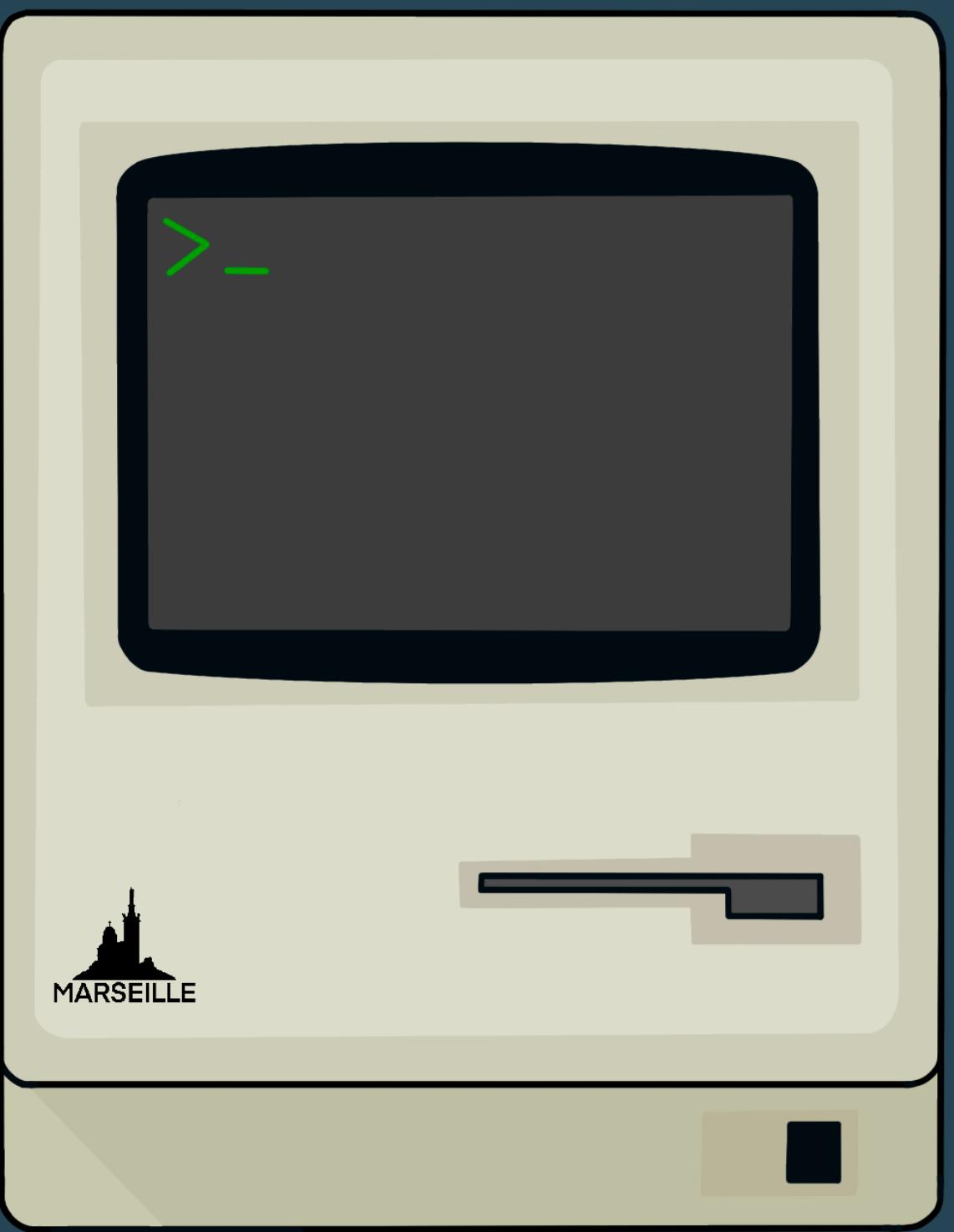


BrainHack

open collaboration in neurosciences

Marseille



Hands on Python tutorial

Dautrevaux Cyprien / Alexandre Lainé

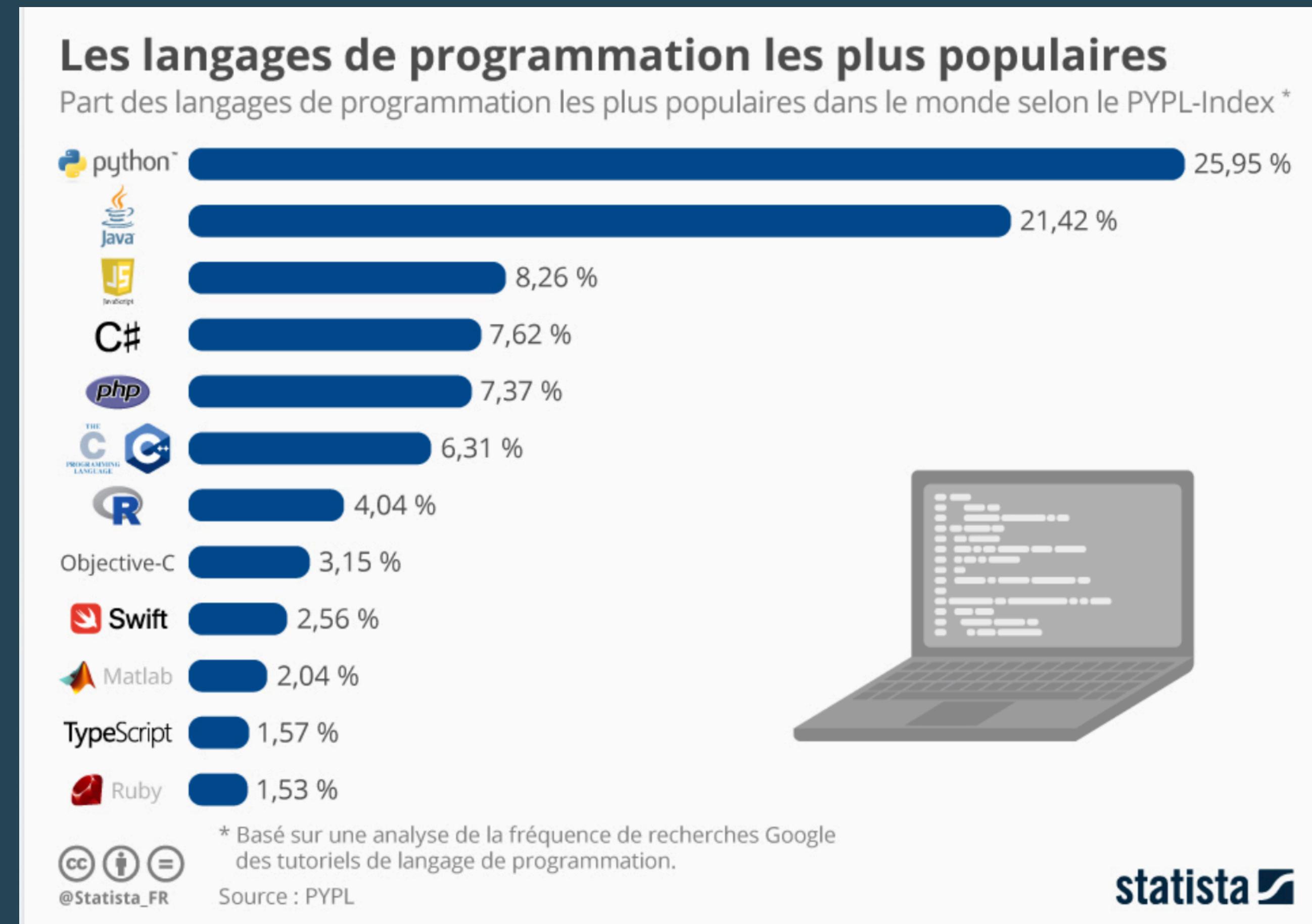
27 October 2024

Hands on Python tutorial ...

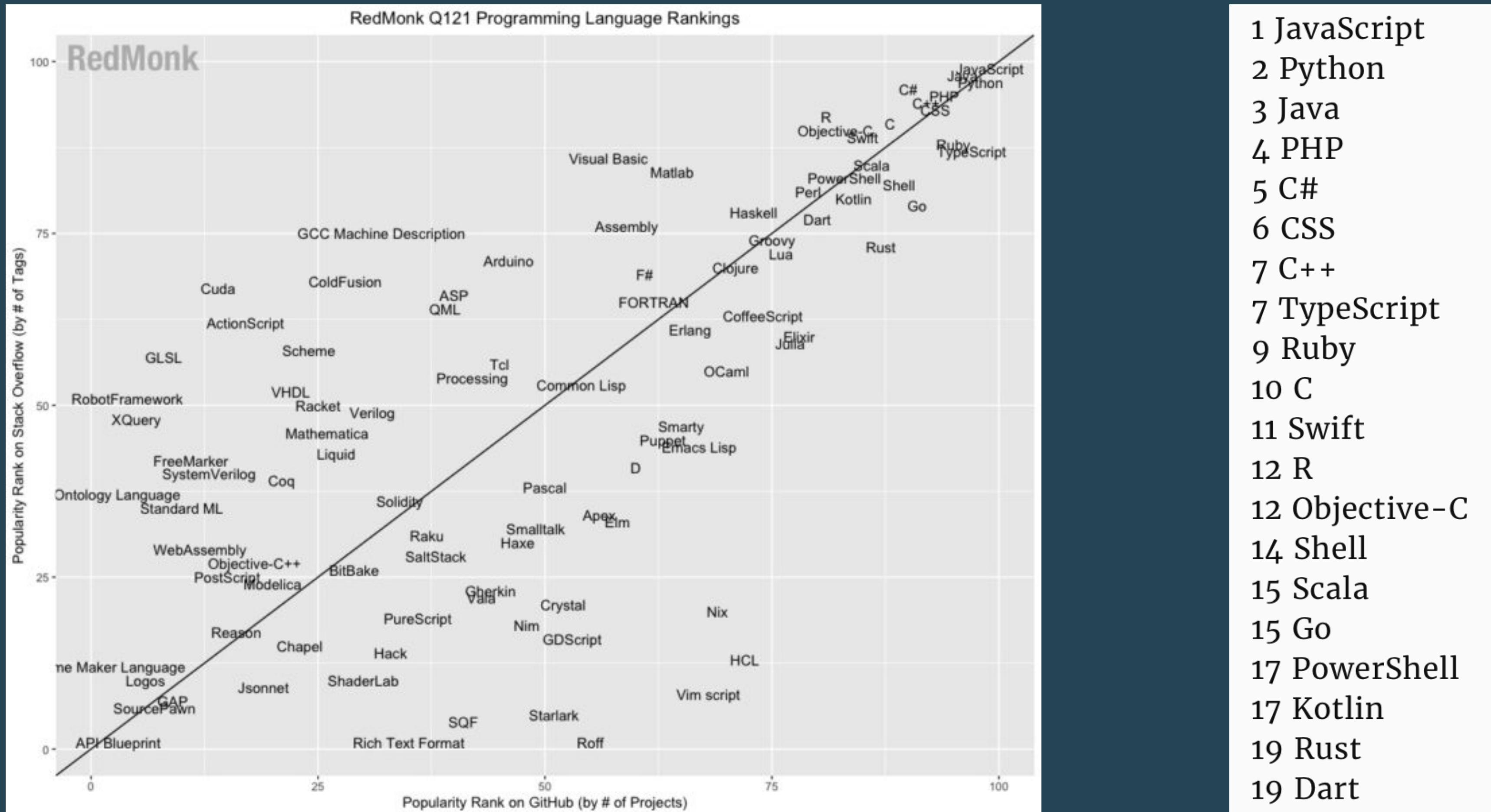
But why Python ?

But why Python ?

In Data Science (the field of data analysis), Python rapidly become the go-to programming language as it's easy and very versatile.

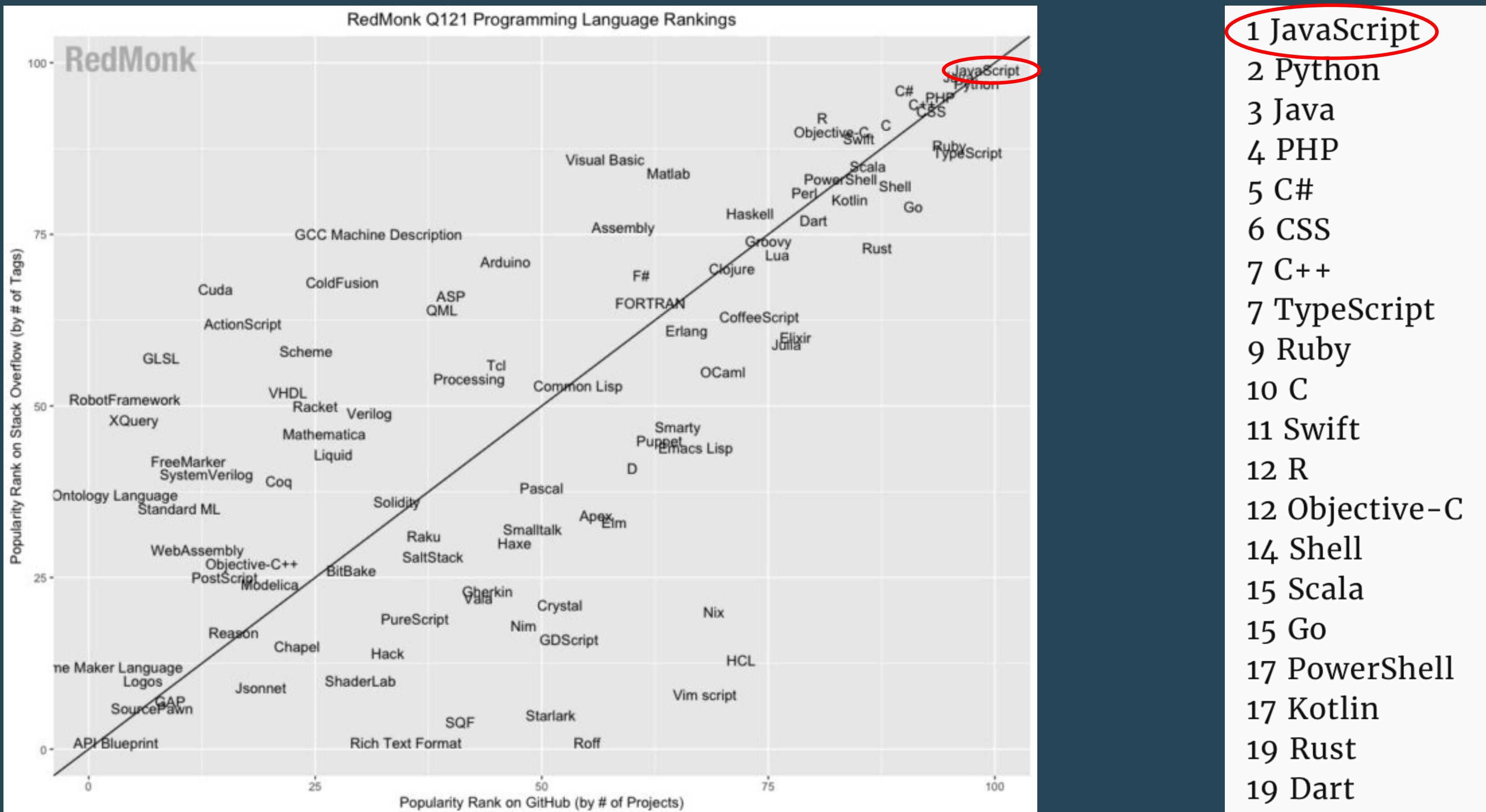


But why Python ?



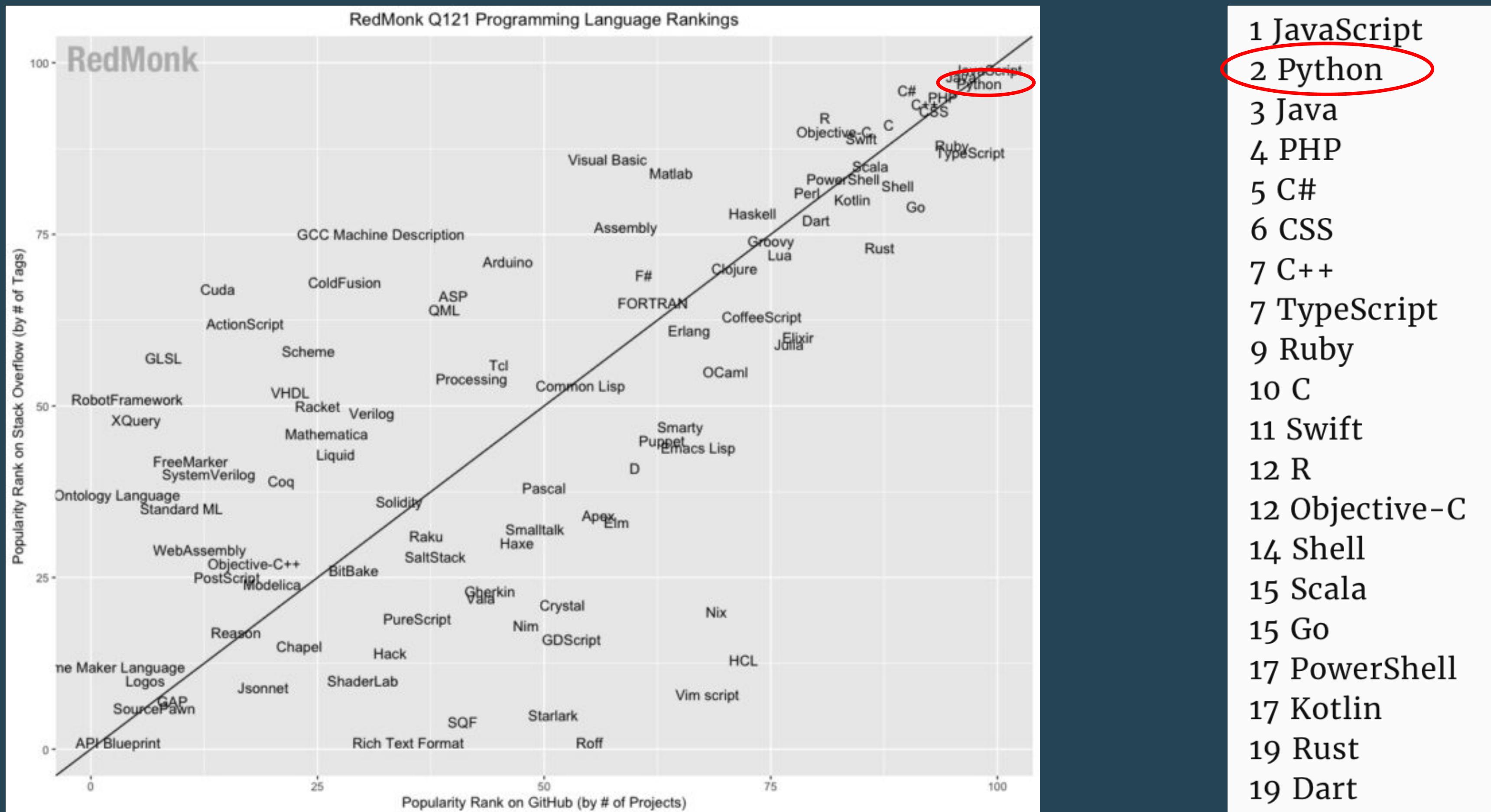
Source : <https://redmonk.com> langage ranking in 2024

But why Python ?



