Operating Systems

Practical 1

Installation of

Mageia 8 (64 Bit) Linux

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February 2025

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Legal

1. Introduction

Linux (pronounced with a short i, as in LIH-nucks) is a UNIX operating system *clone*, which runs on a variety of platforms, especially mobile devices and of course PCs, from the lowly Intel 80386 processor up to the most modern, multi-core, 64-bit processors.

It supports a wide range of technical software, such as the GNU C/C++ compiler, TCP/IP, professional typesetting languages such as TeX and LaTeX, a Graphical User Interface provided by the X Window System, as well as general everyday applications like LibreOffice office suite, numerous Internet browsers, multimedia and games applications. It's a versatile, bona fide implementation of UNIX, freely distributed under the terms of the GNU General Public License (GPL).

What makes Linux so different is that it is a free implementation of UNIX. Note that Linux is *not* a flavour of UNIX. Instead, it is a *clone* of UNIX. It was, and still is, developed co-operatively by a group of volunteers, primarily on the Internet, who exchange code, report bugs, and fix problems in an open-ended environment. In addition, a large number of very big multinational companies and organisations also contribute to the development effort. The most-notable example of these is Google, who have led the development of the Android OS, based on the Linux kernel. Other well-known companies include IBM, US National Security Agency (NSA), Hewlett-Packard, Oracle, Red Hat, Canonical and SUSE to name just a few. Anyone is welcome to join the Linux development effort. All it takes is interest in hacking a free UNIX clone, and some programming know-how.

Currently, there are many different distributions of Linux available. Each distribution contains a Linux operating system, but may also contain additional software, which makes that particular distribution different from another. Examples of distributions include Red Hat, SUSE, Ubuntu, Debian and Mageia.

In this lab, you will learn how to install the Mageia distribution (started in September 2010 as a fork of the Mandriva distribution). Historically, this distribution has its roots in Red Hat Linux, so there are many similarities between Mageia and its predecessors (Mandriva and Mandrake Linux) as well as Red Hat and Red Hat's community distribution Fedora Core. Some of the really nice aspects of Mageia are that it has an easy installation interface and many graphical-based configuration tools.

Whatever distribution you buy or download for free from the Internet, you can always receive the source code of the OS itself for free. This makes it useful for studying Operating Systems, as we can look at the actual code of the OS! Most of this code is written in the C and the C++ programming languages.

2. Objectives & Summary

Please note: this practical requires a reasonably stable Internet connection. Also, the total amount of data downloaded will be approximately 9 GB. So, please bear this in mind in relation to any download limits you may have with your Broadband provider if you do it at home.

In this practical, you are going to learn how to install a Linux operating system (OS) onto a virtual machine. A virtual machine is a computer program that provides an emulation of a real (physical) computer, in a self-contained environment. This means that you can install any OS you want onto this virtual machine, and it won't interfere with the OS controlling the actual real (physical) computer. The use of virtual machine(s) is often referred to as virtualisation. There are several virtualisation programs available. The one *most* of you are going to use is **Oracle VM VirtualBox. However, see note later in relation to AMD Ryzen CPUs**. The OS that you install on your virtual machine is called the **guest OS**. The OS that controls the physical (real) machine/computer is called the **host OS**. Try to remember these terms as we use them extensively throughout the semester.

In this lab, your *guest OS* will be **Mageia 8 Linux X86_64 (64-bit version)**. The *host OS*, which is already installed on your computer, will generally be either a version of Windows, such as **Windows 11** or **OS X** if you are using an Apple computer. Of course, you could instead install Linux directly onto a portion of the hard-drive of your computer, where it will run considerably faster. Please ask me for advice if you wish to do this.

You may occasionally see me refer to "Windoze". This is a playful, somewhat competitive way that Linux users sometimes use to describe Microsoft Windows. Users of Windoze are consequently sometimes referred to as "Dozers" by members of the Linux community. Again, this is just a playful, somewhat competitive thing, which is not to be taken too seriously! You will occasionally see a penguin associated with Linux. This is 'Tux', the mascot for Linux – see picture below!

Although there are various different Linux distributions, the methodology of installing one distribution (Mageia 8 Linux in this case) is generally similar to other distributions.

There are a number of steps involved in this lab are outlined as follows **Note**: this is just a **summary**. Please follow the detailed steps in the later pages:

1. Download and install Oracle VM VirtualBox **along with** the Extension Pack.

2. Download a Mageia 8 64-bit network Boot Disk.

3. Create an Oracle VM VirtualBox Virtual Machine (VM), configure it, and boot it from the Mageia 8 64 bit Linux network boot disk.

4. Input some settings to allow your virtual machine to connect to the Internet to "talk" to a Linux installation server.

