Operating systems Lab

Dated: 09-03-2022

Department of Computer Science and Engineering,

Chitkara University, Punjab

Experiment 1

Installation: Configuration & Customizations of Linux

What Is Linux

- Linux is an open-source operating system like other operating systems such as Microsoft Windows, Apple Mac OS, iOS, Google android, etc. An operating system is a software that enables the communication between computer hardware and software.

- Linux is around us since the mid-90s. It can be used from wristwatches to supercomputers. It is everywhere in our phones, laptops, PCs, cars and even in refrigerators. It is very much famous among developers and normal computer users.
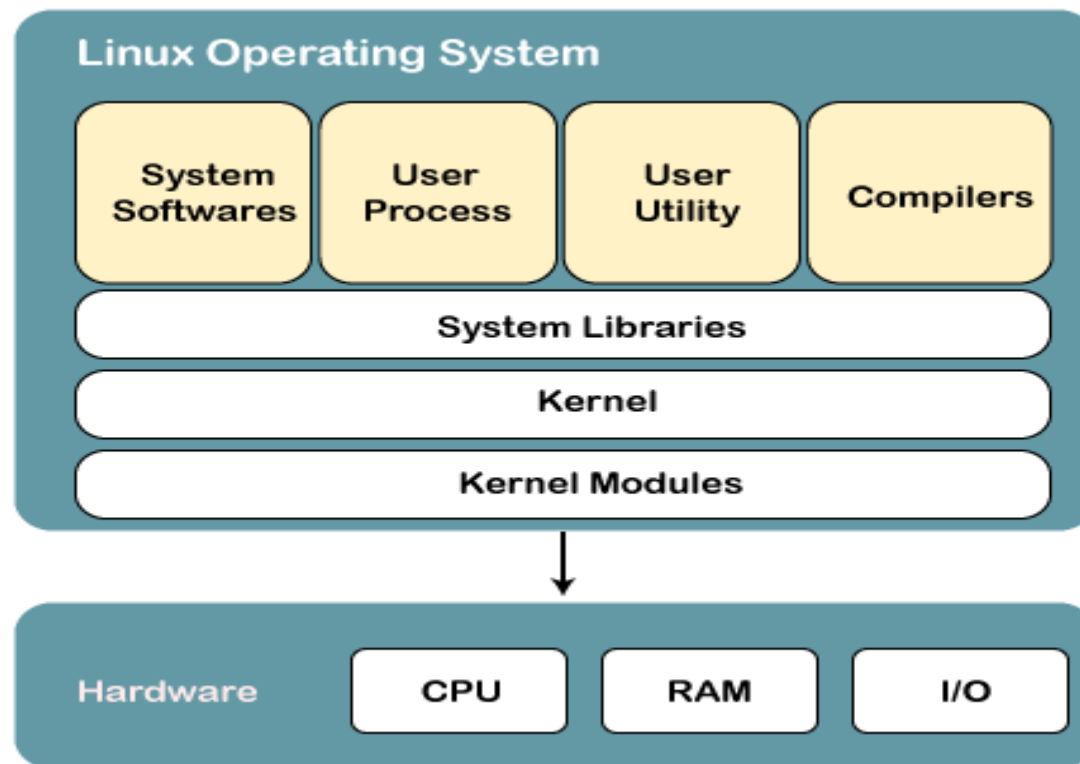
Evolution of Linux OS

- The Linux OS was developed by **Linus Torvalds** in **1991**, which sprouted as an idea to improve the UNIX OS. He suggested improvements but was rejected by UNIX designers. Therefore, he thought of launching an OS, designed in a way that could be modified by its users. Nowadays, Linux is the fastest-growing OS.

- In 1991, Linus Torvalds a student at the university of Helsinki, Finland, thought to have a freely available academic version of Unix started writing its own code. Later this project became the Linux kernel. He wrote this program specially for his own PC as he wanted to use Unix 386 Intel computer but couldn't afford it. He did it on MINIX using GNU C compiler. GNU C compiler is still the main choice to compile Linux code but other compilers are also used like Intel C compiler.

- He started it just for fun but ended up with such a large project. Firstly he wanted to name it as 'Freax' but later it became 'Linux'.

- He published the Linux kernel under his own license and was restricted to use as commercially. Linux uses most of its tools from GNU software and are under GNU copyright. In 1992, he released the kernel under GNU General Public License.

Linux Features

- **Multiuser capability:** Multiple users can access the same system resources like memory, hard disk, etc. But they have to use different terminals to operate.

- **Multitasking:** More than one function can be performed simultaneously by dividing the CPU time intelligently.

- **Portability:** Portability doesn't mean it is smaller in file size or can be carried in pen drives or memory cards. It means that it support different types of hardware.

- **Security:** It provides security in three ways namely authenticating (by assigning password and login ID), authorization (by assigning permission to read, write and execute) and encryption (converts file into an unreadable format).

- **Live CD/USB:** Almost all Linux distros provide live CD/USB so that users can run/try it without installing it.

- **Graphical User Interface (X Window system):** Linux is command line based OS but it can be converted to GUI based by installing packages.

- **Support's customized keyboard:** As it is used worldwide, hence supports different languages keyboards.

- **Application support:** It has its own software repository from where users can download and install many applications.

- **File System:** Provides hierarchical file system in which files and directories are arranged.

- **Open Source:** Linux code is freely available to all and is a community based development project.

- An operating system is a collection of software, each designed for a specific function. Linux OS has following components:

Linux Operating System

System Softwares	User Process	User Utility	Compilers

System Libraries

Kernel

Kernel Modules

↓

Hardware | CPU | RAM | I/O |

1) Kernel

- Linux kernel is the core part of the operating system. It establishes communication between devices and software. Moreover, it manages system resources. It has four responsibilities:

A kernel is the very core of a typical OS. A shell is a CLI (command-line interpreter).

A kernel is a type of low-level program that has its interfacing with the hardware on top of which all the applications run (disks, RAM, CPU, etc.).

A shell allows all of its users to establish communication with the kernel.
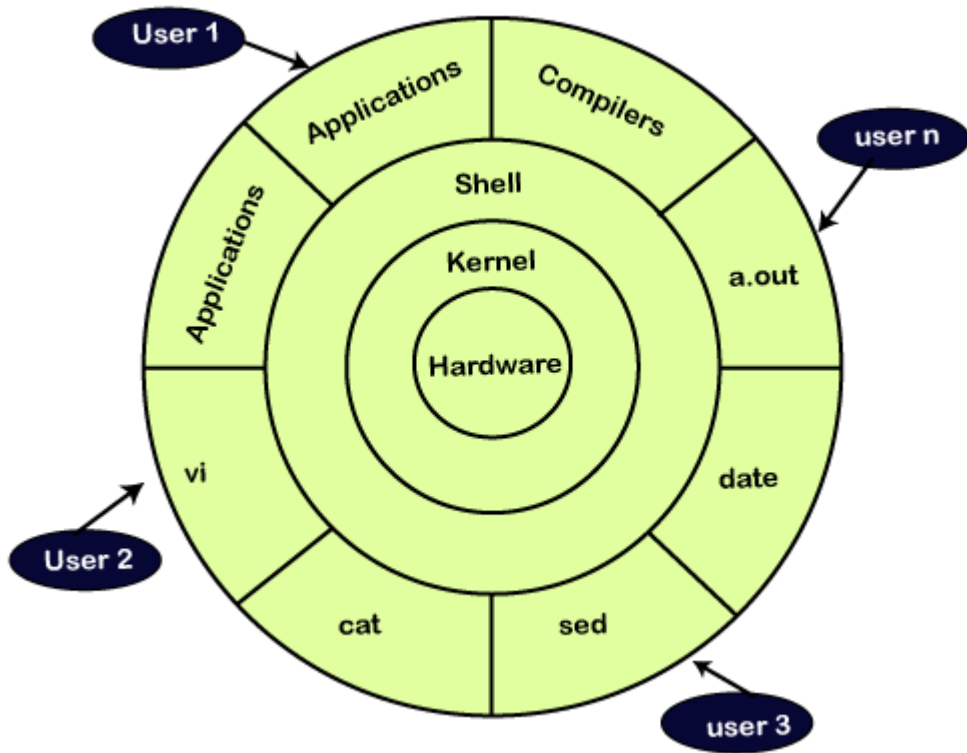
Responsibilities of Kernal

- **Device management:** A system has many devices connected to it like CPU, a memory device, sound cards, graphic cards, etc. A kernel stores all the data related to all the devices in the device driver (without this kernel won't be able to control the devices). Thus kernel knows what a device can do and how to manipulate it to bring out the best performance. It also manages communication between all the devices. The kernel has certain rules that have to be followed by all the devices.

- **Memory management:** Another function that kernel has to manage is the memory management. The kernel keeps track of used and unused memory and makes sure that processes shouldn't manipulate data of each other using virtual memory addresses.

- **Process management:** In the process, management kernel assigns enough time and gives priorities to processes before handling CPU to other processes. It also deals with security and ownership information.

- **Handling system calls:** Handling system calls means a programmer can write a query or ask the kernel to perform a task.

System Libraries & System Tools

2) System Libraries

System libraries are special programs that help in accessing the kernel's features. A kernel has to be triggered to perform a task, and this triggering is done by the applications. But applications must know how to place a system call because each kernel has a different set of system calls. Programmers have developed a standard library of procedures to communicate with the kernel. Each operating system supports these standards, and then these are transferred to system calls for that operating system.

The most well-known system library for Linux is Glibc (GNU C library).

3) System Tools

Linux OS has a set of utility tools, which are usually simple commands. It is a software which GNU project has written and publish under their open source license so that software is freely available to everyone.

With the help of commands, you can access your files, edit and manipulate data in your directories or files, change the location of files, or anything.

4) Development Tools

- With the above three components, your OS is running and working. But to update your system, you have additional tools and libraries. These additional tools and libraries are written by the programmers and are called toolchain. A toolchain is a vital development tool used by the developers to produce a working application.

5) End User Tools

- These end tools make a system unique for a user. End tools are not required for the operating system but are necessary for a user.

- Some examples of end tools are graphic design tools, office suites, browsers, multimedia players, etc.

Why use Linux?

There are various [features of Linux](#) systems that make it completely different and one of the most used operating systems. Linux may be a perfect operating system *if you want to get rid of viruses, malware, slowdowns, crashes, costly repairs,* and many more. Further, it provides various [advantages over other operating systems](#) , we don't have to pay for it.

Free
Open-source
Secure
Distributions
Fast Performance

Why Linux?

Viruses
Malwares
Slow-downs
Crashes
Costly repairs

*In short, Linux is an operating system that is "**for the people, by the people**."*

Why use Linux? contd…

Favorable choice of Developers

- Linux is suitable for the developers, as it supports almost all of the most used programming languages such as C/C++,, Java, Python, Ruby and more. Further, it facilitates with a vast range of useful applications for development.

A flexible operating system

- Linux is a flexible OS, as, it can be used for desktop applications, embedded systems, and server applications.

How does Linux work?

- Linux is a UNIX-like operating system, but it supports a range of hardware devices from phones to supercomputers. Every Linux-based operating system has the Linux kernel and set of software packages to manage hardware resources.

- Also, Linux OS includes some **core GNU tools** to provide a way to manage the kernel resources, install software, configure the security setting and performance, and many more. All these tools are packaged together to make a functional operating system.

How to use Linux?

- We can use Linux through an interactive user interface as well as from the terminal (Command Line Interface).

- Different distributions have a slightly different user interface but almost all the commands will have the same behavior for all the distributions. To run Linux from the terminal, press the "CTRL+ALT+T" keys. And, to explore its functionality, press the application button given on the left down corner of your desktop.

Advantages of Linux

- The **kernel** *is a core part of* the Linux system.

- Linux system is used to manage various services such as:

  ➢ **process scheduling,**

  ➢ **application scheduling,**

  ➢ **basic peripheral devices,**

  ➢ **file system, and more**.

- Some major advantages of the Linux system are:

➢ Open Source

➢ Security

➢ Free

➢ Lightweight

➢ Stability

➢ Performance

➢ Flexibility

➢ Software Updates

➢ GUI

➢ Suitable for programmers

➢ Privacy

➢ Multitaksing

➢ Multiple Desktop support (**GNOME (GNU Network Object Model Environment)** or **KDE (K Desktop Environment)**

Step 1:What you'll need

The steps required to install Ubuntu Desktop on your laptop or PC.
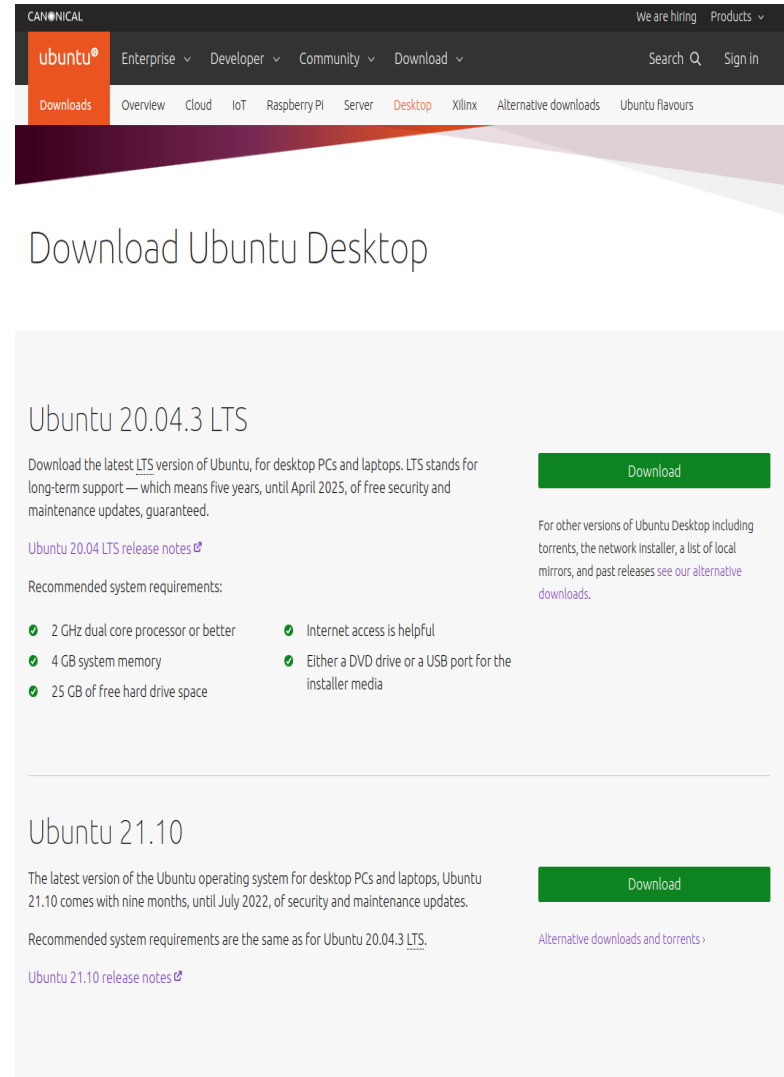
- A laptop or PC (obviously!) with at least 25GB of storage space.