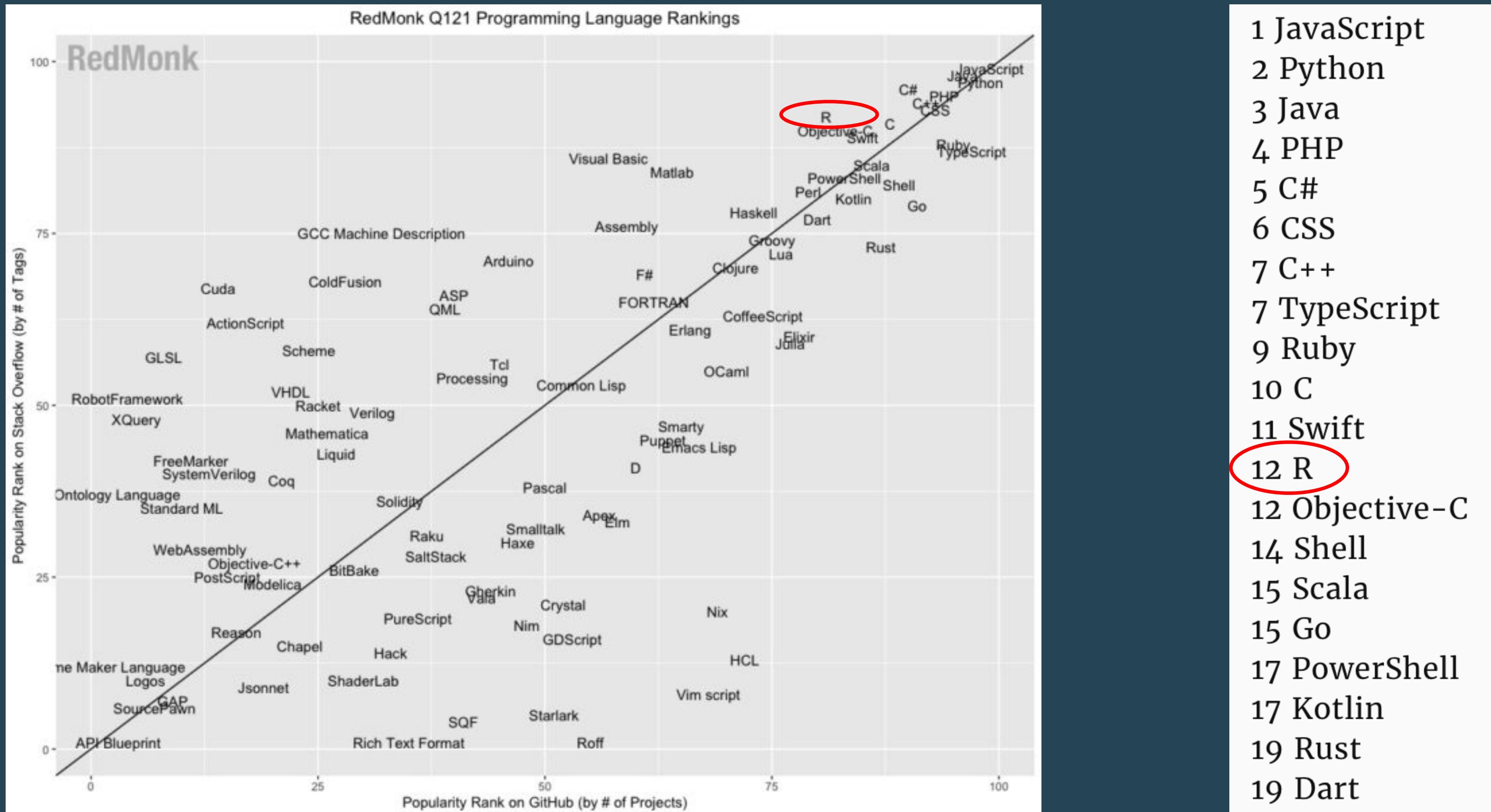
Source : <https://redmonk.com> langage ranking in 2024

But why Python ?



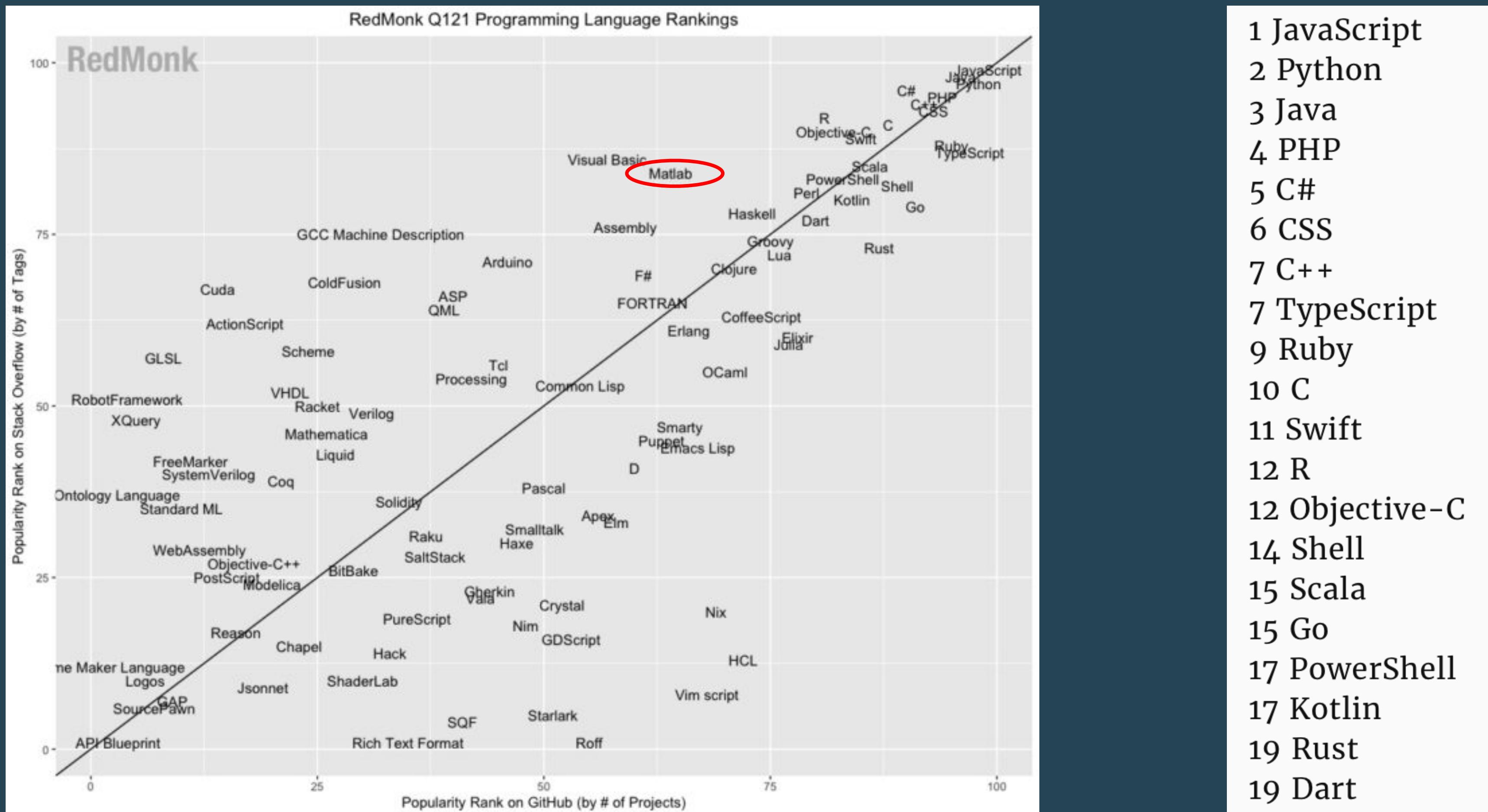
Source : <https://redmonk.com> langage ranking in 2024

But why Python ?



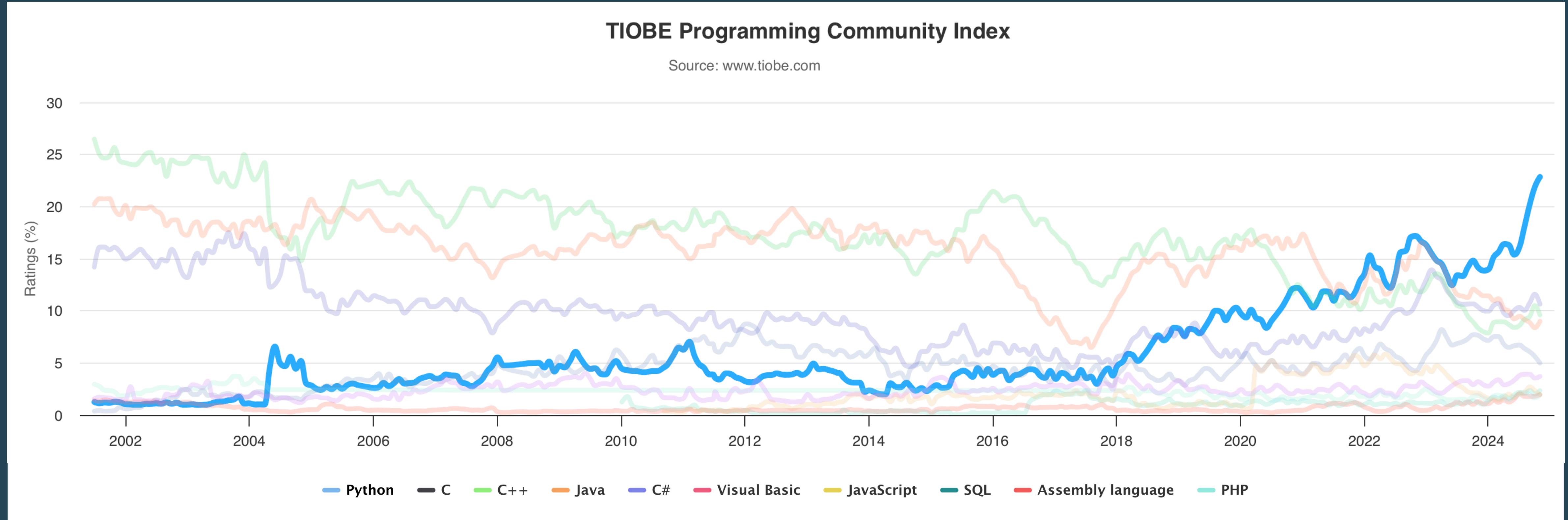
Source : <https://redmonk.com> langage ranking in 2024

But why Python ?



Source : <https://redmonk.com> langage ranking in 2024

But why Python ?



Study performed by TIOBE company in November 2024.

The TIOBE Programming Community index is an indicator of the popularity of programming languages.

Python as been elected most used programming language of the years 2007, 2010, 2018, 2020, 2021 et 2023.

But why Python ?

A very large community of coders



Github



Stack Overflow

But why Python ?

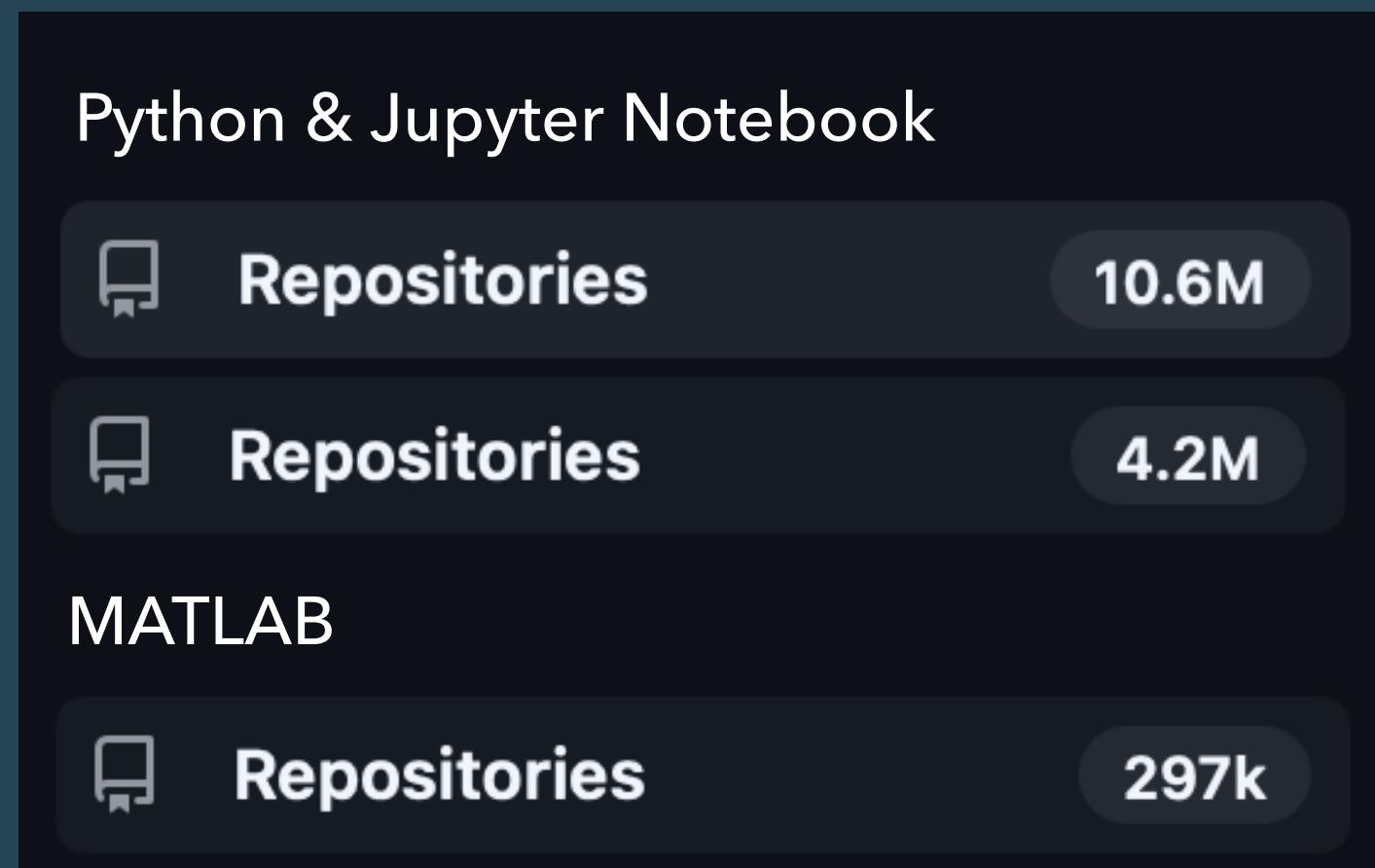


Github

A very large community of coders



Stack Overflow

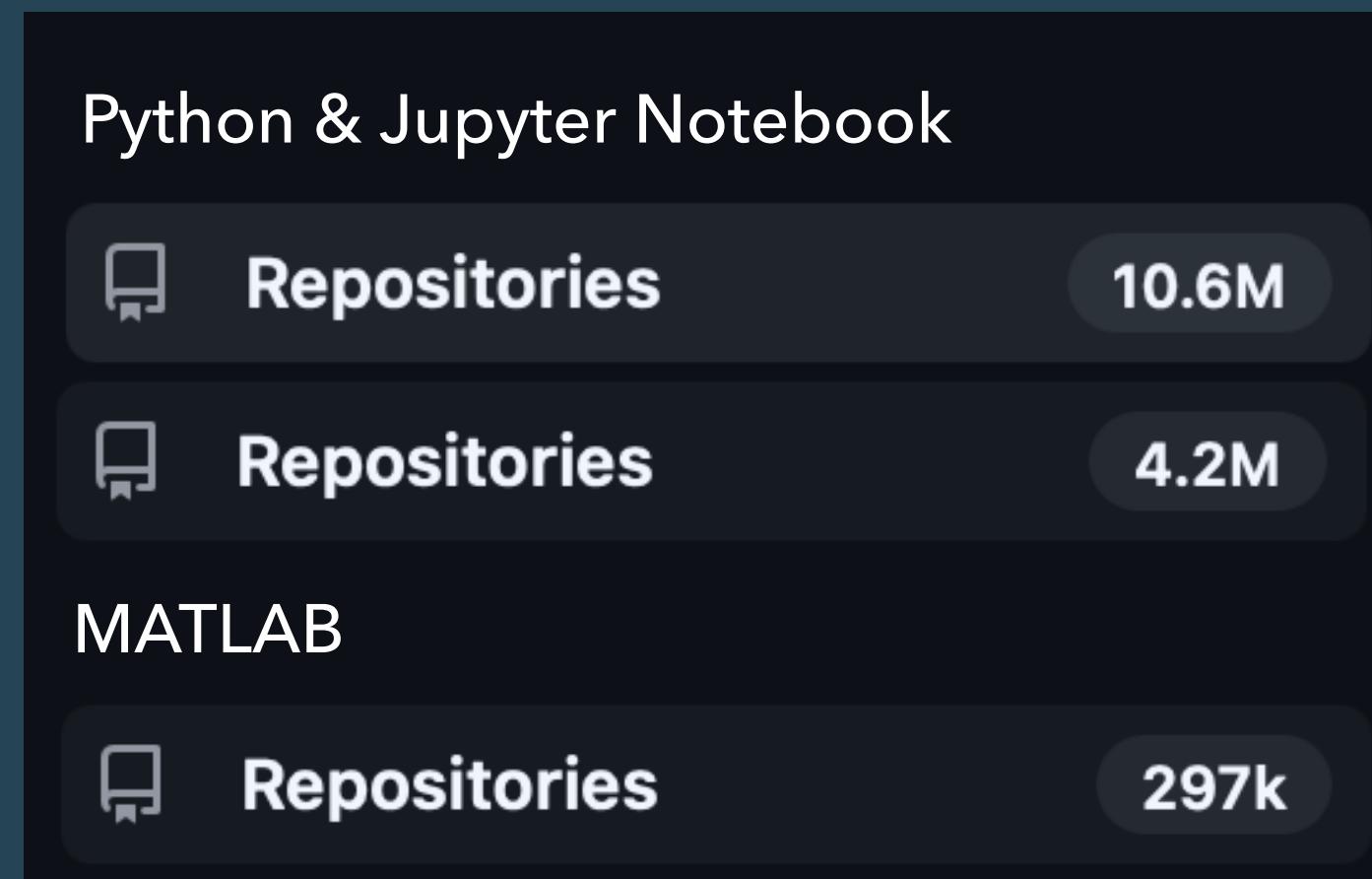


Github: Number of repositories per language

But why Python ?