5. Partition the virtual disk of your virtual machine.

6. Choose packages (software) to install, and start the installation process.

7. Take an intermission while packages are installing and learn about the OS Team Project.

8. Set a password for the Linux Administrator, who is always referred to as "root".

9. Add an ordinary user account for doing day-to-day work.

10. Reboot, log in, explore and enjoy!
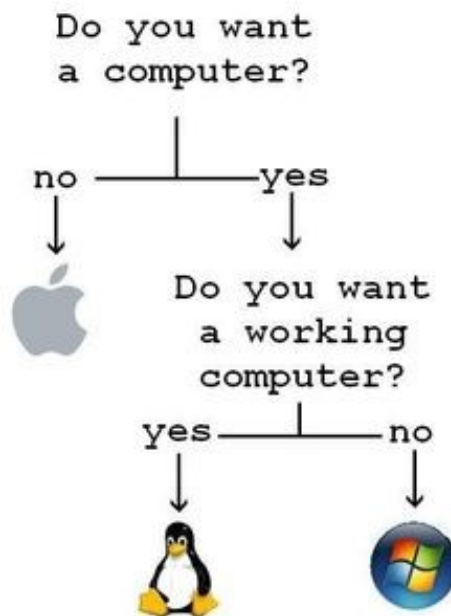
3. Downloading Oracle VM VirtualBox, Installing it

3.1. **Note re: AMD Ryzen CPUs**: If you have an AMD Ryzen CPU, please try using VMware Workstation Player if you find that Oracle VM VirtualBox doesn't work for you. Instructions here are provided for VirtualBox. However, they are broadly similar for VMware Workstation Player, available at:
https://www.vmware.com/products/workstation-player.html
Note: Both VirtualBox and VMware Workstation are installed on the PCs in E124. So, there is no need to install them again!

3.2. If you don't already have an installed version of VirtualBox *on your laptop*, or if you have an older version, navigate to https://www.virtualbox.org/ and click on the **Download** button. At the current time of writing, the most recent version is version 7.1.6. Under **VirtualBox 7.1.6 platform packages**, select the appropriate download – **windows hosts** if you have a Windows computer or **OS X hosts** if you have an Apple computer. If you have an M1 or M2 CPU on an Apple computer, use the E124 desktop PCs for the moment.

3.3. Also, you **must** download the Extension Pack. You will find a link to this further down the webpage under **VirtualBox 7.1.6 Oracle VM VirtualBox Extension Pack**. The link is called **All supported platforms**. This pack is not host-specific. So, there is the same download regardless of whether you have a Windows, OS X or indeed a Linux host. **Please note**: the version of the Extension Pack **must** match the version of VirtualBox.

3.4. Install VirtualBox first *on your laptop*. When it is finished, it may ask you to install the Extensions Pack. Since you have already downloaded this, decline this, and instead go to the menu in VirtualBox: **File -> Tools -> Extension Pack Manager**, and click on the little green "+" icon on the right-hand side. Then find the Extensions Pack file on your computer, and follow the instructions to install it.

4. Creating a VirtualBox Virtual Machine and setting it up

4.1. The following series of steps detail how to create and set up an Oracle VM VirtualBox Virtual Machine (**VM**) to prepare your Computer for installing Linux.

4.2. From your Windoze (MS Windows!!!) Desktop, double-click the **Oracle VM VirtualBox** icon to run it. Create a new Virtual Machine by clicking: <New>.

4.3. If using the E124 PCs, please create a folder in the **D:\Virtual Machines** folder naming it with your **student ID number**. DO NOT store your VM on the **C:** drive because it will be deleted automatically when the PC reboots. If using your laptop, please choose a folder of your choice to store your VM. **Note**: Do not store the VM on an external drive since it's performance will be too slow.

4.4. A series of pop-up windows will now appear. Input the information as described in the ==text steps== here – screenshots are also provided here, but ==as a guide only – don't use the values in the screenshots==.

4.5. **Name and operating system**: Input the following values:

- **Name:** ==<Your Student Number>-OS-Group#== (where the "#" is your group number; i.e. 1 for Group 1, and 2 for Group 2, etc.); For example: **B000123456-OS-Group1**
- **Type:** Linux   **Version**: Mageia (64-bit)
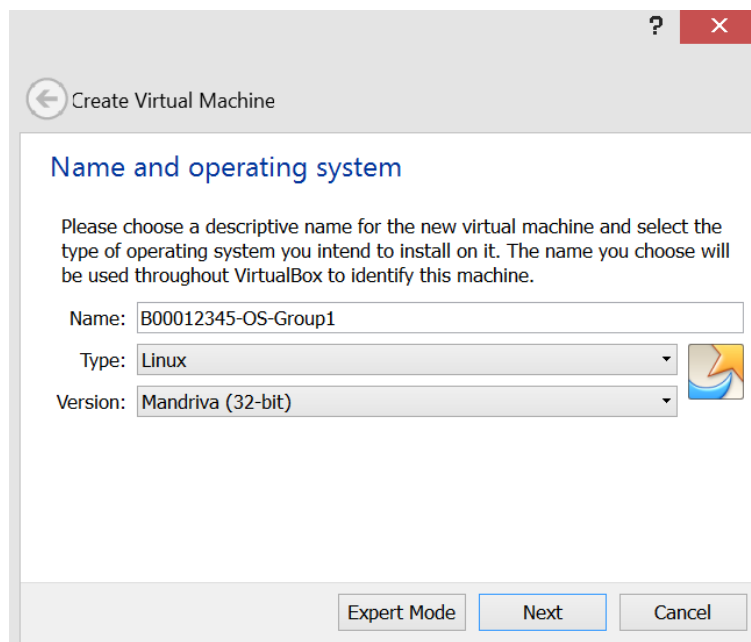
Illustration 1: 01 - Create VM - Name and OS according to the instructions in Section 4.5.

- Then, click <Next>

4.6. **<u>Memory Size</u>**: The amount of memory you allocate to your VM depends on the amount of RAM on your host computer. The PCs in E124 have 32 GB of RAM. However, your laptop will probably have less. Choose an amount of RAM about half the size of the host's RAM. You can use the slider in the window to choose an amount of RAM, which is in the green area – see screenshot below.

4.7. Then click <Next>.
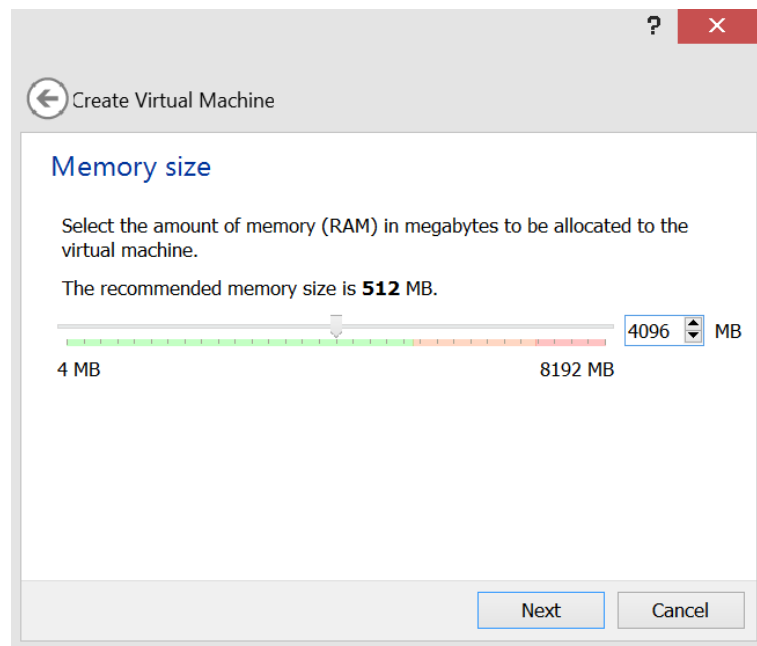
Illustration 2: Memory size: Input amount of memory as explained in Section 4.6. .

4.8. **Hard disk**: Just leave the defaults, and click <Create>. **Note**: you will set the virtual hard disk size later.
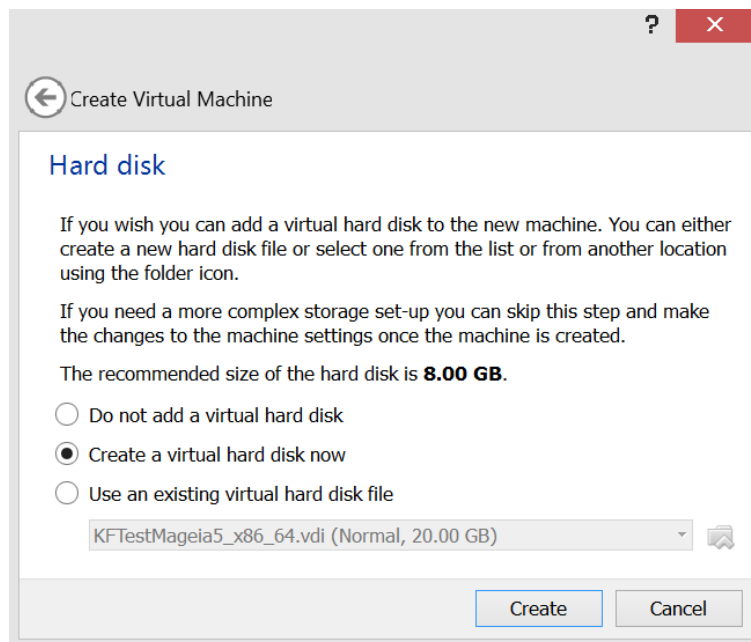
Illustration 3: Hard disk: Just leave the default, and click <Create>.

