



Center for Computational Modeling and Simulation

2020 Programming Bootcamp

What is a computer?

How do we Write Programs to Run on the Computer?

Frank McKenna
University of California at Berkeley



NSF award: CMMI 1612843

Google: What is a Computer

A computer is an electronic device that manipulates information, or data. It has the ability to store, retrieve, and process data.

<https://edu.gcfglobal.org/en/computerbasics/what-is-a-computer/1/>

An electronic device for storing and processing data, typically in binary form, according to instructions given to it in a variable program.

<https://www.lexico.com/en/definition/computer>

A computer is a machine that can be instructed to carry out sequences of arithmetic or logical operations automatically via computer programming.

<https://en.wikipedia.org/wiki/Computer>

A computer is a programmable device that stores, retrieves, and processes data. The term "computer" was originally given to humans (human computers) who performed numerical calculations using mechanical calculators, such as the abacus and slide rule. The term was later given to a mechanical device as they began replacing the human computers. Today's computers are electronic devices that accept data (input), process that data, produce output, and store (storage) the results.

<https://www.computerhope.com/jargon/c/computer.htm>



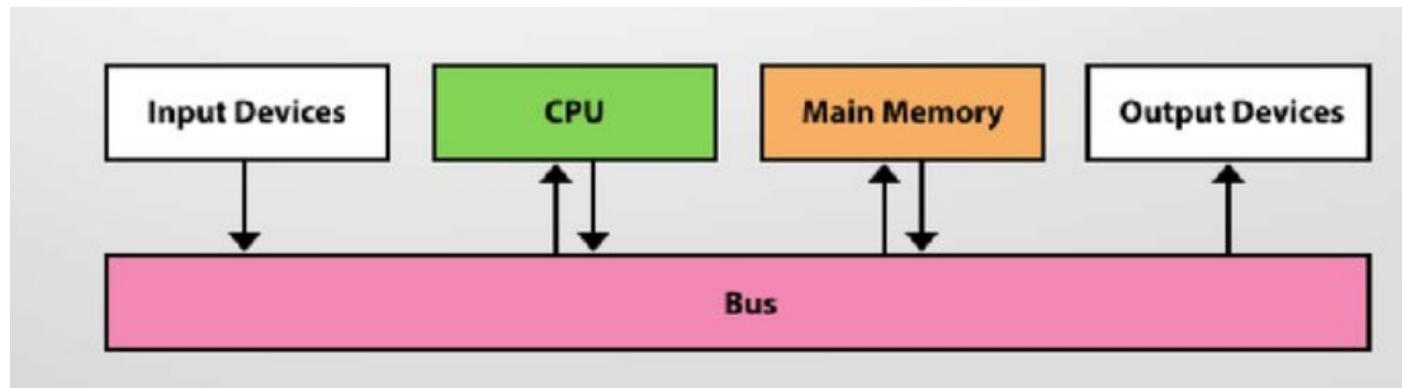
The Data

The Electronic Device

von Neumann Computer Architecture



John von Neumann



An Actual Desktop Computer

Power supply

Fan

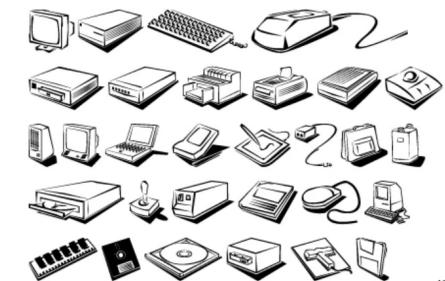
Access Slots



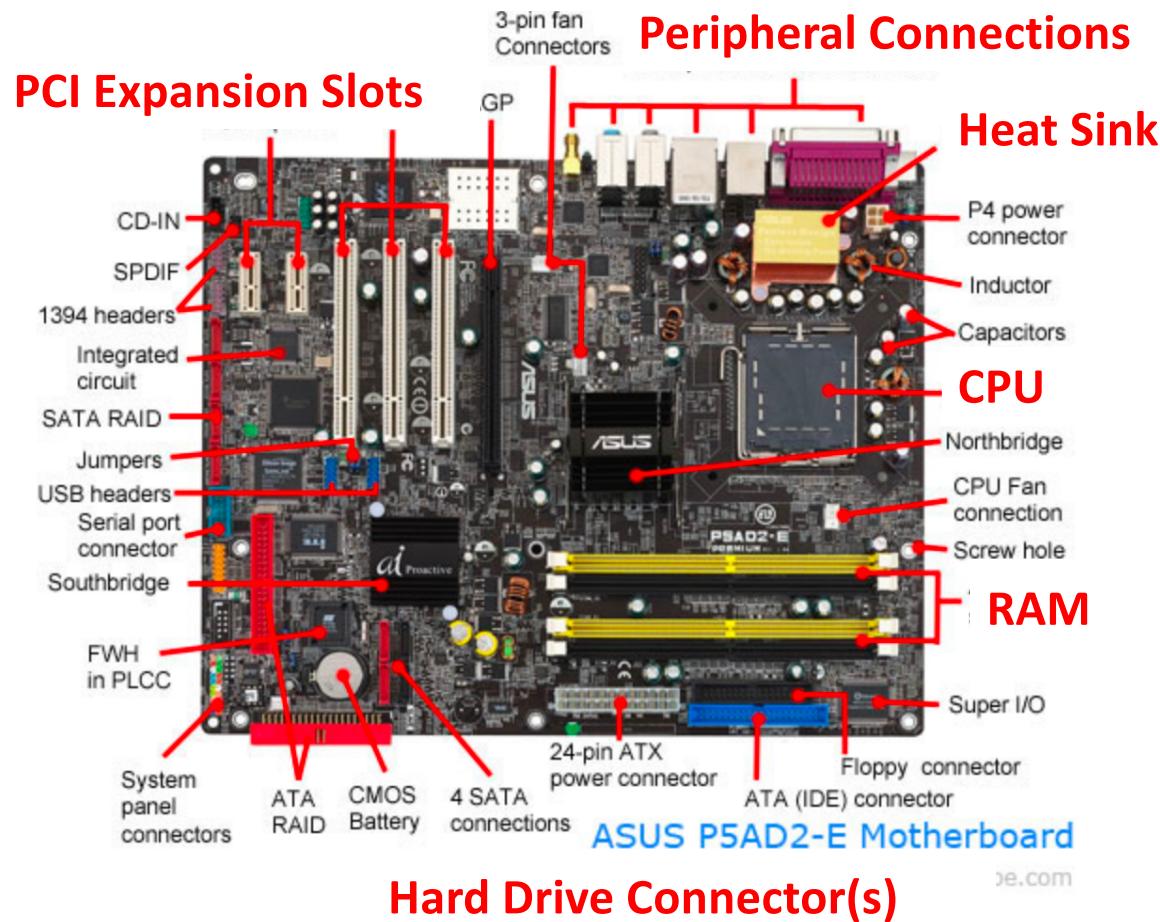
Motherboard

DVD Drive & Other Peripherals

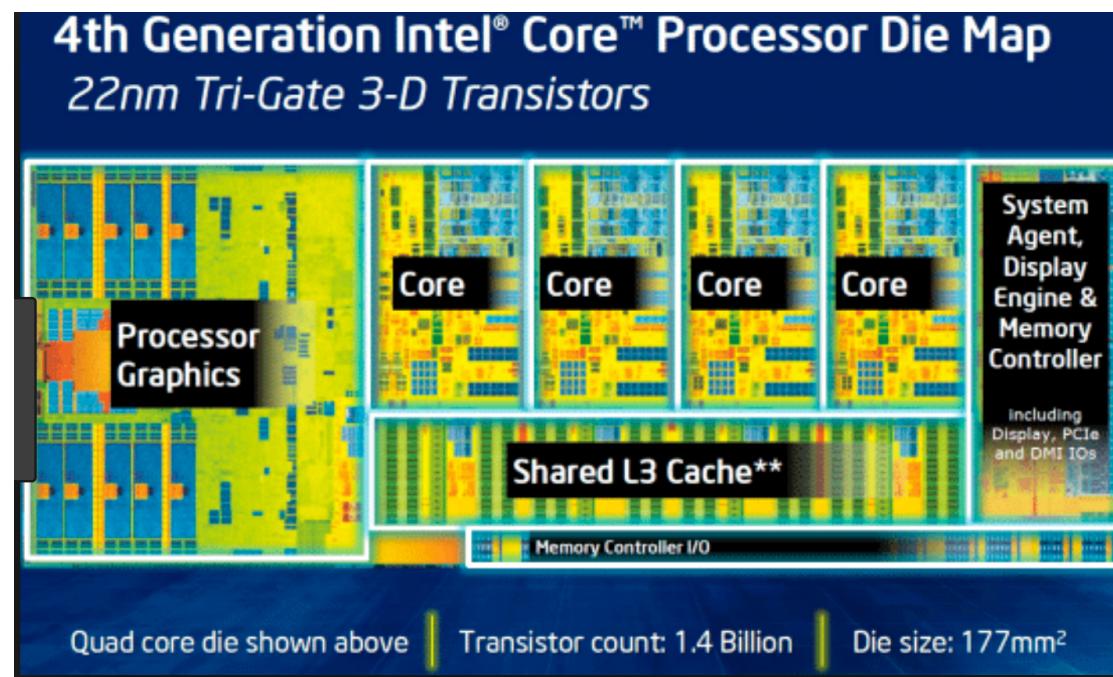
Hard Drive(s)



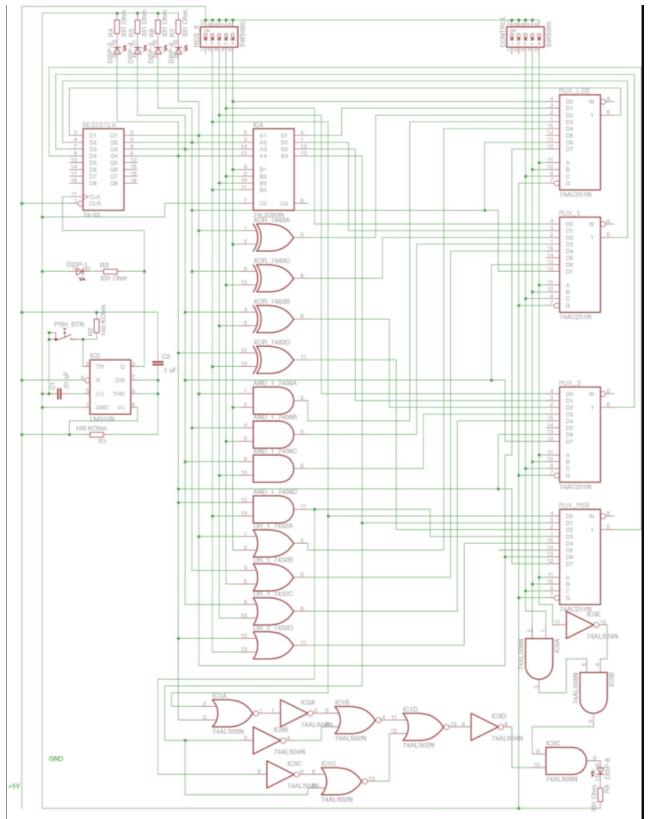
What is on a Motherboard?



