Introduction to Python

Ahmed Moustafa

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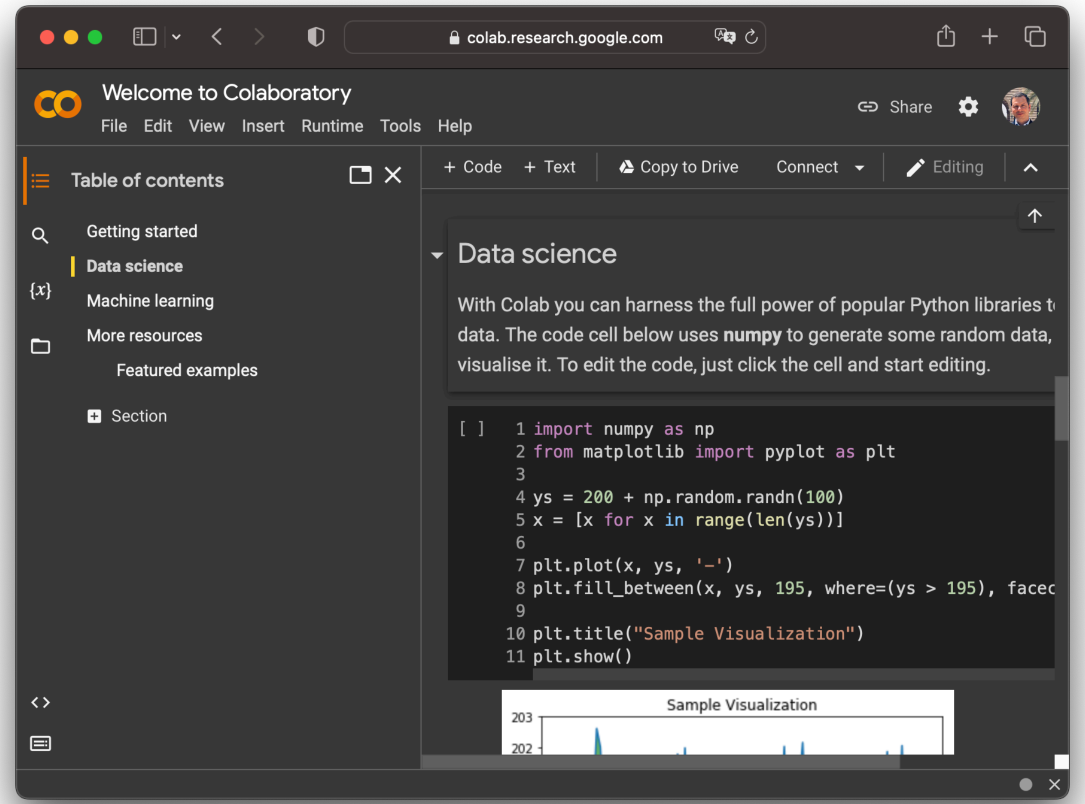
0.1 Why is it called Python?

When he began implementing Python, Guido van Rossum (left) was also reading the published scripts from Monty Python's Flying Circus (Right), a BBC comedy series from the 1970s. Van Rossum thought he needed a name that was short, unique, and slightly mysterious, so he decided to call the language Python. [Source: General Python FAQ]

Figure 1: Guido van Rossum & Monty Python's Flying Circus

0.2 Working with Python using Google Colab

Homepage: https://colab.research.google.com/ (runs online, cloud-computing like)



