

Introduction to the Course

David H Smith IV

University of Illinois Urbana-Champaign

Mon, June 14 2021

Course Outcomes

- Given a small section of code you should be able to:
 - Trace through and predict it's output.
 - Describe, in plain English, what it does.
- Write a small python program some using the fundamentals you will learn in this course.
- Beginner and intermediate spreadsheet operations.
- Beginner level understanding of how the internet works and how to write basic HTML documents.

Today's Topics

- Quick overview of the course
- A history of CS and the general purpose computer
- The process of constructing programs

Lecture Time

- We ask multiple choice questions
- You answer the poll individually, for participation points.
- Then you discuss with your peers in your assigned lecture discord group.
- You will answer the poll a second time for, credit.

First poll question! - Getting Help

- ① It is okay to hire random internet strangers to do all of your homework for you.
- ② You must do all of your homework alone (not even TAs can help)
- ③ You can get any help you want as long as you type in the answers.
- ④ Students can only discuss the homework at a high level; code must not be shown to other students, but you can ask TAs for help.
- ⑤ Assignments can be done in groups of two students.

What is Computer Science?

- CS is concerned with understanding:
 - Historically concerned with investigating what is computable.
 - How to compute it in one or more of the following in mind:
 - Speed
 - Reliability
 - Security
 - Resource cost

What is Programming?

- Programming \neq Computer Science
 - Rather, programming is a subset of Computer Science
- “Computer Science is no more about computers than astronomy is about telescopes”
 - Edsger W. Dijkstra
- **High Level Definition:** A series of instructions that a computer carries out.



The Journey to a General Purpose Computer

Early “Computers”



Figure: Fire Control System

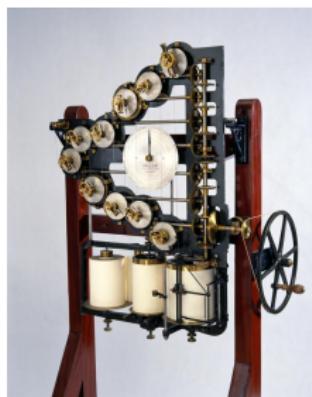


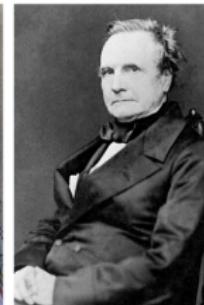
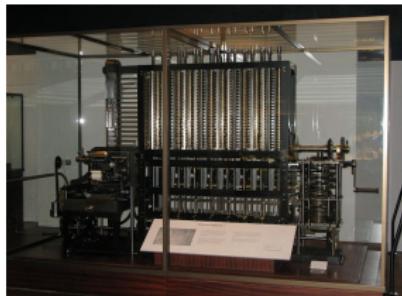
Figure: Tide Predicting Machine



Figure: Antikythera Mechanism

The Difference & Analytical Engines

- ① **Charles Babbage:** Created the Difference Engine and created plans for the Analytical Engine.
- ② **Ada Lovelace:** The first computer programmer who worked with Babbage on the Analytical Engine.
- ③ **Difference Engine:** A large mechanical calculator capable of performing large computations.
- ④ **Analytical Engine:** The first model of a general purpose mechanical computer.



Turing Machines

Turing Machines - An abstract, mathematical model of a machine that moves up and down a strip of paper, one step at a time, and performs operations based on a set of rules.

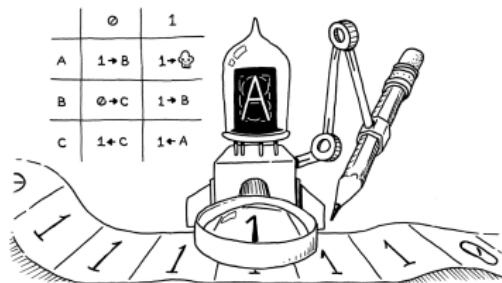


Figure: Artist's Representation of a Turing Machine

Von Neumann Architecture

- ① **Input Devices:** Something with buttons and knobs.
- ② **Central Processing Unit:**
 - ① **Control Unit:** Manages everything.
 - ② **Arithmetic/Logic Unit:** Does math and logical comparisons.
- ③ **Memory Unit:** Supplies info to CPU (i.e., Random Access Memory).
- ④ **External Storage Unit (Not Pictured):** We often need larger storage for data that isn't needed immediately (e.g., Hard Drive).
- ⑤ **Output Devices:** Flashing lights, monitor, etc.

