

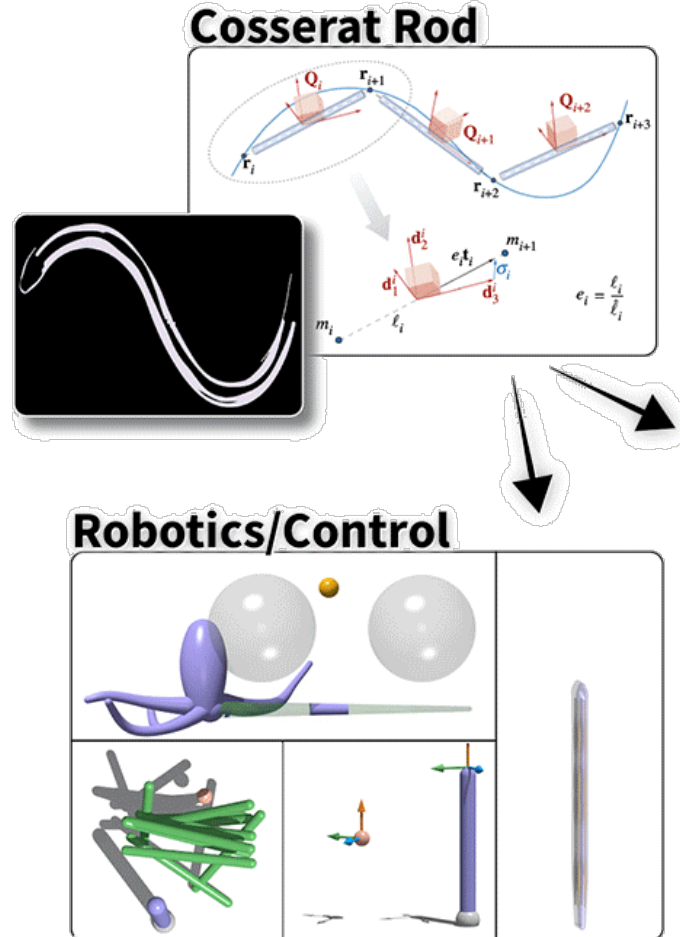
# Introduction to PyElastica Software

**Spring 2022**

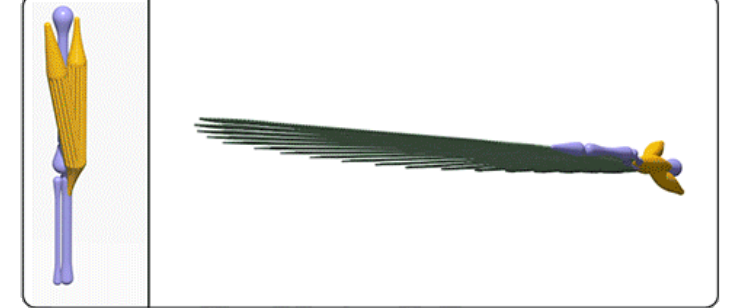
**Instructor: Saravana Prashanth Murali Babu**

# What is PyElastica?

Elastica is a free and open-source software on Python platform for the simulation of assemblies of slender, one-dimensional bodies using Cosserat rod theory.



