Python Summer Course
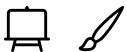
Course 2: Functions, Lists, Dictionaries & Classes

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main

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List

A **list** is an ordered, changeable collection of items, written with square brackets.

```python
1  fruits = ["apple", "banana", "cherry"]
2  empty = []
3  mixed = [1, "yes", True]
```

Key Features:

- Ordered: items have positions (indexes)

- Mutable: you can change, add, or remove items

- Can contain any type, even mixed types

Functions, Lists, Dictionaries & Classes

Downloading package: ipython

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Accessing Elements & Slicing

Python Code ↻ Start Over   ▷ Run Code

```python
fruits = ["apple", "banana", "cherry", "orange", "melon"]
print(fruits[0])
print(fruits[-1])
```

Python Code ↻ Start Over   ▷ Run Code

```python
print(fruits[1:3])    # From index 1 to 2 → ['banana', 'cherry']
print(fruits[:2])     # From start to index 1 → ['apple', 'banana']
print(fruits[2:])     # From index 2 to end → ['cherry', 'orange']
```

Python Code ↻ Start Over   ▷ Run Code

```python
print(fruits[::2])    # Every 2nd item → ['apple', 'cherry']
print(fruits[::-1])   # Reversed list → ['orange', 'cherry', 'banana', 'apple']
```

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List Manipulation

Add & Remove

Python Code ↻ Start Over   ▷ Run Code

```python
fruits = ["apple", "banana", "cherry"]

print(len(fruits))

fruits.append("orange")     # Add at the end
fruits.insert(1, "kiwi")    # Insert at position
fruits.remove("banana")     # Remove by value

print(fruits)
```
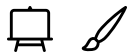
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Looping Through Lists

Python Code ⟳ Start Over   ▷ Run Code

```python
for fruit in fruits:
    print(fruit)
```

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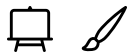Hes·so// VALAIS WALLIS

Useful Functions

Python Code ↻ Start Over   ▷ Run Code

```python
1  print(len(fruits))       # Number of items
2  print(sorted(fruits))    # New sorted list
3  fruits.sort()            # Sort in place
4  print(fruits)
5  fruits.reverse()         # Reverse order
6  print(fruits)
```
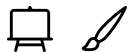
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Indexing Reminder

Python Code   ⟳ Start Over   ▷ Run Code

```python
fruits[2] = "grape"        # Modify item at index 2
print(fruits)
```

Functions, Lists, Dictionaries & Classes

List Comprehension

List comprehensions are a concise way to **create new lists** by transforming or filtering items. it is also more efficient than doing a for loop.

```
1  new_list = [expression for item in iterable]
```
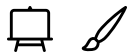
Functions, Lists, Dictionaries & Classes
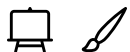
Example: Squares of numbers

Python Code ↻ Start Over   ▷ Run Code

```python
squares = [x**2 for x in range(5)]
print(squares)   # [0, 1, 4, 9, 16]
```

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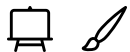Functions, Lists, Dictionaries & Classes

With Condition: Even numbers

Python Code ↻ Start Over   ▷ Run Code

```python
evens = [x for x in range(10) if x % 2 == 0]
print(evens)  # [0, 2, 4, 6, 8]
```

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With Transformation

Python Code ↻ Start Over	▷ Run Code

```python
fruits = ["apple", "banana", "cherry"]
uppercased = [fruit.upper() for fruit in fruits]
print(uppercased)  # ['APPLE', 'BANANA', 'CHERRY']
```

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Tuple

A **tuple** is an ordered, immutable collection of values, like a list, but you **can't change it**.

```python
1  my_tuple = (1, 2, 3)
2  empty = ()
3  single = (5,)  # Comma is required for single-item tuples
```

Key Features:

- Ordered: elements have a position

- Immutable: you can't add, remove, or change items

- Can contain mixed types: `("Alice", 30, True)`

- Supports indexing and slicing like lists
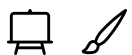
Example

Python Code ↻ Start Over   ▷ Run Code

```python
1  person = ("Alice", 30)
2
3  print(person[0])
4  print(len(person))
```

Python Code ↻ Start Over   ▷ Run Code

```python
1  person = ("Alice", 30)
2  # Immutable
3  person[0] = "Bob"
```

main

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Set

A **set** is an unordered collection of **unique** items. It is great for removing duplicates and testing membership.

```python
my_set = {1, 2, 3, 3, 2}
print(my_set)  # {1, 2, 3}

# Empty set

my_empty_set = set() # not = {} !!
```

