

Java Programming AP Edition

U1C1 Introduction to Computer, Programs and Java

PROGRAMMING LANGUAGES

ERIC Y. CHOU, PH.D.

IEEE SENIOR MEMBER

Programming Languages



Machine Language Assembly Language High-Level Language

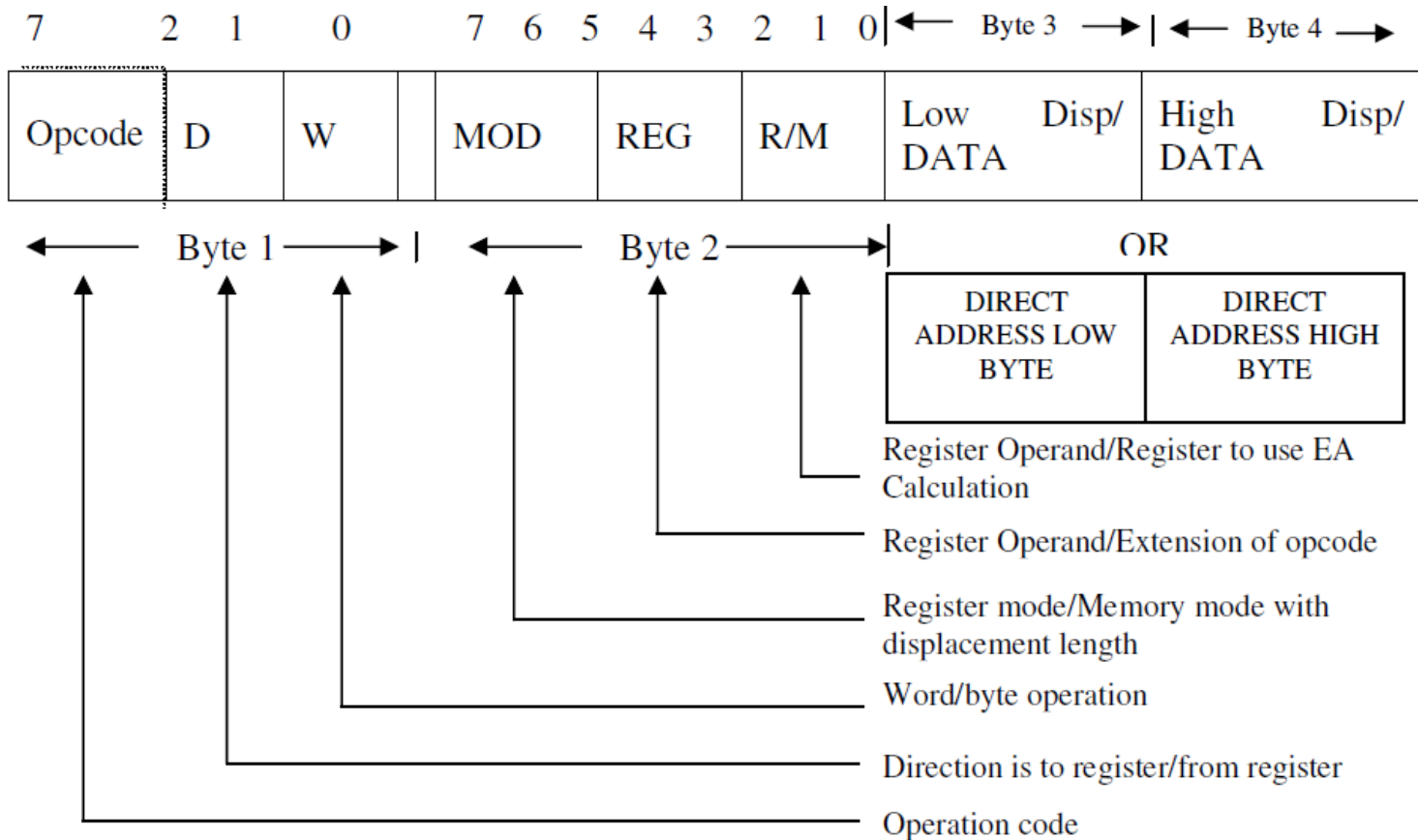
Machine language is a set of primitive instructions built into every computer. The instructions are in the form of binary code, so you have to enter binary codes for various instructions. Program with native machine language is a tedious process. Moreover the programs are highly difficult to read and modify. For example, to add two numbers, you might write an instruction in binary like this:

```
1101101010011010
```



