

CS 111—Intro to Computational Science

Discussion Section Week 1

About Me

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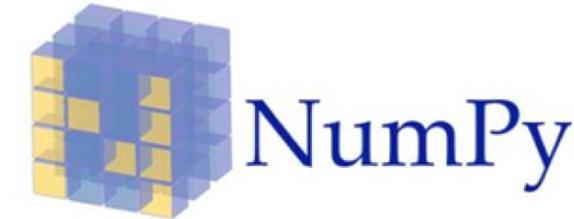
Discussion Section Objectives

- ❑ Install Anaconda on your computer
- ❑ Witness the power of matplotlib
- ❑ Survey debugging tools for Jupyter
- ❑ Grasp the importance of visualization

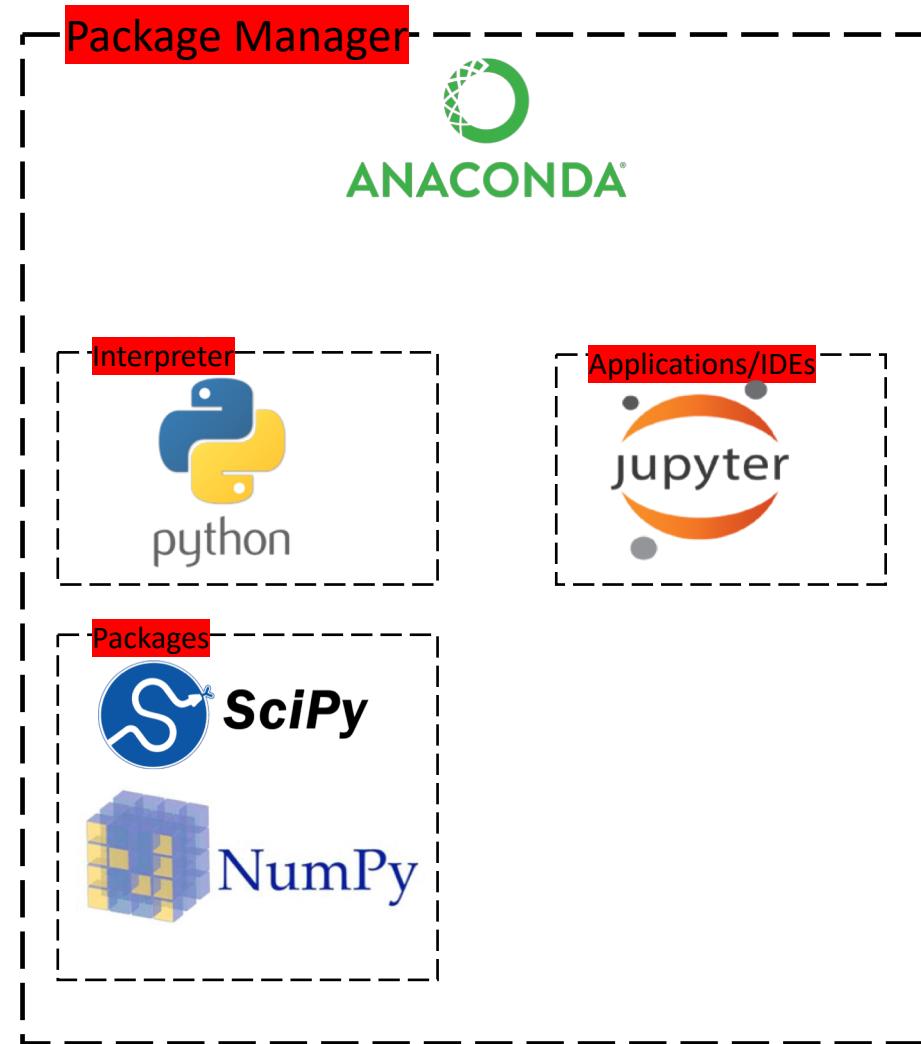
What is Anaconda?



What is Anaconda?

