

# Setting up a Scientific Linux Virtual Machine

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# Outline

- [1. Introduction to Scientific Computing Environment](#)
  - Software for scientific computing
  - Why Python (and which version to use)
  - What is a virtual machine
- [2. Install VirtualBox \(Windows, OS X, or Linux\)](#)
- [3. Setup Ubuntu Linux with a Scientific Computing Environment<sup>1</sup>](#)

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<sup>1</sup>If you are using Linux then you can skip step 2 and go directly to step 3 setting up a scientific computing environment if you wish

## Scientific Software

Continuum makes it easy by providing the Anaconda distribution for free

- Anaconda is a complete set of python tools (329+ of them) that are useful in one simple and straight forward install (available for Linux, OS X, and Windows).
- This collection of packages are geared towards scientific computing.
- Anaconda is also a powerful and simple package manager - which helps in managing the python ecosystem.
- Anaconda is starting to provide additional channels for other languages like R

## What does Anaconda include?

The packages contained in Anaconda are geared towards scientific computing (data analysis, math, science ...)

Package manager + all of the essentials (+ a lot more)

- python, ipython
- jupyter
- matplotlib
- numpy
- pandas

A full list of packages is available at

<http://docs.continuum.io/anaconda/pkg-docs.html>

# Python 2.7 or 3.5?

## Python 2.7

- Pro
  - More packages are available in Python 2.7 (394)
  - A lot of examples are written in Python 2.7 syntax.
- Con
  - In maintenance mode - not getting new features.

## Python 3.5 (Best **default** selection)

- Pro
  - Newest version which is the long term future of Python
  - Most of the scientific stack has been ported to Python 3 (324)
- Con
  - Sometimes want to use a library which has not been migrated to Python 3 yet. (but can make use of conda environments if needed)

# Why use a Virtual Machine

A virtual machine is a software layer that works to share the underlying hardware resources.

Some benefits:

- Using a linux virtual machine allows for everyone to use the same environment in the course [Ubuntu Linux] which unifies the tools we are working with.
- A great way to get started with Linux. Easy to start again with a fresh installation.

Free to use Windows, OS X, or Linux - but instructions for the course will be based on Ubuntu Linux. Python code is cross-platform.

## VirtualBox

VirtualBox is a free, multi-platform virtualization host for running virtual machines.

Further reading: <https://www.virtualbox.org/>

VirtualBox is available for Windows, OS X, and Linux operating systems. This means that you can run a linux virtual machine on any underlying platform.

## VirtualBox - Installation Software

Software is available on the Course USB stick.

- Windows: VirtualBox-5.0.12-104815-Win.exe
- OS X: VirtualBox-5.0.12-104815-OSX.dmg
- Linux (DEB):  
virtualbox-5.0\_5.0.12-104815-Ubuntu-wily\_amd64.deb
- Linux (RPM):  
VirtualBox-5.0-5.0.12\_104815\_fedora22-1.x86\_64.rpm

Download Link: <https://www.virtualbox.org/wiki/Downloads>

## Installation Guides

The following installation guides are available for:

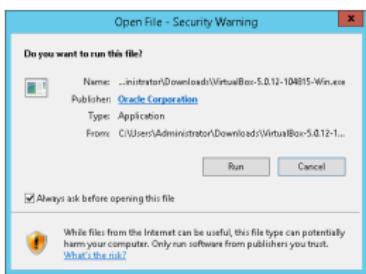
- [1. Windows](#)
- [2. OS X](#)

I can help individuals setting up Linux as it depends on DEB or RPM based package environments.

Alternatively, if you are already using Ubuntu, you can skip to “Setting up a Scientific Computing Environment”

