Python

ACTL3143 & ACTL5111 Deep Learning for Actuaries

Patrick Laub

Lecture Outline

- **Data Science & Python**
- Python Data Types
- Collections
- Control Flow
- Python Functions
- Import syntax
- Lambda functions

About Python

First released on 20 February 1991

An open-source scripting language, named after Monty Python

Led by its “benevolent dictator for life” Guido, until his retirement, now led by Python Software Foundation

Python packages are downloaded at a rate of ~6B/day

Guido van Rossum, creator of Python. Now Python has >3.6K contributors and 1.7M LOC (C).

Designed as a beautiful, simple, and readable language

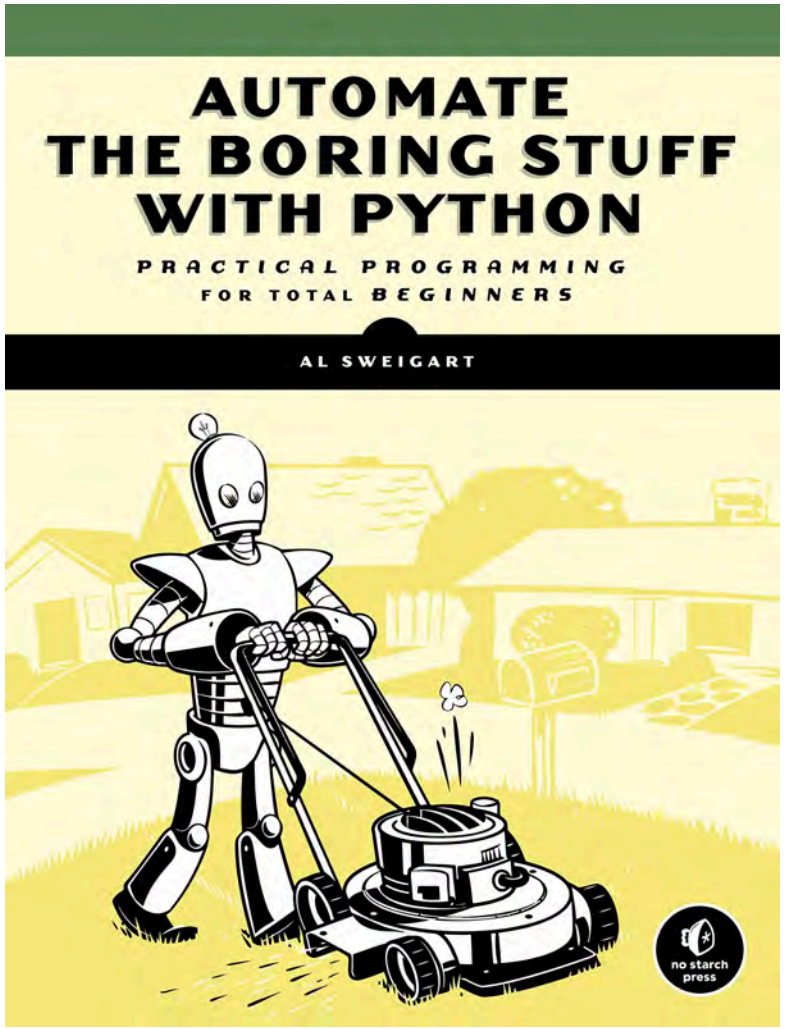
```
1 import this
```

```
The Zen of Python, by Tim Peters

Beautiful is better than ugly.
Explicit is better than implicit.
Simple is better than complex.
Complex is better than complicated.
Flat is better than nested.
Sparse is better than dense.
Readability counts.
Special cases aren't special enough to break the rules.
Although practicality beats purity.
Errors should never pass silently.
Unless explicitly silenced.
In the face of ambiguity, refuse the temptation to guess.
There should be one-- and preferably only one --obvious way to do it.
Although that way may not be obvious at first unless you're Dutch.
```

Easy to learn language, popular first language, taught in high schools

Uses for Python



It is a *general purpose* language

Python powers:

- Instagram
- Spotify
- Netflix
- Uber
- Reddit...

Python is on Mars.

Free book Automate the Boring Stuff with Python

Sources: Blog post and Github.

Python metrics

TIOBE Index **(May 2026)**

Python is #**1** with a **19.98%** rating, well ahead of C (11.55%) and Java (7.94%).

