COBOL — An Introduction

```
identification division.
program-id. COBOL-Workshop.
author. Mike Harris.
procedure division.
display "Hello World!".
```

My Programming Background

- Started with ZX BASIC on ZX81 and ZX Spectrum
- Moved on to Mallard BASIC (Amstrad PCW) and then to (the excellent and still my favourite) GFA BASIC (Atari ST)
- Learnt Pascal, C, Ada, C++ and OCCAM at Uni
- Learnt Java professionally
- For my sins, programmed in Perl and PHP for (far too many) years.
- Also done JavaScript and fiddled with stuff like AngularJS and Reac.js
- Done some Python and Ruby

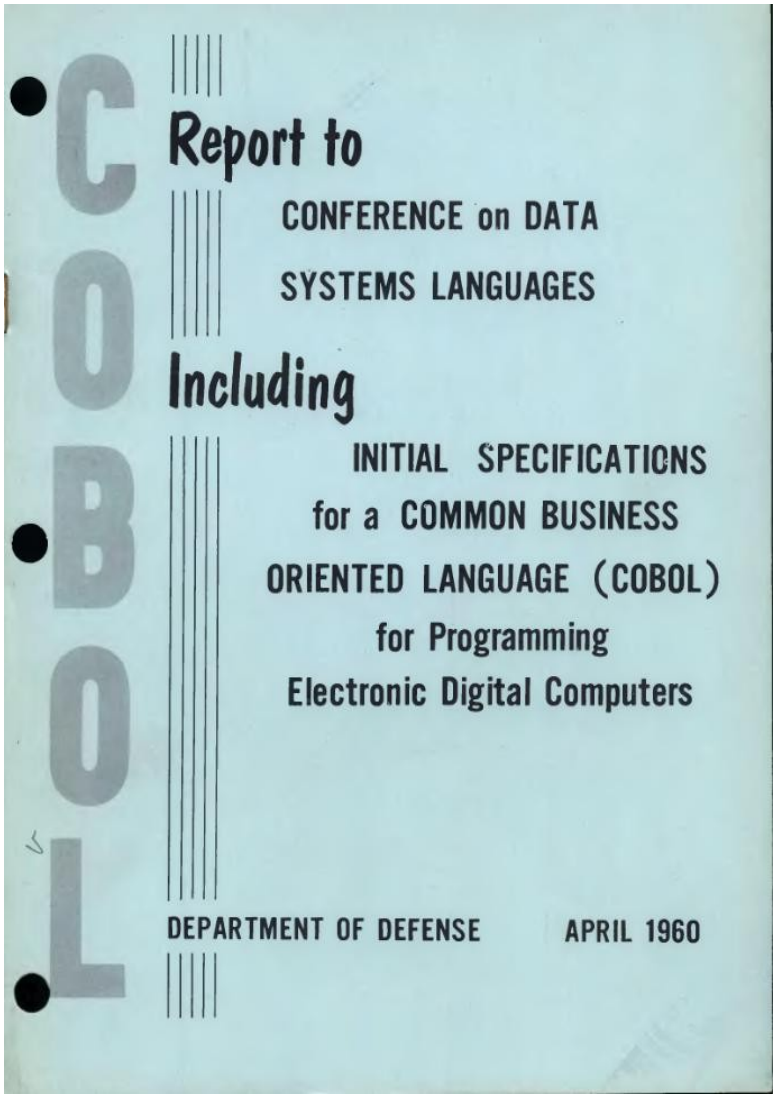
COBOL – History