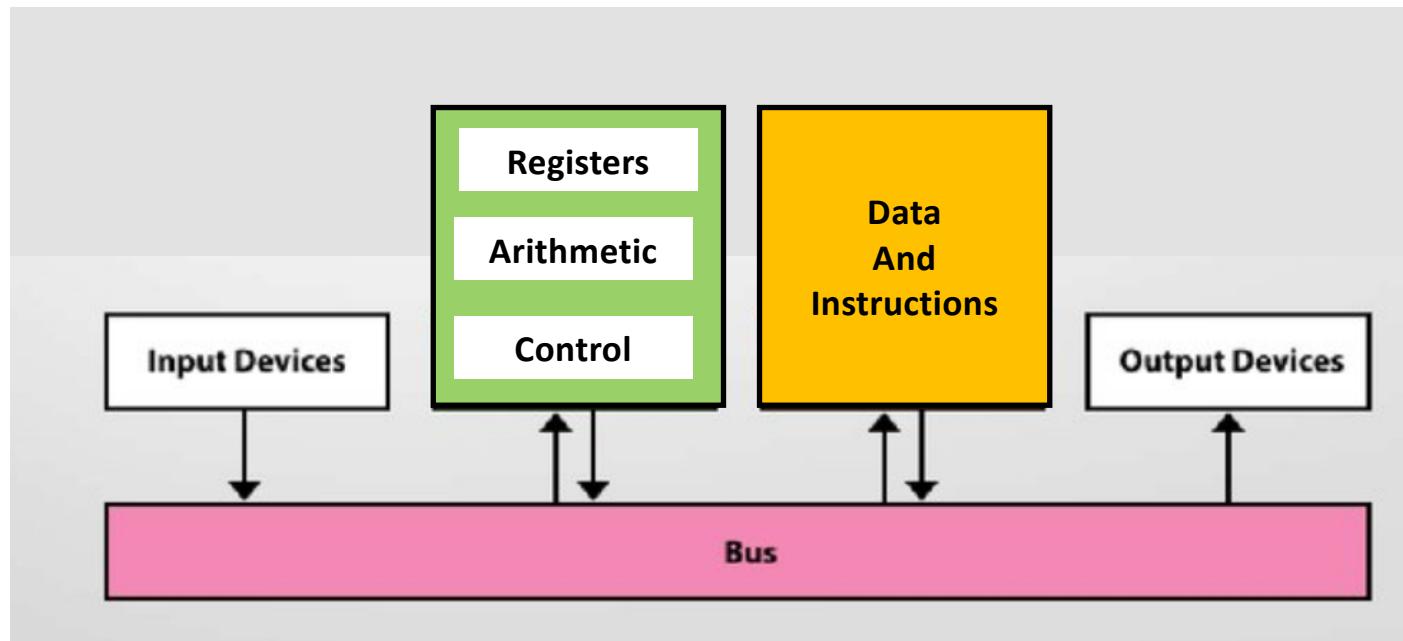
What is in a CPU?



Circuit to add two 4bit integers!



von Neumann Architecture



What is a Computer Program?

- A sequence of separate instructions one after another
- Each instruction tells CPU to do 1 small specific task
- When the instructions are completed the Computer has done something we wanted done.

Memory	
00101110	(Location 0)
11010011	(Location 1)
01010011	(Location 2)
00010000	(Location 3)
10111111	
10100110	
11101001	
00000111	
10100110	
00010001	
00111110	(Location 10)

Art of Programming - I

- Given an algorithmic solution, continually break it down into a series of smaller tasks until ultimately these tasks become a series of small specific individual instructions.

What is Programming?

