[220 / 319]
Operators

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Reading: Chapter 1 of Think Python

Learning Objectives

- Run Python code using:
  - Command line
  - Idle
  - Jupyter Notebook

Evaluate:

- numeric expressions containing mathematical operators (e.g., “+” and “-“)
- string expressions containing string operators and escape characters

Recognize examples of different Python data types:

- int, float, str, bool

Evaluate:

- expressions containing comparison operators (e.g., “==” and “>”)
- Boolean expressions containing the operators “and”, “or”, “not”
- mixed expressions using the correct order of operations

Today's Outline

Software
- Interpreters
- Editors
- Notebooks

Demos

Operator Precedence

Demos

Boolean Logic

Demos

What you need to write/run code

An interpreter

- Python 3 (not 2!)
- Some extra packages (installed with pip)

An editor

- Which one doesn't matter much
- idle comes with Python

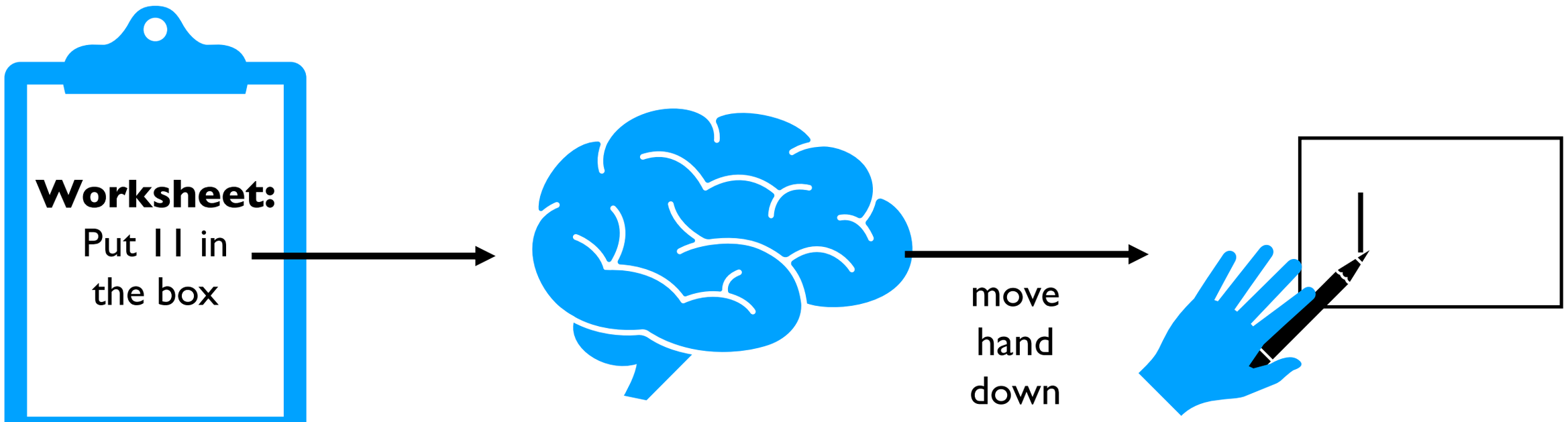
Jupyter Notebooks contain both

- installed with pip

Interpreter

A program that runs a program

- Translates something the human likes (nice Python code) to something the machine likes (ONEs and ZEROs)



You were an interpreter when you did the pseudocode worksheets!

