

# Computer Networks

## CSE 232: Programming Assignment-1

- 1.) a) **'ifconfig'** is used to configure and manage network interfaces. It can be used to assign an IP address and netmask to a specific network interface.

```
molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.29.206.176 netmask 255.255.240.0 broadcast 172.29.207.255
    inet6 fe80::215:5dff:fed0:7c4a prefixlen 64 scopeid 0x20<link>
    ether 00:15:5d:d0:7c:4a txqueuelen 1000 (Ethernet)
    RX packets 344 bytes 321563 (321.5 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 156 bytes 12944 (12.9 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 16 bytes 1731 (1.7 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 16 bytes 1731 (1.7 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

'eth0' represents the IPv4 address assigned to my device on the network. **inet '172.29.206.176'** is the IPv4 address of my device network.

- b) While searching the webpage I got this IPv4 address '**103.25.231.125**' and it is the public IP address which is the address visible to the outside world when we connect to the internet. This is different from the internal (private) IP address that my device has on the local network.

## 2.) Changing the IP address of the device network interface 'eth0'.

```
molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ sudo ifconfig eth0 192.168.1.100 netmask 255.255.240.0
molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.1.100 netmask 255.255.240.0 broadcast 192.168.15.255
    inet6 fe80::215:5dff:fe97:616b prefixlen 64 scopeid 0x20<link>
    ether 00:15:5d:97:61:6b txqueuelen 1000 (Ethernet)
    RX packets 421 bytes 364158 (364.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 201 bytes 29902 (29.9 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

## Reverting back to the original.

```
molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ sudo ifconfig eth0 172.29.206.176 netmask 255.255.240.0
molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.29.206.176 netmask 255.255.240.0 broadcast 172.29.207.255
    inet6 fe80::215:5dff:fe97:616b prefixlen 64 scopeid 0x20<link>
    ether 00:15:5d:97:61:6b txqueuelen 1000 (Ethernet)
    RX packets 429 bytes 365894 (365.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 207 bytes 30342 (30.3 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

## 3.) a) Setting up the TCP client-server and checking the network establishment.

```
molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ nc -l -p 12345
hi
helloo
wassup
```

## Connecting using localhost.

```
molu27@DESKTOP-AI36E3V:/mnt/c/Users/mauli$ nc localhost 12345
hi
helloo
wassup
```

## b) The TCP client-server is showing the TIME\_WAIT state.

```
molu27@DESKTOP-AI36E3V:/mnt/c/Users/mauli$ netstat -t
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 localhost:52010         localhost:12345         TIME_WAIT
```

- 4.) a) To find an authoritative result for 'google. in' I just looked up the IP address through the domain name and did the reverse lookup for through the obtained IP address that was '142.250.182.164'.

```
molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ nslookup google.in
Server:          10.255.255.254
Address:         10.255.255.254#53

Non-authoritative answer:
Name:   google.in
Address: 142.250.182.164
Name:   google.in
Address: 2404:6800:4002:80a::2004

molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ nslookup 142.250.182.164
164.182.250.142.in-addr.arpa    name = del11s10-in-f4.1e100.net.

Authoritative answers can be found from:
250.142.in-addr.arpa    nameserver = ns4.google.com.
250.142.in-addr.arpa    nameserver = ns2.google.com.
250.142.in-addr.arpa    nameserver = ns1.google.com.
250.142.in-addr.arpa    nameserver = ns3.google.com.
ns1.google.com    internet address = 216.239.32.10
ns2.google.com    internet address = 216.239.34.10
ns3.google.com    internet address = 216.239.36.10
ns4.google.com    internet address = 216.239.38.10
ns1.google.com    has AAAA address 2001:4860:4802:32::a
ns2.google.com    has AAAA address 2001:4860:4802:34::a
ns3.google.com    has AAAA address 2001:4860:4802:36::a
ns4.google.com    has AAAA address 2001:4860:4802:38::a
```

b)

```
molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ nslookup -debug iiitd.ac.in
Server:          10.255.255.254
Address:         10.255.255.254#53

-----
      QUESTIONS:
        iiitd.ac.in, type = A, class = IN
      ANSWERS:
        -> iiitd.ac.in
            internet address = 103.25.231.30
            ttl = 74628
      AUTHORITY RECORDS:
      ADDITIONAL RECORDS:
-----