Data science

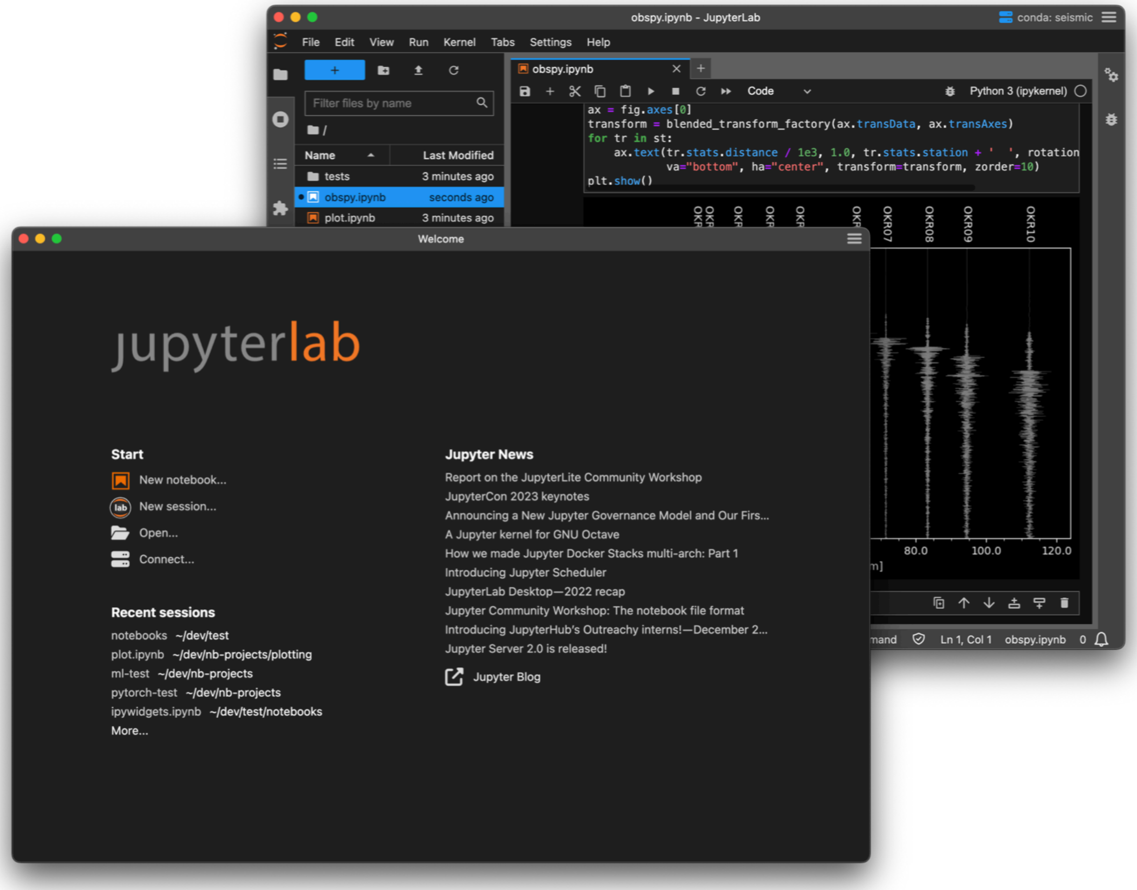
With Colab you can harness the full power of popular Python libraries t
data. The code cell below uses **numpy** to generate some random data,
visualise it. To edit the code, just click the cell and start editing.

```
import numpy as np
from matplotlib import pyplot as plt

ys = 200 + np.random.randn(100)
x = [x for x in range(len(ys))]

plt.plot(x, ys, '-')
plt.fill_between(x, ys, 195, where=(ys > 195), facec

plt.title("Sample Visualization")
plt.show()
```

Figure 2: Google Colab

0.3 Working with Python using JupyterLab Desktop

Homepage: https://github.com/jupyterlab/jupyterlab-desktop (runs offline, desktop)



```
ax = fig.axes[0]
transform = blended_transform_factory(ax.transData, ax.transAxes)
for tr in st:
    ax.text(tr.stats.distance / 1e3, 1.0, tr.stats.station + '  ', rotation
            va="bottom", ha="center", transform=transform, zorder=10)
plt.show()
```

Start

New notebook...
New session...
Open...
Connect...

