Introduction to Programming and Machine Learning in Python Module 1

Lecture 1: Course Introduction

Outline

Note on the 2-modules structure

2-modules structure: http://bit.ly/IProML2021_SNS

This course is the first module of a teaching unit of two modules:

- M1: Focuses on how to *program well*
- M2: Focuses on data analysis and machine learning

Students can attend single modules.

- M1 gives the necessary background for M2

These slides focus on M1

Course Responsibles

- Andrea Vandin
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  - ★ Tenure-track Assistant Professor in Computer Science at Institute of Economics & EMbeDS @ SSSA
  - ★ Adjunct Associate Professor at DTU Denmark
  - ★ Formerly:
    - ▶ Associate Professor in Computer Science at DTU Denmark
      - Most related teaching activity: responsible for 3 years of course 'Programming in C++ for non-computer scientists', 250 students
- Daniele Licari
  - ★ daniele.licari@santannapisa.it
  - ★ Data Engineer and Data Scientist at EMbeDS @ SSSA
  - ★ Expert of Python and machine learning
- Together we provided courses on programming and MachineLlearning at SSSA and GSSI.

Course References & Material

- Webpages of the course:
  - ★ http://bit.ly/IProML2021_SNS
    - ▶ Slides and examples from the lectures, further materials and links
    - ▶ Weekly coding assignments
- Suggested books:
  - ★ M. Lutz, Learning Python;
  - ★ W. McKinney, Python for Data Analysis.
- Well-done tutorial: https://docs.python.org/3/tutorial/
- Software
  - ★ Python: https://www.python.org/
  - ★ Python editor: JupyterLab https://jupyter.org/
  - ★ Setup your machine: http://bit.ly/IProML2021_SNS

Course Description

This course will

introduce the students to the fundamental principles of (object-oriented) structured programming with basic applications to data processing. Using Python as reference language, the course starts from basic notions of programming (variables, data types, collections, control & repetition structures, functions & modules), up to basic data processing functionalities (loading, manipulation, and visualization of CSV data).

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A student who has met the objectives of the course will

acquire an understanding of the issues involved in computer programming, to be able to make informed decisions. The student will be able to write simple to medium python programs of various nature, including those for reading, manipulating and visualizing data.

Learning Objectives

A student who has met the objectives of the course will be able to:

- select and use the correct data types and collections for the problem at hand
- use and describe variables, operations, and control and repetition strctures (if, loops)
- create and use functions and classes
- use libraries for I/O, data manipulation, and data visualization
- use principles of structured program design and methods
- discuss Python-related issues in a clear and concise way, possibly using on-line platforms

Self-Evaluation & Active Learning

These are *attività trasversali*

- There will not be an exam
- Attendance certificate (attestazione di presenza)
  - ★ Mandatory attendance $\geq 80\%$.

To get the best from this course, we will provide you

- Regular coding assignments
  - ★ Available in the wiki. Should be run on Google Colab
    - ▶ Automatic tests for your code and hints to fix bugs
    - ▶ (Soft) deadlines: before the following class
    - ▶ Feel free to contact us for support
  - ★ A fundamental learning tool of this course

Tentative Lecture Plan

Module 1 – 16 hours

Class	Topic	Date	Time
1	Course Introduction & Console I/O & Variables	18/06	15:00-17:00
2	Data types & Operations	21/06	15:00-17:00
3	Collections & First plots	23/06	15:00-18:00
4	Control statements CSV manipulation on COVID19 data	25/06	15:00-18:00
5	Functions Application to epidemiological models Creation of word clouds from online news	28/06	15:00-18:00
6	Modules & Exceptions & OOP	02/07	15:00-18:00

Further info

- No previous experience on computer programming required
- Previous experience in writing small programs is advantageous
- We might adjust the course level according to your expertise and feedback
- You will never learn programming if you don't practice it!
  - ★ Therefore you should regularly do the assignments