Github



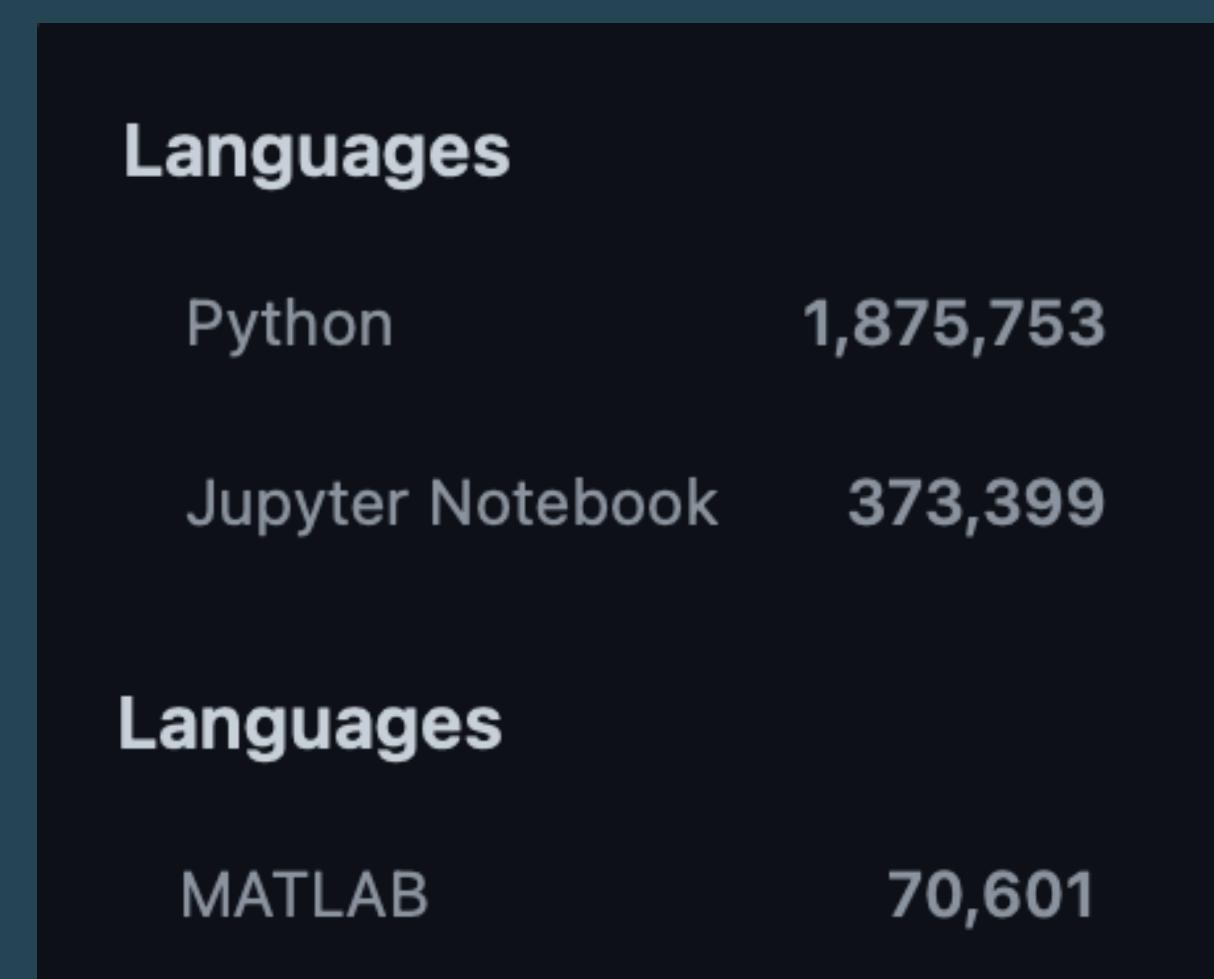
Github: Number of repositories per language

A very large community of coders

Fully Open Source programming language
& of course completely free



Stack Overflow



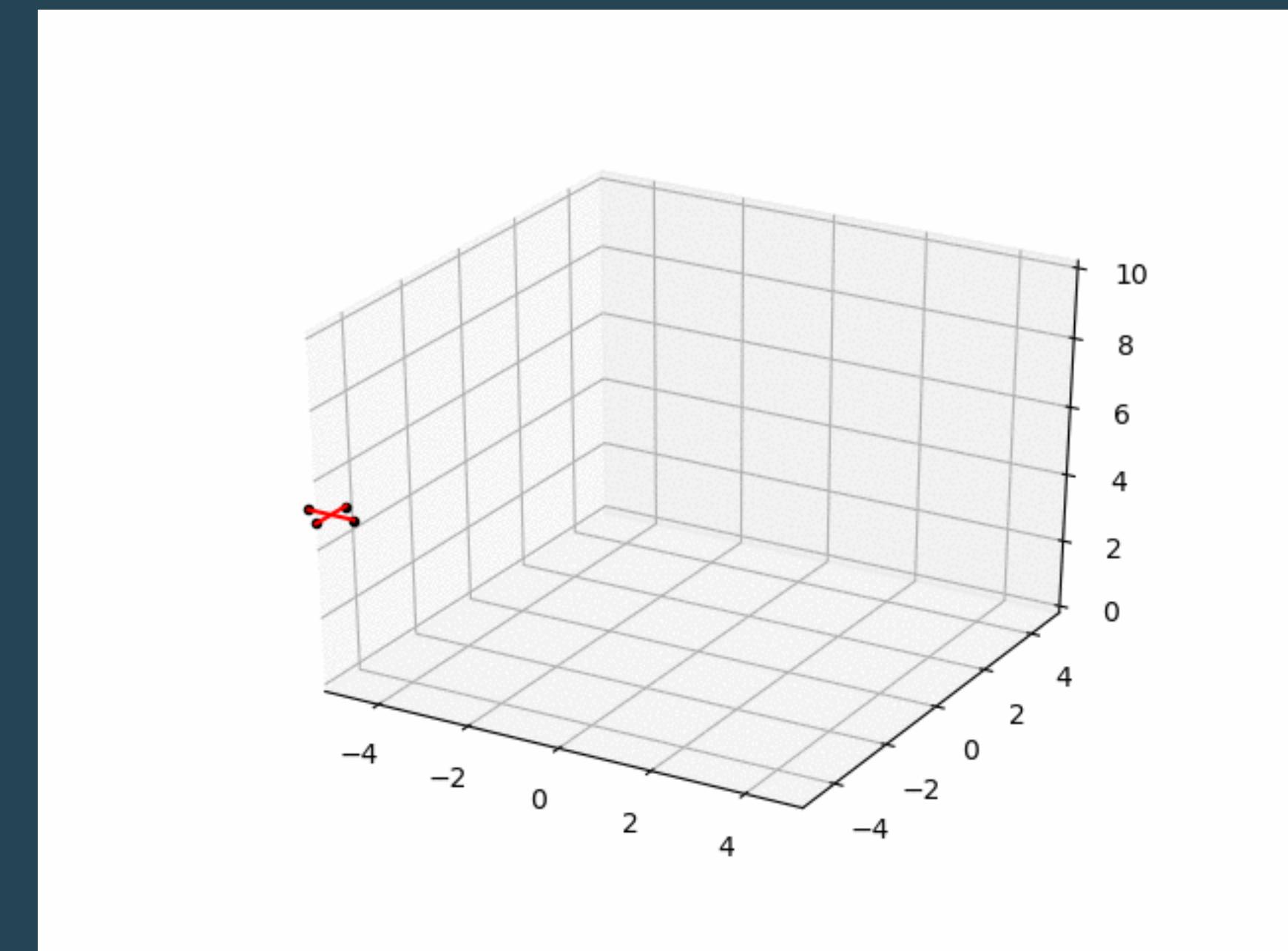
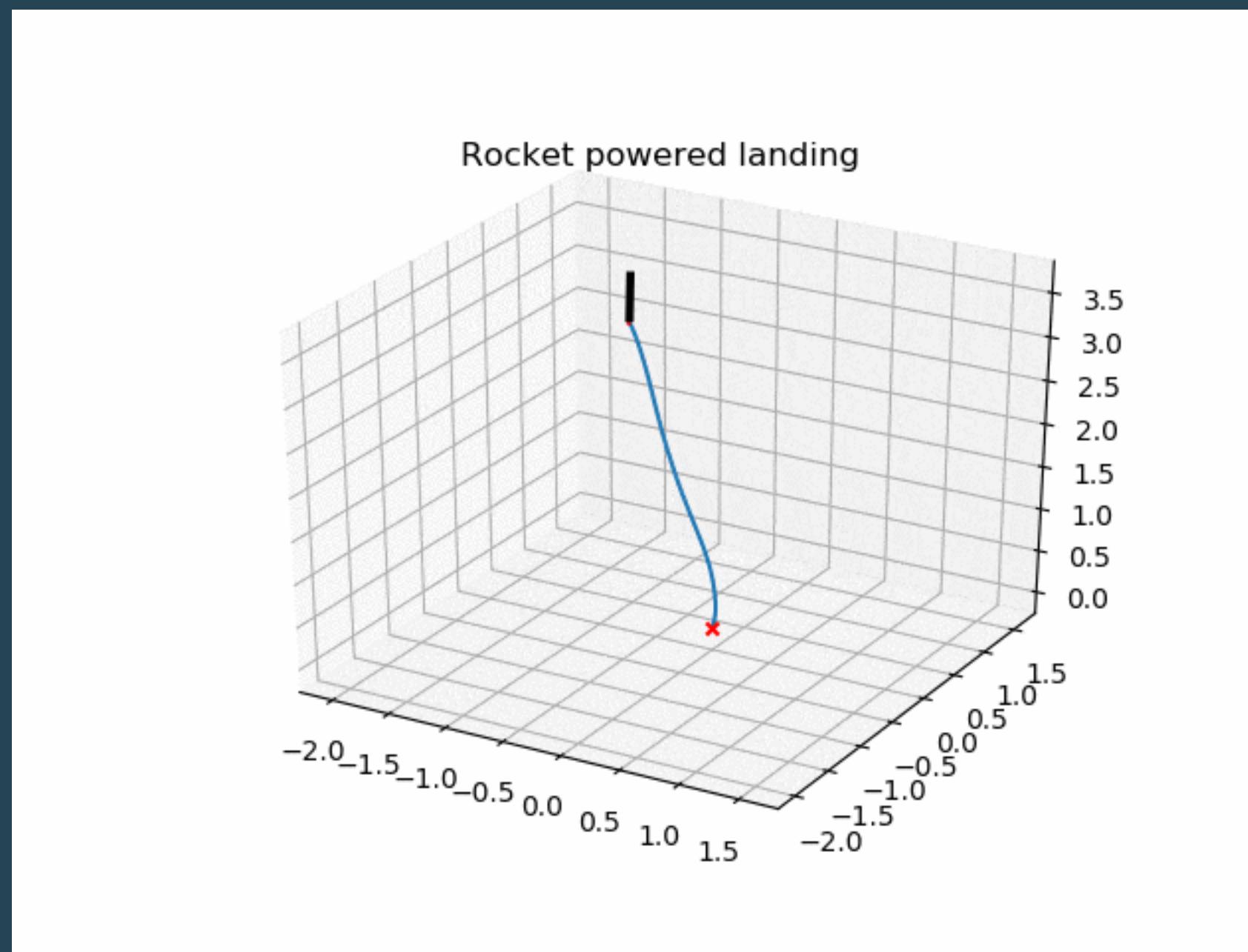
Source: Neuroscience Research Github.

What is python used for ?

What is python used for ?

- Robotic and guidance:

Landing guidance for a rocket or guidance for a drone



All those project are from the GitHub Python Robotics page:
<https://github.com/AtsushiSakai/PythonRobotics>

What is python used for ?

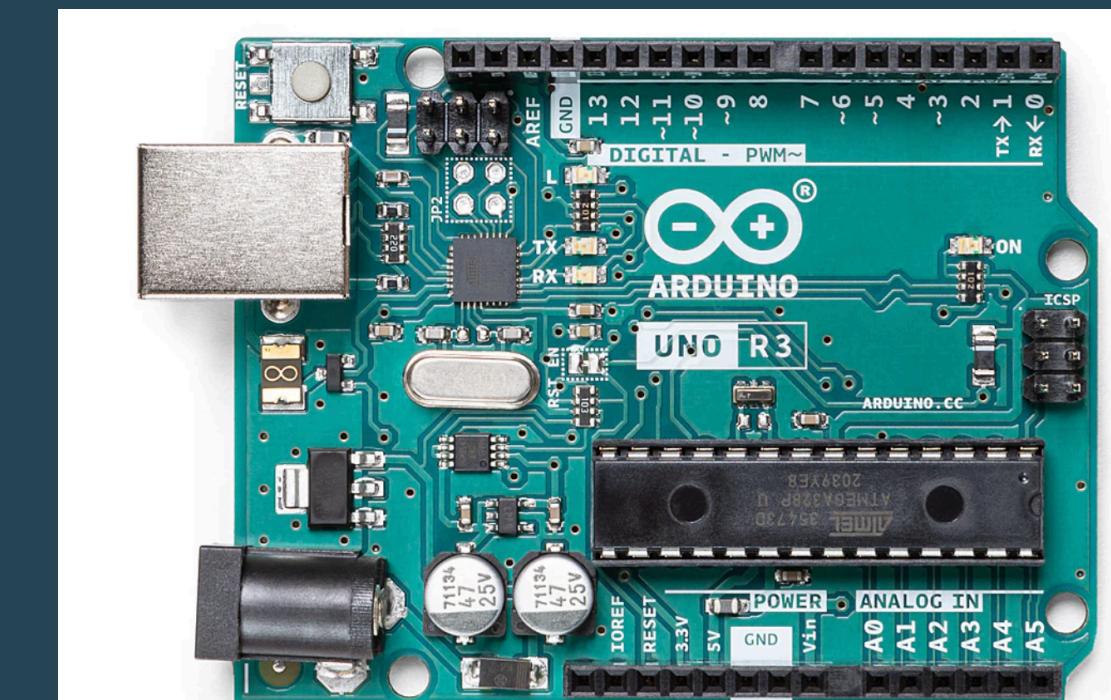
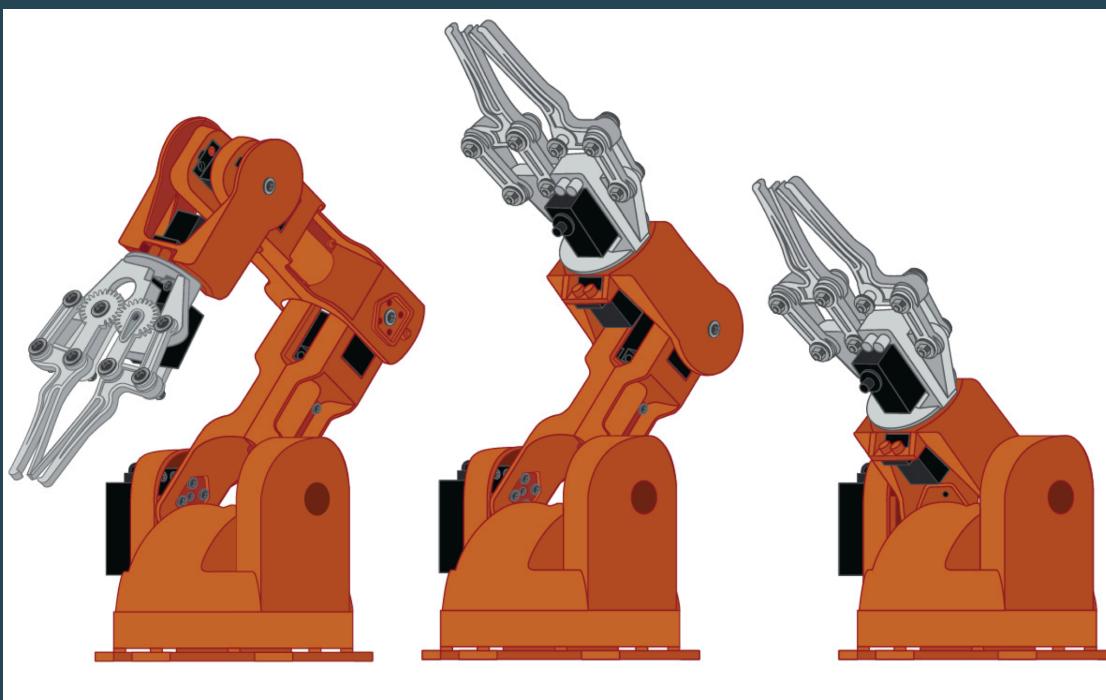
- Robotic and guidance:

To go further here are some python libraries:

- Robot framework
- Pyro
- DART
- PyRobot
- PyDy

Similarly, if some of you are interested in automation/robotics , I encourage you to explore programming with Arduino and stay for the afternoon sessions.

