# [301] Programming

Tyler Caraza-Harter

# Learning Objectives

Skills:

- Run Python
- Run Jupyter

**Reading:** Chapter 1 of Think Python

Learn common Python operators:

- Mathematical (e.g., "+" and "-")
- Comparison (e.g., "==" and ">")
- Logical (e.g., "and" and "not")

Learn about different data types:

- int, float, str, bool

Learn about boolean logic

# 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

- 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)

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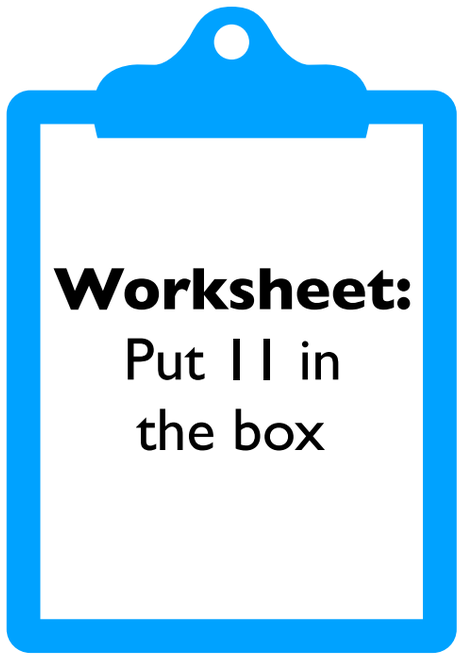


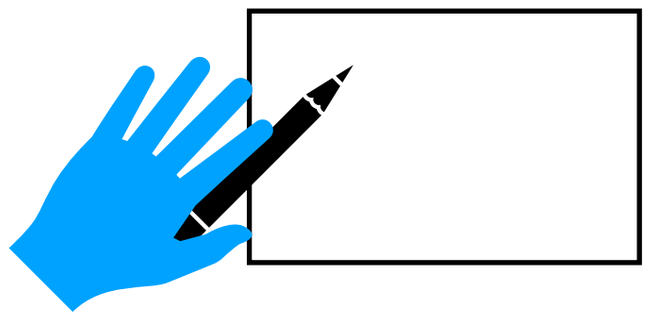

**You were an interpreter when you did the pseudocode worksheets!**

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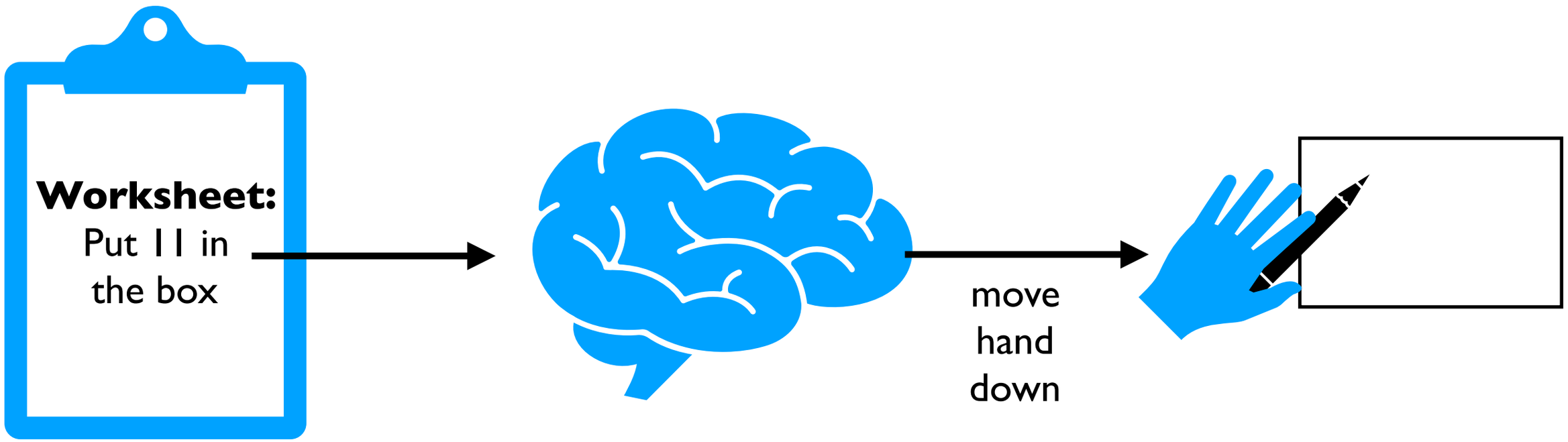