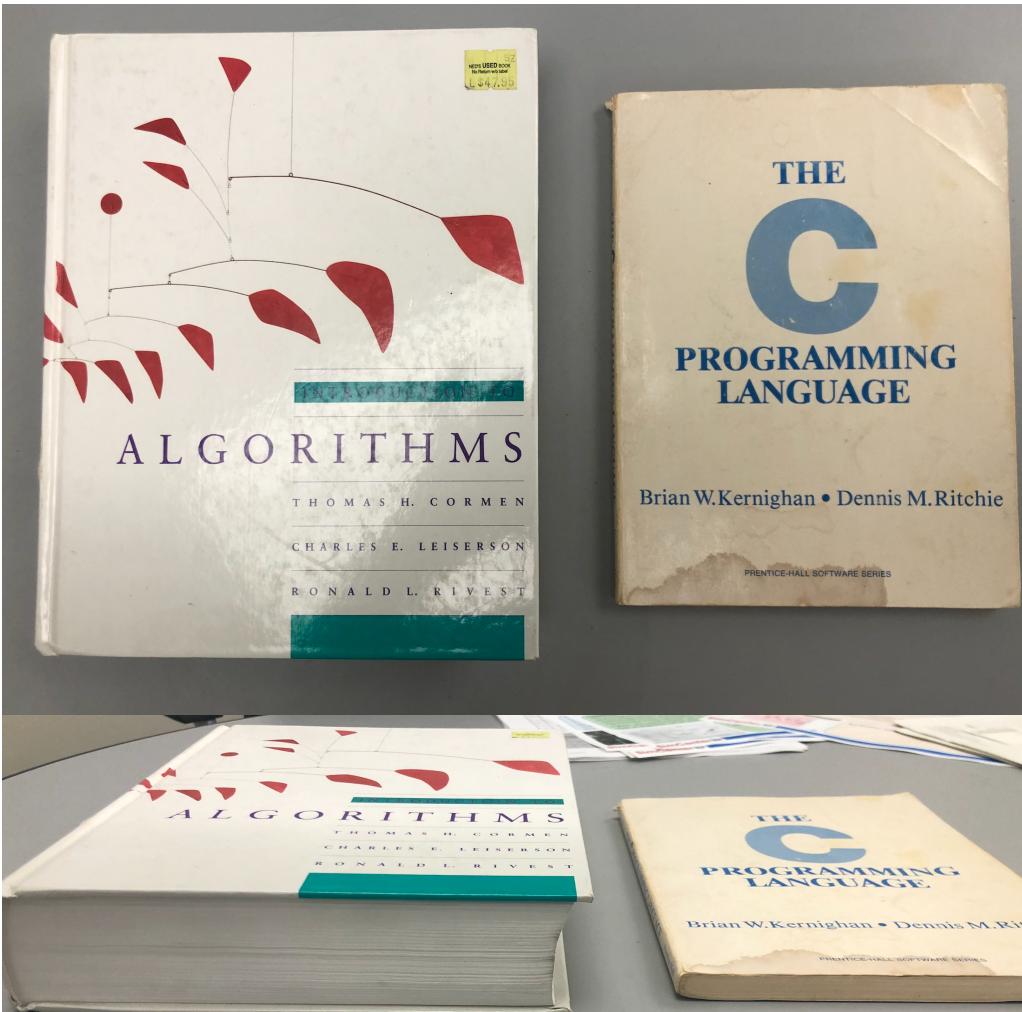
- *Programming is a way to “instruct the computer to perform various tasks”.*
<https://hackr.io/blog/what-is-programming>
- Computers can do amazing things .. But no computer can do anything until a computer programmer tells it to behave in specific ways. That's what computer programming is all about. <https://www.snhu.edu/about-us/newsroom/2018/06/what-is-computer-programming>
- Programming is the art and science of translating a set of ideas into a program - a list of instructions a computer can follow. https://en.wikiversity.org/wiki/What_is_%22programming%22
- **Programming** is the process of taking an **algorithm** and encoding it into a notation, a programming language, so that it can be executed by a computer. Although many programming languages and many different types of computers exist, the important first step is the need to have the solution. Without an algorithm there can be no program.
<https://runestone.academy/runestone/books/published/pythonds/Introduction/WhatIsProgramming.html>
- So programming is writing instructions for a computer to perform. The instructions, called source code, are written in special languages that are unlike natural human languages. **It also involves planning, testing, and debugging source code.** https://www.programmingforbeginnersbook.com/blog/what_is_programming_coding/

What is Programming?