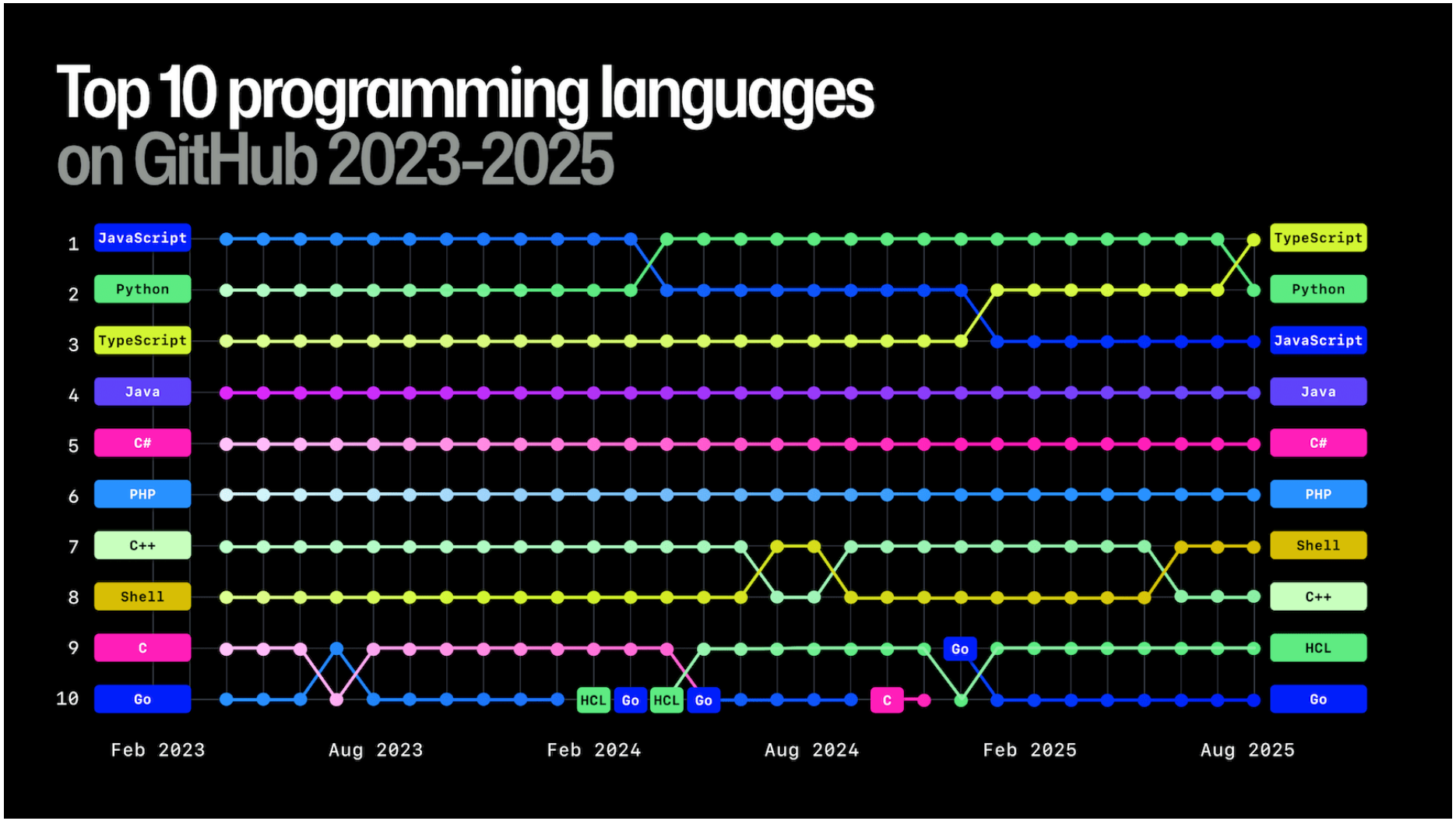
Stack Overflow 2025

Python is the #**1 most-used language** among those learning to code (71.8%) and #**4 overall** (57.9%) — a 7-point jump from 2024.

JetBrains 2025

86% of Python developers use it as their main language. Top uses: data science (51%), web (46%), machine learning (41%).

Popularity on GitHub



From the 2025 State of the Octoverse

Popularity on GitHub II

> "What else we're seeing
>
> Python dominates AI projects. It remains the clear leader inside AI-tagged repositories, where Jupyter Notebook usage nearly doubled in 2025 offering evidence of its role as the go-to language for prototyping, training, and orchestrating AI workloads. GitHub's 2025 State of the Octoverse

Python and machine learning

> …[T]he entire machine learning and data science industry has been dominated by these two approaches: **deep learning** and **gradient boosted trees**… Users of gradient boosted trees tend to use Scikit-learn, XGBoost, or LightGBM. Meanwhile, most practitioners of deep learning use Keras, often in combination with its parent framework TensorFlow. The common point of these tools is **they're all Python libraries**: Python is by far the most widely used language for machine learning and data science.