Ideas for an Effective Course

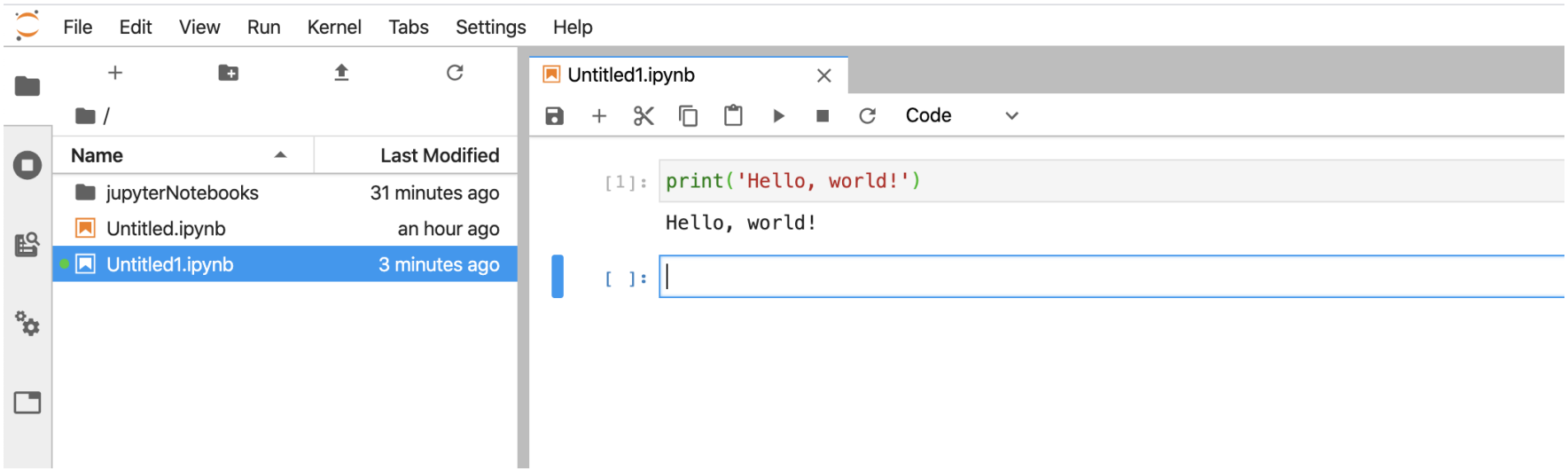
Live Programming & Assignments/Examples

When we have blocks of 3 hours:

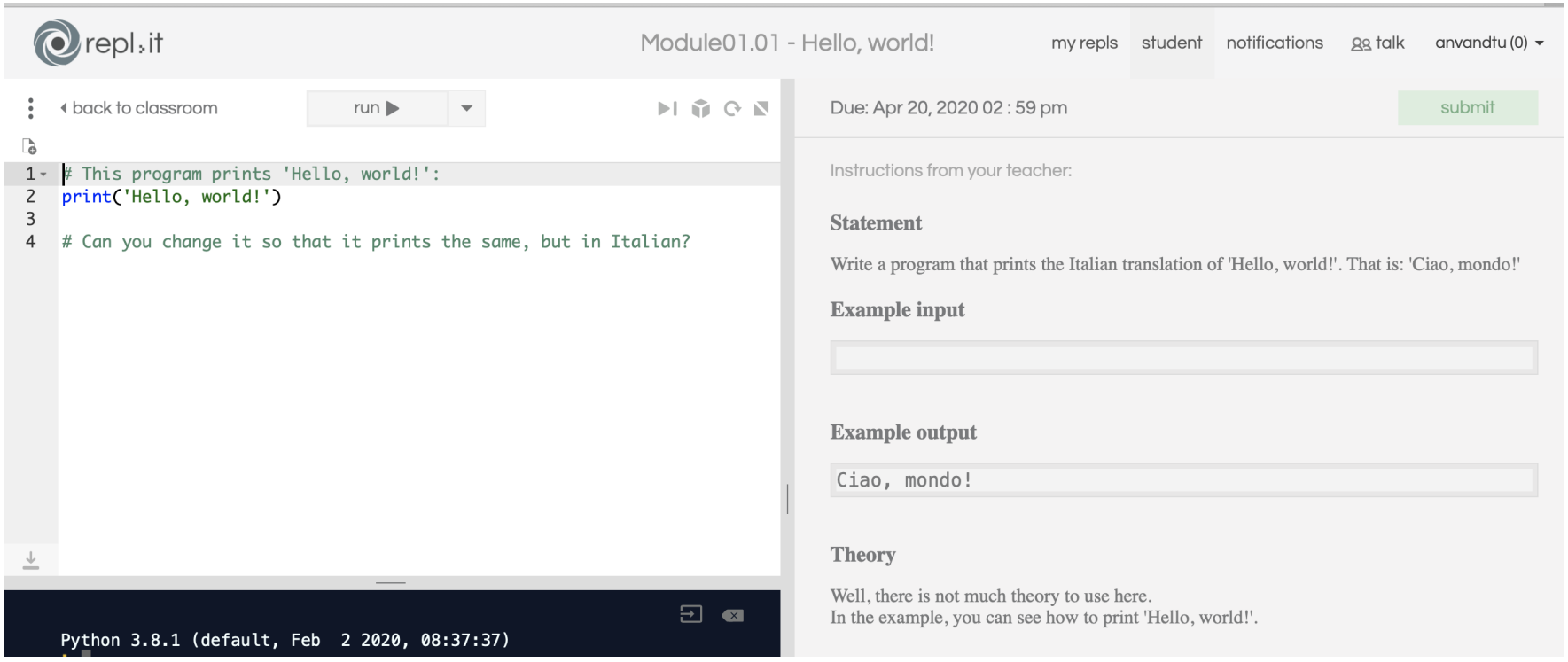
- First part:
  Intro to week's topics & Live programming
  - ★ Not many slides
  - ★ Instead: we develop a few example programs
    - ▶ Please have your laptop ready! http://bit.ly/IProML2021_SNS
    - ▶ You find code in advance here
- Second part:
  You consolidate your understanding working on examples or assignments
  - ★ Begin working on the assignments with our live support if needed
  - ★ Complete them offline before next class. Contact us if needed

Live Programming

Find the JupyterLab notebooks at http://bit.ly/IProML2021_SNS



Colab TODO



- Each lecture comes with a set of simple coding assignments
  - ★ Distributed using Colab
  - ★ Links available in the notebook of the corresponding class

