Homework 8 (80 points) Due Date*: 11:59pm 04/20/2020   Cutoff Deadline**: 11:59pm 04/22/2020

**Submission will NOT be accepted after the cutoff deadline

Submission: Upload and submit it on **Blackboard**. If your homework is in hand-written, please try to SCAN it into a .pdf file or take a clear photo, and then upload/submit it. (NO Paper/Hardcopy or Email submission please!)

Please 1) **include your First Name and Last Name** on the page(s) that you upload & submit on Blackboard

2) name your HW file as "**HW<#><LastName><FirstName>**", e.g., **HW6PolisJared.pdf** for HW6.

Grading: I will also grade it in Adobe Acrobat and post the graded work on Blackboard for everyone who submits it.
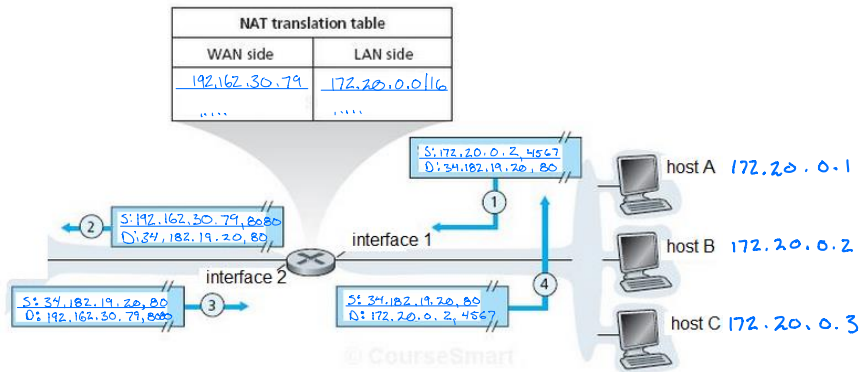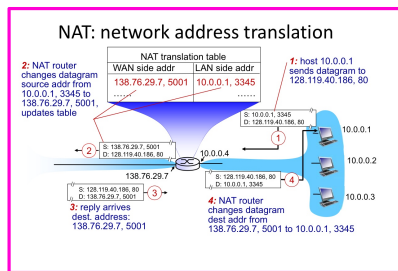
3) leave me some space for grading and writing corrections beside your solution to every problem. Thanks!

PLEASE ORGANIZE YOUR WORK IN THE SEQUENCE GIVEN IN THE ASSIGNMENT!!!

Problem A. Consider the network setup in the following figure, where the router is a NATed router. Suppose that the ISP assigns the router the address 192.162.30.79 and that the network address of the home network is 172.20.0.0/16.

a. Assign addresses to interfaces 1 and 2, and hosts A, B and C.

b. Suppose host B has an ongoing TCP connection to port 4567 at server 34.182.19.20 from port 80 at host B. The NATed router assigns a new port 8080 for this TCP connection. Provide the corresponding entry in the NAT translation table and the source ip, source port, destination ip, and destination port in each of the four IP datagrams shown below.

Problem B. Below is the information displayed by a command "traceroute www.google.com" on my computer.

n-value - # of the router
name of router
router address
round trip delay

```
                       $ traceroute www.google.com
traceroute to www.google.com (216.58.217.4), 64 hops max, 52 byte packets
 1  147.153.172.1 (147.153.172.1)   0.622 ms   0.501 ms   1.171 ms
 2  147.153.181.1 (147.153.181.1)   0.743 ms   0.613 ms   0.606 ms
 3  147.153.8.3 (147.153.8.3)       1.232 ms   1.289 ms   1.334 ms
 4  147.153.8.9 (147.153.8.9)       1.458 ms   2.001 ms   7.919 ms
 5  147.153.69.30 (147.153.69.30)   2.023 ms   2.112 ms   1.793 ms
 6  xe-0-0-1.core-910.frgp.net (192.43.217.170)  1.611 ms  1.741 ms  1.741 ms
 7  72.14.194.239 (72.14.194.239)   1.653 ms   1.766 ms   2.410 ms
 8  72.14.234.59 (72.14.234.59)     2.038 ms   1.886 ms   1.795 ms
 9  209.85.250.237 (209.85.250.237) 2.128 ms   2.179 ms   2.210 ms
10  den03s09-in-f4.1e100.net (216.58.217.4)  1.981 ms  1.920 ms  1.777 ms
```

a.   Is the IP address of my computer included in the information given above? If yes, what is it and is it a private or public IP address?

b.   What is the IP address of www.google.com when this traceroute command was executed? Is it a private or public IP address?

c.   What's the relationship between the two DNS names: www.google.com and den03s09-in-f4.1e100.net? (Hint: which is the alias name and which is the canonical name?)

d.   How many routers are involved in the communication between my computer and the web server at www.google.com?

e.   What are the initial TTL and the destination IP enclosed by my computer in the set of IP datagrams that are dropped by the router 72.14.194.239?

f.   When the router xe-0-0-1.core-910.frgp.net drops the ip datagram enclosing a UDP segment from my computer, does it send a UDP segment or an ICMP message to the host? What are the type and code of router enclosed in such UDP segment or ICMP message? What's the source IP in the IP datagram carrying this UDP/ICMP packet? Whose IP is used as the destination IP for this UDP/ICMP packet? (*hint*: websever's, my computer's, router 147.153.69.30's, or …?)

g.   What are the final TTL and the destination IP enclosed in the set of IP datagrams when they arrive at the webserver www.google.com? Does this webserver send a UDP segment or an ICMP message back to the host? What are the type and code enclosed in such UDP segment or ICMP message? What's the source IP in the IP datagram carrying this UDP/ICMP packet? Whose IP is used as the destination IP for this UDP/ICMP packet? (*hint*: websever's, my computer's, router 147.153.69.30's, or …?)

