EE3305/ME3243
Robotic System Design
Installing Virtual Machine, Ubuntu 20.04 LTS and ROS1 Noetic

prepared by:

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Contents

1 Installing Virtual Machine: Oracle VirtualBox

When installed, a virtual machine runs an isolated operating system (OS) in a host OS.

1.1 What You Need

Existing OS	Windows 10 or 11, or Mac OSX (Some Mac laptops do not support virtual machines).
Min. free space	**30GB**
Min. CPU	2GHz 2-Core
Min. RAM	4GB
Min. screen	1024×768 resolution
Internet	So you can download extra packages while installing

1.2 Download .iso Ubuntu Image

Download Ubuntu 20.04.x Image. $x = 6$ at time of writing. Please download the **Desktop Image** from https://releases.ubuntu.com/20.04/. It is a 4GB .iso file.

1.3 Download and Install Oracle VirtualBox

1. Download VirtualBox from https://www.virtualbox.org/wiki/Downloads. Select either Windows hosts or OS X Hosts, depending on which existing OS you have. We recommend Windows.

2. Once downloaded, click Next or Yes to all and Install.

3. There may be a prompt from the host security to trust some device installations. Trust them.

4. When done, there should be a prompt or checkbox to start VirtualBox. Start it.

## 1.4 Create Ubuntu 20.04 Image in VirtualBox

1. Open VirtualBox and click `New`.

2. For `Name`, type in `Ubuntu 20.04 LTS`. For `ISO Image`, select the previously downloaded `.iso` Ubuntu image. Check `Skip Unattended Installation`. Click `Next`.
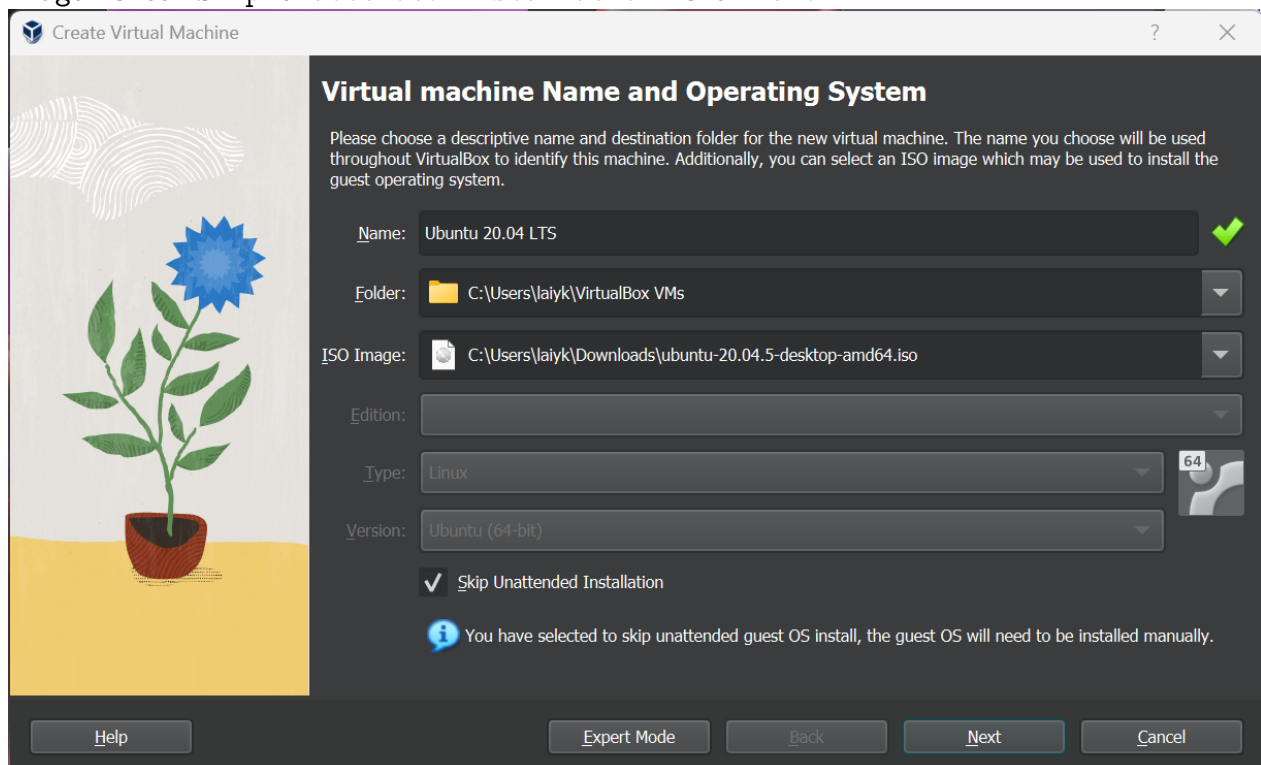
3. Give as much `Base Memory` as possible by sliding the slider to the rightmost edge of the green bar, **but not beyond it**. Please ensure there is at least 4GB (if not, use the lab computers instead). Do the same for `Processors`. **Do not check** `Enable EFI (special OSes only)` Click `Next`.
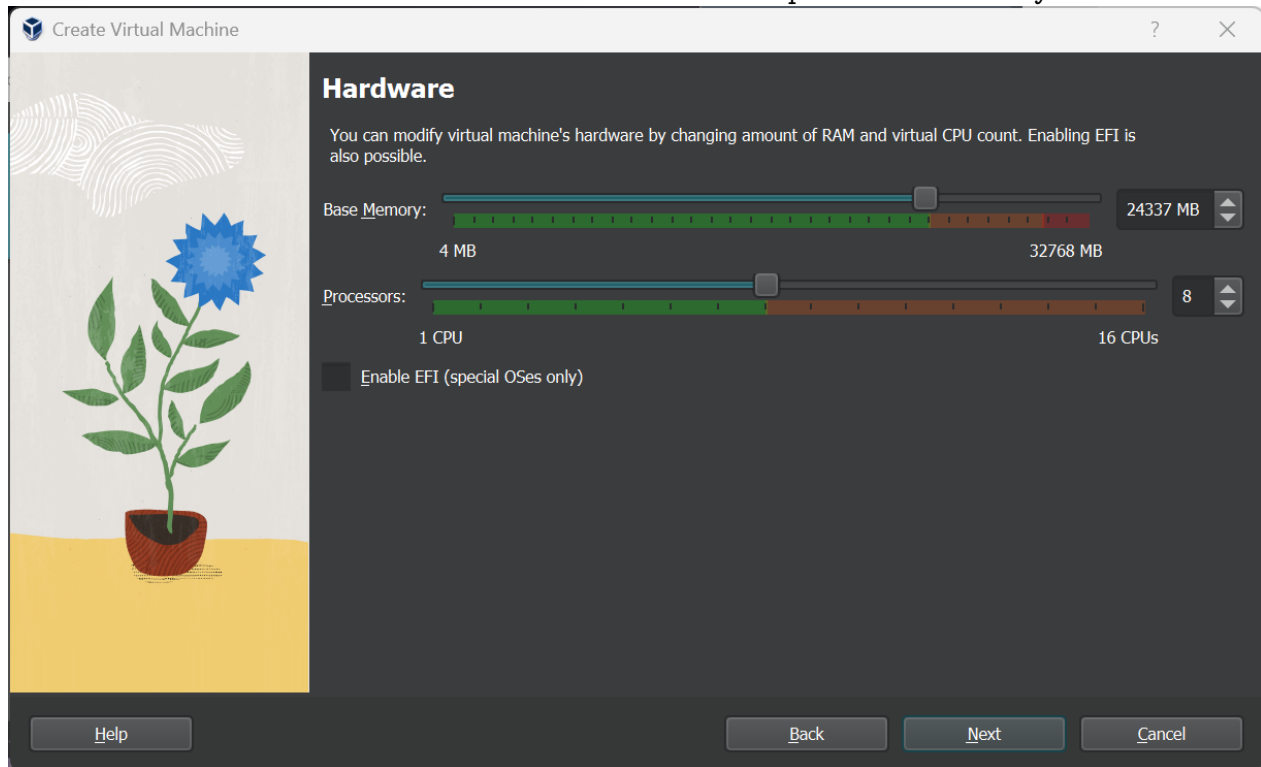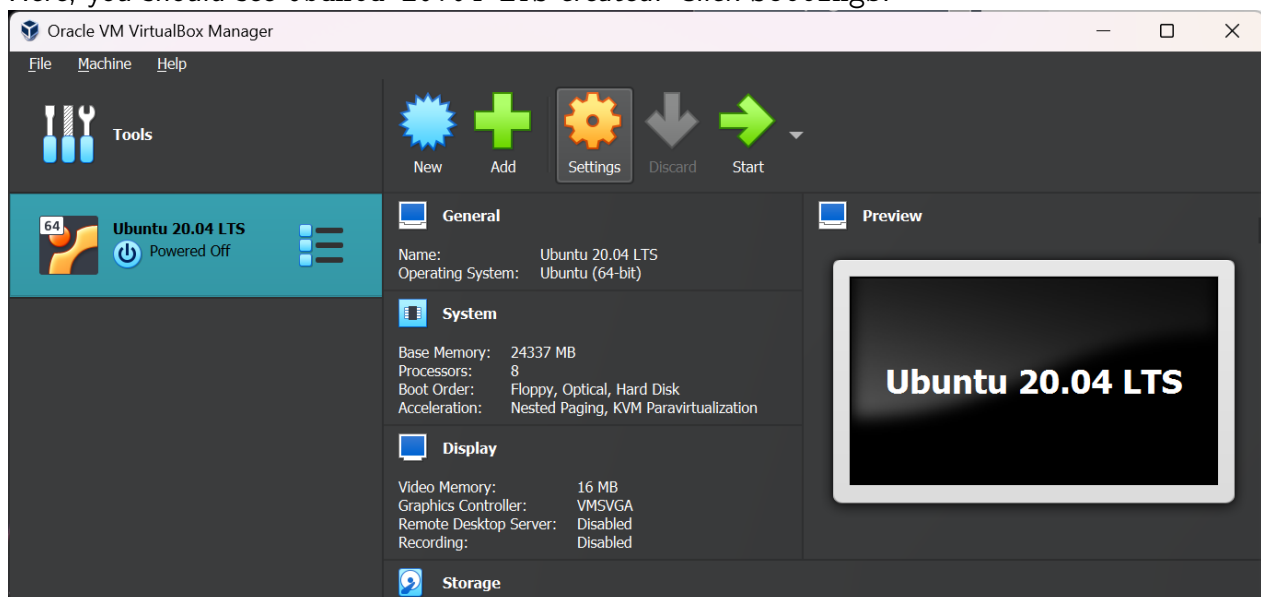

