Cabrillo College

CIS 192 Linux Lab Exercise

Lab 1: Exploring the Linux Network VMs
Spring 2009

Lab 1: Exploring the Linux Network VMs

The purpose of this lab is to become familiar with resources available in the CIS Lab (room 2504) and the CTC. This includes using VMware Server and learning how to operate the CIS 192 Linux Networking VMs. This lab will also teach you some initial methods for exchanging textual information between the Windows host system, the VMs and the remote Opus server.

Supplies

- VMWare Server 1.08 or higher
- CIS 192 VMs: Arwen, Celebrian, Elrond, Fang, Frodo, Legolas, Sauron, Sniffer and William
- Virtual networks: VMnet3 and VMnet4

Preconfiguration

- Original versions of VMs.

Forum

Use the forum to ask for help, post tips and any lessons learned when you have finished. Forum is at: http://simms-teach.com/forum/viewforum.php?f=18

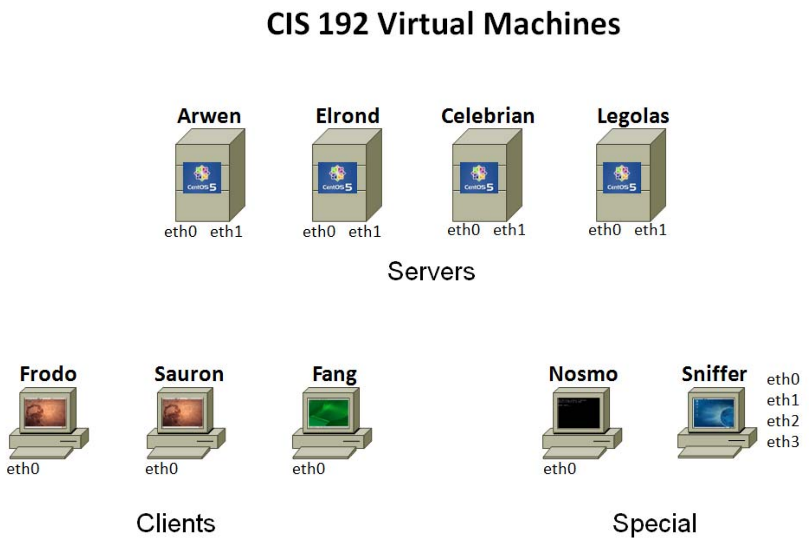
Background

There are systems available in the CIS Lab (room 2504) and the CTC for working on Linux lab assignments. These systems are Windows PC's with VMware Server installed. Using VMware Server allows a single PC to host multiple independent guest computers. The additional computers are virtual and called virtual machines (VMs).

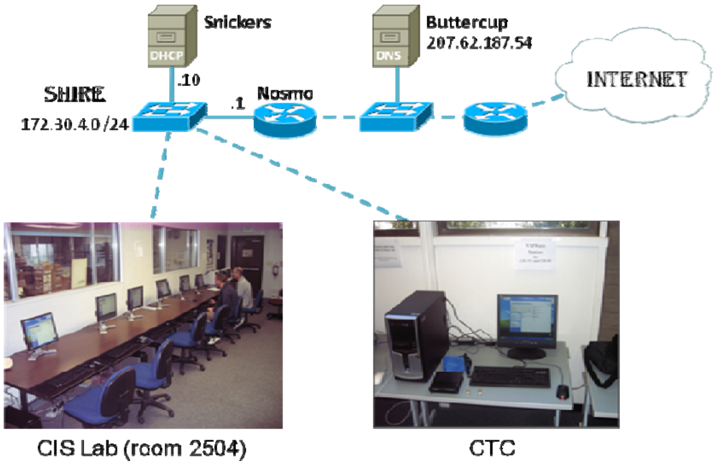
The VMs behave exactly like physical computers. You can load an operating system on them and the OS thinks it is running a physical computer. The Linux VMs are loaded with various distributions of Linux including Ubuntu, CentOS, Fedora, Red Hat and OpenSUSE.

In addition to virtual machines there are virtual networks. VMs can be "cabled" together using virtual networks to create various network topologies. The virtual networks are the VMnets found in the VMware environment.

The VMs and networks are shown in the diagram below.