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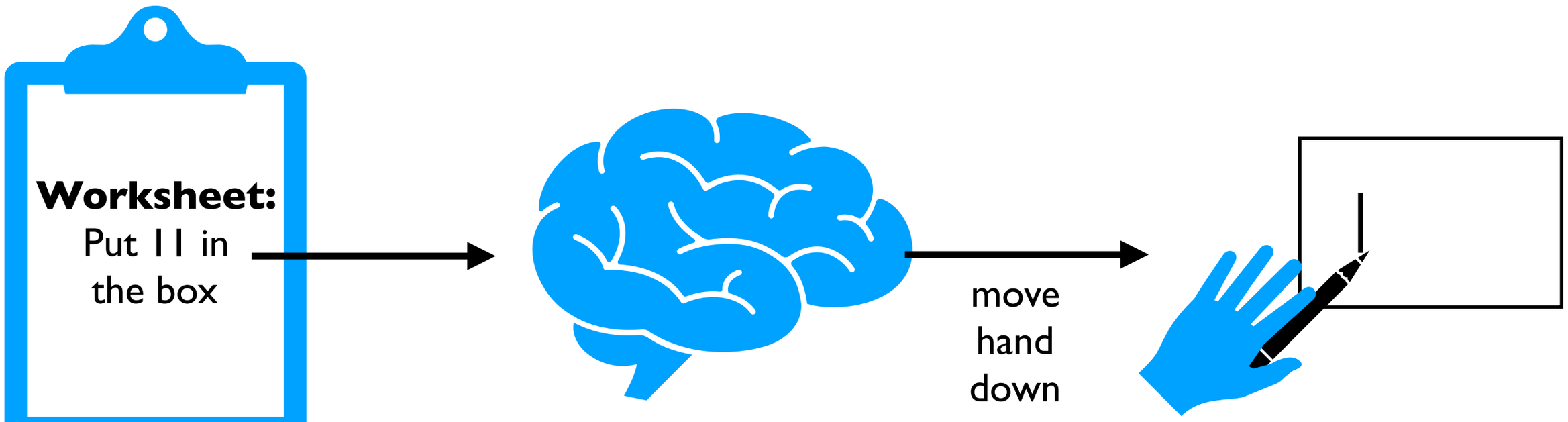


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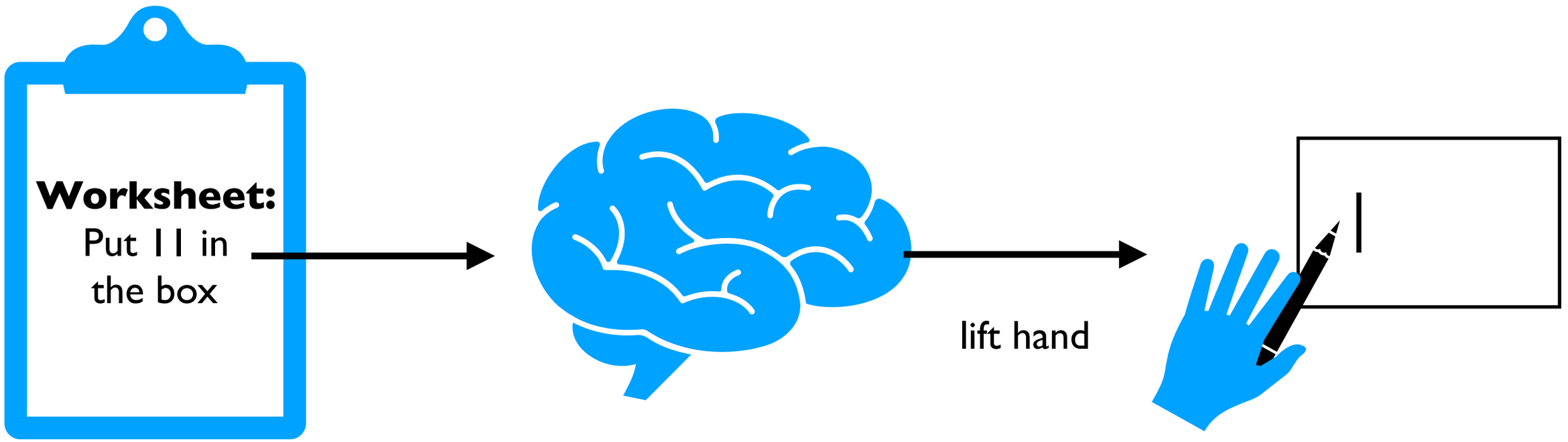