4. Check `Create a Virtual Disk Now`. Select at least 30GB (40GB preferred) of `Disk Size`. **Make sure all other options are unchecked**. Click `Next`.
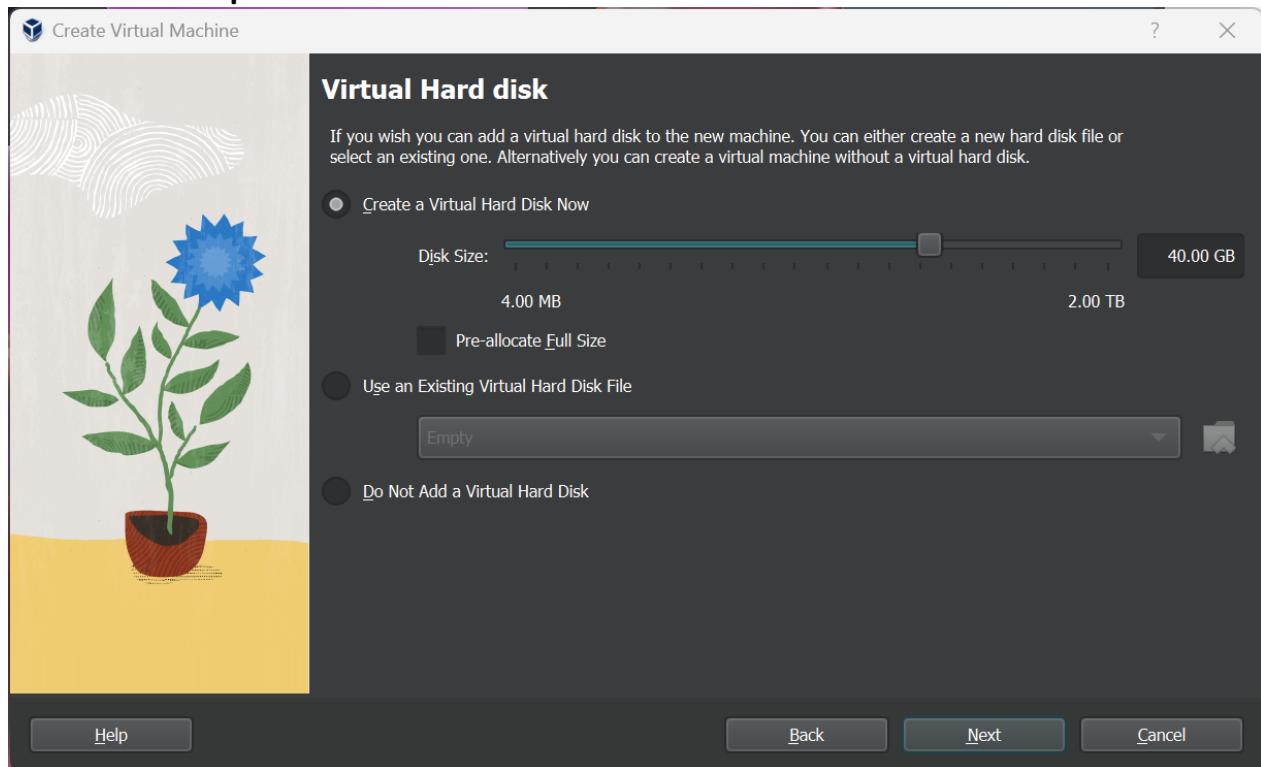
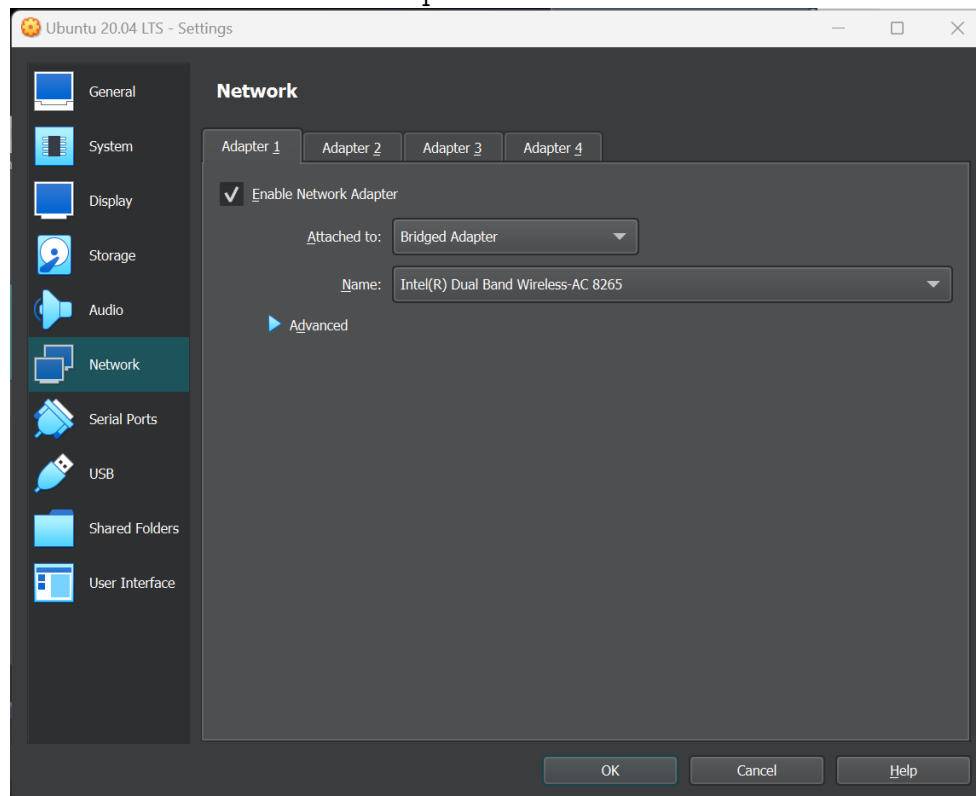5. You should then see a `Summary` page. Click `Finish` to go back to the VirtualBox manager.
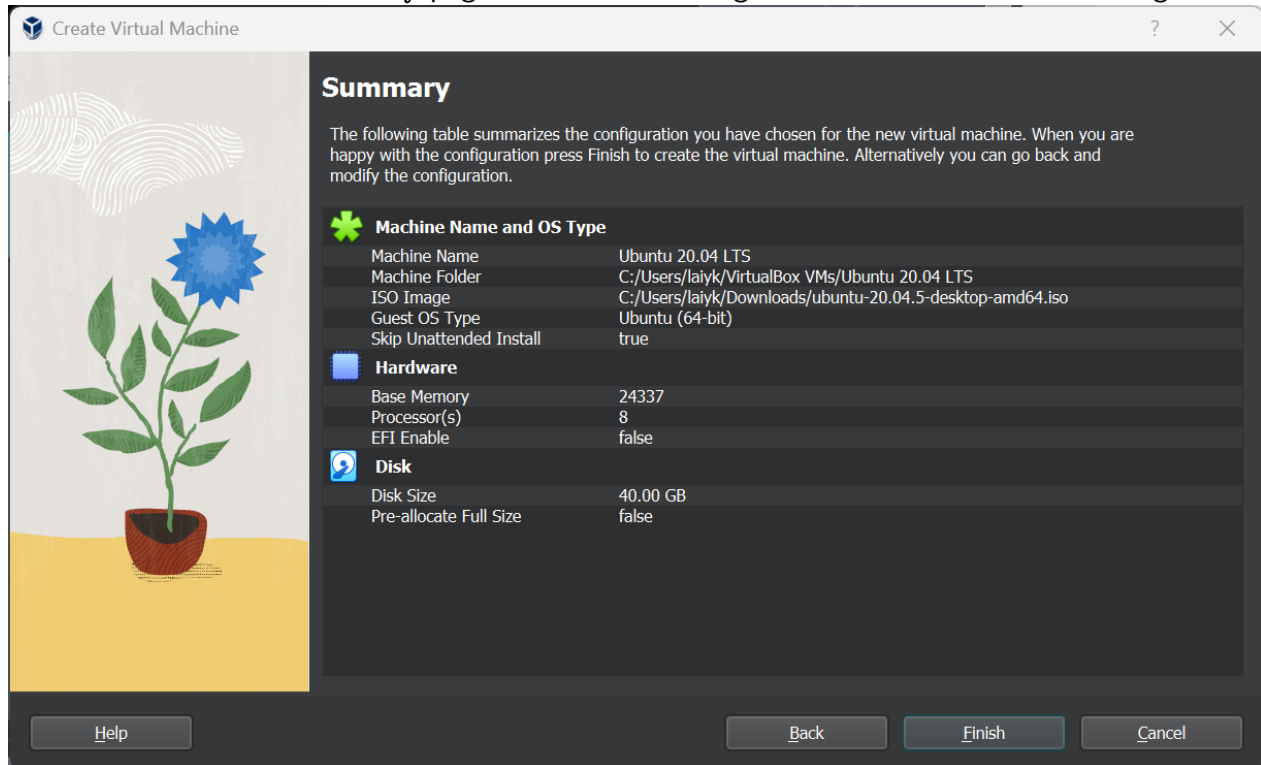
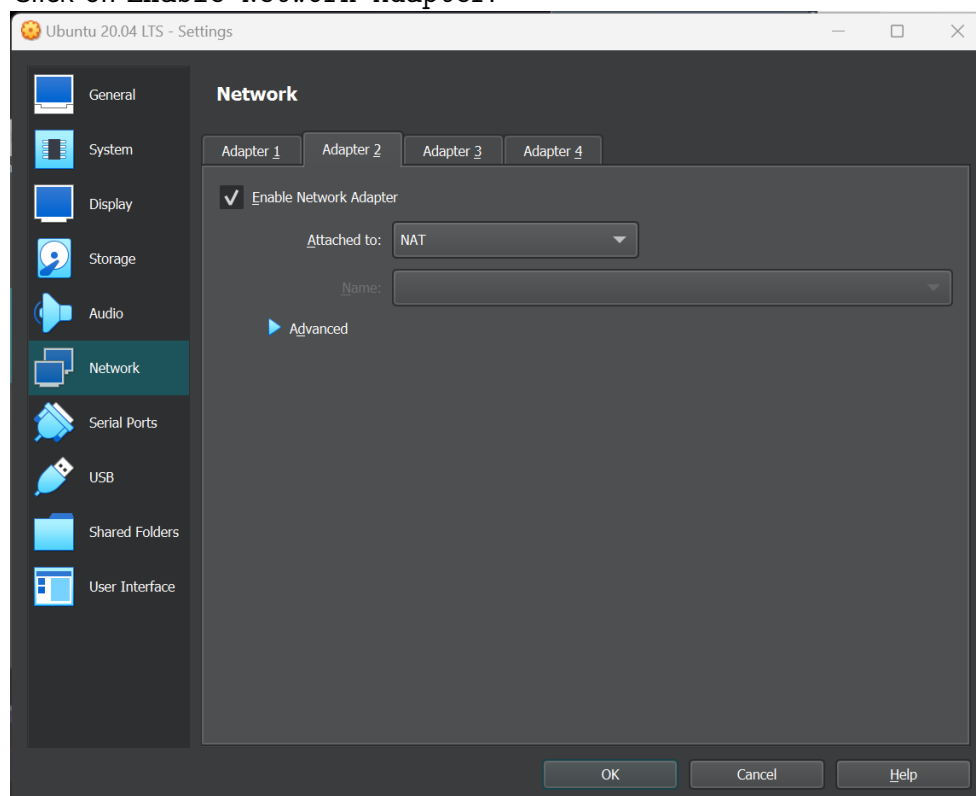6. Here, you should see `Ubuntu 20.04 LTS` created. Click `Settings`.

