Computer Programs in Seismology Installation on VirtualBox

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1. Introduction

This guide focuses on the installation of Computer Programs in Seismology on a LINUX system running under VirtualBox.

VirtualBox is an x86 AMD64/Intel64 product that can run under LINUX, Macintosh, Windows and OpenBSD hosts. The download web page is https://www.virtualbox.org/ .

So what does VirtualBox do? Essentially it provides a new piece of hardware with no operating system installed on it. In this tutorial we will install a LINUX distribution, and then install Computer Programs in Seismology (http://www.eas.slu.edu/eqc/eqccps.html) and necessary software on this "new computer."

The advantage to the user is that the LINUX distribution appears as a file on the host system. This means that the disk is not partitioned to support and independent operating system. Thus nothing will be done to DESTROY your computer.

There are two ways to get Computer Programs in Seismology running. The first involves creating a LINUX system, updating it with the necessary compilers, downloading and installing Computer Programs in Seismology. The result of this effort is a virtual disk image (VDI) that is stored on your local computer.

The other way is to acquire the VDI and then install this under VirtualBox. You can imaging this as physically connecting a disk drive with everything on it to a new piece of hardware. While this is faster, the VDI may be very large and a download will take a long time.

Both techniques will be discussed here. In Section 2, this tutorial will install the following:

`linuxmint-20-xfce-64bit.iso`   which is 1.9 Gb
`NP330.Dec-31-2019.tgz`   which is 31 Mb

Finally in Section 3, we will start with a VDI image which happens to be

`Mint20XFCE.vdi`   which is 13.2 Gb

2. Installation of LINUX and Computer Programs in Seismology

2.1 Install Virtual Box

Go to https://www.virtualbox.org/ and download a version of VirtualBox that was created for the host system of your computer. Also download the Extension Pack. At present the choices for the host systems are

VirtualBox .1.14 platform packages

- Windows hosts

- OS X hosts

- Linux distributions

- _Solaris hosts

and

VirtualBox 6.1.14 Oracle VM VirtualBox Extension Pack

- All supported platforms

Since I am installing this on a MacBook I will get the distribution for "OS X hosts." If you are using a LINUX system, you do not need VirtualBox since you can install CPS directly under LINUX.

Once you have downloaded the VirtualBox, you must install it. On Windows you may have to be in Administrator mode, and on a Mac you may get an error message, which means that you have to go to the "Apple Symbol" at the top right, click on "About this Mac" where you will find a security notice that you must approve the installation of software from Oracle Corporation.

2.2 Install LINUX

2.2.1 Get LINUX distribution

I will install LinuxMint XFCE. I like this version of LINUX and the XFCE window manager should take fewer resources than the Cinnamon edition. I went to https://www.linuxmint.com/download.php and downloaded the XFCE edition, which gave me the file `linuxmint-20-xfce-64bit.iso` which is 1949515776 bytes in size.

The next step is to create LINUX machine from this iso distribution.

2.2.2 Installation

Start VirtualBox – I get the display shown in Figure 2.1. You will see that I have several other "computers" that are running GParted, Lubuntu32, MintXCFE18.3 and MintXFCE19.1_64. Gparted is a disk partitioner, and the others are different LINUX distributions that I have build.
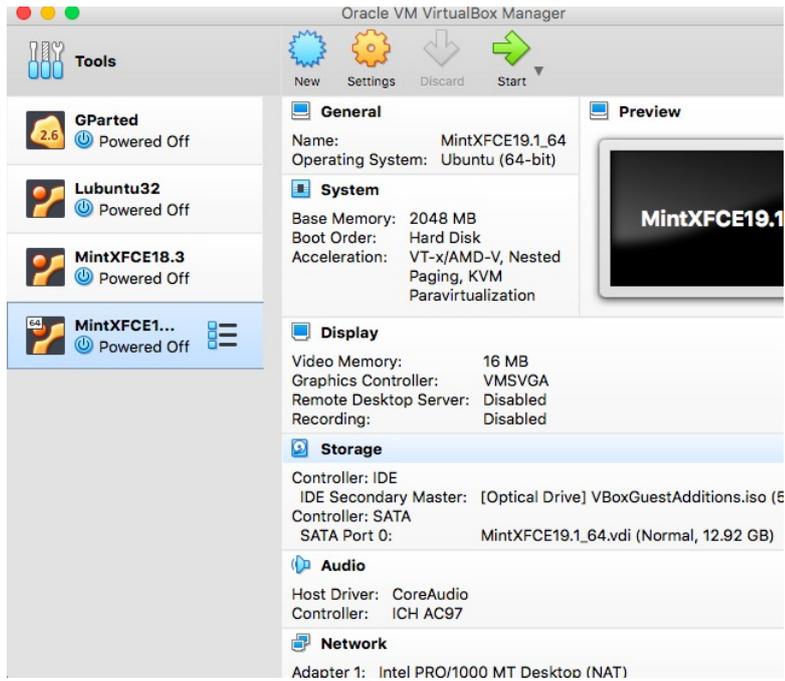
Figure 2.1. Initial Virtual Box display

We will create a new system which we will call Mint20XFCE.

Step 1. Click on "**New**" and enter a name for this new system. I have selected Mint20XFCE. This is shown in Figure 2.2.
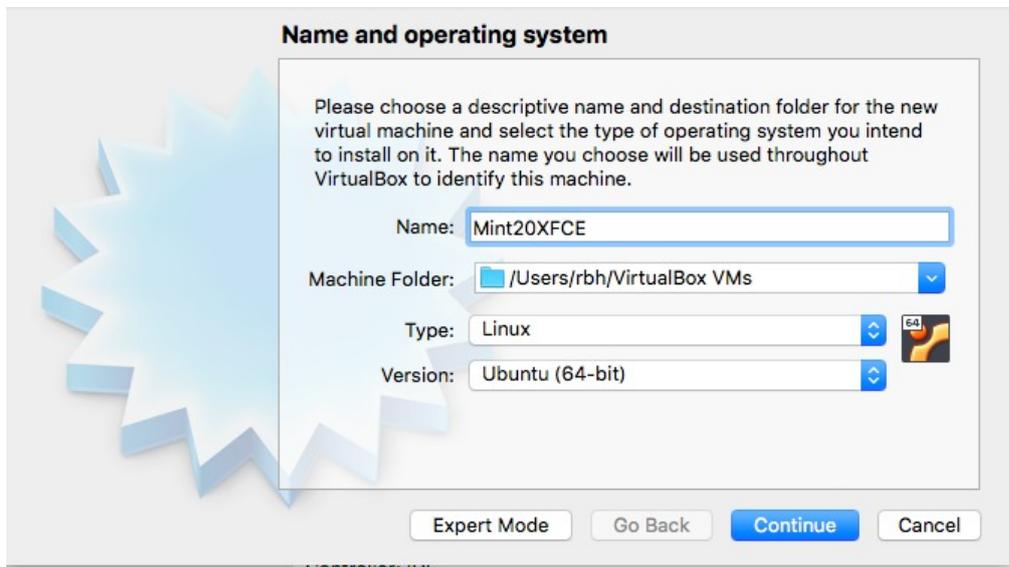

Figure 2.2. Name the system and then press **Continue**

Step 2. After clicking "Continue", select the amount of memory from the host system that should be used. This selection is shown in Figure 2.3. Click "**Continue**."
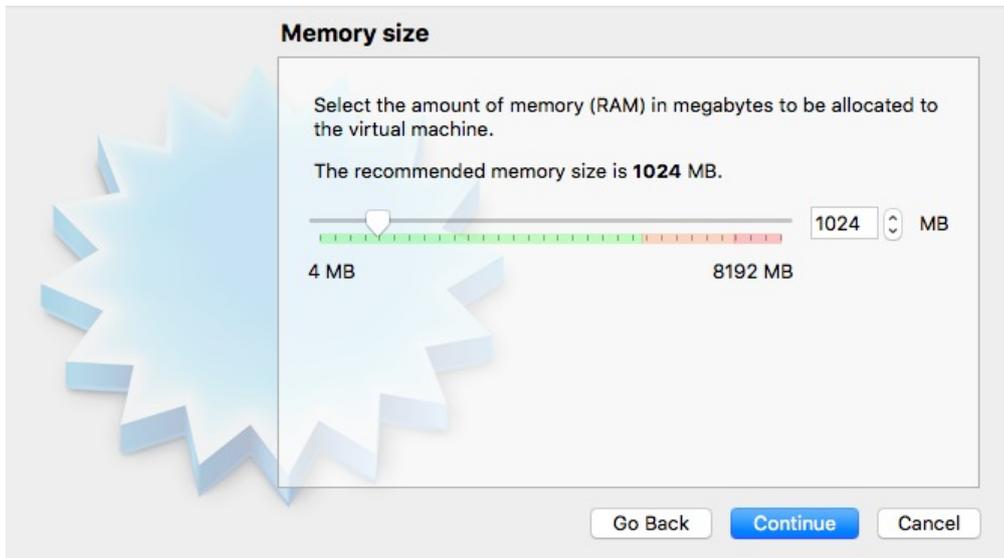
Figure 2.3. Select amount of memory to be used. This can be changed later under **Settings**

Step 3. We will create a virtual hard disk (Figure 2.4). Click "**Create**."

