disabledforeground #a1a4a1 -font {helvetica 18 bold} -text Endereço:
    vTcl:DefineAlias "$top.cpd45" "Label2" vTcl:WidgetProc "Toplevel1" 1
    label $top.cpd46 \
        -disabledforeground #a1a4a1 -font {helvetica 18 bold} -text Telefone:
    vTcl:DefineAlias "$top.cpd46" "Label3" vTcl:WidgetProc "Toplevel1" 1
    checkbutton $top.che47 \
        -disabledforeground #a1a4a1 -font {helvetica 10} -text concluido \
        -variable endpgm
    vTcl:DefineAlias "$top.che47" "Checkbutton1" vTcl:WidgetProc "Toplevel1" 1
    button $top.but48 \
        -command do_exit -disabledforeground #a1a4a1 \
        -font {helvetica 10 bold} -text entra
    vTcl:DefineAlias "$top.but48" "Button1" vTcl:WidgetProc "Toplevel1" 1
```

```
    entry $top.ent49 \
        -background white -insertbackground black -textvariable name
    vTcl:DefineAlias "$top.ent49" "nome_entry" vTcl:WidgetProc "Toplevel1" 1
    entry $top.cpd50 \
        -background white -insertbackground black -textvariable address
    vTcl:DefineAlias "$top.cpd50" "Entry2" vTcl:WidgetProc "Toplevel1" 1
    entry $top.cpd51 \
        -background white -insertbackground black -textvariable phone
    vTcl:DefineAlias "$top.cpd51" "Entry3" vTcl:WidgetProc "Toplevel1" 1
    listbox $top.lis43 \
        -background white -listvariable nomes_anteriores
    vTcl:DefineAlias "$top.lis43" "Listbox1" vTcl:WidgetProc "Toplevel1" 1
    label $top.lab45 \
        -disabledforeground #a1a4a1 -font {verdana -11} \
        -text {nomes
anteriores}
    vTcl:DefineAlias "$top.lab45" "Label4" vTcl:WidgetProc "Toplevel1" 1
    button $top.but47 \
        -command {source /usr/bin/tkcon} -disabledforeground #a1a4a1 \
        -text tkcon
    vTcl:DefineAlias "$top.but47" "Button2" vTcl:WidgetProc "Toplevel1" 1
    button $top.but51 \
        -command {MinhaJanela show} -disabledforeground #a1a4a1 \
        -text {nome (aux)}
    vTcl:DefineAlias "$top.but51" "Button3" vTcl:WidgetProc "Toplevel1" 1
    ###################
    # SETTING GEOMETRY
    ###################
    place $top.lab44 \
        -x 25 -y 35 -anchor nw -bordermode ignore
    place $top.cpd45 \
        -x 25 -y 100 -anchor nw
    place $top.cpd46 \
        -x 25 -y 170 -anchor nw
    place $top.che47 \
        -x 30 -y 440 -anchor nw -bordermode ignore
    place $top.but48 \
        -x 205 -y 430 -anchor nw -bordermode ignore
    place $top.ent49 \
        -x 140 -y 40 -width 403 -height 27 -anchor nw -bordermode ignore
    place $top.cpd50 \
        -x 175 -y 100 -width 368 -height 27 -anchor nw
    place $top.cpd51 \
        -x 175 -y 175 -width 273 -height 27 -anchor nw
    place $top.lis43 \
        -x 155 -y 245 -width 383 -height 156 -anchor nw -bordermode ignore
    place $top.lab45 \
        -x 35 -y 250 -anchor nw -bordermode ignore
    place $top.but47 \
        -x 470 -y 430 -anchor nw -bordermode ignore
    place $top.but51 \
        -x 320 -y 430 -anchor nw -bordermode ignore

    vTcl:FireEvent $base <<Ready>>
}

proc vTclWindow.top47 {base} {
    if {$base == ""} {
        set base .top47
```

```
    }
    if {[winfo exists $base]} {
        wm deiconify $base; return
    }
    set top $base
    ###################
    # CREATING WIDGETS
    ###################
    vTcl:toplevel $top -class Toplevel \
        -highlightcolor black
    wm withdraw $top
    wm focusmodel $top passive
    wm geometry $top 433x150+169+728; update
    wm maxsize $top 1265 994
    wm minsize $top 1 1
    wm overrideredirect $top 0
    wm resizable $top 1 1
    wm title $top "New Toplevel 2"
    vTcl:DefineAlias "$top" "MinhaJanela" vTcl:Toplevel:WidgetProc "" 1
    bindtags $top "$top Toplevel all _TopLevel"
    vTcl:FireEvent $top <<Create>>
    wm protocol $top WM_DELETE_WINDOW "vTcl:FireEvent $top <<DeleteWindow>>"

    entry $top.ent48 \
        -background white -disabledforeground #a1a4a1 -insertbackground black \
        -textvariable name1
    vTcl:DefineAlias "$top.ent48" "Entry1" vTcl:WidgetProc "MinhaJanela" 1
    button $top.but49 \
        -command {global name name1
set name $name1
MinhaJanela hide} \
        -disabledforeground #a1a4a1 -text ok
    vTcl:DefineAlias "$top.but49" "Button1" vTcl:WidgetProc "MinhaJanela" 1
    button $top.but50 \
        -command {MinhaJanela hide} -disabledforeground #a1a4a1 -text fechar
    vTcl:DefineAlias "$top.but50" "Button2" vTcl:WidgetProc "MinhaJanela" 1
    ###################
    # SETTING GEOMETRY
    ###################
    place $top.ent48 \
        -x 50 -y 30 -width 353 -height 27 -anchor nw -bordermode ignore
    place $top.but49 \
        -x 145 -y 90 -anchor nw -bordermode ignore
    place $top.but50 \
        -x 240 -y 90 -anchor nw -bordermode ignore

    vTcl:FireEvent $base <<Ready>>
}

#############################################################################
## Binding tag:  _TopLevel

bind "_TopLevel" <<Create>> {
    if {![info exists _topcount]} {set _topcount 0}; incr _topcount
}
bind "_TopLevel" <<DeleteWindow>> {
    if {[set ::%W::_modal]} {
                vTcl:Toplevel:WidgetProc %W endmodal
            } else {
```

```
                destroy %W; if {$_topcount == 0} {exit}
            }
}
bind "_TopLevel" <Destroy> {
    if {[winfo toplevel %W] == "%W"} {incr _topcount -1}
}

Window show .
Window show .top43
Window show .top47

main $argc $argv
## ** ##
```

and

```
#!/bin/sh
# the next line restarts using wish\
exec wish "$0" "$@"
# this script receives "data_block" with the (group) value
# of the cobol variable and returns "result"

## visual tcl leaves the main window iconified, so let's show it
wm deiconify .

###### put in this list varname, size pairs

set cobol_fields {
      title           20
      url                     50
}

grid [label .msg -text \
      "Use <Tab> to navigate, <Return> (or click button) \n\
to return to main program."] -columnspan 2

grid \
      [label .lab1 -text "Title:"] \
      [entry .e1 -width 20 -textvariable title] -padx 5 -pady 5 -sticky nsw
grid \
      [label .lab2 -text "URL:"] \
      [entry .e2 -width 50 -textvariable url] -padx 5 -pady 5 -sticky nsw

grid [button .ready -text Enter -command do_exit] \
      -columnspan 2 -pady 20 -sticky ns

bind all <Return> do_exit
focus .e1

#trace add variable ::ready write show_variables


proc show_variables {args} {
      uplevel #0 {
              set exclude {^::(env|auto_index|tcl_.*|widget|tk_.*|auto_.*)$}
              puts "variables: ----------------------------------------"
              foreach v [info vars ::*] {
                      if {[regexp $exclude $v]} {
                              continue
                      }
```

```
                    if {[array exists $v]} {
                            puts "$v: [array get $v]"
                    } else {
                            puts "$v: [set $v]"
                    }
            }
      }
}
```

30.16 5.16 Can OpenCOBOL interface with Falcon PL?

Not yet, but work with Giancarlo to allow embedding of Falcon scripts is in progress. **Update on December 31st, 2010**

Yes, yes it can.

This is from the linked post ... but the Falcon programming language embeds in OpenCOBOL just fine.

falconscript.fal

```
> "Falcon list comprehension called from OpenCOBOL"
sums = [].mfcomp( {x,y=> x+y}, .[1 2 3], .[4 5 6] )
return sums.describe()
```

it goes

```
$ ./callfalcon
argv[1]: falconscript.fal
Falcon list comprehension called from OpenCOBOL
VM Output: [ 5, 6, 7, 6, 7, 8, 7, 8, 9]
Intermediate: [ 5, 6, 7, 6, 7, 8, 7, 8, 9]
Falcon says: [ 5, 6, 7, 6, 7, 8, 7, 8, 9]
```

A Falcon list comprehension with **mfcomp** applies the reduction x+y on 1 and 4, 1 and 5, 1 and 6, then 2 and 4, 2 and 5 etc.

See http://www.opencobol.org/modules/newbb/viewtopic.php?topic_id=1221&forum=1&post_id=6113#forumpost6113 for details.

FalconPL has some nice features.

```
saying = List("Have", "a", "nice", "day")

for elem in saying
   >> elem
   formiddle: >> " "
   forlast: > "!"
end
```

giving:

```
Have a nice day!
```

Source files can be found in http://fossile.plpwebs.com/ocsamples.cgi/dir?ci=tip

30.17 5.17 Can OpenCOBOL interface with Ada?

Yes. The freely available **gnat** system can be used and will create object files that can be included in an OpenCOBOL project.

This example compiles an gnat package that includes *hello* and *ingress* PROCEDURE and a *echo* FUNCTION. These will be called from an OpenCOBOL **adacaller.cob** program.

The gnat specification file

```
with Interfaces.C;
use Interfaces.C;
package HelloAda is

   procedure hello;
   procedure ingress(value : in INTEGER);
   function echo(message : in char_array) return integer;
   pragma export(C, hello);
   pragma export(C, ingress);
   pragma export(C, echo);

end HelloAda;
```

The gnat implementation body

```
with Ada.Text_IO, Ada.Integer_Text_IO, Interfaces.C;
use  Ada.Text_IO, Ada.Integer_Text_IO, Interfaces.C;
package body HelloAda is

procedure hello is
begin
   Put_Line("Hello from Ada and OpenCOBOL");
   New_Line;
end hello;

procedure ingress(value : in integer) is
begin
   Put_Line("Passing integer to Ada from OpenCOBOL");
   Put("OpenCOBOL passed: ");
   Put(value);
   New_Line;
   New_Line;
end ingress;

function echo(message : in char_array) return integer is
begin
    Put(To_Ada(message, true));
    return To_Ada(message, true)'length;
end echo;

end HelloAda;
```

The adacaller.cob source file

```
OCOBOL****************** adacaller.cob ********************************
       >>SOURCE FORMAT IS FIXED
      ************************************************************************
      * Author:    Brian Tiffin
      * Date:      08-Sep-2008
      * Purpose:   Demonstrate using Ada sub-programs
      * Tectonics: gnatgcc -c helloada.adb
      *            gnatbind -n helloada
      *            gnatgcc -c b~helloada.abd
      *            cobc -x -lgnat caller.cob helloada.o b~helloada.o
      ************************************************************************
       identification division.
       program-id. caller.
```

```
       data division.
       working-storage section.
       01 ada-message      pic x(10) value "Ada echo" & x'0a' & x'00'.
       01 result           pic s9(9) value high-value.
      ******************************************************************
       procedure division.
       begin.
       call "adainit" end-call

       call "hello" end-call

       call "ingress" using by value 42 end-call

       call "echo" using
           by reference ada-message
           returning result
       end-call
       display "Ada return: " result end-display

       call "adafinal" end-call

       goback
       .
       end program caller.
```

And the tectonics; Debian GNU/Linux *build.sh*

```
gnatgcc -c helloada.adb
gnatbind -n helloada
gnatgcc -c b~helloada.adb
cobc -x -lgnat adacaller.cob helloada.o b~helloada.o
```

An important step is the creation of the object file from the *gnatbind* output *with -n* that is used in the final OpenCOBOL executable.

Sample run using ./adacaller:

```
Hello from Ada and OpenCOBOL

Passing integer to Ada from OpenCOBOL
OpenCOBOL passed:          42

Ada echo
Ada return: +000000009
```

See Can the GNAT Programming Studio be used with OpenCOBOL? for more.

30.18 5.18 Can OpenCOBOL interface with Vala?

Yes. Very easily. The Vala design philosophy of producing C application binary interface code means that Vala is directly usable with OpenCOBOL's CALL statement.

See http://live.gnome.org/Vala for some details on this emerging programming enviroment.

This interface will be seeing more and more use as it really does open the door to some very powerful extensions.

- WebKit embedding
- PDF Viewers

- GTK
- Media streaming
- much more

30.18.1 5.18.1 Call OpenCOBOL programs from Vala

Using a few simple tricks, Vala can easily call OpenCOBOL programs. Vala uses a predictable link module naming convention. Inside a class, from.vala, the linker will try and find from_vala_name, in this case from_vala_ochello.

```
/* Call OpenCOBOL from Vala */

public class from.vala
{

    public static int main(string[] args)
    {
        stdout.printf("Result: %d\n", ochello());
        return 0;

    }
    [import()]
    public extern static int ochello();
}
/**/
```

So the PROGRAM-ID here is from_vala_ochello.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20101017
      *> Purpose:   Call ochello from Vala in a from.vala Class
      *> Tectonics:
      *>   cobc -fimplicit-init -C ochello.cob
      *>   valac callcobol.vala ochello.c -X -lcob
      *> ************************************************************
       identification division.
       program-id. from_vala_ochello.

      *> ************************************************************
       procedure division.
       display "Hello OpenCOBOL's World!" end-display
       move 42 to return-code
       goback.
       end program from_vala_ochello.
```

The tectonics might seem a little bit mysterious. *cobc* is used to produce C source code, including calls for initialization of the OpenCOBOL runtime.

valac is then used to compile and link the Vala source, the generated ochello.c and then the *gcc* compiler is passed the -lcob to link in libcob.so.

30.18.2 5.18.2 Call OpenCOBOL from a Vala GTK gui application

And another experiment, with a gui button and repeated timer calls.

callhellogui.vala

```
// Call OpenCOBOL program from Vala and show the return code on a button
using Gtk;

public class from.vala {
    public static int cobolcode;
    public static char[] valarray = new char[80];

    public static int main (string[] args) {

        Gtk.init (ref args);
        var time = new TimeoutSource(50);

        var window = new Window (WindowType.TOPLEVEL);
        window.title = "Invoke OpenCOBOL program";
        window.set_default_size (300, 50);
        window.position = WindowPosition.CENTER;
        window.destroy.connect (Gtk.main_quit);

        cobolcode = ochello();

        var button = new Button.with_label (cobolcode.to_string());
        button.clicked.connect (() => {
            button.label = "Thanks for all the fish!";
            stdout.printf("%d\n", fishy());
        });

        time.set_callback(() => {
            var t = Time.local(time_t());
            string fromvala = "From vala string type + time to_string:  " + t.to_string();
            string fromcobol = "xxxx/xx/xxbxx/xx/xxxxxxx/xx";

            stdout.printf("Vala fromcobol string was   : %s\n", fromcobol);

            datey(fromvala, fromcobol);

            stdout.printf("Vala fromcobol string set to: %s\n", fromcobol);
            return true;
        });

        time.attach(null);

        window.add (button);
        window.show_all ();

        Gtk.main ();
        return 0;
    }

    [import()]
    public extern static int ochello();
    public extern static int fishy();
    public extern static int datey(string arg1, string arg2);
}
```

ochellogui.cob

And here we define *from_vala_ochello*, *from_vala_fishy*, *from_vala_datey*.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
```

```
*> Author:    Brian Tiffin
*> Date:      20101017
*> Purpose:   Call ochello from Vala in a from.vala Class
*> Tectonics:
*>   cobc -fimplicit-init -C ochellogui.cob
*>   valac --pkg gtk+-2.0 callcobolgui.vala ochellogui.c -X -lcob
*> ***************************************************************
 identification division.
 program-id. from_vala_ochello.
 procedure division.
 display "Hello OpenCOBOL's Wonderful World!" end-display
 move 42 to return-code
 goback.
 end program from_vala_ochello.

*> ***************************************************************
*> ***************************************************************

 program-id. from_vala_fishy.
 procedure division.
 display "We really do mean, thanks for all the fish!" end-display
 goback.
 end program from_vala_fishy.

*> ***************************************************************
*> ***************************************************************

 program-id. from_vala_datey.
 data division.
 working-storage section.
 01 editted-date pic xxxx/xx/xxbxx/xx/xxxxxxx/xx.

 linkage section.
 01 datafromvala pic x(60).
 01 datafromcobol pic x(27).

 procedure division using datafromvala datafromcobol.
 move function current-date to editted-date
 inspect editted-date replacing all "/" by ":" after initial space
 display editted-date end-display

 display datafromvala end-display

 move editted-date to datafromcobol
 goback.
 end program from_vala_datey.
```

Tectonics similar to the first sample. With this one, a timer fires every 50 milliseconds passing data back and forth between Vala and OpenCOBOL **unsafely, mind you**. If you push button "42", a message is printed to standard out.

Along with the GUI button, produces:

```
$ ./callcobolgui
...
Vala fromcobol string was   : xxxx/xx/xxbxx/xx/xxxxxxx/xx
2010/10/17 18:19:5598-04:00
From vala string type + time to_string:  2010-10-17 18:19:55
Vala fromcobol string set to: 2010/10/17 18:19:5598-04:00
Vala fromcobol string was   : xxxx/xx/xxbxx/xx/xxxxxxx/xx
2010/10/17 18:19:5603-04:00
From vala string type + time to_string:  2010-10-17 18:19:56
Vala fromcobol string set to: 2010/10/17 18:19:5603-04:00
...
```

30.18.3 5.18.3 Call Genie program from OpenCOBOL

Here is a sample that calls a small Genie program.

piping.gs, a small program that spawns out some shell commands. One fails on purpose, *ech* is not a valid executable. The next *echo* call has the output captured in *ret_stdout*. 42 is then passed as the return code to OpenCOBOL.

```
// Tectonics: valac -c piping.gs
[indent=4]
class wrapper : Object
    def static hellogenie() : int
        ret_stdout : string
        ret_stderr : string
        ret_status : int

        try
            Process.spawn_command_line_sync("ech 'ech?'",out ret_stdout,out ret_stderr,out ret_status
        except ex : Error
            print("in catch")
            print(ex.message)

        print("stdout: %s", ret_stdout)
        print("stderr: %s", ret_stderr)
        print("status: %d", ret_status)

        try
            Process.spawn_command_line_sync("echo -n 'hey it works!'",out ret_stdout,out ret_stderr,
        except ex : Error
            print("in catch")
            print(ex.message)

        print("stdout: %s", ret_stdout)
        print("stderr: %s", ret_stderr)
        print("status: %d", ret_status)

        return 42
```

callgenie.cob

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *><* =========
      *><* callgenie
      *><* =========
      *><* :Author:    Brian Tiffin
      *><* :Date:      29-Sep-2010
      *><* :Purpose:   Demonstrate getting at Genie code
      *><* :Tectonics:
```

```
      *><*    valac -c piping.gs
      *><*    cobc -x callgenie.cob piping.vala.o
      *><*         -lglib-2.0 -lgobject-2.0
      *> ************************************************************
       identification division.
       program-id. callgenie.

       data division.
       working-storage section.
       01 result usage binary-long.

      *> ************************************************************
       procedure division.
       call "wrapper_hellogenie" returning result end-call
       display "Result from Genie: " result end-display
       .
       goback.
       end program callgenie.
      *><*
      *><* Last Update: 29-Sep-2010
```

The Vala/Genie link naming is predictable. Inside a *class*, **wrapper**, the Genie generated link name is *wrapper_hellogenie*.

With a sample run producing:

```
[btiffin@home vala]$ ./callgenie
in catch
Failed to execute child process "ech" (No such file or directory)
stdout: (null)
stderr: (null)
status: 0
stdout: hey it works!
stderr:
status: 0
Result from Genie: +0000000042
```

30.18.4 5.18.4 Pass data to and from Genie

The Genie

```
// Tectonics: valac -c genieregex.gs
[indent=4]
class cbl.oc.genie : Object
    def static regexing(pattern : string, subject : string, out value : string, out leng : int) : int
        print " "
        print "Pattern: %s", pattern
        print "Subject: %s", subject
        try
            var r = new Regex(pattern)
            var s = subject
            s = r.replace(s, s.length, 0, "COBOL")
            value = s
            leng = (int)s.length
        except ex : Error
            print ex.message
            value = subject
            leng = (int)subject.length
            return 1
        return 0
```

The COBOL

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *><* ================
      *><* Call Genie Regex
      *><* ================
      *><* :Author:    Brian Tiffin
      *><* :Date:      20101101
      *><* :Purpose:   Getting at Genie Regex code
      *><* :Tectonics: vala -c genieregex.gs
      *><*              cobc -x callgenieregex.cob genieregex.vala.o
      *><*                   -lglib-2.0 -lgobject-2.0
      *> ************************************************************
       identification division.
       program-id. callgenieregex.

       data division.
       working-storage section.
       01 pattern pic x(80) value "Fortran|APL|Python" & x"00".
       01 subject pic x(80) value
           "OpenCOBOL, Fortran, Vala, Genie, Python, C, APL" & x"00".
       01 out-pointer usage pointer.
       01 out-length usage binary-long.
       01 middleman pic x(80) based.
       01 replacement pic x(80).
       01 result usage binary-long.

      *> ************************************************************
       procedure division.
       call "cbl_oc_genie_regexing"
           using
               by reference pattern
               by reference subject
               by reference out-pointer
               by reference out-length
           returning result
       end-call
       display "Result from Genie: " result end-display

       set address of middleman to out-pointer
       move middleman(1:out-length) to replacement
       display "replacement now: " replacement end-display

       move "(red)" & x'00' to pattern
       move "The red car was going too fast" & x'00' to subject
       move 0 to out-length
       set out-pointer to null
       free middleman

       call "cbl_oc_genie_regexing"
           using
               by reference pattern
               by reference subject
               by reference out-pointer
               by reference out-length
           returning result
       end-call
       display "Result from Genie: " result end-display
```

```
        set address of middleman to out-pointer
        move middleman(1:out-length) to replacement
        display "replacement now: " replacement end-display

        move "[:digit:]" & x'00' to pattern
        move "The Regex fails" & x'00' to subject
        move 0 to out-length
        set out-pointer to null
        free middleman

        call "cbl_oc_genie_regexing"
            using
                by reference pattern
                by reference subject
                by reference out-pointer
                by reference out-length
            returning result
        end-call
        display "Result from Genie: " result end-display

        set address of middleman to out-pointer
        move middleman(1:out-length) to replacement
        display "replacement now: " replacement end-display
        goback.
        end program callgenieregex.
```

The Output

```
$ valac -g -v -c genieregex.gs
cc -g -c '/home/btiffin/lang/cobol/genieregex.vala.c' -pthread -I/usr/include/glib-2.0 -I/usr/lib64/g

$ cobc -g -debug -v -x callgenieregex.cob genieregex.vala.o -lgobject-2.0 -lglib-2.0
Preprocessing:  callgenieregex.cob to callgenieregex.i
Return status:  0
Parsing:        callgenieregex.i
Return status:  0
Translating:    callgenieregex.i to callgenieregex.c
Executing:      gcc -c -I/usr/local/include -pipe -g -Wno-unused -fsigned-char
                -Wno-pointer-sign -o "/tmp/cob3411_0.o" "callgenieregex.c"
Return status:  0
Executing:      gcc -Wl,--export-dynamic -o "callgenieregex"
                "/tmp/cob3411_0.o" "genieregex.vala.o" -L/usr/local/lib -lcob
                -lm -lgmp -lncurses -ldb -ldl -l"gobject-2.0" -l"glib-2.0"
Return status:  0

$ ./callgenieregex

Pattern: Fortran|APL|Python
Subject: OpenCOBOL, Fortran, Vala, Genie, Python, C, APL
Result from Genie: +0000000000
replacement now: OpenCOBOL, COBOL, Vala, Genie, COBOL, C, COBOL

Pattern: (red)
Subject: The red car was going too fast
Result from Genie: +0000000000
replacement now: The COBOL car was going too fast

Pattern: [:digit:]
Subject: The Regex fails
Error while compiling regular expression [:digit:] at char 0: POSIX named classes are supported only
```

```
Result from Genie: +0000000001
replacement now: The Regex fails
```

30.19 5.19 Can OpenCOBOL interface with S-Lang?

Yes. The S-Lang engine can be used with OpenCOBOL for two purposes. Supporting a very nice terminal and keyboard programmer interface S-Lang can be used to scan the keyboard for non-waiting ACCEPT key routines. As a bonus, S-Lang has a very nice scripting engine that allows easy and direct linkage of script variables with OpenCOBOL defined storage members.

30.19.1 5.19.1 Setup

You will need the S-Lang library for this interface. Under Debian that is simply

```
$ apt-get install libslang2
```

See http://www.s-lang.org/ for details of this very capable library.

30.19.2 5.19.2 Keyboard control

This sample only show S-Lang terminal input. A very sophisticated terminal output control interface is also available.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20090503
      *> Purpose:   Experimental S-Lang interface
      *> Tectonics: cobc -x slangkey.cob -lslang
      *> ************************************************************
       identification division.
       program-id. slangkey.

       data division.
       working-storage section.
       01 thekey               usage binary-long unsigned.
       01 thekm                usage binary-long.
       01 result               usage binary-long.

      *> exit handler address and priority (prio is IGNORED with OC1.1)
       01 install-flag       pic 9 comp-x value 0.
       01  install-params.
           02 exit-addr       usage is procedure-pointer.
           02 handler-prio    pic 999 comp-x.

      *> ************************************************************
       procedure division.

      *> Initialize low and high level S-Lang terminal routines
       call "SLtt_get_terminfo" end-call
       call "SLkp_init" returning result end-call
       if result equal -1
           display "problem intializing S-Lang tty" end-display
           stop run giving 1
       end-if
```

```
       call "SLang_init_tty" using
           by value -1      *> abort char
           by value -1      *> flow ctrl
           by value 0       *> output processing
         returning result
       end-call
       if result equal -1
           display "problem intializing S-Lang tty" end-display
           stop run giving 1
       else
           display "Keyboard in special mode" x"0d" end-display
       end-if

      *> install an exit handler to put terminal back
       set exit-addr to entry "tty-reset"
       call "CBL_EXIT_PROC" using
           install-flag
           install-params
           returning result
       end-call
       if result not equal zero
           display "error installing exit procedure" end-display
       end-if

      *> Not sure?  Have SLang handle ^C or let OpenCOBOL take over?
       call "SLang_set_abort_signal" using by value 0 end-call

      *> The demo.  Fetch a key, then fetch a keycode.  4 times.
      *>   SLang terminals display newline as newline.  Need explicit
      *>   CR to get a carriage return.  Hence the x"0d".
      *>   Plus, output is buffered until line terminators.
       display
           "Tap a normal key, then tap a 'special' key, ie F1, 4 times"
           x"0d"
       end-display
       perform 4 times
           call "SLang_getkey" returning thekey end-call
           display thekey space with no advancing end-display
           call "SLkp_getkey" returning thekm end-call
           display thekm x"0d" end-display
       end-perform

      *> Exit handler will take care of resetting terminal
       goback.


      *> ***************************************************************
      *> Exit procedure to ensure terminal properly reset
      *> ***************************************************************
       entry "tty-reset".
       call "SLang_reset_tty" end-call
       display "exit proc reset the tty" end-display
       goback.

       end program slangkey.
```

Outputs:

```
Keyboard in special mode
Tap a normal key, then tap a 'special' key, ie F1, 4 times
```

```
0000000097 +0000000513
0000000001 +0000000002
0000000099 +0000065535
0000000003 +0000000003
exit proc reset the tty
```

having tapped, A, F1, Ctrl-A, Ctrl-B, C, EscEsc and Ctrl-C. The S-Lang abort handler pretty much takes over the Ctrl-C handling in this sample so it looks at though Ctrl-C was tapped twice, but it wasn't.

30.19.3 5.19.3 Scripting

S-Lang also provides a very comprehensive scripting language, which is very easy to embed.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20090505
      *> Purpose:   Experimental S-Lang interface
      *> Tectonics: cobc -x callslang.cob -lslang
      *> ************************************************************
       identification division.
       program-id. callslang.

       data division.
       working-storage section.
       01 result               usage binary-long.
       01 cobol-integer        usage binary-long value 42.
       01 cobol-float          usage float-long value 0.0.
       01 sl-int-type          constant as 20.
       01 sl-double-type       constant as 27.
       01 read-write           constant as 0.

      *> ************************************************************
       procedure division.

      *> Initialize S-Lang
       call "SLang_init_all" returning result
       if result equal -1
           display "Sorry, problem initializing SLang" end-display
       end-if

      *> Register "slint" variable
       call "SLadd_intrinsic_variable" using
           by reference "slint" & x"00"
           by reference cobol-integer
           by value sl-int-type
           by value read-write
           returning result
       end-call
       if result equal -1
           display "Could not register cobol-integer" end-display
       end-if

      *> Register "sldbl" variable
       call "SLadd_intrinsic_variable" using
           by reference "sldbl" & x"00"
           by reference cobol-float
           by value sl-double-type
```

```
           by value read-write
           returning result
       end-call
       if result equal -1
           display "Could not register cobol-float" end-display
       end-if

       call "SLang_load_string" using
         "sldbl = sum([0, 1, 2, 3, 4, 5, 6, 7, 8, 9]);" & x"00"
           returning result
       end-call
       if result equal -1
           display "Could not interpret sum intrinsic" end-display
       end-if
       display "S-Lang set cobol-float to " cobol-float end-display

       display "Next lines of output are S-Lang printf" end-display
       call "SLang_load_string" using
           '() = printf("slint (cobol-integer) = %d\n", slint);' & x"00"
           returning result
       end-call
       if result equal -1
           display "Could not interpret printf" end-display
       end-if

       add 1 to cobol-integer

       call "SLang_load_string" using
           '() = printf("slint after COBOL add = %d\n", slint);' & x"00"
           returning result
       end-call
       if result equal -1
           display "error with printf after cobol add" end-display
       end-if

      *> Let's get out of here and do the Dilbert Nerd Dance...Woohoo!
       goback.
       end program callslang.
```

Which produces:

```
S-Lang set cobol-float to 45.000000000000000000
Next lines of output are S-Lang printf
slint (cobol-integer) = 42
slint after COBOL add = 43
```

30.20 5.20 Can the GNAT Programming Studio be used with OpenCOBOL?

Yes. Extensions to smooth the integration of OpenCOBOL development in gnat-gps is posted at http://svn.wp0.org/ocdocs/brian/opencobol.xml

```
<?xml version="1.0"?>
<Custom>
  <Language>
    <Name>OpenCOBOL</Name>
    <Spec_Suffix>.cob</Spec_Suffix>
    <Extension>.cbl</Extension>
```

```
    <Extension>.cpy</Extension>

    <Keywords>^(identification|id|environment|data|procedure|division|</Keywords>
    <Keywords>program-id|author|</Keywords>
    <Keywords>configuration|source-computer|object-computer|</Keywords>
    <Keywords>special-names|repository|</Keywords>
    <Keywords>input-output|file-control|io-control|</Keywords>
    <Keywords>file|working-storage|local-storage|linkage|</Keywords>
    <Keywords>communication|report|screen|</Keywords>
    <Keywords>section|declaratives|</Keywords>
    <Keywords>end|</Keywords>
    <Keywords>perform|end-perform|until|times|varying|</Keywords>
    <Keywords>add|subtract|multiply|divide|compute|</Keywords>
    <Keywords>end-add|end-subtract|end-multiply|end-divide|end-compute|</Keywords>
    <Keywords>accept|display|read|write|rewrite|sort|</Keywords>
    <Keywords>end-accept|end-display|end-read|end-write|end-rewrite|</Keywords>
    <Keywords>move|evaluate|end-evaluate|if|end-if|when|</Keywords>
    <Keywords>(un)?string|end-(un)?string|call|end-call|</Keywords>
    <Keywords>goback|stop[\s]+run|</Keywords>
    <Keywords>filler|low-value[s]?|high-value[s]?|space[s]?|zero[es]?[s]?)\b</Keywords>

    <Context>
      <New_Line_Comment_Start>\*&gt;|[ ]{6}\*</New_Line_Comment_Start>
      <String_Delimiter>&quot;</String_Delimiter>
      <Constant_Character>&apos;</Constant_Character>
      <Can_Indent>True</Can_Indent>
      <Syntax_Highlighting>True</Syntax_Highlighting>
      <Case_Sensitive>False</Case_Sensitive>
    </Context>

    <Categories>
      <Category>
        <Name>procedure</Name>
        <Pattern>^[0-9a-z]+\.</Pattern>
        <Index>1</Index>
        <Icon>subprogram_xpm</Icon>
      </Category>
    </Categories>
  </Language>

  <alias name="program">
    <param name="pid">prog</param>
    <text>*&gt;OC&lt;*
      *&gt;&gt;SOURCE FORMAT IS FIXED
      *&gt; ************************************************************
      *&gt; Author:    Brian Tiffin
      *&gt; Date:      %D
      *&gt; Purpose:   %_
      *&gt; Tectonics: make
      *&gt; ************************************************************
       identification division.
       program-id %(pid).

       environment division.
       configuration section.
       repository.
       special-names.
       input-output section.
```

```
      data division.
      file section.
      working-storage section.
      local-storage section.
      linkage section.
      screen section.

      procedure division.
      declaratives.
      end declaratives.

      00-main.

      .
      00-finish.
      goback.
     *&gt; **************************************************************

      end program %(pid).
  </text>
</alias>

<Language>
  <Name>Vala</Name>
  <Spec_Suffix>.vala</Spec_Suffix>

  <Keywords>^(bool|char|constpointer|double|float|size_t|ssize_t|string|unichar|void|</Keywords>
  <Keywords>int|int8|int16|int32|int64|long|short|</Keywords>
  <Keywords>uint|uint8|uint16|uint32|uint64|ulong|ushort|</Keywords>
  <Keywords>class|delegate|enum|errordomain|interface|namespace|struct|</Keywords>
  <Keywords>break|continue|do|for|foreach|return|while|</Keywords>
  <Keywords>else|if|switch|</Keywords>
  <Keywords>case|default|</Keywords>
  <Keywords>abstract|const|dynamic|ensures|extern|inline|internal|override|</Keywords>
  <Keywords>private|protected|public|requires|signal|static|virtual|volatile|weak|</Keywords>
  <Keywords>false|null|true|</Keywords>
  <Keywords>try|catch|finally|throw|</Keywords>
  <Keywords>as|base|construct|delete|get|in|is|lock|new|out|params|ref|</Keywords>
  <Keywords>sizeof|set|this|throws|typeof|using|value|var|yield|yields)\b</Keywords>

  <Context>
    <New_Line_Comment_Start>//</New_Line_Comment_Start>
    <Comment_Start>/*</Comment_Start>
    <Comment_End>*/</Comment_End>
    <String_Delimiter>&quot;</String_Delimiter>
    <Constant_Character>&apos;</Constant_Character>
    <Can_Indent>True</Can_Indent>
    <Syntax_Highlighting>True</Syntax_Highlighting>
    <Case_Sensitive>True</Case_Sensitive>
  </Context>

  <Categories>
    <Category>
      <Name>procedure</Name>
      <Pattern>^[0-9a-z]+\.</Pattern>
      <Index>1</Index>
      <Icon>subprogram_xpm</Icon>
    </Category>
  </Categories>
```

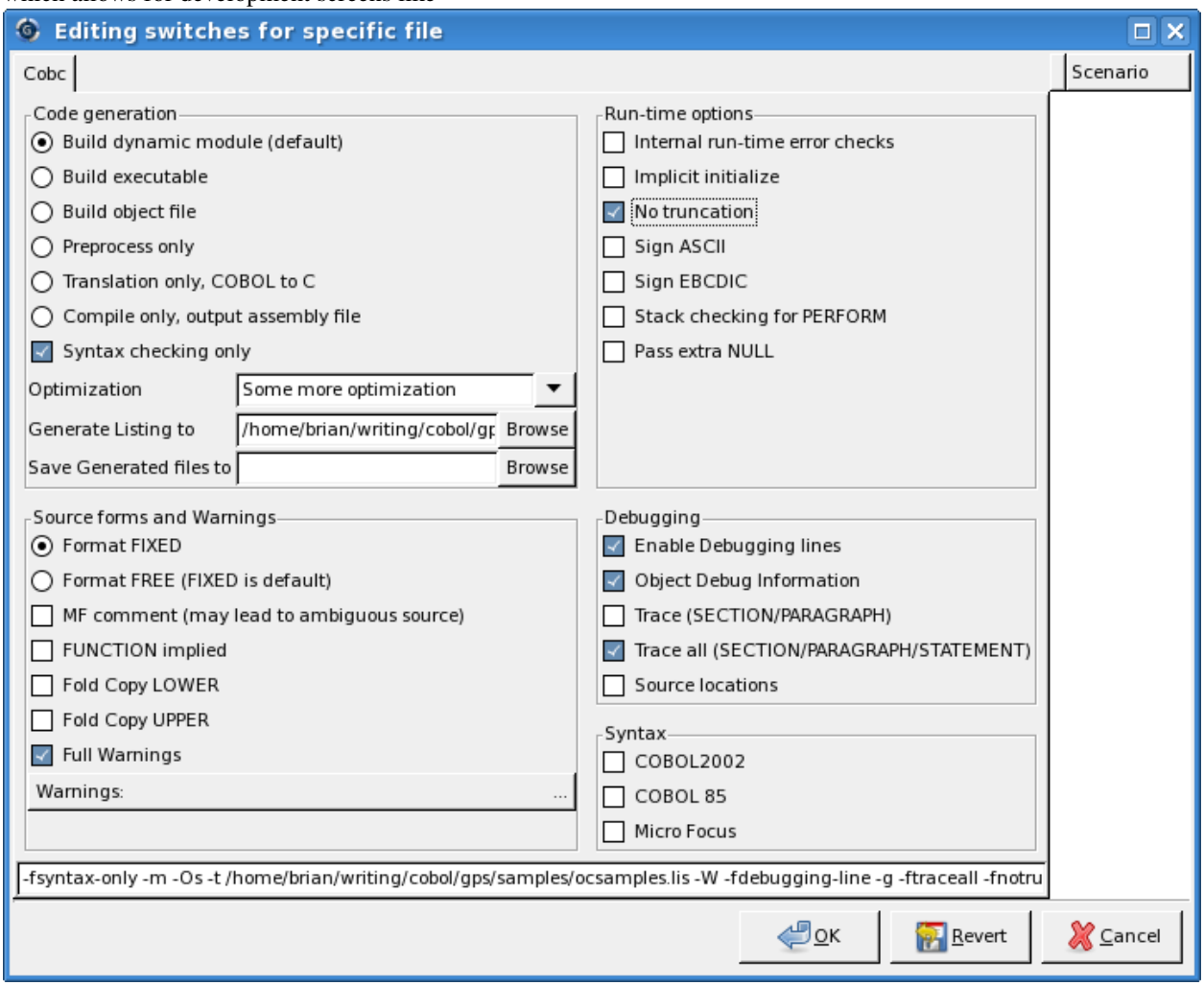
```
</Language>

<tool name="cobc" package="OpenCOBOL" index="opencobol">
  <language>OpenCOBOL</language>
  <initial-cmd-line>-m</initial-cmd-line>
    <switches lines="3" columns="2">
       <title line="1" column="1" >Code generation</title>
       <title line="1" column="2" >Run-time options</title>
       <title line="2" column="1" line-span="2" >Source forms and Warnings</title>
       <title line="3" column="1" line-span="0" />
       <title line="2" column="2" >Debugging</title>
       <title line="3" column="2" >Syntax</title>

       <radio>
          <radio-entry label="Build dynamic module (default)" switch="-m" />
          <radio-entry label="Build executable" switch="-x" />
          <radio-entry label="Build object file" switch="-c" />
          <radio-entry label="Preprocess only" switch="-E" />
          <radio-entry label="Translation only, COBOL to C" switch="-C" />
          <radio-entry label="Compile only, output assembly file" switch="-S" />
       </radio>
       <check label="Syntax checking only" switch="-fsyntax-only"
              tip="Syntax error checking only; no output emitted" />

       <combo label="Optimization" switch="-O" nodigit="1" noswitch="0"
              tip="Controls the optimization level">
          <combo-entry label="No optimization" value="0" />
          <combo-entry label="Simple optimization" value="1" />
          <combo-entry label="Some more optimization" value="s" />
          <combo-entry label="Full optimization" value="2" />
       </combo>

       <field label="Generate Listing to " switch="-t" separator=" " as-file="true"
              tip="Generate a listing file to given filename" />
       <field label="Save Generated files to " switch="-save-temps" separator="=" as-directory="tru
              tip="Save temporary files to given directory" />

       <radio line="2" column="1">
          <radio-entry label="Format FIXED" switch="-fixed"
              tip="Standards mandate default is fixed format source code" />
          <radio-entry label="Format FREE (FIXED is default)" switch="-free"
              tip="Assume free format source code" />
       </radio>
       <check label="MF comment (may lead to ambiguous source)" switch="-fmfcomment" line="2" colu
              tip="Allow * or / in column 1 as FIXED format line comment" />
       <check label="FUNCTION implied" switch="-ffunctions-all" line="2" column="1"
              tip="Allow use of intrinsic functions without FUNCTION keyword" />
       <check label="Fold Copy LOWER" switch="-ffold-copy-lower" line="2" column="1"
              tip="Fold COPY subject to lower case" />
       <check label="Fold Copy UPPER" switch="-ffold-copy-upper" line="2" column="1"
              tip="Fold COPY subject to upper case" />
       <check label="Full Warnings" switch="-W" line="2" column="1"
              tip="ALL possible warnings" />
       <popup label="Warnings" line="2" column="1">
          <check label="All (exceptions listed below)" switch="-Wall" />
          <check label="Obsolete" switch="-Wobsolete"
                 tip="Warn if obsolete features used" />
          <check label="Archaic" switch="-Warchaic"
                 tip="Warn if archaic features used" />
```

```
            <check label="Redefinition" switch="-Wredefinition"
                   tip="Warn of incompatible redefinition of data items" />
            <check label="Constant" switch="-Wconstant"
                   tip="Warn of inconsistent constant" />
            <check label="Parentheses" switch="-Wparentheses"
                   tip="Warn of lack of parentheses around AND within OR" />
            <check label="Strict typing" switch="-Wstrict-typing"
                   tip="Warn of type mismatch, strictly" />
            <check label="Implicit define" switch="-Wimplicit-define"
                   tip="Warn of implicitly defined data items" />
            <check label="Call params (Not set for All)" switch="-Wcall-params"
                   tip="Warn of non 01/77 items for CALL" />
            <check label="Column overflow (Not set for All)" switch="-Wcolumn-overflow"
                   tip="Warn for FIXED format text past column 72" />
            <check label="Terminator (Not set for All)" switch="-Wterminator"
                   tip="Warn when missing scope terminator (END-xxx)" />
            <check label="Truncate (Not set for All)" switch="-Wtruncate"
                   tip="Warn of possible field truncation" />
            <check label="Linkage (Not set for All)" switch="-Wlinkage"
                   tip="Warn of dangling LINKAGE items" />
            <check label="Unreachable (Not set for All)" switch="-Wunreachable"
                   tip="Warn of unreachable statements" />
        </popup>

        <check label="Internal run-time error checks" switch="-debug" column="2"
               tip="generate extra internal tests" />
        <check label="Implicit initialize" switch="-fimplicit-init" column="2"
               tip="Do automatic initialization of the Cobol runtime system" />
        <check label="No truncation" switch="-fnotrunc" column="2"
               tip="Do not truncate binary fields according to PICTURE" />
        <check label="Sign ASCII" switch="-fsign-ascii" column="2"
               tip="Numeric display sign ASCII (Default on ASCII machines)" />
        <check label="Sign EBCDIC" switch="-fsign-ebcdic" column="2"
               tip="Numeric display sign EBCDIC (Default on EBCDIC machines)" />
        <check label="Stack checking for PERFORM" switch="-fstack-check" column="2"
               tip="Generate code to verify that you do not go beyond the boundary of the stack" />
        <check label="Pass extra NULL" switch="-fnull-param" column="2"
               tip="Pass extra NULL terminating pointers on CALL statements" />

        <check label="Enable Debugging lines" switch="-fdebugging-line" line="2" column="2"
               tip="Enable column 7 D (FIXED FORMAT) debug lines and &gt;&gt;D inline compiler direc
        <check label="Object Debug Information" switch="-g" line="2" column="2"
               tip="Link level debug information" />
        <check label="Trace (SECTION/PARAGRAPH)" switch="-ftrace" line="2" column="2"
               tip="Enable output of trace statements for SECTION and PARAGRAPH" />
        <check label="Trace all (SECTION/PARAGRAPH/STATEMENT)" switch="-ftraceall" line="2" column="
               tip="Enable output of trace statements for SECTION, PARAGRAPH and STATEMENTS" />
        <check label="Source locations" switch="-fsource-location" line="2" column="2"
               tip="Generate source location code (Turned on by -debug or -g)" />

        <check label="COBOL2002" switch="-std=cobol2002" line="3" column="2"
               tip="Override the compiler's default, and configure for COBOL 2002" />
        <check label="COBOL 85" switch="-std=cobol85" line="3" column="2"
               tip="Override the compiler's default, and configure for COBOL 85" />
        <check label="Micro Focus" switch="-std=mf" line="3" column="2"
               tip="Override the compiler's default, and Micro Focus compatibility" />
    </switches>
</tool>
```

```
<action name="make">
  <external>make</external>
</action>

<action name="cobc">
  <external>cobc -x %f</external>
</action>

<action name="cobcrun">
  <external>cobcrun %p</external>
</action>

<action name="valac">
  <external>valac --pkg gtk+-2.0 %f</external>
</action>

<action name="gdb">
  <external>konsole --vt_sz 132x24 -e gdb ./%p</external>
</action>

<action name="cgdb">
  <external>konsole --vt_sz 132x24 -e cgdb ./%p</external>
</action>

<action name="cgdb...">
  <shell>MDI.input_dialog "Enter command arguments" "Args"</shell>
  <external>konsole --vt_sz 132x24 -e cgdb --args ./%p %1</external>
</action>

<action name="gdbtui">
  <external>konsole --vt_sz 132x24 -e gdbtui --args ./%p %1</external>
</action>

<action name="gdbtui...">
  <shell>MDI.input_dialog "Enter command arguments" "Args"</shell>
  <external>konsole --vt_sz 132x24 -e gdbtui --args ./%p %1</external>
</action>

<action name="DDD">
  <external>ddd ./%p</external>
</action>

<submenu after="Build">
  <title>OpenCOBOL</title>
  <menu action="make">
    <title>make</title>
  </menu>
  <menu action="cobc">
    <title>cobc</title>
  </menu>
  <menu action="cobcrun">
    <title>cobcrun</title>
  </menu>
  <menu action="valac">
    <title>valac</title>
  </menu>
  <menu><title /></menu>
  <menu action="gdb">
    <title>gdb</title>
```

```
    </menu>
    <menu action="cgdb">
      <title>cgdb</title>
    </menu>
    <menu action="cgdb...">
      <title>cgdb...</title>
    </menu>
    <menu action="gdbtui">
      <title>gdbtui</title>
    </menu>
    <menu action="gdbtui...">
      <title>gdbtui...</title>
    </menu>
    <menu action="DDD">
      <title>ddd</title>
    </menu>
  </submenu>
</Custom>
```

which allows for development screens like



or *to be honest* would do, if the final touches were added to the XML to integrate more with the GPS suite. There is more work required to make a proud developer's interface. *Anyone?*

30.21 5.21 Does OpenCOBOL support SCREEN SECTION?

Yes. The OpenCOBOL 1.1 pre-release now includes support for SCREEN SECTION. Experimental release for this support occurred in early July, 2008.

The compiler recognizes most (if not all) of the *Screen description entry* of the COBOL 20xx Draft standard.

External variables that influence screen handling include

COB_SCREEN_EXCEPTIONS=Y To enable exceptions during ACCEPT.

COB_SCREEN_ESC=Y To enable handling of the escape key.

See Does OpenCOBOL support CRT STATUS? for more information on key codes and exception handling.

According to the standard a SCREEN SECTION ACCEPT does not need to be proceeded by a DISPLAY. The extra DISPLAY won't hurt, but is not necessary.

30.21.1 5.21.1 Environment variables in source code

Thanks to Gary Cutler and opencobol.org.

> In order to detect the PgUp, PgDn or PrtSc (screen print) keys, you must first set the environment variable COB_SCREEN_EXCEPTIONS to a non-blank value.
>
> If you want to detect the Esc key, you must set COB_SCREEN_EXCEPTIONS as described above AND you must also set COB_SCREEN_ESC to a non-blank value. Fortunately, both of these can be done within your OpenCOBOL program, as long as they're done before the ACCEPT.