# Windows

Double click on **VirtualBox-5.0.12-104815-Win.exe**



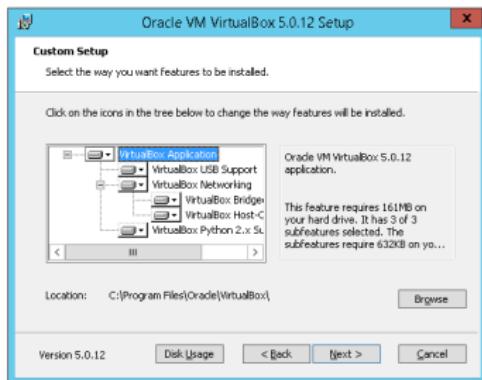
Click on **Next**



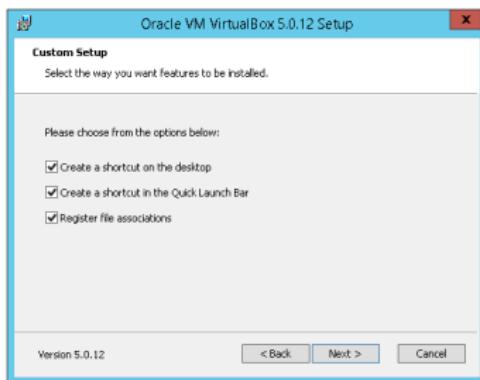
Press **RUN** to continue the installation

# Windows

Click **Next** to accept the default values



Click **Next** to accept the default values

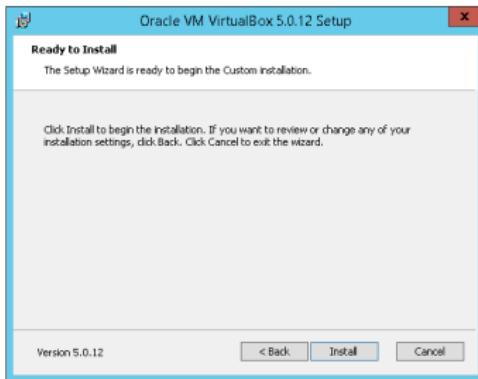


# Windows

You may see this **Warning**



Click **Install**



Click **Yes**

# Windows

You may see this **Windows Security** window



Click **Install**

Installation Complete!



Click **Finish** to run VirtualBox

# Windows

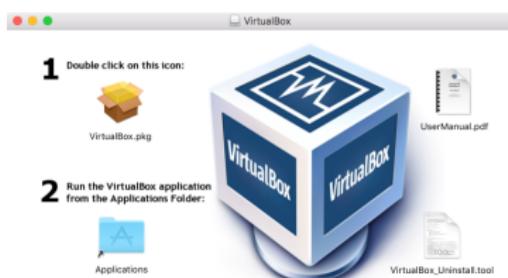
## Note

If Virtualbox only shows you 32-bit host options after installation  
please refer to this link

<http://www.fixedbyvonne.com/2014/11/virtualbox-showing-32-bit-guest-versions-64-bit-host-os/#.Vp1rl3UrL0o>

# OS X

Double click on **VirtualBox-5.0.12-104815-OSX.dmg**



Click on **Continue**



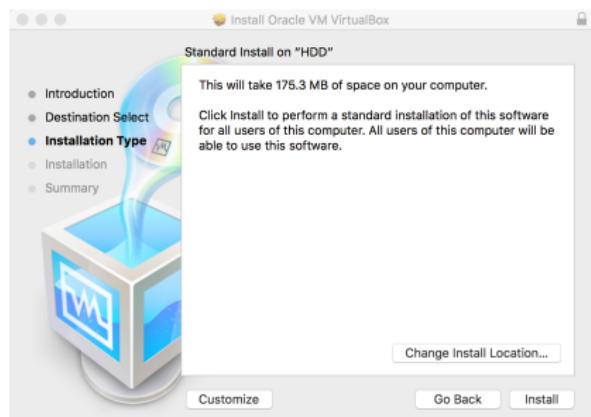
Double click on **VirtualBox.pkg** icon

# OS X

Click on **Continue**



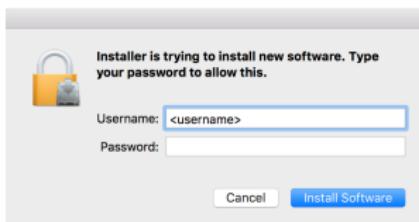
Click on **Install**



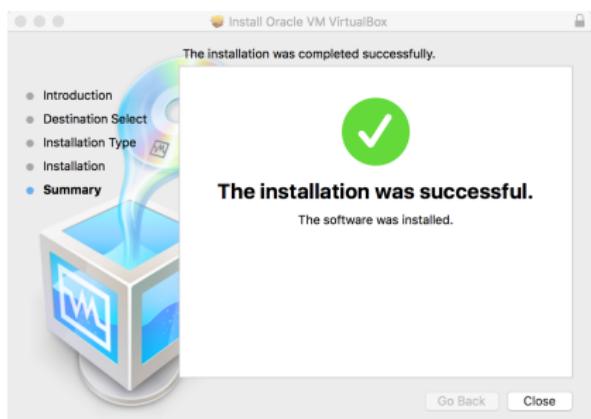
This will install with the default settings

