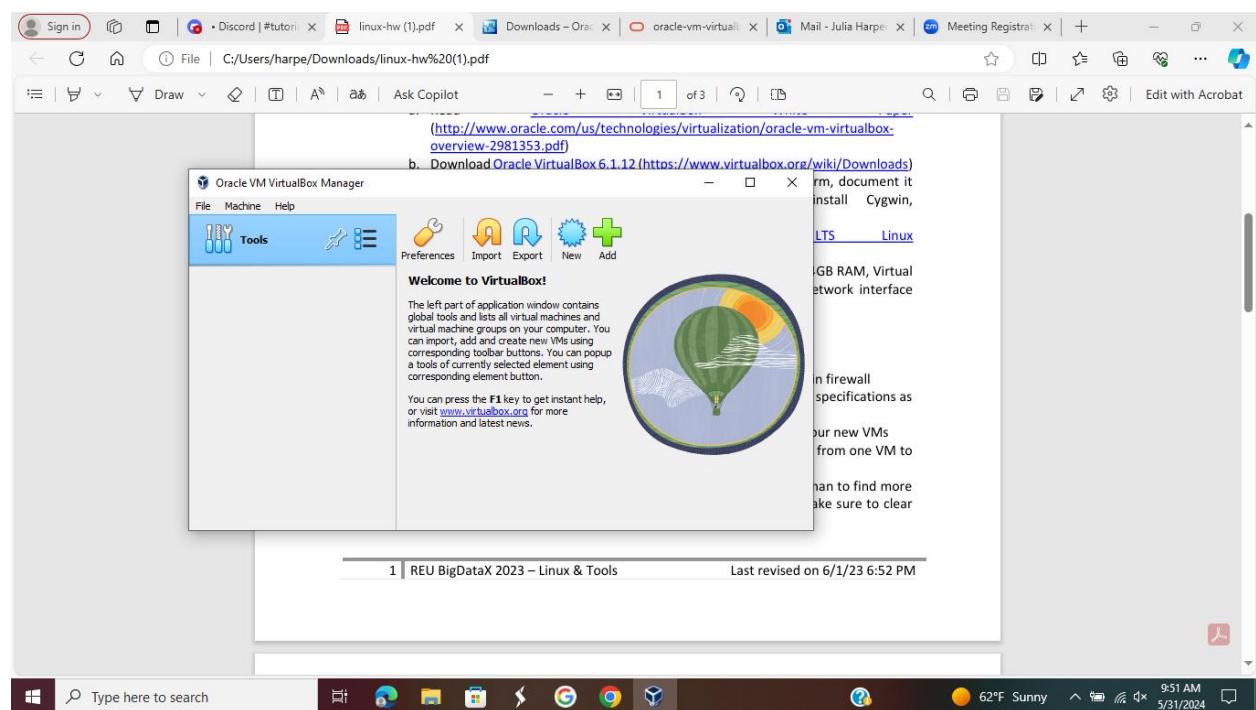
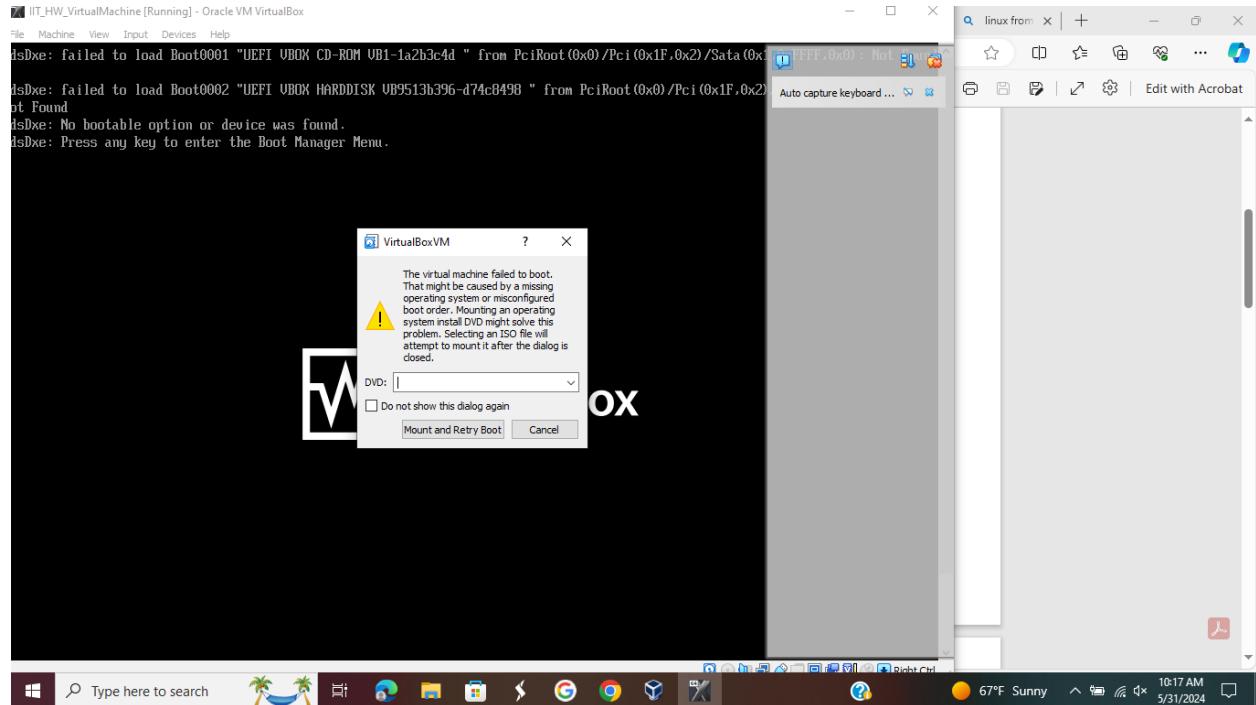
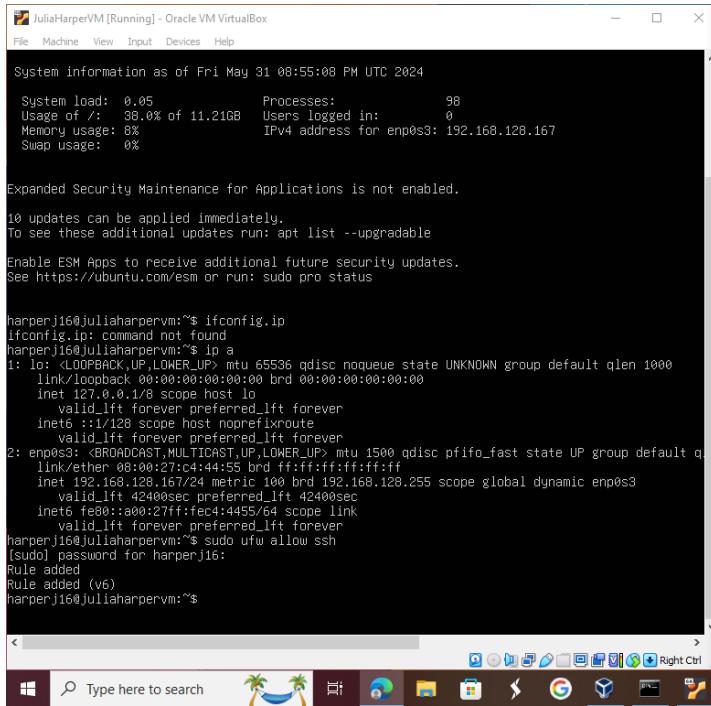


Julia Harper

1. While it is encouraged to use the newest version:

- If continued issues arise in downloading try the server version of Ubuntu





JuliaHarperVM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

System information as of Fri May 31 08:55:08 PM UTC 2024

System load: 0.05 Processes: 96
Usage of /: 38.0% of 11.21GB Users logged in: 0
Memory usage: 8% IPv4 address for enp0s3: 192.168.128.167
Swap usage: 0%

Expanded Security Maintenance for Applications is not enabled.
10 updates can be applied immediately.
To see these additional updates run: apt list --upgradable
Enable ESM Apps to receive additional future security updates.
See <https://ubuntu.com/esm> or run: sudo pro status

```
harperj16@juliaharpervm:~$ ifconfig.ip
ifconfig.ip: command not found
harperj16@juliaharpervm:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
        inet6 ::1/128 scope host noprefixroute
            valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 08:00:27:c4:44:55 brd ff:ff:ff:ff:ff:ff
    inet 192.168.128.167/24 metric 100 brd 192.168.128.255 scope global dynamic enp0s3
        valid_lft 42400sec preferred_lft 42400sec
        inet6 fe80::a0:27ff:fe41:4455/64 scope link
            valid_lft forever preferred_lft forever
harperj16@juliaharpervm:~$ sudo ufw allow ssh
[sudo] password for harperj16:
Rule added
Rule added (v6)
harperj16@juliaharpervm:~$
```

h. Turn on Firewall and block all ports: sudo ufw enable sudo ufw default deny

i. Enable SSH access to your new Linux installation; open SSH port in firewall sudo apt update sudo apt install openssh-server To verify: sudo systemctl status ssh sudo ufw allow ssh

```

JuliaHarperVM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Docs: man:sshd(8)
man:sshd_config(5)
harperj16@juliaharpervm:~$ ssh-keygen
Generating public/private ed25519 key pair.
Enter file in which to save the key (/home/harperj16/.ssh/id_ed25519):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Passphrases do not match. Try again.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/harperj16/.ssh/id_ed25519.
Your public key has been saved in /home/harperj16/.ssh/id_ed25519.pub
The key fingerprint is:
SHA256:N99nRL+0NNw07bSwuQyC187Yg5zDNaSq/nKz4gsc harperj16@juliaharpervm
The key's randomart image is:
++-[SHA256]--+
 . . oo .
 . o =+.
 + ...oo+.
 . + oo .+
 S .++B .+
 .oo .+
 0 . . .+.
 . E. = ....o
 ..oo.*. ....
-----[SHA256]-----
harperj16@juliaharpervm:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group d
link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
inet 127.0.0.1/8 brd 00:00:00:00:00:00 scope host lo
    valid_lft forever preferred_lft forever
inet6 ::1/128 brd 00:00:00:00:00:00 scope host
    valid_lft forever preferred_lft forever
2: emps3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state
link/ether 08:00:27:c4:44:55 brd ff:ff:ff:ff:ff:ff
inet 192.168.128.167/24 metric 100 brd 192.168.128.255 scope global dyn
    valid_lft 41153sec preferred_lft 41153sec
inet6 fe80::a00:27ff:fe44:4455/64 scope link
    valid_lft forever preferred_lft forever
harperj16@juliaharpervm:~$ exit
Connection to 192.168.128.167 closed.

harperj16@juliaharpervm:~$ logout
Connection to 192.168.128.167 closed.

C:\Users\harpe>ssh harperj16@192.168.128.167
harperj16@192.168.128.167's password:
Welcome to Ubuntu 24.04 LTS (GNU/Linux 6.8.0-31-generic x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Fri May 31 09:27:06 PM UTC 2024

System load: 0.01 Processes: 99
Usage of /: 38.1% of 11.21GB Users logged in: 1
Memory usage: 10% IPv4 address for enp0s3: 192.168.128.167
Swap usage: 0%

Expanded Security Maintenance for Applications is not enabled.

10 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

Last login: Fri May 31 21:27:07 2024 from 192.168.128.102
harperj16@juliaharpervm:~$ Hello world
Command 'Hello' not found, did you mean:
  command 'hello' from snap hello (2.19)
  command 'jello' from deb jello (1.6.0-1)
harperj16@juliaharpervm:~$
```

2

a. ssh –secure shell

```

JuliaHarperVM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Ubuntu 24.04 LTS juliaharpervm tty1
juliaharpervm login: harperj16
Password:
Welcome to Ubuntu 24.04 LTS (GNU/Linux 6.8.0-31-generic x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Fri May 31 07:58:05 PM UTC 2024

System load: 0.31 Processes: 100
Usage of /: 37.5% of 11.21GB Users logged in: 0
Memory usage: 8% IPv4 address for enp0s3: 10.0.2.15
Swap usage: 0%

Expanded Security Maintenance for Applications is not enabled.

10 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

harperj16@juliaharpervm:~$
```

2. Download [Oracle VirtualBox 6.1.12](https://www.virtualbox.org/wiki/Downloads) (<https://www.virtualbox.org/wiki/Downloads>)
 3. Install VirtualBox (if VirtualBox is not supported on your platform, do carefully why it does not work, and download/install <https://cygwin.com/install.html>)
 4. Download [Ubuntu Desktop 20.04.1 LTS](https://ubuntu.com/download/desktop) (<https://ubuntu.com/download/desktop>) ISO Image
 5. Create Virtual Machine (VM), to support Linux, Ubuntu, 64-bit, 4GB RAM, Disk 25GB, VDI image, dynamically allocated, 2-core, and a network (1GbE or WiFi) with NAT support
 6. Install Linux from the ISO image
 7. Create a user id and password
 8. Turn on Firewall and block all ports
 9. Enable SSH access to your new Linux installation; open SSH port in firewall
 10. Repeat steps 5 through 9, and create another VM with the same specifications
 11. Test that you can connect remotely to your VMs with your keys, from the other VM

2. Show an example of using the following commands (hint: you can use man to get information about each one); take screen shots of your commands; make sure they work correctly.