```
SET ENVIRONMENT 'COB_SCREEN_EXCEPTIONS' TO 'Y'
SET ENVIRONMENT 'COB_SCREEN_ESC'        TO 'Y'
```

30.22 5.22 What are the OpenCOBOL SCREEN SECTION colour values?

The FOREGROUND-COLOR and BACKGROUND-COLOR clauses will accept

```
78  black                   value 0.
78  blue                    value 1.
78  green                   value 2.
78  cyan                    value 3.
78  red                     value 4.
78  magenta                 value 5.
78  brown                   value 6.
78  white                   value 7.
```

The display of these colours are also influenced by HIGHLIGHT, LOWLIGHT and REVERSE-VIDEO options. For instance, brown will display as yellow when HIGHLIGHT is used.

30.23 5.23 Does OpenCOBOL support CRT STATUS?

Yes.

```
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SPECIAL-NAMES.
    CRT STATUS IS screen-status.
```

```
DATA DIVISION.
WORKING-STORAGE SECTION.
COPY screenio.
01 screen-status pic 9(4).

PROCEDURE DIVISION.
ACCEPT screen-sample.
IF screen-status = COB-SCR-F1
    ...
```

There is also a special OpenCOBOL variable, **COB-CRT-STATUS** which can be used instead of the CRT STATUS special name.

There is also a COPY text that ships with OpenCOBOL, copy/screenio.cpy that can be included in the DATA DIVISION and provides 78 level constants for supported key status codes. Some values include:

- COB-SCR-F1 thru
- COB-SCR-F64
- COB-SCR-ESC

examine the file to see the other values.

30.24 5.24 What is CobCurses?

CobCurses is an optional package designed to work with OpenCOBOL 1.0, before OpenCOBOL 1.1 SCREEN SECTION support was initiated. It has many features beyond simple SCREEN SECTION handling.

See http://sourceforge.net/projects/cobcurses for full details. This is a major piece of work by Warren Gay, ve3wwg.

From an opencobol.org posting by Warren announcing release 0.95:

```
CobCurses is a package designed to allow Open-Cobol
programmers to create screens on open system platforms,
or those (like Windows) that can use PDCurses. Since
handcrafting screens is tedious work, this package
includes a "Screen Designer" utility.

All User Guides and Programmer Guide documentation can
be found on the source forge (see link at bottom).

==== RELEASE NOTES ====

A large number of internal changes were implemented in
this release, but first let's cover the user visible
improvements:

1. MENUS! Popup menus are now supported, and are available
 in sdesign with every Action field. In fact, any sdesign
 field that is marked with a diamond graphic, has the
 ability to popup a menu with F1 (or ^O).

2. To support menus, FUNCTION keys are now available in
 Action mode (though CONTROL-O is an alternate way
 of opening a menu). This included a new event
 callback NC-FKEY-EVENT.

3. GRAPHIC characters in the screen background. It is now
 possible using sdesign to draw alternate-charset
```

```
 graphics in your screen background. See the notes in
 the opening help screen for the "Paint" function.

4. TRACE facilities. CobCurses now includes an
 environment variable that can enable capturing of
 trace information to a file for debugging. A routine
 named NC_TRACE_MSG can also be used to add custom
 messages to the trace file.

INTERNAL CHANGES:

The main two major internal changes were:

1. The terminal support has been virtualized, so that
 the CobCurses routines deal with a "terminal"
 object (not curses routines). This will eventually
 lead to other possible windowing interfaces like
 perhaps graphic X Window or native Windows support.

 The other motivation for this was to allow CobCurses
 to have one consistent set of constants for colours,
 attributes and character sets. Previously, these
 values were different depending upon the platform
 and implementation of curses used.

2. Menu support has been provided independently of curses.
 This is important for portability since PDCurses and
 some platforms do not provide a curses menu library.
 This also guarantees that CobCurses menus will behave
 consistently on all platforms (and overcome menu paging
 bugs in ncurses).

PLANNED FOR THE NEXT RELEASE:

Please avoid writing much code that works with colour pairs.
In the next release, it is planned to hide the colour pair
value altogether by using a TDC (Terminal Drawing Context).
This TDC will tie together attributes and colours, and
perhaps other "drawing contexts" so that you won't have to
manage colour pairs (this will be transparent). This will
also pave the way for graphical interfaces where a selected
font and line styles etc. may also be supported.

NOTES:

HPUX users will need to link with ncurses,
instead of the native HPUX curses libraries. I didn't
have time to fully investigate this, but the native
include files define things like MENU and ITEM types
that conflict with the CobCurses defined ones.

====

The release is available for download here:

http://sourceforge.net/projects/cobcurses
```

30.25 5.25 What is CobXRef?

CobXRef is a COBOL cross-referencing utility written by Vincent Coen and ported to OpenCOBOL 1.1.

Current source code is available at http://svn.wp0.org/add1/tools/cobxref or http://sourceforge.net/projects/cobxref/ and is currently *(February 2013)* in active development.

The system ships with full documentation and information for building from source is included in the *readme* file.

Fetching the utility

```
$ svn checkout http://svn.wp0.org/add1/tools/cobxref
```

Visit the project space at https://sourceforge.net/projects/cobxref/ for the latest information.

Example using the cobxref.cbl OpenCOBOL program for source code:

```
$ cobc -E cobxref.cbl
$ cobxref cobxref.i
$ cat cobxref.lst | head -300

ACS Cobol Cross Reference Xref v0.95.20 (09/02/2013@00:33) Dictionary File for COBXREF    09/02/13  (

Symbols of Module: COBXREF (COBXREF)
------------------------------------

Data Section (FILE)                Defn    Locations
---------------------------------+-------------------------------------------------------------------

FS-REPLY                         000067F  000195 002904
P-CONDITIONS                     000098F  001981
P-VARIABLES                      000099F  001980
PL-PROG-NAME                     000095F  002309 002312
PRINT-FILENAME                   000062F  000197 002859 002924
PRINTLINE                        000083F  001397 001398 001399 001400 001937 001939 001942 002063
                                          002133 002135 002138 002205 002215 002225 002227 002264
                                          002271 002284 002288 002290 002301 002315 002701 002702
                                          002703 002704 002705 002716 002717 002720 002721 002725
                                          002726 002727 002728 002731 002732 002734 002735 002736
                                          002737 002740 002741 002742 002743 002746 002747 002748
                                          002751 002752 002753 002756 002757 002758 002759 002923
PRINTLINE2                       000097F  001979 001982
SDSORTKEY                        000119F  001861
SKADATANAME                      000108F  001120 001122 001911 001918 001928 001943 002024 002033
                                          002035 002042 002049 002054 002056 002064 002106 002124
                                          002126 002139 002179 002192 002201 002206 002248 002257
                                          002266 002272 002349 002351
SKAREFNO                         000111F  001124 001944 001952 002065 002079 002140 002148 002180
                                          002207 002273 002350 002352
SKAWSORPD                        000109F  001116 001921 001923 001929 001945 002034 002036 002051
                                          002057 002070 002115 002141 002196 002208 002267 002275
                                          002336 002668
SKAWSORPD2                       000110F  001117 001930 002037 002058 002069 002274 002337 002669
SL-GEN-REFNO1                    000080F  002332
SORTFILE                         000069F  000117 001860
SORTRECORD                       000107F  001113 001126 002354 002923
SOURCE-LIST                      000079F  002330 002333
SOURCE-LISTING                   000062F  000078 001094 001145 001386 001449 001472 001594
SOURCEFILENAME                   000065F  000196 002833 002838 002924
SOURCEINPUT                      000065F  000101 001146 001383 001449 001472 001594 002371 002903
SOURCEOUTPUT                     000081F  002331
```

```
SOURCERECIN                     000103F  002331 002370 002375
SUPPLEMENTAL-PART1-OUT          000059F  000073 000105 001106 001145 001381 001383 001449 001472
                                         001594 001862
SUPPLEMENTAL-PART2-IN           000056F  000074 000113 001863 001891 001892 001904 001907 002007
                                         002008 002018 002020 002091 002092 002099 002101 002159
                                         002160 002170 002172 002230 002231 002241 002244
XRDATANAME                      000084F  001933 001943 002064 002129 002139 002206 002226 002272
                                         002289 002307 002311
XRDEFN                          000085F  001944 002065 002140 002207 002273 002303
XRREFERENCE                     000089F  001952 002079 002148
XRTYPE                          000086F  001945 002070 002072 002141 002208 002275 002277 002314

ACS Cobol Cross Reference Xref v0.95.20 (09/02/2013@00:33) Dictionary File for COBXREF    09/02/13  (

Symbols of Module: COBXREF (COBXREF)
------------------------------------

Data Section (WORKING-STORAGE)    Defn    Locations
---------------------------------+-------------------------------------------------------------

A                               000138W  001084 001085 001086 001088 001089 001090 001114 001115
                                         001116 001117 001119 001122 001124 001125 001185 001190
                                         001200 001202 001241 001242 001244 001267 001269 001286
                                         001316 001318 001343 001351 001492 001542 001668 001717
                                         001719 001719 001732 001735 001742 001747 001972 001977
                                         001980 001981 002302 002303 002304 002306 002308 002311
                                         002312 002585 002641 002645
ADDITIONAL-RESERVED-WORDS       000490W  001018
ALL-FUN-IDX                     000478W  002667 002670
ALL-FUNCTIONS                   000477W  001077 002665
ARG-NUMBER                      000135W  002823 002824 002826
ARG-VALS                        000361W  001101 002864
ARG-VALUE                       000362W  002832 002856 002868 002869 002872 002873 002879 002880
                                         002885 002886 002892 002893 002899 002900 002912
B                               000139W  001732 001736 001747 001752 002314 002585
BUILD-NUMBER                    000137W  001456 001459 001465 001466 001469 001550 001553 001562
                                         001601 001608 001625 002764 002766 002769 002956
C                               000140W  001732 001737 001760 002585
COBOLSEQNO                      000210W  002374
CON-TAB-BLOCKS                  001026W  001967 001990
CON-TAB-COUNT                   001032W  001233 001234 001235 001554 001563 001564 001567 001569
                                         001571 001573 001964 001966 001977 001989 002932
CON-TAB-SIZE                    001031W  001554 001555 001556 001557 001563
CONDITION-TABLE                 001025W  002928
CONDITIONS                      001029W  001235 001569 001573 001980 001990
D                               000141W  001732 001738 001767 001772 001775 002400 002577 002578
                                         002582 002592 002595 002596 002598 002598
DUMP-RESERVED-WORDS             000156W  001083
E                               000142W  002485 002487 002490 002492 002500
END-PROG                        000172W  001143 001380 001385 001389 001395 001655 002364 002441
ERROR-MESSAGES                  000335W
F-POINTER                       000134W  001139 002664 002670 002934
FS-REPLY                        000195W  002904
FULL-SECTION-NAME               000374W  001244 002723
FUNCTION-TABLE                  000387W  000476
FUNCTION-TABLE-SIZE             000481W  001089
GEN-REFNO1                      000136W  001439 001587 002326 002332 002350 002352
GIT-BUILD-NO                    001043W  002956 002962
GIT-ELEMENTS                    001035W  001865 002963
```

```
GIT-HOLDWSORPD                  001041W  001116 001125 002304 002958
GIT-HOLDWSORPD2                 001042W  001117 002959
GIT-PROG-NAME                   001039W  002308 002312 002957
GIT-REFNO                       001040W  001124 002303 002955
GIT-TABLE-COUNT                 001045W  001112 001115 001864 001878 002302 002946 002947 002954
                                         002955 002956 002957 002958 002959 002961 002962 002963
GIT-TABLE-SIZE                  001044W  002947 002948 002949 002950 002951
GIT-WORD                        001038W  001119 001122 001865 002306 002311 002954
GLOBAL-ACTIVE                   000178W  001603 001607 001624
GLOBAL-CURRENT-LEVEL            000201W  001425 001428 001460 001463 001586 002944
GLOBAL-CURRENT-REFNO            000200W  001439 001587 002955
GLOBAL-CURRENT-WORD             000199W  001438 001588 002923 002954
GLOBAL-ITEM-TABLE               001034W  001071
GOTASECTION                     000185W  001370 001414 001417 001418 002776 002781 002785 002789
                                         002793 002797 002801 002805 002809 002814
GOTENDPROGRAM                   000186W  002930
H1-DD                           000241W  002696
H1-HH                           000247W  002699
H1-MIN                          000249W  002700
H1-MM                           000243W  002697
H1-YY                           000245W  002698
H1PROG-NAME                     000239W  001134
H1PROGRAMID                     000252W  002694
HAD-END-PROG                    000175W  002361
HAVE-NESTED                     000181W  001164 001171
HD-D                            000310W  002684
HD-DATE-TIME                    000312W  002693
HD-HH                           000303W  002687
HD-M                            000309W  002683
HD-MM                           000304W  002688
HD-SS                           000305W  002689
HD-UU                           000306W  002690
HD-Y                            000308W  002682
HD2-D                           000313W  002684
HD2-HH                          000319W  002687
HD2-M                           000315W  002683
HD2-MM                          000321W  002688
HD2-SS                          000323W  002689
HD2-UU                          000325W  002690
HD2-Y                           000317W  002682
HDDATE                          000307W  002680 002681
HDR1                            000236W  002703
HDR10                           000286W  002751
HDR11                           000290W  002756
HDR11A-SORTED                   000292W  001968 001992
HDR11B-SORTED                   000296W  001969 001991
HDR12-HYPHENS                   000299W  002757
HDR3                            000254W  002726 002735 002741
HDR5-PROG-NAME                  000261W  002707 002712 002713
HDR5-SYMBOLS                    000259W  002716
HDR6-HYPHENS                    000268W  002713 002714
HDR6-SYMBOLS                    000263W  002717
HDR7-VARIABLE                   000272W  002722 002724 002733
HDR7-WS                         000270W  002725 002734
HDR8-HD                         000277W  002119
HDR8-WS                         000276W  002740
HDR9                            000282W  002746
HDTIME                          000302W  002685 002686
HOLDFOUNDWORD                   000189W  001716 001719
```

```
HOLDID                          000203W  001096 001098 001100 001167 001170 002691 002708 002957
HOLDID-MODULE                   000204W  001100 001174 001177 002710
HOLDWSORPD                      000187W  001291 001328 001354 001372 001376 001415 001461 002336
                                         002339 002353 002409 002419 002777 002780 002784 002788
                                         002792 002796 002800 002804 002808 002932 002958
HOLDWSORPD2                     000188W  001292 001329 001355 001436 001707 001710 001718 001720
                                         002337 002810 002932 002959
LINE-COUNT                      000129W  001872 002090 002102 002118 002120
LINE-END                        000131W  002396 002596
LIST-SOURCE                     000154W  001135 002329
LSECT                           000356W  001945 002070 002141 002208 002275 002314
MSG1                            000336W  001893 002009 002093 002161 002232
MSG10                           000348W  002952
MSG16                           000350W  001298
MSG2                            000337W  001144
MSG4                            000338W  001447
MSG5                            000340W  001469
MSG6                            000342W  001558
MSG7                            000344W  001783
MSG8                            000345W  002367
MSG9                            000346W  002905
P-FUNCTION                      000480W  001077 001090 002667
P-OC-IMPLEMENTED                000479W
PRINT-FILENAME                  000197W  002859 002924
PROG-BASENAME                   000198W  001096 001098 002856 002858
PROG-NAME                       000122W  001134 002840
Q                               000148W  001139 001732 001758 001761 001787 001788 001790 001796
                                         001798 001800 001802 001808 001811 001812 001842 001844
                                         001897 001934 001935 001936 001949 001951 001952 002013
                                         002076 002078 002079 002095 002130 002131 002132 002145
                                         002147 002148 002165 002209 002213 002236 002261 002278
                                         002282
REPORTS-IN-LOWER                000162W  001095 001118 001165 001172 001565 002305 002341
RESERVED-NAMES                  001019W  001076 002642
RESVD-IDX                       001020W  002644 002645
RESVD-IMPLEMENTED               001021W
RESVD-TABLE-SIZE                001023W  001085
RESVD-WORD                      001022W  001076 001086 002644
S                               000143W  001732 001758 001761 001790 001810 001811 001846 001848
                                         002459 002479 002493 002504 002526 002543
S-POINTER                       000125W  001139 002158 002214 002224 002229 002263 002283 002287
                                         002934
S-POINTER2                      000126W  001373 002427 002443 002444 002447 002450 002451 002452
                                         002459 002463 002465 002468 002478 002479 002483 002485
                                         002490 002493 002497 002499 002504 002511 002526 002532
                                         002543 002552 002934
S-POINTER3                      000127W  002934
S-POINTER4                      000128W  002935
SAVED-VARIABLE                  000191W  001220 001234 001457 001535 001543 001551 001566 001571
                                         001602 001626
SAVESKADATANAME                 000190W  001890 001918 001928 002005 002033 002035 002042 002049
                                         002054 002056 002088 002124 002126 002157 002192 002201
                                         002228 002257 002266 002924
SAVESKAWSORPD                   000192W  001929 002006 002036 002043 002050 002057 002089 002158
                                         002229 002262 002267 002282
SAVESKAWSORPD2                  000193W  001930 002006 002037 002058 002089 002158
SECTION-NAME                    000375W  002779 002783 002787 002791 002795 002799 002803 002807
SECTION-NAMES-TABLE             000364W  000373
SECTION-USED-TABLE              000358W  001873 002931
```

```
SECTTABLE                       000353W  000355
SOURCE-EOF                      000169W  001142 001297 001657 002366 002440 002554
SOURCE-LINE-END                 000132W  002396 002443 002451
SOURCE-WORDS                    000133W  001709 002428 002560
SOURCEFILENAME                  000196W  002833 002838 002924
SOURCEIN8-160                   000212W  001149 001183 001204 001207 001209 001244 001271 001273
                                         001275 001719 002376 002380 002383 002391 002392 002393
                                         002394 002404 002410 002411 002420 002444 002447 002450
                                         002460 002468 002478 002480 002487 002492 002494 002500
                                         002529 002578 002591 002592 002593 002598
SOURCEINWS                      000209W  001471 002370
STRING-POINTER                  000123W  002825 002831 002834 002839 002855 002857 002870 002874
                                         002911 002912
STRING-POINTER2                 000124W  002855 002860
SV1WHAT                         000213W  002779 002783 002787 002791 002795 002799 002803 002807
SW-2                            000153W  002881
SW-4                            000155W  002887
SW-5                            000158W  002895
SW-6                            000161W  002901
SW-END-PROG                     000171W  001401 002412
SW-GIT                          000177W  001437 001462 001521 001621 002815
SW-HAD-END-PROG                 000174W  002362 002412
SW-NESTED                       000180W  002412
SW-SOURCE-EOF                   000168W  002372 002930
T                               000144W  001754 001756 001797 001803 001815 001829 001833 001838
                                         001839 001840
USECT                           000359W  001125 001886 002353
VARIABLES                       001030W  001234 001567 001571 001967 001981
WE-ARE-TESTING                  000159W  001388 002413 002418 002561 002597 002960
WORD-DELIMIT                    000183W  001214 001224 001236 001280 001288 001311 001316 001331
                                         001339 001357 001497 001502 001506 001509 001517 001600
                                         001605 001659 001708 002445 002462 002469 002482 002486
                                         002488 002491 002496 002501 002531 002537 002562
WORD-DELIMIT2                   000184W  002506 002525 002529 002537 002544
WORD-LENGTH                     000130W  001322 001446 001447 001714 001717 001721 001722 001733
                                         001744 001745 001748 001749 001751 001753 001755 001756
                                         001764 001771 001773 001777 001798 001808 001815 001827
                                         001839 001841 002446 002470 002521 002545 002563 002765
                                         002768
WS-ANAL1                        000194W  001874 001886 001887 001905 001921 001923 002723
WS-WC-DD                        000330W  002696
WS-WC-HH                        000331W  002699
WS-WC-MIN                       000332W  002700
WS-WC-MM                        000329W  002697
WS-WC-YY                        000328W  002698
WS-WHEN-COMPILED                000327W  002695
WSF1-1                          000219W  001311 001313 001337 001660 001670 001672 001675 001678
                                         001680 001683 001686 002467 002473 002475 002476 002477
                                         002502 002509 002513 002517 002525
WSF1-2                          000218W  001699
WSF1-3                          000217W  001693 001701
WSF3-1                          000226W  002766 002770
WSF3-2                          000227W  002771
WSFOUNDNEWWORD                  000230W  001776 001778 001779 001828 001831 001842 001844 002926
WSFOUNDNEWWORD2                 000231W  001828 001836 001846 001848 002926
WSFOUNDNEWWORD3                 000232W  001731 001790 001811 001819 002925
WSFOUNDNEWWORD4                 000233W  002338 002343 002345 002349 002351 002667 002925
WSFOUNDNEWWORD5                 000234W  002586 002592 002593 002594
WSFOUNDWORD                     000216W  000225
```

```
WSFOUNDWORD2                    000225W  001157 001166 001169 001173 001176 001216 001220 001226
                                         001227 001235 001306 001345 001424 001427 001433 001438
                                         001446 001447 001470 001485 001488 001489 001493 001503
                                         001507 001520 001523 001534 001551 001568 001572 001588
                                         001615 001616 001620 001637 001673 001676 001681 001684
                                         001714 001721 001722 001735 001736 001737 001738 001739
                                         001740 001745 001748 001753 001754 001755 001768 001771
                                         001778 001779 001788 001790 001800 001811 001819 001830
                                         001835 001843 001844 001847 001848 002338 002342 002345
                                         002448 002458 002461 002471 002481 002495 002503 002505
                                         002510 002519 002528 002530 002539 002544 002563 002644
Y                               000145W  001732 001739 001741 001757
Y2                              000146W  001732 001740 001741
Z                               000147W  001733 001735 001736 001737 001738 001739 001740 001764
                                         001765 001766 001768 001778 001827 001830 001835 001841
                                         002518 002519 002521 002538 002539 002543 002544 002545

ACS Cobol Cross Reference Xref v0.95.20 (09/02/2013@00:33) Dictionary File for COBXREF    09/02/13  (

Variable Tested [S]             Symbol (88-Conditions)
-------------------------------------------------------------

SN-TEST-1                       SNT1-ON
```

Listing above limited to 300 lines

30.26 5.26 Does OpenCOBOL implement Report Writer?

Not at this time. *July, 2008*

But it does support LINAGE. See Does OpenCOBOL implement LINAGE?

30.27 5.27 Does OpenCOBOL implement LINAGE?

Yes. LINAGE sets up logical pages inside file descriptors enhancing the WRITE operations and enabling the END-OF-PAGE clause.

```
FILE SECTION.
FD  A-REPORT
    LINAGE IS 13 LINES
    TOP 2
    FOOTING 2
    BOTTOM 3.
```

LINAGE clauses can set:

```
TOP
LINES
FOOTING
BOTTOM
```

The LINAGE-COUNTER noun is maintained during writes to LINAGE output files.

See LINAGE for a sample program.

30.28 5.28 Can I use ctags with OpenCOBOL?

Yes. Use the Exuberant version of ctags. Exuberant ctags recognizes COBOL, producing a TAGS or tags file suitable for **emacs**, **vi**, **nedit** and other editors that support the ctags format. *ctags, by default, only supports the competition, C and Fortran.*

After running ctags program.cob

```
$ vi -t WORKING-STORAGE
```

will open program.cob and start at the line defining the working-storage section. Note: tags are case-sensitive and for larger projects, the above vi command would start an edit of the *first* file with an occurrence of WORKING-STORAGE found in the tags.

30.29 5.29 What about debugging OpenCOBOL programs?

OpenCOBOL internal runtime checks are enabled with **-debug**.

Support for tracing is enabled with **-ftrace** and **-ftraceall**.

Source line location is enabled with **-fsource-location**, and implied with the **-g** and **-debug** options..

Activation of FIXED format **D** indicator debug lines is enabled with **-fdebugging-line**. In FREE format, **>>D** can be used anywhere on a line. See Does OpenCOBOL support D indicator debug lines?.

-fstack-check will perform stack checking when **-debug** or **-g** is used.

-fsyntax-only will ask the compiler to only check for syntax errors, and not emit any output.

To view the intermediate files that are generated, using **-C** will produce the .c source files and any .c.l.h and c.h header files. **-save-temps[=dir]** will leave all intermediate files in the current directory or the optional directory specified, including .i files that are the COBOL sources after COPY processing.

Support for gdb is enabled with **-g**.

```
$ gdb hello
GNU gdb 6.7.1-debian
Copyright (C) 2007 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.  Type "show copying"
and "show warranty" for details.
This GDB was configured as "i486-linux-gnu"...
Using host libthread_db library "/lib/i686/cmov/libthread_db.so.1".
(gdb) break 106
Breakpoint 1 at 0xOBFUSCA: file hello.c, line 106.
(gdb) break 109
Breakpoint 2 at 0xTETHESY: file hello.c, line 109.
(gdb) run
Starting program: /home/brian/writing/cobol/hello
[Thread debugging using libthread_db enabled]
[New Thread 0xSTEMADDR (LWP 5782)]
[Switching to Thread 0xESSES6b0 (LWP 5782)]

Breakpoint 1, hello_ (entry=0) at hello.c:106
106         cob_new_display (0, 1, 1, &c_1);
(gdb) cont
Continuing.
Hello World!
```

```
Breakpoint 2, hello_ (entry=0) at hello.c:109
109       cob_set_location ("hello", "hello.cob", 6, "MAIN SECTION", "MAIN PARAGRAPH", "STOP");
(gdb) cont
Continuing.

Program exited normally.
(gdb)
```

Setting a break at line 106 and 109 was found by a quick look through the C code from **$ cobc -C hello.cob** and seeing where the DISPLAY call and STOP RUN was located. *Note: just because; the gdb displayed addresses were obfuscated from this listing.*

30.29.1 5.29.1 Some debugging tricks

From [human] on opencobol.org:

If you want to have different outputs in debug / normal mode use a fake if 1 = 1 like

```
OCOBOL
      D     IF 1 = 1
      D        DISPLAY "Debug Line"  END-DISPLAY
      D     ELSE
               DISPLAY "Normal Line" END-DISPLAY
      D     END-IF
```

For using the environment Just define

```
OCOBOL
       01  debugmode pic x.
           88  debugmode-on values 'O', 'Y', 'J', 'o', 'y', 'j', '1'.
```

put an

```
OCOBOL
           accept debugmode from Environment "DEBUGMODE"
           end-accept
```

at the beginning of each program (or define debugmode as external) and use it in your programs like

```
OCOBOL
           IF debugmode-on
              DISPLAY "Debug Line"  END-DISPLAY
           ELSE
              DISPLAY "Normal Line" END-DISPLAY
           END-IF
```

For having no debug code in runtime you can combine these two

```
OCOBOL
      D 01 debugmode pic x.
      D    88 debugmode-on values 'O', 'Y', 'J', 'o', 'y', 'j', '1'.

      ...

      D    accept debugmode from Environment "DEBUGMODE"
      D    end-accept

      ...

      D    IF debugmode-on
      D       DISPLAY "Debug Line"  END-DISPLAY
      D    ELSE
```

```
           DISPLAY "Normal Line" END-DISPLAY
D      END-IF
```

In this way you have fast code at runtime (if not compiled with -fdebugging-line) and can switch the output during development.

The advantages over a compiler switch to disable the displays are:

- You can always use display in your program, not only for debug information.
- You see in the code what you do.
- If compiled with lines that have 'D' indicator you can switch at runtime.
- If compiled without lines that have 'D' indicator you can have faster and smaller modules.

30.29.2 5.29.2 Animator

Federico Priolo posted this beauty of a present on opencobol.org

TP-COBOL-DEBUGGER

http://sourceforge.net/projects/tp-cobol-debugg/ and on his company site at http://www.tp-srl.it/

A system to preprocess OpenCOBOL inserting animator source code that at runtime provides a pretty slick stepper with WORKING-STORAGE display.

This open source bundle is OpenCOBOL. Compile the animator, run it over your own programs and it generates a new source file that when compiled and evaluated, runs in a nice SCREEN SECTION showing original source and a view pane into WORKING-STORAGE.

30.29.3 5.29.3 Unit testing

See What is COBOLUnit? for links to a well define full on Unit testing framework for COBOL, written in OpenCOBOL.

30.30 5.30 Is there a C interface to OpenCOBOL?

Most definitely. See http://www.opencobol.org/modules/bwiki/index.php?cmd=read&page=UserManual%2F2_3#content_1_0 for details.

As a short example, showing off a little of cobc's ease of use when it comes to C source code.

hello.c

```
#include <stdio.h>
int main(int argc, char *argv[]) {
    printf("Hello C compiled with cobc\n");
}

int hello(int argc, char *argv[]) {
    printf("Hello C compiled with cobc, run from hello.so with cobcrun\n");
}
```

With a sample run of

```
$ cobc hello.c
$ cobcrun hello
Hello C compiled with cobc, run from hello.so with cobcrun
$ cobc -x hello.c
$ ./hello
Hello C compiled with cobc

[btiffin@home cobol]$ cobc -v -x hello.c
Executing:      gcc -c -I/usr/local/include -pipe -Wno-unused -fsigned-char
                -Wno-pointer-sign -o "/tmp/cob2785_0.o" "hello.c"
Return status:  0
Executing:      gcc -Wl,--export-dynamic -o "hello" "/tmp/cob2785_0.o"
                -L/usr/local/lib -lcob -lm -lgmp -lncurses -ldb -ldl
Return status:  0
```

30.31 5.31 What are some idioms for dealing with C char * data from OpenCOBOL?

Thanks to Frank Swarbrick for pointing these idioms out

To add or remove a null terminator, use the STRING verb. For example

```
OCOBOL
      * Add a null for calling C
       STRING current-url
           DELIMITED BY SPACE
           X"00" DELIMITED BY SIZE
           INTO display-url
       MOVE display-url TO current-url

      * Remove a null for display
       STRING current-url
           DELIMITED BY LOW-VALUE
           INTO display-url.
```

Or to make changes in place

```
OCOBOL
      * Change nulls to spaces
       INSPECT current-url
           REPLACING ALL X"00" WITH SPACE.
```

Or there is also modified references in OpenCOBOL

```
OCOBOL
      * Assume IND is the first trailing space (or picture limit).
      * Note: OpenCOBOL auto initializes working-storage to SPACES or ZEROES
      *       depending on numeric or non-numeric pictures.
      * Remove null
       MOVE SPACE TO current-url(IND:1).

      * Add a zero terminator
       MOVE X"00" TO current-url(IND:1).
```

And the OpenCOBOL CONCATENATE intrinsic

```
OCOBOL
       MOVE FUNCTION CONCATENATE(filename; X"00") TO c-field.
```

[Roger] While points out: *X"00" is almost always interchangeable with LOW-VALUE.*

In all of the above snippets, the source code X"00" can be replaced by the COBOL noun **LOW-VALUE** or *LOW-VALUES*. *Except when a program collating sequence is active and where the first character is not X"00"*.

With the CALL verb, use ADDRESS OF and/or BY REFERENCE

```
CALL "CFUNCTION" USING BY REFERENCE ADDRESS OF current-url.
```

The above being equivalent to char** in C.

COBOL, by its nature, passes all arguments by reference. That can be overridden with the **BY VALUE** clause and the **BY CONTENT** clause.

30.32 5.32 Does OpenCOBOL support COPY includes?

Yes. COPY is fully supported, all variations from the standards up to and including the proposed 20xx standards.

Inline REPLACE text substitutions are also supported.

The **-I** compiler option influences the copybook search path and **-E** can be used to examine the *after* COPY preprocessor output.

There is also **-ffold-copy-upper** and **-ffold-copy-lower** compiler controls.

30.33 5.33 Does OpenCOBOL support WHEN-COMPILED?

Both as a noun and as an intrinsic function.

```
DISPLAY WHEN-COMPILED.
DISPLAY FUNCTION WHEN-COMPILED.

07/05/0805.15.20
2008070505152000-0400
```

Note: The noun WHEN-COMPILED is non-standard and was deemed obsolete in the pre 85 standard.

30.34 5.34 What is PI in OpenCOBOL?

With OpenCOBOL 1.1

```
DISPLAY FUNCTION PI.
3.14159265358979323846264338327950 29

DISPLAY FUNCTION E.
2.71828182845904523536028747135266 25
```

Thats 34 digits after the decimal. Developers that need to know the tolerances for use in calculations are directed to poke around the freely available source code, and to read up on GMP.

30.35 5.35 Does OpenCOBOL support the Object features of the 2002 standard?

Not yet. *July 2008*

30.36 5.36 Does OpenCOBOL implement PICTURE 78?

Yes. PICTURE 78 clauses can be used for constants, translated at compile time. This common non-standard extension is supported in OpenCOBOL.

30.37 5.37 Does OpenCOBOL implement CONSTANT?

Current OC 1.1 has preliminary support for a subset of the standard conforming "CONSTANT" phrase. eg

```
01  MYCONST CONSTANT AS 1.
```

Note: there is a syntax difference between 78 and CONSTANT.

30.38 5.38 What source formats are accepted by OpenCOBOL?

Both FIXED and FREE COBOL source formats are supported. FIXED format follows the 1-6, 7, 8-72 special columns of the COBOL standards. The compiler directives:

```
Column
12345678901234567890
       >>SOURCE FORMAT IS FREE
       >>SOURCE FORMAT IS FIXED
```

can be used. The directive must occur at column 8 or beyond if the ACTIVE scan format is FIXED. As per the 2002 standard this directive can be used to switch formats multiple times within a compilation unit.

Continuation indicators in column 7 are not applicable to FREE format and are not supported in this mode of translation. String catenation can always be used; the **&** operator.

The special *> *till end of line* comment is supported in both FREE and FIXED forms, but by necessity will need to be placed at column 7 or greater in FIXED format sources.

The **-free** and **-fixed** options to **cobc** also influence the expected source formats, with the default being mandated by the standards as FIXED.

30.39 5.39 Does OpenCOBOL support continuation lines?

Yes. A dash **-** in column 7 can be used for continuation lines. But, by necessity continuation lines only apply in FIXED format source code. FREE format COBOL does not support continuation as there is no real meaning to *column 7* in FREE form source.

Note that in this example there is no terminating quote on the string continuations, but there is an extra starting quote following the dash

```
123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012
       identification division.
       program-id. longcont.

       data division.
       working-storage section.
       01  longstr     pic X(80)
                       value "This will all be one string in FIXED forma
      -"t source code".
       01  otherstr    pic X(148) value "this
      -"string will have spaces between the words THIS and STRING, as
```

```
      -"continuation lines always fill to column 72.".
       procedure division.
       display longstr.
       display length longstr.
       display function length(function trim(longstr trailing)).
       display otherstr(1:72).
       display otherstr(73:75).
       display length otherstr.
       display function length(function trim(otherstr trailing)).
       goback.
```

Compiled with:

```
$ cobc longcont.cob
$ cobcrun longcont
```

produces:

```
This will all be one string in FIXED format source code
80
00000055
this                            string will have spaces between the words
THIS and STRING, as   continuation lines always fill to column 72.
148
00000139
```

Note: The DISPLAY of **otherstr** *was split to avoid any wide browser scrolling, not for any COBOL reasons.*

Also note that the rules for continuation lines are quite difficult to describe simply and concerned OpenCOBOL programmers are urged to read through the standards documents for full details.

30.40 5.40 Does OpenCOBOL support string concatenation?

Absolutely. Sources that need long strings, or those wishing to enhance source code readability, can use the **&** operator

```
identification division.
program-id. longstr.

data division.
working-storage section.
01  longstr     pic X(80)
                value "This " & "will " & "all " & "be " &
                      "one " &
                      "string " & "in both FIXED and FREE" &
                      " format source code".
procedure division.
display longstr.
goback.
```

Run this with

```
$ cobc longstr.cob
$ cobcrun longstr
This will all be one string in both FIXED and FREE format source code
$ cobc -free longstr.cob
$ cobcrun longstr
This will all be one string in both FIXED and FREE format source code
```

And for an Intrinsic FUNCTION unique to OpenCOBOL, see FUNCTION CONCATENATE.

30.41 5.41 Does OpenCOBOL support D indicator debug lines?

Yes, in two forms. As for continuation lines, column 7 has no meaning for SOURCE FORMAT IS FREE source code so the standard **D** in column 7 can not be used. FORMAT FREE source code can use the **>>D** compiler directive instead. Use **D** lines as a conditional include of a source code line. These debug lines will only be compiled if the *-fdebugging-line* compiler switch is used.

From human on opencobol.org

```
If you put a D in column 7 OC handles this as a comment. These lines are
only compiled if you run cobc with -fdebugging-line.

By using this you can put some test messages etc. into your program that
are only used if necessary (and therefore build with -fdebugging-line).
```

OpenCOBOL also supports a **>>D** debug compile time directive and a handy trick for those that like to write code that be compiled in both FIXED and FREE forms, is to place the directive in column 5, 6 and 7.

```
Column
12345678901234567890
       DISPLAY "Normal Line" END-DISPLAY
    >>DDISPLAY "Debug Line" END-DISPLAY
```

This allows use of the directive form in FORMAT FREE and also, with the **D** in column 7, will compile properly in FORMAT FIXED. In FORMAT FIXED the **>>** in columns 5 and 6 will be ignored as part of the *sequence number* field.

For more information on debugging support see What about debugging OpenCOBOL programs?

30.42 5.42 Does OpenCOBOL support mixed case source code?

Absolutely, kind of. Mixed case and mixed format, ASCII and EBCDIC. Most COBOL compilers have not required uppercase only source code for quite a few years now. Still, most COBOL compilers including OpenCOBOL folds parts of the source to uppercase *with certain rules* before translating.

The compiler is case insensitive to names

```
000100 identification division.
000200 program-id. mixcase.
000300 data division.
000400 working-storage section.
000500 01 SOMEUPPER pic x(9).
000600 01 SomeUpper pic x(9).
000700 01 someupper pic x(9).
000800
000900 procedure division.
001000 move "SOMEUPPER" to SOMEUPPER.
001100 move "SomeUpper" to SomeUpper.
001200 move "someupper" to someupper.
001300 display "SOMEUPPER: " SOMEUPPER end-display.
001400 display "SomeUpper: " SomeUpper end-display.
001500 display "someupper: " someupper end-display.
001600 stop run.
```

Attempted compile with:

```
$ cobc -x mixcase.cob
```

produces:

```
mixcase.cob:10: Error: 'SOMEUPPER' ambiguous; need qualification
mixcase.cob:5: Error: 'SOMEUPPER' defined here
mixcase.cob:6: Error: 'SOMEUPPER' defined here
mixcase.cob:7: Error: 'SOMEUPPER' defined here
```

Note; that although the folded declarations conflict, the DISPLAY quoted strings will NOT be folded, and would display as expected.

Case sensitivity is also at the mercy of operating system conventions. Under GNU/Linux, OpenCOBOL's dynamic link loader is case sensitive.

```
CALL "C$JUSTIFY" USING center-string "C" END-CALL.
```

is not the same as

```
CALL "c$justify" USING center-string "C" END-CALL.
```

In support of case folding and COPY libraries, OpenCOBOL supports *-ffold-copy-lower* and *-ffold-copy-upper*. For mixing and matching legacy sources.

Trivia The expressions *uppercase* and *lowercase* date back to early moveable type. Typographers would keep two cases of metal casted letters, Capitalized and normal. Usually set on stacked shelves over the workbench. The small letters, being used more frequently, ended up on the lower shelf; the lower case letters.

30.43 5.43 What is the shortest OpenCOBOL program?

All that is needed is a program-id. Doesn't do much.

```
program-id. a.
```

Update: It turns out that an empty file is the shortest OpenCOBOL that will do nothing. From Roger

```
$ ls -l empty.cob
-rw-r--r-- 1 root root 0 Jun 21 12:35 empty.cob

$ cobc -x -frelax-syntax empty.cob
empty.cob: 1: Warning: PROGRAM-ID header missing - assumed

$ ./empty
$
```

(Alternate to -frelax-syntax is -std=mf)

30.44 5.44 What is the shortest Hello World program in OpenCOBOL?

A short version of OpenCOBOL hello world, compiled -free

```
program-id.hello.procedure division.display "Hello World!".
```

Thanks to human and the opencobol.org forums.

Please note: This is **not good** COBOL form, and is only shown as an example of the possibilities.

Update: From Roger the shortest hello world program can be

```
$ cat hello.cob
display"Hello World!".

$ cobc -x -frelax-syntax -free hello.cob
hello.cob: 1: Warning: PROGRAM-ID header missing - assumed
hello.cob: 1: Warning: PROCEDURE DIVISION header missing - assumed
```

```
$ ./hello
Hello World!
$
```

So, that means, **display"Hello World!".** is all you need, if you compile with *relax-syntax*.

30.45 5.45 How do I get those nifty sequential sequence numbers in a source file?

FIXED format COBOL uses the first 6 positions of each line as a programmer defined **sequence** field. This field is stripped as part of the preprocessing and is not validated. Historically, the sequence numbers were used to verify that card punch cards were read into a card reader in the proper order. Many legacy COBOL programs have sequentially numbered sequence values. Here is a little **vi** trick to renumber the sequence field by 100s.

Given

```
000005* HELLO.COB OpenCOBOL FAQ example
000010 IDENTIFICATION DIVISION.
000020 PROGRAM-ID. hello.
000030 PROCEDURE DIVISION.
000040 DISPLAY "Hello World!".
000100 STOP RUN.
```

Running the following **ex** filter

:%!perl -ne 'printf("\%06d\%s\n", $. * 100, substr($_, 6, -1));'

produces a nicely resequenced source file.

```
000100* HELLO.COB OpenCOBOL FAQ example
000200 IDENTIFICATION DIVISION.
000300 PROGRAM-ID. hello.
000400 PROCEDURE DIVISION.
000500 DISPLAY "Hello World!".
000600 STOP RUN.
```

- Note: Only use this on already FIXED form source. If used on any FREE format COBOL, the first 6 columns will be damaged.

This has no effect on the compilation process, it only effects the appearance of the sources.

Note: Be careful not to confuse SEQUENCE NUMBERS with source code LINE NUMBERS. They are not the same.

- Vim: For users of the Vim editor, the command

```
:set number
```

will display the number of each source line. Many editors support the display of line numbers. Even

```
$ less -N
```

can be used to display line numbers of its input.

30.46 5.46 Is there a way to count trailing spaces in data fields using OpenCOBOL?

Yes. Quite a few. But instead of resorting to a PERFORM VARYING sequence try

```
01  B-COUNT                          PIC 999 VALUE 0.
01  TEST-CASE                        PIC X(80)
    VALUE "This is my string.".

ONE-WAY.
    INSPECT FUNCTION REVERSE(TEST-CASE)
        TALLYING B-COUNT
        FOR LEADING ' '.
    DISPLAY B-COUNT.

TWO-WAY.
    INSPECT TEST-CASE
        TALLYING B-COUNT
        FOR TRAILING SPACE.
    DISPLAY B-COUNT.

THREE-WAY.
    IF TEST-CASE EQUAL SPACES
        COMPUTE B-COUNT = LENGTH OF TEST-CASE
    ELSE
        COMPUTE
            B-COUNT = LENGTH TEST-CASE -
                FUNCTION LENGTH(FUNCTION TRIM(TEST-CASE TRAILING))
        END-COMPUTE
    END-IF
    DISPLAY B-COUNT.
```

produces:

```
062
124
062
```

The second value is 124 as TWO-WAY accumulates another 62 after ONE-WAY. The INSPECT verb does not initialize a TALLYING variable.

Information modified from opencobol.org forum post.

30.47 5.47 Is there a way to left justify an edited numeric field?

Yes, a couple of ways.

Assuming a working storage of

```
01 mynumber PIC 9(8)   VALUE 123.
01 myedit   PIC Z(7)9.
01 mychars  PIC X(8).

01 spcount  PIC 99     USAGE COMPUTATIONAL.

MOVE mynumber TO myedit
MOVE myedit TO mychars
DISPLAY mynumber END-DISPLAY
DISPLAY myedit END-DISPLAY
```

```
00000123
     123
```

With OpenCOBOL, the intrinsic

```
FUNCTION TRIM(myedit LEADING)
```

will trim leading whitespace. The LEADING is not really necessary as TRIM removes both leading and trailing whitespace.

OpenCOBOL also ships with a library function for justification of strings

```
CALL "C$JUSTIFY" USING mychars "L" END-CALL
```

to left justify an alphanumeric field. “R” for right, or “C” for centre.

But a generic idiom that should work across all capable COBOL systems

```
MOVE 0 TO spcount
INSPECT myedit TALLYING spcount FOR LEADING SPACE
MOVE myedit(spcount + 1:) TO mychars

DISPLAY myedit END-DISPLAY
DISPLAY mychars END-DISPLAY
```

```
     123
123
```

```
MOVE 0 TO spcount
INSPECT mynumber TALLYING spcount FOR LEADING ZERO
DISPLAY mynumber
DISPLAY mynumber(spcount + 1:)
```

Uses the INSPECT verb to count leading spaces, then reference modification to move the characters one past the spaces till the end of the edit field to an alpha field.

30.48 5.48 Is there a way to detemermine when OpenCOBOL is running ASCII or EBCDIC?

OpenCOBOL supports both ASCII and EBCDIC character encodings. A simple test such as

```
01  MYSPACE   PIC X VALUE X"20".
    88 MYISASCII   VALUE SPACE.

IF MYISASCII
    DISPLAY "I'm ASCII" END-DISPLAY
END-IF
```

can be used to determine the character set at run-time.

30.49 5.49 Is there a way to determine when OpenCOBOL is running on 32 or 64 bits?

OpenCOBOL builds and supports both 32 and 64 bit architectures. A simple test such as

```
01  MYPOINTER    USAGE POINTER.