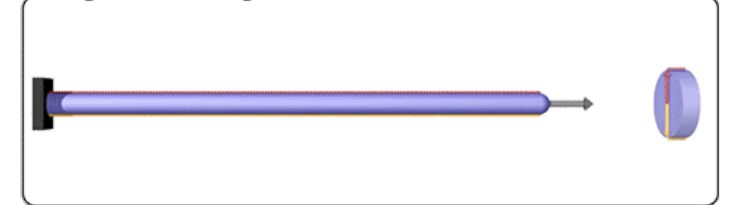
## Bio-Inspired Architecture



## Composite Material



## Physics/Dynamics

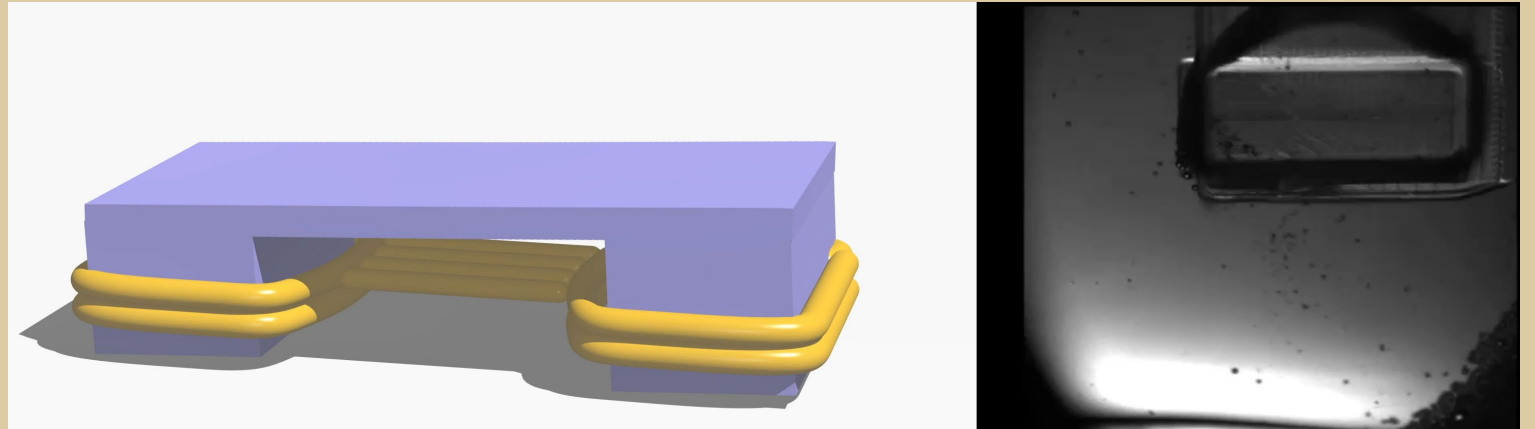


# Examples on PyElastica

- Soft Robotics and Bio-robotics
- Control of Soft Matter Structures
- Traveling wave Locomotion

# Soft Robotics and Bio-robotics

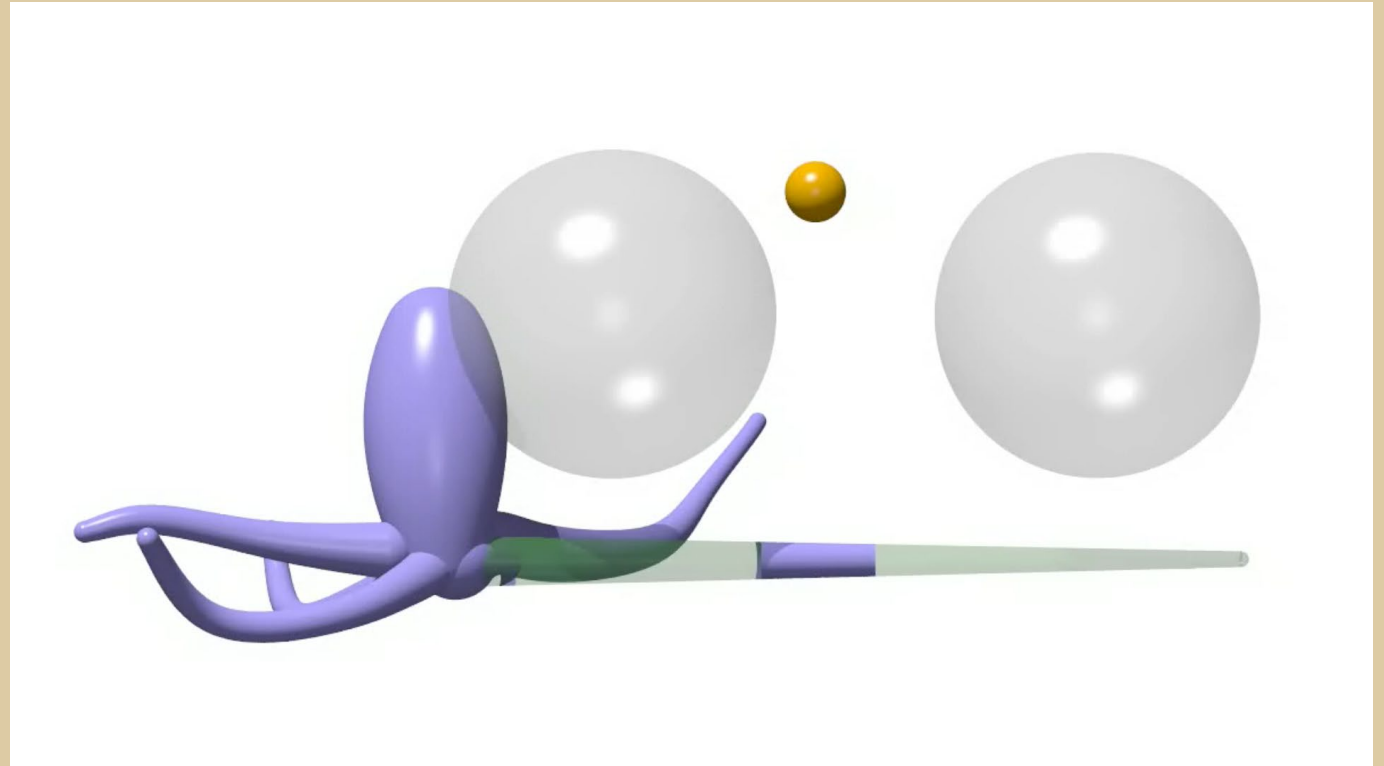
- **Biohybrid machines** have been developed using muscles to actuate soft robotic structures.
- **Soft and flexible robots** require optimization of their designs prior to fabrication, reducing development time and cost.



