Name ______________________________ **Class: 348**

1) (4 pts) The original algorithm for computing a timeout value for a TCP connection is being used with the parameter $\alpha = .75$. If the current estimated RTT is 50 milliseconds and the sample RTT for the most recent transmission is 40 milliseconds.

a) (2 pts) What is the new estimated RTT?

$$RTT = \alpha \times ESTRTT + (1-\alpha)\ Samp.\ RTT$$
$$= (0.75) \times 50ms + (0.25)(40ms)$$
$$\boxed{RTT = 47.5ms}$$

b) (2 pts) What is the timeout time used for this new estimated RTT?

$$Timeout = 2 \times RTT$$
$$Timeout = 2 \times 47.5 = \boxed{95ms}$$

2) (8 pts) TCP is operating over a 1.28×10^9 bps link. This link has an RTT of 100 ms.

a) (3 pts) What is the minimum Advertised Window size (in bits) for this network setting?

to keep pipe full $BW \times delay = 100ms \times 1.28 \times 10^9$
$= 1.28 \times 10^8$ bits $= 160 \times 10^6$ Bytes
$2^n > 160 \times 10^6 \Rightarrow \boxed{n = 24 \text{ bits}}$

b) (3 pts) If TCP utilizes the full bandwidth (keeping the pipe full), how long will it take for the 32-bit sequence number to wrap around?

watch units

$$\frac{\#\text{ of bits or bytes}}{BW}$$

bits: $$\frac{2^{32} \times 8}{1.28 \times 10^9 \text{ bps}} = 26.84 s$$

bytes: $$\frac{2^{32}}{160 \times 10^6 \text{ Bps}} = 26.84 s$$

c) (2 pts) If each sequence number is modified to represent 4 bytes of data instead of 1 byte, how long will it take for the 32-bit sequence number to wrap around?

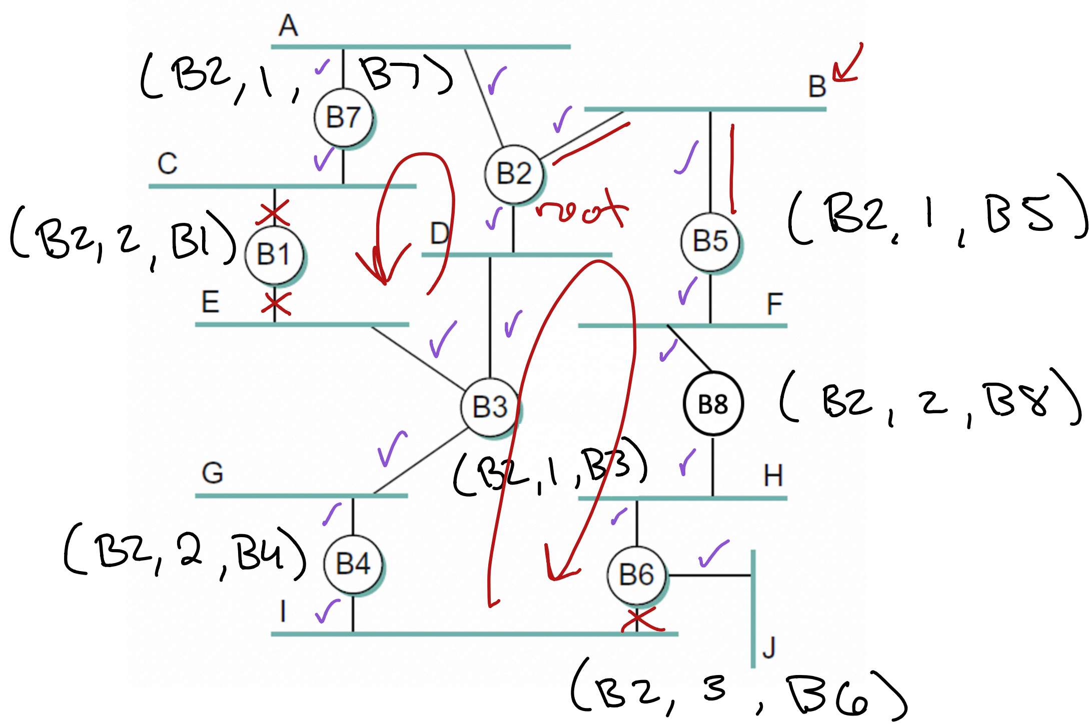
x4

bits: $$\frac{2^{32} \times 8 \times 4}{1.28 \times 10^9 \text{ bps}} = 107.36s$$