Recent sessions

notebooks ~/dev/test
plot.ipynb ~/dev/nb-projects/plotting
ml-test ~/dev/nb-projects
pytorch-test ~/dev/nb-projects
ipywidgets.ipynb ~/dev/test/notebooks
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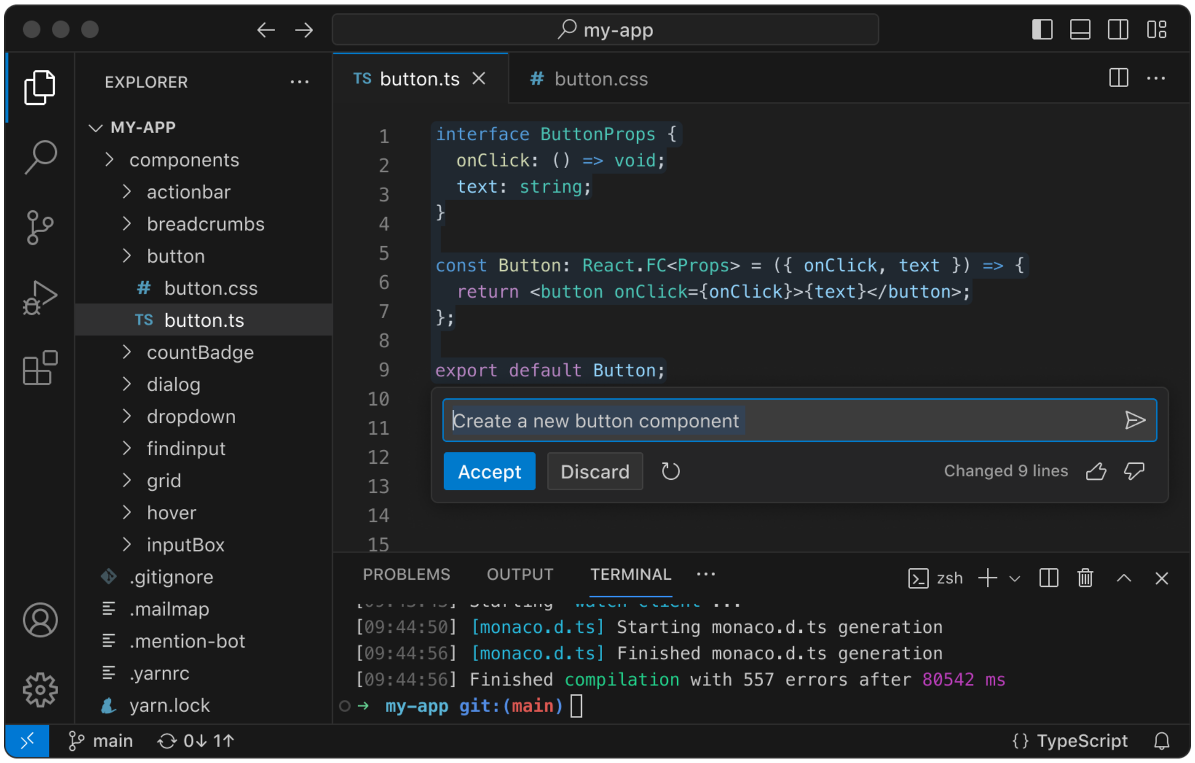
JupyterLab Desktop—2022 recap
Jupyter Community Workshop: The notebook file format
Introducing JupyterHub's Outreachy interns!—December 2...
Jupyter Server 2.0 is released!
Jupyter Blog

Figure 3: JupyterLab Desktop

0.4 Working with Python using Visual Source Code

Homepage: https://code.visualstudio.com/ (runs offline, desktop)



```typescript
interface ButtonProps {
  onClick: () => void;
  text: string;
}

const Button: React.FC<Props> = ({ onClick, text }) => {
  return <button onClick={onClick}>{text}</button>;
};

export default Button;
```

```
[09:44:50] [monaco.d.ts] Starting monaco.d.ts generation
[09:44:56] [monaco.d.ts] Finished monaco.d.ts generation
[09:44:56] Finished compilation with 557 errors after 80542 ms
○ → my-app git:(main)
```