<https://www.arduino.cc/>



What is python used for ?

- Web developpement:



Toga

What is python used for ?

- Modelisation in neurosciences



Single neuron model &
small network



Single neuron model, network
& mean field model

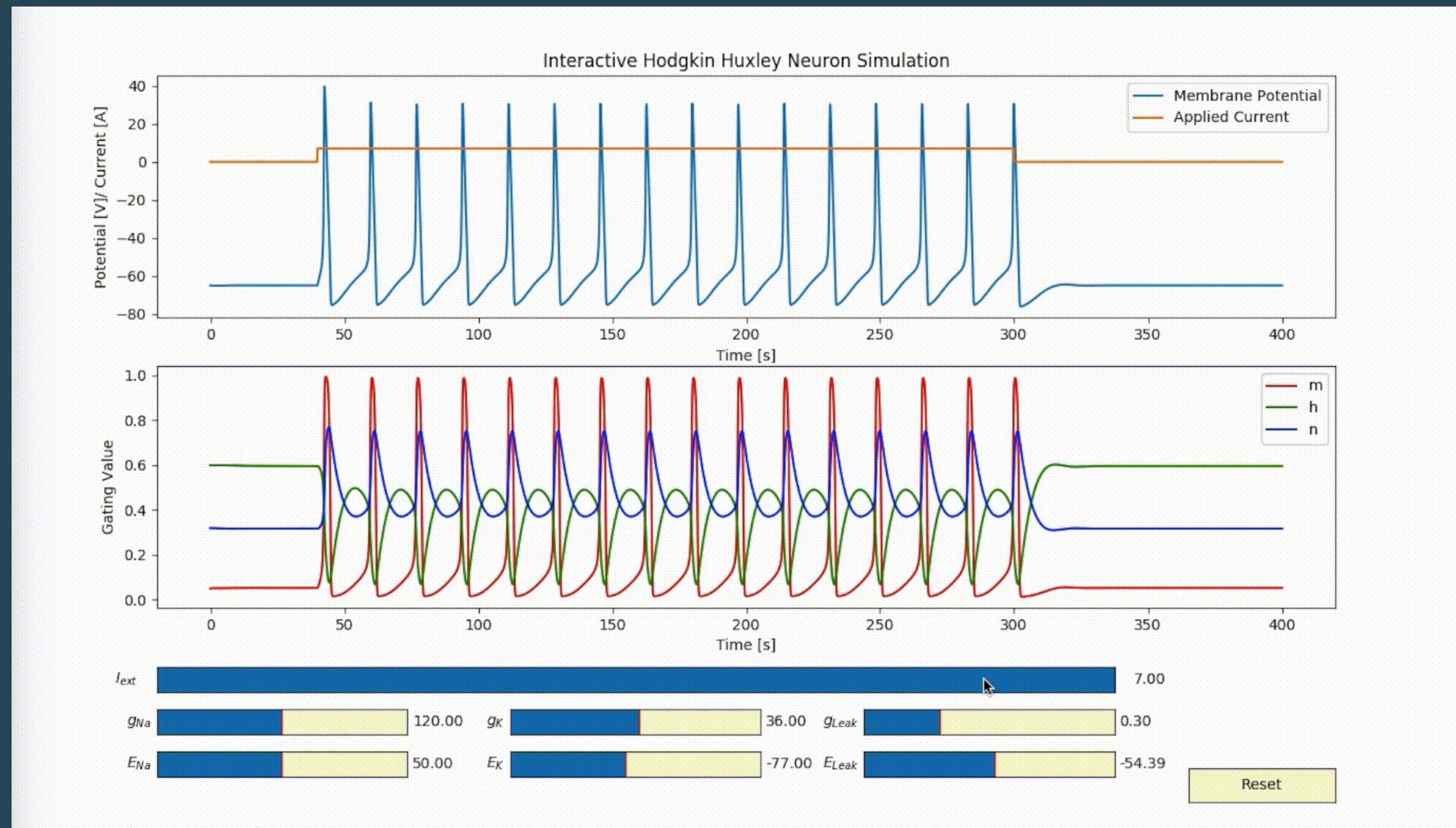


THE VIRTUAL BRAIN.

Whole brain scale modélisation

What is python used for ?

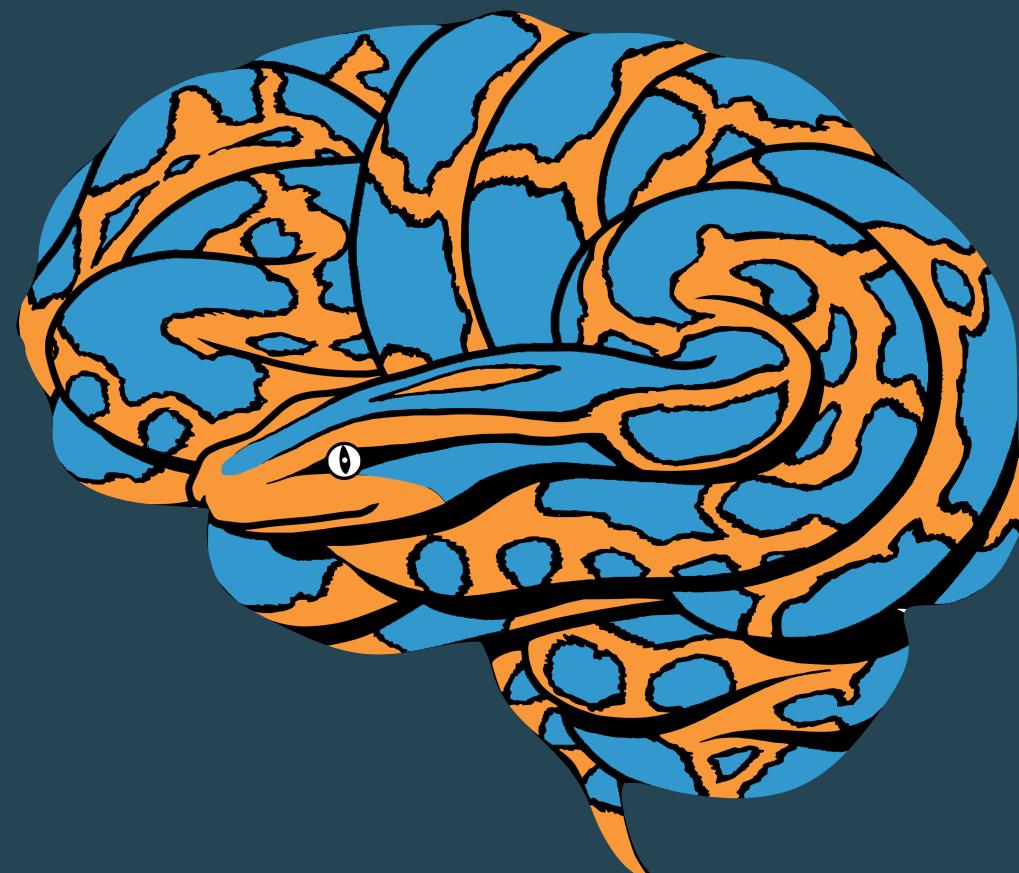
- Modelisation in neurosciences



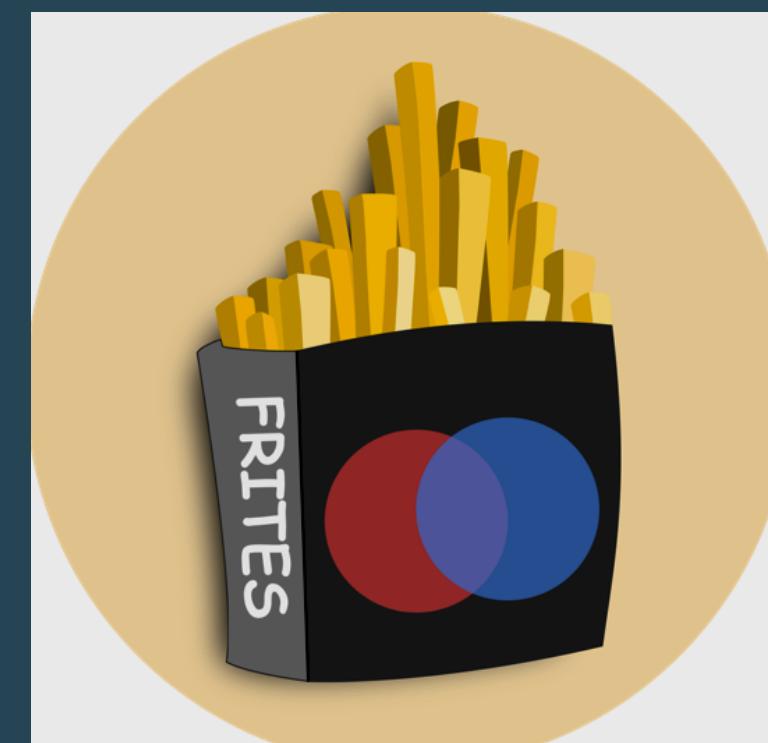
HH modèle in python with Tkinter

What is python used for ?

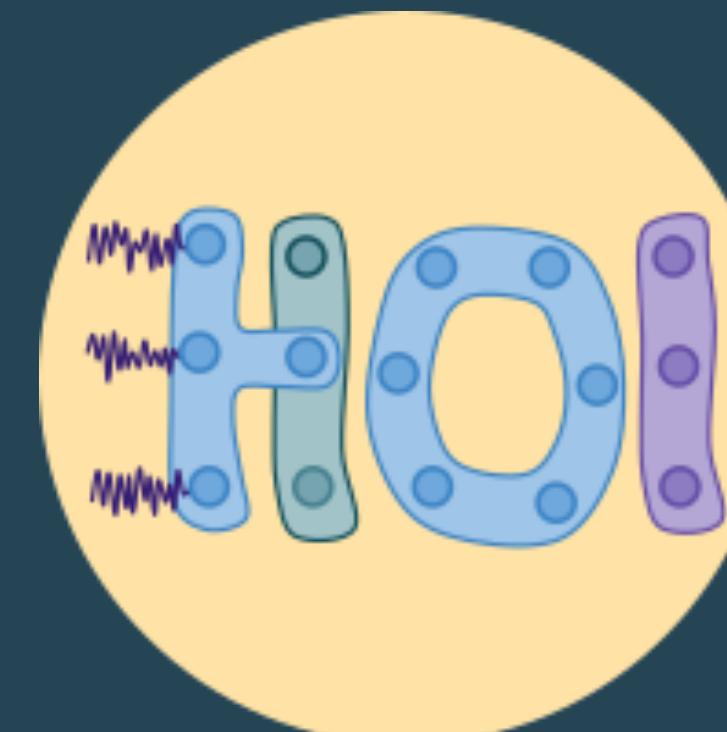
- Signal and data analysis



Nilearn



FRamework for
Information
Theoretical analysis of
Electrophysiological data and
Statistics



HOI (Higher Order
Interactions)

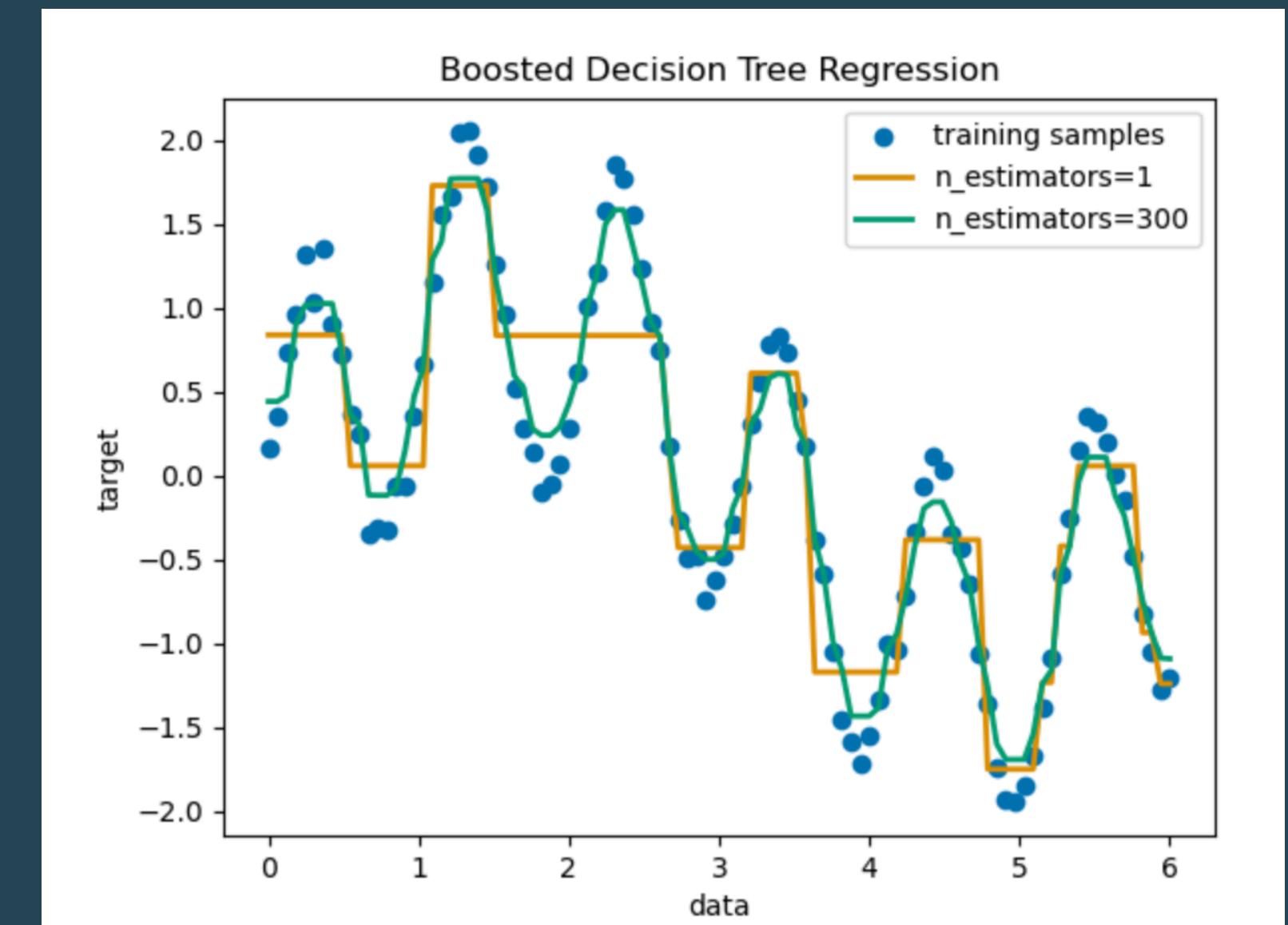
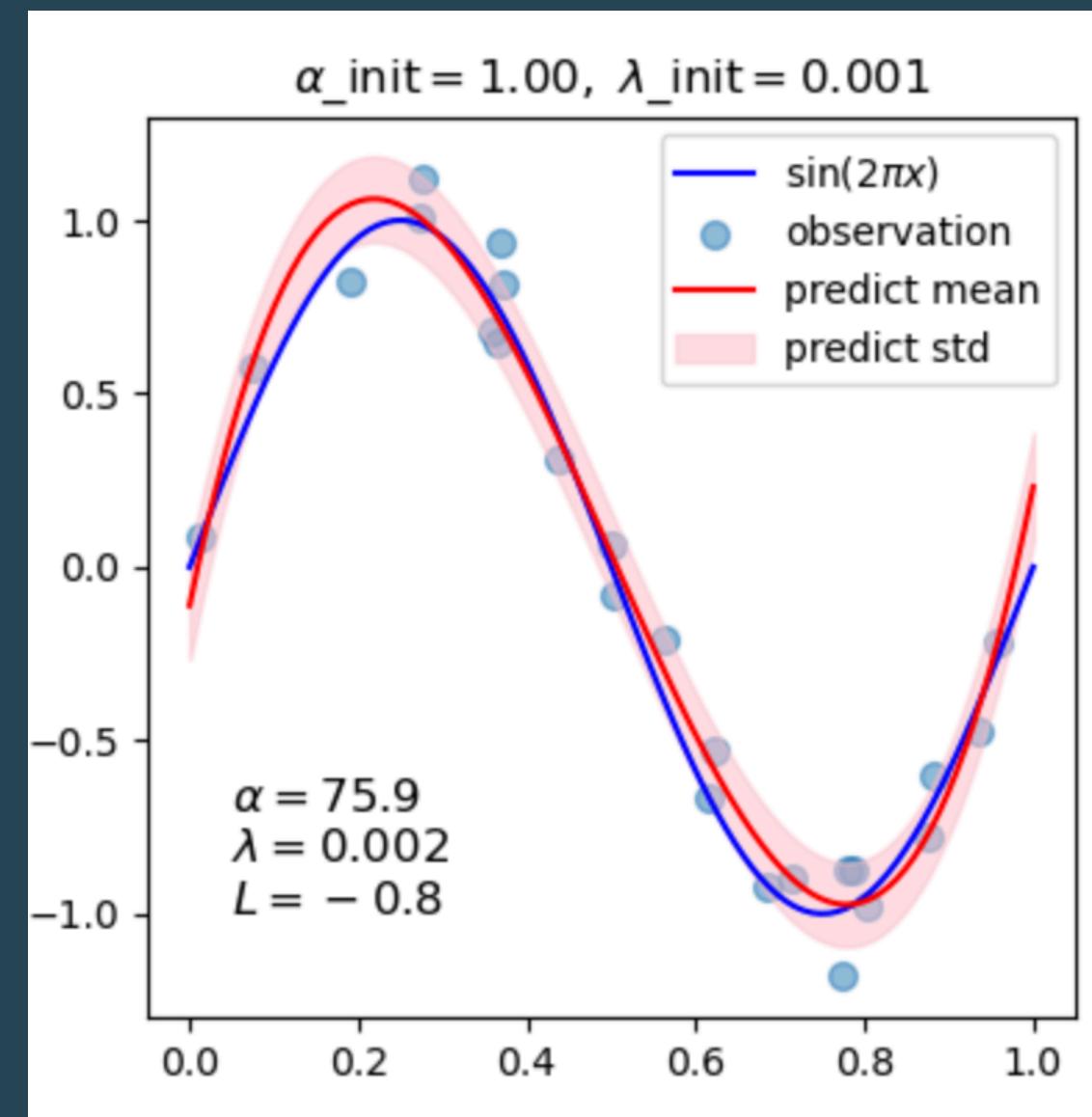
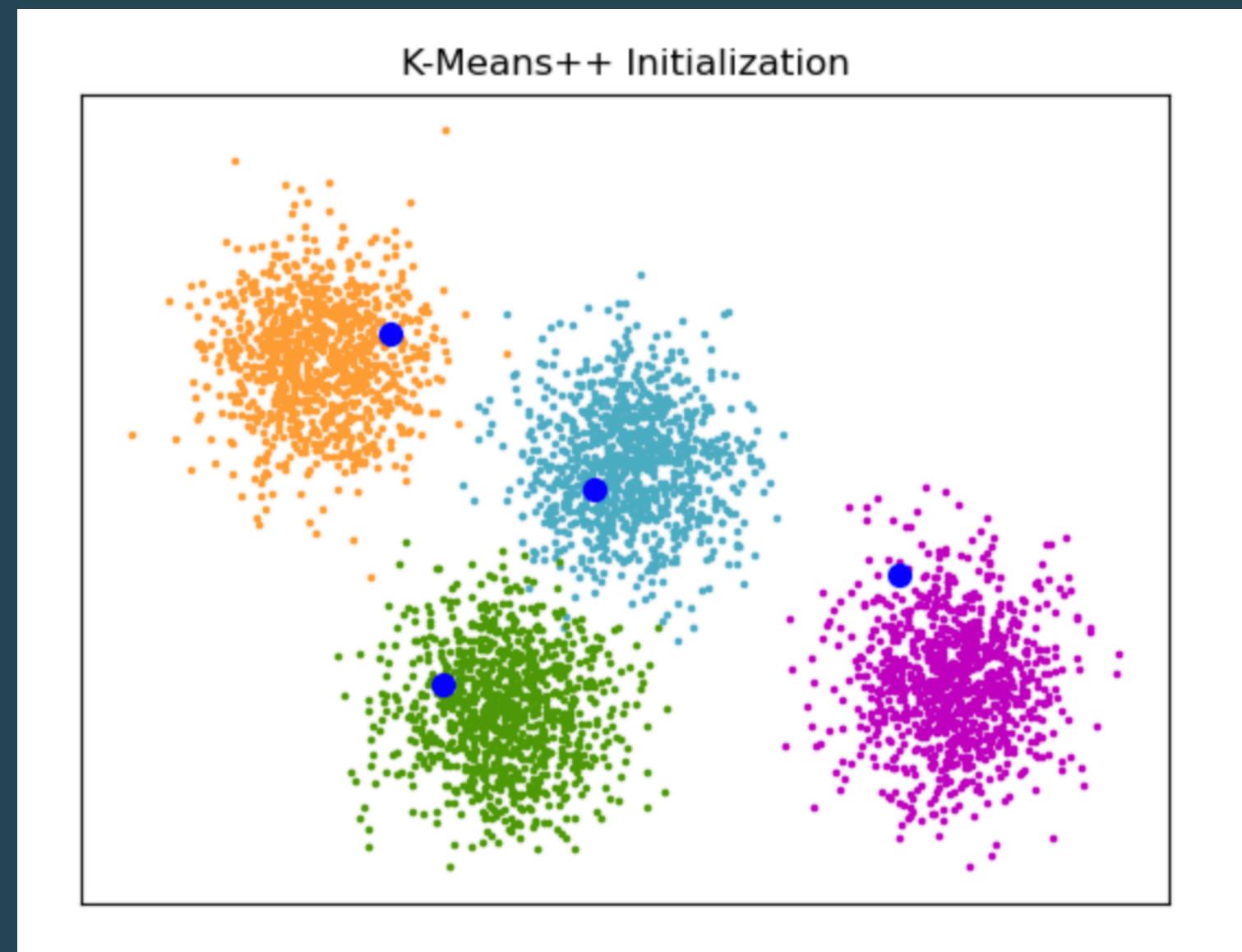
What is python used for ?

