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# CSE232: Computer Network
# Programming Assignment - 1 Report

**Q1)** a) **ifconfig** command is used to configure the kernel-resident network interfaces. It is used at boot time to set up interfaces as necessary. After that, it is usually only needed when debugging or when system tuning is needed.
Command: ifconfig
The output of ifconfig on my device:

```
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.19.253.105  netmask 255.255.0.0  broadcast 172.19.255.255
        inet6 fe80::215:5dff:fe33:5b4f  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:33:5b:4f  txqueuelen 1000  (Ethernet)
        RX packets 12406  bytes 18430144 (18.4 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1147  bytes 100090 (100.0 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 69  bytes 6952 (6.9 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 69  bytes 6952 (6.9 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

The IP address on my eth0 interface are given below:

- IPv4 address: 172.19.253.105
- IPv6 address: fe80:215:5dff:fe33:5d3a

b) The IP address for my machine on https://www.whatismyip.com website is:

- IPv4 address: 103.25.231.125
- IPv6 address: Not detected

The IP addresses shown in both the cases are **different** because the IPs shown in the ifconfig and the website are private and public IP addresses of the device respectively.

**Q2)** To change the IP address I will be using the sudo ifconfig eth0 <new IP address> command where I will be entering a random IP address which is not currently in use.

- To check if an IP address is currently in use or not I will be using the ping command. If the ping command returns the appropriate output it means that the IP address is not currently in use.
- After changing the IP address to the correct value I will be using the same sudo ifconfig eth0 <new IP address> command to change my IP address back to the original value.

1) Pinging IP address 172.19.253.200 to check if it is currently in use to avoid clashes.
Command: ping 172.19.253.200

```
PING 172.19.253.200 (172.19.253.200) 56(84) bytes of data.
From 172.19.253.105 icmp_seq=1 Destination Host Unreachable
From 172.19.253.105 icmp_seq=2 Destination Host Unreachable
From 172.19.253.105 icmp_seq=3 Destination Host Unreachable
From 172.19.253.105 icmp_seq=4 Destination Host Unreachable
From 172.19.253.105 icmp_seq=5 Destination Host Unreachable
From 172.19.253.105 icmp_seq=6 Destination Host Unreachable
^C
--- 172.19.253.200 ping statistics ---
8 packets transmitted, 0 received, +6 errors, 100% packet loss, time 7241ms
pipe 3
```

As we can see Destination Host Unreachable meaning the IP is not currently in use, so we can use this IP address.

2) Changing the IP address to the new IP address and using the ifconfig command to confirm the change.
Command: sudo ifconfig 172.19.253.200

```
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.19.253.200  netmask 255.255.0.0  broadcast 172.19.255.255
        inet6 fe80::215:5dff:fe33:5b4f  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:33:5b:4f  txqueuelen 1000  (Ethernet)
        RX packets 12410  bytes 18431008 (18.4 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1156  bytes 100468 (100.4 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 77  bytes 7848 (7.8 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 77  bytes 7848 (7.8 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

As we can see the IP address of the system changed to the new IP address.

3) Now to revert the changes in the IP address back to the original IP address. I will be using the same command.
Command: sudo ifconfig eth0 172.19.253.105

```
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.19.253.105  netmask 255.255.0.0  broadcast 172.19.255.255
        inet6 fe80::215:5dff:fe33:5b4f  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:33:5b:4f  txqueuelen 1000  (Ethernet)
        RX packets 12419  bytes 18432335 (18.4 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1156  bytes 100468 (100.4 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 77  bytes 7848 (7.8 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 77  bytes 7848 (7.8 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

**Q3)** a) I will be connecting to localhost as I am not working on a virtual machine.
1) First, I will be setting up the server on my wsl bash terminal session using the following command.
Command: nc -lv -p 8080

2) As I am not on a virtual machine I will be connecting my netcat server to the localhost.
Command: nc -v localhost 8080

```
mann@LAPTOP-7ND0EK69:~$ nc -lv -p 8080
Listening on 0.0.0.0 8080
Connection received on localhost 59658
Hello
Message from Terminal 1
Message from Terminal2
```

```
mann@LAPTOP-7ND0EK69:~$ nc -v localhost 8080
Connection to localhost (127.0.0.1) 8080 port [tcp/http-alt] succeeded!
Hello
Message from Terminal 1
Message from Terminal2
```

b)

```
mann@LAPTOP-7ND0EK69:~$ netstat -an | grep 8080
tcp        0      0 0.0.0.0:8080            0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.1:8080          127.0.0.1:59658         ESTABLISHED
tcp        0      0 127.0.0.1:59658         127.0.0.1:8080          ESTABLISHED
mann@LAPTOP-7ND0EK69:~$
```

The second line represents the **established** connection with the port number 59658 at the client side and the port 8080 at the server side.

**Q4)** To get the authoritative result for the google.in website, I will be using the nslookup command.
Command: nslookup -type=soa google.in

