IT 331 On-Prem and Cloud Systems Administration

Lab #1

Spring 2021 – Professor Josh Edgar

This first Lab begins the first Unit of our course, where from Weeks 3 through 7, we will focus on Linux systems administration. Linux operating systems are used in many enterprises because they are free (or have cheaper licenses than Windows) and, when run without a desktop environment/GUI, tend to consume less resources, leaving more system resources available to applications and data processing.

Before we can dive into administering a Linux system, you first must learn how to install it. In this Lab, you will install a variant of Red Hat Enterprise Linux – the most common paid Linux OS on the market. However, we will install CentOS – a free version that operates in an identical way.

Before you begin:

- You must have a VM hypervisor, such as VirtualBox or VMware, installed to do this Lab. You should have set one up as part of previous class announcements. If you do not already have VirtualBox, please download and install it from https://virtualbox.org before proceeding.
- This Lab's instructions assume that you are using VirtualBox. You may need to make small changes to these steps if you choose to use a different hypervisor.
- Download the CentOS 8 ISO image file from your nearest mirror by following this link: http://isoredirect.centos.org/centos/8/isos/x86_64/
    - Make sure to download the image entitled "CentOS-8.3.2011-x86_64-**dvd1**.iso"

What you'll achieve:

- Install CentOS 8.3 (a now-defunct variant of Red Hat Enterprise Linux [RHEL])
- Learn about different configuration options available during installation
- Get comfortable with your hypervisor
- Perform basic user administration and system update tasks
- Learn basic syntax that can be used on UNIX terminals

What you'll turn in with this lab:

- Short answers to the review questions from each Task.

Task 1: Create a Virtual Machine and Install CentOS 8.3

Installing an operating system normally requires that you have the installation disk. A decade ago, this would probably be a CD or DVD. Today, with Internet access, you typically download an ISO file from the OS developer, and can either use network booting to live-load the image from a file server in your data center, or format it onto a USB drive that can be plugged into the

server needing installation. For this Lab, since you are using a hypervisor, we can emulate the latter option by simply pointing VirtualBox to the ISO file. VirtualBox will then essentially mount it as a USB drive.

In this task, we will take the ISO image we have downloaded, attach it to a new virtual machine (VM) we will create in our hypervisor, and install CentOS 8.3. These steps will guide you through what a typical Red Hat OS installation looks like and expose you to some of the common configuration changes you can make prior to the OS being installed.

1. Open VirtualBox. At the top of the main window, click "New" to create a new VM.
2. Name the VM something like "Your Name's CentOS 8 VM." The "machine folder" can be left at the default setting, which is probably in your user folder on your host operating system.
   Vocabulary Tip: On a system that is running virtual machines, whether it's your computer or a server that runs several VMs, the main operating system installed on the physical hardware is called the "host" operating system. Any VMs running on this physical machine have their own "guest" operating systems.
3. If the "Type" and "Version" fields did not automatically change, set them to "Linux" and "Red Hat (64-bit)," respectively. Click "Continue."
4. Set the recommended memory size to 1024 MB, or 1 GB. Click "Continue."
5. When prompted, you will need to create a virtual hard disk for your VM to use. In VirtualBox, tick the option labeled "Create a virtual hard disk now," and click "Continue."
6. For file type, "VDI (VirtualBox Disk Image)" should be selected. Click "Continue."
7. When presented with the option, choose "fixed size" to declare a specific size for this virtual disk. Click "Continue."
8. Set the size of the disk to roughly 20 GB, and click "Continue."
9. Once your VM is created, you must now attach the ISO file you downloaded in Task 1 to it. Select your VM and click "Settings."
10. Go to the "Storage" tab in the pop-up window.
11. Under "Controller: IDE," click on "Empty."
12. Next to "IDE Secondary Master," click on the picture of a CD, and select "Choose a disk file."
13. Browse to where you downloaded the CentOS 8 ISO file, and select it. Click "OK" in the Storage settings window.
14. Back at the VirtualBox main screen, select your VM, and click "Start." If prompted, select "Normal Start."
15. Another pop-up may appear to confirm your ISO file. If so, simply click "Start" again.
16. A primitive menu will appear with a few options. Use your up/down arrow keys to ensure that "Install CentOS Linux" is selected, and then press your Enter key.
17. It may take a minute for the installer to load necessary files, but eventually, you will be presented with a slightly more aesthetic installer application.
    TIP: If the window is too small to see, you can go to View > Virtual Screen 1 > Scale to 200%.