[Pagan-Diaz., et al., 2018](#)

# Control of Soft Matter Structures

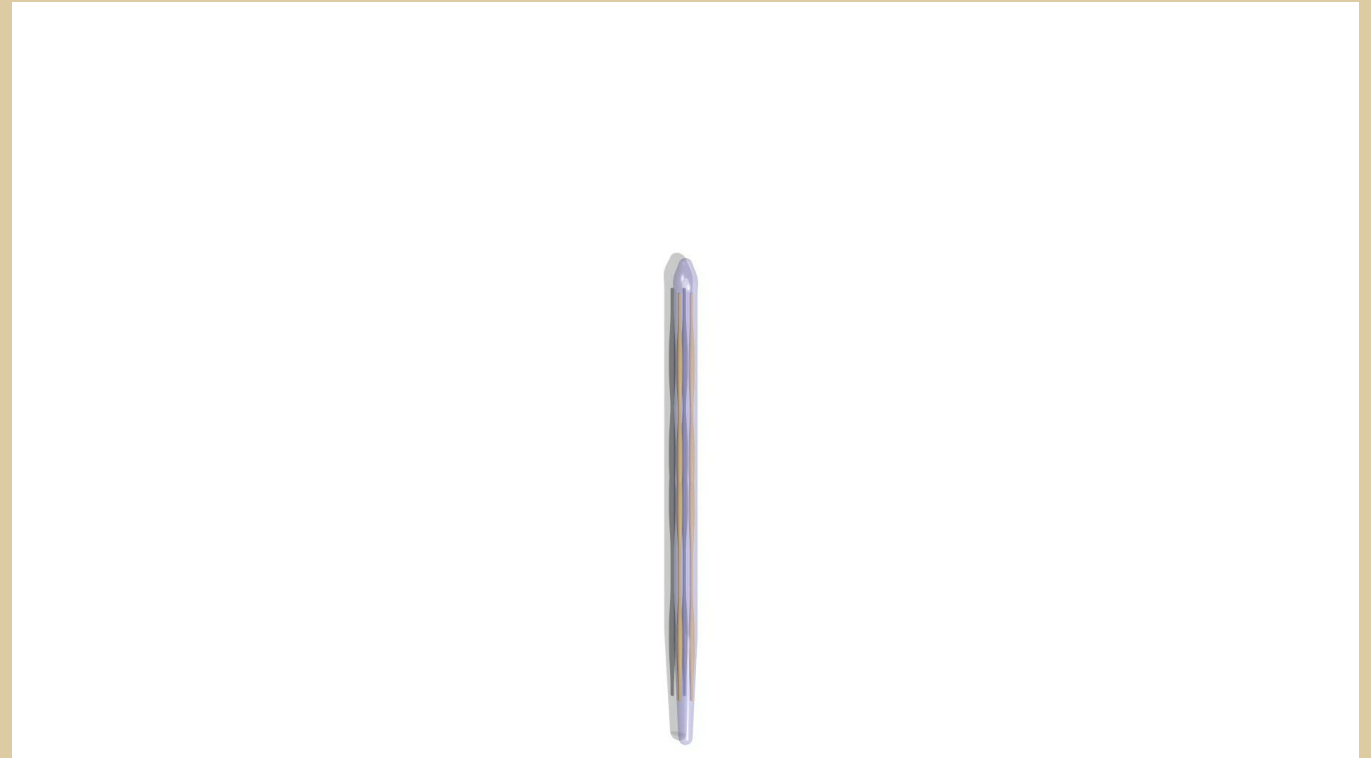
- **Soft robots and structures** have many more degrees of freedom than rigid structures, making the system too complex to control.
- **Cosserat rod theory** can be used model soft slender structures allowing a framework within which novel control strategies for these difficult problems can be developed.