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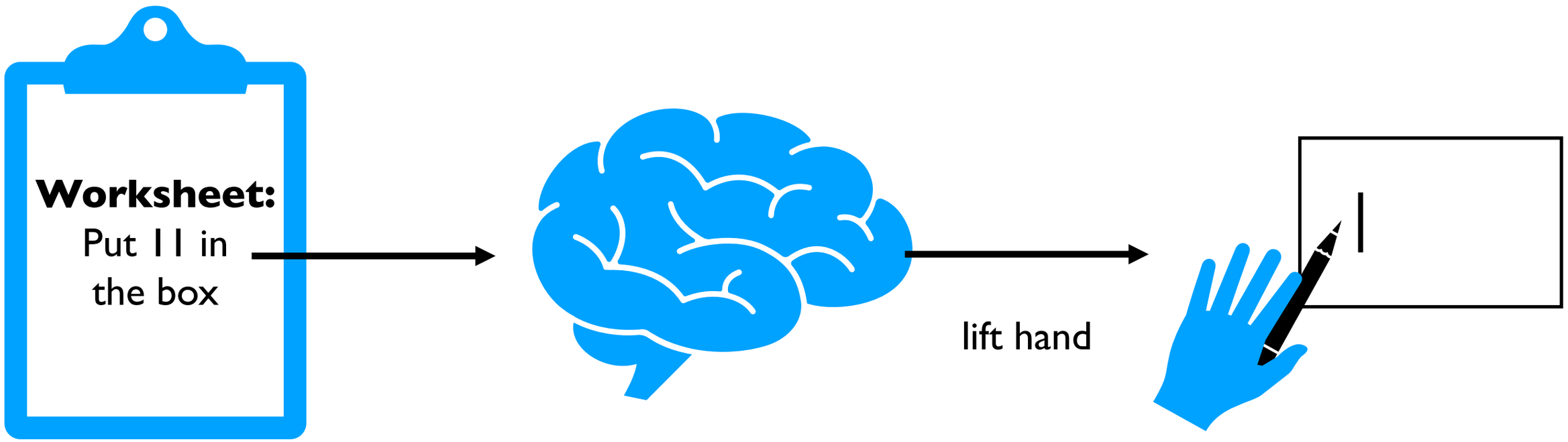

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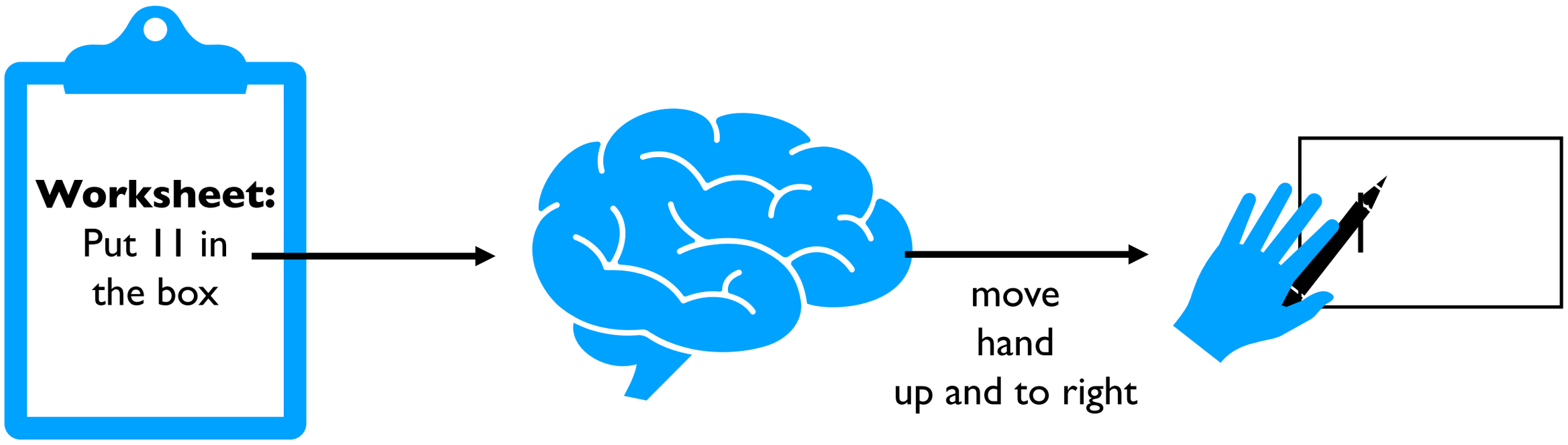