Source: François Chollet (2021), *Deep Learning with Python, Second Edition*, Section 1.2.7.

“The Story of Python and how it took over the world”

Disclaimer on following slides

These slides are for an audience who *already knows programming fundamentals* (variables, control flow, functions, etc.) but just don't know how they work in Python.

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Variables and basic types

```
1 1 + 2
```

```
3
```

```
1 x = 1
2 x + 2.0
```

```
3.0
```

```
1 type(2.0)
```

```
float
```

```
1 type(1), type(x)
```

```
(int, int)
```

```
1 does_math_work = 1 + 1 == 2
2 print(does_math_work)
3 type(does_math_work)
```

```
True
```

```
bool
```

```
1 contradiction = 1 ≠ 1
2 contradiction
```

```
False
```

Shorthand assignments

If we want to add 2 to a variable `x`:

```
1  x = 1
2  x = x + 2
3  x
```

3

```
1  x = 1
2  x += 2
3  x
```

3

Same for:

- `x -= 2` : take 2 from the current value of `x` ,
- `x *= 2` : double the current value of `x`,
- `x /= 2` : halve the current value of `x`.

Strings

```
1 name = "Patrick"
2 surname = "Laub"
```

```
1 coffee = "This is Patrick's coffee"
2 quote = 'And then he said "I need a coffee!"'
```

```
1 name + surname
```

```
'PatrickLaub'
```

```
1 greeting = f"Hello {name} {surname}"
2 greeting
```

```
'Hello Patrick Laub'
```

```
1 "Patrick" in greeting
```

```
True
```

and & or

```
1 name = "Patrick"
2 surname = "Laub"
3 name.istitle() and surname.istitle()
```

```
True
```

```
1 full_name = "Dr Patrick Laub"
2 full_name.startswith("Dr ") or full_name.endswith(" PhD")
```

```
True
```

Important

The dot is used to denote methods, it can't be used inside a variable name.

```
1 i.am.an.unfortunate.R.users = True
```

```
NameError                                 Traceback (most recent call last)
Cell In[18], line 1
----> 1 i.am.an.unfortunate.R.users = True

NameError: name 'i' is not defined
```

`help` to get more details

```
1 help(name.istitle)
```

```
Help on built-in function istitle:

istitle() method of builtins.str instance
    Return True if the string is a title-cased string, False otherwise.

    In a title-cased string, upper- and title-case characters may only
    follow uncased characters and lowercase characters only cased ones.
```

f-strings

```
1 print(f"Five squared is {5*5} and five cubed is {5**3}")
2 print("Five squared is {5*5} and five cubed is {5**3}")
```

```
Five squared is 25 and five cubed is 125
Five squared is {5*5} and five cubed is {5**3}
```

Use f-strings and avoid the older alternatives:

```
1 print(f"Hello {name} {surname}")
2 print("Hello " + name + " " + surname)
3 print("Hello {} {}".format(name, surname))
4 print("Hello %s %s" % (name, surname))
```

```
Hello Patrick Laub
Hello Patrick Laub
Hello Patrick Laub
Hello Patrick Laub
```

Converting types

```
1 digit = 3
2 digit
```

```
3
```

```
1 type(digit)
```

```
int
```

```
1 num = float(digit)
2 num
```

```
3.0
```

```
1 type(num)
```

```
float
```

```
1 num_str = str(num)
2 num_str
```

```
'3.0'
```

Quiz

What is the output of:

```
1 x = 1
2 y = 1.0
3 print(f"{x == y} and {type(x) == type(y)}")
```

```
True and False
```

What would you add before line 3 to get “True and True”?

```
1 x = 1
2 y = 1.0
3 x = float(x)  # or y = int(y)
4 print(f"{x == y} and {type(x) == type(y)}")
```

```
True and True
```

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Lists

```
1 desires = ["Coffee", "Cake", "Sleep"]
2 desires
```

```
['Coffee', 'Cake', 'Sleep']
```

```
1 len(desires)
```

```
3
```

```
1 desires[0]
```

```
'Coffee'
```

```
1 len(desires[0])
```

```
6
```

```
1 desires[-1]
```

```
'Sleep'
```

```
1 desires[2] = "Nap"
2 desires
```

```
['Coffee', 'Cake', 'Nap']
```

Slicing lists

```
1 print([0, 1, 2])
2 desires
```

```
[0, 1, 2]
['Coffee', 'Cake', 'Nap']
```

```
1 desires[0:2]
```

```
['Coffee', 'Cake']
```

```
1 desires[0:1]
```

```
['Coffee']
```

```
1 desires[:2]
```

```
['Coffee', 'Cake']
```

