Operating Systems Laboratory (2024-25)

Getting familiar with a few Linux commands

1. man - The Manual Pages

- **Purpose:** The man command is your primary source for documentation on Linux. It displays the manual pages for commands, system calls, library functions, and other system components.
- **Usage:**
    - man <command>: Displays the manual page for the specified command.
    - man man: Shows the manual for the man command itself (a great starting point!).
- **Example:**
    - man ls : To see all details and options available for the ls command.
- **Important Note:** Mastering the man command is crucial. Get comfortable navigating the manual pages, searching for keywords (using /), and understanding the structure of the documentation.

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ man
What manual page do you want?
For example, try 'man man'.
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ man man
```

```
File  Edit  View  Search  Terminal  Help
MAN(1)                                                  Manual pager utils                                                  MAN(1)

NAME
       man - an interface to the system reference manuals

SYNOPSIS
       man [man options] [[section] page ...] ...
       man -k [apropos options] regexp ...
       man -K [man options] [section] term ...
       man -f [whatis options] page ...
       man -l [man options] file ...
       man -w|-W [man options] page ...

DESCRIPTION
       man  is the system's manual pager.  Each page argument given to man is normally the name of a program, utility or function.  The manual page associated with each of these arguments is then found and
       displayed.  A section, if provided, will direct man to look only in that section of the manual.  The default action is to search in all of the available sections following a pre-defined  order  (see
       DEFAULTS), and to show only the first page found, even if page exists in several sections.

       The table below shows the section numbers of the manual followed by the types of pages they contain.

       1   Executable programs or shell commands
       2   System calls (functions provided by the kernel)
       3   Library calls (functions within program libraries)
       4   Special files (usually found in /dev)
       5   File formats and conventions, e.g. /etc/passwd
       6   Games
       7   Miscellaneous (including macro packages and conventions), e.g. man(7), groff(7), man-pages(7)
       8   System administration commands (usually only for root)
       9   Kernel routines [Non standard]

       A manual page consists of several sections.

       Conventional section names include NAME, SYNOPSIS, CONFIGURATION, DESCRIPTION, OPTIONS, EXIT STATUS, RETURN VALUE, ERRORS, ENVIRONMENT, FILES, VERSIONS, CONFORMING TO, NOTES, BUGS, EXAMPLE, AUTHORS,
       and SEE ALSO.

       The following conventions apply to the SYNOPSIS section and can be used as a guide in other sections.

       bold text          type exactly as shown.
       italic text        replace with appropriate argument.
       [-abc]             any or all arguments within [ ] are optional.
       -a|-b              options delimited by | cannot be used together.
       argument ...       argument is repeatable.
       [expression] ...   entire expression within [ ] is repeatable.

       Exact rendering may vary depending on the output device.  For instance, man will usually not be able to render italics when running in a terminal, and will typically use underlined or coloured  text
       instead.

       The  command  or function illustration is a pattern that should match all possible invocations.  In some cases it is advisable to illustrate several exclusive invocations as is shown in the SYNOPSIS
       section of this manual page.

EXAMPLES
       man ls
            Display the manual page for the item (program) ls.
 Manual page man(1) line 1 (press h for help or q to quit)
```

2. pwd - Print Working Directory

- **Purpose:** Shows the current directory you are working in. The path is displayed as an absolute path (starting from the root directory /).
- **Usage:** pwd

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~/Desktop/assignment4/Laboratory$ pwd
/home/ramesh/Desktop/assignment4/Laboratory
```

3. ls - List Directory Contents

- **Purpose:** Lists the files and directories within a specified directory.
- **Usage:**
  - ls: Lists contents of the current directory.
  - ls <directory>: Lists contents of the specified directory.
  - ls -l: Long listing format, showing permissions, owner, size, modification time, etc.
  - ls -a: Lists all files, including hidden files (those starting with a dot .).
  - ls -lh: Long listing with human-readable file sizes (e.g., 1K, 234M, 2G).
  - ls /: Lists the contents of the root directory.
  - ls -l ..: Lists the contents of the parent directory in long format.