- Machine learning :



What is python used for ?

- Machine learning :

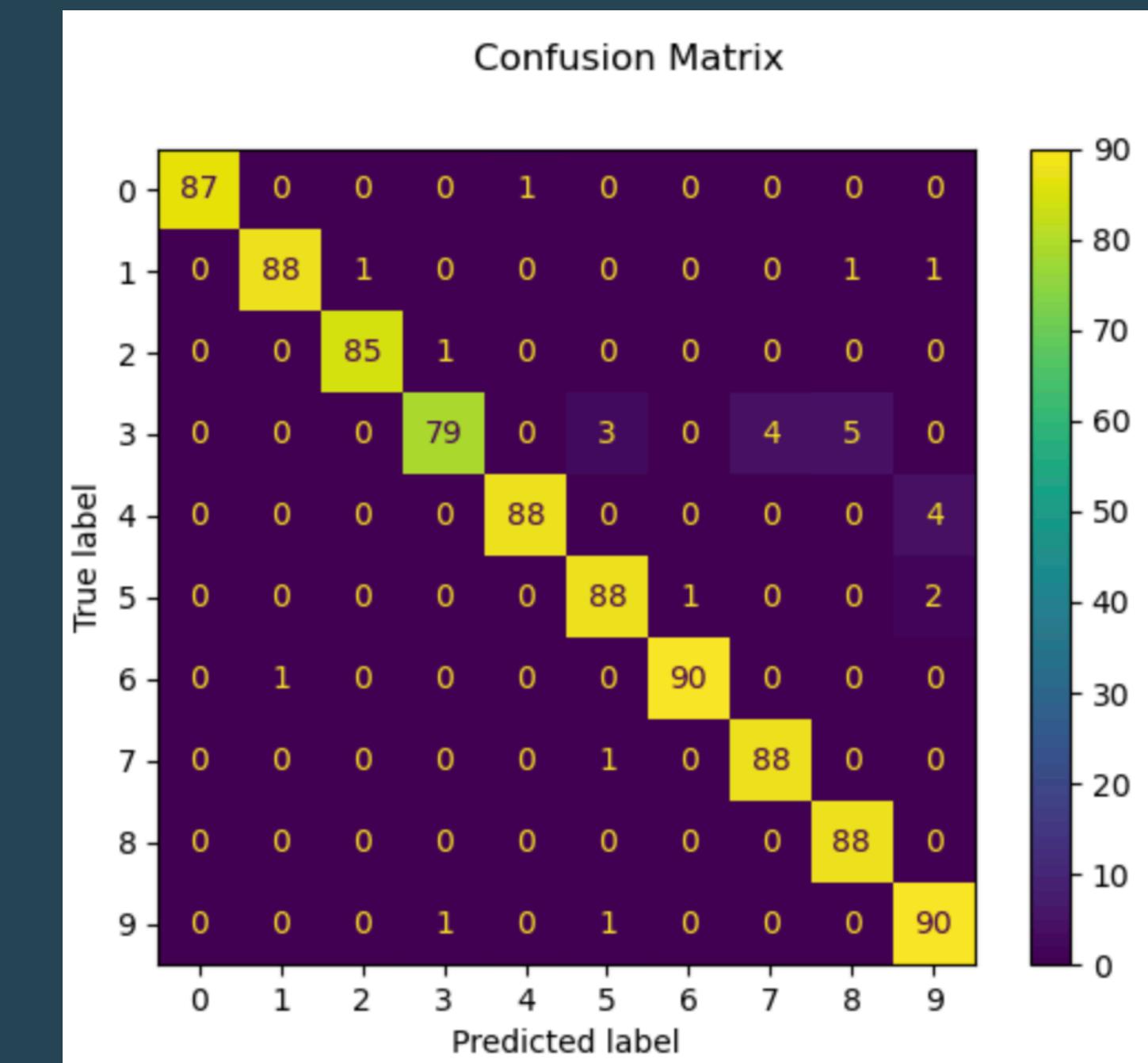
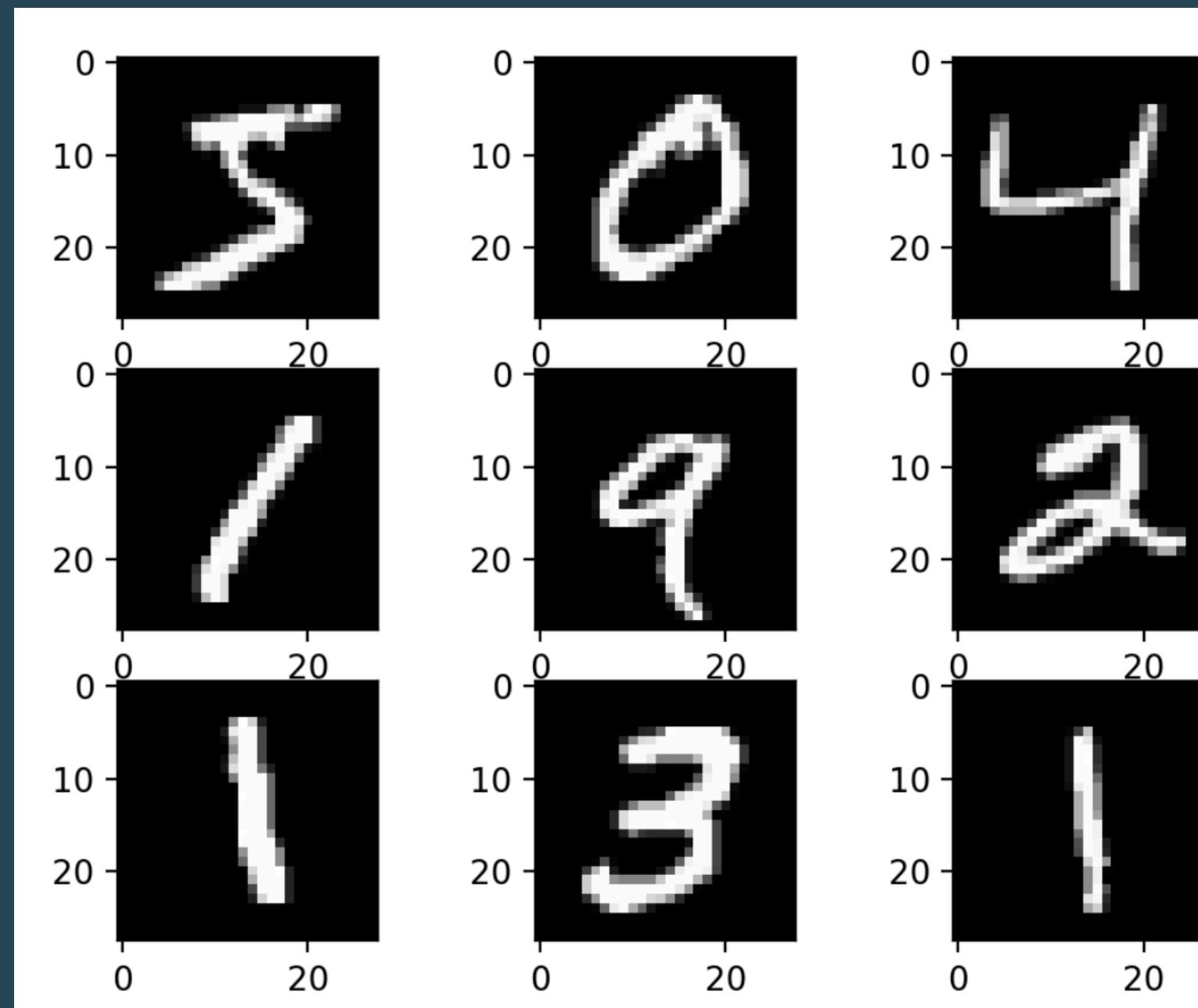


Source: <https://scikit-learn.org/stable/index.html>

What is python used for ?

- Machine learning :

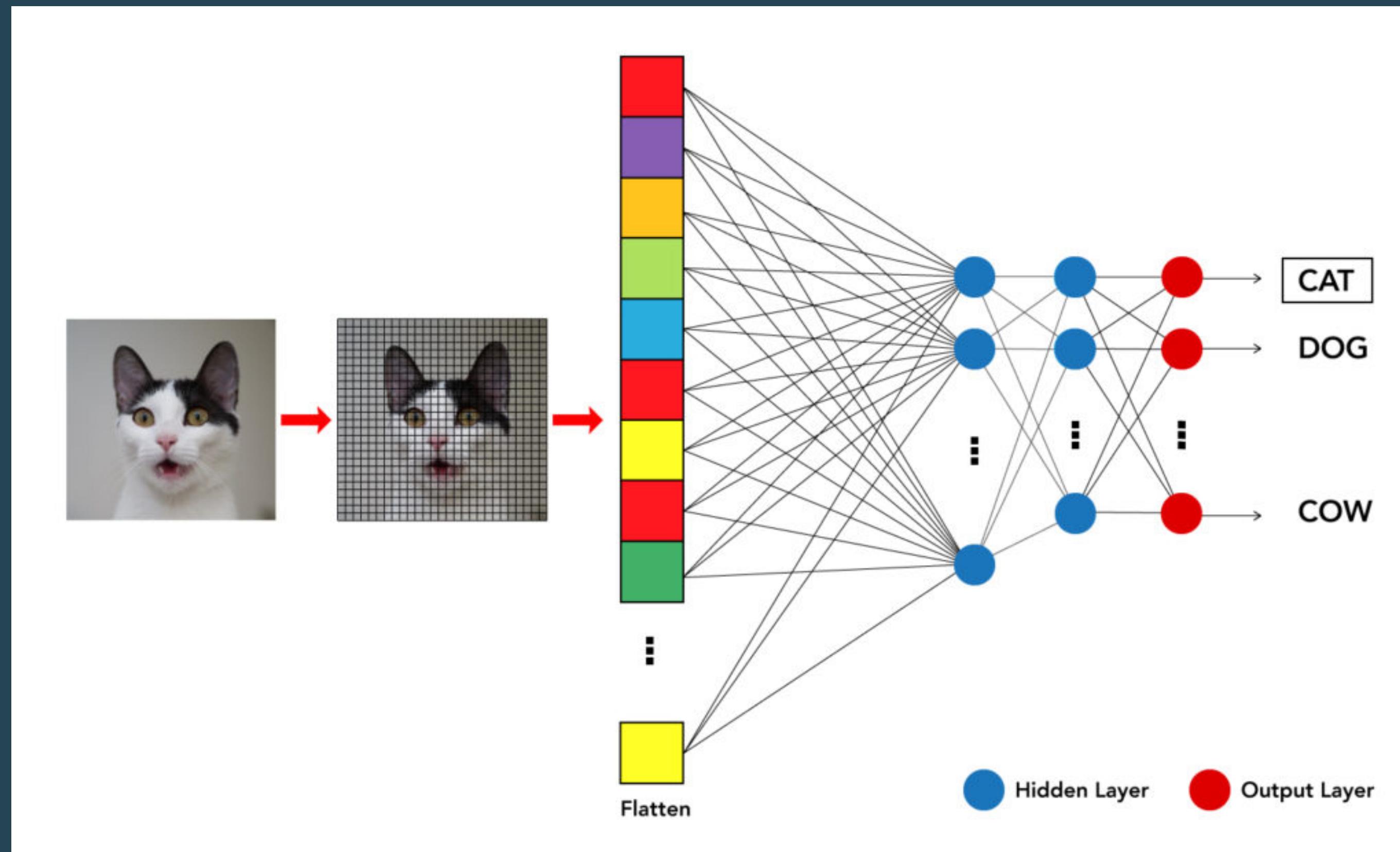
Written number recognition



Source: <https://scikit-learn.org/stable/index.html>

What is python used for ?