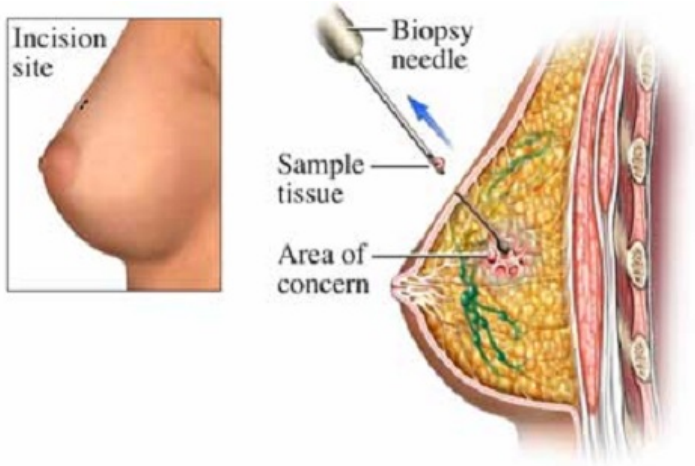
Colab

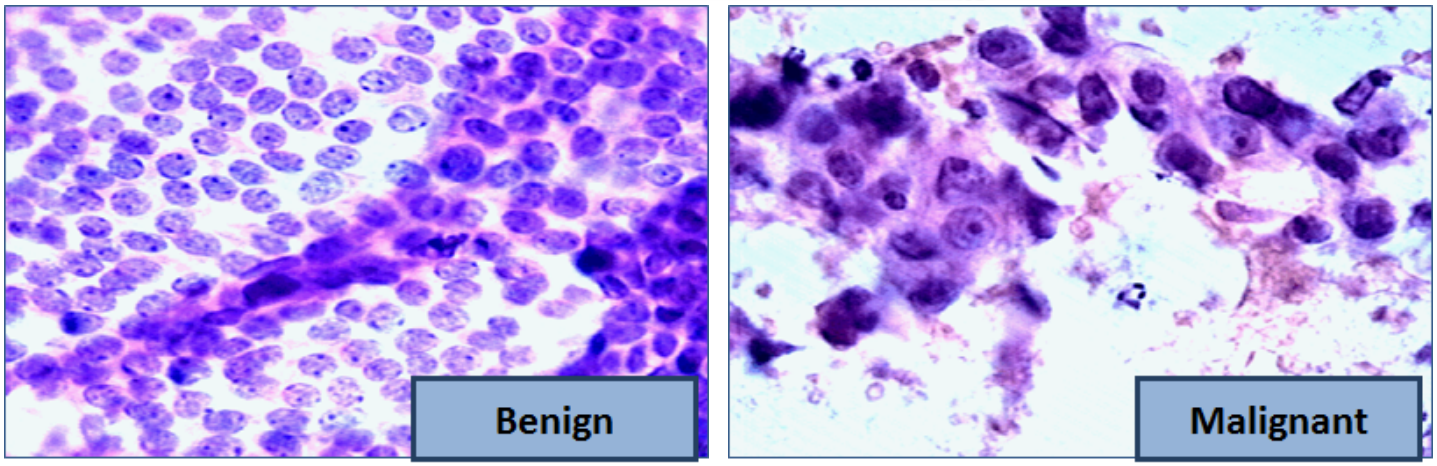
- Colab is a Google service similar to Google docs
  - ★ but for python notebooks.
- Each set of assignments is actually a python notebook
- We implemented in Colab autograding functionalities
  - ★ to test your solution
- You can also download them as jupyter notebooks

Outline

Sneak preview of Module 2

Starting from the competences developed in the first module, we will study how to apply data analysis techniques from Machine learning





Can we classify them automatically?

