

OPS245 Lab 1

Contents

- 1 LAB PREPARATION
 - 1.1 Purpose of Lab 1
 - 1.2 Main Objectives
- 2 INVESTIGATION 1: Create And Install Your First Virtual Machine (c7host)
 - 2.1 Part 1: Using VMware Workstation Pro to Create a New Virtual Machine (VM)
 - 2.2 Part 2: Install CentOS on your Newly-Created VM
 - 2.3 Part 3: Completing the Installation
- 3 INVESTIGATION 2: Common Post-Installation Tasks
 - 3.1 Managing your Virtual Machine
 - 3.2 Part 1: Turning Off Locked Screen-saver
 - 3.3 Part 2: Accessing Administrative Privileges
 - 3.4 Part 3: Turning off SELinux
 - 3.5 Part 4: Perform Software Updates
- 4 INVESTIGATION 3: Using the Shell to Generate System Information Reports
- 5 INVESTIGATION 4: Using Python Scripting to Generate System Information Reports
- 6 LAB 1 SIGN-OFF (SHOW INSTRUCTOR)
- 7 Practice For Quizzes, Tests, Midterm & Final Exam

LAB PREPARATION

Purpose of Lab 1

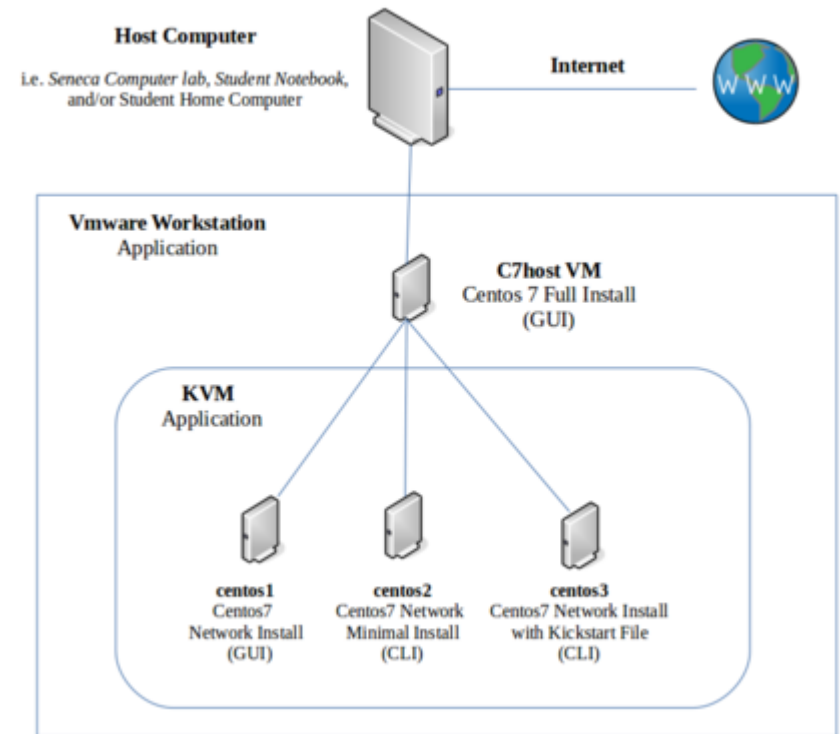
In order to save money and resources when learning to install, to manage, and to connect Linux machines to form networks, we will be using **Virtual Machines** for this course. In fact, we will be using two virtual machine programs:

- **Lab 1:** Create a **CentOS 7 Host virtual machine** (called **c7host**) in the virtual program called **VMware Workstation** (this host will be stored on your Solid State External Drive (SSD)).

- **Lab 2:** Install a **Virtual program package** on your **CentOS 7 Host virtual machine** called **KVM** which will be used to create 3 remaining Virtual Machines (VMs) that will be used to learn about Linux system administration for the remainder of this course.

It is **ESSENTIAL** to have a **Solid State Drive (SSD)** with a **minimum storage capacity of 240 GB** to perform your lab sessions and provide a host for your other CentOS 7 host and other VMs that you will create in Lab 2. **Due to space requirements, you are NOT permitted to share this SSD drive with any other course material than our OPS235 course.**

NOTE: It is feasible to use a notebook computer with sufficient hard disk capacity to perform these labs (as you would for an SSD drive). It would require that your notebook computer can connect to the Internet (including in Seneca's computer labs). You would be required to follow the same instructions for this lab (SSD) Note: It may take one or two weeks before students can obtain their free version of VMware Workstation Pro; therefore, it may be more convenient to purchase an SSD to be able to start lab1 immediately. It is strongly recommended to NOT use VMware Player.



The VMware Workstation application will allow you to create and administer 4 different virtual machines (VMs) on your computer system.

Main Objectives

- **Correctly install the CentOS 7 FULL INSTALL DVD (c7host)** on your SSD using **VMware Workstation**.
- Note common Linux commands and record them in your lab1 logbook.
- Use **Shell scripts** to generate a post-install report for your CentOS 7 host VM.
- **Disable Linux Kernel security enhancements** to allow easier internal networking connections (to be reactivated in a later lab).