Machine Code (Instructions)

The whole legal collection of instructions is called instruction set



Instruction

Instruction

Operand

Instruction

Operand

Operand

mov

destination,

Software

Instruction Set Architecture

Hardware

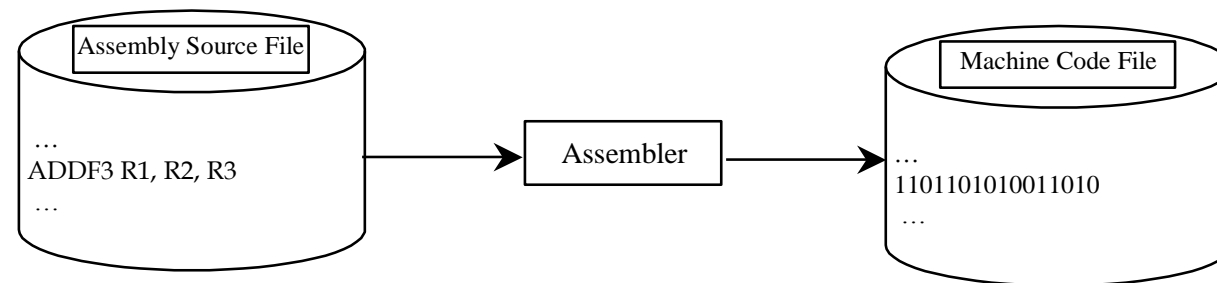
Programming Languages



Machine Language **Assembly Language** High-Level Language

Assembly languages were developed to make programming easy. Since the computer cannot understand assembly language, however, a program called assembler is used to convert assembly language programs into machine code. For example, to add two numbers, you might write an instruction in assembly code like this:

```
ADDF3 R1, R2, R3
```





8086 Assembly language.

The language that can be directly translated to machine code.

LEA is an opcode. BX is a register name. Message is a pointer to a string.

MOV is another opcode. CX is another register name. 27d is decimal 27.

Assembly code is emulated by an emulator. And, there is debugger to help remove coding errors.

Assembly code is used for [device driver](#) or [O.S. Kernels](#).

A screenshot of the '8086 Emulator & Assembler' software interface. The window title is '8086 Emulator & Assembler'. The menu bar includes 'File', 'Edit', 'Assemble', and 'Devices'. The toolbar contains icons for 'New', 'Open', 'Save', 'Assemble', 'Emulate', 'Calculator', 'Convertor', and 'Options'. The main text area displays assembly code with line numbers from 03 to 22. The code includes comments in green and instructions in blue and red. The instructions shown are: 03 ; COM file is loaded at CS:0100h, 04 ORG 100h, 05, 06 LEA BX, message, 07 MOV CX, 27d ; Length of message, 08 MOV AX, 0h ; Ensure top and bottom of, 09 ; ax empty, 10, 11 spit:, 12 MOV AL, [BX] ; Put char into al, 13 OUT 130d, AL ; push char out port, 14 ; (ie. into printer), 15, 16 INC BX ; inc pointer, 17, 18 wait1: ; Loop to ensure the printer, 19 IN AL, 130d ; is ready, it clears, 20 OR AL, 0 ; the port when this is true., 21 JNZ wait1, 22, 23 LOOP spit ; Go back and repeat if we've

```
03 ; COM file is loaded at CS:0100h
04 ORG 100h
05
06 LEA BX, message
07 MOV CX, 27d ; Length of message
08 MOV AX, 0h ; Ensure top and bottom of
09 ; ax empty
10
11 spit:
12 MOV AL, [BX] ; Put char into al
13 OUT 130d, AL ; push char out port
14 ; (ie. into printer)
15
16 INC BX ; inc pointer
17
18 wait1: ; Loop to ensure the printer
19 IN AL, 130d ; is ready, it clears
20 OR AL, 0 ; the port when this is true.
21 JNZ wait1
22
23 LOOP spit ; Go back and repeat if we've
```



