Lab 1: Test Connectivity

Tasks:

1. Ping your gateway and observe TTL value.

```
root@ip-172-31-6-44:/home/ubuntu# ip route
default via 172.31.0.1 dev ens5 proto dhcp src 172.31.6.44 metric 100
172.31.0.0/20 dev ens5 proto kernel scope link src 172.31.6.44 metric 100
172.31.0.1 dev ens5 proto dhcp scope link src 172.31.6.44 metric 100
172.31.0.2 dev ens5 proto dhcp scope link src 172.31.6.44 metric 100
root@ip-172-31-6-44:/home/ubuntu#
```

```
root@ip-172-31-6-44:/home/ubuntu# ping 172.31.0.1
PING 172.31.0.1 (172.31.0.1) 56(84) bytes of data.
64 bytes from 172.31.0.1: icmp_seq=1 ttl=64 time=0.057 ms
64 bytes from 172.31.0.1: icmp_seq=2 ttl=64 time=0.171 ms
64 bytes from 172.31.0.1: icmp_seq=3 ttl=64 time=0.074 ms
64 bytes from 172.31.0.1: icmp_seq=4 ttl=64 time=0.066 ms
64 bytes from 172.31.0.1: icmp_seq=5 ttl=64 time=0.084 ms
64 bytes from 172.31.0.1: icmp_seq=6 ttl=64 time=0.088 ms
^C
--- 172.31.0.1 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5119ms
rtt min/avg/max/mdev = 0.057/0.090/0.171/0.037 ms
root@ip-172-31-6-44:/home/ubuntu#
```

2. Ping a public server like 8.8.8.8 (Google DNS).

```
root@ip-172-31-6-44:/home/ubuntu# ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=113 time=1.25 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=113 time=1.28 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=113 time=1.38 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=113 time=1.31 ms
64 bytes from 8.8.8.8: icmp_seq=5 ttl=113 time=1.30 ms
64 bytes from 8.8.8.8: icmp_seq=6 ttl=113 time=1.32 ms
64 bytes from 8.8.8.8: icmp_seq=7 ttl=113 time=1.37 ms
^C
--- 8.8.8.8 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6009ms
rtt min/avg/max/mdev = 1.253/1.315/1.383/0.042 ms
```

3. Ping a domain name (e.g., google.com) — does DNS resolution work?
   Commands Hint:
   ping <ip>, ping <domain>

```
root@ip-172-31-6-44:/home/ubuntu# ping google.com
PING google.com (142.251.111.139) 56(84) bytes of data.
64 bytes from bk-in-f139.1e100.net (142.251.111.139): icmp_seq=1 ttl=101 time=2.09 ms
64 bytes from bk-in-f139.1e100.net (142.251.111.139): icmp_seq=2 ttl=101 time=2.12 ms
64 bytes from bk-in-f139.1e100.net (142.251.111.139): icmp_seq=3 ttl=101 time=2.09 ms
64 bytes from bk-in-f139.1e100.net (142.251.111.139): icmp_seq=4 ttl=101 time=2.08 ms
64 bytes from bk-in-f139.1e100.net (142.251.111.139): icmp_seq=5 ttl=101 time=2.15 ms
```

Lab 2: Essential Networking Commands

Objective: Use diagnostic tools.
Tasks:

- Display your network interfaces with ifconfig or ip a.

```
root@ip-172-31-6-44:/home/ubuntu# 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
       valid_lft forever preferred_lft forever
2: ens5: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 9001 qdisc mq state UP group default qlen 1000
    link/ether 02:41:e9:9a:d5:6b brd ff:ff:ff:ff:ff:ff
    altname enp0s5
    inet 172.31.6.44/20 metric 100 brd 172.31.15.255 scope global dynamic ens5
       valid_lft 2754sec preferred_lft 2754sec
    inet6 fe80::41:e9ff:fe9a:d56b/64 scope link
       valid_lft forever preferred_lft forever
root@ip-172-31-6-44:/home/ubuntu#
```

- Trace the route to google.com using traceroute.

```
root@ip-172-31-6-44:/home/ubuntu# traceroute google.com
traceroute to google.com (172.253.115.101), 64 hops max
  1   240.3.180.79  1.564ms  1.534ms  1.560ms
  2   99.82.14.178  1.284ms  1.255ms  1.151ms
  3   99.82.14.179  1.455ms  1.351ms  1.376ms
  4   216.239.40.107  1.462ms  1.354ms  1.302ms
  5   192.178.243.2  1.589ms  1.591ms  1.552ms
  6   142.251.49.19  14.633ms  8.347ms  1.567ms
```