Figure 2.4. Create a virtual disk

Step 4. Select the VDI for the image. Click "**Continue**." (Figure 2.5). Then on the next page use the "Dynamically allocated."   This means that you will set a maximum size, but initially the amount of storage on the host system will be smaller.

Figure 2.5. Select **VDI** for disk format

Step 5. You will want to make this a dynamically allocated disk. you will specify a maximum size which may not all be used initially. The actual file size stored on the host will be less than or equal to the maximum amount that you specify. Figure 2.6 shows the storage screen.

Figure 2.6. Select Dynamically allocated.

Assign the maximum size of the VDI that you are creating. this must be

a) large enough to fit the operating system

b) your software

c) your work area, and

d) be small enough to fit on the disk of your computer. So before you install, determine the free space on your actual computer that is the host. When this screen appeared, it recommended 10.00 GB, but I will set this to about 16 GB. (sorry I clicked before I took a screen shot). Click on "**Create**"

At this point you have created your new piece of virtual hardware.

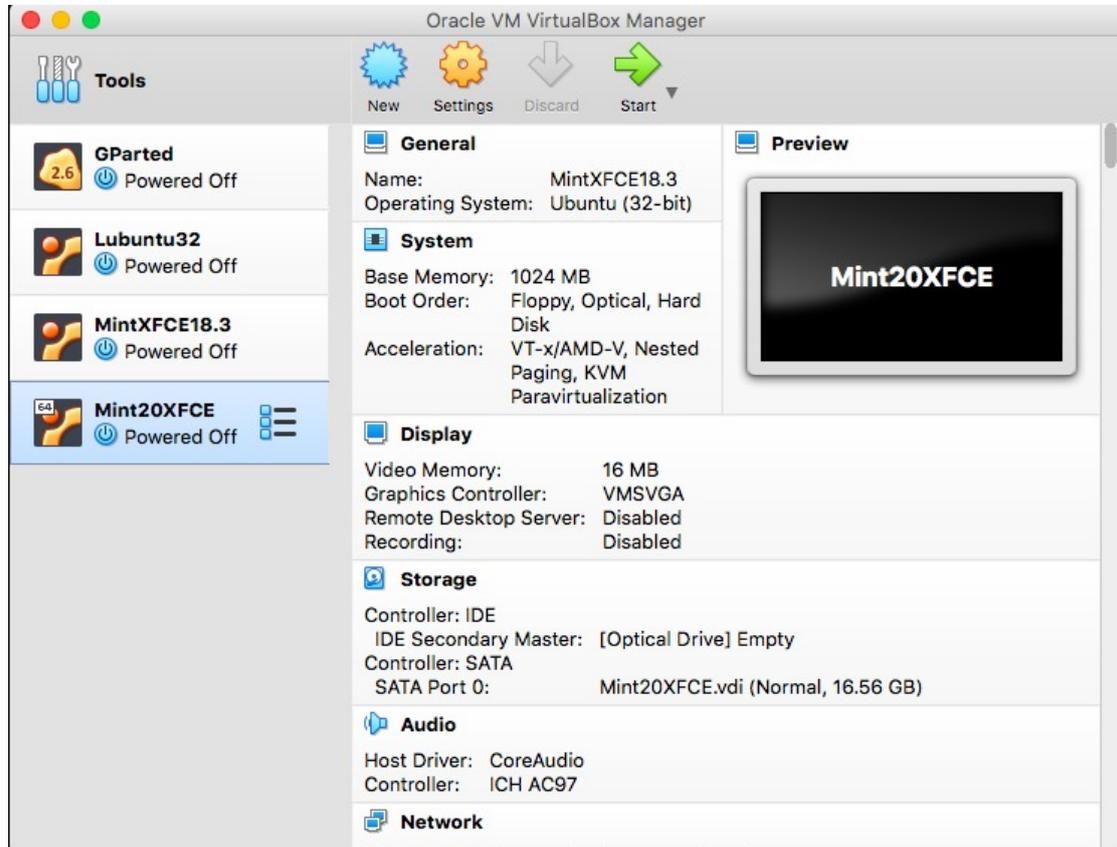**Step 6.** At the main page you will see that there is now a Mint20XFCE tab. (Figure 2.7).

Figure 2.7. VirtualBox screen showing the new tab

Highlight the Mint20XFCE which is why its background color is blue, and click on the green "**Start**" arrow at the top. This gives Figure 2.8. This is how you point to the ISO disk for the LINUX distribution. There is a small file folder icon that permits you look for this on the hist computer. When done, hit "**Start**"
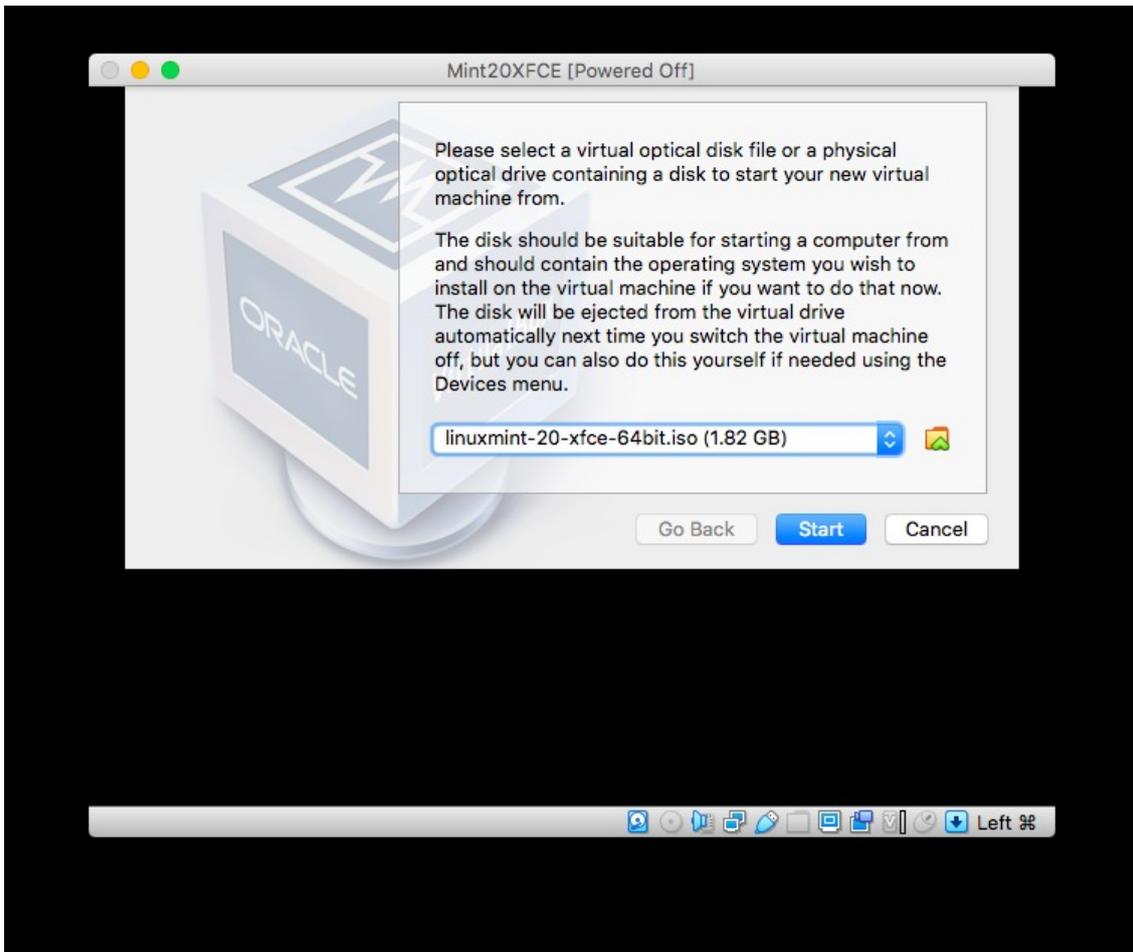
Figure 2.8.   Specify the ISO disk for the LINUX distribution.