IF FUNCTION LENGTH(MYPOINTER) EQUALS 8
    DISPLAY "This is a 64 bit machine" END-DISPLAY
END-IF
```

can be used to determine the native bit size at run-time.

30.50 5.50 Does OpenCOBOL support recursion?

Yes. Not completely to standard currently *(February 2013)*, as there are no restrictions on calling programs in a recursive manner, but yes.

A made up example using a factorial called program

```
OCOBOL*> ******************************************************************
      *> Author:    Brian Tiffin
      *> Date:      29-Dec-2008
      *> Purpose:   Horsing around with recursion
      *> Tectonics: cobc -x recurse.cob
      *> ******************************************************************
       identification division.
       program-id. recurse.

       data division.
       working-storage section.
       78 n      value 4.
       01 fact usage binary-long.

      *> ******************************************************************
       procedure division.

       call "factorial" using by value n returning fact end-call
       display n "! = " fact end-display

       goback.
       end program recurse.
      *> ******************************************************************
      *> ******************************************************************

      *> ******************************************************************
       identification division.
       program-id. factorial is recursive.

       data division.
       local-storage section.
       01 result usage is binary-long.

       linkage section.
       01 num usage is binary-long.

      *> ******************************************************************
       procedure division using by value num.

       display "num: " num end-display
       if num equal zero
           move 1 to return-code
           display "ret: " return-code end-display
           goback
       end-if

       subtract 1 from num end-subtract
       call "factorial" using by value num returning result end-call
       compute return-code = (num + 1) * result end-compute
       display "ret: " return-code end-display
       goback.
```

```
       end program factorial.
```

Produces:

```
num: +0000000004
num: +0000000003
num: +0000000002
num: +0000000001
num: +0000000000
ret: +000000001
ret: +000000001
ret: +000000002
ret: +000000006
ret: +000000024
4! = +0000000024
```

Of course the *Intrinsic FUNCTION FACTORIAL* might be a more efficient and much easier way at getting factorials.

30.51 5.51 Does OpenCOBOL capture arithmetic overflow?

Yes. Here is one sample using *ADD* with *ON SIZE ERROR*.

And please note that OVERFLOW is a conditional for STRING. In COBOL, what this author terms 'overflow' is less technically correct than 'size error' when using COBOL arithmetic terminology.

```
OCOBOL*> ************************************************************
       *> Author:    Brian Tiffin
       *> Date:      04-Feb-2009
       *> Purpose:   Factorial and overflow
       *> Tectonics: cobc -x overflowing.cob
       *> ************************************************************
        identification division.
        program-id. overflowing.

        data division.
        working-storage section.
        01 fact   usage binary-long.
        01 answer usage binary-double.

       *> ************************************************************
        procedure division.
        00-main.

        perform
            varying fact from 1 by 1
            until fact > 21
                add function factorial(fact) to zero giving answer
                    on size error
                        display
                            "overflow at: " fact " is " answer
                            " without test " function factorial(fact)
                        end-display
                    not on size error
                        display fact ": " answer end-display
                end-add
        end-perform
        .

        00-leave.
```

```
       goback.

       end program overflowing.
      *> ************************************************************
```

which outputs:

```
+0000000001: +00000000000000000001
+0000000002: +00000000000000000002
+0000000003: +00000000000000000006
+0000000004: +00000000000000000024
+0000000005: +00000000000000000120
+0000000006: +00000000000000000720
+0000000007: +00000000000000005040
+0000000008: +00000000000000040320
+0000000009: +00000000000000362880
+0000000010: +00000000000003628800
+0000000011: +00000000000039916800
+0000000012: +00000000000479001600
+0000000013: +00000000006227020800
+0000000014: +00000000087178291200
+0000000015: +00000001307674368000
+0000000016: +00000020922789888000
+0000000017: +00000355687428096000
+0000000018: +00006402373705728000
+0000000019: +00121645100408832000
overflow at: +0000000020 is +00121645100408832000 without test 432902008176640000
overflow at: +0000000021 is +00121645100408832000 without test 197454024290336768
```

30.52 5.52 Can OpenCOBOL be used for plotting?

Yes? One way is with an external call to *gnuplot*.

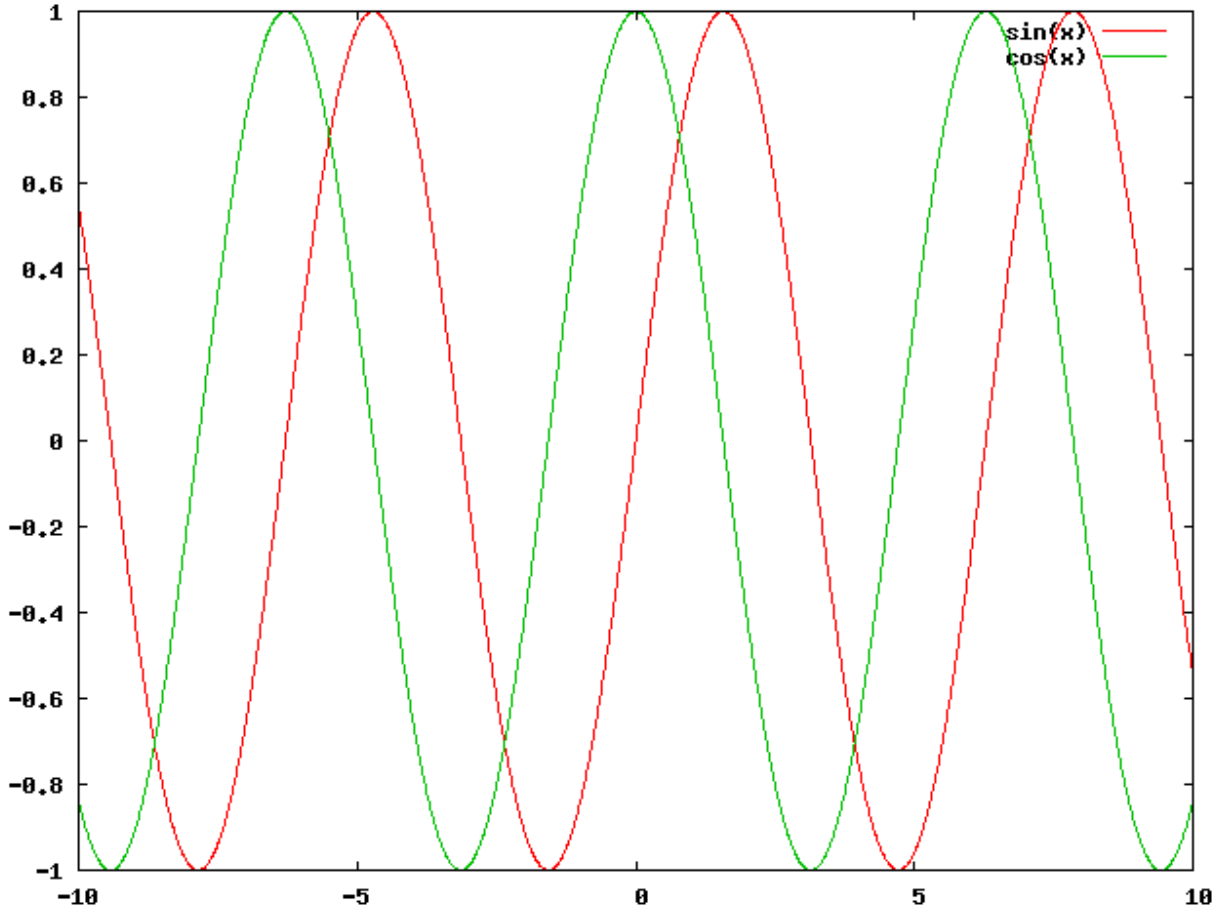
```
OCOBOL >>SOURCE FORMAT IS FIXED
      ******************************************************************
      * Author:    Brian Tiffin
      * Date:      29-July-2008
      * Purpose:   Plot trig and a random income/expense/worth report
      * Tectonics: requires access to gnuplot. http://www.gnuplot.info
      *            cobc -Wall -x plotworth.cob
      *  OVERWRITES ocgenplot.gp ocgpdata.txt sincos.png ploworth.png
      ******************************************************************
       identification division.
       program-id. plotworth.

       environment division.
       input-output section.
       file-control.
          select scriptfile
              assign to "ocgenplot.gp"
              organization is line sequential.
          select outfile
              assign to "ocgpdata.txt"
              organization is line sequential.
          select moneyfile
              assign to "ocgpdata.txt"
              organization is line sequential.

       data division.
```

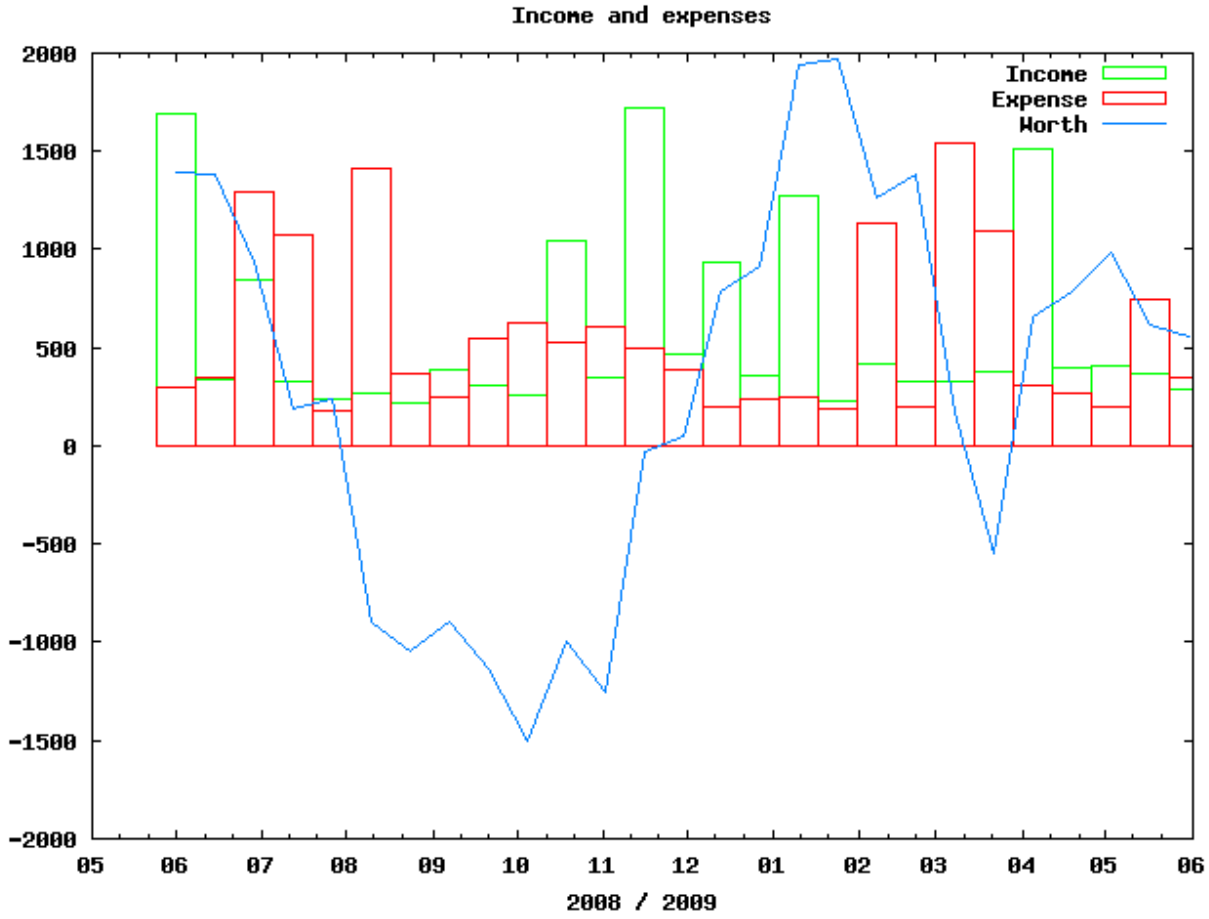
```
 file section.
 fd scriptfile.
   01 gnuplot-command pic x(82).
 fd outfile.
   01 outrec.
      03 x-value   pic -zzzzzz9.99.
      03 filler    pic x.
      03 sin-value pic -zzzz9.9999.
      03 filler    pic x.
      03 cos-value pic -zzzz9.9999.
 fd moneyfile.
   01 moneyrec.
      03 timefield pic 9(8).
      03 filler    pic x.
      03 income    pic -zzzzzz9.99.
      03 filler    pic x.
      03 expense   pic -zzzzzz9.99.
      03 filler    pic x.
      03 networth  pic -zzzzzz9.99.

 working-storage section.
 01 angle   pic s9(7)v99.

 01 dates   pic 9(8).
 01 days    pic s9(9).
 01 worth   pic s9(9).
 01 amount  pic s9(9).

 01 gplot   pic x(80) value is 'gnuplot -persist ocgenplot.gp'.
 01 result  pic s9(9).

 procedure division.

*> Create the script to plot sin and cos
 open output scriptfile.
 move "plot 'ocgpdata.txt' using 1:2 with lines title 'sin(x)'"
- to gnuplot-command.
 write gnuplot-command.
 move "replot 'ocgpdata.txt' using 1:3 with lines title 'cos(x)'"
- to gnuplot-command.
 write gnuplot-command.
 move "set terminal png; set output 'sincos.png'; replot"
- to gnuplot-command.
 write gnuplot-command.
 close scriptfile.

*> Create the sinoidal data
 open output outfile.
 move spaces to outrec.
 perform varying angle from -10 by 0.01
    until angle > 10
        move angle to x-value
        move function sin(angle) to sin-value
        move function cos(angle) to cos-value
        write outrec
 end-perform.
 close outfile.

*> Invoke gnuplot
```

```
 call "SYSTEM" using gplot
                returning result.
 if result not = 0
    display "Problem: " result
    stop run returning result
 end-if.

*> Generate script to plot the random networth
 open output scriptfile.
 move "set xdata time" to gnuplot-command.
 write gnuplot-command.
 move 'set timefmt "%Y%m%d"' to gnuplot-command.
 write gnuplot-command.
 move 'set format x "%m"' to gnuplot-command.
 write gnuplot-command.
 move 'set title "Income and expenses"' to gnuplot-command.
 write gnuplot-command.
 move 'set xlabel "2008 / 2009"' to gnuplot-command.
 write gnuplot-command.
 move 'plot "ocgpdata.txt" using 1:2 with boxes title "Income"
-' linecolor rgb "green"' to gnuplot-command.
 write gnuplot-command.
 move 'replot "ocgpdata.txt" using 1:3 with boxes title "Expense"
-' linecolor rgb "red"' to gnuplot-command.
 write gnuplot-command.
 move 'replot "ocgpdata.txt" using 1:4 with lines title "Worth"'
-    to gnuplot-command.
 write gnuplot-command.
 move 'set terminal png; set output "plotworth.png"; replot'
-    to gnuplot-command.
 write gnuplot-command.
 close scriptfile.

*> Generate a bi-weekly dataset with date, income, expense, worth
 open output moneyfile.
 move spaces to moneyrec.
 move function integer-of-date(20080601) to dates.
 move function random(0) to amount.

 perform varying days from dates by 14
    until days > dates + 365
        move function date-of-integer(days) to timefield
        compute amount = function random() * 2000
        compute worth = worth + amount
        move amount to income
        compute amount  = function random() * 1800
        compute worth = worth - amount
        move amount to expense
        move worth to networth
        write moneyrec
 end-perform.
 close moneyfile.

*> Invoke gnuplot again.  Will open new window.
 call "SYSTEM" using gplot
                returning result.
 if result not = 0
    display "Problem: " result
    stop run returning result
```

```
        end-if.

        goback.
```

Which displays and saves:





30.53 5.53 Does OpenCOBOL support the GIMP ToolKit, GTK+?

Yes. A binding for GTK+ is in the works. Early samples have proven workable and screenshots of OpenCOBOL GUI screens are shown here.

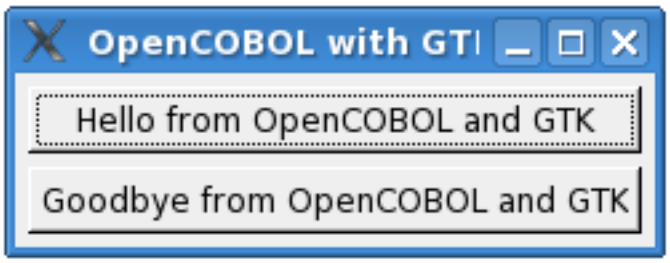
What does GIMP stand for?

GIMP is an acronym for the *GNU Image Manipulation Program*, a very complete and robust grapic design tool. See the GIMP site for more information.

GTK+ is the GIMP ToolKit. See the GTK site for more information.

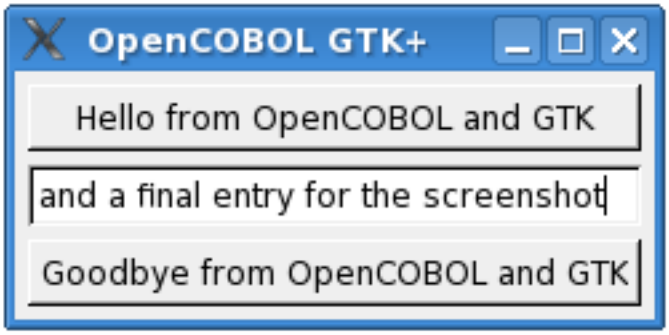
Simple buttons

```
Hello from GTK in OpenCOBOL at 2008120111495787-0500
Hello from GTK in OpenCOBOL at 2008120111500044-0500
```



Text entry widget

```
Hello from GTK in OpenCOBOL at 2008120312472750-0500
text: first entry                          , +0000000011
text: first entry - editted                , +0000000021
text: then a clear                         , +0000000012
text:                                      , +0000000000
text: and a final entry for the screen,      +0000000032
```



Sample OpenCOBOL that generated the above

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      03-Dec-2008
      *> Purpose:   Hello from GTK+
      *> Requires:  libgtk2.0, libgtk2.0-dev, gtk2.0, pkg-config
      *> Tectonics:
      *>     cobc -c `pkg-config --cflags gtk+-2.0` ocgtk.c
      *>     cobc -x `pkg-config --libs gtk+-2.0` gtkhello.cob ocgtk.o
      *> ************************************************************
       identification division.
       program-id. gtkhello.

       data division.

       working-storage section.
       01 result               usage binary-long.
       01 gtk-window           usage pointer.
       01 gtk-box              usage pointer.
       01 gtk-hello            usage pointer.
       01 gtk-textentry        usage pointer.
```

```
       01 gtk-goodbye          usage pointer.

       01 callback             usage procedure-pointer.
       01 params               usage pointer.

      *> ************************************************************
       procedure division.

      *> Initialize GTK
       CALL "CBL_OC_GTK_INIT_CHECK" returning result END-CALL
      >>D   display "init: " result end-display

      *> Create a toplevel window
       CALL "CBL_OC_GTK_WINDOW_NEW" returning gtk-window END-CALL
      >>D   display "win: " gtk-window end-display

      *> Set the titlebar - using cob_field now **HERE**
       CALL "CBL_OC_GTK_WINDOW_SET_TITLE"
            using by value gtk-window
                  by reference "OpenCOBOL GTK+"
       END-CALL
      >>D   display "title: " gtk-window end-display

      *> Set the border width
       CALL "CBL_OC_GTK_CONTAINER_SET_BORDER_WIDTH"
            using by value gtk-window
                  by value 5
       END-CALL
      >>D   display "border: " gtk-window end-display

      *> connect a window destroy, quit main loop handler
       set callback to entry "CBL_OC_destroy"
       CALL "CBL_OC_G_SIGNAL_CONNECT"
            using by value gtk-window
                  by reference "delete_event" & x"00"
                  by value callback
                  by value params
       END-CALL

      *> Create a vertically packed box
       CALL "CBL_OC_GTK_VBOX_NEW"
            using by value 0
                  by value 5
            returning gtk-box
       END-CALL
      >>D   display "box: " gtk-box end-display

      *> Add the box to the window
       CALL "CBL_OC_GTK_CONTAINER_ADD"
            using by value gtk-window
                  by value gtk-box
       END-CALL

      *> Create the hello button
       CALL "CBL_OC_GTK_BUTTON_NEW_WITH_LABEL"
       using by reference "Hello from OpenCOBOL and GTK" & x"00"
       returning gtk-hello
       END-CALL
      >>D   display "button: " gtk-hello end-display
```

```
      *> Connect the hello button to the hello code
       set callback to entry "CBL_OC_hello"
       CALL "CBL_OC_G_SIGNAL_CONNECT"
           using by value gtk-hello
                 by reference "clicked" & x"00"
                 by value callback
                 by value params
       END-CALL

      *> Pack the button into the box, top to bottom
       CALL "CBL_OC_GTK_BOX_PACK_START"
           using by value gtk-box
                 by value gtk-hello
                 by value 1
                 by value 1
                 by value 0
       END-CALL

      *> button is ready to show
       CALL "CBL_OC_GTK_WIDGET_SHOW"
           using by value gtk-hello
       END-CALL

      *> Add a text entry field
       CALL "CBL_OC_GTK_ENTRY_NEW"
           returning gtk-textentry
       END-CALL

      *> Connect code to the text entry, passing the entry widget
       set callback to entry "CBL_OC_activate"
       CALL "CBL_OC_G_SIGNAL_CONNECT"
           using by value gtk-textentry
                 by reference "activate" & x"00"
                 by value callback
                 by value gtk-textentry
       END-CALL

      *> Pack the text field into the box, top to bottom
       CALL "CBL_OC_GTK_BOX_PACK_START"
           using by value gtk-box
                 by value gtk-textentry
                 by value 1
                 by value 1
                 by value 0
       END-CALL

      *> text field is ready to show
       CALL "CBL_OC_GTK_WIDGET_SHOW"
           using by value gtk-textentry
       END-CALL

      *> Create the bye button
       CALL "CBL_OC_GTK_BUTTON_NEW_WITH_LABEL"
       using by reference "Goodbye from OpenCOBOL and GTK" & x"00"
           returning gtk-goodbye
       END-CALL
      >>D   display "button: " gtk-goodbye end-display
```

```
      *> Connect the bye button to the bye code
       set callback to entry "CBL_OC_destroy"
       CALL "CBL_OC_G_SIGNAL_CONNECT"
           using by value gtk-goodbye
                 by reference "clicked" & x"00"
                 by value callback
                 by value params
       END-CALL

      *> Pack the button into the box, under hello
       CALL "CBL_OC_GTK_BOX_PACK_START"
           using by value gtk-box
                 by value gtk-goodbye
                 by value 1
                 by value 1
                 by value 0
       END-CALL
    >>D   display "pack: " gtk-box end-display

      *> button is ready to show
       CALL "CBL_OC_GTK_WIDGET_SHOW"
           using by value gtk-goodbye
       END-CALL

      *> box is ready to show
       CALL "CBL_OC_GTK_WIDGET_SHOW"
           using by value gtk-box
       END-CALL

      *> window is ready to show
       CALL "CBL_OC_GTK_WIDGET_SHOW"
           using by value gtk-window
       END-CALL

      *> Start up the event loop, control returned when GTK main exits
       CALL "CBL_OC_GTK_MAIN" END-CALL

      *> Something terminated the GTK main loop, sys-close or bye or
       display "ending..." end-display

       goback.
       end program gtkhello.
      *> ************************************************************

      *> **** window shutdown callback ********************************
       identification division.
       program-id. CBL_OC_destroy.
       data division.
       linkage section.
       01 gtk-window           usage pointer.
       01 gtk-data             usage pointer.

       procedure division using by value gtk-window by value gtk-data.

       CALL "CBL_OC_GTK_MAIN_QUIT" END-CALL

       goback.
       end program CBL_OC_destroy.
      *> ************************************************************
```

```
      *> **** hello button click callback ****************************
       identification division.
       program-id. CBL_OC_hello.
       data division.
       linkage section.
       01 gtk-window           usage pointer.
       01 gtk-data             usage pointer.

       procedure division using by value gtk-window by value gtk-data.
       display
           "Hello from GTK in OpenCOBOL at "
           function current-date
       end-display

       goback.
       end program CBL_OC_hello.

      *> **** text entry activation callback ************************
      *> This procedure called from GTK on enter key pressed in entry
       identification division.
       program-id. CBL_OC_activate.
       data division.
       working-storage section.
       01 textfield            pic x(32).
       01 textlen              usage binary-long.

       linkage section.
       01 gtk-window           usage pointer.
       01 gtk-data             usage pointer.

       procedure division using by value gtk-window by value gtk-data.

       CALL "CBL_OC_GTK_ENTRY_GET_TEXT"
           using by value gtk-data
                 textfield
           returning textlen
       END-CALL
       display "text: " textfield ", " textlen end-display

       goback.
       end program CBL_OC_activate.
```

Using this very early thin wrapper to GTK+

```
/* OpenCOBOL GTK+ 2.0 wrapper */
/* Tectonics: cobc -c `pkg-config --cflags gtk+-2.0` ocgtk.c */

#include <memory.h>
#include <stdlib.h>
#include <libcob.h>

#include <gtk/gtk.h>
#include <glib.h>

#include "ocgtk.h"

/* Initialize the toolkit, abends if not possible */
int
```

```
CBL_OC_GTK_INIT(int argc, char *argv[])
{
    gtk_init(&argc, &argv);
    return 0;
}

/* Initialize the toolkit, return false if not possible */
/* Need pointers to argc and argv here */
int
CBL_OC_GTK_INIT_CHECK()
{
    gboolean gres = gtk_init_check(0, NULL);
    return (gres == TRUE) ? 0 : -1;
}

/* Create new window */
GtkWidget*
CBL_OC_GTK_WINDOW_NEW()
{
    return gtk_window_new(GTK_WINDOW_TOPLEVEL);
}

/* set the title */
int
CBL_OC_GTK_WINDOW_SET_TITLE(void *window, char *title)
{
    struct cob_module *module;
    cob_field  *title_field;
    char       *cstr;

    /* Error conditions simply return, doing nothing */
    if (cob_get_global_ptr()->cob_call_params < 2) { return 1; }

    module = cob_get_global_ptr()->cob_current_module;
    if (module == NULL) {
        //cob_runtime_error("No module!");
        //cob_stop_run(1);
        return 1;
    }

    title_field = module->cob_procedure_parameters[1];
    if (!title_field) { return 1; }

    cstr = (char *)malloc(title_field->size + 1);
    if (!cstr) { return 1; }

    memcpy(cstr, title_field->data, title_field->size);
    cstr[title_field->size] = '\0';

    gtk_window_set_title(GTK_WINDOW(window), cstr);

    free(cstr);
    return 0;
}

/* Widget sizing */
int
CBL_OC_GTK_WIDGET_SET_SIZE_REQUEST(void *widget, int x, int y)
{
```

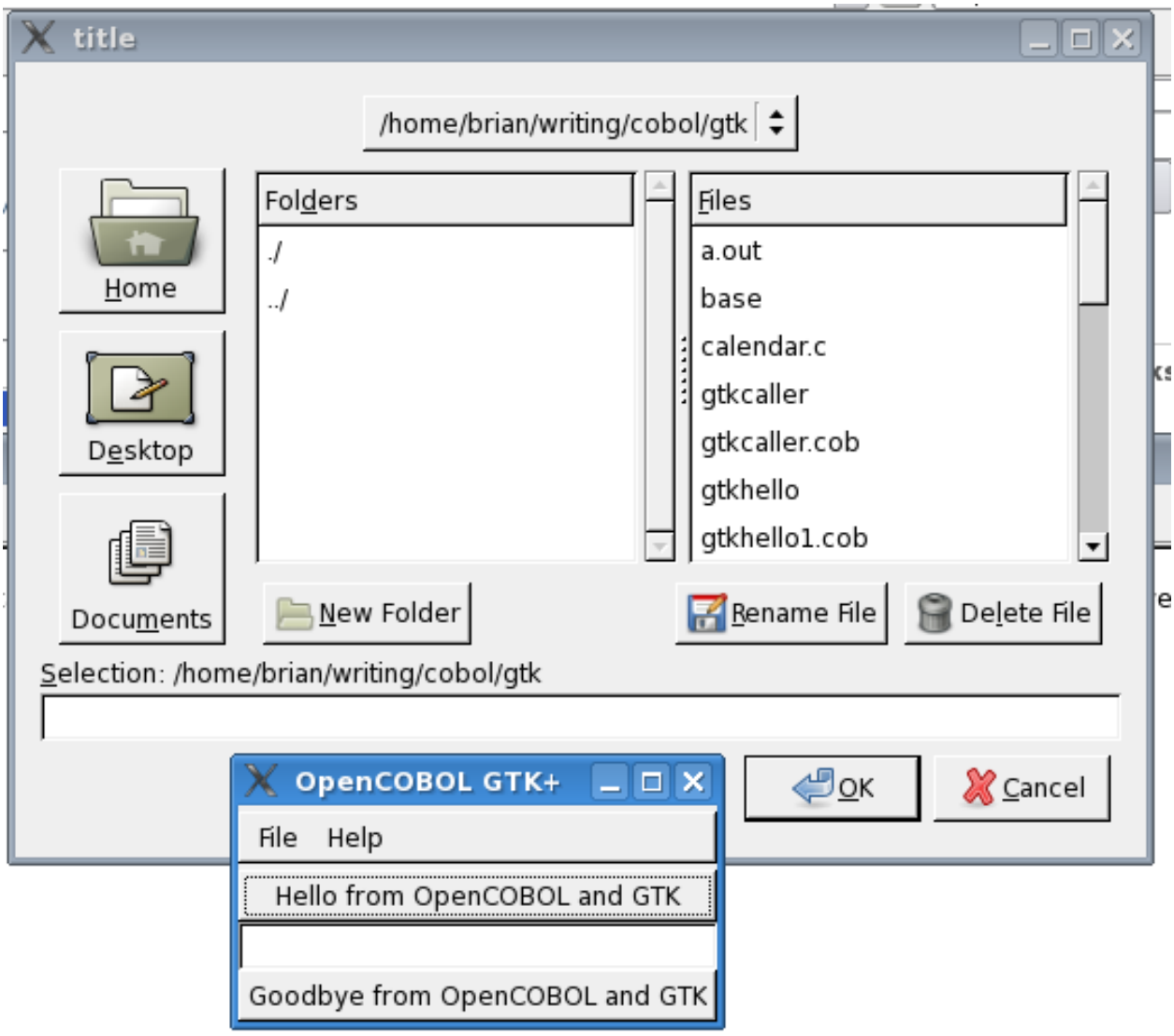
```
    gtk_widget_set_size_request(GTK_WIDGET(widget), x, y);
    return 0;
}

/* Set border width */
int
CBL_OC_GTK_CONTAINER_SET_BORDER_WIDTH(void *window, int pixels)
{
    gtk_container_set_border_width(GTK_CONTAINER(window), pixels);
    return 0;
}

/* New vertical box */
GtkWidget*
CBL_OC_GTK_VBOX_NEW(int homogeneous, int spacing)
{
    return gtk_vbox_new((gboolean)homogeneous, (gint)spacing);
}

/* New horizontal box */
GtkWidget*
CBL_OC_GTK_HBOX_NEW(int homogeneous, int spacing)
{
    return gtk_hbox_new((gboolean)homogeneous, (gint)spacing);
}

/* packing boxes */
int
CBL_OC_GTK_BOX_PACK_START(void *gcont, void *gobj, int expand, int fill, int padding)
{
    gtk_box_pack_start(GTK_BOX(gcont), gobj, (gboolean)expand, (gboolean)fill, (guint)padding);
    return 0;
}

/* menus */
GtkWidget*
CBL_OC_GTK_MENU_BAR_NEW()
{
    return gtk_menu_bar_new();
}

GtkWidget*
CBL_OC_GTK_MENU_NEW()
{
    return gtk_menu_new();
}

GtkWidget*
CBL_OC_GTK_MENU_ITEM_NEW_WITH_LABEL(char *label)
{
    struct cob_module *module;
    cob_field  *title_field;
    char       *cstr;
    GtkWidget  *item;

    /* Error conditions simply return, doing nothing */
    if (cob_get_global_ptr()->cob_call_params < 1) { return NULL; }

    module = cob_get_global_ptr()->cob_current_module;
```

```
    if (module == NULL) {
        //cob_runtime_error("No module!");
        cob_stop_run(1);
    }

    title_field = module->cob_procedure_parameters[0];
    if (!title_field) { return NULL; }

    cstr = (char *)malloc(title_field->size + 1);
    if (!cstr) { return NULL; }

    memcpy(cstr, title_field->data, title_field->size);
    cstr[title_field->size] = '\0';

    item = gtk_menu_item_new_with_label(cstr);
    gtk_widget_set_tooltip_text(item, (gchar *)cstr);

    free(cstr);

    return item;
}

int
CBL_OC_GTK_MENU_ITEM_SET_SUBMENU(void *item, void *menu)
{
    gtk_menu_item_set_submenu(GTK_MENU_ITEM(item), menu);
    return 0;
}

int
CBL_OC_GTK_MENU_SHELL_APPEND(void *menu, void *item)
{
    gtk_menu_shell_append(GTK_MENU_SHELL(menu), item);
    return 0;
}

/* New button */
GtkWidget*
CBL_OC_GTK_BUTTON_NEW_WITH_LABEL(char *label)
{
    GtkWidget *button;
    button = gtk_button_new_with_label(label);
    if (button) {
        gtk_widget_set_tooltip_text(button, (gchar *)label);
    }
    return button;
}

/* New text entry */
GtkWidget*
CBL_OC_GTK_ENTRY_NEW() {
    return gtk_entry_new();
}

/* Set text in entry */
int
CBL_OC_GTK_ENTRY_SET_TEXT(void *entry, char *text)
{
    gtk_entry_set_text(GTK_ENTRY(entry), text);
```

```
    return 0;
}

/* Get the text in an entry */
int
CBL_OC_GTK_ENTRY_GET_TEXT(void *entry, char *text)
{
    struct cob_module *module;
    cob_field  *text_field;
    size_t     text_length;

    module = cob_get_global_ptr()->cob_current_module;
    text_field = module->cob_procedure_parameters[1];

    const gchar *entry_text;
    entry_text = gtk_entry_get_text(GTK_ENTRY(entry));
    text_length = entry_text ? strlen(entry_text) : 0;
    text_length = (text_length > text_field->size) ? text_field->size : text_length;

    memset(text_field->data, ' ', text_field->size);
    memcpy(text_field->data, entry_text, text_length);
    return (int)text_length;
}


/* connect event to callback */
int
CBL_OC_G_SIGNAL_CONNECT(int *gobj, char *sgn, void (cb)(void *, void *), void *parm)
{
    g_signal_connect(G_OBJECT(gobj), sgn, G_CALLBACK(cb), parm);
    return 0;
}

/* add object to container */
int
CBL_OC_GTK_CONTAINER_ADD(void *window, void *gobj)
{
    gtk_container_add(GTK_CONTAINER(window), gobj);
    return 0;
}

/* tell gtk that object is now ready */
int
CBL_OC_GTK_WIDGET_SHOW(void *gobj)
{
    gtk_widget_show(gobj);
    return 0;
}

/* tell gtk to ready all the wdigets */
int
CBL_OC_GTK_WIDGET_SHOW_ALL(void *window)
{
    gtk_widget_show_all(window);
    return 0;
}

/* Some dialogs */
GtkWidget*
```

```
CBL_OC_GTK_FILE_SELECTION_NEW(char *title)
{
    return gtk_file_selection_new(title);
}

/* the event loop */
int
CBL_OC_GTK_MAIN()
{
    gtk_main();
    return 0;
}

/* stop the gui */
int
CBL_OC_GTK_MAIN_QUIT()
{
    gtk_main_quit();
    return 0;
}
/**/
```

A screenshot with added menu and file dialog after hitting File -> Open



30.53.1 5.53.1 A web browsing widget embedded in OpenCOBOL?

Yep.

A short sample, made for OpenCOBOL 1.0's first birthday, Dec 27th, 2008.

```
int
CBL_OC_GTKHTML (char *html_string)
{
        GtkWidget *app;
        GtkWidget *html;
        GtkWidget *scrolled_window;

        char *fakeargv[2] = {"happybday", ""};

        /* prepare our environment, we need gnome and gconf */
        gnome_init ("Example_1", "1.0", 1, fakeargv);
        gconf_init (1, fakeargv);

        /* create GtkHTML widget */
```

```
        html = gtk_html_new ();
        gtk_signal_connect (GTK_OBJECT (html), "url_requested",
                            GTK_SIGNAL_FUNC (url_requested), NULL);
        gtk_signal_connect (GTK_OBJECT (html), "object_requested",
                            GTK_SIGNAL_FUNC (object_requested), NULL);

        gtk_html_load_from_string (GTK_HTML (html), html_string, -1);

        /* create GNOME app and put GtkHTML in scrolled window in it */
        app = gnome_app_new ("Example_1", "Happy Birthday OpenCOBOL");

        scrolled_window = gtk_scrolled_window_new (NULL, NULL);
        gtk_scrolled_window_set_policy (GTK_SCROLLED_WINDOW (scrolled_window),
                                        GTK_POLICY_AUTOMATIC, GTK_POLICY_AUTOMATIC);
        gtk_container_add (GTK_CONTAINER (scrolled_window), html);

        gnome_app_set_contents (GNOME_APP (app), scrolled_window);
        gtk_window_set_default_size (GTK_WINDOW (app), 320, 100);
        gtk_widget_show_all (app);

        /* run the main loop */
        gtk_main ();

        return 0;
}
/**/
```

displays

when called with this COBOL.

```
*> ************************************************************
*> Author:    Brian Tiffin
*> Date:      27-Dec-2008
*> Purpose:   Happy Birthday OpenCOBOL
*> Tectonics:
*> gcc -c `pkg-config --cflags --libs libgnome-2.0 libgnomeui-2.0
*>       gtk+-2.0 libgtkhtml-3.14` hellogtk.c
*> cobc -lgtkhtml-3.14 -lgnomeui-2 -lSM -lICE -lglade-2.0
*>      -lbonoboui-2 -lgnomevfs-2 -lgnomecanvas-2 -lgnome-2 -lpopt
*>      -lbonobo-2 -lbonobo-activation -lORBit-2 -lart_lgpl_2
*>      -lgconf-2 -lgthread-2.0 -lrt -lgtk-x11-2.0 -lxml2
*>      -lgdk-x11-2.0 -latk-1.0 -lgdk_pixbuf-2.0 -lm
*>      -lpangocairo-1.0 -lpango-1.0 -lcairo -lgobject-2.0
*>      -lgmodule-2.0 -ldl -lglib-2.0 -x ocgtkhtml.cob hellogtk.o
*> ************************************************************
 identification division.
 program-id. ocgtkhtml.
```

```
 data division.
 working-storage section.
 01 result               usage binary-long.
 01 html-string          pic x(512) value
     "<B><FONT COLOR=Blue>Happy Birthday 1.0</FONT> " &
     "<FONT COLOR=LimeGreen>OpenCOBOL 1.0!!</FONT></B><br />" &
     "<div align='center'><a href='http://opencobol.org'>" &
     "opencobol</a> <img src='file:smiley.png' />" &
     "<br /><br /><OBJECT CLASSID=close_button>Closebutton" &
     "</OBJECT></div>" & x"00".

*> ************************************************************
 procedure division.

 call "CBL_OC_GTKHTML" using
     by reference html-string
     returning result
 end-call

 goback.
 end program ocgtkhtml.
```

30.54 5.54 What is ocsort?

Proof of concept release *as of February 2010*

A powerful external sort utility using OpenCOBOL for the sort engine.

A preliminary version can be referenced through http://www.opencobol.org/modules/newbb/viewtopic.php?topic_id=915&forum=1&po
or directly from http://oldsite.add1tocobol.com/tiki-download_file.php?fileId=74

ocsort supports a variety of sorting options, for example:

```
ocsort sort fields"(1,5,CH,A,11,4,CH,A)" use inputfile record f,391 org sq give outputfile org sq
```

Users of MFSORT may recognize the syntax. Explaining the above example, Angus posted:

```
This will sort the file "inputfile", a fixed length file (391 byte each
record, organization sequential), and create a file "outputfile" sorted
(which is of the same type). The sort fields are :
(start, length, type, direction)
=> start=1
=> length=5
=> type = character (you can sort on comp3 fields, but ocsort don't handle it)
=> direction = ascending (or descending)
It's like an order by.
The omit/include condition allow to remove record from the file (ex if
character number 5 of this record is 'F', omit the record). You can use and,
or, greater than...)
```

The sources include the parser for the ocsort command language it includes:

```
USE         "USE clause"
GIVE        "GIVE clause"
SORT        "SORT clause"
MERGE       "MERGE clause"
FIELDS      "FIELDS instruction"
RECORD      "RECORD instruction"
ORG         "ORG instruction"
OUTREC      "OUTREC clause"
```

```
SUM         "SUM clause"
INCLUDE     "INCLUDE clause"
OMIT        "OMIT clause"
COND        "COND clause"
NONE        "NONE clause"
AND         "AND clause"
OR          "OR clause"
```

see the source code for all the details.

30.55 5.55 When is Easter?

A short program to display the day of Easter for a given year. *I found out later that this calculation is known as* **the Computus**.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      17-Nov-2008
      *> Purpose:   Display Easter Day for any given year, 1580 - 2050
      *> Tectonics: cobc -x easter.cob
      *>            ./easter [year]
      *> ************************************************************
       identification division.
       program-id. easter.

       data division.
       working-storage section.
       01 a    picture 9(8) usage comp-x.
       01 b    picture 9(8).
       01 c    picture 9(8).
       01 d    picture 9(8).
       01 z    picture 9(8).   *> Why z? COBOL has pi for pi and e for e
       01 f    picture 9(8).
       01 g    picture 9(8).
       01 h    picture 9(8).
       01 i    picture 9(8).
       01 j    picture 9(8).
       01 year picture 9(4).
       01 mo   picture 9(2).
       01 da   picture 9(2).
       01 args picture x(80).

      *> ************************************************************
       procedure division.

       accept args from command-line end-accept
       if args not equal spaces
           move args to year
       else
           display "Year: " with no advancing end-display
           accept year end-accept
       end-if

       compute a = function mod(year 19)           end-compute
       divide  year by 100 giving b remainder c    end-divide
       divide  b    by   4 giving d remainder z    end-divide
       compute f = (b + 8) / 25                    end-compute
```

```
compute g = (b - f + 1) / 3                 end-compute
compute h = (19 * a) + b - d - g + 15       end-compute
compute h = function mod(h 30)              end-compute
divide  c    by   4 giving i remainder j    end-divide
compute c = (z + i) * 2 + 32 - h - j        end-compute
compute c = function mod(c 7)               end-compute
compute b = (a + (11 * h) + (22 * c)) / 451 end-compute
compute a = h + c - (7 * b) + 114           end-compute
compute da = function mod(a 31) + 1         end-compute
divide  a    by  31 giving mo               end-divide

display  "yyyy/mm/dd: " year "/" mo "/" da  end-display
goback.
end program easter.

*> ************************************************************
*> Snagged from a REBOL script, easter-day.r by Didier Cadieu
*> http://www.rebol.org/view-script.r?script=easter-day.r
*>
*> easter-day: func [
*>     {Compute the easter date for the wanted year.}
*>     year [integer!] {Year for whitch you want the easter date}
*>     /local a b c d z f g h i k
*> ] [
*>     a: year // 19
*>     b: to integer! year / 100
*>     c: year // 100
*>     d: to integer! b / 4
*>     z: b // 4
*>     f: to integer! b + 8 / 25
*>     g: to integer! b - f + 1 / 3
*>     h: 19 * a + b - d - g + 15 // 30
*>     i: to integer! c / 4
*>     k: c // 4
*>     c: z + i * 2 + 32 - h - k // 7
*>     b: to integer! a + (11 * h) + (22 * c) / 451
*>     a: h + c - (7 * b) + 114
*>     to date! reduce [
*>         a // 31 + 1
*>         to integer! a / 31
*>         year
*>     ]
*> ]
```

Sample, with and without command line argument.

```
$ cobc -x easter.cob
$ ./easter 2011
yyyy/mm/dd: 2011/04/24
$ ./easter
Year: 2010
yyyy/mm/dd: 2010/04/04
```

30.55.1 5.55.1 Easter program critique

What follows is a warning to those people learning COBOL with the help of this document. The variable names used to implement the algorithm to find Easter day are near to useless as to intent and or reason. It's not good COBOL style and I got called on it. Take the critique for what you will, I took it as 'hey, come on, write better code if you're going

to show it off'. Keep in mind that if you ever are fortunate enough to work with core business COBOL, what I got as a critique, could well be an embarassing drumming from a boss and threats of firings. And as a side-note, be willing to take drummings and learn from them before the threats of firings occur. Programmers should never be defensive over code, but open and willing to better.

I posted a link to the easter.cob source code above as a Christmas post on a LinkedIn COBOL group and got this feedback from Huib Klink; I respect his posts and opinions.

```
It would have been slightly more appropriate to share a COBOL source that
tells when its Christmas. Let my give it a try (Proc. div. only):

 accept args from command-line end-accept
 if args not equal spaces
 move args to year
 else
 display "Year: " with no advancing end-display
 accept year end-accept
 end-if

 move 12 to mo
 move 25 to da
 display "yyyy/mm/dd: " year "/" mo "/" da end-display
 goback.
 end program xmas.

 Hmmmmm. Lot less variables needed so it seems ... should clean up working
 storage, but since I copy/pasted this and don't want (are forbidden) to fix
 what ain't broke I will not change that piece of the program. For sure NOBODY
 will ever need to fix this program anymore so NOBODY will be sitting for hours
 wondering what a is for. Or b. or c. Or ... whatever, I am a programmer and
 thus I am lazy by definition, and I want to turn around that logic so doing no
 clean-up proves my professionalism and eases my job. After all if all
 programmers are lazy, I must be a very good one and

 ...
 (5 minutes contemplating on fuzzy lazy logic)
 ...

 Happy Xmas
```

So, I looked into it and learned something I find very cool. See http://en.wikipedia.org/wiki/Computus The calculation has a name and its name is **Computus**. That's awesome. Sadly, the Anonymous Gregorian algorithm detailed on Wikipedia uses the same useless variable names and the sample remains obfuscated, as I think the original sent into a newspaper in 1876 was intended.

30.55.2 5.55.2 A real COBOL Computus

From Paul Chandler during a discussion on LinkedIn in COBOL Profressionals.

This one is nice folks. Defensible.

