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# Python Tsunami

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# 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



## Center for Health Data Science (HeaDS)

- Upcoming events:
  - RNAseq workshop: 18/19 August 2022
  - GDPR course: 20/21 September 2022
  - Excel to R: 11/12 October 2022

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# About this course

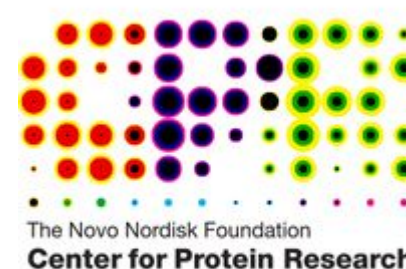
# About this course

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

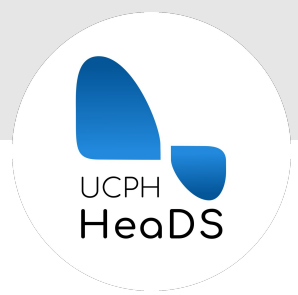
- Alberto Santos Delgado (University of Oxford)
- Henry Webel (NNF CPR)
- Annelaura Bach Nielsen (NNF CPR)
- Rita Colaço (PRI)



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

# About this course

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## Your teachers:

Jose Alejandro Herrera Romero -  
Alex (HeaDS)

Rita Colaço (PRI)

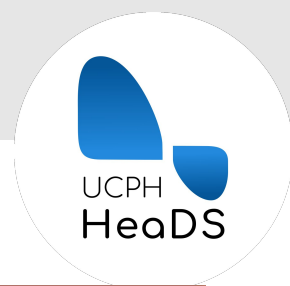
Inigo Prada Luengo (HeaDS)

Viktoria Schuster (HeaDS)

Henrike Zschach (HeaDS)



# About this course



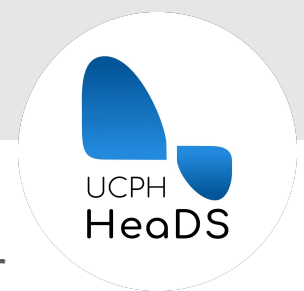
PROGRAM - Python Tsunami Part I		
DAY 1 - Mon 20th of June		DAY 2 - Tue 21st of June
08:30 - 08:45	Morning coffee (optional)	
08:45 - 09:05	Introduction and Motivation	Libraries, Objects, References
09:05 - 09:45	Variables and data types	Questions from yesterday
09:45 - 10:00	Coffee break	
10:00 - 10:45	Iterables I: Lists	Pandas
10:45 - 11:00	Coffee break	
11:00 - 12:00	Iterables II: sets, dicts, tuples	Pandas
12:00 - 13:00	Lunch	
13:00 - 14:00	Booleans, operators and conditions	Pandas
14:00 - 15:15	Loops	Visualization
15:15 - 15:30	Coffee break	
15:30 - 17:00	Functions	Dataset Exercise



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# What is programming?

# What is programming?



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

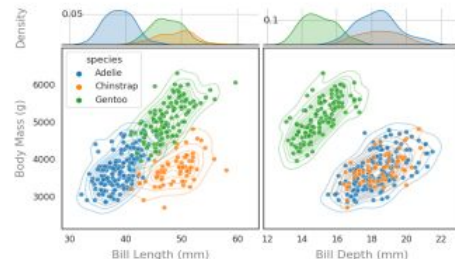


input



program

↑  
We will attempt to  
shed some light on  
this part



output

# Why is programming nice?

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- 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

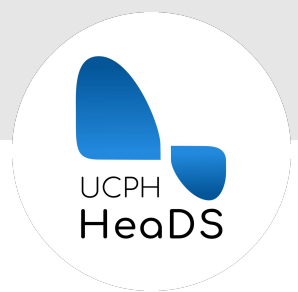
- Many useful online resources

- Automate complex analysis workflows

- Important tool for working since we live in a data driven world

# Why Python?

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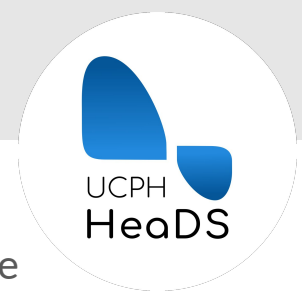
Python is a great programming language for both beginners and advanced programmers:

- 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

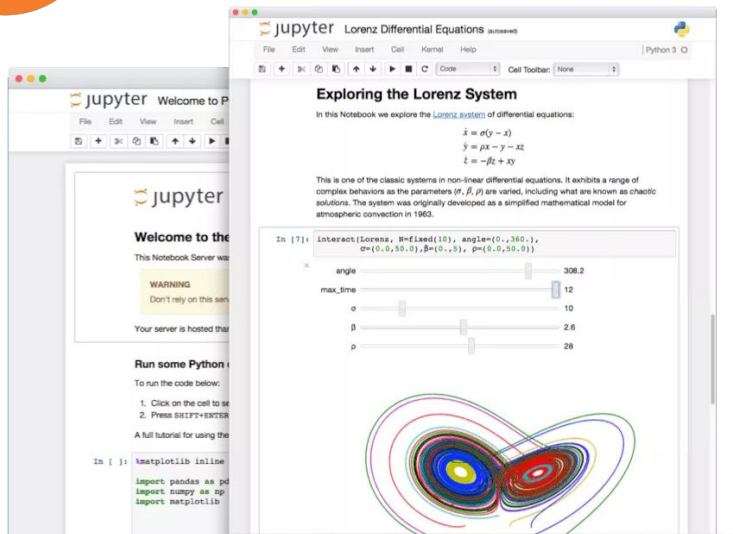
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# Python environments

# Jupyter notebook



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



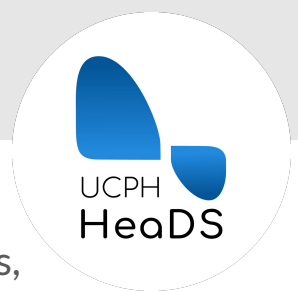
- Browser-based development environment for creating, running and sharing Python code
- Combine code with text and output
- Runs from your **local installation**. I.e., you need Python and the libraries you want to use installed on your computer



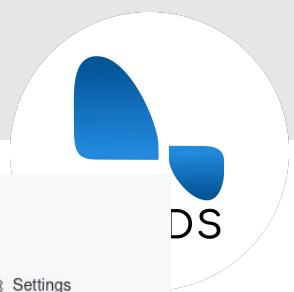
Google Colab is a Jupyter Notebook hosted on Google's servers, not your own machine. It still runs in your browser.