```
mann@LAPTOP-7ND0EK69:~$ nslookup -type=soa google.in
Server:         10.255.255.254
Address:        10.255.255.254#53

Non-authoritative answer:
google.in
        origin = ns1.google.com
        mail addr = dns-admin.google.com
        serial = 668368175
        refresh = 900
        retry = 900
        expire = 1800
        minimum = 60

Authoritative answers can be found from:
ns1.google.com  internet address = 216.239.32.10
ns1.google.com  has AAAA address 2001:4860:4802:32::a
```

**Q5)** a) The output of the traceroute google.in command is given below.

```
mann@LAPTOP-7ND0EK69:~$ traceroute google.in
traceroute to google.in (142.250.193.4), 30 hops max, 60 byte packets
 1  LAPTOP-7ND0EK69.mshome.net (172.19.240.1)  0.530 ms  0.496 ms  0.864 ms
 2  192.168.32.254 (192.168.32.254)  36.433 ms  36.423 ms  36.417 ms
 3  auth.iiitd.edu.in (192.168.1.99)  3.813 ms  3.805 ms  3.777 ms
 4  103.25.231.1 (103.25.231.1)  3.160 ms  4.399 ms  4.392 ms
 5  * * *
 6  10.119.234.162 (10.119.234.162)  7.928 ms  8.441 ms  8.423 ms
 7  72.14.195.56 (72.14.195.56)  8.249 ms 72.14.194.160 (72.14.194.160)  12.737 ms 72.14.195.56 (72.14.195.56)  8.235 ms
 8  142.251.54.111 (142.251.54.111)  27.868 ms 192.178.80.159 (192.178.80.159)  31.623 ms  31.617 ms
 9  142.251.54.89 (142.251.54.89)  27.938 ms  28.322 ms 142.251.54.87 (142.251.54.87)  27.503 ms
10  del11s14-in-f4.1e100.net (142.250.193.4)  30.939 ms  30.932 ms  27.552 ms
mann@LAPTOP-7ND0EK69:~$
```

The different hops that I encountered from the output are given below with their corresponding RTT values being used as latencies for the hops:

1 LAPTOP-7ND0EK69.mshome.net (172.19.240.1)= 0.63ms
2 192.168.32.254 (192.168.32.254)= 36.42ms
3 auth.iiitd.edu.in (192.168.1.99)= 3.80ms
4 103.25.231.1 (103.25.231.1)= 3.98ms
5 * * *
6 10.119.234.162 (10.119.234.162)= 8.26ms
7 72.14.195.56 (72.14.195.56)= 9.74ms
8 142.251.54.111 (142.251.54.111)= 30.37ms
9 142.251.54.89 (142.251.54.89)= 27.92ms
10 del11s14-in-f4.1e100.net (142.250.193.4)= 29.81ms

b) Pasting the screenshot of the whole output will not be feasible so I have pasted the first 6 icmp_seq of the ping command that were issued and I have also pasted the last 4 inmp_seq along with the statistics of the ping command.
Command: ping google.in -c 50

```
mann@LAPTOP-7ND0EK69:~$ ping google.in -c 50
PING google.in (142.250.193.4) 56(84) bytes of data.
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=1 ttl=55 time=45.8 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=2 ttl=55 time=41.3 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=3 ttl=55 time=41.4 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=4 ttl=55 time=58.0 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=5 ttl=55 time=86.7 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=6 ttl=55 time=41.5 ms
```

```
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=47 ttl=55 time=64.1 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=48 ttl=55 time=279 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=49 ttl=55 time=105 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=50 ttl=55 time=64.7 ms