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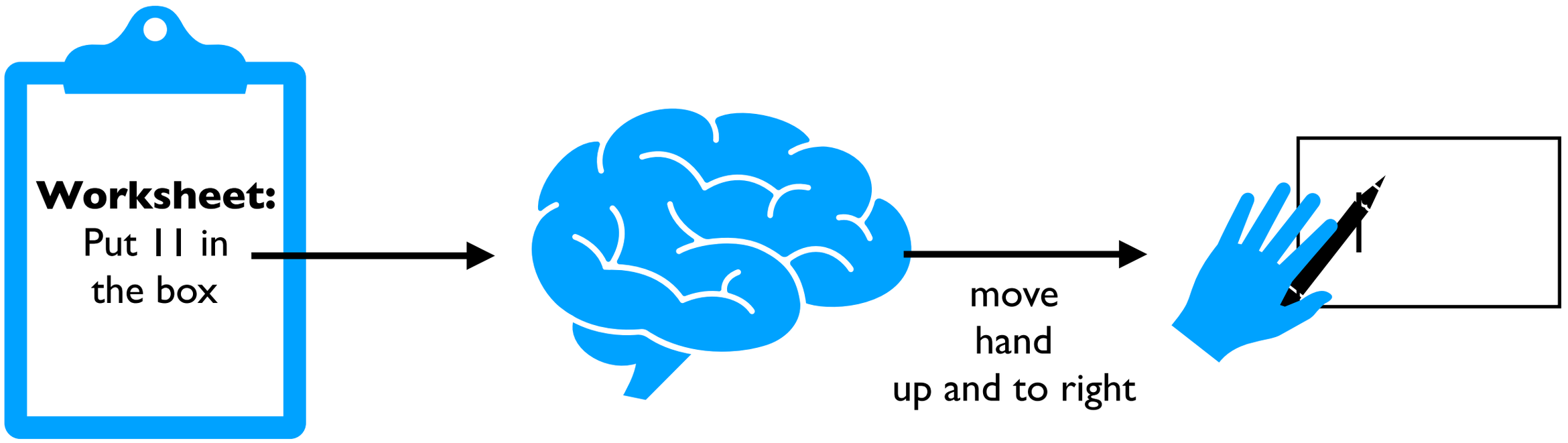


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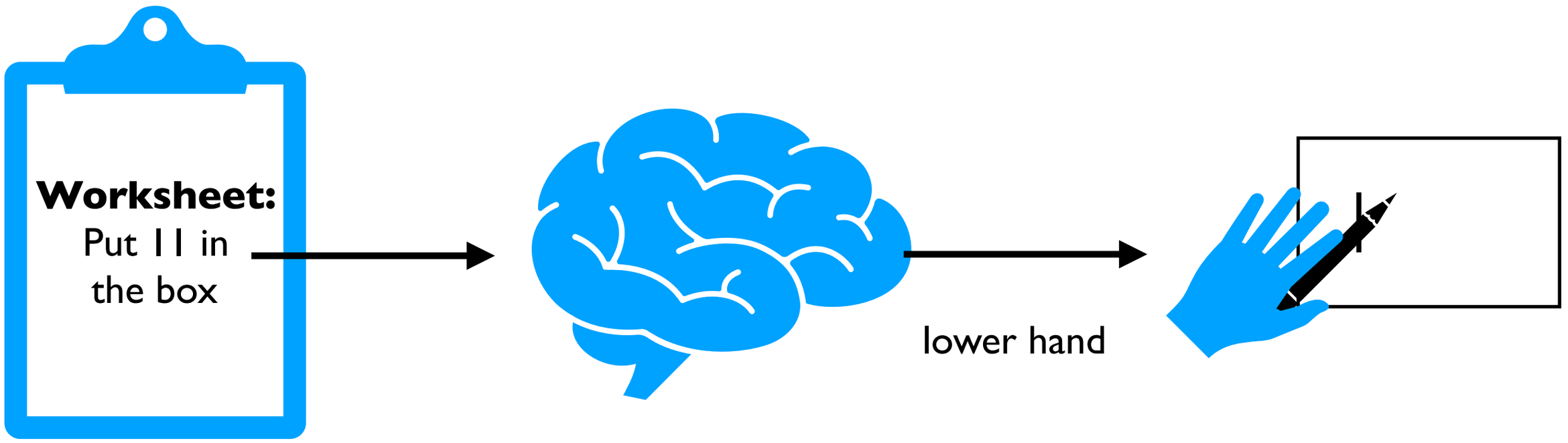


