Programming

CPSC 217: Introduction to Computer Science for Multidisciplinary Studies I
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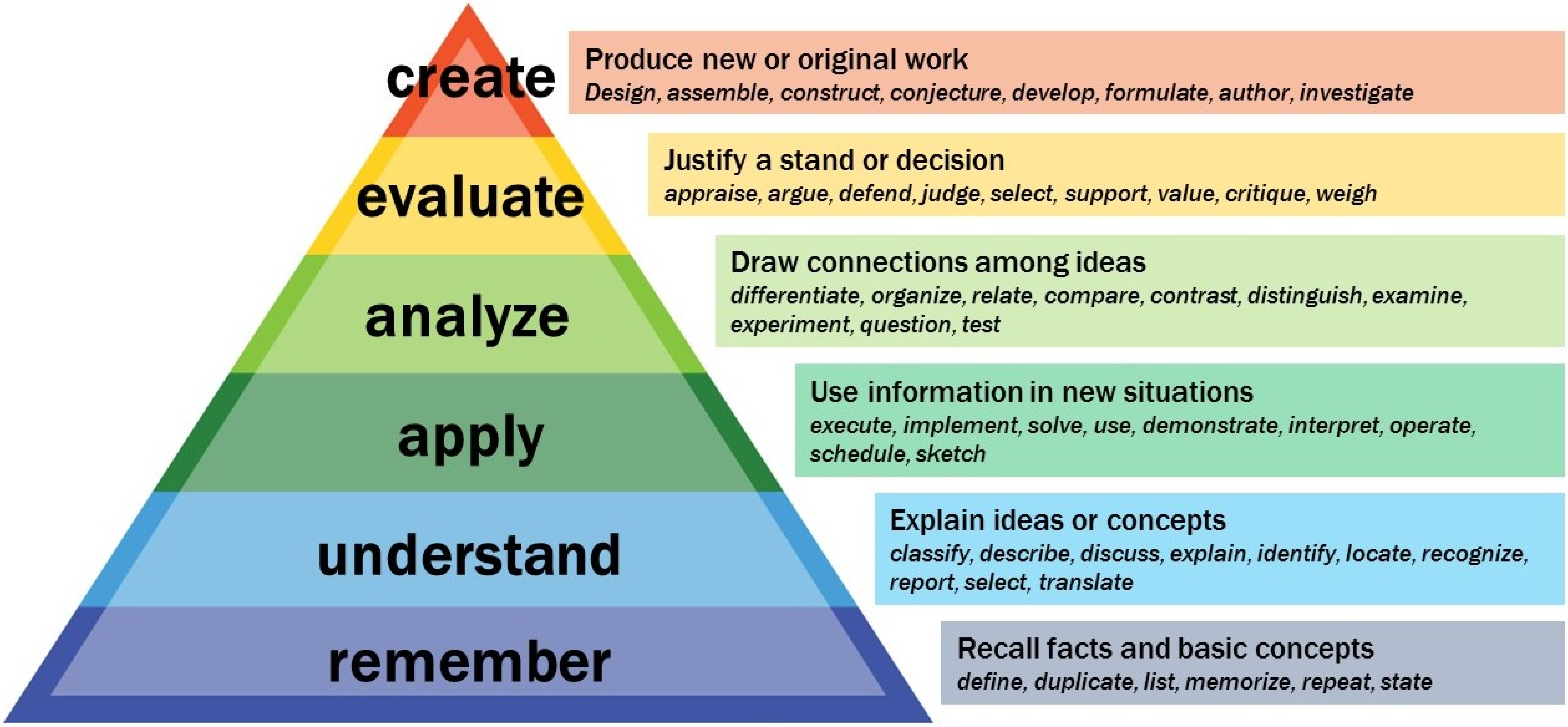
UNIVERSITY OF CALGARY

How Do We Solve Problems with a Computer?

First question: How do we learn?

What does it mean to understand something?

Bloom's Taxonomy



create

Produce new or original work

Design, assemble, construct, conjecture, develop, formulate, author, investigate

evaluate

Justify a stand or decision

appraise, argue, defend, judge, select, support, value, critique, weigh

analyze

Draw connections among ideas

differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

apply

Use information in new situations

execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

understand

Explain ideas or concepts

classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

remember

Recall facts and basic concepts

define, duplicate, list, memorize, repeat, state

Solving Problems

How do we solve problems?

Solving Problems

How do we solve problems?

Break original problem into smaller, more easily solvable parts and repeat on the smaller sub-problems.

Similar process used in expository writing (break topic up into easily-understandable bits, express in coherent way).