- A flash drive (8GB as a minimum, 12GB or above recommended).

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https://ubuntu.com/download/desktop

Make sure to save it to a memorable location on your PC! For this installation, we will use the Ubuntu 20.04 LTS release.

Step 3. Create a Bootable USB stick

- To install Ubuntu Desktop, you need to write your downloaded ISO to a USB stick to create the installation media. This is not the same as copying the ISO, and requires some bespoke software.

- In this, we'll use [balenaEtcher](#), as it runs on Linux, Windows and Mac OS. Choose the version that corresponds to your current operating system, download and install the tool.

Step 3. contd…..

https://www.balena.io/etcher/

DOWNLOAD

Get your assets
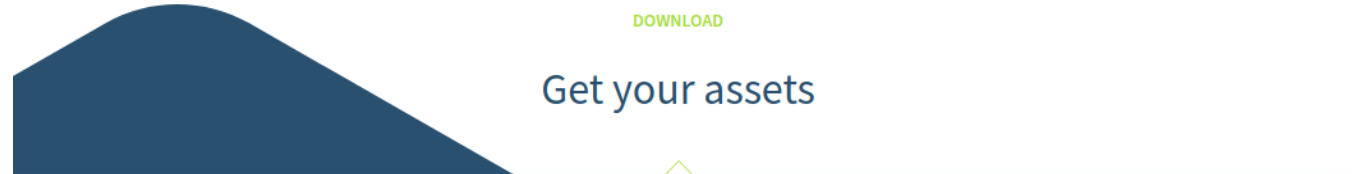
ASSET	OS	ARCH	
Etcher for Windows (x86|x64) (Installer)	Windows	x86|x64	↓ Download
Etcher for Windows (x86|x64) (Portable)	Windows	x86|x64	↓ Download
Etcher for macOS	macOS	x64	↓ Download
Etcher for Linux x64 (64-bit) (AppImage)	Linux	x64	↓ Download
Etcher for Linux x86 (32-bit) (AppImage)	Linux	x86	↓ Download

Looking for Debian (.deb) packages or Red Hat (.rpm) packages?

Step 3. contd…..

- Select your downloaded ISO, choose your USB flash drive, and then click Flash! to install your image.

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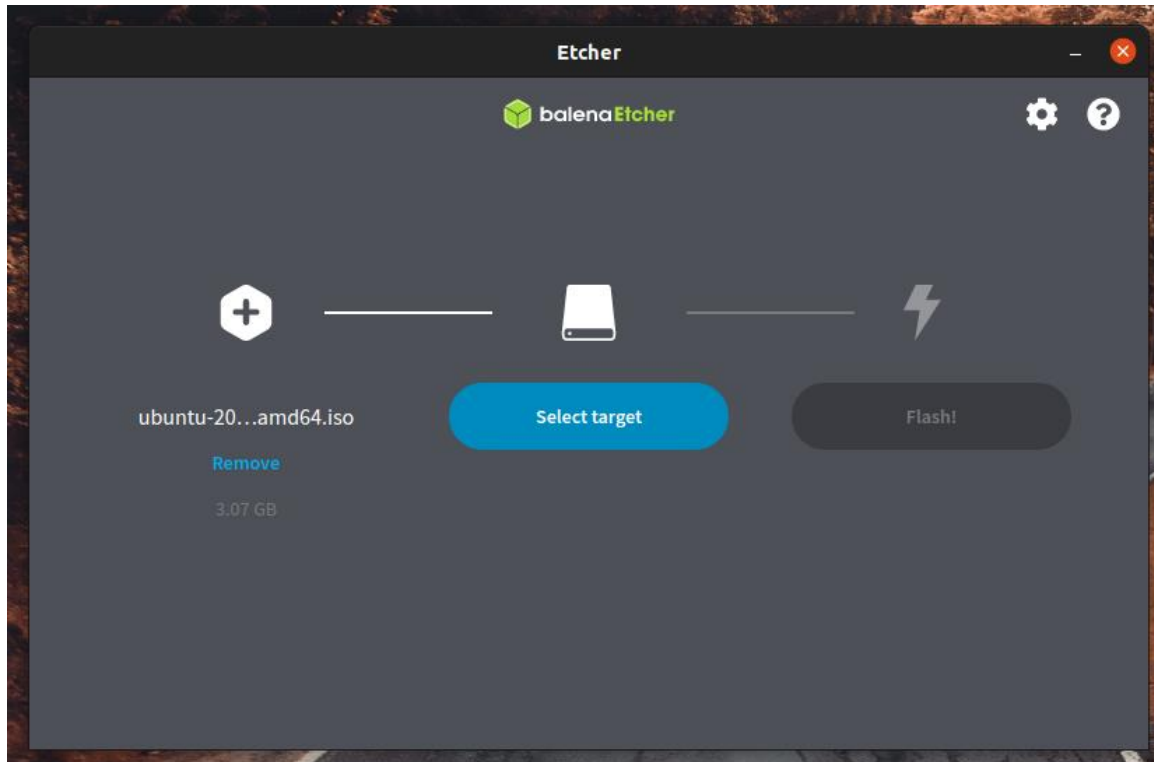
- Insert the USB flash drive into the laptop or PC you want to use to install Ubuntu and boot or restart the device. It should recognize the installation media automatically. If not, try holding F12 during startup and selecting the USB device from the system-specific boot menu.

- You should now see the welcome screen inviting you to either try or install Ubuntu.

- To proceed, click Install Ubuntu.
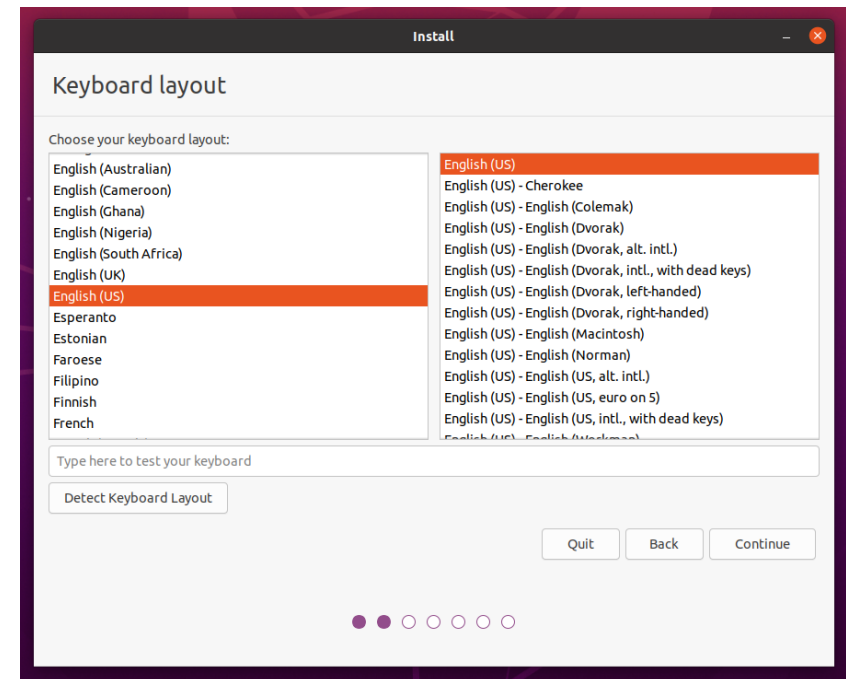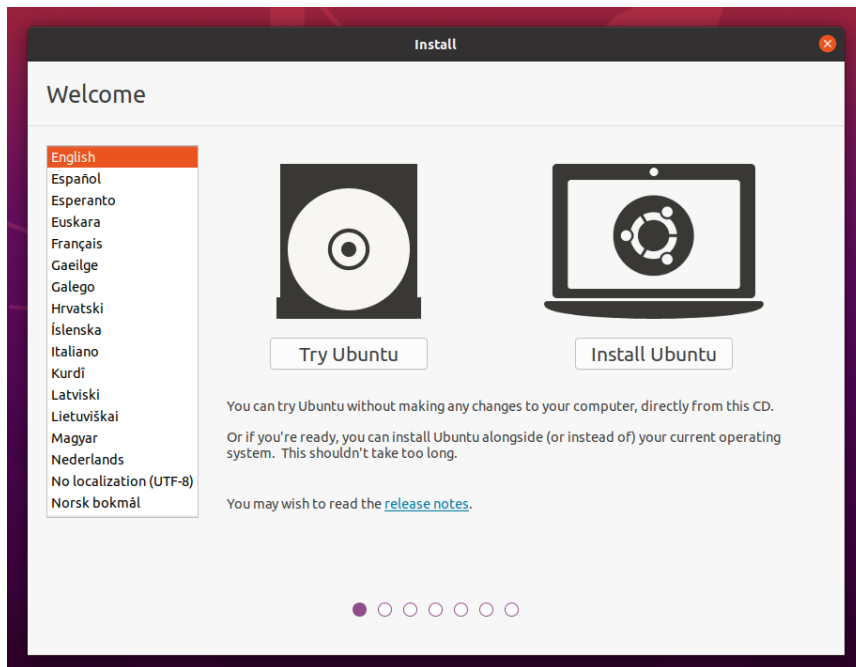
Step 5. Installation Setup

- Next, you will be prompted to choose between the Normal installation and Minimal installation options. The minimal installation is useful for those with smaller hard drives or who don't require as many pre-installed applications.

- In Other options, you will be prompted to download updates as well as third-party software that may improve device support and performance (for example, Nvidia graphics drivers) during the installation. It is recommended to check both of these boxes.

- If you are not currently connected to the internet, you will be prompted to do so at this point. Ensure you are able to remain connected throughout the installation.

Step 5. contd..

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Install

Updates and other software

What apps would you like to install to start with?

🔘 Normal installation
   Web browser, utilities, office software, games, and media players.

⚪ Minimal installation
   Web browser and basic utilities.

Other options

☑ Download updates while installing Ubuntu
   This saves time after installation.

☑ Install third-party software for graphics and Wi-Fi hardware and additional media formats
   This software is subject to license terms included with its documentation. Some is proprietary.

[Quit]   [Back]   [Continue]

● ● ● ● ○ ○ ○

Step 6. Drive Management

- This screen allows you to configure your installation. If you would like Ubuntu to be the only operating system on your device, select Erase disk and install Ubuntu.

Note: If your device currently has another operating system installed, you will receive additional options to install Ubuntu alongside that OS rather than replacing it. This requires some additional steps not covered here. However, you can read more about setting up dual-booting.

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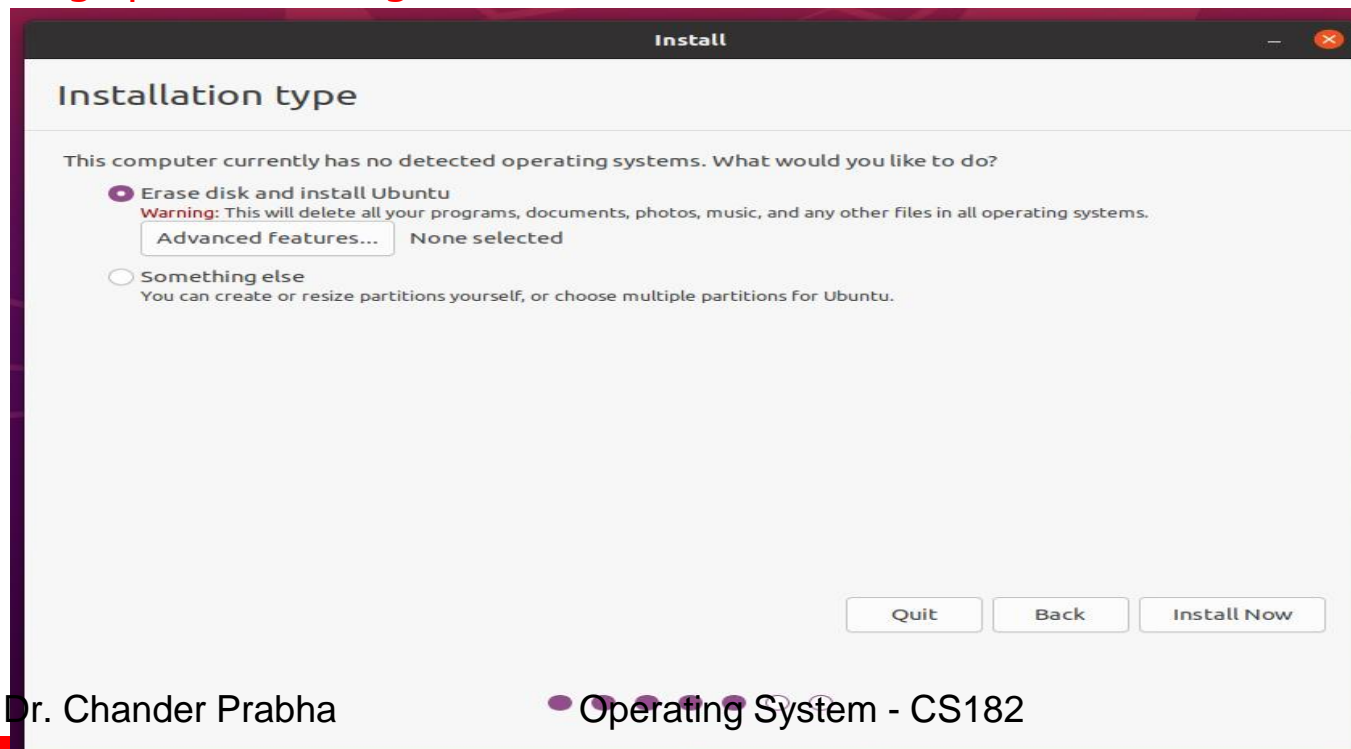
- If you are happy to continue the installation *without* enabling encryption, click Install Now and confirm the changes with Continue. Otherwise keep reading.

