# DIT gentle introduction to Python

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**Basics**

## What is a programming language?

A programming language is just another language. . .

> *A formal language comprising a set of instructions that produce various kinds of output [given an input]*

`https://en.wikipedia.org/wiki/Programming_language`

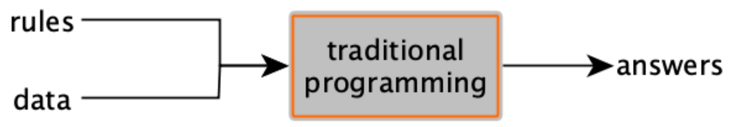


Diagram borrowed from L. Moroney's Introduction to TensorFlow for Artificial Intelligence, Machine Learning, and Deep Learning

## What is a programming language?

*Programming languages are used in computer programming to implement an algorithm**

https://en.wikipedia.org/wiki/Programming_language

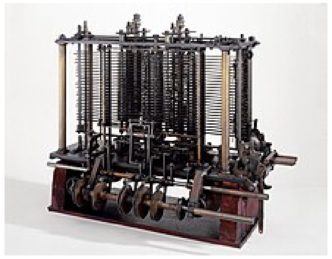
1983 USSR stamp commemorating al-Khwārizmī's (approximate) 1200th birthday

* derived from the 9th century Persian Mathematician Muhammad ibn Mūsā al-Khwārizmī

## The *first* programmer

A. Lovelace by 1840

**Ada Lovelace**[a] (Mathematician) published the first algorithm for Charles Babbage's analytical engine



[a]Lord Byron's daughter

**Algorithms**

## Algorithm

*A finite sequence of well-defined computer-implementable instructions, typically to solve a class of problems or to perform a computation*

https://en.wikipedia.org/wiki/Algorithm

## Algorithm Example: Find out if a number is odd or even*

**Definitions**

- A number is even if it can be divided by 2 without remainder
- A number is odd if it leaves a remainder when divided by 2

**Examples**

Even numbers: 2, 4, 6, 8, etc.

Odd numbers: 1, 3, 5, 7, etc.

**Silly (useless) solution:**

- Fill a bag with all even numbers and a second bag with all odd numbers
- Given an input number, look for it in both bags and return the label of the one in which you found it

*Adapted from `https://www.c-programming-simple-steps.com/algorithm-examples.html`

## Algorithm Example: Find out if a number is odd or even

Problem Definition

Input/Output
$\rightarrow$ an integer (data)
$\leftarrow$ even or odd (more data)

Process
A series of instructions and routines

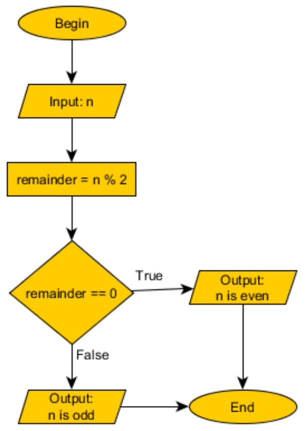
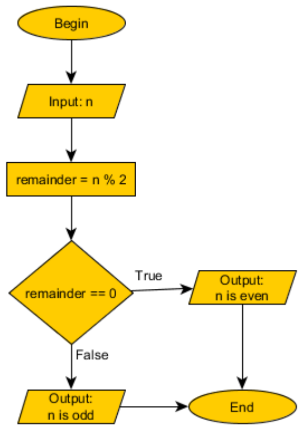


Diagram borrowed from `https://www.c-programming-simple-steps.com/algorithm-examples.html`

## Algorithm Example: Find out if a number is odd or even

From the algorithm to the implementation



```
if n%2 == 0:
  print('even')
else:
  print('odd')
```

**Programming languages**

## History of (some) flagship languages (1/2)

| year | language | highlights |
|---|---|---|
| 1957 | Fortran | Compiled, imperative |
| 1959 | Lisp* | Object-oriented, popular in AI, recursive functions |
| 1964 | Basic* | Procedural, object-oriented ("goto") |
| 1970 | Pascal* | Imperative, procedural, lists, trees |
| 1972 | C* | Procedural, recursion, static type system |
| 1983 | C++* | Object-oriented, compiled, functional |

* language I "speak" (or "spoke" at some point in time)

## History of (some) flagship languages (2/2)

| year | language | highlights |
|---|---|---|
| 1989 | Python* | Interpreted, object-oriented, code readability |
| 1995 | Java* | Compiled, object-oriented |
| 1995 | Javascript | Just-in-time-compiled, object-oriented, WWW |
| 1995 | PHP* | Scripting, Web-oriented |
| 2001 | V. Basic.NET | Object-oriented, .NET framework |
| 2009 | Go | Compiled, C-like (safer) |

* language I "speak" (or "spoke" at some point in time)

## Python

(Among other things), python is. . .

