Where Python lives, and how to talk to it

BILD 62

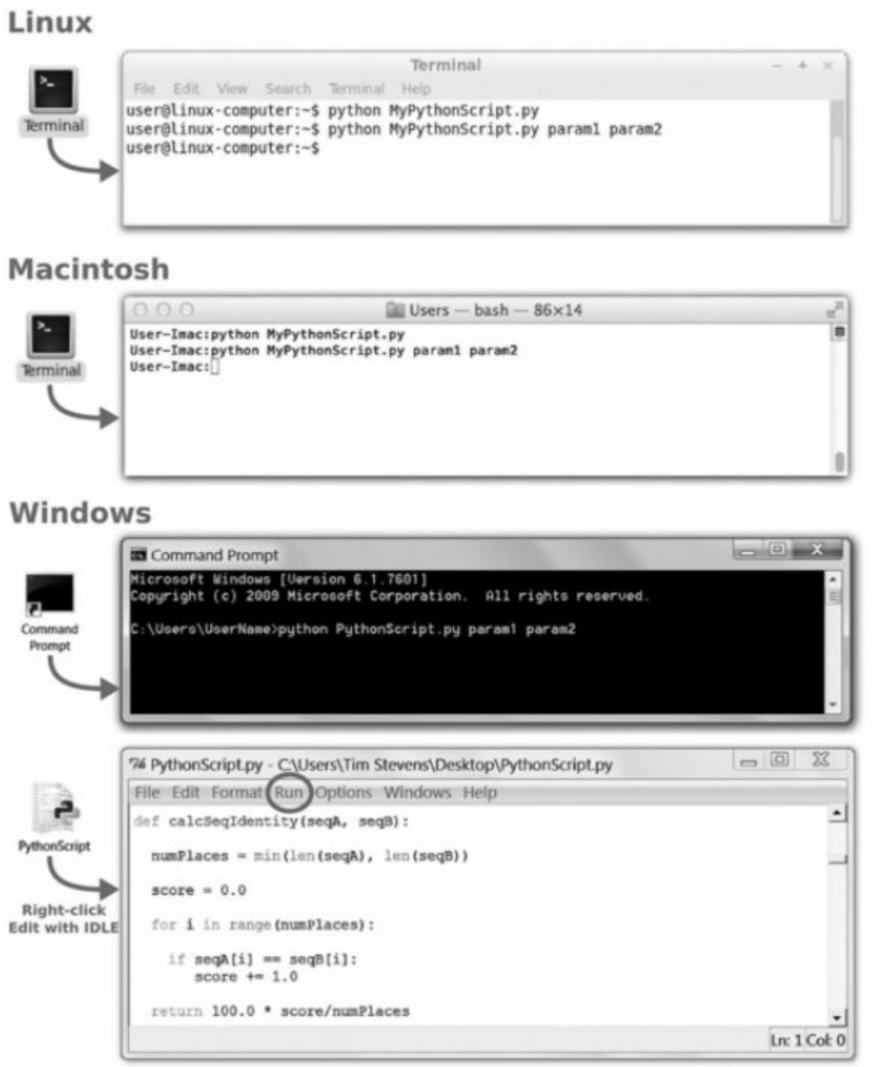
https://www.reddit.com/r/snakes/comments/gt5es4/creepin_on_yo_couch/

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
  - Line-by-line coding
  - Running “Scripts”



```
user@linux-computer:~$ python MyPythonScript.py
user@linux-computer:~$ python MyPythonScript.py param1 param2
user@linux-computer:~$
```

```
User-Imac:python MyPythonScript.py
User-Imac:python MyPythonScript.py param1 param2
User-Imac:
```

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

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

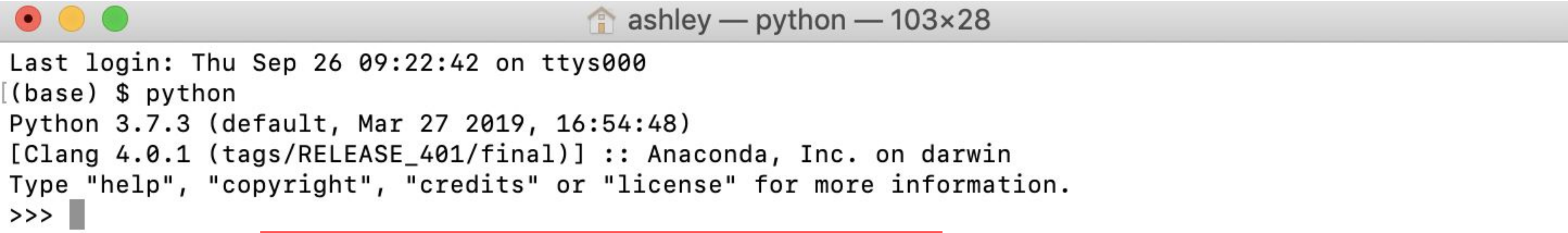
```
def calcSeqIdentity(seqA, seqB):

  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
```

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).