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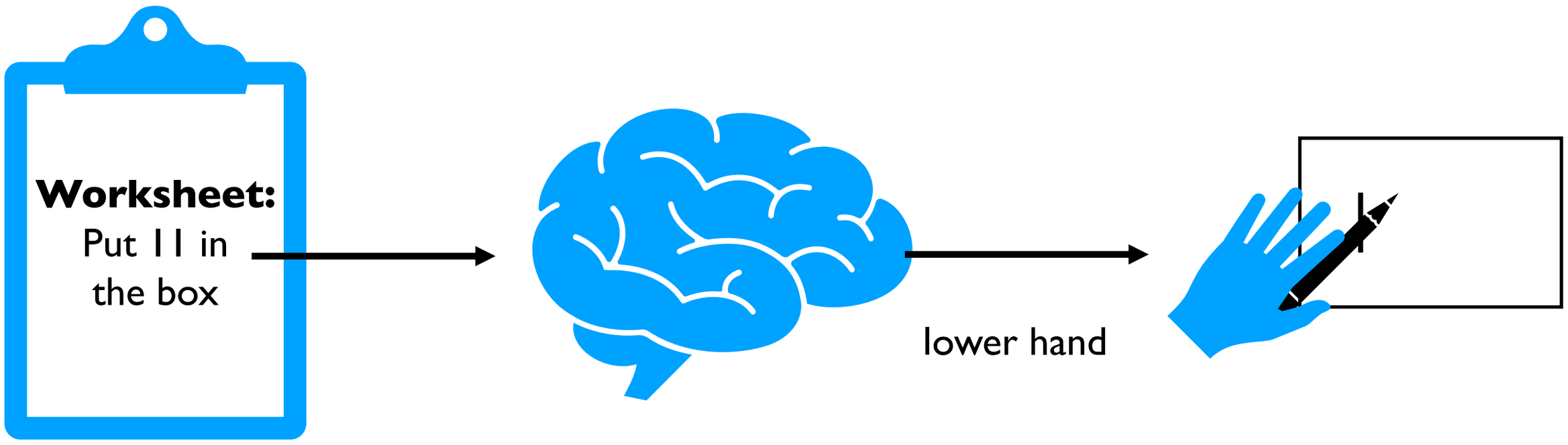

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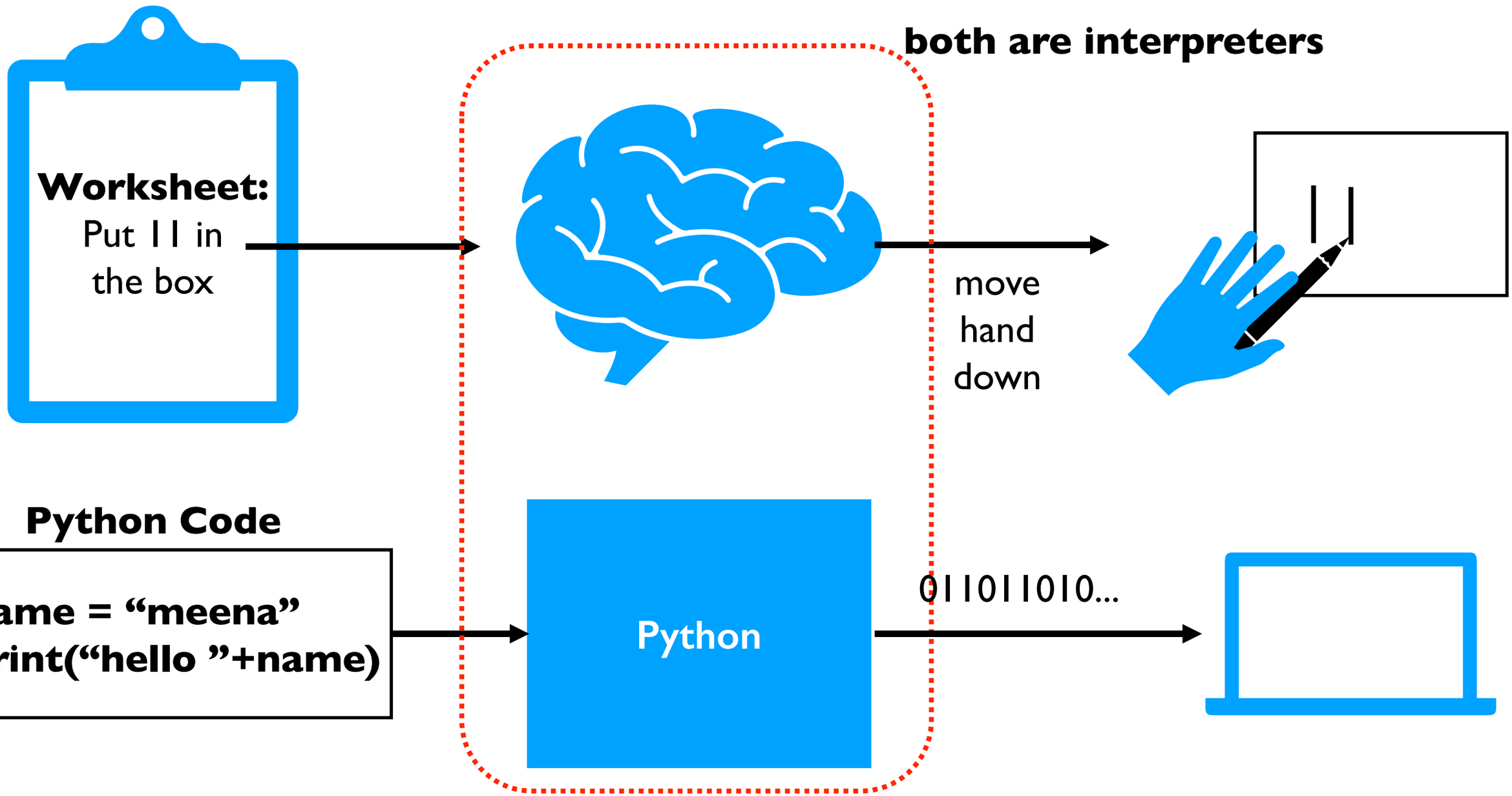