All the physical VMware stations in the CIS Lab and the CTC are connected to a private 172.30.4.0 /24 network. This network is called the Shire network. It uses a Cisco router named Nosmo in the closet of room 2501 to connect to the Cabrillo network. Snickers is a Windows 2003 Domain Controller, also in the room 2501 closet, that provides DHCP services to the Shire network.



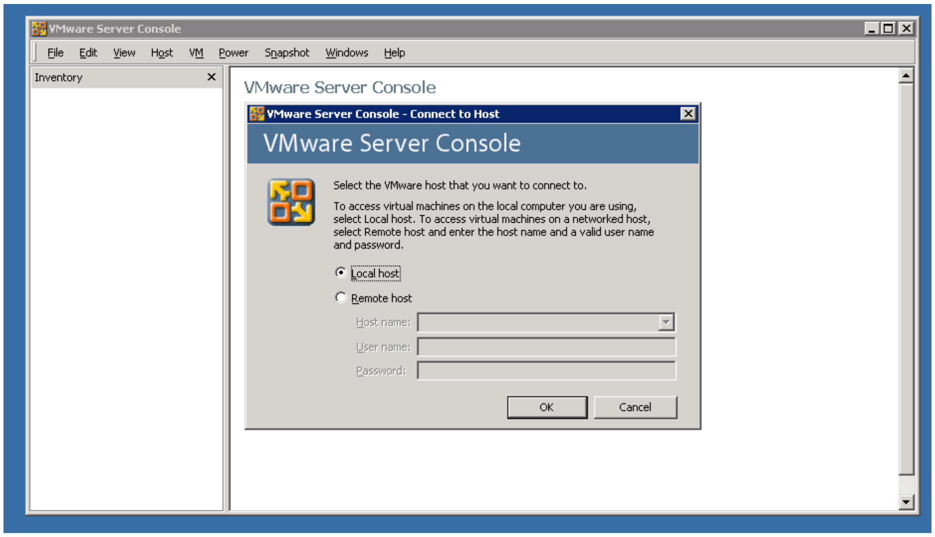
Procedure

This lab explores the Linux network VM's. You will be doing an inventory of the VM's and submitting that inventory at the end of the lab.

Step 1 – Select a physical VMware Station to use

There are VMware stations in the CIS Lab (room 2504) and the CTC. These are Windows PC's with VMware Server installed labeled **CIS-Lab-*XX***. All the stations are physically connected to the Shire (172.30.4.0 /24) network.

Step 2 – Startup the VMware Server Console


VMware Server Console
File Edit View Host VM Power Snapshot Windows Help
Inventory
VMware Server Console
VMware Server Console - Connect to Host
VMware Server Console

Select the VMware host that you want to connect to.

To access virtual machines on the local computer you are using, select Local host. To access virtual machines on a networked host, select Remote host and enter the host name and a valid user name and password.

● Local host

○ Remote host

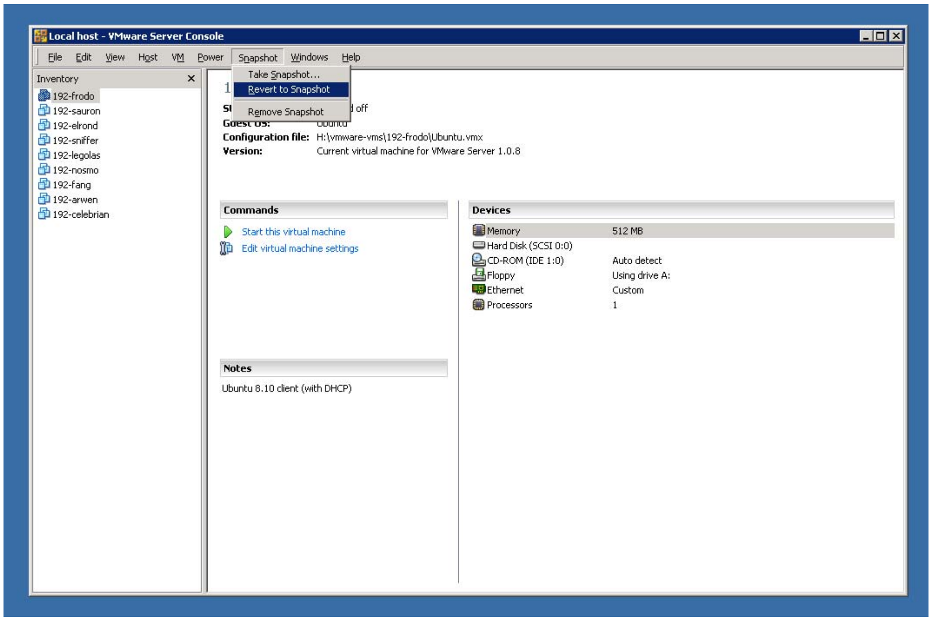
Host name:

User name:

Password:

For the VMware host selection, choose **Local host** and click OK. If **Local host** does not appear as an available choice then the VMware services that are running on the Windows PC have not completed starting up. Cancel and close the VMware Server Console and then try again in about 1-2 minutes. This can happen when running VMware Server Console too quickly after turning on the host PC.

Step 3 – Revert each VM to its snapshot



Guest OS: Ubuntu
Configuration file: H:\vmware-vms\192-frodo\Ubuntu.vmx
Version: Current virtual machine for VMware Server 1.0.8

Commands

Devices

Memory	512 MB
Hard Disk (SCSI 0:0)	
CD-ROM (IDE 1:0)	Auto detect
Floppy	Using drive A:
Ethernet	Custom
Processors	1

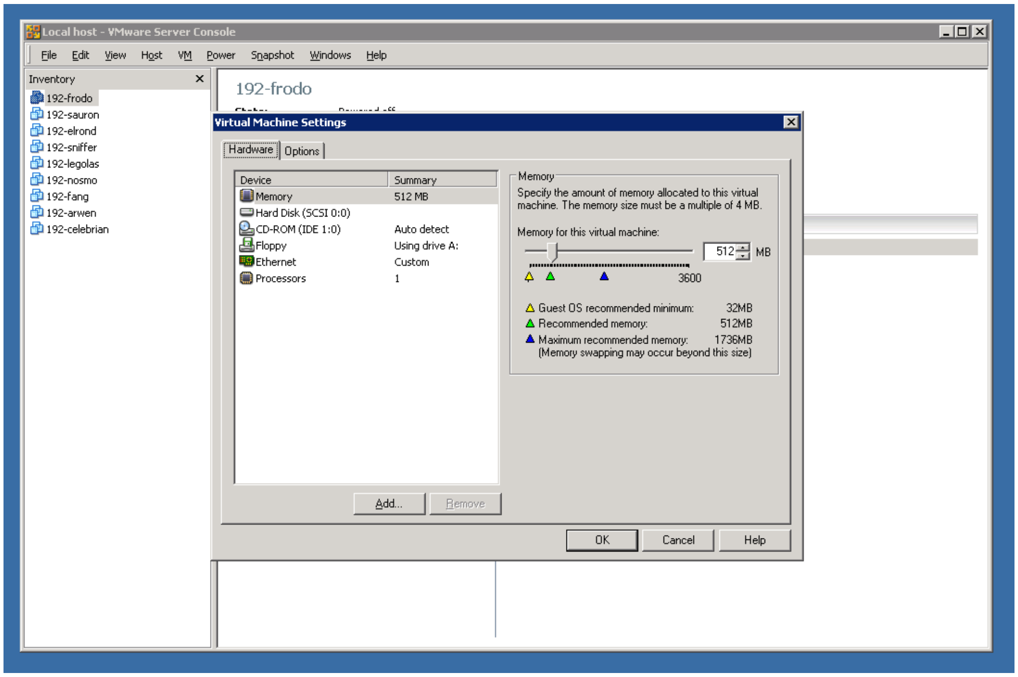
Notes

Ubuntu 8.10 client (with DHCP)

Select each VM, one at a time, from the Inventory list and under the **Snapshot** menu select **Revert to Snapshot**. This restores a pristine version of the VM. If the Inventory list is not visible then select it under the **View** menu or just press F9 to toggle it on.

Step 4 – VM hardware inventory

With the VMs powered off, cycle through each one and select the blue Edit virtual machine settings link or select **Settings…** under the **VM** menu.



Device	Summary
Memory	512 MB
Hard Disk (SCSI 0:0)	
CD-ROM (IDE 1:0)	Auto detect
Floppy	Using drive A:
Ethernet	Custom
Processors	1

Memory

Specify the amount of memory allocated to this virtual machine. The memory size must be a multiple of 4 MB.