A common indexing error

```
1 desires[1.0]
```

```
TypeError                                 Traceback (most recent call last)
Cell In[39], line 1
----> 1 desires[1.0]

TypeError: list indices must be integers or slices, not float
```

```
1 desires[: len(desires) / 2]
```

```
TypeError                                 Traceback (most recent call last)
Cell In[40], line 1
----> 1 desires[: len(desires) / 2]

TypeError: slice indices must be integers or None or have an __index__ method
```

```
1 len(desires) / 2, len(desires) // 2
```

```
(1.5, 1)
```

```
1 desires[: len(desires) // 2]
```

```
['Coffee']
```

Editing lists

```
1 desires = ["Coffee", "Cake", "Sleep"]
2 desires.append("Gadget")
3 desires
```

```
['Coffee', 'Cake', 'Sleep', 'Gadget']
```

```
1 desires.pop()
```

```
'Gadget'
```

```
1 desires
```

```
['Coffee', 'Cake', 'Sleep']
```

```
1 desires.sort()
2 desires
```

```
['Cake', 'Coffee', 'Sleep']
```

```
1 desires[3] = "Croissant"
```

```
IndexError                                Traceback (most recent call last)
Cell In[47], line 1
----> 1 desires[3] = "Croissant"

IndexError: list assignment index out of range
```

None

```
1 desires = ["Coffee", "Cake", "Sleep", "Gadget"]
2 sorted_list = desires.sort()
3 sorted_list
```

```
1 type(sorted_list)
```

NoneType

```
1 sorted_list is None
```

True

```
1 bool(sorted_list)
```

False

```
1 desires = ["Coffee", "Cake", "Sleep", "Gadget"]
2 sorted_list = sorted(desires)
3 print(desires)
4 sorted_list
```

['Coffee', 'Cake', 'Sleep', 'Gadget']

['Cake', 'Coffee', 'Gadget', 'Sleep']

Tuples ('immutable' lists)

```
1 weather = ("Sunny", "Cloudy", "Rainy")
2 print(type(weather))
3 print(len(weather))
4 print(weather[-1])
```

```
<class 'tuple'>
3
Rainy
```

```
1 weather.append("Snowy")
```

```
AttributeError                            Traceback (most recent call last)
Cell In[54], line 1
----> 1 weather.append("Snowy")

AttributeError: 'tuple' object has no attribute 'append'
```

```
1 weather[2] = "Snowy"
```

```
TypeError                                 Traceback (most recent call last)
Cell In[55], line 1
----> 1 weather[2] = "Snowy"

TypeError: 'tuple' object does not support item assignment
```

One-length tuples

```
1 using_brackets_in_math = (2 + 4) * 3
2 using_brackets_to_simplify = (1 + 1 == 2)
```

```
1 failure_of_atuple = ("Snowy")
2 type(failure_of_atuple)
```

```
str
```

```
1 happy_solo_tuple = ("Snowy",)
2 type(happy_solo_tuple)
```

```
tuple
```

```
1 cheeky_solo_list = ["Snowy"]
2 type(cheeky_solo_list)
```

```
list
```

Dictionaries

```
1 phone_book = {"Patrick": "+61 1234", "Café": "(02) 5678"}
2 phone_book["Patrick"]
```

```
'+61 1234'
```

```
1 phone_book["Café"] = "+61400 000 000"
2 phone_book
```

```
{'Patrick': '+61 1234', 'Café': '+61400 000 000'}
```

```
1 phone_book.keys()
```

```
dict_keys(['Patrick', 'Café'])
```

```
1 phone_book.values()
```

```
dict_values(['+61 1234', '+61400 000 000'])
```

```
1 factorial = {0: 1, 1: 1, 2: 2, 3: 6, 4: 24, 5: 120, 6: 720, 7: 5040}
2 factorial[4]
```

```
24
```

Quiz

What does this print out?

```
1 animals = ["dog", "cat", "bird"]
2 animals.append("teddy bear")
3 animals.pop()
4 animals.pop()
5 animals.append("koala")
6 animals.append("kangaroo")
7 print(f"{len(animals)} and {len(animals[-2])}")
```

```
4 and 5
```

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`if` and `else`

```
1 age = 50
```

```
1 if age ⩾ 30:
2     print("Gosh you're old")
```

```
Gosh you're old
```

```
1 if age ⩾ 30:
2     print("Gosh you're old")
3 else:
4     print("You're still young")
```

```
Gosh you're old
```

The weird part about Python...

```
1 if age ⩾ 30:
2     print("Gosh you're old")
3 else:
4 print("You're still young")
```

```
  Cell In[69], line 4
    print("You're still young")
    ^
IndentationError: expected an indented block after 'else' statement on line 3
```

> ⚠ **Warning**
>
> Watch out for mixing tabs and spaces!