Python Code ↻ Start Over   ▷ Run Code

⚠️ Properties:

- Sets are **unordered**: no indexing

- Only **immutable** items allowed (no lists/dicts inside sets)

Set Operations

```python
a = {1, 2, 3}
b = {3, 4, 5}

print(a | b)    # Union
print(a & b)    # Intersection
print(a - b)    # Difference
```

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Methods

| Python Code | ⟳ Start Over | | ▷ Run Code |

```python
1  a.add(6)
2  a.remove(1)
3  print(a)
```

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What I can't put in a set

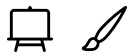Python Code   ⟳ Start Over   ▷ Run Code

```
1  a.add(["a", "b", "c"])
```

Python Code   ⟳ Start Over   ▷ Run Code

```
1  # A tuple is ok!
2  a.add(("a", "b", "c"))
3  print(a)
4  a.add(tuple(["a", "b", "c"]))
5  print(a)
```

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Dictionaries

A **dictionary** is a collection of key–value pairs, like a real-life lookup table.
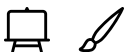
Python Code ⟳ Start Over ▷ Run Code

```python
person = {
    "name": "Alice",
    "age": 30,
    "is_student": False
}

print(person["name"])

# Empy dictionary
my_dict = {} # or dict()

# Add an element
my_dict["Counts"] = 0
print(my_dict)
```

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⚠️ Important:

- Keys must be **unique** and **immutable** (e.g. strings, numbers)

- Values can be any type

- Dictionaries are **unordered** before Python 3.7

Python Code   🔄 Start Over   ▷ Run Code

```
1  # this is ok
2  my_dict[("a", 5)] = [1, 2, 3]
```

Python Code   🔄 Start Over   ▷ Run Code

```
1  # this is NOT ok
2  my_dict[[1, 2, 3]] = 8
```

Dictionary Comprehension

```python
squares = {x: x**2 for x in range(5)}
print(squares)  # {0: 0, 1: 1, 2: 4, 3: 9, 4: 16}
```

You can also add a condition:

Python Code ↻ Start Over ▷ Run Code

```python
evens = {x: x for x in range(10) if x % 2 == 0}
print(evens)
```
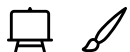
Functions, Lists, Dictionaries & Classes

Common Operations

```python
person = {"name": "Alice", "age": 30}

print(person.keys())
print(person.values())
print(person.get("email"))

person["email"] = "alice@example.com"
del person["age"]
print(person)
```

⚠️ Important:

- dictionnary logic is the base of JSON format (see later)

- dictionnary are used a lot to provdie data samples (e.g. ML/DL)

main

Functions

Functions are reusable blocks of code that perform a specific task.

```python
1  def function_name(parameters):
2      """
3      Optional docstring describing what the function does.
4      """
5      # code block
6      # many compicated things using parameters
7      return result
8      # or does not return anything
```

Example

Python Code | ⟳ Start Over | ▷ Run Code

```python
def greet(name):
    return f"Hello, {name}!" #

print(greet("Alice"))
```

Functions, Lists, Dictionaries & Classes

Function Parameters & Return Values

Functions can take inputs (zero, one or more) and return outputs.

⚠️ Important:

- **Parameters** are local names inside functions

- **Return** ends the function and gives back a value

- **Docstring** helps explain the function's purpose, but is optional

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Functions, Lists, Dictionaries & Classes

Example:

Python Code   ↻ Start Over   ▷ Run Code

```python
def add(a, b):
    """Return the sum of a and b."""
    return a + b

result = add(3, 5)
print(result)
```

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Mutable vs Immutable Parameters

When passing values to functions, behavior depends on **whether the object is mutable or immutable**.
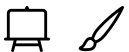
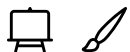# Immutable (e.g. `int`, `str`, `tuple`)

- A **copy of the value** is passed

- Changes inside the function **don't affect** the original

Python Code ⟲ Start Over   ▷ Run Code

```python
def update_number(x):
    x = x + 1
    print("Inside:", x)

n = 5
update_number(n)
print("Outside:", n)  # Still 5
```

Mutable (e.g. `list`, `dict`, `set`)