--- google.in ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49083ms
rtt min/avg/max/mdev = 33.639/53.652/279.153/34.544 ms
mann@LAPTOP-7ND0EK69:~$
```

From the statistics section that we received at the end of the ping command the rtt statistics that return to us the data about the round trip time.
From the average rtt time we can say that the average latency for the 50 ping requests is 53.652ms.

c) From the part (a) of the question on adding up the average rtt times for the intermediate hosts we get the total average rtt value of 150.93ms.
From part (b) we know that the rtt average time of the 50 ping requests was found out to be 53.652ms.
We can see that the 2 average rtt values are not matching at all. There can be many reasons for this outcome and different values for each of the 2 commands. One reason can be that the priority given to the forwarding packets might be greater than the tracing packets thus the time taken for the round trip might be lesser for the ping packets as compared to the traceroute packets. Another reason can be that the route given to the packets by the routers might be different for both thus the rtt time might be different for both the cases.

d) The maximum ping latencies in both the cases are given below:
Part a : 36.42ms in hop number 2.
Part b: 279ms in icmp_seq 48

The rtt maximum values are not matching in these cases. The max value for the ping command is far greater than the max rtt value for the traceroute command. The reason for the difference might be that the ping command calculates the latencies for the overall round trip of a packet while the traceroute measures the intermediate latencies at the hops. As in the case of the ping

command the delays due to the overall network congestion and other delays are also included that's why the final destination latency might be a little greater.

e) The reason for the multiple entries in some of the entries of the traceroute command might be that the packet might be taking different routes to reach the destination address given to it. The reason for this might be that the routers have multiple connections to other routers allowing the packets to take multiple alternative paths for reaching the destination.

f)
Command: ping stanford.edu -c 50

```
mann@LAPTOP-7ND0EK69:~$ ping stanford.edu -c 50
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=241 time=293 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=2 ttl=241 time=288 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=3 ttl=241 time=291 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=4 ttl=241 time=289 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=5 ttl=241 time=289 ms
```

```
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=46 ttl=241 time=307 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=47 ttl=241 time=301 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=48 ttl=241 time=301 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=49 ttl=241 time=293 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=50 ttl=241 time=302 ms

--- stanford.edu ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49068ms
rtt min/avg/max/mdev = 287.858/294.337/320.496/7.588 ms
```

The average latency from the above data can be seen as 294.337ms as given in the stanford.edu statistics section of the ping command output.

g) The output of the traceroute command for the stanford.edu website is shown below.

```
mann@LAPTOP-7ND0EK69:~$ traceroute stanford.edu
traceroute to stanford.edu (171.67.215.200), 30 hops max, 60 byte packets
 1  LAPTOP-7ND0EK69.mshome.net (172.19.240.1)  0.604 ms  0.493 ms  0.453 ms
 2  192.168.32.254 (192.168.32.254)  37.371 ms  37.263 ms  37.254 ms
 3  auth.iiitd.edu.in (192.168.1.99)  9.477 ms  8.926 ms  8.890 ms
 4  103.25.231.1 (103.25.231.1)  8.891 ms  24.028 ms  23.937 ms
 5  10.1.209.201 (10.1.209.201)  54.760 ms  54.731 ms  54.697 ms
 6  10.1.200.137 (10.1.200.137)  54.754 ms  53.155 ms  53.127 ms
 7  10.255.238.122 (10.255.238.122)  53.032 ms 10.255.238.254 (10.255.238.254)  46.002 ms  45.926 ms
 8  180.149.48.18 (180.149.48.18)  45.858 ms  45.855 ms  39.888 ms
 9  * * *
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * campus-east-rtr-vl1120.SUNet (171.66.255.232)  289.800 ms
25  * * campus-ial-nets-a-vl1020.SUNet (171.64.255.232)  287.241 ms
26  * * web.stanford.edu (171.67.215.200)  287.947 ms
```

The number of visible hops in the stanford.edu website are 26 according to the terminal output and in the case of the google.in website only 10 hops were visible.

h) The average latency for the google.in website were 53.652ms but when I sent the same number of packets to stanford.edu then I got the average latency equal to 294.337ms. The reason for the difference between the latencies might be because of the different network paths taken by the packets for both these websites. Taking suboptimal paths might be the cause of higher latencies in some of the networks.

**Q6)** Explanation: To make the Ping command fail for the localhost we need to disable the **lo** interface as it is the loopback interface responsible for handling traffic to the 127.0.0.1 IP address. Disabling it effectively cuts off this traffic, causing the ping command to fail when it tries to reach 127.0.0.1 IP address.

Steps:
1) Disabling the **loopback** interface.
Command: sudo ifconfig lo down

```
mann@LAPTOP-7ND0EK69:~$ sudo ifconfig lo down
[sudo] password for mann:
mann@LAPTOP-7ND0EK69:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.19.253.105  netmask 255.255.0.0  broadcast 172.19.255.255
        inet6 fe80::215:5dff:fe33:556d  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:33:55:6d  txqueuelen 1000  (Ethernet)
        RX packets 2091  bytes 276881 (276.8 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 22  bytes 1568 (1.5 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

As we can see in the above image the interface is disabled.

2) Attempting to ping the localhost IP address(127.0.0.1)
Command: ping 127.0.0.1

```
mann@LAPTOP-7ND0EK69:~$ 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 ---
52 packets transmitted, 0 received, 100% packet loss, time 53038ms
```

In the above image we can see the 100% packet loss when attempting to ping the localhost. So, ping command failed for 127.0.0.1 IP address.