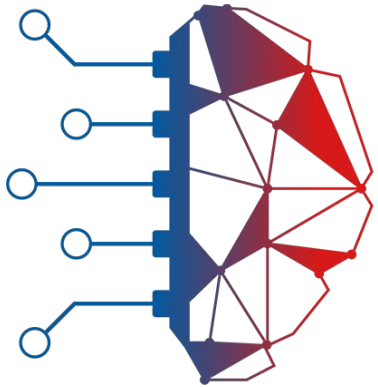


HIBALL

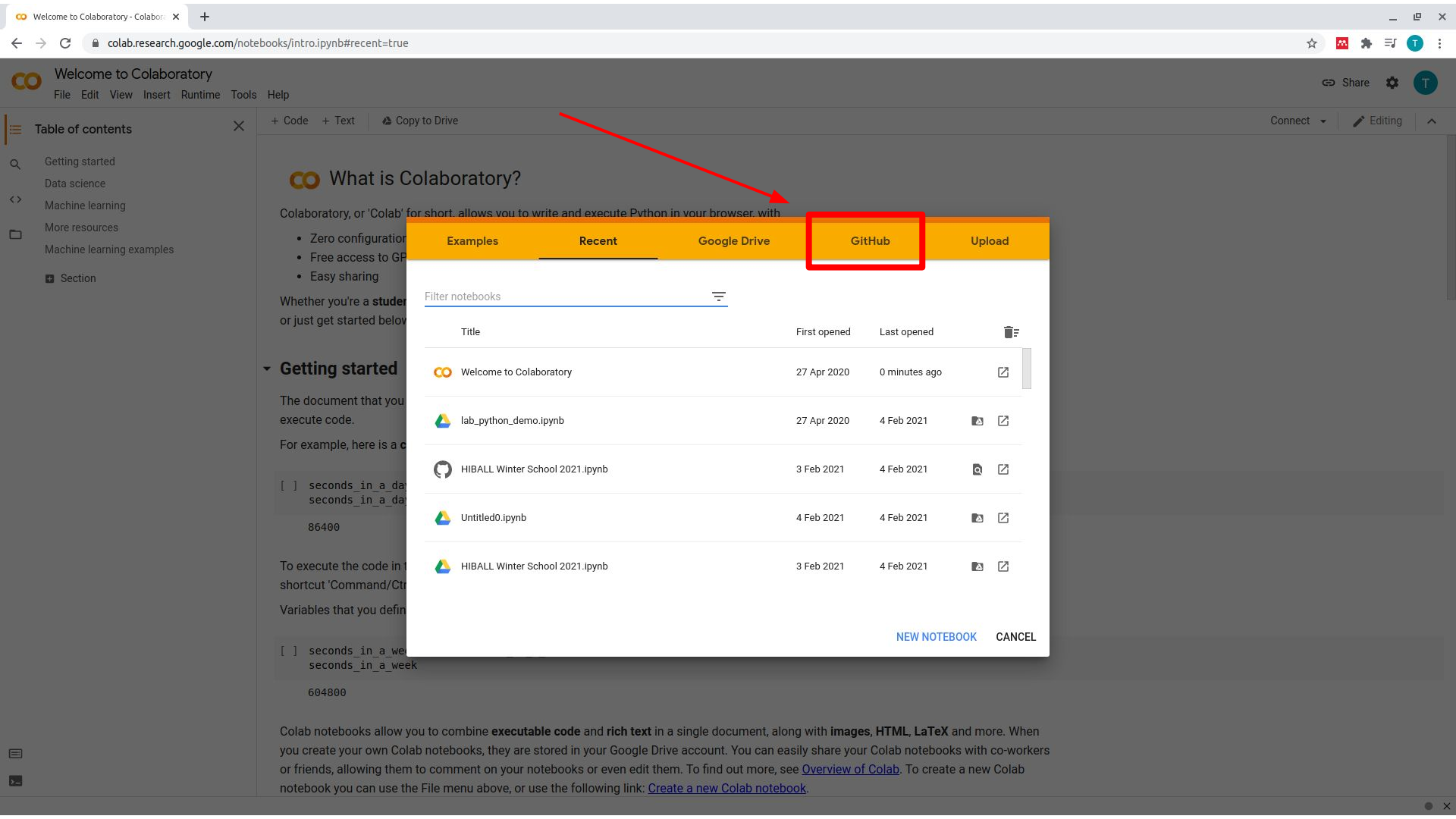
Hacking Hour

JÜLICH Forschungszentrum

McGill

HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

HEALTHY BRAINS