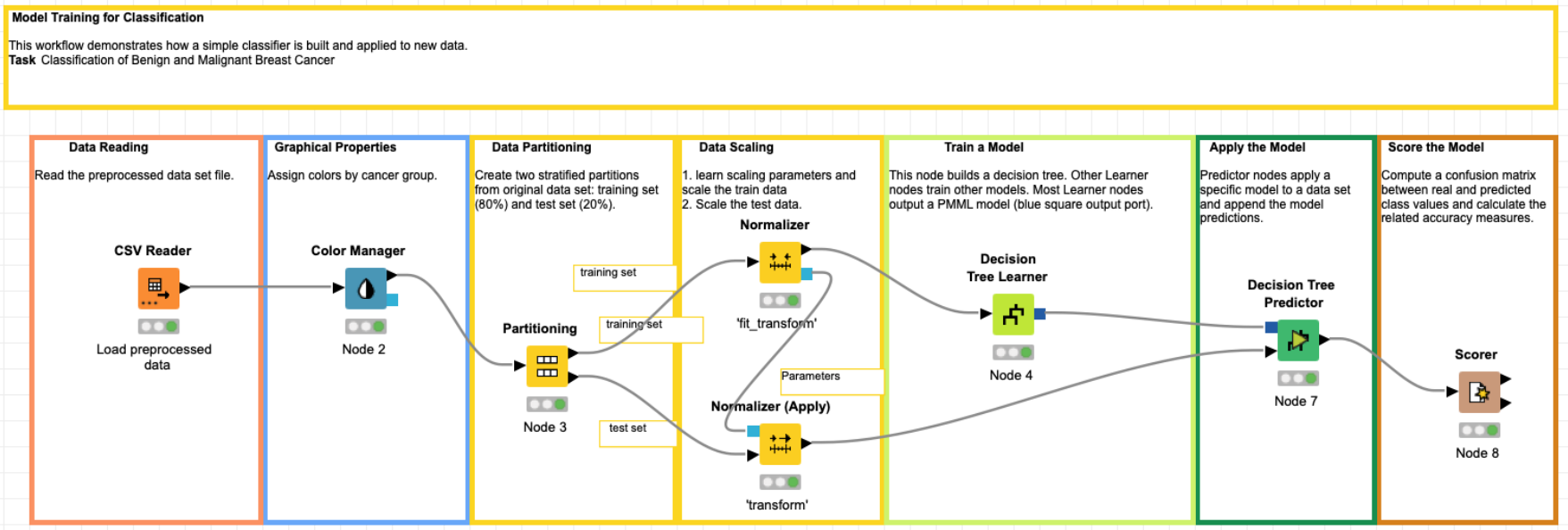
Sneak preview of Module 2

We will go through a classic pipeline for these data analysis tasks

- with emphasis on data pre-processing.

We will use two alternative approaches

- Python: **main focus**
  - ★ NumPy, Pandas, Scikit-learn, Seaborn
- Knime: a graphical workflow language



Sneak preview of Module 2

Self-Evaluation & Active Learning

You will do the same on data of interest or on data on titanic sinking

- Would you have survived the sinking of the titanic?

Let's play a game on Kahoot!

- Using your smartphone or a second monitor
- Visit www.kahoot.it
- Type the code I'll give you during the class

Outline

What is a program?

- A sequence of code instructions to control a machine
  - ★ Input/output
  - ★ Mathematical operations
  - ★ Conditional and repetitive executions
- A recipe to instruct a machine to execute instructions.
  - ★ We can't use a *natural language*.
  - ★ We need a **programming language**

Programming languages

The 7 Most In-Demand Programming Languages of 2019

March 15, 2019

Aspiring developers need to know what languages to learn; they need to select the right education and work on a skill set that will impress future employers and land their dream job. So what are the top programming languages? And what is the best one to learn? We've compiled a list for you that highlights the most in-demand programming languages based off current job postings on the market.

Here are the Top 7 programming languages with most job posting on Indeed as of January 2019:

- Java – 65,986 jobs
- Python – 61,818 jobs
- Javascript – 38,018 jobs
- C++ – 36,798 jobs
- C# – 27,521 jobs
- PHP – 16,890 jobs
- PERL – 13, 727 jobs

http://www.codingdojo.com/blog/the-7-most-in-demand-programming-languages-of-2019

Programming languages

The index can be used to check whether your programming skills are still up to date or to make a strategic decision about what programming language should be adopted when starting to build a new software system. The definition of the TIOBE index can be found here.

Feb 2021	Feb 2020	Change	Programming Language	Ratings	Change
1	2	▲	C	16.34%	-0.43%
2	1	▼	Java	11.29%	-6.07%
3	3		Python	10.86%	+1.52%
4	4		C++	6.88%	+0.71%
5	5		C#	4.44%	-1.48%

May 2021	May 2020	Change	Programming Language	Ratings	Change
1	1		C	13.38%	-3.68%
2	3	▲	Python	11.87%	+2.75%
3	2	▼	Java	11.74%	-4.54%
4	4		C++	7.81%	+1.69%
5	5		C#	4.41%	+0.12%

https://www.tiobe.com/tiobe-index/

The Python Programming language

- High-level: almost human readable. Abstracts from hardware
- Beginner-friendly:
  - ★ streamlined syntax
  - ★ it is easy to write your *first programs*
- Free, open-source and multi-platform
- Developed since the 90s, therefore it has
  - ★ A wide community, and its popularity keeps increasing
  - ★ Many predefined software modules

Python programs

- A sequence of python instructions to control a machine
- Python supports the most common programming styles
  - ★ Imperative: Statements are executed in sequence changing the state of the program (the variables)
  - ★ Procedural: The program is structured in reusable units named functions
  - ★ Object-oriented: The program is structured as a collection of interacting objects that send messages to each other.
  - ★ Functional: Statements are not written/executed as an ordered sequence of instructions. A computation is treated as the evaluation of a mathematical function.