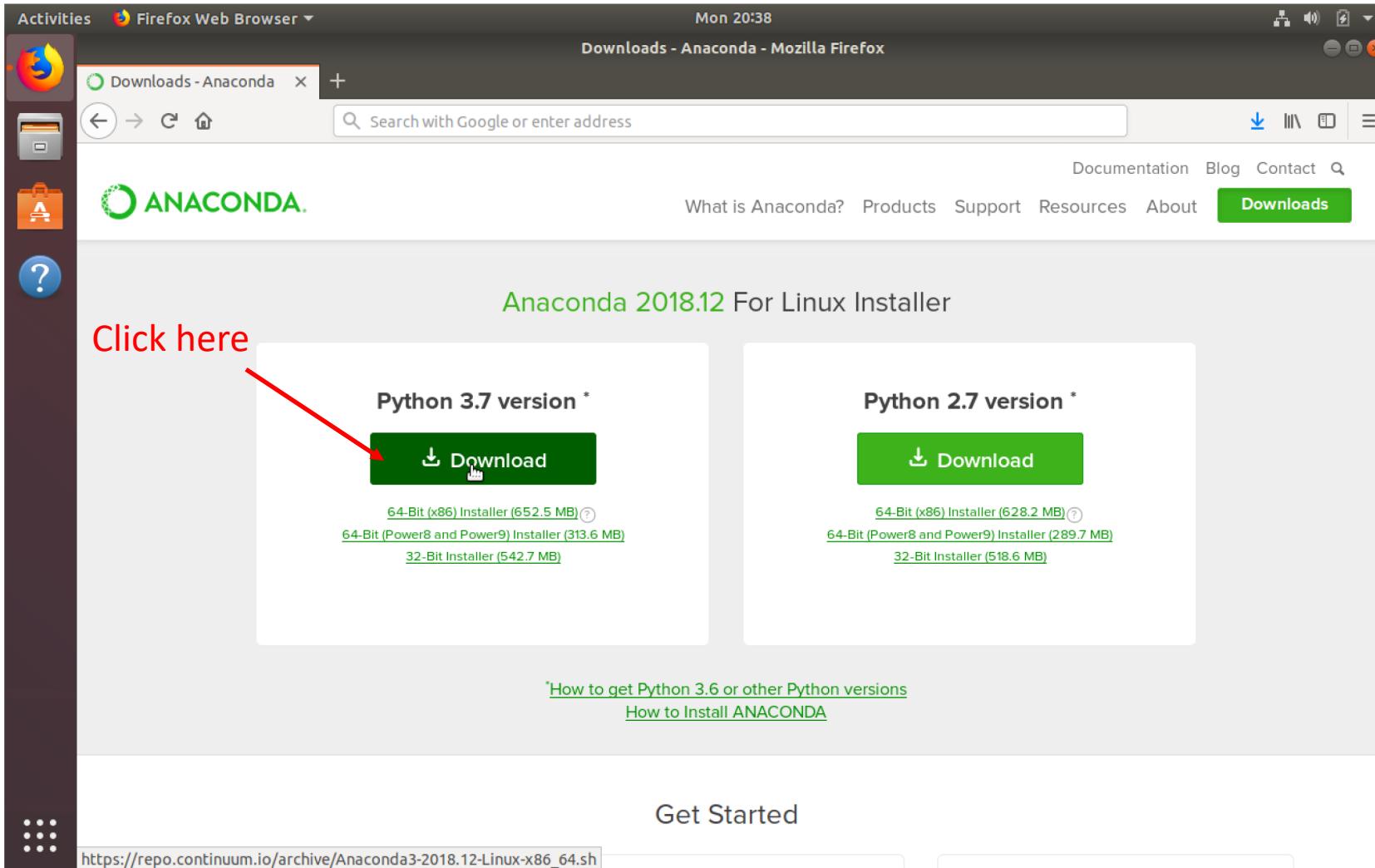


The General Hierarchy

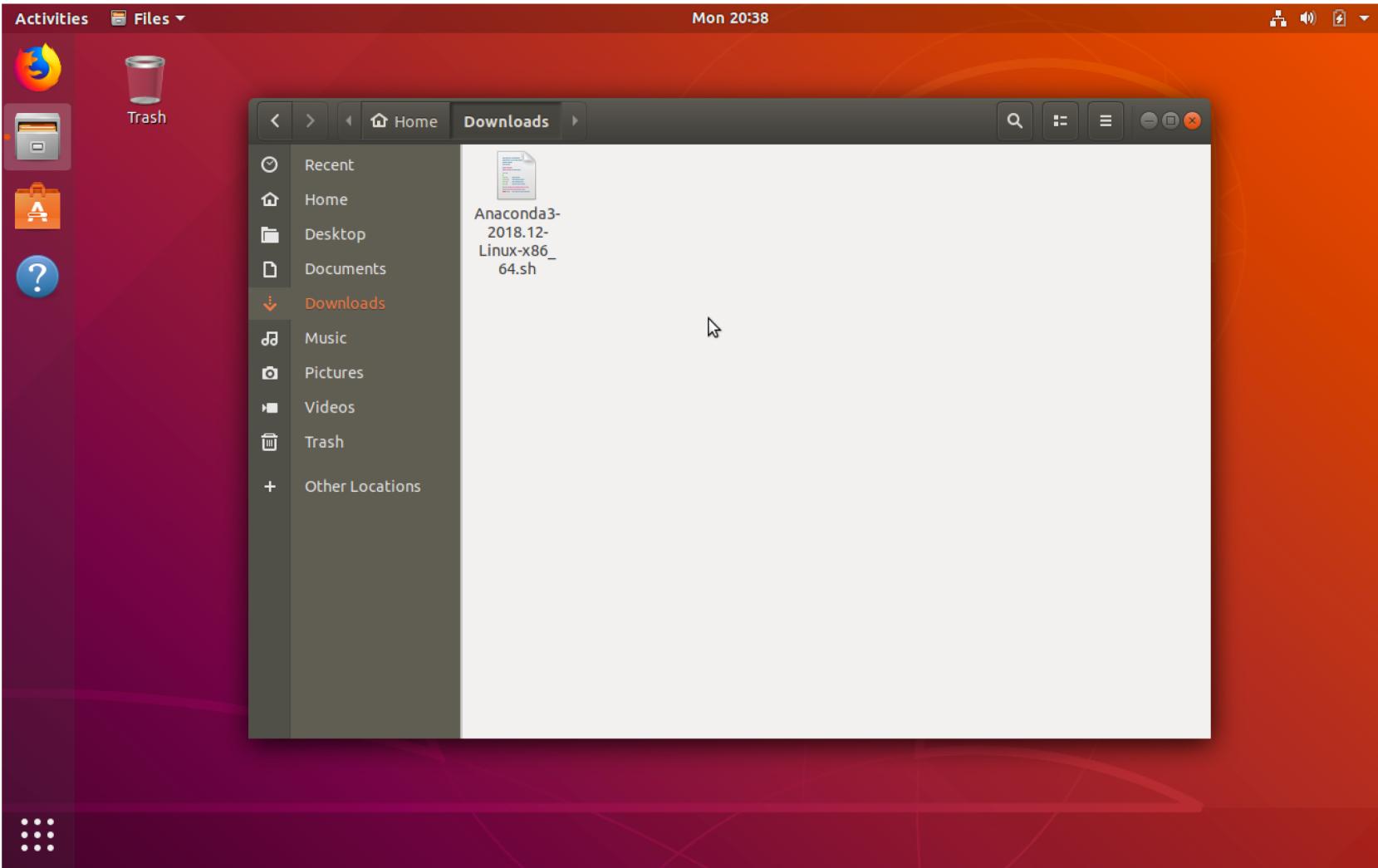


Installing Anaconda Ubuntu 18

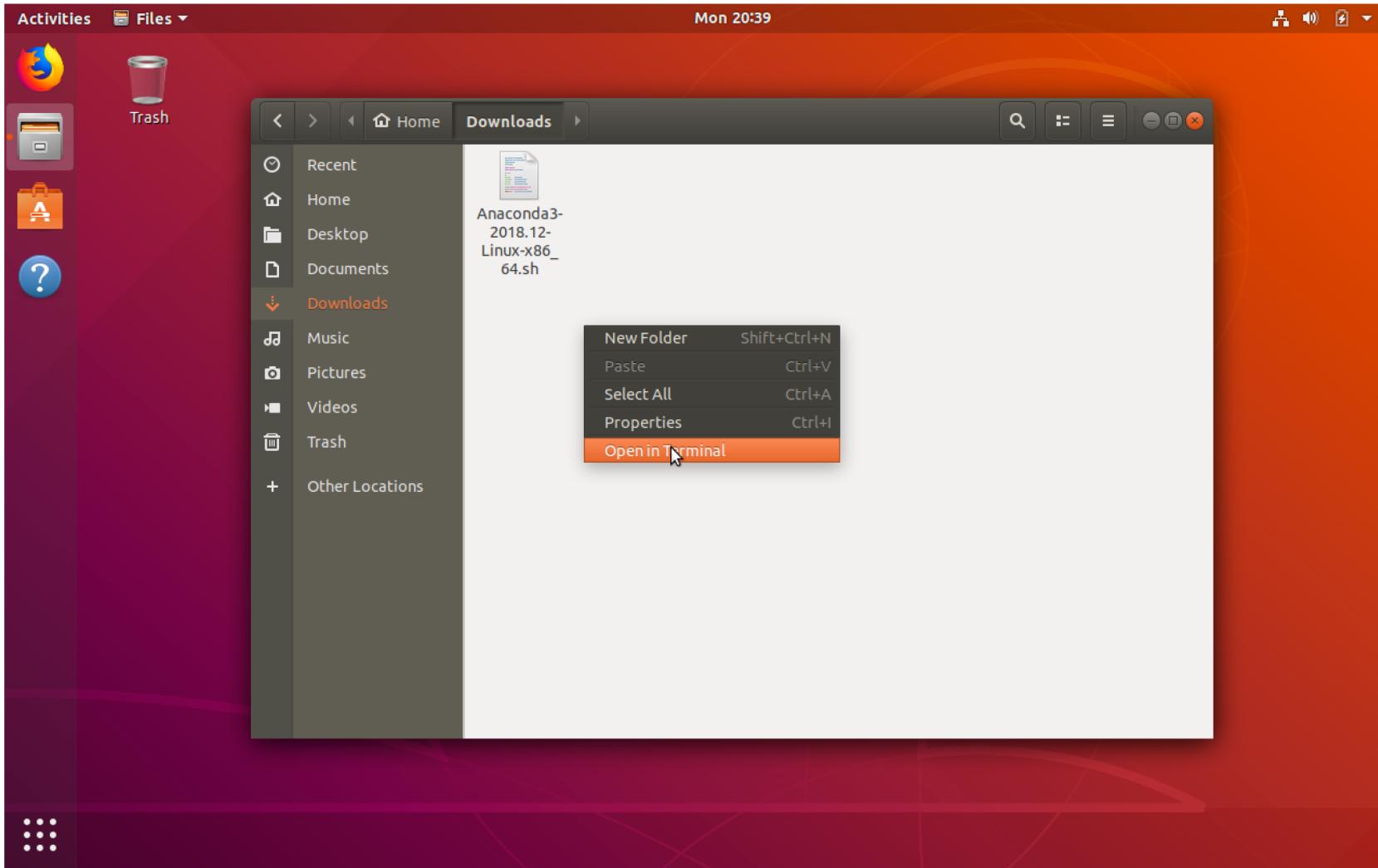
Go to the Anaconda Download Page



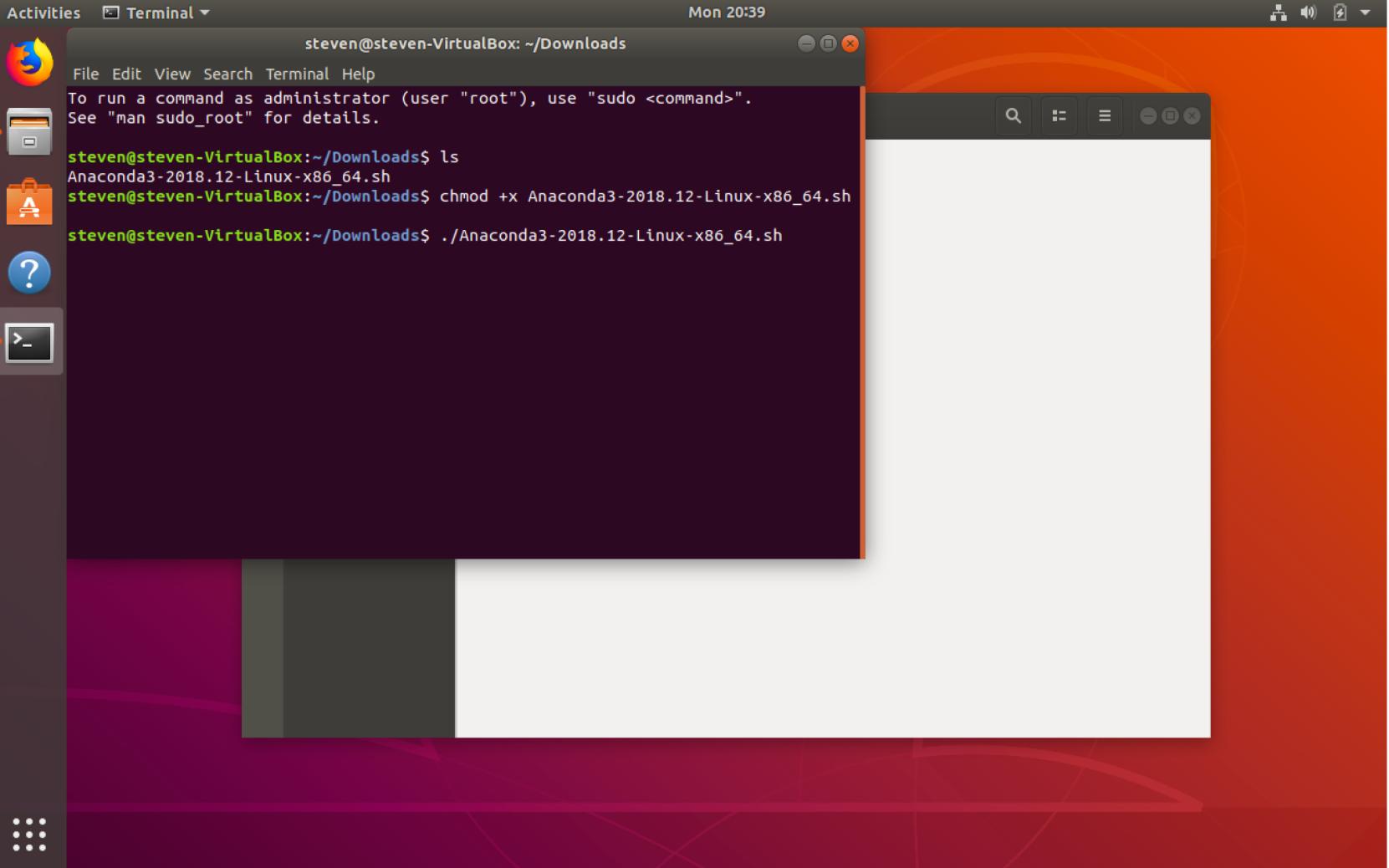
Open the ~/Downloads folder



Right Click Open Terminal



Change Permissions/Run Installer



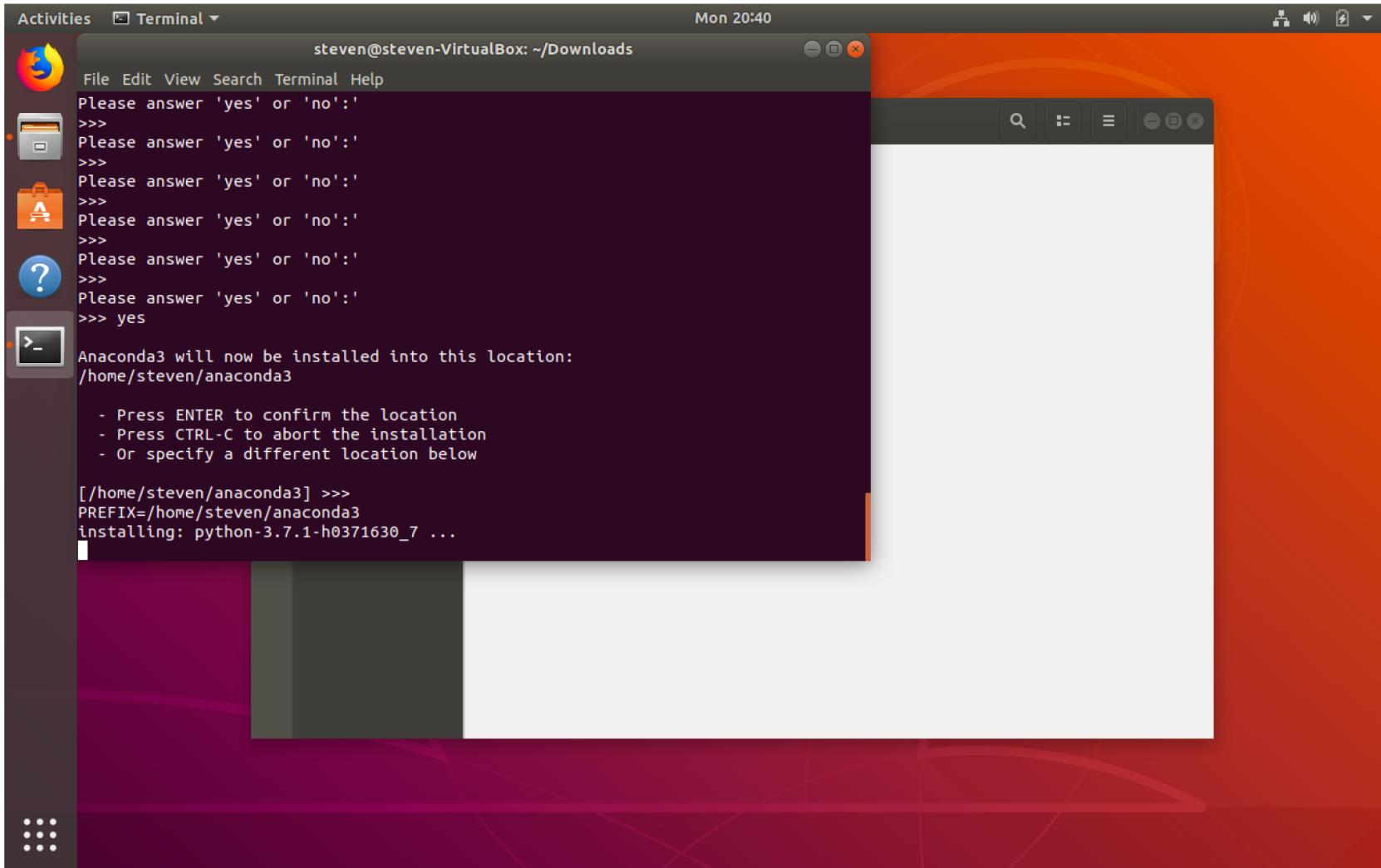
The image shows a screenshot of an Ubuntu desktop environment. A terminal window is open in the foreground, titled "Terminal". The terminal window has a dark background and displays the following text:

```
steven@steven-VirtualBox: ~/Downloads
File Edit View Search Terminal Help