Problem C. Tunneling is used for the transition from IPv4 to IPv6. The route from Host A to Host B is shown as below (see *next* page), where ip1, ip2, … ip10 are the ip addresses of the hosts and the interfaces of routers. Host A sends a TCP segment to Host B. To deliver this TCP segment, for the **IP datagram** transmitted over **EACH of the FIVE link (1st link, 2nd link, …, 5th link)** describe

(1) the type of IP datagram (IPv4 or IPv6),

(2) the source ip address,

(3) the destination ip address.
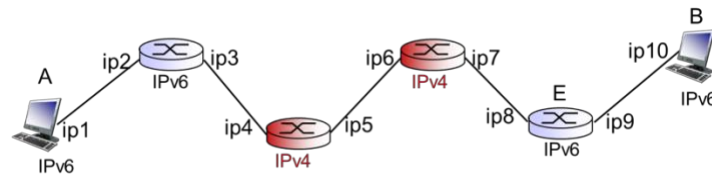
Problem A.

192.162.30.79 → WAN: 11000000.10100010.00011110.01001111
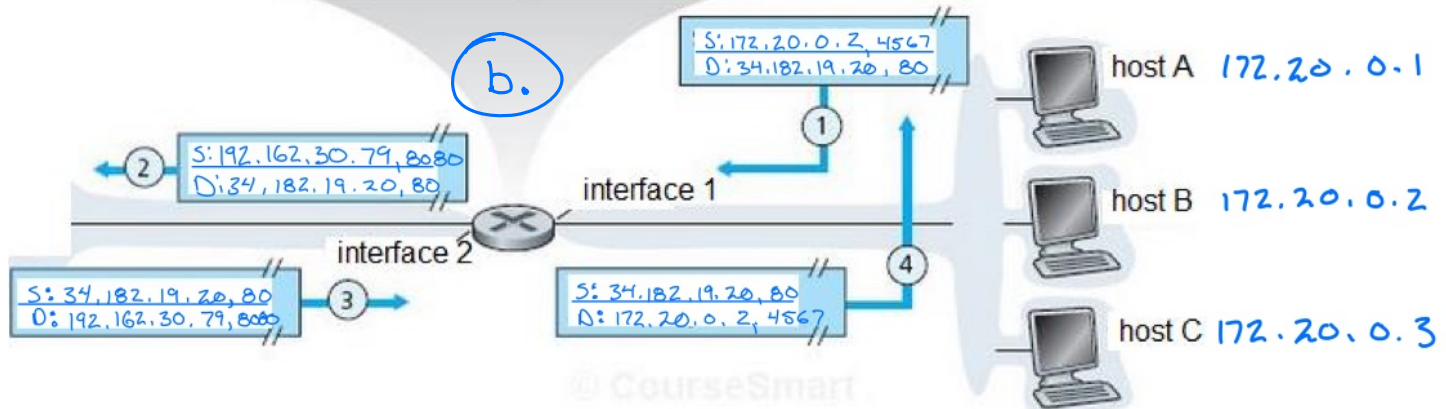
172.20.0.0/16 → LAN: 10101100.00010100.00000000.00000000

mask: 11111111.11111111.00000000.00000000

NAT translation table

WAN side	LAN side
192.162.30.79	172.20.0.0/16
.....	.....

a.

b.

S:172.20.0.2, 4567
D:34.182.19.20, 80

host A   172.20.0.1

1

S:192.162.30.79, 8080
D:34.182.19.20, 80

2

interface 1

host B   172.20.0.2

interface 2

4

S:34.182.19.20, 80
D:192.162.30.79, 8080

3

S:34.182.19.20, 80
D:172.20.0.2, 4567

host C   172.20.0.3

Problem B.

a. Yes, the 1st IP when the traceroute is started is our IP. It is our private IP which is displayed because it is the first hop for tracing of the route. IP is the 1st state of the t.r. results

b. Google IP addr. 216.58.217.4.   This is the private IP of the server.

c. den03s09-in-f4.1e100.net, is an alias name which is used to determine which DNS server has been hosted with a particular address from Google that has many servers. This concept allows for ease of use.

d. There are 8 routers between the host request and the server at Google.

e.   TTL= 1   147.153.172.1

F. When the nth datagram arrives at the nth router the nth router observes that the TTL of the datagram expired. The rules are to discard the datagram and sends an ICMP warning message to the source (type 3 code 3). The warning message will include the name of the router and it's IP address. Source ip = 147.153.172.1. Destination ip = 216.58.217.4. The UDP segment is sent back to the host.

g. TTL = 9, Destination ip 216.58.217.4. the web server will send an ICMP Type 11 code 0 message. The source ip will come from google at 216.58.217.4. The destination ip for the ICMP will be 147.153.172.1.

Problem E.
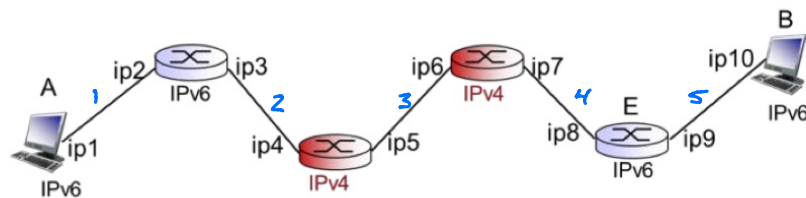
Link	IP datagram Type	Source ip addr	destination ip addr.
1	IPv6	A (ip1)	B (ip2)
2	IPv6	A (ip3)	B (ip4)
3	IPv4	A (ip5)	B (ip6)
4	IPv4	A (ip7)	B (ip8)
5	IPv6	A (ip9)	B (ip10)