

# Intro to programming 4

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2023-10-09

# Terminal cheat sheet reminder

- Bash commands to navigate directories
  - Print Working Directory. Print the path of the current directory

```
pwd
```

- List all files of the current directory

```
ls folder
```

- Moving into folder1 and subfolder2 at once.

```
cd folder1/subfolder2
```

- Moving out of a directory

```
cd ..
```

- Going back and forth in the directory tree

```
cd ../../folder1/subfolder1
```

- Going back to the root directory

```
cd ~
```

- “**Tab**” to use the auto-completion
- **Ctrl + C** to stop a program execution
- “**Upper arrow**” to see last commands
- Many more bash commands to use...

- Python
- Data types:
  - integer
  - float
  - string
  - boolean
- **If, For and While** loops:
  - syntax
  - indentation
- Data collections:
  - list
  - tuple
  - set
  - dictionary
- Python Standard library
  - Python modules
  - Python built-in functions

- Functions:
  - Definition
  - Parameter and argument
  - Return value
  - Scope of variable
  - Module
  - Pure functions vs function vs procedures
- Exercises

## Functions intro 1/2

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- When you call a function, you execute the code written within that function.

```
# definition of a function named 'one_two'  
def one_two():  
    print(1)  
    print(2)  
    print('...')
```

```
one_two() # function calls 1
```

```
## 1  
## 2  
## ...
```

```
one_two() # function calls 2
```

```
## 1  
## 2  
## ...
```

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- Run this code in <http://pythontutor.com/>

```
# definition of a function named 'one_two'
def lorem_ipsum():
    print("Lorem ipsum dolor sit amet, consectetur adipiscing elit.")
    print(" Sed non risus.")
    print("Suspendisse lectus tortor, dignissim sit amet, adipiscing nec, ul
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- What, in your opinion, is the interest of functions?

## Usefulness of functions

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- Using functions generally enhances code readability and may result in shorter code (hopefully. . . ).

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- Remarks:
  - A given script can contain several function definitions.
  - As a convention, all functions definitions must be at the beginning of the script.

# Arguments

- You can provide inputs to your function, which are called parameters.

```
def hello(name):  
    print('Hello, ' + name)
```

```
hello('Alice')
```

```
## Hello, Alice
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hello('Bob')
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- Run it in <http://pythontutor.com/>
- Note: The variable 'name' is created and exists only during the execution of the function `hello()`; it is local to `hello()`.



## Multiple arguments

- If you can pass one argument, you can also pass two or ten, depending on the function's definition.

```
def print_if_divisible(n, div):  
    if (n % div == 0):  
        print(n, ' is a divisible by ', div)
```

```
print_if_divisible(10, 5)
```

```
## 10  is a divisible by  5
```

```
print_if_divisible(11, 5)
```

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- As an exercise, you can use the provided function to find the divisors of numbers like 10, 15, 27, 33, 64, and 100.

- The functions we have seen so far perform actions.

## Return values 1/3

- The functions we have seen so far perform actions.
- Functions can also return the result(s) of a computation.

```
def func(x):  
    y = 2 * x + 1  
    return y
```

```
print(func(0.0))
```

```
## 1.0
```

```
print(func(1.0))
```

```
## 3.0
```

```
print(func(2.5))
```

```
## 6.0
```

## Return values 2/3

```
def func(x):  
    y = 2 * x + 1  
    return y  
  
# compute the values of func for x in [-10, -9, -8, ..., 8, 9, 10]  
xs = range(-10, 11)  
values = []  
for x in xs:  
    values.append(func(x))  
  
# display them on a graphics  
import matplotlib.pyplot as plt  
plt.plot(xs, values)  
plt.show()
```

## Return values 3/3

# Boolean Functions

- Boolean functions return either True or False.

```
def is_divisible(x, y):  
    if (x % y == 0):  
        result = True  
    else:  
        result = False  
  
    return result  
  
print(is_divisible(10, 5))
```

## True

-> Question: How can one simplify (shorten) the function `is_divisible`?

## Returning “complex” objects

- A function in Python can return various data types, including tuples, lists, dictionaries, and more.

```
def f(x):  
    y1 = x + 1  
    y2 = x * 3  
    y3 = x ** 2 + 3  
    return (y1, y2, y3)
```

```
a,b,c =f(2.0)  
print(a,b,c)
```

```
## 3.0 6.0 7.0
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## 3.0 6.0 7.0
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- You can specify default values for function arguments, allowing you to provide a parameter with a default value if none are passed during the function call.
- It is indeed possible to set default values for function arguments.

```
def message(name, msg='Hello'):  
    print(msg + ' ' + name + '!')
```

```
message("Anna")
```

```
## Hello Anna!
```

```
message("Anna", "Goodbye")
```

## Use of position or keyword

- In a function call, parameters are usually assigned values from arguments based on either their position or their names.