# OS X

Type in your password



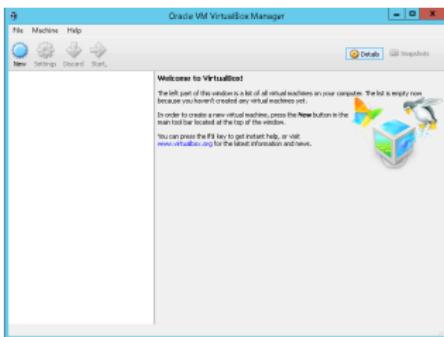
Installation Succesfull



then click on **Install Software**

# The VirtualBox Manager

## Windows



## OS X



Open from the Start Menu, click on **New**

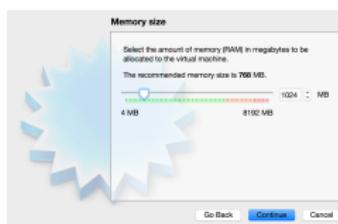
Open from Applications Folder, click on **New**

# Creating an Ubuntu VM

Name your virtual machine  
**ubuntu-15.10**



Set memory size to at least  
**1024MB**



**Note:** This RAM will be captured from your underlying OS when you launch the VM - so you cannot exceed the amount of RAM on your computer.

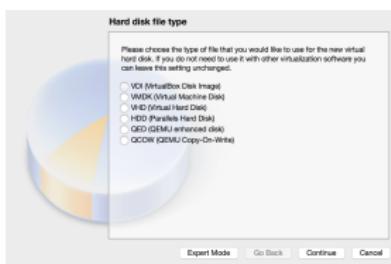
# Creating an Ubuntu VM

Ensure **Create a virtual hard disk now** is selected



Click **Create**

Ensure **VDI (VirtualBox Disk Image)** is selected



Click **Continue**

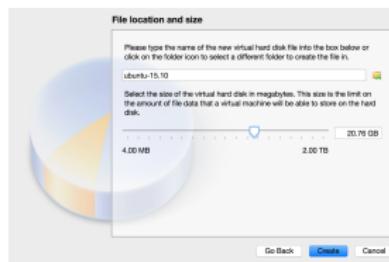
# Creating an Ubuntu VM

Ensure **Dynamically allocated** is selected



Click **Continue**

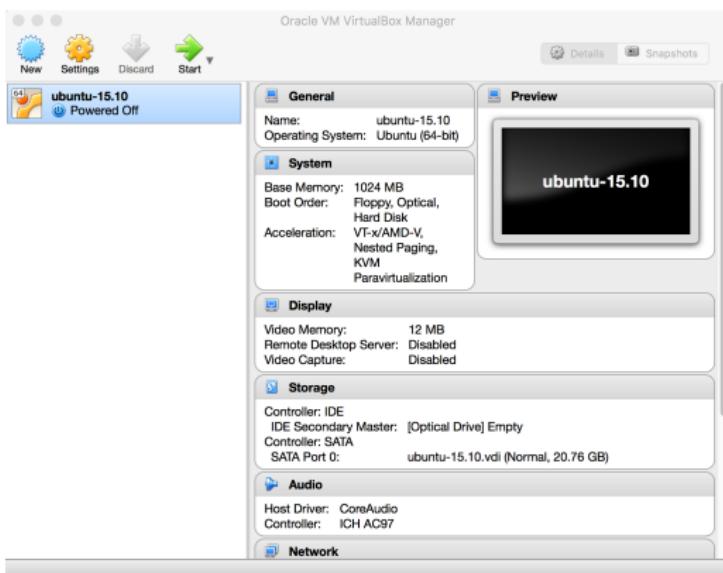
Specify how much HDD you would like to give to the VM



Click **Continue**

# Creating an Ubuntu VM

Hardware for your virtual Machine is now configured!