**General-purpose**
Applicable across application domains

**High-level**
Strong abstraction from the computer (hardware)

**Interpreted**
No previous compilation into machine-level instructions necessary

**(Not-necessarily) object-oriented paradigm**
An object contains data (attributes) and procedures (methods)

## Python

Some notable features

- Elegant syntax (indentation-based) $\rightarrow$ easy to read
- Simple and ideal for prototyping
- It has a large standard library for diverse tasks (e.g., web servers, text search and processing, file reading/modifying)
- Interactive mode $\rightarrow$ continuous snippet testing
- Extendable with modules in compiled languages (e.g., C++)
- Multi-platform (e.g., Mac OS X, GNU Linux, Unix, MS Windows)
- Free: zero-cost to download/use; open-source license
- Large and friendly community

https://wiki.python.org/moin/BeginnersGuide/Overview

## Python

Some programming-language features

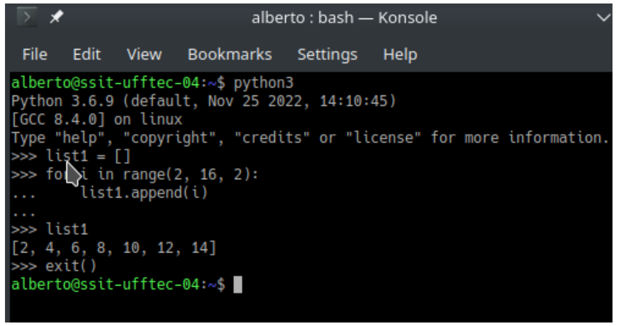
- A variety of basic data types are available:[1]
  - numbers (floating point, complex, integers)
  - strings (both ASCII and Unicode)
  - Lists
  - Dictionaries
- It supports object-oriented programming
- Code can be grouped into modules and packages

[1] Later today

## Python

Some ways to code/launch a python program

UNIX / GNU Linux / Windows terminal

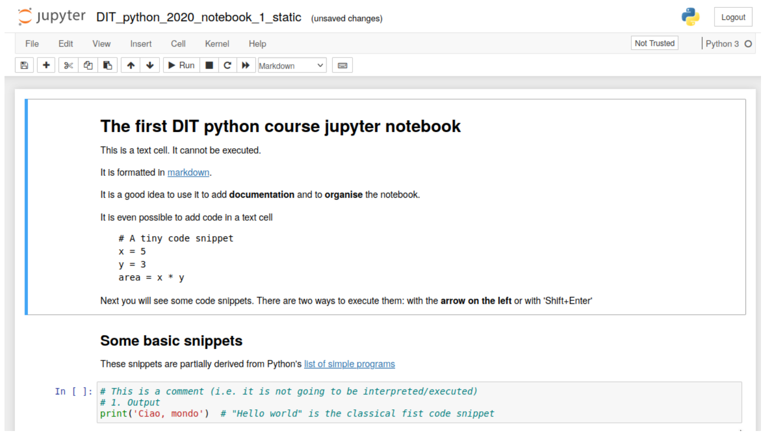


```
alberto@ssit-ufftec-04:~$ python3
Python 3.6.9 (default, Nov 25 2022, 14:10:45)
[GCC 8.4.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> list1 = []
>>> for i in range(2, 16, 2):
...     list1.append(i)
...
>>> list1
[2, 4, 6, 8, 10, 12, 14]
>>> exit()
alberto@ssit-ufftec-04:~$
```

## Python

Some ways to code/launch a python program

Web browser: local, online, on Google's colab


jupyter DIT_python_2020_notebook_1_static (unsaved changes)
Logout
File Edit View Insert Cell Kernel Help
Not Trusted
Python 3
Run
Markdown

**The first DIT python course jupyter notebook**

This is a text cell. It cannot be executed.

It is formatted in markdown.

It is a good idea to use it to add **documentation** and to **organise** the notebook.

It is even possible to add code in a text cell

```
# A tiny code snippet
x = 5
y = 3
area = x * y
```

Next you will see some code snippets. There are two ways to execute them: with the **arrow on the left** or with 'Shift+Enter'

**Some basic snippets**

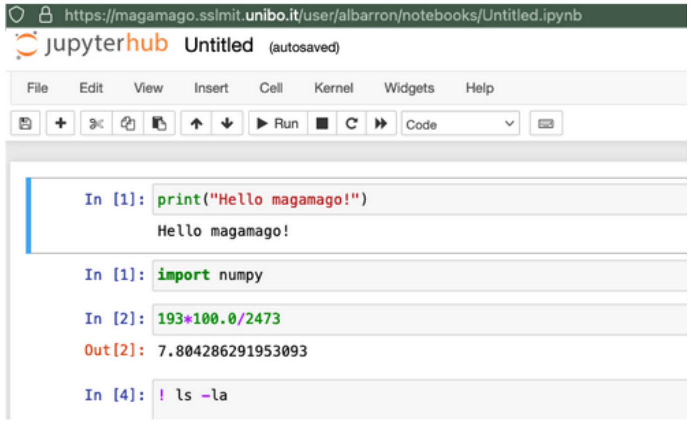
These snippets are partially derived from Python's list of simple programs

```
In [ ]: # This is a comment (i.e. it is not going to be interpreted/executed)
        # 1. Output
        print('Ciao, mondo')  # "Hello world" is the classical fist code snippet
```

