CSc 4220/6220 – Fall 2018
Assignment #4 – Network Layer
Deadline: Friday, November 30th 11:59 pm
No late deadline

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1. (20 points) Even though your computer is not a router, it maintains an internet routing table with entries for the network interface network, the loopback network (where client and server are the machine itself), and details of other internal networks. Give the screenshot of the IPv4 routing table of your system using netstat or route command in the command prompt like the one in the below screenshot and describe what each term in it says. Does metric in the output play any important role in making routing decision, if yes then how?

Command Prompt

```
Microsoft Windows [Version 10.0.17134.285]
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C:\Users\dsril>netstat -nr
===========================================================================
Interface List
  5...9c 30 5b 25 00 99 ......Microsoft Wi-Fi Direct Virtual Adapter
 14...9e 30 5b 25 00 99 ......Microsoft Wi-Fi Direct Virtual Adapter #2
 10...00 ff 61 90 6b 1b ......AnchorFree TAP-Windows Adapter V9
  4...9c 30 5b 25 00 99 ......Realtek 8822BE Wireless LAN 802.11ac PCI-E NIC
  1...........................Software Loopback Interface 1
===========================================================================

IPv4 Route Table
===========================================================================
Active Routes:
Network Destination        Netmask          Gateway       Interface  Metric
          0.0.0.0          0.0.0.0      10.250.48.1    10.250.57.254     50
      10.250.48.0    255.255.240.0         On-link     10.250.57.254    306
    10.250.57.254  255.255.255.255         On-link     10.250.57.254    306
    10.250.63.255  255.255.255.255         On-link     10.250.57.254    306
        127.0.0.0        255.0.0.0         On-link        127.0.0.1    331
        127.0.0.1  255.255.255.255         On-link        127.0.0.1    331
  127.255.255.255  255.255.255.255         On-link        127.0.0.1    331
        224.0.0.0        240.0.0.0         On-link        127.0.0.1    331
        224.0.0.0        240.0.0.0         On-link     10.250.57.254    306
  255.255.255.255  255.255.255.255         On-link        127.0.0.1    331
  255.255.255.255  255.255.255.255         On-link     10.250.57.254    306
===========================================================================
Persistent Routes:
  None
```