4.9. **Hard disk file type**: Leave the default type, and click <Next>:
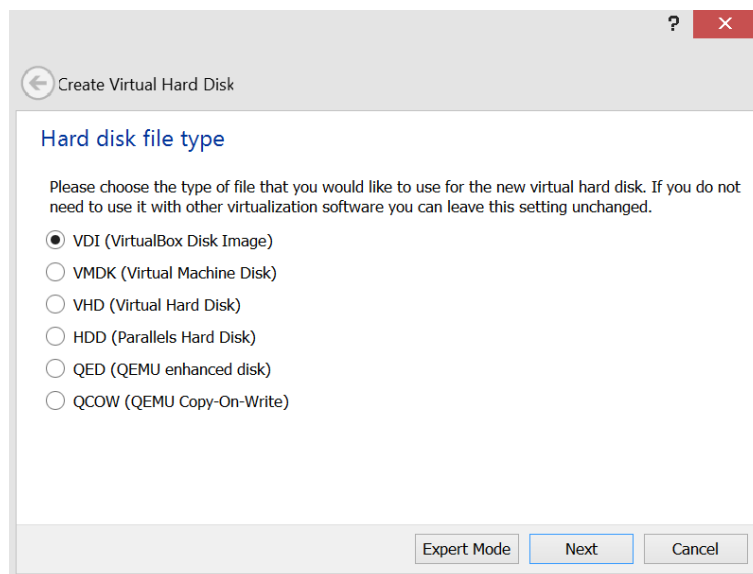
Illustration 4: Hard disk file type: Just leave the default, and click <Next>.

4.10. **Storage and physical hard disk**: Leave the default, and click <Next>:
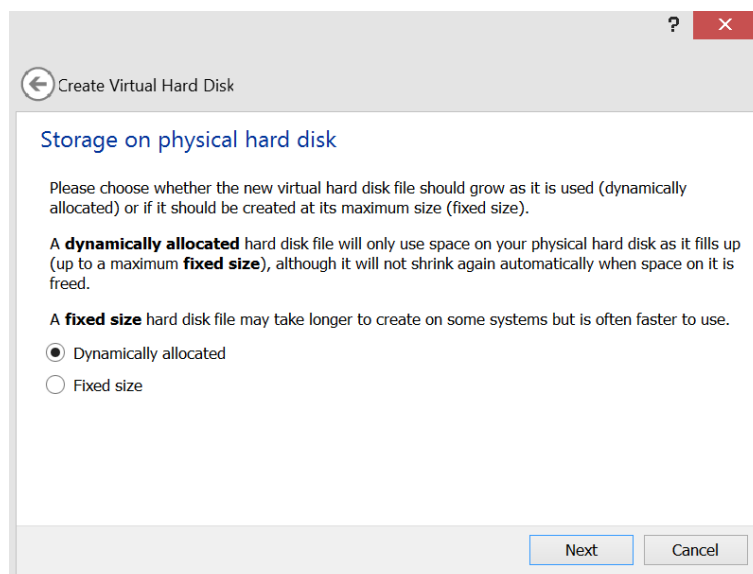
Illustration 5: Storage on physical hard disk: Leave the default, and click <Next>.

4.11. **File location and size**: Input 20.00 GB for the size of the virtual Hard Disk.

Note: this assumes you have 20 GB free on your host computer. If you have less space, you will need to delete some files or move them to an external drive. Then, click <Create>:
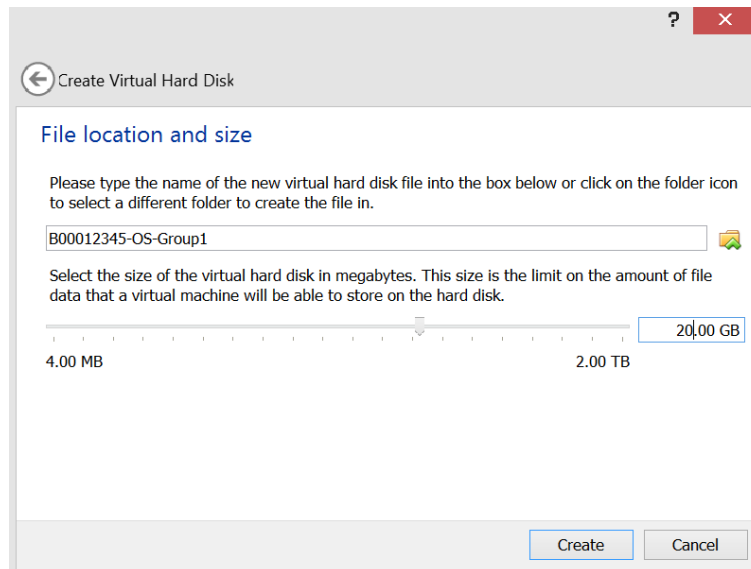

Illustration 6: File location and size: Input the value for disk size according to the instructions in Section 4.11. .

