Assignment 1

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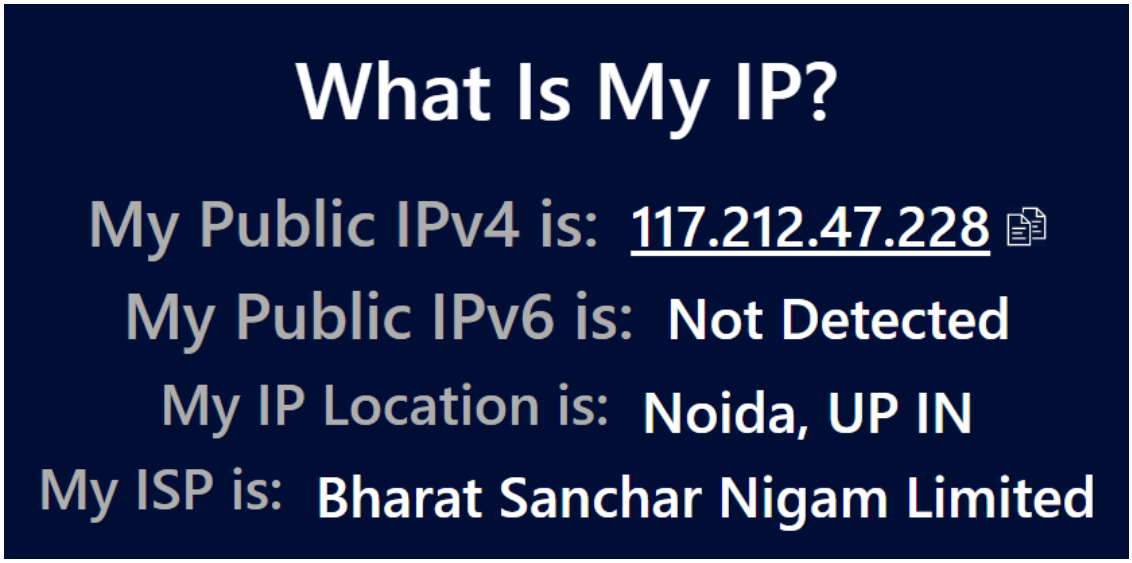
1) a)

```
shubham21099@shubham21099-VirtualBox:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
        inet6 fe80::117:7234:db0c:3131  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:e9:aa:95  txqueuelen 1000  (Ethernet)
        RX packets 11179  bytes 15957721 (15.9 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 3570  bytes 283377 (283.3 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)
        RX packets 213  bytes 23207 (23.2 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 213  bytes 23207 (23.2 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

enp0s3 is the default network interface hence IP Address of my network interface is **10.0.2.15**

1) b)



According to the https://www.whatismyip.com/ my IP address is **117.212.47.228**
This is different from the IP address displayed by the ifconfig command because ifconfig shows the local IP address, and that website displays the global IP address which is used to access the internet, and this IP address is provided by my ISP.

2) **a)** To get an authoritative result, we need to specify the authoritative name server as part of the request.

To get this, we include **-type=soa** switch, which provides us with the origin URL then we use that origin URL to get an authoritative result.

```
shubham21099@shubham21099-VirtualBox:~$ nslookup -type=soa google.in
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
google.in
        origin = ns1.google.com
        mail addr = dns-admin.google.com
        serial = 556730683
        refresh = 900
        retry = 900
        expire = 1800
        minimum = 60

Authoritative answers can be found from:
google.in       nameserver = ns2.google.com.
google.in       nameserver = ns1.google.com.
google.in       nameserver = ns3.google.com.
google.in       nameserver = ns4.google.com.
```

```
shubham21099@shubham21099-VirtualBox:~$ nslookup google.in ns1.google.com
Server:         ns1.google.com
Address:        216.239.32.10#53

Name:   google.in
Address: 216.58.196.100
Name:   google.in
Address: 2404:6800:4002:810::2004
```

2) **b)** TTL for IPv4 is 200 seconds.

TTL for IPv6 is 160 seconds.

So, the entry will expire in 200 seconds from local DNS server.

```
shubham21099@shubham21099-VirtualBox:~$ nslookup -debug google.com
Server:         127.0.0.53
Address:        127.0.0.53#53

------------
    QUESTIONS:
        google.com, type = A, class = IN
    ANSWERS:
    ->  google.com
        internet address = 142.250.192.206
        ttl = 200
    AUTHORITY RECORDS:
    ADDITIONAL RECORDS:
------------
Non-authoritative answer:
Name:   google.com
Address: 142.250.192.206
------------
    QUESTIONS:
        google.com, type = AAAA, class = IN
    ANSWERS:
    ->  google.com
        has AAAA address 2404:6800:4002:817::200e
        ttl = 160
    AUTHORITY RECORDS:
    ADDITIONAL RECORDS:
------------
Name:   google.com
Address: 2404:6800:4002:817::200e
```

3) **a)** Used **tracert** command on Windows machine