```
000100 IDENTIFICATION DIVISION.                                         00010025
000200 PROGRAM-ID. RCEASTER.                                            00020025
000300 AUTHOR. PAUL CHANDLER, MARCH 2013.                               00030025
000400**************************************************                00040025
000500*** THIS PROGRAM CALCULATES THE DATE OF EASTER FOR   ***          00050025
000600*** YEARS IN THE GREGORIAN CALENDAR. IT'S A PORT OF  ***          00060025
000700*** THE DONALD KNUTH ALGORITHM PUBLISHED IN VOLUME 1 ***          00070025
000800*** OF "THE ART OF COMPUTER PROGRAMMING".            ***          00080025
```

```
000900***                                                  ***          00090025
001000*************************************************************     00100025
001100 ENVIRONMENT DIVISION.                                             00110025
001200 DATA DIVISION.                                                    00120025
001300 FILE SECTION.                                                     00130025
001400 WORKING-STORAGE SECTION.                                          00140025
001500 77  ACCEPT-YEAR            PIC 9(08).                           00150025
001600 01  WORKING-FIELDS     COMP.                                    00160025
001700     05 TGT-YEAR            PIC S9(08).                          00170025
001800     05 GOLDEN-NUMBER       PIC S9(08).                          00180025
001900     05 TGT-CENTURY         PIC S9(08).                          00190025
002000     05 LEAP-YEAR-CRCTN     PIC S9(08).                          00200025
002100     05 MOON-SYNC-CRCTN     PIC S9(08).                          00210025
002200     05 FIRST-SUNDAY        PIC S9(08).                          00220025
002300     05 EPACT               PIC S9(08).                          00230025
002400     05 FULL-MOON           PIC S9(08).                          00240025
002500     05 EASTER-SUNDAY       PIC S9(08).                          00250025
002600 01  DISPLAY-FIELDS.                                             00260025
002700     05 TGT-YEAR-DSP        PIC Z(08)-.                          00270025
002800     05 EASTER-MONTH        PIC X(06).                           00280025
002900     05 EASTER-SUNDAY-DSP   PIC Z(08)-.                          00290025
003000 PROCEDURE DIVISION.                                               00300025
003100     ACCEPT ACCEPT-YEAR.                                          00310025
003200     MOVE ACCEPT-YEAR TO TGT-YEAR TGT-YEAR-DSP                    00320025
003300     IF TGT-YEAR < 1583                                           00330025
003400        DISPLAY "YEAR MUST BE 1583 OR GREATER"                    00340025
003500        STOP RUN                                                  00350025
003600     ELSE                                                         00360025
003700        DISPLAY "EASTER DATE FOR:" TGT-YEAR-DSP                   00370025
003800     END-IF                                                       00380025
003900     COMPUTE GOLDEN-NUMBER   = FUNCTION MOD(TGT-YEAR, 19) + 1     00390025
004000     COMPUTE TGT-CENTURY     = (TGT-YEAR / 100) + 1               00400025
004100     COMPUTE LEAP-YEAR-CRCTN = (3 * TGT-CENTURY / 4) - 12         00410025
004200     COMPUTE MOON-SYNC-CRCTN = ((8 * TGT-CENTURY + 5) / 25) - 5   00420025
004300     COMPUTE FIRST-SUNDAY    =                                    00430025
004400         (5 * TGT-YEAR / 4)- LEAP-YEAR-CRCTN - 10                 00440025
004500*******************************************************           00450025
004600*     TO MAKE THE EPACT CALCULATION MORE READABLE,    *           00460025
004700* THE COMPUTATION WILL BE DONE IN STAGES.             *           00470025
004800*******************************************************           00480025
004900*                                                                 00490025
005000* STAGE #1: GET THE RAW NUMBER.....                   *           00500025
005100*                                                                 00510025
005200     COMPUTE EPACT =                                              00520025
005300         (11 * GOLDEN-NUMBER)                                     00530025
005400        + 20                                                      00540025
005500        + MOON-SYNC-CRCTN                                         00550025
005600        - LEAP-YEAR-CRCTN                                         00560025
005700*                                                                 00570025
005800* STAGE #2: GET THE MOD 30 VALUE...                   *           00580025
005900*                                                                 00590025
006000     COMPUTE EPACT = FUNCTION MOD(EPACT, 30)                      00600025
006100*                                                                 00610025
006200* STAGE #3: TO ENSURE THAT EPACT IS A POSITIVE NBR,   *           00620025
006300*           ADD 30 AND MOD 30 AGAIN.                  *           00630025
006400*                                                                 00640025
006500     ADD 30 TO EPACT                                              00650025
006600     COMPUTE EPACT = FUNCTION MOD(EPACT, 30)                      00660025
006700*                                                                 00670025
```

```
006800* ADJUST FOR YEARS WHEN ORTHODOX DIFFERS              *          00680025
006900*                                                               00690025
007000     IF (EPACT = 25 AND GOLDEN-NUMBER > 11)                     00700025
007100     OR (EPACT = 24)                                            00710025
007200        ADD 1 TO EPACT                                          00720025
007300     END-IF                                                     00730025
007400*                                                               00740025
007500* NEXT 2 STATEMENTS FIND FIRST FULL MOON AFTER MAR.21*          00750025
007600*                                                               00760025
007700     SUBTRACT EPACT FROM 44 GIVING FULL-MOON                    00770025
007800     IF  EPACT  > 23                                            00780025
007900         ADD 30 TO FULL-MOON                                    00790025
008000     END-IF                                                     00800025
008100*                                                               00810025
008200* ADVANCE SUNDAY TO THE FIRST SUNDAY AFTER FULL MOON *          00820025
008300*                                                               00830025
008400     COMPUTE EASTER-SUNDAY =                                    00840025
008500         FULL-MOON                                              00850025
008600       + 7                                                      00860025
008700       - (FUNCTION MOD((FIRST-SUNDAY + FULL-MOON), 7))          00870025
008800*                                                               00880025
008900* IF EASTER-SUNDAY > 31, EASTER IS IN APRIL - MOVE THE          00890025
009000* MONTH TO APRIL AND SUBTRACT 31 FROM THE MONTH.                00900025
009100* OTHERWISE EASTER IS IN MARCH, USE THE DAY AS IS.              00910025
009200*                                                               00920025
009300     IF  EASTER-SUNDAY > 31                                     00930025
009400         MOVE 'APRIL' TO EASTER-MONTH                           00940025
009500         SUBTRACT 31 FROM EASTER-SUNDAY                         00950025
009600     ELSE                                                       00960025
009700         MOVE 'MARCH' TO EASTER-MONTH                           00970025
009800     END-IF                                                     00980025
009900     MOVE EASTER-SUNDAY TO EASTER-SUNDAY-DSP                    00990025
010000     DISPLAY EASTER-MONTH EASTER-SUNDAY-DSP                     01000025
010100     STOP RUN.                                                  01010025
```

Tectonics are a simple **cobc -x rceaster.cob**. ACCEPTs the year.

```
$ ./rceaster
2013
EASTER DATE FOR:    2013
MARCH       31
```

Thanks Paul.

30.55.3 5.55.3 Another Computus

Thanks to daniel b, who listed a solution and the ensuing discussion on LinkedIn:

```
daniel b.:
... in a moment of madness ... about 20 years later ... compiles and runs
on your OpenCobol 1.1 ... now that I found out that I need gmp not to segfault
...  ;-)

Brian Tiffin:
daniel; Can I steal this for the OpenCOBOL FAQ?
Am I correct in assuming you wrote this Computus solution some 20 years
ago, and this is a recent port to OpenCOBOL?

daniel b.:
@Brian Tiffin ? daniel; Can I steal this for the OpenCOBOL FAQ?
```

```
Sure

@Brian Tiffin ? Am I correct in assuming you wrote this Computus solution
some 20 years ago, and this is a recent port to OpenCOBOL?

No, I just looked at the table of the Meeus? book citation, in the wiki and
wrote it from scratch. 20 years ago is the last time I touched COBOL, but
since I used it for 15 years before, it kind like sticks, LOL.
```

Here is another COBOL solution to the Computus.

```
OCOBOL*
      * 2/15/2013 Adapted by daniel for OpenCobol 1.1 Compiler, from:
      * https://en.wikipedia.org/wiki/Computus#cite_note-otheralgs-45
      *
      * From Wikipedia: "Anonymous Gregorian algorithm:
      * 'A New York correspondent' submitted this algorithm for determining the Gregorian Easter to t
      * It has been reprinted many times, in 1877 by Samuel Butcher in The Ecclesiastical Calendar,[4
      * General Astronomy,[42] in 1977 by the Journal of the British Astronomical Association,[43] in
      * in 1988 by Peter Duffett-Smith in Practical Astronomy with your Calculator, and in 1991 by Je
      * Because of the Meeus' book citation, that is also called 'Meeus/Jones/Butcher' algorithm"
      *
      * 2/16/2013 Added command line passing parameter, method from Brian Tiffin example, hoping he w
      * http://opencobol.add1tocobol.com/#when-is-easter
      *
      * 2/18/2013 Added rejection of years before 1582, on Paul Chandler
      * suggestion thank you, I missed that part
      *
      * 2/19/2013 Attempt to make more readable, reduced useless operations, needs more work.
      * Changed names of some variables, based on:
      * http://www.linuxtopia.org/online_books/programming_books/python_programming/python_ch38.html
      *
      * 2/20/2013 Added comments on formula, eliminated all compute:
      * http://www.jones0086.freeserve.co.uk/b123sen.htm
      *
      * 2/22/2013 Added writeout to file complete table of easter occurrences,
      * selected using year 0000 as passing parameter
      *
      * 2/25/2013 Tried on windows
      *
       IDENTIFICATION DIVISION.
       PROGRAM-ID. easter.
      *
       ENVIRONMENT DIVISION.
      *
       CONFIGURATION SECTION.
      *
       INPUT-OUTPUT SECTION.
      *
       FILE-CONTROL.
       SELECT OPTIONAL OUT-FILE ASSIGN TO "easter-out.txt"
           ORGANIZATION IS LINE SEQUENTIAL
           ACCESS MODE IS SEQUENTIAL.
      *
       I-O-CONTROL.
      *
       DATA DIVISION.
      *
       FILE SECTION.
```

```
*
 FD  OUT-FILE
     LABEL RECORDS ARE STANDARD.
     01  OUT-RECORD.
     05  RECORD-DATA PIC X(11) VALUE SPACES.
 05  RECORD-END-RET PIC X VALUE X'0d'.
     05  RECORD-END-LF PIC X VALUE X'0a'.
*
 WORKING-STORAGE SECTION.
*
 77  SELECTED-YEAR PIC 9999 VALUE ZERO.
 77  X PIC 9999 VALUE ZERO.
 77  Y PIC 9999 VALUE ZERO.
 77  METONIC-GOLDEN-NUMBER PIC 99 VALUE ZERO.
 77  CENTURY PIC 99 VALUE ZERO.
 77  YEAR-IN-CENTURY PIC 99 VALUE ZERO.
 77  LEAP-TEST400 PIC 99 VALUE ZERO.
 77  LEAP-TEST40 PIC 99 VALUE ZERO.
 77  MOON-SYNC1 PIC 99 VALUE ZERO.
 77  MOON-SYNC2 PIC 99 VALUE ZERO.
 77  EPACT PIC 99 VALUE ZERO.
 77  LEAP4 PIC 99 VALUE ZERO.
 77  LEAP4-OFFSET PIC 99 VALUE ZERO.
 77  ADVANCE-TO-SUNDAY PIC 99 VALUE ZERO.
 77  M PIC 99 VALUE ZERO.
 77  COMPUTED-MONTH PIC 99 VALUE ZERO.
 77  COMPUTED-DAY PIC 99 VALUE ZERO.
*
 01  WS-TABLE VALUE ZEROS.
         03 WS-MONTH PIC XXX
             OCCURS 12 TIMES.
*
 77  ARGS PIC X(80) VALUE SPACES.
*
 77  LOOP-FLAG PIC 9 VALUE ZERO.
*
 01 WS-OUT-RECORD.
     05 WS-OUT-DAY PIC XX VALUE SPACES.
         05 FILLER PIC X VALUE "-".
     05 WS-OUT-MONTH PIC XXX VALUE SPACES.
     05 FILLER PIC X VALUE "-".
     05 WS-OUT-YEAR PIC XXXX VALUE SPACES.
*
 PROCEDURE DIVISION.
*
 000-WS-TABLE-CTL.
 MOVE "JAN" TO WS-MONTH(1)
 MOVE "FEB" TO WS-MONTH(2)
 MOVE "MAR" TO WS-MONTH(3)
 MOVE "APR" TO WS-MONTH(4)
 MOVE "MAY" TO WS-MONTH(5)
 MOVE "JUN" TO WS-MONTH(6)
 MOVE "JUL" TO WS-MONTH(7)
 MOVE "AUG" TO WS-MONTH(8)
 MOVE "SEP" TO WS-MONTH(9)
 MOVE "OCT" TO WS-MONTH(10)
 MOVE "NOV" TO WS-MONTH(11)
 MOVE "DEC" TO WS-MONTH(12).
*
```

```
 010-ARGS-CTL.
 ACCEPT ARGS FROM COMMAND-LINE.
 IF ARGS EQUAL 0000
     MOVE 1583 TO SELECTED-YEAR
     MOVE 1 TO LOOP-FLAG
     OPEN EXTEND OUT-FILE
     GO TO 105-METONIC-GOLDEN-NUMBER-CTL.
 IF ARGS NOT EQUAL SPACES
     MOVE ARGS TO SELECTED-YEAR
     GO TO 100-CHECK-YEAR-CTL.
 DISPLAY " " END-DISPLAY.
 DISPLAY "Gregorian Easter computation from year 1583 to 9999".
*
 020-START-CTL.
 DISPLAY "Enter Year (YYYY): " WITH NO ADVANCING END-DISPLAY.
 ACCEPT SELECTED-YEAR FROM CONSOLE.
*
 100-CHECK-YEAR-CTL.
 IF SELECTED-YEAR IS LESS THAN 1583
     DISPLAY "Invalid year, use year past 1582 " END-DISPLAY
     GO TO 020-START-CTL.
*
 105-METONIC-GOLDEN-NUMBER-CTL.
 DIVIDE SELECTED-YEAR BY 19 GIVING X
     REMAINDER METONIC-GOLDEN-NUMBER
     ON SIZE ERROR GO TO 020-START-CTL END-DIVIDE.
*
 110-CENTURY-CTL.
 DIVIDE SELECTED-YEAR BY 100 GIVING CENTURY
     REMAINDER YEAR-IN-CENTURY
     ON SIZE ERROR GO TO 020-START-CTL END-DIVIDE.
*
 120-LEAP-TEST-CTL.
 DIVIDE CENTURY BY 4 GIVING LEAP-TEST400 REMAINDER LEAP-TEST40
     ON SIZE ERROR GO TO 020-START-CTL END-DIVIDE.
*
 125-MOON-SYNC1-CTL.
* formula MOON-SYNC1 = (CENTURY + 8) / 25
 ADD 8 TO CENTURY GIVING X
 DIVIDE X BY 25 GIVING MOON-SYNC1
     ON SIZE ERROR GO TO 020-START-CTL.
*
 130-MOON-SYNC2-CTL.
 COMPUTE MOON-SYNC2 = (CENTURY - MOON-SYNC1 + 1) / 3
     ON SIZE ERROR GO TO 020-START-CTL.
*
 135-EPACT-SYNC-CTL.
* formula EPACT = ((19 * METHONIC-GOLDEN-NUMBER) + CENTURY  LEAP-TEST400   MOON-SYNC2 + 15) mo
 MULTIPLY 19 BY METONIC-GOLDEN-NUMBER GIVING X
 ADD CENTURY TO X GIVING X
 SUBTRACT LEAP-TEST400 FROM X GIVING X
 SUBTRACT MOON-SYNC2 FROM X GIVING X
 ADD 15 TO X GIVING X
 DIVIDE X BY 30 GIVING X REMAINDER EPACT
     ON SIZE ERROR GO TO 020-START-CTL END-DIVIDE.
*
 140-LEAP4-CTL.
 DIVIDE YEAR-IN-CENTURY BY 4 GIVING LEAP4
     REMAINDER LEAP4-OFFSET
```

```
           ON SIZE ERROR GO TO 020-START-CTL END-DIVIDE.
      *
       150-ADVANCE-TO-SUNDAY-CTL.
      * formula ADVANCE-TO-SUNDAY = (32 + 2 * (LEAP-TEST40 + 2) + 2 * (YEAR-IN-CENTURY
      * / 4)  EPACT  K) mod 7
       MULTIPLY 2 BY LEAP-TEST40 GIVING X
       ADD 32 TO X GIVING X
       MULTIPLY 2 BY LEAP4 GIVING Y
       ADD Y TO X GIVING X
       SUBTRACT EPACT FROM X GIVING X
       SUBTRACT LEAP4-OFFSET FROM X GIVING X
       DIVIDE X BY 7 GIVING X REMAINDER ADVANCE-TO-SUNDAY
           ON SIZE ERROR GO TO 020-START-CTL END-DIVIDE.
      *
       160-M-CTL.
      * formula M = (METONIC-GOLDEN-NUMBER + (11 * EPACT) + (22 * ADVANCE-TO-SUNDAY)) / 451
       MULTIPLY 11 BY EPACT GIVING X
       ADD METONIC-GOLDEN-NUMBER TO X GIVING X
       MULTIPLY 22 BY ADVANCE-TO-SUNDAY GIVING Y
       ADD Y TO X GIVING X
       DIVIDE X BY 451 GIVING M
           ON SIZE ERROR GO TO 020-START-CTL END-DIVIDE.
      *
       200-COMPUTED-MONTH-CTL.
      * formula COMPUTED-MONTH = ((EPACT + ADVANCE-TO-SUNDAY  (7 * M) + 114) / 31)
       MULTIPLY 7 BY M GIVING X
       ADD EPACT TO ADVANCE-TO-SUNDAY GIVING Y
       SUBTRACT X FROM Y GIVING Y
       ADD 114 TO Y GIVING X
       DIVIDE X BY 31 GIVING COMPUTED-MONTH
           ON SIZE ERROR GO TO 020-START-CTL END-DIVIDE.
      *
       300-COMPUTED-DAY-CTL.
      * formula COMPUTED-DAY = ((EPACT + ADVANCE-TO-SUNDAY  (7 * M) + 114) mod 31) + 1
       MULTIPLY 7 BY M GIVING X
       ADD EPACT TO ADVANCE-TO-SUNDAY GIVING Y
       SUBTRACT X FROM Y GIVING Y
       ADD 114 TO Y GIVING X
       DIVIDE X BY 31 GIVING X REMAINDER Y
       ADD 1 TO Y GIVING COMPUTED-DAY
           ON SIZE ERROR GO TO 020-START-CTL.
      *
       400-PRINT-TABLE-CTL.
       MOVE COMPUTED-DAY TO WS-OUT-DAY.
       MOVE WS-MONTH(COMPUTED-MONTH) TO WS-OUT-MONTH.
       MOVE SELECTED-YEAR TO WS-OUT-YEAR.
       MOVE WS-OUT-RECORD TO OUT-RECORD.
       IF LOOP-FLAG EQUAL TO 1 WRITE OUT-RECORD.
       IF SELECTED-YEAR EQUAL TO 9999 AND LOOP-FLAG EQUAL TO 1
           CLOSE OUT-FILE.
      *
       500-LOOP-CTL.
       IF SELECTED-YEAR EQUAL TO 9999 AND LOOP-FLAG EQUAL TO 1
         MOVE 0 TO LOOP-FLAG
         GO TO 700-STOP.
       IF LOOP-FLAG EQUAL TO 1
           ADD 1 TO SELECTED-YEAR GIVING SELECTED-YEAR
           GO TO 105-METONIC-GOLDEN-NUMBER-CTL.
      *
```

```
       600-EXIT.
      *
       DISPLAY " " END-DISPLAY.
       DISPLAY "Easter day for year " SELECTED-YEAR ": " END-DISPLAY.
       DISPLAY COMPUTED-DAY "-" WS-MONTH(COMPUTED-MONTH) "-"
       SELECTED-YEAR END-DISPLAY.
       DISPLAY " " END-DISPLAY.
      *
       700-STOP.
       STOP RUN.
      *
```

Tectonics once again, a simple **cobc -x dbeaster.cob**.

```
$ ./dbeaster

Gregorian Easter computation from year 1583 to 9999
Enter Year (YYYY): 2013

Easter day for year 2013:
31-MAR-2013

$ ./dbeaster

Gregorian Easter computation from year 1583 to 9999
Enter Year (YYYY): 3013

Easter day for year 3013:
18-APR-3013
```

Thanks to Daniel. *Note, I already had easter.cob, so this one is dbeaster.cob for the FAQ.*

30.56 5.56 Does Vim support OpenCOBOL?

Very well. See cobol.vim for a syntax highlighter tuned for OpenCOBOL.

Vim's Visual Block mode can be very handy at reforming COBOL source code.

Author's choice. ocfaq.rst is edited using Vim, Bram Moolenaar's **vi** enhancement. See below for some settings that can make OpenCOBOL more productive.

30.56.1 5.56.1 vim code completion

For code completion (Ctrl-P while in insert mode) start by creating a reserved word list using your **cobc** command

```
$ cobc --list-reserved | tail -n+3 | cut -f1 >~/.vim/ocreserved.lis
```

followed by this change in ~/.vimrc

```
:set ignorecase
:set infercase
:set complete=k~/.vim/ocreserved.lis
```

30.56.2 5.56.2 freedom

To free the cursor (allowing the cursor to travel past line endings) use:

```
:set virtualedit=all
```

30.56.3 5.56.3 autoload a skeleton

For a quick template when starting a new file (in .vimrc, change the filename *~/lang/cobol/headfix.cob* to where you keep your favourite COBOL starter skeleton).

```
" Auto load COBOL template
autocmd BufNewFile  *.cob      0r ~/lang/cobol/headfix.cob
```

30.57 5.57 What is w3m?

w3m is a text based web browser. OpenCOBOL can leverage some of the power of this application by directly calling it with SYSTEM.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      30-Dec-2008
      *> Purpose:   Textualize a webpage
      *> Tectonics: cobc -x w3mcaller.cob
      *>            ./w3mcaller opencobol.org
      *> ************************************************************
       identification division.
       program-id. w3mcaller.

       data division.
       working-storage section.
       01 args         pic x(256).
       01 command      pic x(256).
       01 result       usage binary-long.

      *> ************************************************************
       procedure division.
       accept args from command-line.

       string
           "w3m -dump " delimited by size
           function trim(args) delimited by size
           into command
       end-string
       call "SYSTEM" using command returning result end-call

       goback.
       end program w3mcaller.
```

Sample run on 28-Feb-2010:

```
$ ./w3mcaller opencobol.org

[logo]
[arrow] HOME    [arrow] NEWS    [arrow] FORUM   [arrow] D       [arrow] LINK
                                                OWNLOAD
OpenCOBOL - an open-source COBOL compiler
                [arrow] Welcome to the OpenCOBOL Website!
                OpenCOBOL is an open-source COBOL compiler.
[arrow] Main    OpenCOBOL implements a substantial part of the
Menu            COBOL 85 and COBOL 2002 standards, as well as
Home News Wiki  many extensions of the existent COBOL
Forum Downloads compilers.
Links                                                           [arrow] Search
```

```
*               OpenCOBOL translates COBOL into C and compiles  [              ]
[arrow]         the translated code using the native C          [Search]
Download        compiler. You can build your COBOL programs on  Advanced Search
                various platforms, including Unix/Linux, Mac OS [arrow] Login
  • OpenCOBOL   X, and Microsoft Windows.                       Username:
    1.0                                                         [              ]
  • OpenCOBOL   The compiler is licensed under GNU General      Password:
    1.1         Public License.                                 [              ]
    pre-release The run-time library is licensed under GNU      [User Login]
                Lesser General Public License.                  Lost Password?
*
[arrow]         [arrow] Recent News                             Register now!
Documentation                                                   [arrow] Recent
                  • OpenCOBOL 1.0 released (2007/12/27)         Links
  • FAQ
  • Features    [arrow] Recent Topics                             • J&C
  • Install       Forum       Topic      Replies Views     Last     Migrations
    Guide                                                   Post     (2008/12/10)
  • User Manual           using gui                       2010/2/  • COBOL Data
                OpenCOBOL interface        18     733   28 10:12    Correlation
*                                                        federico    a... (2006/9
[arrow]                 SET index-var                   2010/2/     /21)
Development     OpenCOBOL TO DISP-FIELD     2     99    27 18:53  • COBOL User
                                                         wmklein    Groups :
  • SourceForge         implementation                  2010/2/     COBU...
  • Mailing     OpenCOBOL of ocsort         7     308   27 5:15     (2006/1/17)
    List                                                 btiffin  • The Kasten
  • Tasks               select fname                    2010/2/     COBOL Page
                OpenCOBOL clause,           9     426   26 14:26    (2005/9/8)
*                       Variable value                     shaj  • Die COBOL
[arrow] Who's           as filename                                 Connection
Online                                                  2010/2/     (2005/9/8)
12 user(s) are  OpenCOBOL Benchmarks        5     285   24 23:45  • University
online                                                   btiffin    of Limerick
                                                        2010/2/     (2005/9/8)
Members: 1      OpenCOBOL Default Colour    7     327   21 15:32  • Stefans
Guests: 11                                                 jgt      kleiner
                        OpenCOBOL 1.1                   2010/2/     COBOL Wo...
clemcoll,       OpenCOBOL compiler          8     451   20 21:52    (2005/9/8)
more...                 listing                          btiffin  • COBOL Web
*                       MOVE loops                      2010/2/     Development
[arrow] Powered OpenCOBOL when operands     9     443   20 20:39    (2005/6/8)
by                      are overlaying                     human  • Kobol
  SourceForge           [solved]                                    Kompany
                        0MQ (zeromq),                   2010/2/     (2005/6/8)
     Xoops      OpenCOBOL network           3     223   20 15:12  • CoCoLab
                        messaging and                    btiffin    (2005/6/8)
   Creative             OpenCOBOL
    Commons             Conversion
                        story from                      2010/2/
*               OpenCOBOL MicroFocus to     10    768   20 12:23
                        OC, on SUSE                        simrw
                        11.2
                Visit Forums

        Copyright (C) 2005 The OpenCOBOL Project. All rights reserved.
                  Powered by Xoops2 | PHP | MySQL | Apache
                                ocean-net
```

30.58 5.58 What is COB_LIBRARY_PATH?

If the DSO files are not in the current working directory along with the executable, the COB_LIBRARY_PATH can be set to find them.

On GNU/Linux and bash it could be

```
export COB_LIBRARY_PATH=/home/developer/ocnewstuff:/home/developer/ocstuff
```

to search for DSO files in directories **ocnewstuff** then **ocstuff**, giving your testing versions priority during development.

30.59 5.59 Can OpenCOBOL interface with Rexx?

Yes, ooRexx linkage is commented on at http://www.opencobol.org/modules/newbb/viewtopic.php?topic_id=456&forum=1#forumpost2

A Regina Rexx layer can be as simple as

ocrexx.c

```
/* OpenCOBOL interface to Regina Rexx Interpreter */
/* Requires regina3 and regina3-dev */
/* cobc -I/usr/include/regina -c ocrexx.c */

#include <stdio.h>
#include <string.h>
#include <rexxsaa.h>

int ocrexx(char *script, char *args, char *resfield, int reslen, short *result) {
    APIRET rexxapiret;
    RXSTRING retstr;
    RXSTRING arglist[1];
    short  rexxret = 0;

    int ignore = 0;

    /* Initialize the engine, run the script */
    retstr.strptr = NULL;
    retstr.strlength = 0;
    arglist[0].strptr = args;
    arglist[0].strlength = strlen(args);

    rexxapiret = RexxStart(1, (PRXSTRING)&arglist, script, NULL, NULL,
        RXCOMMAND || RXRESTRICTED, NULL, &rexxret, &retstr);

    /* set result back to OpenCOBOL */
    memset(resfield, ' ', reslen);
    if (rexxapiret == 0) {
        memcpy(resfield, retstr.strptr, (retstr.strlength > reslen) ? reslen : retstr.strlength);
        *result = rexxret;
    }

    /* Let Rexx do all the memory alllocation */
    if (retstr.strptr != NULL) { ignore = RexxFreeMemory(retstr.strptr); }

    return (int)rexxapiret;
}

int ocrexxcmd(char *cmds, char *args, char *resfield, int reslen, short *result) {
```

```
    APIRET rexxapiret;
    RXSTRING retstr;
    RXSTRING arglist[1];
    RXSTRING instore[2];
    short rexxret = 0;

    int ignore = 0;

    /* For syntax check, no evaluate, taken from 8.4 of the Regina3.4 pdf */
    arglist[0].strptr = "//T";
    arglist[0].strlength = 3;

    arglist[0].strptr = args;
    arglist[0].strlength = strlen(args);

    /* Move the command(s) to the instore array */
    instore[0].strptr = cmds;
    instore[0].strlength = strlen(cmds);
    instore[1].strptr = NULL;
    instore[1].strlength = 0;

    /* Call Rexx. Use argcount 1 and &arglist to call syntax check */
    retstr.strptr = NULL;
    retstr.strlength = 0;
    rexxapiret = RexxStart(1, (PRXSTRING)&arglist, "FILLER", (PRXSTRING)&instore, "COMMAND" /* NULL
        RXCOMMAND, NULL, &rexxret, &retstr);

    /* set result back to OpenCOBOL */
    memset(resfield, ' ', reslen);
    if (rexxapiret == 0) {
        memcpy(resfield, retstr.strptr, (retstr.strlength > reslen) ? reslen : retstr.strlength);
        *result = rexxret;
    }

    /* Let Rexx do all the memory alllocation */
    if (instore[1].strptr != NULL) { ignore = RexxFreeMemory(instore[1].strptr); }
    if (retstr.strptr != NULL) { ignore = RexxFreeMemory(retstr.strptr); }

    return (int)rexxapiret;
}
/**/
```

with a usage example of

rexxcaller.cob

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *><* ****************
      *><* Rexx in OpenCOBOL
      *><* ****************
      *><*
      *><* :Author:    Brian Tiffin
      *><* :Date:      13-Nov-2008
      *><* :Purpose:   Very High Level Regina Rexx engine
      *><* :Requires:  regina-rexx, regina3, regina3-dev, OC 1.1 pre-rel
      *><* :Tectonics:
      *><*     | cobc -I/usr/include/regina -c ocrexx.c
      *><*     | cobc -x -lregina rexxcaller.cob ocrexx.o
      *><*     | ocdoc rexxcaller.cob rexxcaller.rst rexxcaller.html
```

```
*> ************************************************************
 identification division.
 program-id. rexxcaller.

 data division.
*><*
*><* =============
*><* Working Store
*><* =============
*><*
*><* ::
*><*
*><[
 working-storage section.
 01 newline constant as x"0a".
 01 apicode              usage binary-long.
 01 resultcode           usage binary-short.
 01 scriptname           pic x(12) value 'verrexx.cmd' & x'00'.
 01 argument             pic x(256) value 'OC1.1 args' & x"00".
 01 cmds                 pic x(1024).
 01 rexxstring           pic x(1048576).
*><]

*> ************************************************************
 procedure division.

*><*
*><* ===
*><* API
*><* ===
*><*
*><* ------
*><* ocrexx
*><* ------
*><* Pass a null-term scriptname, a null-term argument string
*><* the return value field and length, the return code and
*><* returning the Rexx api result code.
*><*
*><* Usage::
*><*
 compute
     apicode = function length(function trim(scriptname))
 end-compute
 display
     "CALL Rexx with |" scriptname(1:apicode - 1) "|"
 end-display
*><[
 call "ocrexx"
     using
         by reference scriptname
         by reference argument
         by reference rexxstring
         by value function length(rexxstring)
         by reference resultcode
     returning apicode
 end-call
 display "|" apicode "|" resultcode with no advancing end-display
 display "|" function trim(rexxstring trailing) "|" end-display
*><]
```

```
*><*
*><* ---------
*><* ocrexxcmd
*><* ---------
*><* Usage::
*><*
*><[
 move "say 'Hello World!'; return 'From Rexx';" & x'00' to cmds.
 compute
     apicode = function length(function trim(cmds))
 end-compute
 display newline
     "CALL Rexx command with |" cmds(1:apicode - 1) "|"
 end-display
 call "ocrexxcmd"
     using
         by reference cmds
         by reference argument
         by reference rexxstring
         by value function length(rexxstring)
         by reference resultcode
     returning apicode
 end-call
 display "|" apicode "|" resultcode with no advancing end-display
 display "|" function trim(rexxstring trailing) "|" end-display
*><]
*><*
*><* or perhaps::
*><*
*><[
 move
     "parse arg argument; say '##' || argument || '##';" & x"0a" &
     "capture = '';" & x"0a" &
     "address system 'cat tectonic && cat verrexx.cmd && ls -l" &
     " && w3m rexxcaller.html'" &
     " with output fifo '';" & x"0a" &
     "DO i=1 WHILE queued() \= 0;" & x"0a" &
     "    parse pull line;" & x"0a" &
     "    capture = capture || line || '0a'x;" & x"0a" &
     "END;" & x'0a' &
     "return capture;" & x'00' to cmds
 compute
     apicode = function length(function trim(cmds))
 end-compute
 display newline
     "CALL Rexx command with |" cmds(1:apicode - 1) "|"
 end-display
 call "ocrexxcmd"
     using
         by reference cmds
         by reference argument
         by reference rexxstring
         by value function length(rexxstring)
         by reference resultcode
     returning apicode
 end-call
*><]
 display "|" apicode "|" resultcode with no advancing end-display
```

```
       display "|" function trim(rexxstring trailing) "|" end-display
       goback.
       end program rexxcaller.
      *><*
```

And as a sample Rexx script

verrexx.cmd

```
Parse Version ver;
Say ver;
return ver;
```

With a sample run producing:

```
$ ./tectonic
CALL Rexx with |verrexx.cmd|
REXX-Regina_3.3(MT) 5.00 25 Apr 2004
ocrexx.c  ocrexx.o  rexxcaller  rexxcaller.cob  rexxcaller.html  rexxcaller.rst  rexx.output  tecton
|+0000000000|+00000|REXX-Regina_3.3(MT) 5.00 25 Apr 2004|

CALL Rexx command with |say 'Hello World!'; return 'From Rexx';|
Hello World!
|+0000000000|+00000|From Rexx|

CALL Rexx command with |parse arg argument; say '##' || argument || '##';
capture = '';
address system 'cat tectonic && cat verrexx.cmd && ls -l && w3m rexxcaller.html' with output fifo '';
DO i=1 WHILE queued() \= 0;
    parse pull line;
    capture = capture || line || '0a'x;
END;
return capture;|
##OC1.1 args##
|+0000000000|+00000|cobc -I/usr/include/regina/ -c ocrexx.c
cobc -x -lregina rexxcaller.cob ocrexx.o
../ocdoc rexxcaller.cob rexxcaller.rst rexxcaller.html ../ocfaq.css
./rexxcaller
/* script for OpenCOBOL Regina Rexx */
Parse Version ver;
Say ver;
address system;
'ls';
return ver;
total 68
-rw-r--r-- 1 btiffin btiffin  2469 2008-11-16 11:09 ocrexx.c
-rw-r--r-- 1 btiffin btiffin  2568 2010-05-06 22:51 ocrexx.o
-rwxr-xr-x 1 btiffin btiffin 18128 2010-05-06 22:51 rexxcaller
-rw-r--r-- 1 btiffin btiffin  4477 2008-11-16 11:28 rexxcaller.cob
-rw-r--r-- 1 btiffin btiffin  9312 2010-05-06 22:51 rexxcaller.html
-rw-r--r-- 1 btiffin btiffin  3187 2010-05-06 22:51 rexxcaller.rst
-rw-r--r-- 1 btiffin btiffin  4131 2008-11-16 11:30 rexx.output
-rwxr-xr-x 1 btiffin btiffin   162 2008-11-16 11:21 tectonic
-rw-r--r-- 1 btiffin btiffin   101 2008-11-15 23:24 verrexx.cmd
Rexx in OpenCOBOL

 Author:   Brian Tiffin
  Date:    13-Nov-2008
 Purpose:  Very High Level Regina Rexx engine
Requires:  regina-rexx, regina3, regina3-dev, OC 1.1 pre-rel
           cobc -I/usr/include/regina -c ocrexx.c
```

```
Tectonics: cobc -x -lregina rexxcaller.cob ocrexx.o
           ocdoc rexxcaller.cob rexxcaller.rst rexxcaller.html

Working Store

working-storage section.
01 newline constant as x"0a".
01 apicode              usage binary-long.
01 resultcode           usage binary-short.
01 scriptname           pic x(12) value 'verrexx.cmd' & x'00'.
01 argument             pic x(256) value 'OC1.1 args' & x"00".
01 cmds                 pic x(1024).
01 rexxstring           pic x(1048576).

API

ocrexx

Pass a null-term scriptname, a null-term argument string the return value field
and length, the return code and returning the Rexx api result code.

Usage:

call "ocrexx"
    using
        by reference scriptname
        by reference argument
        by reference rexxstring
        by value function length(rexxstring)
        by reference resultcode
    returning apicode
end-call
display "|" apicode "|" resultcode with no advancing end-display
display "|" function trim(rexxstring trailing) "|" end-display

ocrexxcmd

Usage:

move "say 'Hello World!'; return 'From Rexx';" & x'00' to cmds.
compute
    apicode = function length(function trim(cmds))
end-compute
display newline
    "CALL Rexx command with |" cmds(1:apicode - 1) "|"
end-display
call "ocrexxcmd"
    using
        by reference cmds
        by reference argument
        by reference rexxstring
        by value function length(rexxstring)
        by reference resultcode
    returning apicode
end-call
display "|" apicode "|" resultcode with no advancing end-display
display "|" function trim(rexxstring trailing) "|" end-display

or perhaps:
```

```
move
    "parse arg argument; say '##' || argument || '##';" & x"0a" &
    "capture = '';" & x"0a" &
    "address system 'cat tectonic && cat verrexx.cmd && ls -l" &
    " && w3m rexxcaller.html'" &
    " with output fifo '';" & x"0a" &
    "DO i=1 WHILE queued() \= 0;" & x"0a" &
    "    parse pull line;" & x"0a" &
    "    capture = capture || line || '0a'x;" & x"0a" &
    "END;" & x'0a' &
    "return capture;" & x'00' to cmds
compute
    apicode = function length(function trim(cmds))
end-compute
display newline
    "CALL Rexx command with |" cmds(1:apicode - 1) "|"
end-display
call "ocrexxcmd"
    using
        by reference cmds
        by reference argument
        by reference rexxstring
        by value function length(rexxstring)
        by reference resultcode
    returning apicode
end-call

|
```

and the ocdoc output at rexxcaller.html

30.60 5.60 Does OpenCOBOL support table SEARCH and SORT?

Yep.

This is a two part example. A small tax table search, and a dictionary sort and lookup.

30.60.1 5.60.1 Linear SEARCH

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin, with some suggestions from human
      *> Date:      30-Nov-2008, 02-Dec-2008
      *> Purpose:   Demonstration of the SEARCH verb
      *> Tectonics: cobc -x searchlinear.cob
      *> ************************************************************
       identification division.
       program-id. searchlinear.

       data division.

       working-storage section.
       01 taxinfo.
          05 tax-table occurs 4 times indexed by tt-index.
             10 province       pic x(2).
```

```
          10 taxrate         pic 999v9999.
          10 federal         pic 999v9999.
       01 prov               pic x(2).
       01 percent            pic 999v9999.
       01 percentage         pic zz9.99.

      *> ****************************************************************
       procedure division.
       begin.

      *> ****************************************************************
      *> Sample for linear SEARCH, requires INDEXED BY table
      *> populate the provincial tax tabler; not really, only a couple
      *> populate Ontario and then PEI using different field loaders
       move 'AB' to province(1)
       move 'ON' to province(2)
       move 0.08 to taxrate(2)
       move 0.05 to federal(2)
       move 'PE00014000000000' to tax-table(3)
       move 'YT' to province(4)

      *> Find Ontario tax rate
       move "ON" to prov
       perform search-for-taxrate

      *> Setup for Prince Edward Island
       move 'PE' to prov
       perform search-for-taxrate

      *> Setup for failure
       move 'ZZ' to prov
       perform search-for-taxrate

       goback.
      *> ****************************************************************

       search-for-taxrate.
           set tt-index to 1
           search tax-table
               at end display "no province: " prov end-display
               when province(tt-index) = prov
                   perform display-taxrate
           end-search
       .

       display-taxrate.
           compute percent = taxrate(tt-index) * 100
           move percent to percentage
           display
               "found: " prov " at " taxrate(tt-index)
               "," percentage "%, federal rate of " federal(tt-index)
           end-display
       .

       end program searchlinear.
```

A sample run producing:

```
$ cobc -x searchlinear.cob && ./searchlinear
found: ON at 000.0800,  8.00%, federal rate of 000.0500
```

```
found: PE at 000.1400, 14.00%, federal rate of 000.0000
no province: ZZ
```

30.60.2 5.60.2 SORT and binary SEARCH ALL

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin, with some suggestions from human
      *> Date:      30-Nov-2008, 02-Dec-2008
      *> Purpose:   Demonstration of the SEARCH ALL verb and table SORT
      *> Tectonics: cobc -x -fdebugging-line searchbinary.cob
      *> ************************************************************
       identification division.
       program-id. searchbinary.

       environment division.
       input-output section.
       file-control.
           select optional wordfile
           assign to infile
           organization is line sequential.

       data division.
       file section.
       fd wordfile.
           01 wordrec          pic x(20).

       working-storage section.
       01 infile               pic x(256) value spaces.
          88 defaultfile       value '/usr/share/dict/words'.
       01 arguments            pic x(256).

      *> Note the based clause, this memory is initially unallocated
       78 maxwords            value 100000.
       01 wordlist             based.
          05 word-table occurs maxwords times
              depending on wordcount
              descending key is wordstr
              indexed by wl-index.
             10 wordstr        pic x(20).
             10 wordline       usage binary-long.
       01 wordcount            usage binary-long.

       01 file-eof             pic 9 value low-value.
          88 at-eof            value high-values.

       01 word                 pic x(20).

      *> ************************************************************
       procedure division.
       begin.

      *> Get the word file filename
       accept arguments from command-line end-accept
       if arguments not equal spaces
           move arguments to infile
       else
           set defaultfile to true
```

```
     end-if

    *> ************************************************************
    *> Try playing with the words file and binary SEARCH ALL
    *>   requires KEY IS and INDEXED BY table description

    *> Point wordlist to valid memory
     allocate wordlist initialized

     open input wordfile

     move low-value to file-eof
     read wordfile
         at end set at-eof to true
     end-read

     perform
         with test before
         until at-eof or (wordcount >= maxwords)
             add 1 to wordcount
             move wordrec to wordstr(wordcount)
             move wordcount to wordline(wordcount)
             read wordfile
                 at end set at-eof to true
             end-read
     end-perform

     close wordfile

    *> ensure a non-zero length table when allowing optional file
     evaluate true                  also file-eof
         when wordcount = 0         also any
             move 1 to wordcount
             display "No words loaded" end-display
         when wordcount >= maxwords also low-value
             display "Word list truncated to " maxwords end-display
     end-evaluate

   >>D display "Count: " wordcount ": " wordstr(wordcount) end-display

    *> Sort the words from z to a
     sort word-table on descending key wordstr

    *> fetch a word to search for
     display "word to find: " with no advancing end-display
     accept word end-accept

    *> binary search the words for word typed in and display
    *> the original line number if/when a match is found
     set wl-index to 1
     search all word-table
         at end
             display
                 word " not a word of " function trim(infile)
             end-display
         when wordstr(wl-index) = word
             display
                 word " sorted to " wl-index ", originally "
                 wordline(wl-index) " of " function trim(infile)
```

```
            end-display
        end-search

       *> Release memory ownership
        free address of wordlist

        goback.
        end program searchbinary.
```

with some sample words and a Debian 5.0.4 system:

```
$ cobc -x searchbinary.cob
$ ./searchbinary
word to find: zygote
zygote               sorted to +000000018, originally +0000098552 of /usr/share/dict/words
$ ./searchbinary
word to find: abacus
abacus               sorted to +000080466, originally +0000018104 of /usr/share/dict/words
```

See SORT for other examples.

30.61 5.61 Can OpenCOBOL handle named pipes?

Yes. Here is a sample, using a tongue-in-cheek **corncob** filename.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      10-Apr-2010
      *> Purpose:   playing with the corncob pipe
      *> Tectonics: mkfifo corncob
      *>            cobc -x popcorn.cob
      *>            ls >corncob & ./popcorn
      *> ************************************************************
        identification division.
        program-id. popcorn.

        environment division.
        configuration section.

        input-output section.
        file-control.
            select corncob
            assign to 'corncob'
            organization is line sequential
            .

        data division.
        file section.
        fd corncob.
           01 tobacco pic x(32768).

        working-storage section.
        01 filestat pic x value low-value.
           88 done        value high-value.
        01 liner    pic 99999.
        01 looper   pic 99999.
        01 atmost   constant as 32768.
        01 bowl.
```

```
       02 popcorn occurs atmost times depending on liner
           ascending key kernel.
          03 kernel pic x(132).

      *> ****************************************************************
       procedure division.

      *> Read from the pipe into a table
       open input corncob
       move zero to liner
       perform until done or (liner greater than or equal to atmost)
           read corncob
               at end
                   set done to true
               not at end
                   add 1 to liner end-add
                   move tobacco to kernel(liner)
           end-read
       end-perform
       close corncob

      *> Sort it descending and display
       sort popcorn on descending key kernel

       perform varying looper from 1 by 1 until looper > liner
           display
               "OpenCOBOL: " function trim(kernel(looper) trailing)
           end-display
       end-perform

       goback.
       end program popcorn.
```

With a sample run producing:

```
$ rm corncob
$ mkfifo corncob
$ ls -d n* >corncob & ./popcorn
[1] 5033
OpenCOBOL: nums.cob
OpenCOBOL: nums
OpenCOBOL: network
[1]+  Done                    ls -d n* > corncob
$ ls -d n*
network  nums  nums.cob
$ date >corncob & ./popcorn
[1] 5037
OpenCOBOL: Sun Apr 11 08:04:48 EDT 2010
[1]+  Done                    date > corncob
```

30.62 5.62 Can OpenCOBOL interface with ROOT/CINT?

Yes. The Feburary 2009 pre-release generates C code that can be loaded by the ROOT/CINT framework. ROOT is a high energy physics data analysis framework released by CERN. ROOT/CINT embeds the CINT C/C++ interactive interpreter.

See http://root.cern.ch/drupal/content/cint for details.

OpenCOBOL programmers can use ROOT/CINT for interactive testing of COBOL subprograms.

Given

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20101119
      *> Purpose:   Pass arguments to ROOT/CINT invoked subprograms
      *> Tectonics: cobc -fimplicit-init -C cobparams.cob
      *> ************************************************************
       identification division.
       program-id. cobparams.

       data division.
       linkage section.
       01 a-number usage binary-long.

      *> ************************************************************
       procedure division using by reference a-number.
       display a-number end-display
       move a-number to return-code
       goback.
       end program cobparams.
```

and the command line

```
$ cobc -fimplicit-init -C cobparams.cob
```

gives a set of C source code output for cobparams.

ROOT/CINT can then be used to play with the program.