4.12. This should return you to the main window, with some details of your new VM shown:
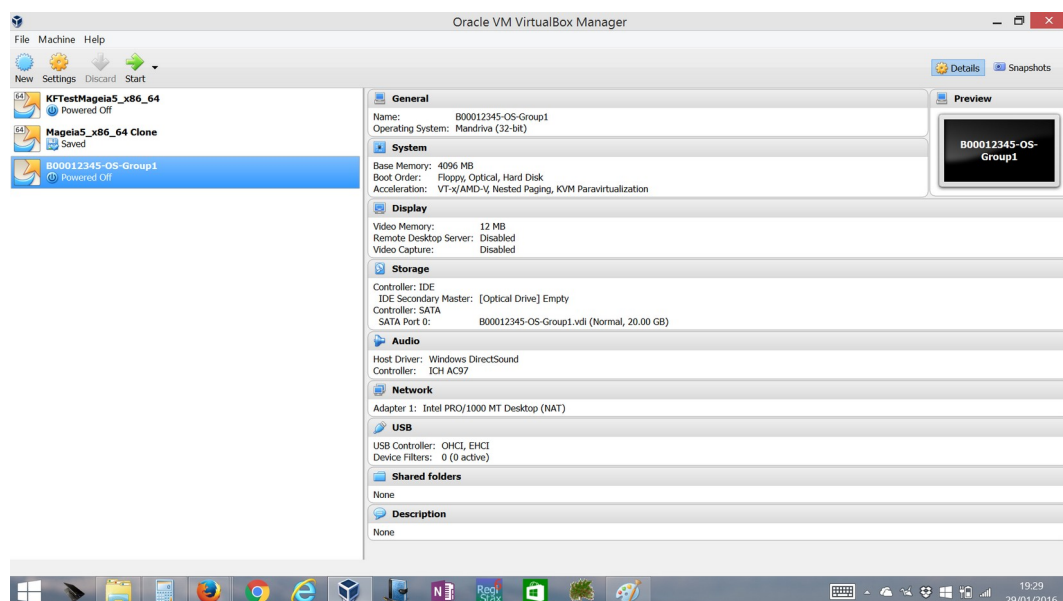
Illustration 7: Virtual Machine created: Configuration details visible in Right-hand pane.

5. Obtaining a Net Boot Disk, and Configuring your Virtual Machine

5.1. Before you start installing Linux, you need a source of installation packages for Mageia 8. Click on this link: https://www.mageia.org/en-gb/downloads/get/?q=Mageia-8-netinstall-nonfree-x86_64.iso to bring you to the Mageia download page for this version of the Mageia Linux distribution. After about 5 - 10 seconds (typically), a pop-up window will open asking you to save the Mageia 8 64-bit Network Boot CD ISO file. This is the **Nonfree Firmware 64 Bit** version.

5.2. Please make a note of where the file is saved, since you will need it for the next step.

5.3. **Storage: Controller: IDE: You** are going to use this boot CD ISO file to boot your virtual machine. To select this boot CD, do the following: in the Right-hand pane of **Oracle VM VirtualBox Manager**, click on "Storage", to bring up a window with the storage details. Then click on "Empty" under the "Controller: IDE" section:
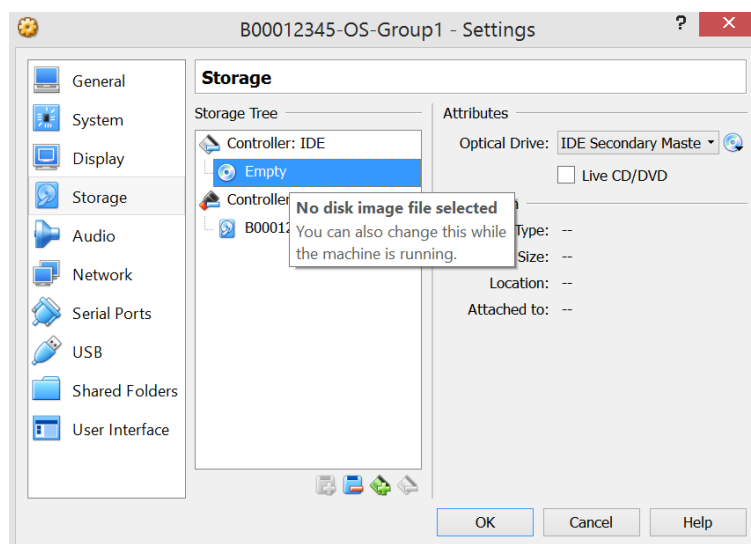
Illustration 8: Controller: IDE: Click on "Empty".