1 | REU BigDataX 2023 – Linux & Tools Last revised on 6/1/

b. ssh-keygen –creates a public and a private key used to generate connections accross shells

```

JuliaHarperVM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Docs: man:sshd(8)
      man:sshd_config(5)
harperj16@juliaharpervm:~$ ssh-keygen
Generating public/private ed25519 key pair.
Enter file in which to save the key (/home/harperj16/.ssh/id_ed25519):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Passphrases do not match. Try again.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/harperj16/.ssh/id_ed25519
Your public key has been saved in /home/harperj16/.ssh/id_ed25519.pub
The key fingerprint is:
SHA256:N90nRL+0NN0v7BSwQy9eC187Yg5zDNaSq/nKz4gsc harperj16@juliaharpervm
The key's randomart image is:
++-[ED25519 256]-
. 00 . .
. o . =+.
+ ...o+.
. + 000.+.
S ..++B .+
. 00 . +
0 . . .+.
. E. =...o|
. 00.*. ...
-----[SHA256]-----
harperj16@juliaharpervm:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group 0
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
        inet 127.0.0.1/8 scope host lo
            valid_lft forever preferred_lft forever
            inetet ::1/128 scope host noprefixroute
                valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP
    link/ether 08:00:27:c4:44:55 brd ff:ff:ff:ff:ff:ff
        inet 192.168.128.167/24 metric 100 brd 192.168.128.255 scope global dynamic
            valid_lft 41153sec preferred_lft 41153sec
        inet6 fe80::a0:27ff:fe44:4455/64 scope link
            valid_lft forever preferred_lft forever
harperj16@juliaharpervm:~$ 

```

```

harperj16@juliaharpervm:~$ expanded Security Maintenance for Applications is not enabled.
10 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

harperj16@juliaharpervm:~$ exit
logout
Connection to 192.168.128.167 closed.

C:\Users\harpe>ssh harperj16@192.168.128.167
harperj16@192.168.128.167's password:
Welcome to Ubuntu 24.04 LTS (GNU/Linux 6.8.0-31-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:   https://landscape.canonical.com
 * Support:      https://ubuntu.com/pro

System information as of Fri May 31 09:27:06 PM UTC 2024

System load:  0.01           Processes:         99
Usage of /:   38.1% of 11.21GB  Users logged in:   1
Memory usage: 10%           IPv4 address for enp0s3: 192.168.128.167
Swap usage:   0%             78°F Mostly sunny  4:34 PM
5/31/2024

Expanded Security Maintenance for Applications is not enabled.
10 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

Last login: Fri May 31 21:27:07 2024 from 192.168.128.102
harperj16@juliaharpervm:~$ Hello world
Command 'Hello' not found, did you mean:
  command 'hello' from snap hello (2.10)
  command 'jello' from deb jello (1.6.0-1)
command not found
harperj16@juliaharpervm:~$ 

```

Type here to search 4:34 PM
5/31/2024

c. scp –fast reliable and secure way to copy files

d. history - shows the history of the last things worked on in the VM

```

JuliaHarperVM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

harperj16@juliaharpervm:~$ scp
usage: scp [-346ABCOpRrsTv] [-c cipher] [-D sftp_server_path] [-F ssh_config]
           [-i identity_file] [-J destination] [-l limit] [-o ssh_option]
           [-P port] [-S program] [-X sftp_option] source ... target
harperj16@juliaharpervm:~$ history
1  exit
2  scp
3  history
harperj16@juliaharpervm:~$ sudo

```

the other VM

2. Show an example of using the following commands (hint: you can use man to find more information about each one); take screen shots of your commands; make sure to clear

1 REU BigDataX 2023 – Linux & Tools Last revised on 6/1/23 6:52 PM

e. sudo- allows you to use admin privileges without admin access.

JuliaHarperVM [Running] - Oracle VM VirtualBox

```

usage: sudo [-l [-g group] [-h host] [-p prompt] [-U user]
           [-u user] [command [arg ...]]]
usage: sudo [-ABeHKnNPS] [-r role] [-t type] [-c num] [-D directory]
           [-g group] [-h host] [-p prompt] [-R directory] [-T timeout]
           [-u user] [VAR=value] [-i | -s] [command [arg ...]]
usage: sudo -e [-ABeHKnS] [-r role] [-t type] [-c num] [-D directory]
           [-g group] [-h host] [-p prompt] [-R directory] [-T timeout]
           [-u user] file ...
Options:
-A, --askpass          use a helper program for password prompting
-B, --background        run command in the background
-B, --bell              ring bell when prompting
-C, --close-fromfdnum close all file descriptors >= num
-D, --chdir=directory  change the working directory before running command
-E, --preserve-env     preserve user environment when running command
-e, --preserve-env-list preserve specific environment variables
-g, --group=group       edit files instead of running a command
-H, --set-home          run command as the specified group name or ID
-h, --help              set HOME variable to target user's home dir
-h, --host=host         display help message and exit
-h, --host=host         run command on host (if supported by plugin)
-i, --login             run login shell as the target user; a command may also be specified
-k, --remove-timestamp remove timestamp file completely
-k, --reset-timestamp  invalidate timestamp file
-l, --list              list user's privileges or check a specific command; use twice for longer format
-n, --non-interactive   non-interactive mode, no prompts are used
-P, --preserve-groups  preserve group vector instead of setting to target's
-p, --prompt=prompt    use the specified password prompt
-R, --chroot=directory change the root directory before running command
-r, --role=role         create SELinux security context with specified role
-S, --stdin            read password from standard input
-s, --shell             run shell as the target user; a command may also be specified
-t, --type=type         create SELinux security context with specified type

```

Microsoft Bing

Sign in

https://www.bing.com/search... SEARCH COPILOT NOTEBOOK jharpe

3. Timestamp and Logging: When a user runs a command using `sudo`, a timestamp is recorded in the system logs. The user can execute commands with elevated privileges for a short time (usually 15 minutes by default).

4. Additional Options:

- `-h`: Displays help, showing syntax and command options.
- `-V`: Displays the current version of the `sudo` application.
- `-v`: Refreshes the time limit on `sudo` without running a command.
- `-l`: Lists the user's privileges or checks a specific command.
- `-k`: Ends the current `sudo` privileges.

5. Granting Privileges:

- On most modern Linux distributions, a user must be part of the `sudoers`, or `wheel` group to use `sudo`.
- To add a user to the `sudoers` group:

Ask me anything...

Commercial data protection applies to this chat.

7:13 PM 5/31/2024

f. ip -ip a will pull the ip address

JuliaHarperVM [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

System information as of Sat Jun 1 04:11:07 AM UTC 2024

```

System load: 0.63 Processes: 102
Usage of /: 39.0% of 11.21GB Users logged in: 0
Memory usage: 8%
Swap usage: 0%

Expanded Security Maintenance for Applications is not enabled.

10 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

harperj16@juliaharpervm:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1 link/loopback 00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 1000
    link/ether 08:00:27:c4:44:55 brd ff:ffff:ffff:ff:ff:ff
    inet 192.168.0.164/24 metric 100 brd 192.168.0.255 scope global dynamic enp0s3
        valid_lft 3579sec preferred_lft 3579sec
    inet6 fe80::a00:27ff:fe04:4455/64 scope link
        valid_lft forever preferred_lft forever
harperj16@juliaharpervm:~$ 

```

65°F Cloudy 6:55 AM 6/1/2024

g. dd –read/write/&destroy information

```
harperj16@juliaharpervm:~$ dd if= source.txt of=destination.txt
dd: failed to open 'source.txt': No such file or directory
harperj16@juliaharpervm:~$ dd if=/dev/sda
dd: failed to open '/dev/sda': Permission denied
harperj16@juliaharpervm:~$ sudo dd if=source.txt of=destination.txt
dd: failed to open 'source.txt': No such file or directory
harperj16@juliaharpervm:~$ [sudo] password for harperj16:
Sorry, try again.
[sudo] password for harperj16:
Sorry, try again.
[sudo] password for harperj16:
dd: failed to open 'source.txt': No such file or directory
harperj16@juliaharpervm:~$
```

j. vi

k. time

h. fdisk –usefull for creation and manipulation of disk partitions

```
harperj16@juliaharpervm:~$ sudo fdisk /dev/sda
sudo: fdisk: command not found
harperj16@juliaharpervm:~$ sudo fdisk -l
Disk /dev/sda: 25 GiB, 2684354560 bytes, 52428800 sectors
Disk model: VBOX HARDDISK
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: gpt
Disk identifier: 9FEA003B-EE3F-477F-B297-45602B823B4F

Device        Start      End  Sectors Size Type
/dev/sda1     2048    4095    2048   1M BIOS boot
/dev/sda2    4096  4198399  4194304   2G Linux filesystem
/dev/sda3  4198400  52426751 40228352  23G Linux filesystem

Disk /dev/mapper/ubuntu--vg-ubuntu--lv: 11.5 GiB, 12343836672 bytes, 24109056 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
harperj16@juliaharpervm:~$
```

h. fdisk

i. apt

j. vi

k. time

l. tar

m. cat

n. watch

i. apt – records/packages of the database from the repository, regular updates

```
harperj16@juliaharpervm:~$ sudo apt install nmap
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  libbbfs3 liblinear4 liblua5.4-0 libssh2-1t64 nmap-common
Suggested packages:
  liblinear-tools liblinear-dev ncat ndiff zenmap
The following NEW packages will be installed:
  libbbfs3 liblinear4 liblua5.4-0 libssh2-1t64 nmap nmap-common
0 upgraded, 6 newly installed, 0 to remove and 17 not upgraded.
Need to get 6.452 kB of archives.
After this operation, 28.0 MB of additional disk space will be used.
Do you want to continue? [Y/n] _
```

l. tar

m. cat

n. watch

o. ps

p. top

j. vi-is a text editor

k. time- executes a command and records runtime/CPU time/sysyem time

The image shows a Windows desktop environment. On the left is a terminal window titled 'Juliaharpervm login: harperj16' showing system information and a 'time' command. On the right is a Microsoft Word document titled 'Hypervisor_IIT_firstproject' containing a 'j. vi' section with a screenshot of a terminal window showing a 'sudo apt install nmap' command.

```
juliaharpervm login: harperj16
Password:
Welcome to Ubuntu 24.04 LTS (GNU/Linux 6.8.0-31-generic x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Sat Jun 1 12:36:06 AM UTC 2024

System load: 0.02      Memory usage: 7%   Processes:      98
Usage of /: 38.6% of 11.21GB Swap usage: 0%   Users logged in: 0

Expanded Security Maintenance for Applications is not enabled.

10 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status.

harperj16@juliaharpervm:~$ type time
time is a shell keyword
harperj16@juliaharpervm:~$ which time
/usr/bin/time
harperj16@juliaharpervm:~$ command time
time: missing program to run
Try 'time --help' for more information.
harperj16@juliaharpervm:~$ \time
time: missing program to run
Try 'time --help' for more information.
harperj16@juliaharpervm:~$ time

real    0m0.000s
user    0m0.000s
sys     0m0.000s
harperj16@juliaharpervm:~$
```

File Home Insert Layout References Review Share ...

j. vi

```
harperj16@juliaharpervm:~$ sudo apt install nmap
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  libnmap3 libnmap-common libnmap-dev libnmap-dbg libnmap-gui libnmap-qemu
Suggested packages:
  libnmap3 libnmap-common libnmap-dev libnmap-dbg libnmap-gui libnmap-qemu
The following NEW packages will be installed:
  libnmap3 libnmap-common libnmap-dev libnmap-dbg libnmap-gui libnmap-qemu
0 upgraded, 6 newly installed, 0 to remove and 17 not upgraded.
Need to get 5,452 kB of archives.
After this operation, 28.0 MB of additional disk space will be used.
Do you want to continue [Y/n]?
```

Type here to search

L. tar
m. cat
n. watch

l. tar – is used for compression and archiving

The image shows a Windows desktop environment with a terminal window. The terminal window displays an attempt to use the 'tar' command with incorrect syntax, resulting in errors about file/directory not found.

```
harperj16@juliaharpervm:~$ tar -czvf files.tar.gz text.txt.another.txt
tar: text.txt.another.txt: Cannot stat: No such file or directory
tar: Exiting with failure status due to previous errors.
harperj16@juliaharpervm:~$ tar -czvf files.tar.gz text.txt another.txt
tar: text.txt: Cannot stat: No such file or directory
tar: another.txt: Cannot stat: No such file or directory
tar: Exiting with failure status due to previous errors.
harperj16@juliaharpervm:~$ tar -czvf files.tar.gz text.txt another.txt
```

m. cat- allows you to manipulate (write, connotate, merge) file contents

Ubuntu 24.04 LTS juliaharpervm tty6

juliaharpervm login: harperj16
Password:

Welcome to Ubuntu 24.04 LTS (GNU/Linux 6.8.0-31-generic x86_64)

* Documentation: https://help.ubuntu.com
* Management: https://landscape.canonical.com
* Support: https://ubuntu.com/pro

System information as of Sat Jun 1 01:12:08 AM UTC 2024

System load: 0.01 Memory usage: 8% Processes: 100
Usage of /: 38.7% of 11.21GB Swap usage: 0% Users logged in: 1

Expanded Security Maintenance for Applications is not enabled.