Top Down Design

01

Start with the entire problem

02

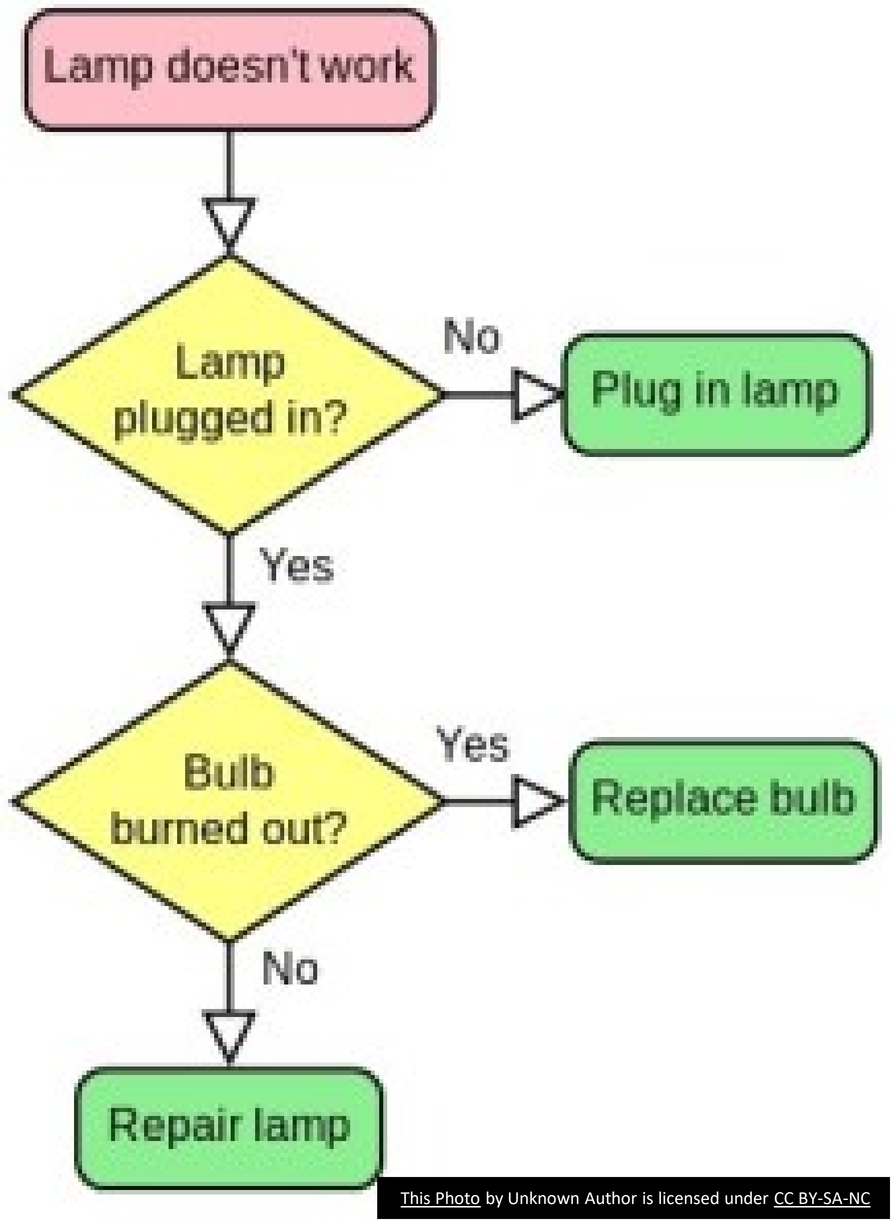
Break the problem into approximately 3 to 5 smaller steps