Assembler and Debugger

```
DOSBox 0.74, Cpu speed: 4000 cycles, Frameskip: 0, Program: INSIGHT
[0100] 00133406  add  [bp+di-8634],ah
0104 3309  xor  ax,ax
0106 0100  mov  ah,00
0108 010220  mov  ax,[2020]
010B 03  ret
010C 0E065006  mov  es,[0650]
010E 0E366406  mov  si,[0664]
0114 200019  mov  di,es:[si]
0117 0002  mov  ah,dl
0119 0002E7  and  di,E7
011C 000126  cmp  di,26
011F 7501  jnz  8122 ↓
0121 90  inc  si
0122 200004  mov  ax,es:[si]
0125 3005  cmp  al,05
0127 7203  jb  0121 ↓
0129 300C  cmp  al,0C
-----
0016:0100  SS:004E = 14
0016:0000  0 1 2 3 4 5 6 7 8 9 A B C D E F 0123456789ABCDEF
0016:0010  CD 20 FF 3F 00 DA FF FF AD DC A1 06 93 01 00 00 = f x i | | | | |
0016:0020  18 01 10 01 18 01 93 01 01 01 01 00 0C FF FF FF 10 00 00 00
0016:0030  FF FF FF FF FF FF FF FF FF FF FF FF 10 00 00 00 00 00 00
0016:0040  93 01 14 00 18 00 16 00 FF FF FF FF 00 00 00 00 00 00 00
```

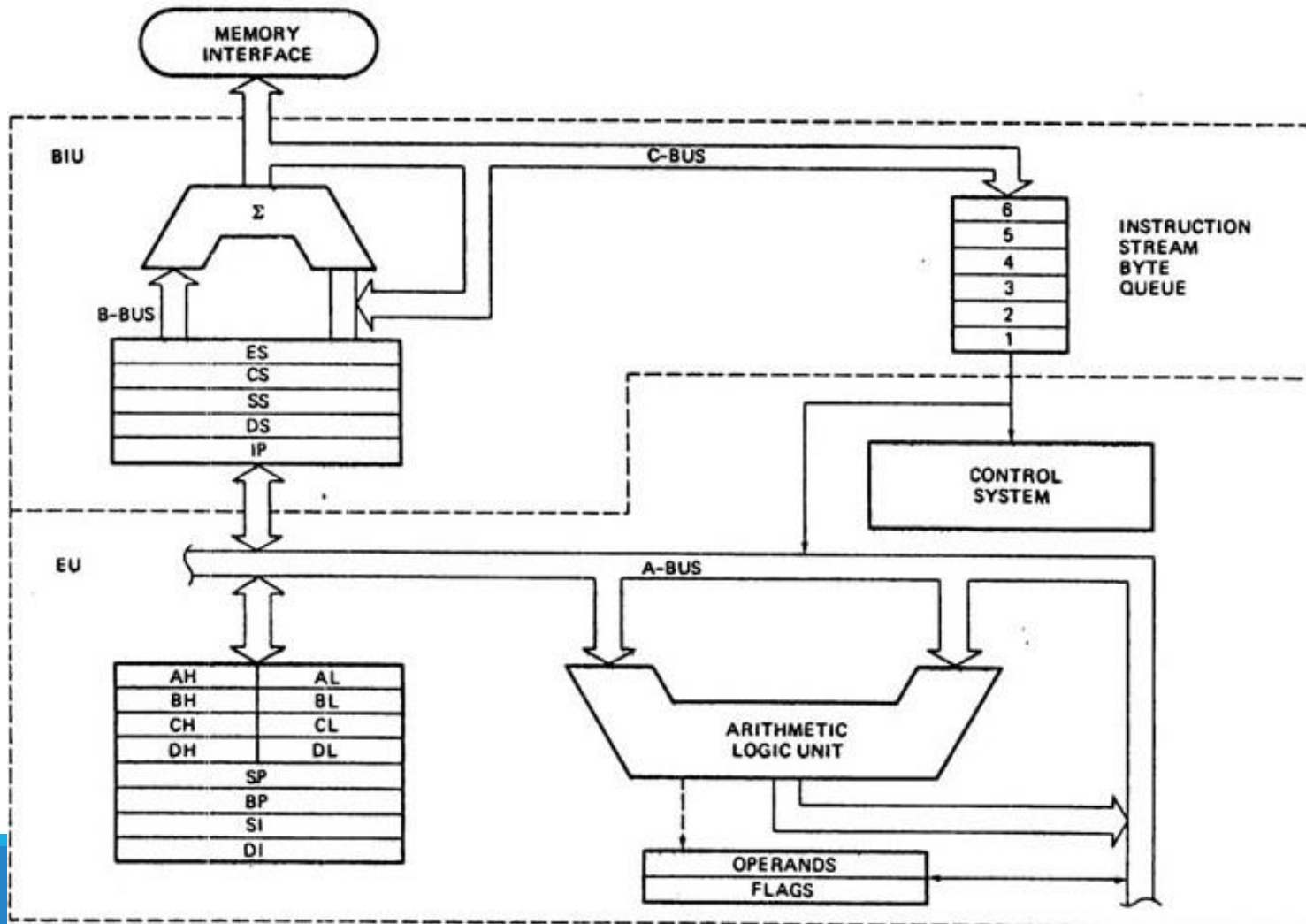
Assembler is the software to convert Assembly Language into Machine code.