## Python

Some ways to code/launch a python program

From your web browser on DIT's magamago (remotely online)[2]


https://magamago.sslmit.unibo.it/user/albarron/notebooks/Untitled.ipynb
jupyterhub Untitled (autosaved)
File Edit View Insert Cell Kernel Widgets Help
Run
Code

```
In [1]: print("Hello magamago!")
        Hello magamago!

In [1]: import numpy

In [2]: 193*100.0/2473
Out[2]: 7.804286291953093

In [4]: ! ls -la
```

[2] Open to advanced students only

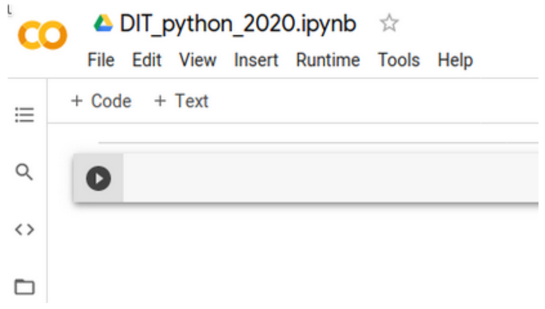
**Enough! Let us look at some code!**

**Baby steps into coding**

## Google's colab

*a free Jupyter notebook environment that runs in the cloud and stores its notebooks on Google Drive*

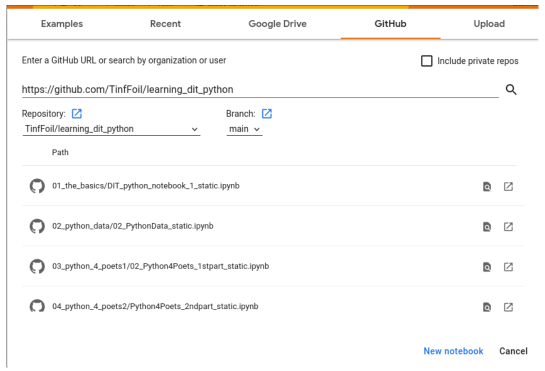
`https://colab.research.google.com`



Our first jupyter notebook

## Google's colab: baby steps

1. Visit `https://colab.research.google.com`
2. Click on Github
3. Type `https://github.com/TinfFoil/learning_dit_python`
4. Press search
5. Select **DIT_python_notebook_1_static.ipynb**



Enter a GitHub URL or search by organization or user

☐ Include private repos

https://github.com/TinfFoil/learning_dit_python

Repository: TinfFoil/learning_dit_python

Branch: main

Path

01_the_basics/DIT_python_notebook_1_static.ipynb

02_python_data/02_PythonData_static.ipynb

03_python_4_poets1/02_Python4Poets_1stpart_static.ipynb

04_python_4_poets2/Python4Poets_2ndpart_static.ipynb

## Baby Steps

What we know so far

**input/output**

- print() displays stuff to the screen
- input() captures information from the user

**variables**

| | |
|---|---|
| x = 5 | x is a variable<br>we assign values to a variable with = |
| x = 5 | is an integer |
| x = 5.5 | is a float |
| x = 'ciao' | is a string |
| x = "ciao" | is also a string |
| x = '5' | is what? |
| x = x * 3 | we can apply operators to variables<br>we can assign the output to a variable |

## Baby Steps

What we know so far

**flow control – conditionals**

```
if (condition):
  execute something
elif (condition):
  execute something
else:
  execute something
```

Only one of these three snippets is executed

```
if (condition):
  execute something
if (condition):
  execute something
else:
  execute something
```

**How is this different?**

**flow control – loops**

The code snippet will be executed during a number of iterations

Danger: a loop could run forever if there is an error

```
for (iterator):
  execute something
```

```
while (condition):
  execute something
```

## Baby Steps

What we know so far

**Basic formatting**

```
# my code
x = 0
while x < 50:
  for i in range(x):
    print('x', end=""
          )
  print()
  x += 1
```

- Comments start with #
- A line break is enough to close an instruction (in Java or C, we need ;)
- Colon opens a special code snippet
- Indentation is crucial

## You know a lot already!

It is your turn to play with the notebook

jupyter