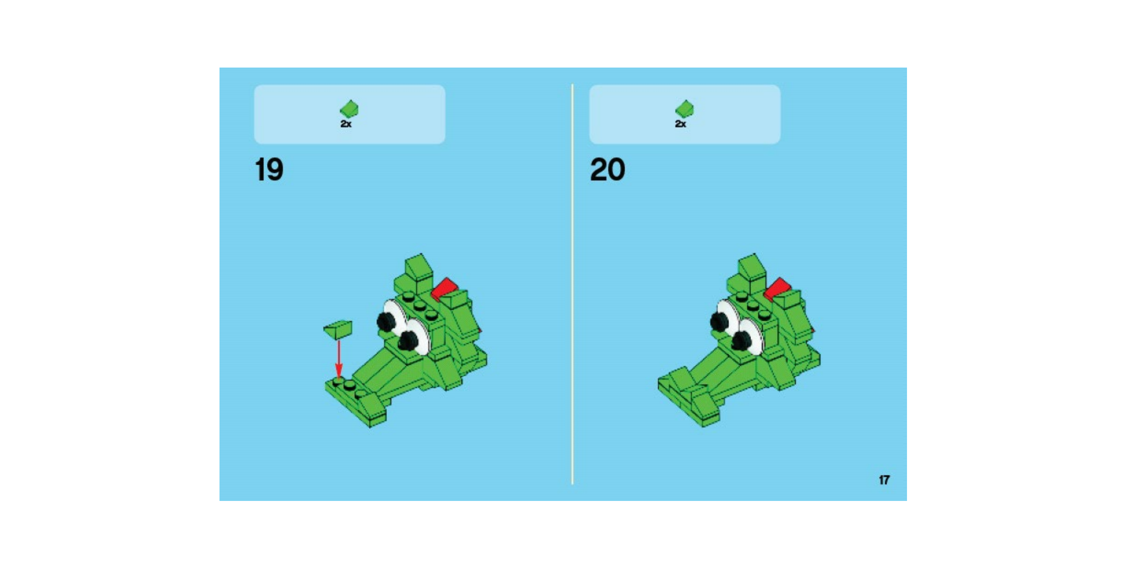
03

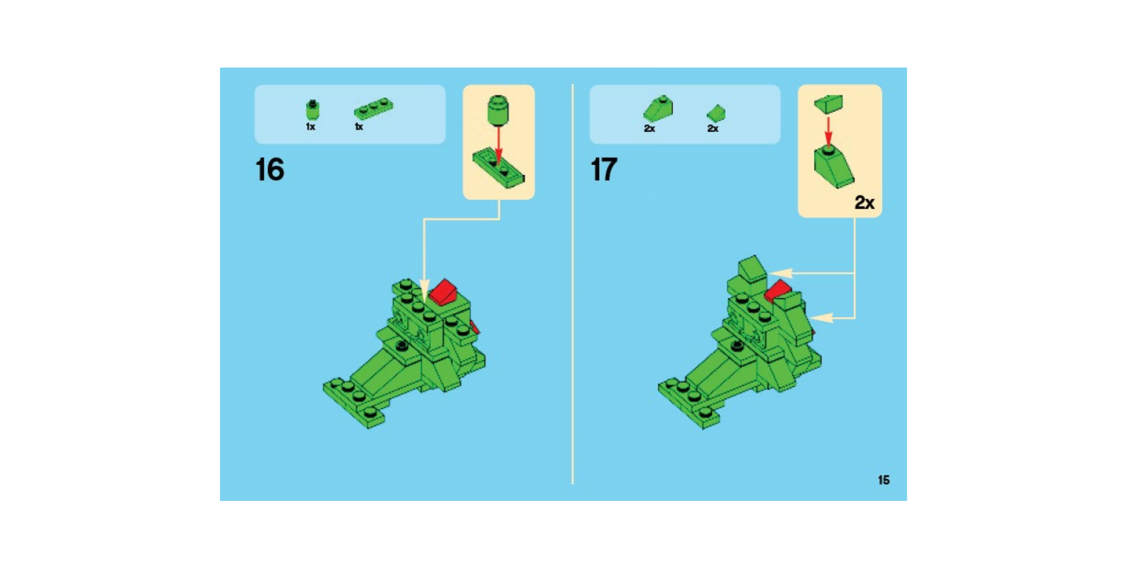
Repeat the process for each step that is still too complex