- **CO**mmon **B**usiness **O**rientated **L**anguage

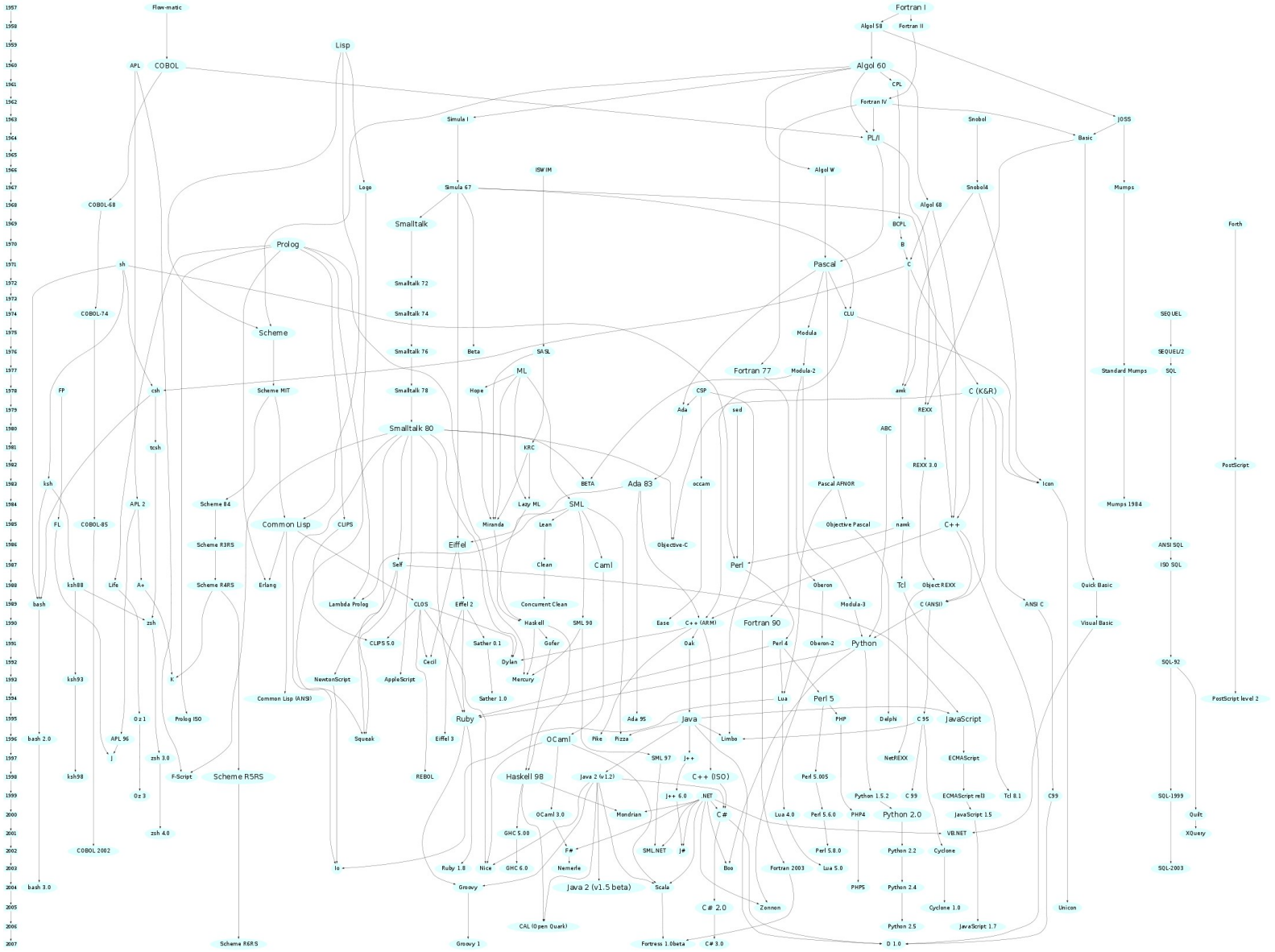
  (Completely Obsolete Business Orientated Language?)
- “Invented” by Grace Hopper, who was the inventor of FLOW-MATIC.
- Standardised between 1959 and 1960 by our friends at the Pentagon by the group CODASYL.
- Design goal was to be platform and proprietor independent.

COBOL – History

- Appeared in 1959.
- CODASYL COBOL-60
- ANSI COBOL-68
- ANSI COBOL-74 (at this point the most used language in world)
- ANSI COBOL-85 (structured programming additions)
- ISO COBOL-2002 (object orientated additions)
- ISO COBOL-2014 (dynamic tables and modular features)