```
PS C:\Users\shubh> tracert google.in

Tracing route to google.in [142.250.192.228]
over a maximum of 30 hops:

  1     2 ms     3 ms     3 ms  192.168.1.1
  2     9 ms     8 ms     9 ms  117.212.40.1
  3    12 ms     8 ms     8 ms  117.212.40.1
  4    11 ms    11 ms    18 ms  218.248.107.38
  5     *        *        *     Request timed out.
  6    12 ms    12 ms    11 ms  142.250.172.220
  7    12 ms    12 ms    13 ms  72.14.234.225
  8    11 ms    12 ms    12 ms  142.251.54.65
  9    12 ms    12 ms    13 ms  del11s13-in-f4.1e100.net [142.250.192.228]

Trace complete.
```

Here, I see **9 intermediate hosts.**
As traceroute command send 3 packets to the hop, and each of the time refers to the round trip time taken by the packet to reach the hop. So, to calculate the average latency for each hop, we have to add the time of packets and divide by 3.

IP Addresses	**Average Latency (T1 + T2 + T3) / 3**
192.168.1.1	2.66
117.212.40.1	8.66
117.212.40.1	9.33
218.248.107.38	13.33
142.250.172.220	11.66
72.14.234.225	12.33
142.251.54.65	11.66
142.250.192.228	12.33

3) b) Average Latency = 38.650 ms

```
shubham21099@shubham21099-VirtualBox:~$ ping -c 50 google.in
PING google.in (142.250.193.100) 56(84) bytes of data.
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=1 ttl=114 time=43.3 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=2 ttl=114 time=38.2 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=3 ttl=114 time=39.2 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=4 ttl=114 time=38.8 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=5 ttl=114 time=38.2 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=6 ttl=114 time=38.6 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=7 ttl=114 time=38.2 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=8 ttl=114 time=38.7 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=9 ttl=114 time=38.2 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=10 ttl=114 time=38.5 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=11 ttl=114 time=38.3 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=12 ttl=114 time=41.6 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=13 ttl=114 time=39.4 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=14 ttl=114 time=38.3 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=15 ttl=114 time=38.2 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=16 ttl=114 time=39.1 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=17 ttl=114 time=39.1 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=18 ttl=114 time=38.3 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=19 ttl=114 time=37.7 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=20 ttl=114 time=38.0 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=21 ttl=114 time=38.1 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=22 ttl=114 time=38.3 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=23 ttl=114 time=39.3 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=24 ttl=114 time=38.2 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=25 ttl=114 time=38.8 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=26 ttl=114 time=37.8 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=27 ttl=114 time=38.4 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=28 ttl=114 time=38.3 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=29 ttl=114 time=38.2 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=30 ttl=114 time=38.9 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=31 ttl=114 time=38.6 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=32 ttl=114 time=37.7 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=33 ttl=114 time=38.6 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=34 ttl=114 time=39.0 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=35 ttl=114 time=38.6 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=36 ttl=114 time=38.4 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=37 ttl=114 time=39.1 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=38 ttl=114 time=38.5 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=39 ttl=114 time=38.5 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=40 ttl=114 time=37.7 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=41 ttl=114 time=38.0 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=42 ttl=114 time=38.6 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=43 ttl=114 time=38.8 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=44 ttl=114 time=39.0 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=45 ttl=114 time=38.5 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=46 ttl=114 time=38.9 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=47 ttl=114 time=38.7 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=48 ttl=114 time=39.0 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=49 ttl=114 time=37.9 ms
64 bytes from maa05s24-in-f4.1e100.net (142.250.193.100): icmp_seq=50 ttl=114 time=38.4 ms

--- google.in ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49563ms
rtt min/avg/max/mdev = 37.693/38.650/43.319/0.894 ms
```

3) c) No, the sum of the average latencies of part(a) is much greater than the average latency of part(b).
It is because traceroute measures the latency at each hop along the path to the destination, while ping measures the round-trip time directly between the source and the destination.

3) d) In part(a), the maximum ping latency is 13.33, which is much smaller than the average ping latency of part(b); hence, they are not matching.
It is because the traceroute command provides hop-to-hop ping latency while ping gives us the average round trip time to the destination.

3) e) As the traceroute command will send packets with some with increasing TTL, and each hop along the path to the destination decrements the TTL value, and when the TTL reaches zero, the hop sends back an ICMP "Time Exceeded" message to the source. Then, the source will again send some packets with increased TTL, and now the packet is forwarded from that hop to the next hop, so this will result in multiple entries for a single hop.

3) f) Average Latency = 258.829 ms

```
shubham21099@shubham21099-VirtualBox:~$ ping -c 50 stanford.edu
PING stanford.edu (171.67.215.200) 56(84) bytes of data.
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=1 ttl=242 time=269 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=2 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=3 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=4 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=5 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=6 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=7 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=8 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=9 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=10 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=11 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=12 ttl=242 time=260 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=13 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=14 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=15 ttl=242 time=260 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=16 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=17 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=18 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=19 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=20 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=21 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=22 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=23 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=24 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=25 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=26 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=27 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=28 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=29 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=30 ttl=242 time=257 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=31 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=32 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=33 ttl=242 time=257 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=34 ttl=242 time=260 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=35 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=36 ttl=242 time=260 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=37 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=38 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=39 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=40 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=41 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=42 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=43 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=44 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=45 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=46 ttl=242 time=259 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=47 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=48 ttl=242 time=258 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=49 ttl=242 time=257 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=50 ttl=242 time=258 ms

