IIT Goa CS 378 (Computer Networks LAB)
Instructor: Neha Karanjkar

LAB 1: Tools of the Trade

Instructions:

- For this lab you can work individually OR in teams of 2 persons. Choose your teammate.
- There is a strict time limit of 2 hours. You will be graded for the exercises you can complete within this time budget.
- You **can** help other teams. However, remember that there is a time limit. Complete your own work first before helping others. Help others by sharing the method to arrive at an answer, don't share your specific answer directly. Exact answers will differ across teams.
- Both persons in the team should work on each problem together and in sequence. **Do not** divide up the questions among team members.
- You **are allowed** to use Google search and the www for information and commands. Use Linux-specific commands.
- Check that your computer is connected to the Internet before starting the lab! Talk to the TAs if there are any issues.
- Write legibly in the blank space provided next to questions.

ROLL NUMBERS (Do not write names):

_____(Team member 1)

_____(Team member 2, if any)

1. Find out and list the following information for the lab computer that you are using.
   For each field, also mention the command/program/website you have used to get the final answer.

   a) MAC address of your ethernet card.

   b) Your ethernet card's manufacturer.

   c) Your IPv4 address (private, within IIT Goa)

   d) Your public IPv4 address as seen by a server outside IIT Goa

   e) Your IPv6 address (private, within IIT Goa)

   f) Your public IPv6 address as seen by a server outside IIT Goa

g) What is the Netmask for your local network? Write it as 4 octets separated by dots.

h) What is the max number of hosts that can be uniquely addressed within this local network?

i) What is the IP address for sending broadcast messages to your local network?

j) What is the MAC address for sending broadcast messages to you link-local network?

2. Just like a router, your computer also maintains a routing table. Each entry in this routing table contains a range of destination IP addresses and the IP address of the "next hop" that should be chosen to forward a packet with the matching destination address. In addition, there is also an entry called "default" which is the route chosen if a destination address does not match any of the other more-specific entries. For a given destination IP address, the entries in the table are searched in the order of the longest prefix to shortest prefix until a match is found. (This is called the "Longest Prefix Match" approach). When a match is found, the computer chooses this entry as the next hop for forwarding the packet.

   a) What command can be used to view your computer's routing table ?

   b) What is your default Gateway's IP address as shown in this table?

   c) Re-write the first 3 entries of your routing table here in the format:
   <destination IP-address/prefix-length>, <next hop's IP address where this packet should be forwarded>

   d) Sometimes, the next hop's IP address may be shown as 0.0.0.0. What does this indicate?

   e) You might notice an address that looks like 169.254.x.x. What are such addresses called and what do they indicate?

3. The Link layer deals with MAC addresses. Thus to forward a packet on a link, your computer needs to know the destination MAC address of the next hop (in addition to the IP address). Your computer discovers the MAC addresses of the neighbouring devices using a method called “the Address Resolution Protocol” (ARP). Spend some time (7-8 minutes) to browse through and understand the Wikipedia entry for ARP. This is a Link-layer protocol.

   a) What command can be used for displaying the list of neighbouring hosts (with their MAC and IP addresses) as discovered by your computer?

   b) In the output of this command, how many entries (neighbouring hosts) were listed ?

   c) What is the MAC address of your default gateway?

4. Use traceroute to find out the IP addresses of the hops visited for communicating with “www.nasa.gov”

   a) What is the IP address of IIT Goa’s firewall?

   b) What is the IP address of the final hop? How many total hops were taken?

   c) Traceroute does 3 trials (sends 3 messages) by default. What is the command to get traceroute to do 5 trials instead?

   d) What is the average round-trip latency for the final destination? (Find the average over 5 trials)

   e) Use online services to find and list the geographical location (City, State, Country) where the last hop is located

5. Use the “host” command to find the IP address of “www.iitgoa.ac.in”. Since you are inside IIT Goa’s private network, this could be a private address, such as 10.x.x.x. Now start up wireshark selecting “any” interface.

   Apply a filter “ip.addr == <the ip address you found for iitgoa>” for example, “ip.addr==10.250.36.36”. Now, open a web browser and open IIT Goa’s website. Observe the traffic captured in Wireshark.

   a) Look out for the SYN, SYN/ACK, ACK sequence. What protocol is being used?

b) What are the source and destination IP addresses for the first SYN message?

c) What are the source and the destination port numbers for the first SYN message?

d) For the first SYN message, what is the sender's sequence number ? (Hint: It is not 0. The "relative" sequence number displayed for human readability is 0, but the actual sequence number may be visible as 4 octets(hex) in the byte stream displayed in the bottom-most window.)

e) For the second SYN/ACK message, what is the acknowledgement number?

6. Explore the Ping command, and report the approximate round-trip time for a ping to :
   a) www.iitgoa.ac.in

   b) www.uaa.alaska.edu

7. Download and modify the programs Client.py and Server.py from the course webpage. (https://nehakaranjkar.github.io/cs348.html)
   Partner with another team, and run the Client and Server programs on different machines. Remember to point out the correct IP address and port number of the Server to the Client! The client should send the string "Hello" to the Server, and the server should respond "Who's there?". Demonstrate a successful run of this setup to the TAs.