

St. Francis Institute of Technology, Mumbai-400 103
Department of Information Technology

A.Y. 2023-2024
 Class: SE-ITA/B, Semester: IV

Subject: UNIX LAB

Experiment – 3: Study and Implementation of UNIX Networking Commands.

- 1. Aim:** To Study and implement UNIX networking commands.
- 2. Objectives:**
 - To understand and implement networking commands.
 - To understand network configuration and various network parameters.
- 3. Outcomes:** After study of this experiment, the student will be able to
 - Apply UNIX networking commands to diagnose network problems.
 - Analyze the network traffic and other network parameters (L402.2).
- 4. Prerequisite:** None.
- 5. Requirements:** Personal Computer, Ubuntu OS, Internet Connection, LibreOffice.

6. Pre-Experiment Exercise:

Brief Theory:

Network Administration

A network is a communication path between two or more systems. Networks vary by the protocols used, the distances between nodes, and the transport media. UNIX uses TCP/IP network protocol to connect heterogeneous machines in a network.

UNIX facilitates network administrators to configure a network, network interface cards, troubleshoot a network, display the network statistics, configure a host, split the network into multiple ones, query the name server, secure the network and many such services with a multitude of simple commands.

7. Laboratory Exercise

A. Procedure

Explain the following UNIX networking commands with syntax and example:
 ifconfig, ping, traceroute, netstat, nslookup, whois, hostname, tcpdump.

B. Result/Observation/Program code

8. Post-Experiments Exercise

A. Extended Theory:

1. Explain and implement the networking commands: dig, route, host, arp, mtr.

B. Questions:

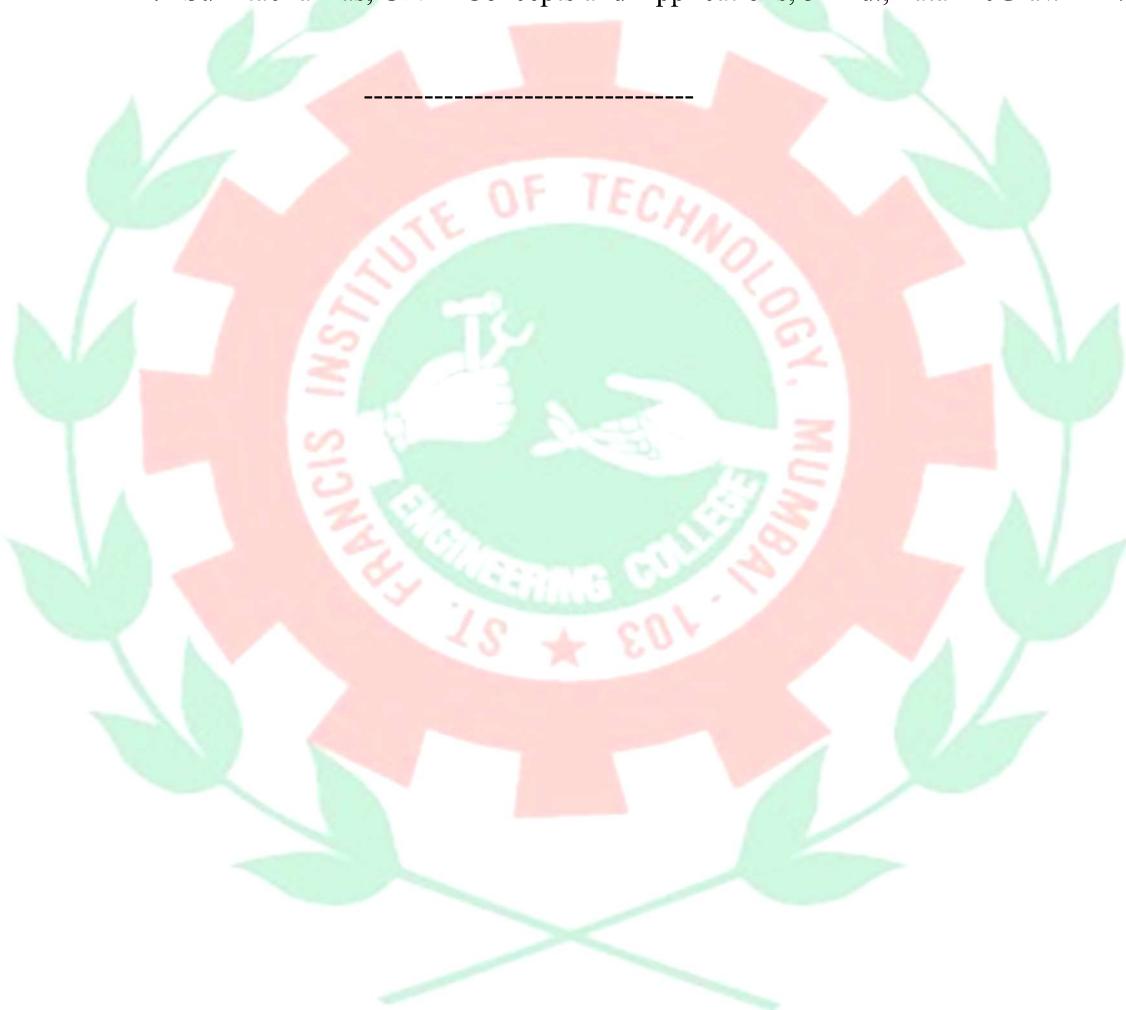
- How do you find out your machine's MAC address?