Once you do this, the "live CD" will boot and you will see LINUX.

Step 7. Once you do this, the "live CD" will boot and you will see LINUX (Figure 2.9). However to install this on the VDI, click the "Install Linux Mint" Icon.

Figure 2.9. Initial LINUX screen. Click on **Install Linux Mint**

Step 8. Installation of LINUX. You will be presented with a number of Screens. These are the selections that I made for my use.

> **English**   - for language
>
> **English (US)** – for keyboard layout
>
> **Do not install multimedia codes** - I do not want to look at movies or listen to music
>
> **Erase disk and install Linux Mint – YES**! Do not worry. This is the Virtual Disk not the real disk on the host computer - Install Now
>
> Warning message → **Continue**
>
> Local time zone. I select Chicago for my area and "**Continue**"
>
> Now (Figure 2.10) is set up a login account. For ease of use and because this is a virtual machine, I set this up with user name and password as "**cps**" and "**cps**". "**Continue**"
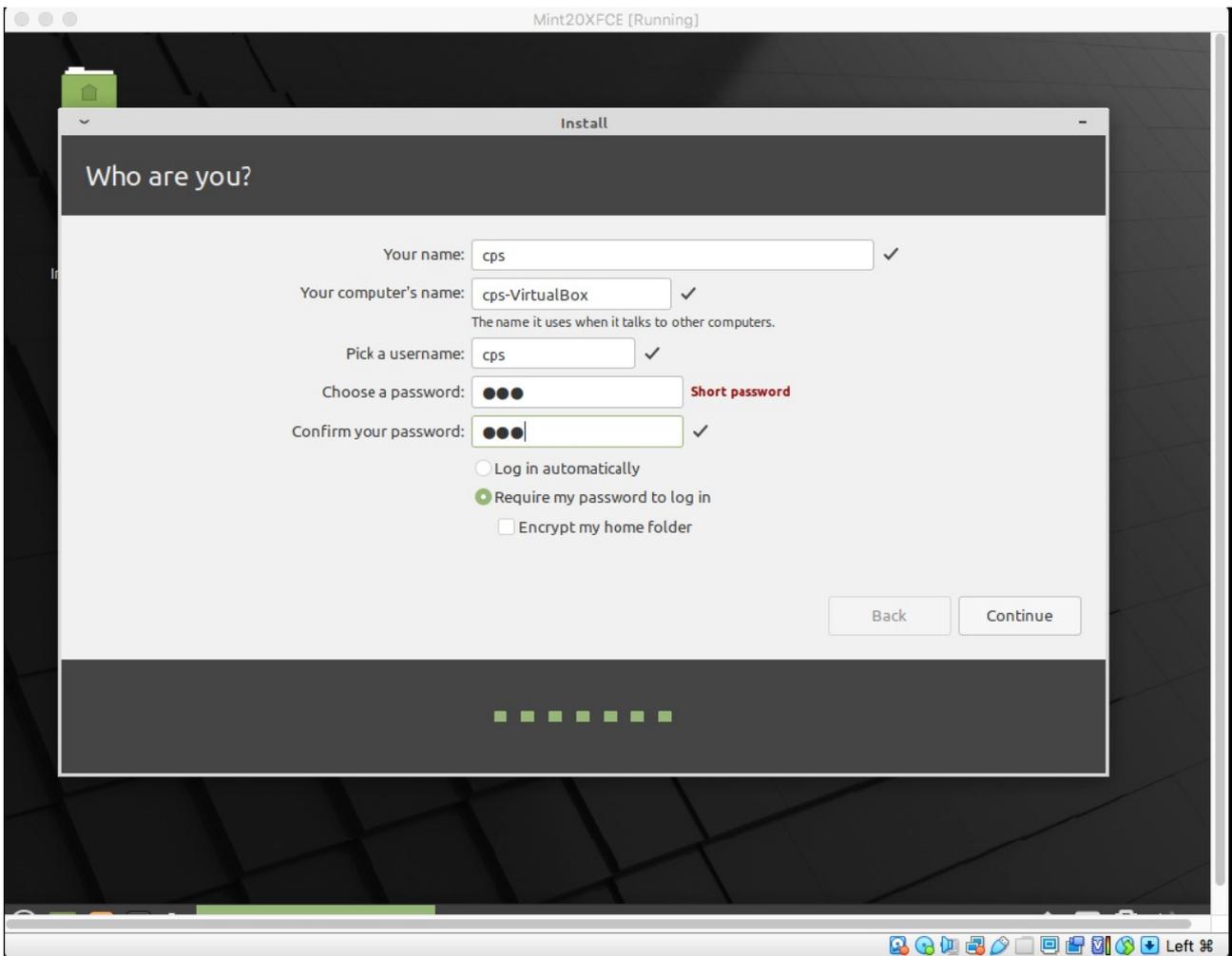
Figure 2.10.   Setup user name and password. The password will be used for superuser permission for software installation and change.

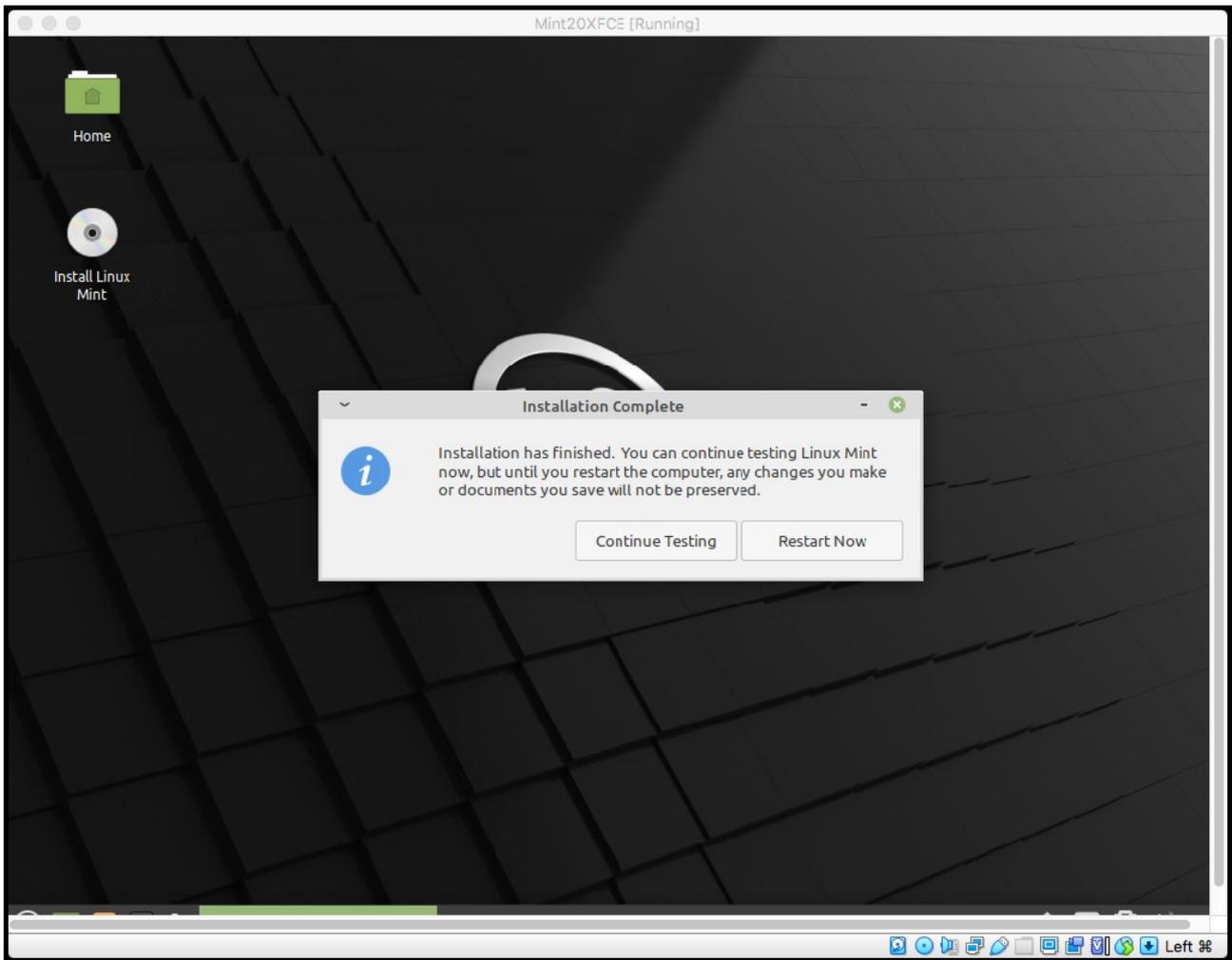The Linux machine is now being built. Then (Figure 2.11) "**Restart Now**"