Emulator is to emulate the assembly code on real hardware to know about what will be the outcome.

Debugger is a software to show the error and contents for each registers and memory.



8086 Instruction Set Architecture



Machine code is the real code for machine. It is used to control the Arithmetic and Logic Unit (ALU) and the register file and the memory.

All programs are eventually executed in machine code.

No one programs on Machine code.

Programming Languages



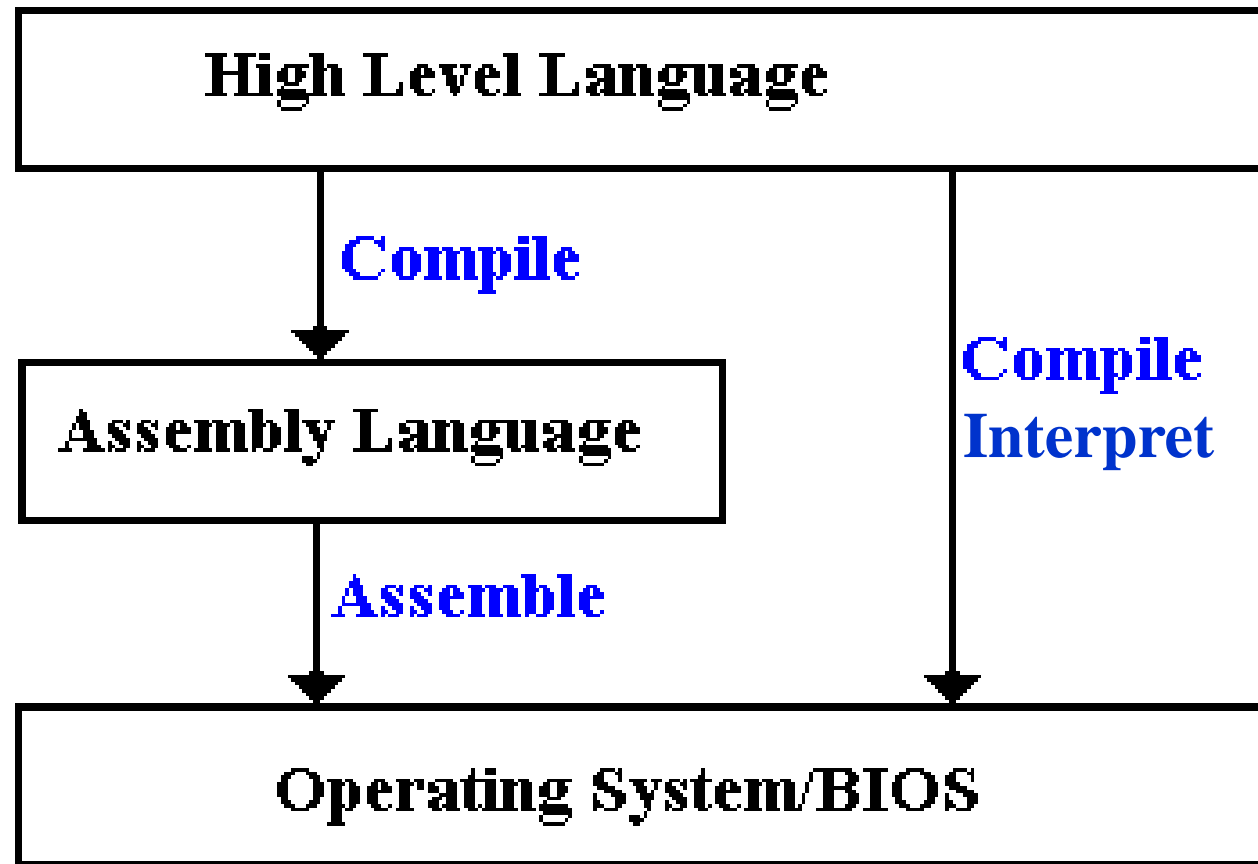
Machine Language Assembly Language **High-Level Language**

