# CMPT 300
# Tutorial 1: Environment Setup

This tutorial's main focus is to get you set up with the environment we will be using throughout the course and give you an intuitive understanding of it.

**Why do we need to set up the environment?** We can specify a standard development environment on any machine with virtualization, so your code will work no matter where it has run.

Your computer is probably running Windows. Mac OS X, or Linux. These are different *operating systems.* They all come with different libraries and pre-installed software. To make sure we all work in the same environment, we will use a **Virtual Machine** (VM) running the Linux-based operating system, Ubuntu.

There are many different softwares available to run VMs. The software allows the OS inside the VM to believe that it's running on a physical computer, even though running it within an OS on another computer. We will be using **VirtualBox** (it is free).
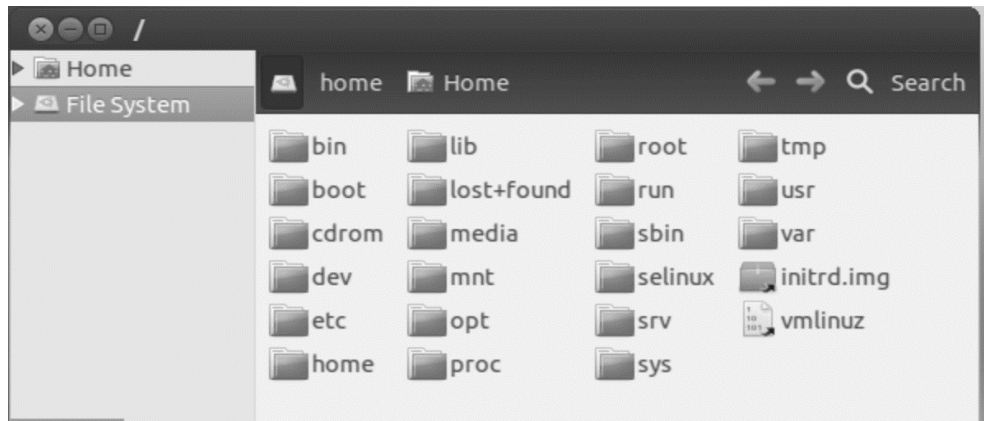
**Linux**
The Linux architecture comprises two main sections: the kernel space and userspace.

- **A kernel** is a bridge between the hardware and the operating system. When a computer boots up, the kernel is the first to load the OS. The kernel also contains the drivers for the hardware devices installed in the system.
- **Userspace** manages the user processes run by people working on the system. Some examples are e-mail client, Web browser, or word processor.

**Directory Structure:**
The Linux file system structure is different from the windows. The drive (C:\, D:\) letters are replaced by a / and cryptic-named directories, most of which have three-letter names.

- All the files are grouped together in the directory structure.
- The file-system is arranged in a hierarchical structure, like an inverted tree.
- Everything on the Linux system is located under the / directory, known as the root directory.
- Linux sorts directories descending from the root directory according to their importance to the boot process.
- The File system hierarchy standard (FHS) governs the unified file system for Linux by defining a standard set of directories, sub-directories and files.
- Linux is a case sensitive operating system

The below table provides a brief description of each of the directories. For more detail, check: https://en.wikipedia.org/wiki/Filesystem_Hierarchy_Standard

| Directory | Description |
|---|---|
| / | Everything on your Linux system is located under the / directory |
| /bin | contains the essential user binaries (programs) that must be present when the system is mounted in single-user mode |
| /boot | contains the files needed to boot the system |
| /dev | contains several special files that represent devices |
| /etc | contains configuration files, which can generally be edited by hand in a text editor |
| /home | contains a home folder for each user |
| /lib | contains libraries needed by the essential binaries in the /bin and /sbin folder |
| /root | home directory of the root user |

| | |
|---|---|
| /media | contains subdirectories where removable media devices inserted into the computer are mounted |
| /mnt | manually mount storage devices or partitions. It is not used very often nowadays. |
| /opt | contains subdirectories for optional software packages |
| /run | place to store transient files they require like sockets and process IDs |
| /sbin | contains essential binaries that are generally intended to be run by the root user for system administration |
| /proc | contains special files that represent system and process information |
| /srv | contains data for services provided by the system |
| /temp | storage of the temporary files |
| /usr | contains applications and files used by users, as opposed to applications and files used by the system |
| /var | contains files to which the system writes data during the course of its operation. |

**Linux Distribution**

Linux is actually just a kernel, so to create a complete Linux system, you have to install the source code of the kernel plus many other freely distributed software programs. These distributions have the same kernel but different interfaces. Some Linux distributions are shown in the below image :

(Image credit: https://images.app.goo.gl/tUu73zAtXJiLXBDR9)

We will use **Ubuntu** in this course for writing and compiling the C code.