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ls
Desktop    Downloads   Firefox_wallpaper.png   node_modules   package.json    Pictures   Public     snap       user.json  'VirtualBox VMs'
Documents  empty.img   Music                   nvim.appimage  package-lock.json  pr       screenshots Templates  Videos     Warpinator
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ls Downloads
20_matrices_formula_sheets_quizrr.pdf   archive.zip   Files.zip   ICPC_Amritaputi_Regionals_Problem_Set.pdf   JakubMelka.PDF4QT_1.4.0.0.msi   kerala.csv   Python-3.12.1   Rainfall.csv
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ls -l
total 11292
drwxr-xr-x   6 ramesh ramesh     4096 Jan  6 15:44  Desktop
drwxr-xr-x   3 ramesh ramesh     4096 May 14  2024  Documents
drwxr-xr-x   3 ramesh ramesh     4096 Jan  7 11:05  Downloads
-rw-rw-r--   1 ramesh ramesh  1474560 Oct 23 19:03  empty.img
-rw-rw-r--   1 ramesh ramesh   195622 Dec 10 14:10  Firefox_wallpaper.png
drwxr-xr-x   2 ramesh ramesh     4096 Oct 31  2023  Music
drwxrwxr-x 126 ramesh ramesh     4096 Mar 24  2024  node_modules
-rwxrw-r--   1 ramesh ramesh 11179200 Jan  4  2024  nvim.appimage
-rw-rw-r--   1 ramesh ramesh      133 Mar 24  2024  package.json
-rw-rw-r--   1 ramesh ramesh    56682 Mar 24  2024  package-lock.json
drwxr-xr-x   5 ramesh ramesh     4096 Jan  7 11:26  Pictures
-rwxrwxr-x   1 ramesh ramesh    26448 Jul  9 06:58  pr
drwxr-xr-x   2 ramesh ramesh     4096 Dec 25  2022  Public
drwxrwxr-x   2 ramesh ramesh     4096 Apr 26  2024  screenshots
drwx------   7 ramesh ramesh     4096 Dec 31 20:08  snap
drwxr-xr-x   2 ramesh ramesh     4096 Dec 25  2022  Templates
-rw-rw-r--   1 ramesh ramesh    19920 Feb 15  2024  user.json
drwxr-xr-x   2 ramesh ramesh     4096 Dec 25  2022  Videos
drwxr-xr-x   3 ramesh ramesh     4096 Dec 30 16:53 'VirtualBox VMs'
drwxrwxr-x   2 ramesh ramesh     4096 Dec 25  2022  Warpinator
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ls -a
.                 .dmrc             .gtkrc-2.0       node_modules        pr                        screenshots               user.json          .xinputrc
..                Documents         .gtkrc-xfce      .node_repl_history  .profile                  snap                      .var               .xsession-errors
.bash_history     .dotnet           .icons           .npm                Public                    .ssh                      Videos             .xsession-errors.old
.bash_logout      Downloads         .kde             .npm-global         .python_history           .streamlit                .viminfo           .yarnrc
.bashrc           empty.img         .lesshst         nvim.appimage       .python_history-02749.tmp .sudo_as_admin_successful 'VirtualBox VMs'
.cache            Firefox_wallpaper.png .linuxmint   package.json        .python_history-06261.tmp .swp                      .vscode
.cargo            .fonts.conf       .local           package-lock.json   .python_history-06824.tmp Templates                 Warpinator
.config           .gnupg            .mozilla         Pictures            .python_history-11785.tmp .themes                   .wine
Desktop           .gphoto           Music            .pki                .rustup                   .thunderbird              .Xauthority
```

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ls -lh
total 12M
drwxr-xr-x   6 ramesh ramesh 4.0K Jan  6 15:44  Desktop
drwxr-xr-x   3 ramesh ramesh 4.0K May 14  2024  Documents
drwxr-xr-x   3 ramesh ramesh 4.0K Jan  7 11:05  Downloads
-rw-rw-r--   1 ramesh ramesh 1.5M Oct 23 19:03  empty.img
-rw-rw-r--   1 ramesh ramesh 192K Dec 10 14:10  Firefox_wallpaper.png
drwxr-xr-x   2 ramesh ramesh 4.0K Oct 31  2023  Music
drwxrwxr-x 126 ramesh ramesh 4.0K Mar 24  2024  node_modules
-rwxrw-r--   1 ramesh ramesh  11M Jan  4  2024  nvim.appimage
-rw-rw-r--   1 ramesh ramesh  133 Mar 24  2024  package.json
-rw-rw-r--   1 ramesh ramesh  56K Mar 24  2024  package-lock.json
drwxr-xr-x   5 ramesh ramesh 4.0K Jan  7 11:26  Pictures
-rwxrwxr-x   1 ramesh ramesh  26K Jul  9 06:58  pr
drwxr-xr-x   2 ramesh ramesh 4.0K Dec 25  2022  Public
drwxrwxr-x   2 ramesh ramesh 4.0K Apr 26  2024  screenshots
drwx------   7 ramesh ramesh 4.0K Dec 31 20:08  snap
drwxr-xr-x   2 ramesh ramesh 4.0K Dec 25  2022  Templates
-rw-rw-r--   1 ramesh ramesh  20K Feb 15  2024  user.json
drwxr-xr-x   2 ramesh ramesh 4.0K Dec 25  2022  Videos
drwxr-xr-x   3 ramesh ramesh 4.0K Dec 30 16:53 'VirtualBox VMs'
drwxrwxr-x   2 ramesh ramesh 4.0K Dec 25  2022  Warpinator
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ls /
bin  boot  cdrom  dev  etc  home  lib  lib32  lib64  libx32  lost+found  media  mnt  opt  proc  root  run  sbin  snap  srv  sys  tmp  usr  var
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ls -l ..
total 4
drwxr-x--- 37 ramesh ramesh 4096 Jan  7 11:26  ramesh
```