[H. -S. Chang \*et al.\*, 2020](#)

# Traveling wave Locomotion

- **Cosserat rods** can be used to understand how different gaits affect swimming and slithering speed.
- Snakes and slender swimmers, such as eels, can be modeled either as a single rod or as the interaction of multiple rods representing different muscle groups.



[Zhang, X. et al., 2019](#)

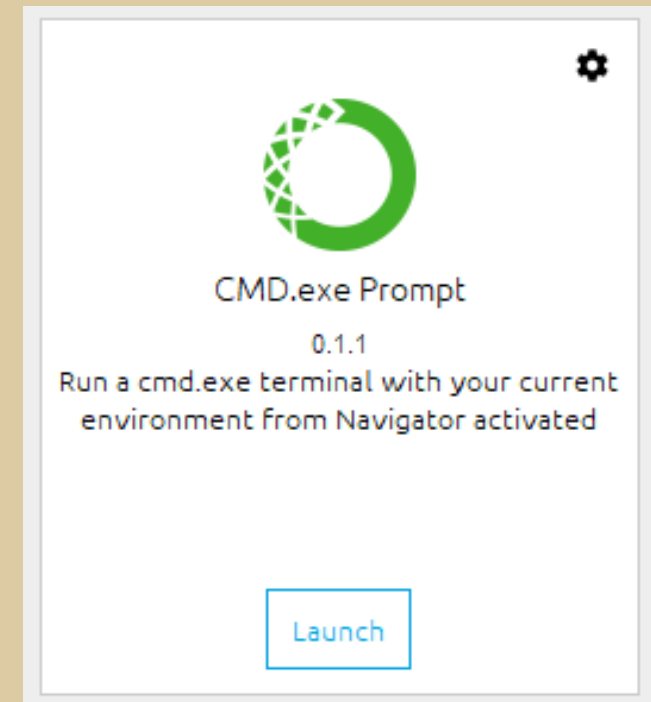
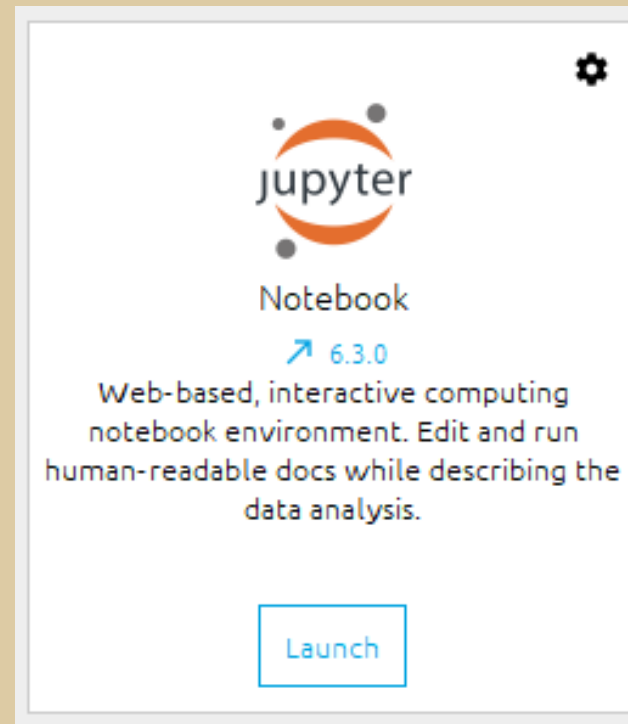
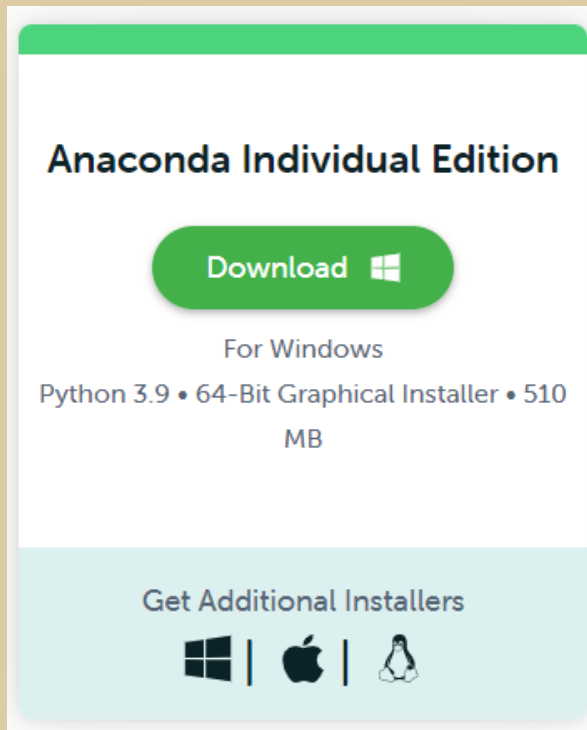
# Installing steps for PyElastica