An example of aging

```
age = 16

if age < 18:
    friday_evening_schedule = "School things"
if age < 30:
    friday_evening_schedule = "Party 🥳🍾"
if age ⩾ 30:
    friday_evening_schedule = "Work"
```

```
print(friday_evening_schedule)
```

```
Party 🥳🍾
```

Using `elif`

```
1  age = 16
2
3  if age < 18:
4      friday_evening_schedule = "School things"
5  elif age < 30:
6      friday_evening_schedule = "Party 🥳🍾"
7  else:
8      friday_evening_schedule = "Work"
9
10 print(friday_evening_schedule)
```

```
School things
```

`for` Loops

```
1 desires = ["coffee", "cake", "sleep"]
2 for desire in desires:
3     print(f"Patrick really wants a {desire}.")
```

```
Patrick really wants a coffee.
Patrick really wants a cake.
Patrick really wants a sleep.
```

```
1 for i in range(3):
2     print(i)
```

```
0
1
2
```

```
1 for i in range(3, 6):
2     print(i)
```

```
3
4
5
```

```
1 range(5)
```

```
range(0, 5)
```

```
1 type(range(5))
```

```
range
```

```
1 list(range(5))
```

```
[0, 1, 2, 3, 4]
```

Advanced `for` loops

```
1 for i, desire in enumerate(desires):
2     print(f"Patrick wants a {desire}, it is priority #{i+1}.")
```

```
Patrick wants a coffee, it is priority #1.
Patrick wants a cake, it is priority #2.
Patrick wants a sleep, it is priority #3.
```

```
1 desires = ["coffee", "cake", "nap"]
2 times = ["in the morning", "at lunch", "during a boring lecture"]
3
4 for desire, time in zip(desires, times):
5     print(f"Patrick enjoys a {desire} {time}.")
```

```
Patrick enjoys a coffee in the morning.
Patrick enjoys a cake at lunch.
Patrick enjoys a nap during a boring lecture.
```

List comprehensions

```
1 [x**2 for x in range(10)]
```

```
[0, 1, 4, 9, 16, 25, 36, 49, 64, 81]
```

```
1 [x**2 for x in range(10) if x % 2 == 0]
```

```
[0, 4, 16, 36, 64]
```

They can get more complicated:

```
1 [x * y for x in range(4) for y in range(4)]
```

```
[0, 0, 0, 0, 0, 1, 2, 3, 0, 2, 4, 6, 0, 3, 6, 9]
```

```
1 [[x * y for x in range(4)] for y in range(4)]
```

```
[[0, 0, 0, 0], [0, 1, 2, 3], [0, 2, 4, 6], [0, 3, 6, 9]]
```

but I'd recommend just using `for` loops at that point.

While Loops

Say that we want to simulate $(X \mid X \geq 100)$ where $X \sim \text{Pareto}(1)$. Assuming we have `simulate_pareto`, a function to generate Pareto(1) variables:

```
samples = []
while len(samples) < 5:
    x = simulate_pareto()
    if x ⩾ 100:
        samples.append(x)

samples
```

```
[125.28600493316272,
 186.04974709289712,
 154.45723763510398,
 101.08310878885993,
 2852.8305399214996]
```

Breaking out of a loop

```python
while True:
    user_input = input(">> What would you like to do? ")

    if user_input == "order cake":
        print("Here's your cake! 🎂")

    elif user_input == "order coffee":
        print("Here's your coffee! ☕")

    elif user_input == "quit":
        break
```

```
>> What would you like to do? order cake
Here's your cake! 🎂
>> What would you like to do? order coffee
Here's your coffee! ☕
>> What would you like to do? order cake
Here's your cake! 🎂
>> What would you like to do? quit
```

Quiz

What does this print out?

```
if 1 / 3 + 1 / 3 + 1 / 3 == 1:
    if 2**3 == 6:
        print("Math really works!")
    else:
        print("Math sometimes works..")
else:
    print("Math doesn't work")
```

```
Math sometimes works..
```

What does this print out?

```
count = 0
for i in range(1, 10):
    count += i
    if i > 3:
        break
print(count)
```

```
10
```

Debugging the quiz code

```
1  count = 0
2  for i in range(1, 10):
3      count += i
4      print(f"After i={i} count={count}")
5      if i > 3:
6          break
```

```
After i=1 count=1
After i=2 count=3
After i=3 count=6
After i=4 count=10
```

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Making a function

```python
def add_one(x):
    return x + 1


def greet_a_student(name):
    print(f"Hi {name}, welcome to the AI class!")
```

```python
add_one(10)
```

```
11
```

```python
greet_a_student("Josephine")
```

```
Hi Josephine, welcome to the AI class!
```

```python
greet_a_student("Joseph")
```

```
Hi Joseph, welcome to the AI class!
```

Here, `name` is a *parameter* and the value supplied is an *argument*.