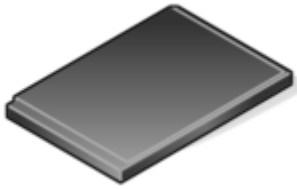
Minimum Required Materials

Linux Command Reference

Package Management

Miscellaneous

Matrix on-line tutorials



Solid State Drive
Minimum Size: 250GB



Lab Logbook
(lab 1)

- rpm (<https://linux.die.net/man/8/rpm>)
- yum (<http://man7.org/linux/man-pages/man8/yum.8.html>)

System Information

- hostname (<http://man7.org/linux/man-pages/man1/hostname.1.html>)
- uname (<http://man7.org/linux/man-pages/man1/uname.1.html>)
- ps (<http://man7.org/linux/man-pages/man1/ps.1.html>)
- lsblk (<http://man7.org/linux/man-pages/man8/lsblk.8.html>)

Networking

- ip (<https://man7.org/linux/man-pages/man8/ip.8.html>)
- nslookup (<http://linux.math.tifr.res.in/manuals/man/nslookup.html>)

- grep (<http://man7.org/linux/man-pages/man1/grep.1.html>)
- wc (<http://man7.org/linux/man-pages/man1/wc.1.html>)
- pwd (<http://man7.org/linux/man-pages/man1/pwd.1.html>)
- ls (<http://man7.org/linux/man-pages/man1/ls.1.html>)
- more (<http://man7.org/linux/man-pages/man1/more.1.html>)
- file (<http://man7.org/linux/man-pages/man1/file.1.html>)
- wget (<http://man7.org/linux/man-pages/man1/wget.1.html>)
- chmod (<http://man7.org/linux/man-pages/man1/chmod.1.html>)
- vi (<https://ss64.com/vi.html>)

- Linux Basics: **/home/ops235/linux-basics**
- Using the vi Text Editor: **/home/ops235/vi-tutorial**
- Shell Scripting - Part I (Scripting Basics): **/home/ops235/scripting-1**

INVESTIGATION 1: Create And Install Your First Virtual Machine (c7host)

In this lab, you will learn how to install your **CentOS Full Install DVD** as a virtual machine using the **VMware Workstation** application.

Part 1: Using VMware Workstation Pro to Create a New Virtual Machine (VM)

c7host VM Details:

- **Name:** c7host
- **Boot media / Installation:** CentOS 7 Full Install DVD (image file)

Download at Seneca Lab (https://mirror.senecacollege.ca/centos/7/isos/x86_64/CentOS-7-x86_64-DVD-2009.iso)

Download from Home (https://mirror.netflash.net/centos/7.9.2009/isos/x86_64/CentOS-7-x86_64-DVD-2009.iso)

- **Disk space:** 238GB
- **CPUs:** 1 CPU, 4 cores (**Do not mix and match! Always use 1 CPU, and multiples of 2 for cores.**)



If you are using an external drive: **FORMAT YOUR External SSD AS exFAT**

You *must* format your external drive as exFAT.

By default, most external drives will be formatted for NTFS. **NTFS-formatted drives will cause issues in this course!** When you plug your drive in, open My Computer, right-click on the new drive, and select *Format...*

If you are storing the vmdk file on your machine's internal storage, this is not necessary.



Confirm External SSD Device is Recognized as a Drive in Windows Explorer

It is essential that your Windows machine recognizes your SSD device with a drive letter on your Windows machine. You may experience problems if you are using the Kingston SSD. If so, then run **diskmgmt.msc** in order to create a volume and format your disk1.



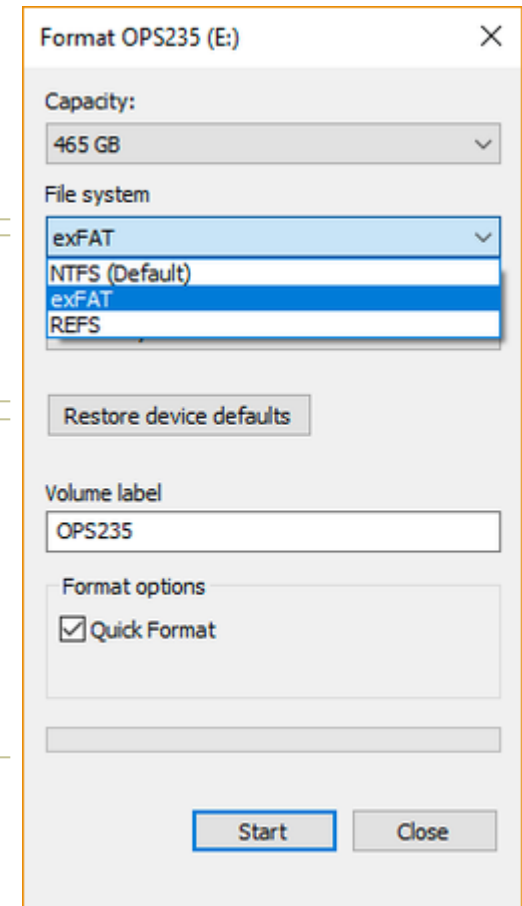
Enabling Virtualization on your Home Computer

If you are going to try this lab on your home computer, there are a few things you need to be aware:

- **RAM Size considerations:** Your Seneca Lab Workstations have **16GB** of RAM. Your home computer should have a sufficient amount of RAM in order to function efficiently.
- **Enable Virtualization in home computer's BIOS:** Most home computers do not have Virtualization enabled on their computer's BIOS. In your machines BIOS/UEFI: Enable the options VT-X(required) and VT-D(only if available)

Before you can install your CentOS Full Install DVD onto your Virtual Machine, you must first create a storage container which is a virtual machine that will provide a platform for you to install your CentOS operating system.

Perform the Following Steps:



Format drive window in order to format your new SSD as exFAT (Windows)

1. Although the images may be a little out of date (i.e. not exact), you can refer to this listing of installation screenshots for general reference:

[installation screen-shots (<http://matrix.senecac.on.ca/~murray.saul/ops235/ssd2/>)]

2. Power up the computer in your Seneca lab in **Windows**.

3. If you haven't already downloaded the CentOS 7 Full Install DVD ISO, then do so now.

4. Plug your SSD drive into your computer. Note the drive letter for that device.

5. Format your SSD to use exFAT, **not** NTFS. Open *My Computer*, right-click on the SSD, and select *Format....* The dialog box should have the **exFAT** option selected, as the example to your right shows. Once selected, click *Start*.