The high-level languages are English-like and easy to learn and program. For example, the following is a high-level language statement that computes the area of a circle with radius 5:

```
area = 5 * 5 * 3.1415;
```




High Level Languages



1956
↓
1958
↓
1960
↓
1962
↓
1964
↓
1966
↓
1968
↓
1970
↓
1972
↓
1974
↓
1976
↓
1978
↓
1980
↓
1982
↓
1984
↓
1986
↓
1988
↓
1990
↓
1992
↓
1994
↓
1996
↓
1998
↓
2000
↓
2002
↓
2004

COBOL is the first Business Language.

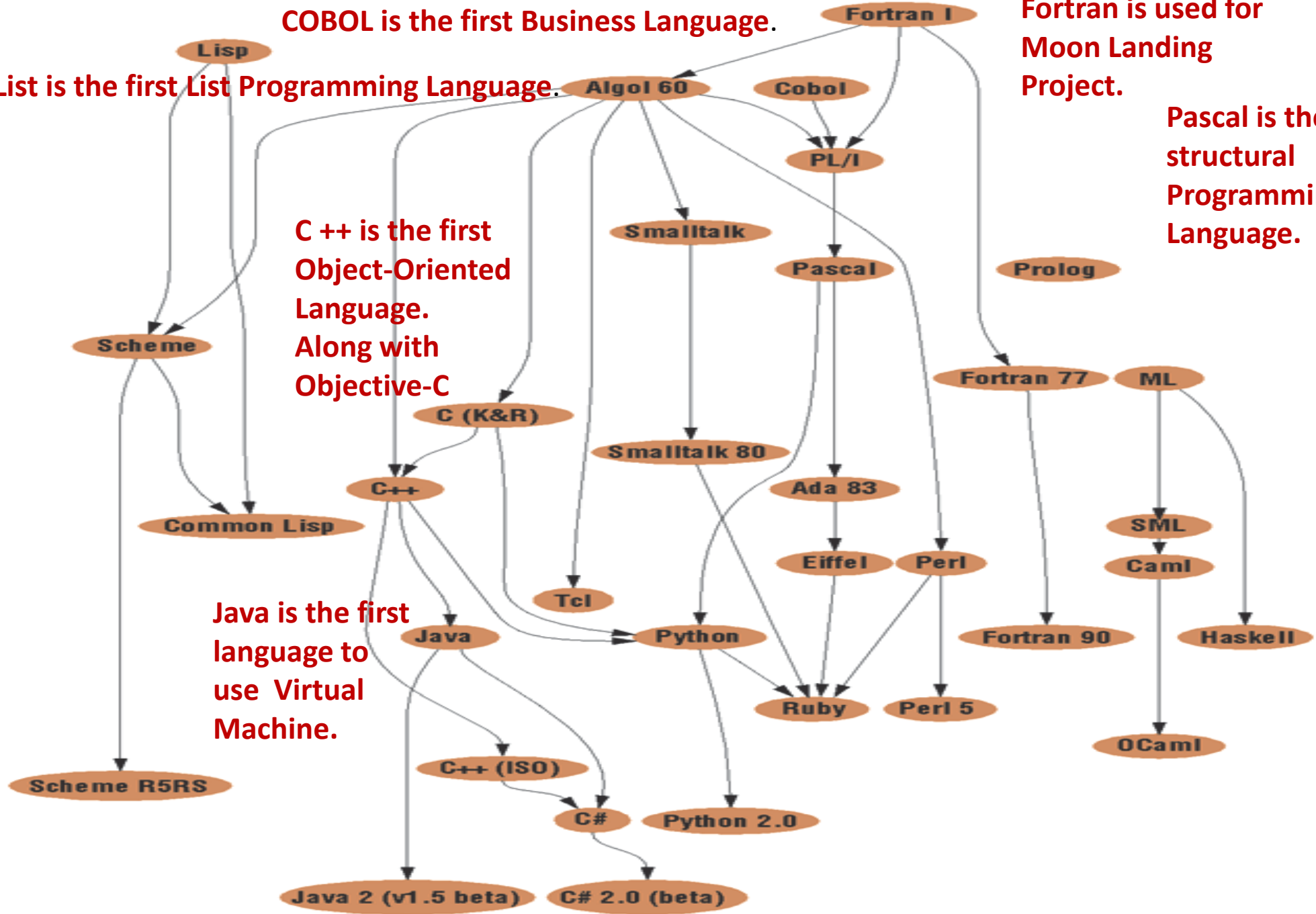
Fortran is used for Moon Landing Project.