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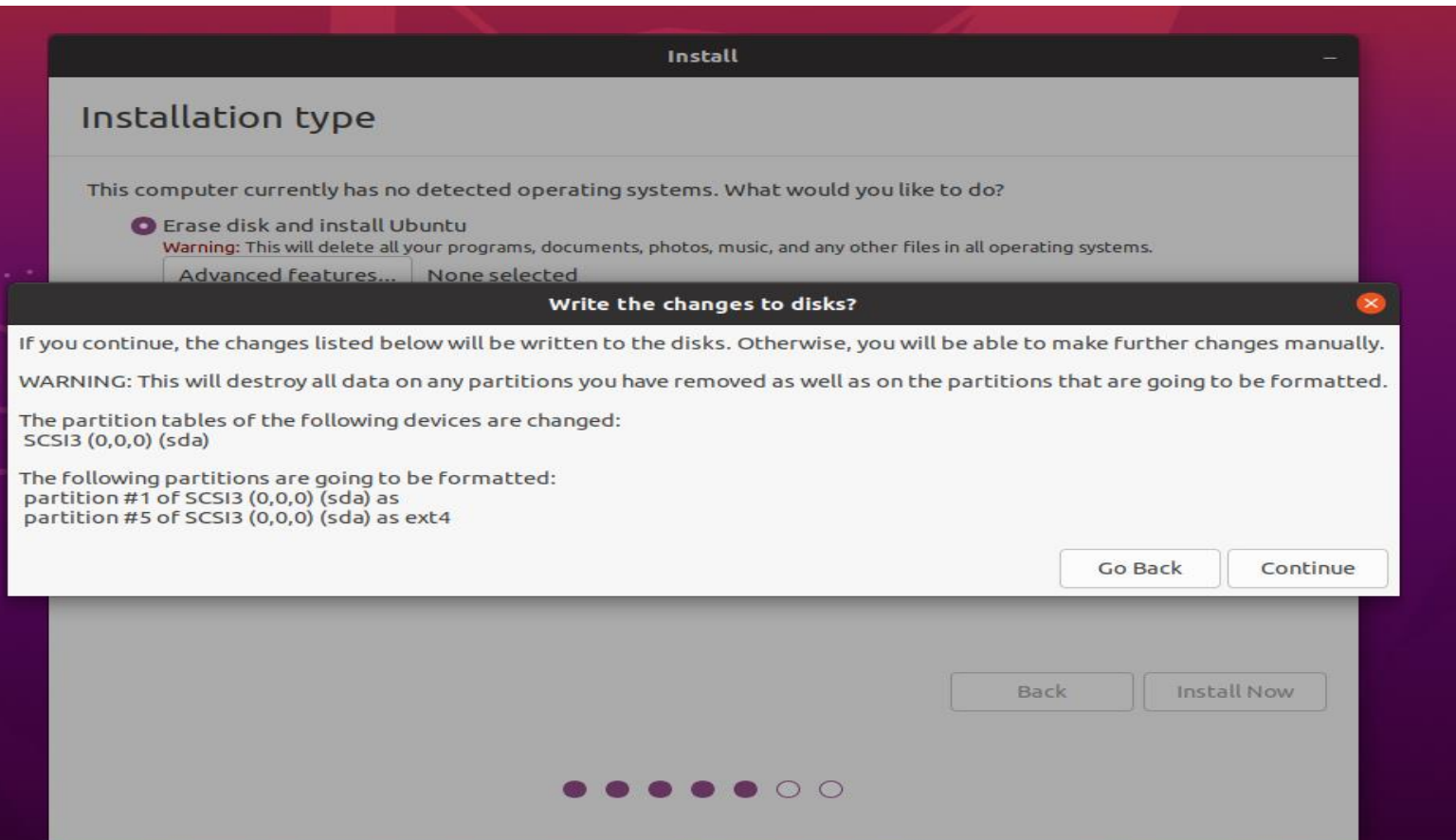
- If you would like to encrypt your device, select Advanced features... > Use LVM with the new Ubuntu installation > Encrypt the new Ubuntu installation for security.
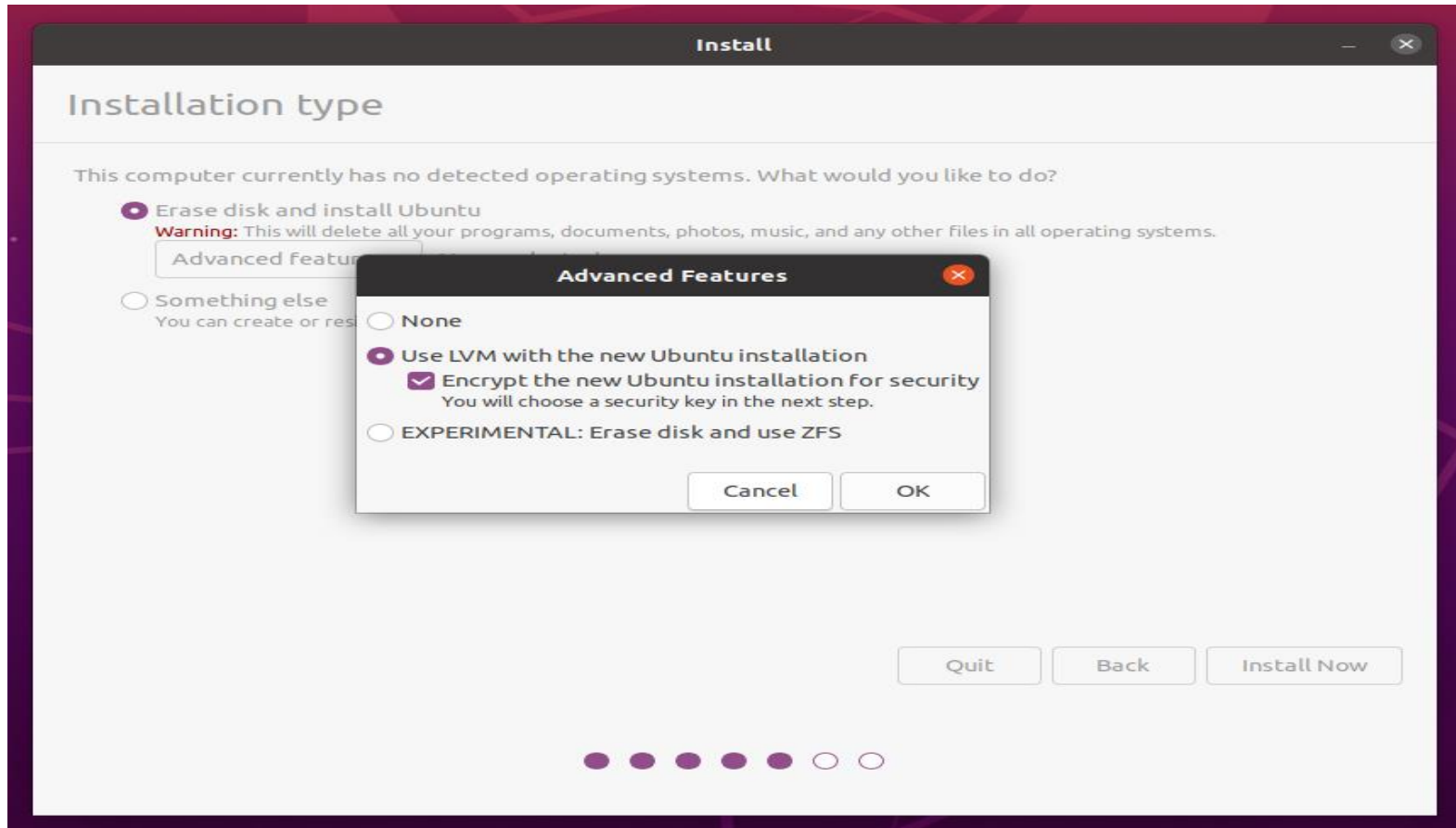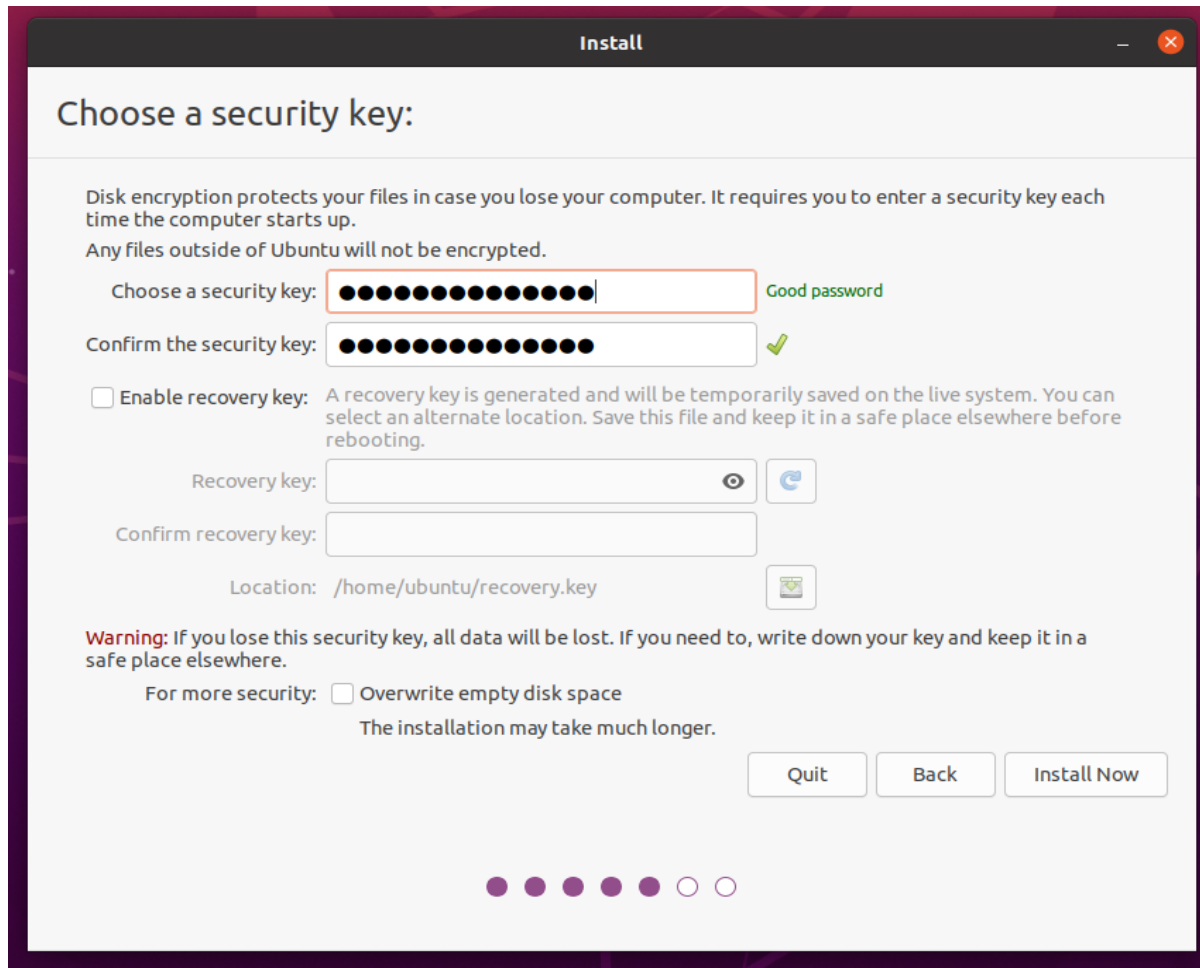
LVM stands for Logical Volume Management. By using LVM during the setup, it makes it easier to create and manage partitions post installation.

Step 7. contd...

- You will be prompted to create a security key once you click Install Now.

Click Install Now and confirm the changes with Continue.
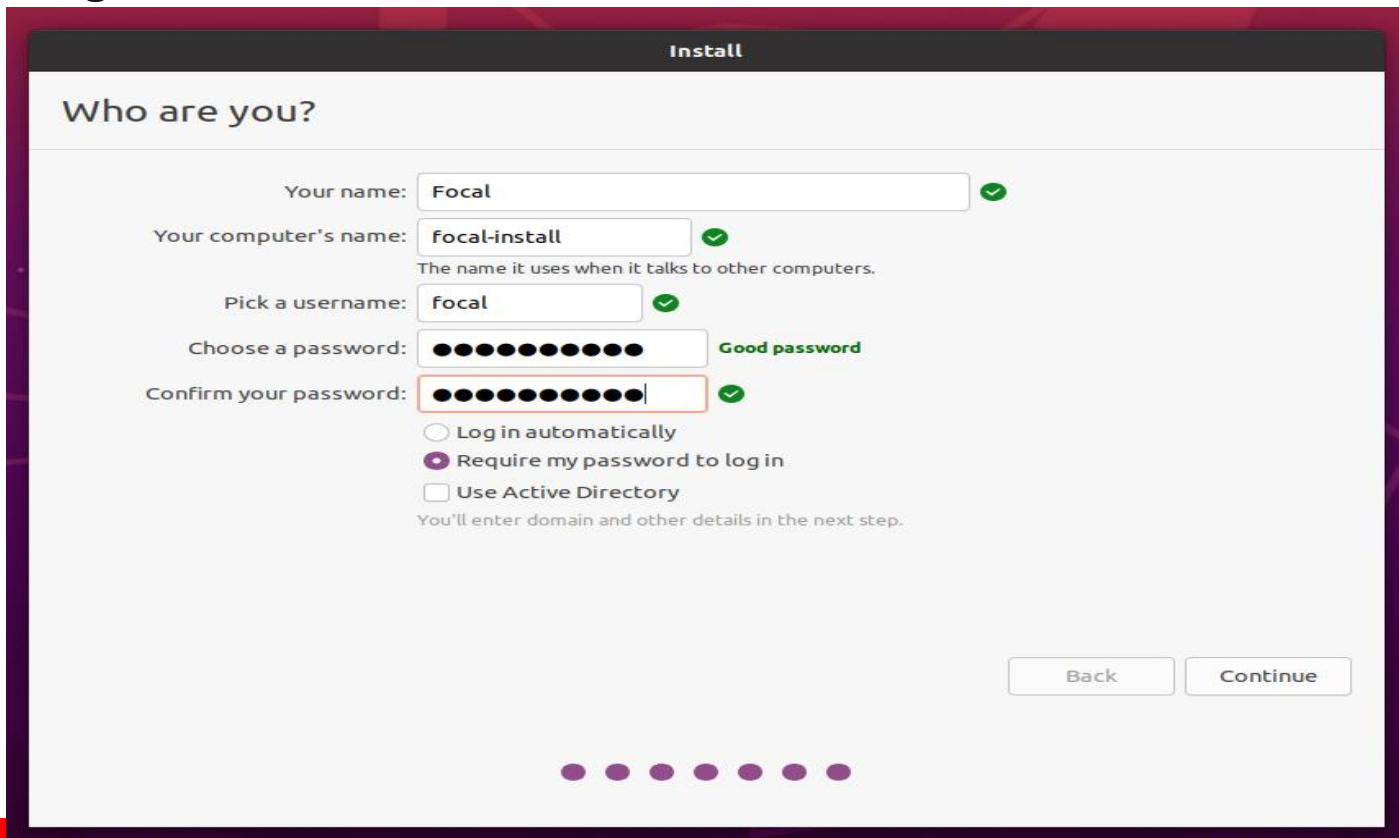
Step 8. Choose your Location