# Step 1: Anaconda Navigator



# Installation procedure

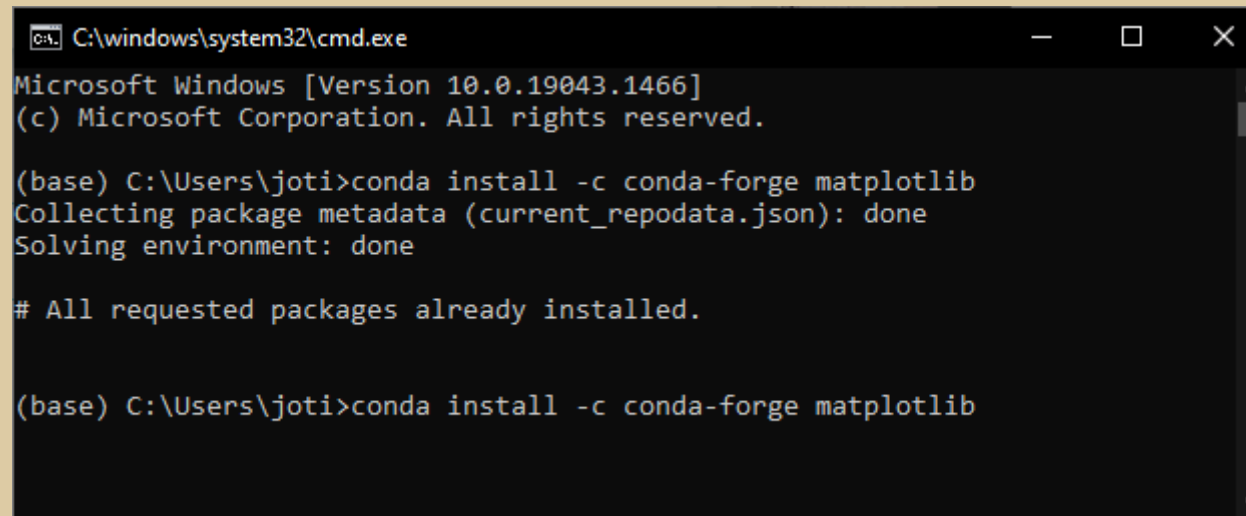
- Download **Anaconda Individual Edition** at [link](#)
- Run **Anaconda3 installer** as administrator
- Open **Anaconda Navigator**
- Launch **CMD.exe Prompt** and **Jupyter Notebook**