5.4. **Storage: Attributes**: On the Right-hand side of this window, in the "Attributes" section, click on the small CD icon beside "Optical Drive: IDE Secondary Master", and select "Choose Virtual Optical Disk File..." as shown in the image below:
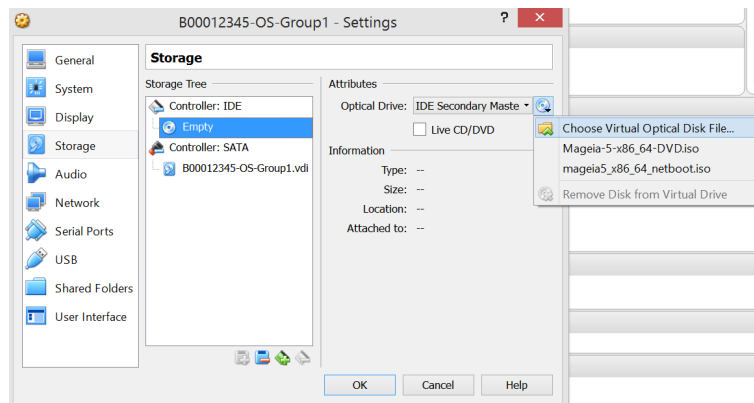
Illustration 9: Controller: IDE: Choose Virtual Optical Disk File, by clicking on CD icon in "Attributes".

5.5. **Please choose a virtual optical disk file**: In the listing, you should see the file called **Mageia-8-netinstall-nonfree-x86_64.iso**. If you don't see it, navigate to where you saved it. Click on it, and then click "Choose".

5.6. This should bring you back to the "Storage" window, which should look something like the following illustration:
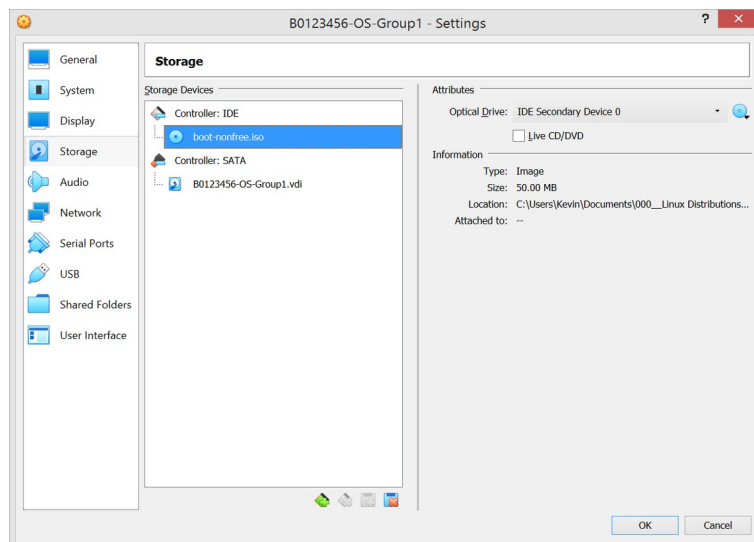
Illustration 10: boot disk selected should read: "Mageia-8-netinstall-nonfree-x86_64.iso".

5.7. Click <OK>. This brings you back to the main **Oracle VM VirtualBox Manager** window.

5.8. At this point, your new virtual machine doesn't have any operating system installed on it yet. Proceed to the next section to carry out task of installing Mageia 8 64 bit Linux.

6. Installing Mageia 8 64 bit Linux

6.1. In this section you are going to install Mageia 8 64 bit Linux using the boot disk in tandem with the installation files provided by a Linux Server running on the Internet. Therefore, you will need an internet connection for the entirety of this installation. As mentioned previously, the installation involves a data download totalling 9 GB approximately. The boot disk is used to allow your virtual machine to "talk" to the Linux Server, from which it will obtain all the necessary installation files. This is much handier than having to use loads of installation CDs!

6.2. Power on your Virtual Machine, by clicking on the green **Start** button near the top-left of the VirtualBox window.