- 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



Center-for-Health-Data-Science / PythonTsunami Public  
forked from pythontsunami/teaching

<> Code Issues 10 Pull requests Discussions Actions Projects Wiki Security Insights Settings

You can find the course material here:

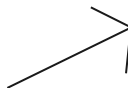
<https://github.com/Center-for-Health-Data-Science/PythonTsunami>

spring2022 16 branches 0 tags

Go to file Add file Code

This branch is 111 commits ahead of pythontsunami/teaching:heads. Contribute Fetch upstream

hezscha Add files via upload 078c67a 2 days ago 376 commits	
Conditionals	Add files via upload 6 days ago
Exercise	Add files via upload 2 days ago
Functions	Add files via upload 2 days ago
Introduction_and_tools	Add files via upload 7 days ago
Iterables	Add files via upload 2 days ago
Loops	Add files via upload 2 days ago
Pandas	Minor changes to pandas examples 6 days ago
Recap	Add files via upload 9 days ago
Variables_data_types	Add files via upload 6 days ago





# Course material



spring2022 PythonTsunami / Variables\_data\_types /

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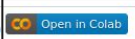
hezscha Add files via upload ab1c127 6 days ago History

..

README.md	Minor fixes	7 days ago
variables.ipynb	Update Colab link within the notebook	6 days ago
variables_solutions.ipynb	Add files via upload	6 days ago

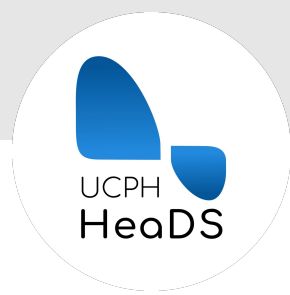
README.md



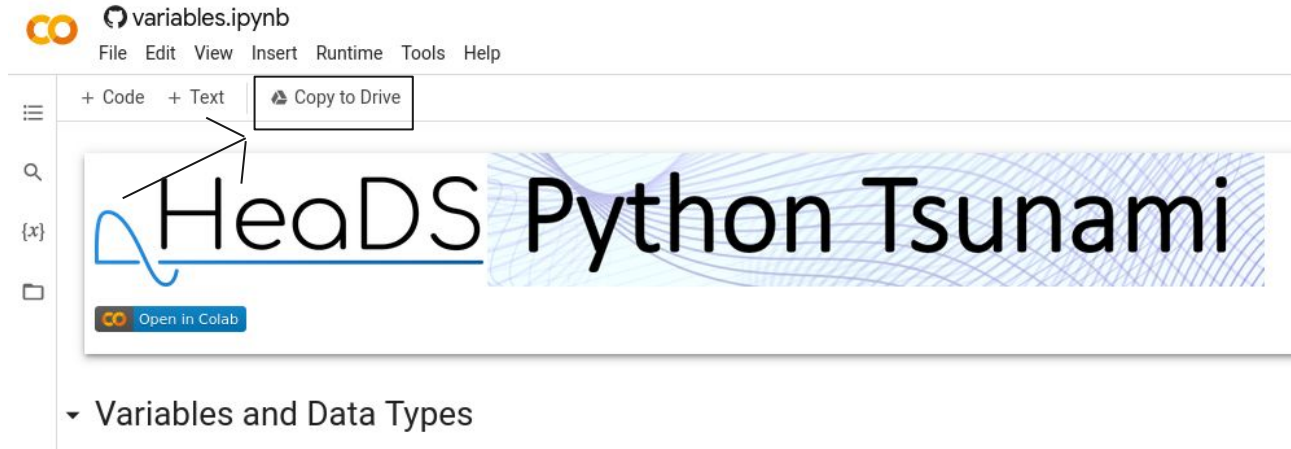
notebook	content
<a href="#">variables.ipynb</a> 	Variables and data types



# Course material

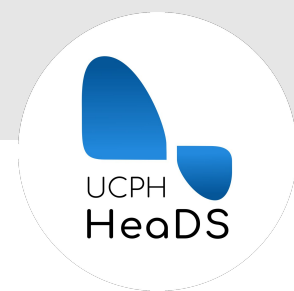


Remember to **save a copy** to your own google drive so you can save your notes and exercises!



# Questions

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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 2 we will tell a bit more about the inner workings of Python and take up the most popular questions from the board.

# Short Introduction

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Take the next 5-7 mins to introduce yourself at your table:

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

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# Using libraries/packages

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)

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)
```

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# Objects, variables, references



# The language of python

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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

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An object:

```
my_int = 3
```

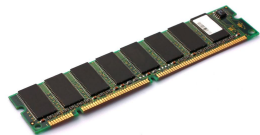
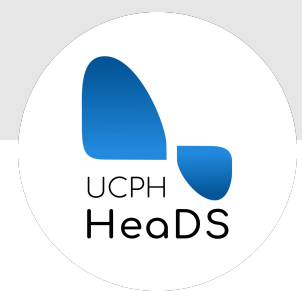
A function:

```
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.