- Show ARP table and analyze entries.

```
root@ip-172-31-6-44:/home/ubuntu# arp -n
Address                  HWtype  HWaddress           Flags Mask            Iface
172.31.0.1               ether   02:e2:0a:8a:8b:c9   C                     ens5
172.31.0.2               ether   02:e2:0a:8a:8b:c9   C                     ens5
root@ip-172-31-6-44:/home/ubuntu#
```

- Examine the routing table using route -n.
  Commands: ifconfig, traceroute, arp -n, route -n, ip route

```
root@ip-172-31-6-44:/home/ubuntu# route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         172.31.0.1      0.0.0.0         UG    100    0        0 ens5
172.31.0.0      0.0.0.0         255.255.240.0   U     100    0        0 ens5
172.31.0.1      0.0.0.0         255.255.255.255 UH    100    0        0 ens5
172.31.0.2      0.0.0.0         255.255.255.255 UH    100    0        0 ens5
root@ip-172-31-6-44:/home/ubuntu# ifconfig
ens5: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 9001
        inet 172.31.6.44  netmask 255.255.240.0  broadcast 172.31.15.255
        inet6 fe80::41:e9ff:fe9a:d56b  prefixlen 64  scopeid 0x20<link>
        ether 02:41:e9:9a:d5:6b  txqueuelen 1000  (Ethernet)
        RX packets 32026  bytes 45136082 (45.1 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 2796  bytes 354716 (354.7 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

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)
```

Lab 3: DNS and Name Resolution

Objective: Investigate how DNS works.
Tasks:

- Use nslookup or dig to resolve www.github.com.

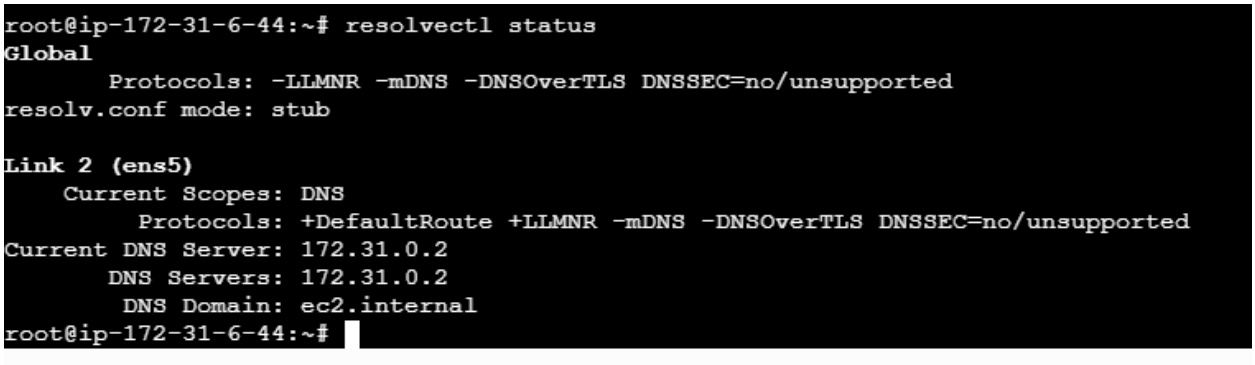
```
root@ip-172-31-6-44:/home/ubuntu# nslookup www.github.com
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
www.github.com  canonical name = github.com.
Name:   github.com
Address: 140.82.112.4

root@ip-172-31-6-44:/home/ubuntu#
```

Obtain information about Domain Names

- Identify the IP address of your DNS server.



- Flush and recheck DNS cache.

- Explain difference between recursive and iterative DNS queries.
  Commands: dig, nslookup, cat /etc/resolv.conf

Recursive	Iterative
Client expects final answer	Client follows referrals
Used by browsers	Used by DNS servers
Example: EC2 → Route53	Root → TLD → Authoritative

Lab 4: Use Traceroute

Tasks:

1. Run a traceroute to google.com.

```
root@ip-172-31-6-44:~# traceroute google.com
traceroute to google.com (142.251.111.138), 64 hops max
  1   100.100.32.28  1.285ms  0.838ms  1.565ms
  2   240.0.184.33  1.139ms  1.089ms  1.675ms
  3   100.100.2.32  6.163ms  40.847ms  13.401ms
```

2. How many hops are there?

   3

3. Identify which hop belongs to your ISP.
   Commands Hint:
   traceroute google.com


```
root@ip-172-31-6-44:~# traceroute google.com
traceroute to google.com (142.251.111.138), 64 hops max
  1   100.100.32.28  1.285ms  0.838ms  1.565ms
  2   240.0.184.33  1.139ms  1.089ms  1.675ms
  3   100.100.2.32  6.163ms  40.847ms  13.401ms
```


