

A large yellow and orange patterned snake, likely a Ball Python, is coiled around a dark grey leather couch. The snake's head is extended towards the bottom left of the frame. A dark semi-transparent rectangle with white text is overlaid on the right side of the image.

# Where Python lives, and how to talk to it

BILD 62

[https://www.reddit.com/r/snakes/comments/qt5es4/creepin\\_on\\_yo\\_couch/](https://www.reddit.com/r/snakes/comments/qt5es4/creepin_on_yo_couch/)

# Objectives for today

- Identify various ways of writing and running Python code
- Learn basics of Python syntax
- Define three types of variables: integers, floats, and strings
- Concatenate & slice strings
- Determine rules for variable names

# There are multiple ways to interact with the Python interpreter

- Command line (terminal)
  - Line-by-line coding
  - Running “Scripts”

“Terminal” comes from the days *before* desktop computers, when a computer occupied a set of cabinets or even an entire room. A terminal was a device with a (text-only) monitor and keyboard whereby a user could control the computer from a distance over a dedicated, wired connection.



A DEC VT100 terminal at the Living Computer Museum (apparently connected to the museum's DEC PDP-11/70 mainframe computer). Source: [Wikipedia](#)

## Linux



```
Terminal
File Edit View Search Terminal Help
user@linux-computer:~$ python MyPythonScript.py
user@linux-computer:~$ python MyPythonScript.py param1 param2
user@linux-computer:~$
```

## Macintosh



```
Users — bash — 86x14
User-Imac:python MyPythonScript.py
User-Imac:python MyPythonScript.py param1 param2
User-Imac:~
```

## Windows



```
Command Prompt
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\UserName>python PythonScript.py param1 param2
```



Right-click  
Edit with IDLE

```
PythonScript.py - C:\Users\Tim Stevens\Desktop\PythonScript.py
File Edit Format Run Options Windows Help

def calcSeqIdentity(seqA, seqB):
    numPlaces = min(len(seqA), len(seqB))
    score = 0.0
    for i in range(numPlaces):
        if seqA[i] == seqB[i]:
            score += 1.0
    return 100.0 * score/numPlaces

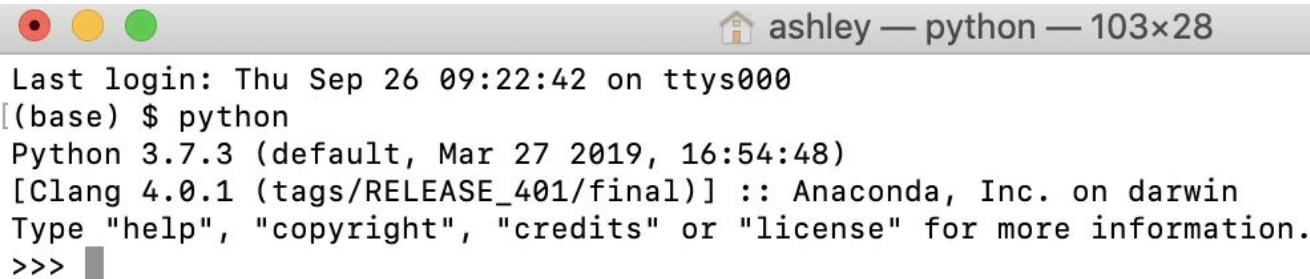
Ln: 1 Col: 0
```

Running a Python script from  
different operating systems

(from <http://www.cambridge.org/pythonforbiology>)

# If you have a Mac

- Macs ship with Python already installed.
- You can check which version by opening **Terminal** & typing **python --version**
  - **For this course, we'll be using Python 3.7** (or above).