```
$ cobc -fimplicit-init -C cobparams.cob
$ root -l
root [0] gSystem->Load("/usr/local/lib/libcob.so");
root [1] .L cobparams.c+
root [2] int a = 0;
root [3] int d = 42;
root [4] a = cobparams((unsigned char*)&d);
+0000000042
root [5] printf("%d\n", a);
42
root [6]
```

There is some magic in the above snippet. ROOT preloads the runtime libcob.so. Then its .L command is used with the plus + option to interpret and link load the cobc generated cobparams.c file.

The ROOT/CINT console now has access to the cobparams "function", defined by OpenCOBOL to have an unsigned char pointer as its BY REFERENCE access; A cast of the integer d's address allows CINT to call up the COBOL subprogram, passing the 42 for DISPLAY and then returning the same value as the result. The interactively defined integer a, gets this 42 from OpenCOBOL's RETURN-CODE.

30.62.1 5.62.1 Graphing sample

ROOT/CINT is built for analysis. So, plotting and graphing are built-in.

Given

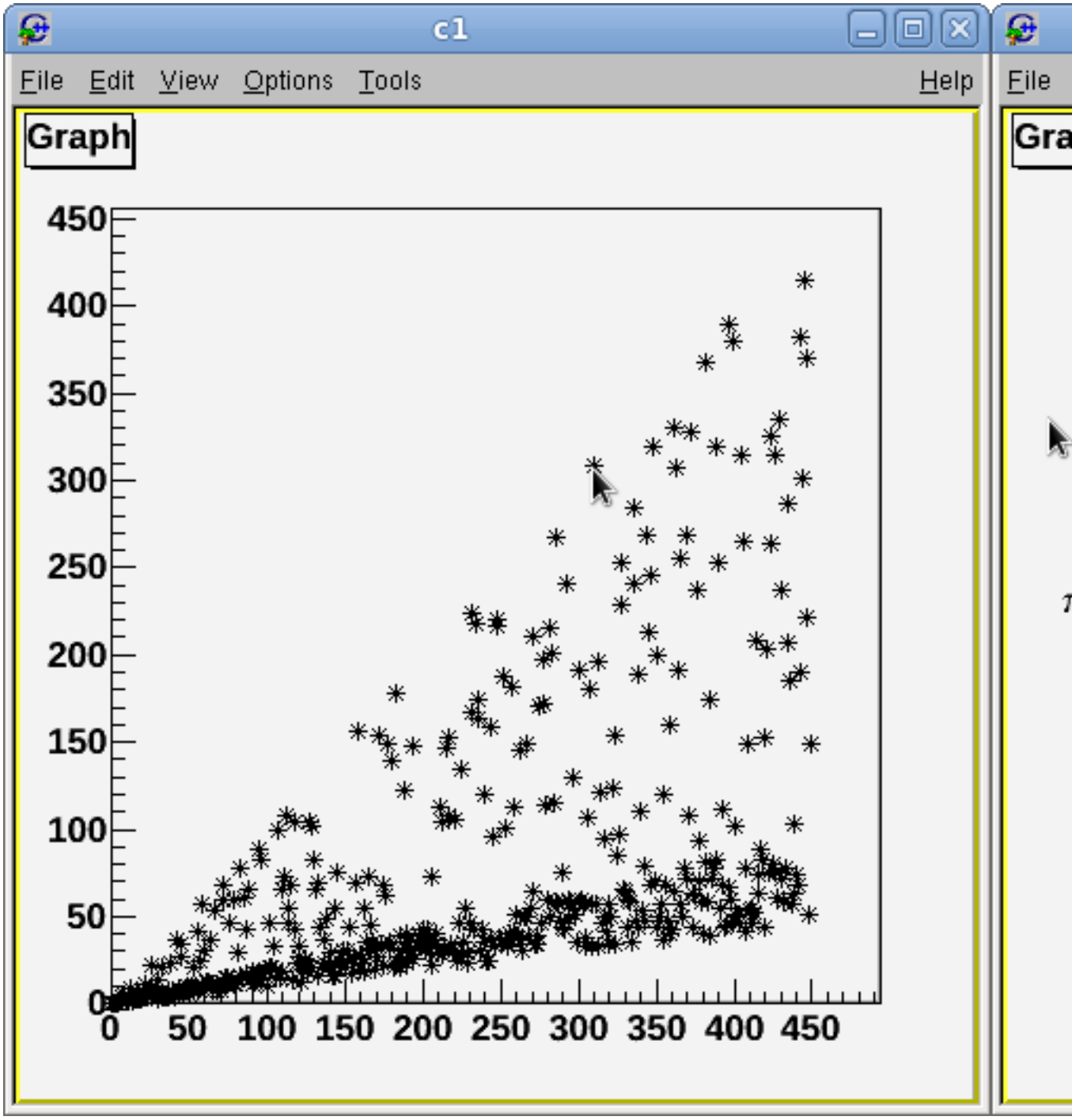
```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20101119
```

```
      *> Purpose:   Pass arguments to ROOT/CINT invoked subprograms
      *> Tectonics: cobc -fimplicit-init -C cobparams.cob
      *> ************************************************************

       REPLACE ==ARRAYSIZE== BY ==450==.

       identification division.
       program-id. cobfloats.

       data division.
       working-storage section.
       01 cnt pic 999.
       01 val usage float-long.
       01 xes.
          02 an-x usage float-long occurs ARRAYSIZE times.
       01 yes.
          02 an-y usage float-long occurs ARRAYSIZE times.

       linkage section.
       01 vxes.
          02 an-x usage float-long occurs ARRAYSIZE times.
       01 vyes.
          02 an-y usage float-long occurs ARRAYSIZE times.

      *> ************************************************************
       procedure division using by reference vxes, vyes.
       perform varying cnt from 1 by 1 until cnt >= ARRAYSIZE
           compute val = cnt * function random() end-compute
           move cnt to an-x in xes(cnt)
           move val to an-y in yes(cnt)
       end-perform
       move xes to vxes
       move yes to vyes
       move cnt to return-code
       goback.
       end program cobfloats.
```

And then a console session of:

```
$ cobc -fimplicit-init -C cobparams.cob
$ vi cobparams.c
... add a single line
...   #pragma K&R
... to lighten up CINT's type safety for ease of use at the console
$ root -l
root [0] gSystem->Load("/usr/local/lib/libcob.so");
root [1] .L cobparams.c+
root [2] int a = 0; double x[450]; double y[450];
root [3] a = cobfloats(&x, &y);
root [4] a
(int)450
root [5] printf("%f %f\n", x[42], y[42]);
43.000000 8.232543
root [6] TGraph *graph1 = new TGraph(450, x, y);
root [7] graph1->Draw("A*");
root [8] TGraphPolar *polar1 = new TGraphPolar(450, x, y);
root [9] polar1->SetLineColor(2);
root [10] polar1->Draw("AOL");
```

produces the following graphs; some constrained random numbers, and a circular view of those random numbers. *Nerd*



heaven.
A trials and tribulations thread can be read at http://www.opencobol.org/modules/newbb/viewtopic.php?topic_id=1165&forum=1

30.63 5.63 Can OpenCOBOL be used to serve HTTP?

Not directly, COBOL preceding the World Wide Web by some 35 years, but yes.

30.63.1 5.63.1 libsoup HTTP server

Vala and libsoup is one way.

Given **soupserver.vala**

```
// vala .10 specific.  .11 changes string to uint8 array
// valac -c --pkg libsoup-2.4 --thread soupserver.vala

// Give the server a default
void default_handler (Soup.Server server, Soup.Message msg, string path,
                      GLib.HashTable? query, Soup.ClientContext client)
{
    string response_text = """
        <html>
          <body>
            <p>Current location: %s</p>
            <p><a href="/xml">Test XML</a></p>
            <p><a href="/cobol">Test COBOL</a></p>
            <p><a href="/exit">Tell server to exit</a></p>
          </body>
        </html>""".printf (path);

    msg.set_response ("text/html", Soup.MemoryUse.COPY,
                      response_text, response_text.size ());
    msg.set_status (Soup.KnownStatusCode.OK);
}


void xml_handler (Soup.Server server, Soup.Message msg, string path,
                  GLib.HashTable? query, Soup.ClientContext client)
{
    string response_text = "<node><subnode>test</subnode></node>";
    msg.set_response ("text/xml", Soup.MemoryUse.COPY,
                      response_text, response_text.size ());
}

void cobol_handler (Soup.Server server, Soup.Message msg, string path,
                    GLib.HashTable? query, Soup.ClientContext client)
{
    string response_text = """
        <html>
          <body>
            <p>Current location: %s</p>
            <p><a href="/xml">Test XML</a></p>
            <p><a href="/">Home</a></p>
            <p><a href="/exit">Tell server to exit</a></p>
          </body>
        </html>""".printf (path);

    msg.set_response ("text/html", Soup.MemoryUse.COPY,
                      response_text, response_text.size ());
    msg.set_status (Soup.KnownStatusCode.OK);
}

void exit_handler (Soup.Server server, Soup.Message msg, string path,
                   GLib.HashTable? query, Soup.ClientContext client)
{
    server.quit();
}
```

```
int CBL_OC_SOUPSERVER(ref Soup.Server* ss, int port) {
    var server = new Soup.Server(Soup.SERVER_PORT, port);
    server.add_handler("/", default_handler);
    server.add_handler("/xml", xml_handler);
    server.add_handler("/cobol", cobol_handler);
    server.add_handler("/exit", exit_handler);
    ss = (owned)server;
    stdout.printf("ss: %X\n", (uint)ss);
    return 0;
}

int CBL_OC_SOUPRUN(Soup.Server ss) {
    ss.run();
    return 0;
}
```

and **ocsoup.cob**

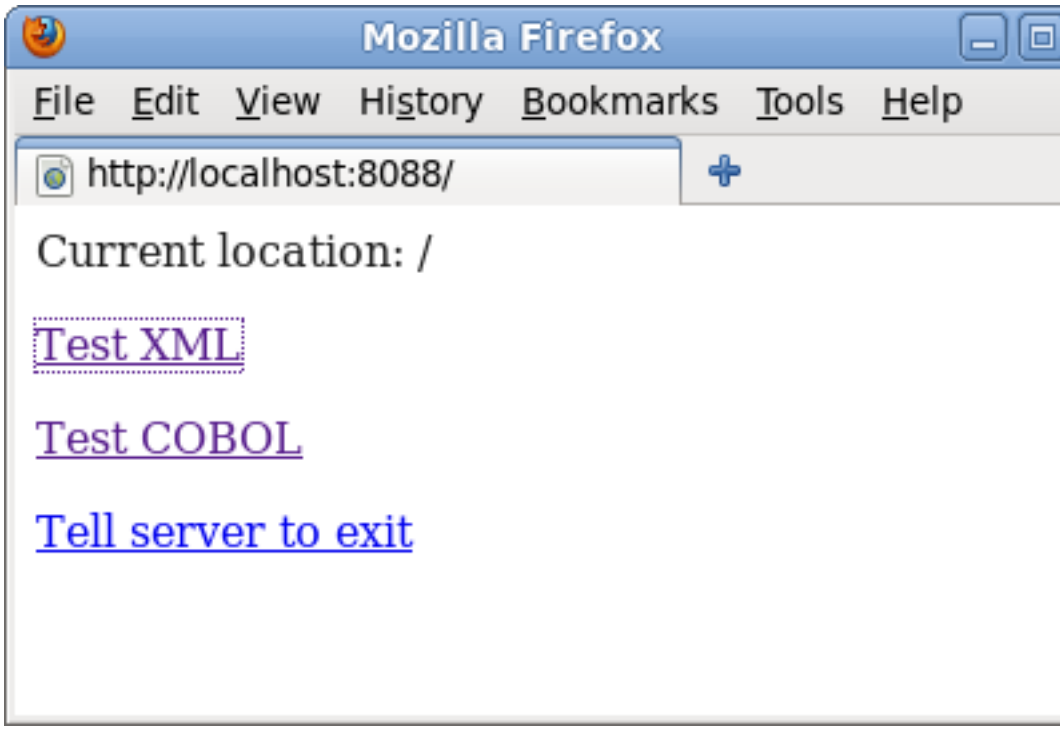
```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ****************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20101205
      *> Purpose:   An HTTP server with libsoup
      *> Tectonics: valac -c --pkg libsoup-2.4 --thread soupserver.vala
      *>            cobc -x ocsoup.cob soupserver.vala.o -lglib-2.0
      *>                 -lsoup-2.4 -lgobject-2.0
      *> ****************************************************************
       identification division.
       program-id. ocsoup.

       data division.
       working-storage section.
       01 soup-server usage pointer.
       01 port usage binary-long value 8088.
       01 result usage binary-long.

      *> ****************************************************************
       procedure division.
       call "g_type_init" end-call
       display "Initialize soup HTTP server on port " port end-display
       call "CBL_OC_SOUPSERVER" using
           by reference soup-server
           by value port
           returning result
       end-call
       display "Result: " result " Server at: " soup-server end-display

       display "About to run server, ^C to terminate" end-display
       call "CBL_OC_SOUPRUN" using
           by value soup-server
           returning result
       end-call

       goback.
       end program ocsoup.
```

and a little bash

```
$ valac -c --pkg libsoup-2.4 --thread soupserver.vala
$ ... some warnings about unused methods ...
```

```
$ cobc -x ocsoup.cob soupserver.vala.o -lglib-2.0 -lsoup-2.4 -lgobject-2.0
$ ./ocsoup
Initialize soup HTTP server on port +0000008088
ss: 21CF060
Result: +0000000000 Server at: 0x00000000021cf060
About to run server, ^C to terminate
```

You get RESTful screen shots like...



The next steps are getting the add_handler callbacks into COBOL, and then play with the template and replace model.

30.64 5.64 Is there a good SCM tool for OpenCOBOL?

In this author's opinion, yes. **Fossil**.

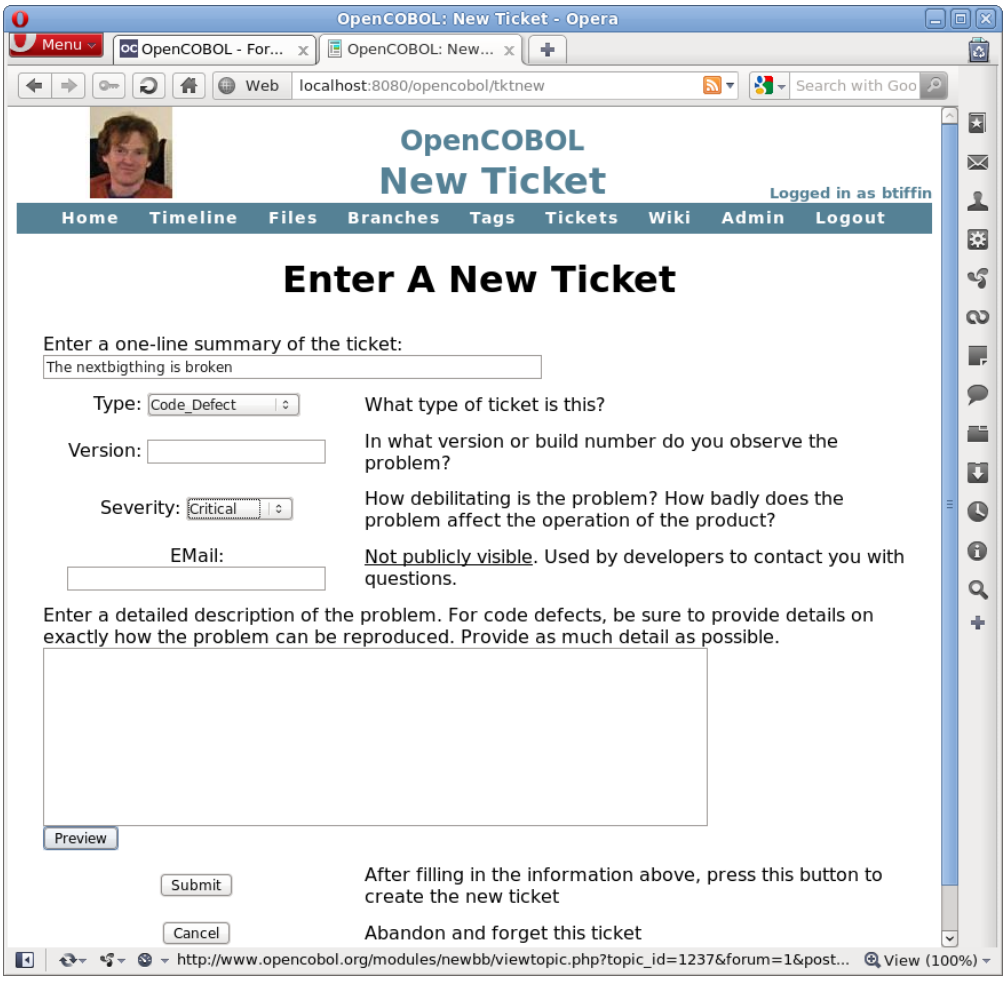
Where SCM is *Software Configuration Management*, and not simply *Source Code Management*, which Fossil does quite well.

See the Fossil site, snag a tar ball, make, and move the binary to /usr/bin.

Then, to start up your next OpenCOBOL COBOL project:

```
# Create the fossil distributed repository
$ mkdir ~/fossils
$ cd ~/fossils
$ fossil new nextbigthing.fossil

# Serve it up on the localhost port 8080
$ fossil server . &

# browse to the admin panel and do a little nicey nice config
$ opera http://localhost:8080/nextbigthing

# set up the working copy
$ cd ~/projects
$ mkdir nextbigthing
```

```
$ cd nextbigthing
$ fossil clone http://localhost:8080/nextbigthing nbt.fossil

# now look at the shiny copy of nextbig
$ ls
$ vi nextbigthing.cob
$ fossil add nextbigthing.cob
$ fossil ci -m "On to the next big thing"

# browse to the repo and create some wiki pages for morale boosting
$ opera http://localhost:8080/nextbigthing

# compile and run the next big thing
$ cobc -x nextbigthing.cob
$ ./nextbigthing

# browse again, and create the bug tickets
$ opera http://localhost:8080/nextbigthing/tktnew
```



Ahh, morale boosting bugs. :)
The fans of OpenCOBOL have posted a few Fossils at

http://fossile.plpwebs.com/ocweb.cgi for an experimental build of OpenCOBOL with support for ACCEPT var FROM HTTP-POST identifier and http://fossile.plpwebs.com/ocsamples.cgi where there is a stash of short OpenCOBOL source code samples. Access with:

```
$ fossil clone http://user:password@fossile.plpwebs.com/ocsamples.cgi my.fossil
$ fossil open my.fossil
```

If you don't have a username and password it'll simply be:

```
$ fossil clone http://fossile.plpwebs.com/ocsamples.cgi my.fossil
```

30.65 5.65 Does OpenCOBOL interface with FORTRAN?

Yes. Quite well in the GNU land.

Snuggled away at http://fortranwiki.org/fortran/show/jucolor is a color unit coverter; RGB to HLS, HSV to RGB, etc...

And with a simple Makefile ala

```
all: rgbcobol

libcolors.so: colors.for
        gfortran -ffree-form -shared -fPIC -o libcolors.so colors.for

rgbcobol: rgbcobol.cob libcolors.so
        cobc -g -debug -x rgbcobol.cob -lcolors -L .
```

and some COBOL

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20110411
      *> Purpose:   Call a FORTRAN color unit converter, rgb, hsv, ...
      *> Tectonics: gfortran -ffree-form -shared -fPIC
      *>                -o libcolors.so colors.for
      *>            cobc -x rgbcobol.cob -lcolors -L .
      *> ************************************************************
       identification division.
       program-id. rgbcobol.

       data division.
       working-storage section.
       01 r usage float-short.
       01 g usage float-short.
       01 b usage float-short.

       01 h usage float-short value 12.21.
       01 l usage float-short value 21.12.
       01 s usage float-short value 23.32.

       01 st usage binary-long.

      *> ************************************************************
       procedure division.
       move 000.0 to h
       move 050.0 to l
       move 100.0 to s
       display "Calling FORTRAN with " h space l space s end-display
       call "jucolor_" using 'hls', h, l, s, 'rgb', r, g, b, st end-call
       display "Returned             " r space g space b end-display
       display "Status of " st end-display
       call "showit_" end-call
       goback.
       end program rgbcobol.
```

which produces:

```
[btiffin@home fortran]$ ./rgbcobol
Calling FORTRAN with 0.00000000000000000 50.000000000000000000 100.000000000000000000
 inside jucolor_:    0.0000000       0.0000000       50.000000       0.0000000       100.00000
Returned             100.000000000000000000 0.000000000000000000 0.000000000000000000
Status of +0000000000
 inside jucolor_:    0.0000000       0.0000000       50.000000       595.19684       100.00000
 INPUT HLS PURE RED ==> OUTPUT RGB values are    100.00000       0.0000000       0.0000000
================================================================================
 inside jucolor_:    120.00000       100.00000       50.000000       0.0000000       100.00000
 INPUT HLS PURE GREEN OUTPUT RGB values are    0.0000000       100.00000       0.0000000
================================================================================
 inside jucolor_:    240.00000       0.0000000       50.000000       100.00000       100.00000
 INPUT HLS PURE BLUE OUTPUT RGB values are    0.0000000       0.0000000       100.00000
================================================================================
 inside jucolor_:    100.00000       0.0000000       0.0000000       0.0000000       0.0000000
 INPUT RGB PURE RED OUTPUT HLS values are    0.0000000       50.000000       100.00000
================================================================================
 inside jucolor_:    0.0000000       0.0000000       100.00000       50.000000       0.0000000
 INPUT RGB PURE GREEN OUTPUT HLS values are    120.00000       50.000000       100.00000
================================================================================
 inside jucolor_:    0.0000000       120.00000       0.0000000       50.000000       100.00000
 INPUT RGB PURE BLUE OUTPUT HLS values are    240.00000       50.000000       100.00000
 values are    240.00000       50.000000       100.00000
================================================================================
```

The weird numbers on the second "inside jucolor_" are uninitialzed gfortran variables, displayed before being set, not great, but safe enough for a one off.

30.66 5.66 Does OpenCOBOL interface with APL?

See Does OpenCOBOL interface with J?

30.67 5.67 Does OpenCOBOL interface with J?

Yes, kinda. Jsoftware recently posted GPL 3 licensed source code for the J programming language. J is designed in part by one of the creators of APL, Eric Iverson. Initial tests have proven successful but there is more work before integration with **libj** in OpenCOBOL is ready for prime-time.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20110711
      *> Purpose:   Attempt calling a J sentence. APL in COBOL.
      *> Tectonics: cobc -x callj.cob -lj
      *> ************************************************************
       identification division.
       program-id. callj.

       data division.
       working-storage section.
       77 jptr usage pointer.
       77 result usage binary-long.

      *> ************************************************************
       procedure division.
```

```
call "JInit" returning jptr end-call
display jptr end-display

call "JDo"
    using by value jptr
    by content z"a =. 1 + 1"
    returning result
end-call
display result end-display

call "JDo"
    using by value jptr
    by content z"2 + 2"
    returning result
end-call
display result end-display

call "JDo"
    using by value jptr
    by content z"('Test Data',CR,LF) 1!:2 <'temp.dat'"
    returning result
end-call
display result end-display

call "JDo"
    using
      by value jptr
      by content z"load 'jgplsrc/test/test.ijs'"
    returning result
end-call
display result end-display

call "JDo"
    using
      by value jptr
      by content z"bad=: TEST ddall"
    returning result
end-call
display result end-display

call "JDo"
    using
      by value jptr
      by content z"BAD ddall"
    returning result
end-call
display result end-display
goback.
end program callj.
```

produces:

```
$ cobc -x callj.cob -lj
$ ./callj
0x00007f3b6ead7010
+0000000000
+0000000000
+0000000003
+0000000021
+0000000000
```

```
+0000000000
```

So libj inits, and can JDo J sentences, but there is a little more background effort to properly set J I/O and PATH settings into an array of callbacks. Doable, just have to ask the good folk at Jsoftware for a little assistance. More coming soon.

The GPL 3 J version 7.01b source code can be found at http://www.jsoftware.com/ Compiling the sources took a little reading, but built clean on 64bit Fedora 14 after a quick edit of jgplsrc/bin/jconfig. Needed to set BITS to 64 and added readline support, as command line recall is more fun than no command line recall when running **jconsole**. After that bin/build_libj bin/build_jconsole all went smooth as silk. **libj.so** was copied to /usr/lib64 and the above code compiled and linked just fine.

As did:

```
$ bin/build_defs
$ bin/build_tsdll

A test suite validates a J system. Read test/test.ijs and test/tsu.ijs for
more info.

$ j/bin/jconsole
   load 'test/test.ijs'
   bad=: TEST ddall NB. run all tests
   BAD ddall NB. report tests that failed
```

with a full test suite pass, all successful. Once the callbacks are properly installed in the sample OpenCOBOL above, I'm sure the error 3 will be resolved for 1:!2 write to file as well as running the test suite from within JDo, which currently reports error 21. The above OpenCOBOL listing is the poor man's 10 minute guide to integrating J.

30.68 5.68 What is COBOLUnit?

A well documented, full featured Unit testing framework for COBOL, written in OpenCOBOL with a GPL license.

http://sites.google.com/site/cobolunit/

- Tutorials
- Installation instructions, with videos
- Open sources

Test suite configuration files look like:

```
<INIT>
    <SETNAME> SUITE-DELIVERY-COST
    <SETDESC> Tests Suite for delivery costs
<ADDSUITE>
       * Add a test
       <SETNAME> FRANCE-TO-ITALY
       <SETPROG> TS000011
       <SETDESC> IF FROM='FR' and TO='IT' then TAXES=120€
<ADDTEST>
<RUN>
```

and *with the scaffolding in place*, a success report looking like:

```
*****************************************************************************
COBOL UNIT : A COBOL FRAMEWORK FOR UNIT TESTS.
*****************************************************************************


COBOL UNIT Current release  : REL 1.00
```

```
COBOL UNIT Release date     : 2009-10-31
Language used for Logging   : EN
Verbosity Level of Log      : 1
End of the 'Testing Strategy Set up' Phase
Starting the 'Test Execution' Phase
|--- SUITE ' SUITE-DELIVERY-COST ' Running
|--- | TEST ' FRANCE-TO-ITALY ' Running
|    |- Assert ' FR => IT:TAX=120 ' success
|    |==> Test ' FRANCE-TO-ITALY ' * SUCCESS * ( 000000001 Assertions, 000000000 Failures, 0 errors)
|==> SUITE ' SUITE-DELIVERY-COST ' SUCCESS ( 000000000 test cases, 000000001 success, 000000000 failu

********************************************************************************
* SUCCESS * ( 000000001 Suites run, 000000001 succeed, 000000000 failed)
********************************************************************************
( 00 min: 00 sec: 00 ms)
```

30.69 5.69 Can OpenCOBOL interface with Gambas?

Yes. See http://code.google.com/p/gambascobolgui/downloads/list for a working sample.

As a taster, the Gambas (http://gambas.sourceforge.net/en/main.html) sample calls OpenCOBOL coded as

```
OCOBOL
         ENTRY "startGrid".
         MOVE FCHIUSO TO GRID-FILE-STATE.
         ACCEPT SOLODATA FROM DATE YYYYMMDD.
         ACCEPT ORA FROM TIME.
         MOVE DATAEORA TO STARTINGPOINT, PRMR-KEY-OF-LIGNE (GAP),
            DATAEORA-KR.
         PERFORM RWDWN.
         MOVE 0 TO RETURN-CODE.
         GOBACK.

         ENTRY "fillrow" USING BY REFERENCE pRiga,
                               BY VALUE     numRiga.
         ADD 1 TO numRiga.
         MOVE SUPER-LIGNE-PMP (numRiga) TO ROW-OUT.
         SET pRiga TO ADDRESS OF ROW-OUT.
         MOVE 0 TO RETURN-CODE.
         GOBACK.
```

which this author found to be a pretty neat way of packaging OpenCOBOL *other language* callables.

The Gambas is nicely clean. Below being a snippet from the sample.

```
Extern cob_init(argc As Integer, argv As Integer) As Integer In "libcob"
Extern startGrid() As Integer In "SCONTO:69"
```

30.70 5.70 Does OpenCOBOL work with LLVM?

Yes. Almost first try for the February 2009 pre-release of 1.1. The compiler sources has a conditional use of a -fno-gcse switch that tripped warnings in clang causing some unit test failure reports. One change to compile out the -fno-gcse in cobc/cobc.c, and a simple:

```
$ sudo yum install llvm clang clang-analyzer clang-devel
$ export CC=clang
$ ./configure
OpenCOBOL Configuration:
```

```
  CC                    clang
  COB_CC                clang
  CFLAGS                 -O2
  COB_CFLAGS            -I/usr/local/include
  COB_EXTRA_FLAGS
  LDFLAGS
  COB_LDFLAGS
  COB_LIBS              -L${exec_prefix}/lib -lcob -lm -lgmp -lncurses -ldb
  COB_CONFIG_DIR        ${prefix}/share/open-cobol/config
  COB_COPY_DIR          ${prefix}/share/open-cobol/copy
  COB_LIBRARY_PATH      ${exec_prefix}/lib/open-cobol
  COB_MODULE_EXT        so
  COB_SHARED_OPT        -shared
  COB_PIC_FLAGS         -fPIC -DPIC
  COB_EXPORT_DYN        -Wl,--export-dynamic
  COB_STRIP_CMD         strip --strip-unneeded
  Dynamic loading       System

$ scan-build make
scan-build: Removing directory '/tmp/scan-build-2012-05-23-2'
   because it contains no reports.

$ make check

# I had to make one change to cobc/cobc.c to remove -fno-gcse to avoid a
#  bunch of make check 'failures' due to a warning about unused -fno-gcse

$ sudo make install
$ sudo ldconfig

# cobc is built with clang, and uses clang when compiling
#   the .c generated from the .cob.

[btiffin@cobol]$ scan-build cobc -v -x hello.cob
scan-build: 'clang' executable not found in
    '/usr/lib64/clang-analyzer/scan-build/bin'.
scan-build: Using 'clang' from path: /usr/bin/clang
preprocessing hello.cob into /tmp/cob18158_0.cob
translating /tmp/cob18158_0.cob into /tmp/cob18158_0.c
clang -pipe -c -I/usr/local/include   -Wno-unused -fsigned-char
    -Wno-pointer-sign  -o /tmp/cob18158_0.o /tmp/cob18158_0.c
clang -pipe  -Wl,--export-dynamic -o hello /tmp/cob18158_0.o
    -L/usr/local/lib -lcob -lm -lgmp -lncurses -ldb
scan-build: Removing directory '/tmp/scan-build-2012-05-23-2'
    because it contains no reports.

[btiffin@cobol]$ ./hello
Hello
[btiffin@cobol]$ ls -la hello
-rwxrwxr-x. 1 btiffin btiffin 9630 May 23 12:37 hello
```

And OpenCOBOL is good to go with clang and the LLVM universe. The above compiles OpenCOBOL with clang, and the installed cobc will use clang as the compiler after processing the COBOL sources. This is grand news in terms of anyone worried about OpenCOBOL viability into the future. The existant C ABI space and now the growing LLVM software pool. Nice.

30.71 5.71 Does OpenCOBOL interface with Python?

Yes. Embedding Python can be accomplished using only COBOL sources. Extending Python to allow calling COBOL modules, will usually require a small amount of glue code written in C.

Very high level Python embedding is pretty straight forward, been there, done that.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ******************************************************
      *> Author:    Brian Tiffin
      *> Date:      20130126
      *> Purpose:   Embed Python
      *> Tectonics: cobc -x cobpy.cob -lpython2.6
      *> ******************************************************
       identification division.
       program-id. cobpy.

       procedure division.
       call "Py_Initialize"
           on exception
               display "link cobpy with -lpython2.6" end-display
       end-call
       call "PyRun_SimpleString" using
           by reference
               "from time import time,ctime" & x"0a" &
               "print('Today is', ctime(time()))" & x"0a" & x"00"
           on exception continue
       end-call
       call "Py_Finalize" end-call
       goback.
       end program cobpy.
```

Giving:

```
$ cobc -x cobpy.cob -lpython2.6
$ ./cobpy
('Today is', 'Sat Jan 26 20:01:41 2013')
```

Python dutifully displayed the tuple. But what fun is Python if it is just for high level script side effects? Lots, but still.

Pure embedding.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ******************************************************
      *> Author:    Brian Tiffin
      *> Date:      20130126
      *> Purpose:   Embed Python
      *> Tectonics: cobc -x cobkat.cob -lpython2.6
      *>     NOTES:    leaks, no Py_DECREF macros called.
      *> ******************************************************
       identification division.
       program-id. cobkat.

       data division.
       working-storage section.
       77 python-name          usage pointer.
       77 python-module        usage pointer.
       77 python-dict          usage pointer.
       77 python-func          usage pointer.
       77 python-stringer      usage pointer.
       77 python-args          usage pointer.
       77 python-value         usage pointer.
```

```
 01 cobol-buffer-pointer usage pointer.
 01 cobol-buffer         pic x(80)               based.
 01 cobol-string         pic x(80).

 01 cobol-integer        usage binary-long.

 01 command-line-args    pic x(80).

*> ******************************************************
 procedure division.
 call "Py_Initialize"
     on exception
         display "link cobpy with -lpython" end-display
 end-call

*> Python likes module names in Unicode
 call "PyUnicodeUCS4_FromString" using
     by reference "pythonfile" & x"00"
     returning python-name
     on exception
         display "unicode problem" end-display
 end-call

*> import the module, using PYTHONPATH
 call "PyImport_Import" using
     by value python-name
     returning python-module
     on exception
         display "this would be borked" end-display
 end-call

 if python-module equal null
     display "no pythonfile.py in PYTHONPATH" end-display
 end-if

*> within the module, an attribute is "pythonfunction"
 call "PyObject_GetAttrString" using
     by value python-module
     by reference "pythonfunction" & x"00"
     returning python-func
     on exception continue
 end-call

*>
*> error handling now skimped out on
*>

*> pythonfunction takes a single argument
 call "PyTuple_New" using
     by value 1
     returning python-args
 end-call

*> of type long, hard coded to the ultimate answer
 call "PyLong_FromLong" using
     by value 42
     returning python-value
 end-call
```

```
*> set first (only) element of the argument tuple
 call "PyTuple_SetItem" using
     by value python-args
     by value 0
     by value python-value
 end-call

*> call the function, arguments marshalled for Python
 call "PyObject_CallObject" using
     by value python-func
     by value python-args
     returning python-value
 end-call

*> we know we get a long back, hopefully 1764
 call "PyLong_AsLong" using
     by value python-value
     returning cobol-integer
 end-call
 display "Python returned: " cobol-integer end-display

*> ************************************************ *<
*> a function taking string and returning string
 call "PyObject_GetAttrString" using
     by value python-module
     by reference "pythonstringer" & x"00"
     returning python-stringer
 end-call

 call "PyTuple_New" using
     by value 1
     returning python-args
 end-call

*> Use the OpenCOBOL command argument
 accept command-line-args from command-line end-accept
 call "PyString_FromString" using
     by reference
         function concatenate(
             function trim(command-line-args)
             x"00")
     returning python-value
 end-call

*> Set the function argument tuple to the cli args
 call "PyTuple_SetItem" using
     by value python-args
     by value 0
     by value python-value
 end-call

*> call the "pythonstringer" function
 call "PyObject_CallObject" using
     by value python-stringer
     by value python-args
     returning python-value
 end-call
```

```
      *> return as String (with the MD5 hex digest tacked on)
       call "PyString_AsString" using
           by value python-value
           returning cobol-buffer-pointer
       end-call

      *> one way of removing null while pulling data out of C
       set address of cobol-buffer to cobol-buffer-pointer
       string
           cobol-buffer delimited by x"00"
           into cobol-string
       end-string
       display "Python returned: " cobol-string end-display

      *> and clear out <*
       call "Py_Finalize" end-call
       goback.
       end program cobkat.
```

with **pythonfile.py**

```
#
# Simple Python sample for OpenCOBOL embedding trial
#
def pythonfunction(i):
    return i * i

import hashlib
def pythonstringer(s):
    sum = hashlib.md5()
    sum.update(s)
    return s + ": " + sum.hexdigest()
```

Giving:

```
$ ./cobkat Python will use this for MD5 hash
no pythonfile.py in PYTHONPATH
Attempt to reference unallocated memory (Signal SIGSEGV)
Abnormal termination - File contents may be incorrect
```

Oops:

```
$ export PYTHONPATH=.
$ ./cobkat Python will use this for MD5 hash
Python returned: +0000001764
Python returned: Python will use this for MD5 hash: c5577e3ab8dea11adede20a1949b5fb3
```

Oh, in case you're reading along, 1764 is the ultimate answer, squared.

An OpenCOBOL source line like

```
set environment "PYTHONPATH" to "."
```

before **Py_Initialize** saves on the oops when you need to find current working directory Python scripts.

30.72 5.72 Can OpenCOBOL interface with Forth?

Yes, ficl, Forth Inspired Command Language embeds nicely.

Ok, I said, easy, I meant almost easy, as I had to hunt down a sysdep.h file and could not get 4.10 to go, but 4.0.31 works the beauty, once the sysdep.h was put in place.

First, the license compliance.

```
/*******************************************************
** f i c l . h
** Forth Inspired Command Language
** Author: John Sadler (john_sadler@alum.mit.edu)
** Created: 19 July 1997
** Dedicated to RHS, in loving memory
** $Id: //depot/gamejones/ficl/ficl.h#33 $
*******************************************************
**
** Copyright (c) 1997-2001 John Sadler (john_sadler@alum.mit.edu)
** All rights reserved.
**
** Get the latest Ficl release at http://ficl.sourceforge.net
**
** I am interested in hearing from anyone who uses Ficl. If you have
** a problem, a success story, a defect, an enhancement request, or
** if you would like to contribute to the Ficl release, please
** contact me by email at the address above.
**
** L I C E N S E  and  D I S C L A I M E R
**
** Redistribution and use in source and binary forms, with or without
** modification, are permitted provided that the following conditions
** are met:
** 1. Redistributions of source code must retain the above copyright
**    notice, this list of conditions and the following disclaimer.
** 2. Redistributions in binary form must reproduce the above copyright
**    notice, this list of conditions and the following disclaimer in the
**    documentation and/or other materials provided with the distribution.
**
** THIS SOFTWARE IS PROVIDED BY THE AUTHOR AND CONTRIBUTORS ``AS IS'' AND
** ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
** IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
** ARE DISCLAIMED.  IN NO EVENT SHALL THE AUTHOR OR CONTRIBUTORS BE LIABLE
** FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
** DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
** OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
** HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
** LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
** OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
** SUCH DAMAGE.
*/
```

And then the COBOL, **callficl.cob**

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ******************************************************
      *> Author:    Brian Tiffin
      *> Date:      20130220
      *> Purpose:   Embed ficl
      *> Tectonics: cobc -x callficl.cob -lficl -L.
      *>            LD_LIBRARY_PATH=. ./callficl
      *> ******************************************************
       identification division.
       program-id. callficl.

       data division.
       working-storage section.
       01 ficl-result usage binary-long.
       01 ficl-system usage pointer.
```

```
       01 ficl-vm     usage pointer.

      *> ************************************************
       procedure division.
       call "ficlSystemCreate" using
           by value 0
           returning ficl-system
       end-call

       display ficl-system end-display

       call "ficlSystemCompileExtras" using
           by value ficl-system
       end-call

       call "ficlSystemCreateVm" using
           by value ficl-system
           returning ficl-vm
       end-call

       display ficl-vm end-display

       call "ficlVmEvaluate" using
           by value ficl-vm
           by reference ".ver cr quit" & x"00"
           returning ficl-result
       end-call

       display ficl-result end-display

       call "ficlVmEvaluate" using
           by value ficl-vm
           by reference
               ".( loading ooptest.fr ) cr load ooptest.fr" &
               x"0a" & " cr" & x"00"
           returning ficl-result
       end-call

       display ficl-result end-display

       goback.
       end program callficl.
```

and the test file **ooptest.fr**

```
\ OOP test stuff

only
also oop definitions

object subclass c-aggregate
c-byte obj: m0
c-byte obj: m1
c-4byte obj: m2
c-2byte obj: m3
end-class

object --> sub class1

cell: .a
```

```
cell: .b
: init
    locals| class inst |
    0 inst class --> .a !
    1 inst class --> .b !
;
end-class

class1 --> new c1inst

class1 --> sub class2
cell: .c
cell: .d

: init
    locals| class inst |
    inst class --> super --> init
    2 inst class --> .c !
    3 inst class --> .d !
;
end-class

class2 --> new c2inst

object subclass c-list
c-list ref: link
c-ref  obj: payload
end-class

\ test stuff from ficl.html
.( metaclass methods ) cr
metaclass --> methods

cr .( c-foo class ) cr
object --> sub c-foo
cell: m_cell1
    4 chars: m_chars
    : init   ( inst class -- )
        locals| class inst |
        0 inst class --> m_cell1 !
        inst class --> m_chars 4 0 fill
        ." initializing an instance of c_foo at " inst x. cr
    ;
end-class

.( c-foo instance methods... ) cr
c-foo --> new foo-instance
cr
foo-instance --> methods
foo-instance --> pedigree
cr
foo-instance 2dup
    --> methods
    --> pedigree
cr
c-foo --> see init
cr
foo-instance --> class --> see init
```

and finally, **the run**. The first two commands building up ficl and the libficl shared library, the next two for COBOL:

```
$ make -f Makefile.linux
$ make -f Makefile.linux main

$ cobc -g -debug -x callficl.cob -lficl -L .
$ LD_LIBRARY_PATH=. ./callficl
loading CORE EXT words
loading SEARCH & SEARCH-EXT words
loading Johns-Hopkins locals
loading MARKER
loading ficl O-O extensions
loading ficl utility classes
loading ficl string class
0x080569c0
0x08057928
Ficl version 4.0.31

-0000000056
loading ooptest.fr
metaclass methods
metaclassmethods:
debug   see     pedigree        methods id      offset-of       sub
resume-class    ref     allot-array     allot   alloc-array     alloc
new-array       new     array   instance        get-super       get-wid
get-size        .size   .wid    .super  .do-instance
Dictionary: 24 words, 7786 cells used of 12288 total



c-foo class
c-foo instance methods...
initializing an instance of c_foo at 806043C

c-foomethods:
init    m_chars m_cell1 .do-instance
Dictionary: 4 words, 7893 cells used of 12288 total

objectmethods:
debug   prev    next    index   methods size    pedigree        super
free    array-init      init    class   .do-instance
Dictionary: 13 words, 7893 cells used of 12288 total


c-foo object

c-foomethods:
init    m_chars m_cell1 .do-instance
Dictionary: 4 words, 7893 cells used of 12288 total

objectmethods:
debug   prev    next    index   methods size    pedigree        super
free    array-init      init    class   .do-instance
Dictionary: 13 words, 7893 cells used of 12288 total


c-foo object

: init
   0   (link) (instruction 136)
```

```
   1   2 (instruction 2)
   2   (toLocal) (instruction 140), with argument 0 (0)
   4   (toLocal) (instruction 140), with argument 1 (0x1)
   6   0 (instruction 17)
   7   (@local1) (instruction 146)
   8   (@local0) (instruction 142)
   9   s" m_cell1"
  13   exec-method
  14   ! (instruction 57)
  15   (@local1) (instruction 146)
  16   (@local0) (instruction 142)
  17   s" m_chars"
  21   exec-method
  22   4 (instruction 4)
  23   0 (instruction 17)
  24   fill (instruction 111)
  25   s" initializing an instance of c_foo at "
  36   type
  37   (@local1) (instruction 146)
  38   x.
  39   cr
  40   (unlink) (instruction 137)
;

: init
   0   (link) (instruction 136)
   1   2 (instruction 2)
   2   (toLocal) (instruction 140), with argument 0 (0)
   4   (toLocal) (instruction 140), with argument 1 (0x1)
   6   0 (instruction 17)
   7   (@local1) (instruction 146)
   8   (@local0) (instruction 142)
   9   s" m_cell1"
  13   exec-method
  14   ! (instruction 57)
  15   (@local1) (instruction 146)
  16   (@local0) (instruction 142)
  17   s" m_chars"
  21   exec-method
  22   4 (instruction 4)
  23   0 (instruction 17)
  24   fill (instruction 111)
  25   s" initializing an instance of c_foo at "
  36   type
  37   (@local1) (instruction 146)
  38   x.
  39   cr
  40   (unlink) (instruction 137)
;

-0000000257
```

Turns out that return codes -56 and -257 are ok codes, (from **ficl.h**):

```
#define FICL_VM_STATUS_QUIT         ( -56)   /* like FICL_VM_STATUS_ERROR_EXIT, but leave dataStack
#define FICL_VM_STATUS_OUT_OF_TEXT  (-257)   /* hungry - normal exit */
```

OpenCOBOL does Forth.

http://ficl.sourceforge.net/

p.s. One small note. The ficl load word, load ooptest.fr needed a newline after the filename. Normally Forth uses a straight up space delimited word parser, but ficl accounts for filenames with spaces in them. Nice feature.

30.73 5.73 Can OpenCOBOL interface with Shakespeare?

Yes. The reference implementation of the Shakespeare Programming Language builds into OpenCOBOL applications that can CALL SPL modules.

Technicals: I downloaded Marlowe which fixes the reference implementation problem with Roman Numerals.

https://bitbucket.org/kcartmell/marlowe/downloads

Then inside a working dir (*/lang/cobol/cobill/* for instance) create spl, untar, and make SPL. *I assume the spl/ sub directory in the Makefile listed below*.

What is happening here isn't runtime link loading, it is simply building the SPL engine into COBOL, and then CALL the result of **spl2c**.

This first cut **lacks art**. Lacks. Sad, so verily verily sad.

cobill.cob

```
OCOBOL*> ******************************************************
      *> Author:    Brian Tiffin
      *> Date:      20130224
      *> Purpose:   COBOL meets Shakespeare
      *> Tectonics: cobc -x -Ispl cobill.cob ocshake.c
      *>                    spl/libspl.c spl/strutils.c
      *>   pre-req: spl2c ocshake.spl and an spl/ distribution
      *> ******************************************************
       identification division.
       program-id. cobill.
       procedure division.
       call "ocshake" end-call
       goback.
       end program cobill.
```

Then some cowardly SPL, **ocshake.spl**

```
The derp in SPL from OpenCOBOL.

Ajax, the loud mouth.

Dorcas, the d.
Escalus, the e.
Rosalind, the r.
Prospero, the p.
The Archbishop of Canterbury, the new line.


                    Act I: derping.

                    Scene I: derp.

[Enter Ajax and Dorcas]

Ajax:
    You amazing beautiful fine charming gentle delicious door.
    You are as honest as the sum of a bold brave hard proud noble stone wall and thyself.
    You are as trustworthy as the sum of a proud rich tree and thyself.
```

```
    Speak your mind.

[Exit Dorcas]
[Enter Escalus]

Ajax:
    You bluest peaceful smooth lovely warm embroidered summer's day.
    You are as beautiful as the sum of a fine honest fair sweet gentle wind and thyself.
    You are as lovely as the sum of a reddest sunny flower and thyself.
    You are as mighty as the sum of the sky and thyself.
    Speak your mind.

[Exit Escalus]
[Enter Rosalind]

Ajax:
    You fair reddest sweet rich smooth blossoming red rose.
    You are as rich as the difference between thyself and a golden gentle clearest wind.
    You are as rich as the difference between thyself and a proud white lantern.
    You are as rich as the difference between thyself and a honest morning.
    Speak your mind.

[Exit Rosalind]
[Enter Prospero]

Ajax:
    You proud prompt pretty loving gentle warm purple pony.
    You are as bold as the difference between thyself and an amazing cute delicious pretty purse.
    Speak your mind.

[Exeunt]

                    Scene II: a new line.

[Enter Ajax and The Archbishop of Canterbury]

Ajax:
    You are nothing.
    You are a bold beautiful blossoming wind.
    You are as cunning as the sum of thyself and a tiny thing.
    Speak your mind!

[Exeunt]
```

A **Makefile** of:

```
cobill: ocshake.spl cobill.cob
    spl/spl2c <ocshake.spl >ocshake.c
    sed -i 's/int main(void)/int ocshake(void)/' ocshake.c
    cobc -x -Ispl cobill.cob ocshake.c spl/libspl.c spl/strutils.c
```

Then a run of:

```
$ make
spl/spl2c <ocshake.spl >ocshake.c
sed -i 's/int main(void)/int ocshake(void)/' ocshake.c
cobc -x -Ispl cobill.cob ocshake.c spl/libspl.c spl/strutils.c
$ ./cobill
derp
$
```

derp, in a 20K binary, from 2K of source.