Genealogy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2007
Flow-matic
Lisp
Fortran I
Algol 58
Fortran II
APL
COBOL
Algol 60
CPL
Fortran IV
Simula I
Snobol
JOSS
PL/I
Basic
ISWIM
Algol W
Logo
Simula 67
Snobol4
Mumps
COBOL-68
Algol 68
Smalltalk
BCPL
B
Forth
Prolog
C
Pascal
sh
Smalltalk 72
Smalltalk 74
CLU
SEQUEL
COBOL-74
Modula
Scheme
Smalltalk 76
Beta
SASL
SEQUEL2
Standard Mumps
SQL
Fortran 77
Modula-2
ML
FP
csh
Scheme MIT
Smalltalk 78
Hope
CSP
awk
C (K&R)
Ada
sed
REXX
Smalltalk 80
ABC
tcsh
KRC
REXX 3.0
PostScript
ksh
BETA
Ada 83
occam
Pascal AFNOR
Icon
APL 2
Scheme 84
Lazy ML
SML
Mumps 1984
FL
COBOL-85
Common Lisp
CLIPS
Miranda
Lean
Objective Pascal
nawk
C++
Scheme R3RS
Eiffel
Objective-C
ANSI SQL
Self
Clean
Caml
Perl
ISO SQL
Ish88
Life
A+
Scheme R4RS
Erlang
Oberon
Tcl
Object REXX
Quick Basic
bash
Lambda Prolog
CLOS
Eiffel 2
Concurrent Clean
Modula-3
C (ANSI)
ANSI C
zsh
Haskell
SML 90
Ease
C++ (ARM)
Fortran 90
Visual Basic
CLIPS 5.0
Sather 0.1
Gofer
Oak
Perl 4
Oberon-2
Python
Cecil
Dylan
SQL-92
Ish93
K
NewtonScript
AppleScript
Mercury
Common Lisp (ANSI)
Sather 1.0
Lua
Perl 5
PostScript level 2
Ruby
Ada 95
Java
PHP
Delphi
C 95
JavaScript
bash 2.0
0z 1
Prolog ISO
APL 96
Squeak
Eiffel 3
OCaml
Pike
Pizza
Limbo
NetREXX
ECMAScript
J
zsh 3.0
SML 97
J++
Ish98
F-Script
Scheme R5RS
REBOL
Haskell 98
Java 2 (v1.2)
C++ (ISO)
Perl 5.005
Python 1.5.2
C 99
ECMAScript ref3
Tcl 8.1
C99
SQL-1999
0z 3
OCaml 3.0
Mondrian
J++ 6.0
.NET
C#
Lua 4.0
Perl 5.6.0
PHP4
Python 2.0
JavaScript 1.5
Quilt
zsh 4.0
GHC 5.00
VB.NET
XQuery
COBOL 2002
F#
SML.NET
J#
Perl 5.8.0
Python 2.2
Cyclone
Io
Ruby 1.8
Nice
GHC 6.0
Nemerle
Boo
Fortran 2003
Lua 5.0
SQL-2003
bash 3.0
Groovy
Java 2 (v1.5 beta)
Scala
PHP5
Python 2.4
C# 2.0
Zonnon
Cyclone 1.0
Unicon
CAL (Open Quark)
Python 2.5
JavaScript 1.7
Scheme R6RS
Groovy 1
Fortress 1.0beta
C# 3.0
D 1.0

COBOL: pros & cons

- It's arguably very well adapted to its domain of finance and mass data processing.
- It's verbose and this helps readability of code and thus is said to be self-documenting.
- It's very stable. With the exception of OO additions, the last major change was in 1985. This makes it also very maintainable.
- It runs across many, many platforms and OSes.
- It's relative simple as a language.
- It's nonproprietary.
- It has powerful file, string and numerical handling functions built in.
- Legacy code base is very stable with almost no new bugs being introduced.
- There's a LOT of legacy code, which is spaghetti-like (but then there's a lot of JavaScript like that!)
- OO is still not fully supported in all versions.
- It's not suitable for a lot of applications, such as embedded programming.
- It has a lot of reserved words, which could be a good thing depending on your viewpoint.
- Structured programming is possible, but it may feel 'clunky' compared to other languages.
- Best IDE is MicroFocus, but this is commercial software – then again the best IDEs normally are (excepting vi & emacs).