- Select your location and timezone from the map screen and click Continue. This information will be detected automatically if you are connected to the internet.
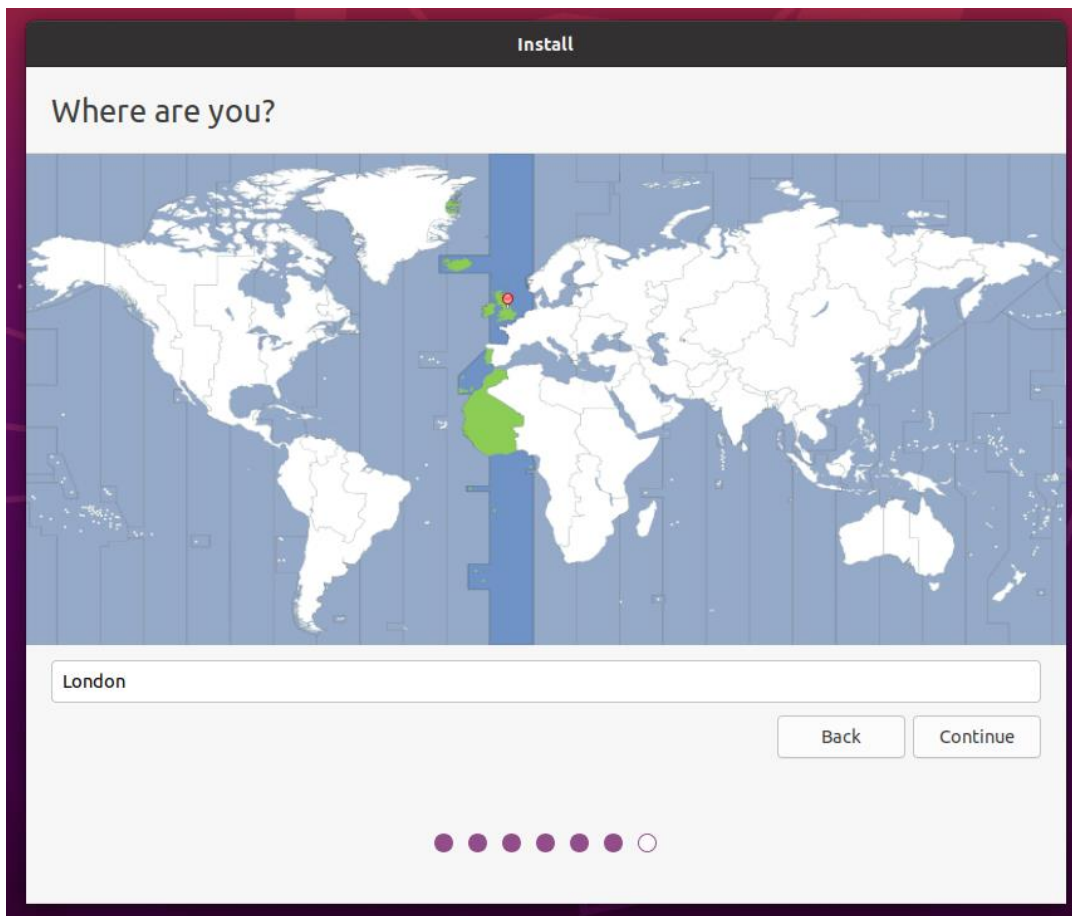
Step 9. Create Your Login Details

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- On this screen, you will be prompted to enter your name and the name of your computer as it will appear on the network. Finally, you will create a username and a strong password.

- You can choose to log in automatically or require a password. If you are using your device whilst travelling, it's recommended to keep automatic login disabled.

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- Now sit back and enjoy the slideshow as Ubuntu installs in the background!
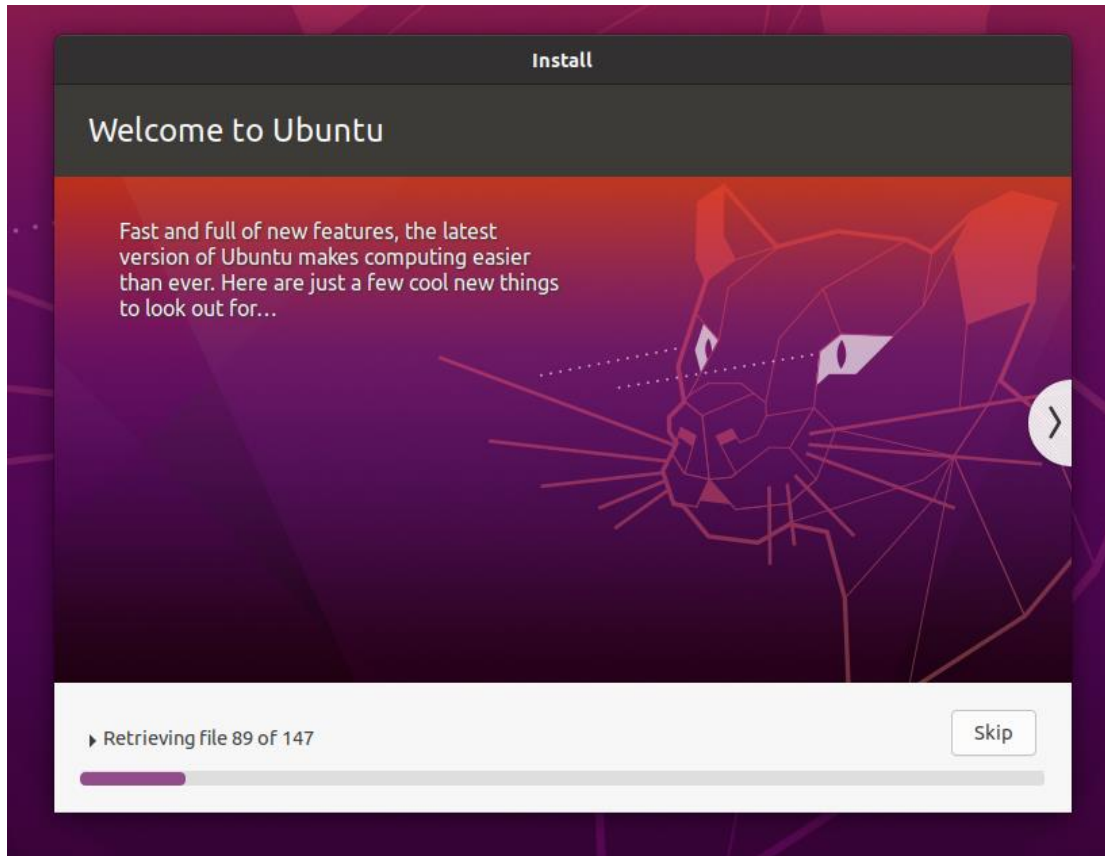
Step 10. Contd..

- Once the installation has completed, you will be prompted to restart your machine.

- Click Restart Now.

Installation Complete

Installation is complete. You need to restart the computer in order to use the new installation.

Restart Now
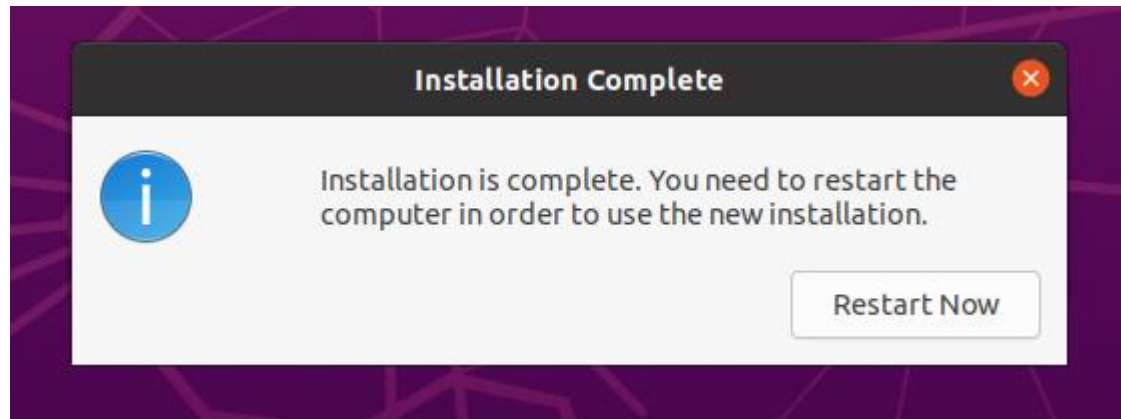
- When you restart, you will be prompted to remove your USB flash drive from the device. Once you've done this, press ENTER.

Step 10. Contd..

Enter your password on the login screen (assuming you selected that option when creating your login details).
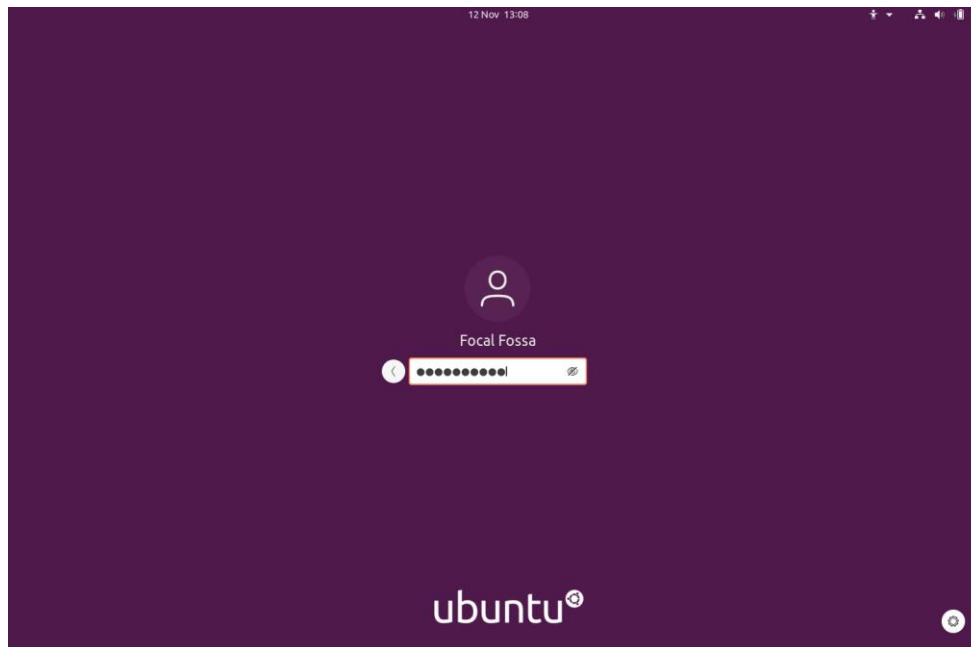
Step 10. Contd..

- And that's it, welcome to your new Ubuntu Desktop!

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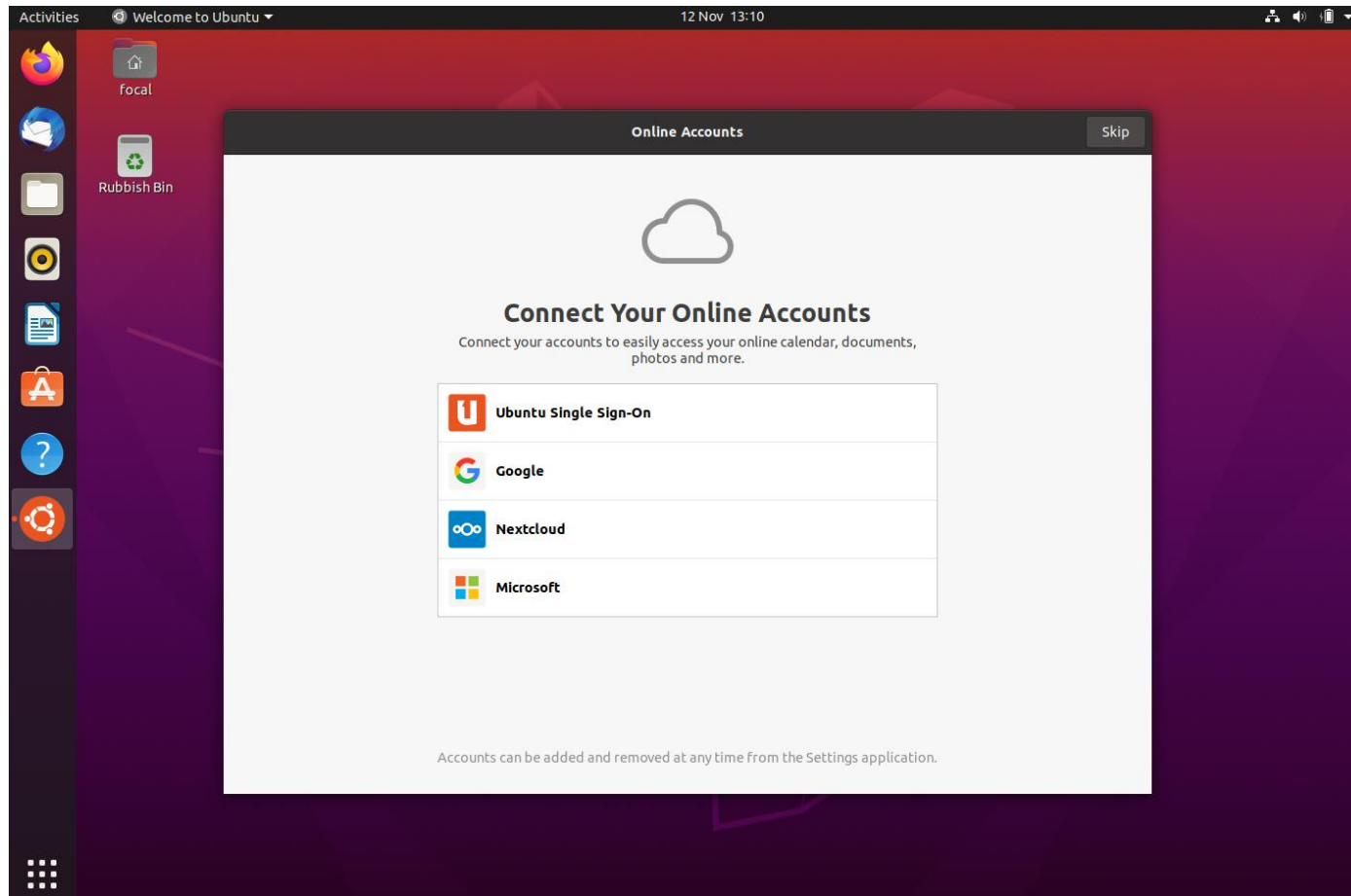
- The welcome widget will help you with some additional setup options, including:

- Connecting your profile to various online accounts.