Figure 4: VS Code

0.5 First Things First

As with any programming course, here is the `Hello World!` in Python.

```python
print ("Hello World!")
```

```
Hello World!
```

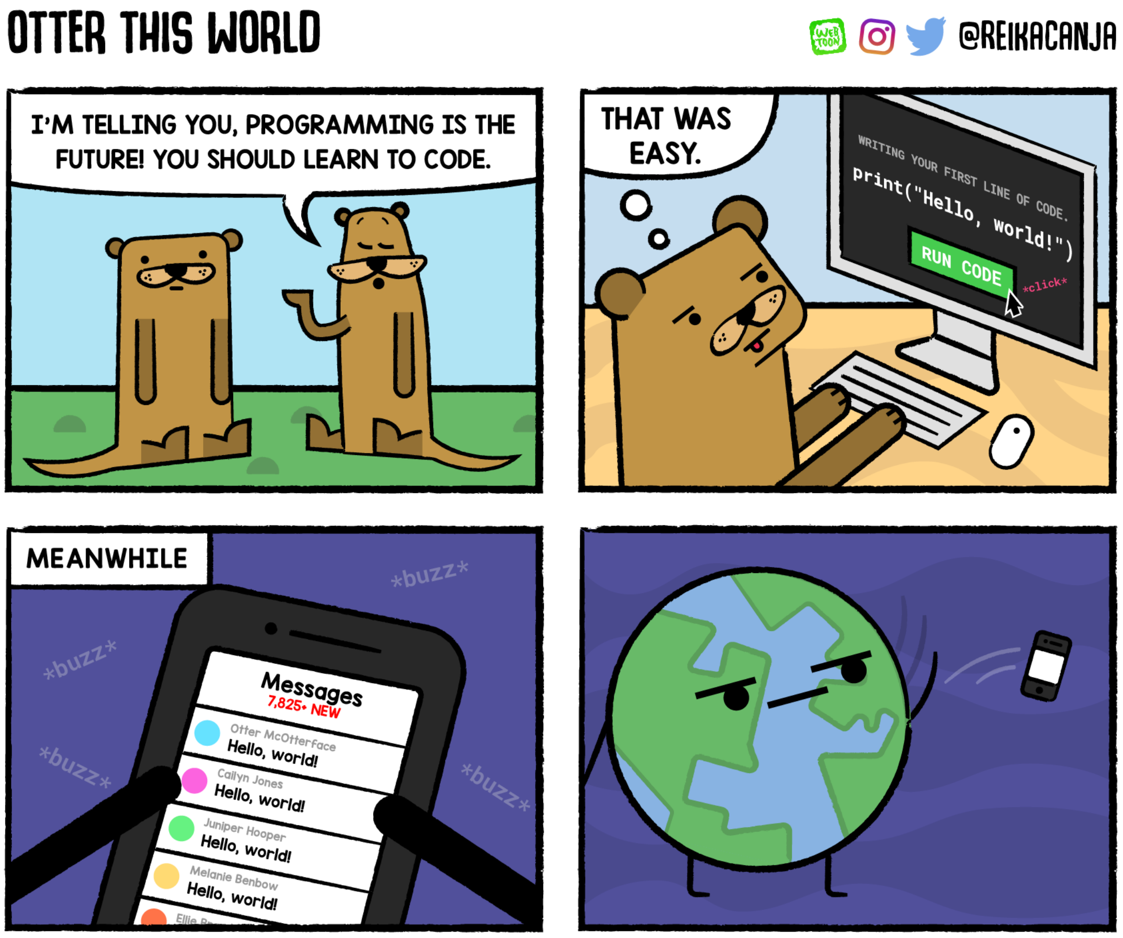


Figure 5: Hello, World!