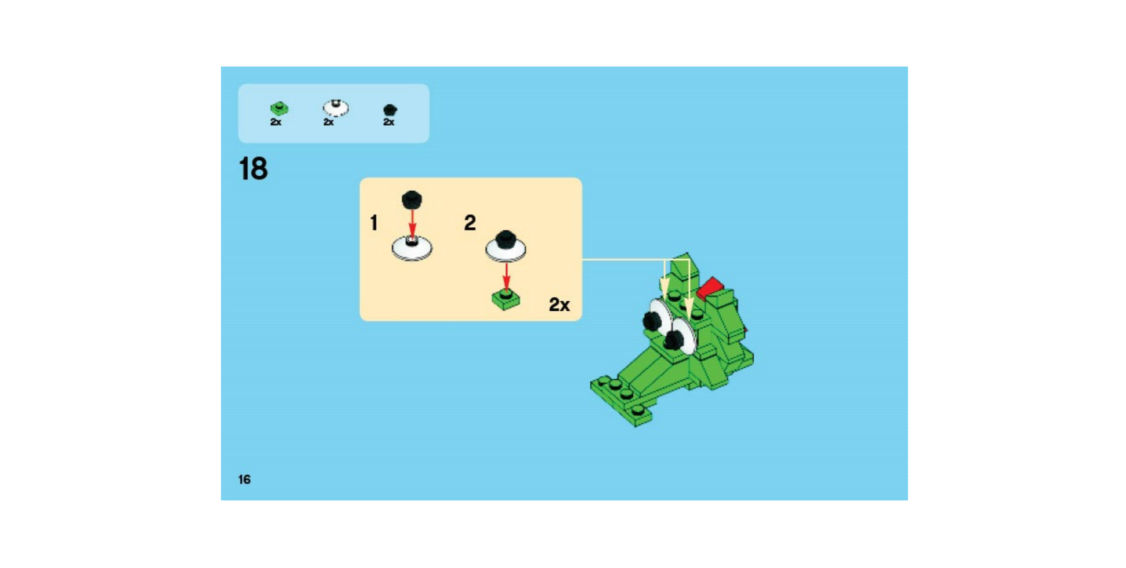
What is an Algorithm?

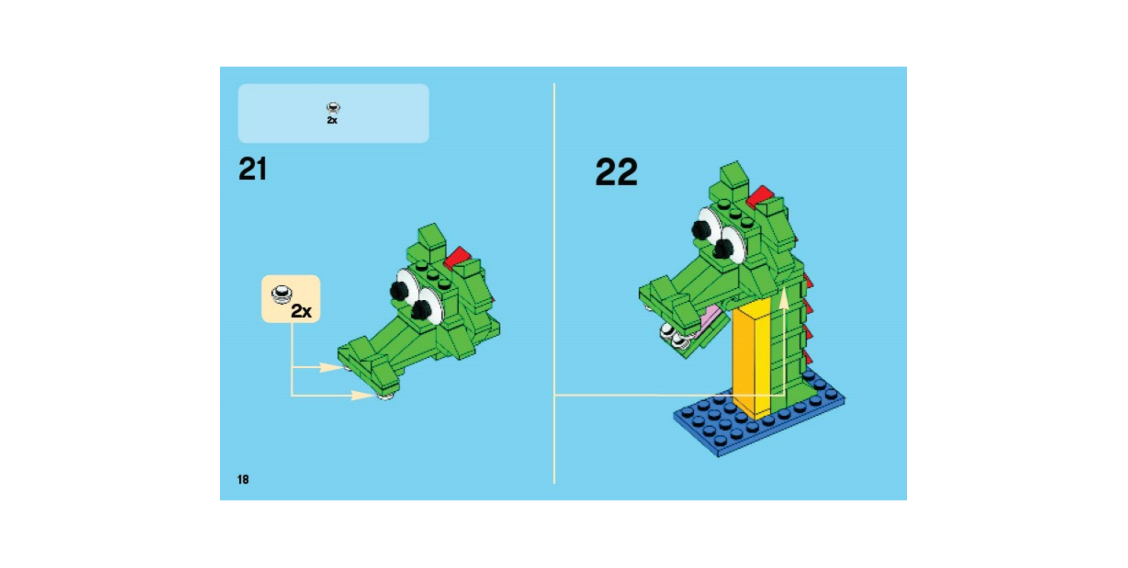
What is an Algorithm?




2x
19
2x
20
17


1x
1x
16
2x
2x
17
2x
15


2x
2x
2x
18
1
2
2x
16


2x
21
2x
22
18

What is an Algorithm?

- Algorithm: A finite sequence of effective (unambiguous, possible) steps to solve a problem.
- Expressed in English, human-oriented form
- Result of top-down design (or other problem solving strategy)
- A well written algorithm can be written in any computer programming language

What is Programming?

What is Programming?

- Programming: the process of creating software by translating algorithms into a computer language.
- Algorithm: human readable form, layout/syntax is free as long as a reasonable person can understand it
- Computer Program: computer readable form, precise syntax that must be followed exactly, will do exactly what you say (not what you meant!)

Where Are We Going?