- **Computer programming** is the process of designing and building an executable computer program to accomplish a specific computing result or to perform a specific task. Programming involves tasks such as: analysis, generating algorithms, profiling algorithms' accuracy and resource consumption, and the implementation of algorithms in a chosen programming language (commonly referred to as **coding**).

https://en.wikipedia.org/wiki/Computer_programming

Algorithm & Coding the Algorithm



How Do We Input the Instructions?

Memory	
00101110	(Location 0)
11010011	(Location 1)
01010011	(Location 2)
00010000	(Location 3)
10111111	.
10100110	.
11101001	.
00000111	.
10100110	.
00010001	.
00111110	(Location 10)

MITS Altair 8800	
Introduced:	January 1975
Available:	February 1975
Prices:	US \$395 as a kit (prior to March) US \$650 assembled
How many:	estimated 2000+
CPU:	Intel 8080, 2.0 MHz
RAM:	256 bytes, 64K max
Display:	front panel LEDs
Controls:	front panel switches
Expansion:	Altair-bus card-cage
Storage:	paper tape, cassette or floppy drive
OS:	CP/M, BASIC



Of course we now create our programs in textual format that meets the syntax requirements of a Programming Language.

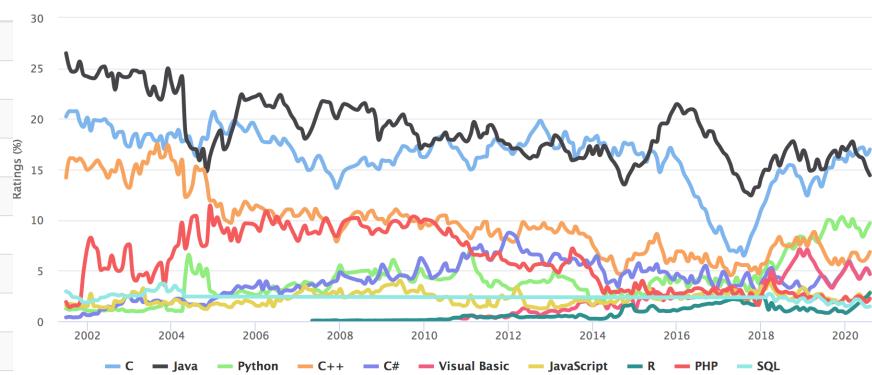
What Programming Language?

- Hundreds of languages
- Only a dozen or so are popular at any time
- We will be looking at C, C++ and Python