- A **reference to the object** is passed

- Changes inside the function **do affect** the original

Python Code ↻ Start Over ▷ Run Code

```python
def add_item(my_list):
    my_list.append("new")

items = ["apple", "banana"]
add_item(items)
print(items)
```

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Functions Call Functions

Functions can be combined, one function can call another to build **modular and reusable** logic.
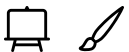
Example: Grading system

Python Code   ⟳ Start Over   ▷ Run Code

```python
def calculate_average(scores):
    return sum(scores) / len(scores)

def determine_grade(average):
    if average >= 90:
        return "A"
    elif average >= 75:
        return "B"
    elif average >= 60:
        return "C"
    else:
        return "F"

def grade_student(scores):
    avg = calculate_average(scores)
    grade = determine_grade(avg)
    return f"Average: {avg:.1f}, Grade: {grade}"

# Example usage
grade_student([88, 92, 79])
```
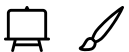
⬅ main   Functions, Lists, Dictionaries & Classes
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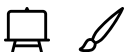
Key Concepts

- Each function has a **clear responsibility**

- Complex logic is broken into **smaller, reusable pieces**
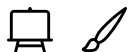
- You can use `if`, `for`, and `return` together

Other features (introduced later or in provided references):

- Default values

- Function as arguement

- Lambda functions

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Classes and Objects

A **class** defines a blueprint for objects: t groups **data** and **behavior** together.

We will not go into much details here, but just give an overview for yu to understand objects and how to use them.

Create a Simple Class

Python Code ↻ Start Over   ▷ Run Code

```python
class Dog:
    def bark(self):
        print("Woof!")
```

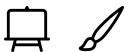Functions, Lists, Dictionaries & Classes

Create and Use an Object (Instance)

Python Code | ↻ Start Over | ▷ Run Code

```python
1  my_dog = Dog()    # Create an object
2  my_dog.bark()     # Call a method
```

The object `my_dog` is an **instance** of the class `Dog`.

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Class Initialization with `__init__`

The `__init__` method runs **when the object is created** and sets initial values of the attributes.

Example with Constructor

Python Code | ↻ Start Over | ▷ Run Code

```python
class Dog:
    def __init__(self, name, age):
        self.name = name
        self.age = age

    def speak(self):
        print(f"{self.name} says: Woof!")

my_dog = Dog("Rex", 4)
my_dog.speak()      # "Rex says: Woof!"
print(my_dog.age)   # 4
```

⚠️ Important: `self` refers to the **current object**: you must include it in all methods!

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Adding Behavior with Methods

You can define your own methods to give objects useful **behaviors**.

If a class represents a **coffee machine**, the methods represent different programms to make different coffee.

But all the programms use the same internal attributes (e.g. coffee, water), or even internal functions (e.g. grind coffee, heat water)
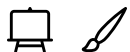
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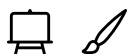
Example with State Change

Python Code ↻ Start Over   ▷ Run Code

```python
class Counter:
    def __init__(self):
        self.value = 0

    # We use default value if not supplied
    def increment(self, inc = 1):
        self.value += 1

    def reset(self):
        self.value = 0

counter = Counter()
counter.increment()
counter.increment()
print(counter.value)  # 2
counter.reset()
print(counter.value)  # 0
```

Objects **remember their state**, and methods can **modify** it.

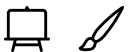Functions, Lists, Dictionaries & Classes

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Your turn!

Define student data: Create a list of students. Each student is a dictionary containing:
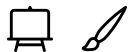
- "name" (string),

- "age" (int),

- "grades" (a dictionary of course:grade pairs)

Functions, Lists, Dictionaries & Classes

Solution

Show Solution | Enter code

Functions, Lists, Dictionaries & Classes

Write functions, taking your list of students, to:

- Display all student names

- Calculate average grade for a given student (using buillding `sum()` function)

Functions, Lists, Dictionaries & Classes
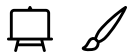
Solution

Show Solution | Enter code

Create a Student class

Define a class with attributes: name, age, grades, and methods to:

- Add a grade for a given course

- Compute the average for the student

- Display infos (whatever you want to print)

Solution

Show Solution | Enter code
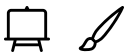
Functions, Lists, Dictionaries & Classes

More references

[Python course for data analysis](#)

[The Python tutorial](#)