Non-authoritative answer:
Name:   iiitd.ac.in
Address: 103.25.231.30
-----

      QUESTIONS:
        iiitd.ac.in, type = AAAA, class = IN
      ANSWERS:
      AUTHORITY RECORDS:
        -> iiitd.ac.in
            origin = ns1.iiitd.edu.in
            mail addr = admin-it.iiitd.ac.in
            serial = 2014013342
            refresh = 86400
            retry = 7200
            expire = 3600000
            minimum = 86400
            ttl = 84690
      ADDITIONAL RECORDS:
-----
```

- **A Record for iiitd.ac.in:** This record, which points to the IPv4 address 103.25.231.30, will expire from the local DNS cache given the TTL after 74628 seconds **approximately 20 hours and 43 minutes**.
- **SOA Record for iiitd.ac.in:** This record, which includes administrative details for the domain, will expire given the TTL 84690 seconds after **approximately 23 hours and 31 minutes**.

5.) a)

```
molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ traceroute google.in
traceroute to google.in (142.250.193.4), 30 hops max, 60 byte packets
 1  DESKTOP-AI36E3V.mshome.net (172.29.192.1)  0.937 ms  0.700 ms  0.693 ms
 2  192.168.32.254 (192.168.32.254)  32.810 ms  32.802 ms  32.796 ms
 3  vpn.iiitd.edu.in (192.168.1.99)  2.978 ms  2.918 ms  2.958 ms
 4  103.25.231.1 (103.25.231.1)  3.346 ms  3.339 ms  3.309 ms
 5  * * *
 6  10.119.234.162 (10.119.234.162)  8.715 ms  13.448 ms  15.862 ms
 7  72.14.194.160 (72.14.194.160)  6.224 ms  72.14.195.56 (72.14.195.56)  18.045 ms  72.14.194.160 (72.14.194.160)  5.984 ms
 8  142.251.54.111 (142.251.54.111)  27.254 ms  192.178.80.159 (192.178.80.159)  31.335 ms  142.251.54.111 (142.251.54.111)  26.799 ms
 9  142.251.54.87 (142.251.54.87)  27.299 ms  142.251.54.89 (142.251.54.89)  29.593 ms  32.993 ms
10  del11s14-in-f4.1e100.net (142.250.193.4)  34.842 ms  33.207 ms  30.323 ms
```

The number of intermediate hosts and their IP addresses are as follows:

- Host 1: DESKTOP-AI36E3V.mshome.net (IP: 172.29.192.1). **Latency**=0.777 ms
- Host 2: 192.168.32.254 (IP: 192.168.32.254). **Latency**=32.803 ms
- Host 3: vpn.iiitd.edu.in (IP: 192.168.1.99). **Latency**=2.951 ms
- Host 4: 103.25.231.1 (IP: 103.25.231.1). **Latency**= 3.331 ms
- Host 5: \* (IP: \*\*\*) - This host is not visible.
- Host 6: 10.119.234.162 (IP: 10.119.234.162). **Latency**= 12.008 ms
- Host 7: 72.14.194.160 (IP: 72.14.194.160) or 72.14.195.56 (IP: 72.14.195.56). **Latency**= 10.084 ms
- Host 8: 142.251.54.111 (IP: 142.251.54.111) or 192.178.80.159 (IP: 192.178.80.159). **Latency**= 28.463 ms
- Host 9: 142.251.54.87 (IP: 142.251.54.87) or 142.251.54.89 (IP: 142.251.54.89). **Latency**= 29.962 ms
- Host 10: del11s14-in-f4.1e100.net (IP: 142.250.193.4). **Latency**= 32.791 ms

b)