**ubuntu-15.10** is now listed as a machine

## Install Ubuntu Linux - Preliminaries

For this step you will need to get a copy of the Ubuntu Linux iso file from the course usb

ubuntu-15.10-desktop-amd64.iso

and you will need  $\geq$  10GB HDD space free, it is best to have an active internet connection, and have plenty of battery remaining (or plugged in).

This installation process should take around 15 minutes

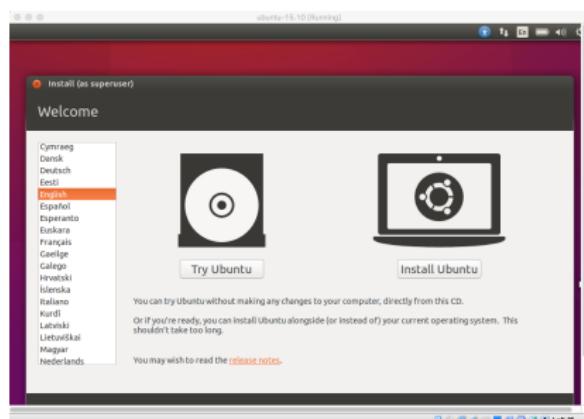
# Installing Ubuntu Linux

Click on **ubuntu-15.10** virtual machine and click **Start**



It will prompt you for an installation disk. Click the folder icon and select the ubuntu iso file on the USB drive.

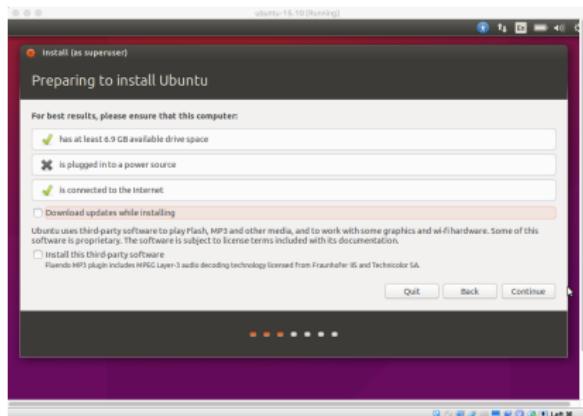
Ubuntu will load from the iso and a welcome screen will appear