Lab 5: Check Host Reachability with telnet/nc

Tasks:

1. Check if port 80 on a server is reachable.

```
root@ip-172-31-6-44:~# nc -zv google.com 80
Connection to google.com (64.233.180.139) 80 port [tcp/http] succeeded!
root@ip-172-31-6-44:~#
```

2. Check SSH port 22 connectivity.

```
root@ip-172-31-6-44:~# nc -zv 172.31.6.44 22
Connection to 172.31.6.44 22 port [tcp/ssh] succeeded!
root@ip-172-31-6-44:~#
```

3. Test a closed port and observe behavior.
   Commands Hint:
   telnet <ip> <port> or nc -zv <ip> <port>

```
root@ip-172-31-6-44:~# nc -zv google.com 81
nc: connect to google.com (192.178.218.101) port 81 (tcp) failed: Connection timed out
```

Lab 6: Default Gateway & Routing Table

Tasks:

1. Display your routing table.

```
root@ip-172-31-6-44:~# ip route show
default via 172.31.0.1 dev ens5 proto dhcp src 172.31.6.44 metric 100
172.31.0.0/20 dev ens5 proto kernel scope link src 172.31.6.44 metric 100
172.31.0.1 dev ens5 proto dhcp scope link src 172.31.6.44 metric 100
172.31.0.2 dev ens5 proto dhcp scope link src 172.31.6.44 metric 100
root@ip-172-31-6-44:~#
```

2. Add a temporary static route to another network.

```
root@ip-172-31-6-44:~# sudo ip route add 10.10.10.0/24 via 172.31.0.1
root@ip-172-31-6-44:~#
```

3. Delete that static route.
   Commands Hint:
   ip route show,

ip route add,
ip route del

```
root@ip-172-31-6-44:~# sudo ip route del 10.10.10.0/24
root@ip-172-31-6-44:~#
```

Lab 7: Network Security and Attack Simulation

Objective: Identify and defend against common attacks.
Tasks:

- Simulate a simple ping flood using ping -f (in a safe, local test).

```
root@ip-172-31-6-44:~# ping -f 127.0.0.1
```

- Use netstat to detect unusual open connections.

```
root@ip-172-31-6-44:~# netstat -tulnp
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
tcp        0      0 0.0.0.0:22              0.0.0.0:*               LISTEN      614/sshd: /usr/sbin
tcp        0      0 127.0.0.53:53           0.0.0.0:*               LISTEN      345/systemd-resolve
tcp6       0      0 :::22                   :::*                    LISTEN      614/sshd: /usr/sbin
udp        0      0 127.0.0.1:323           0.0.0.0:*                           447/chronyd
udp        0      0 127.0.0.53:53           0.0.0.0:*                           345/systemd-resolve
udp        0      0 172.31.6.44:68          0.0.0.0:*                           343/systemd-network
udp6       0      0 ::1:323                 :::*                                447/chronyd
root@ip-172-31-6-44:~#
```

- Discuss mitigation techniques for DDoS and Man-in-the-Middle attacks.

  DDoS:

  AWS Shield

  WAF

  Rate limiting

Auto Scaling

MITM:

HTTPS / TLS

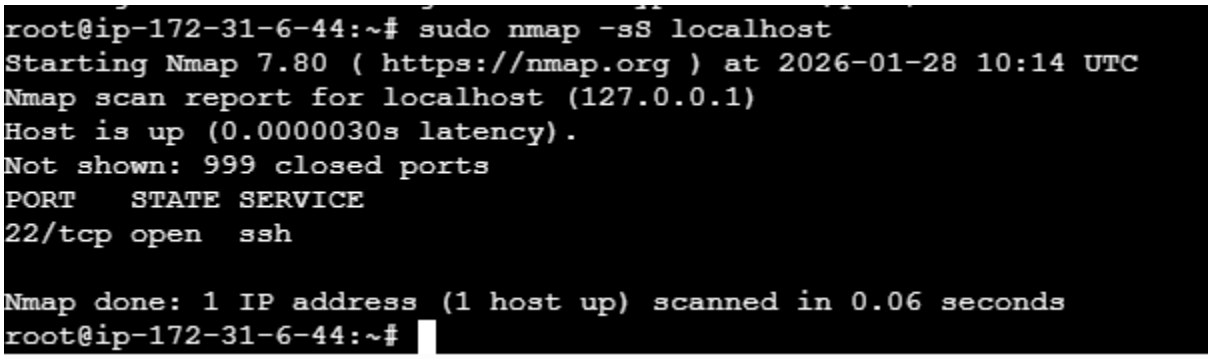
Certificate pinning

VPN

ARP inspection

- Identify open ports and services using nmap.
  Commands: ping, netstat -tulnp, nmap -sS localhost

