Computers, Operating Systems, Programming Languages, and Python

At a high level, a computer consists of three types of components:

- A processing unit - execute instructions and process data
- Input & output devices - let you input data & instructions into the computer, and get results out
- Memory & storage - somewhere to store instructions, data, results,...

Processing Unit

Executes instructions - add these numbers, multiply this, check this clause, print out this value,...

Central Processing Unit (CPU) - Intel Core, ARM

Graphical Processing Unit (GPU) - special type of processor that executes certain mathematical commands really, really fast

We’re mostly worried about CPUs in this course

I/O Devices

Humans and other systems need to tell the computer what to do, and use the results.

- Keyboard
- Mouse
- Trackpad
- Controller
- Display
- Printer
- Network interface

Memory/Storage

You have to be able to put data & instructions somewhere

We want lots of it, and we want it to be fast (cheap is nice, too)

- Random Access Memory (RAM) on chip
- Solid-State Drive (SSD)
- Hard Drive
- USB key
- DVD

Operating Systems

A program or set of programs for controlling a specific computer

- Manages CPU & GPUs; controls I/O devices; manages memory
- Manages user interface (UX)

Examples:

- Windows
- Mac OS (“OSX”)
- Android
- iOS
- Linux

Some O/S history

1969 - Unix written by Bell Labs - part of AT&T at the time

- Source code made available to others because they didn’t sell it
  - AT&T Unix & Berkeley Unix
- Andrew Tenenbaum wrote Minix modeled on Unix
- Linus Torvalds wrote Linux to do better than Minix
  - Made available as open source; freely available to use; modification allowed
- Android is built on Linux
  - Google bought Android, supported & enhanced the system & made it freely available
- MacOS (“OSX”) is based on Berkeley Unix
- iOS is “new” but owes debts to Unix
- ChromeOS is built off Linux; a subset of Android focused on the browser

Computer Programs

A program is just a set of a instructions to the computer

- Do these things to that data
- Algorithms & Data
  - An algorithm is a “recipe” - a set of instructions - for solving a problem
  - Programs implement algorithms
  - Data is what the algorithm operates on

Programming Languages

You have to be able to communicate with the computer

- CPU understands machine language - a series of 1’s and 0’s
- Humans do not do well at understanding and working with long strings of 1’s and 0’s
- Computer science has included a long history of trying to develop ways to communicate with the computer in ways that humans understand, that efficiently translate into machine language
- High-level languages are translated by interpreters or compilers into machine language for execution

Example programming languages

- C - developed with Unix; good for O/S like programs - fast but hard to understand, unconstrained - no type enforcement
- C++, C# - enhance C with more modern constructs
- Java - “new” language in the 1990’s to facilitate web applications and networks
- Javascript - language for web apps; not actually related to Java
- R - language for analyzing large sets of data
- GO (or Golang) -
- Python - general purpose language; open source; widely used; lots of available libraries
    - Not necessarily the best for any one task, but good for a lot of things

Syntax and Semantics

Any language has a defined syntax that must be followed, and semantics that define the meaning

If you don’t follow the syntactic rules, the compiler or interpreter will reject your program because it can’t figure out what you meant

- Humans are much better at figuring out what you meant, but you’re not dealing with humans here.
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Example python syntax:

- Any line starting with a # is a comment and the rest of the line will be ignored - not executed
- Variable names cannot start with a digit and can’t contain many special characters
- Reserved words have defined meanings and can’t be used any other way

Python Reserved Words

false	class	finally	Is	return
none	continue	for	lambda	try
true	def	from	nonlocal	while
and	del	global	not	with
as	elif	if	or	yield
assert	else	import	pass	
break	except	in	Raise	

Distraction: Which of the following is not true about Al Arsenault?

- I was not born in the United States
- I lost on Jeopardy! To Ken Jennings (the guy who won 74 straight games)
- I have four children who are all UMBC alums
- I can fly the plane or jump out of it
- I have four degrees but not a PhD

An example program:

```
# Your first program in any language should be to make it

# print the words “Hello, world” on the screen

print(“Hello, world”)
```

Let’s analyze this program and see what we know about it

Types in Python

All values in python have a defined Type that limits what operations you can legally perform on them

Strings - one or more characters treated as a single entity

- Inside double quotes - Hello, world is the string

Integers - whole numbers

Floats (real numbers) - numbers that include decimal points and exponents

Booleans - things that are either TRUE or FALSE

Variables

A variable is a name assigned to a location in memory that will store a value of a certain type. You initialize a variable by putting it on the left side of an equals sign and assigning it a value

An_int = 6

Myname = “Al Arsenault”

Pi = 3.14159

That single equals sign is an assignment operator. If there is already a location in memory, this statement will cause the value on the right side to be stored in that location. If there is not one, python will create a new location, give it the variable name, and store the value there

Integrated Development Environments (IDEs)

PyCharm

Spyder

GL

Distraction: Which of the following is not true about Al Arsenault?

- I was not born in the United States - True - Stuttgart, Germany is the birthplace of Mercedes-Benz, Porsche, and me
- I lost on Jeopardy! To Ken Jennings (the guy who won 74 straight games) - True - June 11, 2004 - http://www.j-archive.com/showgame.php?game_id=1594
- I have four children who are all UMBC alums - False. Two graduated from UMBC, one from College Park and one from Hood
- I can fly the plane or jump out of it - True, although both my pilot's license and my sport parachute certificate are inactive
- I have four degrees but not a PhD - True