4. mkdir - Make Directory

- **Purpose:** Creates a new directory (folder).
- **Usage:**
  - mkdir <directory_name>: Creates a directory in the current location.
  - mkdir -p <path/to/directory>: Creates parent directories as needed.

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$  mkdir temp
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ mkdir temp/abc
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ mkdir -p projects/python/my_project
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ mkdir /tmp/xyz
```

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ tree temp
temp
└── abc

1 directory, 0 files
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ tree projects
projects
└── python
    └── my_project

2 directories, 0 files
```

5. touch - Create Empty File or Update Timestamp

- **Purpose:**
  - Creates an empty file if it doesn't exist.
  - Updates the access and modification timestamps of an existing file to the current time.
- **Usage:**
  - touch <file_name>: Creates or updates the timestamp of a file.

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ touch abc.xyz
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ touch new_file.txt
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ls
abc.xyz   Documents   empty.img        Music         node_modules   package.json      Pictures   projects   screenshots   temp        user.json   'VirtualBox VMs'
Desktop   Downloads   Firefox_wallpaper.png   new_file.txt   nvim.appimage   package-lock.json   pr        Public     snap          Templates   Videos      Warpinator
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ tree -L 1
.
├── abc.xyz
├── Desktop
├── Documents
├── Downloads
├── empty.img
├── Firefox_wallpaper.png
├── Music
├── new_file.txt
├── node_modules
├── nvim.appimage
├── package.json
├── package-lock.json
├── Pictures
├── pr
├── projects
├── Public
├── screenshots
├── snap
├── temp
├── Templates
├── user.json
├── Videos
├── VirtualBox VMs
├── Warpinator

15 directories, 9 files
```

6. cd - Change Directory

- **Purpose:** Navigates to a different directory in the file system.

- **Usage:**
  - cd <directory>: Changes to the specified directory.
  - cd: Changes to your home directory.
  - cd ..: Moves up to the parent directory.
  - cd -: Moves to the previous directory you were in.
  - cd /tmp: Change directory to /tmp

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ls
abc.xyz    Documents    empty.img      Music         node_modules    package.json      Pictures    projects    screenshots    temp          user.json    'VirtualBox VMs'
Desktop    Downloads    Firefox_wallpaper.png    new_file.txt    nvim.appimage   package-lock.json    pr          Public      snap           Templates    Videos       Warpinator
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ cd ..
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:/home$ cd ~/Documents
```

7. cp - Copy Files and Directories

- **Purpose:** Copies files or directories from one location to another.
- **Usage:**
  - cp <source> <destination>: Copies a file or directory.
  - cp -r <source_directory> <destination_directory>: Copies a directory recursively (including all its contents).
  - cp xyz abc: Copies file xyz to file abc
  - cp xyz temp/: Copies file xyz to temp/ directory.
  - cp -r temp /tmp/.: Copies directory temp and its contents to /tmp

8. mv - Move or Rename Files and Directories

- **Purpose:**
  - Moves files or directories to a different location.
  - Renames files or directories.
- **Usage:**
  - mv <source> <destination>: Moves or renames a file or directory.
  - mv xyz abc: Renames file xyz to abc
  - mv xyz temp: Moves file xyz to directory temp

9. rm - Remove Files and Directories

- **Purpose:** Deletes files or directories.
- **Usage:**
  - rm <file_name>: Removes a file.
  - rm -r <directory_name>: Removes a directory recursively (including all contents).
  - rm -f <file_name>: Forcefully removes a file (without prompting for confirmation).
  - rm -rf <directory_name>: **Use with extreme caution!** Forcefully removes a directory recursively, without confirmation.