C. Conclusion:

- Write what was performed in the experiment.
- Mention few applications of what was studied.
- Write the significance of the topic studied in the experiment.

D. References:

- <https://www.networkworld.com/article/2697039/unix-top-networking-commands-and-what-they-tell-you.html>.
- Sumitabha Das, UNIX Concepts and Applications, 3rd Ed., Tata McGraw Hill.

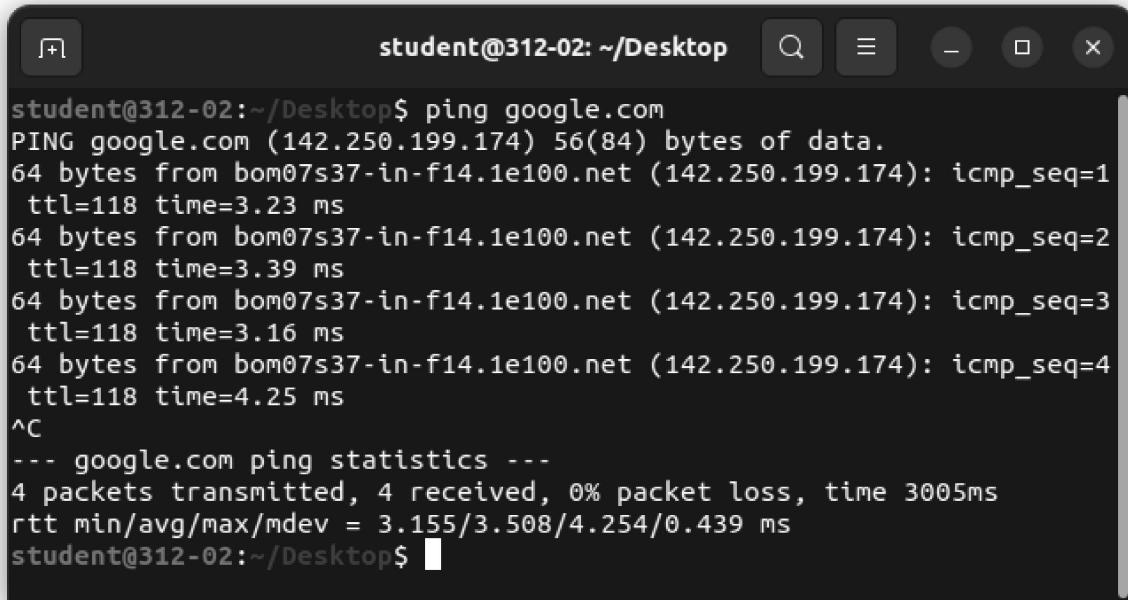


EXP 3: Study and Implementation of UNIX Networking Commands

Command 1 : Ping

Description:

When I use Ubuntu Command "ping google.com", it sends ICMP echo requests to google.com and measures the round-trip time for packets to travel from the local machine to Google's servers, helping diagnose network connectivity issues.



A screenshot of a terminal window titled "student@312-02: ~/Desktop". The window contains the following text output from the "ping" command:

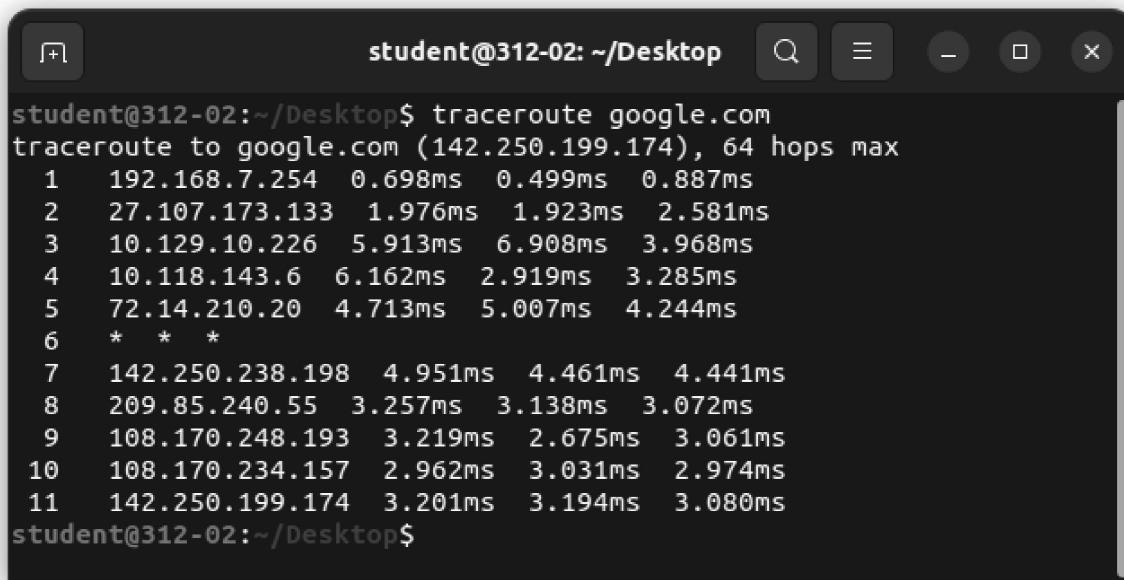
```
student@312-02:~/Desktop$ ping google.com
PING google.com (142.250.199.174) 56(84) bytes of data.
64 bytes from bom07s37-in-f14.1e100.net (142.250.199.174): icmp_seq=1
  ttl=118 time=3.23 ms
64 bytes from bom07s37-in-f14.1e100.net (142.250.199.174): icmp_seq=2
  ttl=118 time=3.39 ms
64 bytes from bom07s37-in-f14.1e100.net (142.250.199.174): icmp_seq=3
  ttl=118 time=3.16 ms
64 bytes from bom07s37-in-f14.1e100.net (142.250.199.174): icmp_seq=4
  ttl=118 time=4.25 ms
^C
--- google.com ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3005ms
rtt min/avg/max/mdev = 3.155/3.508/4.254/0.439 ms
student@312-02:~/Desktop$
```