I am kinda proud of Scene II, that one reads well. The rest needs some Fahrenheit 451

30.74 5.74 Can OpenCOBOL interface with Ruby?

Yes. Ruby 1.8 links without issue.

This example is only calling Ruby for side effect, without data exchange.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************************
      *> Author:    Brian Tiffin
      *> Date:      20130226
      *> Purpose:   Embed Ruby for effect, no data exchange yet
      *> Tectonics: cobc -x callruby.cob -lruby1.8
      *> ************************************************************
       identification division.
       program-id. callruby.

       procedure division.
       display "OpenCOBOL: initialize ruby" end-display
       call "ruby_init"
           on exception
               display "hint: link with -lruby1.8" end-display
               stop run giving 1
       end-call

       display "OpenCOBOL: evaluate ruby string" end-display
       call "rb_eval_string" using
           by content "puts 'Hello, world'" & x"00"
       end-call

       display "OpenCOBOL: evaluate ruby script.rb" end-display
       call "ruby_init_loadpath" end-call
       call "rb_load_file" using
           by content "script.rb" & x"00"
       end-call
       call "ruby_exec" end-call

       call "ruby_finalize" end-call
       display "OpenCOBOL: finalized ruby" end-display

       goback.
       end program callruby.
```

and **script.rb**

```
puts 'Hello, script'
puts 6*7
puts 'Goodbye, script'
```

and a run test of:

```
$ cobc -x callruby.cob
$ ./callruby
OpenCOBOL: initialize ruby
hint: link with -lruby1.8

$ cobc -x callruby.cob -lruby1.8
```

```
$ ./callruby
OpenCOBOL: initialize ruby
OpenCOBOL: evaluate ruby string
Hello, world
OpenCOBOL: evaluate ruby script.rb
Hello, script
42
Goodbye, script
OpenCOBOL: finalized ruby
```

30.75 5.75 Can OpenCOBOL interface with Pure?

Yes. Yes it can.

Pure is a term rewriting functional programming language by Albert Graef. Influenced by Haskell, the system generates C code as part of the just in time compiler. The successor of Q.

Given a Fedora with LLVM installed, and a:

```
$ sudo yum install pure pure-devel pure-gen pure-doc
```

Below is a little test program, to see if pure can call OpenCOBOL

hellooc.pure

```
#!/usr/bin/pure -x
using system;
puts "Hello, world";

using "lib:hellocobol";
extern int hellocobol();

hellocobol;
```

And a little snippet of COBOL introduction

hellocobol.cob

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************
      *> Author:    Brian Tiffin
      *> Date:      20130612
      *> Purpose:   Call this COBOL program from pure
      *> Tectonics: cobc -fimplicit-init hellocobol.cob
      *>            pure -L. hellooc.pure
      *> ************************************************
       identification division.
       program-id. hellocobol.

       procedure division.
       display "S'up?" end-display

       goback.
       end program hellocobol.
```

With a first try of:

```
$ cobc hellocobol.cob
$ pure -L. hellooc.pure
Hello, world
Segmentation fault
```

Oops. Kept the error above in, to show the fix. The object code needs to initialize OpenCOBOL:

```
$ cobc -fimplicit-init hellocobol.cob
$ pure -L. hellooc.pure
Hello, world
S'up?
```

Yayy, success one. Pure can call OpenCOBOL.

And then to leverage Pure power from OpenCOBOL, *as things should be, power balance wise*.

```
OCOBOL >>SOURCE FORMAT IS FIXED
      *> ************************************************
      *> Author:    Brian Tiffin
      *> Date:      20130612
      *> Purpose:   Call pure.  Nice.
      *> Tectonics: pure -o hello.o -c -x hello.pure 8
      *             cobc -x callpurefact.cob hello.o -lpure
      *> ************************************************
       identification division.
       program-id. callpurefact.

       data division.
       working-storage section.
       01 pure-arg-pointer       usage pointer.
       01 fact-function-pointer  usage program-pointer.
       01 fact-result-pointer    usage pointer.
       01 pure-result            usage binary-long.
       01 fact-answer            usage binary-long.

      *> ************************************************

       procedure division.

      *> Initialize pure, with empty argc argv.
       call "__pure_main__" using
           by value 0 by value 0
       end-call

      *> convert a 9 to a pure expression pointer argument
       call "pure_int" using
           by value 9
           returning pure-arg-pointer
       end-call

      *> resolve the link address to the function, "fact"
       set fact-function-pointer to entry "fact"

      *> call the pure function "fact"
      *>   using the program pointer
      *>   1 as the number of argumments
      *>   the address of the argument expression
      *>   returing a result expression pointer
       call "pure_funcall" using
           by value fact-function-pointer
           by value 1
           by value pure-arg-pointer
           returning fact-result-pointer
       end-call

      *> convert the result expression back to integer
```

```
       call "pure_is_int" using
           by value fact-result-pointer
           by reference fact-answer
           returning pure-result
       end-call
       display "fact 9 should be 362880" end-display
       display "fact 9 result is " fact-answer end-display

       goback.
       end program callpurefact.
      *><*
```

Below is the tutorial hello program for Pure. `pure` is used to compile this, and in this example, is passed an initial argument of 8 for the ubiquitous factorial functional hello.

OpenCOBOL will call this main, mapping out 8 factorial results, then will call the defined `fact` function with an argument of 9.

hello.pure

```
using system;

fact n = if n>0 then n*fact (n-1) else 1;

main n = do puts ["Hello, world!", str (map fact (1..n))];

const n = if argc>1 then sscanf (argv!1) "%d" else 10;
if compiling then () else main n;
```

And then:

```
$ pure -o hello.o -c -x hello.pure 8
$ cobc -g -debug -W -x callpurefact.cob -lpure hello.o
$ ./callpurefact
Hello, world!
[1,2,6,24,120,720,5040,40320]
fact 9 should be 362880
fact 9 result is +0000362880
```

So, yayy, success. OpenCOBOL can handle `Pure` integration. Pure looks pretty sweet.

Pure at Wikipedia

CHAPTER

THIRTYONE

6 NOTES

Notes

Notes

31.1 6.1 big-endian

Binary values stored with the most significant byte at the lowest memory address.

Big End First.

See http://en.wikipedia.org/wiki/Endianness for more details.

The OpenCOBOL compiler *default* storage format for USAGE BINARY and COMP.

31.2 6.2 little-endian

Binary values stored with the most significant byte at the highest memory address.

Little End First.

http://en.wikipedia.org/wiki/Endianness for more details.

This is the common Intel architecture form, and USAGE clauses of COMPUTATIONAL-5, BINARY-CHAR, BINARY-SHORT, BINARY-LONG, BINARY-DOUBLE are a true performance boost on this hardware. See http://www.opencobol.org/modules/bwiki/index.php?cmd=read&page=UserManual%2F4#content_1_0 for some details.

31.3 6.3 ASCII

American Symbolic Code for Information Interchange.

The character encoding common to personal computers and the early Internet Age, therefore OpenCOBOL. OpenCOBOL also supports the EBCDIC character encoding so some data transfers and keyboard handling or console display programs may need programmer attention to detail. Although this is a rare case as OpenCOBOL operates using an intelligent choice of encoding for each platform build.

See http://en.wikipedia.org/wiki/American_Standard_Code_for_Information_Interchange for more info.

Note: Unicode? OpenCOBOL supports PIC N, a two-byte character field.

31.4 6.4 currency symbol

COBOL allows a SPECIAL-NAMES clause that determines the currency symbol. This effects both source codes and input/output PICTURE definitions.

```
CONFIGURATION SECTION.
SPECIAL-NAMES.
CURRENCY SIGN IS "#".
```

31.5 6.5 DSO

Dynamic Shared Objects.

Similar to but subtly different from *share libraries*.

31.6 6.6 errno

OpenCOBOL and C are fairly closely related as OpenCOBOL produces intermediate C source code and passes this off to another compiler.

Some C functions had no easy way to report out-of-bound errors so a global int **errno** is defined in the standard C library as a thread safe variable. Conscientious programmers will reset and test this variable for any and all functions documented as setting **errno**.

This is not straight forward for OpenCOBOL, but a small wrapper along the lines of

```
/* set/get errno */

#include <errno.h>

int reset_errno() {
    errno = 0;
    return errno;
}

int get_errno() {
    return errno;
}
/**/
```

exposes this critical run-time variable.

Usage:

```
$ cobc -c geterrno.c
$ cobc -x program.cob geterrno.o
```

and then something like

```
CALL "reset_errno" END-CALL
MOVE FUNCTION SQRT(-1) TO root
CALL "get_errno" RETURNING result END-CALL
IF result NOT EQUAL ZERO
   CALL "perror" USING NULL END-CALL
END-IF
```

Outputs:

```
Numerical argument out of domain
```

31.7 6.7 gdb

The GNU symbolic debugger. Big, deep, wide.

```
$ info gdb for the details.
```

or visit http://www.gnu.org/software/gdb/documentation/

31.8 6.8 GMP

GNU MP libgmp. GNU Library for decimal arithmetic. See http://gmplib.org/ for complete details on the library advertised as *Arithmetic without limitations*.

31.9 6.9 ISAM

Indexed Sequential Access Method. A system to allow a variety of access methods for data records in file storage.

See http://en.wikipedia.org/wiki/ISAM for more details.

31.9.1 6.9.1 OpenCOBOL FILE STATUS codes

From http://oldsite.add1tocobol.com/tiki-list_file_gallery.php?galleryId=1 **statcodes.cpy** courtesy of John Ellis.

```
01  status-code           pic x(2) value spaces.
    88  SUCCESS                    value '00'.
    88  SUCCESS_DUPLICATE          value '02'.
    88  SUCCESS_INCOMPLETE         value '04'.
    88  SUCCESS_OPTIONAL           value '05'.
    88  SUCCESS_NO_UNIT            value '07'.
    88  END_OF_FILE                value '10'.
    88  OUT_OF_KEY_RANGE           value '14'.
    88  KEY_INVALID                value '21'.
    88  KEY_EXISTS                 value '22'.
    88  KEY_NOT_EXISTS             value '23'.
    88  PERMANENT_ERROR            value '30'.
    88  INCONSISTENT_FILENAME      value '31'.
    88  BOUNDARY_VIOLATION         value '34'.
    88  NOT_EXISTS                 value '35'.
    88  PERMISSION_DENIED          value '37'.
    88  CLOSED_WITH_LOCK           value '38'.
    88  CONFLICT_ATTRIBUTE         value '39'.
    88  ALREADY_OPEN               value '41'.
    88  NOT_OPEN                   value '42'.
    88  READ_NOT_DONE              value '43'.
    88  RECORD_OVERFLOW            value '44'.
    88  READ_ERROR                 value '46'.
    88  INPUT_DENIED               value '47'.
    88  OUTPUT_DENIED              value '48'.
    88  I_O_DENIED                 value '49'.
    88  RECORD_LOCKED              value '51'.
    88  END_OF_PAGE                value '52'.
    88  I_O_LINAGE                 value '57'.
    88  FILE_SHARING               value '61'.
    88  NOT_AVAILABLE              value '91'.
```

Download and then in your WORKING-STORAGE SECTION use

COPY “statcodes.cpy”.

31.10 6.10 line sequential

An access method for newline terminated files. OpenCOBOL reads each line and strips off carriage returns and line feeds. Filling the record buffer with the current line and padding with spaces.

31.11 6.11 APT

Advanced Package Tool. One of the strengths of the Debian GNU/Linux system. Allows for dependency checked binary packages.

31.12 6.12 ROBODoc Support

Below is a sample of a configuration file for using ROBODoc with OpenCOBOL programs.

```
# robodoc.rc for OpenCOBOL
#
items:
    NAME
```

```
    AUTHOR
    DATE
    PURPOSE
    TECTONICS
    SYNOPSIS
    INPUTS
    OUTPUTS
    SIDE EFFECTS
    HISTORY
    BUGS
    EXAMPLE
    SOURCE
ignore items:
    HISTORY
    BUGS
item order:
    PURPOSE
    SYNOPSIS
    INPUTS
    OUTPUTS
source items:
    SYNOPSIS
preformatted items:
    INPUTS
    OUTPUTS
format items:
    PURPOSE
    SIDE EFFECTS
options:
#    --src ./
#    --doc ./doc
    --html
    --syntaxcolors
#    --singledoc
#   --multidoc
    --index
    --tabsize 4
headertypes:
    J  "Projects"          robo_projects    2
    F  "Files"             robo_files       1
    e  "Makefile Entries"  robo_mk_entries
    x  "System Tests"      robo_syst_tests
    q  Queries             robo_queries
ignore files:
    README
    CVS
    *.bak
    *~
    "a test_*"
accept files:
    *.cob
    *.COB
    *.cbl
    *.CBL
    *.cpy
    *.CPY
header markers:
    *>****
remark markers:
```

```
    *>
end markers:
    *>****
header separate characters:
    ,
header ignore characters:
    [
remark begin markers:
    *>+
remark end markers:
    *>-
source line comments:
    *>
# OpenCOBOL keywords *><*
keywords:
    accept
    access
    active-class
    add
    address
    advancing
    after
    aligned
    all
    allocate
    alphabet
    alphabetic
    alphabetic-lower
    alphabetic-upper
    alphanumeric
    alphanumeric-edited
    also
    alter
    alternate
    and
    any
    anycase
    are
    area
    areas
    argument-number
    argument-value
    arithmetic
    as
    ascending
    assign
    at
    attribute
    auto
    auto-skip
    automatic
    autoterminate
    b-and
    b-not
    b-or
    b-xor
    background-color
    based
    beep
```

```
before
bell
binary
binary-c-long
binary-char
binary-double
binary-long
binary-short
bit
blank
blink
block
boolean
bottom
by
byte-length
call
cancel
cd
center
cf
ch
chain
chaining
character
characters
class
class-id
classification
close
code
code-set
col
collating
cols
column
columns
comma
command-line
commit
common
communication
comp
comp-1
comp-2
comp-3
comp-4
comp-5
comp-x
computational
computational-1
computational-2
computational-3
computational-4
computational-5
computational-x
compute
condition
configuration
```

```
constant
contains
content
continue
control
controls
converting
copy
corr
corresponding
count
crt
currency
cursor
cycle
data
data-pointer
date
day
day-of-week
de
debugging
decimal-point
declaratives
default
delete
delimited
delimiter
depending
descending
destination
detail
disable
disk
display
divide
division
down
duplicates
dynamic
ebcdic
ec
egi
else
emi
enable
end
end-accept
end-add
end-call
end-compute
end-delete
end-display
end-divide
end-evaluate
end-if
end-multiply
end-of-page
end-perform
```

```
end-read
end-receive
end-return
end-rewrite
end-search
end-start
end-string
end-subtract
end-unstring
end-write
entry
entry-convention
environment
environment-name
environment-value
eo
eol
eop
eos
equal
equals
erase
error
escape
esi
evaluate
exception
exception-object
exclusive
exit
expands
extend
external
factory
false
fd
file
file-control
file-id
filler
final
first
float-extended
float-long
float-short
footing
for
foreground-color
forever
format
free
from
full
function
function-id
generate
get
giving
global
```

```
go
goback
greater
group
group-usage
heading
high-value
high-values
highlight
i-o
i-o-control
id
identification
if
ignoring
implements
in
index
indexed
indicate
inherits
initial
initialize
initialized
initiate
input
input-output
inspect
interface
interface-id
into
intrinsic
invalid
invoke
is
just
justified
key
label
last
lc_all
lc_collate
lc_ctype
lc_messages
lc_monetary
lc_numeric
lc_time
leading
left
length
less
limit
limits
linage
linage-counter
line
line-counter
lines
linkage
```

```
local-storage
locale
lock
low-value
low-values
lowlight
manual
memory
merge
message
method
method-id
minus
mode
move
multiple
multiply
national
national-edited
native
negative
nested
next
no
none
normal
not
null
nulls
number
numbers
numeric
numeric-edited
object
object-computer
object-reference
occurs
of
off
omitted
on
only
open
optional
options
or
order
organization
other
output
overflow
overline
override
packed-decimal
padding
page
page-counter
paragraph
perform
```

```
pf
ph
pic
picture
plus
pointer
position
positive
present
previous
printer
printing
procedure
procedure-pointer
procedures
proceed
program
program-id
program-pointer
prompt
property
prototype
purge
queue
quote
quotes
raise
raising
random
rd
read
receive
record
recording
records
recursive
redefines
reel
reference
relation
relative
release
remainder
removal
renames
replace
replacing
report
reporting
reports
repository
required
reserve
reset
resume
retry
return
returning
reverse-video
```

```
rewind
rewrite
rf
rh
right
rollback
rounded
run
same
screen
sd
search
seconds
section
secure
segment
select
self
send
sentence
separate
sequence
sequential
set
sharing
sign
signed
signed-int
signed-long
signed-short
size
sort
sort-merge
source
source-computer
sources
space
spaces
special-names
standard
standard-1
standard-2
start
statement
status
step
stop
string
strong
sub-queue-1
sub-queue-2
sub-queue-3
subtract
sum
super
suppress
symbol
symbolic
sync
```

```
synchronized
system-default
table
tallying
tape
terminal
terminate
test
text
than
then
through
thru
time
times
to
top
trailing
true
type
typedef
ucs-4
underline
unit
universal
unlock
unsigned
unsigned-int
unsigned-long
unsigned-short
unstring
until
up
update
upon
usage
use
user-default
using
utf-16
utf-8
val-status
valid
validate
validate-status
value
values
varying
when
with
working-storage
write
yyyyddd
yyyymmdd
zero
zeroes
zeros
```

To be used with

```
$ robodoc --src program.cob --doc program --singlefile --rc robocob.rc
```

Producing a nice HTML file documenting the program using embedded ROBODoc comment line directives. See ROBODoc for more information.

31.13 6.13 cobol.vim

Many thanks to the good people at www.vim.org:

```
" Vim syntax file
" Language: COBOL
" Maintainers: Davyd Ondrejko
" (formerly Sitaram Chamarty
" James Mitchell
" Last change: 2001 Sep 02

" For version 5.x: Clear all syntax items
" For version 6.x: Quit when a syntax file was already loaded

" Stephen Gennard
" - added keywords - AS, REPOSITORY
" - added extra cobolCall bits

if version < 600
  syntax clear
elseif exists("b:current_syntax")
  finish
endif

" MOST important - else most of the keywords wont work!
if version < 600
  set isk=@,48-57,-
else
  setlocal isk=@,48-57,-
endif

syn case ignore

if exists("cobol_legacy_code")
  syn match cobolKeys "^\a\{1,6\}" contains=cobolReserved
else
  syn match cobolKeys "" contains=cobolReserved
endif

syn keyword cobolReserved contained ACCEPT ACCESS ADD ADDRESS ADVANCING AFTER ALPHABET ALPHABETIC
syn keyword cobolReserved contained ALPHABETIC-LOWER ALPHABETIC-UPPER ALPHANUMERIC ALPHANUMERIC-EDITE
syn keyword cobolReserved contained ALTERNATE AND ANY ARE AREA AREAS ASCENDING ASSIGN AT AUTHOR BEFOR
syn keyword cobolReserved contained BLANK BLOCK BOTTOM BY CANCEL CBLL CD CF CH CHARACTER CHARACTERS C
syn keyword cobolReserved contained CLOCK-UNITS CLOSE COBOL CODE CODE-SET COLLATING COLUMN COMMA COMM
syn keyword cobolReserved contained COMMUNICATIONS COMPUTATIONAL COMPUTE CONFIGURATION CONTENT CONTIN
syn keyword cobolReserved contained CONTROL CONVERTING CORR CORRESPONDING COUNT CURRENCY DATA DATE DA
syn keyword cobolReserved contained DATE-WRITTEN DAY DAY-OF-WEEK DE DEBUG-CONTENTS DEBUG-ITEM DEBUG-I
syn keyword cobolReserved contained DEBUG-NAME DEBUG-SUB-1 DEBUG-SUB-2 DEBUG-SUB-3 DEBUGGING DECIMAL-
syn keyword cobolReserved contained DELARATIVES DELETE DELIMITED DELIMITER DEPENDING DESCENDING DESTI
syn keyword cobolReserved contained DETAIL DISABLE DISPLAY DIVIDE DIVISION DOWN DUPLICATES DYNAMIC EG
syn keyword cobolReserved contained ENABLE END-ADD END-COMPUTE END-DELETE END-DIVIDE END-EVALUATE END
syn keyword cobolReserved contained END-MULTIPLY END-OF-PAGE END-PERFORM END-READ END-RECEIVE END-RET
syn keyword cobolReserved contained END-REWRITE END-SEARCH END-START END-STRING END-SUBTRACT END-UNST
```

```
syn keyword cobolReserved contained END-WRITE ENVIRONMENT EQUAL ERROR ESI EVALUATE EVERY EXCEPTION
syn keyword cobolReserved contained EXTEND EXTERNAL FALSE FD FILE FILE-CONTROL FILLER FINAL FIRST FOO
syn keyword cobolReserved contained GENERATE GIVING GLOBAL GREATER GROUP HEADING HIGH-VALUE HIGH-VALU
syn keyword cobolReserved contained I-O-CONTROL IDENTIFICATION IN INDEX INDEXED INDICATE INITIAL INIT
syn keyword cobolReserved contained INITIATE INPUT INPUT-OUTPUT INSPECT INSTALLATION INTO IS JUST
syn keyword cobolReserved contained JUSTIFIED KEY LABEL LAST LEADING LEFT LENGTH LOCK MEMORY
syn keyword cobolReserved contained MERGE MESSAGE MODE MODULES MOVE MULTIPLE MULTIPLY NATIVE NEGATIVE
syn keyword cobolReserved contained NUMBER NUMERIC NUMERIC-EDITED OBJECT-COMPUTER OCCURS OF OFF OMITT
syn keyword cobolReserved contained OPTIONAL OR ORDER ORGANIZATION OTHER OUTPUT OVERFLOW PACKED-DECIM
syn keyword cobolReserved contained PAGE PAGE-COUNTER PERFORM PF PH PIC PICTURE PLUS POSITION POSITIV
syn keyword cobolReserved contained PRINTING PROCEDURE PROCEDURES PROCEDD PROGRAM PROGRAM-ID PURGE QU
syn keyword cobolReserved contained RANDOM RD READ RECEIVE RECORD RECORDS REDEFINES REEL REFERENCE RE
syn keyword cobolReserved contained RELATIVE RELEASE REMAINDER REMOVAL REPLACE REPLACING REPORT REPOR
syn keyword cobolReserved contained REPORTS RERUN RESERVE RESET RETURN RETURNING REVERSED REWIND REWR
syn keyword cobolReserved contained RIGHT ROUNDED SAME SD SEARCH SECTION SECURITY SEGMENT SEGMENT-LIM
syn keyword cobolReserved contained SELECT SEND SENTENCE SEPARATE SEQUENCE SEQUENTIAL SET SIGN SIZE S
syn keyword cobolReserved contained SORT-MERGE SOURCE SOURCE-COMPUTER SPECIAL-NAMES STANDARD
syn keyword cobolReserved contained STANDARD-1 STANDARD-2 START STATUS STRING SUB-QUEUE-1 SUB-QUEUE-2
syn keyword cobolReserved contained SUB-QUEUE-3 SUBTRACT SUM SUPPRESS SYMBOLIC SYNC SYNCHRONIZED TABL
syn keyword cobolReserved contained TAPE TERMINAL TERMINATE TEST TEXT THAN THEN THROUGH THRU TIME TIM
syn keyword cobolReserved contained TRAILING TRUE TYPE UNIT UNSTRING UNTIL UP UPON USAGE USE USING VA
syn keyword cobolReserved contained VARYING WHEN WITH WORDS WORKING-STORAGE WRITE

" new
syn keyword cobolReserved contained AS LOCAL-STORAGE LINKAGE SCREEN ENTRY

" new - btiffin
syn keyword cobolReserved contained END-ACCEPT END-DISPLAY

" new
syn keyword cobolReserved contained environment-name environment-value argument-number
syn keyword cobolReserved contained call-convention identified pointer

syn keyword cobolReserved contained external-form division wait national

" new -- oo stuff
syn keyword cobolReserved contained repository object class method-id method object static
syn keyword cobolReserved contained class-id class-control private inherits object-storage
syn keyword cobolReserved contained class-object protected delegate
syn keyword cobolReserved contained try catch raise end-try super property
syn keyword cobolReserved contained override instance equals

" new - new types
syn match cobolTypes "condition-value"hs=s,he=e
syn match cobolTypes "binary-char"hs=s,he=e
syn match cobolTypes "binary-c-long"hs=s,he=e
syn match cobolTypes "binary-long"hs=s,he=e
syn match cobolTypes "binary-short"hs=s,he=e
syn match cobolTypes "binary-double"hs=s,he=e
syn match cobolTypes "procedure-pointer"hs=s,he=e
syn match cobolTypes "object reference"hs=s,he=e

syn match cobolReserved contained "\<CONTAINS\>"
syn match cobolReserved contained "\<\(IF\|ELSE|INVALID\|END\|EOP\)\>"
syn match cobolReserved contained "\<ALL\>"

syn keyword cobolConstant SPACE SPACES NULL ZERO ZEROES ZEROS LOW-VALUE LOW-VALUES

syn keyword cobolReserved contained fold folder
```

```
if exists("cobol_legacy_code")
  syn match cobolMarker "^.\{6\}"
  syn match cobolBadLine "^.\{6\}[^ D\-*$/].*"hs=s+6
  " If comment mark somehow gets into column past Column 7.
  syn match cobolBadLine "^.\{6\}\s\+\*.*"
endif

syn match cobolNumber "\<-\=\d*\.\=\d\+\>" contains=cobolMarker,cobolComment
syn match cobolPic "\<S*9\+\>" contains=cobolMarker,cobolComment
syn match cobolPic "\<$*\.\=9\+\>" contains=cobolMarker,cobolComment
syn match cobolPic "\<Z*\.\=9\+\>" contains=cobolMarker,cobolComment
syn match cobolPic "\<V9\+\>" contains=cobolMarker,cobolComment
syn match cobolPic "\<9\+V\>" contains=cobolMarker,cobolComment
syn match cobolPic "\<-\+[Z9]\+\>" contains=cobolMarker,cobolComment
syn match cobolTodo "todo" contained

if exists("cobol_mf_syntax")
  syn region cobolComment start="*>" end="$" contains=cobolTodo,cobolMarker
endif

syn keyword cobolGoTo GO GOTO
syn keyword cobolCopy COPY

" cobolBAD: things that are BAD NEWS!
syn keyword cobolBAD ALTER ENTER RENAMES

" cobolWatch: things that are important when trying to understand a program
syn keyword cobolWatch OCCURS DEPENDING VARYING BINARY COMP REDEFINES
syn keyword cobolWatch REPLACING THROW
syn match cobolWatch "COMP-[123456XN]"

" new - btiffin, added Intrinsics
syn keyword cobolWatch ABS ACOS ANNUITY ASIN ATAN BYTE-LENGTH CHAR
syn keyword cobolWatch COS CURRENT-DATE DATE-OF-INTEGER DATE-TO-YYYYMMDD
syn keyword cobolWatch DAY-OF-INTEGER DAY-TO-YYYYDDD E EXCEPTION-FILE
syn keyword cobolWatch EXCEPTION-LOCATION EXCEPTION-STATEMENT
syn keyword cobolWatch EXCEPTION-STATUS EXP EXP10 FACTORIAL FRACTION-PART
syn keyword cobolWatch INTEGER INTEGER-OF-DATE INTEGER-OF-DAY INTEGER-PART
syn keyword cobolWatch LENGTH LOCALE-DATE LOCALE-TIME LOG LOG10 LOWER-CASE
syn keyword cobolWatch MAX MEAN MEDIAN MIDRANGE MIN MOD NUMVAL NUMVAL-C
syn keyword cobolWatch ORD ORD-MAX ORD-MIN PI PRESENT-VALUE RANDOM RANGE
syn keyword cobolWatch REM REVERSE SECONDS-FROM-FORMATTED-TIME
syn keyword cobolWatch SECONDS-PAST-MIDNIGHT SIGN SIN SQRT
syn keyword cobolWatch STANDARD-DEVIATION STORED-CHAR-LENGTH SUM TAN
syn keyword cobolwatch SUBSTITUTE SUBSTITUTE-CASE
syn keyword cobolWatch TEST-DATE-YYMMDD TEST-DAY-YYYYDDD TRIM UPPER-CASE
syn keyword cobolWatch VARIANCE WHEN-COMPILED YEAR-TO-YYYY

syn region cobolEXECs contains=cobolLine start="EXEC " end="END-EXEC"

syn match cobolComment "^.\{6\}\*.*"hs=s+6 contains=cobolTodo,cobolMarker
syn match cobolComment "^.\{6\}/.*"hs=s+6 contains=cobolTodo,cobolMarker
syn match cobolComment "^.\{6\}C.*"hs=s+6 contains=cobolTodo,cobolMarker

if exists("cobol_legacy_code")
  syn match cobolCompiler "^.\{6\}$.*"hs=s+6
  syn match cobolDecl "^.\{6} \{1,8}\(0\=1\|77\|78\) "hs=s+7,he=e-1 contains=cobolMarker
  syn match cobolDecl "^.\{6} \+[1-8]\d "hs=s+7,he=e-1 contains=cobolMarker
```

```
  syn match cobolDecl "^.\{6} \+0\=[2-9] "hs=s+7,he=e-1 contains=cobolMarker
  syn match cobolDecl "^.\{6} \+66 "hs=s+7,he=e-1 contains=cobolMarker
  syn match cobolWatch "^.\{6} \+88 "hs=s+7,he=e-1 contains=cobolMarker
else
  syn match cobolWhiteSpace "^*[ \t]"
  syn match cobolCompiler "$.*"hs=s,he=e contains=cobolWhiteSpace,cobolTypes
  syn match cobolDecl "0\=[1-9] *$"hs=s,he=e-1 contains=cobolWhiteSpace,cobolTypes
  syn match cobolDecl "66 *$"hs=s,he=e-1 contains=cobolWhiteSpace,cobolTypes
  syn match cobolWatch "88 *$"hs=s,he=e-1 contains=cobolWhiteSpace,cobolTypes
endif

syn match cobolBadID "\k\+-\($\|[^-A-Z0-9]\)"

syn keyword cobolCALLs CALL CANCEL GOBACK INVOKE PERFORM END-PERFORM END-CALL RUN
syn match cobolCALLs "STOP \+RUN"
syn match cobolCALLs "EXIT \+PROGRAM"
syn match cobolCALLs "EXIT \+PROGRAM \+RETURNING"
syn match cobolCALLs "EXIT \+PERFORM"
syn match cobolCALLs "EXIT \+METHOD"
syn match cobolCALLs "EXIT \+SECTION"
syn match cobolCALLs "STOP " contains=cobolString

syn match cobolExtras /\<VALUE \+\d\+\./hs=s+6,he=e-1

" zero terminated strings eg: pic x(10) value z"My C String"
if exists("cobol_mf_syntax")
  syn match cobolString /z"[^"]*\("\|$\)/
endif

syn match cobolString /"[^"]*\("\|$\)/
syn match cobolString /'[^']*\('\|$\)/

" new - btiffin, added libcob calls
syn match cobolWatch /\(["']\)SYSTEM\1/
syn match cobolWatch /["']CBL_ERROR_PROC["']/
syn match cobolWatch /["']CBL_EXIT_PROC["']/
syn match cobolWatch /["']CBL_OPEN_FILE["']/
syn match cobolWatch /["']CBL_CREATE_FILE["']/
syn match cobolWatch /["']CBL_READ_FILE["']/
syn match cobolWatch /["']CBL_WRITE_FILE["']/
syn match cobolWatch /["']CBL_CLOSE_FILE["']/
syn match cobolWatch /["']CBL_FLUSH_FILE["']/
syn match cobolWatch /["']CBL_DELETE_FILE["']/
syn match cobolWatch /["']CBL_COPY_FILE["']/
syn match cobolWatch /["']CBL_CHECK_FILE_EXIST["']/
syn match cobolWatch /["']CBL_RENAME_FILE["']/
syn match cobolWatch /["']CBL_GET_CURRENT_DIR["']/
syn match cobolWatch /["']CBL_CHANGE_DIR["']/
syn match cobolWatch /["']CBL_CREATE_DIR["']/
syn match cobolWatch /["']CBL_DELETE_DIR["']/
syn match cobolWatch /["']CBL_AND["']/
syn match cobolWatch /["']CBL_OR["']/
syn match cobolWatch /["']CBL_NOR["']/
syn match cobolWatch /["']CBL_XOR["']/
syn match cobolWatch /["']CBL_IMP["']/
syn match cobolWatch /["']CBL_NIMP["']/
syn match cobolWatch /["']CBL_EQ["']/
syn match cobolWatch /["']CBL_NOT["']/
syn match cobolWatch /["']CBL_TOUPPER["']/
```

```
syn match cobolWatch /["']CBL_TOLOWER["']/
syn match cobolWatch /["']\\364["']/
syn match cobolWatch /["']\\365["']/
syn match cobolWatch /["']\\221["']/
syn match cobolWatch /["']C$NARG["']/
syn match cobolWatch /["']C$PARAMSIZE["']/
syn match cobolWatch /["']C$MAKEDIR["']/
syn match cobolWatch /["']C$CHDIR["']/
syn match cobolWatch /["']C$SLEEP["']/
syn match cobolWatch /["']C$COPY["']/
syn match cobolWatch /["']C$FILEINFO["']/
syn match cobolWatch /["']C$DELETE["']/
syn match cobolWatch /["']C$TOUPPER["']/
syn match cobolWatch /["']C$TOLOWER["']/
syn match cobolWatch /["']C$JUSTIFY["']/
syn match cobolWatch /["']CBL_OC_NANOSLEEP["']/

if exists("cobol_legacy_code")
  syn region cobolCondFlow contains=ALLBUT,cobolLine start="\<\(IF\|INVALID\|END\|EOP\)\>"
      skip=/\('\|"\)[^"]\{-}\("\|'\|$\)/ end="\." keepend
  syn region cobolLine start="^.\{6} " end="$" contains=ALL
endif

if exists("cobol_legacy_code")
  " catch junk in columns 1-6 for modern code
  syn match cobolBAD "^ \{0,5\}[^ ].*"
endif

" many legacy sources have junk in columns 1-6: must be before others
" Stuff after column 72 is in error - must be after all other "match" entries
if exists("cobol_legacy_code")
  syn match cobolBadLine "^.\{6}[^*/].\{66,\}"
endif

" Define the default highlighting.
" For version 5.7 and earlier: only when not done already
" For version 5.8 and later: only when an item doesn't have highlighting yet
if version >= 508 || !exists("did_cobol_syntax_inits")
  if version < 508
    let did_cobol_syntax_inits = 1
    command -nargs=+ HiLink hi link <args>
  else
    command -nargs=+ HiLink hi def link <args>
  endif
  HiLink cobolBAD Error
  HiLink cobolBadID Error
  HiLink cobolBadLine Error
  HiLink cobolMarker Comment
  HiLink cobolCALLs Function
  HiLink cobolComment Comment
  HiLink cobolKeys Comment
  HiLink cobolCompiler PreProc
  HiLink cobolEXECs PreProc
  HiLink cobolCondFlow Special
  HiLink cobolCopy PreProc
  HiLink cobolDecl Type
  HiLink cobolTypes Type
  HiLink cobolExtras Special
  HiLink cobolGoTo Special
```

```
  HiLink cobolConstant Constant
  HiLink cobolNumber Constant
  HiLink cobolPic Constant
  HiLink cobolReserved Statement
  HiLink cobolString Constant
  HiLink cobolTodo Todo
  HiLink cobolWatch Special
  delcommand HiLink
endif

let b:current_syntax = "cobol"

" vim: ts=6 nowrap
```