Review Question:

15. What is the first thing the installer asks you to configure? Which option did you select?

18. Select the option that best suits you on the first screen, and click the blue "Continue" button in the bottom right.
    NOTE: You may be prompted to allow VirtualBox to pass your mouse functions through to the guest OS. Make note of the last thing it mentions – your "host key" – as this is the key combination you will enter for mouse and keyboard control to be returned to your computer's host OS. Click "Capture" to continue using your VM. You can also check "Do not show this message again" to keep this dialog from appearing every time you switch between operating systems.
19. Take a look at the options available to you. Newer Linux installers with UIs like this make it easy to configure your network connectivity, root passwords, and filesystem partitioning.
20. Under the "System" section, click "Installation Destination."

Review Question:

20. What is the name and sizing of the disk drive that has a checkmark on it, indicating that this is the volume where CentOS will be installed?

21. Leave the options on this screen at their current settings, and click "Done" at the top left.
22. Under the same "System" section as before, click "Network & Host Name."
23. Next to the Ethernet interface name on the right half of this page, drag the switch into the "ON" position. This should connect your guest OS to the Internet.

Review Question:

23. What IP address does your guest OS receive? Is this different from the IP addresses you customarily receive on your network? If so, why?
    (Tip: Click the  icon at the bottom of VirtualBox and click "Network Settings." What your virtual network card is "attached to" may give you a hint, if you've taken any networking classes before.)

24. Click "Done" at the top left.
25. Finally, under "User Settings," click "Root Password." This is the master administrative password for the account that has *all* privileges to the system. It should be fairly complex. Enter a strong password, twice, and then click "Done" at the top left.
26. Click the blue "Begin Installation" button at the bottom right.
    ***This process will take about 15-30 minutes.** This is a good time to take a break.
27. Once installation is "Complete," click the blue "Reboot System" button at the bottom right. If you are prompted with the installation options screen again, click the blue CD icon at the bottom of VirtualBox, and click "Remove disk from virtual drive," followed by "Force Unmount." Then go to the Host menu and click "Reset."
28. Once the system reboots, you should be able to click on a "Licensing" option that looks very similar to the original installation options. Click on this option, check the box

indicating that you agree to the EULA, click “Done” at the top left, and then click “Finish Configuration” at the bottom right.

29. At the Welcome screen, click the blue “Next” button at the top right.
30. Drag the slider to disable Location Services, then click “Next” at the top right.
31. On the Online Accounts screen, click “Skip” at the top right.
32. When requested, enter your full name. Change the automatically generated username to just your first initial and last name, for example, “jedgar.” Then, click the “Next” button at the top right. This creates a user account just for you, which will be separate from the root account created earlier.
33. Set a password for your personal account, then click “Next” at the top right.
34. Click the blue “Start Using CentOS Linux” button. You have successfully installed a Red Hat Enterprise-like Linux operating system!

Task 2: Create an Administrative User

During pre-installation, you set a password for the “root” account, which has unfettered access to everything on the system. If you log in to a system as root and attempt to delete a file, no matter what it is, Linux will allow it instantly, even if you just made a mistake. If you work in a company with more than one administrator, this also makes it harder to log who performed certain tasks with the root account, and requires that you share a singular password.