List is the first List Programming Language.

Pascal is the first structural Programming Language.

C ++ is the first Object-Oriented Language. Along with Objective-C

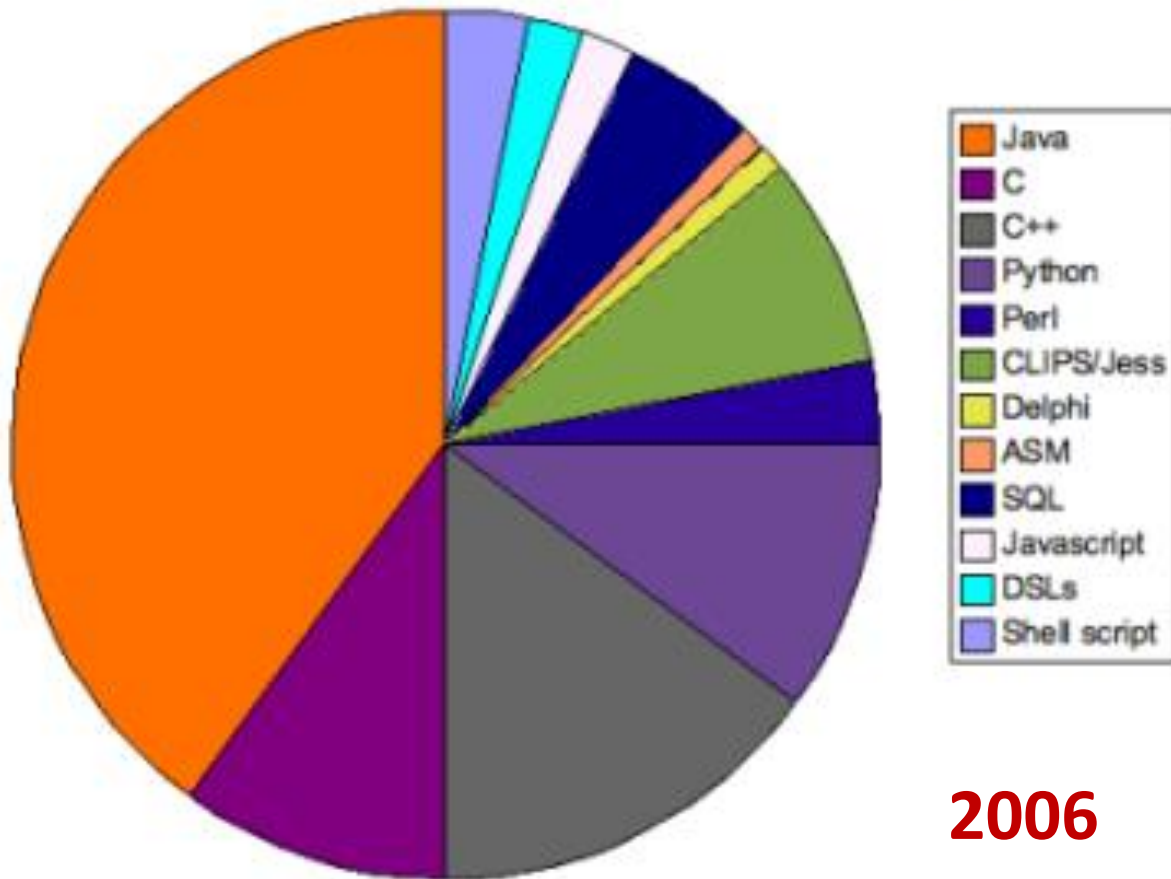
Java is the first language to use Virtual Machine.