0.6 Variables in Python

Variables are containers for storing data values. In Python, variables are created the moment you assign a value to it.

0.6.1 Example

```python
x = 5
name = "Alice"
```

0.7 Naming Conventions

- Variables names must start with a letter or an underscore.
- Can contain letters, numbers, and underscores.
- Case-sensitive (`age`, `Age`, and `AGE` are three different variables).

1 Data Types in Python

Python has various data types including:

- **Integers**: `int` (e.g., `5`)
- **Floating-point numbers**: `float` (e.g., `5.0`)
- **Strings**: `str` (e.g., `"Hello, World!"`)
- **Booleans**: `bool` (e.g., `True` or `False`)

1.1 Dynamic Typing

Python is dynamically typed, which means the type of a variable is determined at runtime.

```python
x = 4       # x is an integer
x = "Sally" # x is now a string
```

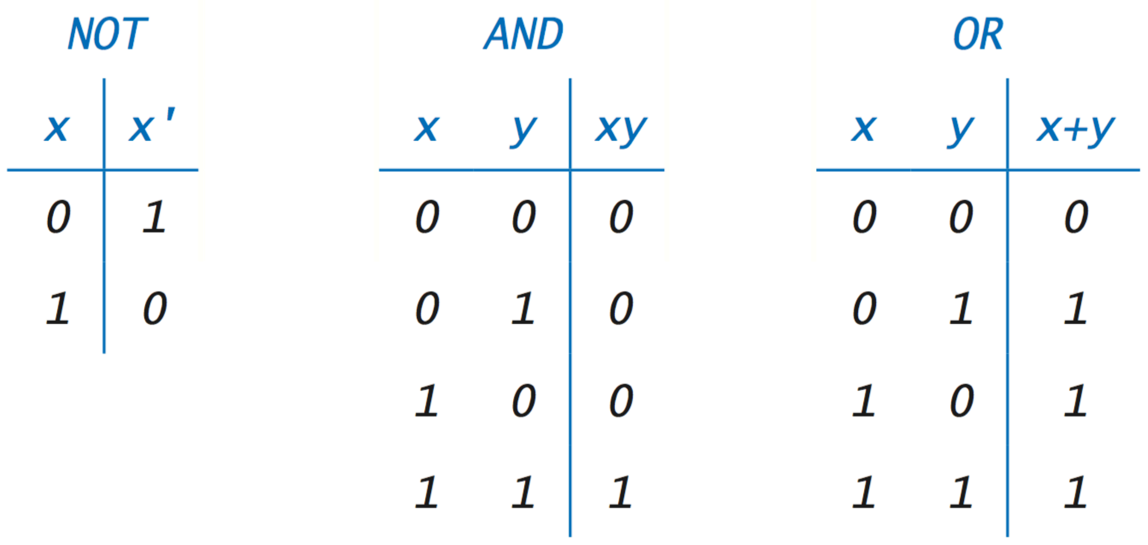
- Pros of Dynamic Typing:
  - very easy to work with
  - faster development time
- Cons of Dynamic Typing:
  - may result in unexpected bugs!

1.2 Boolean Variables and Logic Operations

Boolean variables in Python are defined by two constant objects `True` and `False`. Understanding how Boolean operations work is crucial for control flow in programming.