Figure 2.11.　　Hit　**Restart Now**

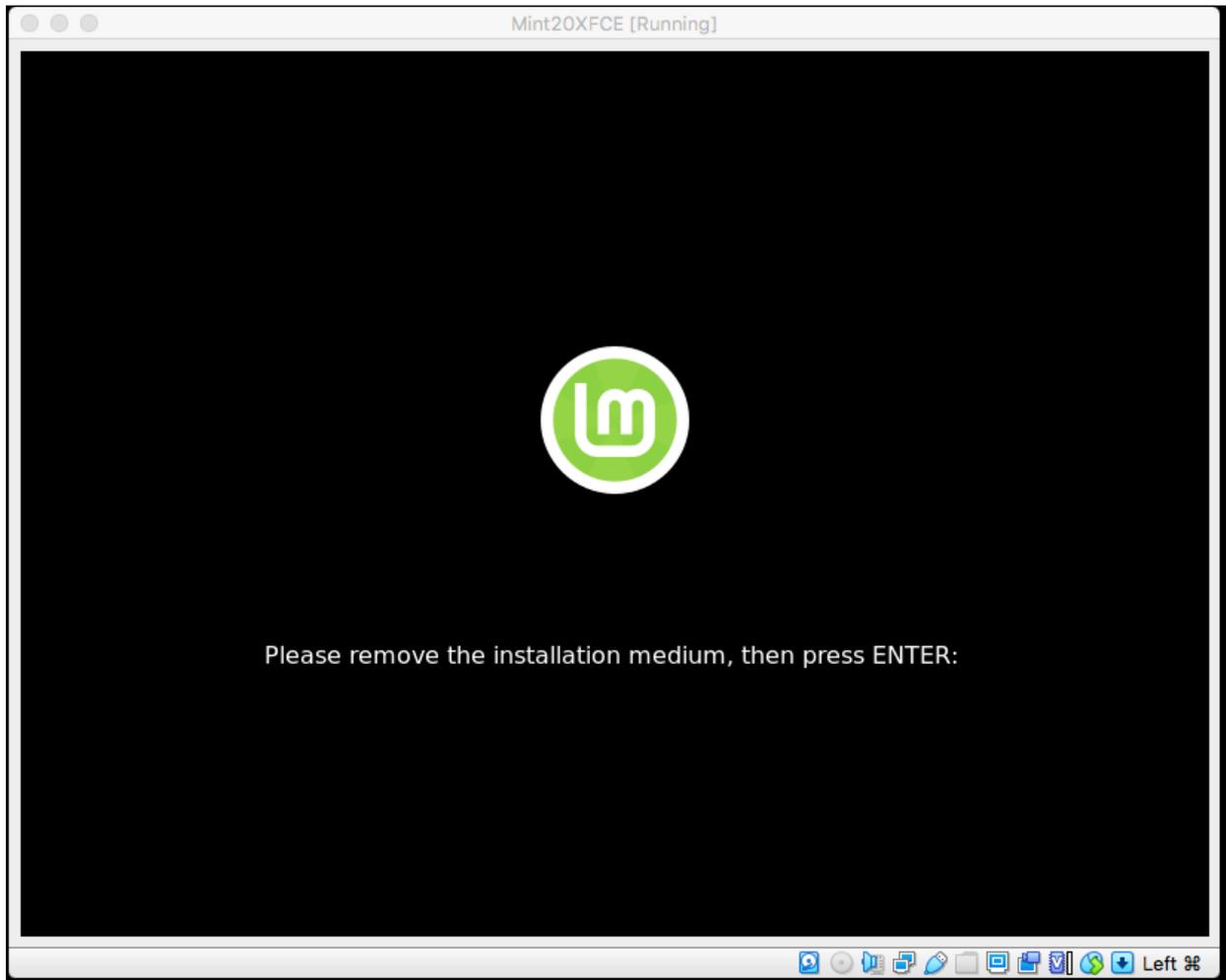**Step 9**. Click　"**Enter**" (Figure 2.12)

Figure 2.12. Press **Enter**   (or **Return**)

Step 10. Login screen now appears. Normally you would log in as **cps** / **cps** (Figure 2.13).
However we will do this right . At the top right there is a power off icon ⏻Click   on it , select
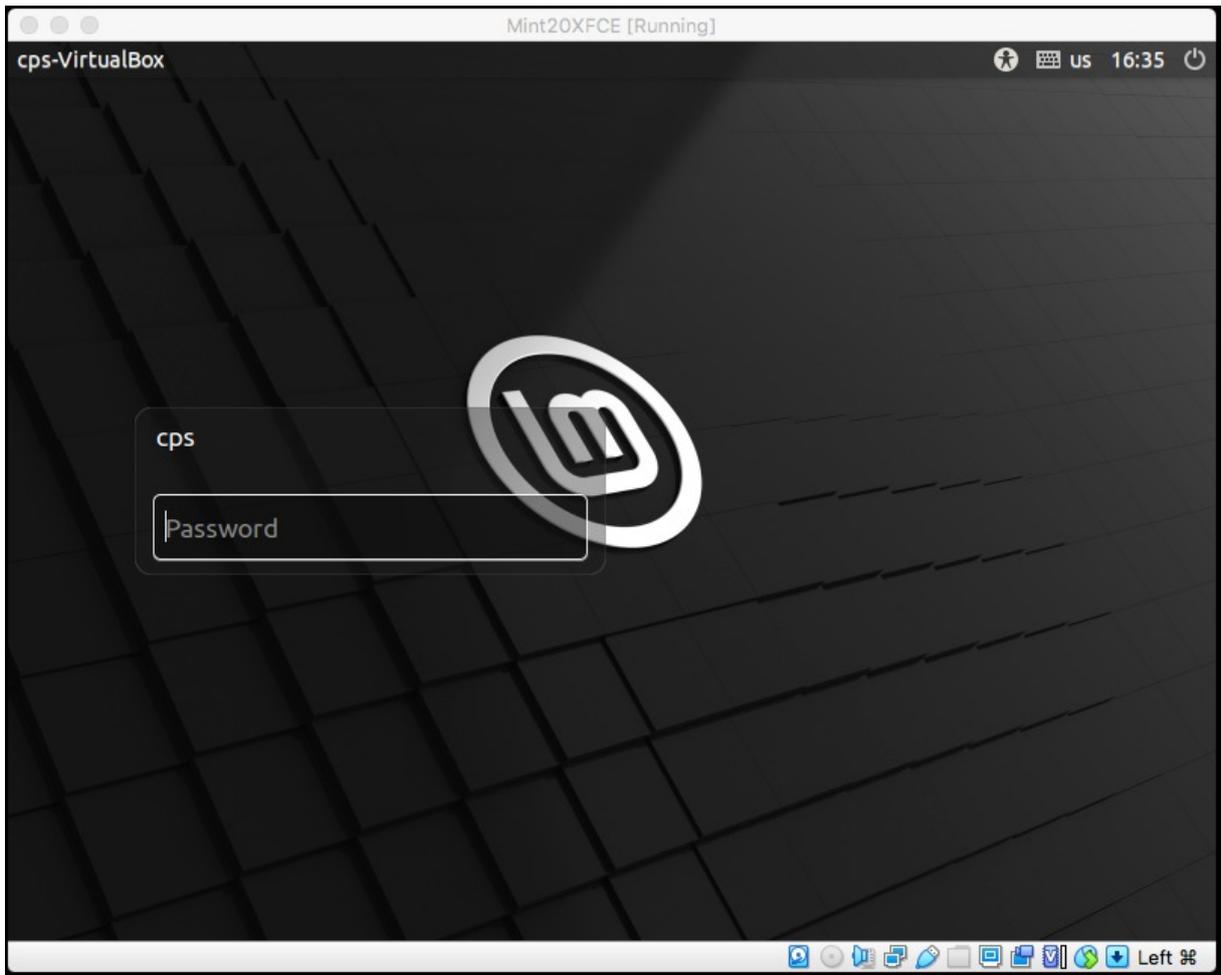"quit" and then on the next window "Shut Down."