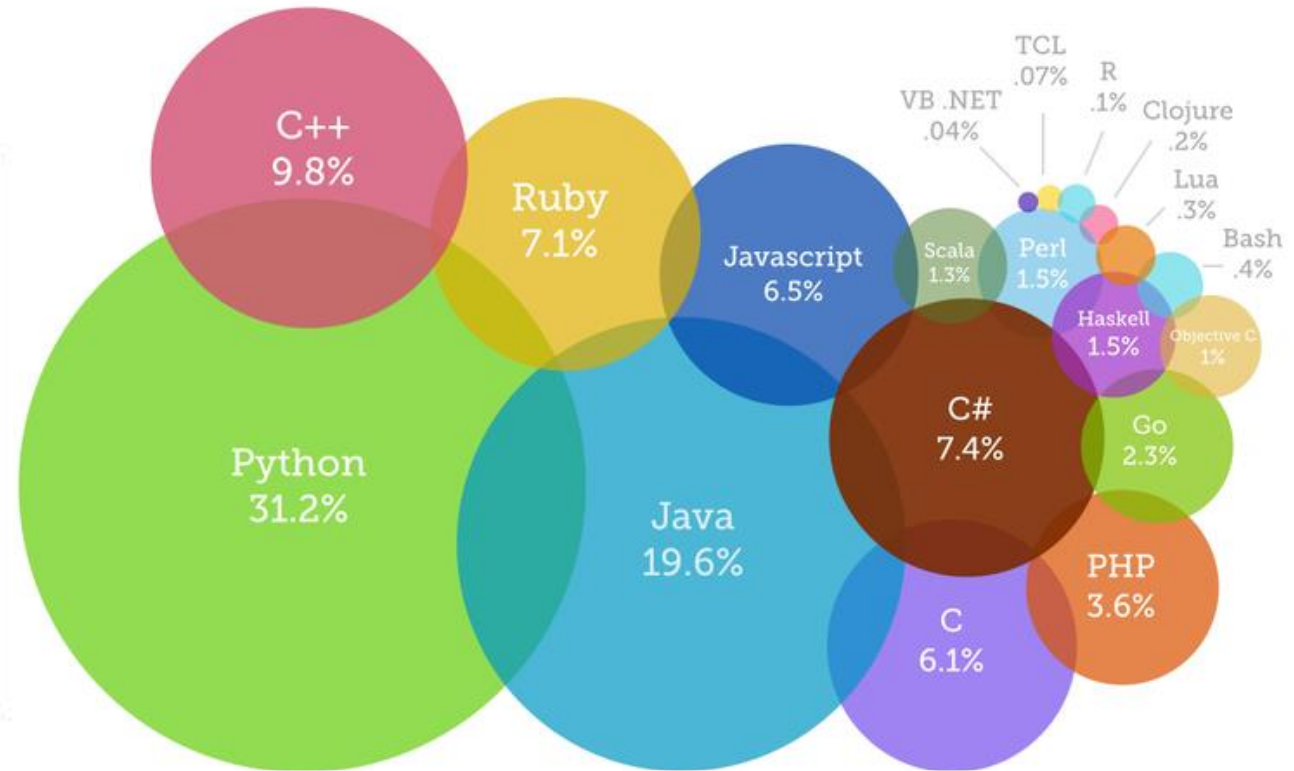
Popularity of Languages

Work Languages (career)



2006

Most Popular Coding Languages of 2015



2015