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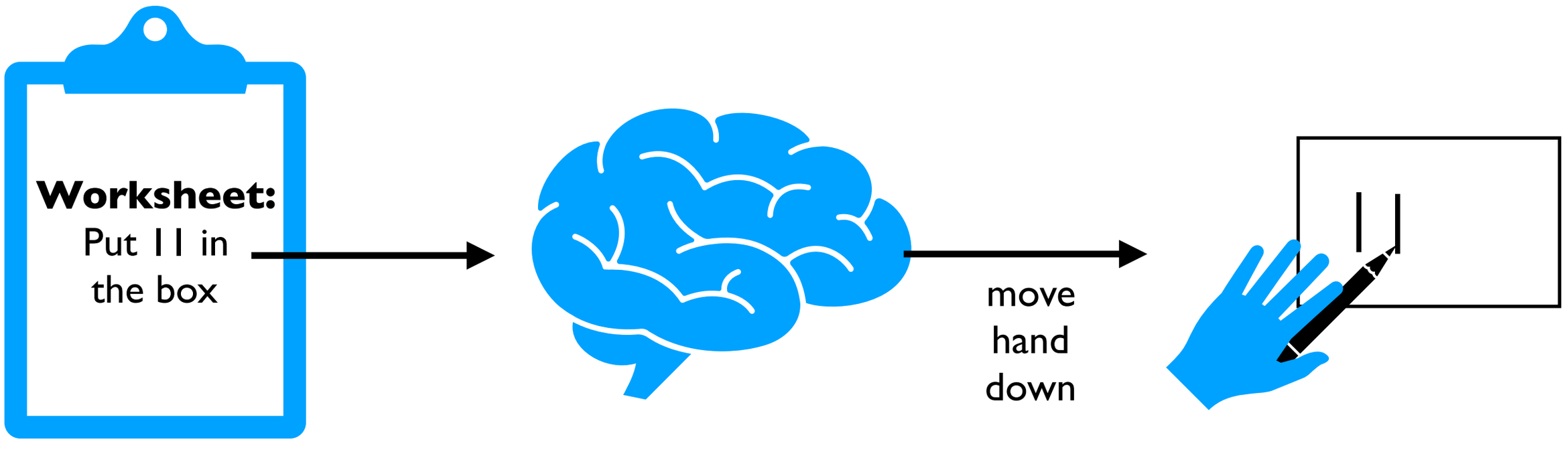


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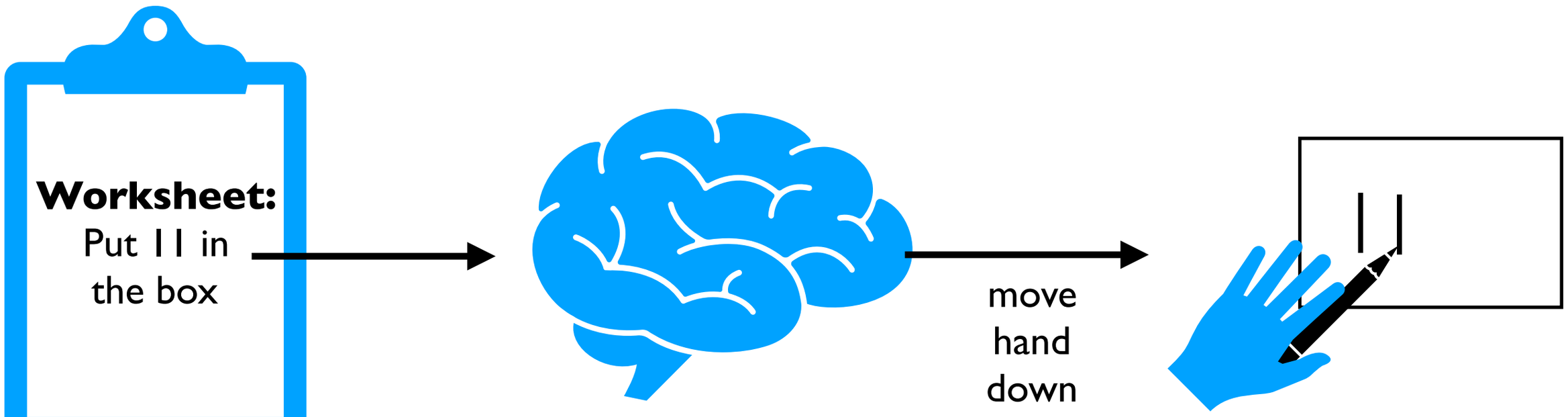