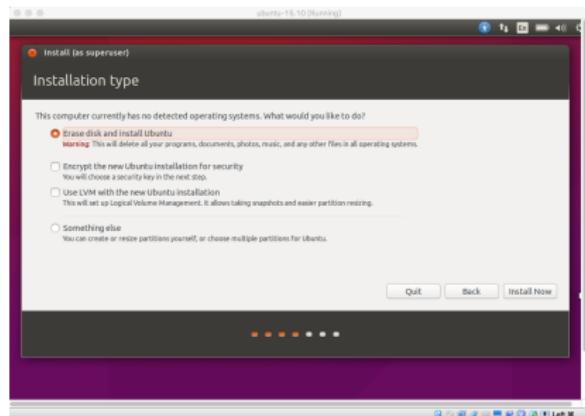
Select **Install Ubuntu**

# Installing Ubuntu Linux

Click **Continue**



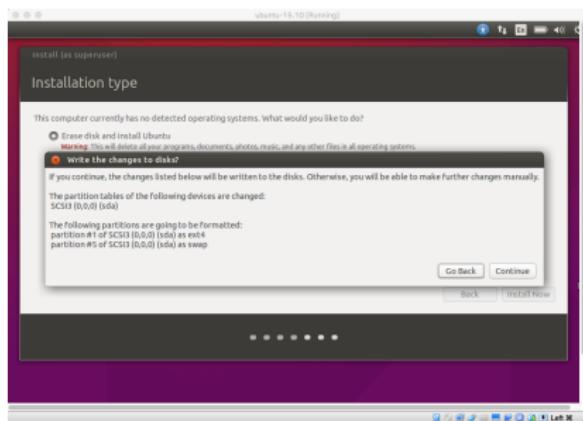
Check **Erase disk and install Ubuntu**



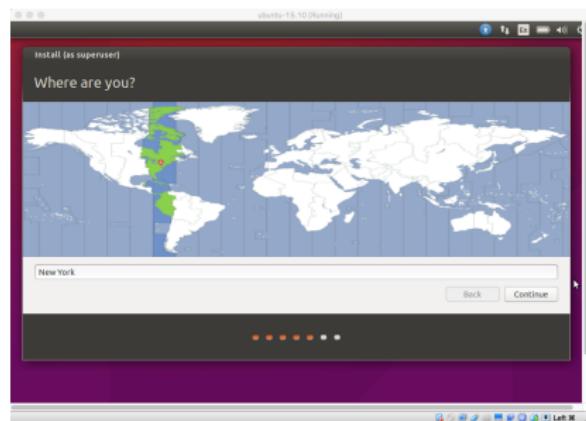
Click on **Install Now**

# Installing Ubuntu Linux

Click on **Continue**



Should detect New York

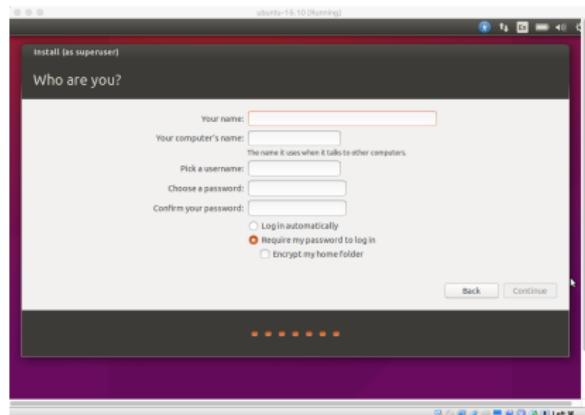
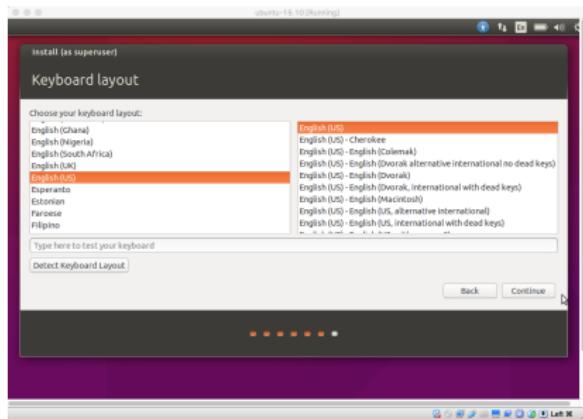


Click on **Continue**

# Installing Ubuntu Linux

Click on **Continue**

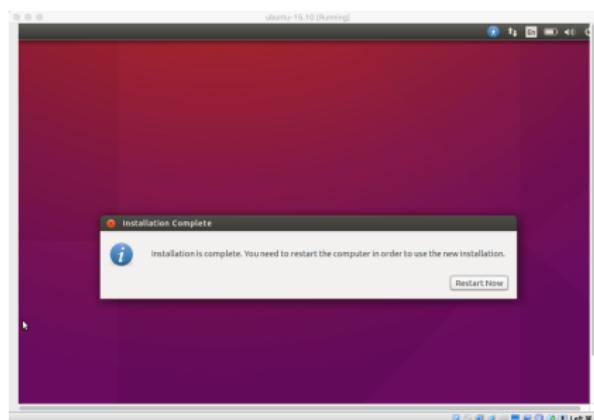
Fill in your account details and select **Log in automatically** for convenience



Remember your username and password, then click **Continue**

# Installing Ubuntu Linux

Ubuntu is installed



Click on **Restart Now**

# Install VirtualBox Drivers in Guest VM

1. Boot your Ubuntu VM
2. Open a terminal in Ubuntu
3. Run: `sudo apt-get install virtualbox-guest-dkms *`
4. Reboot Ubuntu

\*because this requires sudo privileges you will need to enter your password.

## Enable Clipboard and Drag and Drop Features

For convenience when working with a Virtual Machine you may want to enable shared Clipboard and Drag and Drop features.

1. Boot your Ubuntu VM
2. On the VirtualBox menu bar select Devices
3. Enable Shared Clipboard\*
4. Enable Drag and Drop\*

\*You can choose a direction if you wish.

## Installing Scientific Software - Preliminaries

For this section of the tutorial you will need the course usb stick that contains the following files:

1. [Anaconda3-2.4.1-Linux-x86\\_64.sh](#) ( 283.8 MB)
2. [texlive2015.iso](#) ( 2.7 GB)

We will now install the Anaconda Python 3.5 Distribution, and TexLive 2015 for LaTex Support.