# Step 2: Numpy and Matplotlib

# Installation procedure

- Launch **CMD.exe Prompt**
- Run the code `conda install -c anaconda numpy` at conda prompt
- Run the code `conda install -c conda-forge matplotlib` at conda prompt or run one of the alternative codes provided on the [link](#)



```
C:\windows\system32\cmd.exe
Microsoft Windows [Version 10.0.19043.1466]
(c) Microsoft Corporation. All rights reserved.

(base) C:\Users\joti>conda install -c conda-forge matplotlib
Collecting package metadata (current_repodata.json): done
Solving environment: done

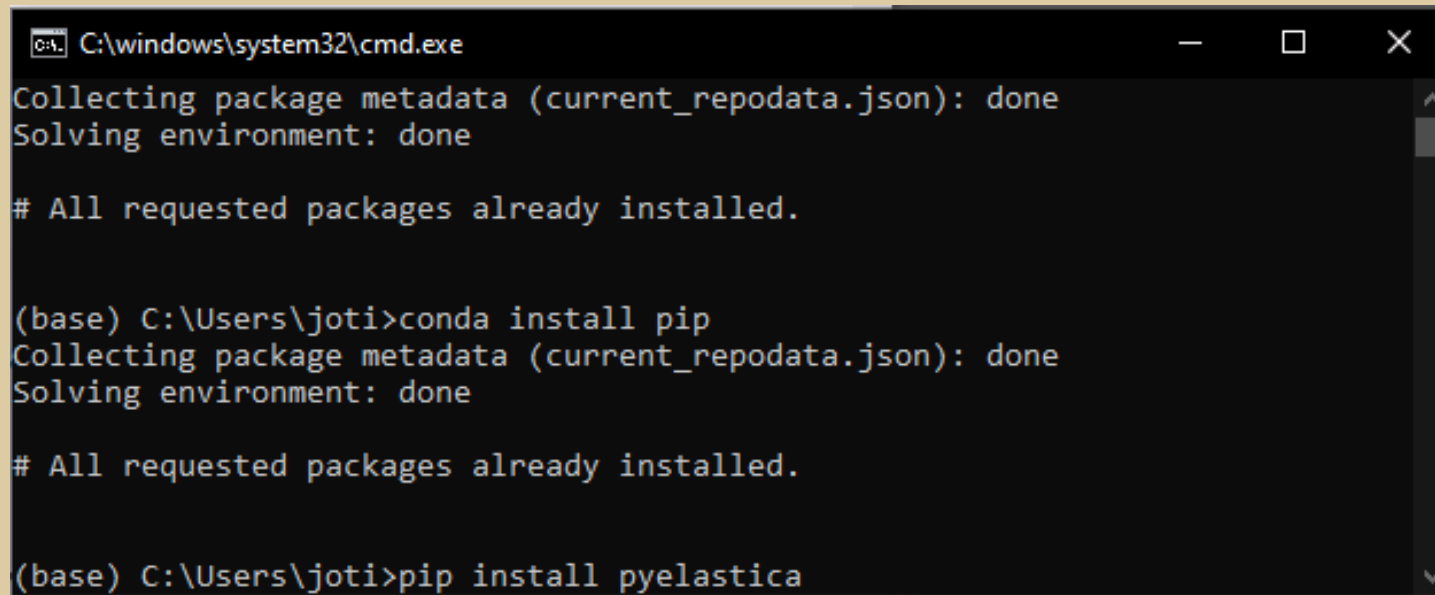
# All requested packages already installed.

(base) C:\Users\joti>conda install -c conda-forge matplotlib
```