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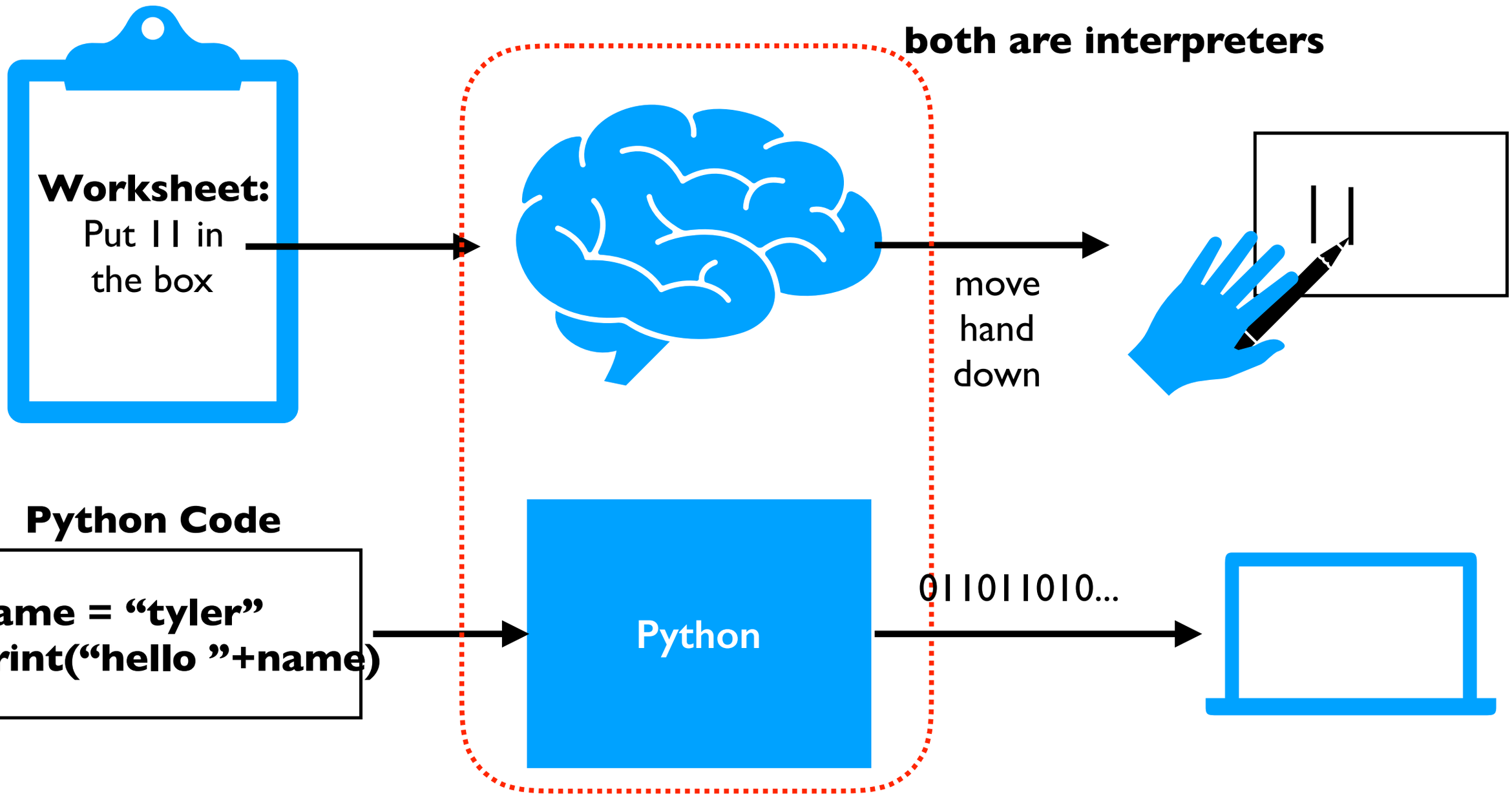