HEALTHY LIVES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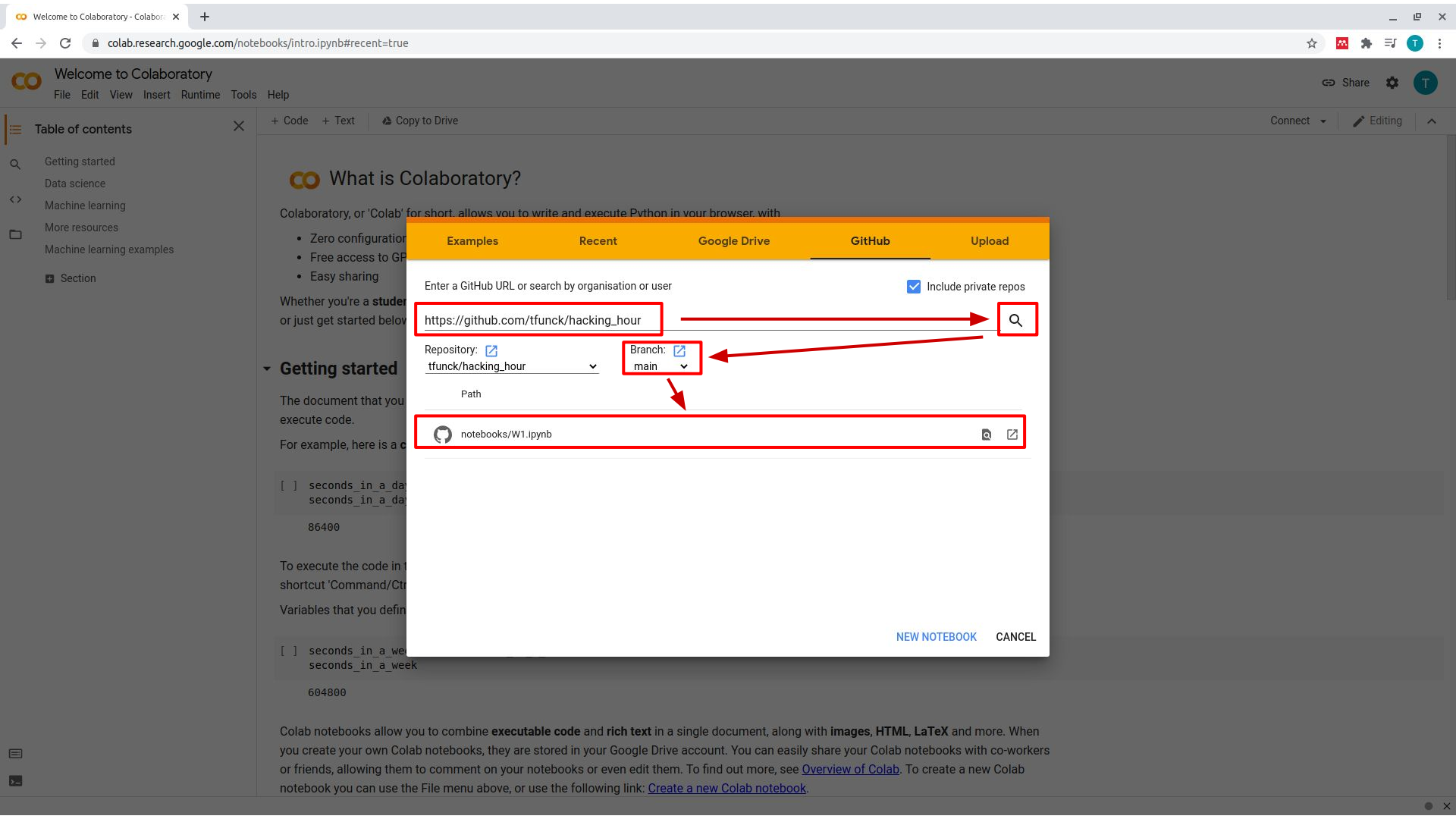
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Repository:
tfunck/hacking_hour
Branch:
main
Path
notebooks/W1.ipynb
NEW NOTEBOOK
CANCEL