10. dd - Convert and Copy a File

- **Purpose:** A powerful utility primarily used for low-level copying and conversion of data. Often used for tasks like creating disk images, backups, and data recovery.
- **Usage:**
  - dd if=<input_file> of=<output_file> bs=<block_size> count=<number_of_blocks>
  - if: Input file (or device).
  - of: Output file (or device).
  - bs: Block size (how much data to read/write at a time).
  - count: Number of blocks to copy.

11. ssh - Secure Shell

- **Purpose:** Allows you to securely connect to and manage a remote server over an encrypted connection.
- **Usage:**
  - ssh <username>@<hostname_or_IP>: Connects to the remote server.
  - ssh -X manas@10.2.1.40: Connects to remote server and enables X11 forwarding

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ssh test@test.rebex.net
The authenticity of host 'test.rebex.net (194.108.117.16)' can't be established.
ED25519 key fingerprint is SHA256:d7Te2DHmvBNSWJNBWik2KbDTjmWtYHe2bvXTMM9lVg4.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'test.rebex.net' (ED25519) to the list of known hosts.
Welcome to test.rebex.net! See https://test.rebex.net/ for more information.
(test@test.rebex.net) Password:
test@test.rebex.net's password:
For a list of supported commands, type 'help'.
test@test:/$ help
Supported commands:
 whoami  uname   hostname
 echo    mv      rm
 pwd     mkdir   rmdir
 dir     cp      ls
 groups  cd      set
 exit    help
test@test:/$
```

12. scp - Secure Copy

- **Purpose:** Securely copies files between your local machine and a remote server (or between two remote servers) over an SSH connection.
- **Usage:**
  - scp <source> <username>@<hostname_or_IP>:<destination>: Copies a file to the remote server.
  - scp <username>@<hostname_or_IP>:<source> <destination>: Copies a file from the remote server.

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ scp yourfile.txt test@test.rebex.net:/upload
Welcome to test.rebex.net! See https://test.rebex.net/ for more information.
(test@test.rebex.net) Password:
yourfile.txt
```

13. sudo - Superuser Do

- **Purpose:** Allows you to run commands with the privileges of another user, typically the root user (superuser). This is necessary for administrative tasks.
- **Usage:**
  - sudo <command>: Executes the command with root privileges.
  - sudo bash: Start a bash shell as a super user