Reserved words

```
ABS, ACOS, ANNUITY, ASIN, ATAN, BYTE-LENGTH, CHAR, COMBINED-DATETIME,
CONCATENATE, COS, CURRENCY-SYMBOL, 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, FORMATTED-CURRENT-DATE, FORMATTED-DATE, FORMATTED-DATETIME,
FORMATTED-TIME, FRACTION-PART, HIGHEST-ALGEBRAIC, INTEGER,
INTEGER-OF-DATE, INTEGER-OF-DAY, INTEGER-OF-FORMATTED-DATE,
INTEGER-PART, LENGTH, LENGTH-AN, LOCALE-COMPARE, LOCALE-DATE,
LOCALE-TIME, LOCALE-TIME-FROM-SECONDS, LOG, LOG10, LOWER-CASE,
LOWEST-ALGEBRAIC, MAX, MEAN, MEDIAN, MIDRANGE, MIN, MOD,
MODULE-CALLER-ID, MODULE-DATE, MODULE-FORMATTED-DATE, MODULE-ID,
MODULE-PATH, MODULE-SOURCE, MODULE-TIME, MONETARY-DECIMAL-POINT,
MONETARY-THOUSANDS-SEPARATOR, NUMERIC-DECIMAL-POINT,
NUMERIC-THOUSANDS-SEPARATOR, NUMVAL, NUMVAL-C, NUMVAL-F, 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, TEST-FORMATTED-
DATETIME,
TEST-NUMVAL, TEST-NUMVAL-C, TEST-NUMVAL-F, TRIM, UPPER-CASE, VARIANCE,
WHEN-COMPILED, YEAR-TO-YYYY IDENTIFICATION DATA DIVISION SECTION
GREATER LESS SET STRING UNSTRING EVA
WHEN IS THEN IF END PROGRAM FUNCTION
PICTURE
```

COBOL has some 500+ reserved words.

C in contrast has just 50.

Prolog has none!

Verbosity

```
// Calculation in C:

  if (hours_worked <= standard_hours)
          amount = 40 * payrate;
  else
          amount = hours * payrate;
```

```
       *> Calculation in COBOL:

       IF NumberOfHoursWorked IS LESS THAN OR EQUAL TO StandardHours THEN
               MULTIPLY Payrate BY 40 GIVING Amount
       ELSE
               MULTIPLY Payrate BY Hours GIVING Amount
       END-IF.
```

```
*> Shorter-form calculation in COBOL:

IF NumberOfHoursWorked <= StandardHours
        COMPUTE Amount = Payrate * 40
ELSE
        COMPUTE Amount = hours * payrate
END-IF.
```

Legibility

```
identification division.
program-id. SalesTax.
working-storage section.
01 beforeTax      picture 999V999 value 123.45.
01 salesTaxRate   picture V9999     value .065.
01 afterTax       picture 999.99.
procedure division.
Main.
      compute afterTax rounded = beforeTax + (beforeTax
* salesTaxRate)
      display “After tax amount is “ afterTax.
```

```
import java.math.BigDecimal;
public class SalesTaxWithBigDecimal
{
  public static void main(java.lang.String[] args)
  {
    BigDecimal beforeTax    = BigDecimal.valueOf(12345, 2);
    BigDecimal salesTaxRate = BigDecimal.valueOf(65, 3);
    BigDecimal ratePlusOne  =
salesTaxRate.add(BigDecimal.valueOf(1));
    BigDecimal afterTax   = beforeTax.multiply(ratePlusOne);
    afterTax = afterTax.setScale(2, BigDecimal.ROUND_HALF_UP);
    System.out.println( "After tax amount is " + afterTax);
} }
```

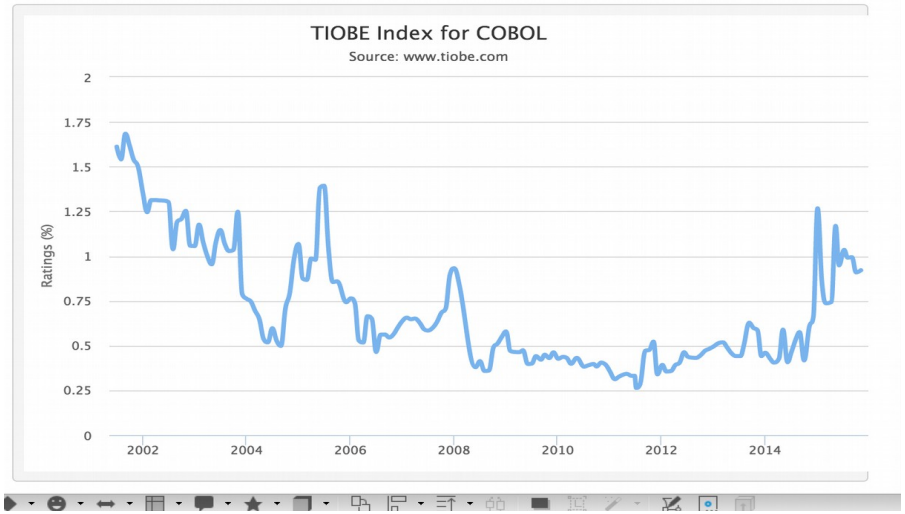
```
identification division.
program-id. sumofintegers.
data division.
working-storage section.

01 n binary-int.
01 i binary-int.
01 sum binary-int.

procedure division.

display “Enter a positive integer:”
accept n
perform varying i from 1 by 1 until i is greater than n
      add i to sum
end-perform
display “The sum is:” sum.
```

```
import java.util.Scanner;

public class sumofintegers {

      public static void main(String[] arg) {
            System.out.println(“Enter a positive integer:”);
            Scanner scan=new Scanner(System.in);
            int n=scan.nextInt();
            int sum=0;
            for (int i=1;i<=n;i++) {
                  sum=sum+i;
            }

            System.out.println(“The sum is “+sum);
      }
}
```