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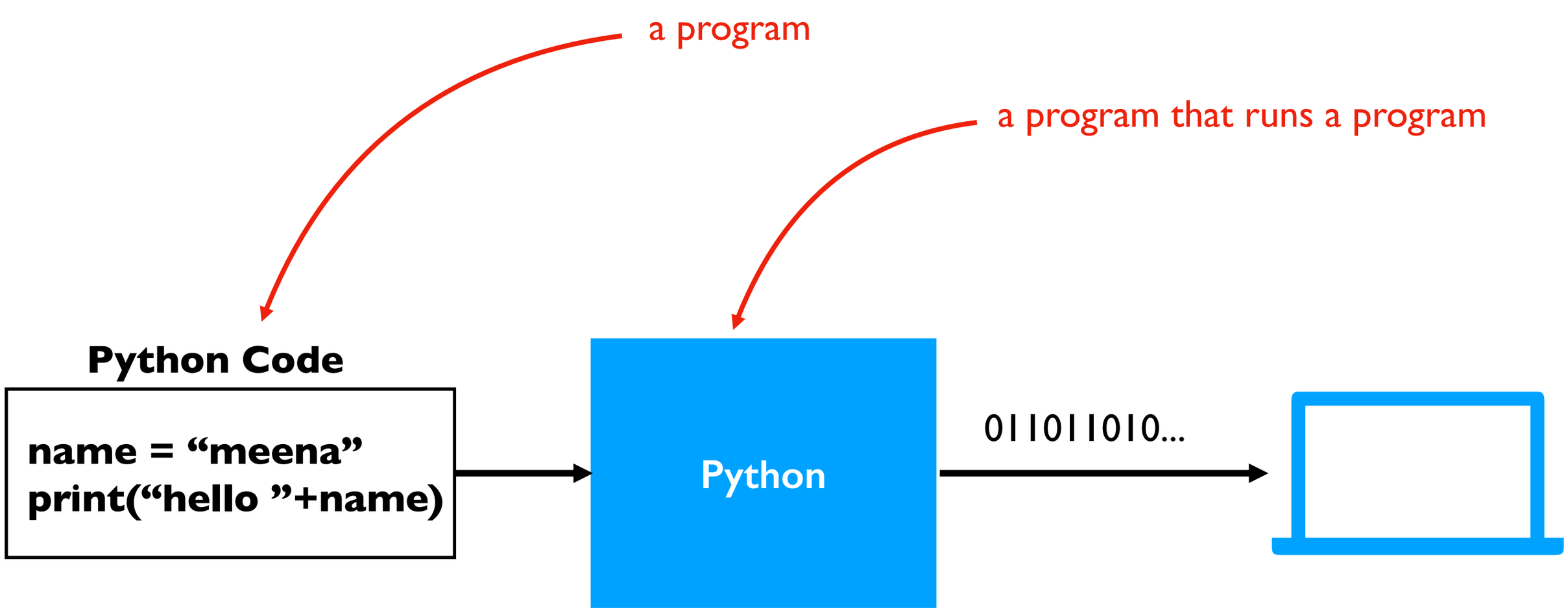
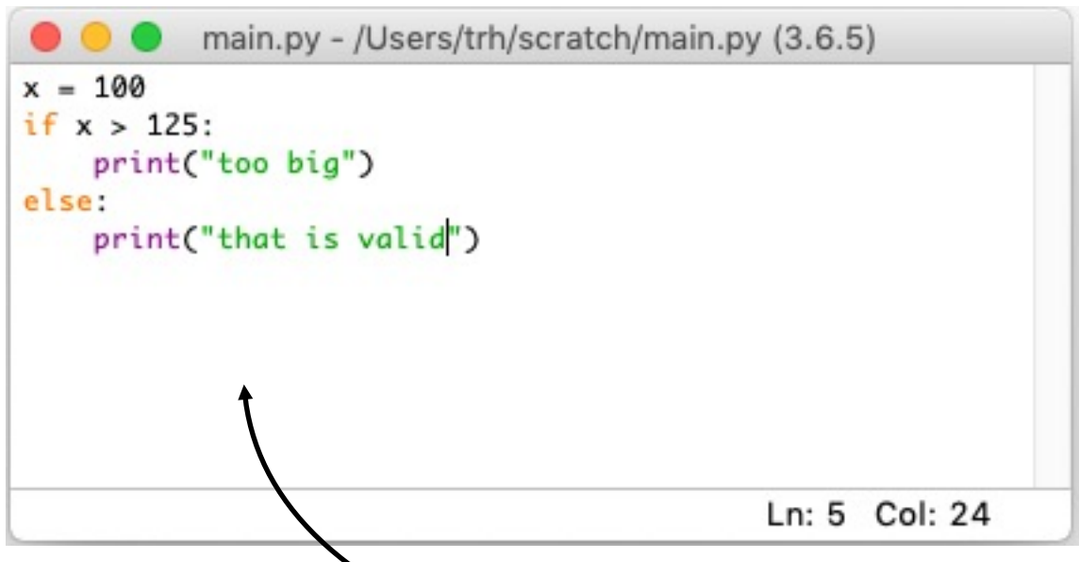