# Step 3: PyElastica

# Installation procedure

- Launch **CMD.exe Prompt**
- Run the code *conda install pip* at conda prompt
- Run the code *pip install pyelastica* at conda prompt



```
C:\windows\system32\cmd.exe
Collecting package metadata (current_repodata.json): done
Solving environment: done

# All requested packages already installed.

(base) C:\Users\joti>conda install pip
Collecting package metadata (current_repodata.json): done
Solving environment: done

# All requested packages already installed.

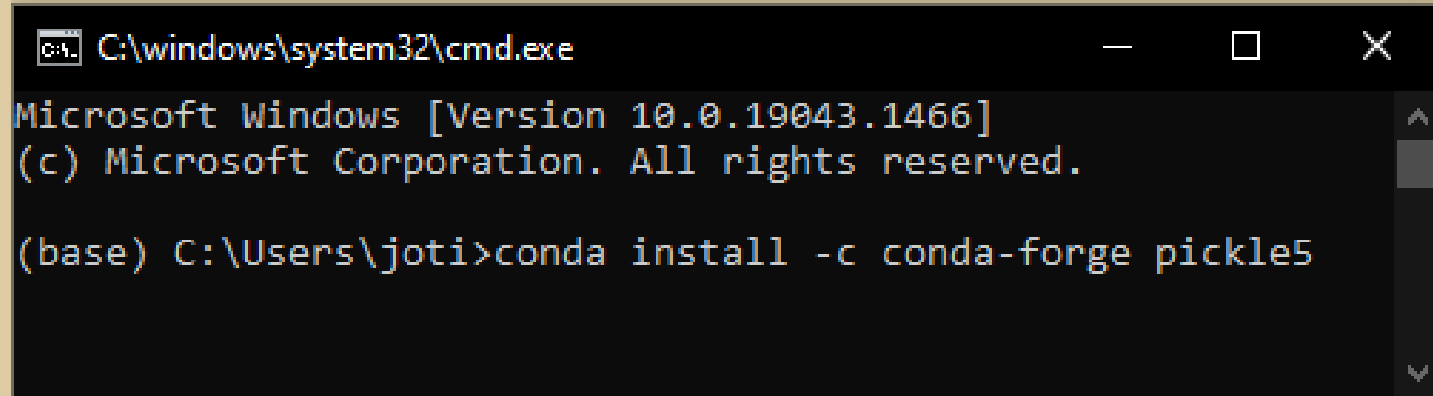
(base) C:\Users\joti>pip install pyelastica
```

Check additional information about PyElastica at [link](#)  
GitHub: [PyElastica](#)