That’s a lot of things to go wrong, which can cause a lot of uncontrollable damage to your system. To mitigate this, we will create users that have “sudo” privileges (“super user, do”), so that a user can elevate to perform administrative tasks only when necessary. This also allows our system logs to show *who* is performing such tasks, so that if something bad happens…we’ll know who to blame.

35. Click the “X” at the top right of the Getting Started window to close it.
36. Click “Activities” at the top left. This is similar to a Start menu on Windows. In the search box that appears, type in “Terminal,” then click on the Terminal icon that appears.

Most Linux systems used for enterprise workloads don’t have the full desktop environment/GUI that you currently see, freeing up memory and other resources for more strenuous work. Linux systems administrators typically remotely connect to a Terminal via a Secure Shell, or SSH, and interact with the system solely with the command line you should now be seeing. You should get used to interacting with a Linux system with this method.

Review Question:

36. What prompt is shown at the command line you are now seeing? What do you think this prompt tells you, and/or why is it useful to see instead of a simple “>” pointer?

37. We want to create an account for Linus Torvalds, the inventor of Linux. To create a user, we will use the "adduser" command. At your command line, type the following and press your Enter key:
    `useradd ltorvalds`

You will receive an error, because you currently do not have permission to create new users. This is where the super user command "sudo" comes in handy. By prefacing just about any command with "sudo," we are telling the system that, if we are in fact administrators, we want to run the described task as an administrator. You will be prompted for your password the first time to verify that you are indeed the logged-in user.

We'll eventually make Mr. Torvalds' account an administrator, but in your case, the user that you created in steps 32-33 was automatically entered into a "sudoers file" – a list of users who are administrators.

38. Let's try our command again, but this time, type:
    `sudo useradd ltorvalds`
39. In this case, no news is good news. If you received no error message, and were simply given a new, blank prompt, the user was created successfully.
40. We now need to create a password for that account, or it won't be able to log in. To do this, we would use the "passwd" command, followed by the username whose password we are (re)setting, however, once more, we must preface our command with "sudo" to obtain the necessary permissions to carry out this task:
    `sudo passwd ltorvalds`
41. Set the password to "linuxrules" by typing this, without quotes, and pressing Enter. You will be asked to confirm it a second time. The password change is successful once you receive a message that states "all authentication tokens updated successfully."
42. Finally, we want to make Mr. Torvalds' account an administrator, as mentioned above. To do this, we need to add him to the usergroup called "wheel," which is a default Red Hat usergroup for administrators. To do this, we will use the "usermod" command, followed by a few flags – letters that follow a hyphen (-) – to indicate how we want to modify this user's account:
    `usermod -a -G wheel ltorvalds`
    The "a" flag indicates that we want to *add* a user to a group, specified by "G." If we did not have the "a" flag, Mr. Torvalds' account would be removed from any groups to which it *currently* belongs. The "a" flag allows us to "append" the account into an additional group, beyond any current groups, which will remain untouched.

    Review Question:
    42. When you ran the above command you probably received a "permission denied" error. Why? What are we forgetting in this command?

43. Make the necessary correction to the command, as referenced in the Review Question, and run it again. If you do not receive an error message, the modification was made successfully. Linus Torvalds' account is now an administrator!

Task 3: Elevate to Root & Update the Operating System

It's important to keep the operating system updated with the latest security patches to system files and applications. Doing this regularly – while ensuring that doing so does not interrupt any of your workloads or system users – ensures that your system is protected against newly-identified vulnerabilities that can expose your Linux machine to attackers. Fortunately, the process is rather straightforward.

44. Isn't it annoying to have to keep typing "sudo?" To avoid that, let's temporarily switch users into that root account we created earlier. The root account is allowed to do anything, so running commands from it won't require constant sudo-ing. To do this, we'll use just the "su" – switch user – command. You can add a username after this to switch into any user account you have access to, however, if you don't, the system will assume that – if you have permissions – you want to switch to "root." Of course, to do this, we will need "sudo" one last time:
    `sudo su`

    Review Question:
    44. What does the command line prompt show you now? What changed, and what is this telling you when compared to the prompt you saw when answering Review Question # 36?