COBOL Usage

- 2012 Computer World survey found that over 60% of organisations used COBOL with 54% saying that more than half of their internal business code was written in it (compared to 39% for Java).
- Over 27% said that COBOL was used for more than half of new development.
- In May 2013 IBM noted that 15% of all new enterprise functionality is written in COBOL and that there are 200,000,000,000 lines of code in use, growing between 3% and 5% per year.
- 2005 report cited that COBOL handles 75% of all computer transactions and 90% of all financial transactions.
- But I work in the world of the web and nobody is talking about it there.

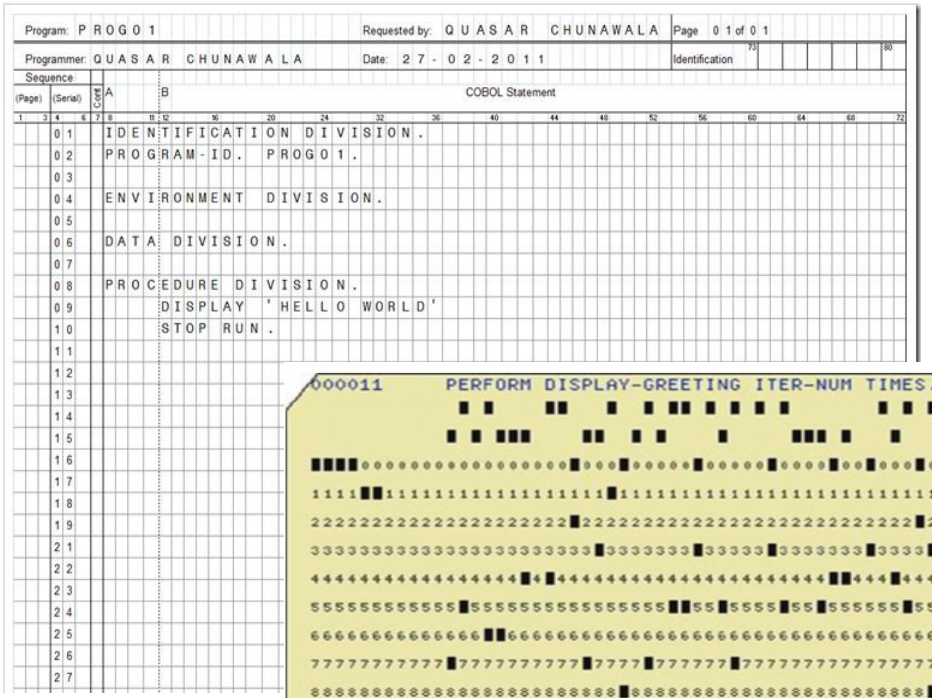
- 2.6 million lines of code (LOC) in 100 programs.
- Estimates are that some 4 million new lines of code written every year.
- It's currently at position 20 TIOBE's index of top programming languages (up from 28th last year)
- It's been 8th and 47th in the last 14 years.



