COMP 445 – Winter 2022
Data Communications & Computer Networks
Theoretical Assignment 3

1.
   a. No. The two sessions will transmit the same number of segments per RTT. But since the RTT of the A-B connection is half that of the other session, its throughput will be twice as large.
   b. The TCP timer takes the estimate of the RTT and adds on a factor to ac- count for the variation in RTTs. Therefore, the C-D connection timeout value will be larger.
   c. Suppose a client transmits multiple SYN messages that take a long time to be received at the server, so the client terminates (thinking the server is dead). The server then accepts these SYN connections (with only a two-way handshake, the server needs to commit as soon as the SYN is received). However, the client side is no longer present, so the server now has multiple connections opened with no client on the other side.

2.
   a. 10000001 00010001 10000001 01100001.
   b. 129.17.129.96 to 129.17.129.127.
   c. There are 32 addresses in the range; we give 8 addresses to each block and utilize two extra bits for the subnet prefix; thus 129.17.129.96/29, 129.17.129.104/29, 129.17.129.112/29, and 129.17.129.120/29

3.
   a. The range belongs to the space of private IP addressing defined in RFC 1918. Other ranges are 172.16.0.0/12 and 192.168.0.0/16
   b. The home router is either using a NAT to a public IP address to be able to route packets to my home network or it is part of an interior routing protocol that allows routing of private IP addresses (and carrier grade NAT is applied further in the path to Internet).
   c. The two computers are behind NAT routers that convert private IP addresses to public IP addresses, so the two computers are reachable from the Internet and so the private IP is never exposed publicly.
   d. The video game application is likely using UDP and employing UDP hold punching to traverse the two NAT routers.

4.

a.

N	D(A),p(A)	D(B),p(B)	D(C),p(C)	D(E),p(E)	D(F),p(F)
D	4,D	infty	1,D	4,D	infty
DC	3,C	9,C		4,D	infty
DCA		5,A		4,D	infty
DCAE		5,A			6,E
DCAEB					6,E

b. The shortest path from D to B is D C A B. The cost of this path is 5.

5.

a.

	Destination					
node	A	B	C	D	E	F
A	0	2	2	3	7	6
B	2	0	4	5	6	4
C	2	4	0	1	5	7
D	3	5	1	0	4	6
E	7	6	5	4	0	2
F	6	4	7	6	2	0

b. From its neighbors, nodes A, B, and D. Note that C does not receive distance vectors from nodes E and F, since they are not direct neighbors

c. C's cost to E via B is $c(C,B) + D_B(E) = 8 + 6 = 14$
C's cost to E via A is $c(C,A) + D_A(E) = 2 + 7 = 9$ (note that A's shortest path to E is through C!)
C's cost to E via D is $c(C,D) + D_D(E) = 1 + 4 = 5$
Thus, C will route to E via D, since that path through D has minimum cost.

6.

a. A will advertise that it can reach w and y, since x needs to know which networks its provider can reach. It may also advertise that it can reach B and C. However, if B and C are only transit networks (that is, only providing service to/from their customers networks), then A would not have to advertise B and C to x.

b. X will not advertise any routes to A, since otherwise A might try to route through x, and x is a customer network, not a transit network

c. A will advertise that it can reach w and x. Note that since C is a peer network, A will only advertise its customers to X. In particular, A wouldn't advertise y to C, since that might cause C to route to y via A.

7. The communication layer is responsible for the communication between the SDN controller

and those controlled network devices, via a protocol such as OpenFlow. Through this layer, an SDN controller controls the operation of a remote SDN-enabled switch, host, or other devices, and a device communicates locally-observed events (e.g., a message indicating a link failure) to the controller.

The network-wide state-management layer provides up-to-date information about state a network's hosts, links, switches, and other SDN-controlled devices. A controller also maintains a copy of the flow tables of the various controlled devices.

The applications at the network-control application layer use the APIs provided by a SDN controller to specify and control the data plane in the network devices. For example, a routing network-control application or an application that performs access control.

8.

In the case of destination-based forwarding packet switch, a router only tries to find a match between a flow table entry with the destination IP address of an arriving packet, and the action is to decide to which interface(s) the packet will be forwarded. In the case of an SDN, there are many fields can be matched, for example, IP source address, TCP source port, and source MAC address; there are also many actions can be taken, for example, forwarding, dropping, and modifying a field value.