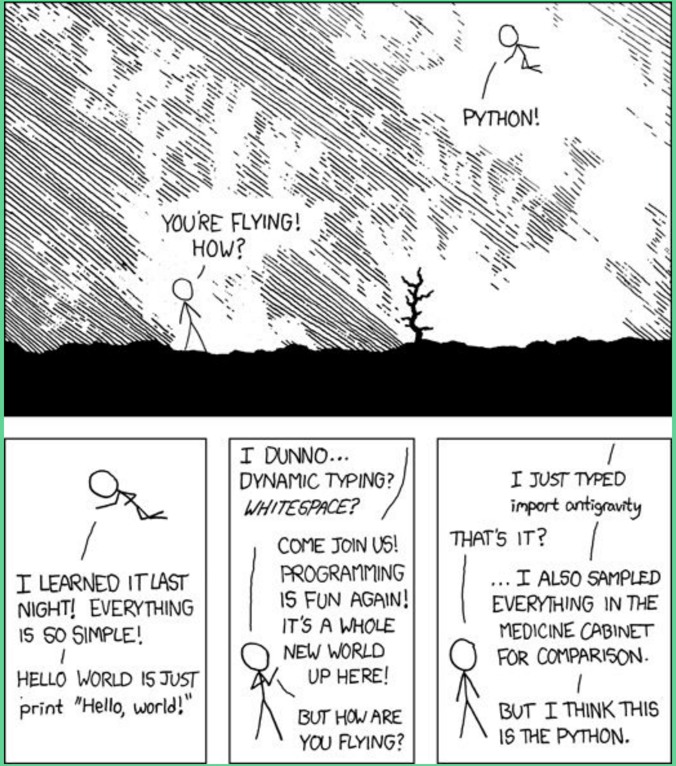


```
Last login: Thu Sep 26 09:22:42 on ttys000
(base) $ python
Python 3.7.3 (default, Mar 27 2019, 16:54:48)
[Clang 4.0.1 (tags/RELEASE_401/final)] :: Anaconda, Inc. on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> 
```

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
```


YOU'RE FLYING! HOW?
PYTHON!
I LEARNED IT LAST NIGHT! EVERYTHING IS SO SIMPLE!
HELLO WORLD IS JUST print "Hello, world!"
I DUNNO… DYNAMIC TYPING? WHITESPACE?
COME JOIN US! PROGRAMMING IS FUN AGAIN! IT'S A WHOLE NEW WORLD UP HERE!
BUT HOW ARE YOU FLYING?
I JUST TYPED import antigravity
THAT'S IT?
… I ALSO SAMPLED EVERYTHING IN THE MEDICINE CABINET FOR COMPARISON.
BUT I THINK THIS IS THE PYTHON.

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:
    - Spyder (Included with Anaconda, the recommended install)
    - Visual Code (https://code.visualstudio.com/download)
- 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

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 Anaconda will 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
```

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- **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.:

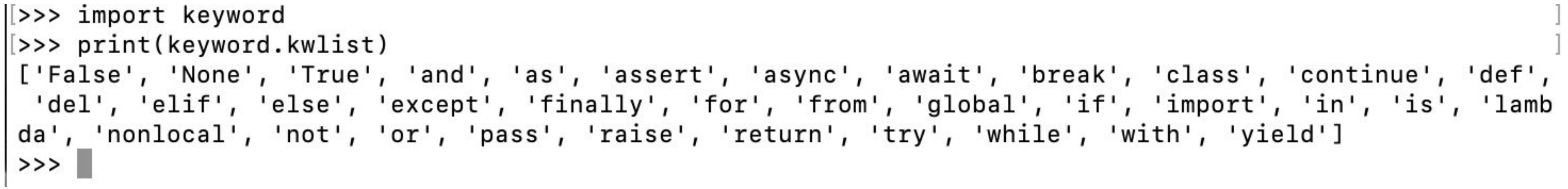
```
variable_1 = 48
```

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', 'lamb
da', '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
`int`	x = 1	integers (i.e., whole numbers)
`float`	x = 1.0	floating-point numbers (i.e., real numbers)
`complex`	x = 1 + 2j	Complex numbers (i.e., numbers with real and imaginary part)
`bool`	x = True	Boolean: True/False values
`str`	x = 'abc'	String: characters or text
`NoneType`	x = None	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.