bytes: $$\frac{2^{32} \times 4}{160 \times 10^6 \text{ Bps}} = 107.36s.$$

3) (6 pts) Given the extended LANs connected by 8 bridges shown below, indicate the trimmed network by the spanning tree algorithm to avoid possible loops. Suppose **B2** is elected as the root. (You may just mark them on the graph.)

(root, dist, sender)



trimmed:

B1 - C
B1 - E
B6 - I

initial msg: (node, 0, itself)

1. pick root → lowest ID unless told
2. sending msgs. + picking shorter paths and lower IDs
3. tiebreaker → lower ID

★ Beware links you absolutely need. → double check!

4**) (18 pts)** Answer the following short answer questions.

a) (3 pts) What makes the correct estimation of RTT in TCP difficult or even impossible?

→ RTT is related to distance → large dist.

→ congestion + BGP

→ intermediate devices (switches + routers)

c) (2 pts) For the Distance Vector Routing Protocol, what information does a node exchange and which nodes receive this information?

cost to neighbors

d) (2 pts) For the Link State Routing Protocol, what information does a node exchange and which nodes receive this information?

cost to all nodes

e) (3 pts) How to address the triangle routing problem in the mobile IP?

share care-of-address

→ on exam?
email pending.

$2^{32-x} \geq$ # of hosts → prefix

f) (4 pts) Alice decides to start a small company. She asks her ISP, GoChargers, to give her enough addresses for 1000 hosts. GoChargers has the following available address range for Alice. All range (0-255) of IP addresses can be used.

$$\frac{1000}{256 \text{ hosts}} = 4$$

192.1.0.*
192.1.1.*
192.1.2.*
192.1.3.*
192.1.4.*

Classless interdomain routing

In order to save money, what should Alice claim under CIDR to get fewest number of address possible to cover her hosts? (please use address & prefix format, e.g., 128.2/16) (3pts)

And how many unused IP address will be incurred under this kind of purchase? (1pts)

$\underbrace{192.1}_{16 \text{ bits}}.0.0 - 192.1.3.231$

0000 0000 0000 0011

$(256 \times 4) - 1000 = \boxed{24 \text{ hosts wasted}}$

$255 - 24 = 231$

Prefix $= 16 + 6 = 22$ $\boxed{192.1.0/22}$

g) (4 pts) A router has the following (CIDR) entries in its routing table:

Address/mask	Next hop	third octets
135.46.56.0/22	Interface 0	0011 1000
135.46.60.0/22	Interface 1	0011 1100
192.53.40.0/23	Router 1	0010 1000
default	Router 2	

★ overlapping prefixes → pick longest match

For each of the following addresses, what will the router do if a packet with that address arrives?

i. 135.46.52.2
ii. 192.53.56.7

i.)

52 → 0011 0100

no matches

=> $\boxed{\text{Router 2}}$

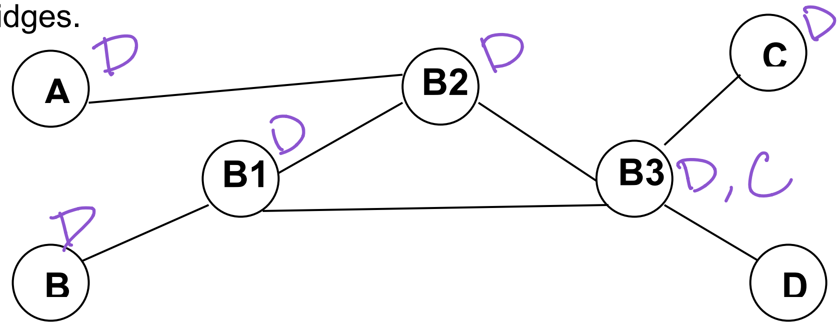
ii.)