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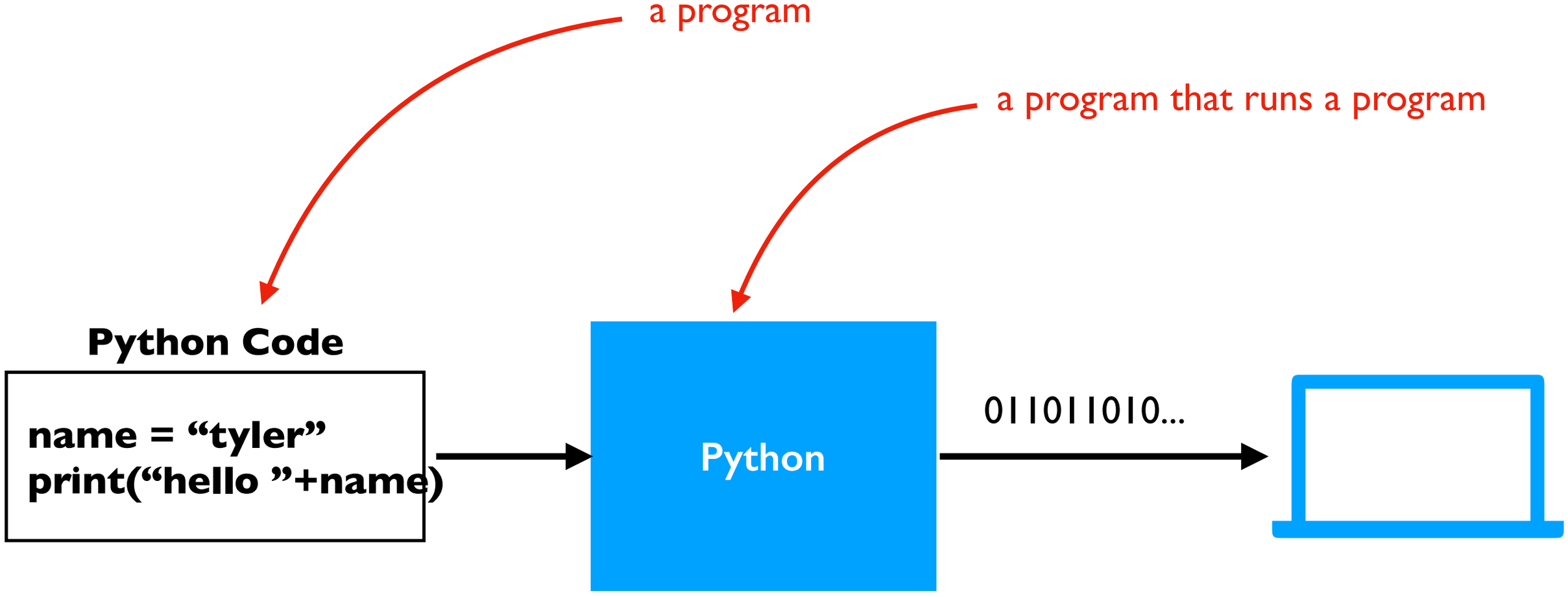
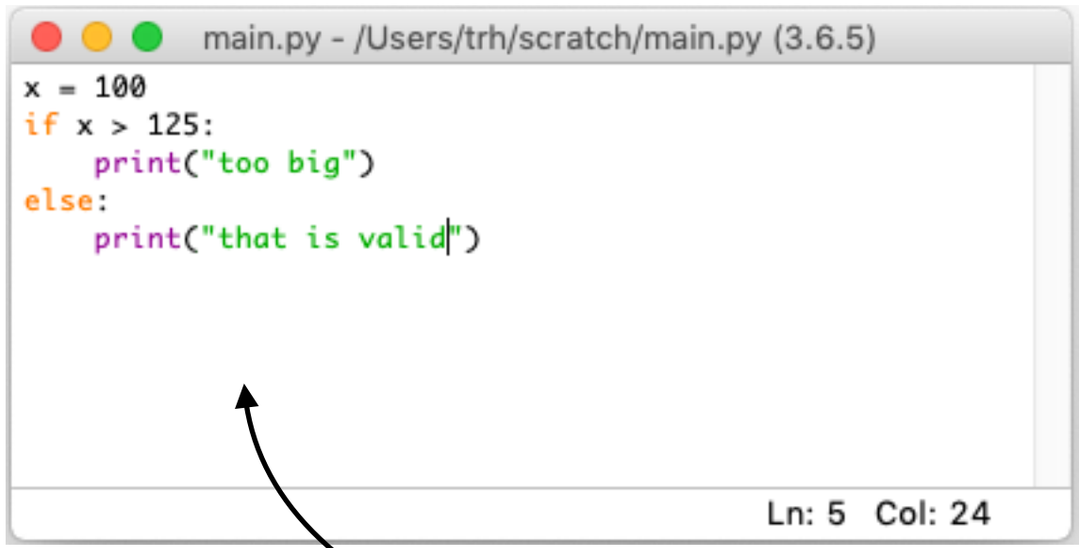


