

# Mathematics and Programming Bootcamp

UCLA Anderson School of Management (Summer 2021)

Master of Financial Engineering

## 1 Introduction

Hi MFE Class of 2022!

Welcome to the mathematics and programming bootcamp. Tobias and I (Anand) will be your instructors for this bootcamp. We will discuss some topics in mathematics that will help you in the MFE program and interview preparation, and also explore the fascinating world of programming in Python. This document will walk you through the workshop structure and the required software. This will involve downloading and installing just one software (Anaconda), which comes with the Python programming language and multiple environments (Jupyter, Spyder, etc.) to write and compile your code.

## 2 Bootcamp Structure

### Outline

The bootcamp will be 6 weeks long. We will have 18 classes in total (3 times a week). A list of topics that we will cover are (not exhaustive) -

- **Week 1** - Python programming (data types, NumPy, Pandas, functions, Matplotlib)
- **Week 2** - Probability Theory (elements of probability, bayes theorem, densities, distributions)
- **Week 3** - Statistics (expectation, correlation, causation, central limit theorem)
- **Week 4** - Calculus (univariate and multivariate calculus, continuous time finance)
- **Week 5** - Linear Algebra (matrix algebra, projection, regression)
- **Week 6** - Numerical Methods (monte-carlo methods, portfolio construction)

### Assignments

We will have assignments distributed at the end of each class and due start of next class. You will be divided into groups of 4 and are highly encouraged to discuss these assignments with your group members.

Please **email** all your assignments to Tobias ([tobias.ingebrigtsen.phd@anderson.ucla.edu](mailto:tobias.ingebrigtsen.phd@anderson.ucla.edu)) **before** the start of the next class. If it is a programming based assignment, you are encouraged to do it in Python. If the assignment involves solving problems, you can use LaTeX or scan your handwritten work and email the PDF. *Suggestion* : Overleaf is a great platform for collaborating with your colleagues.

We will not be having any final or midterm exams.

### Other Administrative Points

The bootcamp will be help remotely. The zoom link for accessing the meeting will be shared in the email. Codes and other class material will be shared via Github and email.

The next section mentions the necessary steps in downloading and installing Python.

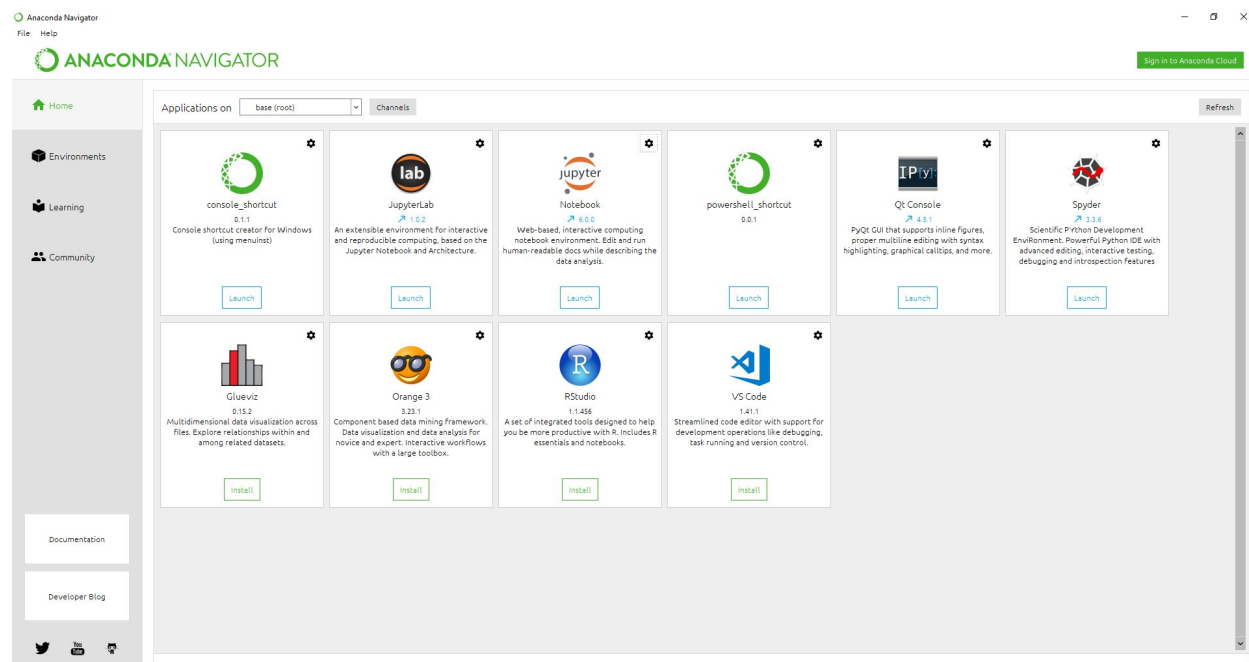
### 3 Python

Python was originally designed for readability and flexibility. It is a language that displays complexity through simplicity. The applications range from software development to database management and from web applications to analyzing big data. Compared to R, which is geared specifically towards data analysis, Python is more versatile. Compared to MATLAB, which is not open source, Python is free. And finally, compared to lower-level programming languages like C++ & Java, Python is relatively easy to learn!