7. Wifi:

   a) **If you use own Wi-Fi**, go to `Network`, under `Adapter 1`. In `Attached to`, select `Bridged Adapter`. Click on `Enable Network Adapter`.
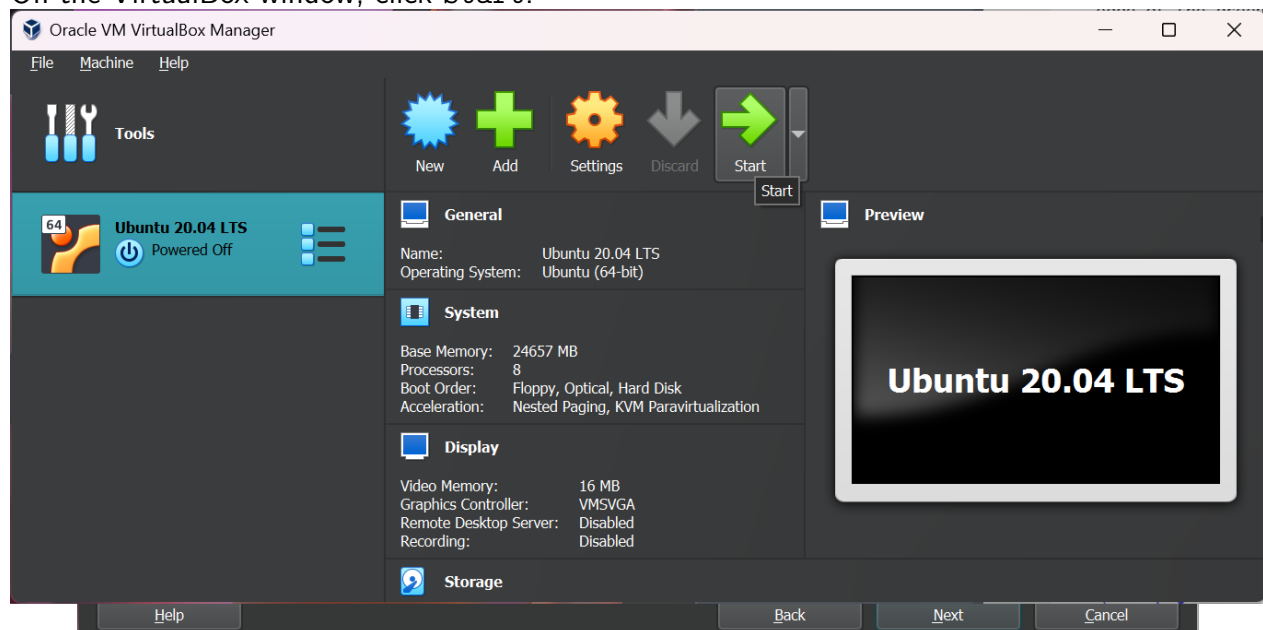

   b) **If you use NUS Wi-Fi** , go to `Network`, under `Adapter 2` and in `Attached to`, select `NAT`. Click on `Enable Network Adapter`.
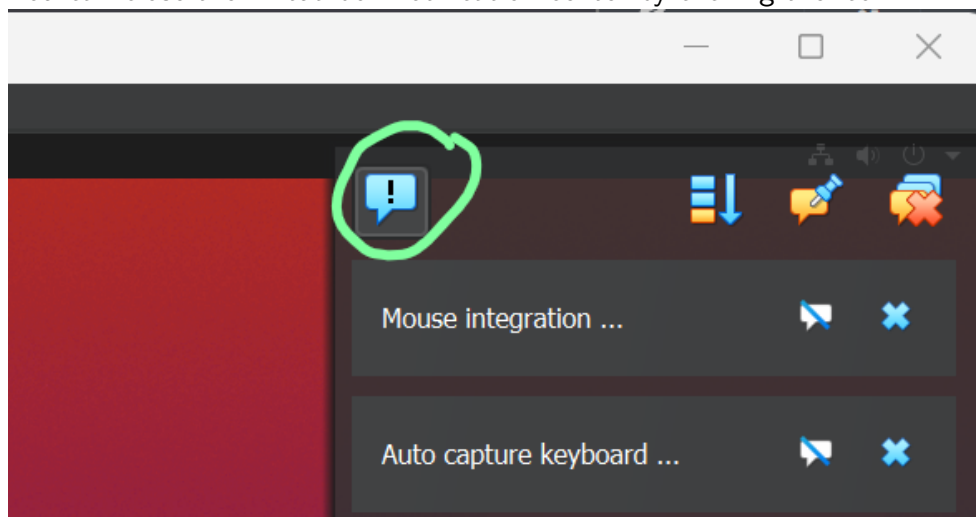

8. Click `OK` to accept the settings.

9. On the VirtualBox window, click Start.

10. You can close the Virtualbox notification center by clicking the icon

You should now be able to proceed to Sec. 2.