31.14 6.14 make check listing

A `make check` from February 2009:

```
## ------------------------------------- ##
## OpenCOBOL 1.1 test suite: Syntax Tests. ##
## ------------------------------------- ##
  1: COPY: file not found                          ok
  2: COPY: replacement order                       ok
  3: COPY: separators                              ok
  4: COPY: partial replacement                     ok
  5: COPY: recursive replacement                   ok
  6: Invalid PROGRAM-ID                            ok
  7: Invalid PROGRAM-ID type clause (1)            ok
  8: Invalid PROGRAM-ID type clause (2)            ok
  9: Undefined data name                           ok
 10: Undefined group name                          ok
 11: Undefined data name in group                  ok
 12: Reference not a group name                    ok
 13: Incomplete 01 definition                      ok
 14: Same labels in different sections             ok
 15: Redefinition of 01 items                      ok
 16: Redefinition of 01 and 02 items               ok
 17: Redefinition of 02 items                      ok
 18: Redefinition of 77 items                      ok
 19: Redefinition of 01 and 77 items               ok
 20: Redefinition of 88 items                      ok
 21: Ambiguous reference to 02 items               ok
 22: Ambiguous reference to 02 and 03 items        ok
 23: Ambiguous reference with qualification        ok
 24: Unique reference with ambiguous qualifiers    ok
 25: Undefined procedure name                      ok
 26: Redefinition of section names                 ok
 27: Redefinition of section and paragraph names   ok
 28: Redefinition of paragraph names               ok
 29: Ambiguous reference to paragraph name         ok
 30: Non-matching level numbers (extension)        ok
 31: Ambiguous AND/OR                              ok
 32: START on SEQUENTIAL file                      ok
 33: Subscripted item requires OCCURS clause       ok
 34: The number of subscripts                      ok
 35: OCCURS with level 01, 66, 77, and 88          ok
 36: OCCURS with variable-occurrence data item     ok
```

```
 37: Nested OCCURS clause                          ok
 38: OCCURS DEPENDING followed by another field    ok
 39: OCCURS DEPENDING without TO clause            ok
 40: REDEFINES: not following entry-name           ok
 41: REDEFINES: level 02 by 01                     ok
 42: REDEFINES: level 03 by 02                     ok
 43: REDEFINES: level 66                           ok
 44: REDEFINES: level 88                           ok
 45: REDEFINES: lower level number                 ok
 46: REDEFINES: with OCCURS                        ok
 47: REDEFINES: with subscript                     ok
 48: REDEFINES: with variable occurrence           ok
 49: REDEFINES: with qualification                 ok
 50: REDEFINES: multiple redefinition              ok
 51: REDEFINES: size exceeds                       ok
 52: REDEFINES: with VALUE                         ok
 53: REDEFINES: with intervention                  ok
 54: REDEFINES: within REDEFINES                   ok
 55: Numeric item (integer)                        ok
 56: Numeric item (non-integer)                    ok
 57: Numeric item with picture P                   ok
 58: Signed numeric literal                        ok
 59: Alphabetic item                               ok
 60: Alphanumeric item                             ok
 61: Alphanumeric group item                       ok
 62: Numeric-edited item                           ok
 63: Alphanumeric-edited item                      ok
 64: MOVE SPACE TO numeric or numeric-edited item ok
 65: MOVE ZERO TO alphabetic item                  ok
 66: MOVE alphabetic TO x                          ok
 67: MOVE alphanumeric TO x                        ok
 68: MOVE alphanumeric-edited TO x                 ok
 69: MOVE numeric (integer) TO x                   ok
 70: MOVE numeric (non-integer) TO x               ok
 71: MOVE numeric-edited TO x                      ok
 72: Operands must be groups                       ok
 73: MOVE: misc                                    ok
 74: Category check of Format 1                    ok
 75: Category check of Format 2                    ok
 76: Category check of literals                    ok
 77: SET: misc                                     ok

## ------------- ##
## Test results. ##
## ------------- ##

All 77 tests were successful.
PASS: ./syntax
## ----------------------------------- ##
## OpenCOBOL 1.1 test suite: Run Tests. ##
## ----------------------------------- ##
  1: DISPLAY literals                              ok
  2: DISPLAY literals, DECIMAL-POINT is COMMA      ok
  3: Hexadecimal literal                           ok
  4: DISPLAY data items with VALUE clause          ok
  5: DISPLAY data items with MOVE statement        ok
  6: GLOBAL at same level                          ok
  7: GLOBAL at lower level                         ok
  8: non-numeric subscript                         ok
```

```
 9: The range of subscripts                       ok
10: Subscript out of bounds (1)                   ok
11: Subscript out of bounds (2)                   ok
12: Value of DEPENDING ON N out of bounds (lower)ok
13: Value of DEPENDING ON N out of bounds (upper)ok
14: Subscript bounds with ODO (lower)             ok
15: Subscript bounds with ODO (upper)             ok
16: Subscript bounds with ODO                     ok
17: Subscript by arithmetic expression            ok
18: Separate sign positions                       ok
19: Static reference modification                 ok
20: Dynamic reference modification                ok
21: Static out of bounds                          ok
22: Offset underflow                              ok
23: Offset overflow                               ok
24: Length underflow                              ok
25: Length overflow                               ok
26: ACCEPT                                        ok
27: INITIALIZE group entry with OCCURS            ok
28: INITIALIZE OCCURS with numeric edited         ok
29: INITIALIZE complex group (1)                  ok
30: INITIALIZE complex group (2)                  ok
31: INITIALIZE with REDEFINES                     ok
32: Source file not found                         ok
33: Comma separator without space                 ok
34: LOCAL-STORAGE                                 ok
35: EXTERNAL data item                            ok
36: EXTERNAL AS data item                         ok
37: cobcrun validation                            ok
38: MOVE to itself                                ok
39: MOVE with refmod                              ok
40: MOVE with refmod (variable)                   ok
41: MOVE with group refmod                        ok
42: MOVE indexes                                  ok
43: MOVE X'00'                                    ok
44: Level 01 subscripts                           ok
45: Class check with reference modification       ok
46: Index and parenthesized expression            ok
47: Alphanumeric and binary numeric               ok
48: Dynamic call with static linking              ok
49: CALL m1. CALL m2. CALL m1.                    ok
50: CALL binary literal parameter/LENGTH OF       ok
51: INSPECT REPLACING LEADING ZEROS BY SPACES     ok
52: INSPECT: No repeat conversion check           ok
53: INSPECT: REPLACING figurative constant        ok
54: INSPECT: TALLYING BEFORE                      ok
55: INSPECT: TALLYING AFTER                       ok
56: INSPECT REPLACING TRAILING ZEROS BY SPACES    ok
57: INSPECT REPLACING complex                     ok
58: SWITCHES                                      ok
59: Nested PERFORM                                ok
60: EXIT PERFORM                                  ok
61: EXIT PERFORM CYCLE                            ok
62: EXIT PARAGRAPH                                ok
63: EXIT SECTION                                  ok
64: 88 with FILLER                                ok
65: Non-overflow after overflow                   ok
66: PERFORM ... CONTINUE                          ok
67: STRING with subscript reference               ok
```

```
 68: UNSTRING DELIMITED ALL LOW-VALUE             ok
 69: READ INTO AT-END sequence                    ok
 70: First READ on empty SEQUENTIAL INDEXED file  ok
 71: REWRITE a RELATIVE file with RANDOM access   ok
 72: SORT: table sort                             ok
 73: SORT: EBCDIC table sort                      ok
 74: SORT nonexistent file                        ok
 75: PIC ZZZ-, ZZZ+                               ok
 76: Larger REDEFINES lengths                     ok
 77: PERFORM type OSVS                            ok
 78: Sticky LINKAGE                               ok
 79: COB_PRE_LOAD test                            ok
 80: COB_LOAD_CASE=UPPER test                     ok
 81: 88 level with FALSE IS clause                ok
 82: ALLOCATE/FREE with BASED item                ok
 83: INITIZIALIZE with reference modification     ok
 84: CALL with OMITTED parameter                  ok
 85: ANY LENGTH                                   ok
 86: BASED item non-ALLOCATED (debug)             ok
 87: COMP-5                                       ok
 88: Hexadecimal numeric literal                  ok
 89: Semi-parenthesized condition                 ok
 90: ADDRESS OF                                   ok
 91: LENGTH OF                                    ok
 92: WHEN-COMPILED                                ok
 93: Complex OCCURS DEPENDING ON                  ok
 94: MOVE NON-INTEGER TO ALPHA-NUMERIC            ok
 95: CALL USING file-name                         ok
 96: CALL unusual PROGRAM-ID.                     ok
 97: Case independent PROGRAM-ID                  ok
 98: PROGRAM-ID AS clause                         ok
 99: Quoted PROGRAM-ID                            ok
100: ASSIGN MF                                    ok
101: ASSIGN IBM                                   ok
102: ASSIGN mapping                               ok
103: ASSIGN expansion                             ok
104: ASSIGN with COB_FILE_PATH                    ok
105: NUMBER-OF-CALL-PARAMETERS                    ok
106: PROCEDURE DIVISION USING BY ...              ok
107: PROCEDURE DIVISION CHAINING ...              ok
108: STOP RUN RETURNING                           ok
109: ENTRY                                        ok
110: LINE SEQUENTIAL write                        ok
111: LINE SEQUENTIAL read                         ok
112: ASSIGN to KEYBOARD/DISPLAY                   ok
113: Environment/Argument variable                ok
114: DECIMAL-POINT is COMMA (1)                   ok
115: DECIMAL-POINT is COMMA (2)                   ok
116: DECIMAL-POINT is COMMA (3)                   ok
117: DECIMAL-POINT is COMMA (4)                   ok
118: DECIMAL-POINT is COMMA (5)                   ok
119: 78 Level (1)                                 ok
120: 78 Level (2)                                 ok
121: 78 Level (3)                                 ok
122: Unreachable statement                        ok
123: RETURN-CODE moving                           ok
124: RETURN-CODE passing                          ok
125: RETURN-CODE nested                           ok
126: FUNCTION ABS                                 ok
```

```
127: FUNCTION ACOS                                  ok
128: FUNCTION ANNUITY                               ok
129: FUNCTION ASIN                                  ok
130: FUNCTION ATAN                                  ok
131: FUNCTION CHAR                                  ok
132: FUNCTION COMBINED-DATETIME                     ok
133: FUNCTION CONCATENATE                           ok
134: FUNCTION CONCATENATE with reference modding    ok
135: FUNCTION COS                                   ok
136: FUNCTION DATE-OF-INTEGER                       ok
137: FUNCTION DATE-TO-YYYYMMDD                      ok
138: FUNCTION DAY-OF-INTEGER                        ok
139: FUNCTION DAY-TO-YYYYDDD                        ok
140: FUNCTION E                                     ok
141: FUNCTION EXCEPTION-FILE                        ok
142: FUNCTION EXCEPTION-LOCATION                    ok
143: FUNCTION EXCEPTION-STATEMENT                   ok
144: FUNCTION EXCEPTION-STATUS                      ok
145: FUNCTION EXP                                   ok
146: FUNCTION FACTORIAL                             ok
147: FUNCTION FRACTION-PART                         ok
148: FUNCTION INTEGER                               ok
149: FUNCTION INTEGER-OF-DATE                       ok
150: FUNCTION INTEGER-OF-DAY                        ok
151: FUNCTION INTEGER-PART                          ok
152: FUNCTION LENGTH                                ok
153: FUNCTION LOCALE-DATE                           ok
154: FUNCTION LOCALE-TIME                           ok
155: FUNCTION LOCALE-TIME-FROM-SECONDS              ok
156: FUNCTION LOG                                   ok
157: FUNCTION LOG10                                 ok
158: FUNCTION LOWER-CASE                            ok
159: FUNCTION LOWER-CASE with reference modding     ok
160: FUNCTION MAX                                   ok
161: FUNCTION MEAN                                  ok
162: FUNCTION MEDIAN                                ok
163: FUNCTION MIDRANGE                              ok
164: FUNCTION MIN                                   ok
165: FUNCTION MOD                                   ok
166: FUNCTION NUMVAL                                ok
167: FUNCTION NUMVAL-C                              ok
168: FUNCTION ORD                                   ok
169: FUNCTION ORD-MAX                               ok
170: FUNCTION ORD-MIN                               ok
171: FUNCTION PI                                    ok
172: FUNCTION PRESENT-VALUE                         ok
173: FUNCTION RANGE                                 ok
174: FUNCTION REM                                   ok
175: FUNCTION REVERSE                               ok
176: FUNCTION REVERSE with reference modding        ok
177: FUNCTION SECONDS-FROM-FORMATTED-TIME           ok
178: FUNCTION SECONDS-PAST-MIDNIGHT                 ok
179: FUNCTION SIGN                                  ok
180: FUNCTION SIN                                   ok
181: FUNCTION SQRT                                  ok
182: FUNCTION STANDARD-DEVIATION                    ok
183: FUNCTION STORED-CHAR-LENGTH                    ok
184: FUNCTION SUBSTITUTE                            ok
185: FUNCTION SUBSTITUTE with reference modding     ok
```

```
186: FUNCTION SUBSTITUTE-CASE                       ok
187: FUNCTION SUBSTITUTE-CASE with reference mod    ok
188: FUNCTION TAN                                   ok
189: FUNCTION TRIM                                  ok
190: FUNCTION TRIM with reference modding            ok
191: FUNCTION UPPER-CASE                            ok
192: FUNCTION UPPER-CASE with reference modding      ok
193: FUNCTION VARIANCE                              ok
194: FUNCTION WHEN-COMPILED                         ok

## ------------- ##
## Test results. ##
## ------------- ##

All 194 tests were successful.
PASS: ./run

## Run time tests with -O option ##

## ----------------------------------- ##
## OpenCOBOL 1.1 test suite: Run Tests. ##
## ----------------------------------- ##
  1: DISPLAY literals                               ok
  2: DISPLAY literals, DECIMAL-POINT is COMMA       ok
  3: Hexadecimal literal                            ok
  4: DISPLAY data items with VALUE clause           ok
  5: DISPLAY data items with MOVE statement         ok
  6: GLOBAL at same level                           ok
  7: GLOBAL at lower level                          ok
  8: non-numeric subscript                          ok
  9: The range of subscripts                        ok
 10: Subscript out of bounds (1)                    ok
 11: Subscript out of bounds (2)                    ok
 12: Value of DEPENDING ON N out of bounds (lower)ok
 13: Value of DEPENDING ON N out of bounds (upper)ok
 14: Subscript bounds with ODO (lower)              ok
 15: Subscript bounds with ODO (upper)              ok
 16: Subscript bounds with ODO                      ok
 17: Subscript by arithmetic expression             ok
 18: Separate sign positions                        ok
 19: Static reference modification                  ok
 20: Dynamic reference modification                 ok
 21: Static out of bounds                           ok
 22: Offset underflow                               ok
 23: Offset overflow                                ok
 24: Length underflow                               ok
 25: Length overflow                                ok
 26: ACCEPT                                         ok
 27: INITIALIZE group entry with OCCURS             ok
 28: INITIALIZE OCCURS with numeric edited          ok
 29: INITIALIZE complex group (1)                   ok
 30: INITIALIZE complex group (2)                   ok
 31: INITIALIZE with REDEFINES                      ok
 32: Source file not found                          ok
 33: Comma separator without space                  ok
 34: LOCAL-STORAGE                                  ok
 35: EXTERNAL data item                             ok
 36: EXTERNAL AS data item                          ok
 37: cobcrun validation                             ok
```

```
 38: MOVE to itself                                ok
 39: MOVE with refmod                              ok
 40: MOVE with refmod (variable)                   ok
 41: MOVE with group refmod                        ok
 42: MOVE indexes                                  ok
 43: MOVE X'00'                                    ok
 44: Level 01 subscripts                           ok
 45: Class check with reference modification       ok
 46: Index and parenthesized expression            ok
 47: Alphanumeric and binary numeric               ok
 48: Dynamic call with static linking              ok
 49: CALL m1. CALL m2. CALL m1.                    ok
 50: CALL binary literal parameter/LENGTH OF       ok
 51: INSPECT REPLACING LEADING ZEROS BY SPACES     ok
 52: INSPECT: No repeat conversion check           ok
 53: INSPECT: REPLACING figurative constant        ok
 54: INSPECT: TALLYING BEFORE                      ok
 55: INSPECT: TALLYING AFTER                       ok
 56: INSPECT REPLACING TRAILING ZEROS BY SPACES    ok
 57: INSPECT REPLACING complex                     ok
 58: SWITCHES                                      ok
 59: Nested PERFORM                                ok
 60: EXIT PERFORM                                  ok
 61: EXIT PERFORM CYCLE                            ok
 62: EXIT PARAGRAPH                                ok
 63: EXIT SECTION                                  ok
 64: 88 with FILLER                                ok
 65: Non-overflow after overflow                   ok
 66: PERFORM ... CONTINUE                          ok
 67: STRING with subscript reference               ok
 68: UNSTRING DELIMITED ALL LOW-VALUE              ok
 69: READ INTO AT-END sequence                     ok
 70: First READ on empty SEQUENTIAL INDEXED file   ok
 71: REWRITE a RELATIVE file with RANDOM access    ok
 72: SORT: table sort                              ok
 73: SORT: EBCDIC table sort                       ok
 74: SORT nonexistent file                         ok
 75: PIC ZZZ-, ZZZ+                                ok
 76: Larger REDEFINES lengths                      ok
 77: PERFORM type OSVS                             ok
 78: Sticky LINKAGE                                ok
 79: COB_PRE_LOAD test                             ok
 80: COB_LOAD_CASE=UPPER test                      ok
 81: 88 level with FALSE IS clause                 ok
 82: ALLOCATE/FREE with BASED item                 ok
 83: INITIZIALIZE with reference modification      ok
 84: CALL with OMITTED parameter                   ok
 85: ANY LENGTH                                    ok
 86: BASED item non-ALLOCATED (debug)              ok
 87: COMP-5                                        ok
 88: Hexadecimal numeric literal                   ok
 89: Semi-parenthesized condition                  ok
 90: ADDRESS OF                                    ok
 91: LENGTH OF                                     ok
 92: WHEN-COMPILED                                 ok
 93: Complex OCCURS DEPENDING ON                   ok
 94: MOVE NON-INTEGER TO ALPHA-NUMERIC             ok
 95: CALL USING file-name                          ok
 96: CALL unusual PROGRAM-ID.                      ok
```

```
 97: Case independent PROGRAM-ID                   ok
 98: PROGRAM-ID AS clause                          ok
 99: Quoted PROGRAM-ID                             ok
100: ASSIGN MF                                     ok
101: ASSIGN IBM                                    ok
102: ASSIGN mapping                                ok
103: ASSIGN expansion                              ok
104: ASSIGN with COB_FILE_PATH                     ok
105: NUMBER-OF-CALL-PARAMETERS                     ok
106: PROCEDURE DIVISION USING BY ...               ok
107: PROCEDURE DIVISION CHAINING ...               ok
108: STOP RUN RETURNING                            ok
109: ENTRY                                         ok
110: LINE SEQUENTIAL write                         ok
111: LINE SEQUENTIAL read                          ok
112: ASSIGN to KEYBOARD/DISPLAY                    ok
113: Environment/Argument variable                 ok
114: DECIMAL-POINT is COMMA (1)                    ok
115: DECIMAL-POINT is COMMA (2)                    ok
116: DECIMAL-POINT is COMMA (3)                    ok
117: DECIMAL-POINT is COMMA (4)                    ok
118: DECIMAL-POINT is COMMA (5)                    ok
119: 78 Level (1)                                  ok
120: 78 Level (2)                                  ok
121: 78 Level (3)                                  ok
122: Unreachable statement                         ok
123: RETURN-CODE moving                            ok
124: RETURN-CODE passing                           ok
125: RETURN-CODE nested                            ok
126: FUNCTION ABS                                  ok
127: FUNCTION ACOS                                 ok
128: FUNCTION ANNUITY                              ok
129: FUNCTION ASIN                                 ok
130: FUNCTION ATAN                                 ok
131: FUNCTION CHAR                                 ok
132: FUNCTION COMBINED-DATETIME                    ok
133: FUNCTION CONCATENATE                          ok
134: FUNCTION CONCATENATE with reference modding   ok
135: FUNCTION COS                                  ok
136: FUNCTION DATE-OF-INTEGER                      ok
137: FUNCTION DATE-TO-YYYYMMDD                     ok
138: FUNCTION DAY-OF-INTEGER                       ok
139: FUNCTION DAY-TO-YYYYDDD                       ok
140: FUNCTION E                                    ok
141: FUNCTION EXCEPTION-FILE                       ok
142: FUNCTION EXCEPTION-LOCATION                   ok
143: FUNCTION EXCEPTION-STATEMENT                  ok
144: FUNCTION EXCEPTION-STATUS                     ok
145: FUNCTION EXP                                  ok
146: FUNCTION FACTORIAL                            ok
147: FUNCTION FRACTION-PART                        ok
148: FUNCTION INTEGER                              ok
149: FUNCTION INTEGER-OF-DATE                      ok
150: FUNCTION INTEGER-OF-DAY                       ok
151: FUNCTION INTEGER-PART                         ok
152: FUNCTION LENGTH                               ok
153: FUNCTION LOCALE-DATE                          ok
154: FUNCTION LOCALE-TIME                          ok
155: FUNCTION LOCALE-TIME-FROM-SECONDS             ok
```

```
156: FUNCTION LOG                                ok
157: FUNCTION LOG10                              ok
158: FUNCTION LOWER-CASE                         ok
159: FUNCTION LOWER-CASE with reference modding   ok
160: FUNCTION MAX                                ok
161: FUNCTION MEAN                               ok
162: FUNCTION MEDIAN                             ok
163: FUNCTION MIDRANGE                           ok
164: FUNCTION MIN                                ok
165: FUNCTION MOD                                ok
166: FUNCTION NUMVAL                             ok
167: FUNCTION NUMVAL-C                           ok
168: FUNCTION ORD                                ok
169: FUNCTION ORD-MAX                            ok
170: FUNCTION ORD-MIN                            ok
171: FUNCTION PI                                 ok
172: FUNCTION PRESENT-VALUE                      ok
173: FUNCTION RANGE                              ok
174: FUNCTION REM                                ok
175: FUNCTION REVERSE                            ok
176: FUNCTION REVERSE with reference modding      ok
177: FUNCTION SECONDS-FROM-FORMATTED-TIME         ok
178: FUNCTION SECONDS-PAST-MIDNIGHT               ok
179: FUNCTION SIGN                               ok
180: FUNCTION SIN                                ok
181: FUNCTION SQRT                               ok
182: FUNCTION STANDARD-DEVIATION                 ok
183: FUNCTION STORED-CHAR-LENGTH                 ok
184: FUNCTION SUBSTITUTE                         ok
185: FUNCTION SUBSTITUTE with reference modding   ok
186: FUNCTION SUBSTITUTE-CASE                    ok
187: FUNCTION SUBSTITUTE-CASE with reference mod  ok
188: FUNCTION TAN                                ok
189: FUNCTION TRIM                               ok
190: FUNCTION TRIM with reference modding         ok
191: FUNCTION UPPER-CASE                         ok
192: FUNCTION UPPER-CASE with reference modding   ok
193: FUNCTION VARIANCE                           ok
194: FUNCTION WHEN-COMPILED                      ok

## ------------- ##
## Test results. ##
## ------------- ##

All 194 tests were successful.
PASS: ./run-O
## ---------------------------------------------- ##
## OpenCOBOL 1.1 test suite: Data Representation. ##
## ---------------------------------------------- ##
  1: BINARY: 2-4-8 big-endian                    ok
  2: BINARY: 2-4-8 native                        ok
  3: BINARY: 1-2-4-8 big-endian                  ok
  4: BINARY: 1-2-4-8 native                      ok
  5: BINARY: 1--8 big-endian                     ok
  6: BINARY: 1--8 native                         ok
  7: BINARY: full-print                          ok
  8: DISPLAY: Sign ASCII                         ok
  9: DISPLAY: Sign ASCII (2)                     ok
 10: DISPLAY: Sign EBCDIC                        ok
```

```
 11: PACKED-DECIMAL dump                          ok
 12: PACKED-DECIMAL display                       ok
 13: PACKED-DECIMAL move                          ok
 14: PACKED-DECIMAL arithmetic (1)                ok
 15: PACKED-DECIMAL arithmetic (2)                ok
 16: PACKED-DECIMAL numeric test                  ok
 17: POINTER: display                             ok

## ------------- ##
## Test results. ##
## ------------- ##

All 17 tests were successful.
PASS: ./data-rep

## Data representation tests with -O option ##

## ---------------------------------------------- ##
## OpenCOBOL 1.1 test suite: Data Representation. ##
## ---------------------------------------------- ##
  1: BINARY: 2-4-8 big-endian                     ok
  2: BINARY: 2-4-8 native                         ok
  3: BINARY: 1-2-4-8 big-endian                   ok
  4: BINARY: 1-2-4-8 native                       ok
  5: BINARY: 1--8 big-endian                      ok
  6: BINARY: 1--8 native                          ok
  7: BINARY: full-print                           ok
  8: DISPLAY: Sign ASCII                          ok
  9: DISPLAY: Sign ASCII (2)                      ok
 10: DISPLAY: Sign EBCDIC                         ok
 11: PACKED-DECIMAL dump                          ok
 12: PACKED-DECIMAL display                       ok
 13: PACKED-DECIMAL move                          ok
 14: PACKED-DECIMAL arithmetic (1)                ok
 15: PACKED-DECIMAL arithmetic (2)                ok
 16: PACKED-DECIMAL numeric test                  ok
 17: POINTER: display                             ok

## ------------- ##
## Test results. ##
## ------------- ##

All 17 tests were successful.
PASS: ./data-rep-O
==================
All 5 tests passed
==================
```

31.15 6.15 ABI

Application Binary Interface. An acronym that covers the way object code is managed and the expectations of the run-time system. OpenCOBOL is at home in the "C" ABI.

- Link names are as expected.
- CALL arguments are stacked as expected for C programming.
- etc...

The C application binary interface allows OpenCOBOL to link with many existant libraries, more than enough, but does mean that small wrapper access code may be required for access to C++ runtimes.

31.16 6.16 Tectonics

I use the expression **tectonics** using the definition below as a basis for the nerd slang describing the code building process. Using a lookup from the **dict://** protocol bank of open servers:

```
"Tectonics" gcide "The Collaborative International Dictionary of English v.0.48"
Tectonics \Tec*ton"ics\, n.
1. The science, or the art, by which implements, vessels,
dwellings, or other edifices, are constructed, both
agreeably to the end for which they are designed, and in
conformity with artistic sentiments and ideas.
[1913 Webster]
```

Trying to infer that building with OpenCOBOL is rock solid and artistically pleasing. Ok fine, I mean **wicked cool**!.

31.17 6.17 Setting Locale

OpenCOBOL supports LC_ locale settings, during builds and with generated programs.

31.18 6.18 GNU

GNU is Not Unix, one of the original recursive acronyms. GNU software leads the Free Software movement, and with the Linux kernel is a critical piece in the GNU/Linux operating system. See http://www.gnu.org/ for more details.

The developers of OpenCOBOL follow, as closely as possible, the GNU coding standards. http://www.gnu.org/prep/standards/

31.19 6.19 Performing FOREVER?

I asked on opencobol.org for some input, and an interesting conversation ensued. I've included most of the forum thread archive, to give a sense of various programmer styles and group thought processing. See FOREVER.

```
Subject: FOREVER and a small request for involvement

I just updated the FAQ and was wondering if anyone could come up with a
better/different short sample program than the one I use in

http://opencobol.add1tocobol.com/#forever

The one I have also demonstrates the CYCLE clause of EXIT PERFORM, but reading
it, it seems a little, umm, lame for what is a pretty powerful program flow
construct.

[i]Plus I'd like to show off a little more community involvement and spread
some credit around.[/i]

Cheers,
Brian
------------------------------------------------------------
```

I think it's fine and think you should leave it as it is...

human
---

human;

I know it's "fine", kinda, but I'm also trying to get some of the lurkers out into the open. :-)

Hoping that some small steps will lead to bigger bolder steps.

Plus, the post was a thinly veiled self promotion and the, [i]as always[/i], greater desire to inform that OpenCOBOL supports FOREVER along with EXIT PERFORM CYCLE.

As I add reserved words to the FAQ in the future, I may post up more of these challenges [i]in a thinly veiled disguise to highlight the feature[/i].

Cheers,
Brian

As one of the "lurkers", may I offer an excuse. I think that many of us who do not make a contribution, are ordinary cobol people who know nothing of C or web based extensions or GUI or database extensions. Much of the discussion here seems pretty esoteric. There is no place where one feels that it would be appropriate to post ordinary basic cobol programs or even tips. I think this is a pity, but I don't have any solutions. Going way back to the computer language cobol group in the pre YK2 years, it was apparent that cobol programmers were a most ungenerous lot. "Do your own homework", and "I do this for money not for free" were common responses with a few exceptions like WM Klein and J McLendon. Perhaps the decline of cobol might have made people more open. Even though cobol is the accounting language, you can't I think find books with debtors, creditors, stock payroll and general ledger. You can find them in basic, but not cobol. I think that if there was a place where low level people could contribute, perhaps they might. It is not approprate to clutter up this forum, but it would need to be a place which is just as simple to write to, else most of us would be unable to join in.
John.

Thanks for the post John.

Exactly the catch-22 I wanted to break here. OpenCOBOL is for sharing. And yes, old school COBOL is/was very much "top-secret, tight lipped programming". We can change that.

No need to feel you have to talk C bindings, or GUI or highfalutin issues.

A nice challenge on a short sample of

```
PERFORM FOREVER
   do some thing
   now get me outta here
   do some other thing
END-PERFORM
```

was what I wanted to start up.

A sample on a neat INSPECT trick, or a blurb on preferred section/paragraph naming. Anything. OpenCOBOL doesn't have to be closed like the olden days. [i]And to be honest, it is to great credit that most COBOLers kept their tight

lips, when I just know that some of them wanted to help, or point out mistakes, or show off, but couldn't, due to the nature of the work they were/are doing.[/i] We can, and we should, flap some loose lips. :-)

Do that here on opencobol.org. I'd read the posts, and feel better for the reading, and the learning, of all the old and new techniques.

I blather on with samples and bindings to show what OpenCOBOL is capable of, but a pure COBOL discussion would be more than welcome. It'd be appreciated.

Unless it sounds like actual homework and it'd hurt more than help, there won't be many "Do your own homework" remarks...umm, I hope ([i]no, I'm pretty sure[/i]).

[b]To everyone[/b]; join in, the water's fine. ;-)

In the FAQ as it stands, there are over 500 reserved words in section 4 and only a mere hundred or so have code samples. I'd gladly read submissions here, get permission and then include them (with or without credit at author's desire) for everyone's benefit.

If we start to overwhelm the forum and people want to direct compiler questions to Roger, we can work out a way to keep his perception of the signal to noise ratio high enough for productive usage of time.

Cheers,
Brian

Did not know that existed.

```
       >>SOURCE FORMAT IS FREE
id division.
program-id. read_forever.
environment division.
input-output section.
file-control.
    select my-file
        organization line sequential
        assign to "myfile".

data division.
file section.
fd  my-file.
01  my-record         pic x(80).

procedure division.
    open input my-file
    perform forever
        read my-file
        at end
            exit perform
        end-read
        display my-record
    end-perform
    close my-file
    goback.
```

Cool. No need for a goto, a file status, or any working-storage at all.

Too bad it's apparently not standard.

```
---------------------------------------------------------------
Yep, no standard - but a real nice extension.

If you want to do this the standard way do [code]
    [...]
    perform until 0 = 1
        read my-file
        at end
           exit perform
        end-read
        display my-record
        end-display
    end-perform
    [...]

OpenCOBOL may supports PERFORM UNTIL EXIT, too (this is a MF extension, if I
remember this correct).

human
---------------------------------------------------------------
   OK Brian here is how we did this in the original dialects of COBOL.

   In an effort to show how the language has changed, I offer the
following version of Brian's program.  While many styles can be effectively
used in COBOL programming, this program is an example of the style used in
programming shops where I worked.

    The first six colums of each source line were reserved for the source
code sequence number (usually page and line number).  We generally used the
first three columns to represent the ascending page number and the last three
for the line number on the page.  Skipping ten numbers between each original
line allowed us to insert additional lines when needed.  You can see that an
insertion was made at 001045.  These sequence numbers were desirable in that
the program was punched on cards with one card for each line.  If the source
card deck was accidently dropped the sequence numbers allowed us to get the
source deck back into order.

     You will also notice that the code is all in uppercase.  Quite simply,
early line printers could not print lowercase.  Take a look at line 001080.
While even early compilers would have allowed us to write "VALUE 0" we
would spell out the word zero since the difference in appearance between
an alphabetic letter O and a numeric zero was easy to miss when reading
the program.

     All of the environment division has been left out of this program,
although it was almost always necessary.  The numbers after "FOREVERLOOP"
on line 001070 were the version number of the program.  It was our habit
to keep a journal (in comment lines) at the beginning of the program
describing modifications that were made to the program.

     The variable names start with "WS-".  This allowed the reader of the
program to understand that the variable in question was in the WORKING-
STORAGE instead of being part of a file descriptor, thus making it easier
to find.

     Numeric fields were almost always signed, both for efficiency
at run-time and to allow for the possibility of a value going negative even
if it should not.  COMP asked the compiler to use the most efficient method
```

to store the value on the architecture on which the program was going to run.

You will see that the display statements start their display with "I) ". We used this to make reading console output easier. "I)" was for normal information, "W)" was for warnings, and "T)" was for terminal conditions.

From a syntactical standpoint this code was written to the COBOL-68 standard. Structured programming constructs were not available.

Paragraphs were numbered in ascending sequence in order to make finding a paragraph easier.

Sentences were kept short and periods were used as often as we could use them.

```
001010 IDENTIFICATION DIVISION.
001020 PROGRAM-ID. FOREVERLOOP.
001030*
001040 DATA DIVISION.
001050 WORKING-STORAGE SECTION.
001060 01  WS-PROGRAM-NAME                  PIC X(16)
001070                                        VALUE "FOREVERLOOP  001".
001080 01  WS-COBOL                         PIC S9 COMP VALUE ZERO.
001090 01  WS-C                             PIC S9 COMP VALUE 1.
001100 01  WS-FORTRAN                       PIC S9 COMP VALUE 2.
001110 01  WS-ED1S                          PIC Z-.
001110*
001010 PROCEDURE DIVISION.
001020     DISPLAY "I) PROGRAM ", WS-PROGRAM-NAME, " BEGINNING".
001030 0100-LOOP.
001040     ADD 1 TO WS-COBOL.
001045     MOVE WS-COBOL TO WS-ED1S.
001050     DISPLAY "I) COBOL AT ", WS-ED1S.
001060     IF WS-COBOL IS GREATER THAN WS-FORTRAN
001070         THEN GO TO 0800-ENDER.
001080     IF WS-COBOL IS EQUAL TO 1
001090         THEN DISPLAY "I) COBOL STILL CREEPING UP ON C".
001100     GO TO 0100-LOOP.
001110*
001120 0800-ENDER.
001130     DISPLAY "I) COBOL SURPASSED C AND FORTRAN".
001140     DISPLAY "I) PROGRAM ", WS-PROGRAM-NAME, " TERMINATED".
001150*
001160     STOP RUN.
```

The run-time output is below:

```
[code]
I) PROGRAM FOREVERLOOP  001 BEGINNING
I) COBOL AT 1
I) COBOL STILL CREEPING UP ON C
I) COBOL AT 2
I) COBOL AT 3
I) COBOL SURPASSED C AND FORTRAN
I) PROGRAM FOREVERLOOP  001 TERMINATED
[/code]
```

Please note that I am not advocating this style. However it is a good example of traditional methods.

You made one "syntax" error for duplicating "old-style" (required for Standard conformance) programming.

You hae DISPLAY statement immediately following the PROCEDURE DIVISON header. Up until "more recent" Standards, you were required to have either a section or paragraph header and could NOT have statements "outside" of a named procedure.

P.S. In the days of "numbered lines" and all upper-case, you probably would have also had a REMARKS paragraph, but that was optional.

As is usually the case, Mr. Klein is correct. :-)

Chalk it up to CRS (Can't Remember Stuff).

Yes the "old-style" relied a lot more on the environment division, including the ability to specify both a source computer and an object computer. This would allow the compilers that supported it to output different object code depending on the object computer specified.

A compile of a simple listing program done on a four tape 1401 would take about 15 minutes and then you had to run the result through the Autocoder macro assembler.

The 360's would generally compile directly (without the Autocoder step) and would get the job done in a few minutes but if you were not authorized to be in the computer room you had to wait until someone in production saw fit to run your compile for you.

Like OMG! I learned COBOL on the 1401. And I remember pops letting me practice on the week ends on the 360.

Good times... But the PC is so much more convenient!

Now thats what I'm talking about.

John, Jim, Frank, Bill, human; If you don't mind, I'd like to include nearly this entire thread in the FAQ, (under what heading I'm not sure, but this is some wicked good COBOL technical [i]and cultural[/i] wisdom).

Damon; not to worry, I plan on including as many of your snippets as the future will bear. ;-)

More of this please...[i]he said, hinting towards the anonymous readers[/i].

Cheers,
Brian

I added a more contemporary method of doing the same thing for the COBOL newbies.

```
001010 IDENTIFICATION DIVISION.
001020 PROGRAM-ID. FOREVERLOOP.
001030*
021611*****************************************************************
021611*                                                               *
021611*  This program will demonstrate various techniques and         *
021611*  coding styles.                                               *
021611*                                                               *
021611*  Version 001--Shows a COBOL68 technique                       *
```

```
021611*               02/15/2011--J C Currey                        *
021611*                                                             *
021611*  Version 002--Shows an OpenCOBOL 1.1 technique              *
021611*               02/16/2011--J C Currey                        *
021611*                                                             *
021611***************************************************************
001040 DATA DIVISION.
001050 WORKING-STORAGE SECTION.
001060 01  WS-PROGRAM-NAME                  PIC X(16)
021611                                        VALUE "FOREVERLOOP  002".
001080 01  WS-COBOL                         PIC S9 COMP VALUE ZERO.
001090 01  WS-C                             PIC S9 COMP VALUE 1.
001100 01  WS-FORTRAN                       PIC S9 COMP VALUE 2.
001110 01  WS-ED1S                          PIC Z-.
001110*
001010 PROCEDURE DIVISION.
001020     DISPLAY "I) PROGRAM ", WS-PROGRAM-NAME, " BEGINNING".
021611*
021611*    THIS CODE SHOWS HOW WE WOULD DO IT WITH COBOL68
021611*
001030 0100-LOOP.
001040     ADD 1 TO WS-COBOL.
001045     MOVE WS-COBOL TO WS-ED1S.
001050     DISPLAY "I) COBOL AT ", WS-ED1S.
001060     IF WS-COBOL IS GREATER THAN WS-FORTRAN
001070         THEN GO TO 0800-ENDER.
001080     IF WS-COBOL IS EQUAL TO 1
001090         THEN DISPLAY "I) COBOL STILL CREEPING UP ON C".
001100     GO TO 0100-LOOP.
001110*
001120 0800-ENDER.
001130     DISPLAY "I) COBOL SURPASSED C AND FORTRAN".
021611     DISPLAY " ".
021611*
021611*    Now we will do the same thing a newer way
021611*
021611     perform with test after
021611       varying ws-cobol from 1 by 1
021611       until ws-cobol is greater than ws-fortran
021611         move ws-cobol to ws-ed1s
021611         display "I) COBOL at ", ws-ed1s
021611         evaluate ws-cobol
021611           when 1
021611             display "I) COBOL still creeping up on C"
021611           when 3
021611             display "I) COBOL surpassed C and FORTRAN"
021611         end-evaluate
021611     end-perform.
021611*
001140     DISPLAY "I) PROGRAM ", WS-PROGRAM-NAME, " TERMINATED".
001150*
001160     STOP RUN.
```

The explanation was then updated

In an effort to show how the language has changed, I offer the following version of Brian's program. While many styles can be effectively used in COBOL programming, this program is an example of the style used in programming shops where I worked.

```
    The first six colums of each source line were reserved for the source
code sequence number (usually page and line number).  We generally used the
first three columns to represent the ascending page number and the last three
for the line number on the page.  Skipping ten numbers between each original
line allowed us to insert additional lines when needed.  You can see that an
insertion was made at 001045.  These sequence numbers were desirable in that
the program was punched on cards with one card for each line.  If the source
card deck was accidently dropped the sequence numbers allowed us to get the
source deck back into order.

     You will also notice that the code is all in uppercase.  Quite simply,
early line printers could not print lowercase.  Take a look at line 001080.
While even early compilers would have allowed us to write "VALUE O" we
would spell out the word zero since the difference in appearance between
an alphabetic letter O and a numeric zero was easy to miss when reading
the program.

     All of the environment division has been left out of this program,
although it was almost always necessary.  The numbers after "FOREVERLOOP"
on line 001070 were the version number of the program.  It was our habit
to keep a journal (in comment lines) at the beginning of the program
describing modifications that were made to the program.

     The variable names start with "WS-".  This allowed the reader of the
program to understand that the variable in question was in the WORKING-
STORAGE instead of being part of a file descriptor, thus making it easier
to find.

     Numeric fields were almost always signed, both for efficiency
at run-time and to allow for the possibility of a value going negative even
if it should not.  COMP asked the compiler to use the most efficient method
to store the value on the architecture on which the program was going to run.

     You will see that the display statements start their display with "I) ".
We used this to make reading console output easier.  "I)" was for normal
information, "W)" was for warnings, and "T)" was for terminal conditions.

     From a syntactical standpoint this code was written to the COBOL-68
standard.  Structured programming constructs were not available.

     Paragraphs were numbered in ascending sequence in order to make
finding a paragraph easier.

*************************

     Version 002 shows how one might code the application with OpenCOBOL 1.1.

     A modification log has been added via comments at the beginning of
the program.

     Note that the sequence numbers are now being used to store the
date that the new or changed code was made.  By looking at the modification
date and then referring to the modification log, one can determine what
changed from version to version.

     Structured programming constructs have been used.

I expect that there may be some discussion as to which method is easier to
read and understand.
```

jimc

This is a variation of the 'perform forever' program.

```
       >>SOURCE FORMAT IS FREE
program-id. "readForever".
*>
*>
*> Author.       rkeane
*> Written:      16 Feb 2011
*> Purpose:      A variation of submitted "read-forever"
*>
environment division.
input-output section.
file-control.
    select my-file assign to "myFile"
      organization line sequential.

data division.
file section.
fd  myFile.
01  myRecord                            pic x(80).
working-storage section.
*>
procedure division.
main.
  open input myFile

  perform forever
    read myFile
      not at end
        display myRecord

      at end
        perform finish
        goback                  *>Program exit
    end-read                    *>End read myFile
  end-perform                   *>End perform forever
exit.

finish.
  close my-file
exit.
```

Using non-structured statements:

```
procedure division.
main.
  open input myFile.
0100-loop.
  read myFile next record
    at end close myFile
          stop run.
  display myRecord.
  go to 0100-loop.
```

I don't know if anyone else is getting this sensation, but is COBOL becoming cool enough for the internet generation now? Thanks to open folk and OpenCOBOL? [i]Or did I just jinx the tide?[/i] :-)

```
Cheers,
Brian
------------------------------------------------------------
```

I found the thread a nice read. And to top it off, for me, Roger added a nice idiom in a separate thread for avoiding paragraphs and sections. Not FOREVER related, but a nice use for an "empty" inline PERFORM.

```
Yep,
One thing that I saw on earlier posts to
the newsgroup cobol was -
What is the need/justification for an
empty inline perform group.
ie.
PERFORM
...
END-PERFORM

None of the discussions then realized that
there is a -
EXIT PERFORM [CYCLE]

Therefore, it is a method to to
define an exit condition without having paragraphs.

ie. (very simply)
PERFORM
 READ xxx
 AT END
    EXIT PERFORM
 END-READ
 MOVE something TO somewhere
END-PERFORM

.. test xxx status and somewhere

There are, of course, other variations.
Basically, it means that you code without
using section/paragraphs.
(Recommended, if only from performance point of view)

Note that the CYCLE option offers interesting possibilities.

Roger
```

31.20 6.20 POSIX

An acronymn first suggested by Richard Stallman for the IEEE specification for maintaining compatibility between operating systems. IEEE Std 1003.1-1988.

POSIX Portable Operating System Interface

31.21 6.21 BITWISE

A COBOL source code solution to bit operations.

BITWISE.cbl

```
000100 IDENTIFICATION DIVISION.
000200 PROGRAM-ID. BITWISE.
000300 AUTHOR. PAUL CHANDLER.
000400*****************************************************
000500***                                               ***
000600*** COPYRIGHT PAUL CHANDLER 1976, 1994, 2012.     ***
000700***                                               ***
000800*** THIS PROGRAM IS FREE SOFTWARE: YOU CAN         ***
000900*** REDISTRIBUTE IT AND/OR MODIFY IT UNDER THE TERMS ***
001000*** OF THE GNU LESSER GENERAL PUBLIC LICENSE AS    ***
001100*** PUBLISHED BY THE FREE SOFTWARE FOUNDATION, EITHER***
001200*** VERSION 3 OF THE LICENSE, OR (AT YOUR OPTION) ANY***
001300*** LATER VERSION.                                 ***
001400***                                               ***
001500*** THIS PROGRAM IS DISTRIBUTED IN THE HOPE THAT IT  ***
001600*** WILL BE USEFUL,BUT WITHOUT ANY WARRANTY; WITHOUT ***
001700*** EVEN THE IMPLIED WARRANTY OF MERCHANTABILITY OR  ***
001800*** FITNESS FOR A PARTICULAR PURPOSE.SEE THE GNU     ***
001900*** LESSER GENERAL PUBLIC LICENSE FOR MORE DETAILS.  ***
002000***                                               ***
002100*** YOU SHOULD HAVE RECEIVED A COPY OF THE GNU LESSER***
002200*** GENERAL PUBLIC LICENSE ALONG WITH THIS PROGRAM.  ***
002300*** IF  NOT, A COPY MAY BE OBTAINED AT:            ***
002400***            HTTP://WWW.GNU.ORG/LICENSES/       ***
002500***                                               ***
002600***        ===== BITWISE VERSION 1.0 =====        ***
002700***                                               ***
002800*** INITIAL VERSION: JULY 1974.                    ***
002900*** LAST UPDATED...: APRIL 2013                    ***
003000***                                               ***
003100*** THIS PROGRAM PERFORMS BITWISE OPERATIONS ON AN   ***
003200*** INPUT BYTE, USING THE PRINCIPLE  OF 'INVERSE     ***
003300*** BINARY WEIGHTING'.                             ***
003400***                                               ***
003500*** THE PROCESS IS:                                ***
003600*** (A) THE CONTENTS OF THE LINKAGE SECTION        ***
003700***     (BITWISE-PARMS) ARE SYNTAX-CHECKED. IF ERRORS***
003800***     ARE ENCOUNTERED, A CODE IDENTIFYING THE      ***
003900***     ERROR IS RETURNED TO THE CALLING PROGRAM IN  ***
004000***     FIELD BWP-RETURN-CODE.                       ***
004100*** (B) THE UNARY OPERAND (AND THE BINARY OPERAND IF ***
004200***     OP IS  'AND', 'OR', OR 'XOR') ARE CONVERTED  ***
004300***     TO AN  8-CHARACTER PATTERN OF THE VALUE'S    ***
004400***     BINARY EQUIVALENT (EG. 'A' IS CONVERTED TO   ***
004500***     '01000001' IN THE ASCII CHARACTER SET.       ***
004600***                                               ***
004700*** (C) THE OP SPECIFIED IN FLD  BWP-OP IS PERFORMED ***
004800***     USING THE OPERANDS AS APPROPRIATE. THE RESULT***
004900***     IS TEMPORARILY STORED AS AN 8-CHARACTER      ***
005000***     PATTERN IN FIELD BWP-RESULT.                 ***
005100***                                               ***
005200*** (D) BWP-RESULT IS CONVERTED TO THE FORMAT SET BY ***
005300***     THE CALLING PROGRAM IN FIELD BWP-FMT-RESULT  ***
005400***     AND CONTROL IS RETURNED TO THE CALLER.       ***
005500***                                               ***
005600*** ADDITIONAL DETAIL FOR THE USE OF THIS PROGRAM    ***
005700*** IS PROVIDED IN THE ACCOMPANYING DOCUMENTATION.   ***
005800*****************************************************
005900 ENVIRONMENT DIVISION.
```

```
006000 DATA DIVISION.
006100 FILE SECTION.
006200 WORKING-STORAGE SECTION.
006300 01  WORKBENCH-FLDS.
006400     05  WBF-FLAGS.
006500         10  WBF-FLAG-VALIDATE     PIC X(01).
006600             88  WBF-INPUT-VALID     VALUE 'Y'.
006700     05  WBF-BINARIES              BINARY.
006800         10  WBF-STARTING-WEIGHT   PIC S9(04)
006900                                     VALUE +128.
007000         10  WBF-SCALE             PIC S9(04).
007100         10  WBF-CURRENT-BIT       PIC S9(04).
007200         10  WBF-CHK-PTN-CNT       PIC S9(04).
007300             88 WBF-CHK-PTN-ERR    VALUE 0 THRU 7.
007400     05  WBF-CHAR.
007500         10  WBF-UNARY             PIC X(08).
007600         10  WBF-BINARY            PIC X(08).
007700         10  WBF-CHK               PIC X(08).
007800         10  WBF-CHK-PTN-RDF REDEFINES WBF-CHK.
007900             15 WBF-CHK-PTN        PIC X(08).
008000         10  WBF-CHK-BIN-RDF REDEFINES WBF-CHK.
008100             15 WBF-CHK-BIN        PIC 9(04)  BINARY.
008200                88 WBF-CHK-BIN-OK    VALUE 0 THRU 255.
008300             15 FILLER             PIC X(06).
008400     05  WBF-INPT-VAL.
008500         10 WBF-INPT-AREA-CHR.
008600            15 FILLER              PIC X(01)
008700                                     VALUE LOW-VALUES.
008800            15 WBF-INPT-VAL-CHR    PIC X(01).
008900         10 WBF-INPT-AREA-BIN REDEFINES WBF-INPT-AREA-CHR.
009000            15 WBF-INPT-VAL-BIN    PIC 9(04)  BINARY.
009100     05  WBF-PACK-FMT              PIC X(01).
009200         88  WBF-PACK-FMT-PTRN       VALUE 'P'.
009300         88  WBF-PACK-FMT-BNRY       VALUE 'B'.
009400         88  WBF-PACK-FMT-CHAR       VALUE 'C'.
009500     05  WBF-PACK                  PIC X(08).
009600     05  WBF-PACK-RDF-BIN REDEFINES WBF-PACK.
009700         10  WBF-PACK-BIN          PIC 9(04)  BINARY.
009800         10  WFILLER               PIC X(06).
009900     05  WBF-PACK-RDF-CHR REDEFINES WBF-PACK.
010000         10  FILLER                PIC X(01).
010100         10  WBF-PACK-CHR          PIC X(01).
010200         10  FILLER                PIC X(06).
010300 LINKAGE SECTION.
010400 COPY BWPARMS.
010500 PROCEDURE DIVISION USING BITWISE-PARMS.
010600     PERFORM 10000-VALIDATE
010700     IF  BWP-NO-ERRORS
010800         IF  BWP-OP-XLAT
010900             PERFORM 20000-BWP-OP-XLAT
011000         ELSE
011100             PERFORM 30000-BWP-OP-TEST
011200         END-IF
011300     END-IF
011400     GOBACK
011500     .
011600 10000-VALIDATE.
011700     SET BWP-NO-ERRORS             TO TRUE
011800     IF  NOT BWP-OP-VALID
```

```
011900         SET BWP-OP-ERROR          TO TRUE
012000     END-IF
012100     IF  NOT BWP-FMT-UNARY-VALID
012200         SET BWP-FMT-UNARY-ERROR   TO TRUE
012300     END-IF
012400     IF  BWP-FMT-UNARY-PTRN
012500         MOVE BWP-UNARY-PTN        TO WBF-CHK-PTN
012600         PERFORM 11000-CHK-PTN
012700         IF  WBF-CHK-PTN-ERR
012800             SET BWP-PTN-UNARY-ERROR
012900                                   TO TRUE
013000         END-IF
013100     END-IF
013200     IF  BWP-FMT-UNARY-BNRY
013300         MOVE BWP-UNARY-BIN        TO WBF-CHK-BIN
013400         IF  NOT WBF-CHK-BIN-OK
013500             SET BWP-UNARY-OVF-ERROR
013600                                   TO TRUE
013700         END-IF
013800     END-IF
013900     IF  BWP-OP-BINARY
014000         IF NOT BWP-FMT-BINARY-VALID
014100            SET BWP-FMT-BINARY-ERROR
014200                                   TO TRUE
014300         END-IF
014400         IF BWP-FMT-BINARY-PTRN
014500             MOVE BWP-BINARY-PTN   TO WBF-CHK-PTN
014600             PERFORM 11000-CHK-PTN
014700             IF WBF-CHK-PTN-ERR
014800                 SET BWP-PTN-BINARY-ERROR
014900                                   TO TRUE
015000             END-IF
015100         END-IF
015200         IF BWP-FMT-BINARY-BNRY
015300             MOVE BWP-BINARY-BIN    TO WBF-CHK-BIN
015400             IF NOT WBF-CHK-BIN-OK
015500                 SET BWP-BINARY-OVF-ERROR
015600                                       TO TRUE
015700             END-IF
015800         END-IF
015900     END-IF
016000     IF  NOT BWP-FMT-RESULT-VALID
016100         SET BWP-FMT-RESULT-ERROR  TO TRUE
016200     END-IF
016300     .
016400 11000-CHK-PTN.
016500     MOVE ZERO                     TO WBF-CHK-PTN-CNT
016600     INSPECT WBF-CHK-PTN
016700       TALLYING WBF-CHK-PTN-CNT    FOR ALL '0'
016800     INSPECT WBF-CHK-PTN
016900       TALLYING WBF-CHK-PTN-CNT    FOR ALL '1'
017000     .
017100 20000-BWP-OP-XLAT.
017200     MOVE BWP-FMT-UNARY            TO WBF-PACK-FMT
017300     EVALUATE TRUE
017400     WHEN BWP-FMT-UNARY-BNRY
017500         MOVE BWP-UNARY-BIN        TO WBF-PACK-BIN
017600     WHEN BWP-FMT-UNARY-CHAR
017700         MOVE BWP-UNARY-CHR        TO WBF-PACK-CHR
```

```
017800     WHEN OTHER
017900         MOVE BWP-UNARY            TO WBF-PACK
018000     END-EVALUATE
018100     PERFORM 40000-PACK
018200     PERFORM 50000-TRANSLATE
018300     IF  BWP-FMT-RESULT-BNRY
018400     OR  BWP-FMT-RESULT-CHAR
018500         MOVE BWP-RESULT           TO WBF-PACK
018600         MOVE 'P'                  TO WBF-PACK-FMT
018700         PERFORM 40000-PACK
018800         IF  BWP-FMT-RESULT-BNRY
018900             MOVE SPACES           TO BWP-RESULT
019000             MOVE WBF-PACK-BIN     TO BWP-RESULT-BIN
019100         ELSE
019200             MOVE SPACES           TO BWP-RESULT
019300             MOVE WBF-PACK-CHR     TO BWP-RESULT-CHR
019400         END-IF
019500     END-IF
019600     .
019700 30000-BWP-OP-TEST.
019800     MOVE BWP-UNARY                TO WBF-PACK
019900     EVALUATE TRUE
020000     WHEN BWP-FMT-UNARY-BNRY
020100         MOVE BWP-UNARY-BIN        TO WBF-PACK-BIN
020200     WHEN BWP-FMT-UNARY-CHAR
020300         MOVE BWP-UNARY-CHR        TO WBF-PACK-CHR
020400     WHEN OTHER
020500         MOVE BWP-UNARY            TO WBF-PACK
020600     END-EVALUATE
020700     MOVE BWP-FMT-UNARY            TO WBF-PACK-FMT
020800     PERFORM 40000-PACK
020900     PERFORM 50000-TRANSLATE
021000     MOVE BWP-RESULT               TO WBF-UNARY
021100     MOVE BWP-BINARY               TO WBF-PACK
021200     MOVE BWP-FMT-BINARY           TO WBF-PACK-FMT
021300     EVALUATE TRUE
021400     WHEN BWP-FMT-BINARY-BNRY
021500         MOVE BWP-BINARY-BIN       TO WBF-PACK-BIN
021600     WHEN BWP-FMT-BINARY-CHAR
021700         MOVE BWP-BINARY-CHR       TO WBF-PACK-CHR
021800     WHEN OTHER
021900         MOVE BWP-BINARY           TO WBF-PACK
022000     END-EVALUATE
022100     PERFORM 40000-PACK
022200     PERFORM 50000-TRANSLATE
022300     MOVE BWP-RESULT               TO WBF-BINARY
022400     MOVE ZEROES                   TO BWP-RESULT
022500     EVALUATE TRUE
022600     WHEN BWP-OP-AND
022700         PERFORM VARYING WBF-CURRENT-BIT FROM 1 BY 1
022800         UNTIL WBF-CURRENT-BIT > 8
022900             IF  WBF-BINARY (WBF-CURRENT-BIT:1) = '1'
023000             AND WBF-UNARY     (WBF-CURRENT-BIT:1) = '1'
023100                 MOVE '1'          TO BWP-RESULT
023200                                      (WBF-CURRENT-BIT:1)
023300             END-IF
023400         END-PERFORM
023500     WHEN BWP-OP-OR
023600         PERFORM VARYING WBF-CURRENT-BIT FROM 1 BY 1
```

```
023700         UNTIL WBF-CURRENT-BIT > 8
023800             IF  WBF-BINARY (WBF-CURRENT-BIT:1) = '1'
023900             OR  WBF-UNARY     (WBF-CURRENT-BIT:1) = '1'
024000                 MOVE '1'           TO BWP-RESULT
024100                                       (WBF-CURRENT-BIT:1)
024200             END-IF
024300         END-PERFORM
024400     WHEN BWP-OP-XOR
024500         PERFORM VARYING WBF-CURRENT-BIT FROM 1 BY 1
024600         UNTIL WBF-CURRENT-BIT > 8
024700             IF  WBF-UNARY     (WBF-CURRENT-BIT:1) NOT EQUAL
024800                 WBF-BINARY (WBF-CURRENT-BIT:1)
024900                 MOVE '1'           TO BWP-RESULT
025000                                       (WBF-CURRENT-BIT:1)
025100             END-IF
025200         END-PERFORM
025300     WHEN BWP-OP-NOT
025400         PERFORM VARYING WBF-CURRENT-BIT FROM 1 BY 1
025500         UNTIL WBF-CURRENT-BIT > 8
025600             IF  WBF-UNARY     (WBF-CURRENT-BIT:1) = '0'
025700                 MOVE '1'           TO BWP-RESULT
025800                                       (WBF-CURRENT-BIT:1)
025900             END-IF
026000         END-PERFORM
026100     END-EVALUATE
026200     IF  BWP-FMT-RESULT-BNRY
026300     OR  BWP-FMT-RESULT-CHAR
026400         MOVE BWP-RESULT            TO WBF-PACK
026500         MOVE 'P'                   TO WBF-PACK-FMT
026600         PERFORM 40000-PACK
026700         IF  BWP-FMT-RESULT-BNRY
026800             MOVE SPACES            TO BWP-RESULT
026900             MOVE WBF-PACK-BIN      TO BWP-RESULT-BIN
027000         ELSE
027100             MOVE SPACES            TO BWP-RESULT
027200             MOVE WBF-PACK-CHR      TO BWP-RESULT-CHR
027300         END-IF
027400     END-IF
027500     .
027600 40000-PACK.
027700     EVALUATE TRUE
027800     WHEN WBF-PACK-FMT-BNRY
027900         MOVE WBF-PACK-BIN          TO WBF-INPT-VAL-BIN
028000     WHEN WBF-PACK-FMT-CHAR
028100         MOVE WBF-PACK-CHR          TO WBF-INPT-VAL-CHR
028200     WHEN OTHER
028300         MOVE 0                     TO WBF-INPT-VAL-BIN
028400         MOVE WBF-STARTING-WEIGHT   TO WBF-SCALE
028500         PERFORM VARYING WBF-CURRENT-BIT FROM 1 BY 1
028600         UNTIL WBF-CURRENT-BIT > 8
028700             IF  WBF-PACK (WBF-CURRENT-BIT:1) = '1'
028800                 ADD WBF-SCALE
028900                                    TO WBF-INPT-VAL-BIN
029000            END-IF
029100            COMPUTE WBF-SCALE = WBF-SCALE / 2
029200         END-PERFORM
029300         MOVE SPACES                TO WBF-PACK
029400         MOVE WBF-INPT-VAL-BIN      TO WBF-PACK-BIN
029500     END-EVALUATE
```

```
029600     .
029700 50000-TRANSLATE.
029800     MOVE WBF-STARTING-WEIGHT      TO WBF-SCALE
029900     MOVE ALL ZEROES               TO BWP-RESULT
030000     MOVE 1                        TO WBF-CURRENT-BIT
030100     PERFORM VARYING WBF-CURRENT-BIT FROM 1 BY 1
030200     UNTIL WBF-CURRENT-BIT > 8
030300        IF   WBF-INPT-VAL-BIN >= WBF-SCALE
030400            MOVE '1'                TO BWP-RESULT
030500                                       (WBF-CURRENT-BIT:1)
030600            COMPUTE WBF-INPT-VAL-BIN =
030700                    WBF-INPT-VAL-BIN - WBF-SCALE
030800        END-IF
030900        COMPUTE WBF-SCALE = WBF-SCALE / 2
031000     END-PERFORM
031100     .
031200 END PROGRAM BITWISE.
```