- Computers are tools that we use to solve problems
  - Need to understand the problem that we want to solve
  - Need to understand how a computer works to model the problem
  - Need to learn how to program the computer to solve the problem

Programming Languages

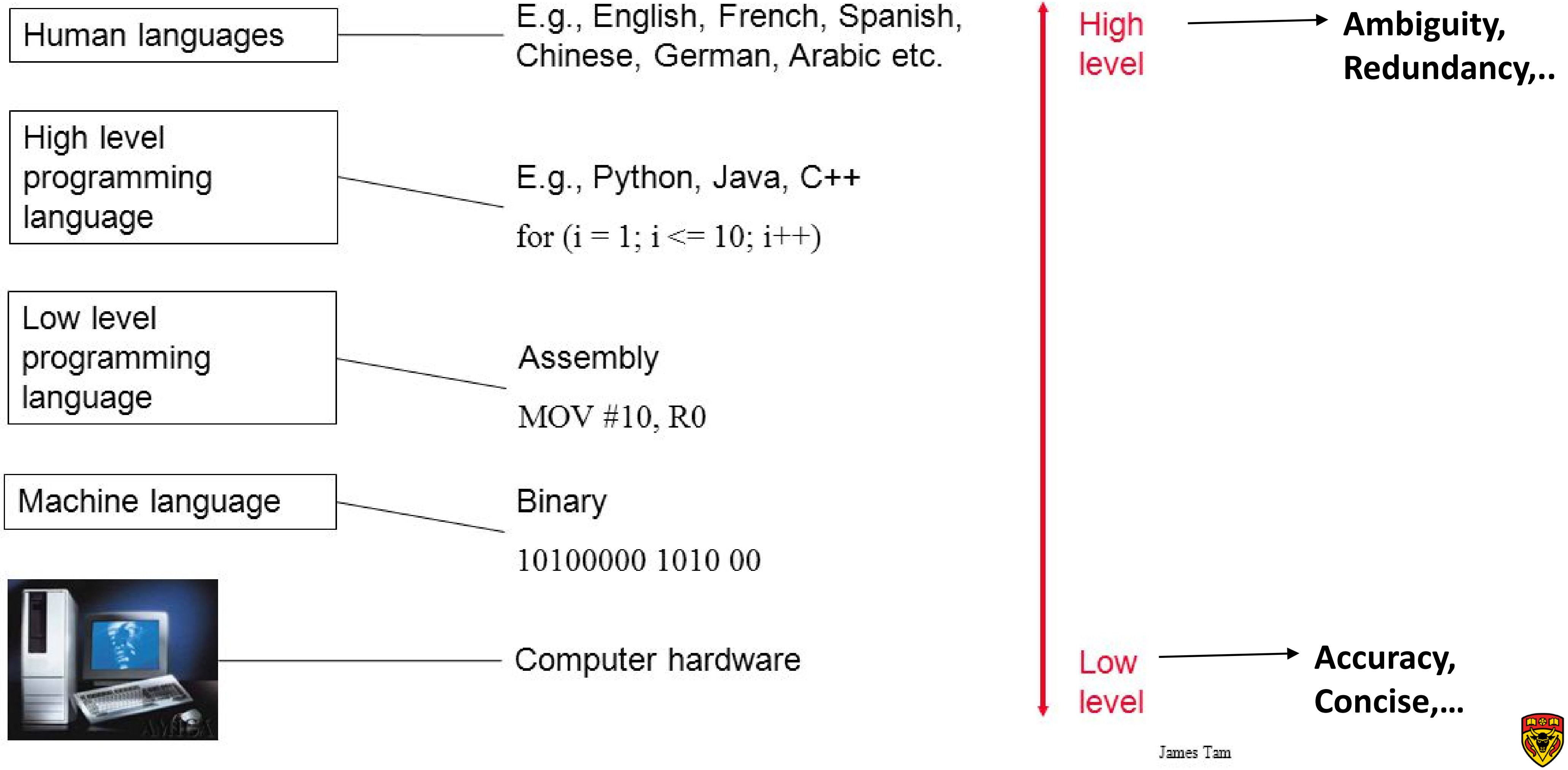
Many programming languages available

- Offer different features
- **Each has its own strengths and weaknesses**

Common features

- Allow us to control the behaviour of a computer
- **Defined syntactic and semantic rules**
  - **Syntactic** – what does a valid statement look like
  - **Semantic** – what is meaning of a statement

High Level Vs. Low Level Languages



Human languages — E.g., English, French, Spanish, Chinese, German, Arabic etc.