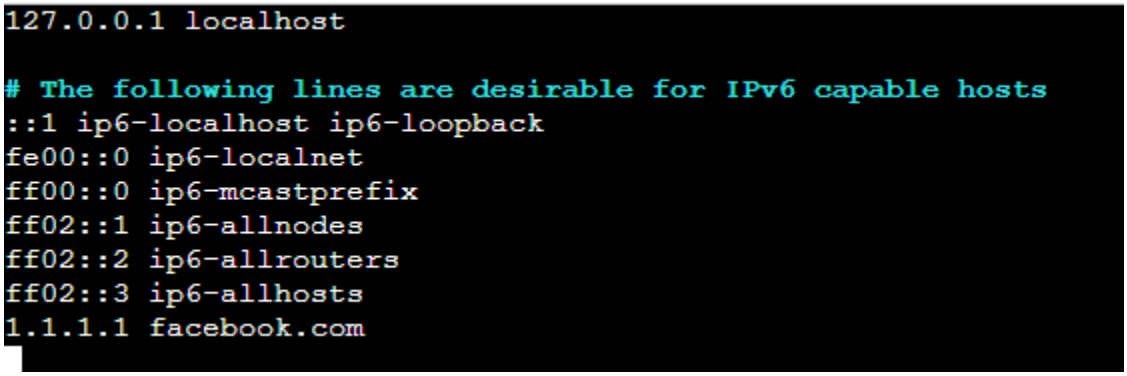
  Scan Open Ports



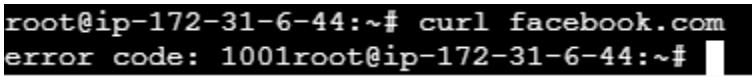
Lab 8: Hosts File Resolution Priority

Tasks:

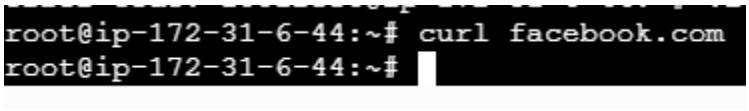
1. Add a fake entry for facebook.com in /etc/hosts.



2. Curl to see if it resolves to your fake IP.



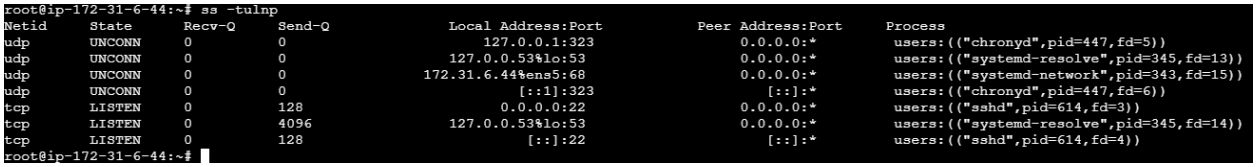
3. Remove the entry and test again.



Lab 9: Understand Ports, Services & Firewall Rules

Tasks:

1. List which services are listening on your machine.



2. Identify which ports are open for TCP and UDP.

```
root@ip-172-31-6-44:~# sudo nmap -sS -sU localhost
Starting Nmap 7.80 ( https://nmap.org ) at 2026-01-28 10:25 UTC
Nmap scan report for localhost (127.0.0.1)
Host is up (0.0000040s latency).
Not shown: 1999 closed ports
PORT   STATE SERVICE
22/tcp open  ssh

Nmap done: 1 IP address (1 host up) scanned in 0.10 seconds
root@ip-172-31-6-44:~#
```

3. Enable or disable a port using ufw (Ubuntu firewall).

```
root@ip-172-31-6-44:~# sudo ufw allow 80
Rule added
Rule added (v6)
root@ip-172-31-6-44:~# sudo ufw deny 22
Rule added
Rule added (v6)
root@ip-172-31-6-44:~#
```

4. Verify whether a port is reachable using nc or telnet.

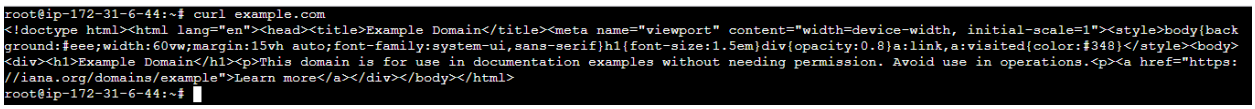
```
root@ip-172-31-6-44:~# nc -zv localhost 80
Connection to localhost (127.0.0.1) 80 port [tcp/http] succeeded!
root@ip-172-31-6-44:~#
```