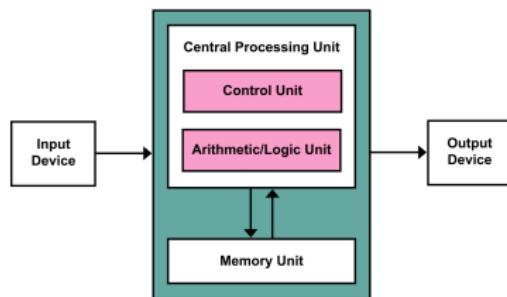


Figure: Von Neumann Architecture

How Programs are Constructed

Computers Run Low-Level Instructions

- Computers don't "Play a video"
- They...
 - ① Move some numbers into memory.
 - ② Do some math, or a comparison, or both
 - ③ Make a decision based on the results
 - ④ Rise a and repeat a few million time before something useful happens
- Programming at this level is:
 - Tedious and error prone.
 - Needs **A LOT** of code to do anything useful.
 - Isn't portable. Each processor is it's own machine and will require a different set of instructions that works with it's parts.

Enter Python (And Other High-Level Languages)

- They are:
 - **Productive** → A few lines do a lot and it's easy to debug.
 - **Safer** → Less likely to write code that is insecure or damaging.
 - **Portable** → Works on all systems that support the Python interpreter.
- Used for everything from machine learning to general scripting.
- We use Python 3.x (not Python 2.x)

How programs are Constructed

- **Algorithms** → A step-by-step process for achieving a result
 - Often Written in pseudo-code
- **Programming** → Express the commands in a form the computer understands.
- **Testing** → Designing inputs that test specific behaviours of the code.
- **Debugging** → Finding errors in the code based on the results of your tests and fixing them.

A Search Algorithm

- **Input:** (1) An array of numbers and (2) number for which we're searching.
- **Output:** Whether or not the number exists in the list of numbers.
- **Algorithm:**
 - ① Look at first item.
 - ② Check if it's the item we're looking for.
 - ③ If it's the item we're looking for stop otherwise go to next item.
 - ④ Repeat steps 2 & 3 if there are still items in the list.

Searching Number: 4

Input List:

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---



Is 1 equal to 4? No, so we check the next one.



Is 2 equal to 4? No, so we check the next one.



Is 3 equal to 4? No, so we check the next one.



Is 4 equal to 4? Yes, so we stop searching.

Algorithm:

- ① Look at first item.
- ② Check if it's the item we're looking for.
- ③ If it's the item we're looking for stop otherwise go to next item.
- ④ Repeat steps 2 & 3 if there are still items in the list.

Code:

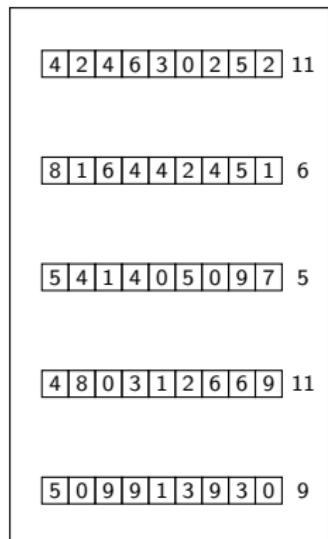
```
def search(list, searchitem):  
    for item in items:  
        if item == searchitem:  
            return True  
    return False
```

How Languages are Constructed

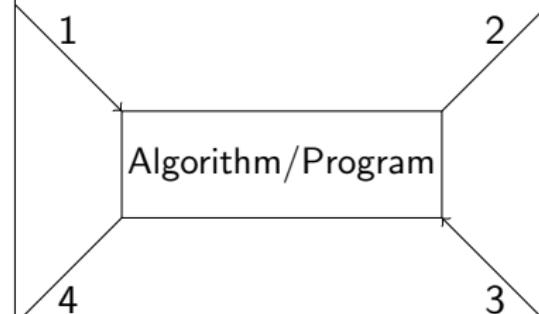
- **Syntax** → The rules specifying the structure and symbols that are allowable within the programming language.
- **Semantics** → Rules defining the behaviour of symbols or combinations of symbols.

Testing and Debugging

Testing



Debugging



- (1) Observe output
- (2) Determine errors
- (3) Propose fixes

Next Lecture Input and Print

- **The Input Function:** A builtin function that gets a string from the user.
 - `input()` → Doesn't give a prompt.
 - `input("A test input: ")` → Will output the message "A test input:" to the screen and let the user type their input in after it.
- **The Print Function:** A builtin function that takes a string as a parameter (in between the parentheses) and outputs that string
 - `print("Hello, World!")` → Will output the "Hello, World!".

Next Lecture: Data Types in Python

- Two types we'll need to know now:
 - **Strings:** A long list of characters accompanied by surrounding quotes (e.g., "Hello, CS 105!").
 - **Integers:** Whole numbers, both positive and negative.
- You can check the type of a variable or expression with the `type()` function.
- You can convert between them with the `str()` and `int()` functions.
- It's important to keep the type of your variables in mind when programming.
- Keeping types in mind when attempting to deduce what a program is doing is very important.