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

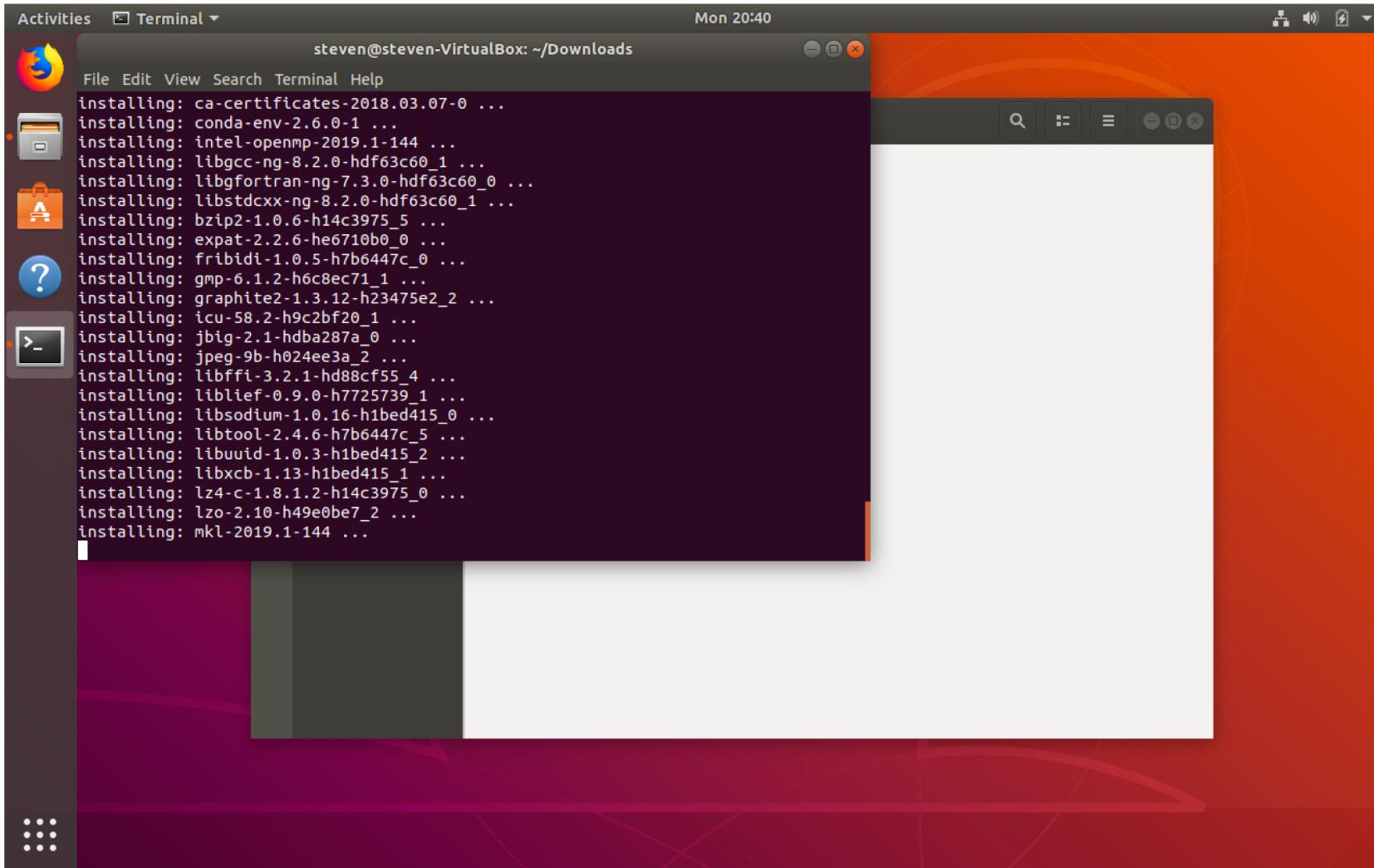
steven@steven-VirtualBox:~/Downloads$ ls
Anaconda3-2018.12-Linux-x86_64.sh
steven@steven-VirtualBox:~/Downloads$ chmod +x Anaconda3-2018.12-Linux-x86_64.sh
steven@steven-VirtualBox:~/Downloads$ ./Anaconda3-2018.12-Linux-x86_64.sh
```

The desktop background is orange and red. On the left side, there is a dock with several icons: a browser icon, a file manager icon, a help icon, and a terminal icon. The bottom of the screen features a dock with various application icons.

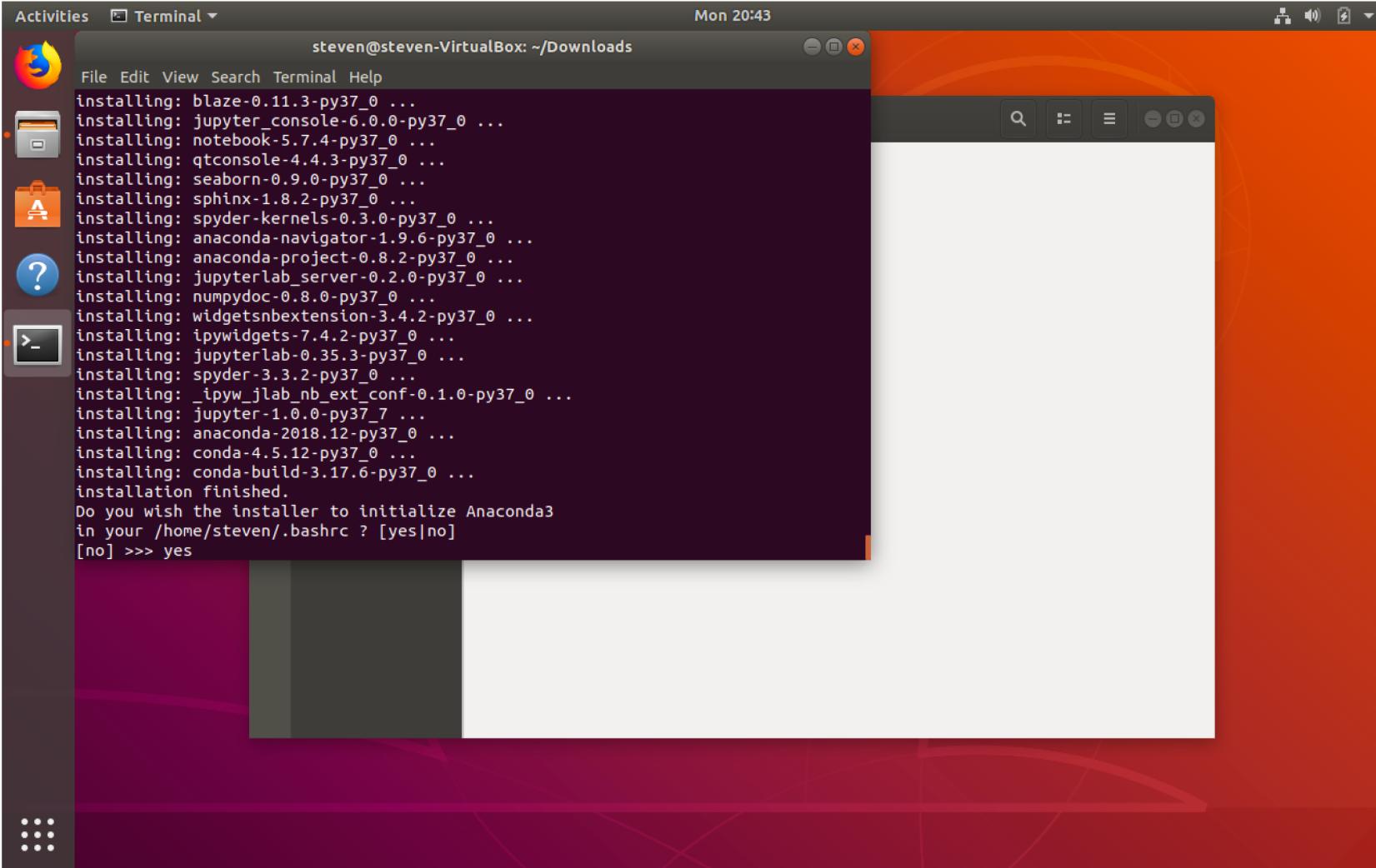
Follow Instructions



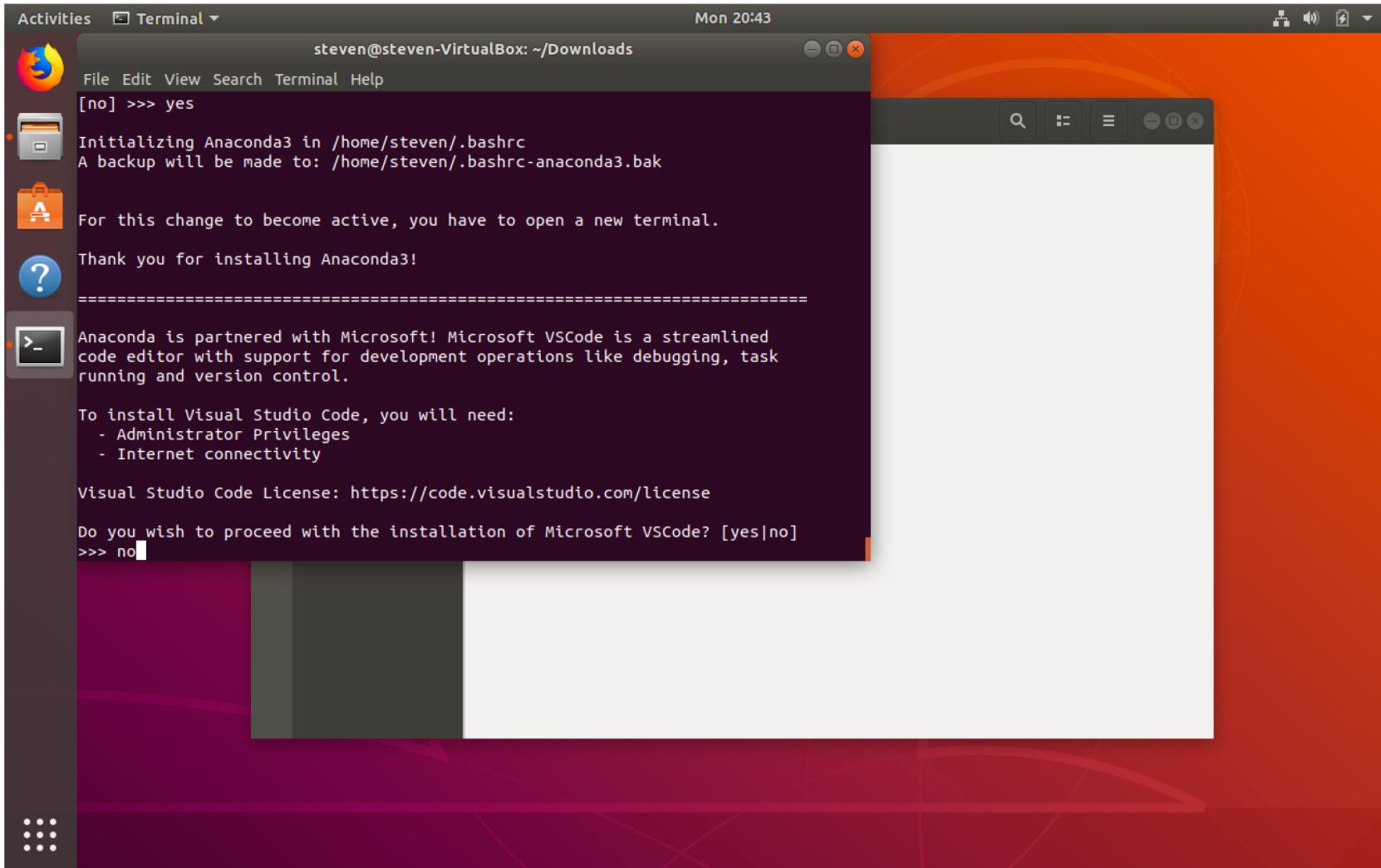
Grab your favorite book and relax for a while