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Command 2 : TraceRoute

Description: When I use Ubuntu Command "traceroute google.com", it traces the path packets take from the local machine to Google's servers, showing each hop along the way and helping identify network routing issues or delays.



A screenshot of a terminal window titled "student@312-02: ~/Desktop". The window contains the output of the "traceroute google.com" command. The output shows the path taken by the packets from the local machine to Google's servers, listing 11 hops. The first hop is the local machine (192.168.7.254). Subsequent hops include various IP addresses from different ISPs, such as 27.107.173.133, 10.129.10.226, and 108.170.248.193. The last hop is the destination, 142.250.199.174, which is Google's server. Each hop is followed by its round-trip time (RTT) in milliseconds.

```
student@312-02:~/Desktop$ traceroute google.com
traceroute to google.com (142.250.199.174), 64 hops max
 1  192.168.7.254  0.698ms  0.499ms  0.887ms
 2  27.107.173.133  1.976ms  1.923ms  2.581ms
 3  10.129.10.226  5.913ms  6.908ms  3.968ms
 4  10.118.143.6  6.162ms  2.919ms  3.285ms
 5  72.14.210.20  4.713ms  5.007ms  4.244ms
 6  * * *
 7  142.250.238.198  4.951ms  4.461ms  4.441ms
 8  209.85.240.55  3.257ms  3.138ms  3.072ms
 9  108.170.248.193  3.219ms  2.675ms  3.061ms
10  108.170.234.157  2.962ms  3.031ms  2.974ms
11  142.250.199.174  3.201ms  3.194ms  3.080ms
student@312-02:~/Desktop$
```

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Command 3 : netstat

Description: When I use Ubuntu Command "netstat", it displays network statistics including active network connections, routing tables, interface statistics, masquerade connections, and multicast memberships.

```
student@312-02: ~/Desktop$ netstat
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address
State
tcp      0      0 312-02:42318          93.243.107.34.bc.:https
ESTABLISHED
udp      0      0 312-02:bootpc          sophos.sfit.co.i:bootps
ESTABLISHED
Active UNIX domain sockets (w/o servers)
Proto RefCnt Flags       Type      State         I-Node    Path
unix    3      [ ]        STREAM    CONNECTED   35400    /run/user
/1000/wayland-0
unix    3      [ ]        STREAM    CONNECTED   28555
unix    3      [ ]        STREAM    CONNECTED   27201
unix    3      [ ]        STREAM    CONNECTED   27138
```

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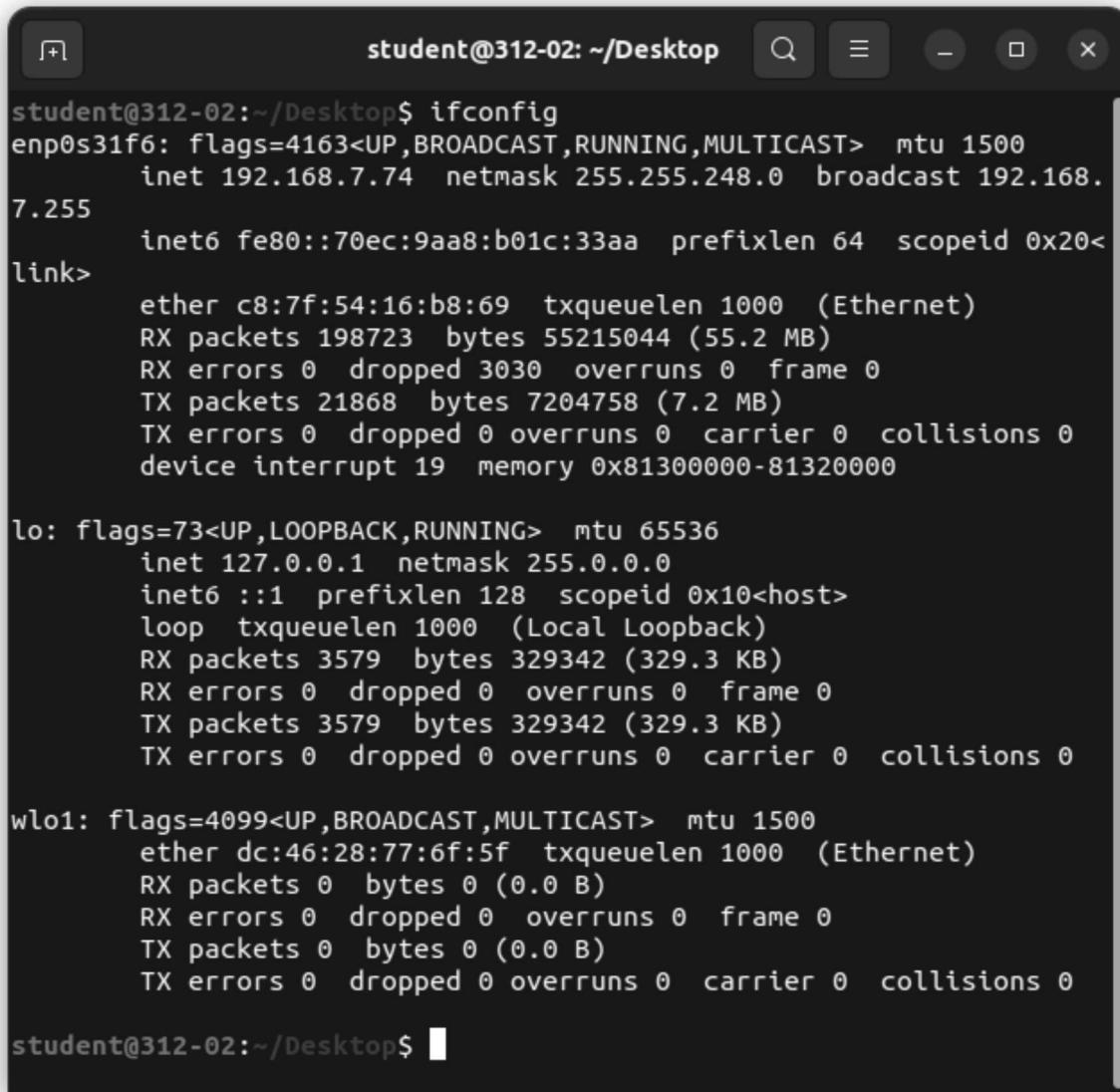
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Command 4 : ifconfig