Figure 2.13. Login window

Step 11. You will now see the   Virtual Box GUI   as in Figure 2.7. With the Mint20XFCE highlighted, click on **Settings**. We will fine tune the system. You are now presented with Figure 2.14. I will indicate what changes to make and show you the results of some.
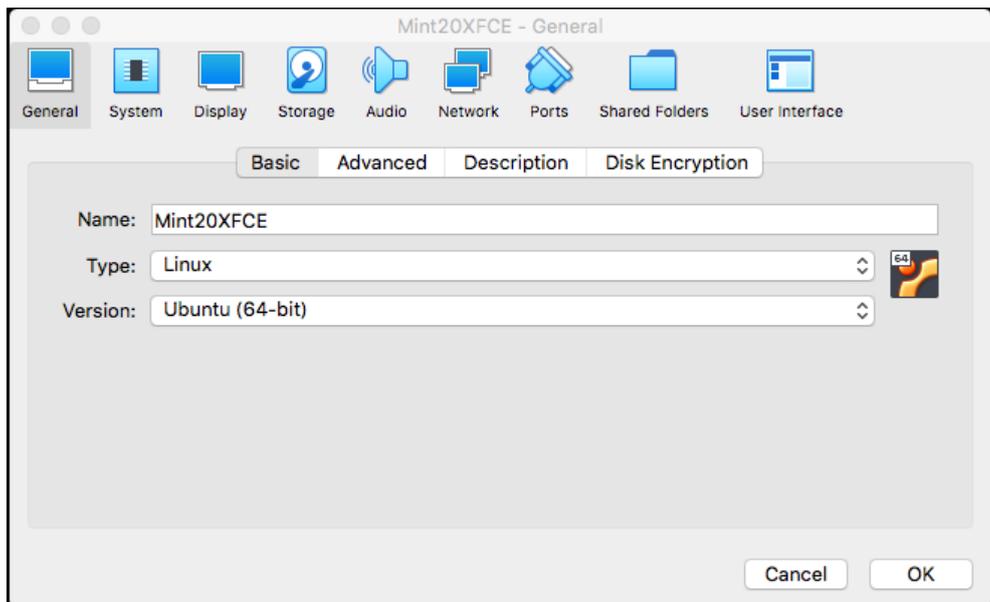
Figure 2.14. Settings for Mint20XFCE

The initial screen is "**General**"

General → Advanced: On the pull down menus set

Shared Clipboard: **Bidirectional**

Drag,n,Drop: **Bidirectional**

(this will permit you to cut and paste from displays on the host to this LINUX system)

System → Motherboard: **Uncheck** "Floppy" and "Optical" This is the boot selection.

Pointing Device: USB Tablet or PS/2 mouse will enable you to use you mouse on LINUX

My system had 8192 GB of memory so I can assign more to this virtual machine using the slider.

System → Processor:

My system has multiple threads on the CPU so I could assign more. I will leave it at 1 CPU. I will not enable any extended features.

System → Acceleration: Use the default

Display → Screen: Graphics controller is **VMSVGA**. Do not enable acceleration. You may increase the video memory but do not use all of it.

Shared Folders: This means that you will be able to transfer files between the LINUX virtual machine and your host computer. Click on the green "**plus**" sign. It will ask for a folder path. Use the pull down menu and click on "**Other**" This will open a file page of your login directory on the host machine. On this Mac it is /*Users/rbh* Click on "**Open**" **Select Auto-Mount** and then **OK**. This is shown in Figure 2.15 Finally click **OK**
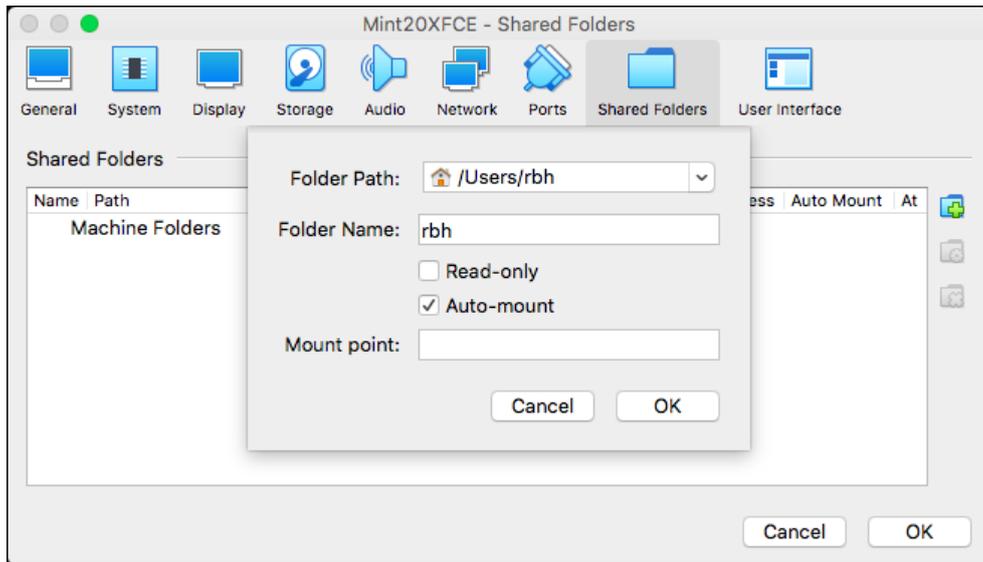
Figure 2.15. Selection for shared folder on host

You are now returned to the main menu.

With the Mint20XFCE highlighted, "**Start**" and login as **cps** with password **cps**, or the login name and password that you selected in Figure 2.10.

2.2.3 Linux Mint

Login as cps with password cps

We must install the VirtualBox Extension Pack that was downloaded earlier. The Extension Pack will permit access to the host computer file system, resizing of the Mint window, and cut/paste between applications on Mint and those on the host.

On my Mac there is a top banner associated with the VirtualBox machine that is running. Under "**Devices**" select "**Insert Guest Additions CD image** " In the terminal window, do a

"df -H" and you will see something like /media/cps/Vbox_GAs_6.1.12

In the terminal window enter the command

> **cd /media/cps/Vbox_GAs_6.1.12**

and then

> **sudo sh ./VBoxLinuxAdditions.run**

You will be asked for the cps password which is cps

This modifies the LINUX operating system kernel to support the extensions.

Next

> **sudo xedit /etc/group**

Find the line vboxsf×999: and change it to vboxsf×999:cps

Then from the menu at the top "**Save**" and then "**Quit**"

This operation now gives the user **cps** permission to use the extensions.

Now from the Mint menu at the bottom left, click on the Mint symbol to open the menu, and at the top click on the Sign off menu and select shutdown or reboot. If you enter shutdown then you are at the VirtualBox menu and you can **Start**. In both cases the Mint will reboot and you will see the login window of Figure 2.13.

Sign on to LINUX

Open a terminal window. Enter the command "**df -H**" This tells you disk storage space. The result is

```
cps@cps-VirtualBox:~$ df -H
Filesystem       Size  Used Avail Use% Mounted on
udev             468M     0  468M   0% /dev
tmpfs            103M  1.2M  102M   2% /run
/dev/sda5         17G  7.4G  8.7G  46% /
tmpfs            515M     0  515M   0% /dev/shm
tmpfs            5.3M  4.1k  5.3M   1% /run/lock
tmpfs            515M     0  515M   0% /sys/fs/cgroup
/dev/sda1        536M  4.1k  536M   1% /boot/efi
rbh              500G  434G   66G  87% /media/sf_rbh
tmpfs            103M   13k  103M   1% /run/user/1000
```

First the / directory, e.g., LINUX, has a maximum of 17GB and only 7.4GB are used. you thus have space to work and install software.