Default arguments

Assuming we have `simulate_standard_normal`, a function to generate Normal(0, 1) variables:

```
1 def simulate_normal(mean=0, std=1):
2     return mean + std * simulate_standard_normal()
```

```
1 simulate_normal()  # same as 'simulate_normal(0, 1)'
```

```
0.47143516373249306
```

```
1 simulate_normal(1_000)  # same as 'simulate_normal(1_000, 1)'
```

```
998.8090243052935
```

> **Note**
>
> We'll cover random numbers next week (using `numpy`).

Use explicit parameter name

```
1 simulate_normal(mean=1_000)  # same as 'simulate_normal(1_000, 1)'
```

```
1001.4327069684261
```

```
1 simulate_normal(std=1_000)  # same as 'simulate_normal(0, 1_000)'
```

```
-312.6518960917129
```

```
1 simulate_normal(10, std=0.001)  # same as 'simulate_normal(10, 0.001)'
```

```
9.999279411266635
```

```
1 simulate_normal(std=10, 1_000)
```

```
  Cell In[102], line 1
    simulate_normal(std=10, 1_000)
                                  ^
SyntaxError: positional argument follows keyword argument
```

Why would we need that?

E.g. to fit a Keras model, we use the `.fit` method:

```
model.fit(x=None, y=None, batch_size=None, epochs=1, verbose='auto',
        callbacks=None, validation_split=0.0, validation_data=None,
        shuffle=True, class_weight=None, sample_weight=None,
        initial_epoch=0, steps_per_epoch=None, validation_steps=None,
        validation_batch_size=None, validation_freq=1,
        max_queue_size=10, workers=1, use_multiprocessing=False)
```

Say we want all the defaults except changing `use_multiprocessing=True`:

```
model.fit(None, None, None, 1, 'auto', None, 0.0, None, True, None,
        None, 0, None, None, None, 1, 10, 1, True)
```

but it is *much nicer* to just have:

```
model.fit(use_multiprocessing=True)
```

Further viewing

Quiz

What does the following print out?

```python
def get_half_of_list(numbers, first=True):
    if first:
        return numbers[: len(numbers) // 2]
    else:
        return numbers[len(numbers) // 2 :]

nums = [1, 2, 3, 4, 5, 6]
chunk = get_half_of_list(nums, False)
second_chunk = get_half_of_list(chunk)
print(second_chunk)
```

```
[4]
```

```python
f"nums ⇝ {nums[:len(nums)//2]} and {nums[len(nums)//2:]}"
```

```
'nums ⇝ [1, 2, 3] and [4, 5, 6]'
```

```python
f"chunk ⇝ {chunk[:len(chunk)//2]} and {chunk[len(chunk)//2:]}"
```

```
'chunk ⇝ [4] and [5, 6]'
```

Multiple return values

```
1 def limits(numbers):
2     return min(numbers), max(numbers)
3
4 limits([1, 2, 3, 4, 5])
```

```
(1, 5)
```

```
1 type(limits([1, 2, 3, 4, 5]))
```

```
tuple
```

```
1 min_num, max_num = limits([1, 2, 3, 4, 5])
2 print(f"The numbers are between {min_num} and {max_num}.")
```

```
The numbers are between 1 and 5.
```

```
1 _, max_num = limits([1, 2, 3, 4, 5])
2 print(f"The maximum is {max_num}.")
```

```
The maximum is 5.
```

```
1 print(f"The maximum is {limits([1, 2, 3, 4, 5])[1]}.")
```

```
The maximum is 5.
```

Tuple unpacking

```
1 lims = limits([1, 2, 3, 4, 5])
2 smallest_num = lims[0]
3 largest_num = lims[1]
4 print(f"The numbers are between {smallest_num} and {largest_num}.")
```

```
The numbers are between 1 and 5.
```

```
1 smallest_num, largest_num = limits([1, 2, 3, 4, 5])
2 print(f"The numbers are between {smallest_num} and {largest_num}.")
```

```
The numbers are between 1 and 5.
```

This doesn't just work for functions with multiple return values:

```
1 RESOLUTION = (1920, 1080)
2 WIDTH, HEIGHT = RESOLUTION
3 print(f"The resolution is {WIDTH} wide and {HEIGHT} tall.")
```

```
The resolution is 1920 wide and 1080 tall.
```