# Editor

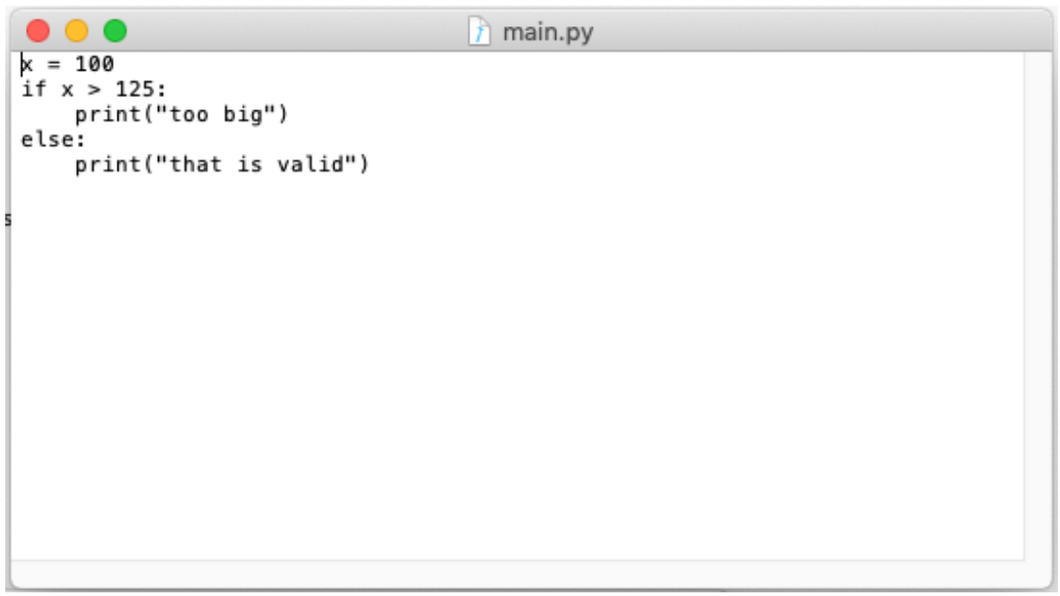
Program for typing code

- 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

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("")
```

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

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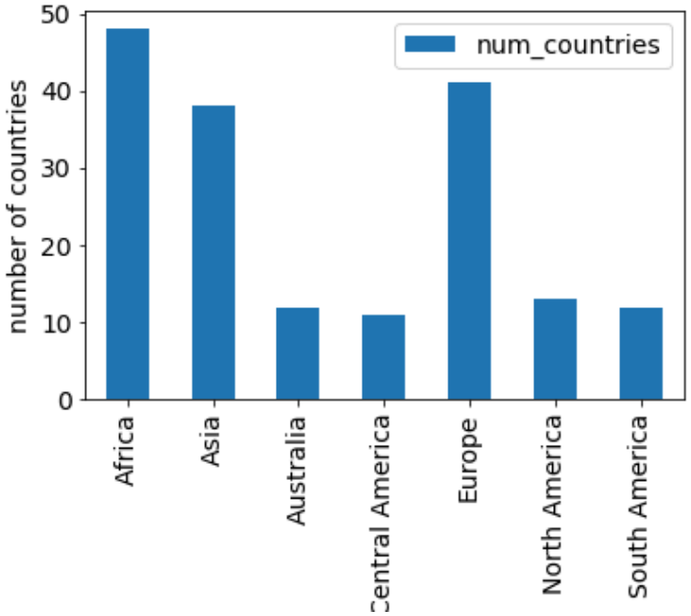
```
Out[35]: Text(0.5, 0, '')
```

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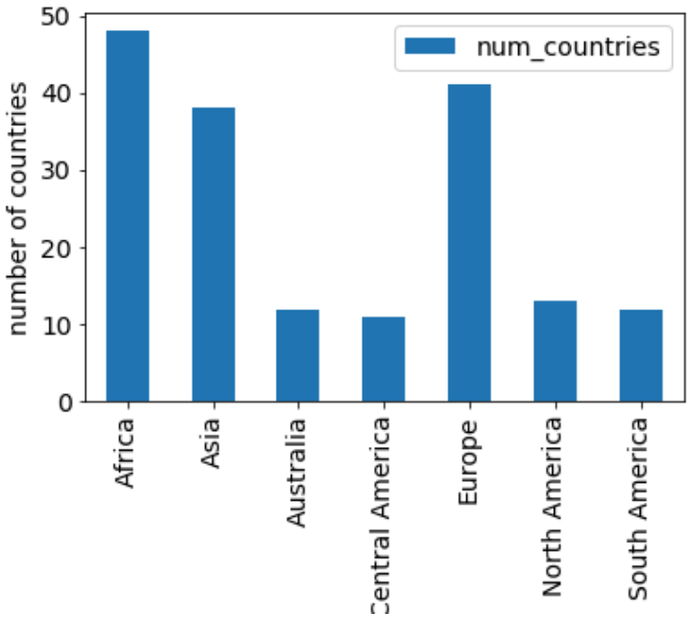


visuals produced by the code are interleaved

.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 3.7.2 (v3.7.2:9a3ffc0492, Dec 24 2018, 02:44:43)
[Clang 6.0 (clang-600.0.57)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> 1 + 1
2
```

