DE LA RECHERCHE À L'INDUSTRIE

Remise à niveau en Python

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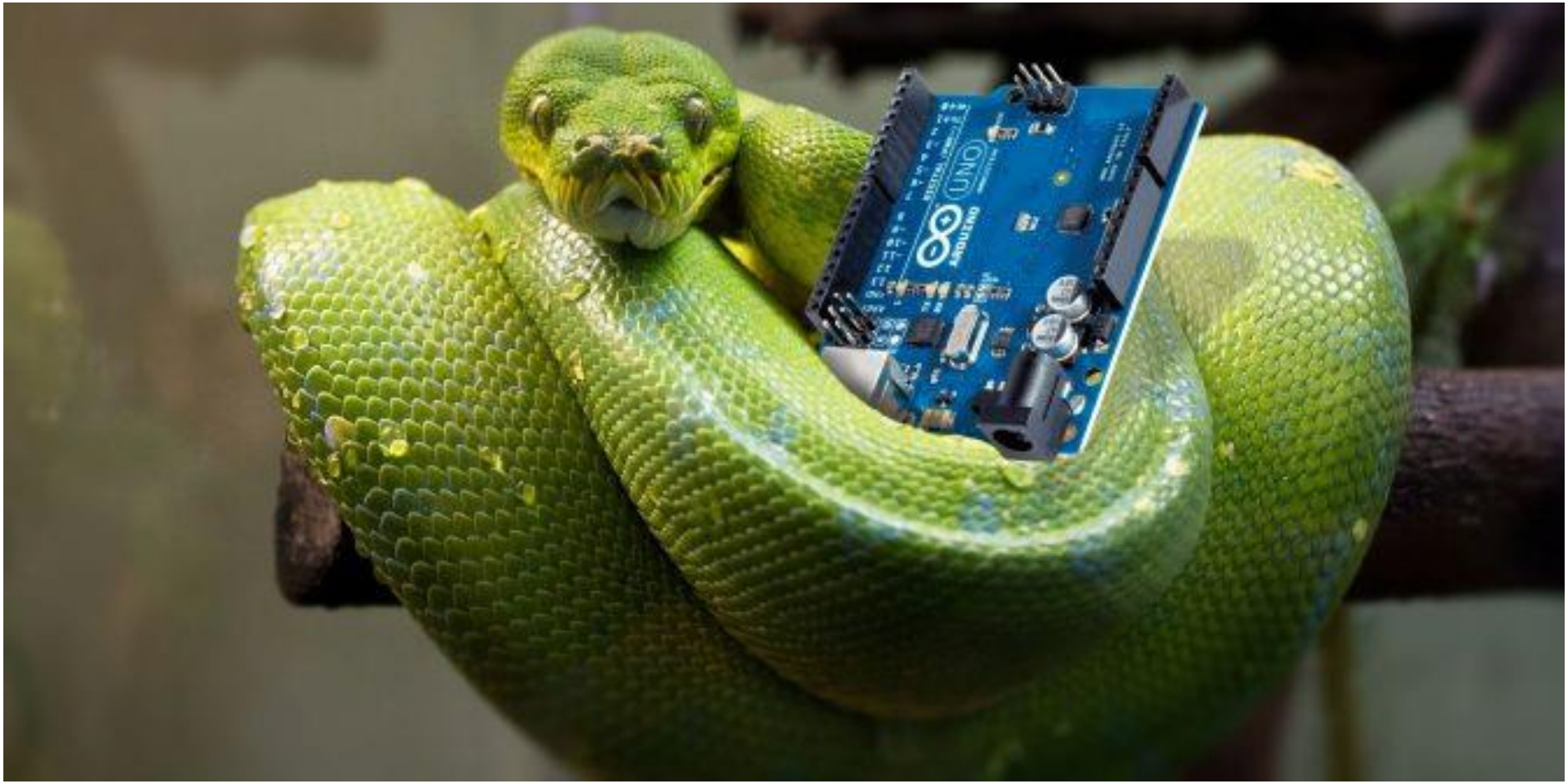
QUESTION POUR COMMENCER

- Qui sait déjà un peu programmer ?
  (quelque soit le langage)
- Qui connait déjà Python et les jupyter notebooks ?

PYTHON ?!?!?



python™

WHAT?