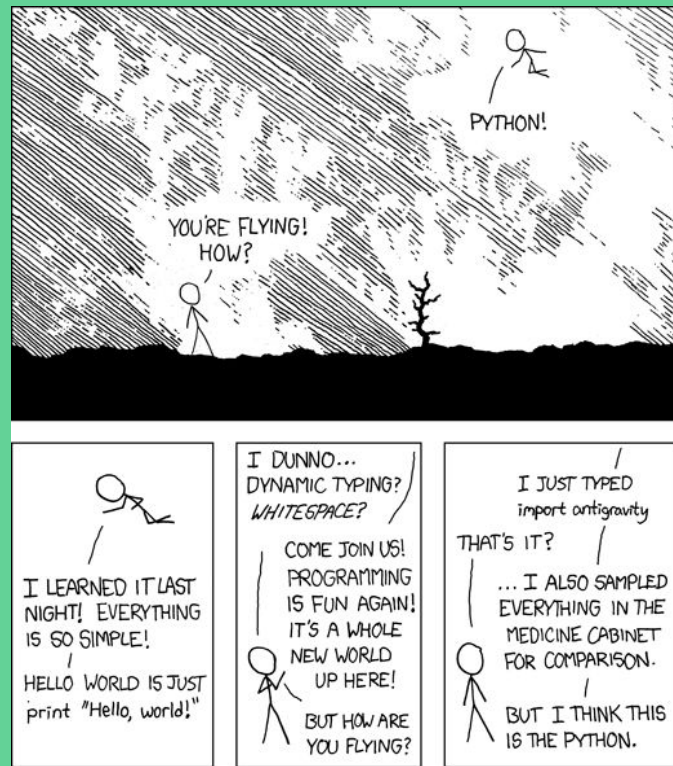
A screenshot of a macOS Terminal window. The title bar shows three colored window control buttons (red, yellow, green) on the left and a title "ashley — python — 103x28" on the right. The terminal content shows the command "python" being executed, resulting in the output: "Python 3.7.3 (default, Mar 27 2019, 16:54:48) [Clang 4.0.1 (tags/RELEASE\_401/final)] :: Anaconda, Inc. on darwin". It also displays the help text: "Type 'help', 'copyright', 'credits' or 'license' for more information." and the prompt ">>>" with a cursor.

```
Last login: Thu Sep 26 09:22:42 on ttys000
(base) $ python
Python 3.7.3 (default, Mar 27 2019, 16:54:48)
[Clang 4.0.1 (tags/RELEASE_401/final)] :: Anaconda, Inc. on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> █
```

The “>>>” tells you you’re inside the Python prompt, and the computer is ready for some code!

# Let's see if Python can make us fly...?

```
import antigravity
```




<https://xkcd.com/353/>

Code: <https://github.com/python/cpython/blob/main/Lib/antigravity.py#L7-L17>

Explanation: <https://martinapugliese.github.io/tech/python-antigravity/>

# Useful Linux Commands

In Jupyter Notebook, add a **!** in front to use these. E.g., **!pwd**



Command	Description
pwd	Print working directory
ls	List contents
cd	Change directory
cp	Copy files from the current directory to a different directory
mv	Move or rename files
mkdir	Make a directory
touch	Create a blank file

More details: <https://www.hostinger.com/tutorials/linux-commands>  
<https://jakevdp.github.io/PythonDataScienceHandbook/01.05-ipython-and-shell-commands.html>



# There are multiple ways to interact with the Python interpreter

- Command line
  - Line-by-line coding
  - Running “Scripts”
- Integrated Development Environments
  - Folks have strong opinions about these, and each have pros/cons.
  - A few good options are:
    - Visual Code (<https://code.visualstudio.com/download>)
    - Spyder (Included with Anaconda)
- Jupyter Notebook — *most of what we'll do in this course*



# Integrated Development Environments (IDEs)

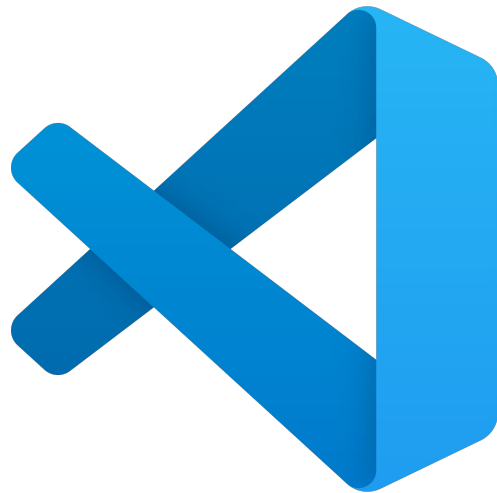
- Help you write, debug, and compile code
  - **Compiling** is the process of translating your **source code** into **machine code**
- Useful because they have features like **line numbers** and **syntax highlighting**, which colors your code based on the syntax.
- Often have auto-completion, memory for commands, and provide information about functions

# Visual Studio (VS Code)

- Supports many different languages, highly customizable
- Integrates with multiple AI assistants, including GitHub Copilot, an AI assistant specifically for programming

Links:

<https://code.visualstudio.com/download>



**Anaconda** is an open-source distribution of Python, focused on scientific computing in Python.

Includes:

- “Conda,” a package management tool
- Useful code packages
- A couple applications for editing & running code:
  - Spyder (Python IDE)
  - Jupyter Notebooks



## A few notes

**Macs** have a native installation of Python.

- It may be older & will not include the extra packages that you will need for this class, and is best left untouched.
- Downloading via Anaconda or VS Code may install a separate, independent install of Python, leaving your native install untouched.