Description: When I use Ubuntu Command "ifconfig", it displays information about network interfaces, including IP addresses, MAC addresses, and other network-related details, allowing configuration and troubleshooting of network connections.



A screenshot of a terminal window titled "student@312-02: ~/Desktop". The window contains the output of the "ifconfig" command. The output shows three network interfaces: enp0s31f6, lo, and wlo1. For each interface, it displays flags (e.g., UP, BROADCAST, RUNNING, MULTICAST), MTU, link layer address (MAC), and various statistics for RX and TX packets, bytes, errors, dropped, overruns, frame, carrier, collisions, and device interrupt. The terminal prompt "student@312-02: ~/Desktop\$" is visible at the bottom.

```
student@312-02:~/Desktop$ ifconfig
enp0s31f6: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.7.74 netmask 255.255.248.0 broadcast 192.168.7.255
        inet6 fe80::70ec:9aa8:b01c:33aa prefixlen 64 scopeid 0x20<link>
            ether c8:7f:54:16:b8:69 txqueuelen 1000 (Ethernet)
            RX packets 198723 bytes 55215044 (55.2 MB)
            RX errors 0 dropped 3030 overruns 0 frame 0
            TX packets 21868 bytes 7204758 (7.2 MB)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
            device interrupt 19 memory 0x81300000-81320000

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
        loop txqueuelen 1000 (Local Loopback)
        RX packets 3579 bytes 329342 (329.3 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 3579 bytes 329342 (329.3 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

wlo1: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
    ether dc:46:28:77:6f:5f 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

student@312-02:~/Desktop$
```

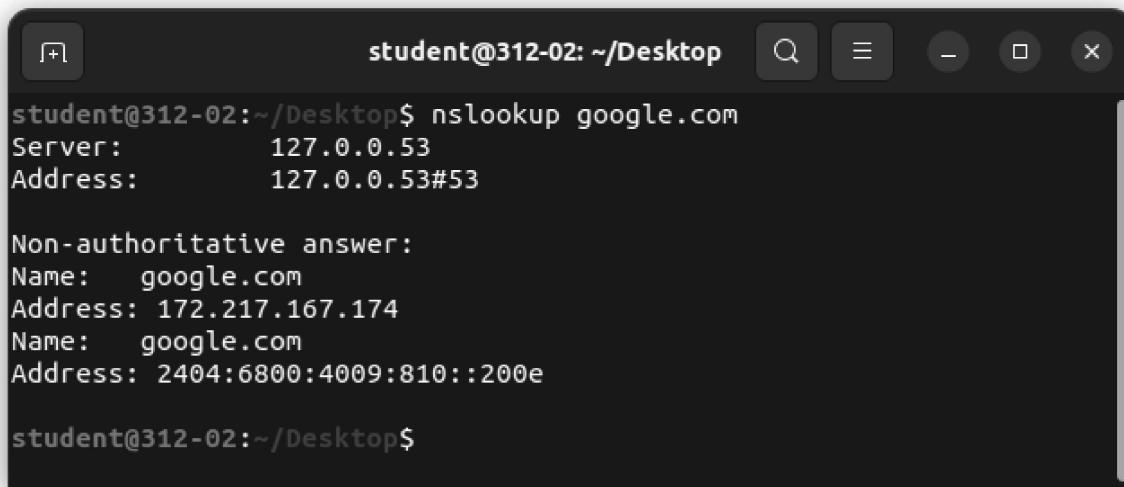
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Command 5 : nslookup

Description :

When I use Ubuntu Command "nslookup", it performs DNS (Domain Name System) queries to retrieve information about domain names, such as IP addresses or DNS records, aiding in network troubleshooting and domain configuration analysis.