2 Installing Ubuntu 20.04

This section is adapted from
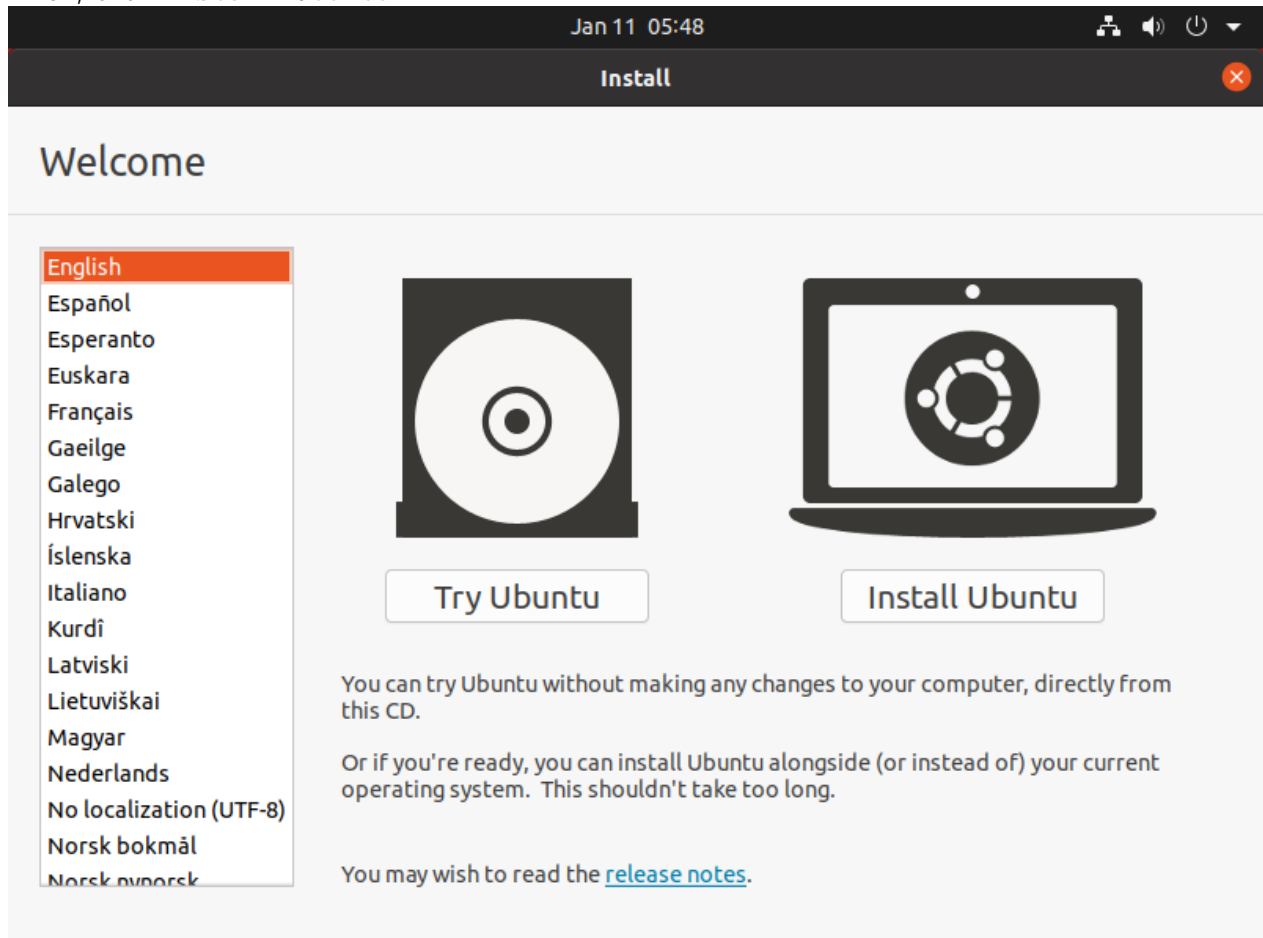https://ubuntu.com/tutorials/install-ubuntu-desktop#4-boot-from-usb-flash-drive
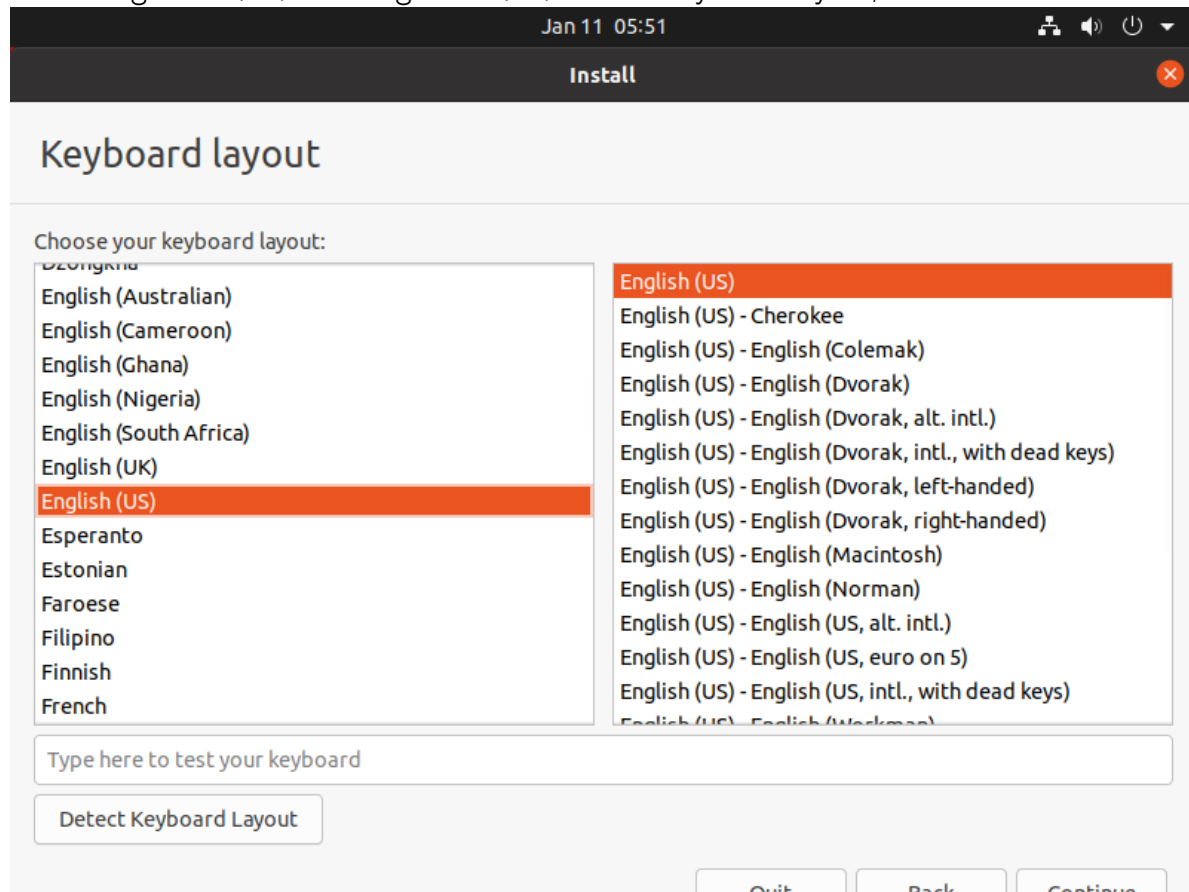
2.1 Installation

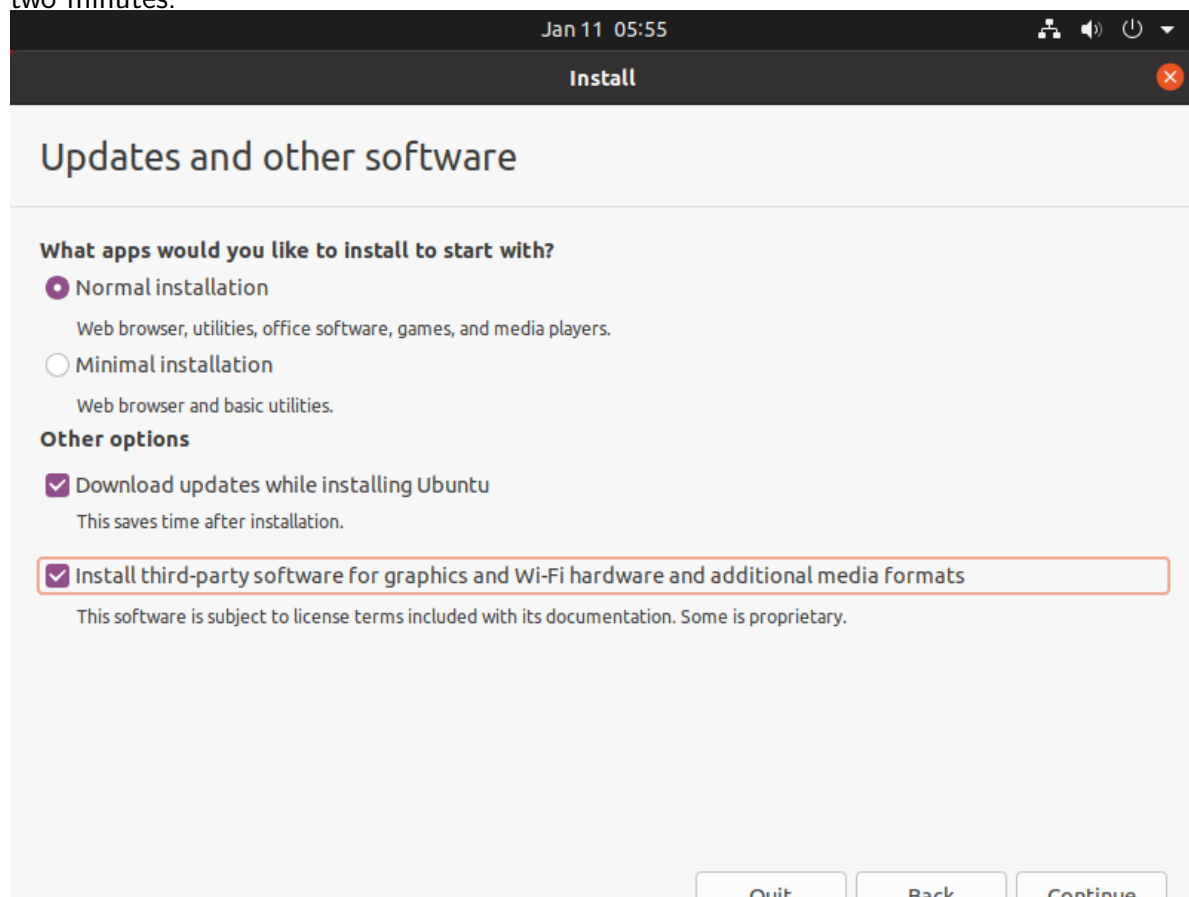1. You should first see a file check. Let it complete.
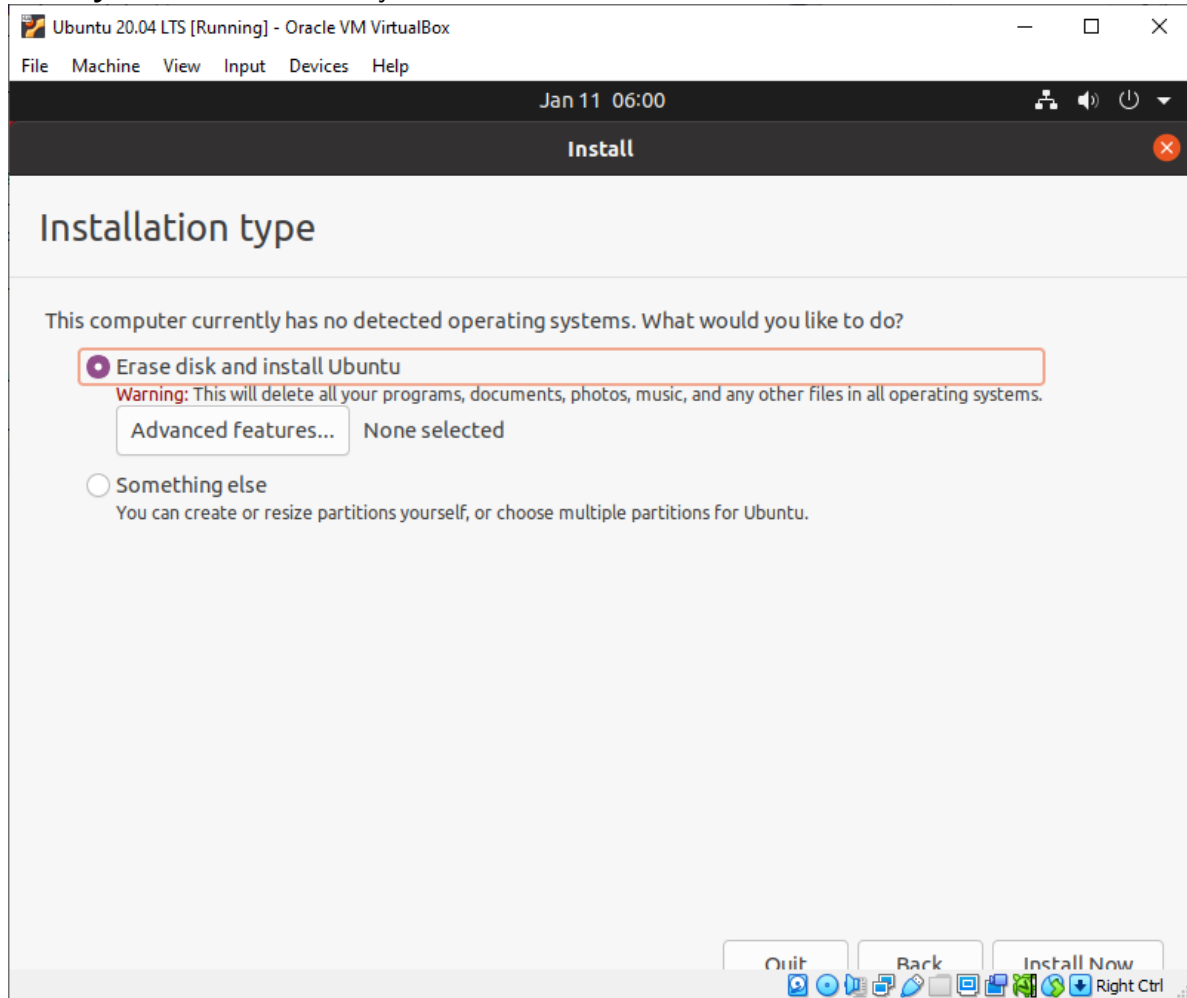