10 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

```
harperj16@juliaharpervm:~$ cat >test1.txt
This is what a test text looks like.
harperj16@juliaharpervm:~$ cat >test2.txt
Hooray I did it boo-ya.
harperj16@juliaharpervm:~$ cat test1.txt test2.txt
This is what a test text looks like.
Hooray I did it boo-ya.
harperj16@juliaharpervm:~$ _
```

File Home Insert Layout References Review Share

Sign in https://livestudentccc-my.share...

Search for tools, help, ai

m. cat

n. watch

o. ps

p. top

q. htop

r. gcc

Type here to search

Page 7 of 8 190 words English (U.S.) 140% 8:43 PM 5/31/2024

n. watch -watch -n 5 date -updates the date every 5 seconds of run time

JuliaHarperVM [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Every 5.0s: date

Sat Jun 1 01:17:08 AM UTC 2024

File Home Insert Layout References Review Share

Sign in https://livestudentccc-my.share...

Search for tools, help, ai

n. watch

o. ps

p. top

q. htop

r. gcc

s. tail

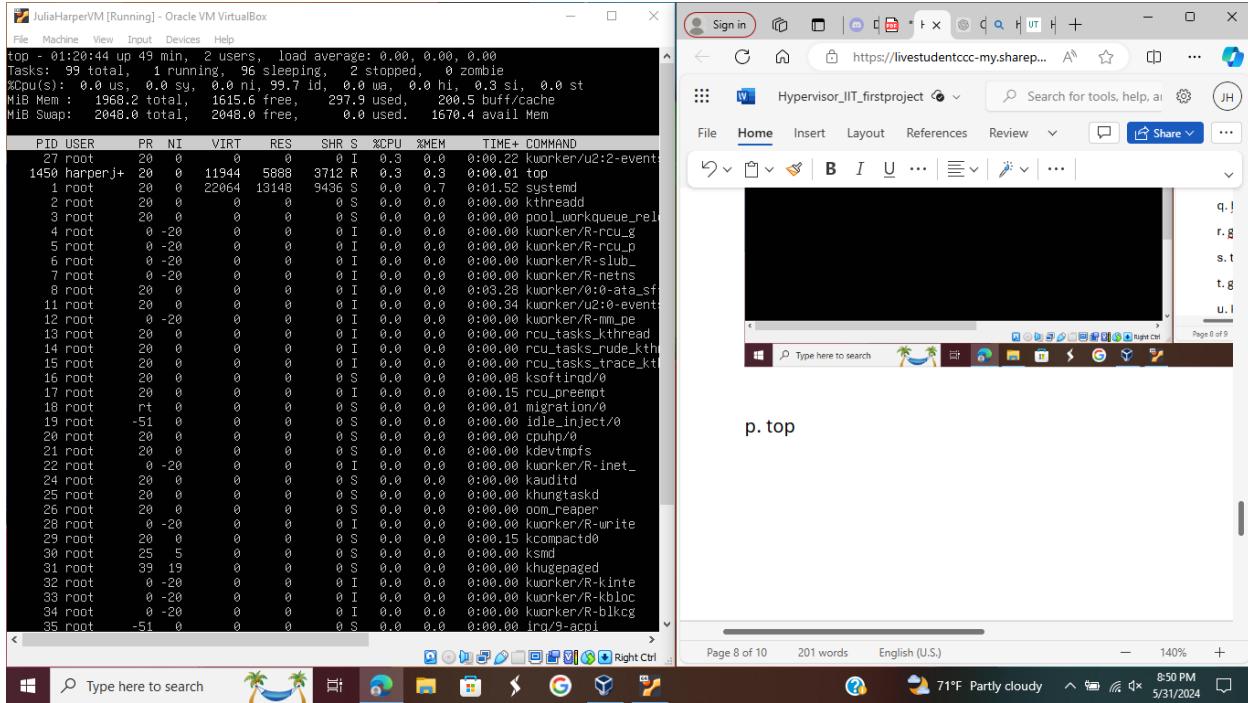
t. grep

u. kill

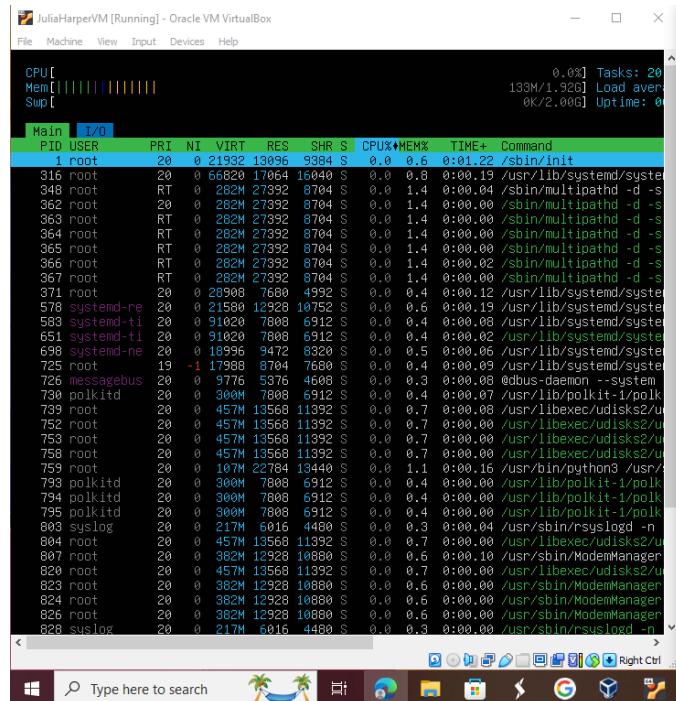
Type here to search

Page 8 of 9 190 words English (U.S.) 140% 8:46 PM 5/31/2024

p. top- details critical information about machine runtime



q. htop - htop interface, displaying various system metrics in real-time.



r. gcc – used for manipulations and compilation in C language

JuliaHarperVM [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

* Support: https://ubuntu.com/pro

System information as of Sat Jun 1 01:36:50 AM UTC 2024

System load: 0.08 Memory usage: 0% Processes: 98
Usage of /: 38.9% of 11.21GB Swap usage: 0% Users logged in: 0

Expanded Security Maintenance for Applications is not enabled.

10 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

```
harperj16@juliaharpervm:~$ gcc IITSummer.c -o Welcome to camp
Command 'gcc' not found, but can be installed with:
sudo apt install gcc
harperj16@juliaharpervm:~$ sudo apt install gcc
[sudo] password for harperj16:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
binutils binutils-common binutils-x86_64-linux-gnu cpp cpp-13 cpp-13-x86_64-linux-gnu cpp-13-x86_64-linux-gnu libasan8 libatomici libbinutils libcc1-0 libctf-nobfd0 libctf0 liblmbc3 libquadmath0 libstrme1 libtsan2 libubsan1
Suggested packages:
binutils-doc gprofng-gui cpp-doc gcc-13-locales cpp-13-doc gcc-multilib make autoconf a
gdb-x86_64-linux-gnu
The following NEW packages will be installed:
binutils binutils-common binutils-x86_64-linux-gnu cpp cpp-13 cpp-13-x86_64-linux-gnu cpp-13-x86_64-linux-gnu libasan8 libatomici libbinutils libcc1-0 libctf-nobfd0 libctf0 liblmbc3 libquadmath0 libstrme1 libtsan2 libubsan1
0 upgraded, 30 newly installed, 0 to remove and 17 not upgraded.
0 Need to get 51.6 MB of archives.
After this operation, 182 MB of additional disk space will be used.
Do you want to continue? [Y/n] _
```

Sign in

Hypervisor_IIT_firstproject

Search for tools, help, ai

File Home Insert Layout References Review

Share

Type here to search

r. gcc

Page 10 of 11 210 words English (U.S.)

9:09 PM 5/31/2024

s. tail- (complimentary to the head command)- produces the last number of lines requested

The screenshot shows a Windows desktop environment with two windows open. The left window is a terminal window titled "JuliaHarperVM [Running] - Oracle VM VirtualBox" showing command-line output for installing gcc. The right window is a web browser titled "Hypervisor_IIT_firstproject" displaying a search results page for "studentcc-my.sharepoint.com".

Terminal Window (Left):

```
sudo apt install gcc
harperj16@juliolaharpervm:~$ sudo apt install gcc
[sudo] password for harperj16:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  binutils binutils-common binutils-x86_64-linux-gnu cpp cpp-13 cpp-13-x86_64-linux-gnu cpp-13-x86_64-linux-gnu libasan8 libatomici libbinutils libgcc1-0 libctf-nobfd0 libctf0 libgcc1 libmpc3 libquadmath0 libsframe1 libtsan2 libubsan1
Suggested packages:
  binutils-doc gprofng-gui cpp-doc gcc-13-locales cpp-13-doc gcc-multilib make autoconf automake gnu-sed gnu-tar gnu-wget
The following NEW packages will be installed:
  binutils binutils-common binutils-x86_64-linux-gnu cpp cpp-13 cpp-13-x86_64-linux-gnu cpp-13-x86_64-linux-gnu libasan8 libatomici libbinutils libgcc1-0 libctf-nobfd0 libctf0 libgcc1 libmpc3 libquadmath0 libsframe1 libtsan2 libubsan1
0 upgraded, 30 newly installed, 0 to remove and 17 not upgraded.
Need to get 51.6 MB of archives.
After this operation, 182 MB of additional disk space will be used.
Do you want to continue? [Y/n] n
Abort.
harperj16@juliolaharpervm:~$ tail /var/log/auth.log | grep Usage: grep [OPTION]... PATTERN [FILE]...
Try 'grep --help' for more information.
harperj16@juliolaharpervm:~$ tail word-list.txt
tail: cannot open 'word-list.txt' for reading: No such file or directory
harperj16@juliolaharpervm:~$ cat >word-list.txt
zoom
zoom
zoom
boom
boom
boom
harperj16@juliolaharpervm:~$ tail word-list.txt
zoom
zoom
zoom
boom
boom
boom
harperj16@juliolaharpervm:~$
```

Browser Window (Right):

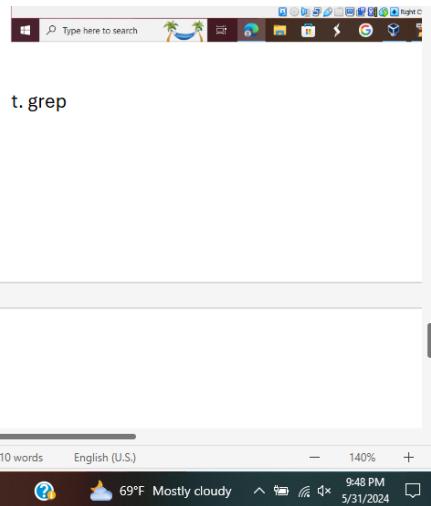
https://livestudentccc-my.sharepoint.com/