*triple arrows mean Python code runs as you type it*

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## 2. script mode

*the interpreter program is named "python"; run it*

```
ty-mac:~$ python my_program.py
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*the name of the file containing your code (called a "script") is passed as an argument to the python program*

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

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## 3. notebook "mode"

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

*open Jupyter in a web browser*

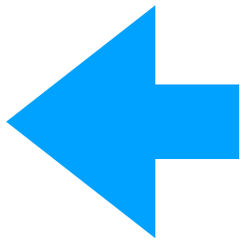
**we'll do most work in notebooks this semester**

# Today's Outline

Software

- Interpreters
- Editors
- Notebooks

*Demos*



Operator Precedence

*Demos*

Boolean Logic

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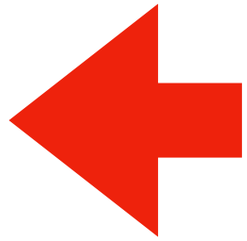
Operator Precedence 

*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)

Rules

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

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

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

Rules

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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

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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

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

Rules

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

Rules

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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~~

Rules

- First work within parentheses
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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
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# Operator Precendence

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

**simplify first**

**simplify last***

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"

# 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 | |

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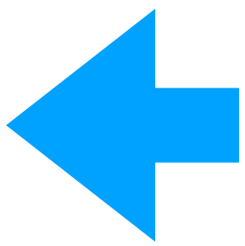

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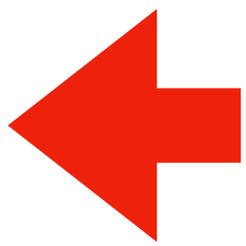
Boolean Logic 

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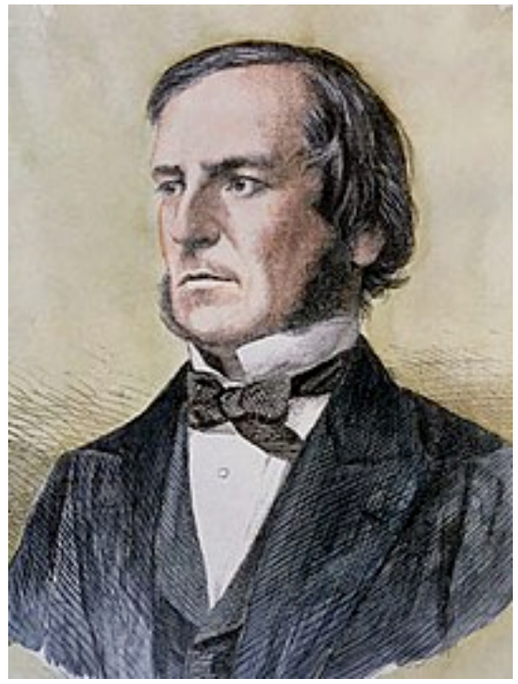
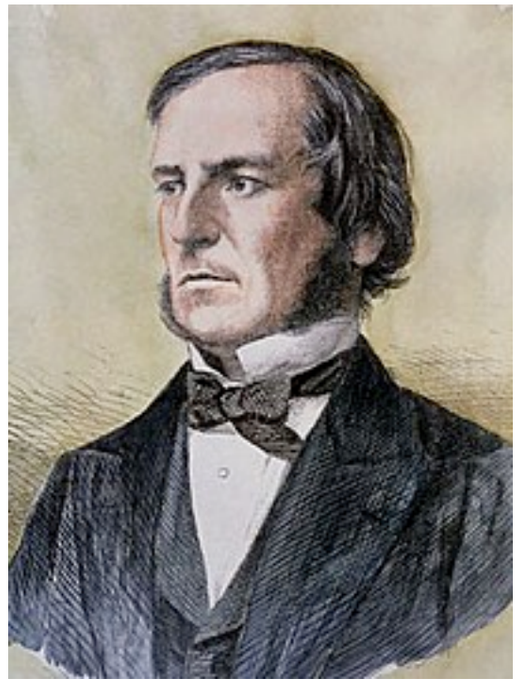


The logic of truth:

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

# Boolean Logic



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 |

**It's a Saturday AND we're in CS 301**

## AND

| | False | **True** |
|---|---|---|
| False | False | False |
| **True** | False | **True** |

## OR

| | False | **True** |
|---|---|---|
| False | False | **True** |
| **True** | **True** | **True** |

## NOT

| False | **True** |
|---|---|
| **True** | False |

It's a Saturday **AND** we're in CS 301

## AND

| | False | **True** |
|---|---|---|
| False | False | False |
| **True** | False | **True** |

## OR

| | False | **True** |
|---|---|---|
| False | False | **True** |
| **True** | **True** | **True** |

## NOT

| False | **True** |
|---|---|
| **True** | False |

It's a Saturday **AND** we're in CS 301

## 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 in CS 301**

## AND

| | False | **True** |
|---|---|---|
| False | False | False |
| **True** | False | **True** |

## OR

| | False | **True** |
|---|---|---|
| False | False | **True** |
| **True** | **True** | **True** |

## NOT

| False | **True** |
|---|---|
| **True** | False |

**Project 1 is due today**
**OR I'll eat my hat**

## AND

| | False | **True** |
|---|---|---|
| False | False | False |
| **True** | False | **True** |

## OR

| | False | **True** |
|---|---|---|
| False | False | **True** |
| **True** | **True** | **True** |

## NOT

| False | **True** |
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**Project 1 is due today**
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## AND

| | False | **True** |
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| False | False | False |
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| | False | **True** |
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## NOT

| False | **True** |
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| **True** | False |

**TRUE!**

**Project 1 is due today**
**OR I'll eat my hat**

## AND

| | False | **True** |
|---|---|---|
| False | 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** |
|---|---|
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