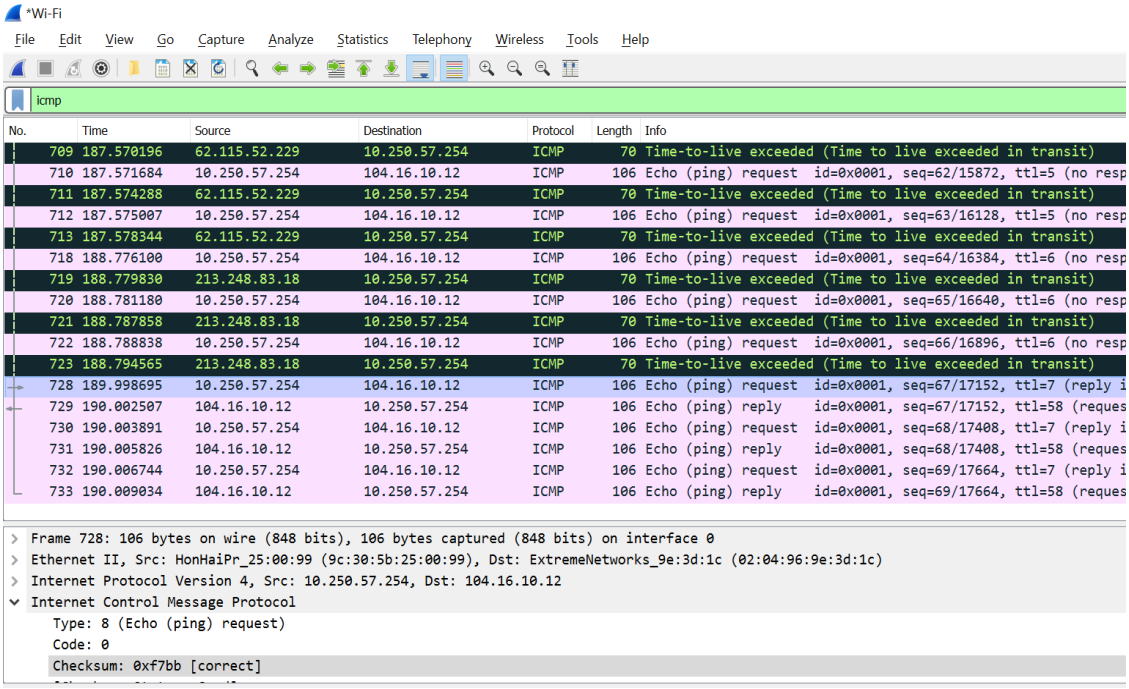
2. (20 points) In assignment-1 when traceroute is found for any website, the results shows the routers connected intermediately to connect to the final destination. When we run traceroute command we are not actually sending any data to any routers, we are just pinging whether the router is available or not. If router is available, then the amount of time taken to make a trip to that router is given as output. If the router is not available, then it indicates that the ping request is lost which can indicate the packet-loss. The ping requests made here use ICMP protocol.
   List out the destination IP addresses that ping request has taken place in Wireshark for the traceroute in command-prompt and provide a screenshot of the traceroute in command-prompt. Close all browsers or any apps using internet to avoid confusion.

```
C:\Users\dsril>tracert www.gsu.edu

Tracing route to www.gsu.edu.cdn.cloudflare.net [104.16.10.12]
over a maximum of 30 hops:

  1   597 ms   367 ms     3 ms  vw-2013-mc04-nat-sec-private.gsu.edu [10.250.48.1]
  2     4 ms     1 ms     5 ms  fwcdfxedge-rt000009-new-gsusecure-gw.gsu.edu [10.32.9.1]
  3     3 ms     2 ms     1 ms  VW-4055-00-Wireless-NAT.gsu.edu [131.96.208.1]
  4     *        *       43 ms  TSIC-Pri-TO-GSU.gsu.edu [131.96.125.38]
  5     3 ms     2 ms     3 ms  atl-bb1-link.c.telia.net [62.115.52.229]
  6     3 ms     6 ms     5 ms  cloudflare-ic-309901-atl-bb1.c.telia.net [213.248.83.18]
  7     4 ms     2 ms     2 ms  104.16.10.12

Trace complete.
```



3. (20 points) Like tracert, ‘ping’ is a command which tells the reachability of the host in the IP network. It also uses ICMP protocol to find the round-trip time to connect to the host. Ping also gives details about packet-loss, maximum and minimum round-trip time and ping statistics. Provide a screenshot for pinging any website from command-prompt like below.

```
C:\Users\dsril>ping www.gsu.edu

Pinging www.gsu.edu.cdn.cloudflare.net [104.16.11.12] with 32 bytes of data:
Request timed out.
Reply from 104.16.11.12: bytes=32 time=69ms TTL=54
Reply from 104.16.11.12: bytes=32 time=43ms TTL=54
Request timed out.

Ping statistics for 104.16.11.12:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 43ms, Maximum = 69ms, Average = 56ms
```

4. (20 points) Ping command on a default uses on a default of 4 echo request. Provide a screenshot in which you make 7 echo requests to the same host used in problem-3. Increasing the number of echo requests decreases the average round-trip time compared to the problem-3 average round-trip time. [See the Ping command options for solving this try ping –help in command prompt]
5. Let the RRT's be 40, 45, 56, 131, 87 and 68 for 6 ping requests to the same host. Write a program to calculate the minimum, maximum, mean, standard deviation of the given RRT which helps in finding the ping stats. Provide output as screenshot and include the program source code as well.

Graduate students:

Suppose a network has the following topology and has weights as below for each edge between the routers. Ask the user for a source vertex, then print the shortest paths (and costs) from the source vertex to all other vertices in the graph. Make sure to document your code.