Also the `/media/sf_rbh` is the shared mount. You can transfer and use files on the host computer. note the name sf_rbh represents "shared file" for user "rbh" on the host. If you do something like

ls /media/sf_rbh

you will see all of the files in that part of the host file system.

2.2.4 Fine tuning LINUX

To install Computer Programs in Seismology we need additional software.

So **click** the Linux Mint button at the bottom left.

We need additional software. On Mint we could use

Mint → System → Software Manager   or

Mint → System → Synaptic Package Manager

The second   method would apply to Ubuntu distributions also. We could also get the required software using the command line, and run the following commands:

```
sudo apt-get install gcc
sudo apt-get install gfortran
sudo apt-get install xorg-dev
sudo apt-get install libncurses5-dev
sudo apt-get install gawk
sudo apt-get install gv
sudo apt-get install imagemagick
```

ImageMagick (https://imagemagick.org/script/index.php) will be used to convert EPS to PNG or other image formats, However we need to change one file. As superuser edit a control file for ImageMagick

sudo edit /etc/ImageMagick-6/policy.xml t

o change the lines

```
<policy domain="coder" rights="none" pattern="PS" />
<policy domain="coder" rights="none" pattern="PS2" />
<policy domain="coder" rights="none" pattern="PS3" />
<policy domain="coder" rights="none" pattern="EPS" />
<policy domain="coder" rights="none" pattern="PDF" />
```

to

```
<policy domain="coder" rights="read|write" pattern="PS" />
<policy domain="coder" rights="read|write" pattern="PS2" />
<policy domain="coder" rights="read|write" pattern="PS3" />
<policy domain="coder" rights="read|write" pattern="EPS" />
<policy domain="coder" rights="read|write" pattern="PDF" />
```

2.2.5 Install CPS

Download CPS from the location given in the Introduction.

Place is in the login directory, e.g.,   /home/cps

Unpack it

```
gunzip -c NP330.Dec31-2019.tgz |tar xf -
cd PROGRAMS.330
./Setup LINUX6440
./C > C.txt 2>&1
```

The C.txt has all of the output of the compile. If there is a problem, send me that file so that I can determine what is not working.

The next thing to do is to modify the PATH variable so that you can execute the command from whereever you are in the file system. When you enter a command at the terminal, the system looks at every directory in the PATH to find that program and uses the first one that it finds.

The PATH is set in the .profile file in the login directory. Here that name of the file is

```
/home/cps/.profile
```

Using any editor (Mint → Accessories → Text Editor for example) add the following to the end of the .profile :

```
OPATH=$PATH
PATH=:.:PROGRAMS.330/bin:$PATH
```
To test
```
echo $PATH
```

```
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/
games:/usr/local/games
```

You will see that nothing changed. This is because the new values will take effect at your next **login** or when you force it with the command

```
source ~/.profile
echo $PATH
```

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```
.:.:PROGRAMS.330/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/
bin:/sbin:/bin:/usr/games:/usr/local/games
```

The :.: means to look in the current directory for executables. This is useful when you do work. It is also good to

```
mkdir ~/bin
source ~/.profile
echo $PATH
```

```
.:.:PROGRAMS.330/bin:/home/cps/bin::.:PROGRAMS.330/bin:/usr/local/s
bin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/
local/games
```
Note that the PATH was changed to look into your personal bin directory, where you may put other codes, such at tau-p

As a quick test of everything

```
cps@cps-VirtualBox:~$ cd
cps@cps-VirtualBox:~$ gsac
GSAC - Computer Programs in Seismology [V1.1.52 28 JAN 2020]
      Copyright 2004-2019 R. B. Herrmann
GSAC> fg imp delta 0.05 npts 512
imp delta 0.05 npts 512
FUNCGEN: creating synthetic with DELTA = 0.050000 and NPTS =
512
GSAC> w imp.sac
imp.sac
GSAC> r imp.sac
imp.sac
GSAC> bp c 1 2 n 2
BP: corners fl 1.000000 fh 2.000000 npoles 2 pass 1
Butterworth
GSAC> p


PROGRAMS.330/bin/calxvig


>>> XviG Graphics Package   Copyright Imec (c) 1993 <<<

Executing: PROGRAMS.330/bin/calxvig
calxvig: Allocated all 35 CALPLOT colors
Initializing Interactive Graphics
Hold is OFF
XLIM is turned off
GSAC> q
```

You will see a plot of a band pass filtered impulse. Everything works.

2.2.6 Further tuning

Note many of the commands are specific to the Mint20 XFCE distribution. However other distributions will have similar functions.

Updates: Keep the operating system update as follows.

Mint Button → System → Update Manager

     Initially it asks to install a new version of the Update Manager "Apply the Update" It will ask for the password which is "cps". When this is done, you will see a long list of codes to update. Click on the "Install Updates". If the kernel is updated you may have to reboot.

If you have a modern monitor that supports HDPI you will not like the screen since everything will be too small. Do a Google search "LINUX XFCE HDPI for hints." This will point you to instructions like

     Xfce supports HiDPI scaling which can be enabled using the settings manager:

     1.Go to *Settings Manager > Appearance > Settings > Window Scaling* and select 2 as the scaling factor.
     2.Go to *Settings Manager > Window Manager > Style* and select `Default-xhdpi` theme.

The VirtualBox Extensions permit the following:

Access to the file system of the host. This can be used to storing files, or for printing a document on the host system.

Copy and paste something on the host to something on LINUX Mint. Note that the Copy/Paste syntax on the terminals may differ.

Resizing the Mint20XFCE Window. By grabbing a corner with the mouse you can make the Mint window larger.

If you wander around the Mint menu → System you will find a link to load other software such as Octave which works like MATLAB and GMT for graphics.

2.2.7 Transferring the VDI

On my host machine, the VDI that was created is located at

/Users/rbh/VirtualBox Vms/Mint20XFCE as the file Mint20XFCE.vdi

You can upload this to a server, or place on a portable USB drive. To do this you must reformat the drive to the NTFS files system so that it can contain one large file. For ordinary use, there is no problem with placing many small files on the USB drive as long at they are not greater than 8GB, I believe. To do this on a Mac you may need special software. There is no problem on a Windows machine. So just do a search on "reformatting USB drive to NTFS"

One the drive is reformatted just copy the VDI to the drive. Most system will be able to read the file.

Before we start, the VirtualBox setup of Mint20XFCE on my host computer had the following file structure in my login (HOME) directory:

```
VirtualBox Vms
|--- Mint20XFCE
        | Logs/
        | --- Mint20XFCE.vbox
        | --- Mint20XFCE.vbox-prev
        | --- Mint20XFCE.vdi
```

I mention this since I want to place the Mint20XFCE.vdi in the same location on another host.

3. Installation of an existing VDI image

The advantage of the VDI image is that someone else ensured that everything that you need is installed. When the VDI is installed, just log in and then start working.

The installation steps are similar to those performed in Section 2, except that the LINUX system has been prepared with all of the required software. However the fine tuning of Settings for the new VDI will be similar to what was done above.

Step 1: Install VirtualBox if it has not been previously installed. Then start VirtualBox. You will see the images as in Figure 3.1

Figure 3.1. Initial VirtualBox display

Step 2: Click on **New.** You will be presented with Figure 3.2. Enter the same name as the VDI and also the operating system associated with that VDI, which is a 64 bit Ubuntu (Mint is derived from Ubuntu) distribution, to give Figure 3.3.
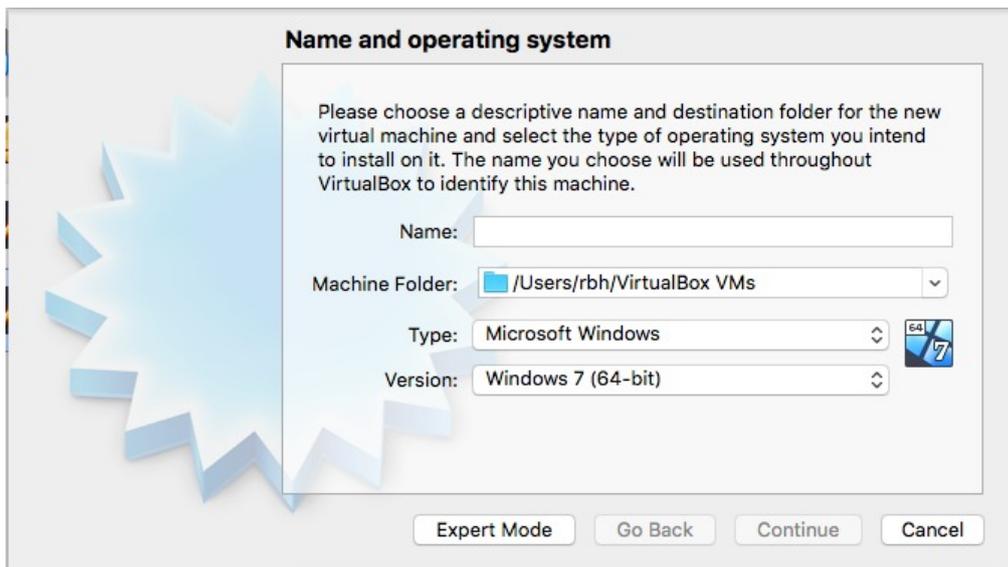
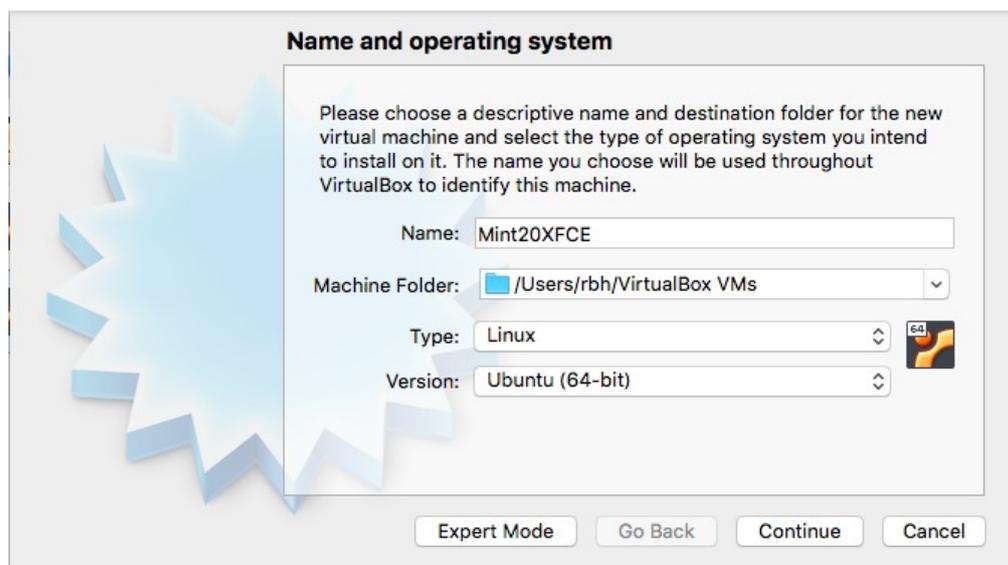Figure 3.2. Initial screen to define a New system

Figure 3.3. Name the new system

Continue

Step 3: Assign portion of host memory that this operating system will use (Figure 3.4). Then press **Continue.**
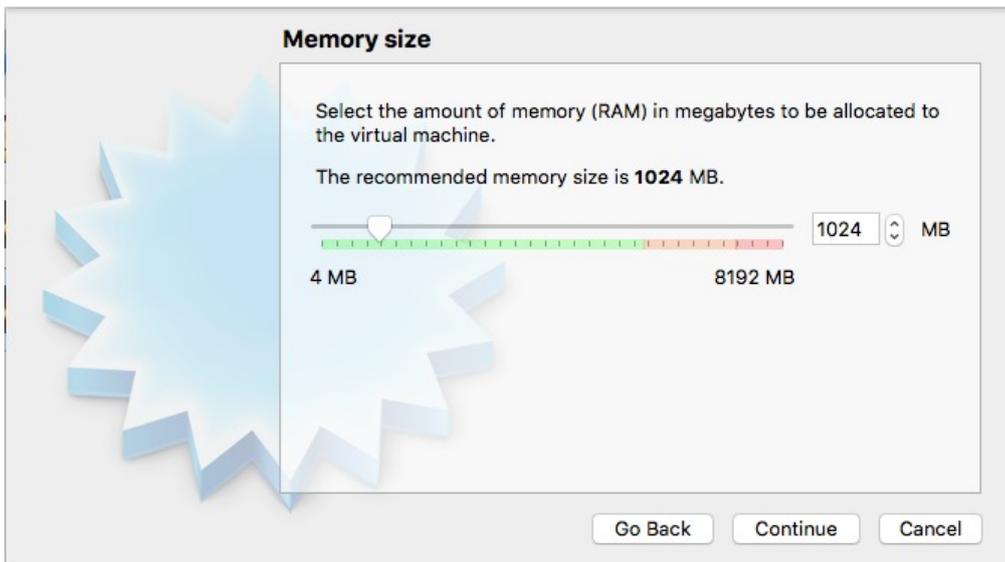
Figure 3.4. Select memory size. this can be changed later in the Settings

Step 4: This is where we select the VDI image. At this point the subdirectory Mint20XFCE has been created. To keep everything organized, I manually move the vdi image to this directory, e.g., if Mint20XFCE is in **VirtualBox Vms,** then I execute the command

　　　mv Mint20XFCE.vdi Mint20XFCE

The initial display for the Hard Disk is shown in Figure 3.5 and the display after selecting "Use an existing virtual hard disk file" and identifying that file is shown in Figure 3.6.

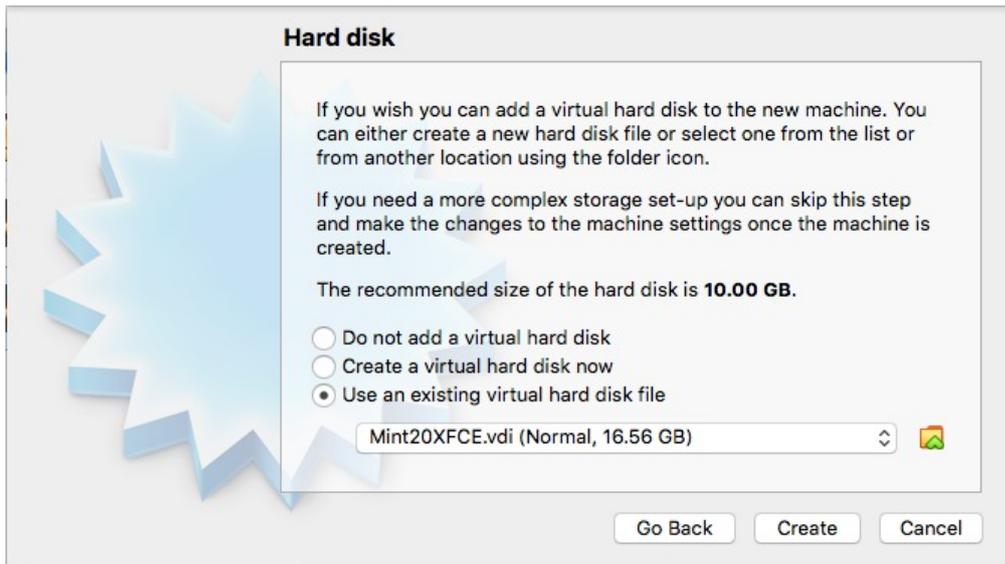

Figure 3.5. Initial page for selecting the disk

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Figure 3.6. Result after selecting the use of an existing VDI and locating it in the host file system.

Create