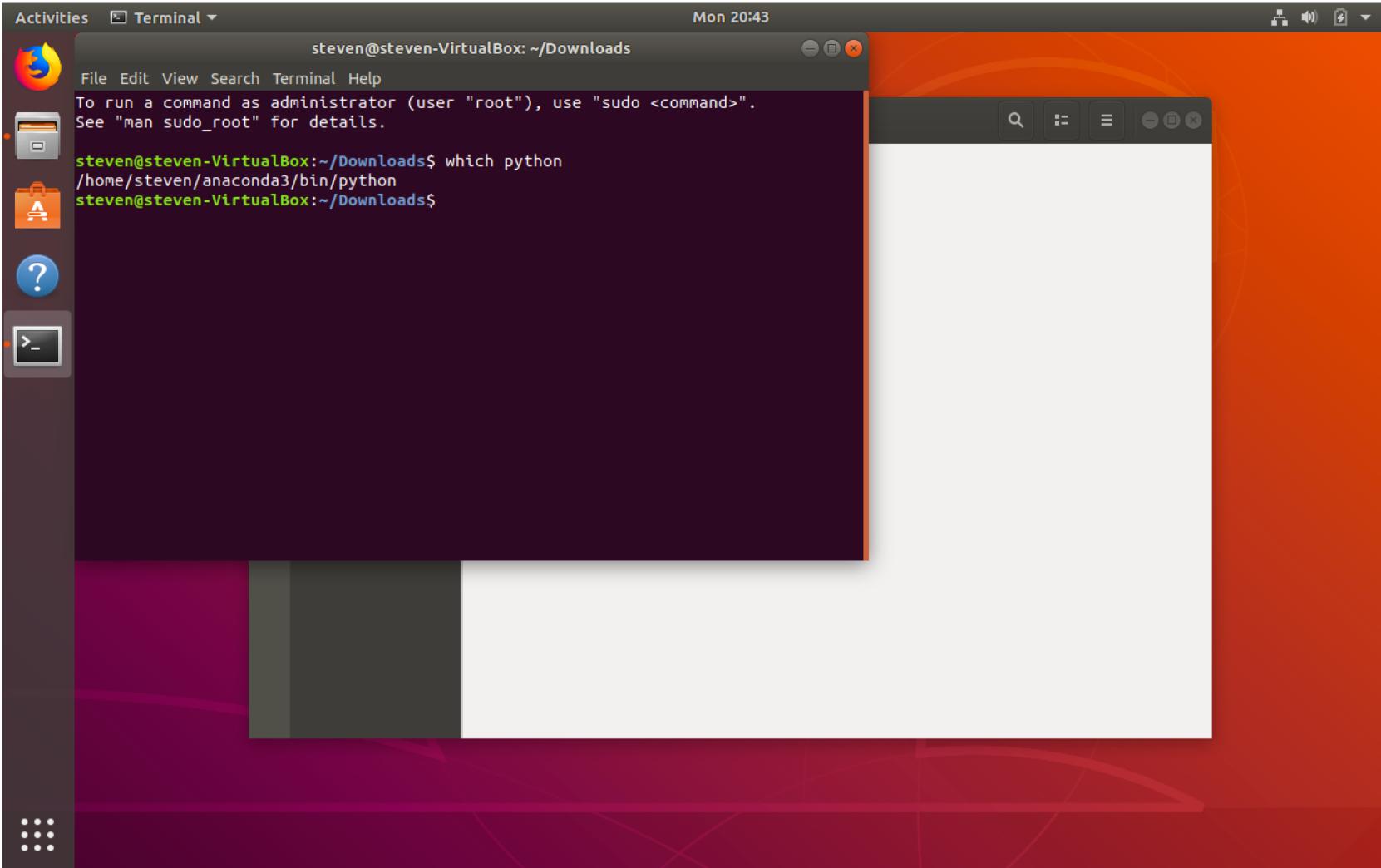
Set as default interpreter



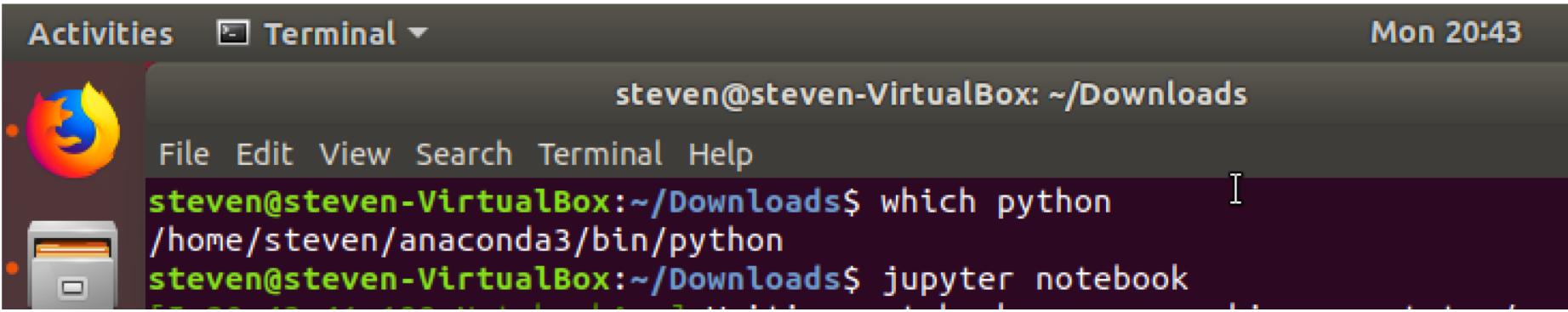
You do not need VSCode



Restart the terminal and check installation



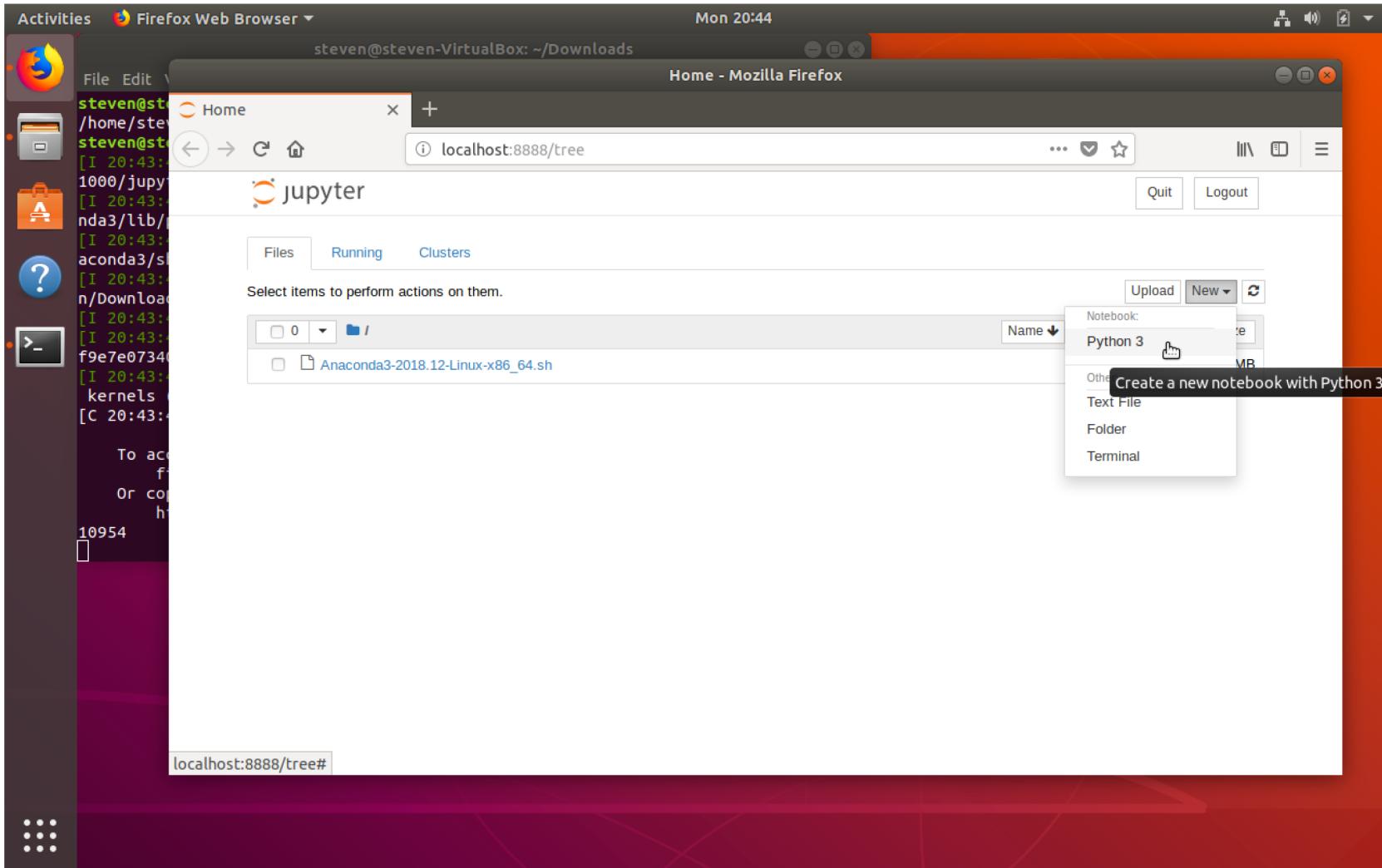
Launch Jupyter

A screenshot of an Ubuntu desktop environment. At the top, there's a dark header bar with the text "Activities" and "Terminal" (with a dropdown arrow) on the left, and "Mon 20:43" on the right. Below the header is a dock containing icons for the Dash (Ubuntu logo), the Home screen (home icon), and the Dash again. A terminal window is open in the foreground, showing a command-line session:

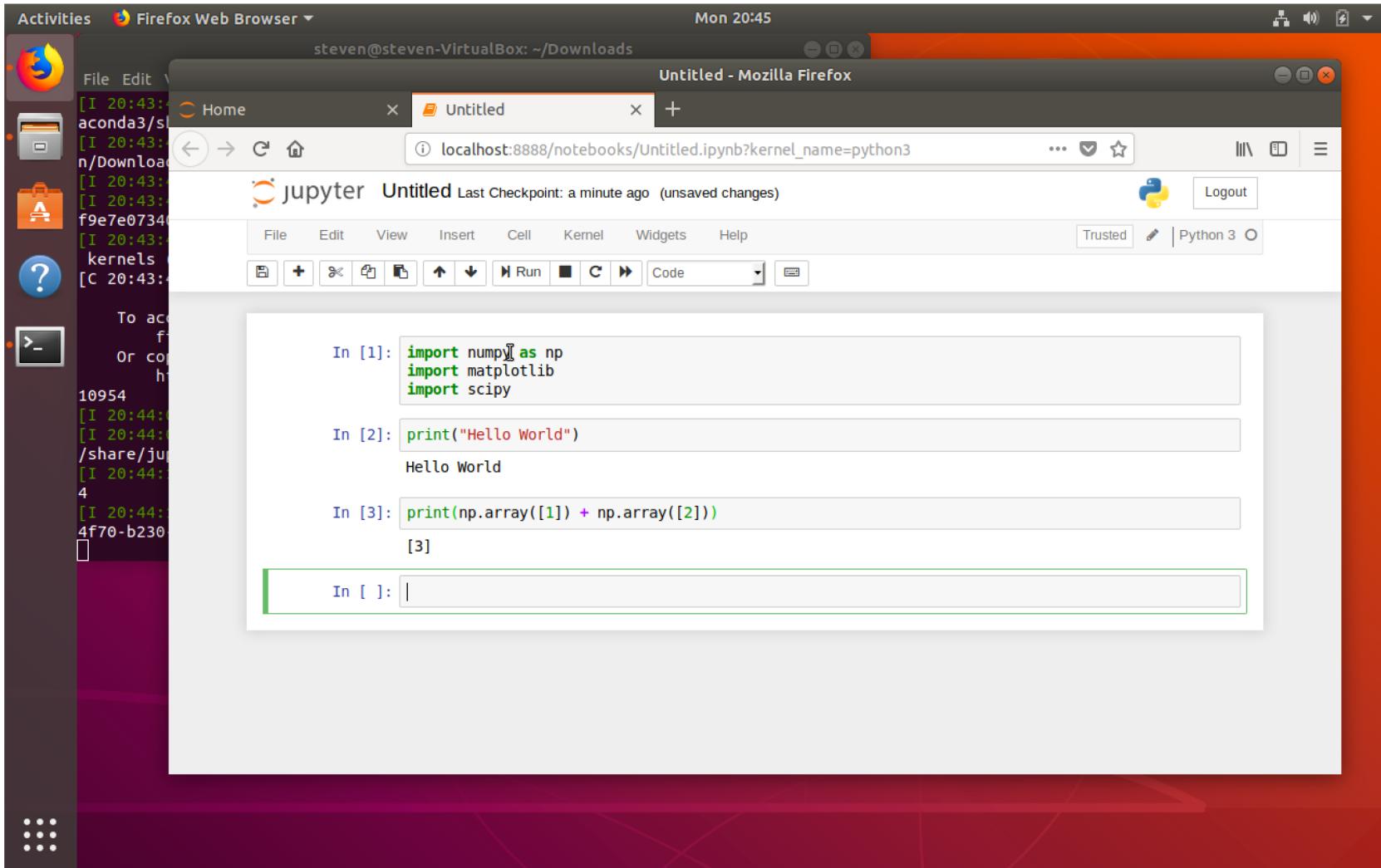
```
steven@steven-VirtualBox: ~/Downloads
File Edit View Search Terminal Help
steven@steven-VirtualBox:~/Downloads$ which python
/home/steven/anaconda3/bin/python
steven@steven-VirtualBox:~/Downloads$ jupyter notebook
```

The terminal has a dark background with light-colored text. The prompt "steven@steven-VirtualBox: ~/Downloads" is at the top, followed by the menu bar "File Edit View Search Terminal Help". The command "which python" is run, showing the path to the Python executable. Finally, "jupyter notebook" is run, starting a Jupyter Notebook server.

Create a Notebook



Do computer science stuff..



Installing Anaconda Windows 10

Surprisingly easy actually..

Go to the Anaconda Website

A screenshot of a web browser displaying the Anaconda download page at <https://www.anaconda.com/download/>. The page has a green header with the Anaconda logo and navigation links for Documentation, Blog, Contact, What is Anaconda?, Products, Support, Resources, About, and Downloads. The main content area features three columns: 'High-Performance Distribution' (Easily install 1,400+ [data science packages](#)), 'Package Management' (Manage packages, dependencies and environments with [conda](#)), and 'Portal to Data Science' (Uncover insights in your data and create interactive visualizations). Below this, there are download sections for Windows, macOS, and Linux. The Windows section is highlighted with a red arrow pointing to the 'Python 3.7 version' download button. The text 'Click here' is overlaid in red on the left side of the Windows section. At the bottom, there are links for users behind firewalls and instructions for getting Python 3.6 or other versions.

Click here

High-Performance Distribution

Easily install 1,400+ [data science packages](#)

Package Management

Manage packages, dependencies and environments with [conda](#)

Portal to Data Science

Uncover insights in your data and create interactive visualizations

Windows macOS Linux

Anaconda 2018.12 For Windows Installer

Python 3.7 version *

[Download](#)

64-Bit Graphical Installer (614.3 MB) ②
32-Bit Graphical Installer (509.7 MB)

Python 2.7 version *

[Download](#)

64-Bit Graphical Installer (560.6 MB) ②
32-Bit Graphical Installer (458.6 MB)

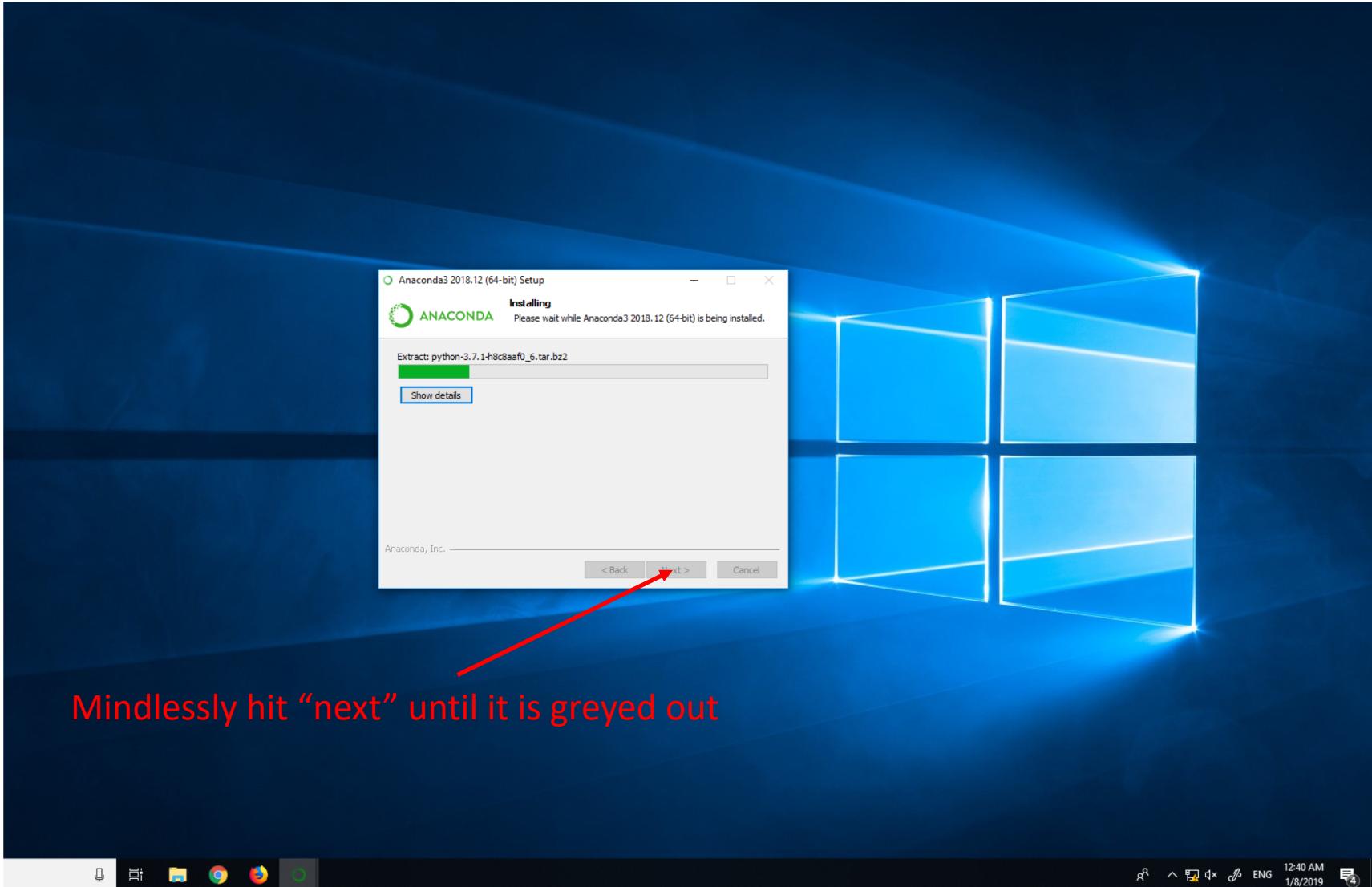
Behind a firewall?
[How to get Python 3.6 or other Python versions](#)
[How to Install ANACONDA](#)