6. Create a folder called: **Virtual Machines** on your SSD device.

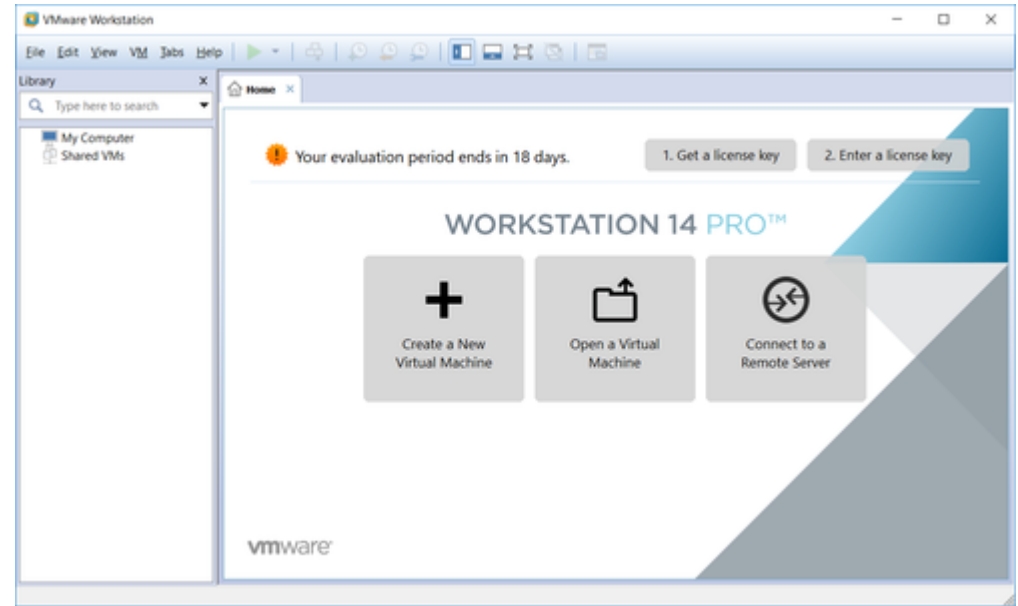
7. On your Seneca computer lab workstation, click the **Windows Menu** button and type **VMware**.

8. There are two VMware products: **VMware Workstation Pro** and *VMware Player*.

9. Run the **VMware Workstation Pro** application (do **NOT** run *VMware Player*!).

10. In your VMware Workstation application window, click the **Edit** menu, then select **Preferences**. Under the **Default Location For Virtual Machines**, enter the pathname for the newly created folder in your SSD device and click **OK**.

11. Click on the item labelled **Create a New Virtual Machine**.



Main VMware application window in order to create a new Virtual Machine (VM)

NOTE: We will just be creating a "shell" for the VM to contain our CentOS 7 Linux operating system. This will allow us to configure the VM properly so it will boot-up properly in our Seneca labs.

12. Select the **Custom (advanced)** for the Virtual Machine Configuration setting and click **Next**.

13. Click **Next** at the next screen to proceed.

14. Select the **I will install the operating system later** option and click **Next**.

15. In the next screen, select **Linux** as the **Guest Operating System**, and **CentOS 7 64-bit** for the OS *version* and click **Next**.

16. Enter **c7host** for the *Virtual machine name* and note the location where the image will be stored on your Windows machine and click **Next**.

NOTE: Since this "virtual machine" will be supporting other virtual machines (i.e. nested VMs), it is recommended to select a **higher number or core processors** (like 2 or 3).

You can always change this setting later on to maximize the performance of running the "nested" VMs on your Host VM.

17. Select **1 CPU, 4 cores** and click **Next**.

18. In the following screen, change the Memory from *1GB* to **8GB** (i.e. **8192 MB**) and click **Next**.

19. Click **Next** to accept the default (i.e. **NAT**) for the network type.

20. Click **Next** to accept the default (i.e. **LSI Logic**) for the SCSI Controller type.
21. Click **Next** to accept the default (i.e. **SCSI** for the virtual disk type).
22. Click **Next** to accept *Create New Virtual Disk*.
23. Change the Maximum Disk Size from *20GB* to **238GB** and click **Next**.
24. Accept the default Disk File name (i.e. *c7host.vmdk*) and click **Next**.
25. Quickly review your VM settings in the final setup wizard dialog box and click **Finish**.
26. You should now see a detailed screen for your **c7host** VM on the right-hand side.



ATTENTION

PRIOR to proceeding, you **MUST** perform the following step BEFORE starting your Host VM in order to allow your Host VM to run correctly!!!

Students that do not follow these procedures exactly will run in to problems when trying to perform lab2 !!! You have been warned!!!.

27. Make certain that your Host VM is **NOT** powered on before proceeding!
28. In the right-hand window (below "c7host"), and below "*Power on this virtual machine*", click the link called **Edit virtual machine settings**.
29. In this setup dialog box, click the **options** tab and then click the **Advanced** option at the bottom of the list. On the right-hand side, under *Firmware Type*, **select the radio button for UEFI**. Then click on the **Hardware** tab, and then select the **CD/DVD (IDE)** device and select in the right-side select the radio button for the **use ISO Image file**. Click the **Browse** button and specify the path of your downloaded CentOS 7 Full install DVD (most likely file is contained in your Downloads folder). Click **Processors**, and click the check-box to enable **Virtual Intel VT-X/EPT or AMD-V/RVI**. When finished, click on the **OK** button.
30. You will return to your c7host VM. Click **Power on this virtual machine** icon near the top to boot your c7host VM to start your c7host VM, and proceed to Part 2.

Part 2: Install CentOS on your Newly-Created VM

The next step is to perform a custom installation for your CentOS 7 virtual machine using the CentOS 7 Full DVD. Upon creation of your c7host virtual machine, The VMware Workstation application will automatically simulate a "boot" to allow you to complete the installation process to create the CentOS 7 operating system on that virtual machine.

Perform the following steps:

1. Select from the installation menu: **Install CentOS 7**.
2. Next, you will be prompted for a language. In the first screen, select language **English** with subselection **English-Canada** and then click the **Continue** button on the bottom right-hand screen.
3. The **Install Summary** should now appear. This screen allows the installer to customize their CentOS 7 system prior to installation.