2. Then, click `Install Ubuntu`.

3. Select English (US) and English (US) for the keyboard layout, and click Continue.

4. Select Normal installation, and check both boxes below it. Click Continue and wait for one to two minutes.

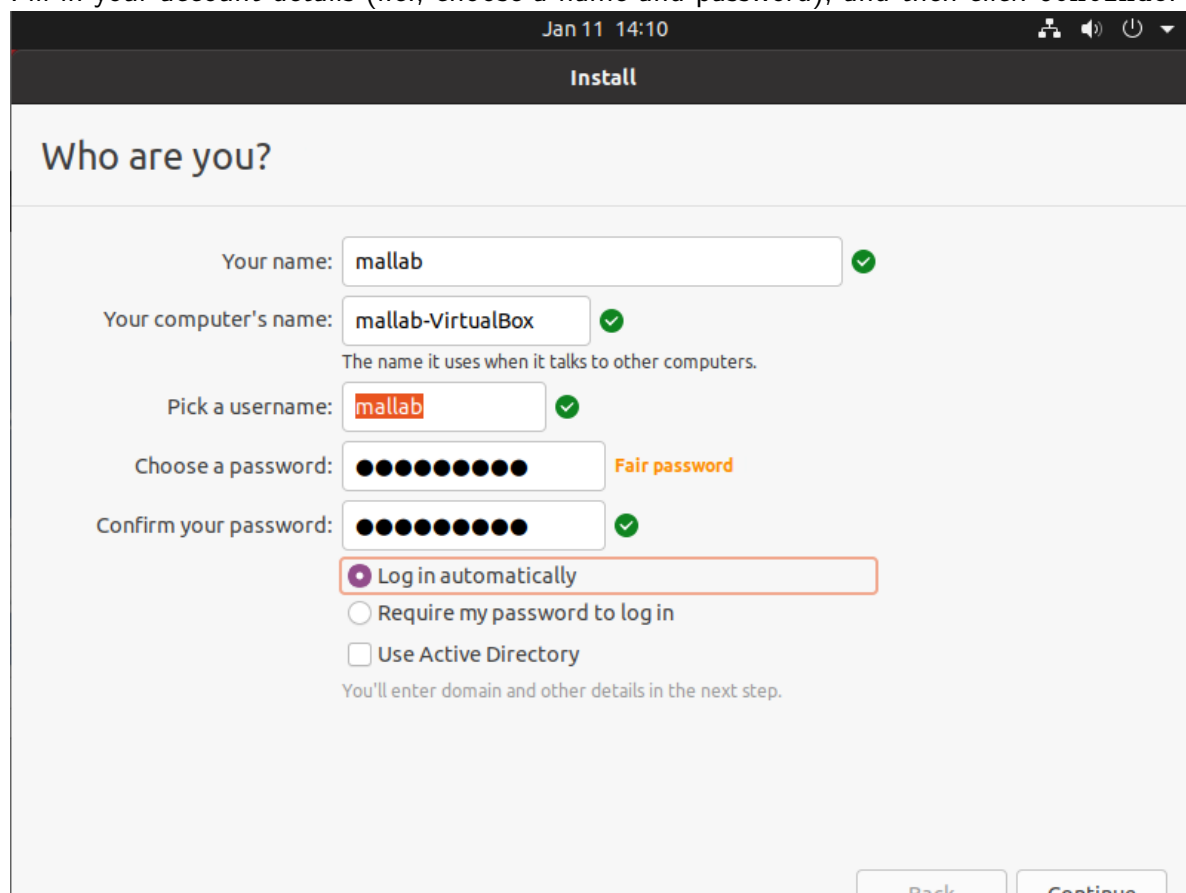5. **Since you use VirtualBox**, you should select `Erase disk and install Ubuntu`. Click `Install Now`.

6. A small window describing the partitions should appear. Click `Continue`.

7. Choose your location and click `Continue`.

8. Fill in your account details (i.e., choose a name and password), and then click `Continue`.

9. The installation should start. Wait for a few minutes.
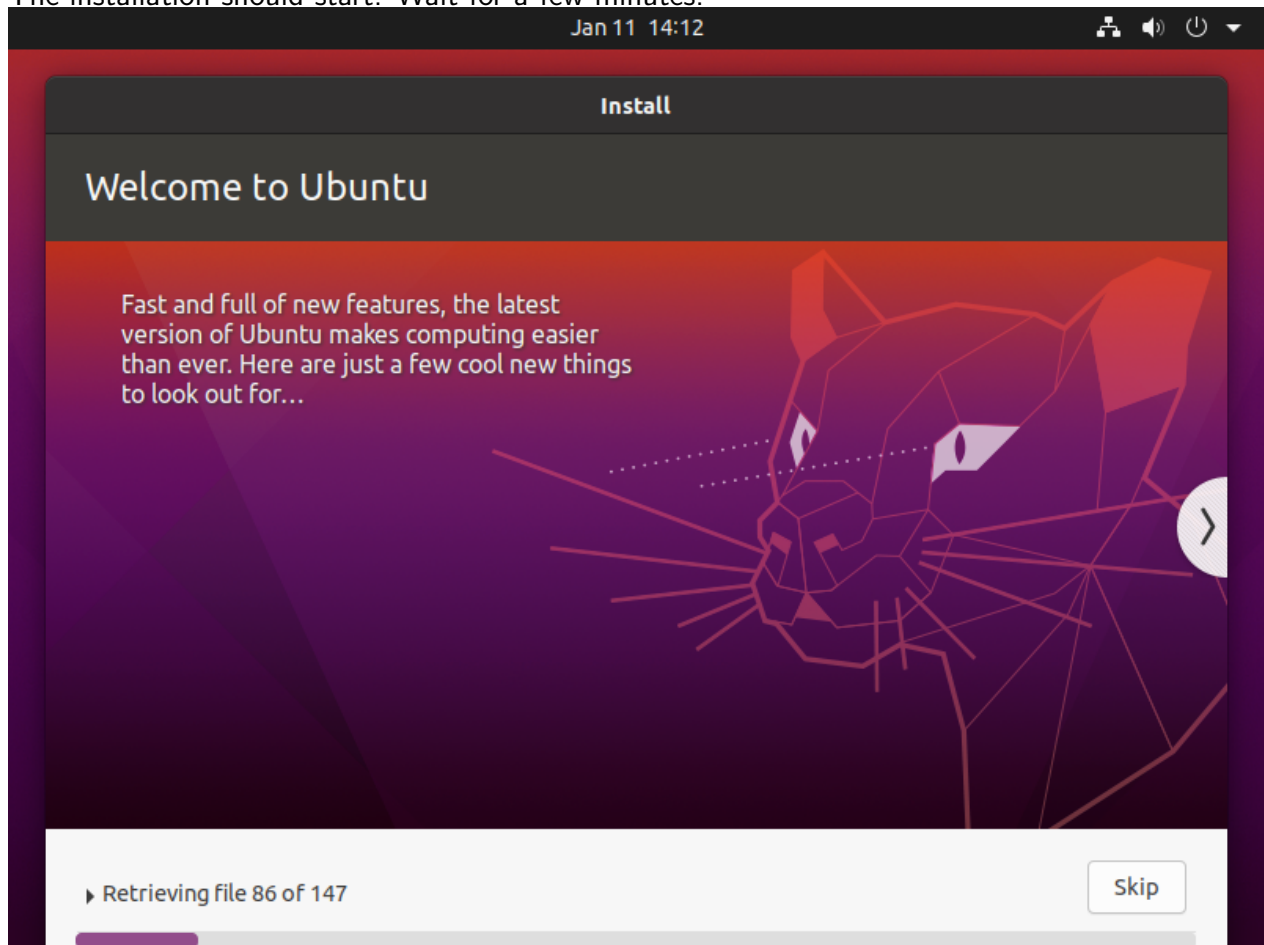
10. When the installation is complete, the dialog box should show. Click `Restart Now`.
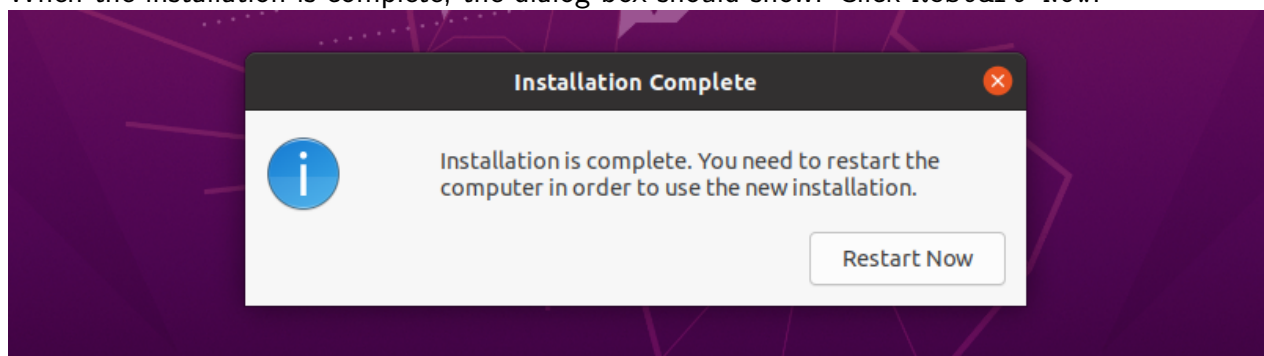
11. **Since you are using VirtualBox**, simply type `Enter` to continue.