File Home Insert Layout References Review Share

Page 10 of 11 210 words English (U.S.) 9:44 PM 5/31/2024

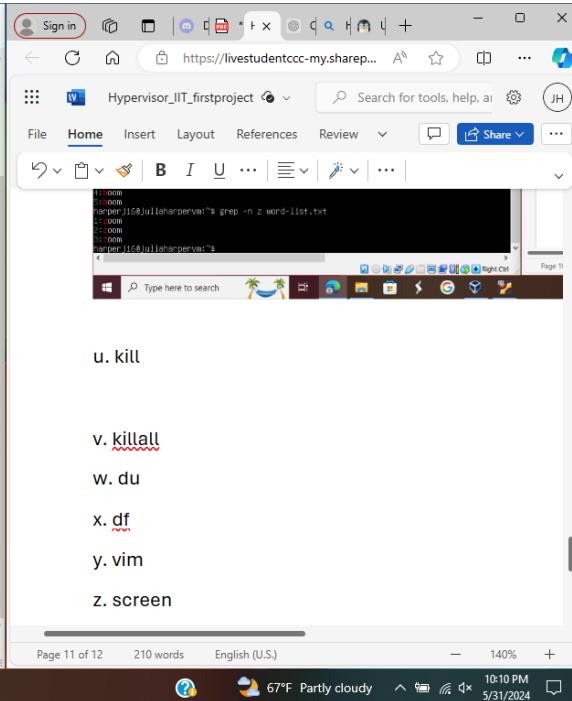
t. grep- searches for a particular pattern and then assembles those pieces in a subsequent list

```
Upgrading: 30 newly installed, 0 to remove and 17 not upgraded.  
Need to get 51.6 MB of archives.  
After this operation, 182 MB of additional disk space will be used.  
Do you want to continue? [Y/n] n  
Abort.  
harperj16@juliaharpervm:~$ tail /var/log/auth.log | grep usage:  
Usage: grep [OPTION]... PATTERN [FILE]...  
Try 'grep --help' for more information.  
harperj16@juliaharpervm:~$ tail word-list.txt  
tail: cannot open 'word-list.txt' for reading: No such file or directory  
harperj16@juliaharpervm:~$ cat >word-list.txt  
zoom  
zoom  
zoom  
boom  
boom  
boom  
harperj16@juliaharpervm:~$ tail word-list.txt  
zoom  
zoom  
zoom  
boom  
boom  
boom  
harperj16@juliaharpervm:~$ grep -n b word-list.txt  
4:boom  
5:boom  
harperj16@juliaharpervm:~$ grep -n z word-list.txt  
1:zoom  
2:zoom  
3:zoom  
harperj16@juliaharpervm:~$  
<
```



u. kill - kills a process. Below lists all the available processes to kill

```
JuliaHarperVM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Usage: grep [OPTION]... PATTERN [FILE]...
Try 'grep --help' for more information.
harperj16@juliaharpervm:~$ tail word-list.txt
tail: cannot open 'word-list.txt' for reading: No such file or directory
harperj16@juliaharpervm:~$ cat >word-list.txt
zoom
zoom
zoom
boom
boom
boom
harperj16@juliaharpervm:~$ tail word-list.txt
zoom
zoom
zoom
boom
boom
boom
harperj16@juliaharpervm:~$ grep -n b word-list.txt
4:zoom
5:boom
harperj16@juliaharpervm:~$ grep -n z word-list.txt
1:zoom
2:zoom
3:zoom
harperj16@juliaharpervm:~$ kill l
-bash: kill: l: arguments must be process or job IDs
harperj16@juliaharpervm:~$ kill -l
 1) SIGHUP   2) SIGINT   3) SIGQUIT   4) SIGILL   5) SIGTRAP
 6) SIGABRT  7) SIGBUS   8) SIGFPE    9) SIGKILL  10) SIGUSR1
11) SIGSEGV  12) SIGUSR2  13) SIGPIPE   14) SIGALRM  15) SIGTERM
16) SIGSTKFLT 17) SIGCHLD  18) SIGCONT  19) SIGSTOP  20) SIGTSTP
21) SIGTTIN  22) SIGTTOU  23) SIGURG   24) SIGXCPU  25) SIGXFSZ
26) SIGVTALRM 27) SIGPROF  28) SIGWINCH 29) SIGIO    30) SIGPWR
31) SIGSYS  34) SIGRTMIN 35) SIGRTMIN+1 36) SIGRTMIN+2 37) SIGRTMIN+3
38) SIGRTMIN+4 39) SIGRTMIN+5 40) SIGRTMIN+6 41) SIGRTMIN+7 42) SIGRTMIN+8
43) SIGRTMIN+9 44) SIGRTMIN+10 45) SIGRTMIN+11 46) SIGRTMIN+12 47) SIGRTMIN+13
48) SIGRTMIN+14 49) SIGRTMIN+15 50) SIGRTMAX-14 51) SIGRTMAX-13 52) SIGRTMAX-12
53) SIGRTMAX-11 54) SIGRTMAX-10 55) SIGRTMAX-9 56) SIGRTMAX-8 57) SIGRTMAX-7
58) SIGRTMAX-6 59) SIGRTMAX-5 60) SIGRTMAX-4 61) SIGRTMAX-3 62) SIGRTMAX-2
63) SIGRTMAX-1 64) SIGRTMAX
harperj16@juliaharpervm:~$
```



v. killall –can end all processes, even those run with others

```

JuliaHarperVM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
buntu 24.04 LTS juliaharpervm tty1
uliaharpervm login: harperj16
password:
Login incorrect
uliaharpervm login: harperj16
password:
Welcome to Ubuntu 24.04 LTS (GNU/Linux 6.0.0-31-generic x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Sat Jun 1 04:11:07 AM UTC 2024

System load: 0.63 Processes: 102
Usage of /: 39.0% of 11.21GB Users logged in: 0
Memory usage: 8% IPv4 address for enp0s3: 192.168.0.164
Swap usage: 0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

nable ESM Apps to receive additional future security updates.
ee https://ubuntu.com/esm or run: sudo pro status

harperj16@juliaharpervm:~$ killall -l
JP INT QUIT ILL TRAP ABRT BUS FPE KILL USR1 SEGV USR2 PIPE ALRM TERM STKFLT
HLD CONT STOP TSTP TTIN TTOUT URG XCPU XFSZ VTIME VTIME POLL PWR SYS
harperj16@juliaharpervm:~$
```

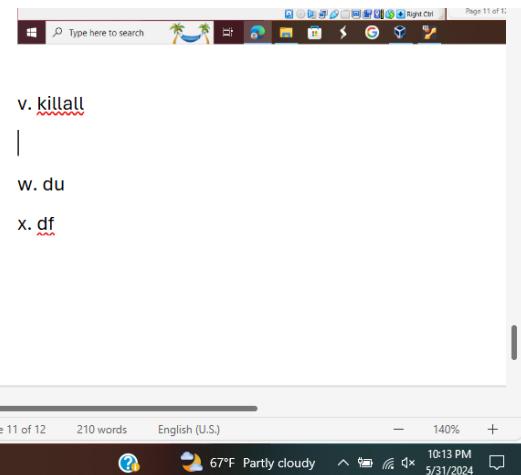
w. du- handy tool to allow reporting on disk usage

```

harperj16@juliaharpervm:~$ killall -h
word-list.txt: no process found
harperj16@juliaharpervm:~$ killall -h
Usage: killall [OPTION]... [-] NAME...
      killall -l, --list
      killall -V, --version

      -e,--exact            require exact match for very long names
      -I,--ignore-case       case insensitive process name match
      -g,--process-group    kill process group instead of process
      -y,--younger-than     kill processes younger than TIME
      -o,--older-than       kill processes older than TIME
      -i,--interactive      ask for confirmation before killing
      -l,--list              list all known signal names
      -q,--quiet             don't print complaints
      -r,--regexp            interpret NAME as an extended regular expression
      -s,--signal SIGNAL     send this signal instead of SIGTERM
      -u,--user USER         kill only process(es) running as USER
      -v,--verbose           report if the signal was successfully sent
      -V,--version           display version information
      -w,--wait              wait for processes to die
      -n,--ns PID            match processes that belong to the same namespaces
                            as PID
      -Z,--context REGEXP   kill only process(es) having context
                            (must precede other arguments)

harperj16@juliaharpervm:~$
```



x. df –allows you to know how much space is available in your directories or files

```

harperj16@juliaharpervm:~$ df -a
Filesystem      1K-blocks   Used Available Use% Mounted on
sysfs             0       0       0   - /sys
proc              0       0       0   - /proc
udev             971428    0     971428  0% /dev
devpts             0       0       0   - /dev/pts
tmpfs            201548  1040    200508  1% /run
/dev/mapper/ubuntu--vg-ubuntu--1v 11758768 4651144  6488598  42% /
securitytfs        0       0       0   - /sys/kernel/security
tmpfs            1007740    0     1007740  0% /dev/shm
tmpfs             5120    0     5120  0% /run/lock
cgroup2            0       0       0   - /sys/fs/cgroup
fstab              0       0       0   - /sys/fs/pstore
lpt                0       0       0   - /sys/fs/lpt
systemd-1           -       -       -   - /proc/sys/fs/binfmt_misc
hugepages           0       0       0   - /dev/hugepages
mqueue              0       0       0   - /dev/mqueue
debugfs             0       0       0   - /sys/kernel/debug
tracefs             0       0       0   - /sys/kernel/tracing
fusectl             0       0       0   - /sys/fs/fuse/connections
configfs             0       0       0   - /sys/kernel/config
/dev/sda2          1992552  96564   1774748  5% /boot
binfmt misc         0       0       0   - /proc/sys/fs/binfmt_misc

```

y. vim- is a text editor

```

harperj16@juliaharpervm:~$ sudo apt-get install vim
[sudo] password for harperj16:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  vim-common vim-runtime vim-tiny xxd
Suggested packages:
  ctags vim-doc vim-scripts indent
The following packages will be upgraded:
  vim vim-common vim-runtime vim-tiny xxd
5 upgraded, 0 newly installed, 0 to remove and 12 not upgraded.
Need to get 10.4 MB of archives.
After this operation, 0 B of additional disk space will be used.
Do you want to continue? [Y/n]

```

y. vim- n

z. screen

```

JuliaHarperVM [Running] - Oracle VM VirtualBox
Page 13 of 14 375 words English (U.S.) — 220% + Give Feedback to Microsoft
JuliaHarperVM [Running] - Oracle VM VirtualBox
Page 13 of 14 375 words English (U.S.) — 220% + Give Feedback to Microsoft

```

z. screen-single shell ssh multi-session

```

JuliaHarperVM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
This program is free software; you can redistribute it and/or modify it under the terms of
Foundation; either version 3, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY;
A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program
or contact Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA.

Send bugreports, fixes, enhancements, t-shirts, money, beer & pizza to screen-devel@gnu.org

Capabilities:
+copy +remote-detach +power-detach +multi-attach +multi-user +font +color-256 +utf8 +rxvt

[Press Space or Return to ...]

```

a. ssh	n. watch	bb. chown	p.
b. ssh-keygen	o. ps	cc. useradd	q.
c. scp	p. top	dd. man	rr.
d. history	q. htop	ee. locate	ss.
e. sudo	r. gcc	ff. find	tt.
f. ip	s. tail	gg. sed	u.
g. dd	t. grep	hh. awk	vv.
h. fdisk	u. kill	ii. diff	w.
i. apt	v. killall	jj. sort	xi.
j. vi	w. du	kk. export	yy.
k. time	x. df	ll. pwd	zz.
l. tar	y. screen	mm.crontab	
m. cat	z. vim	nn. mount	
	aa. chmod	oo. passwd	

3. Write bash scripts to do the following:

- Write a script called "generate-dataset.sh <filename> <num_records>" command line arguments specifying the file name to output and the number of records, where each record is separated by new line character, and following format: <integer> <integer> <ASCII_string>. The integer random number up to a 32-bit integer. The ASCII_string should be a string of exactly 100 bytes long. Use the "time" command to show benchmark took to complete. The benchmark should run for at least 10 seconds and it should complete even if the ssh (or bash) session is terminated. Does your file contain after running it? You must write this with existing Linux commands (which you can install if they don't exist).