High level programming language — E.g., Python, Java, C++

```
for (i = 1; i <= 10; i++)
```

Low level programming language — Assembly

```
MOV #10, R0
```

Machine language — Binary

```
10100000 1010 00
```

Computer hardware

High level → **Ambiguity, Redundancy,..**

Low level → **Accuracy, Concise,…**

James Tam

Using Python

- **Python 3 is the official programming language for this course.**
- There are different ways to tell Python to execute your code:
  - Interactive coding
  - System command lines and files

- This course does not encourage the use of IDE such as Eclipse
- We encourage direct interaction with the computer systems

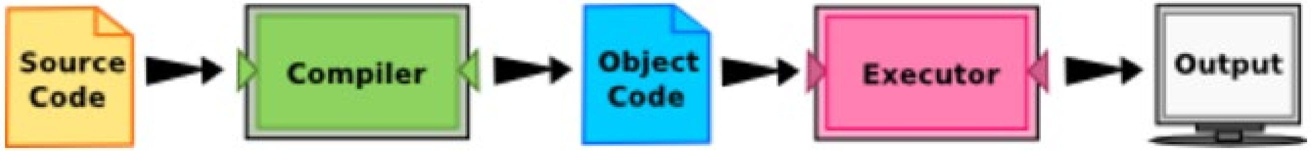
Compiler/Interpreter

Programming

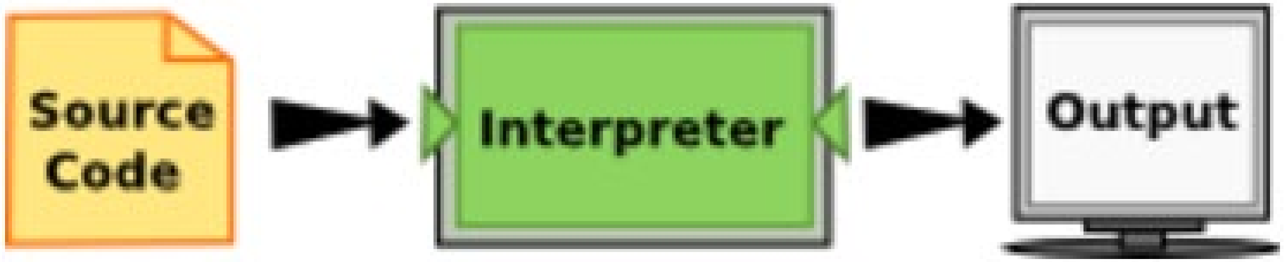
- Computer programs are stored in source files
  - Human readable / editable
  - Can also be understood by a computer
  - typically have the extension .py
- Once the file is created, it is run using the python interpreter
  - python myfile.py

Compilers Vs. Interpreter

- A **compiler**:
  - Is like **translating an entire book** and give it to a reader.
  - A compiler reads the program and translates it completely before the program starts running



- An **interpreter**
  - is **like translating a line at a time** and give the line to the uses until the book is finished.
  - It processes the program a little at a time, alternately reading lines and performing computations.

