Python Tsunami

Part 1: Intro to Python by HeaDS

Who are we?

Who are we

Center for Health Data Science (HeaDS)

- The Data Lab
  - Provides data science support for all research groups at SUND
  - Organizes workshops/seminars

- Research Units
  - work on different areas and topics within the field of health data science

https://heads.ku.dk

Who are we

Center for Health Data Science (HeaDS)

- Upcoming events:
  - Just Bash It: 21 November 2022
  - RNAseq workshop: 18-20 January 2023

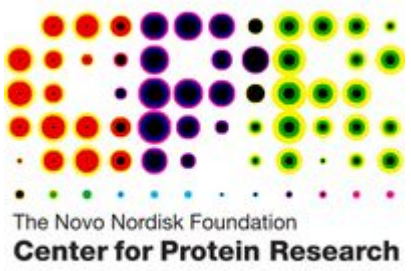
https://heads.ku.dk

About this course

About this course

Originally developed at the Center for Protein Research (CPR) by:

- Alberto Santos Delgardo (University of Oxford)
- Henry Webel (NNF CPR)
- Annelaura Bach Nielsen (NNF CPR)
- Rita Colaço (PRI)



We say thank you for the course material which we have adapted.

About this course

Your teachers:

Jose Alejandro Herrera Romero - Alex (HeaDS)

Rita Colaço (PRI)

Inigo Prada Luengo (HeaDS)

Tugce Karaderi (HeaDS)

Chloe Pitman (HeaDS)

Eleonora Nigro (HeaDS)

Henrike Zschach (HeaDS)







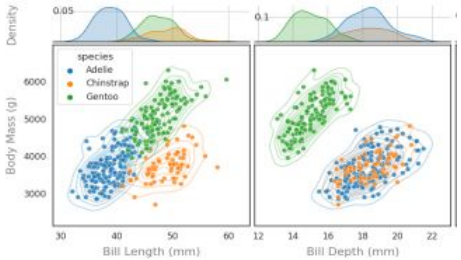
About this course

Starting time	Day 1	Day 2	Day 3
8:30	Morning coffee (optional)		
8:45	**Introduction & Motivation** *(Henrike)*	**Pandas: Series and dataframes, import and examine data, Renaming index/colum** *(Rita)*	**Yesterday Questions + Recap Quiz** *(Henrike)*
9:05	**Variables & Data types** *(Tugce)*		
9:45	Coffee break		Coffee break
10	**Iterables I: Lists** (Chloe)		**Visualization** *(Alex)*
10:15		Coffee break	
10:30		**Pandas: Indexing and Selecting Data, Summary functions** *(Rita)*	
11:30	**Iterables II: sets, dicts, tuples** *(Chloe)*		
12:00	Lunch		
13:00	**Booleans, operators & conditions** *(Iñigo)*	**Pandas: Modifying data** *(Rita)*	**Dataset exercise** *(Henrike, Iñigo, Chloe)*
14:00		Coffee break	
14:15	Coffee break	**Pandas: GroupBy Operations, Sorting and Imputation** *(Rita)*	
14:30	**Loops** *(Iñigo)*		
15:30		**Pandas Q + A** *(Rita)*	
16:00	- END -		

What is programming?

What is programming?

Programming is a set of **machine-readable** instructions that transform your input into your desired output.



input → program → output

We will attempt to shed some light on this part

Why is programming nice?

- Learning by doing:

  Difficult to ‘break’ a computer with wrong programming
- Reproducibility:

  The same thing should happen every time you run (*though some tasks involve some randomness)
- Transferable:

  Easily share your work with colleagues
- Many useful online resources
- Automate complex analysis workflows
- Important tool for working since we live in a data driven world

Why Python?

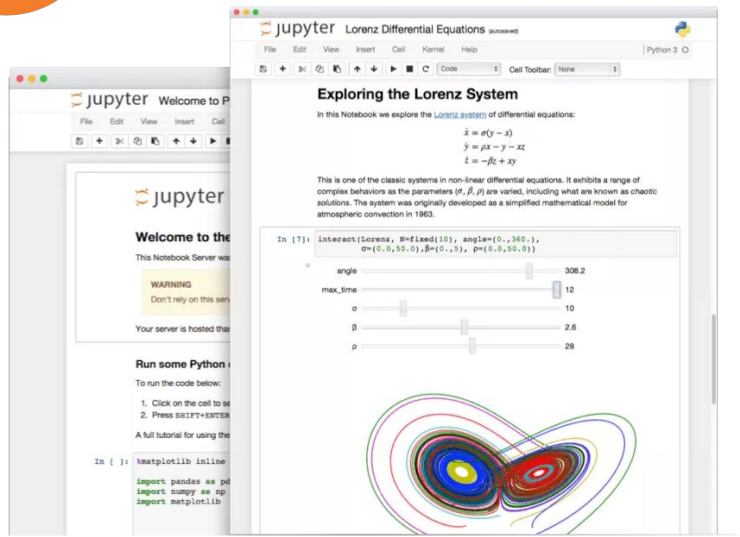
Python is a great programming language for both beginners and advanced programmers:

- Easy to grasp, close to natural language
- Many learning resources available
- Large community (i.e. stackoverflow for questions)
- Libraries
- Can do very advanced things like neural networks

Python environments

Jupyter notebook

The Jupyter Notebook is an **open-source application** to create and share documents that contain code, equations, visualizations and text (markdown).



- Browser-based development environment for creating, running and sharing Python code
- Combine code with text and output
- Runs from your **local installation**. I.e., you need Python and the libraries you want to use installed on your computer

Google Colab

Google Colab is a Jupyter Notebook hosted on Google's servers, not your own machine. It still runs in your browser.

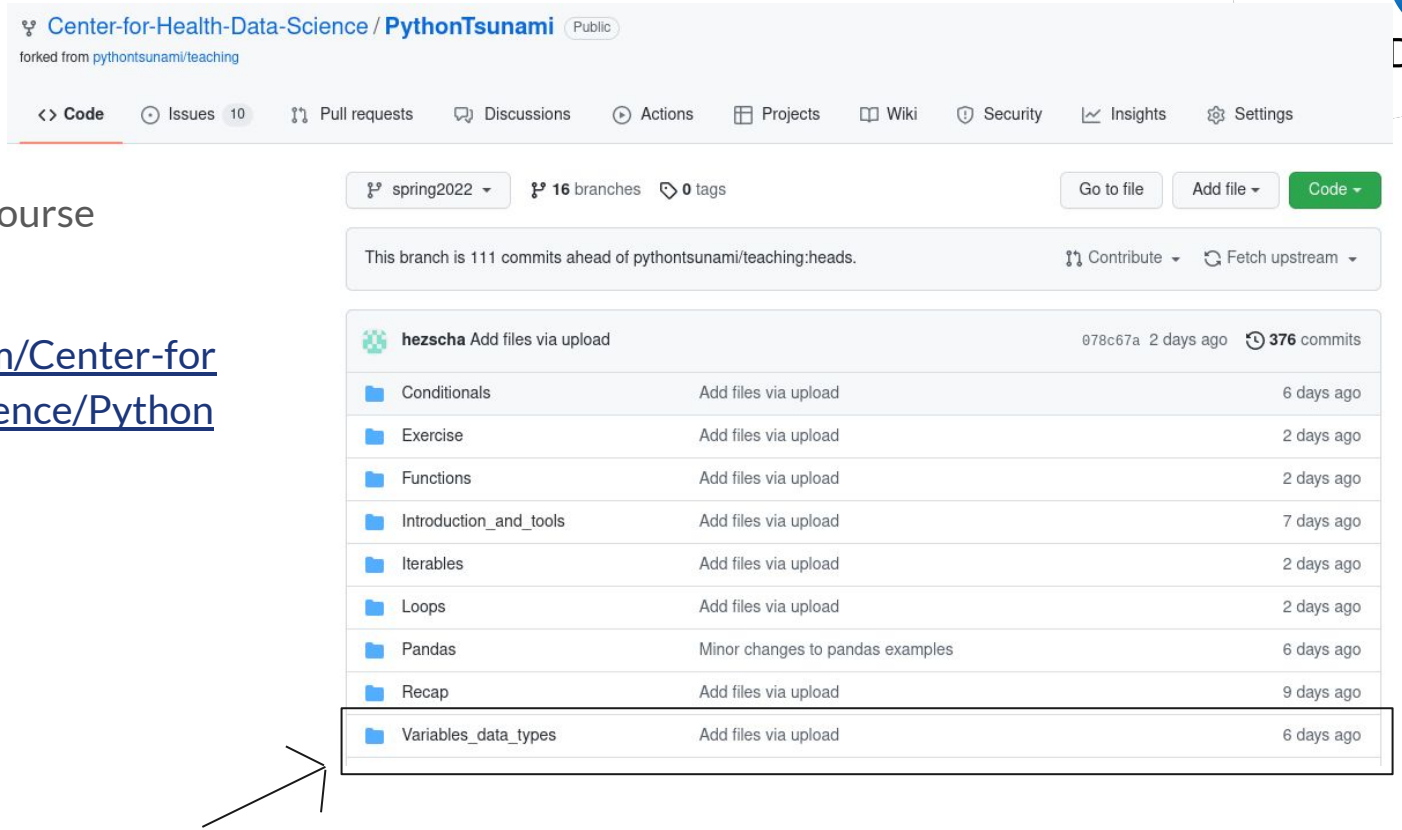
- tool to write, execute and share Python code through the browser
- requires no setup to use and provides free access to computing resources on Google's servers including GPUs
- is connected to a Google account and data and notebooks can be accessed through Google Drive.