https://repo.continuum.io/archive/Anaconda3-2018.12-Windows-x86_64.exe

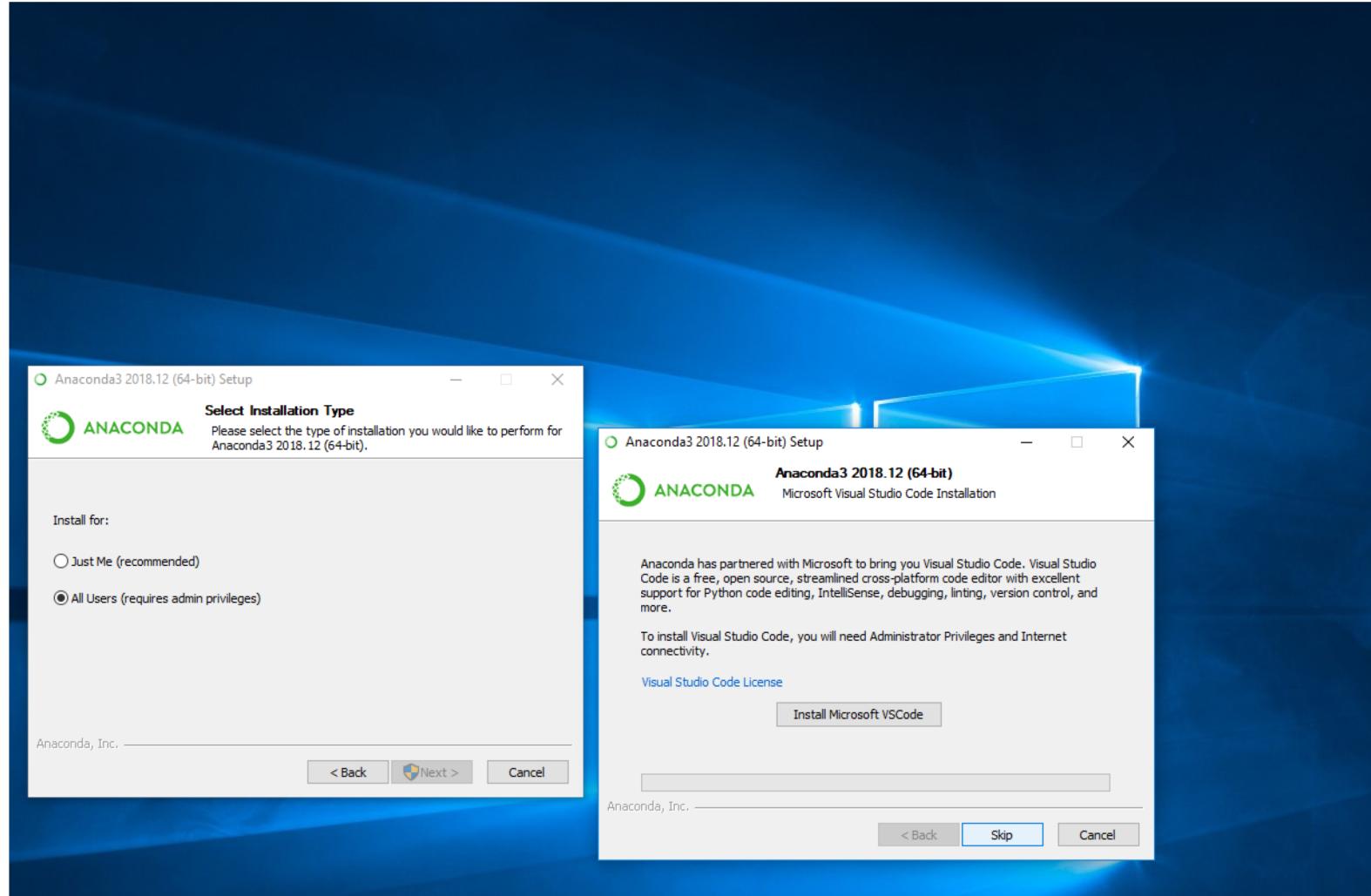
Type here to search

12:38 AM ENG 1/8/2019

Open the .exe

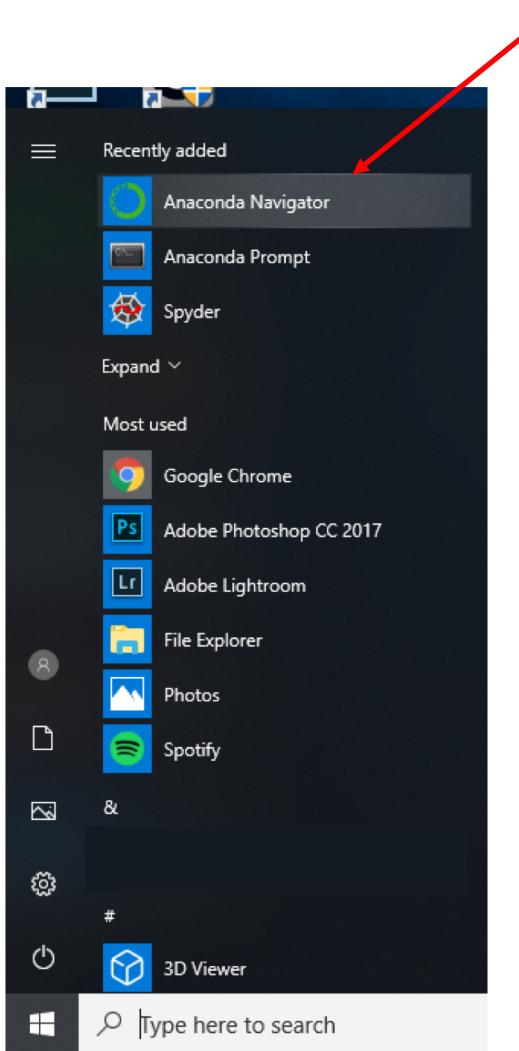


Skip VScode



Find the Anaconda Navigator

Click here



Find Jupyter

Anaconda Navigator

File Help

ANACONDA NAVIGATOR

Sign in to Anaconda Cloud

Home Environments Learning Community Documentation Developer Blog

Applications on base (root) Channels Refresh

JupyterLab 0.35.3 An extensible environment for interactive and reproducible computing, based on the Jupyter Notebook and Architecture. Launch

Jupyter Notebook 5.7.4 Web-based, interactive computing notebook environment. Edit and run human-readable docs while describing the data analysis. Launch

Qt Console 4.4.3 PyQt GUI that supports inline figures, proper multiline editing with syntax highlighting, graphical calltips, and more. Launch

Spyder 3.3.2 Scientific Python Development Environment. Powerful Python IDE with advanced editing, interactive testing, debugging and introspection features. Launch

Glueviz 0.13.3 Multidimensional data visualization across files. Explore relationships within and among related datasets. Install

Orange 3 3.17.0 Component based data mining framework. Data visualization and data analysis for novice and expert. Interactive workflows with a large toolbox. Install

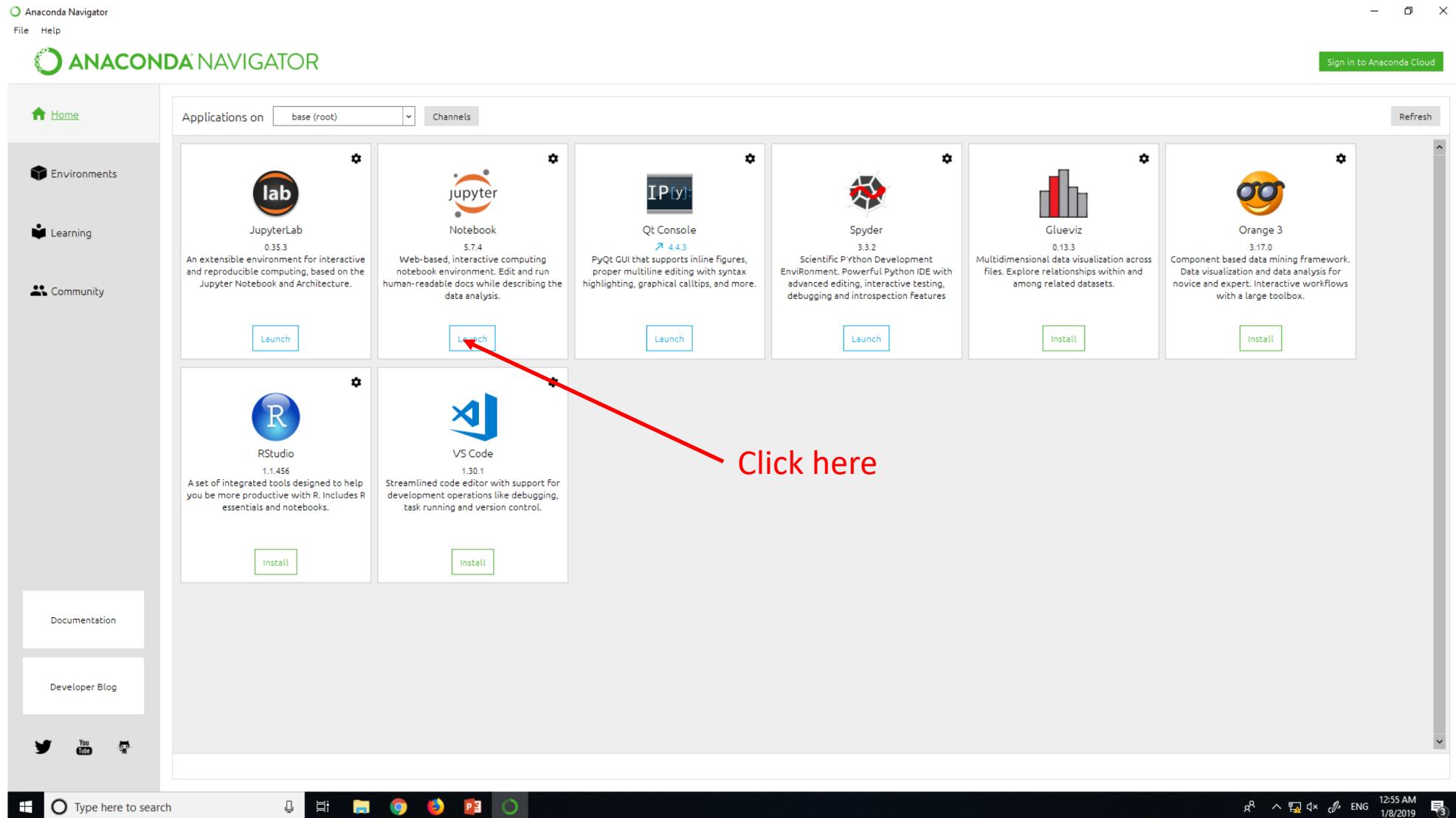
RStudio 1.1.456 A set of integrated tools designed to help you be more productive with R. Includes R essentials and notebooks. Install

VS Code 1.30.1 Streamlined code editor with support for development operations like debugging, task running and version control. Install