4. Configure the following installation settings from the *Install Summary Screen*:

DATE & TIME:

- Click on the Map to select Toronto area (you may also select from the drop-down menu section)
- Click the **DONE** button at the top-left corner to finish and return to the Installation Summary screen.

SOFTWARE SELECTION:

- Select the software packages labelled: **Gnome Desktop**
- Click the **DONE** button at the top-left corner to finish and return to the Installation Summary screen.

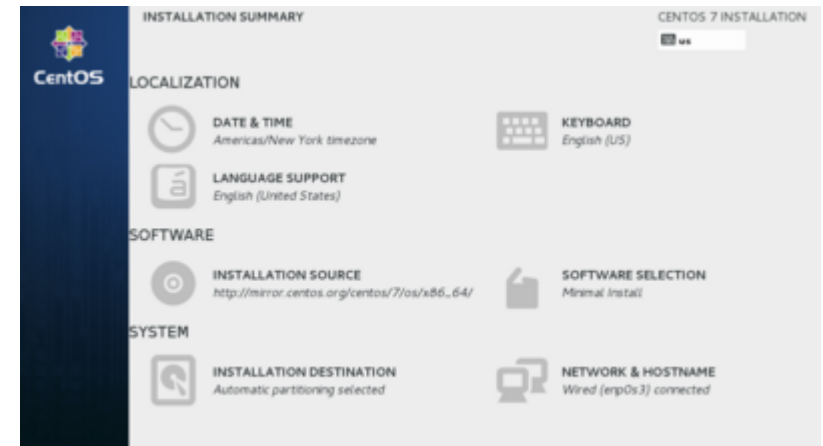
NETWORK & HOSTNAME (you may need to scroll downwards):

- Select the default Ethernet connection and click the button on the top right-hand side to change the setting from **OFF** to **ON**.
- **Also, at the bottom left-hand corner**, type the hostname: **c7host** (all lowercase letters)
- Review your settings, then click the **DONE** button at the top-left corner to finish and return to the Installation Summary screen.

INSTALLATION DESTINATION:

- From the installation summary screen, click **Installation Destination**.
- In the installation destination screen, select the destination option: **I will configure partitioning** and then click **Done**.
- The manual partitioning screen should appear.
- If you have used your hard disk for previous Linux (CentOS) distributions, you should remove them. Click on the distribution, and for each partition, select the partition and click the remove button (minus sign) and confirm deletion.

Remember that the sizes are recorded in MB (eg. 30 GB = 30000 MB) and you should multiply GB by a factor of 1024



The **Installation Summary** screen provides flexibility when configuring to install on your computer.



Mount Points and Linux File System Types

Similar to other Operating Systems like windows **fat** / **vfat** / **ntfs** file system types, it is good to know a few common file system types in Linux for comparison:

- **xfs**: Newer filesystem (fast transfer rates for large files, Journaling)
- **ext4**: Newer filesystem supporting large files and Journaling (used in for this lab)
- **ext2**: Stable filesystem popular for databases (no journaling)

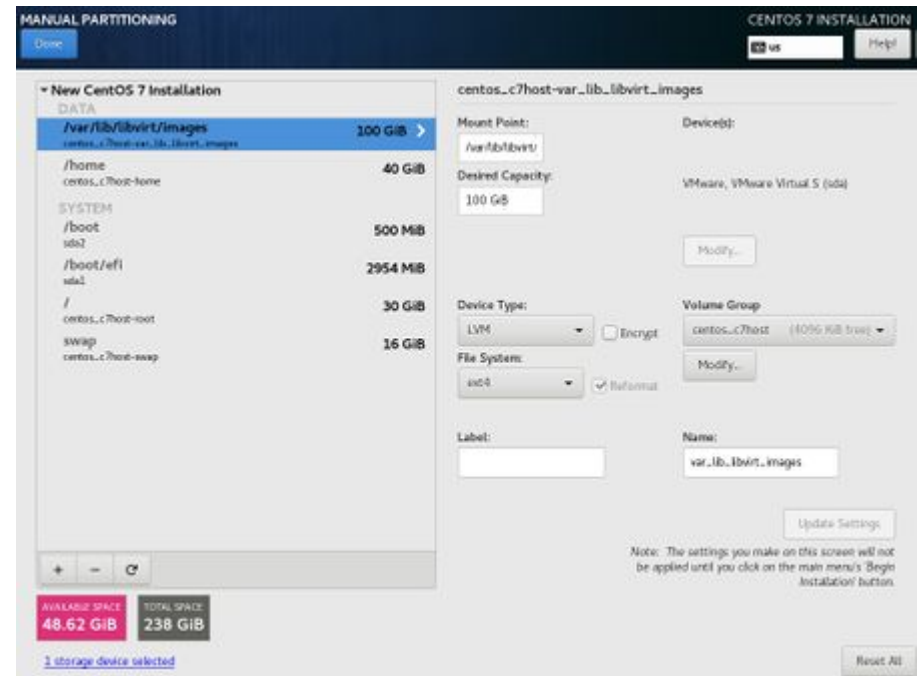
to get the correct size. (eg. **30 GB x 1024 = 30720 MB**)