Memory for this virtual machine: 512 MB

3600

Guest OS recommended minimum:	32MB
Recommended memory:	512MB
Maximum recommended memory: (Memory swapping may occur beyond this size)	1736MB

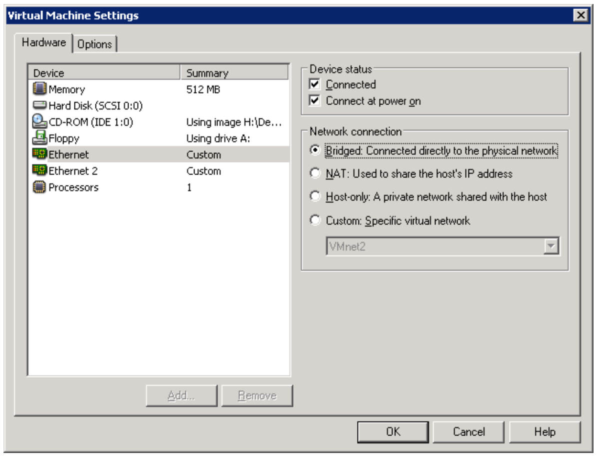
Explore and become familiar with all the settings under the **Hardware** and **Options** tabs. There is lots of useful information here. To find where VMware maintains the files that comprise the VM look at **File Locations** on the **Advanced Settings** under the **Options** tab.

The Ethernet devices are the NICs (Network Interface Controllers) in your VMs. Cabling your VMs is done by configuring these Ethernet devices as **bridged** or to a custom **VMnet**.

If you connect a Ethernet device as **bridged** then it is connected to the same network the physical host PC is. The actual NIC in the host PC is shared between the host PC and the VM. Both host PC and the VM have full access to the actual network at the same time.

An Ethernet device can also be connected to a custom **VMnet**. VMnets are virtual networks that behave just like a physical network except that they exist inside the host PC. Several VMnets are available. Think of a VMnet as a virtual **hub** that you can connect VMs into to form a network.

Let's use this information to see how Elrond is cabled.

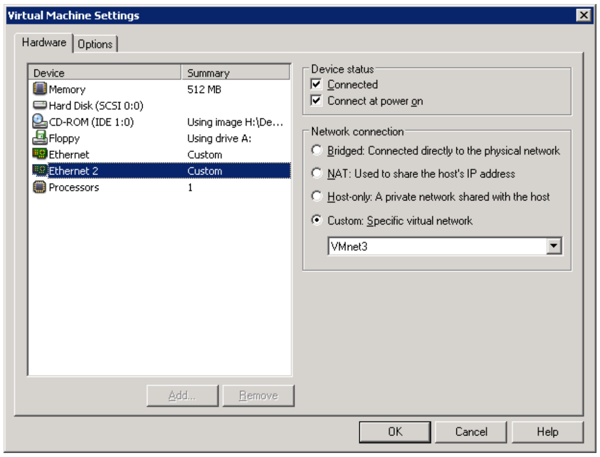


Device	Summary
Memory	512 MB
Hard Disk (SCSI 0:0)	
CD-ROM (IDE 1:0)	Using image H:\De...
Floppy	Using drive A:
Ethernet	Custom
Ethernet 2	Custom
Processors	1

Device status
☑ Connected
☑ Connect at power on

Network connection
● Bridged: Connected directly to the physical network
○ NAT: Used to share the host's IP address
○ Host-only: A private network shared with the host
○ Custom: Specific virtual network
VMnet2

Elrond eth0



Device	Summary
Memory	512 MB
Hard Disk (SCSI 0:0)	
CD-ROM (IDE 1:0)	Using image H:\De...
Floppy	Using drive A:
Ethernet	Custom
Ethernet 2	Custom
Processors	1

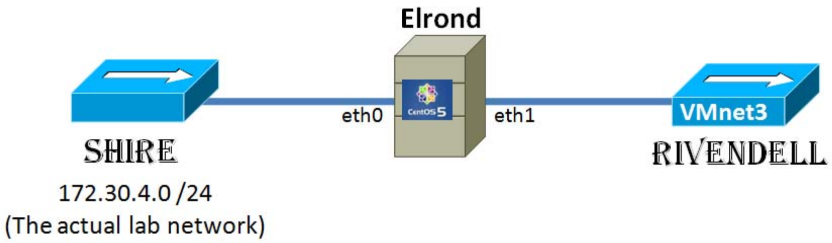
Device status
☑ Connected
☑ Connect at power on

Network connection
○ Bridged: Connected directly to the physical network
○ NAT: Used to share the host's IP address
○ Host-only: A private network shared with the host
● Custom: Specific virtual network
VMnet3

Elrond eth1

Note the Elrond VM has two NICs. One NIC is connected to the lab network (172.30.4.0 /24) and the second NIC is connected to a virtual network (VMnet3). You can think of this as if Elrond's first NIC has been cabled (with a virtual LAN cable) into a switch on actual lab network. A second (virtual) cable connects Elrond's second NIC to a hub named VMnet3.