Editor

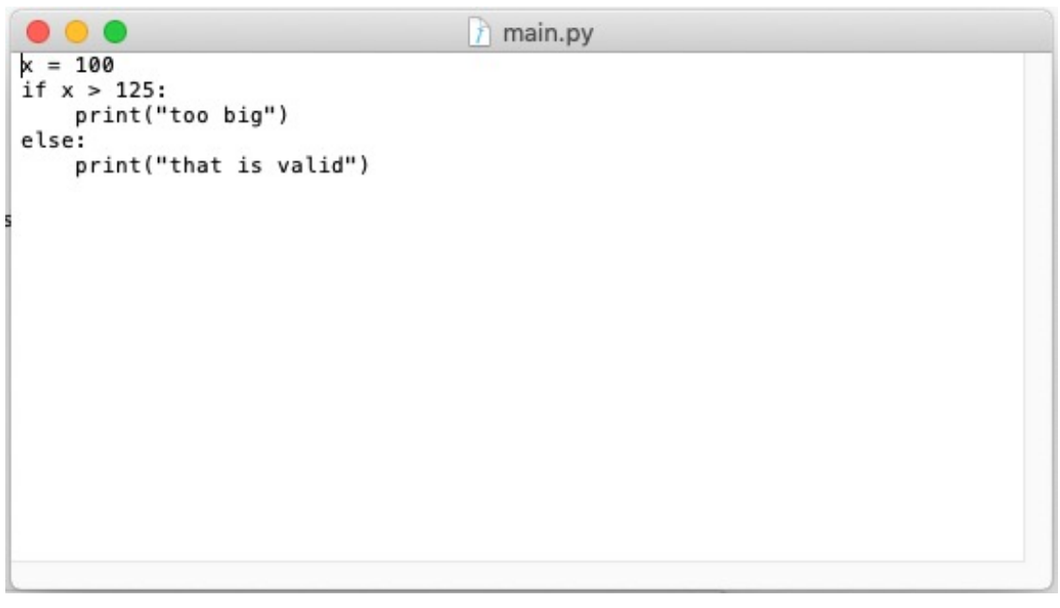
Program for typing code

- Different editors can open the same .py files (Python programs)
  (like different browsers can show the same page)