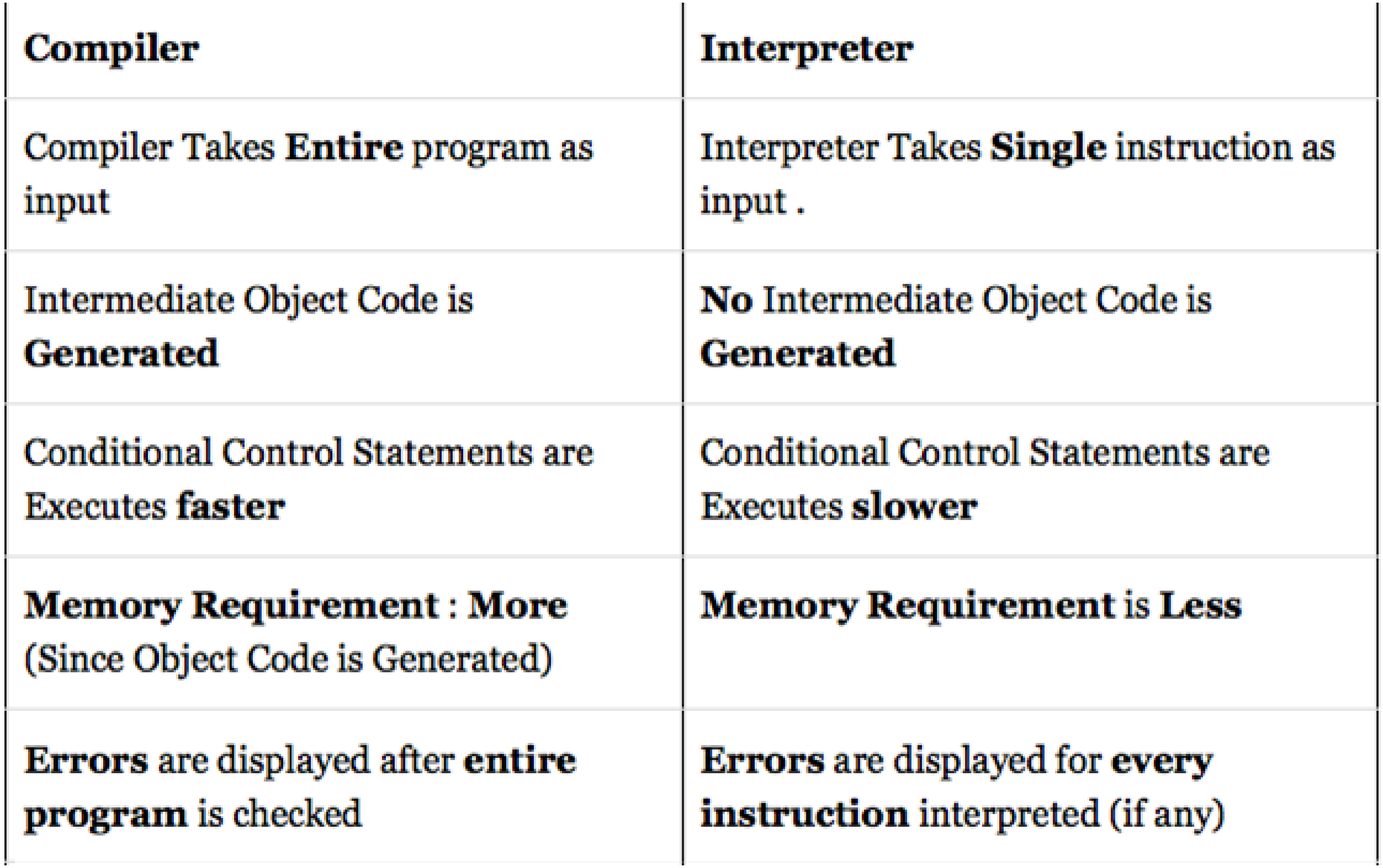


Compiler or Interpreter

- Many modern languages use both processes.
- They are first compiled into a lower level language, called **byte code**, and then interpreted by a program called a **virtual machine**.

- Python uses both processes, but because of the way programmers interact with it, it is usually considered an interpreted language.

Difference between Compiler and Interpreter

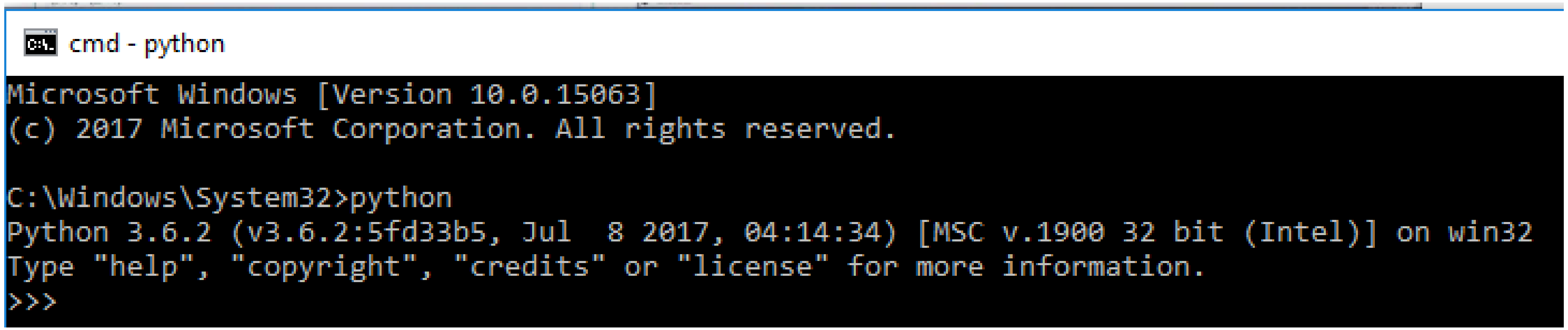


Compiler	**Interpreter**
Compiler Takes **Entire** program as input	Interpreter Takes **Single** instruction as input .
Intermediate Object Code is **Generated**	**No** Intermediate Object Code is **Generated**
Conditional Control Statements are Executes **faster**	Conditional Control Statements are Executes **slower**
Memory Requirement : More (Since Object Code is Generated)	**Memory Requirement** is **Less**
Errors are displayed after **entire program** is checked	**Errors** are displayed for **every instruction** interpreted (if any)