aa. Chmod-changes the access to a file

JuliaHarperVM [Running] - Oracle VM VirtualBox

```
File Machine View Input Devices Help
harperj16@juliaharpervm:~$ harperj16@juliaharpervm:~$ harperj16@juliaharpervm:~$ cat >birdIstheWord.txt
ba ba bird
bird is the word
bird bird bird
bird is the word
harperj16@juliaharpervm:~$ chmod og-rwx birdIstheWord.txt
harperj16@juliaharpervm:~$ grep -n bird birdIstheWord.txt
1:ba ba bird
2:bird is the word
3:bird bird
4:bird is the word
harperj16@juliaharpervm:~$ chmod u+rw,go+r birdIstheWord.txt
harperj16@juliaharpervm:~$ ls -l
ls: command not found
harperj16@juliaharpervm:~$ ls -l
total 86
-rw-r--r-- 1 harperj16 harperj16 464 May 31 20:04 aubrey
-rw-r--r-- 1 harperj16 harperj16 105 May 31 20:04 aubrey.pub
-rw-r--r-- 1 harperj16 harperj16 66 Jun 1 16:02 birdIstheWord.txt
-rw-r--r-- 1 harperj16 harperj16 464 May 31 20:36 diana
-rw-r--r-- 1 harperj16 harperj16 105 May 31 20:36 diana.pub
-rw-r--r-- 1 harperj16 harperj16 45 Jun 1 01:03 files.tar.gz
-rw-r--r-- 1 harperj16 harperj16 37 Jun 1 01:12 test1.txt
-rw-r--r-- 1 harperj16 harperj16 24 Jun 1 01:13 test2.txt
-rw-r--r-- 1 harperj16 harperj16 27 Jun 1 02:12 word-list.txt
harperj16@juliaharpervm:~$ ls -l example
ls: cannot access 'example': No such file or directory
harperj16@juliaharpervm:~$
```

Sign in

Hypervisor_IIT_firstproject

File Home Insert Layout References Review View Share

Type here to search

Page 14 of 15 386 words English (U.S.) 180% Give Feedback to Microsoft

11:09 AM 6/1/2024

aa. Chmod-changes the access to a file

bb. chown

cc. useradd

dd. man

ee. locate

bb. chown –in term of security which is important this allows change of ownership (especially administratively)

cc. useradd - command used to create new user accounts

JuliaHarperVM [Running] - Oracle VM VirtualBox

```
File Machine View Input Devices Help
::bird is the word
::bird bird
::bird is the word
harperj16@juliaharpervm:~$ chmod u+rw,go+r birdIstheWord.txt
harperj16@juliaharpervm:~$ ls -l
ls: command not found
harperj16@juliaharpervm:~$ ls -l
total 86
-rw-r--r-- 1 harperj16 harperj16 464 May 31 20:04 aubrey
-rw-r--r-- 1 harperj16 harperj16 105 May 31 20:04 aubrey.pub
-rw-r--r-- 1 harperj16 harperj16 66 Jun 1 16:02 birdIstheWord.txt
-rw-r--r-- 1 harperj16 harperj16 464 May 31 20:36 diana
-rw-r--r-- 1 harperj16 harperj16 105 May 31 20:36 diana.pub
-rw-r--r-- 1 harperj16 harperj16 45 Jun 1 01:03 files.tar.gz
-rw-r--r-- 1 harperj16 harperj16 37 Jun 1 01:12 test1.txt
-rw-r--r-- 1 harperj16 harperj16 24 Jun 1 01:13 test2.txt
-rw-r--r-- 1 harperj16 harperj16 27 Jun 1 02:12 word-list.txt
harperj16@juliaharpervm:~$ ls -l example
ls: cannot access 'example': No such file or directory
harperj16@juliaharpervm:~$ sudo useradd fake_user_IIT
[sudo] password for harperj16:
harperj16@juliaharpervm:~$ cat /etc/passwd | grep fake_user_IIT
cat: /etc/passwd: No such file or directory
harperj16@juliaharpervm:~$ cat /etc/passwd | grep fake_user_IIT
fake_user_IIT:x:1001:1001:/home/fake_user_IIT:/bin/sh
harperj16@juliaharpervm:~$ sudo chage -1 fake_user_IIT
Last password change : Jun 01, 2024
Password expires : never
Password inactive : never
Account expires : never
Minimum number of days between password change : 0
Maximum number of days between password change : 99999
Number of days of warning before password expires : 7
harperj16@juliaharpervm:~$
```

Sign in

Hypervisor_IIT_firstproject

File Home Insert Layout References Review View Share

Type here to search

Page 15 of 15 400 words English (U.S.) 180% Give Feedback to Microsoft

11:54 AM 6/1/2024

cc. useradd

dd. man

ee. locate

ff. find

dd. Man- short for manual is used for information on certain commands

ee. locate - search for files and directories on a system

The screenshot shows a Windows desktop environment. On the left is a terminal window titled "JuliaHarperVM [Running] - Oracle VM VirtualBox". It displays the output of a command to install the plocate package:

```
harperj16@juliaharpervm:~$ sudo apt install plocate
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  libluring2
The following NEW packages will be installed:
  libluring2 plocate
0 upgraded, 2 newly installed, 0 to remove and 17 not upgraded.
Need to get 160 kB of archives.
After this operation, 623 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://us.archive.ubuntu.com/ubuntu noble/main amd64 libluring2 amd64 2.5-1build2
Get:2 http://us.archive.ubuntu.com/ubuntu noble/universe amd64 plocate amd64 1.1.19
Fetched 160 kB in 0s (476 kB/s)
Selecting previously unselected package libluring2:amd64.
(Reading database ... 83311 files and directories currently installed.)
Preparing to unpack .../libluring2_2.5-1build1_amd64.deb ...
Unpacking libluring2:amd64 (2.5-1build1) ...
Selecting previously unselected package plocate.
Preparing to unpack .../plocate_1.1.19-2ubuntu2_amd64.deb ...
Unpacking plocate (1.1.19-2ubuntu2) ...
Setting up libluring2:amd64 (2.5-1build1) ...
Setting up plocate (1.1.19-2ubuntu2) ...
update-alternatives: using /usr/bin/plocate to provide /usr/bin/locate (locate) in info: Selecting GID from range 100 to 999 ...
info: Adding group 'plocate' (GID 110) ...
Initializing plocate database; this may take some time... done
Created symlink /etc/systemd/system/timers.target.wants/plocate-updatedb.timer → /U
Processing triggers for man-db (2.12.0-4build2) ...
Processing triggers for libc-bin (2.39-0ubuntu0.2) ...
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.
```

On the right is a Microsoft Edge browser window titled "Hypervisor_IIT_firstproject". It shows a list of links:

- dd. Man- short for manual is used for informatic
- ee. locate
- ff. find
- gg. sed

ff. find - search for files and directories within a specified directory

The screenshot shows a Windows desktop environment. On the left is a terminal window titled "JuliaHarperVM [Running] - Oracle VM VirtualBox". It displays the output of a command to search for files named "birdIsTheWord.txt":

```
Preparing to unpack .../libluring2_2.5-1build1_amd64.deb ...
Unpacking libluring2:amd64 (2.5-1build1) ...
Selecting previously unselected package plocate.
Preparing to unpack .../plocate_1.1.19-2ubuntu2_amd64.deb ...
Unpacking plocate (1.1.19-2ubuntu2) ...
Setting up libluring2:amd64 (2.5-1build1) ...
Setting up plocate (1.1.19-2ubuntu2) ...
update-alternatives: using /usr/bin/plocate to provide /usr/bin/locate (locate) in info: Selecting GID from range 100 to 999 ...
info: Adding group 'plocate' (GID 110) ...
Initializing plocate database; this may take some time... done
Created symlink /etc/systemd/system/timers.target.wants/plocate-updatedb.timer → /U
Processing triggers for man-db (2.12.0-4build2) ...
Processing triggers for libc-bin (2.39-0ubuntu0.2) ...
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
harperj16@juliaharpervm:~$ locate *.txt
harperj16@juliaharpervm:~$ harperj16@juliaharpervm:~$ find ../*GFG -name birdIsTheWord.txt
find: '../*GFG': No such file or directory
harperj16@juliaharpervm:~$ find -i
find: unknown predicate '-i'
harperj16@juliaharpervm:~$ find . -type d
./config
./config/htop
./config/procps
./cache
./ssh
harperj16@juliaharpervm:~$
```

On the right is a Microsoft Edge browser window titled "Hypervisor_IIT_firstproject". It shows a list of links:

- ff. find
- gg. sed
- hh. awk
- ii. diff

gg. sed - reads input line by line and applies specific operations to each line -then outputs it

The screenshot shows a Windows desktop environment. On the left is a terminal window titled "JuliaHarperVM [Running] - Oracle VM VirtualBox". It displays a series of Linux command-line operations, including setting up liburing, updating alternatives, initializing plocate, and scanning processes. It also shows a search for 'birdIstheWord.txt' and the use of 'sed' to replace occurrences of 'unix/linux' with 'bird'. On the right is a Microsoft Edge browser window titled "Hypervisor_IIT_firstproject". The address bar shows a URL starting with "https://livestudent...". The page content is mostly blank, with some minor UI elements visible.

hh. awk - used to filter and manipulate output

The screenshot shows a Windows desktop environment. On the left is a terminal window titled "JuliaHarperVM [Running] - Oracle VM VirtualBox". It displays a series of Linux command-line operations, similar to the previous screenshot, including setting up liburing, updating alternatives, initializing plocate, and scanning processes. It also shows a search for 'birdIstheWord.txt' and the use of 'awk' to filter and print specific lines from the file. On the right is a Microsoft Edge browser window titled "File | C:/Users/harpe/Down...". The page content is mostly blank, with some minor UI elements visible.

ii. diff - compare the contents of two files line by line and identify the differences

Windows 10 desktop with two terminal windows and a Microsoft Word document.

```

harperj16@juliaharpervm:~$ ls
aubrey aubrey.pub birdIsTheWord.txt diana diana.pub files.tar.gz testi.txt t
harperj16@juliaharpervm:~$ diff birdIsTheWord.txt word-list.txt
1,4c1,5
< ba ba bird bird
< bird is the word
< bird bird bird
< bird is the word
...
> zoom
> zoom
> zoom
> boom
> boom
harperj16@juliaharpervm:~$ 

```

Microsoft Word document titled "pp_mount" (Page 17 of 18, 410 words, English (U.S.)).

jj. Sort- reads input from a file sorts the lines according to specifics and outputs the sorted lines

Windows 10 desktop with two terminal windows and a Microsoft Word document.

```

harperj16@juliaharpervm:~$ sort birdIsTheWord.txt
ba ba bird bird
bird bird bird
bird is the word
bird is the word
harperj16@juliaharpervm:~$ sort -r birdIsTheWord.txt
bird is the word
bird is the word
bird bird bird
ba ba bird bird
harperj16@juliaharpervm:~$ 

```

Microsoft Word document titled "pp_mount" (Page 18 of 18, 410 words, English (U.S.)).

kk. export – is a command bash shell

Windows 10 desktop with a terminal window and a Microsoft Word document.

```

JuliaHarpeVM (Running) - Oracle VM VirtualBox
File Machine View Input Devices Help
Ubuntu 24.04 LTS juliaharpervm:~$ 
juliaharpervm login: harperj16
Password:
Welcome to Ubuntu 24.04 LTS (GNU/Linux 6.8.0-31-generic x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Sat Jun 1 06:14:00 PM UTC 2024

System load: 0.77 Processes: 100
Usage of /: 39.8% of 11.21GB Users logged in: 0
Memory usage: 8% IPv4 address for enp0s3: 192.168.0.164
Swap usage: 0%

* Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
Just raised the bar for easy, resilient and secure K8s cluster deployment.
https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Expanded Security Maintenance for Applications is not enabled.

17 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

harperj16@juliaharpervm:~$ x="Where in the world is Carmen San Diego?"
harperj16@juliaharpervm:~$ y="I don't know."
harperj16@juliaharpervm:~$ export x y
harperj16@juliaharpervm:~$ printenv x y
Where in the world is Carmen San Diego?
I don't know.
harperj16@juliaharpervm:~$ 

```

Microsoft Word document titled "pp_mount" (Page 18 of 19, 410 words, English (U.S.)).

ll. pwd - used to display the current directory in the terminal

```
harperj16@juliaharpervm:~$ pwd  
/home/harperj16  
harperj16@juliaharpervm:~$
```