Short-circuiting

```
1 def is_positive(x):
2     print("Called is_positive")
3     return x > 0
4
5 def is_negative(x):
6     print("Called is_negative")
7     return x < 0
8
9 x = 10
```

```
1 x_is_positive = is_positive(x)
2 x_is_positive
```

```
Called is_positive

True
```

```
1 x_is_negative = is_negative(x)
2 x_is_negative
```

```
Called is_negative

False
```

```
1 x_not_zero = is_positive(x) or is_negative(x)
2 x_not_zero
```

```
Called is_positive

True
```

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Python standard library

```
1 import os
2 import time
```

```
1 time.sleep(0.1)
```

```
1 os.getlogin()
```

```
'z3535837'
```

```
1 os.getcwd()
```

```
'/Users/z3535837/Library/CloudStorage/Dropbox/Lecturing/ACTL3143/DeepLearningForActuaries/Lectu
```

Import a few functions

```
1 from os import getcwd, getlogin
2 from time import sleep
```

```
1 sleep(0.1)
```

```
1 getlogin()
```

```
'z3535837'
```

```
1 getcwd()
```

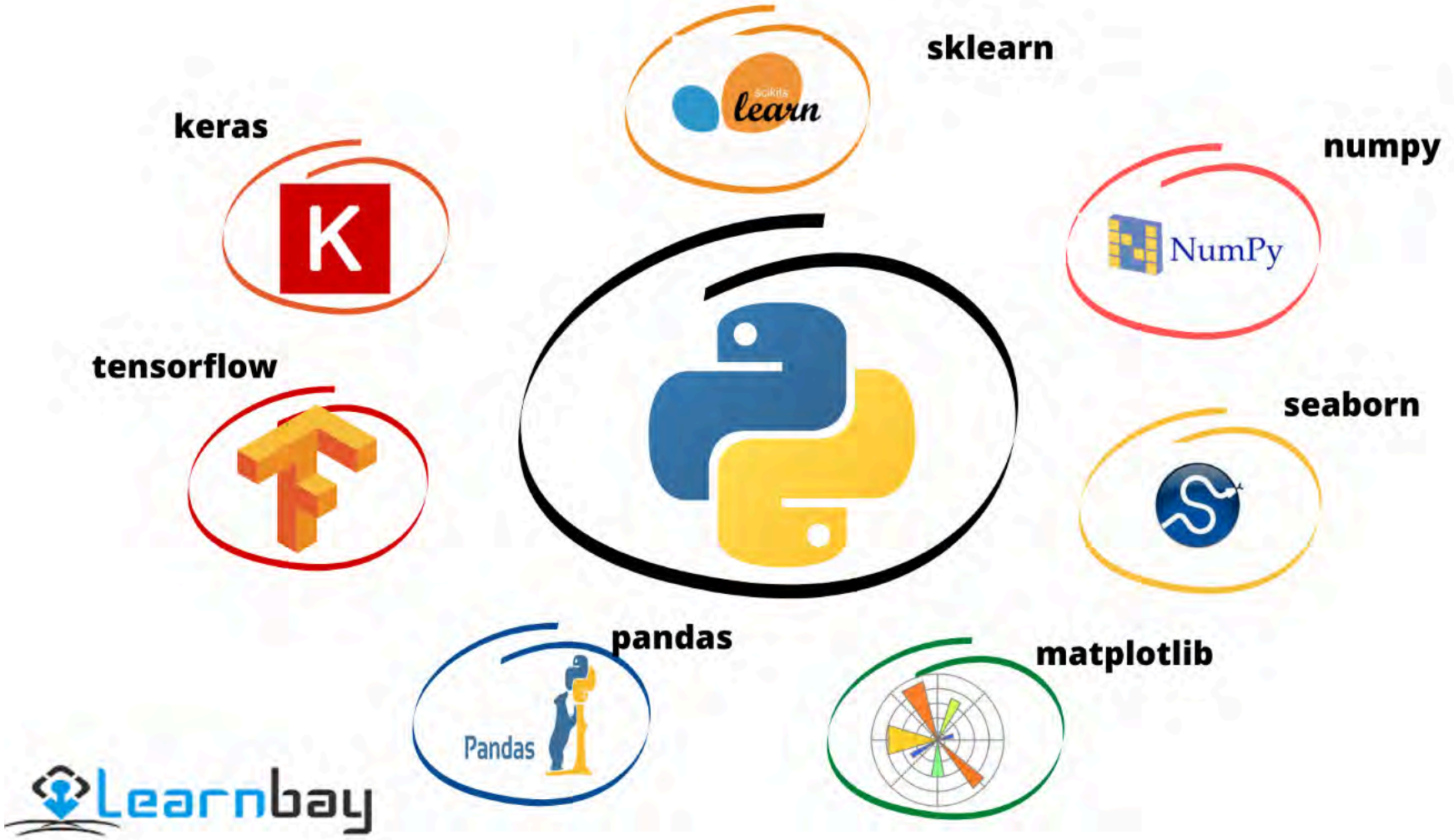
```
'/Users/z3535837/Library/CloudStorage/Dropbox/Lecturing/ACTL3143/DeepLearningForActuaries/Lectu
```