- Deep Learning:



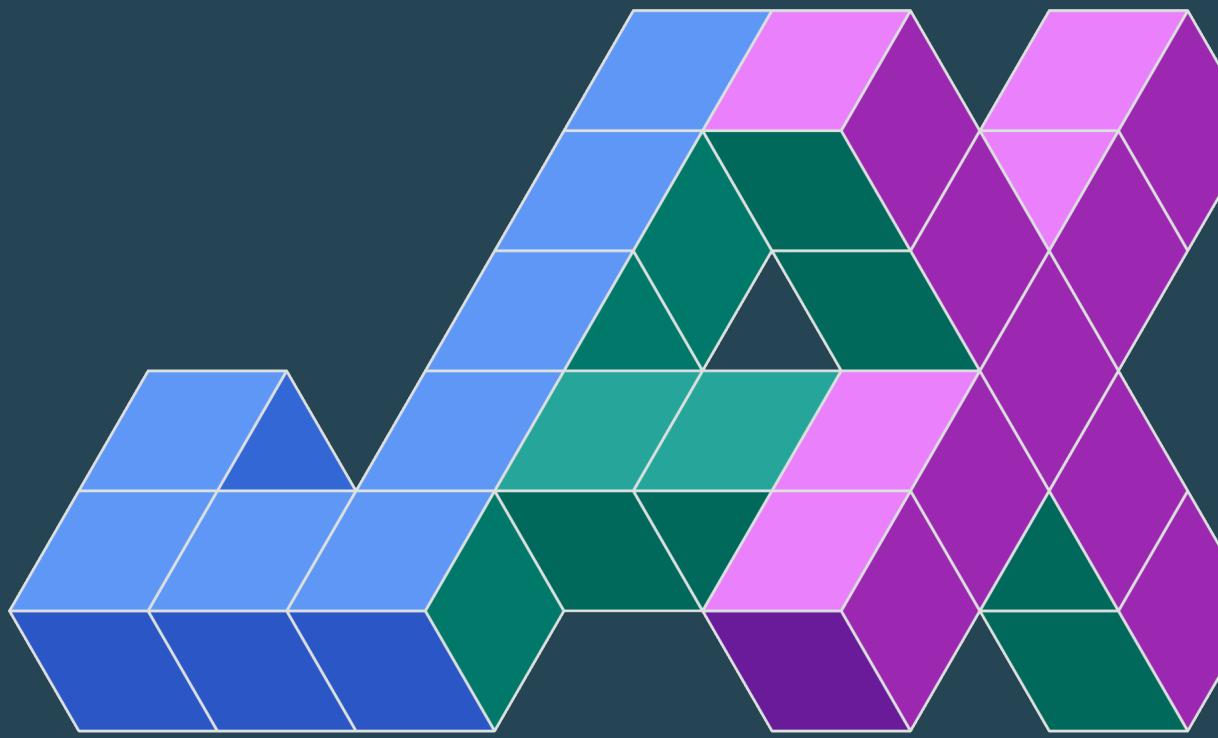
Exemple of Convolutional Neuronal Network

What is python used for ?

- Deep Learning:



TensorFlow



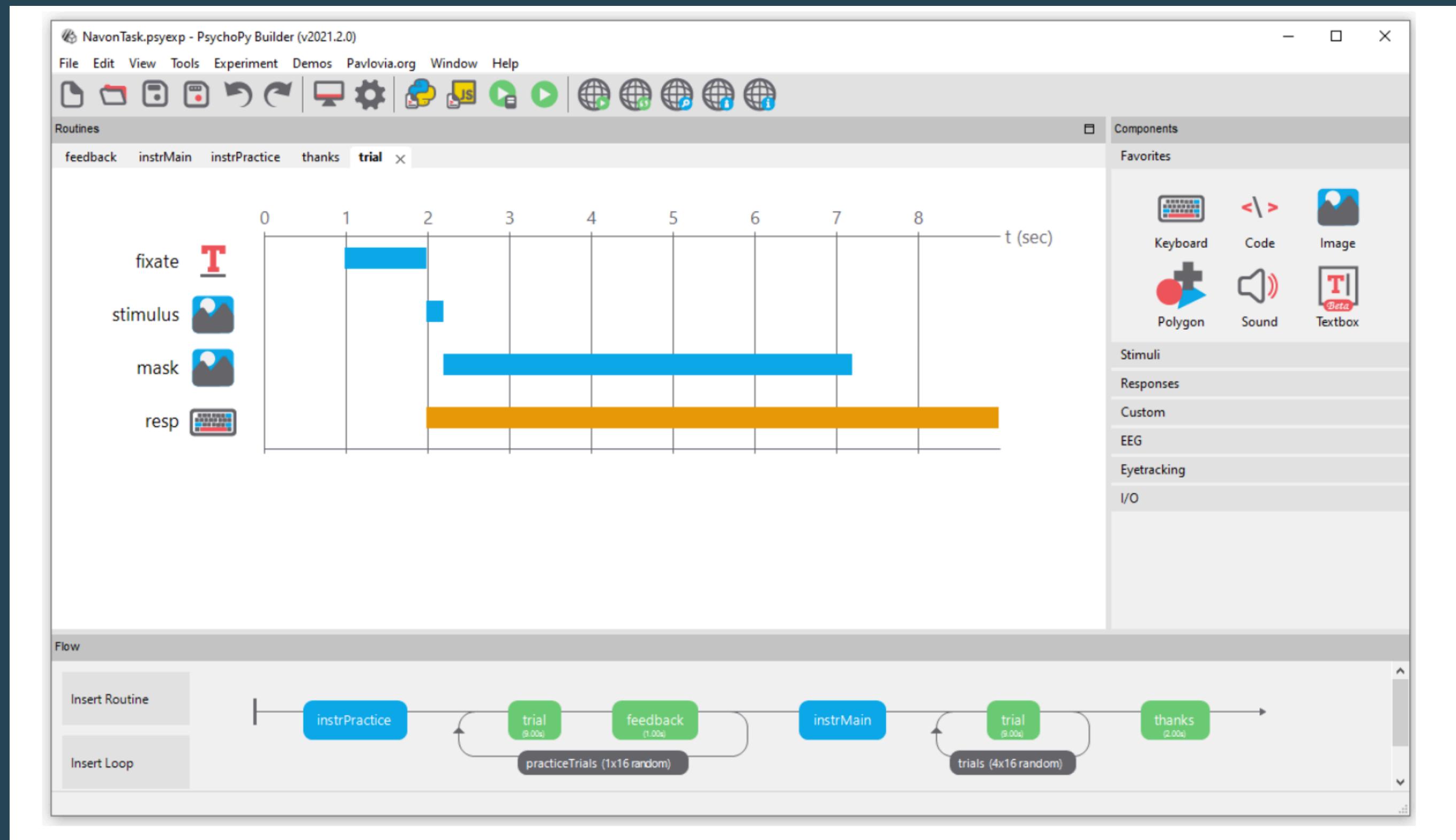
What is python used for ?

- Neuroscience protocole creation



What is python used for ?

- Neuroscience protocole creation



Allows the creation of a wide range of protocols:

- Classic reaction time tasks
- Stroop tasks
- Posner cueing
- Automatic attention capture (rare stimuli)
- Eye tracking
- Audio playback
- Custom protocol

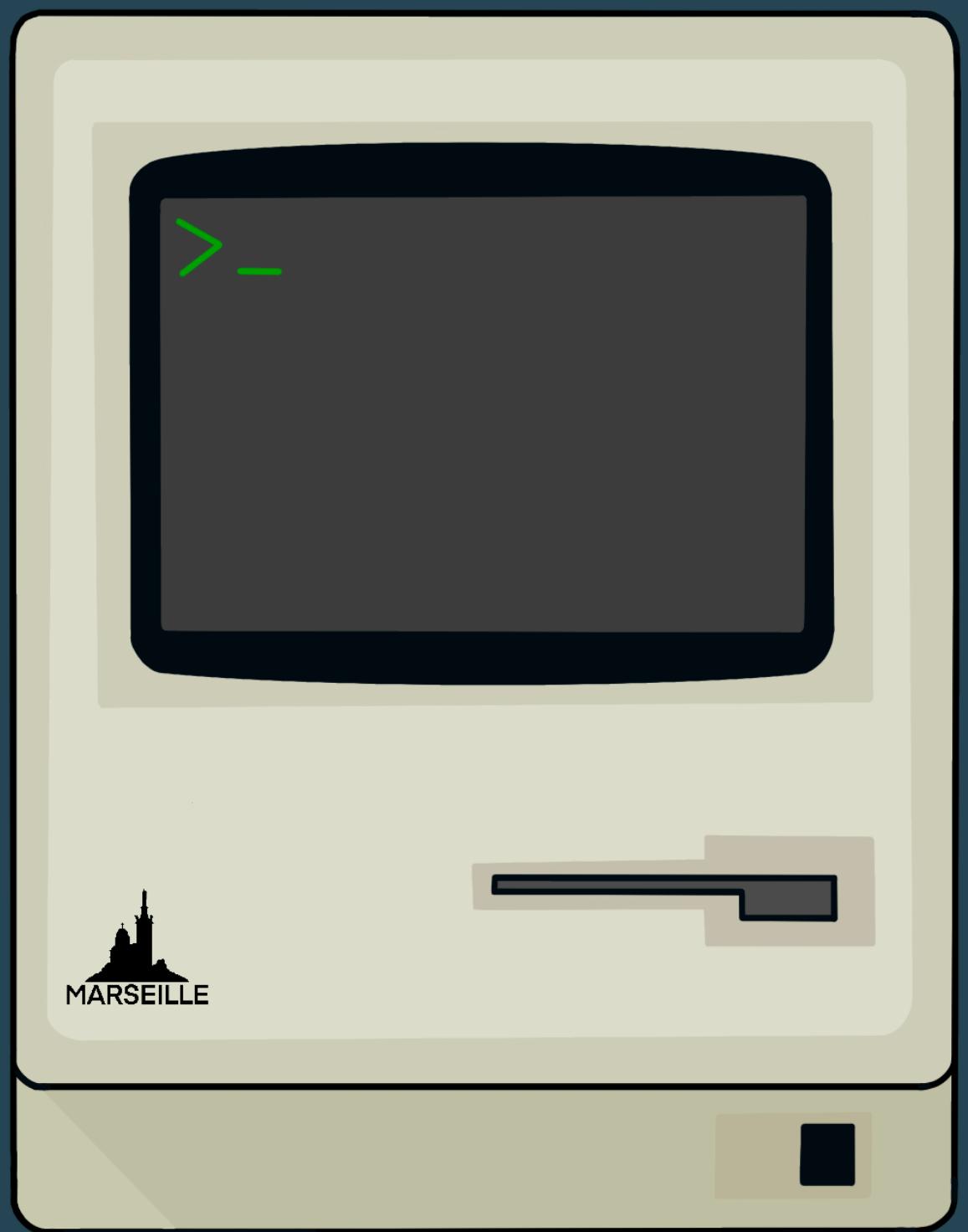
**Now you have a better idea of why
Python is used and how useful it is**

Let's try to learn and enjoy it together!

BrainHack

open collaboration in neurosciences

Marseille



Hands on Python tutorial
Thank you for your attention !

Supplementary slides

To begin

...

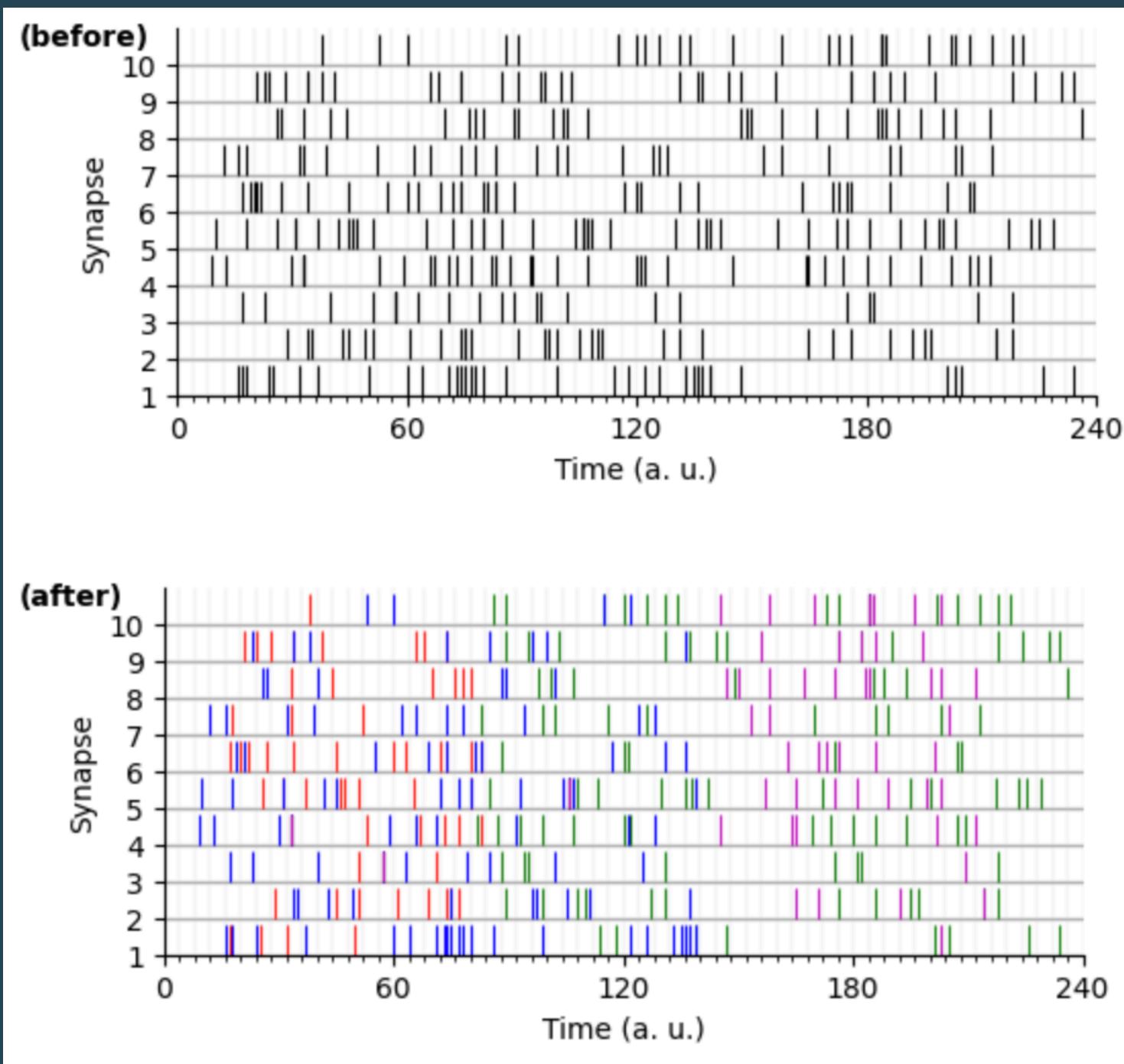
To begin
Who are we ?

Who are we ?