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ sudo apt-get update #for demo only
[sudo] password for ramesh:
Get:2 https://dl.winehq.org/wine-builds/ubuntu jammy InRelease [8,041 B]
Hit:3 http://archive.ubuntu.com/ubuntu jammy InRelease
Get:4 https://dl.winehq.org/wine-builds/ubuntu jammy/main amd64 Packages [277 kB]
Get:1 https://packages.microsoft.com/repos/code stable InRelease [3,590 B]
Get:5 https://packages.microsoft.com/repos/code stable/main arm64 Packages [17.0 kB]
Get:6 http://archive.ubuntu.com/ubuntu jammy-updates InRelease [128 kB]
Get:7 https://packages.microsoft.com/repos/code stable/main armhf Packages [17.1 kB]
Get:8 https://dl.winehq.org/wine-builds/ubuntu jammy/main i386 Packages [276 kB]
Get:9 https://packages.microsoft.com/repos/code stable/main amd64 Packages [16.9 kB]
Get:10 http://security.ubuntu.com/ubuntu jammy-security InRelease [129 kB]
Hit:11 https://ppa.launchpadcontent.net/maveonair/helix-editor/ubuntu jammy InRelease
Hit:12 https://ppa.launchpadcontent.net/touchegg/stable/ubuntu jammy InRelease
Ign:13 http://packages.linuxmint.com vera InRelease
Get:14 http://packages.linuxmint.com vera Release [24.1 kB]
Get:15 http://archive.ubuntu.com/ubuntu jammy-backports InRelease [127 kB]
Get:16 http://archive.ubuntu.com/ubuntu jammy-updates/main i386 Packages [743 kB]
Get:17 http://packages.linuxmint.com vera Release.gpg [833 B]
Get:18 http://packages.linuxmint.com vera/main i386 Packages [17.4 kB]
Get:19 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [2,271 kB]
Get:20 http://packages.linuxmint.com vera/main amd64 Packages [18.0 kB]
Get:21 http://packages.linuxmint.com vera/upstream amd64 Packages [48.4 kB]
Get:22 http://security.ubuntu.com/ubuntu jammy-security/main i386 Packages [581 kB]
Get:23 http://archive.ubuntu.com/ubuntu jammy-updates/main Translation-en [382 kB]
Get:24 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 DEP-11 Metadata [103 kB]
Get:25 http://archive.ubuntu.com/ubuntu jammy-updates/restricted amd64 Packages [2,867 kB]
Get:26 http://archive.ubuntu.com/ubuntu jammy-updates/restricted Translation-en [500 kB]
Get:27 http://archive.ubuntu.com/ubuntu jammy-updates/restricted amd64 DEP-11 Metadata [212 B]
Get:28 http://archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages [1,181 kB]
Get:29 http://archive.ubuntu.com/ubuntu jammy-updates/universe i386 Packages [754 kB]
```

14. ping - Test Network Connectivity

- **Purpose:** Sends ICMP Echo Request packets to a host to check if it's reachable and measure round-trip time.
- **Usage:**
  - ping <hostname_or_IP>: Pings the specified host.
  - ping 10.2.1.40
  - ping 10.2.0.1
  - ping www.google.com

15. ifconfig - Interface Configuration (deprecated)

- **Purpose:** Used to configure and display network interface parameters. However, it is **deprecated** in favor of the ip command.
- **Usage (for reference, but use ip instead):**
  - ifconfig: Displays the configuration of all network interfaces.
  - ifconfig <interface_name> <IP_address> netmask <netmask>: Assigns an IP address and netmask to an interface.

16. netstat - Network Statistics

- **Purpose:** Displays network connections, routing tables, interface statistics, masquerade connections, and multicast memberships.
- **Usage:**
  - netstat -a: Displays all active connections and listening ports.
  - netstat -t: Displays TCP connections.
  - netstat -u: Displays UDP connections.
  - netstat -l: Displays listening ports.
  - netstat -r: Displays the routing table.
  - netstat -i: Displays interface statistics.

○   netstat -rn: Displays routing table in numeric format

17. route - Show/Manipulate IP Routing Table (partially deprecated)

- **Purpose:** Used to view or modify the IP routing table. While still functional, some of its functionality is superseded by the ip route command.
- **Usage:**
  ○   route: Displays the routing table.
  ○   route add default gw <gateway_IP>: Adds a default gateway.
  ○   route del default gw <gateway_IP>: Deletes a default gateway.

18. ip - The Modern Networking Command

- **Purpose:** A powerful and versatile command that replaces many older networking tools like ifconfig and route. It's used to show or manipulate routing, network devices, interfaces, and tunnels.
- **Usage:**
  ○   ip addr show: Displays IP addresses and interface information (equivalent to ifconfig).
  ○   ip link set <interface_name> up/down: Enables or disables an interface.
  ○   ip route show: Displays the routing table.
  ○   ip route add <destination> via <gateway>: Adds a route.
  ○   ip addr show: show interface address information

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ping www.google.com
PING www.google.com (142.250.182.196) 56(84) bytes of data.
64 bytes from bom07s28-in-f4.1e100.net (142.250.182.196): icmp_seq=1 ttl=115 time=67.4 ms
64 bytes from bom07s28-in-f4.1e100.net (142.250.182.196): icmp_seq=2 ttl=115 time=96.0 ms
64 bytes from bom07s28-in-f4.1e100.net (142.250.182.196): icmp_seq=3 ttl=115 time=97.4 ms
^C
--- www.google.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 67.363/86.917/97.390/13.838 ms
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ifconfig eth0
eth0: error fetching interface information: Device not found
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ip link show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: eno1: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc fq_codel state DOWN mode DEFAULT group default qlen 1000
    link/ether 5c:60:ba:64:6b:29 brd ff:ff:ff:ff:ff:ff
    altname enp4s0
3: wlp0s20f3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP mode DORMANT group default qlen 1000
    link/ether 54:6c:eb:b8:0a:c9 brd ff:ff:ff:ff:ff:ff
4: docker0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc noqueue state DOWN mode DEFAULT group default
    link/ether 02:42:2a:6b:df:8f brd ff:ff:ff:ff:ff:ff
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ifconfig eno1
eno1: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        ether 5c:60:ba:64:6b:29  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ netstat -t
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address          Foreign Address         State
tcp        0    239 ramesh-Victus-by-:54038 ec2-34-237-73-95.:https ESTABLISHED
tcp        0      0 ramesh-Victus-by-:58320 93.243.107.34.bc.:https ESTABLISHED
tcp        0      0 ramesh-Victus-by-:51476 del12s04-in-f10.1:https ESTABLISHED
tcp        0      0 ramesh-Victus-by-:43418 123.208.120.34.bc:https TIME_WAIT
tcp        0      0 ramesh-Victus-by-:49816 del11s15-in-f10.1:https ESTABLISHED
tcp        0      0 ramesh-Victus-by-:42612 del12s02-in-f3.1e:https ESTABLISHED
tcp        0      0 ramesh-Victus-by-:51462 del12s04-in-f10.1:https ESTABLISHED
tcp        0      0 ramesh-Victus-by-:55760 104.18.31.173:https     TIME_WAIT
tcp        0      0 ramesh-Victus-by-:33720 del11s15-in-f14.1:https ESTABLISHED
tcp        0      0 ramesh-Victus-by-:36286 172.64.41.4:https       ESTABLISHED
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
default         _gateway        0.0.0.0         UG    600    0        0 wlp0s20f3
link-local      0.0.0.0         255.255.0.0     U     1000   0        0 docker0
172.17.0.0      0.0.0.0         255.255.0.0     U     0      0        0 docker0
192.168.51.0    0.0.0.0         255.255.255.0   U     600    0        0 wlp0s20f3
```