5. We will now create our partitions. **Click on the add button (plus) sign.**
6. In the **Add a New Mount Point**, click the drop-down button and select **/boot/efi** for the mount point and type **2954** as the desired capacity, and then click **Add mount point**.
7. When you return to the main screen, make certain that this mount point is a **Standard Partition** and not **LVM**.
8. Add the **/boot** mount point with a size of **500**. Leave the default settings and file system as **xfs**.
9. Add another mount point, but in the **Add a New Mount Point** screen, select **/** as the mount-point (either by typing or selecting from drop-down menu), and enter **30720** in for partition size and click **Add Mount Point** button.
10. You will return to the previous dialog box.
For the **/** partition, change the file-system type from **xfs** to **ext4** and make certain that the Device Type is set to **LVM**.
11. Repeat the same steps above for the **/home** partition (calculate the equivalent size for **40GiB** (**ext4** file-system type and **LVM** as device type).
12. Add a mount point **/var/lib/libvirt/images** (type yourself, check spelling!) for size **100GiB** (file-system type **ext 4** and device type **LVM**).
13. Recheck each of the created partitions, and make certain that the file-system type is set to **ext4** and the Device Type should be **LVM**, **unless the instructions above tell you otherwise**.
14. Finally, add a swap partition (Mount Point: swap) for **16 GiB**.
15. Check that your partition settings are correct (you can ask your instructor or lab monitor to confirm), and then click **Done** (possibly **twice**) in order to proceed
16. A Summary of Changes screen will appear to show the partitioning operations that will be created. Click the **Accept Changes** and click **Begin Installation** in the Installation Summary screen to proceed with the installation.

Part 3: Completing the Installation

Perform the Following Steps:

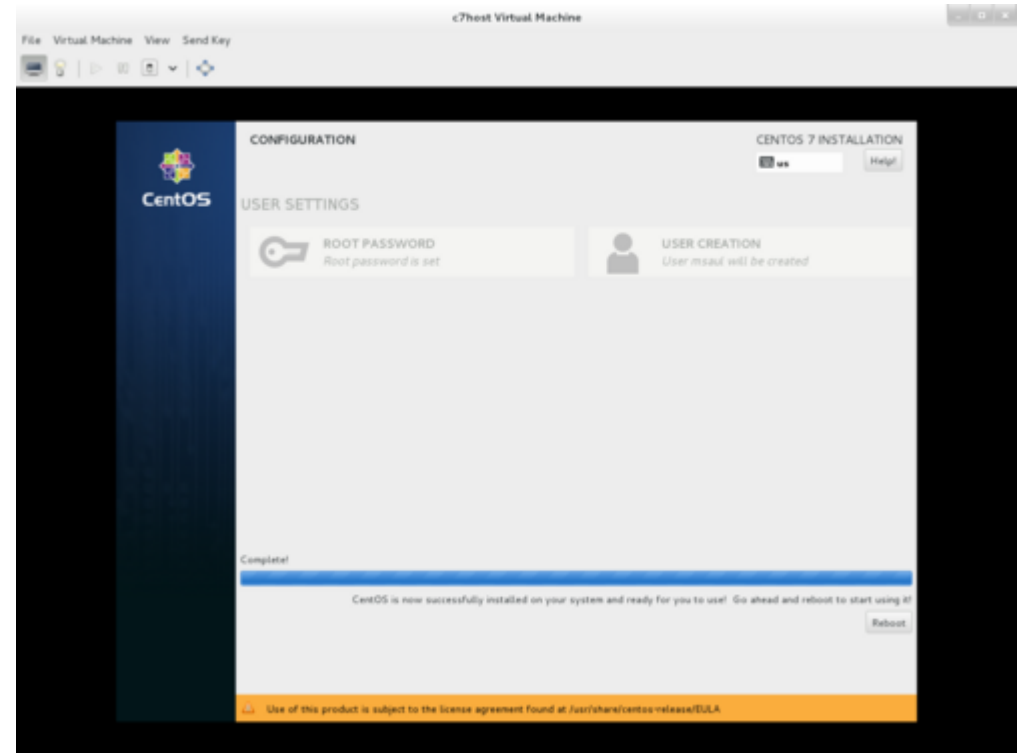
1. During the installation process, you will required to create a **root password** (for administration access) and create a **regular user account**. Click on **Root Password** and enter



Carefully verify partition mount-names and sizes prior to proceeding with install.
Check installation screenshots (<http://matrix.senecac.on.ca/~murray.saul/ops235/installation/>) link for verification.

your root password. Think of an appropriate password and record that password somewhere in case you forget! An indicator will appear to show you how secure your password is. Retype your root password and click **Done** (you may have to click Done twice if your password is not considered to be a strong password).

2. You need to create a regular user account. This account will be used to graphical log into your host machine. It is never recommended to graphically log into a graphical Linux/Unix system as root. It is better to log into a regular user account, then run a command with temporarily elevated privileges (you will learn how to do this later in this lab).
3. Click **User Creation** and enter your **full name, username,** and an appropriate **password** (and confirm password). Make sure the box labelled 'Make this user administrator' is checked. Click **Done** to finish (click twice if password is not considered to be a strong password).



This screen indicates that installation is complete.



Keep the root password the same for Host and VMs

In order to simplify running the lab checking scripts in future labs, using the same root password for ALL machines (c7host and virtual machines). Also use the same username and passwords for all of your machines (c7host and virtual machines). **Do not do this in a production environment!**

4. When installation is complete, you will notice a message at the bottom of the screen stating: **CentOS is now successfully installed and ready for you to use!**
5. Click the **Reboot** button. Your DVD will briefly open in the DVD drive bay. Make certain to remove this installation DVD so that CentOS will boot from your hard drive.

6. After the system reboots, a boot menu should briefly appear, then prompt the user to accept the License Information (this is only a one-time occurrence).

In order to accept the license agreement, Click on **License Not Accepted** and graphically accept the license and then click **FINISH CONFIGURATION** to finish the installation process.

NOTE: If you have an older version of CentOS 7, you must perform the alternative steps:
Issue the following keystrokes:

1 followed by ENTER (to select the license agreement prompt)

2 followed by ENTER (to accept the license agreement)

c followed by ENTER (to save the selection)

c followed by ENTER (a second time to continue booting into the system)

7. The system should then graphically prompt the user to login with their regular user account. Click on your **regular user account name** and **enter your regular user password**.

8. The last phase of the installation process should now run:

- Confirm English as the default input source and click **Next**.
- Skip the creation of online accounts by clicking **Next**.
- Start using your installed Linux system by clicking **Start Using CentOS Linux**.