The screenshot shows a terminal window titled "student@312-02: ~/Desktop". The command entered is "nslookup google.com". The output shows the server being used (127.0.0.53) and the address of the server (127.0.0.53#53). It then displays a "Non-authoritative answer" for the domain google.com, listing two different IP addresses: 172.217.167.174 and 2404:6800:4009:810::200e.

```
student@312-02:~/Desktop$ nslookup google.com
Server:      127.0.0.53
Address:     127.0.0.53#53

Non-authoritative answer:
Name:   google.com
Address: 172.217.167.174
Name:   google.com
Address: 2404:6800:4009:810::200e

student@312-02:~/Desktop$
```

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Command 6 : tcpdump

Description :When I use Ubuntu Command "tcpdump", it captures and displays network packets flowing through a network interface, allowing for real-time monitoring, analysis, and debugging of network traffic.

```
student@312-02: ~/Desktop$ sudo tcpdump
[sudo] password for student:
tcpdump: verbose output suppressed, use -v[v]... for full protocol d
ecode
listening on enp0s31f6, link-type EN10MB (Ethernet), snapshot length
262144 bytes
11:49:43.926260 ARP, Request who-has 192.168.7.4 tell 192.168.5.218,
length 46
11:49:43.942331 IP6 fe80::580d:26ae:c9a8:a4c1.63141 > ff02::1:3.5355
: UDP, length 23
11:49:43.942332 IP6 fe80::580d:26ae:c9a8:a4c1.63835 > ff02::1:3.5355
: UDP, length 23
```

```
student@312-02: ~/Desktop$ 
11:49:58.427205 IP 192.168.5.118.63514 > 224.0.0.252.5355: UDP, leng
th 23
11:49:58.428131 IP6 fe80::3df:bbe2:c98c:fdc6.51409 > ff02::1:3.5355:
UDP, length 23
11:49:58.428133 IP 192.168.5.118.51409 > 224.0.0.252.5355: UDP, leng
th 23
^C
1934 packets captured
5257 packets received by filter
3314 packets dropped by kernel
student@312-02: ~/Desktop$ ^C
student@312-02: ~/Desktop$
```

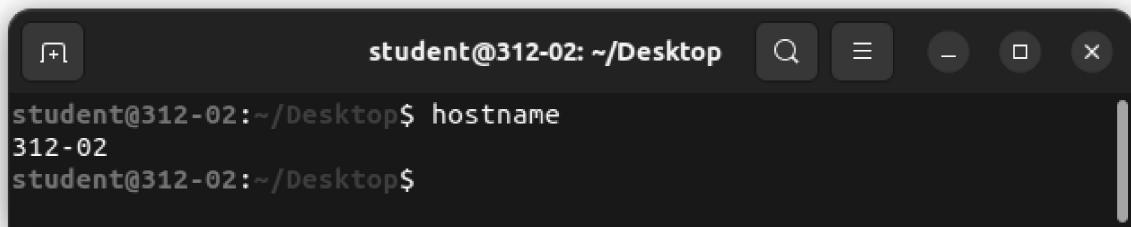
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Command 7 : hostname

Description:

When I use Ubuntu Command "hostname", it displays the name of the current host system, providing identification within a network environment.



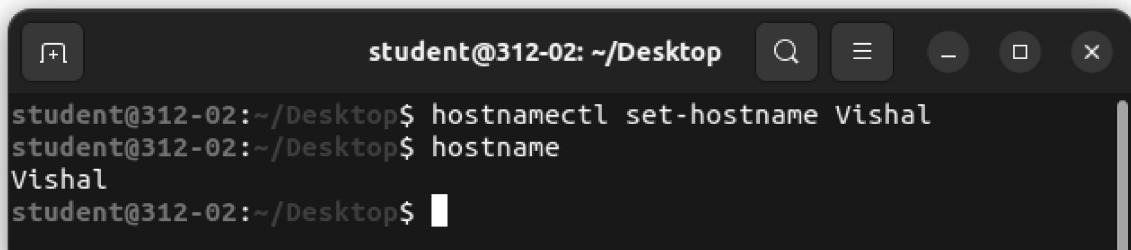
```
student@312-02: ~/Desktop
student@312-02:~/Desktop$ hostname
312-02
student@312-02:~/Desktop$
```

A screenshot of a terminal window titled "student@312-02: ~/Desktop". The window has standard OS X-style controls at the top right. The terminal prompt is "student@312-02: ~/Desktop". The user enters the command "hostname" and receives the output "312-02". The prompt then changes back to "student@312-02:~/Desktop\$".