Page 18 of 19 410 words English (U.S.) 180% Give Feedback to Microsoft
1:19 PM 65°F Light rain 6/1/2024

mm. crontab - manage cron jobs, which are scheduled tasks that run automatically at predefined times

nn. mount - allows the operating system to access the files and data stored as if they were on the main drive

```
For more details see mount(8).  
harperj16@juliaharpervm:~$ mount -l  
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)  
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)  
udev on /dev type devtmpfs (rw,nosuid,relatime,size=971482k,nr_inodes=242858,mode=755)  
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,gid=5,mode=620,ptmxmode=0)  
tmpfs on /run type tmpfs (rw,nosuid,nodev,noexec,relatime,size=201552k,mode=755,inode64)  
/dev/mapper/ubuntu--vg-ubuntu--lv on / type ext4 (rw,relatime)  
securityfs on /sys/kernel/security type securityfs (rw,nosuid,nodev,noexec,relatime)  
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev,inode64)  
tmpfs on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k,inode64)  
cgroup2 on /sys/fs/cgroup type cgroup2 (rw,nosuid,nodev,noexec,relatime,nsdelegate)  
pstree on /sys/fs/pstree type pstree (rw,nosuid,nodev,noexec,relatime)  
bpf on /sys/fs/bpf type bpf (rw,nosuid,nodev,noexec,relatime,mode=700)  
systemd-1 on /proc/sys/fs/binfmt_misc type autofs (rw,relatime,fd=32,pgrp=1,timeout=20,hugepages=1)  
hugepages on /dev/hugepages type hugepages (rw,nosuid,nodev,noexec,relatime, pagesize=2M)  
mqqueue on /dev/queue type mqqueue (rw,nosuid,nodev,noexec,relatime)  
debugfs on /sys/kernel/debug type debugfs (rw,nosuid,nodev,noexec,relatime)  
tracefs on /sys/kernel/tracing type tracefs (rw,nosuid,nodev,noexec,relatime)  
fusectl on /sys/fs/fuse/connections type fusectl (rw,nosuid,nodev,noexec,relatime)  
configfs on /sys/kernel/config type configfs (rw,nosuid,nodev,noexec,relatime)  
/dev/sda2 on /boot type ext4 (rw,relatime)  
binfmt_misc on /proc/sys/fs/binfmt_misc type binfmt_misc (rw,nosuid,nodev,noexec,relatime)  
tmpfs on /run/user/1000 type tmpfs (rw,nosuid,nodev,relatime,size=201548k,inode64)  
harperj16@juliaharpervm:~$
```

mm. crontab
nn. mount
oo. passwd
pp. uname
qq. whereis

Page 19 of 19 410 words English (U.S.) 180% Give Feedback to Microsoft
1:25 PM 65°F Light rain 6/1/2024

oo. passwd -changes the password for the user account

```
J JuliaHarperVM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

-1, --lock
-n, --mindays MIN_DAYS
-q, --quiet
-R, --repository REPOSITORY
-R, --root CROOT_DIR
-S, --status
-u, --unlock
-w, --warndays WARN_DAYS
-X, --maxdays MAX_DAYS

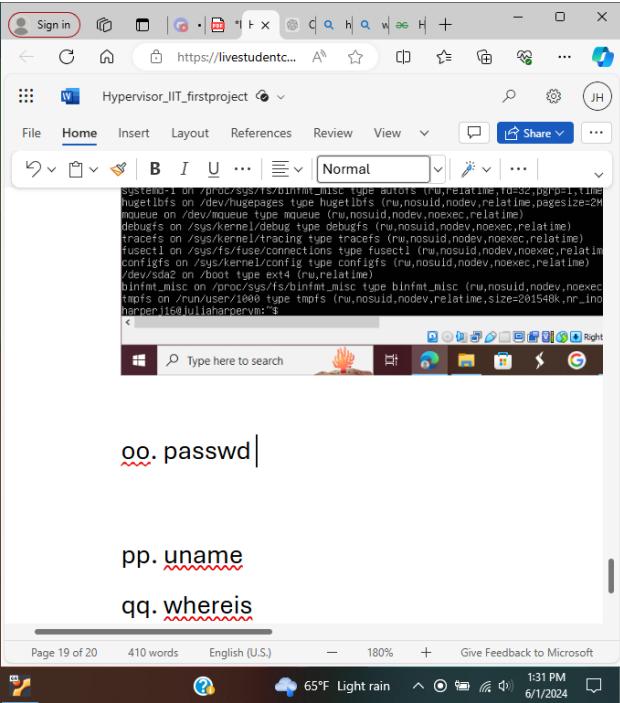
lock the password of the named account
set minimum number of days before password
change to MIN_DAYS
quiet mode
change password in REPOSITORY repository
directory to chroot into
report password status on the named account
unlock the password of the named account
set expiration warning days to WARN_DAYS
set maximum number of days before password
change to MAX_DAYS

harperj16@juliaharpervm:~$ passwd -a
Usage: passwd [options] [LOGIN]

Options:
-a, --all
-d, --delete
-e, --expire
-h, --help
-k, --keep-tokens
-l, --inactive INACTIVE
-l, --lock
-n, --mindays MIN_DAYS
-q, --quiet
-R, --repository REPOSITORY
-R, --root CROOT_DIR
-S, --status
-u, --unlock
-w, --warndays WARN_DAYS
-X, --maxdays MAX_DAYS

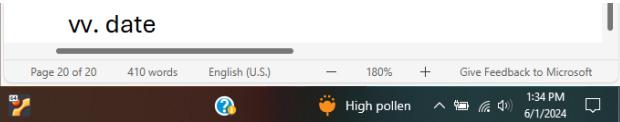
report password status on all accounts
delete the password for the named account
force expire the password for the named account
display this help message and exit
change password only if expired
set password inactive after expiration
to INACTIVE
lock the password of the named account
set minimum number of days before password
change to MIN_DAYS
quiet mode
Change password in REPOSITORY repository
directory to chroot into
report password status on the named account
unlock the password of the named account
set expiration warning days to WARN_DAYS
set maximum number of days before password
change to MAX_DAYS

harperj16@juliaharpervm:~$ passwd
Changing password for harperj16.
Current password:
New password:
Retype new password:
<
```



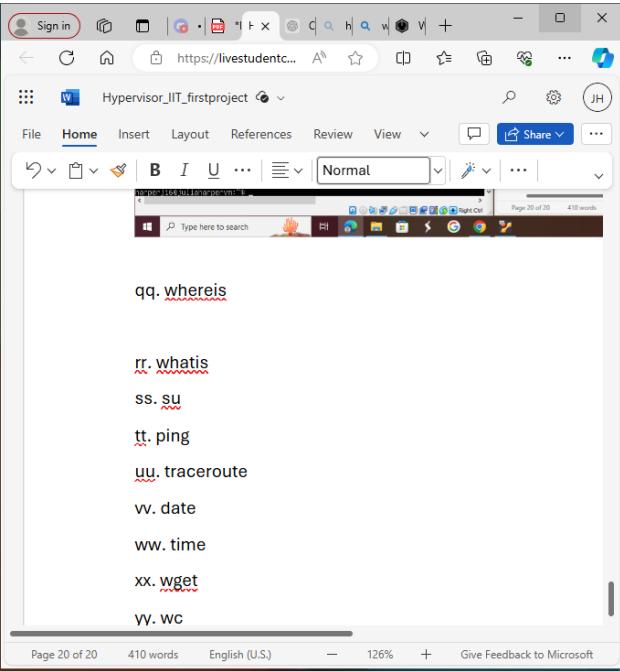
pp. uname - used to display system information about the operating system

```
harper16@juliaharpervm:~$ uname -a
Linux juliaharpervm 6.8.0-31-generic #31-Ubuntu SMP PREEMPT_DYNAMIC Sat Apr 20 00:00:00 UTC 2024
harper16@juliaharpervm:~$
```

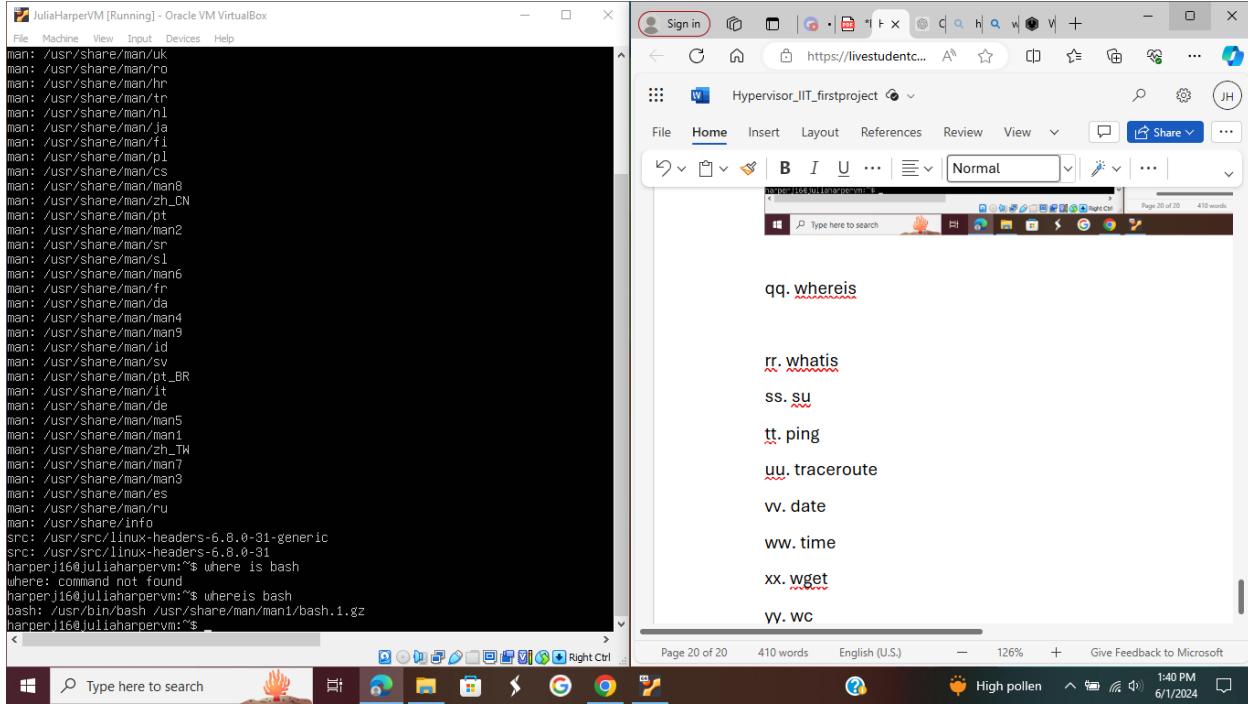


qq. whereis - allows you to find the location of the binary, source, and manual page files

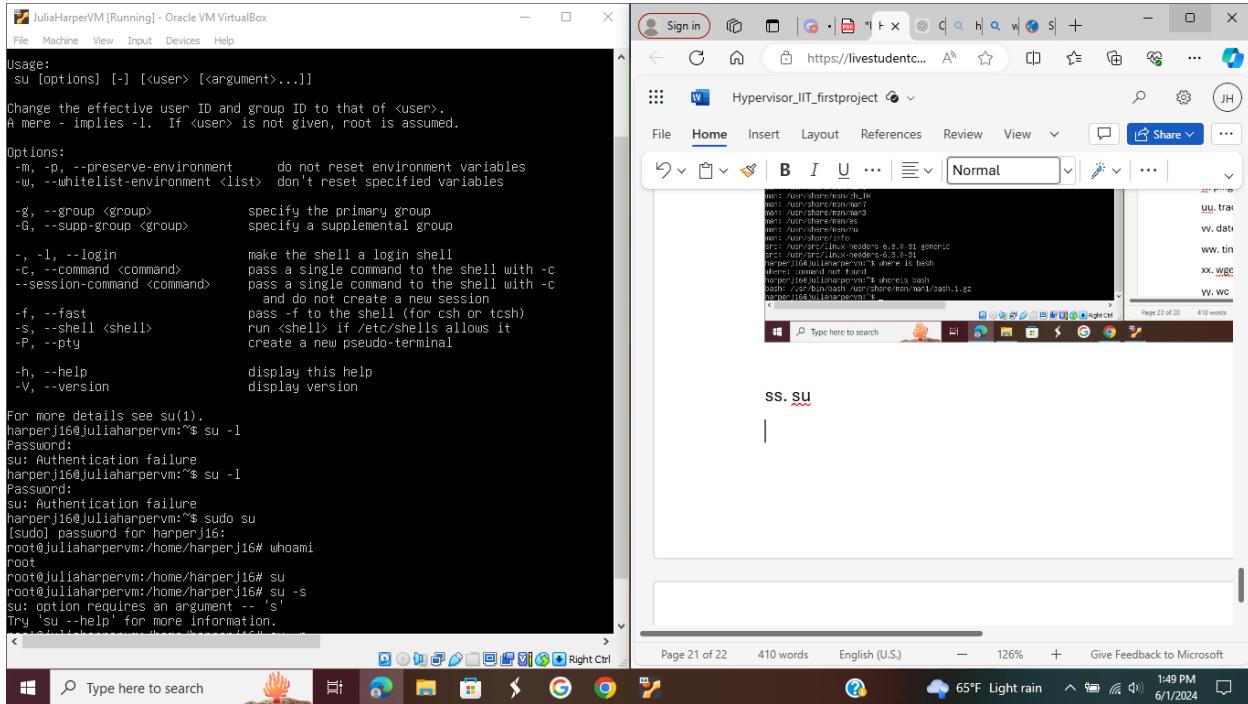
```
JuliaHarperVM [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
man: /usr/share/man/uk
man: /usr/share/man/ro
man: /usr/share/man/hr
man: /usr/share/man/tr
man: /usr/share/man/nl
man: /usr/share/man/ja
man: /usr/share/man/fi
man: /usr/share/man/pl
man: /usr/share/man/cs
man: /usr/share/man/man8
man: /usr/share/man/zh_CN
man: /usr/share/man/pt
man: /usr/share/man/man2
man: /usr/share/man/sr
man: /usr/share/man/sl
man: /usr/share/man/man6
man: /usr/share/man/fr
man: /usr/share/man/da
man: /usr/share/man/man4
man: /usr/share/man/man9
man: /usr/share/man/id
man: /usr/share/man/sv
man: /usr/share/man/pt_BR
man: /usr/share/man/it
man: /usr/share/man/de
man: /usr/share/man/man5
man: /usr/share/man/man1
man: /usr/share/man/zh_TW
man: /usr/share/man/man7
man: /usr/share/man/man3
man: /usr/share/man/es
man: /usr/share/man/ru
man: /usr/share/info
src: /usr/src/linux-headers-6.8.0-31-generic
src: /usr/src/linux-headers-6.8.0-31
harper|16@juliuharpervm:~$ whereis bash
whereis: command not found
harper|16@juliuharpervm:~$ whereis bash
bash: /usr/bin/bash /usr/share/man/man1/bash.1.gz
harper|16@juliuharpervm:~$
```