The lab network is also called the Shire network. The network cabled using VMnet3 is called the Rivendell network.



Record this:

1. Create a **text** file on the VMware station you selected. Use a **text** editor like notepad or notepad++. Name the **text** file lab1.*lastname* and put it in the My Documents folder.
2. Add the following to your lab1.*lastname* file:
   a. CIS 192 Lab 1
   b. Your Name
   c. Date
   d. TBA hours used to complete this lab (fill this in at the end of the lab)
   e. Station number of the VMware host PC
   f. CPU and memory information of the VMware host PC (right-click on the My Computer (CIS-Lab-XX) desktop icon and select Properties)
3. Create a hardware inventory table in your lab1.*lastname* file and record the following information for each VM. The 1st entry has been completed as an example.

VM Hardware Inventory Table

	Disk					
Name	Space	Memory	Ethernet	Ethernet2	Ethernet3	Ethernet4
192-arwin	5 GB	512 MB	VMnet3	VMnet4	NA	NA
192-celebrian						

```
192-elrond
192-fang
192-frodo
192-legolas
192-sauron
192-nosmo
192-william
```

Step 5 – Power on the VMs

1. Start powering on the VMs starting with 192-arwen. Record the Linux distribution and observe the bootup sequence. Do this by selecting a VM on the Inventory list then clicking on the blue **Start this virtual machine** link. Currently there is only enough physical memory to run 5-6 VMs at the same time.
2. Notice that your mouse cursor will get "stuck" inside the VM. To get your mouse out of the VM press the left **Ctrl** and **Alt** keys on the keyboard. To give focus back to the VM, click inside the VM again.
3. You can use a single VMware Server Console window and toggle between VMs by selecting them on the Inventory list.
4. You can also click on the desktop VMware Server icon and bring up multiple VMware Consoles to display different VMs in different windows at the same time.
5. **Tip**: For the VMs that are running in graphical mode (run level 5) you may experience **cursor drift inside the VM**. If you curser drifts too far from your actual mouse position do this:
    a. Hit Ctrl and Alt keys to release the mouse from the VM.
    b. Move the mouse to the left Inventory panel outside of the VM and right click there.
    c. Move the mouse to the right again, back into the VM and do a right click so the VM will capture the mouse again.
    d. The mouse and cursor should be together again.

Step 6 – System inventory

1. Log into each VM as **cis192** and use the password given out in class.
2. There is a terminal icon on all desktops. Start up a terminal window and use **su –** to become root. Don't leave off the "-" as this will enable root's shell environment.
3. Record which Linux distribution (**cat /boot/grub/grub.conf** or **cat /boot/grub/menu.lst**) is loaded on each VM and the version of the Kernel (**uname –r**).
4. Use the **lspci** command to view the NIC hardware (look for the AMD 79c970 Ethernet controller at the end)
5. Use **dmesg | grep eth0** and **dmesg | grep net** to see kernel boot messages regarding the NIC card hardware.

Record this:

Create a system inventory table in your lab1.*lastname* file and record the following information for each VM. The 1st entry has been completed as an example.

VM System Inventory Table

Name	OS/Distro	Kernel Version
192-arwen	CentOS	2.6.18-92.1.22.el5
192-celebrian		
192-elrond		
192-fang		

```
192-frodo
192-legolas
192-sauron
192-sniffer
192-william
```

Record this:
All the VMs are using the same hardware. Record in your lab1.*lastname* file the name and model of the NIC being used by the VMs. This is the last entry (or entries) in the **lspci** output.

Step 7 – NIC drivers

Once you know what your NIC hardware is you will need to locate a NIC driver. Fortunately the Linux distributions ship with lots of NIC drivers included. This is not always the case though as you may have a NIC that is newer that your distribution. In that case you will need to locate, download and possibly build the correct Linux driver.