6.3. After your VM boots from the boot CD, you should see the Mageia Linux boot menu; hit <Return>

6.4. Note that you **cannot** use your mouse for a number of windows that follow. You can only use the keyboard.

6.5. Using the arrow keys, highlight "HTTP Server". Hit <Return>.

6.6. **Network Connection Type**: Choose "DHCP". Hit <Return>.

6.7. If a pop-up appears in relation to your Windows Firewall, then allow VirtualBox access to the Internet.

6.8. **Hostname and domain-name**: Input the following settings:

6.9. Choose **<firstinitial><surname>PC** as the hostname (without the angled brackets); for e.g.: for Kevin Farrell, the hostname would be **kfarrellPC**.

6.10. Hit the Tab key (usually to the left of "Q" on the keyboard) to move to the domain name line. Type in **example.com** as the domain name.

6.11. Hit the Tab key again to highlight <OK>, and hit <Return>

6.12. **HTTP proxy host and port**: Leave blank. Just Tab to highlight OK, and then hit <Return>

6.13. **"Please select a medium from the list below"**: Choose **Mageia8** with the arrow keys, and hit <Return>.

6.14. **"Please select a mirror from the list below"**: <mark>Choose a site (a "mirror") which is relatively close to Ireland, since this will give a faster download speed. I usually choose a site in the Netherlands of Germany (one ending in .nl or .de)</mark>. Hit <Return>

6.15. A window should then appear with the server and directory details automatically filled in. If not, highlight cancel and try a different mirror. Otherwise, just Tab to highlight OK, and hit <Return>.

6.16. You should now see a red progress bar with the text "Loading program into memory".

6.17. Once the program has loaded into memory, the Graphical Installer will start. Choose the options listed below. You should be able to use your mouse at this point.

6.18. Language = Europe → English (Ireland)

6.19. License: Accept it, and click <next>

6.20. If this is not your first time installing Mageia Linux on this virtual machine (for example if this is your second or subsequent attempt), choose to INSTALL **not** UPGRADE. If it is your first time, this message won't appear.

6.21. Keyboard: Irish

6.22. Partitioning: Partitioning refers to dividing your virtual hard disk drive up into separate, distinct portions called partitions. Each partition can be used for different purposes.

6.23. Click Custom disk partitioning, followed by <next>

6.24. Click in the white space of the rectangle of the empty disk graphic (the rectangle with the label "**sda**"). The button click <Create> should appear on the right-hand side. Create the first of three partitions as follows:

- A **" / "** partition, pronounced "Slash", known as the root partition. Used for storing system files. Using the slider, choose a size = 11 GB (approx.). Note that the units are in MB on-screen Choose the default filesystem **Journalised FS: ext4**.

- Click in the white space again, and create a **swap** partition. Used for virtual memory. Choose a size = 2 GB (approx.). Choose the Linux swap filesystem. (There is no mount point for swap space).

- Click in the white space again, and create a **/home** partition, pronounced "Slash home". Used for user accounts and users' files. Choose all the remaining space, and make sure to select the mount-point **/home**. Choose the default filesystem **Journalised FS: ext4**.

6.25. If you have done this all correctly, you should see a window with a red **" / "** partition of size 11 GB (approx.) followed by a green **swap** partition of size 2 GB (approx.), followed by another red partition, called **/home** of size 7 GB (approx.). Don't worry about the sizes. They don't have to be exact! If this is not what you see. Then please click the "Clear All" button, and work through these instructions again, taking your time to follow them exactly.

6.26. Click on each partition, and note down the name of the Device (for e.g.: hard disk device names could be listed as: **sda1**, **sda2**, etc., (Strictly speaking, these should be written as **/dev/sda1**, **dev/sda2**, but the Mageia developers decided to omit the "**/dev**" portion in the description for some reason!)

6.27. Once you have recorded the names of your partitions, click "Done", and then "OK" to write the partition table to disk.

6.28. The partitions are then formatted automatically

6.29. Next, a window will appear asking you if you have additional media. You have none, so just click <Next>

6.30. Media Selection: Another window appears relating to media selection. Just click <Next>.

6.31. Under "Desktop Selection", **choose Custom**, and click <Next>. **This step is very important**. **DO NOT** **choose Plasma or GNOME**.

6.32. **Packages**: Depending on the speed of your internet connection and also the

speed of the connection to the server, it could take 10 – 15 minutes for the packages menu to completely load up. When it does, you should see listings for **Workstation**, **Server** and **Graphical Environment** package groups.

6.33. Choose ALL workstation packages.

6.34. Do not add any Server packages.

6.35. Under Graphical Environment section, you will see that Plasma/Plasma Workstation is chosen by default. ==**This is fine – leave the box ticked**==.

6.36. # DO NOT choose GNOME.