Error	Meaning
Connection refused	No service
Connection timed out	Firewall drop

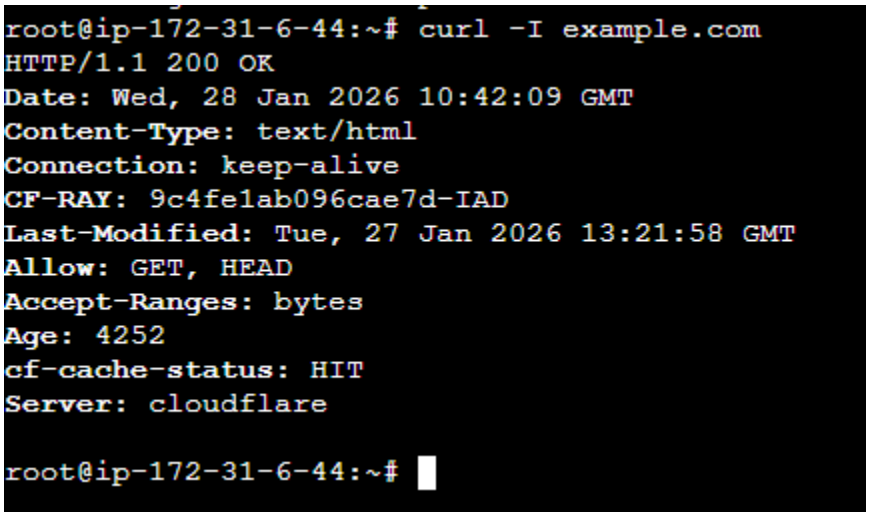
Lab 11: HTTP Requests & Web Debugging

Tasks:

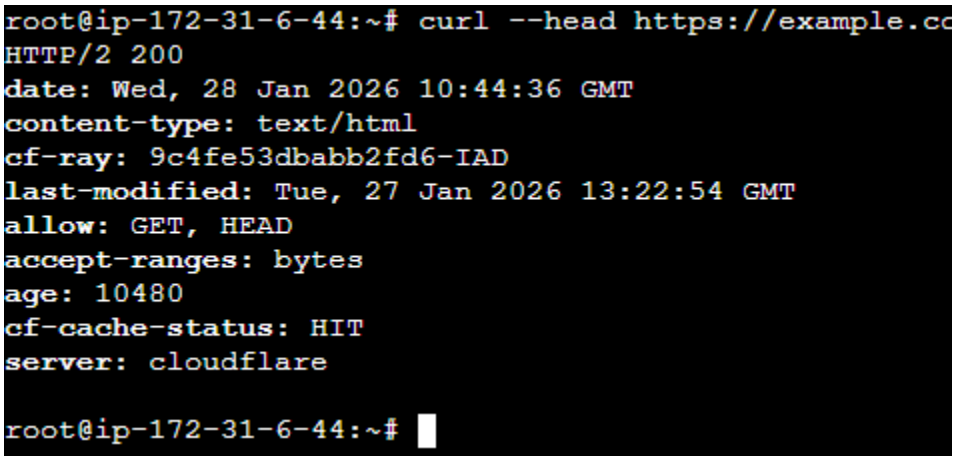
1. Use curl to fetch the homepage of a website (e.g., example.com).



2. View only HTTP response headers.



3. Send a HEAD request to check server details.



4. Test an HTTPS endpoint and observe certificate details

```
root@ip-172-31-6-44:~# curl -v https://google.com
*   Trying 142.251.167.139:443...
* Connected to google.com (142.251.167.139) port 443 (#0)
* ALPN, offering h2
* ALPN, offering http/1.1
*  CAfile: /etc/ssl/certs/ca-certificates.crt
*  CApath: /etc/ssl/certs
* TLSv1.0 (OUT), TLS header, Certificate Status (22):
* TLSv1.3 (OUT), TLS handshake, Client hello (1):
* TLSv1.2 (IN), TLS header, Certificate Status (22):
* TLSv1.3 (IN), TLS handshake, Server hello (2):
* TLSv1.2 (IN), TLS header, Finished (20):
* TLSv1.2 (IN), TLS header, Supplemental data (23):
* TLSv1.3 (IN), TLS handshake, Encrypted Extensions (8):
* TLSv1.3 (IN), TLS handshake, Certificate (11):
* TLSv1.3 (IN), TLS handshake, CERT verify (15):
* TLSv1.3 (IN), TLS handshake, Finished (20):
* TLSv1.2 (OUT), TLS header, Finished (20):
```