**Windows** does not require Python natively and so it is not typically pre-installed.

If you're not sure which Python your computer is using, ask it (in Python):

```
>>> which python
```

# Objectives for today

- Identify various ways of writing and running Python code
- **Learn basics of Python syntax**
- Define three types of variables: integers, floats, and strings
- Concatenate & slice strings
- Determine rules for variable names

# There are different types of programming languages, each with their own syntax, or rules.

- **Syntax:** the rules of a programming language
  - Includes punctuation, spacing, indentation, etc.
- Each language has strengths & weaknesses.
- Regardless, each language ultimately needs to communicate with the hardware of the computer, in 1's and 0's.
  - It's similar to DNA! And similar to DNA, we don't often describe it in individual base pairs. Instead we describe genes and describe DNA in a higher level way.

# Storing values

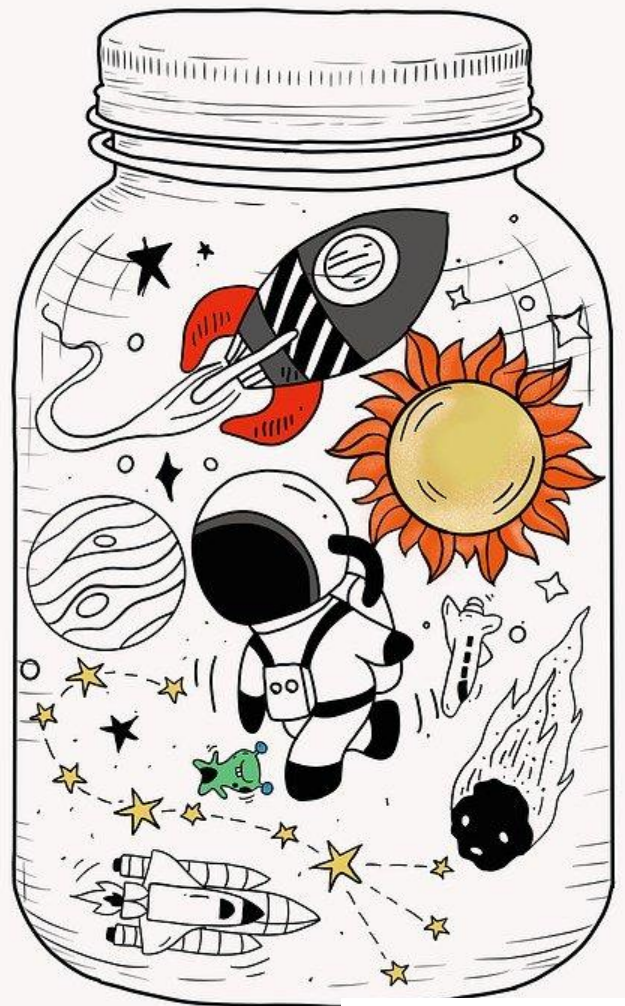
We can store values in variables, e.g.:

```
variable_1 = 48
```

← name      ← value

Variables can be text, integers, or floats (with decimals), e.g.:

```
text_string = 'hello'
```