Idle



TextEdit



some editors might colorize code

Jupyter Notebooks

Tool for mixing analysis code with other things
(e.g., documentation, images, tables, etc.)

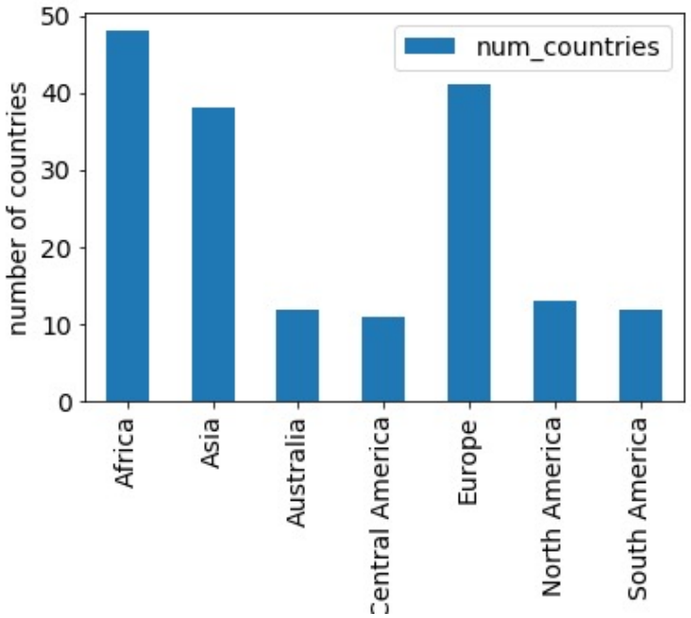
...

notebooks breakup code into "cells" containing Python code

```
In [35]: #q22
         df = pd.read_sql("""
         SELECT continent, count() as num_countries
         from countries_table
         group by continent
         ORDER BY num_countries, continent
         """, conn).set_index("continent")

         ax = df.sort_index().plot.bar()
         ax.set_ylabel("number of countries")
         ax.set_xlabel("")

Out[35]: Text(0.5, 0, '')
```



visuals produced by the code are interleaved

.ipynb (Interactive Python Notebook) files are not easy to open in a regular text editor

3 ways we'll run Python

1. interactive mode

```
ty-mac:~$ python
Python 3.8.8 (default, Apr 13 2021, 12:59:45)
[Clang 10.0.0 ] :: Anaconda, Inc. on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> 1 + 1
2
```

triple arrows mean Python code runs as you type it

2. script mode

the interpreter program is named "python"; run it

```
ty-mac:~$ python my_program.py
```

the name of the file containing your code (called a "script") is passed as an argument to the python program

3. notebook "mode"

```
ty-mac:~$ jupyter notebook
```

open Jupyter in a web browser

we'll do most work in notebooks this semester

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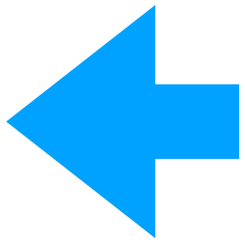

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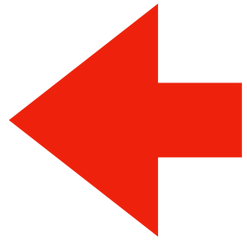
Operator Precedence 

Demos

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Order of Simplification

Python works by simplifying, applying one operator at a time

3 * 3 + 2 * 2 + 16 ** (1/2)
3 * 3 + 2 * 2 + 16 ** (**0.5**)

Rules

- First work within parentheses
- Do higher precedence first
- Break ties left to right

