# Introduction to Python Day 7

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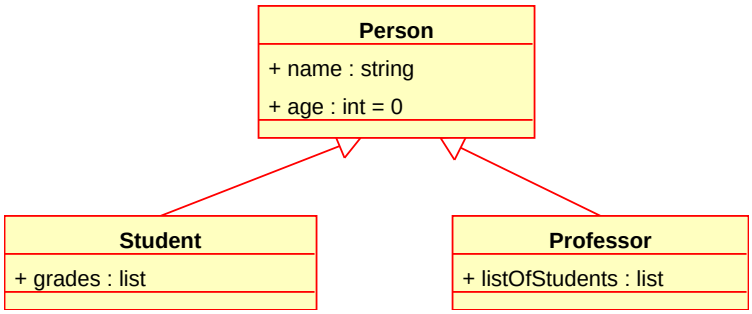
## Classes

- Classes are objects
- Can combine data and functions
- Can create complex data structures
- Helps you to organise your code and data

## Where are they useful?

- You want to combine different structures
- You need to add information to your data
- You want to use/reuse specific functions with your data

## Class structure and relationship



## General structure

```
class ClassName:
    def __init__(self, parameters):
        # Constructor
        self.attribute = parameters

    def method(self, parameters):
        # Method
        return self.attribute + parameters
```

- `ClassName` is the name of the class
- `__init__` is the constructor
- `self` is the instance of the class
- `parameters` are the function inputs
- `self.attribute` is the attribute of the class
- `method` is a method of the class
  - methods are functions that belong to the class
- `return` is the output of the method

## The concept of `self`

- `self` is a reference to the current instance of the class
- Accessing `self` with dot notation allows you access/modification of the class
  - `self.attribute`
- A method of a class might require to access the class itself
  - `self` is passed as first argument to the method
  - `self` could be also called `this`, `cls`, or any other name
  - It is convention to use `self` in Python

## What could a class look like?

```
class Experiment:
    def __init__(self, name, date):
        self.name = name
        self.date = date
        self.data = []

    def add_data(self, data):
```

```
        self.data.append(data)

    def get_data(self):
        return self.data
```

### How to use them?

```
test_experiment = Experiment("LTP", "2025-04-15")
type(test_experiment)
test_experiment.name
test_experiment.date
test_experiment.add_data([1.41, 1.38, 1.39])
test_experiment.get_data()
```

```
__main__.Experiment
```

```
'LTP'
```

```
'2025-04-15'
```

```
[[1.41, 1.38, 1.39]]
```

- Similar to what we saw before:
  - `test_experiment` is an instance of the class `Experiment`
  - `name` and `date` are attributes of the class (dot notation)
  - `add_data` and `get_data` are methods of the class (dot notation)

### How to use them?

- We can now write functions which use the class as input

```
def average_LTP(experiment: Experiment) -> float:
    """
    Calculate the average of the data in an Experiment object.
    Parameters:
    experiment (Experiment): The Experiment object containing data.
    Returns:
    float: The average of the data.
    """
    import numpy as np
```

```
    if not isinstance(experiment, Experiment):
        raise TypeError("Input must be an Experiment object.")

    return np.mean(experiment.data)
```

- Function requires the `Experiment` class as input
- Checks if the input is of the correct type
- Calculates the average of the data in the `Experiment` object

Notice we can use type hints to specify the input and output type of the function. In our case the input is an `Experiment` object and the output is a float. This is not mandatory, but it helps to understand the function better. You can use the import statement to import the numpy library inside the function.

### What is an advantage of using a class?

- We could specify sensible functions to use with the object
- An external function could require to use multiple inputs
  - A class can combine all the inputs into one object
- Well defined classes can be reused for different functions
- A lot of information can be stored in one object
- Classes can be dynamic

### Example for an event class

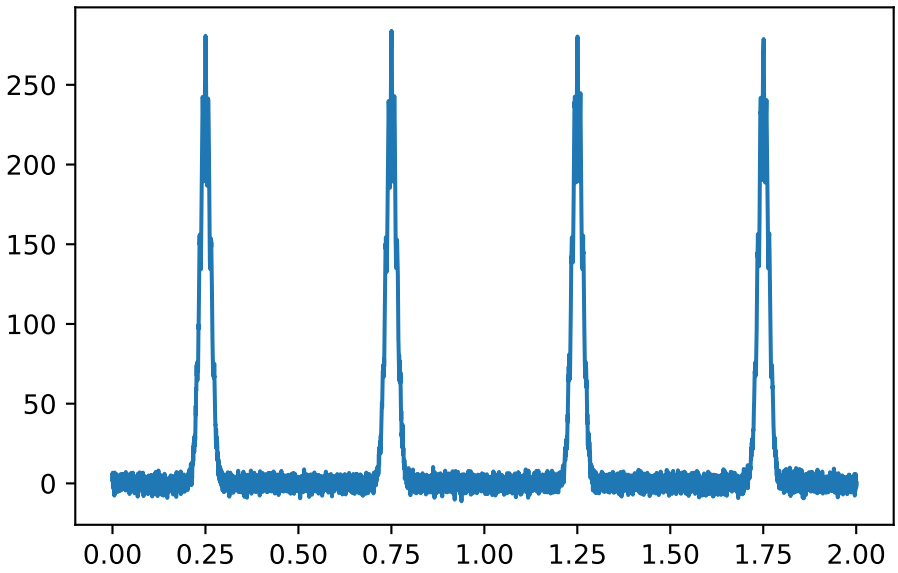
```
time = np.linspace(start=0, stop=0.5, num=2000)
mu, sigma = 0.25, 0.01
sinewave = np.sin(time * 250 * np.pi)
gaussian = (1 / (np.sqrt(2 * np.pi * np.square(sigma))) *
            np.exp(-(np.square(time - mu) /np.square(2 * sigma))))
ripple = gaussian * sinewave
```

- Recall from previous lessons

### Example for an event class

```
np.random.seed(0)
trace = ripple + gaussian*6
# repeat the trace 4 times
```

```
# add noise
trace = np.tile(trace, 4)
trace += np.random.normal(0, 3, size=trace.shape)
# add time to the trace
time = np.arange(start=0, step=time[1], stop=len(trace)*time[1])
plt.plot(time, trace)
plt.show()
```




- We can use the `trace` and `time` to create an event class

### In class coding

- Create an `Event` class

### Now let's make our own

- Make a class!