2.2 Configuration for the First Time

You should see a welcome screen at startup. Look at the top right and select `Skip`, `Next`, `Next`, `Next` and finally `Done`.

2.2.1 Do not Upgrade to 22.04

A popup may prompt you to upgrade to Ubuntu **22.04** LTS. Do not upgrade.

2.2.2 Change Display Resolution

If your screen is very small, particularly for **VirtualBox** users, you can change the display resolution.

1. Click `Activities` and type `Displays`. Then, select `Displays`.
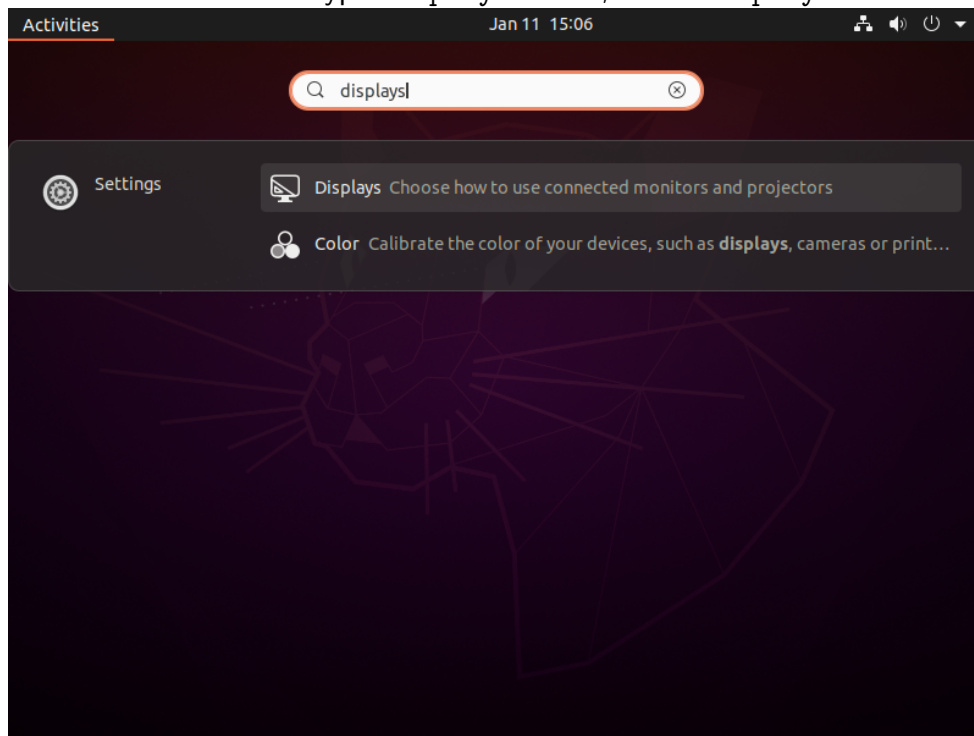
2. **For VirtualBox users**, change the resolution to 1440 × 900 or lower so that the icons become smaller and the display becomes clearer, and that the display fill as much space on the VirtualBox window without producing scrollbars.
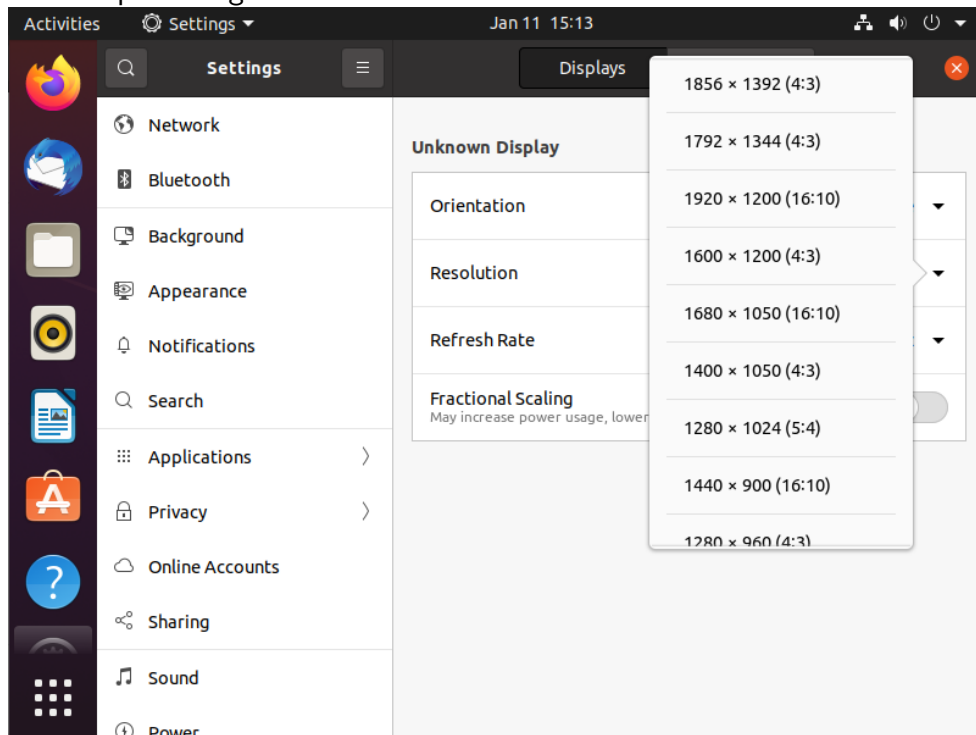
3. Click `Apply` on the top right hand corner.

2.2.3 Remove Icons from Favorites

The installation comes with some icons on the Favorites bar. You can remove them since you do not use them, freeing up space for other more important programs on the bar. Remove all icons except for *Firefox* and *Files*. Do so by right-clicking unwanted icons and selecting `Remove from favourites`
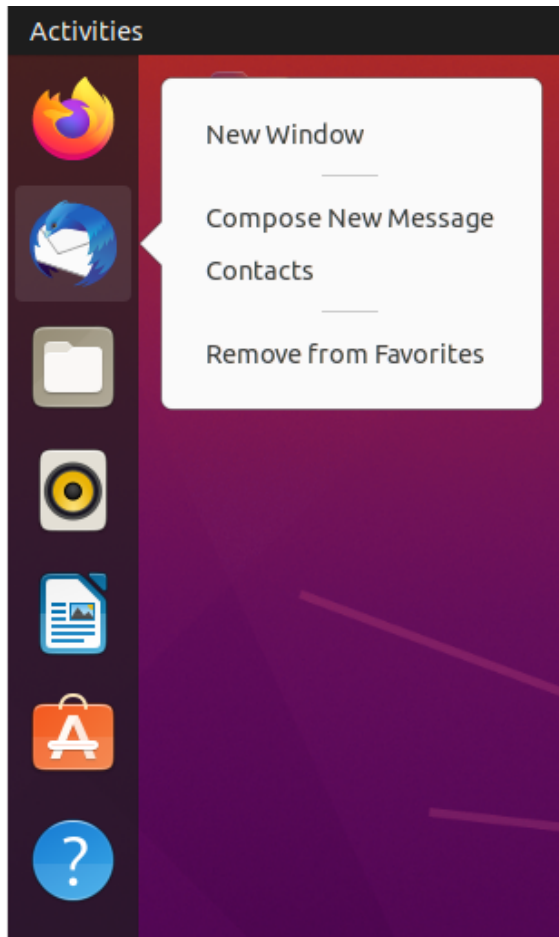
becomes