Let's program some COBOL

Hello World

- Classic COBOL



- Modern COBOL

```
program-id. HelloWorld.
procedure division.
display "Hello World!".
```

```
//COBUCLG  JOB (001),'COBOL BASE TEST',                          00010000
//             CLASS=A,MSGCLASS=A,MSGLEVEL=(1,1)                 00020000
//BASETEST EXEC COBUCLG                                          00030000
//COB.SYSIN DD *                                                 00040000
00000* VALIDATION OF BASE COBOL INSTALL                         00050000
01000 IDENTIFICATION DIVISION.                                   00060000
01100 PROGRAM-ID. 'HELLO'.                                       00070000
02000 ENVIRONMENT DIVISION.                                      00080000
02100 CONFIGURATION SECTION.                                     00090000
02110 SOURCE-COMPUTER.  GNULINUX.                                00100000
02120 OBJECT-COMPUTER.  HERCULES.                                00110000
02200 SPECIAL-NAMES.                                             00120000
02210     CONSOLE IS CONSL.                                      00130000
03000 DATA DIVISION.                                             00140000
04000 PROCEDURE DIVISION.                                        00150000
04100 00-MAIN.                                                   00160000
04110     DISPLAY 'HELLO, WORLD' UPON CONSL.                     00170000
04900     STOP RUN.                                              00180000
```

Installing COBOL

Linux (Debian)
sudo apt-get install open-cobol python3-pip python-qt5
sudo pip3 install OpenCobolIDE --upgrade

GnuCOBOL 1.1 is stable and 2.0 is in development.

Linux (CentOS/RedHat)
sudo yum install

OS X
Install home brew (from http://brew.sh/)
brew install gnu-cobol
Get the IDE from **http://ttfa.net/cobolide**
Run the IDE

Windows
Binary build from
http://ttfa.net/gnucobol1
Get the IDE from
http://ttfa.net/cobolide

HackEdit is a cool project – an editor that supports Python & COBOL

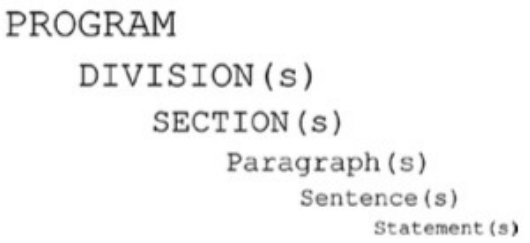
Find it on GitHub

Or try http://www.tutorialspoint.com/compile_cobol_online.php
(doesn't work in Chrome for me; but does in Firefox)

Basic Structure

- Programs are organised into Programs, Divisions, Sections, Paragraphs, Sections, Sentences and Statements.
- Not case sensitive, but traditional way is to use UPPER CASE; I prefer lower case.
- Program must have a *program-id*
- *It's very verbose and has a lot of noise words.*

```
identification division.
program-id. HelloWorld.
data division.
working-storage section.
01 Friend pic x(5) value “Bob”.
procedure division.
display "Hello " Friend
move “Alice” to Friend
display “Hello “ Friend.
```



Let's program some COBOL

- Getting it and an IDE
- Type in Hello World example
- Introduce PIC and ACEPT.
- Write Hello “Name” program.
- Introduce reading from command line and improve our program.
- Introduce IF and EVALUATE.
- Improve our example again.

Hello World example

```
program-id. HelloWorld.
procedure division.
display "Hello World!".
```

Extending our program

- PIC (PICTURE) clause used to define storage for a variable.
- 01 YourName PIC X(20).
- Defines a variable called 'YourName' that can hold 20 alphanumeric characters.
- Level 88 allows for conditions on variables!

- ACCEPT reads input from the console and writes to a variable.
- ACCEPT SomeVar
- Takes input from the console and writes the result into SomeVar.

Personanlised Hello World

```
identification division.
program-id. HelloWorld.


data division.
working-storage section.
01 MyName   pic x(20).
   88 UserIsMike  value “Mike” spaces.
procedure division.
display "Enter your name: " with no advancing
accept MyName
display "Hello " MyName "!"
if UserIsMike then
   display “You're so great at COBOL!”
end-if.
```

```
$ cobc -x -free myprogram.cbl
$ ./myprogram
```

Command Line Hello World

```
identification division.
program-id. HelloWorld.

data division.
working-storage section.
01 MyName   pic x(20).

procedure division.
display "Enter your name: " with no advancing
accept MyName from argument-value
display "Hello " MyName "!".
```

```
$ cobc -x -free myprogram.cbl
$ ./myprogram “Mike Harris”
```