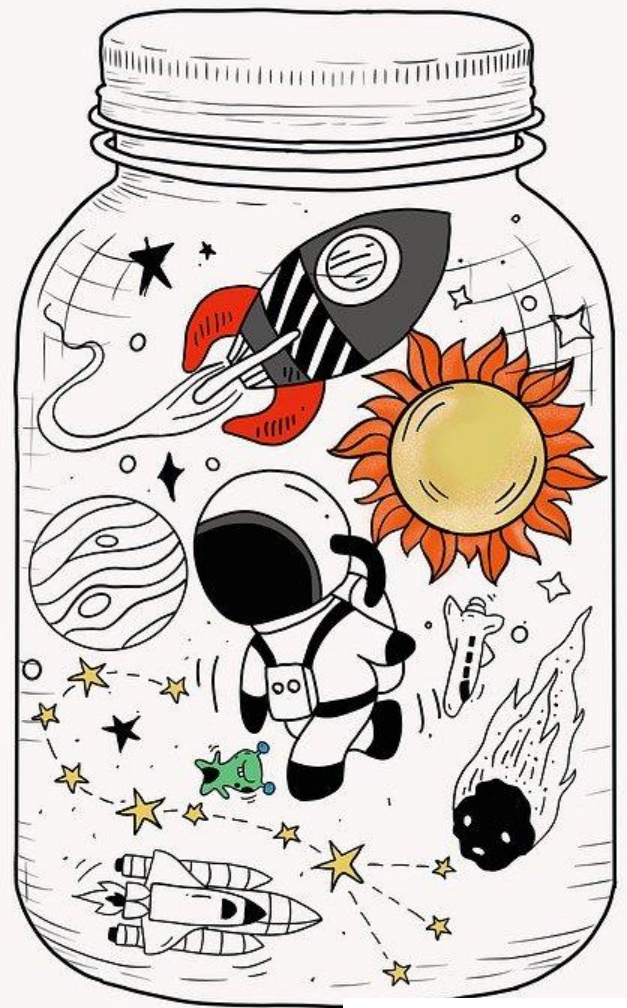
# Storing values

We can store values in variables, e.g.:

```
variable_1 = 48
```

We use an equal sign to *assign* the value to a name, but it's not the same thing as saying they are equal.

In other words, we're storing that value in the variable. (Think of them like cookie jars)



# Creating new variables

- Names are always on the left of the `=`, values are always on the right
- Pick names that describe the data / value that they store
- Make variable names as **descriptive** and **concise** as possible (this is an art!)
- Variables cannot be Python keywords:

```
[>>> import keyword  
[>>> print(keyword.kwlist)  
['False', 'None', 'True', 'and', 'as', 'assert', 'async', 'await', 'break', 'class', 'continue', 'def',  
 'del', 'elif', 'else', 'except', 'finally', 'for', 'from', 'global', 'if', 'import', 'in', 'is', 'lambda',  
 'nonlocal', 'not', 'or', 'pass', 'raise', 'return', 'try', 'while', 'with', 'yield']  
>>> █
```

( There are other rules for variable names.... )

Python has many variable types, and each function a little bit differently.

Understanding your variable type is crucial for working with it.



# Built-in simple variable types in Python

Type	Example	Description
<code>int</code>	<code>x = 1</code>	integers (i.e., whole numbers)
<code>float</code>	<code>x = 1.0</code>	floating-point numbers (i.e., real numbers)
<code>complex</code>	<code>x = 1 + 2j</code>	Complex numbers (i.e., numbers with real and imaginary part)
<code>bool</code>	<code>x = True</code>	Boolean: True/False values
<code>str</code>	<code>x = 'abc'</code>	String: characters or text
<code>NoneType</code>	<code>x = None</code>	Special object indicating nulls

# Integers, strings, floats

function to convert to integer



- **Integers (`int`)**: any whole number
- **Float (`float`)**: any number with a decimal point (floating point number)
- **String (`str`)**: letters, numbers, symbols, spaces
  - Represented by matching beginning & ending quotes
  - Quotes can be single or double; use single *within* double
  - Use `\` to ignore single quote
  - Concatenate strings with `+`

# Checking variable types

*This is a very useful troubleshooting step!*

- You can check what type your variable (**a**) is by using **type(a)**
  - Alternatively, we can use:  

```
>>> type(a) is float
```

*or*  

```
>>> isinstance(x, float)
```
- Python lets you change the type of variables, however, ***you cannot combine types.***
- Use **del** to delete variables

It's important to know the precision of your variables.

In most datasets, we are working with floats.



Autopsy Report:

Dr. Andrew Esty

Time of Death: 03/16 11:53

Cause of Death: Rounding Errors



Use  
`print()`  
often!