## Connect the USB drive to Ubuntu

Some OS's like (OS X) automatically capture a usb drive when attached to the computer.

Best to  **eject** it and then:

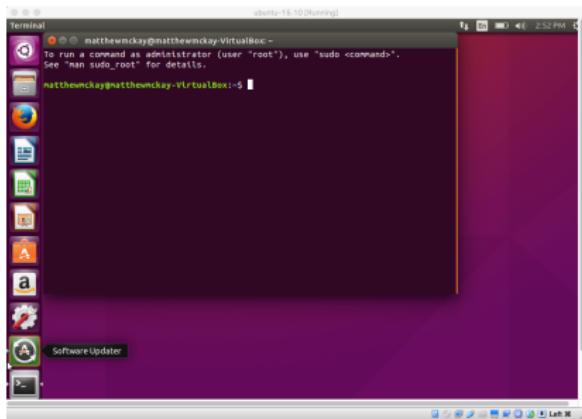
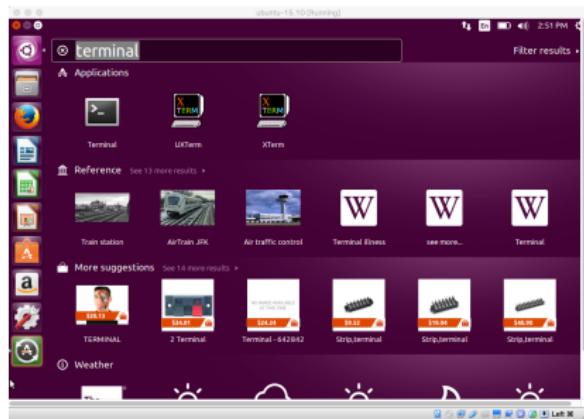
1. Select **Devices** from the drop down menu
2. Select **USB**
3. Click on **SMI Corporation USB DISK**

The Ubuntu VM will then automatically mount the USB stick.

## Opening a Terminal

In Linux the terminal is a very important tool. So let's add it to your sidebar for future use.

Click on the top icon **Search your computer and online sources** and type in **Terminal** followed by **Enter**. To add it permanently to the sidebar **right click** on the terminal icon and select **Lock to Launcher**.



## Install Anaconda

To install Anaconda, open a Terminal window and type:

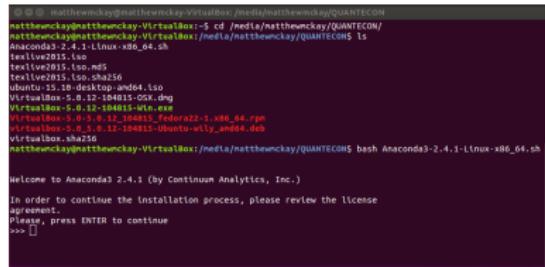
```
cd /media/<your-username>/QUANTECON
```

```
ls
```

Check the Anaconda file is there and then to start installation type:

```
bash Anaconda3-2.4.1-Linux-x86_64.sh
```

# Install Anaconda - Linux



```
matthewncay@matthewncay-VirtualBox:~$ cd /media/matthewncay/QUANTECON/
matthewncay@matthewncay-VirtualBox:~/media/matthewncay/QUANTECON$ ls
Anaconda3-2.4.1-Linux-x86_64.sh
twinklev015.tso
twinklev015.tso.mds
twinklev015.tso.sha256
ubuntu-15.10-desktop-and64.tso
VirtualBox-5.0.12-dkms_amd64.deb
VirtualBox-5.0.12-dkms_i386.deb
VirtualBox-5.0.12_104415_Ubuntu-v1.y_and64.deb
VirtualBox-5.0.12_104415_Ubuntu-v1.y_and64.deb
VirtualBox-5.0.12_104415_Ubuntu-v1.y_and64.sh

Welcome to Anaconda3 2.4.1 (by Continuum Analytics, Inc.)

In order to continue the installation process, please review the license
agreement.
Press 'y' or 'n', press ENTER to continue
>>> [ ]
```