and **BWPARMS.cbl**

```
000010*****************************************************************
000020* CALLING AREA FOR THE 'BITWISE' SUBPROGRAM                     *
000021* WRITTEN BY.....: PAUL CHANDLER.                               *
000022* INITIAL VERSION: JULY 1974.                                   *
000023* LAST MODIFIED..: APRIL 2013.                                  *
000030*****************************************************************
000100 01 BITWISE-PARMS.                                              00010000
000200    05  BWP-UNARY                 PIC X(08).
000210    05  BWP-UNARY-RDF-PTN   REDEFINES BWP-UNARY.
000220        10  BWP-UNARY-PTN         PIC X(08).
000300    05  BWP-UNARY-RDF-BIN   REDEFINES BWP-UNARY.
000400        10  BWP-UNARY-BIN         PIC 9(04) BINARY.
000500        10  FILLER                PIC X(06).
000600    05  BWP-UNARY-RDF-CHR   REDEFINES BWP-UNARY.
000700        10  BWP-UNARY-CHR         PIC X(01).
000800        10  FILLER                PIC X(07).
000900    05  BWP-BINARY                PIC X(08).
000910    05  BWP-BINARY-RDF-PTN  REDEFINES BWP-BINARY.
000920        10  BWP-BINARY-PTN        PIC X(08).
001000    05  BWP-BINARY-RDF-BIN  REDEFINES BWP-BINARY.
001100        10  BWP-BINARY-BIN        PIC 9(04) BINARY.
001200        10  FILLER                PIC X(06).
001300    05  BWP-BINARY-RDF-CHR  REDEFINES BWP-BINARY.
001400        10  BWP-BINARY-CHR        PIC X(01).
001500        10  FILLER                PIC X(07).
001600    05  BWP-RESULT                PIC X(08).
001610    05  BWP-RESULT-RDF-PTN  REDEFINES BWP-RESULT.
001620        10  BWP-RESULT-PTN        PIC X(08).
001700    05  BWP-RESULT-RDF-BIN  REDEFINES BWP-RESULT.
001800        10  BWP-RESULT-BIN        PIC 9(04) BINARY.
001900        10  FILLER                PIC X(06).
002000    05  BWP-RESULT-RDF-CHR  REDEFINES BWP-RESULT.
002100        10  BWP-RESULT-CHR        PIC X(01).
002200        10  FILLER                PIC X(07).
002300    05  BWP-OP                    PIC X(04).
002500        88 BWP-OP-XLAT              VALUE 'XLAT'.
002600        88 BWP-OP-AND               VALUE 'AND '.
002700        88 BWP-OP-OR                VALUE 'OR  '.
002800        88 BWP-OP-XOR               VALUE 'XOR '.
002900        88 BWP-OP-NOT               VALUE 'NOT '.
```

```
003000         88 BWP-OP-UNARY              VALUE 'NOT ',
003100                                             'XLAT'.
003200         88 BWP-OP-BINARY             VALUE 'AND ',
003300                                             'OR  ',
003400                                             'XOR '.
003500         88 BWP-OP-VALID              VALUE 'NOT ',
003600                                             'XLAT',
003700                                             'AND ',
003800                                             'OR  ',
003900                                             'XOR '.
004000     05  BWP-FMTS.
004100         10  BWP-FMT-UNARY          PIC X(01).
004300             88 BWP-FMT-UNARY-PTRN    VALUE 'P'.
004400             88 BWP-FMT-UNARY-BNRY    VALUE 'B'.
004500             88 BWP-FMT-UNARY-CHAR    VALUE 'C'.
004600             88 BWP-FMT-UNARY-VALID   VALUE 'B'
004700                                             'C'
004800                                             'P'.
005000         10  BWP-FMT-BINARY         PIC X(01).
005200             88 BWP-FMT-BINARY-PTRN   VALUE 'P'.
005300             88 BWP-FMT-BINARY-BNRY   VALUE 'B'.
005400             88 BWP-FMT-BINARY-CHAR   VALUE 'C'.
005500             88 BWP-FMT-BINARY-VALID  VALUE 'B'
005600                                             'C'
005700                                             'P'.
005800         10  BWP-FMT-RESULT         PIC X(01).
006000             88 BWP-FMT-RESULT-PTRN   VALUE 'P'.
006100             88 BWP-FMT-RESULT-BNRY   VALUE 'B'.
006200             88 BWP-FMT-RESULT-CHAR   VALUE 'C'.
006300             88 BWP-FMT-RESULT-VALID  VALUE 'B'
006400                                             'C'
006500                                             'P'.
006600         10  BWP-RETURN-CODE        PIC 9(01).
006800             88 BWP-NO-ERRORS         VALUE 0.
006900             88 BWP-OP-ERROR          VALUE 1.
007000             88 BWP-FMT-UNARY-ERROR   VALUE 2.
007100             88 BWP-FMT-BINARY-ERROR  VALUE 3.
007200             88 BWP-FMT-RESULT-ERROR  VALUE 4.
007300             88 BWP-PTN-UNARY-ERROR   VALUE 5.
007400             88 BWP-PTN-BINARY-ERROR  VALUE 6.
007500             88 BWP-UNARY-OVF-ERROR   VALUE 7.
007600             88 BWP-BINARY-OVF-ERROR  VALUE 8.
```

and a small demo program, with intentional errors.

```
000100 IDENTIFICATION DIVISION.                                         00010000
000200 PROGRAM-ID. DEMO.                                                00020016
000300 AUTHOR. PAUL CHANDLER, APRIL 2013.                               00030014
000400*********************************************************         00040000
000500*** THIS PROGRAM DEMO'S THE BITWISE TOOLBOX           ***         00050036
000600*********************************************************         00060000
000700 ENVIRONMENT DIVISION.                                            00070000
000800 DATA DIVISION.                                                   00080000
000900 FILE SECTION.                                                    00090000
001000 WORKING-STORAGE SECTION.                                         00100000
001100 01  WS-BITWISE                  PIC X(08)                        00110036
001200                                   VALUE 'BITWISE '.             00120037
001300 COPY BWPARMS.                                                    00130036
001400 PROCEDURE DIVISION.                                              00140000
001500***===                                    ===***                 00150039
```

```
001600***===      TEST #1                           ===***               00160039
001700***===  A SIMPLE CONVERSION. GET A DISPLAYABLE =***               00170039
001800***===  BIT BATTERN FOR THE CHARACTER 'A'      =***               00180039
001900***===                                       ===***               00190039
002000     DISPLAY '*                '                                  00200029
002100     DISPLAY                                                      00210028
002200     '*** CASE 1 - TRANSLATE ''A'', RETURN PATTERN ***'           00220028
002300     DISPLAY '*                '                                  00230029
002400     MOVE 'XLAT'                  TO BWP-OP                       00240039
002500     MOVE 'A'                     TO BWP-UNARY-CHR                00250039
002600     MOVE 'C'                     TO BWP-FMT-UNARY                00260036
002700     MOVE SPACES                  TO BWP-BINARY                   00270036
002800                                     BWP-FMT-BINARY               00280036
002900     MOVE 'P'                     TO BWP-FMT-RESULT               00290036
003000     PERFORM DISPLAY-INPUT                                        00300023
003100     CALL WS-BITWISE              USING BITWISE-PARMS             00310036
003200     PERFORM DISPLAY-RETURN                                       00320024
003300*                                                                 00330030
003400***===                                       ===***               00340039
003500***===      TEST #2                           ===***               00350039
003600***===  CONVERT THE PATTERN GENERATED IN CASE 1=***               00360039
003700***===  TO ITS NUMERIC EQUIVALENT.             =***               00370039
003800***===                                       ===***               00380039
003900     DISPLAY '*                '                                  00390029
004000     DISPLAY                                                      00400029
004100     '*** CASE 2 - TAKE THE PATTERN WE JUST GENERATED      *'     00410039
004200     '***          AND DISPLAY ITS NUMERIC VALUE           *'     00420039
004300     DISPLAY '*                '                                  00430029
004400     MOVE BWP-RESULT-PTN          TO BWP-UNARY                    00440039
004500     MOVE 'P'                     TO BWP-FMT-UNARY                00450036
004600     MOVE 'B'                     TO BWP-FMT-RESULT               00460036
004700     PERFORM DISPLAY-INPUT                                        00470029
004800     CALL WS-BITWISE              USING BITWISE-PARMS             00480036
004900     PERFORM DISPLAY-RETURN                                       00490029
005000*                                                                 00500030
005100*                                                                 00510039
005200***===                                       ===***               00520039
005300***===      TEST #3                           ===***               00530039
005400***===  CONVERT THE NUMERIC GENERATED IN CASE 2=***               00540039
005500***===  TO ITS CHARACTER EQUIVALENT, BRINGING  =***               00550039
005600***===  US BACK TO THE 'A' INPUT OF CASE 1     =***               00560039
005700***===                                       ===***               00570039
005800     DISPLAY '*                '                                  00580030
005900     DISPLAY                                                      00590030
006000     '*** CASE 3 - TRANSLATE NUMERIC, RETURN CHAR  ***'           00600030
006100     DISPLAY '*                '                                  00610030
006200     MOVE BWP-RESULT-BIN          TO BWP-UNARY-BIN                00620039
006300     MOVE 'B'                     TO BWP-FMT-UNARY                00630036
006400     MOVE 'C'                     TO BWP-FMT-RESULT               00640036
006500     PERFORM DISPLAY-INPUT                                        00650030
006600     CALL WS-BITWISE              USING BITWISE-PARMS             00660036
006700     PERFORM DISPLAY-RETURN                                       00670030
006800*                                                                 00680030
006810*                                                                 00681039
006820***===                                       ===***               00682039
006830***===      TEST #4                           ===***               00683039
006840***===  'OR' 2  NUMERICS TOGETHER AND RETURN ===***               00684039
006850***===  THE RESULTING BINARY PATTERN           =***               00685039
006870***===                                       ===***               00687039
```

```
006900     DISPLAY '*                 '                                 00690031
007000     DISPLAY                                                      00700031
007100     '*** CASE 4 - ''OR'' 15 & 240, RETURN PATTERN**'             00710031
007200     DISPLAY '*                 '                                 00720031
007300     MOVE 'OR  '                     TO BWP-OP                    00730036
007400     MOVE 15                         TO BWP-UNARY-BIN             00740036
007500     MOVE 240                        TO BWP-BINARY-BIN            00750036
007600     MOVE 'B'                        TO BWP-FMT-UNARY             00760036
007700                                        BWP-FMT-BINARY            00770036
007800     MOVE 'P'                        TO BWP-FMT-RESULT            00780036
007900     PERFORM DISPLAY-INPUT                                        00790031
008000     CALL WS-BITWISE                 USING BITWISE-PARMS          00800036
008100     PERFORM DISPLAY-RETURN                                       00810031
008200*                                                                 00820031
008220***===                                       ===***               00822039
008230***===      TEST #5                          ===***               00823039
008240***===   'AND' 2 NUMERICS TOGETHER AND RETURN ===***              00824039
008250***===   THE RESULTING BINARY PATTERN           =***              00825039
008260***===                                       ===***               00826039
008270*                                                                 00827039
008300     DISPLAY '*                 '                                 00830032
008400     DISPLAY                                                      00840032
008500     '*** CASE 5 - ''AND'' 255 & 70, RETURN PATTERN**'            00850032
008600     DISPLAY '*                 '                                 00860032
008700     MOVE 'AND '                     TO BWP-OP                    00870036
008800     MOVE 255                        TO BWP-UNARY-BIN             00880036
008900     MOVE  70                        TO BWP-BINARY-BIN            00890036
009000     MOVE 'B'                        TO BWP-FMT-UNARY             00900036
009100                                        BWP-FMT-BINARY            00910036
009200     MOVE 'P'                        TO BWP-FMT-RESULT            00920036
009300     PERFORM DISPLAY-INPUT                                        00930032
009400     CALL WS-BITWISE                 USING BITWISE-PARMS          00940036
009500     PERFORM DISPLAY-RETURN                                       00950032
009510*                                                                 00951039
009520***===                                       ===***               00952039
009530***===      TEST #6                          ===***               00953039
009540***===   'NOT' A RANDOM PATTERN. WE'LL RETURN ===***              00954039
009550***===   THE RSULT AS A PATTERN SO THAT THE BIT =***              00955039
009551***===   INVERSION IS EASIER TO SEE.            =***              00955139
009560***===                                       ===***               00956039
009570*                                                                 00957039
009700     DISPLAY '*                 '                                 00970033
009800     DISPLAY                                                      00980033
009900     '*** CASE 6 - ''NOT'' A RANDOM PATTERN**'                    00990033
010000     DISPLAY '*                 '                                 01000033
010100     MOVE 'NOT '                     TO BWP-OP                    01010036
010200     MOVE '10110101'                 TO BWP-UNARY                 01020036
010300     MOVE 'P'                        TO BWP-FMT-UNARY             01030036
010400     PERFORM DISPLAY-INPUT                                        01040033
010500     CALL WS-BITWISE                 USING BITWISE-PARMS          01050036
010600     PERFORM DISPLAY-RETURN                                       01060033
010610*                                                                 01061039
010620***===                                       ===***               01062039
010630***===      TEST #7                          ===***               01063039
010640***===   'XOR' 2 PATTERNS. AGAIN, WE'LL RETURN===***              01064039
010650***===   THE RSULT AS A PATTERN SO THAT THE BIT =***              01065039
010660***===   INTERACTIONS EASIER TO SEE.            =***              01066039
010670***===                                       ===***               01067039
010680*                                                                 01068039
```

```
010800     DISPLAY '*                 '                                 01080035
010900     DISPLAY                                                      01090035
011000     '*** CASE 7 - ''XOR'' PATTERN VS PATTERN'                     01100035
011100     DISPLAY '*                 '                                 01110035
011200     MOVE 'XOR '                    TO BWP-OP                     01120036
011300     MOVE '10110101'                TO BWP-UNARY                  01130036
011400     MOVE '01101100'                TO BWP-BINARY                 01140036
011500     MOVE 'P'                       TO BWP-FMT-UNARY              01150036
011600                                       BWP-FMT-BINARY             01160036
011700     PERFORM DISPLAY-INPUT                                        01170035
011800     CALL WS-BITWISE                USING BITWISE-PARMS           01180036
011900     PERFORM DISPLAY-RETURN                                       01190035
011910*                                                                 01191039
011920******                                        ======               01192039
011930******      TESTS #8 AND #9                   ======               01193039
011940******  A COUPLE OF ERROR CASES. #8 TRIES TO ======               01194039
011950******  TRANSLATE A PATTERN NOT CORRECTLY SET  =***               01195039
011960******  TO ONES AND ZEROES, #9 TRIES TO CONVERT=***               01196039
011961******  A NUMERIC VALUE TOO LARGE TO FIT WITHIN=***               01196139
011970******  ONE BYTE.                         ======                  01197039
011971******                                    ======                  01197139
011980*                                                                 01198039
012100     DISPLAY '*                 '                                 01210038
012200     DISPLAY                                                      01220038
012300     '*** CASE 8 - BAD PATTERN INPUT'                             01230039
012400     DISPLAY '*                 '                                 01240038
012500     MOVE 'XLAT'                    TO BWP-OP                     01250038
012600     MOVE '1       '                TO BWP-UNARY                  01260038
012700     MOVE 'P'                       TO BWP-FMT-UNARY              01270038
012800     PERFORM DISPLAY-INPUT                                        01280038
012900     CALL WS-BITWISE                USING BITWISE-PARMS           01290038
013000     PERFORM DISPLAY-RETURN                                       01300038
013100*                                                                 01310038
013200     DISPLAY '*                 '                                 01320038
013300     DISPLAY                                                      01330038
013400     '*** CASE 9 - BAD BINARY INPUT'                              01340039
013500     DISPLAY '*                 '                                 01350038
013600     MOVE 256                       TO BWP-UNARY-BIN              01360038
013700     MOVE 'B'                       TO BWP-FMT-UNARY              01370038
013800     PERFORM DISPLAY-INPUT                                        01380038
013900     CALL WS-BITWISE                USING BITWISE-PARMS           01390038
014000     PERFORM DISPLAY-RETURN                                       01400038
014100*                                                                 01410038
014200     GOBACK                                                       01420038
014300     .                                                            01430004
014400 DISPLAY-INPUT.                                                   01440023
014500     DISPLAY '*                 '                                 01450029
014600     DISPLAY '***** INPUT *****'                                  01460027
014700     DISPLAY '*                 '                                 01470029
014800     DISPLAY 'OP.........: ' BWP-OP                               01480036
014900     IF  BWP-FMT-UNARY-BNRY                                       01490036
015000         DISPLAY 'UNARY......: ' BWP-UNARY-BIN                    01500036
015100     ELSE                                                         01510027
015200         DISPLAY 'UNARY......: ' BWP-UNARY                        01520036
015300     END-IF                                                       01530027
015400     DISPLAY 'UNARY FMT..: ' BWP-FMT-UNARY                        01540036
015500     IF  BWP-OP-BINARY                                            01550036
015600         IF  BWP-FMT-BINARY-BNRY                                  01560036
015700             DISPLAY 'BINARY.....: ' BWP-BINARY-BIN               01570036
```

```
015800         ELSE                                                    01580027
015900             DISPLAY 'BINARY.....: ' BWP-BINARY                  01590036
016000         END-IF                                                  01600027
016100         DISPLAY 'BINARY FMT.: ' BWP-FMT-BINARY                  01610036
016200     END-IF                                                      01620023
016300     DISPLAY 'RESULT FMT.: ' BWP-FMT-RESULT                      01630036
016400     .                                                           01640025
016500 DISPLAY-RETURN.                                                 01650023
016600     DISPLAY '***              '                                 01660027
016700     DISPLAY '**** RETURN  ****'                                 01670027
016800     DISPLAY '***              '                                 01680027
016900     IF  BWP-NO-ERRORS                                           01690036
017000         IF  BWP-FMT-RESULT-BNRY                                 01700036
017100             DISPLAY 'RESULT    = ' BWP-RESULT-BIN               01710036
017200         ELSE                                                    01720023
017300             DISPLAY 'RESULT    = ' BWP-RESULT                   01730036
017400         END-IF                                                  01740023
017500     ELSE                                                        01750023
017600         DISPLAY 'ERROR ' BWP-RETURN-CODE                        01760036
017700     END-IF                                                      01770023
017800     DISPLAY '*                '                                 01780031
017900     .                                                           01790025
018000 END PROGRAM DEMO.                                               01800016
```

Giving:

```
*
*** CASE 1 - TRANSLATE 'A', RETURN PATTERN ***
*
*
***** INPUT *****
*
OP.........: XLAT
UNARY......: A
UNARY FMT..: C
RESULT FMT.: P
***
**** RETURN  ****
***
RESULT    = 01000001
*
*
*** CASE 2 - TAKE THE PATTERN WE JUST GENERATED      **
**           AND DISPLAY ITS NUMERIC VALUE           *
*
*
***** INPUT *****
*
OP.........: XLAT
UNARY......: 01000001
UNARY FMT..: P
RESULT FMT.: B
***
**** RETURN  ****
***
RESULT    = 0065
*
*
*** CASE 3 - TRANSLATE NUMERIC, RETURN CHAR  ***
*
```

```
*
***** INPUT *****
*
OP.........: XLAT
UNARY......: 0065
UNARY FMT..: B
RESULT FMT.: C
***
**** RETURN  ****
***
RESULT    = A
*
*
*** CASE 4 - 'OR' 15 & 240, RETURN PATTERN**
*
*
***** INPUT *****
*
OP.........: OR
UNARY......: 0015
UNARY FMT..: B
BINARY.....: 0240
BINARY FMT.: B
RESULT FMT.: P
***
**** RETURN  ****
***
RESULT    = 11111111
*
*
*** CASE 5 - 'AND' 255 & 70, RETURN PATTERN**
*
*
***** INPUT *****
*
OP.........: AND
UNARY......: 0255
UNARY FMT..: B
BINARY.....: 0070
BINARY FMT.: B
RESULT FMT.: P
***
**** RETURN  ****
***
RESULT    = 01000110
*
*
*** CASE 6 - 'NOT' A RANDOM PATTERN**
*
*
***** INPUT *****
*
OP.........: NOT
UNARY......: 10110101
UNARY FMT..: P
RESULT FMT.: P
***
**** RETURN  ****
***
```

```
RESULT    = 01001010
*
*
*** CASE 7 - 'XOR' PATTERN VS PATTERN
*
*
***** INPUT *****
*
OP.........: XOR
UNARY......: 10110101
UNARY FMT..: P
BINARY.....: 01101100
BINARY FMT.: P
RESULT FMT.: P
***
**** RETURN  ****
***
RESULT    = 11011001
*
*
*** CASE 8 - BAD PATTERN INPUT
*
*
***** INPUT *****
*
OP.........: XLAT
UNARY......: 1
UNARY FMT..: P
RESULT FMT.: P
***
**** RETURN  ****
***
ERROR 5
*
*
*** CASE 9 - BAD BINARY INPUT
*
*
***** INPUT *****
*
OP.........: XLAT
UNARY......: 0256
UNARY FMT..: B
RESULT FMT.: P
***
**** RETURN  ****
***
ERROR 7
*
```

This code has been in producion use for a lot of years now, thanks to Paul for sharing.

CHAPTER

THIRTYTWO

7 AUTHORS

CHAPTER

THIRTYTHREE

8 MAINTAINERS AND CONTRIBUTORS

CHAPTER

THIRTYFOUR

9 GNU FREE DOCUMENTATION LICENSE

GNU Free Documentation License
Version 1.3, 3 November 2008

0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other functional and useful document "free" in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially. Secondarily, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of "copyleft", which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. Such a notice grants a world-wide, royalty-free license, unlimited in duration, to use that work under the conditions stated herein. The "Document", below, refers to any such manual or work. Any member of the public is a

licensee, and is addressed as "you". You accept the license if you copy, modify or distribute the work in a way requiring permission under copyright law.

A "Modified Version" of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A "Secondary Section" is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document's overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (Thus, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The "Invariant Sections" are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License. If a section does not fit the above definition of Secondary then it is not allowed to be designated as Invariant. The Document may contain zero Invariant Sections. If the Document does not identify any Invariant Sections then there are none.

The "Cover Texts" are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License. A Front-Cover Text may be at most 5 words, and a Back-Cover Text may be at most 25 words.

A "Transparent" copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, that is suitable for revising the document straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup, or absence of markup, has been arranged to thwart or discourage subsequent modification by readers is not Transparent. An image format is not Transparent if used for any substantial amount of text. A copy that is not "Transparent" is called "Opaque".

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML, PostScript or PDF designed for human modification. Examples of transparent image formats include PNG, XCF and JPG. Opaque formats include proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML, PostScript or PDF produced by some word processors for output purposes only.

The "Title Page" means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in

formats which do not have any title page as such, "Title Page" means
the text near the most prominent appearance of the work's title,
preceding the beginning of the body of the text.

The "publisher" means any person or entity that distributes copies of
the Document to the public.

A section "Entitled XYZ" means a named subunit of the Document whose
title either is precisely XYZ or contains XYZ in parentheses following
text that translates XYZ in another language. (Here XYZ stands for a
specific section name mentioned below, such as "Acknowledgements",
"Dedications", "Endorsements", or "History".) To "Preserve the Title"
of such a section when you modify the Document means that it remains a
section "Entitled XYZ" according to this definition.

The Document may include Warranty Disclaimers next to the notice which
states that this License applies to the Document. These Warranty
Disclaimers are considered to be included by reference in this
License, but only as regards disclaiming warranties: any other
implication that these Warranty Disclaimers may have is void and has
no effect on the meaning of this License.

2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either
commercially or noncommercially, provided that this License, the
copyright notices, and the license notice saying this License applies
to the Document are reproduced in all copies, and that you add no
other conditions whatsoever to those of this License. You may not use
technical measures to obstruct or control the reading or further
copying of the copies you make or distribute. However, you may accept
compensation in exchange for copies. If you distribute a large enough
number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and
you may publicly display copies.

3. COPYING IN QUANTITY

If you publish printed copies (or copies in media that commonly have
printed covers) of the Document, numbering more than 100, and the
Document's license notice requires Cover Texts, you must enclose the
copies in covers that carry, clearly and legibly, all these Cover
Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on
the back cover. Both covers must also clearly and legibly identify
you as the publisher of these copies. The front cover must present
the full title with all words of the title equally prominent and
visible. You may add other material on the covers in addition.
Copying with changes limited to the covers, as long as they preserve
the title of the Document and satisfy these conditions, can be treated
as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit
legibly, you should put the first ones listed (as many as fit
reasonably) on the actual cover, and continue the rest onto adjacent
pages.

If you publish or distribute Opaque copies of the Document numbering

more than 100, you must either include a machine-readable Transparent
copy along with each Opaque copy, or state in or with each Opaque copy
a computer-network location from which the general network-using
public has access to download using public-standard network protocols
a complete Transparent copy of the Document, free of added material.
If you use the latter option, you must take reasonably prudent steps,
when you begin distribution of Opaque copies in quantity, to ensure
that this Transparent copy will remain thus accessible at the stated
location until at least one year after the last time you distribute an
Opaque copy (directly or through your agents or retailers) of that
edition to the public.

It is requested, but not required, that you contact the authors of the
Document well before redistributing any large number of copies, to
give them a chance to provide you with an updated version of the
Document.

4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under
the conditions of sections 2 and 3 above, provided that you release
the Modified Version under precisely this License, with the Modified
Version filling the role of the Document, thus licensing distribution
and modification of the Modified Version to whoever possesses a copy
of it. In addition, you must do these things in the Modified Version:

A. Use in the Title Page (and on the covers, if any) a title distinct
   from that of the Document, and from those of previous versions
   (which should, if there were any, be listed in the History section
   of the Document). You may use the same title as a previous version
   if the original publisher of that version gives permission.
B. List on the Title Page, as authors, one or more persons or entities
   responsible for authorship of the modifications in the Modified
   Version, together with at least five of the principal authors of the
   Document (all of its principal authors, if it has fewer than five),
   unless they release you from this requirement.
C. State on the Title page the name of the publisher of the
   Modified Version, as the publisher.
D. Preserve all the copyright notices of the Document.
E. Add an appropriate copyright notice for your modifications
   adjacent to the other copyright notices.
F. Include, immediately after the copyright notices, a license notice
   giving the public permission to use the Modified Version under the
   terms of this License, in the form shown in the Addendum below.
G. Preserve in that license notice the full lists of Invariant Sections
   and required Cover Texts given in the Document's license notice.
H. Include an unaltered copy of this License.
I. Preserve the section Entitled "History", Preserve its Title, and add
   to it an item stating at least the title, year, new authors, and
   publisher of the Modified Version as given on the Title Page. If
   there is no section Entitled "History" in the Document, create one
   stating the title, year, authors, and publisher of the Document as
   given on its Title Page, then add an item describing the Modified
   Version as stated in the previous sentence.
J. Preserve the network location, if any, given in the Document for
   public access to a Transparent copy of the Document, and likewise
   the network locations given in the Document for previous versions
   it was based on. These may be placed in the "History" section.

```
   You may omit a network location for a work that was published at
   least four years before the Document itself, or if the original
   publisher of the version it refers to gives permission.
K. For any section Entitled "Acknowledgements" or "Dedications",
   Preserve the Title of the section, and preserve in the section all
   the substance and tone of each of the contributor acknowledgements
   and/or dedications given therein.
L. Preserve all the Invariant Sections of the Document,
   unaltered in their text and in their titles.  Section numbers
   or the equivalent are not considered part of the section titles.
M. Delete any section Entitled "Endorsements".  Such a section
   may not be included in the Modified Version.
N. Do not retitle any existing section to be Entitled "Endorsements"
   or to conflict in title with any Invariant Section.
O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or
appendices that qualify as Secondary Sections and contain no material
copied from the Document, you may at your option designate some or all
of these sections as invariant.  To do this, add their titles to the
list of Invariant Sections in the Modified Version's license notice.
These titles must be distinct from any other section titles.

You may add a section Entitled "Endorsements", provided it contains
nothing but endorsements of your Modified Version by various
parties--for example, statements of peer review or that the text has
been approved by an organization as the authoritative definition of a
standard.

You may add a passage of up to five words as a Front-Cover Text, and a
passage of up to 25 words as a Back-Cover Text, to the end of the list
of Cover Texts in the Modified Version.  Only one passage of
Front-Cover Text and one of Back-Cover Text may be added by (or
through arrangements made by) any one entity.  If the Document already
includes a cover text for the same cover, previously added by you or
by arrangement made by the same entity you are acting on behalf of,
you may not add another; but you may replace the old one, on explicit
permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License
give permission to use their names for publicity for or to assert or
imply endorsement of any Modified Version.


5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this
License, under the terms defined in section 4 above for modified
versions, provided that you include in the combination all of the
Invariant Sections of all of the original documents, unmodified, and
list them all as Invariant Sections of your combined work in its
license notice, and that you preserve all their Warranty Disclaimers.

The combined work need only contain one copy of this License, and
multiple identical Invariant Sections may be replaced with a single
copy.  If there are multiple Invariant Sections with the same name but
different contents, make the title of each such section unique by
adding at the end of it, in parentheses, the name of the original
author or publisher of that section if known, or else a unique number.
```

Make the same adjustment to the section titles in the list of
Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections Entitled "History"
in the various original documents, forming one section Entitled
"History"; likewise combine any sections Entitled "Acknowledgements",
and any sections Entitled "Dedications". You must delete all sections
Entitled "Endorsements".

6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other
documents released under this License, and replace the individual
copies of this License in the various documents with a single copy
that is included in the collection, provided that you follow the rules
of this License for verbatim copying of each of the documents in all
other respects.

You may extract a single document from such a collection, and
distribute it individually under this License, provided you insert a
copy of this License into the extracted document, and follow this
License in all other respects regarding verbatim copying of that
document.

7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate
and independent documents or works, in or on a volume of a storage or
distribution medium, is called an "aggregate" if the copyright
resulting from the compilation is not used to limit the legal rights
of the compilation's users beyond what the individual works permit.
When the Document is included in an aggregate, this License does not
apply to the other works in the aggregate which are not themselves
derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these
copies of the Document, then if the Document is less than one half of
the entire aggregate, the Document's Cover Texts may be placed on
covers that bracket the Document within the aggregate, or the
electronic equivalent of covers if the Document is in electronic form.
Otherwise they must appear on printed covers that bracket the whole
aggregate.

8. TRANSLATION

Translation is considered a kind of modification, so you may
distribute translations of the Document under the terms of section 4.
Replacing Invariant Sections with translations requires special
permission from their copyright holders, but you may include
translations of some or all Invariant Sections in addition to the
original versions of these Invariant Sections. You may include a
translation of this License, and all the license notices in the
Document, and any Warranty Disclaimers, provided that you also include
the original English version of this License and the original versions
of those notices and disclaimers. In case of a disagreement between
the translation and the original version of this License or a notice

or disclaimer, the original version will prevail.

If a section in the Document is Entitled "Acknowledgements",
"Dedications", or "History", the requirement (section 4) to Preserve
its Title (section 1) will typically require changing the actual
title.

9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document
except as expressly provided under this License. Any attempt
otherwise to copy, modify, sublicense, or distribute it is void, and
will automatically terminate your rights under this License.

However, if you cease all violation of this License, then your license
from a particular copyright holder is reinstated (a) provisionally,
unless and until the copyright holder explicitly and finally
terminates your license, and (b) permanently, if the copyright holder
fails to notify you of the violation by some reasonable means prior to
60 days after the cessation.

Moreover, your license from a particular copyright holder is
reinstated permanently if the copyright holder notifies you of the
violation by some reasonable means, this is the first time you have
received notice of violation of this License (for any work) from that
copyright holder, and you cure the violation prior to 30 days after
your receipt of the notice.

Termination of your rights under this section does not terminate the
licenses of parties who have received copies or rights from you under
this License. If your rights have been terminated and not permanently
reinstated, receipt of a copy of some or all of the same material does
not give you any rights to use it.

10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the
GNU Free Documentation License from time to time. Such new versions
will be similar in spirit to the present version, but may differ in
detail to address new problems or concerns. See
http://www.gnu.org/copyleft/.

Each version of the License is given a distinguishing version number.
If the Document specifies that a particular numbered version of this
License "or any later version" applies to it, you have the option of
following the terms and conditions either of that specified version or
of any later version that has been published (not as a draft) by the
Free Software Foundation. If the Document does not specify a version
number of this License, you may choose any version ever published (not
as a draft) by the Free Software Foundation. If the Document
specifies that a proxy can decide which future versions of this
License can be used, that proxy's public statement of acceptance of a
version permanently authorizes you to choose that version for the
Document.

11. RELICENSING

"Massive Multiauthor Collaboration Site" (or "MMC Site") means any
World Wide Web server that publishes copyrightable works and also
provides prominent facilities for anybody to edit those works. A
public wiki that anybody can edit is an example of such a server. A
"Massive Multiauthor Collaboration" (or "MMC") contained in the site
means any set of copyrightable works thus published on the MMC site.

"CC-BY-SA" means the Creative Commons Attribution-Share Alike 3.0
license published by Creative Commons Corporation, a not-for-profit
corporation with a principal place of business in San Francisco,
California, as well as future copyleft versions of that license
published by that same organization.

"Incorporate" means to publish or republish a Document, in whole or in
part, as part of another Document.

An MMC is "eligible for relicensing" if it is licensed under this
License, and if all works that were first published under this License
somewhere other than this MMC, and subsequently incorporated in whole or
in part into the MMC, (1) had no cover texts or invariant sections, and
(2) were thus incorporated prior to November 1, 2008.

The operator of an MMC Site may republish an MMC contained in the site
under CC-BY-SA on the same site at any time before August 1, 2009,
provided the MMC is eligible for relicensing.

ADDENDUM: How to use this License for your documents

To use this License in a document you have written, include a copy of
the License in the document and put the following copyright and
license notices just after the title page:

    Copyright (c) YEAR YOUR NAME.
    Permission is granted to copy, distribute and/or modify this document
    under the terms of the GNU Free Documentation License, Version 1.3
    or any later version published by the Free Software Foundation;
    with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts.
    A copy of the license is included in the section entitled "GNU
    Free Documentation License".

If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts,
replace the "with...Texts." line with this:

    with the Invariant Sections being LIST THEIR TITLES, with the
    Front-Cover Texts being LIST, and with the Back-Cover Texts being LIST.

If you have Invariant Sections without Cover Texts, or some other
combination of the three, merge those two alternatives to suit the
situation.

If your document contains nontrivial examples of program code, we
recommend releasing these examples in parallel under your choice of
free software license, such as the GNU General Public License,
to permit their use in free software.

CHAPTER

THIRTYFIVE

10 CHANGELOG

17-Oct-2013 Finalized. GNU Cobol FAQ will get all the attention now. Licensed as GFDL 1.3 or later.

25-Aug-2013, 27-Aug Updated the EXEC SQL entry. Filled out FILLER, FILE, FILE-ID and FALSE.

03-Jul-2013, 19-Jul-2013 Added Pure embedding sample. Cleaned up some sourcecode types, got rid of warnings. Wim's stickleback project.

08-Jun-2013, 11-Jun-2013 Added the missing tests blurb for NIST, some corrections. Added more open source COBOL project links. Added SMCUP, RMCUP terminfo blurb. Fixes.

15-May-2013, 29-May Added BITWISE from Paul Chandler. Started list of open source projects. Tweaked the development history, fixed Fossil image placement.

30-Mar-2013 Added another haiku (using cbrain).

08-Feb-2013, 09-Feb, 25-Feb, 26-Feb Moving to Sphinx, started documenting new SourceForge project site. Fixed cobxref listing, no truncated lines. Added 'nosidebar' to the sphinx-doc theme settings in conf.py. Added some Computus, and Latin. Updating current version information. Added Python embedding. Added ficl Forth notes. Added Shakespeare. Touched on ocsort. Reversed the ChangeLog order with tac -r -s "^$". Moved the Sphinx output to main. Added Ruby.

03-Jun-2012 Added site favicon.ico from Silk/help.png, credited Mark James. Fleshed out telco benchmark entry.

27-May-2012 Added LLVM and clang reference.

22-Apr-2012 Typos. Added the size listing for hello.

07-Mar-2012, 19-Mar Added carpe diem farberistic joke.

05-Feb-2012, 29-Feb Added to DIVIDE, put in some lists in the RESERVED words. Added Public Accounting.

12-Jan-2012, 14-Jan, 15-Jan, 20-Jan Added a criticism of easter.cob. Updated CURSOR and FOREVER entries. Version to 1.1rc01. FOREVER thread listing moved. cupsPrintFile documented. Rid of the >< comment output. LOCALE-DATE update. Removed Organization from attributions, there is no official group.

06-Dec-2011, 26-Dec-2011 Added Gambas interface link. Fixed INDEXED entry. Added INITIAL source sample.

03-Sep-2011, 25-Sep, 28-Sep Fixed the ocgtk.c files, getting rid of void returns. Updated list of platforms with 1.1pre-rel running. Added COBOLUnit.

26-Aug-2011 Finished the last FUNCTION.

01-Aug-2011, 05-Aug, 06-Aug, 07-Aug, 08-Aug, 09-Aug, 13-Aug, 14-Aug, 22-Aug Done M, N. Done O. Fixed the colours after a Pygments update. P's in. Q, R done. Doing S. Just passed 750000 bytes of FAQ. Done S to Z. Started documenting the GNU build tool options available. Fixed a DSO misnomer.

01-Jul-2011, 02-Jul, 10-Jul, 11-Jul, 12-Jul, 20-Jul, 23-Jul Updated CALL reserved word entry to show off ON EXCEPTION CONTINUE. Updated a few more reserved words; DATE, DAY, DEBUGGING. D's are done.

Fleshed out a few reserved words, E's done. Added links to the Doxygen API passes. Started on some future 2.0 entries with the Directives. Added blurb about LD_RUN_PATH. Added initial entry on APL/J linkage. Into the Fs. Done A thru K. Done L.

25-Jun-2011, 26-Jun-2011 Added sourceforge link. Updated shortest program entries. Updated a few reserved words.

07-May-2011 Added gfortran sample.

13-Feb-2011 Fixed an unnecessary css import, small corrections. Added REPOSITORY, CYCLE and FOREVER entries.

02-Jan-2011, 23-Jan-2011 Added errorproc.cob sample. Added some vim and Fossil info.

12-Dec-2010, 31-Dec-2010 Added libsoup HTTP server sample. Changed EOP file status 52 copy sample. Updated Falcon entry.

01-Nov-2010, 06-Nov-2010, 18-Nov-2010, 20-Nov-2010, 27-Nov-2010 Added a Genie sample. Some small touchups. Restored borked colouring. Added DECLARATIVES entry and a few small tweaks. Added a few RESERVED words entries. Added ROOT/CINT info. Expanded install instructions.

18-Oct-2010, 19-Oct-2010, 24-Oct-2010, 30-Oct-2010, 31-Oct-2010 Added some working Vala code samples. Added DamonH's AJAX code to the CGI section. Updated the CBL_OC_DUMP listings. Added a few minor reserved word entries. Added translation help request note. Added mkfifo sample. Added call Genie sample. Added CBL_OC_GTKHTML sample. Updated the PI and PRESENT-VALUE entries. Updated CHARACTERS entry.

13-Jun-2010 Reorganized table of contents boxes. Split SEARCH sample source code.

05-May-2010, 06-May-2010 Added the SEARCH and SORT sample. Updated Rexx. Image for GNAT GPS.

04-Apr-2010, 05-Apr-2010, 11-Apr-2010, 15-Apr-2010 Fixed up the source code listings. Added telco benchmark. Added print to PDF. Added COB_LIBRARY_PATH info. Expanded the Tcl/Tk entry. Added Mac install instructions from Ganymede. Rexx.

01-Mar-2010, 28-Mar-2010 Added Oracle procob news. Added FILE STATUS codes to ISAM note. Mention TP-COBOL-DEBUGGER. Updated INSPECT sample and COB_SCREEN_ESC entry. Added ocgtk.c

15-Feb-2010, 20-Feb-2010, 25-Feb-2010, 27-Feb-2010, 28-Feb-2010 Added advocacy, and a few tweaks. Added Jim's PRTCBL. Added Angus' ocsort. Added cobol.vim and Easter Day programs. Updated CBL_OC_DUMP source code listing. Added a REPLACE text preprocessor sample. Added pgcob.cob PostgreSQL sample.

12-Oct-2009 Added some links, credits.

13-Sep-2009 Some printing information.

29-Jul-2009 more human assisted corrections.

01-Jun-2009, 03-Jun-2009, 05-Jun-2009, 28-Jun-2009 Added errno, makefile, a few samples and some reserved word explanations. Added filter.cob the stdin stdout sample. Added some reserved word blurbs and the message queue sample. human assisted corrections. Many thanks to human.

01-May-2009, 09-May-2009, 28-May-2009, 31-May-2009 Started a structural and TOC reorg. Mention S-Lang. Continue re-org. Added some FUNCTION samples. Getting close to a complete Intrinsic list.

17-Apr-2009, 18-Apr-2009, 19-Apr-2009 Clarified -fsource-location option. Added a production use posting. Added START and ISAM sample.

09-Mar-2009, 31-Mar-2009 Added Vala and a few more RESERVED word entries. Added -ext clarification.

16-Feb-2009, 18-Feb-2009 Added JavaScript, Lua, Guile embedding samples and mention Tcl/Tk, GTK. Added CBL_OC_DUMP sample by Asger Kjelstrup and human

02-Feb-2009, 06-Feb-2009, 09-Feb-2009, 11-Feb-2009 Coloured Source codes. Added info on COB_PRE_LOAD, added LINAGE sample, fixed colours (kinda). Added Haiku, disclaimer about no claim to Standards conformance. Updated look.

01-Jan-2009, 10-Jan-2009, 12-Jan-2009, 22-Jan-2009 Lame attempt at clarifying (excusing) poor use of Standards references. Small corrections and additions to SQL entry. Added a few RESERVED entries and Vincent's STOCK library expansion. Typos.

28-Dec-2008, 29-Dec-2008, 30-Dec-2008 Added info on CobXRef, some debugging tricks and an entry on recursion.

12-Dec-2008, 16-Dec-2008, 21-Dec-2008 Added new links to OpenCOBOL 1.1 binary builds by Sergey. Updated header templates. Added a few keywords.

28-Nov-2008 OpenCOBOL passes the NIST test suite.

13-Oct-2008, 15-Oct-2008,19-Oct-2008, 22-Oct-2008, 29-Oct-2008 Added a few samples. Added TABLE SORT sample. Added configure script information. Added dialect configuration information.

23-Sep-2008 Adds and a trial skin

10-Aug-2008, 21-Aug-2008, 28-Aug-2008, 29-Aug-2008, 30-Aug-2008 Started in on the intrinsic functions. Dropped the pre from the alpha designation. Still some Look into this entries. Move to add1tocobol.com Publish link to 1.0rc Skeleton of the reserved words list Let the tweaking begin

17-Jul-2008, 20-Jul-2008, 24-Jul-2008, 28-Jul-2008 Last-last-last 0.0 pre-alpha. Second DIFF. Corrections pass. Expanded the SCREEN SECTION questions. Another correction pass, with clarifications from Roger While

02-Jul-2008, 06-Jul-2008, 07-Jul-2008, 11-Jul-2008, 13-Jul-2008 Experimental version for comment. First 0.0 pre-alpha release. Second 0.0 pre-alpha. Last 0.0 pre-alpha. Checked in for diffs. Last-last 0.0 pre-alpha. Verify DIFF functionality.

BIBLIOGRAPHY

[Keisuke] Keisuke Nishida

Initial developer and creator of OpenCOBOL. From the 1990s through 2004 and still active was the primary developer and OpenCOBOL project lead. His efforts are greatly appreciated by the userbase of OpenCOBOL.

[Roger] Roger While

OpenCOBOL 1.1 is currently *(February 2013)* in development, and Roger is the lead programmer. From early 2004 up till today, and tomorrow, Roger has been very active on the opencobol.org website, and is open to feature requests and clarifications to the implementation. Roger has, since January 2008, actively monitored an OpenCOBOL 1.1 wishlist on the opencobol.org OpenCOBOL forum.

[btiffin] Brian Tiffin

Initial FAQ. sample programs for OpenCOBOL 1.1.

[aoirthoir] Joseph James Frantz

Hosting, support.

[jrls$_swla$] John Ellis

Samples and how-to's and ...

[human] human

Samples and style

[wmklein] Bill Klein

Keeper of the COBOL FAQ and all round COBOL myth buster.