This will return you to the VirtualBox menu and will show that you have a system Mint20XFCE. (Figure 3.7).
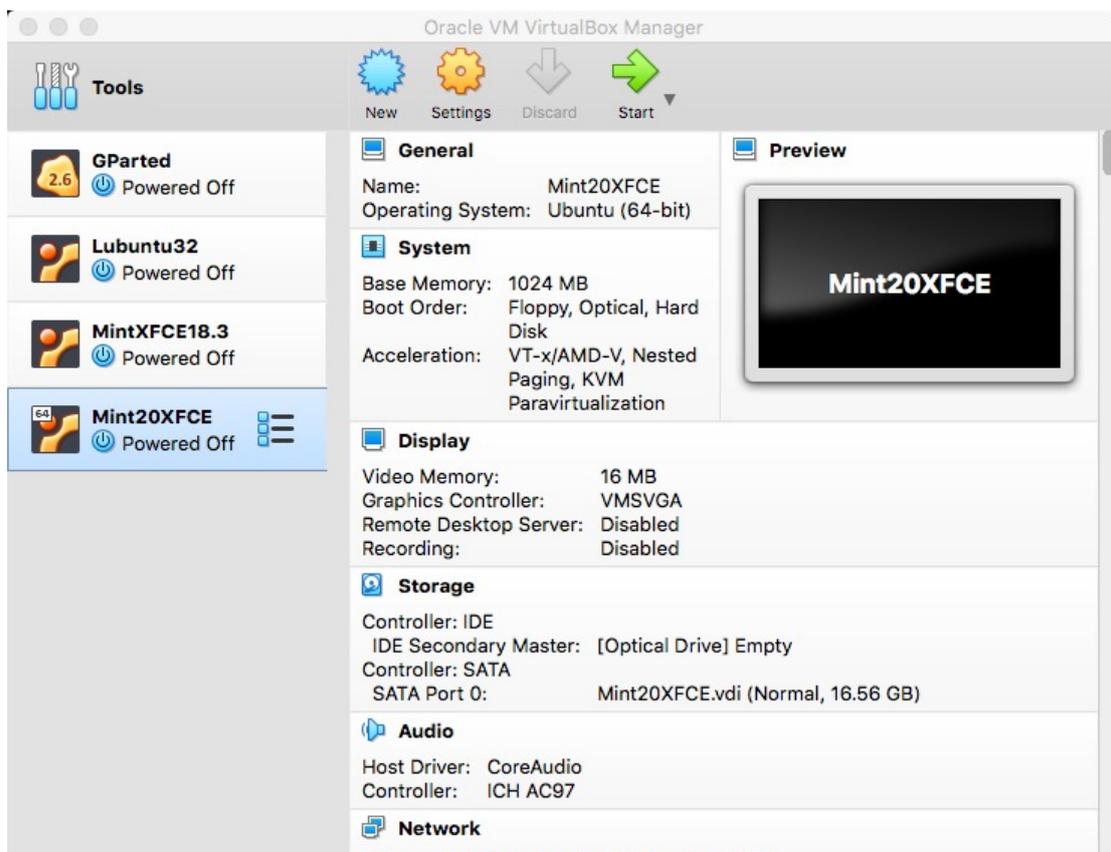

Figure 3.7. VirtualBox menu showing the Mint20XFCE system

Step 5: Before starting Mint20XFCE, click on **Settings**. This will give Figure 3.8.
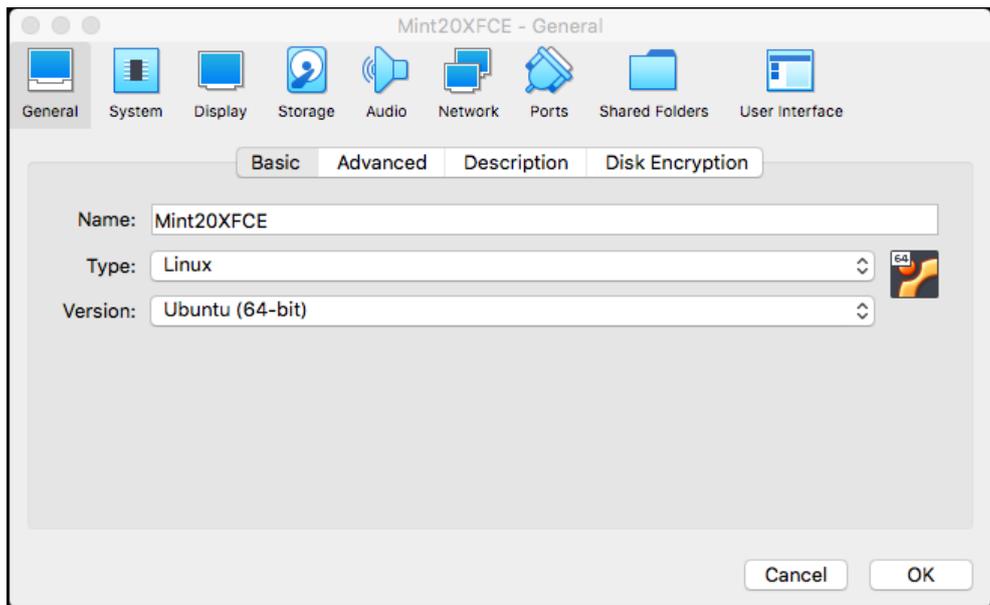

Figure 3.8. Settings for Mint20XFCE

As in Step 11 of Section 2.2.2, we want the following done. Rather than showing the individual GUI's, I will indicate the values to be set.

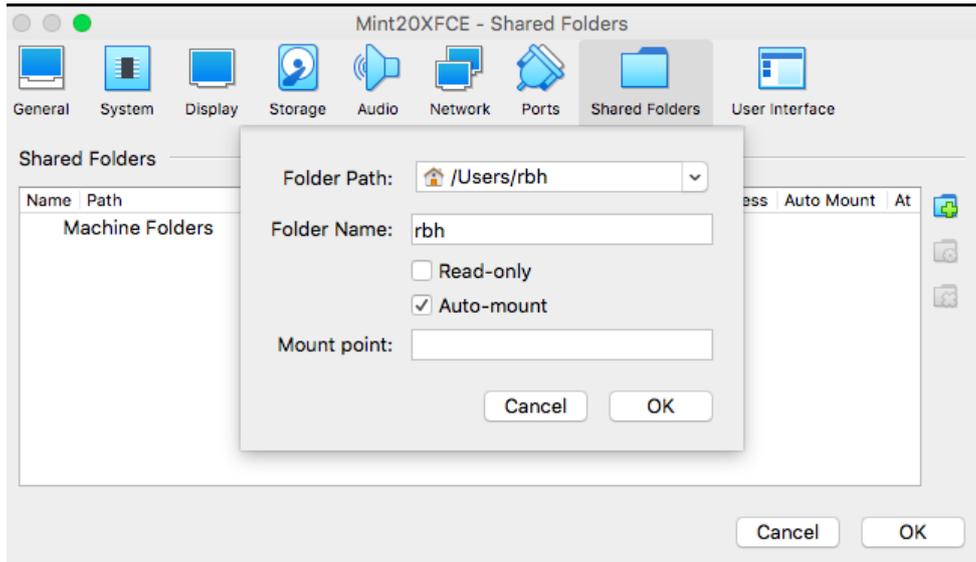|	
General → Basic	No change
General → Advanced	Make **Shared Clipboard:** *Bidirectional*
	Make **Drag'nDrop:** *Bidirectional*
General → Description	No change
General → Disk Encryption	Do not change
System → Motherboard	Uncheck Floppy and Optical for the **Boot Order:**
	Pointing Device: USB Tablet will work
	Use defaults for the rest
System → Processor	If you have more than one CPU and expect to do significant computations, you may use more than one CPU
	Do not change anything else.
System → Acceleration	Use the defaults.
Display -. Screen	You can increase video memory.
	Use **VMSVGA** for **Graphics Controller:**
	Do not enable 3D Acceleration – leave it blank
Storage	No change
Audio	No change
Network	No change. Adapter 1 is attached to NAT. It uses the network access of the host computers

Ports	Not needed. do not change
User Interface	Do not change
Shared Folders	This is as discussed above. the steps are **Click** on folder wth + sign This gives a menu to select the directory on the host. Click on **Auto-mount** The folder name will be the name of the folder on the host. The completed sub-menu is

Click **OK** to see the result

Click **OK**

Step 6: You will be returned to the VirtualBox menu. If necessary highlight the Mint20XFCE. On the right side of the window you will see all parameters set for that operating system including those you changed in Settings.

Step 7: Start

Mint20XFCE will start. Login and start working.

Step 8:

The although Mint20XFCE is running on a virtual computer, you must carefully shut down this system. If you do not this may corrupt the VDI image. Take as much care as with real hardware, where you would never turn off the power without first turning off the operating system,.

4. Simple tests for Computer Programs in Seismology