Press **ENTER** to continue the installation

Scroll through the licence terms and conditions.



```
matthewncay@matthewncay-VirtualBox:~/media/matthewncay/QUANTECON$ more cryptography
cryptography: openssl
The OpenSSL Project is a collaborative effort to develop a robust, cross-platform-grade, full-featured, and Open Source toolkit implementing the Transport Layer Security (TLS) and Secure Sockets Layer (SSL) protocols as well as a full-strength general purpose cryptography library.
pycrypto
A collection of both secure hash functions (such as SHA256 and RIPEMD160), and various encryption algorithms (AES, DES, RSA, ElGamal, etc.).
pyopenssl
A thin Python wrapper around (a subset of) the OpenSSL library.
kerberos (krb5, non-Windows platforms)
A network authentication protocol designed to provide strong authentication for client/server applications by using secret-key cryptography.
cryptography
A Python library which exposes cryptographic recipes and primitives.
Do you approve the license terms? [yes|no]
>>> yes[ ]
```

When asked if you approve type **yes**

# Install Anaconda - Linux

Keep the default install location by hitting **ENTER**. This will setup an **anaconda3** directory in your user account.

```
matthewmkay@matthewmkay-VirtualBox:/media/matthewmkay/QUANTECON
A collection of both secure hash functions (such as SHA256 and RIPEMD160),
and various encryption algorithms (AES, DES, RSA, ElGamal, etc.).

pyopenssl
A thin Python wrapper around (a subset of) the OpenSSL library.

kerberos (krb5, non-Windows platforms)
A network authentication protocol designed to provide strong authentication
for client/server applications by using secret-key cryptography.

cryptography
A Python library which exposes cryptographic recipes and primitives.

Do you approve the license terms? [yes|no]
>>> yes

anaconda3 will now be installed into this location:
/home/matthewmkay/anaconda3

Press ENTER to confirm the location
Press CTRL-C to abort the installation
Or specify a different location below

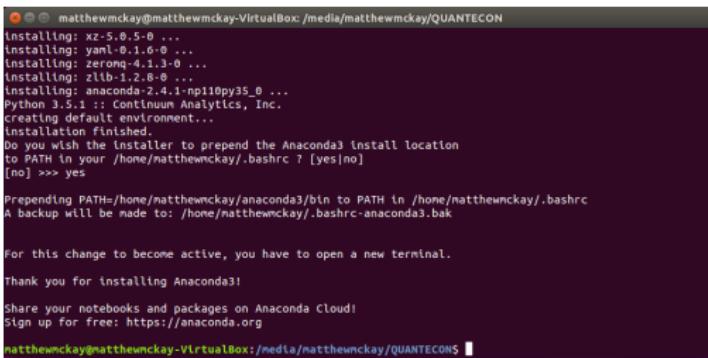
/home/matthewmkay/anaconda3] >>> 
```

Make sure to type **yes** to prepend the anaconda installation to your **PATH**. This ensures anaconda is the default python library on your system.

```
matthewmkay@matthewmkay-VirtualBox:/media/matthewmkay/QUANTECON
installing: theano-0.7.0-py35_0 ...
installing: numpy-1.10.4-py35_0 ...
installing: toolz-0.7.4-py35_0 ...
installing: tornado-4.3-py35_0 ...
installing: traitlets-4.3-py35_0 ...
installing: tensorflow-1.3-py35_0 ...
installing: unicodedev-0.2.14-py35_0 ...
installing: util-linux-2.21.0 ...
installing: werkzeug-0.12.2-py35_0 ...
installing: xlrd-0.9.4-py35_0 ...
installing: xlibxtreter-0.7.7-py35_0 ...
installing: xz-5.1.5 ...
installing: yaml-0.1.6-0 ...
installing: zeromq-4.1.3-0 ...
installing: zlib-1.2.8 ...
installing: anaconda-2.4.1-00110by35_0 ...
Python 3.5.1 :: Continuum Analytics, Inc.
creating default environment...
installing: base-2.4.1-00110by35_0 ...
do you wish the installer to prepend the Anaconda3 install location
to PATH in your /home/matthewmkay/.bashrc ? [yes|no]
[no] >>> yes
```

# Install Anaconda - Linux

Installation finished!