1. Open up a web browser and browse to http://tldp.org (The Linux Documentation Project).
2. Navigate to the web based Ethernet Howto at http://tldp.org/HOWTO/Ethernet-HOWTO.html. Look in the section 4.5 to find driver information for the various AMD NICs.
3. Can you find the name of the driver for the AMD 79C970?
4. All of the following steps will be done using the **Elrond VM**. Make sure it is running and you have logged in as **root**. We will be doing copy and paste to your Windows lab1.*lastname* file so Elrond needs to go into graphics mode (run level 5). Do this with the **startx** command.
5. Bring up a graphical terminal using the icon on Elrond's desktop.
6. On Elrond, issue the **lsmod** command to see all the dynamic drivers currently loaded. These are all dynamic kernel modules.
7. Look for the module with the name of the driver for the AMD 79C970. You can use **lsmod | grep pcnet32** to locate it. Note it is used in conjunction with the MII (Media Independent Interface) module.
8. Look at all the available NIC drivers (kernel modules) that are available using
   ls ***/lib/modules/2.6.18-92.1.22.el5/kernel/drivers/net***
   (use tab completion!) Note they all have a .ko suffix.
9. Type **ifconfig** to see the current interfaces in operation.
10. Type **ifconfig eth0 up** then issue the **ifconfig** (no arguments) command again by itself. Is eth0 up now?
11. Let's remove the NIC driver temporarily then load it again.
12. Use **ifconfig eth0 down** to shutdown that interface on Elrond.
13. Use **rmmod pcnet32** to unload the NIC driver (kernel module)
14. Use **lsmod** or **lsmod | grep pcnet32** to verify the module is no longer loaded.
15. Use **modprobe pcnet32** to reload the kernel module and use **lsmod** to verify it is loaded. Note that the modprobe command does not require the path or suffix for the network drivers in */lib/modules.2.6.18-92.e15/kernel/drivers/net.*

Record this:
Record in your lab1.*lastname* file the NIC driver information for Elrond. Include

1. The **lsmod | grep pcnet32** output showing the loaded NIC driver and
2. A **short listing** of the NIC drivers in your */lib/modules.2.6.18-92.e15/kernel/drivers/net* directory.

TIP: To enable copy and paste from the Elrond VM to your lab1.*lastname* file. Type

vmware-toolbox &

then minimize the dialog box that comes up.

Remember, the NIC drivers are dynamic kernel modules that can be loaded and removed dynamically. Different NIC brands and models require different drivers. The following table shows the drivers and NICs for systems found in the CIS Lab systems:

NIC	Linux Driver
Intel PRO 100 NIC	e100
D-Link NICs with RealTek 8129/8139 chipsets	8139too
3Com 3c905x NICs	3c59x
Lite-on Communications LNE 100TX cards with DEC chipsets	tulip
AMD 79c970 NIC (used in VMware VMs)	pcnet32

Step 8 – Record new Linux commands

The **man** command is useful for documenting commands, options and arguments. However it is almost guaranteed that there will be no examples for a command you can't get to work.

Record this:

Record in your lab1.*lastname* file example commands you used for this lab. This should be a concise set of documented examples that you can use in the future for reference.

To turn in

Your lab1.*lastname* **text** file should contain the following sections. For details on what to record see the "Record this" sections in blue above.

- Lab title, your name and date
- Time spent doing lab (used to record your TBA hours)
- VMware host PC inventory
- VM hardware inventory
- VM system inventory
- VM's NIC make and model
- Elrond's lsmod output showing pcnet32 driver loaded
- Elrond's ls (short listing) of available NIC drivers on Elrond
- Linux command examples

Check your work for completeness then submit as many times as you wish up until the due date deadline. Remember, **late work is not accepted**, so start early, plan ahead for things to go wrong and use the forum to collaborate.

To submit your work, on the Windows host bring up the Command Prompt line window, navigate (use dir and cd commands) to the My Documents folder and use the pscp to submit your work:

pscp lab1.*lastname* cis192@opus.cabrillo.edu:lab1.*lastname*

Grading rubric (30 points)

5 points for correct submittal, professional appearance and quality
5 points for correct VMware host PC station information
5 points for correct VM hardware inventory
5 points for correct VM system inventory
5 points for correct and complete NIC and NIC driver information
5 points for complete and concise command summary