Timing using pure Python

```python
from time import time

start_time = time()

counting = 0
for i in range(1_000_000):
    counting += 1

end_time = time()

elapsed = end_time - start_time
print(f"Elapsed time: {elapsed} secs")
```

```
Elapsed time: 0.04956388473510742 secs
```

Data science packages



Common data science packages

Source: Learnbay.co, Python libraries for data analysis and modeling in Data science, Medium.

Importing using `as`

```python
import pandas

pandas.DataFrame(
    {
        "x": [1, 2, 3],
        "y": [4, 5, 6],
    }
)
```

	x	y
0	1	4
1	2	5
2	3	6

```python
import pandas as pd

pd.DataFrame(
    {
        "x": [1, 2, 3],
        "y": [4, 5, 6],
    }
)
```

	x	y
0	1	4
1	2	5
2	3	6

Importing from a subdirectory

Want `keras.models.Sequential()`.

```
1 import keras
2
3 model = keras.models.Sequential()
```

Alternatives using `from`:

```
1 from keras import models
2
3 model = models.Sequential()
```

```
1 from keras.models import Sequential
2
3 model = Sequential()
```

Lecture Outline

- Data Science & Python
- Python Data Types
- Collections
- Control Flow
- Python Functions
- Import syntax
- **Lambda functions**

Anonymous ‘lambda’ functions

Example: how to sort strings by their second letter?

```
1 names = ["Josephine", "Patrick", "Bert"]
```

If you try `help(sorted)` you’ll find the `key` parameter.

```
1 for name in names:
2     print(f"The length of '{name}' is {len(name)}.")
```

```
The length of 'Josephine' is 9.
The length of 'Patrick' is 7.
The length of 'Bert' is 4.
```

```
1 sorted(names, key=len)
```

```
['Bert', 'Patrick', 'Josephine']
```

Anonymous ‘lambda’ functions

Example: how to sort strings by their second letter?

```
1 names = ["Josephine", "Patrick", "Bert"]
```

If you try `help(sorted)` you’ll find the `key` parameter.

```
1 def second_letter(name):
2     return name[1]
```

```
1 for name in names:
2     print(f"The second letter of '{name}' is '{second_letter(name)}'.")
```

```
The second letter of 'Josephine' is 'o'.
The second letter of 'Patrick' is 'a'.
The second letter of 'Bert' is 'e'.
```

```
1 sorted(names, key=second_letter)
```

```
['Patrick', 'Bert', 'Josephine']
```

Anonymous ‘lambda’ functions

Example: how to sort strings by their second letter?

```
1 names = ["Josephine", "Patrick", "Bert"]
```

If you try `help(sorted)` you’ll find the `key` parameter.

```
1 sorted(names, key=lambda name: name[1])
```

```
['Patrick', 'Bert', 'Josephine']
```

Caution

Don’t use `lambda` as a variable name! You commonly see `lambd` or `lambda_` or `λ`.

with keyword

Example, opening a file:

Most basic way is:

```
1 f = open("haiku1.txt", "r")
2 print(f.read())
3 f.close()
```

```
Chaos reigns within.
Reflect, repent, and reboot.
Order shall return.
```

Instead, use:

```
1 with open("haiku2.txt", "r") as f:
2     print(f.read())
```

```
The Web site you seek
Cannot be located, but
Countless more exist.
```

Haikus from http://www.libertybasicuniversity.com/lbnews/nl107/haiku.htm

Package Versions

```
1 from watermark import watermark
2 print(watermark(python=True, packages="keras,matplotlib,numpy,pandas,seaborn,scipy,torch"
```

```
Python implementation: CPython
Python version       : 3.14.3
IPython version      : 9.13.0

keras     : 3.14.1
matplotlib: 3.10.9
numpy     : 2.4.4
pandas    : 3.0.2
seaborn   : 0.13.2
scipy     : 1.17.1
torch     : 2.11.0
```

Links

If you came from C (i.e. are a joint computer science student), and were super interested in Python's internals, maybe you'd be interested in this How variables work in Python video.

Glossary

- default arguments
- dictionaries
- f-strings
- function definitions
- Google Colaboratory
- `help`
- list
- `pip install ...`
- `range`
- slicing
- tuple
- `type`
- whitespace indentation
- zero-indexing