#### Installing Anaconda

The most recent version of Python is Python3. The interpreter we will be installing for Python3 is Anaconda. The link to download and install is - <https://www.anaconda.com/distribution/#download-section>. Click, download and install **Python3.7** for your operating system (Windows, Linux, or macOS). After successfully installing Anaconda on your system and opening it, you will see the following screen -

For the purpose of this workshop, we will be using Jupyter notebooks. However, you are encouraged to explore other Python environments like Spyder and Jupyter Lab.



#### Jupyter Notebook

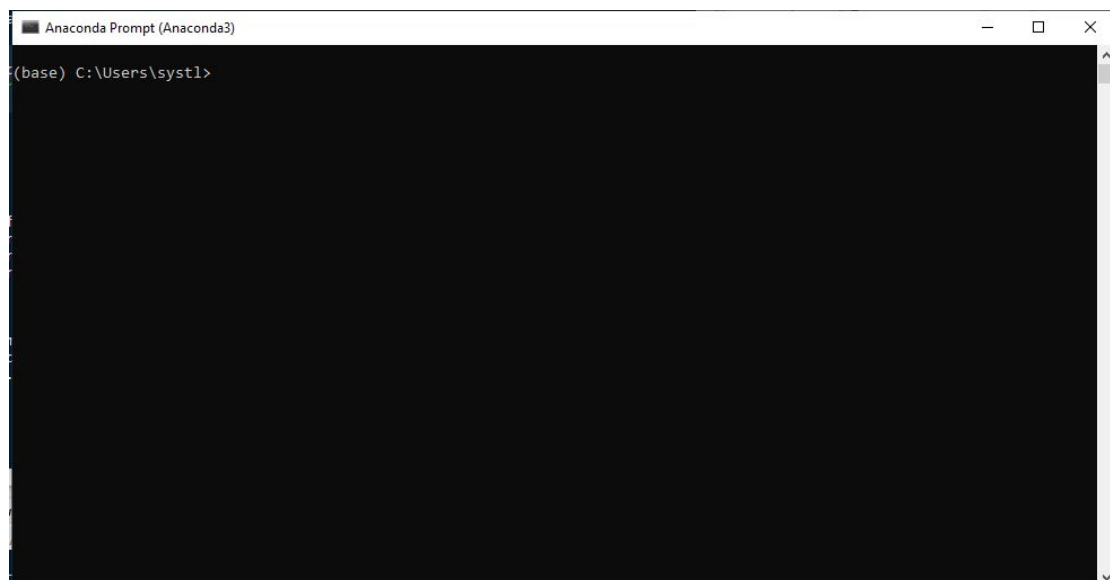
For the next step, launch the Jupyter notebook. Your Jupyter notebook will open in a web browser.

Jupyter Notebook is a web based interactive environment. The extension under which a Jupyter Notebook is saved is “.ipynb”. The Jupyter Notebook can support multiple programming languages (**Julia**, **Python**, **R**, etc.) and can be converted to number of open standard output formats (HTML, PDF, .py etc.). You will get familiar with this interface over the next few days.



## Anaconda Prompt

The command prompt (CMD) allows you to communicate with your computer. Post installation, a new command prompt (specifically for Anaconda) is also installed. Anaconda command prompt is just like command prompt, but it makes sure that you are able to use anaconda and conda commands from the prompt, without having to change directories or your path (which can be quite painful!).



We will be using only the **Anaconda Prompt** and not your system's command prompt for installing and updating packages. Once you open Anaconda Prompt you will see the following black screen. Mac users open launchpad and click on the terminal icon.

You are now all equipped to explore Python! Over the course of this workshop, experienced programmers in any other language can pick up Python very quickly, and beginners will find the clean syntax and indentation structure easy to learn.

## Resources

With growing number of books and online resources, we have tried to list some of the resources that will be helpful to continue your education in Python and mathematics beyond this bootcamp. This list is not exhaustive by any means and you are encouraged to look further -

## Python Programming Books

- Python For Finance by Yves Hilpisch, O'Reilly 2014 (Intermediate Level)
- Python For Data Analysis by Wes McKinney, O'Reilly 2013 (Intermediate Level)
- Other mentions: Pro Python by Marty Alchin, Python Cookbook by David Beazly

## Websites (For Queries and Competitions)

- Hacker Rank (competitive programming challenges platform)
- Stack Overflow is every programmers go-to website for queries and bugs. There is a good chance someone else had the same problem as you and an expert has provided a solution to the problem on this website. You'll be visiting this website .. a lot!
- Kaggle (Data science & quant finance competitions)
- QuantConnect (quant trading and back testing platform)

## Books for Mathematics

- Statistical Inference by Casella and Berger
- Introduction to Linear Algebra by Gilbert Strang (check out his MIT OCW youtube videos!)
- Monte-Carlo Methods in Financial Engineering by Glasserman
- Elements of Statistical Learning by Friedman, Tibshirani & Hastie

If any questions arise, do not hesitate to contact us. We look forward to meeting you all soon!

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