Alexandre Lainé

PhD Student - **NeOpTo** team at the **INT**

Under the supervision of Laurent Perrinet



Détection de motifs dans les trains de Spikes

<https://github.com/SpikeAI/>

2022-11_brainhack_DetecSpikMotifs

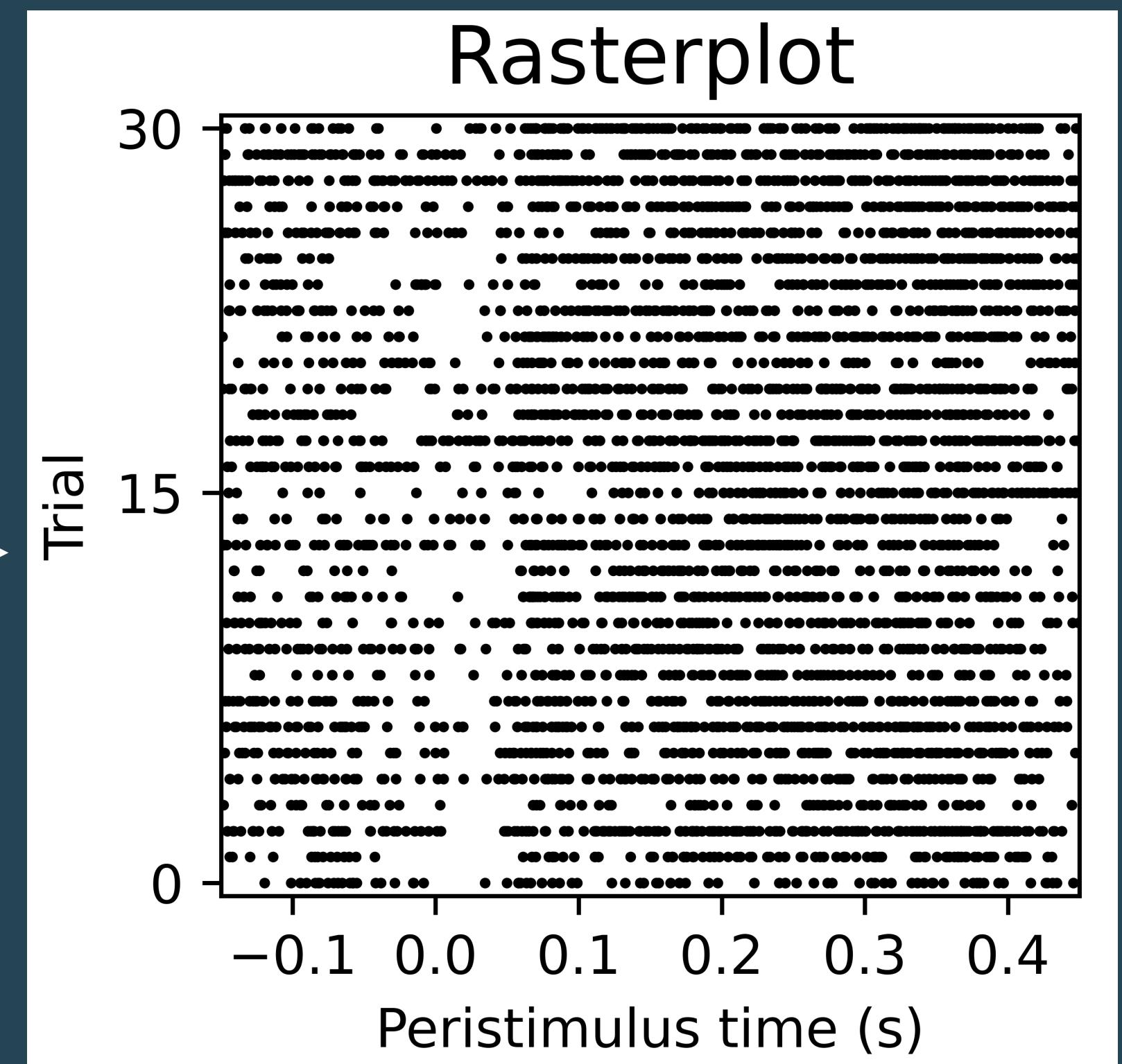
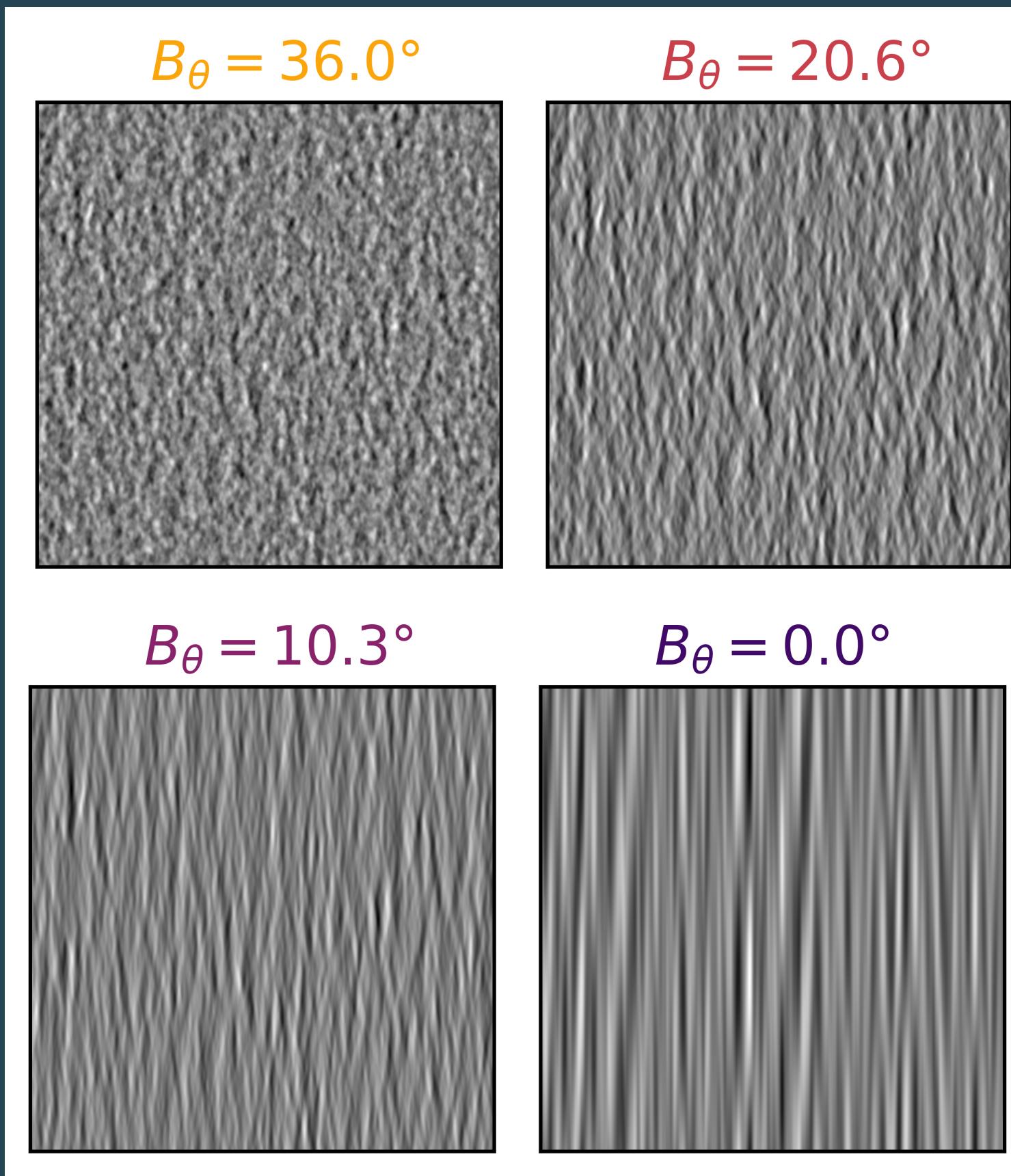


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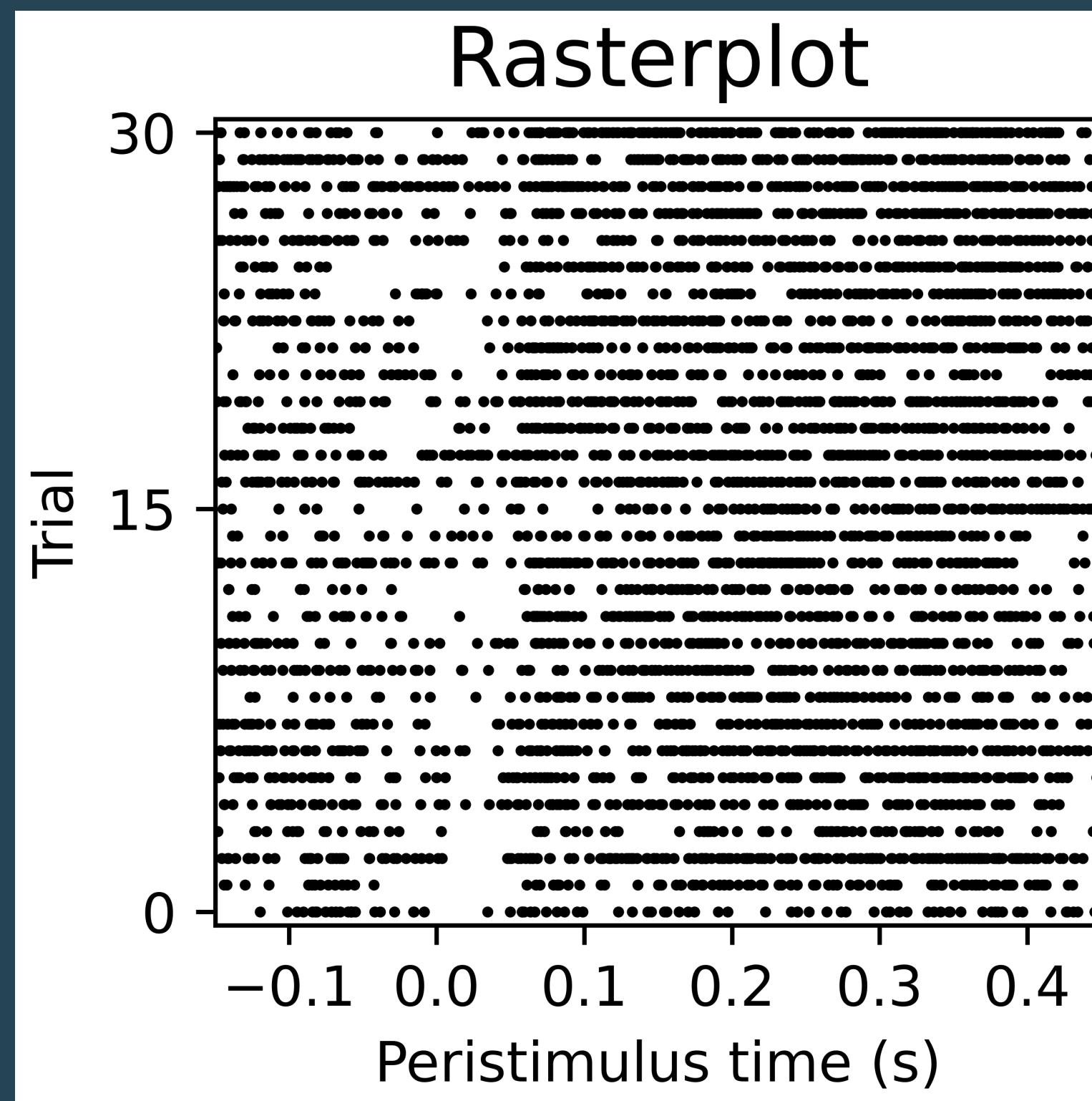


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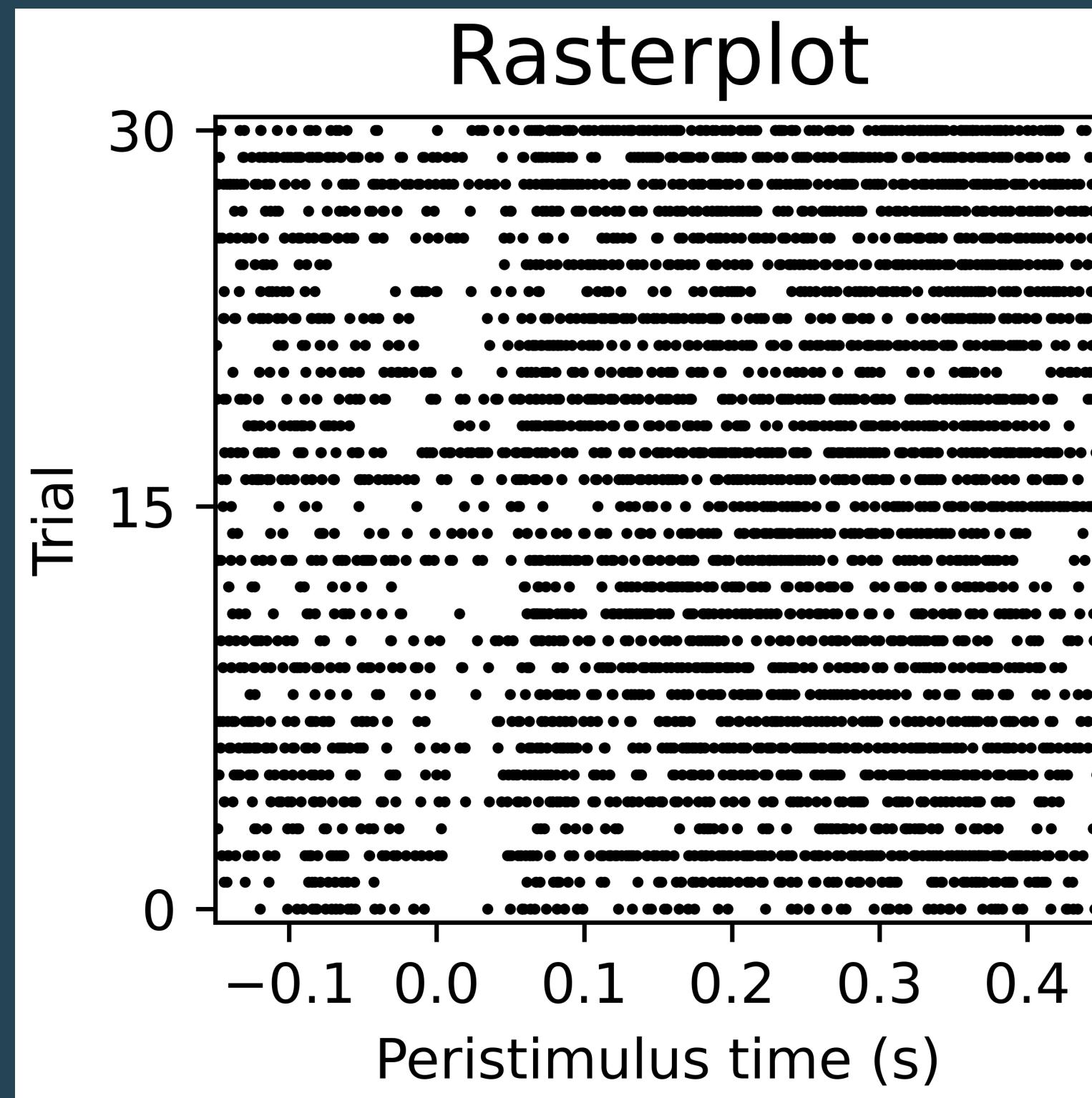


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$$p(x) = \frac{1}{1 + e^{-B_0 + \sum_n^i B_i x_i}}$$

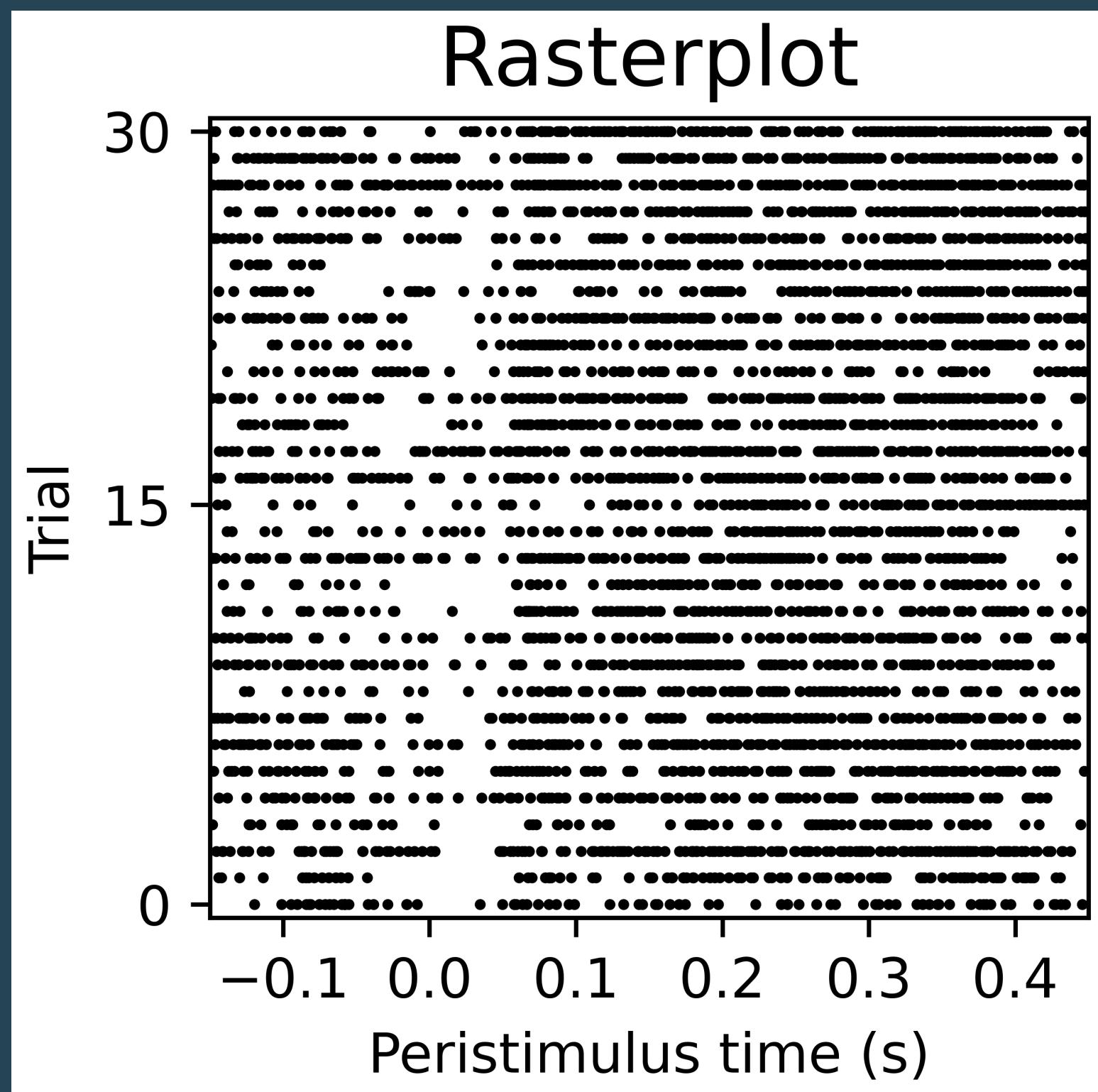
Regression logistique

Who are we ?