- **Part 1**: Basics
  - Basics I
    - variables, data structures, functions
  - Basics II
    - standard Python functions and libraries, strings, I/O
  - Software Design
    - writing safe, reusable software

- **Part 2**: Neuroimaging Libraries
  - 2D and 3D Images
    - numpy, imageio, nibabel
  - Data frames and visualization
    - pandas, matplotlib
  - Image processing
    - scipy, skimage

- **Part 3**: Neuroimaging Applications
  - some ideas…
    - Statistics
    - Segmentation
    - Registration
    - Machine Learning / AI
    - fMRI

```
# Programming is about writing instructions that can be executed by a computer and read by human beings.

# Data and functions that manipulate data
```

```
[ ] ### Variables and integers

    # variables are the most basic data structure.

    x = 1 #here set <x> to equal the integer 1

    print(x) #print is a function that displays the value of a variable or other data types

    x = 2 #here we modify the variable <x> to equal the integer 2

    print(x)
```

```
1
2
3
```

```
[ ] ### Characters
    # variables can point to different types of data

    x = 'c' #instead of pointing to an integer, the variable now points to a character, 'c'

    print(x)
```

```
[ ] ### Booleans
    x = True #booleans are another type of data, they can be True or False

    print(x)

    x=3
    y='3' #here we define a new variable and equate it to the character, not the number, 3

    print(x == y) #using the == operator, we can check if two data structures are equal to one another.

    z = x == y # we can also assign the result of a == operator to a new variable,<z>

    print(z)
```

What is programming?

- Programming is about writing instructions that:
  - Can be executed by a computer
  - Read by human beings ← very important!

- Programs are composed of
  - Data
  - Functions that manipulate data

Programming Languages

- Programming languages are different ways of writing those instructions
  - Programming languages are much simpler than natural languages

- “Low-level”
  - Require very detailed, specific instructions
  - Example: C, C++

- “High-level”
  - More general, abstract instructions
  - Example: Python, Matlab, R

Algorithms

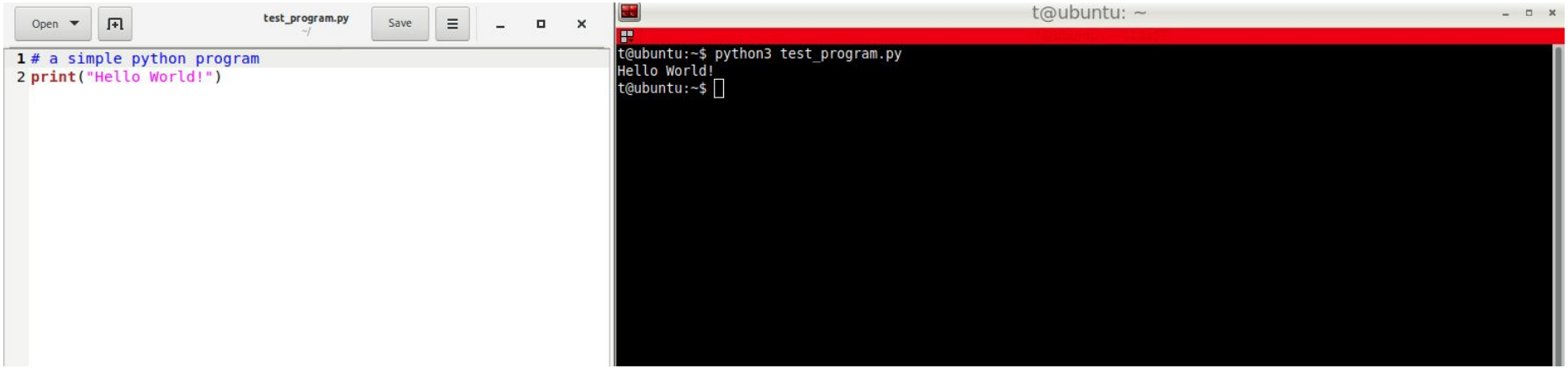
- A finite set of instructions for performing computational operations
  - Like a cooking recipe, but for computers