1.2.1 Truth Table

- `AND` operation (`True` if both are true)
- `OR` operation (`True` if at least one is true)
- `NOT` operation (Inverts the Boolean value)



NOT

x	x'
0	1
1	0

AND

x	y	xy
0	0	0
0	1	0
1	0	0
1	1	1

OR

x	y	$x+y$
0	0	0
0	1	1
1	0	1
1	1	1

Figure 6: The Truth Table (Modified from Intro To Programming)

1.3 Types of Operators

- **Arithmetic Operators**: `+`, `-`, `*`, `/`, `//`, `%`, `**` for basic math operations.
- **Comparison Operators**: `==`, `!=`, `<`, `>`, `<=`, `>=` for comparing values.
- **Logical Operators**: `and`, `or`, `not` for boolean logic.
- **Assignment Operators**: `=`, `+=`, `-=`, `*=`, `/=`, etc., to assign values to variables.
- **Membership Operators**: `in`, `not in`, to check membership in sequences.

1.4 Examples

- `5 + 3` results in `8` (Arithmetic)
- `5 == 3` results in `False` (Comparison)
- `True and False` results in `False` (Logical)

1.5 Type Conversion

You can convert between different types using Python's built-in functions like `int()`, `float()`, and `str()`.

```python
int(5.4) # Converts to integer
str(20) # Converts to string
float("3.14") # Converts to float
```

1.6 Working with Strings

Strings in Python are used to handle textual data. They can be enclosed in either single quotes (`'...'`) or double quotes (`"..."`).

1.7 Operations

- Concatenation: `'Hello ' + 'world!'`
- Repetition: `'Ha' * 3`
- Indexing: `'Hello'[1]` returns `'e'`
- Slicing: `'Hello'[1:4]` returns `'ell'`

1.8 Useful String Methods

- `.upper()`, `.lower()`, `.strip()`, `.split()`, `.replace()`, `.find()`, `.join()`, `.count()`, `.startswith()`, `.endswith()`
- An even more comprehensive list of string methods in Python can be found:
  - here: Python String Functions at Digital Ocean, and
  - here: Python String Methods at Geeks for Geeks
  - BTW, both are excellent resources for additional documentation and examples.

2 Introduction to Lists

Lists in Python are used to store multiple items in a single variable. Lists are ordered, changeable, and allow duplicate values.

2.1 Creating a List

```python
my_list = [1, 2, 3]
names = ["Alice", "Bob", "Charlie"]
```

2.2 Accessing Elements

- Access by index: `my_list[0]` returns `1`.
- Slicing: `names[1:3]` returns `['Bob', 'Charlie']`.

2.3 List Operations

- Append: `my_list.append(4)`
- Remove: `my_list.remove(1)`
- Sort: `names.sort()`

3 Advanced Variable Usage

Understanding variable scopes and mutability is crucial for Python programming.

3.1 Variable Scope

- **Global Scope**: Variables defined at the top-level of a script or module are global.
- **Local Scope**: Variables created within a function are local to that function.

3.2 Mutability

- Immutable types: `int`, `float`, `bool`, `str`. Changing the value creates a new object.
- Mutable types: `list`, `dict`, `set`. They can be changed in place without creating a new object.

4 In-depth Data Types

Exploring Python's built-in data types reveals the language's flexibility.

4.1 Sequences

- **Tuples**: Immutable and ordered. `my_tuple = (1, 2, 3)`
- **Ranges**: Immutable sequence of numbers. `range(1, 10)`

4.2 Mapping Type

- **Dictionaries**: Key-value pairs. `my_dict = {"name": "Alice", "age": 30}`

4.3 Set Types

- **Sets**: Unordered collection of unique elements. `my_set = {1, 2, 3}`
- **Frozen Sets**: Immutable version of a set. `frozen_set = frozenset([1, 2, 3])`

4.4 Escape Characters

- Use \ to insert special characters, e.g.,
- new line:

```python
print ("Hello\nWorld!")
```

```
Hello
World!
```

- tab:

```python
print ("Hello\tWorld!")
```

```
Hello   World!
```

4.5 Summary

- Python is awesome
- Python uses **dynamic typing**
- Parentheses `( )` are for calling **functions**
- Square brackets `[ ]` are are indexing **lists**
- Strings are **immutable** lists
- Lists start indexing at **zero**