**Mathieu Alain** @mathieualain@mastodon.social  
@miniapeur



People: What debugging tool you use ?

me: `print()`



[Original tweet](#)



Yani Bellini Saibene

@yabellini@fosstodon.org

7m\*

@grimalkina my @thecarpentries rubber duck and my Groot. They are very helpful 😊

I also love to be the rubber duck for my team mates or friends 🦹

[Translate](#)



# Rubber ducking!!!!

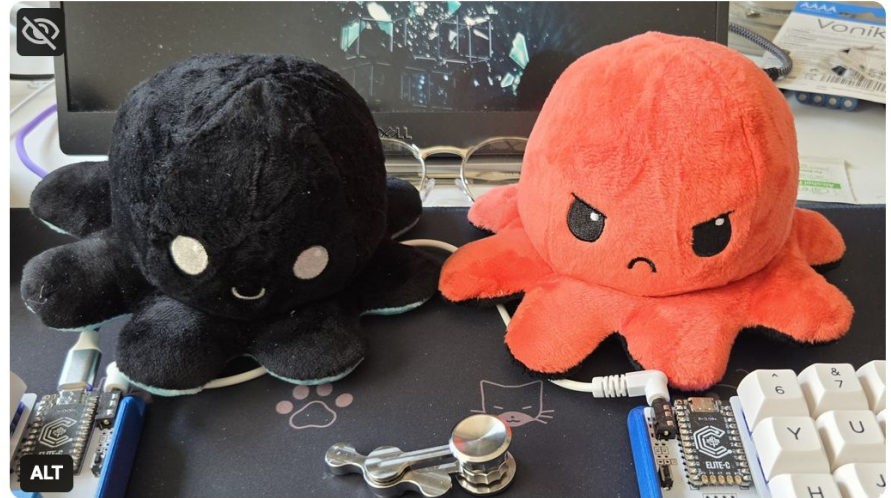


sungo

@sungo@anti.social.sungo.cloud

1h

@grimalkina Not always ducks 🦸



0



## Historical sidenote

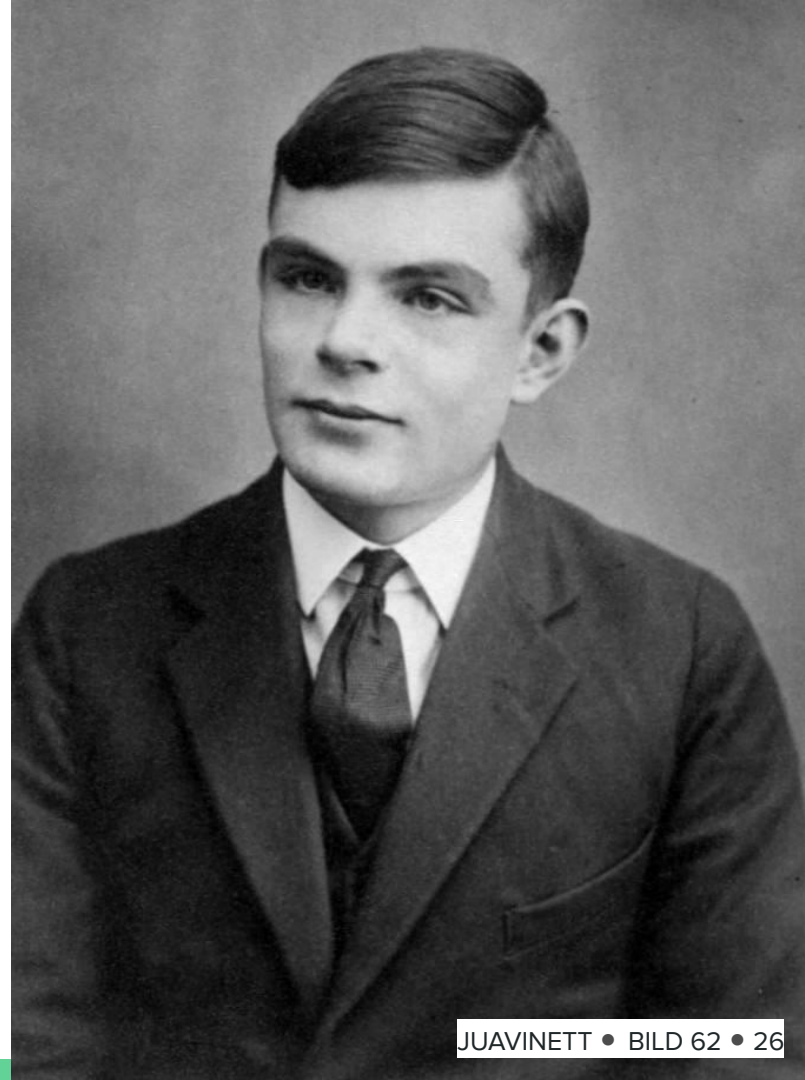
- A **cipher** is a procedure for **encoding** and **decoding** messages or data.
- By manipulating strings, it's quite straightforward to create an encoder using a few lines of code.
- During WWII, Germany used a **variable encoder** which changes its encoding strategy each time it runs.