**Shell**: Shell forms a layer between the user and kernel so that the user can give the command to the kernel. The kernel understands only binary codes. The shell basically converts the user recognizable commands into binary code.

**Terminal:** A terminal at the other end is the combination of all. It provides a graphical user interface to the user to write commands for the shell to convert it into a binary language.

**Installing Ubuntu**

For installing Ubuntu on Windows or Mac, you need to use Oracle VirtualBox. VirtualBox is a free platform that helps create a virtual machine and an OS installed in that machine.

Follow the below instructions to set-up VirtualBox and Ubuntu on your system.

**Note:** If VirtualBox is already installed on your system, you can find that by typing' virtual box' on your local OS's search bar.

**Task 1: Download and install Oracle VirtualBox**(On Windows) **:**
1. Download oracle VirtualBox installation .exe file from
https://www.virtualbox.org/wiki/Downloads by clicking on 'Windows hosts'

2. Double click on the downloaded .exe file and install the virtual box with all default settings.

(On Mac)

1. Download oracle VirtualBox installation .dmg file from
https://www.virtualbox.org/wiki/Downloads by clicking on 'OS X hosts'.
2. Double click on the DMG file to start the installation process.
3. Double click on the VirtualBox.pkg installer in the prompted window.
4. Select where you want to install VirtualBox and install it.
5. Keep the downloaded DMG file, which will be required for uninstalling the application.

## Task 2: Download and install Ubuntu on VirtualBox

1. Download Ubuntu ISO file from https://ubuntu.com/download/desktop by clicking on
'Download.'
2. Double click on the recently installed VirtualBox icon on your desktop.
3. Click on 'new' on VirtualBox, 'create virtual machine' window will open.
4. Set the name field as 'Ubuntu,' type as 'Linux,' and version as 'Ubuntu_64'. Click on next.
5. Memory size is default 1024Mb, but you can drag it up to the green portion. (Maximum limit
for selecting memory varies from device to device)
6. Click on next.
7. On the hard disk option, select create a virtual disk now. Then click on create.
8. Click next.
9. Click next.
10. Select the amount of space. The default space is 10GB. This space is enough for general use.
11. Click create.
12. A virtual machine is created. Now it is time to install Ubuntu on the machine.
13. Select Ubuntu and go to its setting from the top menu.
14.Click on the storage category. You will see an 'Empty' under the Control IDE.
15. Click on the CD/DVD icon, keep the option IDE Secondary Master, and upload the Ubuntu
iso file on it. Now close the pop-up window.
16. Click on start.
17. Click on install Ubuntu.
18. Click on both the checkbox and click on continue.
19. Select 'Erase disk and install Ubuntu.'
20. Click on install now.
21. Click on continue.
22. Select a time zone and click on continue.
23. Select preferred language and keyboard. Click on continue.
24. Set your name, computer name, username, and password.
25. Select 'Require my password to log in' and click on continue.
26. Please wait until Ubuntu is installed. Do not click on anything during the installation time.

27. Restart the virtual machine, and You are done!
28. Double click on your machine, and it will open your Ubuntu Operating System.

**Note:** C compiler is by default installed on Ubuntu; hence you are all set for Operating System programming.

**Some common issues faced during the installation process**

1. If you are trying to install Ubuntu on your Windows using VirtualBox, you may encounter the following error:

The installer encountered an error copying files to the hard disk: [Errno 5] Input/output error. This is often due to a faulty CD/DVD or drive or a faulty hard disk. It may help to clean the CD/DVD, to burn the CD/DVD at a lower speed, to clean the CD/DVD drive lens (cleaning kits are often available from electronics suppliers), to check whether the hard disk is old and in need of replacement, or to move the system to a cooler environment.

To fix this error, follow the steps down below:
   a) Search the start menu with 'Turn windows feature on or off' and open it.
   b) Untick the hyper-v
   c) Type cmd on the start menu search bar again and open the command prompt as administrator.
   d) Run the following command on the command prompt:
      bcedit /set hypervisorlaunchtype off
   e) Reboot your system and reinstall Ubuntu on the VirtualBox.

If you face other issues, feel free to visit the following links:
https://askubuntu.com/questions/1239382/error-when-installing-ubuntu-20-04-in-virtualbox

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