- Configure Livepatch to automatically apply updates to your device (this option is only available when using a long term support [LTS] version of Ubuntu).

- Opting into sending device information to Canonical to help improve Ubuntu (by default, Canonical doesn't collect device information).

- Activating location services.

- Downloading additional apps from Ubuntu Software.

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- It's always good practice to ensure your system is up to date, especially after a fresh install.

- The easiest way to do this is via the Software Updater app. Search for Software Updater via the app menu (the icon with 9 squares in the bottom corner of your window) and it will check for updates and apply them.
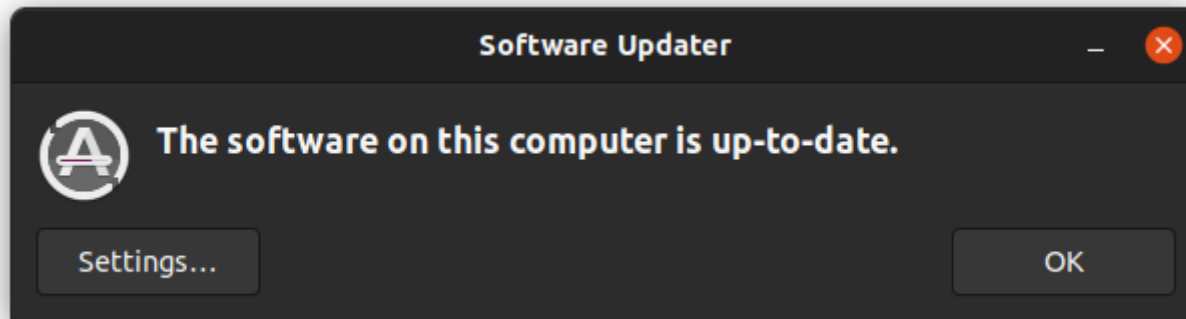
You can also update Ubuntu using the terminal.
Press CTRL+ALT+T to bring up a Terminal window (or click the terminal icon in the sidebar).
Type in:

```
sudo apt update
```

You will be prompted to enter your login password.
This will check for updates and tell you if there are any that need applying. To apply any updates, type:

```
sudo apt upgrade
```

Type Y, then press ENTER to confirm to finish the update process.

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- You've installed Ubuntu!

2ⁿᵈ Method

- [How to run Ubuntu Desktop on a virtual machine using VirtualBox](#)

Ubuntu Desktop on a virtual machine

- One of the easiest ways to try out Ubuntu Desktop on a virtual machine.

- VirtualBox is a general purpose virtualiser that is available across Linux, Mac OS and Windows.

- It's a great way to experience Ubuntu regardless of your current operating system.

➢ How to install and configure VirtualBox https://www.virtualbox.org/

➢ How to import an Ubuntu image

➢ How to run a virtual instance of Ubuntu Desktop

➢ Further configuration options

- What you'll need

- A PC with internet access!

Ubuntu Image

- First Download an Ubuntu Image

- You can download an Ubuntu image

- https://ubuntu.com/download/desktop

- Make sure to save it to a memorable location on your PC! For this tutorial, we will use the Ubuntu 20.04 LTS release.

Download VirtualBox

- Duration: 5:00

- On Mac OS or Windows you can download VirtualBox from the downloads page https://www.virtualbox.org/wiki/Downloads

- This page also includes instructions to download VirtualBox for Linux. However, on Ubuntu, you can find VirtualBox by simply searching for it in the Ubuntu Software app.

Download VirtualBox Contd..

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VirtualBox

★★★☆☆ (644)

VirtualBox
Run several virtual systems on a single host computer

Remove

VirtualBox is a free x86 virtualization solution allowing a wide range of x86 operating systems such as Windows, DOS, BSD or Linux to run on a Linux system.

This package provides the Qt based graphical user interface for VirtualBox.

Website

Details

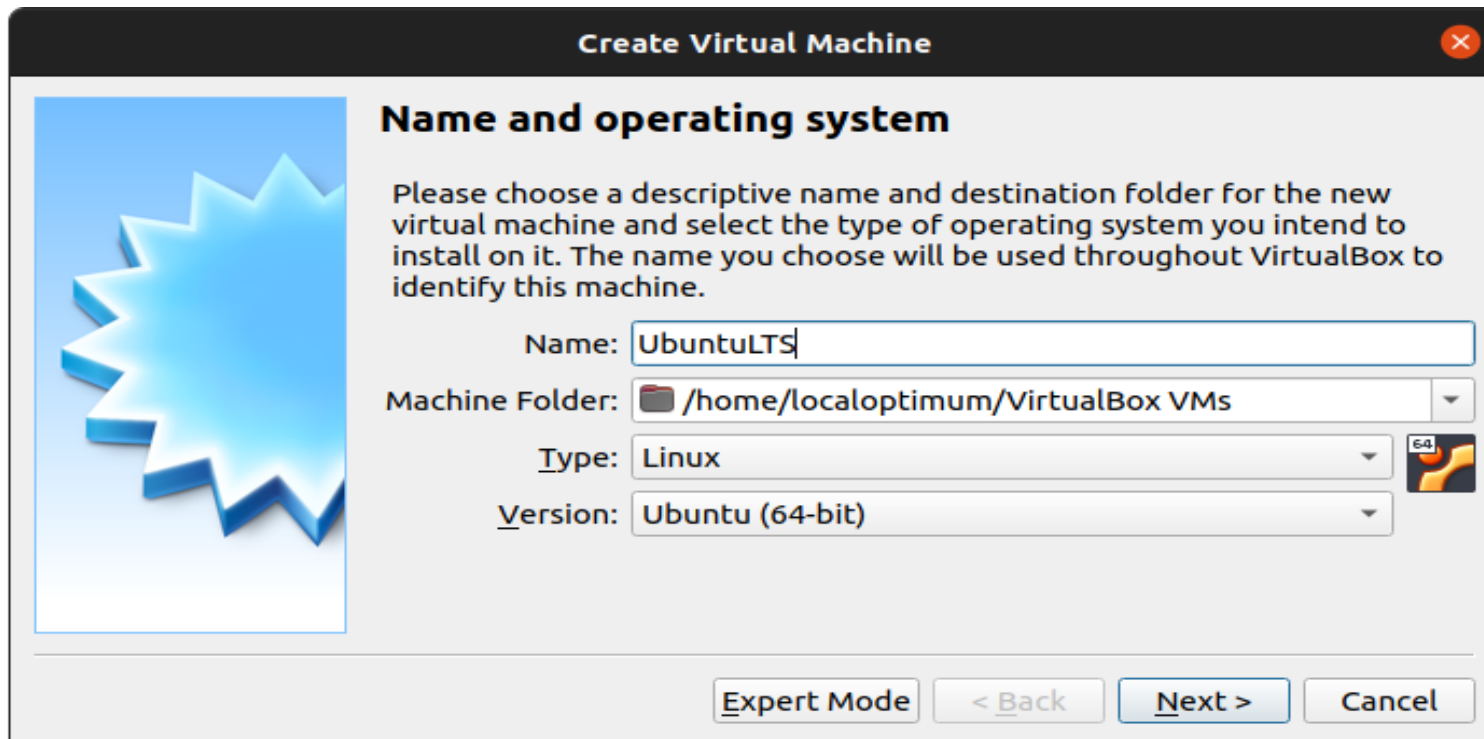|	
Version	6.1.26-dfsg-4
Updated	Never
Licence	Proprietary
Source	ubuntu-impish-multiverse
Installed Size	59.4 MB

Download VirtualBox Contd..

- Once you have completed the installation, go ahead and run VirtualBox.
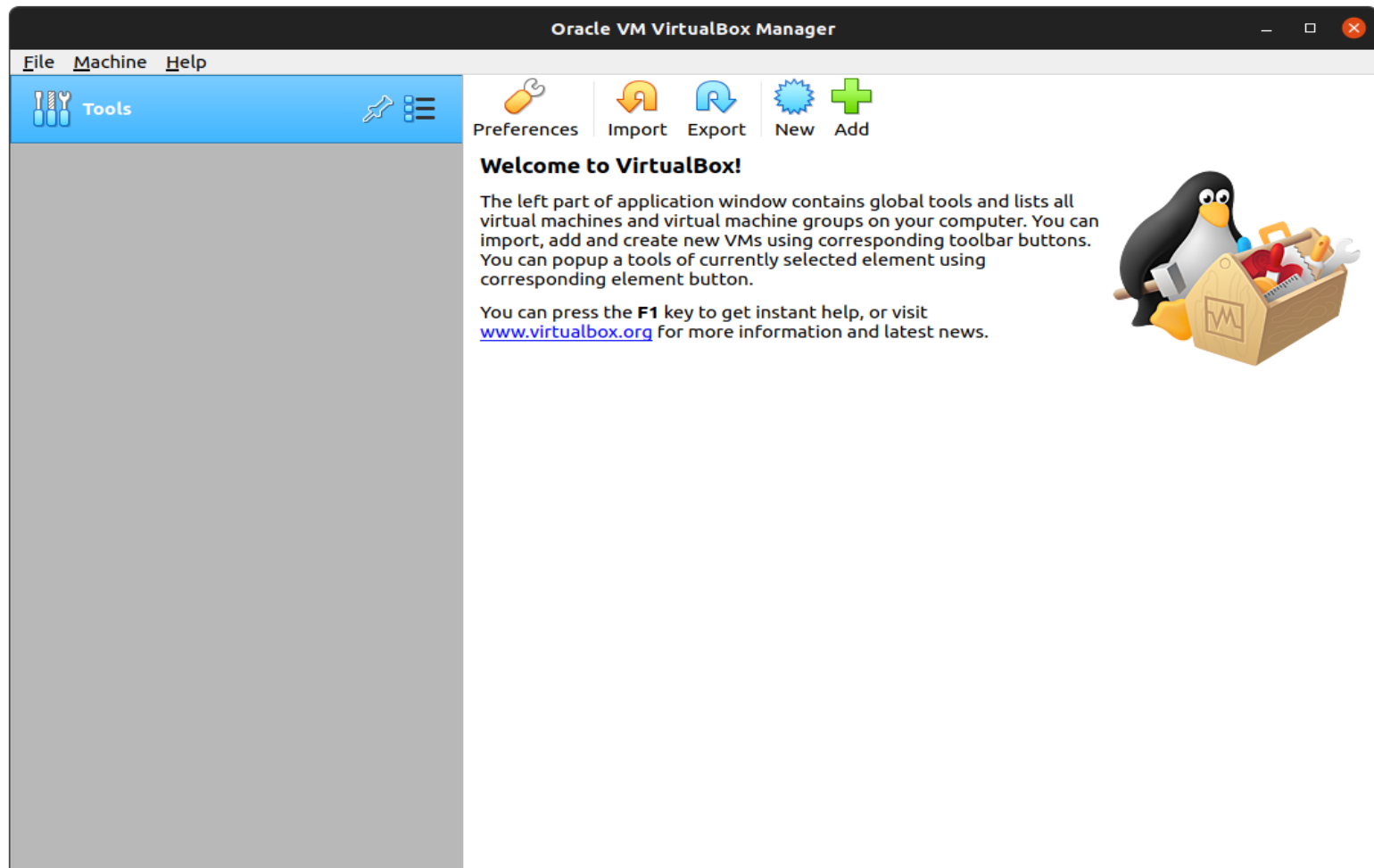
- Click New to create a new virtual machine. Fill in the appropriate details:

- Name: If you include the word Ubuntu in your name the Type and Version will auto-update.

- Machine Folder: This is where your virtual machines will be stored so you can resume working on them whenever you like.

- Type: Linux

- Version: Ubuntu (64-bit)

Create Virtual Machine

Name and operating system

Please choose a descriptive name and destination folder for the new virtual machine and select the type of operating system you intend to install on it. The name you choose will be used throughout VirtualBox to identify this machine.

Name: UbuntuLTS

Machine Folder: 📁 /home/localoptimum/VirtualBox VMs

Type: Linux

Version: Ubuntu (64-bit)

Expert Mode   < Back   Next >   Cancel

On the next screen, you will be able to select the amount of RAM from your main PC that the virtual machine will access. Be sure to remain inside the green bar to ensure you can continue to work outside of the VM whilst it's running!

Step 2. contd...