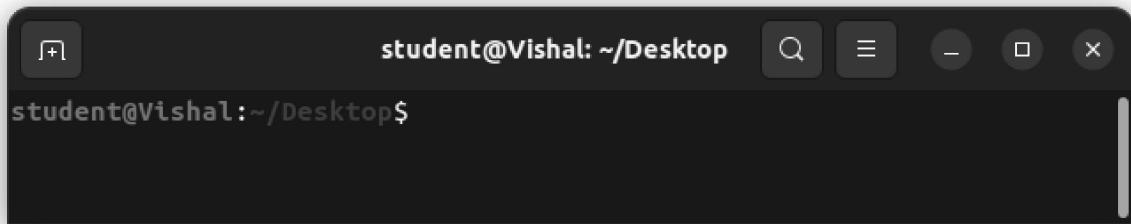
Command 8 : hostnamectl set-hostname

Description:

When I use Ubuntu Command "hostnamectl set-hostname Vishal", it changes the system's hostname to "Vishal", thereby updating its identification within the network environment to the specified name.



```
student@312-02:~/Desktop
student@312-02:~/Desktop$ hostnamectl set-hostname Vishal
student@312-02:~/Desktop$ hostname
Vishal
student@312-02:~/Desktop$
```

A screenshot of a terminal window titled "student@312-02: ~/Desktop". The window has standard OS X-style controls at the top right. The terminal prompt is "student@312-02: ~/Desktop". The user enters the command "hostnamectl set-hostname Vishal". After pressing enter, they run "hostname" to verify the change, which returns "Vishal". The prompt then changes back to "student@312-02:~/Desktop\$".

```
student@Vishal: ~/Desktop
student@Vishal:~/Desktop$
```

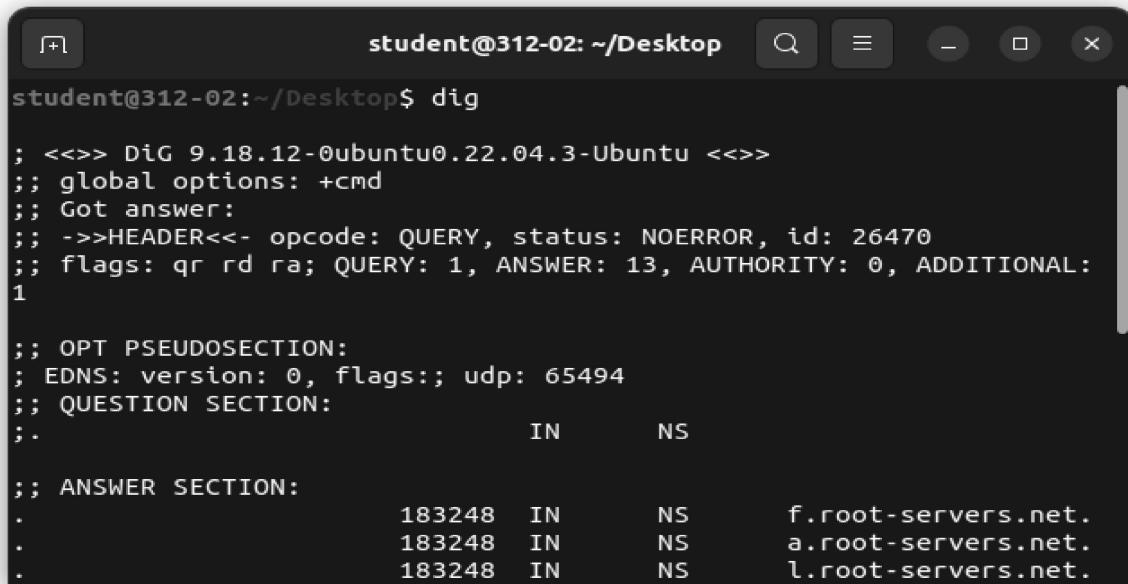
A screenshot of a terminal window titled "student@Vishal: ~/Desktop". The window has standard OS X-style controls at the top right. The terminal prompt is "student@Vishal: ~/Desktop". The user has changed the system's hostname to "Vishal". The prompt then changes back to "student@Vishal:~/Desktop\$".

POST - EXPERIMENT EXERCISE :

Command 1 : dig

Description:

When I use Ubuntu Command "dig", it is a DNS lookup utility that retrieves information from DNS servers, such as IP addresses, DNS records, and other domain-related details, aiding in network troubleshooting and domain configuration analysis.



The screenshot shows a terminal window titled "student@312-02: ~/Desktop". The command "dig" was run, and the output is displayed. The output shows the following information:

```
student@312-02:~/Desktop$ dig

; <>> DiG 9.18.12-0ubuntu0.22.04.3-Ubuntu <>>
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 26470
;; flags: qr rd ra; QUERY: 1, ANSWER: 13, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;.

;; ANSWER SECTION:
.          183248  IN      NS      f.root-servers.net.
.          183248  IN      NS      a.root-servers.net.
.          183248  IN      NS      l.root-servers.net.
```

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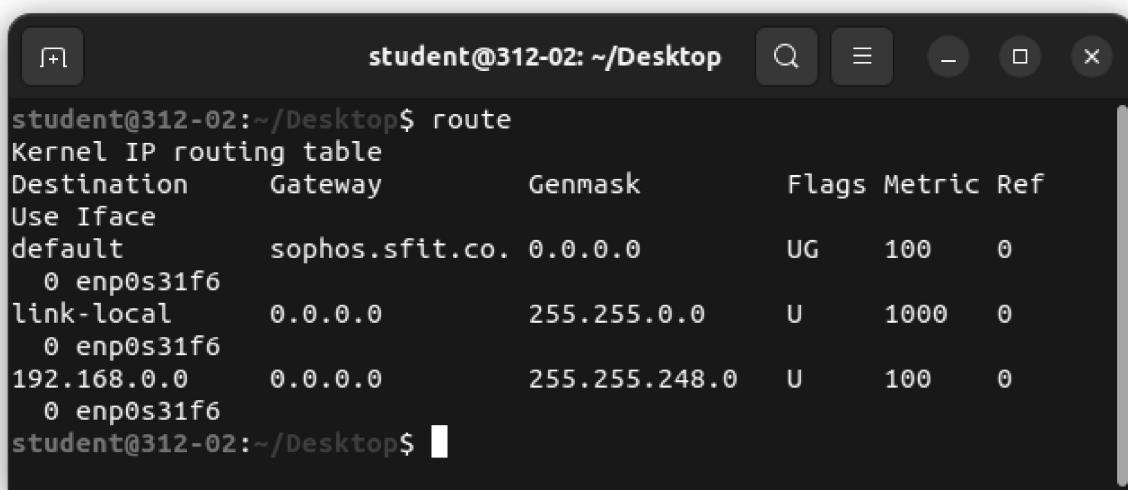
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Command 2 : route