- Programming language
  - High-level, general purpose (data science +++)
  - Dynamic types, auto memory management
  - Object-oriented
- Interpreted
- Free and open-source
- Multiplatform
- Community-based
- Created by Guido van Rossum 1991 ; python3 in 2008 ; Monty Python ; py-something

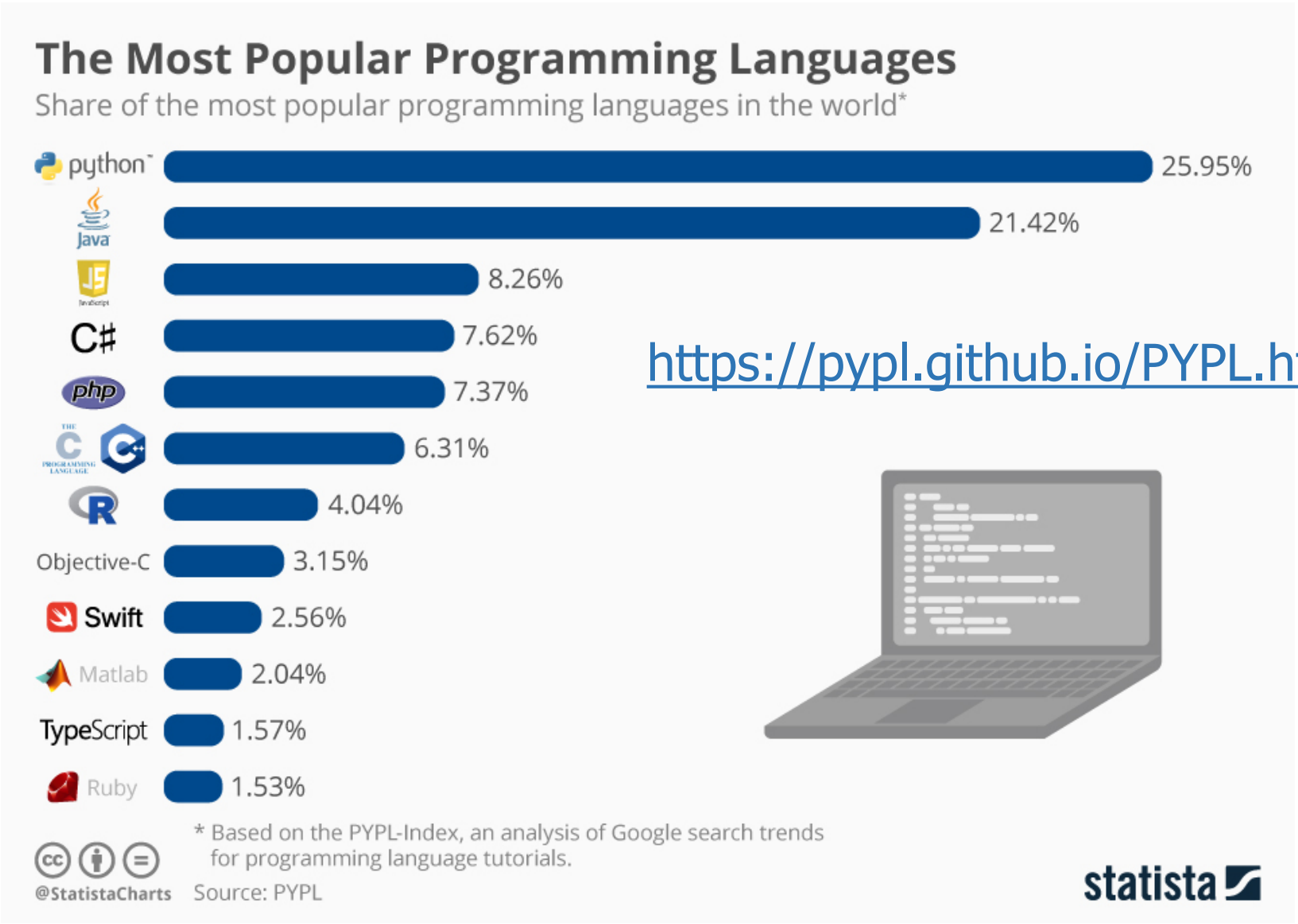
ZEN OF PYTHON

- Beautiful is better than ugly
- Explicit is better than implicit
- Simple is better than complex
- Complex is better than complicated
- Readability counts

INTERESTS

- Great functionality to deal with mathematics, statistics and scientific function
- Large (and larger) community
- Extensive libraries
- Ease of use
- Simple syntax making it easy to adapt for people who even do not have an engineering background

- Prototyping, scripting, data analysis
- #1/#3 of all languages, #1 for machine-learning



https://pypl.github.io/PYPL.html

DRAWBACKS AND LIMITATION

- Not (always) as fast as other languages
- Maybe to be difficult for large projects (permissive)

A perfect fit for medical physicists and biomedical imaging scientists

EXAMPLE

```
x = 34 - 23     # x is a number
y = "Hello"     # y is a string
z = 3.45
if z == 3.45 or y == "Hello":
    x = x + 1
    y = y + " World"
print(x) # will be 12
print(y) # will be "Hello World"
```