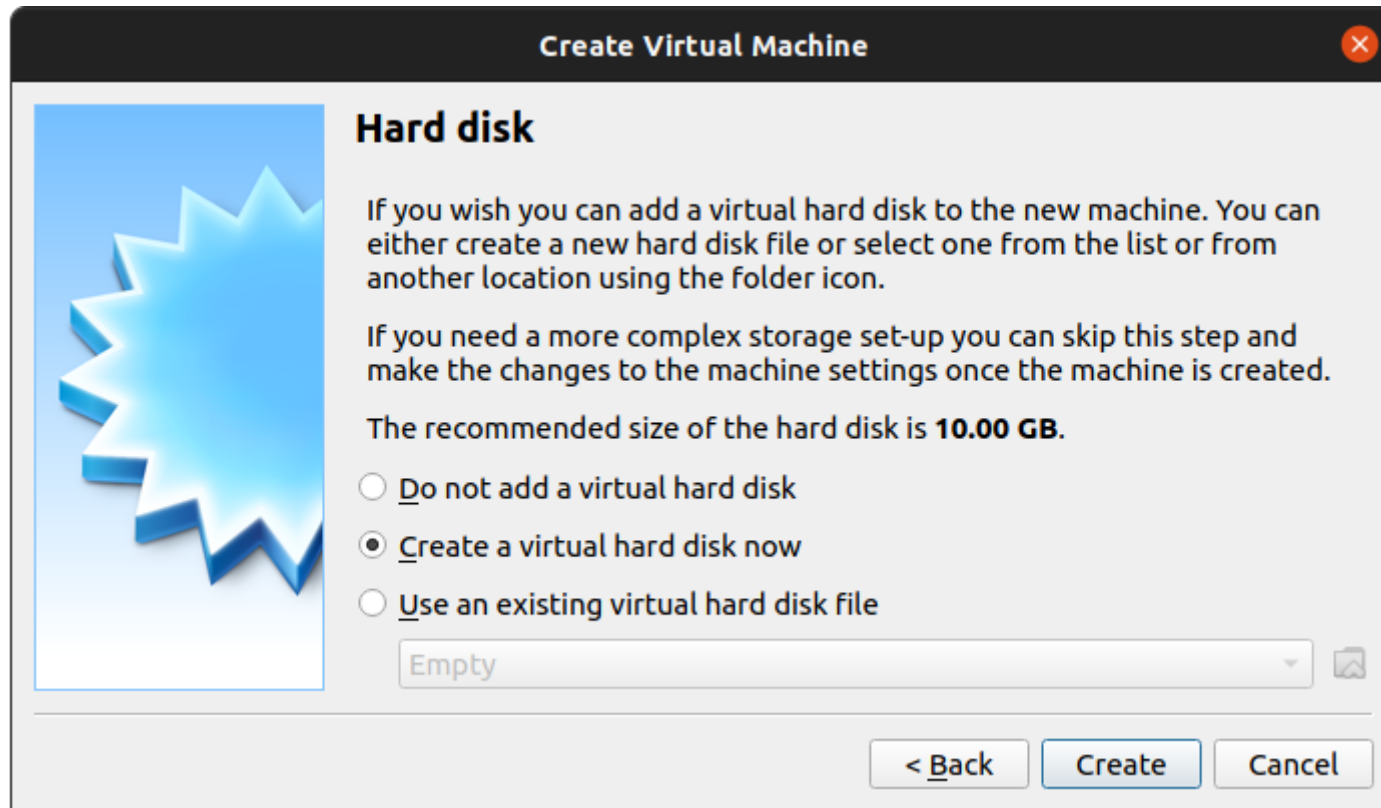- Note: If you select Expert Mode, you will be given the option to set all of these parameters in one go. Useful for future setups! (In previous Slide)

- It's fine to use the default settings for now.

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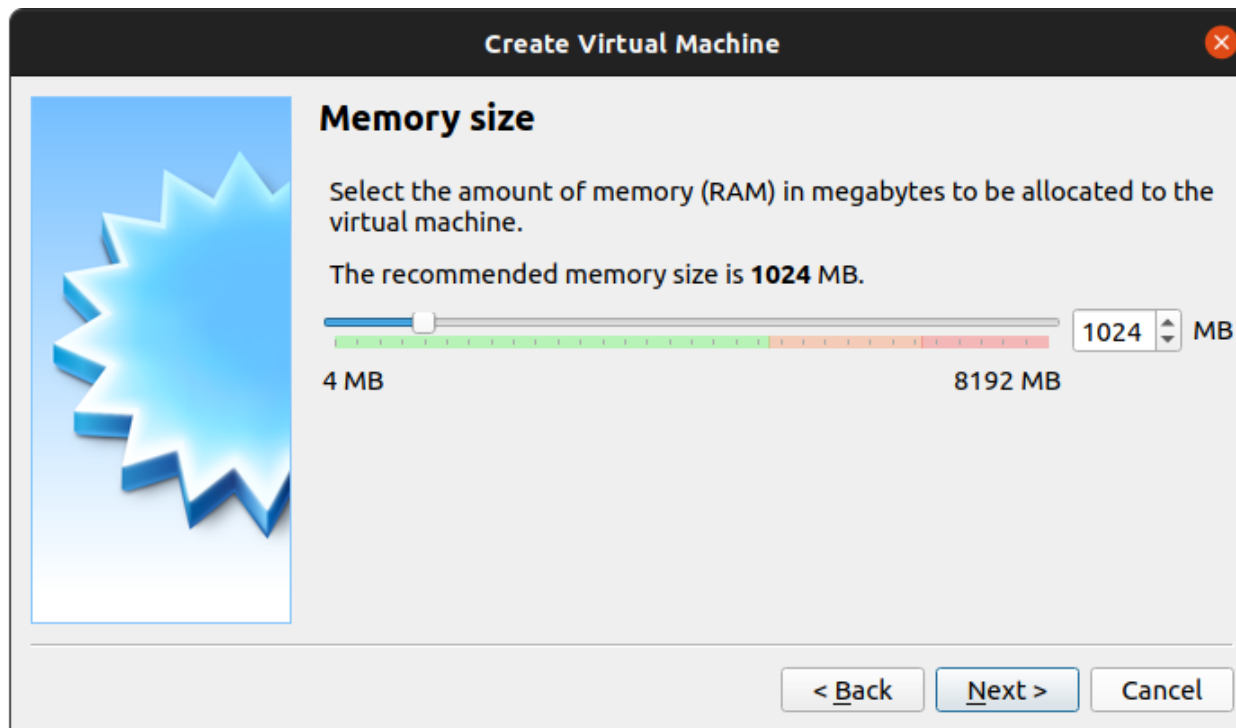
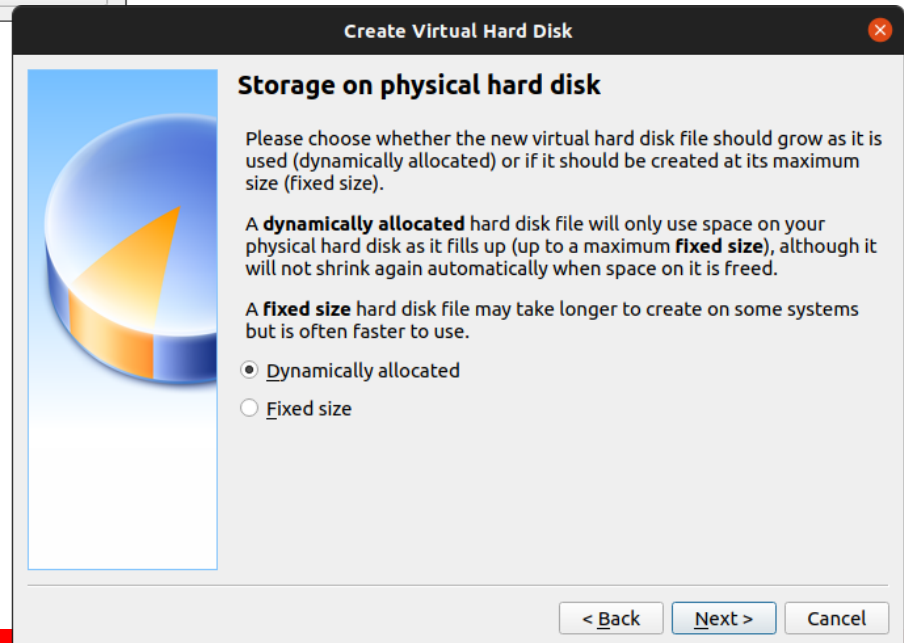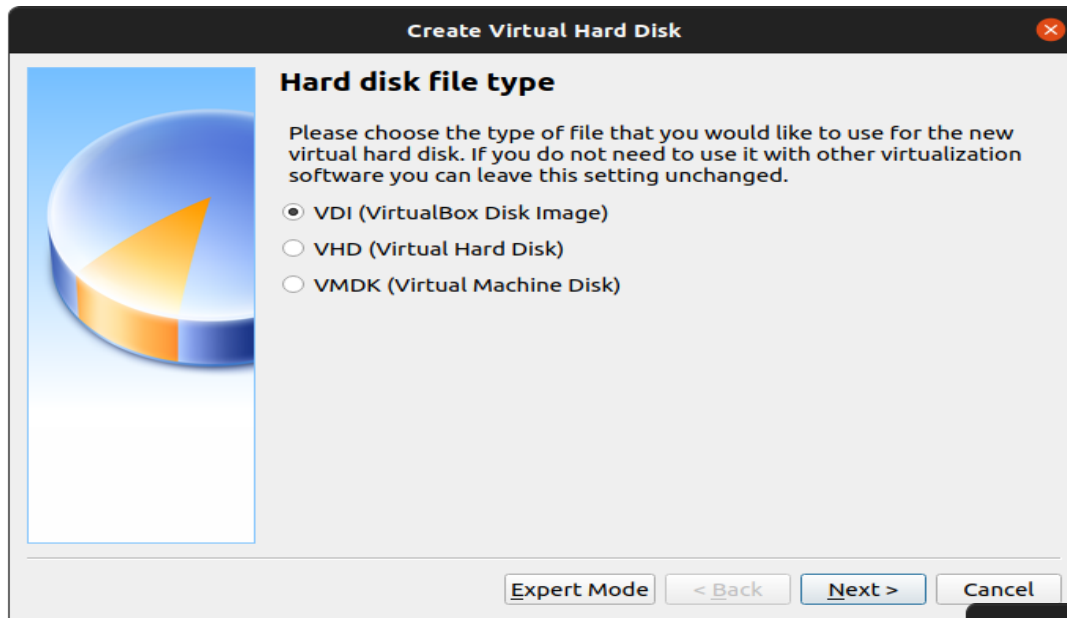- After that, you can select how much of your hard disk your VM will use.

The type of hard disk depends on whether you use VirtualBox with other VM software. For now, we can leave this as a VDI.

Step 2. contd…

Create Virtual Hard Disk

Hard disk file type

Please choose the type of file that you would like to use for the new virtual hard disk. If you do not need to use it with other virtualization software you can leave this setting unchanged.

- ⦿ VDI (VirtualBox Disk Image)
- ◯ VHD (Virtual Hard Disk)
- ◯ VMDK (Virtual Machine Disk)
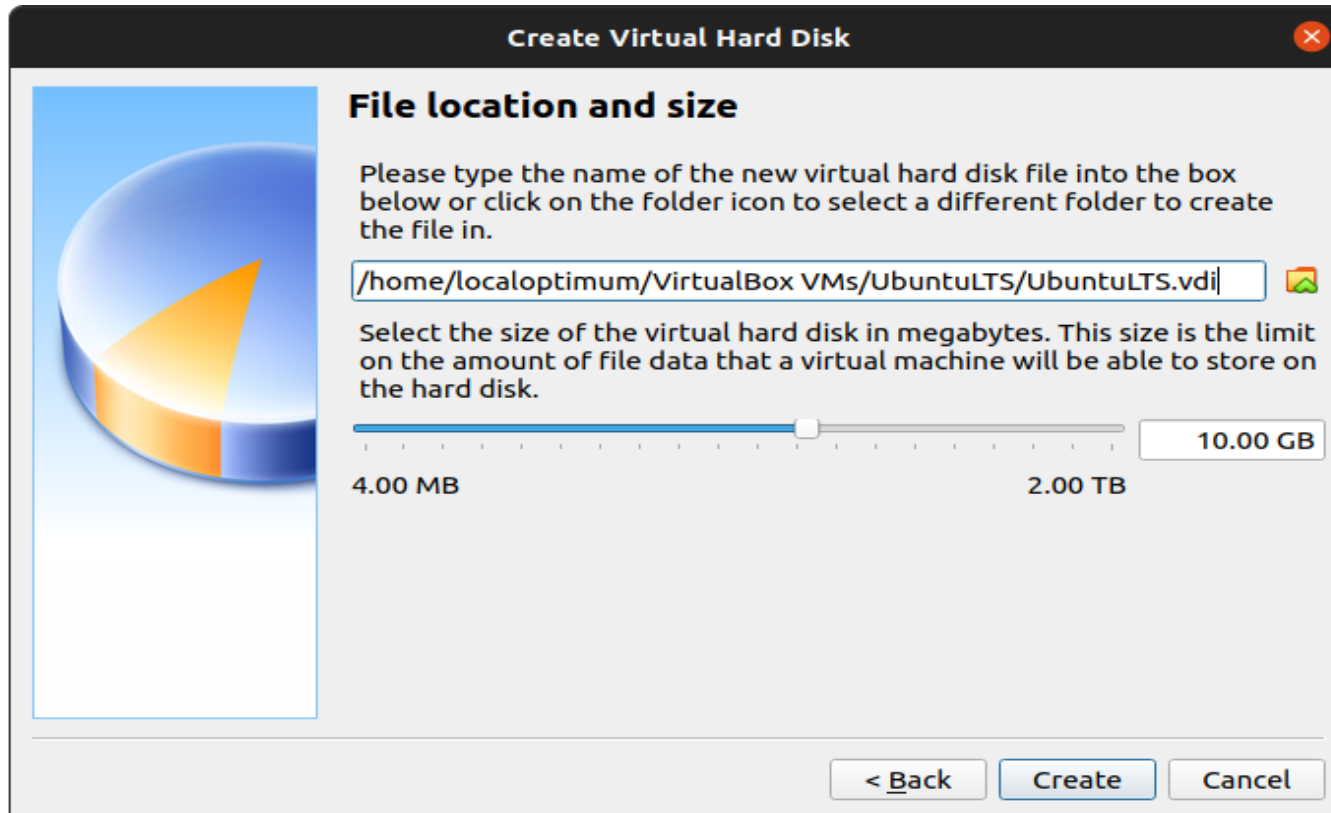
[Expert Mode] [< Back] [Next >] [Cancel]