Order of Simplification

Python works by simplifying, applying one operator at a time

3 * 3 + 2 * 2 + 16 ** (1/2)
3 * 3 + 2 * 2 + 16 ** (0.5)
3 * 3 + 2 * 2 + **4**

Rules

- First work within parentheses
- Do higher precedence first
- Break ties left to right

Order of Simplification

Python works by simplifying, applying one operator at a time

3 * 3 + 2 * 2 + 16 ** (1/2)
3 * 3 + 2 * 2 + 16 ** (0.5)
3 * 3 + 2 * 2 + 4
9 + 2 * 2 + 4

Rules

- First work within parentheses
- Do higher precedence first
- Break ties left to right

Order of Simplification

Python works by simplifying, applying one operator at a time

```
3 * 3 + 2 * 2 + 16 ** (1/2)
3 * 3 + 2 * 2 + 16 ** (0.5)
3 * 3 + 2 * 2 + 4
9 + 2 * 2 + 4
9 + 4 + 4
13 + 4
17
```

Rules

- First work within parentheses
- Do higher precedence first
- Break ties left to right

Operator Precendence

	What is it?	Python Operator	
Mathematical	exponents	**	**simplify first**
	signs	+x, -x	
	multiply/divide	*, /, //, %	
	add/subtract	+, -	
	comparison	==, !=, <, <=, >, >=	
Logic	boolean stuff	not	
	…	and	**simplify last***
	…	or	

these are the ones you should be learning at this point in the semester (there are a few more not covered now)

* one exception is an optimization known as "short circuiting"

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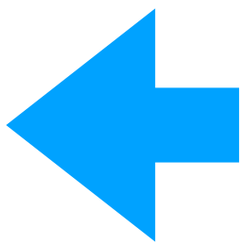

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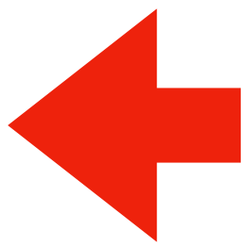
Boolean Logic 

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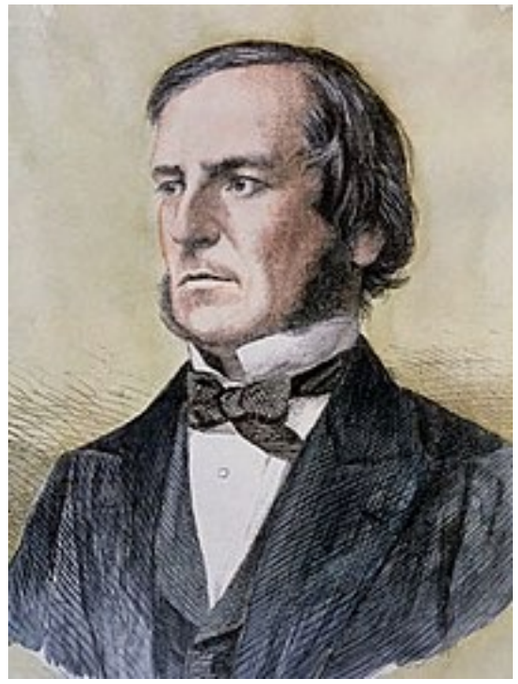

The logic of truth:

- Named after George Boole
- Two values: True and False
- Three operators: **and**, **or**, and **not**

AND

	False	**True**
False	False	False
True	False	**True**

OR

	False	**True**
False	False	**True**
True	**True**	**True**

NOT

False	**True**
True	False

FALSE!

It's a Saturday AND
we're attending CS 220 lecture

AND

	False	**True**
False	False	False
True	False	**True**

OR

	False	**True**
False	False	**True**
True	**True**	**True**

NOT

False	**True**
True	False

TRUE!

Project 1 is due on Wednesday

OR I'll eat my hat

AND

False	**True**
False	False
True	False	**True**

OR

False	**True**
False	False	**True**
True	**True**	**True**

NOT

False	**True**
True	False

Control Flow: Remember that conditionals and loops *sometimes* do something. We'll use bool logic a LOT to control when we do/don't.

AND

	False	**True**
False	False	False
True	False	**True**

OR

	False	**True**
False	False	**True**
True	**True**	**True**

NOT

False	**True**
True	False

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