https://commons.wikimedia.org/wiki/File:Traditional_Eggs_Benedict.jpg

- Eggs Benedict Algorithm
  - Low-level language
    - Apply heat to 500mL of water to bring to 100C
    - Add 2 tb of white vinegar to water
    - Collect 2 unfertilized chicken eggs
    - For each chicken egg: apply 1n of force to shell, empty egg into water
    - …
  - High-level language
    - Poach 2 eggs
    - Make a cup of bechamel sauce
    - Toast 2 sides of a bagel
    - For each side of toasted bagel: add 1 poached egg and then half of bechamel sauce

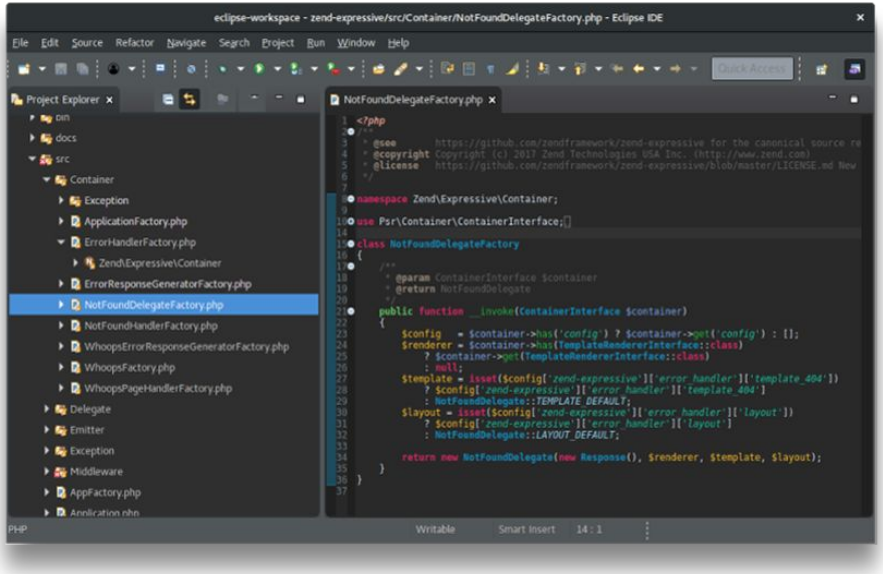
How Do People Normally Write Software?

- Text editor + command line interface



How Do People Normally Write Software?