The screenshot shows a terminal window titled 'matthewmckay@matthewmckay-VirtualBox: /media/matthewmckay/QUANTECON'. The window displays the following text:

```
Installing: xz-5.8.5-0 ...
installing: yaml-0.1.6-0 ...
installing: zeromq-4.1.3-0 ...
installing: zlib-1.2.8-0 ...
installing: anaconda-2.4.1-npl10py35_0 ...
python 1.5.1 :: Continuum Analytics, Inc.
creating default environment...
installation finished.
Do you wish the installer to prepend the Anaconda3 install location
to PATH in your /home/matthewmckay/.bashrc ? [yes/no]
[no] >>> yes

Prepending PATH=/home/matthewmckay/anaconda3/bin to PATH in /home/matthewmckay/.bashrc
A backup will be made to: /home/matthewmckay/.bashrc-anaconda3.bak

For this change to become active, you have to open a new terminal.

Thank you for installing Anaconda3!

Share your notebooks and packages on Anaconda Cloud!
Sign up for free: https://anaconda.org

matthewmckay@matthewmckay-VirtualBox:/media/matthewmckay/QUANTECON$
```

**Note:** To make the changes to your PATH effective you need to start a new terminal window.

## Some simple tests ...

Run these commands in a terminal.

Note: For Windows systems these should be run in a cmd or powershell terminal.

1. Try updating conda by typing: `conda update conda`
2. Try updating the anaconda library by typing:  
`conda update anaconda`
3. Open IPython Notebook by typing: `jupyter notebook`. Open a new notebook and try out a few python examples
4. Install QuantEcon library by typing: `pip install quantecon` in the terminal. Next open an Jupyter notebook and try importing the library using: `import quantecon as qe`

# Install TexLive 2015

To install texlive 2015, open a terminal, navigate to the connected USB drive named QUANTECON (as shown in the left hand figure below), and mount the `texlive2015.iso` to `/mnt`.

```
○○○ matthewmckay@matthewmckay-VirtualBox:/mnt$ cd /media/matthewmckay/QUANTECON/
matthewmckay@matthewmckay-VirtualBox:/media/matthewmckay/QUANTECON$ ls
Anaconda3-2.4.1-1Linux-x86_64.sh  VirtualBox-5.0.12-104815-OSX.dmg
texlive2015.iso                  VirtualBox-5.0.12-104815-Win.exe
texlive2015.iso.md5               VirtualBox-5.0.12-104815_Fedora22-1.x86_64.rpm
VirtualBox-5.0.12-104815        VirtualBox-5.0.12-104815-Ubuntu-Utility_x86_64.deb
ubuntu-15.10-desktop_amd64.iso   virtualbox.sh#256
matthewmckay@matthewmckay-VirtualBox:/media/matthewmckay/QUANTECON$ sudo mount -t iso9660 -o ro,loop,noatime,nodiratime ./texlive2015.iso /mnt
matthewmckay@matthewmckay-VirtualBox:/media/matthewmckay/QUANTECON$ cd /mnt
matthewmckay@matthewmckay-VirtualBox:/mnt$ ls
advanced.bet      release-tl-windows.bat    tl-tray-menu.exe
index.html        LICENSE.CTAN            readme-txt.dir  texlive-doc
install-tl        LICENSE.TL             README.txt     tlpkg
install-tl        README.usergroups
```

run `sudo ./install-tl` to start installation

```
○○○ matthewmckay@matthewmckay-VirtualBox:/mnt$ ./texlive2015/texmf-var
TEXMFVAR (personal directory for variable and automatically generated data):
  ~/texlive2015/texmf-var
TEXMFCONFIG (personal directory for local config):
  ~/texlive2015/texmf-config
TEXMFHOME (directory for user-specific files):
  ~/texmf
> options:
  [ ] use letter size instead of A4 by default
  [x] allow execution of restricted list of programs via \write18
  [x] create all format files
  [x] create all configuration files
  [x] create all copyright tree
  [x] install macro/font tree
  [ ] create symlinks to standard directories
  [x] after install, use tlnet on CTAN for package updates
>V> set up for portable installation
Actions:
  <1> start installation to hard disk
  <2> help
  <Q> quit
Enter command: I
```

Type “I” and then **ENTER** to start the installation

## Install Sublime Text

The easiest way to install Sublime is using an Ubuntu PPA. Open a terminal and type

```
sudo add-apt-repository ppa:webupd8team/sublime-text-3  
sudo apt-get update  
sudo apt-get install sublime-text-installer
```

There are other interesting text editors also such as vim, emacs, atom.