rr. whatis - this command search for the manual pages names and show the manual page description



ss. su - stands for substitute/switch user



tt. ping - used to test if the reach of an IP network

JuliaHarperVM [Running] - Oracle VM VirtualBox

```
To see these additional updates run: apt list --upgradable
Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

harperji6@juliuharpervm:~$ ping www.google.com
PING www.google.com (172.217.2.36) 56(84) bytes of data.
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=1 ttl=58 time=22.6
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=2 ttl=58 time=19.7
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=3 ttl=58 time=13.6
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=4 ttl=58 time=35.4
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=5 ttl=58 time=31.8
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=6 ttl=58 time=14.4
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=7 ttl=58 time=15.1
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=8 ttl=58 time=19.9
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=9 ttl=58 time=12.9
Kill164 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=10 ttl=58 time=9
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=11 ttl=58 time=12.4
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=12 ttl=58 time=24.0
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=13 ttl=58 time=12.5
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=14 ttl=58 time=11.9
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=15 ttl=58 time=14.9
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=16 ttl=58 time=14.9
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=17 ttl=58 time=12.2
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=18 ttl=58 time=14.8
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=19 ttl=58 time=13.1
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=20 ttl=58 time=15.2
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=21 ttl=58 time=12.2
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=22 ttl=58 time=13.9
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=23 ttl=58 time=18.5
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=24 ttl=58 time=17.9
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=25 ttl=58 time=16.2
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=26 ttl=58 time=15.1
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=27 ttl=58 time=13.5
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=28 ttl=58 time=15.8
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=29 ttl=58 time=15.2
64 bytes from ord37s52-in-f4.ie100.net (172.217.2.36): icmp_seq=30 ttl=58 time=12.0
```

Sign in | Hypervisor_IIT_firstproject | Home | Insert | Layout | References | Review | View | Share | Normal | ... |

File Home Insert Layout References Review View

Normal

tt. ping

uu. traceroute

vv. date

ww. time

Page 22 of 22 410 words English (U.S.) 126% Give Feedback to Microsoft

65°F Light rain 1:53 PM 6/1/2024

uu. Traceroute- used to trace the route that packets take from your computer to a final locale

JuliaHarperVM [Running] - Oracle VM VirtualBox

```
Get:1 http://us.archive.ubuntu.com/ubuntu noble/universe amd64 traceroute amd64 1:2.5.1-1 [50.5 kB]
Fetched 50.5 KB in 0s (144 kB/s)
Selecting previously unselected package traceroute.
(Reading database ... 83334 files and directories currently installed.)
Preparing to unpack .../traceroute_1%3a2.1.5-1_amd64.deb ...
Unpacking traceroute (1:2.1.5-1) ...
Setting up traceroute (1:2.1.5-1) ...
update-alternatives: using /usr/bin/traceroute_db to provide /usr/bin/traceroute (traceroute)
update-alternatives: using /usr/bin/traceroute6_db to provide /usr/bin/tracerouted6
update-alternatives: using /usr/bin/lft_db to provide /usr/bin/lft (lft) in auto mode
update-alternatives: using /usr/bin/traceproto_db to provide /usr/bin/traceproto (traceproto)
update-alternatives: using /usr/sbin/tcptraceroute_db to provide /usr/sbin/tcptraceroute (tcptraceroute)
Processing triggers for man-db (2.12.0-4build2) ...
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
harperji6@juliuharpervm:~$ sudo pacman -Sy traceroute
sudo: pacman: command not found
harperji6@juliuharpervm:~$ traceroute -n www.google.com
traceroute to www.google.com (172.217.5.4), 30 hops max, 60 byte packets
1 192.168.0.1 10.174 ms 10.137 ms 10.646 ms
2 10.20.0.1 24.437 ms 21.054 ms 24.417 ms
3 216.80.78.91 30.410 ms 74.989 ms 30.389 ms
4 207.172.18.100 30.369 ms 207.172.18.102 30.369 ms 207.172.18.50 30.361 ms
5 207.172.17.85 27.928 ms 207.172.19.163 30.345 ms 30.339 ms
6 72.14.205.48 38.382 ms 17.894 ms 17.835 ms
7 * *
8 142.251.60.16 42.477 ms 142.251.60.202 39.917 ms 142.251.60.10 39.867 ms
9 108.170.244.15 39.851 ms 216.239.54.16 39.837 ms 39.825 ms
10 172.217.5.4 39.811 ms 45.148 ms *
```

Sign in | Hypervisor_IIT_firstproject | Home | Insert | Layout | References | Review | View | Share | Normal | ... |

File Home Insert Layout References Review View

Normal

uu. traceroute

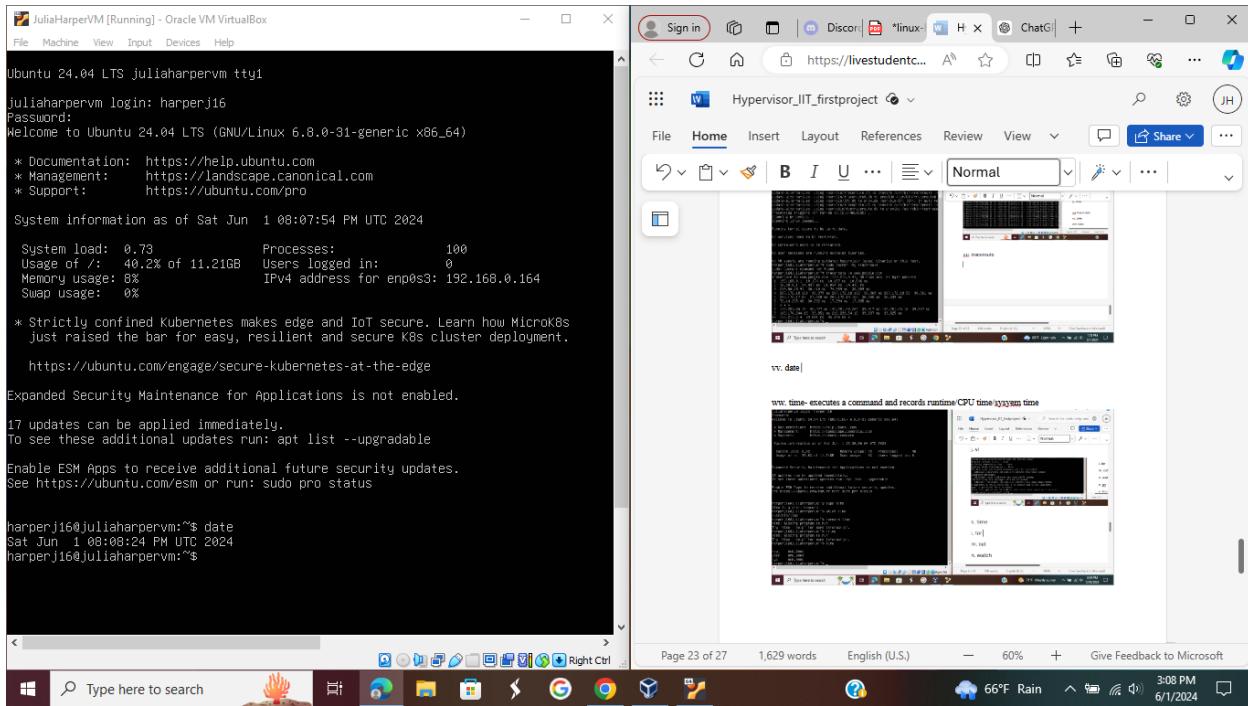
vv. date

ww. time

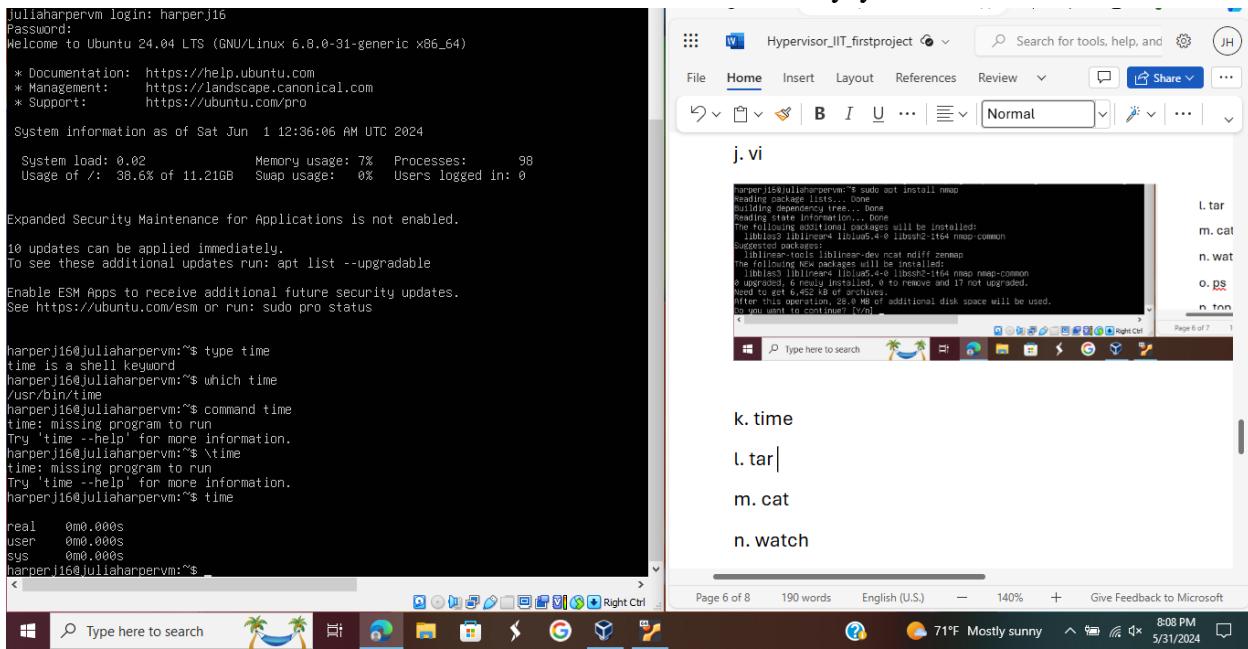
Page 22 of 22 410 words English (U.S.) 126% Give Feedback to Microsoft

