## Homework must be done individually. Due at 11:59pm on Apr 12, 2019. Please submit your solutions via Sakai.

## 1. ( 10 pts ) [PD] Page 285: Problem 2

Using the example network given in Figure 3.44, give the virtual circuit tables for all the switches after each of the following connections is established. Assume that the sequence of connections is cumulative; that is, the first connection is still up when the second connection is established, and so on. Also assume that the VCI assignment always picks the lowest unused VCI on each link, starting with 0 , and that a VCI is consumed for both directions of a virtual circuit.
(a) Host D connects to host H .
(b) Host B connects to host G.
(c) Host F connects to host A.


Figure 3.44

## 2. (10 pts) [PD] Page 286: Problem 7

Propose a mechanism that virtual circuit switches might use so that if one switch loses all its state regarding connections then a sender of packets along a path through that switch is informed of the failure.
3. (5 pts) [PD] Page 288: Problem 13

Given the extended LAN shown in Figure 3.48, indicate which ports are not selected by the spanning tree algorithm.


Figure 3.48
4. (5 pts) [PD] Page 288: Problem 16

As in the previous problem, consider the arrangement of learning bridges shown in Figure 3.49. Assuming all are initially empty, give the forwarding tables for each of the bridges B1 to B4 after the following transmissions:
(a) D sends to C .
(b) C sends to D .
(c) A sends to C.


Figure 3.49

## 5. (10 pts) [PD] Page 292: Problem 33

What aspect of IP addresses makes it necessary to have one address per network interface, rather than just one per host? In light of your answer, why does IP tolerate point-to-point interfaces that have non-unique addresses or no addresses?
6. (10 pts) [PD] Page 294: Problem 46

For the network shown in Figure 3.53, give global distance vector tables like those of Tables 3.10 and 3.13 when
(a) Each node knows only the distances to its immediate neighbors.
(b) Each node has reported the information it had in the preceding step to its immediate neighbors.
(c) Step (b) happens a second time.


Figure 3.53
Table 3.10 Initial Distances Stored at Fach Node (Global View)

| Information | Distance to Reach Node |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | A | B | C | D | E | F | G |
| A | 0 | 1 | 1 | $\infty$ | 1 | 1 | $\infty$ |
| B | 1 | 0 | 1 | $\infty$ | $\infty$ | $\infty$ | $\infty$ |
| C | 1 | 1 | 0 | 1 | $\infty$ | $\infty$ | $\infty$ |
| D | $\infty$ | $\infty$ | 1 | 0 | $\infty$ | $\infty$ | 1 |
| E | 1 | $\infty$ | $\infty$ | $\infty$ | 0 | $\infty$ | $\infty$ |
| F | 1 | $\infty$ | $\infty$ | $\infty$ | $\infty$ | 0 | 1 |
| G | $\infty$ | $\infty$ | $\infty$ | 1 | $\infty$ | 1 | 0 |

Table 3.10
Table 3.13 Final Distances Stored at Each Node (Global View)

| Information | Distance to Reach Node |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | A | B | C | D | E | F | G |
| A | 0 | 1 | 1 | 2 | 1 | 1 | 2 |
| B | 1 | 0 | 1 | 2 | 2 | 2 | 3 |
| C | 1 | 1 | 0 | 1 | 2 | 2 | 2 |
| D | 2 | 2 | 1 | 0 | 3 | 2 | 1 |
| E | 1 | 2 | 2 | 3 | 0 | 2 | 3 |
| F | 1 | 2 | 2 | 2 | 2 | 0 | 1 |
| G | 2 | 3 | 2 | 1 | 3 | 1 | 0 |

Table 3.13

## 7. (10 pts) [PD] Page 297: Problem 53

Suppose we have the forwarding tables shown in Table 3.17 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.

## Table 3.17 Forwarding Tables for Exercise 53



Table 3.17
8. (10 pts) [PD] Page 300: Problem 63

Give the steps as in Table 3.14 in the forward search algorithm as it builds the routing database for node A in the network shown in Figure 3.60.

| Step | Confirmed | Tentative | Comments |
| :---: | :---: | :---: | :---: |
| 1 | ( $\mathrm{D}, 0,-$ ) |  | Since $D$ is the only new member of the confirmed list, look at its LSP. |
| 2 | (D,0,-) | $(\mathrm{B}, 11, \mathrm{~B})(\mathrm{C}, 2, \mathrm{C})$ | D's LSP says we can reach $B$ through $B$ at cost 11 , which is better than anything else on either list, so put it on Tentative list; same for $C$. |
| 3 | ( $\mathrm{D}, 0,-$ ) (C,2,C) | (B,11,B) | Put lowest-cost member of Tentative (C) onto Confirmed list. Next, examine LSP of newly confirmed member (C). |
| 4 | ( $\mathrm{D}, 0,-)(\mathrm{C}, 2, \mathrm{C})$ | (B,5,C) (A, 12,C) | Cost to reach B through C is 5 , so replace $(\mathrm{B}, 11, \mathrm{~B})$. C's LSP tells us that we can reach $A$ at cost 12 . |
| 5 | $(\mathrm{D}, 0,-)(\mathrm{C}, 2, \mathrm{C})(\mathrm{B}, 5, \mathrm{C})$ | ( $\mathrm{A}, 12, \mathrm{C}$ ) | Move lowest-cost member of Tentative (B) to Confirmed, then look at its LSP. |
| 6 | $(\mathrm{D}, 0,-)(\mathrm{C}, 2, \mathrm{C})(\mathrm{B}, 5, \mathrm{C})$ | (A, 10,C) | Since we can reach A at cost 5 through B, replace the Tentative entry. |
| 7 | $(\mathrm{D}, 0,-)(\mathrm{C}, 2, \mathrm{C})(\mathrm{B}, 5, \mathrm{C})(\mathrm{A}, 10, \mathrm{C})$ |  | Move lowest-cost member of Tentative (A) to Confirmed, and we are all done. |

Table 3.14


Figure 3.60
9. (10 pts) [PD] Page 383: Problem 5

Suppose P, Q, and R are network service providers with respective CIDR address allocations C1.0.0.0/8, C2.0.0.0/8, and C3.0.0.0/8. Each providers customers initially receive address allocations that are a subset of the providers. P has the following customers: PA, with allocation C1.A3.0.0/16 PB, with allocation C1.B0.0.0/12. Q has the following customers: QA, with allocation C2.0A.10.0/20 QB, with allocation C2.0B.0.0/16. Assume there are no other providers or customers.
(a) Give routing tables for $\mathrm{P}, \mathrm{Q}$, and R assuming each provider connects to both of the others.
(b) Now assume P is connected to Q and Q is connected to R , but P and R are not directly connected. Give tables for P and R .
(c) Suppose customer PA acquires a direct link to Q , and QA acquires a direct link to P , in addition to existing links. Give tables for P and Q , ignoring R .
10. (10 pts) [PD] Page 384: Problem 9

Suppose a small ISP X pays a larger ISP A to connect him to the rest of the Internet and also pays another ISP $B$ to provide a fall-back connection to the Internet in the event that he loses connectivity via ISP A. If ISP X learns of a path to some prefix via ISP A, should he advertise that path to ISP B? Why or why not?