Popular Programming Languages

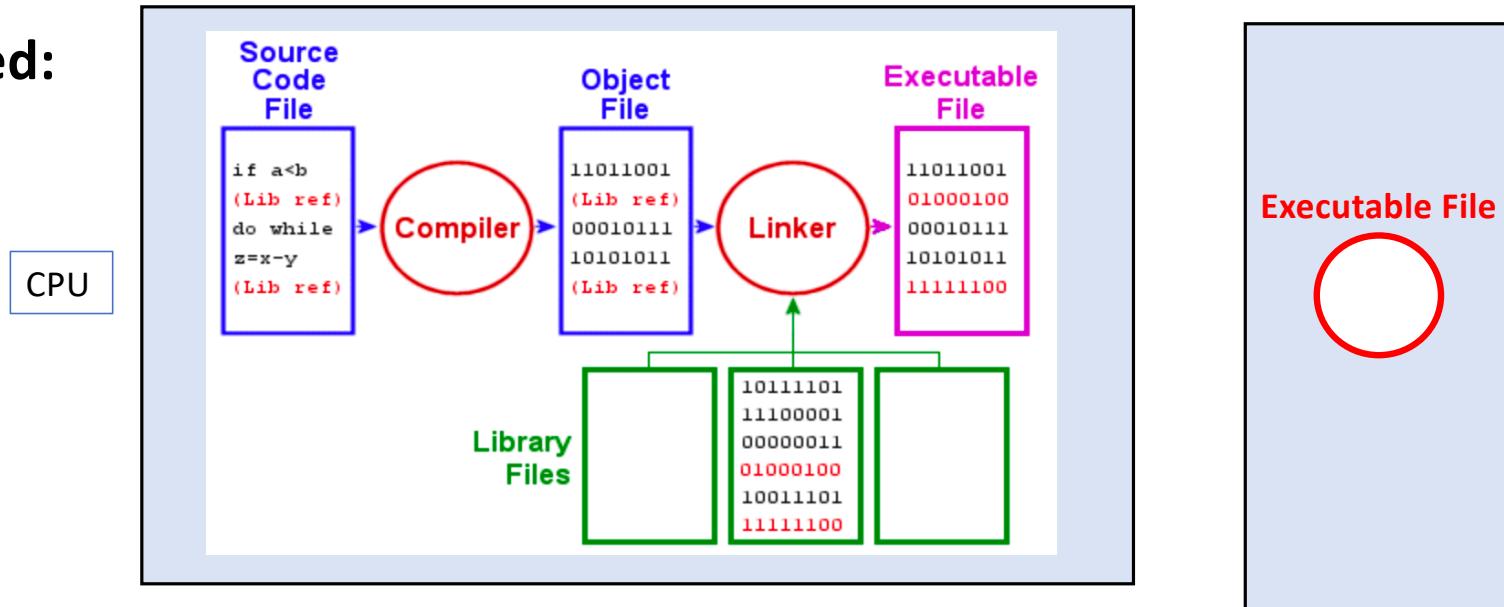
Tiobe Index:

Aug 2020	Aug 2019	Change	Programming Language	Ratings	Change
1	2	▲	C	16.98%	+1.83%
2	1	▼	Java	14.43%	-1.60%
3	3		Python	9.69%	-0.33%
4	4		C++	6.84%	+0.78%
5	5		C#	4.68%	+0.83%
6	6		Visual Basic	4.66%	+0.97%
7	7		JavaScript	2.87%	+0.62%
8	20	▲	R	2.79%	+1.97%
9	8	▼	PHP	2.24%	+0.17%
10	10		SQL	1.46%	-0.17%