```
def f(a, b):  
    print('a=', a)  
    print('b=', b)
```

```
f(1, 2)
```

```
## a= 1  
## b= 2
```

```
f(2, 1)
```

```
## a= 2  
## b= 1
```

```
f(b=2, a=1)    # but one can also use the names of arguments
```

```
## a= 1  
## b= 2
```

# Methods vs Functions

- Methods are quite similar to functions.
- Each data type has its own set of methods.
- For example the **list** data type has methods such:
  - `append()`
  - `sort()`
  - `index()`
  - `reverse()`
  - and more...
- Unlike functions, methods are called on specific values (e.g., lists, dictionaries, sets, etc.).
- Here's an example illustrating the difference between a method and a function.

```
def appending(list1,new_element):  
    list1[-1] = new_element  
    return list1
```

```
element = "g"  
myList = ["a", "b", "c", "d", "e" ]  
myList.append(element) # method  
print(myList)
```

```
## ['a', 'b', 'c', 'd', 'e', 'g']
```

```
print(appending(myList,element)) # function
```

```
## ['a', 'b', 'c', 'd', 'e', 'g']
```

## Scope of variables 1/2

- Try the following code in <http://pythontutor.com/>

```
name = 'chris'

def hello(name):
    print('Hello, ' + name)

print(name)

## chris

hello('Alice')

## Hello, Alice

hello('Bob')

## Hello, Bob

print(name)

## chris
```

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```

- Two variables with the same name, **Name**, can be used for different purposes. This is possible but can be confusing because they have different scopes.

## Scope of variables 2/2

- **local variables** : These are arguments or variables defined within the body of a function. They exist only while the function is being executed and are destroyed when the function finishes, freeing up the associated memory.

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- The reason for avoiding it is to make functions self-contained and easy to understand based solely on their calls.
- You can read more about local and global scope in the section titled “Local and Global Scope” in the book : “Automate the Boring Stuff” Chapter 3  
<https://automatetheboringstuff.com/chapter3/>

# Functions can call other functions

Functions can call each other.

```
def func1():  
    print(1)  
  
def func2():  
    func1()  
    print(2)  
    func1()  
  
func2()
```

-> Predict the output of this script.

# Functions can call other functions

Note that functions can call each other.

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```
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    print(2)  
    func1()
```

```
func2()
```

```
## 1  
## 2  
## 1
```

# Recursive functions

Recursive functions are functions that contain calls to themselves.

For example:

```
def fact(n):  
    if n == 0:  
        return 1  
    else:  
        return n * fact(n - 1)
```

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- Functions defined in a file like myfunc.py in the current folder can be called from another Python script.

```
### file "mymodule.py"  
def hello(name):  
    print("Hello ", name, "!")
```

```
### file "myscript.py"  
import mymodule  
  
mymodule.hello("Chris")
```



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- Modules (or libraries) allow you to reuse functions and keep your scripts more organized.
- Python comes with many built-in modules, including random, math, and os.

## if name == 'main'

- Many scripts consist of a series of functions followed by the line:

```
if __name__ == '__main__':
```

- The behavior of the script can vary depending on whether it is the main script or if it is imported by another script.
- The condition `if name == 'main':` is true only if the script is executed as a Python script (not imported).
- Functions defined before the `if name == 'main':` block can be reused when the script is imported by other scripts.
- This structure is designed this way to allow a script to be both executable and importable as a module. It is useful when creating libraries or modules that may require configuration tests or settings but should also be used as a module by others who only need the functions.

# Functions vs Procedures

- Different types of functions in programming:

-1 *A pure function always returns the same value for the same parameter and has no side effects.*

```
'''python
def addition(a,b):
    return a+b
x=addition(1,2)
print(x)
'''
```

```
'''
## 3
'''
```

-2 *A function returns a value and calculates that value based on its input.*

```
'''python
a=1
def addition(b):
    return a+b
x=addition(2)
print(x)
'''
```

```
'''
```

## Exercises:

- 1- Define a function with two arguments — a string `msg` and a number `nrepetitions` — that prints `msg`, `nrepetition` times.
- 2- Read <https://en.wikipedia.org/wiki/Fahrenheit> and write a function that converts from Fahrenheit to Celsius, and another one that converts from Celsius to Fahrenheit
- 3- Define a function `is_prime(x)` which returns `True` if `x` is a prime number, else `False`. Use it to list all prime numbers below 1000.
- 4- Two taxis companies propose different pricing schemes: Company A charges 4.80€ plus 1.15€ by km traveled. Company B charges 3.20€ plus 1.20€ by km traveled. Write a first function which, given a distance, returns the costs of both companies, and a second function that returns 'company A' or 'company B', the cheapest company for a given distance.
- 5- Write a function `are_anagrams(word1, word2)` that tests if two words are anagrams, that is contain the same letters in different orders.

## Even more exercises:

See

- <https://pcbs.readthedocs.io/en/latest/representing-numbers-images-text.html>
- [https://pcbs.readthedocs.io/en/latest/building\\_abstractions\\_with\\_functions.html](https://pcbs.readthedocs.io/en/latest/building_abstractions_with_functions.html)