```
--- google.in ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49091ms
rtt min/avg/max/mdev = 32.083/63.032/207.261/38.712 ms
```

**Average Latency (63.032 ms):** This is the average time it took for a packet to travel from your machine to google.in and back across all 50 attempts.

- c) Total Latency obtained = 153.17 ms  
Avg Latency = 63.032 ms

They are different, and the reason might be different and multiple paths. **Traceroute** and **ping** might be using slightly different paths to reach the destination.

**Network conditions** can vary over time. The traceroute and ping measurements may have been taken at different times, leading to different latency results.

- d) **Maximum Latency from Traceroute:** 32.791 ms  
**Average Latency from Ping:** 63.032 ms

The maximum latency from the traceroute does not match the average latency from the ping command. This discrepancy is due to the different nature of the measurements, the potential for different paths, and varying network conditions. The average latency in the ping command represents the total round-trip time, which naturally will be higher than the latency to any single intermediate host.

- e) Multiple entries for a single hop occur when the router sends back multiple responses to the traceroute probes at that hop. Traceroute sends three packets (by default) for each hop to measure the round-trip time (RTT). If all three packets take different amounts of time to get a response, traceroute will display each of these times as separate entries.

f)

```
--- stanford.edu ping statistics ---  
50 packets transmitted, 50 received, 0% packet loss, time 49073ms  
rtt min/avg/max/mdev = 297.057/358.171/520.273/50.921 ms
```

The **average latency** to stanford.edu is **358.171 ms**. This value represents the average round-trip time it took for the 50 ping packets to travel from my machine to stanford.edu and back.

g)

```
mo1u27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ traceroute stanford.edu
traceroute to stanford.edu (171.67.215.200), 30 hops max, 60 byte packets
 1  DESKTOP-AI36E3V.mshome.net (172.29.192.1)  1.385 ms  1.150 ms  0.931 ms
 2  192.168.32.254 (192.168.32.254)  93.198 ms  92.324 ms  92.029 ms
 3  auth.iiitd.edu.in (192.168.1.99)  15.920 ms  15.897 ms  15.596 ms
 4  103.25.231.1 (103.25.231.1)  13.771 ms  13.552 ms  13.331 ms
 5  10.1.209.201 (10.1.209.201)  45.061 ms  45.036 ms  45.019 ms
 6  10.1.200.137 (10.1.200.137)  45.878 ms  40.738 ms  47.783 ms
 7  10.255.238.122 (10.255.238.122)  47.329 ms  41.056 ms  10.255.238.254 (10.255.238.254)  31.411 ms
 8  180.149.48.18 (180.149.48.18)  40.412 ms  40.375 ms  40.354 ms
 9  * * *
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  campus-nw-rtr-v11004.SUNet (171.64.255.200)  336.211 ms  campus-ial-nets-b-v11120.SUNet (171.66.255.232)  336.116 ms  campus-east-rtr-v11020.SUNet (171.64.255.232)  336.032 ms
25  campus-ial-nets-a-v11020.SUNet (171.64.255.232)  303.635 ms  campus-ial-nets-b-v11104.SUNet (171.66.255.200)  303.547 ms  *
26  web.stanford.edu (171.67.215.200)  303.724 ms  *  411.154 ms
```

The traceroute to `stanford.edu` took significantly more hops (26) compared to `google.in` (10).

h) The difference in latency between `google.in` and `stanford.edu` can be attributed to the following factors:

- More hops usually mean more intermediate routers and switches, each adding some processing delay. The higher the number of hops, the more likely it is that latency will increase due to the cumulative effect of these delays.
- Higher congestion or suboptimal routing through multiple networks can add to the delay.
- The efficiency of the server in processing and responding to requests also affects the round-trip time.

6.)

```
molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ sudo ifconfig lo down
[sudo] password for molu27:
molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.29.206.176 netmask 255.255.240.0 broadcast 172.29.207.255
    inet6 fe80::215:5dff:fee6:1840 prefixlen 64 scopeid 0x20<link>
    ether 00:15:5d:e6:18:40 txqueuelen 1000 (Ethernet)
    RX packets 1653 bytes 744923 (744.9 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 526 bytes 81886 (81.8 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

molu27@DESKTOP-AI36E3V:/mnt/c/Windows/System32$ 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 ---
16 packets transmitted, 0 received, 100% packet loss, time 15603ms
```

First of all, the IP address `127.0.0.1` is called the loopback address and is used by a computer to refer to itself. It is also known as `localhost`. When a server is running on your local PC, it will be accessible at the `127.0.0.1` address.

By bringing down the loopback interface using `ifconfig lo down`, we prevent any packets from being processed by the local system. Since `127.0.0.1` is routed through the loopback interface, disabling it means that any attempt to send packets to `127.0.0.1` will fail.