9. Open a web-browser and check to see if you can connect to the Internet.

Answer Investigation 1 observations (all parts and questions) in your lab log book.

INVESTIGATION 2: Common Post-Installation Tasks

Managing your Virtual Machine

In future labs, you will have to run your VMware Workstation application to boot-up your CentOS 7 host VM. Usually, you are NOT required to use this menu (unless you need to "force-off" the c7host7 machine, but should only be



The **VM Workstation taskbar** is useful when in full-screen mode to perform common virtual machine management tasks.

performed if you cannot normally shut-down the c7host VM from the OS.

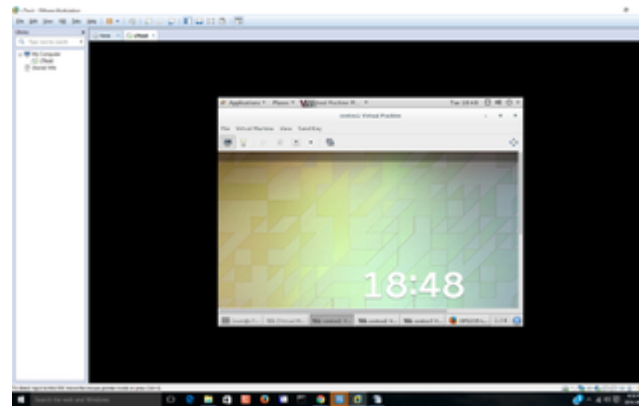
On the other hand, there are useful short-cut key you should use:

ALT-CTRL-ENTER

Toggles the VM Workstation application window between **full screen mode** and **window mode**.

ALT-CTRL

Return focus from your c7host VM to your **host computer system**.



This diagram shows VMware Workstation running VM in **window mode**. This is NOT recommended to work in this mode. You can press **ALT-CTRL-ENTER** to change to fullscreen mode, and then again to toggle back to **window mode** if you need to access your main computer.



It is recommended to run VMware Workstation in **full screen mode**. You can press **ALT-CTRL-ENTER** to toggle between window and fullscreen mode. It is recommended that you stay in fullscreen mode for the duration of your lab work. You can press **ALT-CTRL-ENTER** to change back to **window mode** if you need to access your main computer.

VMware Tools is a collection of utilities to help improve the performance and efficiency of the VM's operating system. Some features include:

- Faster Graphics
- Allow applications running in a VM to be accessed in the host machine (unity interface)
- Sharing folders between host and VM
- Copying and pasting text between host and among VMs
- Clock synchronization among host and VMs

It is recommended to install VMware Tools on your system. Click the **VM** menu and select **Install VM Tools**. The installation program will run in the background until the install is complete.



Properly Exiting CentOS 7 Session and Safely Removing USB Device

It is **ABSOLUTELY ESSENTIAL** that you do **NOT** remove your SSD drive during your CentOS 7 session. You are required to correctly shutdown your CentOS 7 host virtual machine as you would with any operating system. Also, you are required to use the **Safely Remove Hardware and Eject Media** tool in the system tray on your Windows machine to properly disconnect your SSD device.

FAILURE TO DO THIS MAY DAMAGE YOUR HOST VM AND NOW ALLOW IT TO BOOT PROPERLY (YOU HAVE BEEN WARNED).

Part 1: Turning Off Locked Screen-saver

Your system automatically enables a **screen-saver** application which is a useful security tool to prevent unauthorized viewing of information on a terminal after a certain amount of inactivity. Turning-off the locked screen-saver for this (and other) virtual machine can be useful when waiting for your instructor to come over to "sign-off" your computer lab without having to re-issue user passwords.

To Disable the Locked Screen-saver, Perform the following steps:

1. Click on the **power button at the top right-hand corner of the window**.
2. Click the **Settings** icon (bottom left-hand side of menu - looks like a screw-driver and wrench icon).
3. Click the **Power** icon located in the *Settings* Dialog Box
4. Change the amount of time in the **Power Saving** section to **Never** or a **longer period of time**
5. Close the *Settings* Dialog box.

Part 2: Accessing Administrative Privileges

Perform the following steps:

1. Refer to the Information box regarding how to access administrative privileges from the command line.
2. Issue the command **whoami**. This will display the name of your currently logged in user.
3. Issue the command **sudo whoami**. The first time you run any command with sudo, you will receive a warning asking you if you know what you are doing (i.e. running a command with the privileges of the root account). It will then prompt you for your password (the one for the account running the command through sudo, not the root account). If you enter your password correctly, sudo will run the command as the **root account**. This time the command will return **root**, showing the elevated privileges.
4. An installation log file called **/var/log/anaconda/packaging.log** has been created to record the installation of your c7host machine. This file is an ASCII file which can be viewed with the **more** command.
 1. Issue the command **more /var/log/anaconda/packaging.log**. You should be told **permission denied**.
 2. Issue the command **sudo more /var/log/anaconda/packaging.log**. This time you will be allowed to



Accessing Administrative Privileges

Many administrative tasks require the root administrative account. While it is possible to log into the root account directly, or to change your current logged in account to root, this behaviour is strongly discouraged. Both of those methods would require multiple administrators to know the password for the root account, and would not record which administrator runs which command as root.

Instead, we will use a command called **sudo** to temporarily gain root privileges in order to run a command, but still be our normal user. This method of obtaining elevated privileges has several advantages over logging in as root: First, it only requires each administrator to know their own password. Second, we can control exactly which commands a user is allowed to run as root

view the contents of the file.

5. You can make use of this file to determine how many packages have been installed: complete the following command to count the number of packages that are labelled "Installing" in the installation log file:

```
sudo grep -i packaging /var/log/anaconda/packaging.log | wc -l
```

Part 3: Turning off SELinux



Never disable SELinux in the real world

It is highly discouraged and unsafe to disable SELinux on a public-facing server.