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ip addr show eno1
2: eno1: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc fq_codel state DOWN group default qlen 1000
    link/ether 5c:60:ba:64:6b:29 brd ff:ff:ff:ff:ff:ff
    altname enp4s0
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ip addr show lo
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
       valid_lft forever preferred_lft forever
```

Editors:

19. vim - Vi Improved

- **Purpose: A powerful, highly configurable, modal text editor. It has a steeper learning curve but is very efficient once mastered.**
- **Modes:**
  - **Normal Mode: For navigation, text manipulation, and commands.**
  - **Insert Mode: For inserting text.**
  - **Visual Mode: For selecting text.**
- **Basic Commands:**
  - **i: Enter Insert mode.**
  - **Esc: Exit Insert mode and return to Normal mode.**
  - **:w: Save the file.**
  - **:q: Quit Vim.**
  - **:wq or ZZ: Save and quit.**
  - **:q!: Quit without saving.**
  - **h, j, k, l: Move cursor left, down, up, right.**
  - **x: Delete a character.**
  - **dd: Delete a line.**
  - **yy: Yank (copy) a line.**
  - **p: Paste.**

20. nano - A Simple Editor

- **Purpose: A beginner-friendly, non-modal text editor. It's easier to learn than Vim but has fewer features.**
- **Basic Commands:**
  - **Ctrl + X: Exit.**
  - **Ctrl + O: Save.**
  - **Ctrl + G: Get help.**
  - **Ctrl + W: Search.**
  - **Arrow keys: Navigate.**

Compilers and Debuggers:

21. gcc - GNU Compiler Collection (C Compiler)

- **Purpose: Compiles C code into executable programs.**
- **Usage:**
  - **gcc <source_file.c> -o <output_file>: Compiles source_file.c and creates an executable named output_file.**
  - **gcc -Wall <source_file.c> -o <output_file>: Compiles with all warnings enabled (recommended).**

```c
myprogram.c ×
#include <stdio.h>
int main() {
    // printf() displays the string inside quotation
    printf("Hello, World!");
    return 0;
}
```

```
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ gcc myprogram.c
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ ./a.out
ramesh@ramesh-Victus-by-HP-Gaming-Laptop-15-fa0xxx:~$ 
```

22. gdb - GNU Debugger

- **Purpose: Helps you debug programs by allowing you to step through code, inspect variables, set breakpoints, and examine the program's state.**
- **Usage:**
  - **gdb <executable>: Starts GDB with the specified executable.**
  - **gdb --args <executable> <arguments>: Starts GDB with arguments for executable.**
  - **Common GDB Commands:**
    - **run or r: Starts the program.**
    - **break or b <line_number> or b <function_name>: Sets a breakpoint.**
    - **next or n: Executes the next line of code.**
    - **step or s: Steps into a function call.**
    - **print or p <variable>: Prints the value of a variable.**
    - **continue or c: Continues execution until the next breakpoint or program termination.**
    - **quit or q: Exits GDB.**

23. gas - GNU Assembler

- **Purpose: Assembles assembly language code into object files.**
- **Usage:**
  - **as <source_file.s> -o <output_file.o>: Assembles source_file.s into output_file.o.**