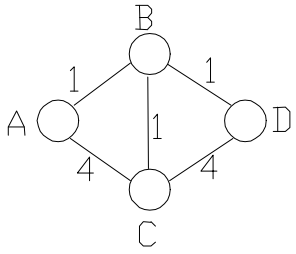
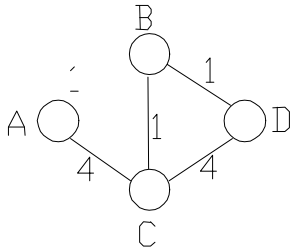
2.993: Principles of Internet Computing
Homework #7 Solutions



1. In the figure shown above, assume that link BA goes down, so that B routes A through C. If B uses split horizon (explained in Lecture 14), it will report to C an infinite distance to A, since B uses C to reach A. Similarly, D also reports to C an infinite distance to A. Now, suppose the CA link goes down.

(Some clarification: Before link BA fails, B reports to C about its cost to A. That's why (immediately) after link BA fails, B reports to C (and also to D) infinite distance to A. Upon receiving this message, D reports to C an infinite cost to A, since D routes packets to A through B. C now reports to B and D that it has a link to A at a cost of 4. Now we have the following topology.)



If link CA fails, C reports infinite cost of A to B and D. Now, the timing of subsequent events is critical. Before link CA fails, D reports to A that it can route packets to A with a cost of 6 (not knowing that the packets have to go through C). But C does not forward packets (destined to A) through D because it has a shorter link of cost 3.

(a) What distance to A will C report to B and D?
Infinity.

(b) What is the distance to A that D reports to C?
6.

(c) What does C think the shortest path to A is?
8 through via D.

(d) What does C tell B about its distance to A?
8.

(e) What is C's route to A now?
Through B and D, then back to C via B.

(f) What does B tell D? Then, what does D tell C?
B tells D that it can reach A with a cost of 9.
D tells C that it costs 10 to reach A.

(g) When does this cycle end?
C now thinks it costs 12 to reach A and reports to B. The cycle never ends.

2. The traffic matrix shown below represents the number of packets waiting at the input queues of a switch to be transferred to their corresponding output ports. Determine the minimum number of time-slots required to transfer all packets from the input ports to the output ports.

Input \ Output

	1	**2**	**3**	**4**
1	2		3	1
2		4	3	
3	3			2
4		1		4

Step 1

	1	**2**	**3**	**4**
1	2		3	0X
2		4	2X	
3	2X			2
4		0X		4

Step 2

	1	**2**	**3**	**4**
1	2		2X	
2		3X	2	
3	1X			2
4				3X

Step 3

	1	**2**	**3**	**4**
1	2		1X	
2		2X	2	
3	0X			2
4				2X

Step 4

	1	**2**	**3**	**4**
1	1X		1	
2		1X	2	
3				1X
4				2

Step 5

	1	**2**	**3**	**4**
1	1		0X	
2		0X	2	
3				0X
4				2

Step6

	1	**2**	**3**	**4**
1	0X			
2			1X	
3				
4				1X

Step 7

	1	**2**	**3**	**4**
1				
2			0X	
3				
4				0X

3. Draw a 16-by-16 Banyan switching fabric. Trace how packets with labels: 0100, 1010, and 1110, presented to the 1^{st}, 5^{th}, and 12^{th} input ports will be routed through the fabric.