Alexandre Lainé

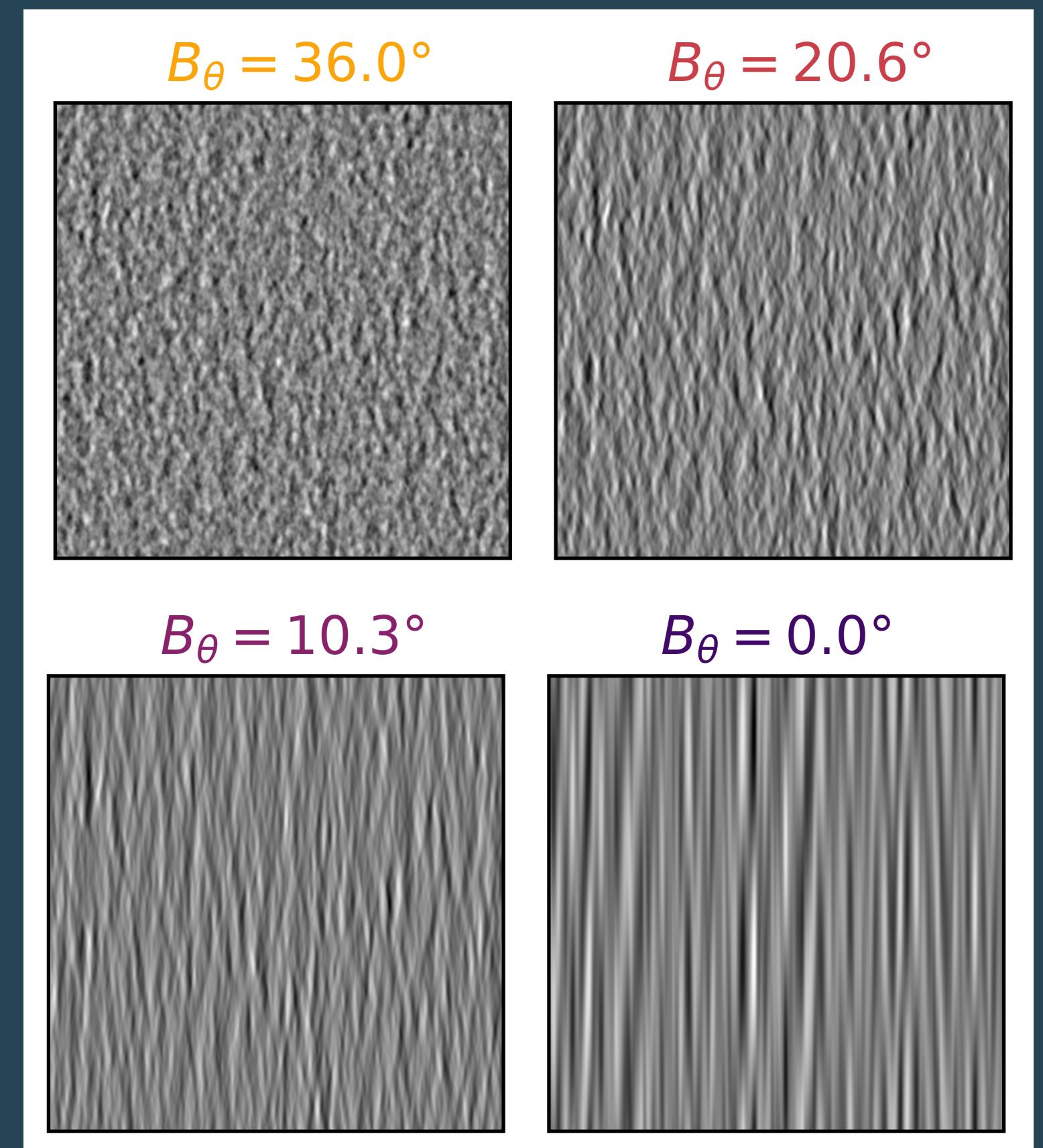
PhD Student - **NeOpTo** team at the **INT**

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Regression logistique

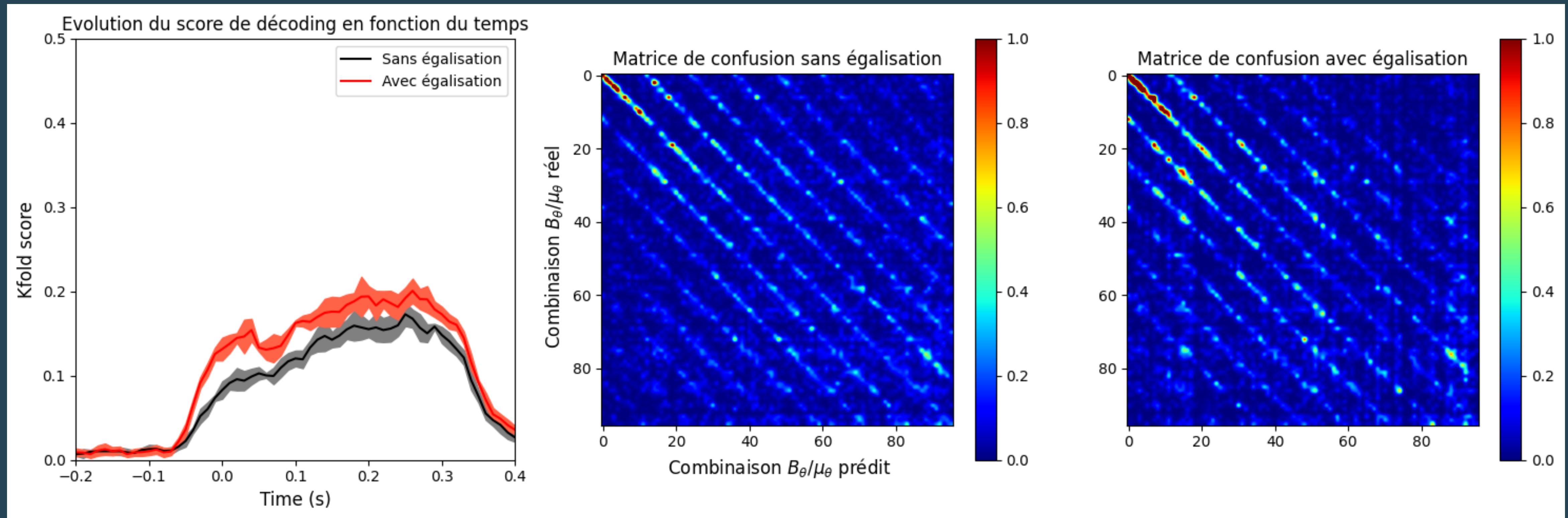


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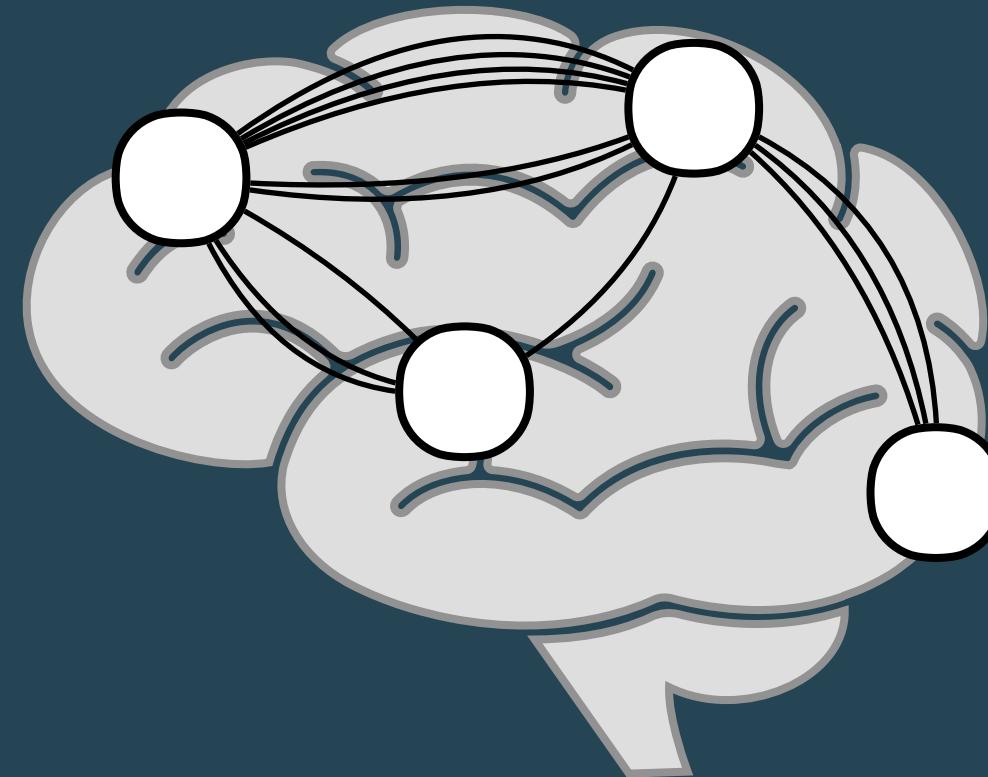
Who are we ?

Dautrevaux Cyprien

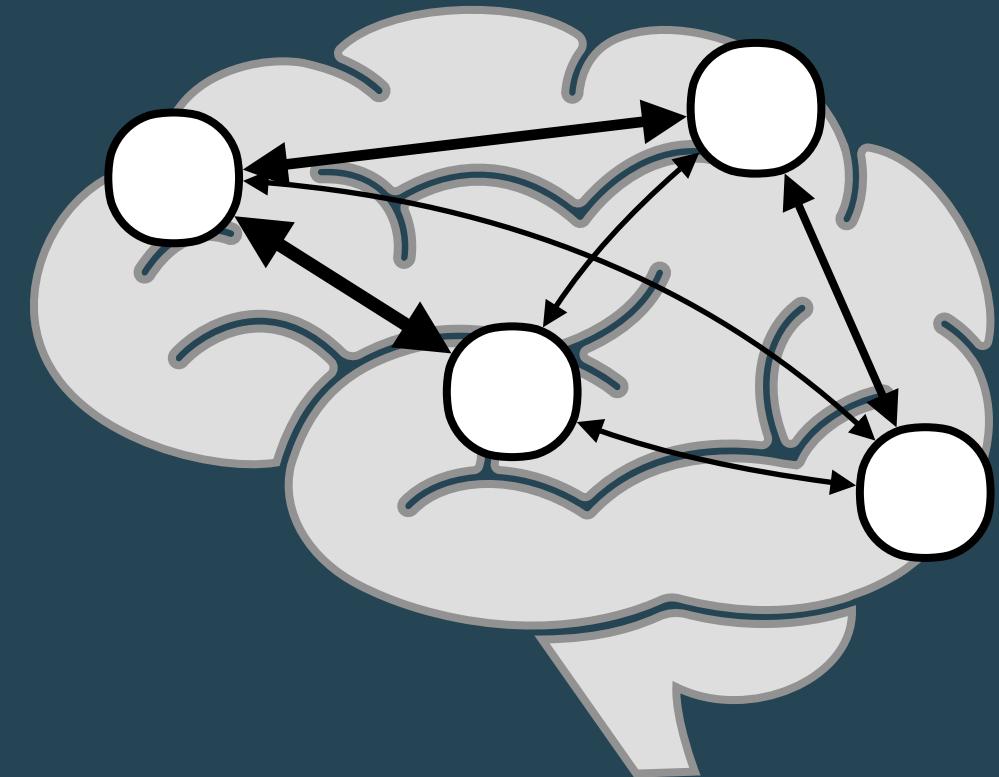
PhD Student - **NeuroStim** at **INS** & **BraiNet** at **INT**

Under the joint supervision of Olivier David & Mathieu Gilson

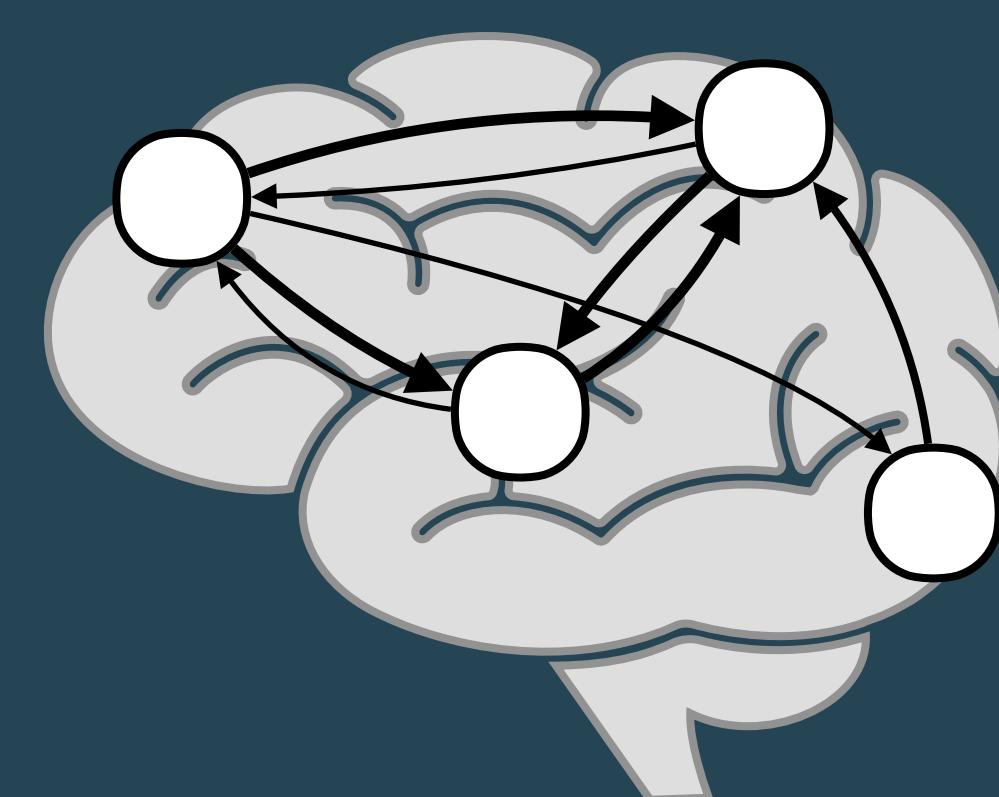
Structural connectivity (SC)



Functional connectivity (FC)



Effective connectivity (EC)



Adapted from O.Sporns 2007



Who are we ?

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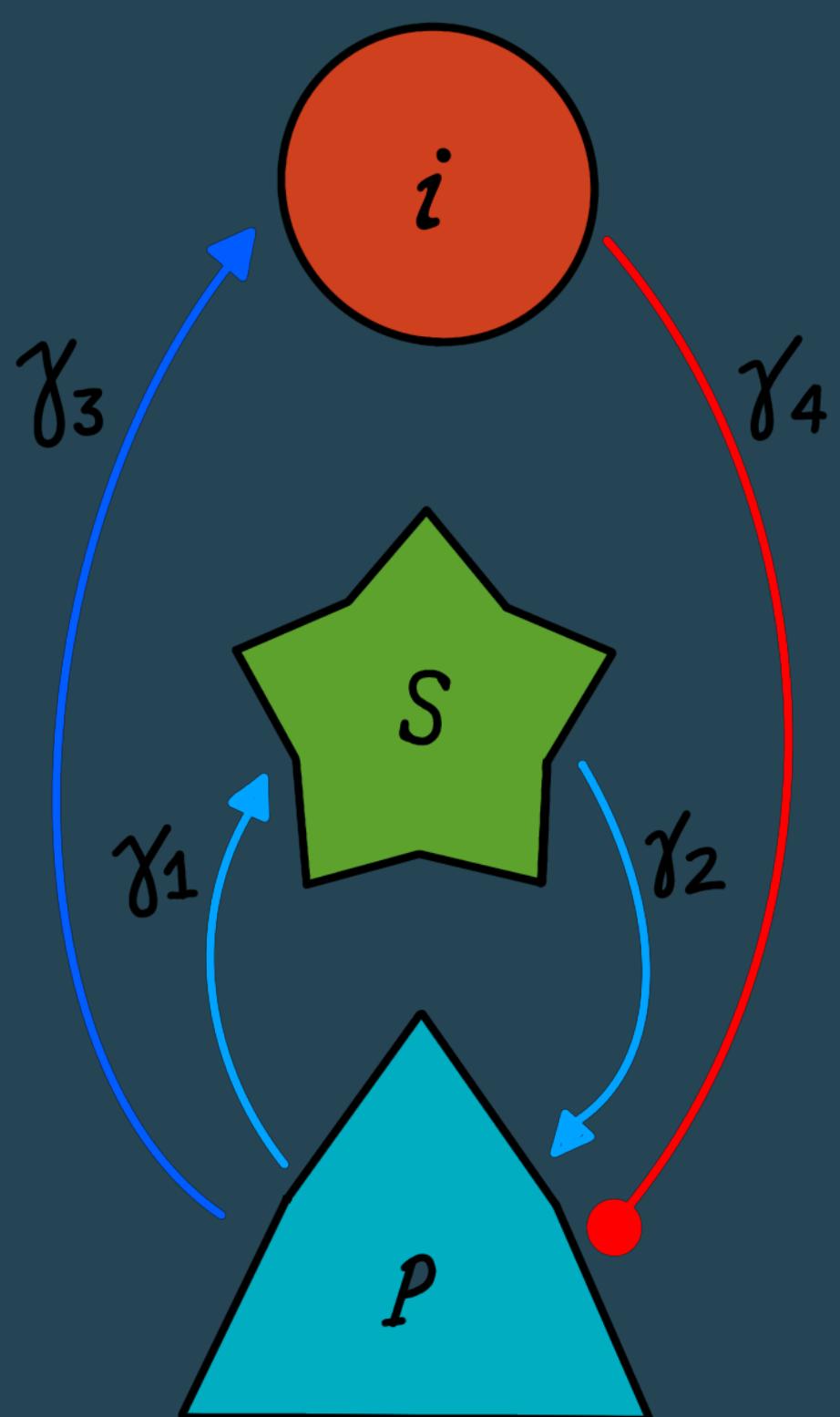
Pyramidal

$$\dot{c}_{pe} = \frac{H_e}{\tau_e}((A^B + A^L)S(v_p) + \gamma_2 S(v_s)) - \frac{2}{\tau_e}c_{pe} - \frac{1}{\tau_e^2}v_{pe}$$

$$\dot{V}_{pi} = c_{pi}$$

$$\dot{c}_{pi} = \frac{H_i}{\tau_i}(\gamma_4 S(v_i)) - \frac{2}{\tau_i}c_{pi} - \frac{1}{\tau_i^2}v_{pi}$$

$$\dot{V}_p = c_{pe} - c_{pi}$$



Inhibitory

$$\dot{V}_i = c_i$$

$$\dot{c}_i = \frac{H_e}{\tau_e}(A^B + A^L + \gamma_3 S(v_p)) - \frac{2}{\tau_e}c_i - \frac{1}{\tau_e^2}v_i$$

Stellate

$$\dot{V}_s = c_s$$

$$\dot{c}_s = \frac{H_e}{\tau_e}(S(u) + A^F + A^L + \gamma_1 S(v_p)) - \frac{2}{\tau_e}c_s - \frac{1}{\tau_e^2}v_s$$

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		1	2	3	
		1	$a_{1,1}$	$a_{1,2}$	$a_{1,3}$
		2	$a_{2,1}$	$a_{2,2}$	$a_{2,3}$
		3	$a_{3,1}$	$a_{3,2}$	$a_{3,3}$
Regions Cibles		Regions Sources			

Estimation Bayesienne des règles de connections

Python :

- Sbi
- NumPyro



Markov chain
Monte Carlo

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