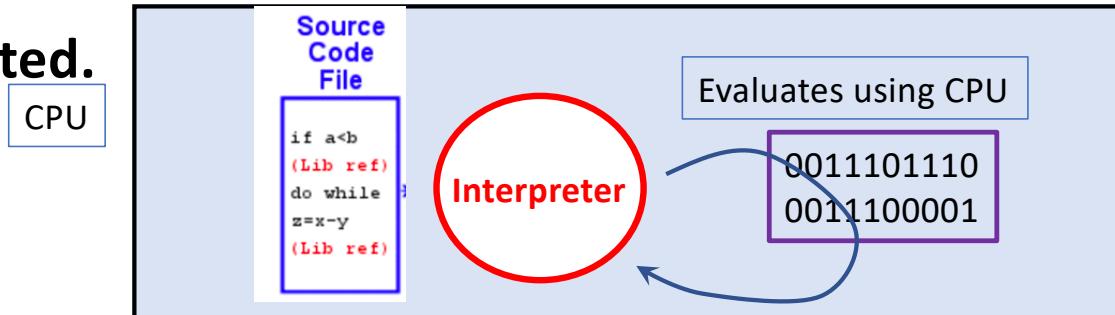


Types of Languages – Compiled & Interpreted

- **Compiled:**

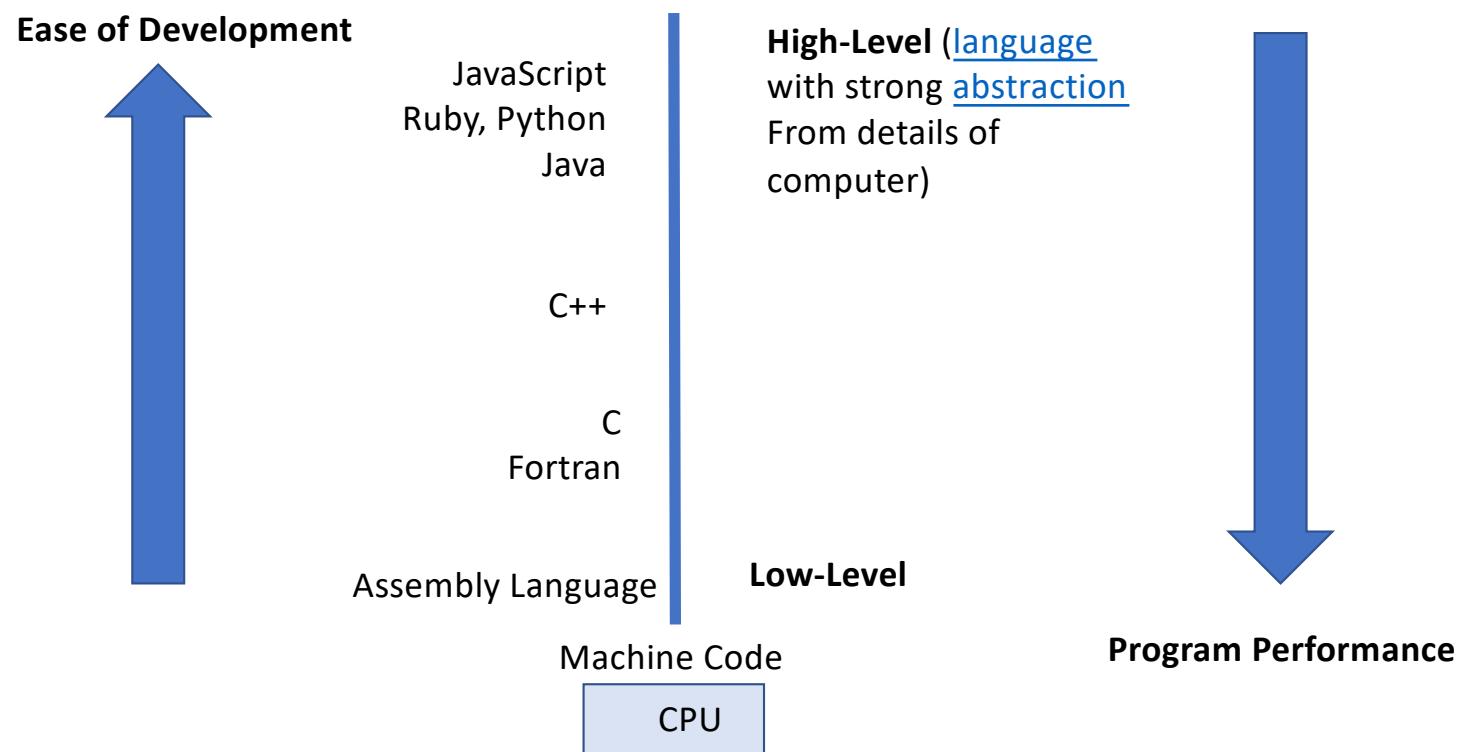


- **Interpreted:**



- Hybrid, e.g. Java. Compiler converts to another language, e.g. bytecode. Interpreter runs on machine and interprets this language, e.g. javaVM.

Programming Language Hierarchy



What is Coding?

- Writing the instructions as a series of program statements.
- A statement uses words, numbers and punctuation to detail the instruction. They are like properly formed sentences in English.
- A poorly formed statement -> compiler error
- Each programming language has a unique “**syntax**” that defines what constitutes correct statements in that language

And we are going to start with PYTHON