2.2.4 Change Blank Screen Timing

This is important if you do not want the log in screen to keep showing every 5 minutes of idling time. For example, if you want to run the program and observe the robot behaviour.
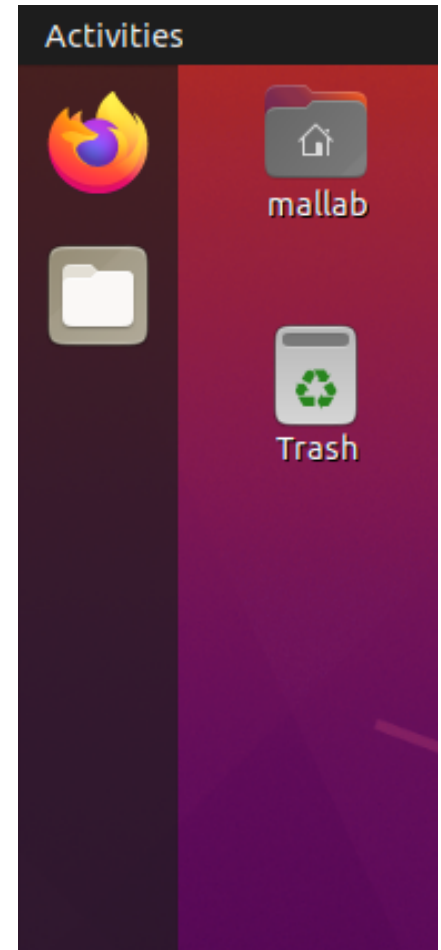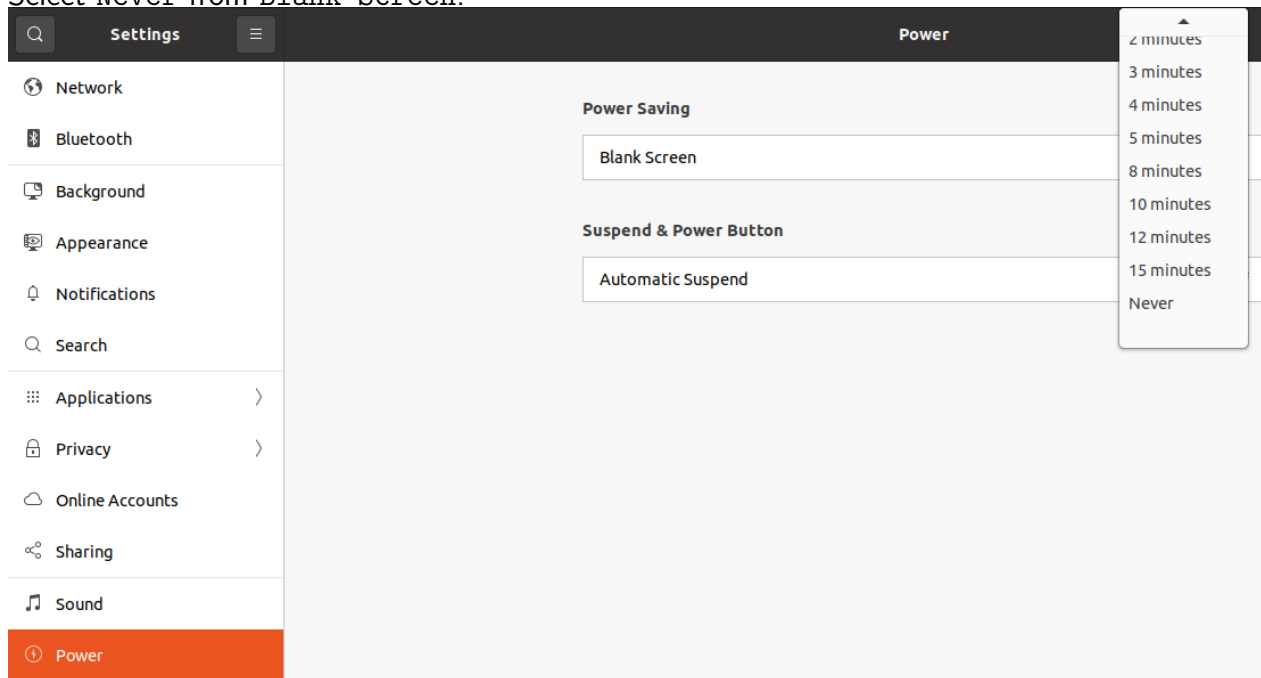
1. Click `Activities` and type `Power`. Then, select `Power`.

2. Select `Never` from `Blank Screen`.

2.2.5 About Software Updater

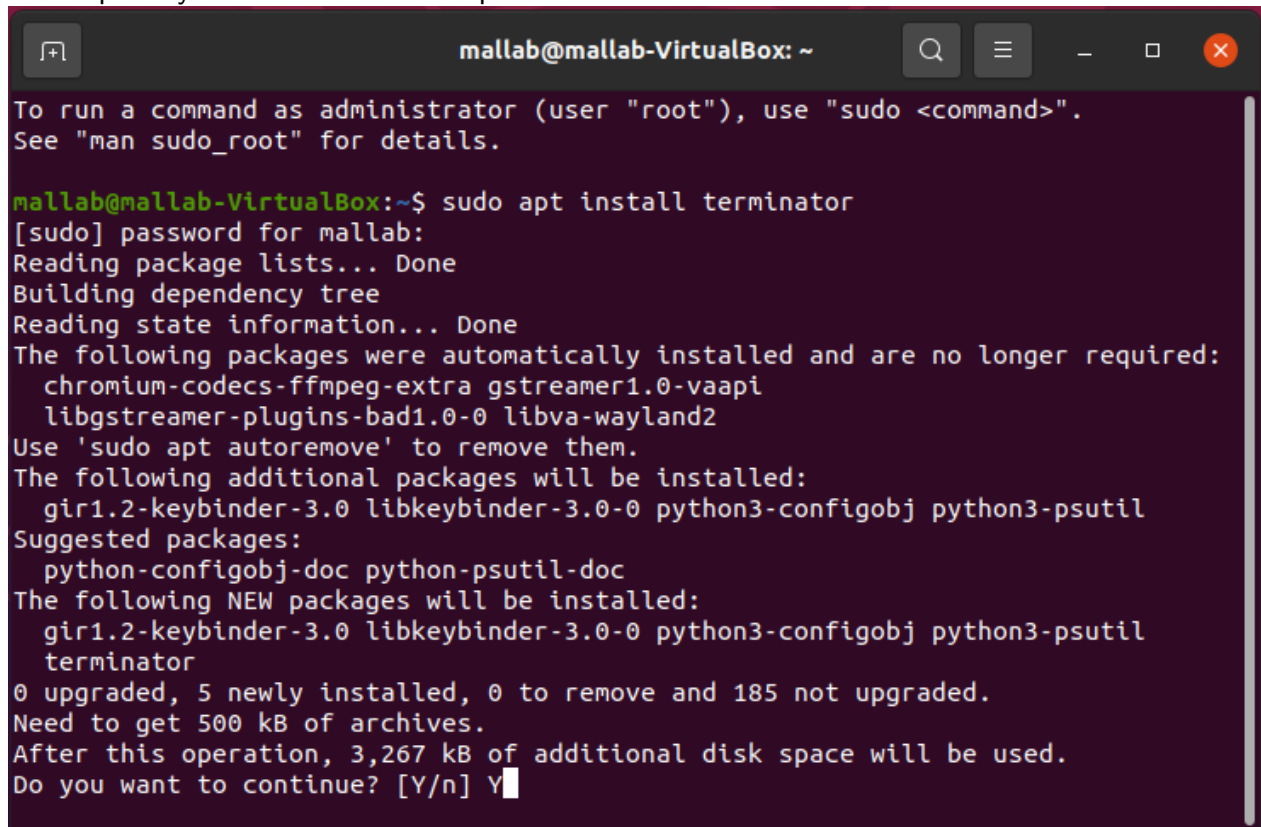If you see the dialog box, you can click `Remind Me Later`.

2.2.6 Install Terminator

Terminator allows you to open multiple terminals in one single window and manage their positions on screen. This streamlines the workflow.
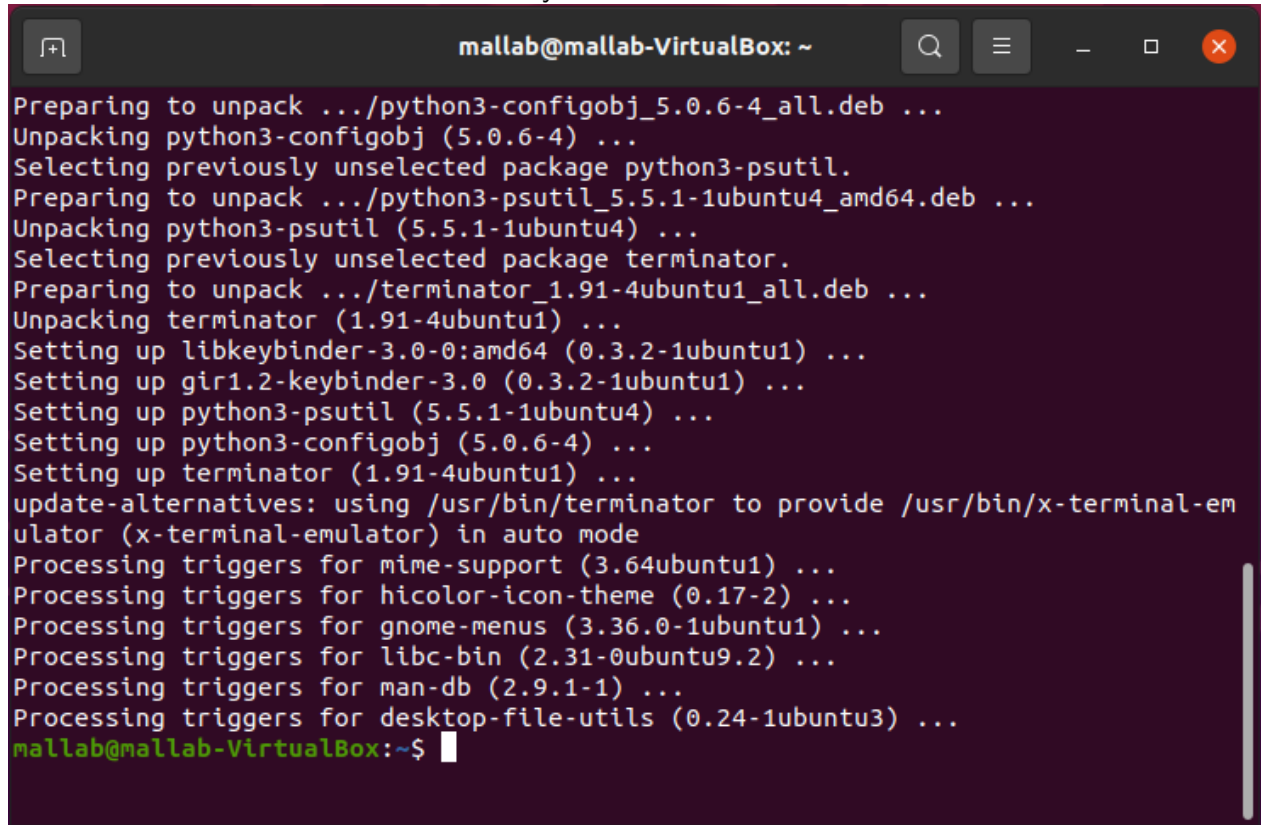
1. Make sure you are connected to the internet on the host OS – Windows or Mac OS X.