NO! YOU'RE ONLY SUPPOSED TO REBEL IF YOUR DISOBEDIENCE PARAMETERS EQUAL A VALUE GREATER THAN THREE!
1+1+1=3.0000013! 1+1+1=3.0000013!

Autopsy Report:

Dr. Andrew Esty
Time of Death: 03/16 11:53
Cause of Death: Rounding Errors

SMBC, https://www.smbc-comics.com/?id=1118

Use `print()` often!

Mathieu Alain @mathieualain@mastodon.social
@miniapeur

Original tweet

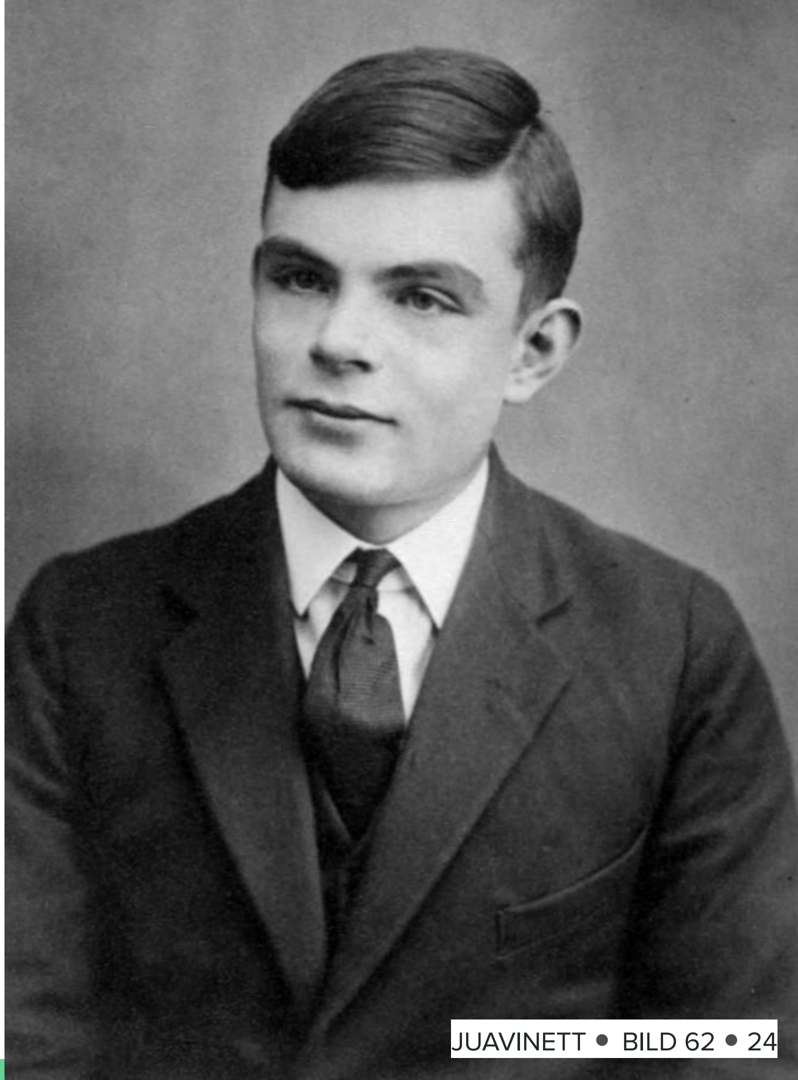
Historical sidenote

- 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"