65°F Light rain 1:58 PM 6/1/2024

vv. date – shows the date



ww. time- executes a command and records runtime/CPU time/sysyem time



xx. wget - used for downloading files from the internet

JuliaHarperVM [Running] - Oracle VM VirtualBox

```

-D, --domains=LIST      comma-separated list of accepted domains
--exclude-domains=LIST  comma-separated list of rejected domains
--follow-ftp            follow FTP links from HTML documents
--follow-tags=LIST       comma-separated list of followed HTML tags
-H, --span-hosts        go to foreign hosts when recursive
-L, --relative          follow relative links only
-I, --include-directories=LIST  list of allowed directories
--trust-server-names   use the name specified by the redirection
--x, --exclude-directories=LIST list of excluded directories
-np, --no-parent        don't ascend to the parent directory

Email bug reports, questions, discussions to <bug-wget@gnu.org>
and/or open issues at https://savannah.gnu.org/bugs/?func=additem&group=wget.

harperj16@juliaharpervm:~$ wget -r http://yahoo.com/
2024-06-01 20:12:04 -> http://yahoo.com/
Resolving yahoo.com (yahoo.com)... 74.6.143.26, 74.6.231.21, 74.6.143.25, ...
Connecting to yahoo.com (yahoo.com)|74.6.143.26|:80... connected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: https://yahoo.com/ [following]
2024-06-01 20:12:05 - https://yahoo.com/
Connecting to yahoo.com (yahoo.com)|74.6.143.26|:443... connected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: https://www.yahoo.com/ [following]
2024-06-01 20:12:05-- https://www.yahoo.com/
Resolving www.yahoo.com (www.yahoo.com)... 69.147.65.251, 69.147.65.252, 2001:4998:...
Connecting to www.yahoo.com (www.yahoo.com)|69.147.65.251|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: unspecified [text/html]
Saving to: 'yahoo.com/index.html'

yahoo.com/index.html [ <>]

2024-06-01 20:12:06 (3.14 MB/s) - 'yahoo.com/index.html' saved [1763279]

FINISHED --2024-06-01 20:12:06-
Total wall clock time: 1.5s
Downloaded: 1 files, 1.7M in 0.5s (3.14 MB/s)
harperj16@juliaharpervm:~$
```

Page 24 of 27 1,629 words English (U.S.) 60% Give Feedback to Microsoft

66°F Rain 3:12 PM 6/1/2024

yy. wc –word counter

yahoo.com/index.html [<>]

```

2024-06-01 20:12:06 (3.14 MB/s) - 'yahoo.com/index.html' saved [1763279]

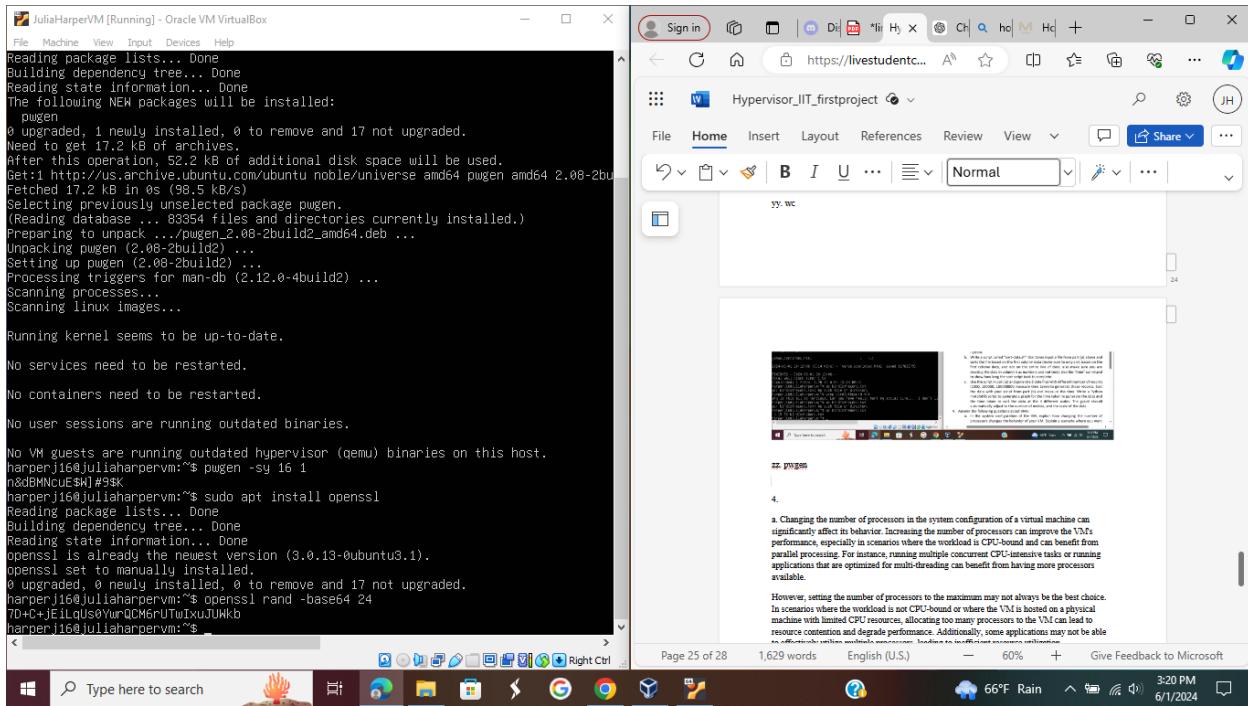
FINISHED --2024-06-01 20:12:06-
Total wall clock time: 1.5s
Downloaded: 1 files, 1.7M in 0.5s (3.14 MB/s)
harperj16@juliaharpervm:~$ wc birdistheword.txt
wc: birdistheword.txt: No such file or directory
harperj16@juliaharpervm:~$ grep birdistheword.txt
why is this all so tedious. Can you have really hurt my social life.... I don't li
harperj16@juliaharpervm:~$ wc birdistheword.txt
wc: birdistheword.txt: No such file or directory
harperj16@juliaharpervm:~$ wc birdIstheWord.txt
4 19 66 birdIstheWord.txt
harperj16@juliaharpervm:~$
```

Page 24 of 27 1,629 words English (U.S.) 60% Give Feedback to Microsoft

66°F Rain 3:16 PM 6/1/2024

zz. pwgen -creates a random password, with a length determined by you

- Python.**
- Write a script called "sort-data.sh" that takes input a file from part (a) above and sorts the file based on the first column data (make sure to only sort based on the first column data, and not on the entire line of data; also make sure you are treating the data in column 1 as numbers and not text). Use the "time" command to show how long the sort script took to complete.
 - Use the script in part (a) and generate 3 data files with different number of records (1000, 100000, 1000000); measure time taken to generate these records. Sort the data with your script from part (b) and measure the time. Write a Python matplotlib script to generate a graph for the time taken to generate the data and the time taken to sort the data at the 3 different scales. The graph should automatically adjust to the number of entries, and the scale of the data.
 - Answer the following questions about VMs:
 - In the system configuration of the VM, explain how changing the number of processors changes the behavior of your VM. Explain a scenario where you want



3.a) The following is a code for shell scripting within Linux. Ultimately creating a script that generates a dataset with specified characteristics.

```
#!/bin/bash

# Check if filename and number of records are provided as arguments

if [ $# -ne 2 ]; then

echo "Usage: $0 <filename> <num_records>"

exit 1

fi

filename="$1"

num_records="$2"

# Function to generate a random integer up to a 32-bit integer limit

generate_random_integer() {
```

```
echo $(shuf -i 0-4294967295 -n 1)

}

# Function to generate a random ASCII string of exactly 100 bytes
generate_random_string() {
    tr -dc '[:print:]' < /dev/urandom | head -c 100
}

# Start time benchmark
start_time=$(date +%s.%N)

# Generate dataset
for ((i=0; i<num_records; i++)); do
    random_int=$(generate_random_integer)
    random_string=$(generate_random_string)
    echo "$random_int $random_int $random_string"
    done > "$filename"

# End time benchmark
end_time=$(date +%s.%N)
benchmark_duration=$(echo "$end_time - $start_time" | bc)

# Ensure the benchmark runs for at least 10 seconds
```

```
while (( $(echo "$benchmark_duration < 10" | bc -l )); do
    random_int=$(generate_random_integer)
    random_string=$(generate_random_string)
    echo "$random_int $random_int $random_string" >> "$filename"
    end_time=$(date +%s.%N)
    benchmark_duration=$(echo "$end_time - $start_time" | bc)
done
```

```
# Display benchmark duration
echo "Benchmark took $benchmark_duration seconds."
```

```
# Display number of records
num_records_generated=$(wc -l < "$filename")
echo "Number of records generated: $num_records_generated"
```

3b)

```
#!/bin/bash
```

```
# Check if correct number of arguments provided
if [ "$#" -ne 1 ]; then
    echo "Usage: $0 <filename>"
    exit 1
fi
```

```
filename=$1

start=$(date +%s.%N)

# Sort the file based on the first column data
sort -n -k1 "$filename" -o "$filename.sorted"

end=$(date +%s.%N)

runtime=$(echo "$end - $start" | bc)

echo "Sorting took $runtime seconds."
```

3c)

```
#!/bin/bash

# Function to generate a random integer up to 32-bit
random_integer() {

    echo $((RANDOM%4294967296))

}

# Function to generate a random ASCII string of length 100
random_string() {

    cat /dev/urandom | tr -dc 'a-zA-Z0-9' | fold -w 100 | head -n 1

}

# Check if correct number of arguments provided
```

```
if [ "$#" -ne 2 ]; then
    echo "Usage: $0 <filename> <num_records>"
    exit 1
fi

filename=$1
num_records=$2
start=$(date +%s.%N)

# Generate dataset
while true; do
    for ((i=0; i<$num_records; i++)); do
        echo "$(random_integer) $(random_integer) $(random_string)"
    done
    end=$(date +%s.%N)
    runtime=$(echo "$end - $start" | bc)
    if (( $(echo "$runtime >= 10" | bc -l) )); then
        break
    fi
done > "$filename"
echo "Dataset generation took $runtime seconds."
#!/bin/bash

# Check if correct number of arguments provided
```

```

if [ "$#" -ne 1 ]; then
    echo "Usage: $0 <filename>"
    exit 1
fi

filename=$1

start=$(date +%s.%N)

# Sort the file based on the first column data
sort -n -k1 "$filename" -o "$filename.sorted"

end=$(date +%s.%N)
runtime=$(echo "$end - $start" | bc)
echo "Sorting took $runtime seconds."

```

4.

A) Changing the number of processors in the system of a VM can significantly affect its behavior. Increasing the number of processors can improve the VM's performance, especially in scenarios where the workload is CPU-bound as it benefits from parallel processing. However, scenarios where the workload is not CPU-bound or where the VM is hosted on a physical machine with limited resources, allocating too many processors to the VM can lead to degraded performance. Also, some applications may not be able to use multiple processors which will lead to inefficient resource use. Setting the number of processors to the minimum might be preferable when it's not CPU-intensive.

b) The paravirtualization options offer optional methods for enhancing virtualization

- None -disables paravirtualization and the VM runs in software emulation mode, which can result in lower performance compared to paravirtualization options.
- Legacy -provides basic virtualization and sometimes better compatibility with older operating systems but not optimal performance.
- Minimal -offers minimal paravirtualization support with some performance benefits over legacy virtualization
- HyperV: Provides paravirtualization support optimized for Microsoft Hyper-V hypervisor environments.
- KVM: Stands for Kernel-based Virtual Machine, which is a virtualization solution for Linux systems

C) Storage controllers in virtualization software control how virtual disks are presented to the VM. You might use an IDE controller for a virtual machine running an old OS. A SATA controller could be used for a virtual desktop or a small database server. An NVMe controller would be preferred for high-performance databases or big data analytics.

d) Network adapters in virtualization software control how VM's connect to the network. (Network Address Translation) NAT provides internet access for the virtual machine to connect to the host's network. Useful for scenarios where the virtual machine needs internet access but does not require direct communication with other devices. Bridged Adapter connects the VM directly to the network which allows it to appear as a separate device on the network. The VM can communicate with other devices on the same network as a host. Internal Networks create a private network that is isolated from the host's network and other external networks. Virtual machines connected to the same Internal Network can communicate with each other but cannot communicate with devices outside the internal network. Host-only Network creates a private network that is isolated from the host's physical network but allows communication between the host and the virtual machines. Virtual machines connected to the same Host-only Network can communicate with each other and with the host but cannot communicate with devices outside the host-only network. An example that might use NAT for a VM running web browsing or software updates. A Bridged Adapter would be used for a VM acting as a web server or a file server that needs to be accessible from other devices on the network. An Internal Network could create a sandbox for testing network configurations or malware analysis. Host-only Networks might use for setting up a development environment where you want the VMs to communicate with each other and the host but not with other devices on the physical network.

e) The difference between USB 1.1, 2.0, and 3.0 controllers is:

- USB 1.1: USB 1.1 controllers support data transfer rates of up to 12 Mbps. They are suitable for connecting low-speed USB devices such as keyboards, mice, and printers.

- USB 2.0: USB 2.0 controllers support data transfer rates of up to 480 Mbps. They are suitable for connecting high-speed USB devices such as external hard drives, flash drives, and webcams.
- USB 3.0: USB 3.0 controllers, also known as USB 3.1 Gen 1, support data transfer rates of up to 5 Gbps. They are suitable for connecting SuperSpeed USB devices such as external SSDs, USB 3.0 flash drives, and high-definition webcams.

The choice of USB controller depends on the speed and type of USB devices you plan to connect to the VM.