The University of Queensland
School of Information Technology and Electrical Engineering

Semester Two, 2011

COMS3200 – Tutorial 9 - Solutions

Question 1

Assuming that all routers and hosts are working properly and that all the software in both is free of all errors, is there any chance, however small, that a packet will be delivered to the wrong destination? Explain your answer.

It is possible for data being sent over a network to be delivered to the wrong node. There is a non-zero probability that a packet will be corrupted in such a way as to alter the destination address but at the same time have the packet pass checksum or CRC checks. In other words, an occasional noise burst could change a perfectly legal packet for one destination into a perfectly legal packet for another destination.

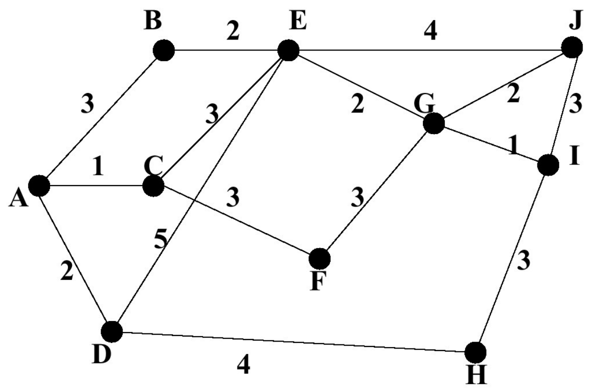
Question 2

Give a simple algorithm for finding two paths through a network from a given source to a given destination that can survive the loss of any communication line. The routers are considered reliable enough, so it is not necessary to worry about the possibility of router crashes.

Any simple algorithm (such as shortest path routing) if it is used in the following manner:
1. Establish a route between the source and destination
2. Remove all links involved with this route
3. Establish an alternative route between the source and destination

Question 3

Given the network below and using the metrics shown on the links as the basis for optimality, sketch the shortest path from A to J using Dijkstra's algorithm. Show the spanning tree rooted at A (make sure your sketch clearly shows which links are on the tree and which are not). The metrics are the same in each direction on the link.

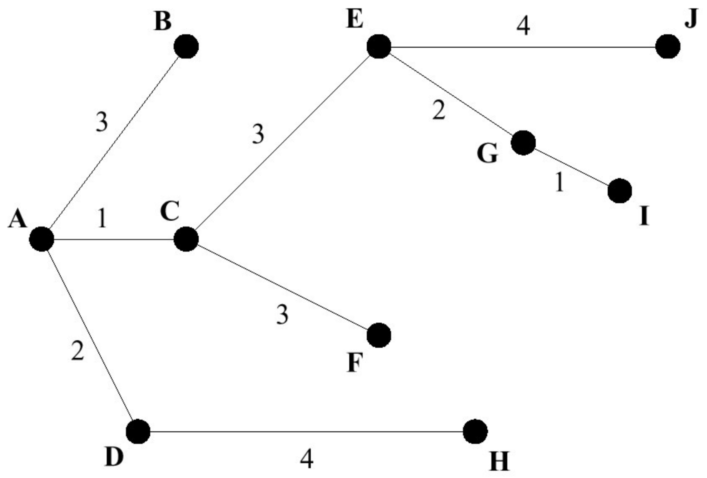


The following table was generated using Dijkstra's algorithm. Temporary labels are marked with ( ), permanent labels are marked with [ ] and temporary labels which were generated by the algorithm and discarded (because the weighting value was too high) are marked with ~~( )~~. Remember you cannot relabel a node unless the relabel value is **less than** the existing value. Where two nodes have the same tentative cost, we make both labels permanent and select both as the next working nodes.

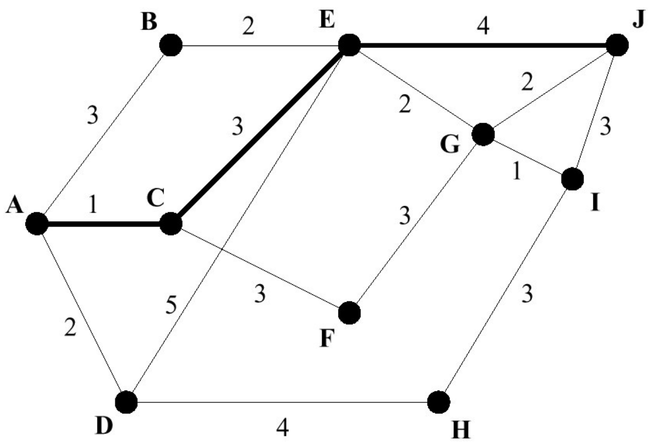
n_W	A	B	C	D	E	F	G	H	I	J
A	**[0,A]**	(∞,-)	(∞,-)	(∞,-)	(∞,-)	(∞,-)	(∞,-)	(∞,-)	(∞,-)	(∞,-)

n_W	A	B	C	D	E	F	G	H	I	J
		(3,A)	(1,A)	(2,A)						
C			**[1,A]**							
					(4,C)	(4,C)				
D				**[2,A]**						
					~~{7,D}~~			(6,D)		
B		**[3,A]**								
					~~{5,B}~~					
E,F					**[4,C]**	**[4,C]**				
							(6,E) ~~{7,F}~~			(8,E)
G,H							**[6,E]**	**[6,D]**		
									(7,G) ~~{9,H}~~	~~{8,G}~~
I									**[7,G]**	
										~~{10,I}~~
J										**[8,E]**