Description:

When I use Ubuntu Command "route", it displays and manipulates the IP routing table, showing information about the network routes configured on the system, helping manage network traffic and connectivity.

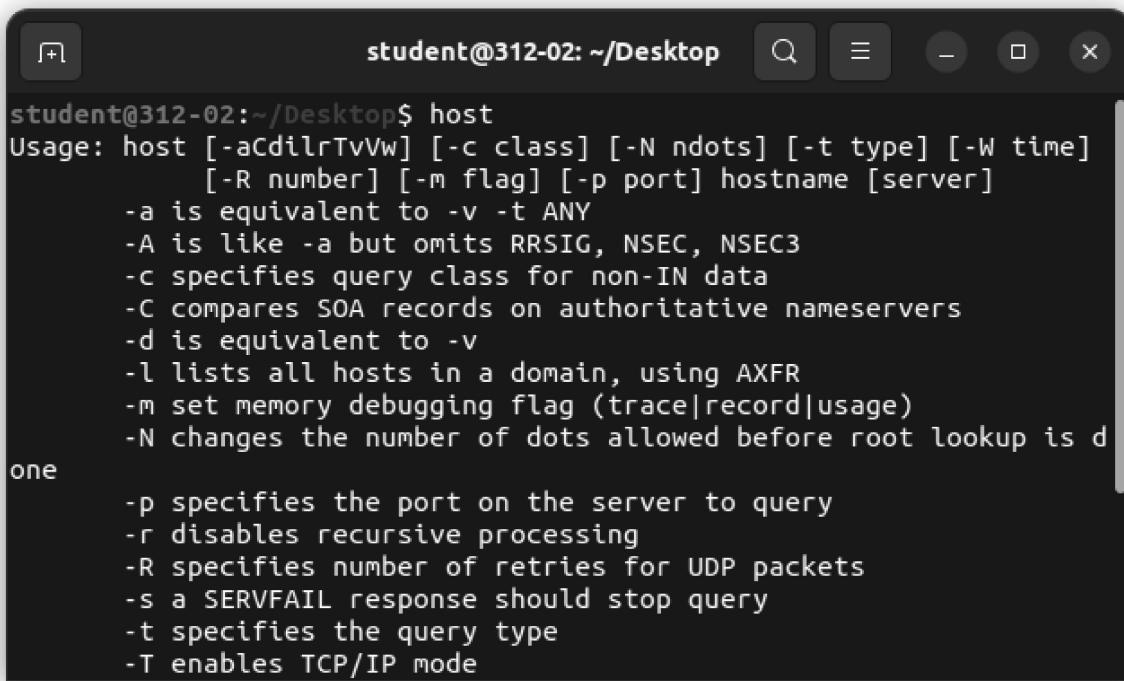


A screenshot of a terminal window titled "student@312-02: ~/Desktop". The window contains the output of the "route" command. The output shows the Kernel IP routing table with columns: Destination, Gateway, Genmask, Flags, Metric, and Ref. The table includes entries for default gateway via enp0s31f6, link-local gateway via enp0s31f6, and a local interface entry for 192.168.0.0.

Destination	Gateway	Genmask	Flags	Metric	Ref
default	sophos.sfit.co.	0.0.0.0	UG	100	0
0	enp0s31f6				
link-local	0.0.0.0	255.255.0.0	U	1000	0
0	enp0s31f6				
192.168.0.0	0.0.0.0	255.255.248.0	U	100	0
0	enp0s31f6				

Command 3 : host

Description: When I Used Ubuntu Command “Host” without any option , it printed the general syntax of the command along with the various options that can be used with the host command as well as gave a brief description about each option.



The screenshot shows a terminal window with the title bar "student@312-02: ~/Desktop". The command "host" is entered at the prompt. The output displays the usage information for the "host" command, including options like -a, -A, -c, -C, -d, -l, -m, -N, -p, -r, -R, -s, -t, and -T, along with their descriptions. The terminal has a dark theme with light-colored text.

```
student@312-02:~/Desktop$ host
Usage: host [-aCdilrvVw] [-c class] [-N ndots] [-t type] [-W time]
           [-R number] [-m flag] [-p port] hostname [server]
-a is equivalent to -v -t ANY
-A is like -a but omits RRSIG, NSEC, NSEC3
-c specifies query class for non-IN data
-C compares SOA records on authoritative nameservers
-d is equivalent to -v
-l lists all hosts in a domain, using AXFR
-m set memory debugging flag (trace|record|usage)
-N changes the number of dots allowed before root lookup is done
-p specifies the port on the server to query
-r disables recursive processing
-R specifies number of retries for UDP packets
-s a SERVFAIL response should stop query
-t specifies the query type
-T enables TCP/IP mode
```