Some applications may require tedious steps to setup SELinux rules. Disabling SELinux is never the correct way to solve an issue.

(We will learn how to do this later in the course), instead of giving them access to everything. Third, the system will log any command that is run using sudo, so that it can be audited later in case something goes awry.

Most user accounts are not allowed to run any commands using sudo, but when we created our first regular account in investigation 1, the check box 'Make this user administrator' gave them permission to run any command using sudo.

SELinux stands for **Security-Enhanced Linux**. It is a component that helps to better secure the system to protect against intrusion (hackers). SELinux is enabled upon the default install of CentOS. SELinux can be a good thing, if you take care of it and know how it works. For this course it is strongly recommended that you **turn off SELinux by default** because we won't have the time to reconfigure it every time the labs make it necessary.

Perform the following Steps:

1. Using elevated privileges, edit the file `/etc/selinux/config`: `sudo vim /etc/selinux/config`
2. In the editing session, set **SELINUX** to **permissive** (from *enforcing*) and save your editing session.
3. Restart your VM.
4. You can check the status of SELinux at any time at the command line by typing: `getenforce` or `sestatus`

Part 4: Perform Software Updates

Running software updates regularly is an important part of keeping your computer secure and stable. On Linux, we use package managers to install software and updates. Package managers not only perform installations, but they keep track of everything that is currently installed on the system for easy management. For CentOS, this manager is called yum. Yum is also the command used.

Perform the following steps:

1. Open Terminal.
2. Type: `sudo yum update`
3. Follow the prompts.
4. If there is a kernel update, reboot your system. (There usually is on a first update after OS installation.)

Answer Investigation 2 observations (all parts and questions) in your lab log book.

INVESTIGATION 3: Using the Shell to Generate System Information Reports

It is very common for System Administrators to keep records regarding their installed computer systems. For example, it is necessary to have a record of all the hardware information for each machine in order to help fix computer hardware problems, and to assist when purchasing additional consistent computer hardware.

Therefore, it makes sense to also have a record of the installed computer software as well. This can contain information regarding the Linux operating system, installed software, and network connectivity information.

Perform the Following Steps:

1. Study the Linux commands and their purpose to note computer software information for your installed c7hostVM. You should take time to issue each of these commands to view the output, and record this chart in your lab1 logbook. Run each one as a regular user, then with sudo to see the differences.
2. Make certain to **record output** from these commands (except for the **ps -ef** output) in your lab1 logbook.

Linux/Unix System Information Utilities

Command(s)	Purpose
<code>uname -rv</code> <code>hostname</code> <code>ps -ef</code>	Basic Linux OS information such as kernel version, host-name of Linux server, and all processes that are running on the system after installation.
<code>rpm -q -a wc -l</code> <code>rpm -q -a -l wc -l</code> <code>rpm -q -l gedit wc -l</code>	Obtain number of installed packages in the rpm database. Option -q is to "query" information, option -a



Bash Shell Reference Guide:

Variables

Environment

- System-wide or "global" variable
- Usually appear in UPPERCASE letters
- Can view with command: **set | more**
- \$ in front to expand variable to value
- Examples: **USER, PATH, HOME, SHELL**

User-defined

- Variable created by user (command line, scripting)
- Examples:
myVar="my value"; readonly myVar; export myVar
read -p "enter value: " myVar

Command Substitution

- Useful method to expand output from a command to be used as an argument for another command.
- Examples:
file \$(ls)
*set \$(ls);echo \$#;echo \$**

means for all installed packages,
option **-I** means all files installed as
opposed to just the application.

<code>ip address show</code> <code>ip route show</code> <code>nslookup</code> (at prompt, enter command: server)	Obtain network connectivity confirmation including: IP ADDRESS , Netmask , routing (default gateway), and the default Domain Name Server .
---	---

You may have learned about creating and running Bash Shell Scripts in your ULI101 course. Shell scripts help Linux users and system administrators to automate repetitive tasks to become more efficient and to help them save time. In order to avoid confusion with syntax, you will not be writing bash scripts in this course. You will however still run bash commands to perform various tasks, e.g. to generate information reports for your newly-installed Linux host machine.

4. Refer to the Bash Shell Reference Guide prior to proceeding with this section.
5. Create a directory called **bin** in your home directory to store your shell scripts by issuing the command:
`mkdir ~/bin`
6. Change to that newly-created **bin** directory
7. Using output redirection, send the output from each of the following commands to a file called **report.txt**. Note that when you are done, you should have one file that has output from all of the commands.
 - `date +%A %B %d, %Y (%I:%M %p)`
 - `hostname`
 - `uname -rv`
 - `ps aux`
 - `ip address show`
8. View the *report.txt* contents. You should be able to understand them because you just put that content there, but what would this look like if you look at the file several months from now? In order to make this file more readable, use the command line to add a blank line between the output from each command, and a header before each command briefly describing what the output is (note that this will likely require re-running all of these commands).

```
echo "hostname: $(hostname)"
```

if / elif / else statements

- If a command runs (even pipeline command like to grep to match) will be true (0); otherwise, false (non-zero), thus can use with logic statements.
Example:

```
if echo $myVar | grep "match"
then
echo "Match"
fi
```
- The **test** command is used to test conditions. Square brackets [] is short-cut for test command (args contained inside with spaces). The **exit** command can be used to terminate the shell script with a false value.
Example:

```
if [ $USER = "root" ]
then
echo "You must be root"
exit 1
fi
```
- For numeric comparison, use the **test** options: **-gt**, **-ge**, **-lt**, **-le**, **-eq**, **-ne**
Example:

```
if [ $grade -gt 79 ]
then
echo "You get Good Mark"
elif [ $grade -gt 49 ]
then
echo "You pass"
else
echo "You fail"
fi
```
- For testing for file information, you can use **-d** to test if directory pathname exists, and **-f** if the file pathname exists. You can

Answer Investigation 3 observations (all parts and questions) in your lab log book.