Saying hello to lots of people

```
$ cobc -x -free myprogram.cbl
$ ./myprogram Mike Bob Alice
```

```
program-id. HelloWorld.
environment division.
data division.
working-storage section.
01 MyName                  pic x(255).
01 NumberOfArguments       pic 9.
01 CurrentArgumentIndex pic 9.
procedure division.
accept NumberOfArguments from argument-number
    perform varying CurrentArgumentIndex from 1 by 1
       until CurrentArgumentIndex > NumberOfArguments
        accept MyName from argument-value
        display "Hello " function trim(MyName trailing)
          " welcome to HacktionLab"
    end-perform
.
```

Rock, paper, scissors

```
EVALUATE TRUE ALSO TRUE
    WHEN RockA ALSO RockB SET NobodyWins TO TRUE
    WHEN PaperA ALSO PaperB SET NobodyWins TO TRUE
    WHEN ScissorsA ALSO ScissorsB SET NobodyWins TO TRUE
    WHEN RockA ALSO ScissorsB SET PlayerAWins TO TRUE
    WHEN RockB ALSO ScissorsA SET PlayerBWins TO TRUE
    WHEN PaperA ALSO RockB SET PlayerAWins TO TRUE
    WHEN PaperB ALSO RockA SET PlayerBWins TO TRUE
    WHEN ScissorsA ALSO PaperB SET PlayerAWins TO TRUE
    WHEN ScissorsB ALSO PaperA SET PlayerBWins TO TRUE
    WHEN OTHER SET NobodyWins TO TRUE
END-EVALUATE.
```

Calculator

```
PERFORM WITH TEST BEFORE UNTIL OperatorIsStopRun
PERFORM EnterNumbers
EVALUATE TRUE
WHEN OperatorIsAdd COMPUTE Result = Num1 + Num2
WHEN OperatorIsSubtract COMPUTE Result = Num1 - Num2
WHEN OperatorIsMultiply COMPUTE Result = Num1 * Num2
WHEN OperatorIsDivide DIVIDE Num1 BY Num2 GIVING Result
WHEN OTHER SET Result TO 0
END-EVALUATE

DISPLAY "Result is ", Result
PERFORM ValidateOperator WITH TEST AFTER UNTIL ValidOperator
END-PERFORM
```

Final exercise

Write a new version of Rock, Paper, Scissors that has the following new features:

1. When called with a single command line parameter, it will run the game that number of times before stopping. If no parameters are entered then it runs just once, as it does currently.

2. When called with three command line parameters, the first is used as the number of rounds to play and the next two are the names of the players, for example:

```
$ ./rps 5 Alice Bob
```

Plays 5 rounds between Alice and Bob. If Alice were to win a round it should output her name, rather than PlayerA, like it does at present.

What else can it do?

- File handling – sequential and direct acess.
- External sub-programs (libraries)
- Copybooks (include files)
- Powerful string handling and other intrinsic functions.
- GnuCOBOL Hooks into databases, but not MySQL at the moment.
- Powerful report writing.
- User defined functions.
- Object-orientated COBOL with classes, objects, factories, inheritance, interfaces, etc.

```
CLASS-ID. Tester-cls AS "tester"
          INHERITS FROM Base.

REPOSITORY.
    CLASS BASE AS "base"
    CLASS Tester-cls AS "tester".

FACTORY.
WORKING-STORAGE SECTION.
01 InstCounter-fws   PIC 9 VALUE ZEROS.
01 FactoryData-fws   PIC 9 VALUE ZEROS.

METHOD-ID. New.
LOCAL-STORAGE SECTION.

01 LocalData-mls   PIC 9 VALUE ZEROS.
LINKAGE SECTION.
01 TestObject-lnk  OBJECT REFERENCE.
PROCEDURE DIVISION RETURNING TestObject-lnk.
. . . .
END METHOD New.
END FACTORY.
END CLASS TesterCls.
```

Conclusions

- COBOL is not dead
- COBOL is not really all that bad either
- Good, clean COBOL code can be written
- Old, nasty COBOL code can be refactored
- Good, clean any code can be written
- Old, nasty code can be refactored
- Refactor your code early and often to avoid technical debt
- Re-writing a project in a new code base is often the highest risk approach to take; the result is likely not to be an improvement
- Any code you write in whatever programming language could end up being around for a very, very long time; as can the language (to wit ALGOL, FORTRAN, BASIC, COBOL, PL/1 and even Perl are all still out there!)

```
        display “Thank You”
            stop run.
end program COBOL-Workshop.
```


Lean Bytes