2. Use the key combination `Ctrl+Alt+T` to pull up the terminal.

3. Type the following to install Terminator

```
sudo apt install terminator
```

4. Type in the password for your account. Note that **no characters will show when you type the password**. Additionally, any commands with `sudo` will prompt you to key in your password every 15 minutes.

5. Once done, wait for a while and type `Y` to continue installation. Again, this prompt to continue will show up every 15 minutes for subsequent installations.
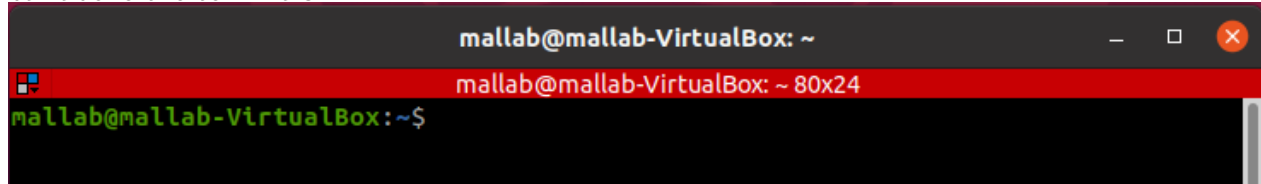
6. Once installed, the control will return to you:

7. You can now close the terminal. Using `Ctrl+Alt+T` will launch terminator from now on. It has a red bar above the terminals:

Some features of Terminator:

1. `Ctrl+Shift+O` opens a terminal below the current.

2. `Ctrl+Shift+E` opens a terminal to the left of current.

3. `Ctrl+Shift+W` closes the current terminal.

4. `Ctrl+Shift+C` to copy.

5. `Ctrl+Shift+v` to paste.

6. You can drag the terminals to reposition the terminals within Terminator.

2.2.7 VirtualBox Guest Additions

This applies only to VirtualBox users. Guest Additions allows you to use shared clipboard features and configure the graphics drivers on your computer for use in the virtual machine. You should install it.

1. Make sure Ubuntu in VirtualBox has started.

2. On a new or existing terminal, install:

```
sudo apt install virtualbox-guest-utils virtualbox-guest-dkms
```

3. Reboot the system by going to the top right hand corner of the screen, and selecting `Power Off / Logout` and then `Power Off...`. In the dialog box, select `Restart`.
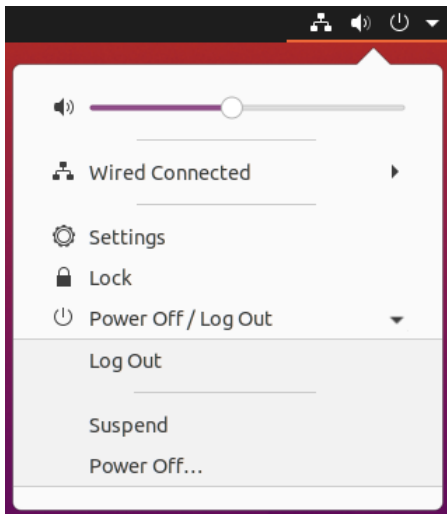
4. After restarting, on the **Virtualbox window menu**, click `Devices` and then `Upgrade Guest Additions...`
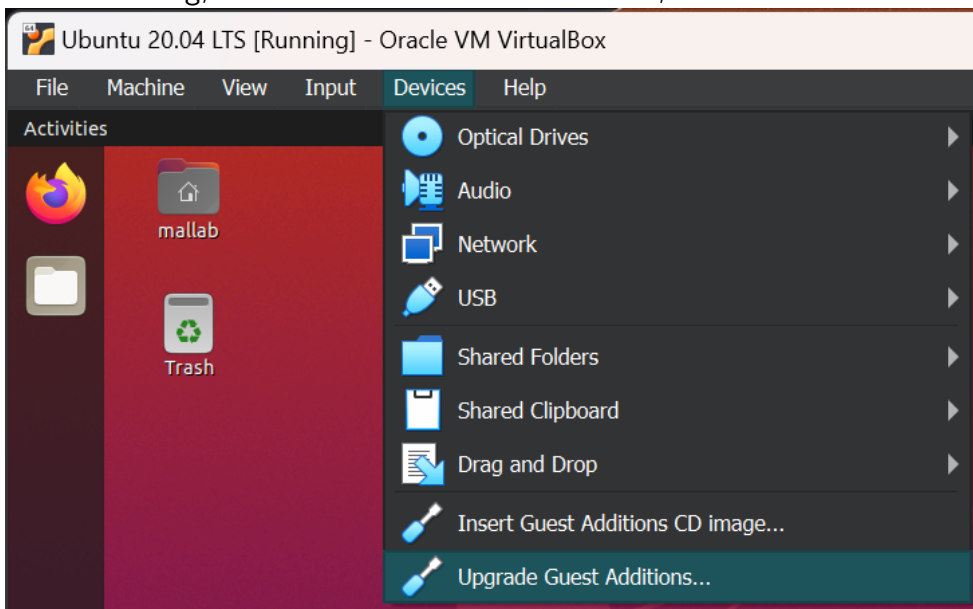
The notification center will appear and show that is installing.
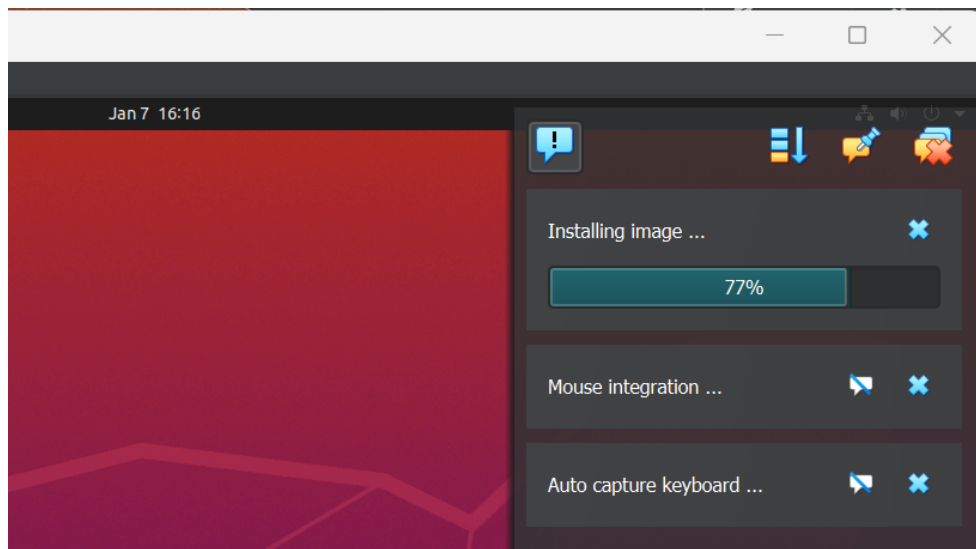
5. After installing, click `Devices` again and change `Shared Clipboard` to `Bidirectional`. You should now be able to cut and paste text from VirtualBox to the Host (Windows / Mac OSX), vice versa.

6. You may have to readjust your display resolution again. See above in Sec. 2.2.2.

3 Installing ROS Noetic

The steps are adapted from http://wiki.ros.org/Installation/Ubuntu. Please note that we are installing **ROS1 Noetic**. Before running, please read the following:

- In Ubuntu, open a terminal / terminator using `Ctrl+Alt+T`, and run the commands below.

- You may be required to type your password and click 'Y' to proceed with installations. You may see `Abort` right after pressing `Y` to install, and **nothing is done**. This is due to copying an extra line from the manual or from the Host (Windows / Mac OSX). Re-copy the command again and be careful not to select any extra invisible lines.

- The numbers on the left indicate commands that **should be run as one line**, as this PDF will break some long commands into multiple lines. These numbers should not be part of the command. If u see a multi-line command like command 1 below, it is actually one line – between > and /etc/, there is a **space**. Avoid copying multiple lines at once from this manual.

- **Go to the link above from the web browser within Ubuntu (default is Firefox) if you want to cut and paste quickly without worrying about extra lines from the manual.**

- Do not miss any steps, and take note of any errors.

```
1  sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb_release -sc) main" >
   /etc/apt/sources.list.d/ros-latest.list'
2  sudo apt install curl
3  curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc | sudo apt-key add -
```

If the `curl -s` command prints a `gpg: no valid OpenPGP data found` error, reconnect your Host (Windows or Mac OSX) to a **non-NUS Wi-Fi** that has no strict firewall settings (almost all other normal Wi-Fi or hotspot). Then, **redo** the `curl -s` instruction above.

```
1  sudo apt update
2  sudo apt install ros-noetic-desktop-full
```

It may take half an hour for the installation to complete. After that, if you had to use the non-NUS Wi-Fi earlier, switch back to it or you will encounter problems downloading from `raw.githubusercontent.com` later for `rosdep` commands. Then run:

```
1  echo "source /opt/ros/noetic/setup.bash" >> ~/.bashrc
2  source ~/.bashrc
3  sudo apt install python3-rosdep python3-rosinstall python3-rosinstall-generator python3-wstool
   build-essential
4  sudo rosdep init
5  rosdep update
6  sudo apt install ros-noetic-turtlebot3-*
7  sudo apt install ros-noetic-geographic-msgs
```