Linux operating systems rely on "package managers" to automatically find, install, or uninstall applications – or "packages" – including those that keep the system working properly. On Red Hat-based distributions like CentOS, the "yum" package manager is used. It works similar to aptitude/apt-get, if you have previous experience with Ubuntu.

45. Let's ask the yum package manager to perform a general update of our entire system. Since we are now root, we do not need to preface this command with "sudo."
    `yum update`
46. You will be prompted with a list of packages that will be updated or installed as part of this maintenance, as well as the total size of the download. Type "y" and press your Enter key to proceed with the updates. Also type "y" and press Enter for any other prompts that appear.
    This may take up to 10 minutes, so this is another good time for a break before proceeding into Task 4.
47. Once the update tasks are finished and the terminal says "Complete," type `exit` and press Enter to relinquish your root-level access. This will return you to your user-level prompt.

Task 4: Learning Basic Useful Commands

Finally, we will briefly walk through a few basic and useful commands that you will often see on a Linux command line. When used properly, they can be very powerful and help with a variety of tasks.

48. Changing Directories and Viewing Their Contents.

To change the directory you are in, we will use the "cd" command. By default, the terminal places you in your home directory, which is usually /home/username. (Notice how there are no drive letters, such as C:, in Linux – everything simply starts with a forward-slash from the boot volume.) Your home directory is indicated by the tilde (~) in your command prompt.

- **a.** Try this, to change to the directory /etc (pronounced "etsy" in conversation; this directory contains many system configuration files):
  ```
  cd /etc
  ```
- **b.** To see what is inside this directory, we will use the list command (the first letter is L):
  ```
  ls
  ```
- **c.** To limit this list to only show us things that match a certain search expression, we will use a pipe symbol "|" (by pressing Shift+Backslash) after our "ls" command, followed by a "grep" command. Grep allows you to search the output of the command it is paired with for a specific regular expression or search phrase. Try this to list /etc again, but only show items with the word "init:"
  ```
  ls | grep init
  ```

Review Question:

48. Three (3) files or directories should have appeared. What are their names?

- **d.** Let's go back to our home directory. There are two ways to do this, and you can choose either one – they mean the same thing. You can either directly point to your home directory as a path, or simply use the tilde:
  ```
  cd /home/yourusername
  cd ~
  ```

49. Creating, Viewing and Deleting Files

- **a.** Let's create an empty file. Make sure you're in your home directory as stated in step 48(d). We can do this with the "touch" command:
  ```
  touch myfile.txt
  ```
- **b.** Now, list the files in your home directory with the list command we used in step 48(b). You should see your "myfile.txt" among the other directories in your home folder.
- **c.** Let's put some content in this file with a simple "echo" command (which merely outputs whatever you tell it – like a real-life echo) and direct the output to your

file with a greater-than symbol (>). Try this:
`echo This is my file > myfile.txt`

d. We can now view the contents your file with the "cat" command.
`cat myfile.txt`

Review Question:

49. Include a screenshot of your terminal window after running the command specified in step 49(d).

e. Delete this file by using the remove command, "rm."
`rm myfile.txt`

f. Verify that it is gone by listing the files in your home directory again.

50. Checking System Processes

Run the below command to see what processes are consuming the most resources:
`top`

As the name suggests, you will see the processes using the most resources at the top. The list is in descending order, and probably doesn't even show processes using very little system resources.

Review Questions:

50a. Which process is using the most resources on your Linux VM right now? What % of CPU is it consuming?

50b. Does the list of processes remain stable? Why or why not?

Press Ctrl+C on your keyboard – a common "stop" command for a running Linux process, including this one – to exit back to your terminal.

That's it! You have a basic, functional understanding of using a Linux/UNIX terminal!

Please upload your answers to the Review Questions, preferably in a separate document, to Canvas.