# Step 4: Ffmpeg and Pickle

# Installation procedure

- Launch **CMD.exe Prompt**
- Run the code `conda install -c conda-forge ffmpeg` at conda prompt or run one of the alternative codes provided on the [link](#)
- Run the code `conda install -c conda-forge pickle5` at conda prompt or run one of the alternative codes provided on the [link](#)



```
C:\windows\system32\cmd.exe
Microsoft Windows [Version 10.0.19043.1466]
(c) Microsoft Corporation. All rights reserved.

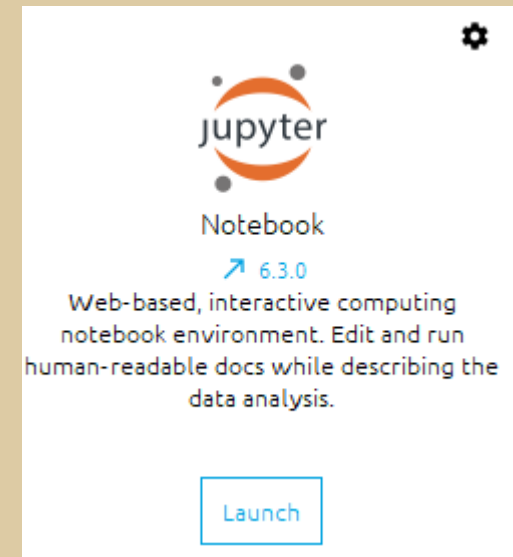
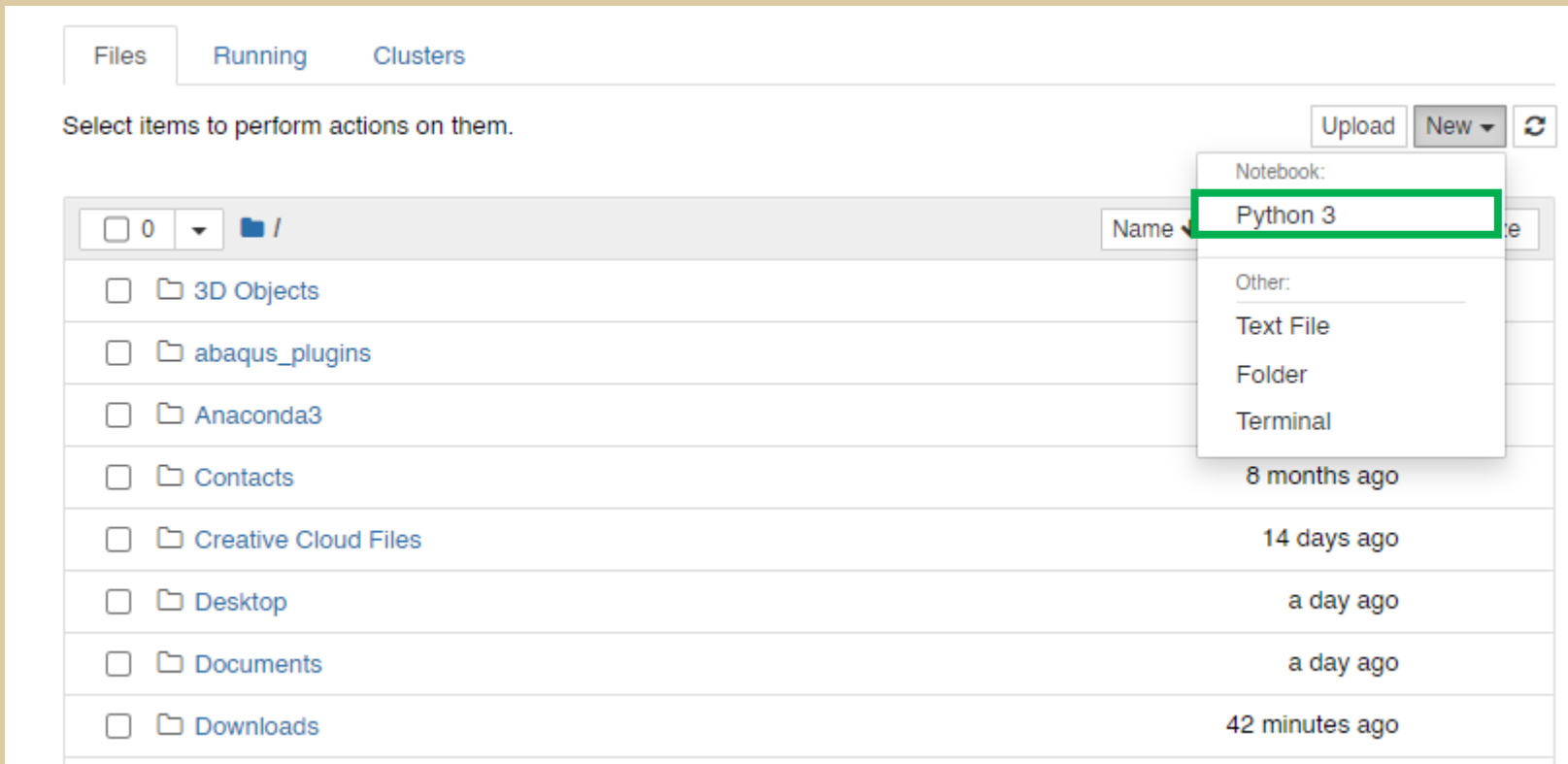
(base) C:\Users\joti>conda install -c conda-forge pickle5
```

# Step 5: Jupyter Notebook



# Code Information

- Open **Jupyter Notebook** in **Anaconda Navigator**
- Open a **New Notebook**
- Import the libraries: **Numpy, Matplotlib, Elastica**



```
In [1]: import numpy
import matplotlib
import elastica
```