We'll use Colab during the course.

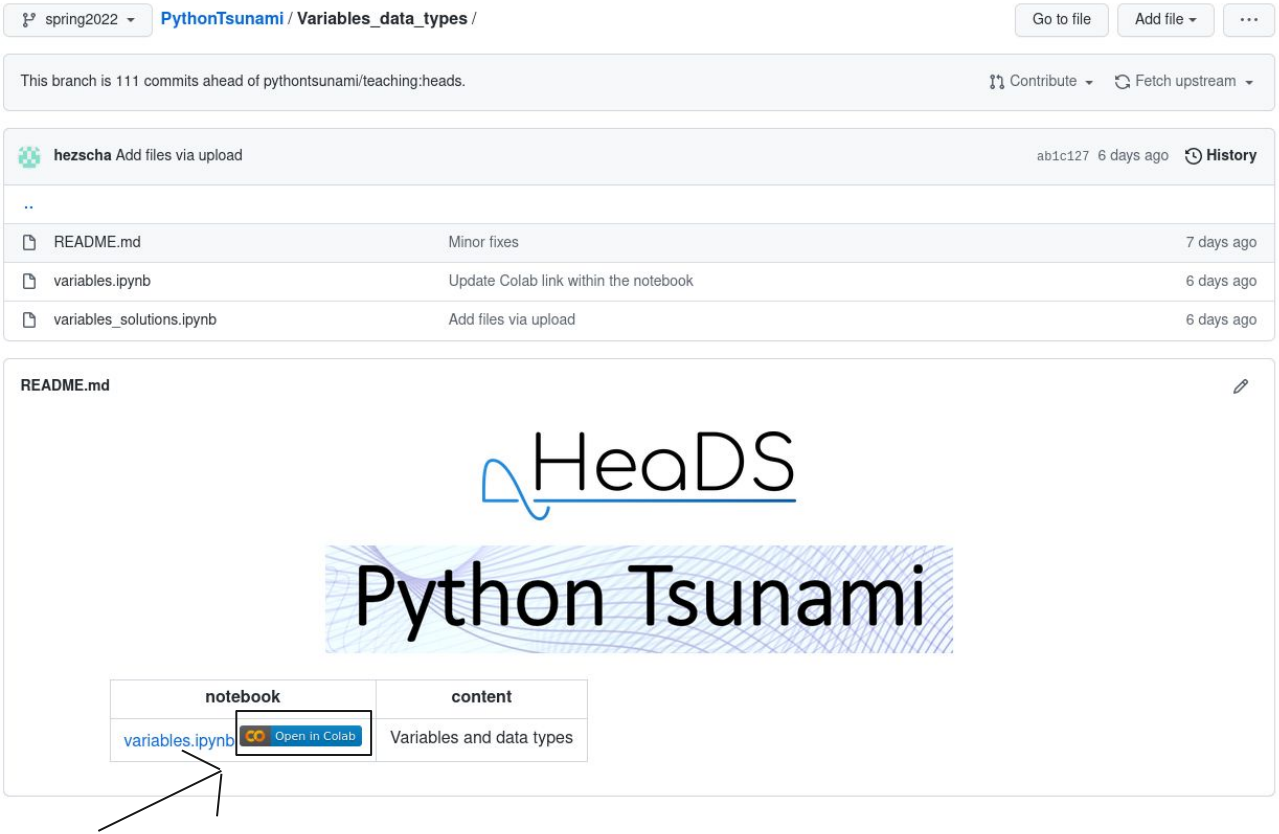
Course material

You can find the course material here:

https://github.com/Center-for-Health-Data-Science/PythonTsunami

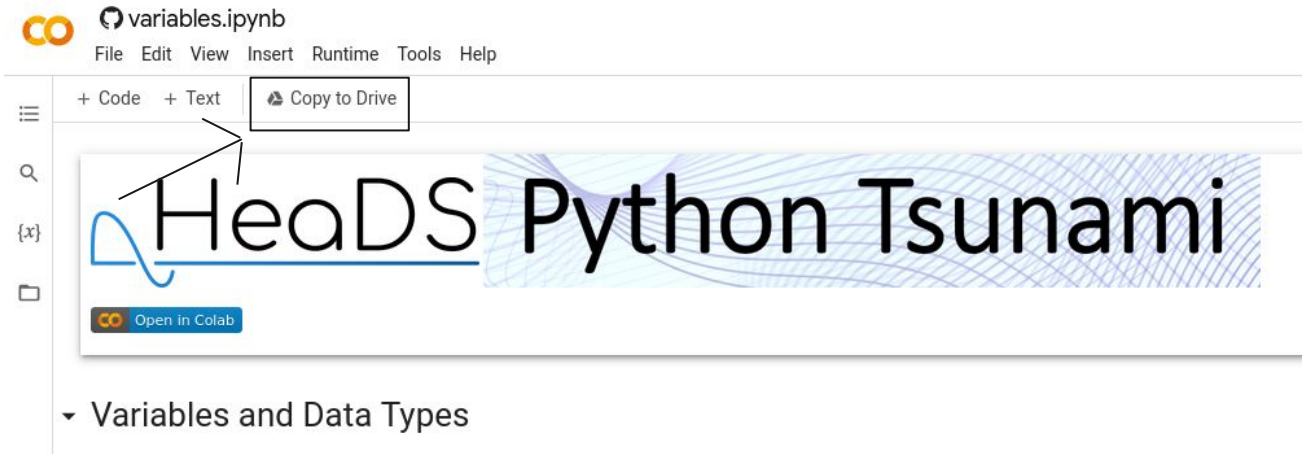


Course material



Course material

Remember to **save a copy** to your own google drive so you can save your notes and exercises!



Questions

You are always welcome to ask question during the course.

We also have a **padlet** board you can post your questions to. If you see a question posted that you also have, press the ‘like’ button.

At the start of day 3 we will take up the most popular questions from the board.

Short Introduction

Take the next 5 mins to introduce yourself at your table:

- Name
- Position
- Unit
- Research topic (very briefly!)

Using libraries/packages

Libraries

Python has many libraries, also called packages, that other programmers have developed. Find and **use** them!

Well-maintained libraries generally are:

- Tested
- Optimized
- Documented

There is no need to reinvent the wheel. During this course we will use:

- Pandas (all the data analysis!)
- Math (basic math)
- Plotly express (visualization)

Libraries

If you are running Python from a local installation, you need to have libraries **installed** before you can use them.

On Google Colab you can generally just import, they are already installed.

- Import the math library:

```
import math
```

- Now I can use functions from that library, i.e. calculating the logarithm or square root:

```
math.log(3)

math.sqrt(4)
```

Objects, variables, references

The language of python

Python is an **object-oriented** programming language. Therefore it helps if you primarily think of two different things:

Objects and functions*

- Objects are **pieces of information** (i.e. a number, a string of letters, a data table).
- We perform functions on objects. They are what we **do** to the information pieces.
- Which functions we can perform depends on the type of the object.

*technically functions are objects too, but let's not get too technical

An example

An object:

```
my_int = 3
```

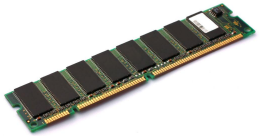
A function:

```
math.log(my_int)
```

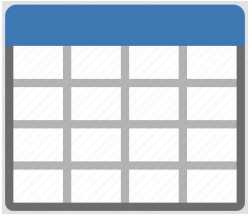
This does not work because the object is the wrong type:

```
math.log('hello')
```

Variables and Objects



RAM = physical memory



Object = piece of info, i.e. a pandas dataframe

```
my_df = read.csv(...)

my_int = 3

cities_list = ['New York',
'Copenhagen', 'Berlin']
```

Variable inside Python program

Every piece of data you use in Python is stored somewhere in physical memory as an **object.**

Variables are **references** to the stored object.