Then you can choose whether the hard disk is dynamically allocated (up to the limit we will set on the next screen), filling up as the VM requires it. Otherwise, we can tell it to allocate the full amount of memory right from the start. This will improve performance but may take up unnecessary space. We'll leave it as dynamically allocated for this installation.
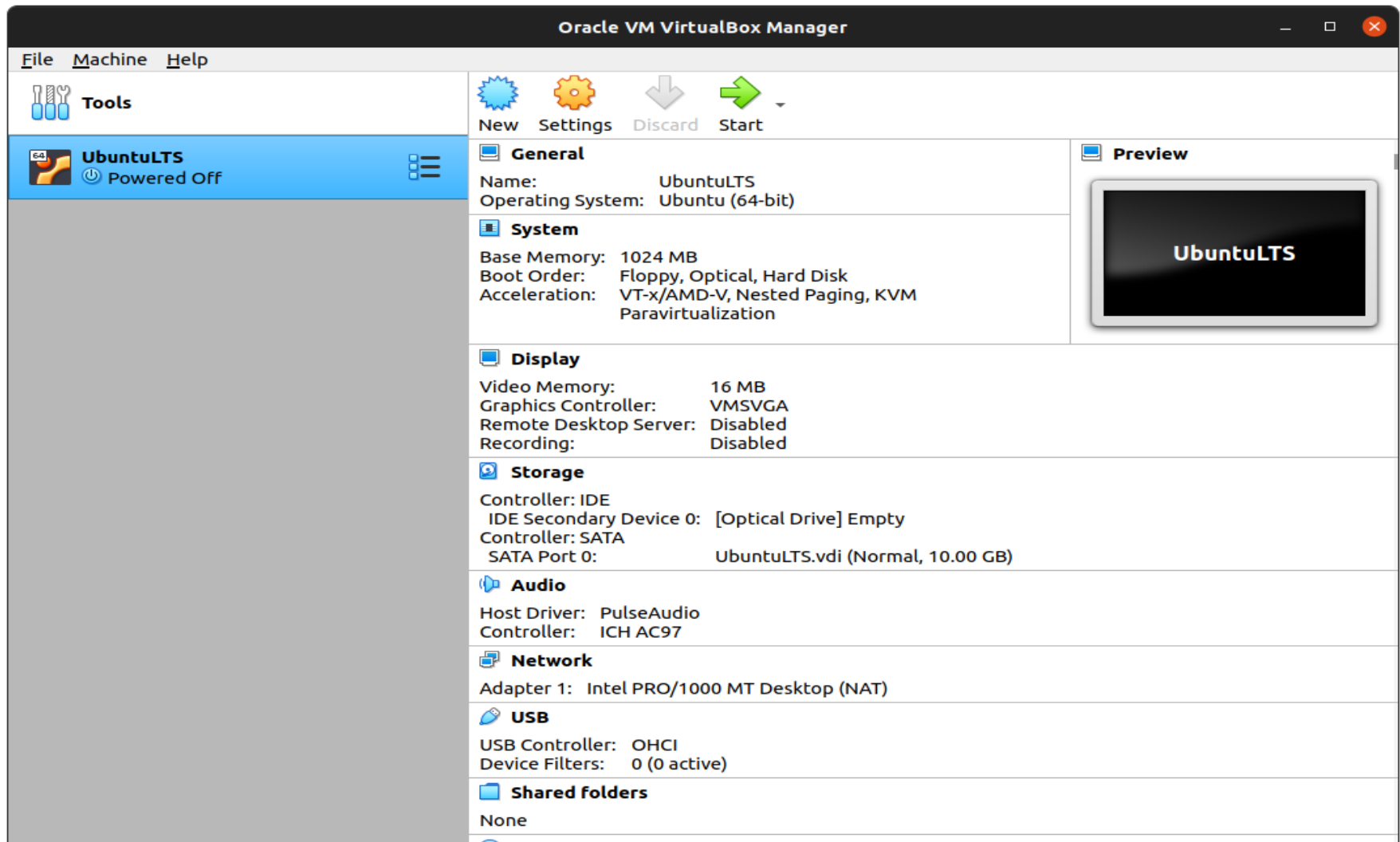
Create Virtual Hard Disk

Storage on physical hard disk

Please choose whether the new virtual hard disk file should grow as it is used (dynamically allocated) or if it should be created at its maximum size (fixed size).

A **dynamically allocated** hard disk file will only use space on your physical hard disk as it fills up (up to a maximum **fixed size**), although it will not shrink again automatically when space on it is freed.

A **fixed size** hard disk file may take longer to create on some systems but is often faster to use.

- ⦿ Dynamically allocated
- ◯ Fixed size

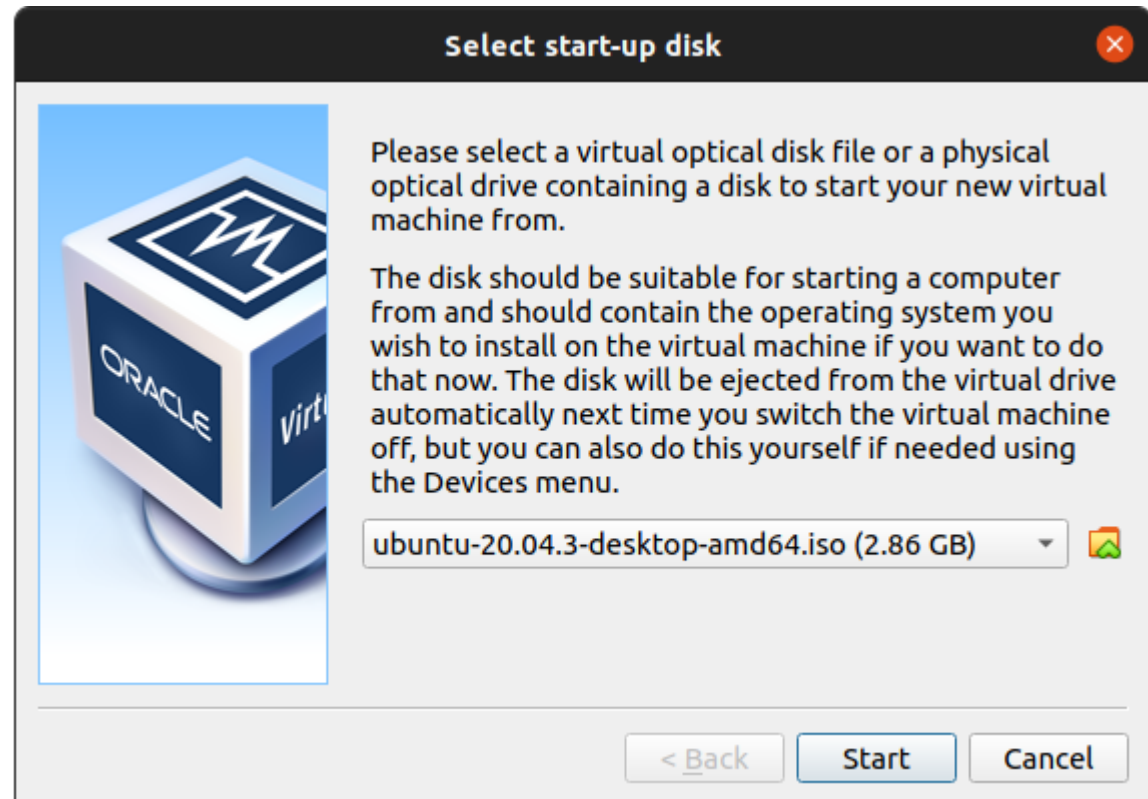[< Back] [Next >] [Cancel]

- Finally you can set the maximum amount of memory your VM can access.

Step 2. contd...
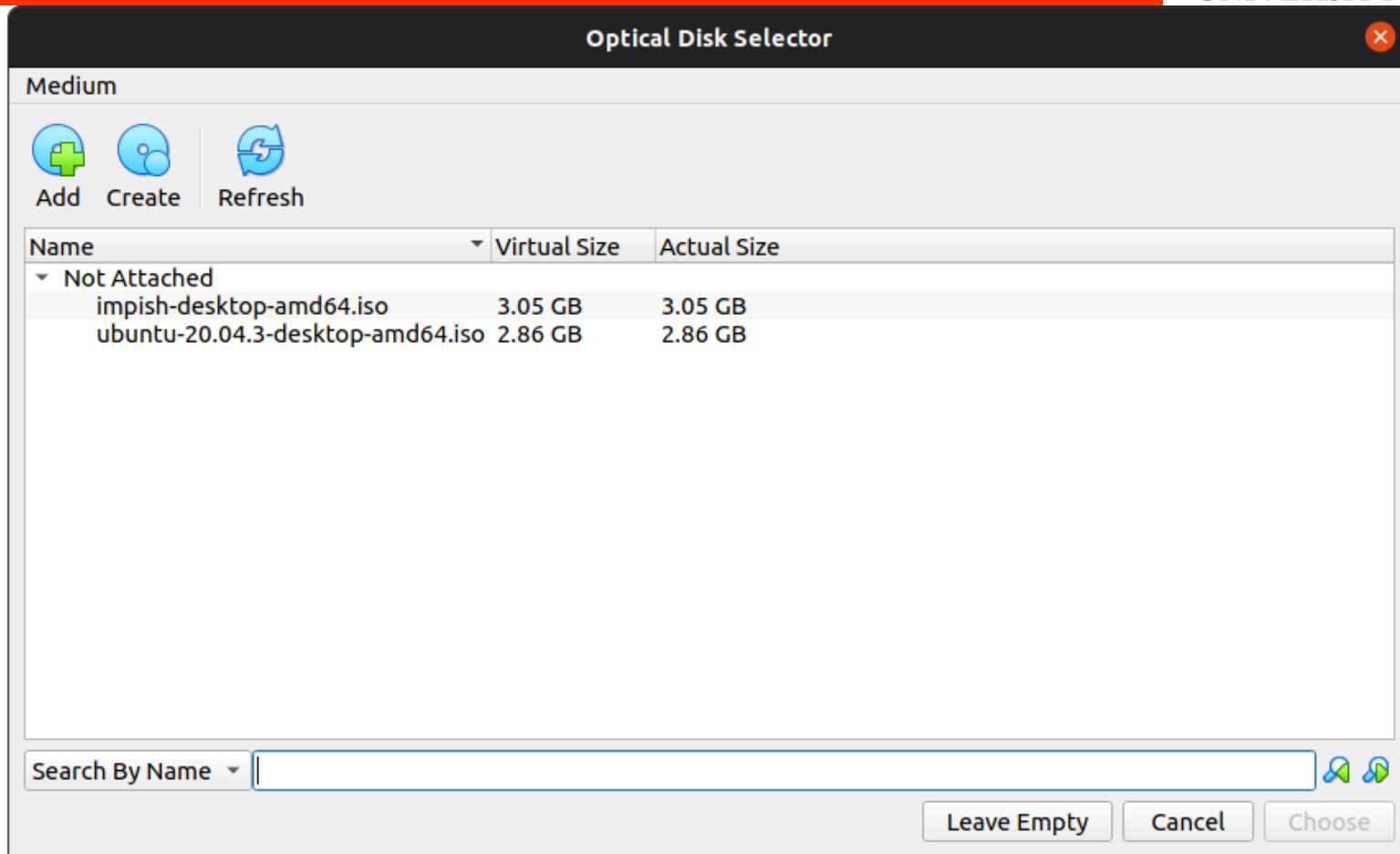
- After this click Create to initialize the machine!

- Click Start to launch the virtual machine. You will be prompted to select the start-up disk. Use the file icon to open the Optical disc selector and click Add to find your .iso file

Step 3. contd…

Optical Disk Selector

Medium

Add   Create   Refresh

Name	Virtual Size	Actual Size
▾ Not Attached		
impish-desktop-amd64.iso	3.05 GB	3.05 GB
ubuntu-20.04.3-desktop-amd64.iso	2.86 GB	2.86 GB

Search By Name

Leave Empty   Cancel   Choose

Choose the disc image you want to use, then click Start on the start-up disc window.

Note: If you close this window before selecting an image you can still do so from the Devices menu at the top of the VM window. Select Devices > Optical Drives > Choose/Create a disc image…
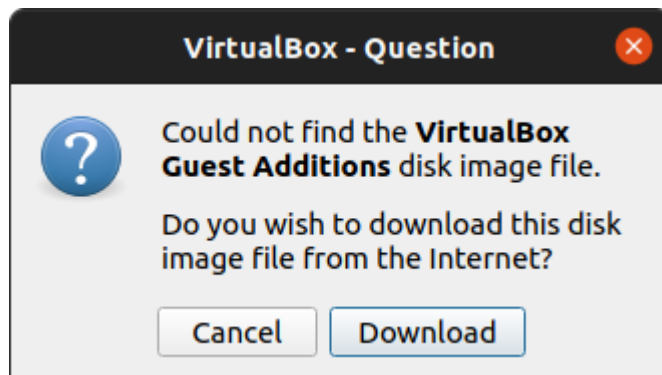
Step 3. contd...