56 → 0011 1000

no matches

=> $\boxed{\text{Router 2}}$

6) (6 pts) Consider the following network where A, B, C and D are nodes and B1, B2 and B3 are learning bridges.



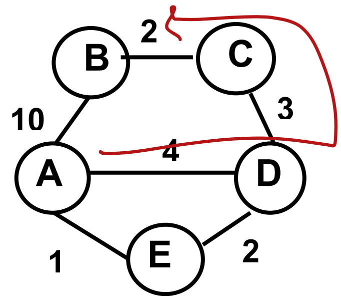
Assume that the forwarding tables for the three bridges are all empty when the three **transmissions below are made in the order shown**. When the transmissions are made in the following consecutive order, identify if terminal A, B, C, D can overhear the ongoing transmission on its network interface.

Transmission: 1) D transmits to B 2) C transmits to D 3) A transmits to C

If a node can receive that packet for that transmission, please put **Y**; otherwise, put **N**. For the respective initiator (i.e., sender) of each transmission, **N/A** is already placed in the table.

Transmission 1)		**Transmission 2)**		**Transmission 3)**	
Node	**Hear Transmission?**	**Node**	**Hear Transmission?**	**Node**	**Hear Transmission?**
A	Y	**A**	N	**A**	**N/A**
B	Y	**B**	N	**B**	Y
C	Y	**C**	**N/A**	**C**	Y
D	**N/A**	**D**	Y	**D**	N

7) (8 pts) Distance Vector: The Distance Vector Routing Algorithm is to be performed starting with the initial table shown below. Entries in the table are in the **form of cost/next hop.** So the initial table indicates which nodes are neighbors of a particular node (i.e. neighbors that will provide updated information to a particular node). In this problem, node A receives vectors from nodes B, D and E. Fill in the tables below for the results after one exchange of vectors and after two exchanges. Give entries in the table in the **form of cost/next hop** as shown in the initial table. For each of the distance vector tables, complete the known routing table for node B.



Info at Node	Distance to reach node – initial table				
	A	B	C	D	E
A	---	10/B	∞	4/D	1/E
B	10/A	---	2/C	∞	∞
C	∞	2/B	---	3/D	∞
D	4/A	∞	3/C	---	2/E
E	1/A	∞	∞	2/D	---

Node B Routing Table		
Destination	Cost	NextHop
A	10	A
C	2	C
D	—	—
E	—	—

Info at Node	Distance to reach node – after 1 exchange				
	A	B	C	D	E
A	---	10/B	7/D	3/E	1/E
B	10/A	---	2/C	5/C	11/A
C	7/D	2/B	---	3/D	5/D
D	3/E	5/C	3/C	---	2/E
E	1/A	11/A	5/D	2/D	---

Node B Routing Table		
Destination	Cost	NextHop
A	10	A
C	2	C
D	5	C
E	11	A

this is wrong?

Info at Node	Distance to reach node – after 2 exchanges				
	A	B	C	D	E
A	---	8/D	6/E	3/E	1/E
B	9/C	---	2/C	5/C	7/C
C	6/D	2/B	---	3/D	5/D
D	3/E	5/C	3/C	---	2/E
E	1/A	7/D	5/D	2/D	---

Node B Routing Table		
Destination	Cost	NextHop
A	9	C
C	2	C
D	5	C
E	7	C

Optional

6) **(Not graded)** Chapter 3 Text Book Problem 52

52. Suppose we have the forwarding tables shown in Table 3.16 for nodes A and F, in a network where all links have cost 1. Give a diagram of the smallest network consistent with these tables.

→ cost = # of hops

Table 3.16 Forwarding Tables for Exercise 52

A

Node	Cost	Nexthop
~~B~~	~~1~~	~~B~~
C	2	B
~~D~~	~~1~~	~~D~~
E	2	B
F	3	D

F

Node	Cost	Nexthop
A	3	E
B	2	C
~~C~~	~~1~~	~~C~~
D	2	E
~~E~~	~~1~~	~~E~~