INVESTIGATION 4: Using Python

Scripting to Generate System Information Reports

Before we can successfully automate parts of configuration using python, we need to learn how to use it. Initially we will perform simple tasks we have already learned how to do in bash. This way can learn how the language works as we go.

In this investigation you will write a python script that duplicates (as closely as possible with the parts of python we have covered so far) the file we created in the previous investigation.

```
use ! for negation.  
Examples:  
if [ -d directory-pathname ]  
then  
echo "directory exists"  
fi  
  
if [ ! -f file-pathname ]  
then  
echo "File does not exist"  
fi
```

Perform the Following Steps:

1. Install python3 on your Centos Host machine. Open a terminal and type:

```
sudo yum install python3
```

2.
 - Create a new file in your ~/bin directory called **myreport.py**
 - Since we haven't covered if statements in python yet, we won't be able to check if the user running the script is root. For now, we will have to trust ourselves to remember to use elevated permissions to run this script. We will correct this in lab 2.
3. Populate the beginning of the file with sh-bang line and block comment describing what this script does:

```
#!/usr/bin/env python3  
# Author: *** INSERT YOUR NAME ***  
# Date:   *** CURRENT DATE ***  
  
# Purpose: Creates system info report  
# USAGE: ./myreport.py
```

4. Add a line that will print out the heading **System Report**

```
print('System Report')
```

5. Save your script and run it. Does it work?

6. You'll notice that the python script is currently sending its output to your terminal. Since we haven't covered how to write to a file yet, this is ok for now. Just use output redirection on the command line when you run the script to send the output to ~/bin/pythonreport.txt.

7. Add the extra commands for your python script to also output (with appropriate headings):

- The current date.
- The hostname of the machine.
- The kernel version.
- The list of all processes.
- The IP address.

8. Run your script to make sure it works. Note that the output does not need to match investigation 3 exactly, but it should be very close.

LAB 1 SIGN-OFF (SHOW INSTRUCTOR)

Follow the submission instructions for lab 1 on Blackboard.

Shell scripting is so essential for Linux administration that this course has created a shell script for every lab for this course that a student must download and run in order to check their work.

If you have performed the lab correctly, then you will get a series of **OK** messages and you can proceed with the SIGN-OFF for lab1. On the other hand, if there were errors, then a **WARNING** message will appear with general suggestions that you will need to fix on your c7hostVM in order to have your professor sign-off in this lab in order to proceed to the next lab.

Perform the Following Steps:

1. Make certain that your **c7host** VM is running, open the Bash Shell terminal.

2. Change to the **~/bin** directory.

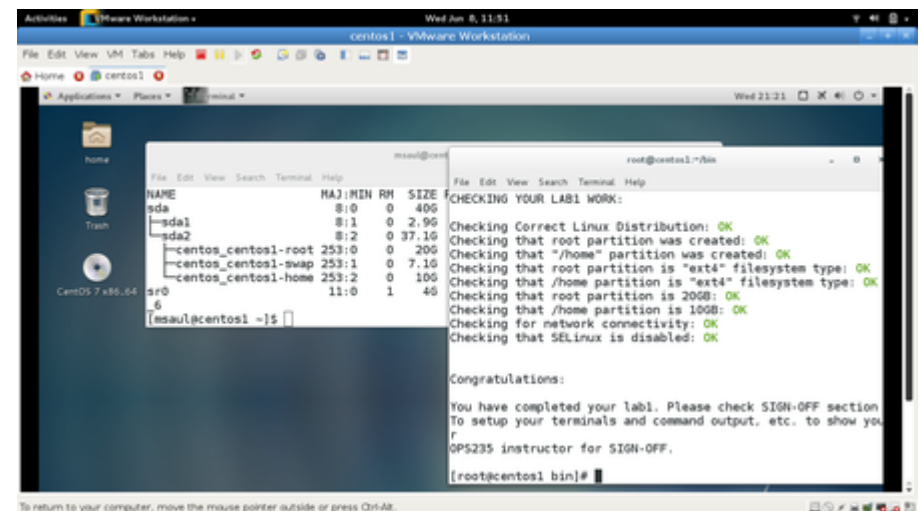
3. Download the checking script by issuing the following Linux command:

wget <https://raw.githubusercontent.com/OPS245/labs/main/lab1-check.bash>

4. Give that downloaded shell script file execute permissions (for the file owner).

5. Run the shell script using **sudo** and if there are any warnings, make fixes and re-run shell script until you receive a "congratulations" message.

6. Arrange evidence (command output) for each of these items on your screen:



Students should be prepared with **all required commands** (system information) displayed in a terminal (or multiple terminals) prior to calling the instructor for signoff.

- ✓ Run the **lab1-check.bash** script (must have all OK messages, and the congratulations message)
- ✓ Proof that c7host VM is set for **virtualization** (Refer to: **INVESTIGATION 1 - Part 1 - Step #29**)

7. Take a screenshot of the evidence and upload it, the file generated by the lab1-check.bash script, your logbook, and your myreport.py to blackboard.

Practice For Quizzes, Tests, Midterm & Final Exam

1. Define the term Virtual Machine.
2. List the major screens (steps) in the installation of CentOS 7 full install DVD.
3. What key-combination is used to toggle the view of your running VM from "window-mode" to "full-screen-mode"?
4. List the steps for setting SELinux to permissive mode.
5. What is the home directory for the user "root"?
6. How do you determine the host name of your GNU/Linux workstation?
7. What command can display the NIC's MAC address?
8. What command is used to get a list of running processes on your newly-installed system?
9. Write the Linux command to download the on-line file: <http://linux.server.org/package.tar.gz>
10. Write a Python Shell Script to prompt the user for a directory, and then display the file types for all files in that specified directory (hint: use the **read** command and then use the **file** command and **command substitution** with the **ls** command). Test the Bash Shell script by adding execute permissions and run the Bash Shell Script.

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