--- stanford.edu ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 54082ms
rtt min/avg/max/mdev = 256.909/258.829/269.158/1.623 ms
```

3) g) No. of Hops in google.in = **9**

No. of Hops in stanford.edu = **15**

```
C:\Users\shubh>tracert stanford.edu

Tracing route to stanford.edu [171.67.215.200]
over a maximum of 30 hops:

  1     1 ms     1 ms     1 ms  192.168.1.1
  2     6 ms     8 ms     8 ms  117.212.40.1
  3     6 ms     8 ms     8 ms  117.212.40.1
  4    11 ms    10 ms    11 ms  218.248.107.38
  5     *        *        *     Request timed out.
  6    15 ms    13 ms    18 ms  nsg-corporate-105.89.186.122.airtel.in [122.186.89.105]
  7   252 ms   252 ms   252 ms  116.119.44.134
  8     *      252 ms     *     port-channel11.core3.lax2.he.net [64.62.148.113]
  9   252 ms   257 ms   253 ms  port-channel8.core2.lax1.he.net [184.104.197.109]
 10     *        *        *     Request timed out.
 11     *      255 ms     *     eqix-sv8.hurricaneelectric.com [198.32.176.20]
 12   255 ms   255 ms   255 ms  stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
 13   260 ms   259 ms   260 ms  woa-west-rtr-vl2.SUNet [171.64.255.132]
 14     *        *        *     Request timed out.
 15   255 ms   254 ms   254 ms  web.stanford.edu [171.67.215.200]

Trace complete.
```

3) h) Average latency of google.in is much lower than stanford.edu it is because Google has multiple data centers distributed around the globe, which reduces latency for users, while stanford.edu is an educational institute's website it will not have that much data centers that's why users will face high latency rate because data centers are located far away.

4) To get 100% packet for ping 127.0.0.1 we have to shut down our loopback interface because it will be responsible for sending acknowledgements to 127.0.0.1.

To shut down, we simply have to run the below command:

sudo ifconfig lo down

```
shubham21099@shubham21099-VirtualBox:~$ sudo ifconfig lo down
[sudo] password for shubham21099:
shubham21099@shubham21099-VirtualBox:~$ ping 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
^C
--- 127.0.0.1 ping statistics ---
11 packets transmitted, 0 received, 100% packet loss, time 10246ms
```

5)

```
shubham21099@shubham21099-VirtualBox:~$ telnet 192.168.24.12 9900
Trying 192.168.24.12...
Connected to 192.168.24.12.
Escape character is '^]'.
GET /secret HTTP/1.1
Host: 192.168.24.12

HTTP/1.1 200 OK
Content-Type: text/plain
ip: 192.168.1.99
X-secret: U2FsdGVkX18/5sx5xfrs8Tlr9nyPIM+MCYAMWBYKxjMBFhh6ifEi4cu0SFwFT8Ow
Date: Tue, 22 Aug 2023 13:07:26 GMT
Connection: keep-alive
Keep-Alive: timeout=5
Content-Length: 8

Success
quit
HTTP/1.1 400 Bad Request
Connection: close

Connection closed by foreign host.
```

6)

```
shubham21099@shubham21099-VirtualBox:~$ telnet 192.168.24.12 smtp
Trying 192.168.24.12...
Connected to 192.168.24.12.
Escape character is '^]'.
220 Welcome to CSE232 Mail Server
helo cse232.com
250 xeon01-rs-iiitd.iiitd.edu.in
MAIL FROM: 21099@cse232.com
250 2.1.0 Ok
RCPT TO: 21002@cse232.com
250 2.1.5 Ok
DATA
354 End data with <CR><LF>.<CR><LF>
to: 21002@cse232.com
from: 21099@cse232.com
Subject: CN Assignment 1 Question 6 Testing
Testing Done
.
250 2.0.0 Ok: queued as 5A6936F643A5
quit
221 2.0.0 Bye
Connection closed by foreign host.
```

```
From 21099@cse232.com  Tue Aug 22 19:06:59 2023
Return-Path: <21099@cse232.com>
X-Original-To: 21002@cse232.com
Delivered-To: 21002@cse232.com
Received: from cse232.com (auth.iiitd.edu.in [192.168.1.99])
        by xeon01-rs-iiitd.iiitd.edu.in (Postfix) with SMTP id 5A6936F643A5
        for <21002@cse232.com>; Tue, 22 Aug 2023 19:04:33 +0530 (IST)
to: 21002@cse232.com
from: 21099@cse232.com
Subject: CN Assignment 1 Question 6 Testing

Testing Done
```