- Ubuntu desktop should now boot and display the installation menu.
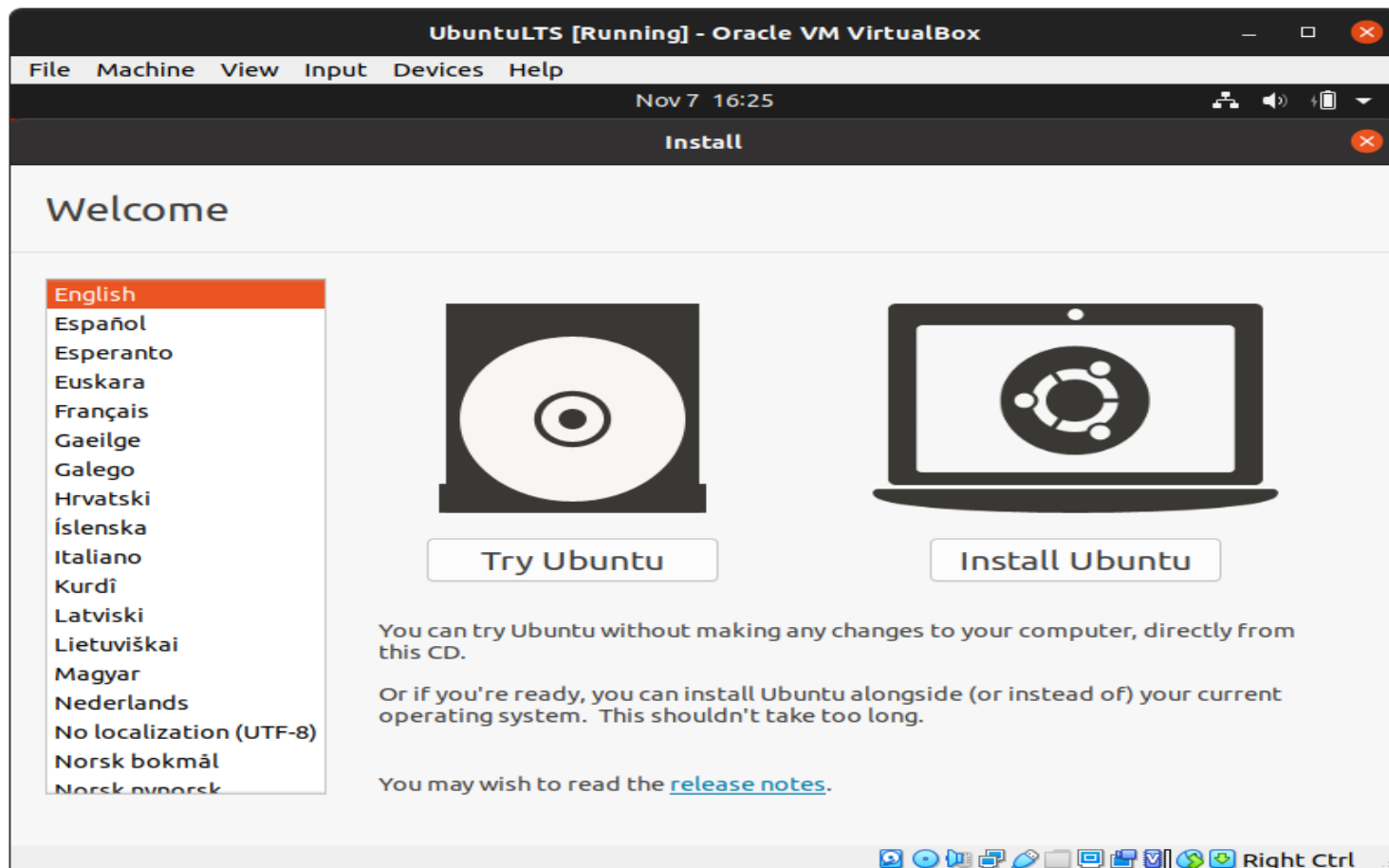
After this point you can follow the normal [installation flow](#) for Ubuntu Desktop.
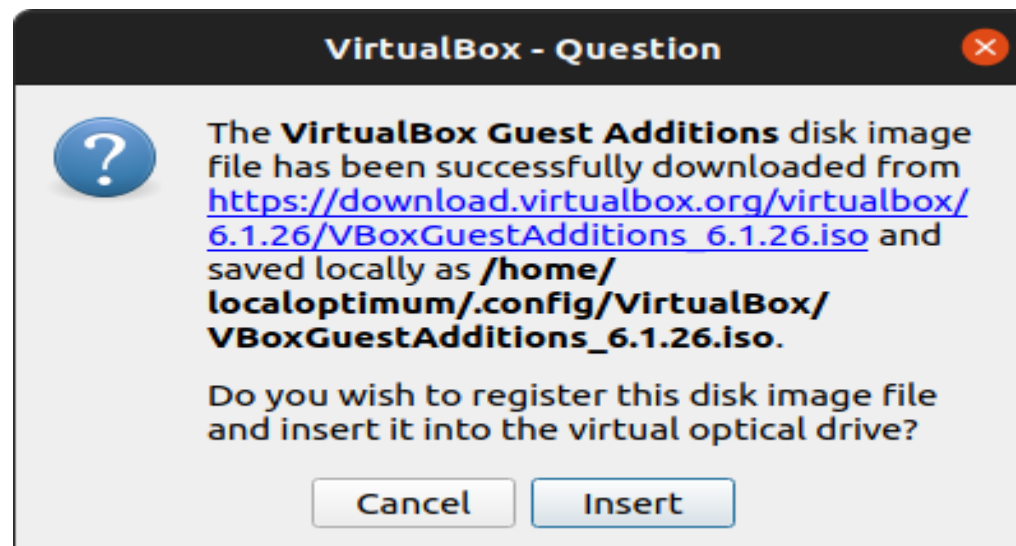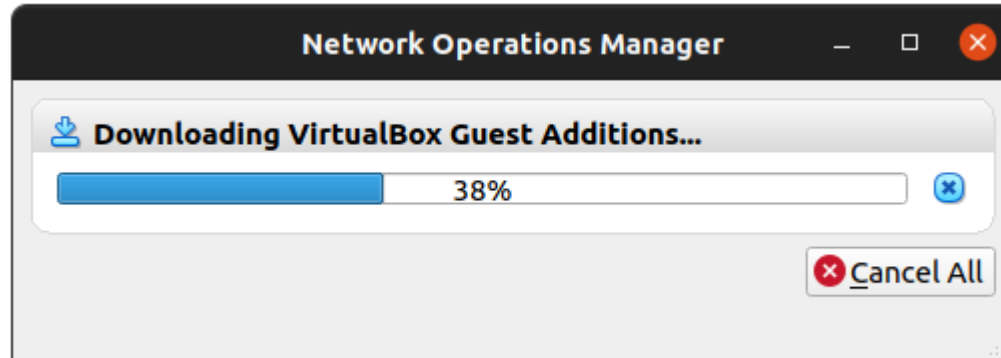
Installing Guest Additions

- Guest Additions is an extra piece of software that unlocks some more advanced features of VirtualBox. This includes better integration between your virtual machine and the host machine, as well as improved video support that enables the display resolution options when using VMSVGA.

- To install Guest Additions, you need to complete your installation of Ubuntu in your virtual machine and boot to the desktop.

- From there, select Devices > Insert Guest Additions CD.

- This will prompt you to download the Guest Additions disk image file.

VirtualBox - Question

Could not find the **VirtualBox Guest Additions** disk image file.

Do you wish to download this disk image file from the Internet?

Cancel   Download

Click Download.

Installing Guest Additions…contd..

Network Operations Manager

Downloading VirtualBox Guest Additions...

38%

Cancel All

VirtualBox - Question

The **VirtualBox Guest Additions** disk image file has been successfully downloaded from https://download.virtualbox.org/virtualbox/6.1.26/VBoxGuestAdditions_6.1.26.iso and saved locally as **/home/localoptimum/.config/VirtualBox/VBoxGuestAdditions_6.1.26.iso**.

Do you wish to register this disk image file and insert it into the virtual optical drive?

Cancel   Insert

Then click Insert.

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- The disc will appear inside your virtual desktop and you will be prompted to run the software.
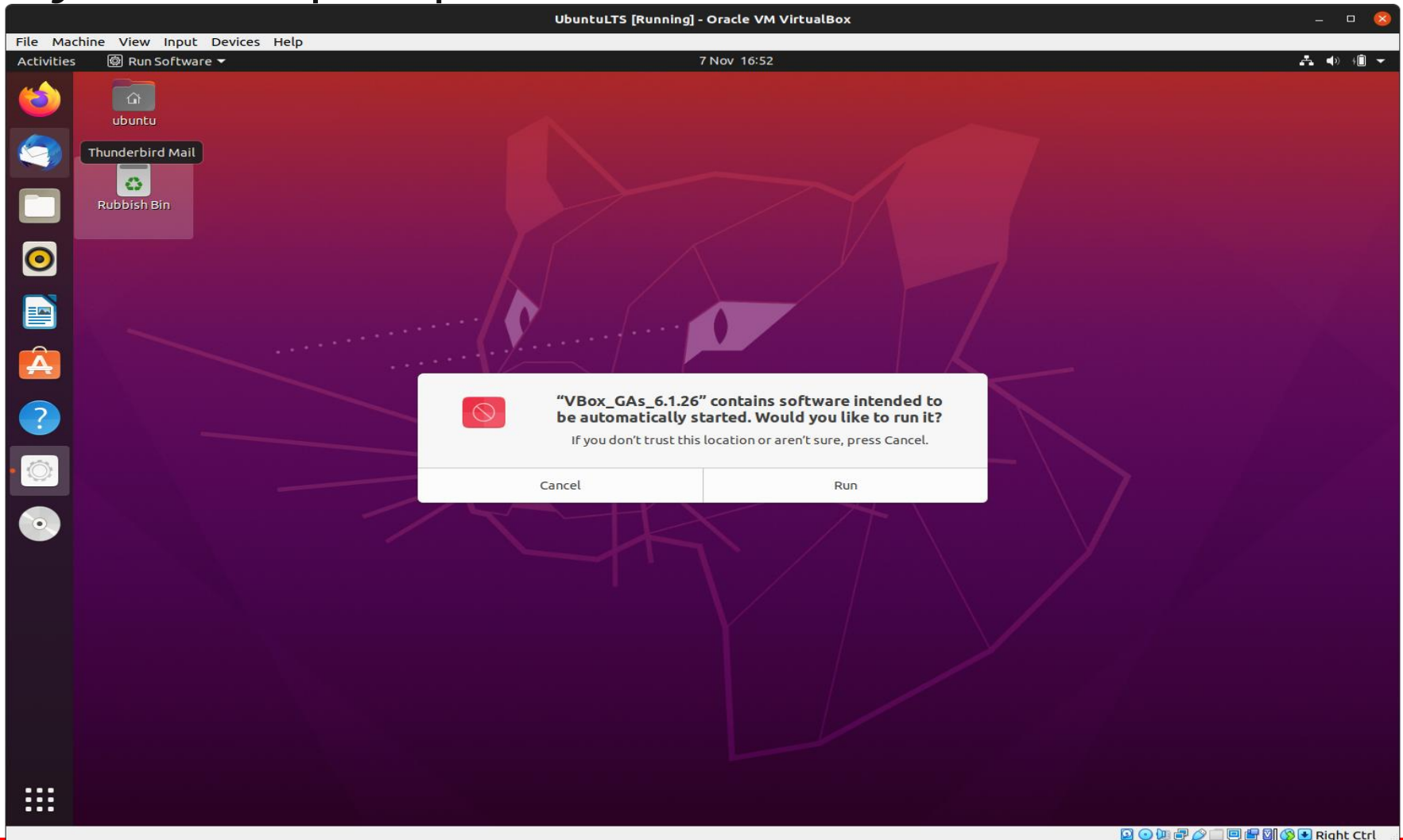
- ## Enter your password to install it.
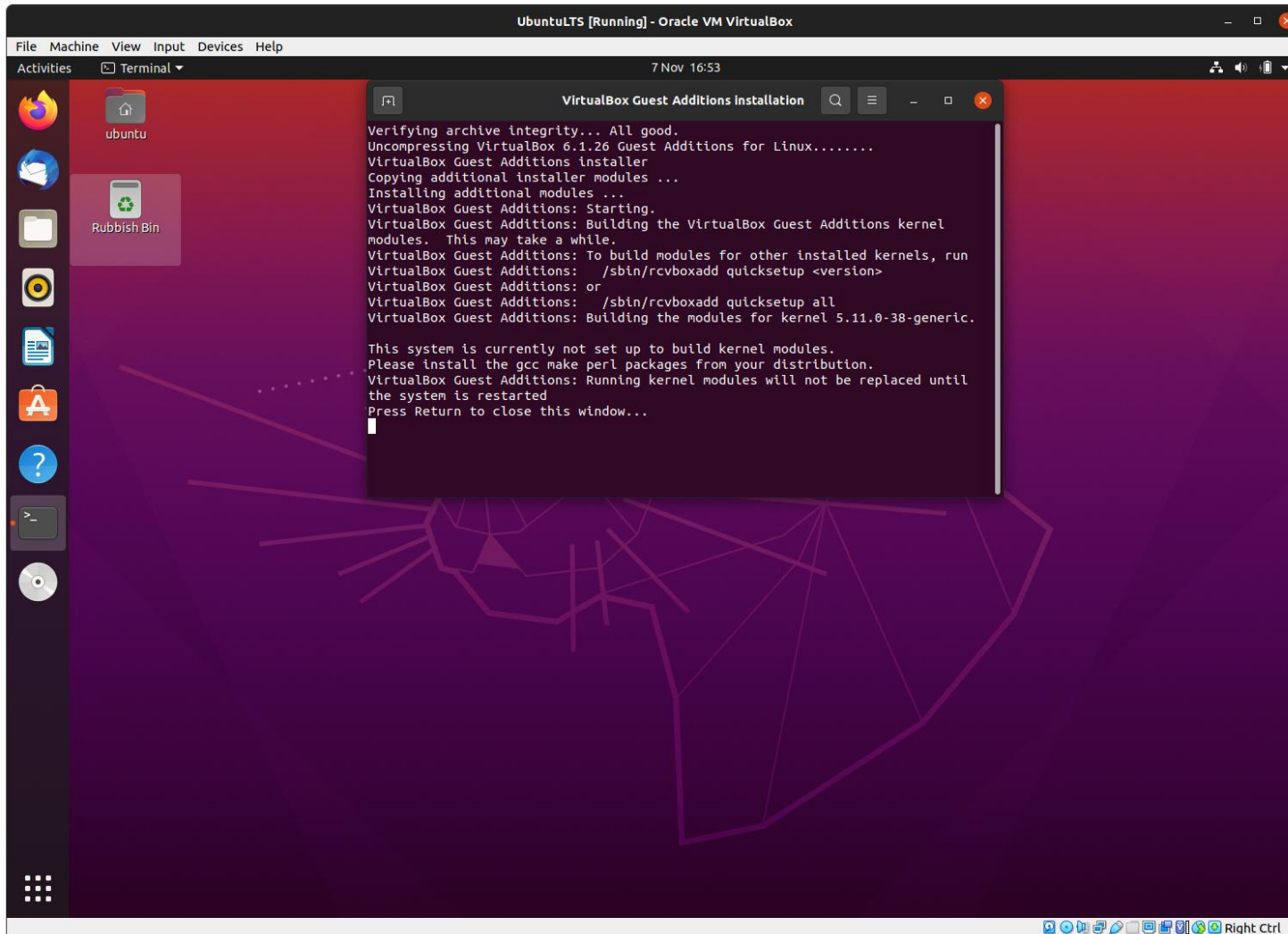
Once this is complete, you will need to restart your virtual machine for the new features to take effect.

Explore Virtual Box

- As you can probably tell, there are tonnes of further configuration options available in VirtualBox and we've only scratched the surface.

- VirtualBox allows you to create and configure multiple virtual machines, so don't be afraid to create new instances of Ubuntu to try out different system and storage configurations to fine tune your performance.

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Ubuntu flavours

Ubuntu flavours offer a unique way to experience Ubuntu, each with their own choice of default applications and settings. Ubuntu flavours are backed by the full Ubuntu archive for packages and updates.

Kubuntu ↗

Kubuntu offers the KDE Plasma Workspace experience, a good-looking system for home and office use.

Lubuntu ↗

Lubuntu is a light, fast, and modern Ubuntu flavor using LXQt as its default desktop environment. Lubuntu used to use LXDE as its default desktop environment.

Ubuntu Budgie ↗

Ubuntu Budgie provides the Budgie desktop environment which focuses on simplicity and elegance. It provides a traditional desktop metaphor based interface utilising a customisable panel based menu driven system.

Ubuntu Kylin ↗

The Ubuntu Kylin project is tuned to the needs of Chinese users, providing a thoughtful and elegant Chinese experience out-of-the-box.

Ubuntu MATE ↗

Ubuntu MATE expresses the simplicity of a classic desktop environment. Ubuntu MATE is the continuation of the GNOME 2 desktop which was Ubuntu's default desktop until October 2010.

Ubuntu Studio ↗

Ubuntu Studio is a multimedia content creation flavor of Ubuntu, aimed at the audio, video and graphic enthusiast or professional.

Xubuntu ↗

Xubuntu is an elegant and easy to use operating system. Xubuntu comes with Xfce, which is a stable, light and configurable desktop environment.