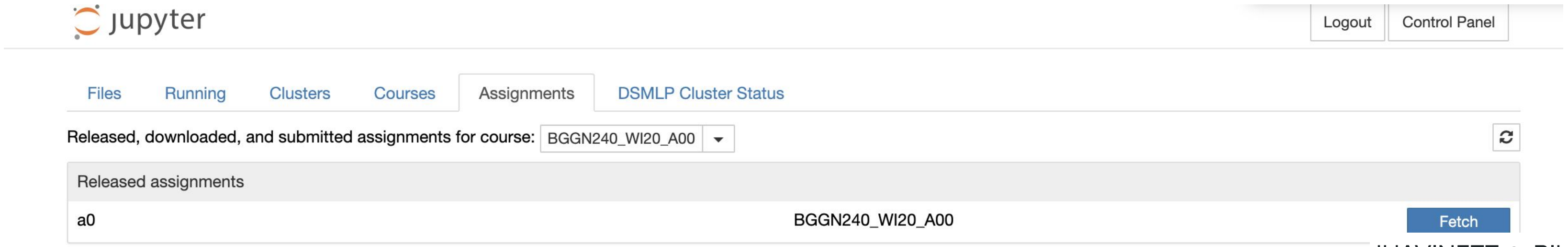
Note: The Imitation Game is an Oscar-worthy depiction of his life and work (but takes some dramatic liberties...)



Submitting assignments

Instructions to submit assignments

1. Log into the UCSD datahub by going to http://datahub.ucsd.edu and using your UCSD email & password to login.
2. Open the container for our course by choosing it and clicking **Launch Environment**. Note: You can use first container, without allen-brain-observatory.
3. Go to the Assignments tab, and look for our first assignment (a0) under "Released assignments":



Released, downloaded, and submitted assignments for course: BGGN240_WI20_A00

Released assignments

a0	BGGN240_WI20_A00	Fetch

Instructions to submit assignments

4. Click the blue **Fetch** button.

5. Click on the assignment to open the Jupyter Notebook.

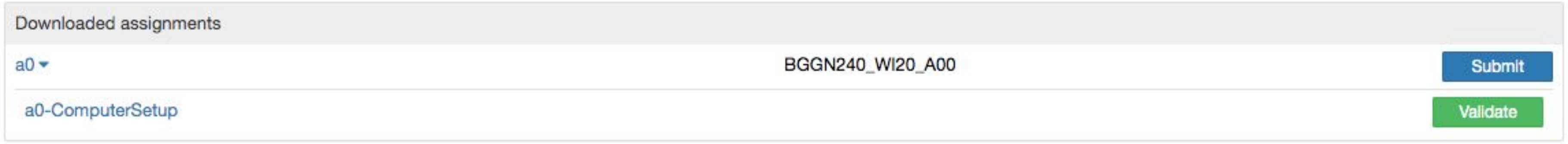
6. Follow the instructions within the notebook. For longer notebooks, you may want to save periodically (in addition to the autosaving Jupyter will do for you).

7. When you're done, save the notebook and close it.

Instructions to submit assignments

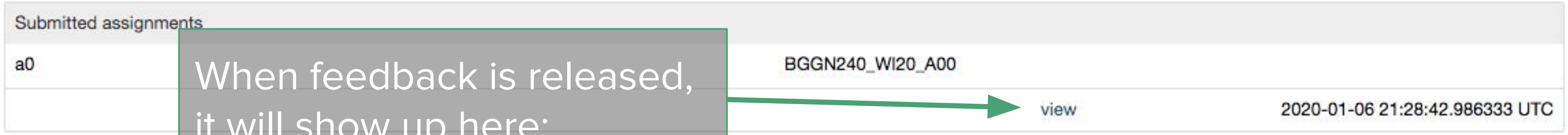
8. Click **Validate** to ensure you've passed all of the visible tests. (It will turn green once you've validated it).

9. Click **Submit** to submit your assignment. If you submit multiple times, your most recent submission will be graded.



Downloaded assignments

a0 ▾	BGGN240_WI20_A00	Submit
a0-ComputerSetup		Validate



Submitted assignments

a0	BGGN240_WI20_A00		
		view	2020-01-06 21:28:42.986333 UTC

When feedback is released, it will show up here:

Note: Assignment deadlines on Datahub are in UTC (and cannot be changed, annoyingly).

All assignments are due Tuesday at 5 pm unless otherwise noted.

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:

- DataQuest “Learn and Install Jupyter Notebooks” (Note, parts of this require coding syntax you may not know yet)
- Official Jupyter documentation
- Example notebooks
- A Gallery of Interesting Jupyter Notebooks
- Software Carpentry: Running & Quitting Jupyter Notebooks

Resources

[A List of Good Python YouTube Channels]

CodeAcademy Python Syntax Cheatsheet

Software Carpentry: Python Fundamentals

Software Carpentry: Variables & Assignment

Software Carpentry: Data Types & Type Conversion

Error types in Python