6.37. Click <Next>.

6.38. The system may give a warning regarding servers: If this question appears, answer "Yes", and click <Next>.

6.39. The installation of the chosen packages then begins. Click the <details> button to see what packages are being installed. This takes quite some time, so there is an "Intermission" section for you to work on using your Windoze host PC while the installation takes place.

7. Intermission: Reading about the Project

7.1. Download the Project Description from BrightSpace, and read it.

7.2. Search the Internet for some understandable explanations of the Dining Philosophers Problem. Discuss the Problem with your Project Team mates, explaining the things to them that you understand, and asking them if they can provide an explanation for the things that you do not understand.

7.3. If, after this, you still have difficulty understanding it, please ask your Lecturer to explain it to you.

7.4. Access the ThreadMentor Tutorial at Michigan Technological University, by clicking on the following link:
https://pages.mtu.edu/~shene/NSF-3/e-Book/index.html

7.5. Read the section on "Thread Fundamentals", and the following corresponding subsections in this section:

- Why Threads?

- Basic Thread Management

- Thread Management: ThreadMentor's Way

- Visualising Thread Execution

7.6. You may find some of the details of the material in this section challenging right now. That's okay! **<u>Note</u>**: you should return to this section several times over the course of the semester in studying your Team Project.

7.7. On paper, or in a document on your laptop/PC, list **five** things that you understand, and **five** things that you do not understand.

7.8. Discuss these **10** things with your Project Team mates, explaining the things to them that you understand, and asking them if they can provide an explanation for the things that you do not understand.

7.9. If, after this, you still do not understand some of the **five** items you listed, ask your Lecturer to explain them, and we will have a group discussion.

8. Finishing Off the Installation of Mageia 8 64 bit Linux

8.1. Set the password for the user **root** (system administrator): In the E124 Lab in TU Dublin, we would normally just set this to "qwerty". However, since it is on your laptop connected to the Internet, it would probably be best to choose a more-secure password. **<u>Please note</u>**: you must remember this password!!! If you forget it, it will cause all kinds of problems for you in future practicals. As is normal, make sure to put the same password in each of the two boxes for root.

8.2. Ordinary user: I suggest using the following convention for username (account name):

- First Initial followed by surname (without spaces)
- For e.g.: for Kevin Farrell, choose a username = kfarrell
- Input a secure password, that you can remember(!!!), for the ordinary user account. This should *not* be the same password as the **root** password. Do *not* user qwerty. Again, it is important that you remember your password! Then click <Next>.

8.3. Bootloader: In this version of Mageia Linux, the installation of the bootloader happens automatically. The bootloader is written to the FIRST sector of the drive.

This location is the Master Boot Record (MBR).

8.4. Monitor set-up: Just accept the defaults and click <Next>

8.5. Summary screen: This screen summarises your setup. Click <Next>.

8.6. Eventually, you will arrive at a screen which asks you if you wish to Setup Online Media. Answer **YES** to this question.

8.7. **You are then asked if you wish to perform updates. Answer NO to this question since updating the system would be very time consuming.**

8.8. Final Screen: You are asked to Reboot your newly installed Linux VM: click <Reboot>. Normally, this step also removes the Virtual CD from the CD Drive. However, if on rebooting, the installation commences again, power off your VM and remove the CD manually by following these steps: click: Machine → Settings → Storage → Mageia-8-netinstall-nonfree-x86_64.iso and then click on the CD icon on the Right-hand side -> click Remove Virtual CD.

8.9. First boot: If you are asked to fill in a Mageia Survey, just decline this.

8.10. Login using your ORDINARY user account NOT the root account! Well done!

8.11. Take a few minutes to explore your new Linux system. Here are some questions to get you thinking about how you can use your system. Please, write down/type the answers to these, since, later, you will be using some of the applications that I am asking you to explore:

1. What office suites (word processor, spreadsheet, presentation) are available on your system?

2. What is the desktop environment?

3. What is the name of the most common "file explorer" application available on Mageia Linux?

4. What is the file **path** to your user account home directory?

5. What application allows you to take screenshots of the screen – screenshot of the whole screen of regions or of individual windows?

6. Take a screenshot of any application window (not the full screen!), save it as a JPG.

7. Examine   the   properties   of   your   desktop: Are   there   any   desktop

wallpapers/backgrounds you can download directly from the Internet using the desktop properties? Find one, and change the wallpaper on your desktop background to it.

8. Plasma/KDE Application Panel ("Start Bar"): See if you can work out how to add and remove an "application button" to your Plasma/KDE Application Panel. See if you can add the **konsole** button to the Panel. The **konsole** program gives you a Linux command line. If you have trouble doing this, please ask me!