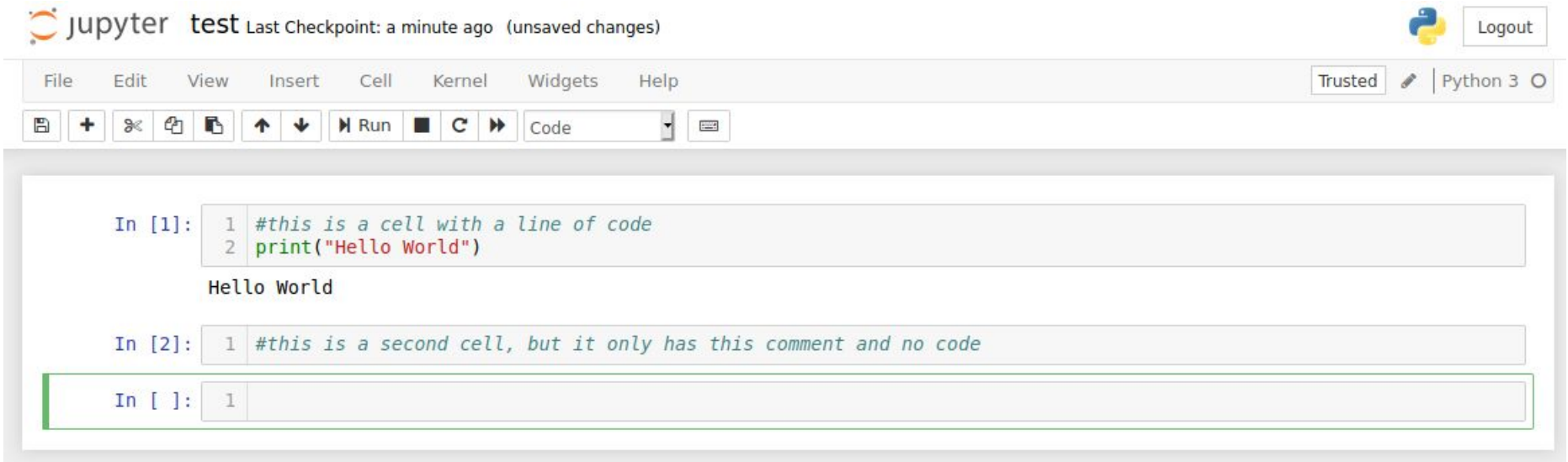
- Integrated Development Environment (IDE)
  - Software dedicated to writing code.
  - Lots of features, but can be a bit complex.



Eclipse IDE

How Do People Normally Write Software?

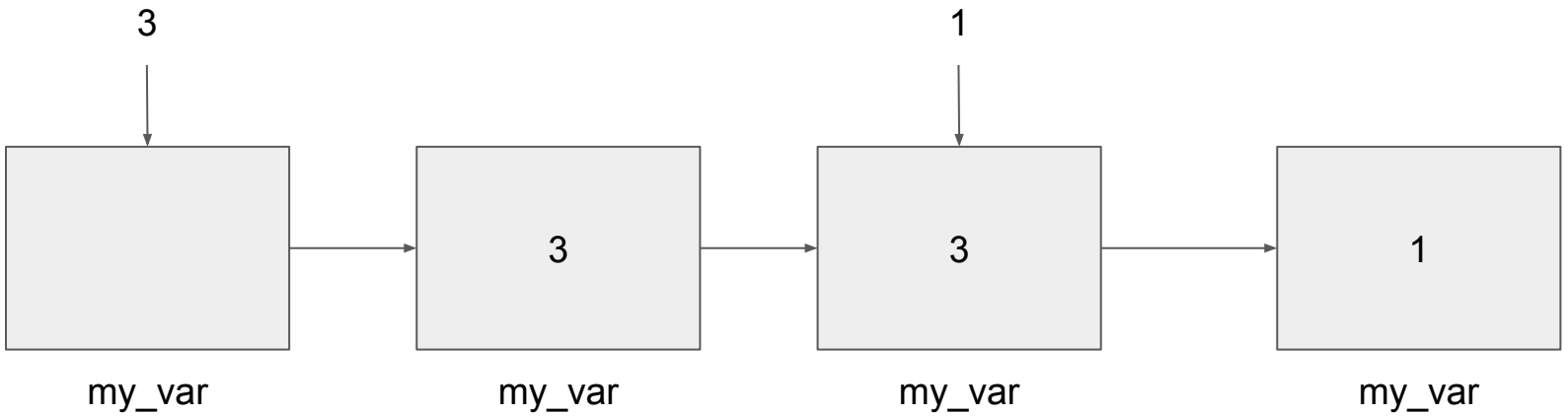
- Jupyter Notebooks
  - Not a good way to develop software, but very good for educational purposes
  - Consists of blocks of code, i.e., “cells”, that can be run one at a time.



- Instead of installing anything, we can use jupyter notebooks on Google Colab

Variables

- A memory address containing a *value* referenced by an *identifier*



Functions

- Functions take inputs, do some computations, and then return outputs
  - Inputs are usually called “arguments”