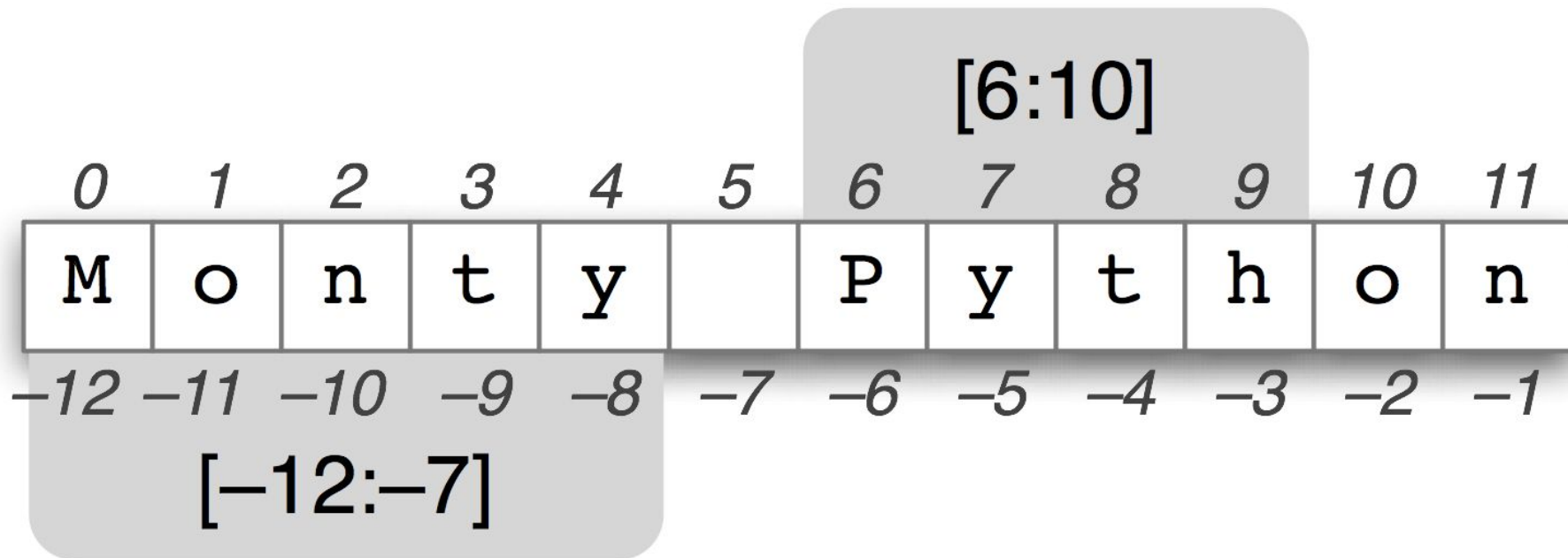
## *Historical sidenote*

- A team led by **Alan Turing** built & programmed machines that could crack the ENIGMA code, ultimately shortening the war & saving many lives.
- Alan Turing went on to make many contributions to computer science until he was prosecuted by the British Government for “homosexual activity”

Note: The Imitation Game is an Oscar-worthy depiction of his life and work (but takes some dramatic liberties...)



## String indexing & slicing



Let's get into a Jupyter notebook!  
Use the magic link to sync up your DataHub  
with our folder, and open notebook 02.

You'll also need to open the quiz on Canvas.

# Resources

## Jupyter Notebooks:

- [Official Jupyter documentation](#)
- [Example notebooks](#)
- [A Gallery of Interesting Jupyter Notebooks](#)
- [Software Carpentry: Running & Quitting Jupyter Notebooks](#)
- [A List of Good Python YouTube Channels](#)
- [Python Fundamentals](#) (Software Carpentries)
- [Error types in Python](#)