The spanning tree is as follows:

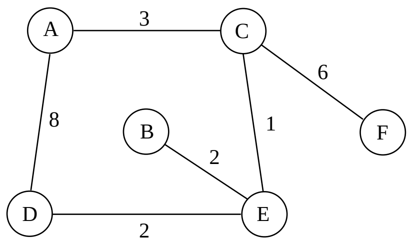


so the shortest path from A to J is ACEJ:



Question 4

(PD 4.12) For the network shown below, give the distance-vector routing tables for each node (i.e. destination, cost, next-hop) when:
(a) Each node knows only the distances to its immediate neighbours
(b) Each node has reported the information it had in the preceding step to its immediate neighbours
(c) Step (b) happens a second time.



(a)

Node A

Dest	Cost	Next Hop
C	3	C
D	8	D

Node B

Dest	Cost	Next Hop
E	2	E

Node C

Dest	Cost	Next Hop
A	3	A
E	1	E
F	6	F

Node D

A	8	A
E	2	E

Node E

B	2	B
C	1	C
D	2	D

Node F

C	6	C

(b)

Node A

Dest	Cost	Next Hop
C	3	C
D	8	D
E	4	C
F	9	C

Node B

Dest	Cost	Next Hop
E	2	E
C	3	E
D	4	E

Node C

Dest	Cost	Next Hop
A	3	A
E	1	E
F	6	F
B	3	E
D	3	E

Node D

A	8	A
E	2	E
B	4	E
C	3	E

Node E

B	2	B
C	1	C
D	2	D
A	4	C
F	7	C

Node F

C	6	C
A	9	C
E	7	C

(c)

Node A

Dest	Cost	Next Hop
B	6	C
C	3	C
D	6	C
E	4	C
F	9	C

Node B

Dest	Cost	Next Hop
A	6	E
C	3	E
D	4	E
E	2	E
F	9	E

Node C

Dest	Cost	Next Hop
A	3	A
B	3	E
D	3	E
E	1	E
F	6	F

Node D

A	6	E
B	4	E
C	3	E
E	2	E
F	9	E

Node E

A	4	C
B	2	B
C	1	C
D	2	D
F	7	C

Node F

A	9	C
B	9	C
C	6	C
D	9	C
E	7	C

Question 5

(PD 4.13) For the same network, use Djikstra's algorithm to generate the spanning tree rooted at node D. What will the routing table for D look like?

n_W	A	B	C	D	E	F
D	(∞,-)	(∞,-)	(∞,-)	**[0,D]**	(∞,-)	(∞,-)
	(8,D)				(2,D)	
E					**[2,D]**	
		(4,E)	(3,E)			
C			**[3,E]**			
	(6,C)					(9,C)
B		**[4,E]**				
A	**[6,C]**					
F						**[9,C]**

The links on the spanning tree are DE, CE, BE, CA, CF. The routing table for D will specify that all packets be sent to E.

Question 6

(PD4.15) For the same network, suppose the forwarding tables are all established as in Q4 and then the C-E link fails. Give
(a) the tables of A, B, D and F after C and E have reported the news
(b) the tables of A and D after their next mutual exchange
(c) the table of C after A exchanges with it

The first step is to determine the forwarding tables as they would be initially, e.g. for A they will show that the costs to B, C, D, E, and F are 6, 3, 6, 4, and 9 respectively. The nexthop for all entries will be C. C’s table will show the nexthop for B, D and E as being E so when the C-E link fails, C will report the costs to B, D and E being infinity. Because A has recorded that the nexthop for B, D and E is C, A will update the B, D and E entries in it’s table. Other tables are determined similarly.

(a) A:

dest	cost	nexthop
B	∞	-
C	3	C
D	∞	-
E	∞	-
F	9	C

B:

dest	cost	nexthop
A	∞	-
C	∞	-
D	4	E
E	2	E
F	∞	-

D:

dest	cost	nexthop
A	∞	-
B	4	E
C	∞	-
E	2	E
F	∞	-

F:

dest	cost	nexthop
A	9	C
B	∞	-
C	6	C
D	∞	-
E	∞	-

(b) A:

dest	cost	nexthop
B	12	D
C	3	C
D	8	D
E	10	D
F	9	C

D:

dest	cost	nexthop
A	8	A
B	4	E
C	11	A
E	2	E
F	17	A

(c) C:

dest	cost	nexthop
A	3	A
B	15	A
D	11	A
E	13	A
F	6	F

Question 7

(PD4.14) Suppose we have the forwarding tables shown below 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:

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