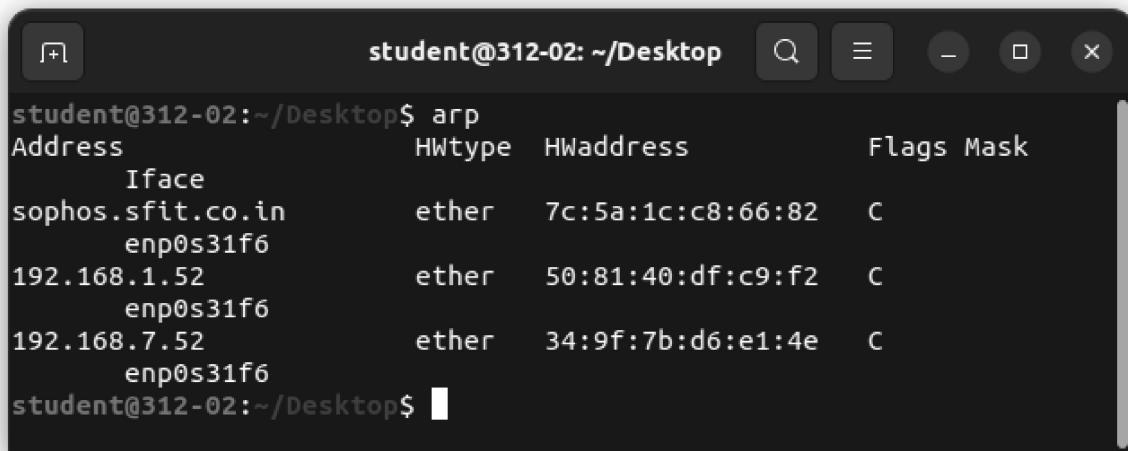
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Command 4 : arp

Description:

When I use Ubuntu Command "arp", it displays and manipulates the ARP (Address Resolution Protocol) cache, showing information about the mapping between IP addresses and MAC addresses on the local network, assisting in network troubleshooting and monitoring.



A screenshot of a terminal window titled "student@312-02: ~/Desktop". The window shows the output of the "arp" command. The output is a table with columns: Address, Iface, Hwtype, Hwaddress, Flags, and Mask. The data in the table is as follows:

Address	Iface	Hwtype	Hwaddress	Flags	Mask
sophos.sfit.co.in	enp0s31f6	ether	7c:5a:1c:c8:66:82	C	
192.168.1.52	enp0s31f6	ether	50:81:40:df:c9:f2	C	
192.168.7.52	enp0s31f6	ether	34:9f:7b:d6:e1:4e	C	

Command 5 : mtr

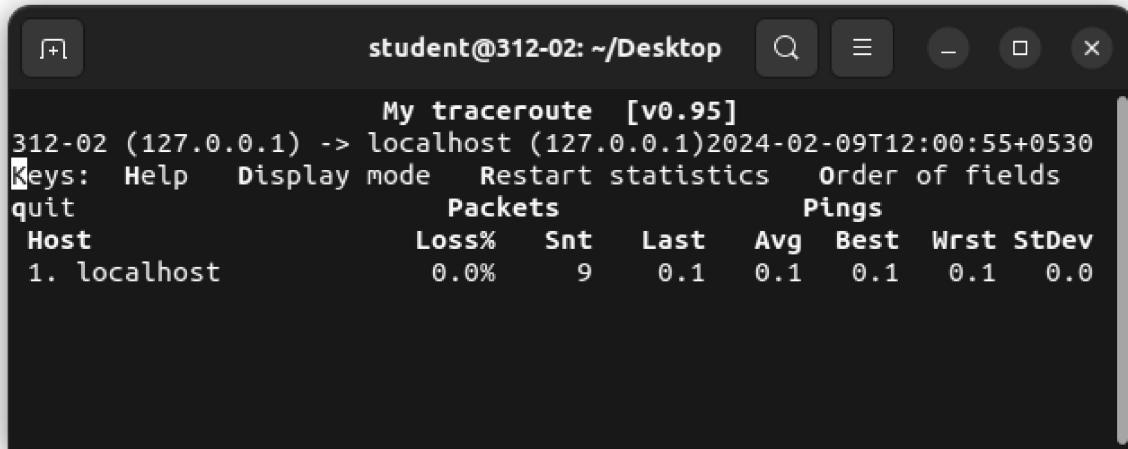
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Description: When I use Ubuntu Command "mtr", it combines the functionality of traceroute and ping, continuously probing network hops and providing real-time statistics about packet loss and latency, offering comprehensive network diagnostics and monitoring capabilities.



The screenshot shows a terminal window titled "student@312-02: ~/Desktop". The window contains the output of the "mtr" command. The title bar has standard window controls (minimize, maximize, close) on the right. The terminal content is as follows:

```
My traceroute [v0.95]
312-02 (127.0.0.1) -> localhost (127.0.0.1) 2024-02-09T12:00:55+0530
Keys: Help Display mode Restart statistics Order of fields
quit
          Packets                      Pings
Host      Loss%     Snt    Last     Avg   Best  Wrst StDev
1. localhost        0.0%     9     0.1    0.1   0.1   0.1   0.0
```