DATA TYPES

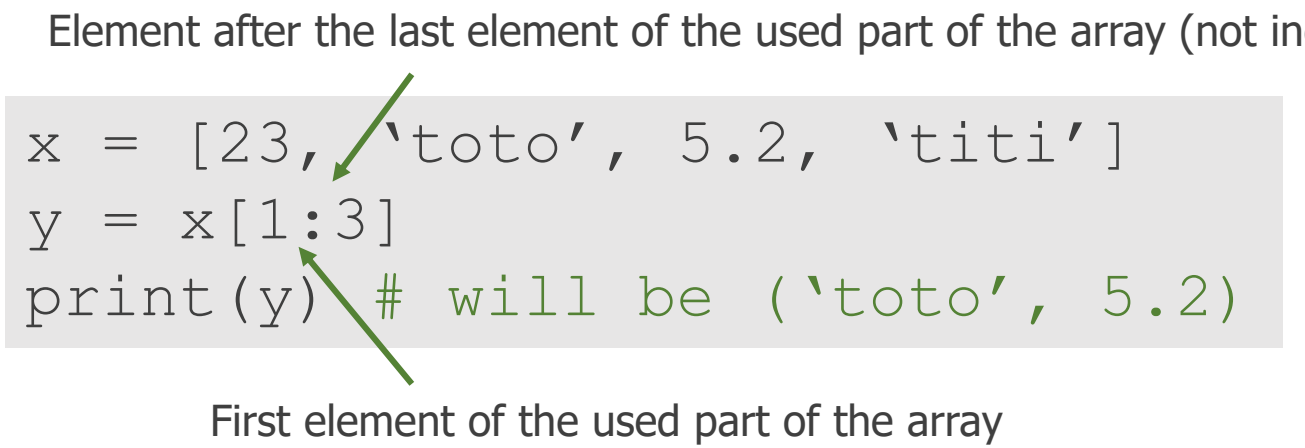
- Powerful data structures: lists, tuples, and dictionaries

- Lists
  - One-dimensional arrays (but you can also create lists of other lists and get a multidimensional array)
- Dictionaries
  - Associative arrays (so-called hash tables, which can be any data type)
- Tuples
  - Unchangeable one-dimensional arrays (in Python, "arrays" can be of any type, so you can mix, for example, integers, strings, etc. in lists / dictionaries / tuples)

- The index of the first element in arrays of all types is 0, and the last element can be obtained by index -1

SLICING

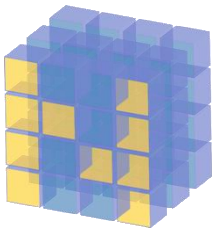
- To work only with a part of the array elements, use a colon (:)



- Main drawback: type errors are only caught at runtime

- NumPy

Fundamental package
for scientific programming



NumPy

Simple itk

- Matplotlib

For 2D or 3D data visualization
(line graphs, histograms, pie charts can be easily generated)

matplotlib

- SimpleITK

Toolkit for image manipulation and analysis derived from ITK

- SciPy

For linear algebra, integration, optimization, statistics

SciPy.org Sponsored By ENTHOUGHT

Easy to install : ie

```
pip install numpy
```

FOCUS ON NUMPY

- Powerful data types: vector, matrices, tensors

… and algorithms for algebra

- Example:

```
import numpy as np
x = np.array([1,2,3,4])
print(x.shape, x)
y = np.array([5,4,3,2])
z = x + y                # Elementwise sum
w = np.sqrt(x)           # Elementwise sqrt
t = np.dot(x,y)          # inner product
```

ENVIRONMENT

- Spyder
- Pycharm
- Atom
- Anaconda
- Emacs, vi, gedit

...

IDE
Integrated Development Environment

NEEDS

Language

Environment (IDE)

Modules

Version control

Community

RESSOURCES (IN FRENCH)

- Programmation en Python pour les sciences de la vie (Patrice Fuchs et Pierre Poulain - Ed. Dunod)

https://python.sdv.univ-paris-diderot.fr/cours-python.pdf

- Apprendre à programmer avec Python 3 (Gérard Swinnen - Ed. Eyrolles)
- Apprendre à programmer en Python (Vincent Legoff - Openclassrooms)
- ...

OTHER RESSOURCES

- Thousands of web tutorials, courses
- Q&A: stackoverflow

WORKFLOW

- Notebooks principle
  - Cells, run
- Google Cloud Collab principle
- Retrieving data files

Execute a line :
Shift + Return

1 – Download the notebooks

Download the zip archive :

https://we.tl/t-3viISmQUv3

Unzip the archive

2 – Use Google Colab

Go to: https://colab.research.google.com

or

Open new notebook, upload the file gc_notebook1.ipynb

2 – Use Jupyter notebook

In a terminal, go in folder IA-master_TP1,

Type: jupyter notebook

In the web page select and open the notebook

Merci de votre attention