Coding

Interactive coding

- >>> is a Python prompt indicating that python is ready to accept commands

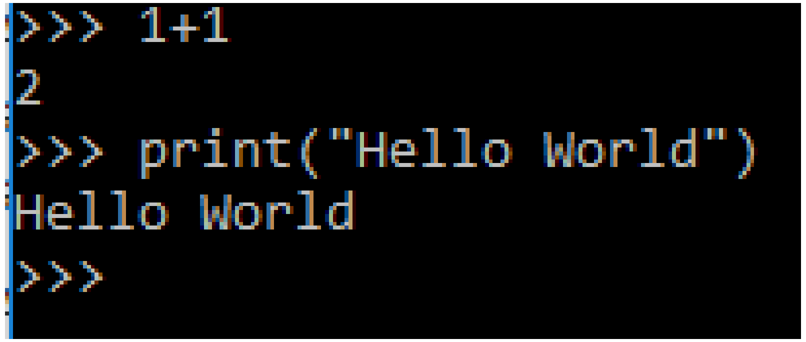


cmd - python

```
Microsoft Windows [Version 10.0.15063]
(c) 2017 Microsoft Corporation. All rights reserved.

C:\Windows\System32>python
Python 3.6.2 (v3.6.2:5fd33b5, Jul  8 2017, 04:14:34) [MSC v.1900 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

- Python Functions:
  - **print()** → prints text to the screen
  - **exit()** → exits python



```
>>> 1+1
2
>>> print("Hello World")
Hello World
>>>
```

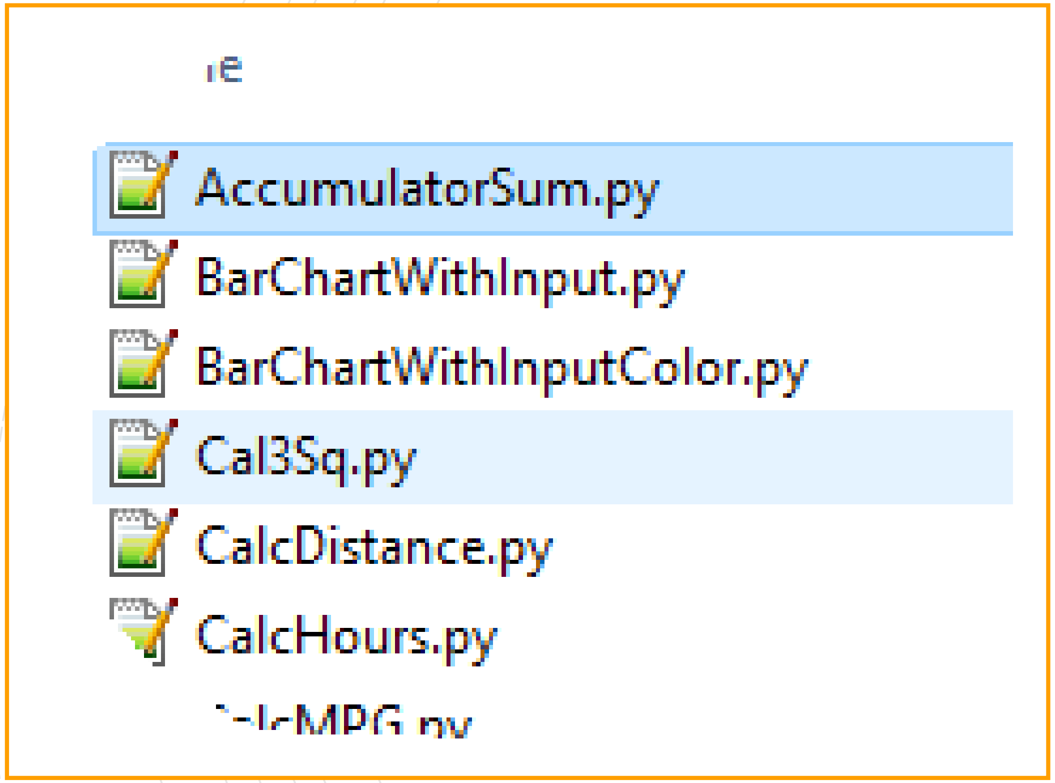
Command lines and files

You can check your version using **python –version**

If the result is 2.X.X then

You will have to use: **python3 hello.py**

Command Lines and Files



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AccumulatorSum.py

BarChartWithInput.py

BarChartWithInputColor.py

Cal3Sq.py

CalcDistance.py

CalcHours.py

CalcMPG.py

- ***Source code* is a file containing your code often referred to as a *program*.**
- The filename ends with a *.py* suffix e.g. **hello.py**
- To execute on CPSC computers: **python hello.py in the command prompt**
- To save the output into a file: **python hello.py > output.txt**

Onward to … variables.

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