Click here

Type here to search

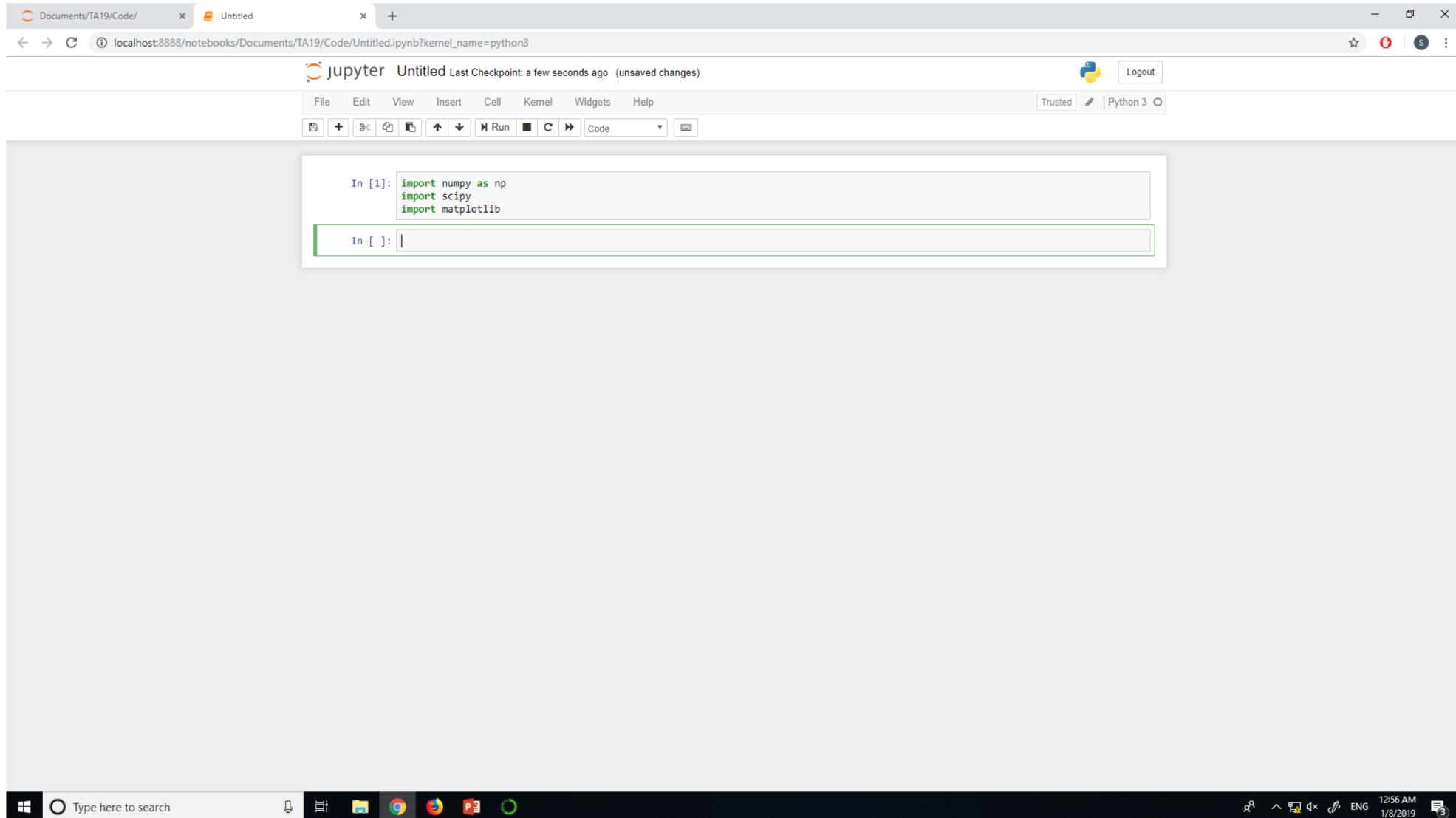
12:55 AM ENG 1/8/2019



Navigate to Your Directory



New > Python3 notebook



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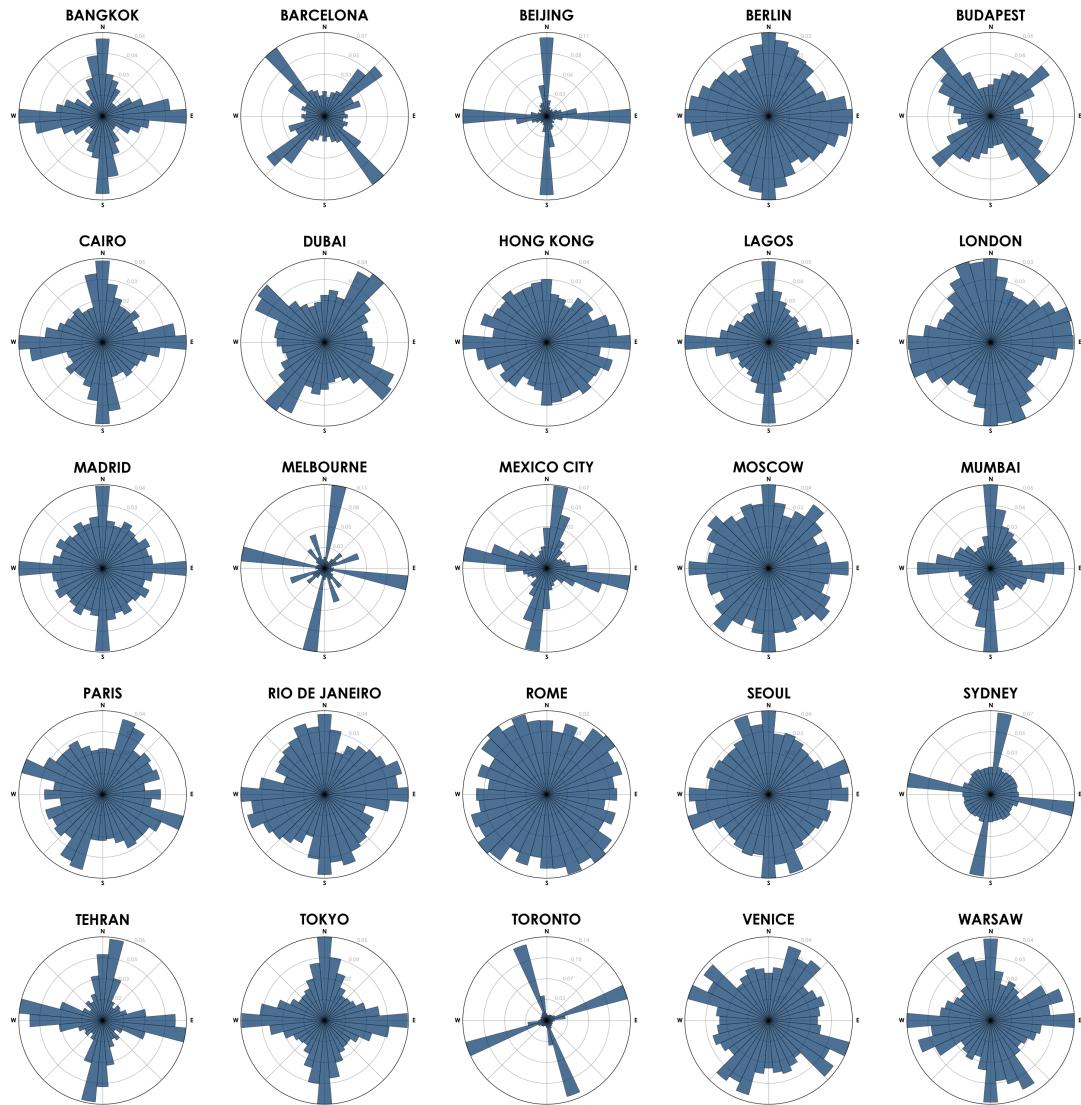
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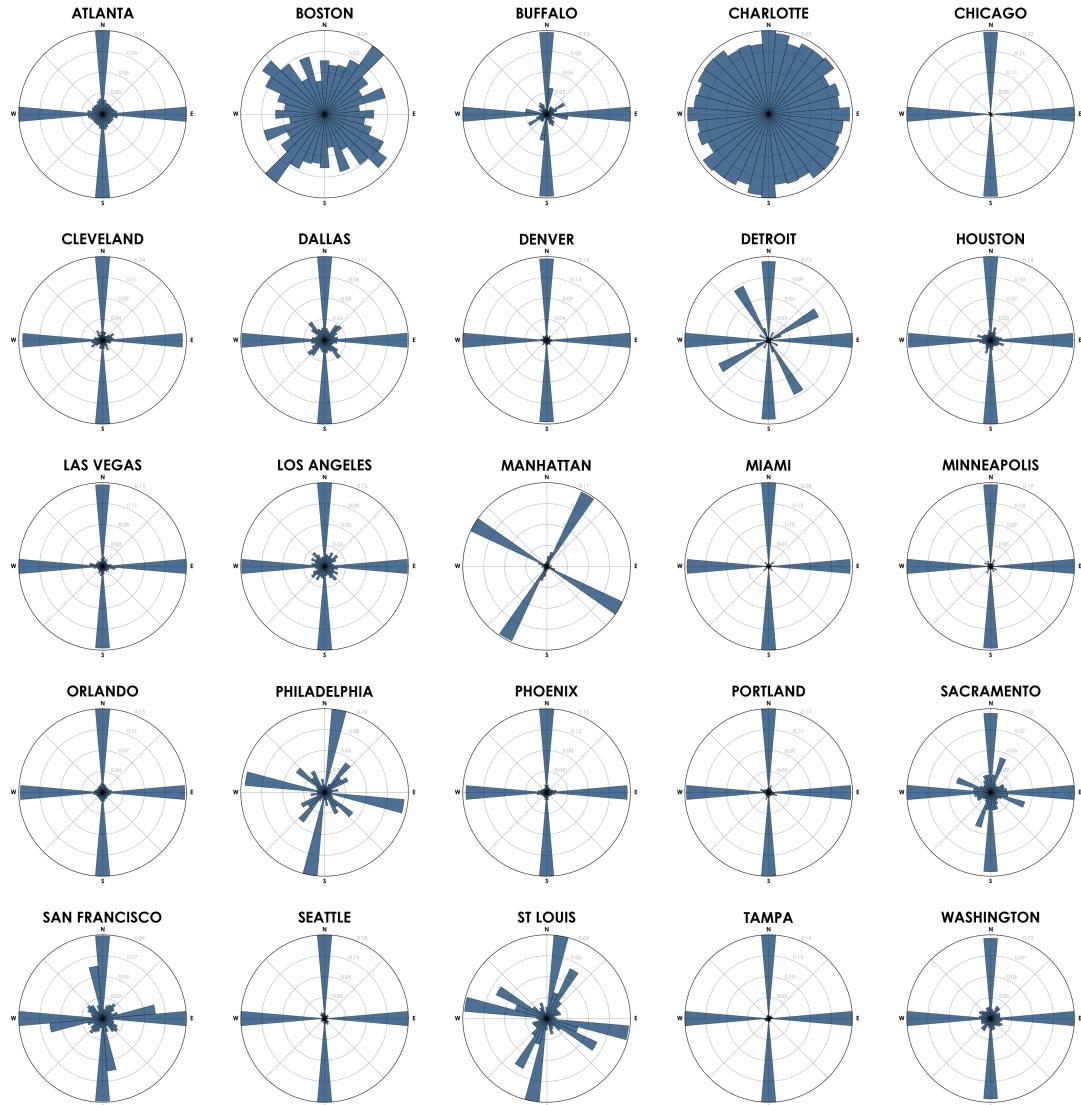
Urban Spatial Order: Street Network Orientation, Configuration, and Entropy