Variables

Basic abstraction to represent units of data

A variable has a name and a value

- Names can contain any letter, number, or the underscore _

False	await	else	import	pass
None	break	except	in	raise
True	class	finally	is	return
and	continue	for	lambda	try
as	def	from	nonlocal	while
assert	del	global	not	with
async	elif	if	or	yield

Note:

- ★ Cannot start with numbers
- ★ Cannot be a keyword
- ★ Names are case-sensitive

- We assign/update values to variables using assignment statements

```
month_number=3
month_name="April"
print("The number of",month_name,"is",month_number)
month_number=4
print("The number of",month_name,"is",month_number)
```

Live Programming

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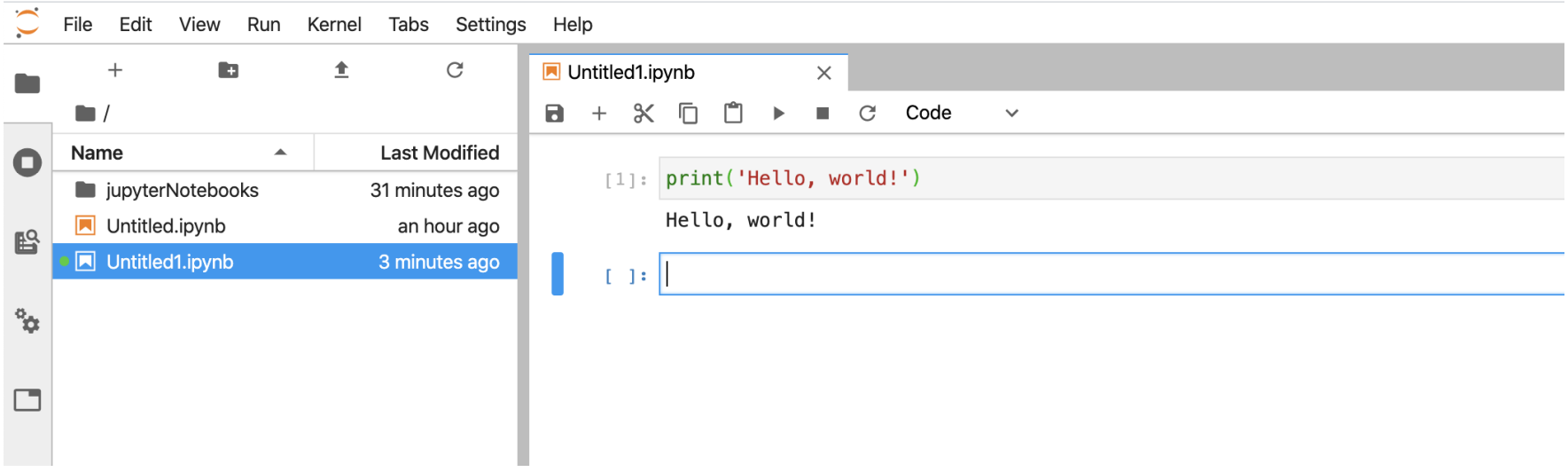

Configure your machine

If you have not done it yet

Follow the instructions in
http://bit.ly/IProML2021_SNS

"But it works . . ."

"Can You Learn To Ski Without Lessons?"

https://www.skibro.com/blog/en/can-you-learn-to-ski-without-lessons/

Most of the times you get to the valley.

The problem is how you get there . . .