My favorite visualization paper

City Street Network Orientation



City Street Network Orientation



Just a Matplotlib Polar Plot

```
In [6]: def count_and_merge(n, bearings):
    # make twice as many bins as desired, then merge them in pairs
    # prevents bin-edge effects around common values like 0° and 90°
    n = n * 2
    bins = np.arange(n + 1) * 360 / n
    count, _ = np.histogram(bearings, bins=bins)

    # move the last bin to the front, so eg 0.01° and 359.99° will be binned together
    count = np.roll(count, 1)
    return count[::2] + count[1::2]

In [7]: # function to draw a polar histogram for a set of edge bearings
def polar_plot(ax, bearings, n=36, title=''):

    bins = np.arange(n + 1) * 360 / n
    count = count_and_merge(n, bearings)
    _, division = np.histogram(bearings, bins=bins)
    frequency = count / count.sum()
    division = division[0:-1]
    width = 2 * np.pi / n

    ax.set_theta_zero_location('N')
    ax.set_theta_direction('clockwise')

    x = division * np.pi / 180
    bars = ax.bar(x, height=frequency, width=width, align='center', bottom=0, zorder=2,
                  color="#003366", edgecolor='k', linewidth=0.5, alpha=0.7)

    ax.set_ylim(top=frequency.max())

    title_font = {'family':'Century Gothic', 'size':24, 'weight':'bold'}
    xtick_font = {'family':'Century Gothic', 'size':10, 'weight':'bold', 'alpha':1.0, 'zorder':3}
    ytick_font = {'family':'Century Gothic', 'size': 9, 'weight':'bold', 'alpha':0.2, 'zorder':3}

    ax.set_title(title.upper(), y=1.05, fontdict=title_font)

    ax.set_yticks(np.linspace(0, max(ax.get_ylim()), 5))
    yticklabels = ['{:,.2f}'.format(y) for y in ax.get_yticks()]
    yticklabels[0] = ''
    ax.set_yticklabels(labels=yticklabels, fontdict=ytick_font)

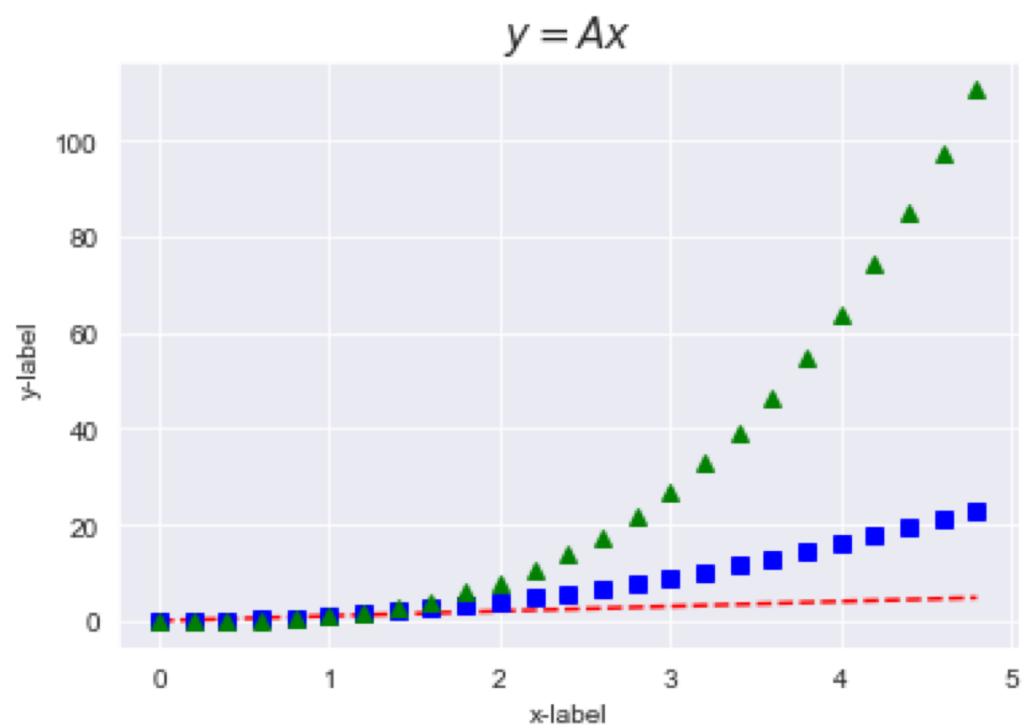
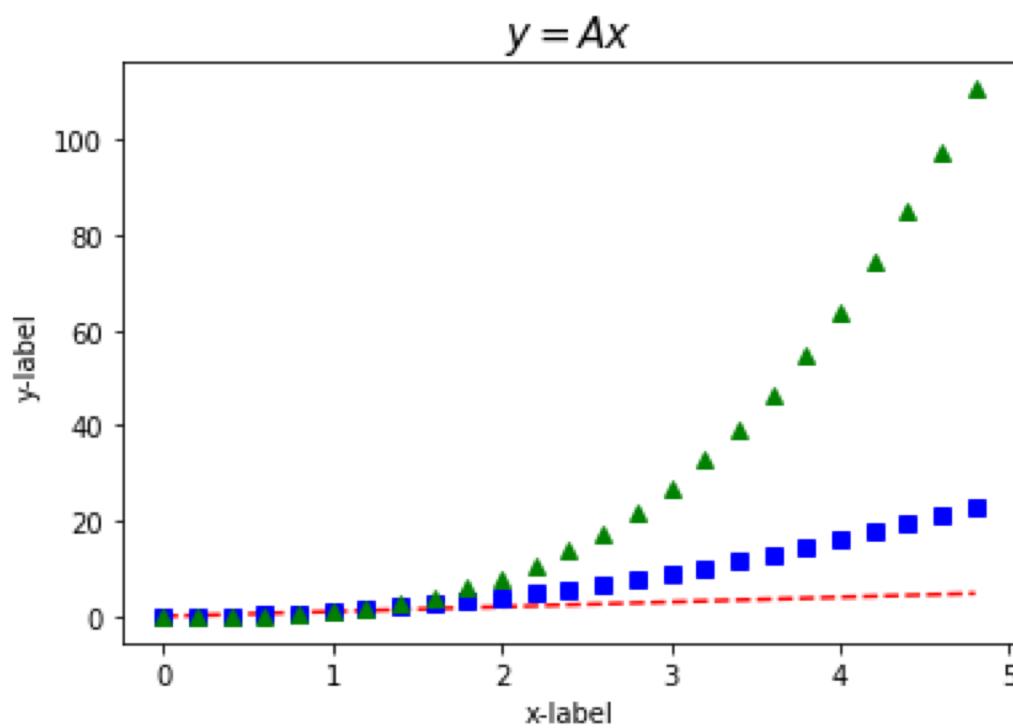
    xticklabels = ['N', '', 'E', '', 'S', '', 'W', '']
    ax.set_xticklabels(labels=xticklabels, fontdict=xtick_font)
    ax.tick_params(axis='x', which='major', pad=-2)
```

1. Store orientation counts in a numpy array
2. Make a polar plot, bar angles = street orientations

Full code available at,

<https://github.com/gboeing/osmnx-examples/blob/master/notebooks/17-street-network-orientations.ipynb>

Matplotlib Styles



Simple Scripts

Matplotlib recipes notebook..

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Pinpointing Problems with Jupyter

Jupyter debugging notebook..

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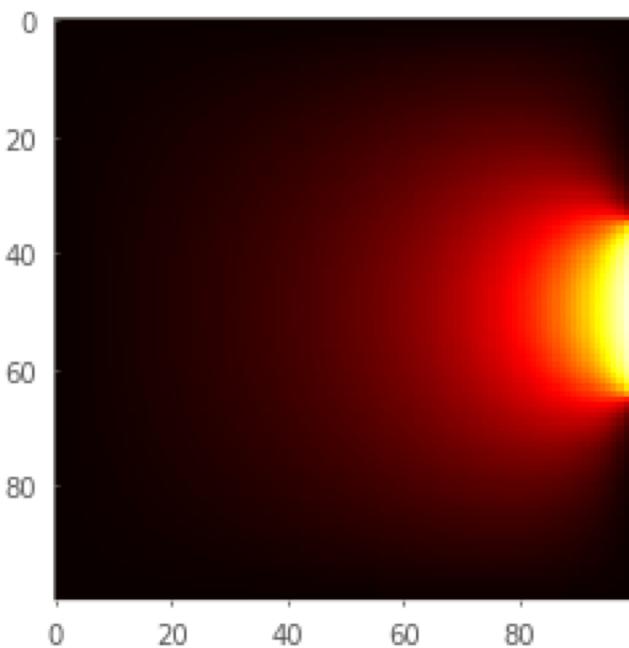
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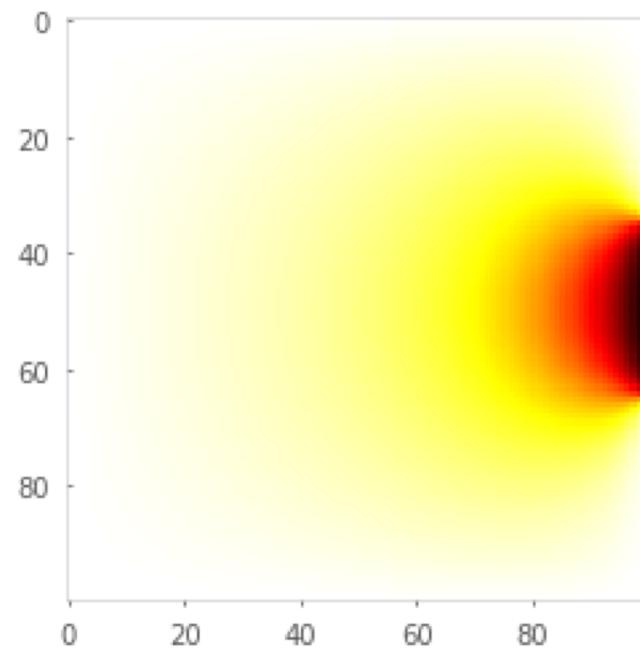
Plots Are Often the Best Way
to Find Bugs

The Temperature Problem

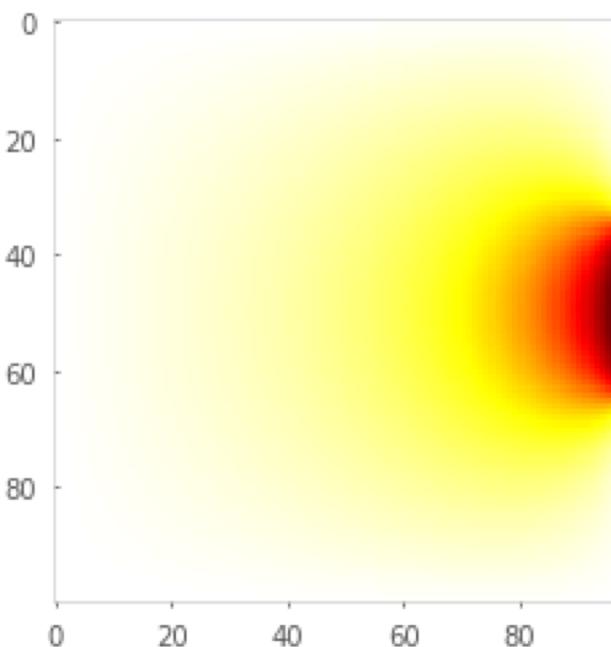
Bug Free



Buggy



Where is the coldest part of the room?



Debugging Computational Code

1. Check for error messages and common mistakes (pointwise instead of matrix multiplication, forgot to execute parts of the script, ..)
2. Plot your results, try to identify the specific issues and isolate them
3. Think about the most difficult step in your calculations, check all the variables before this step, then check the variables after this step
4. Think about 2nd most difficult step in your calculations and repeat 3
5. Etc. until you find a step where the results don't make sense

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Group Exercise:

1. Split into groups of 3 to 5 (3 preferred)
2. Write your names
3. Memorize each other's names
4. Write a sentence or less to answer: What is most important problem computers will solve in a foreseeable future?

Example 1: Autonomous driving

Example 2: Finding the optimal syrup to pancake ratio for breakfast