C432 Solutions to HW 1

Problem P26

Only new shortest paths discovered at each iteration are shown. Ties resolved in alphabetical order

Iteration	Set M	To t	To u	To v	To w	To y	To z
1	x	-	-	xv(3)	xw(6)	xy(6)	xz(8)
2	xv	xvt(7)	xvu(6)				
3	xvu						
4	xvuw						
5	xvuwy						
6	xvuwyt						
7	xvuwytz						

Problem P27

f) Do others yourself similarly

Iteration	Set M	To t	To u	To v	To w	To x	To y
1	z					zx(8)	zy(12)
2	zx			zxv(11)	zxw(14)		
3	zxv	zxvt(15)	zxvu(14)				
4	zxvy						
5	zxvyu						
6	zxvyuw						
7	zxvyuwt						

Problem P28

Node	To u	To v	To x	To y	To z
z	∞	6	2	∞	0

Problem P30

a

Node	To w	To y	To u
x	2	4	7

b.

Cost of path x-w-u is 2+5=7 and that of x-y-u is 5+6=11. If the cost of x-w becomes 7 or more then x-y-u becomes the new shortest path from x to u (cost of x-w-u will be 12 or more whereas cost of x-y-u is 11) and x will have to advertise this new path to its neighbors. Only if the cost of y-u becomes 0 x-y-u becomes the new shortest path from x to u (Cost of x-y-u will be 6 whereas the cost of x-w-u is 7) and x will have to advertise this new path to its neighbors

c. Cost of x-w can increase up to 6 while keeping x-w-u as the least cost path

Cost of x-y can be any value other than 0 while keeping x-w-u as the least cost path.

In these cases, x will not have to advertise any new path to u.

Problem P31

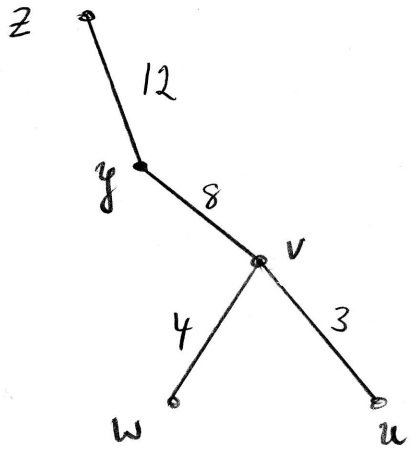
Initial distance vectors

Node	To x	To y	To z
x	0	3	4
y	3	0	6
z	4	6	0

There will be no change in subsequent iterations.

Problem P44

The tree will be as shown below with total cost of 27

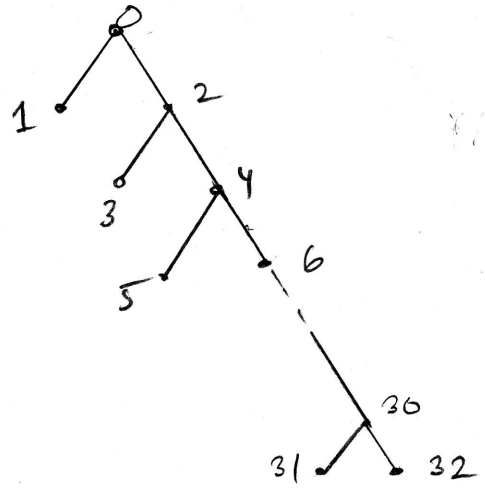


Informal argument why this is a minimal cost tree:

It is seen that every edge Z-Y, Y-V, V-W and V-U is the minimal cost path between its end points.

Problem P45

Binary tree is shown below with node 0 as the sender and nodes 1-32 as receivers



Since it is a spanning tree with 33 nodes, there will be 32 edges and hence the cost of broadcast is 32x1 =32

Cost of unicast along the binary tree can be worked out as below

Cost of reaching 1 and 2 = 1+1 =2

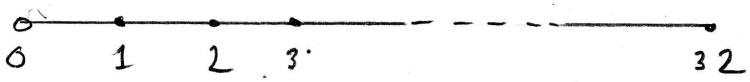
Cost of reaching 3 and 4 = 2+2 =4

And so on

Cost of reaching 31 and 32 = 16+16 =32

Total unicast cost = 2+4+6+…+32 = 2*(1+2+…16) = (2*16*17)/2 = 272

Worst case topology for unicast is as shown below



Cost of unicast = 1+2+…+32 =(32*33)/2 = 528

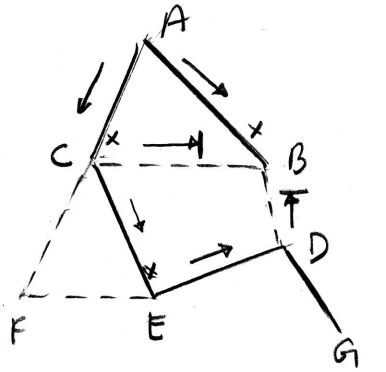
Problem P46

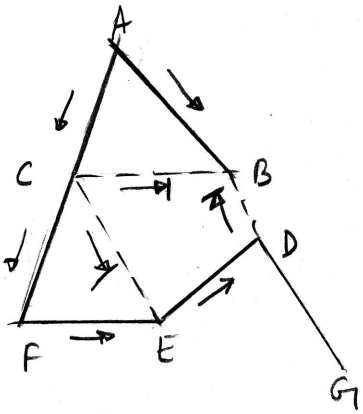
Since A is the source of the broadcast it will send a copy of the message each on A-B and A-C. Hence B will get a copy of the message from A anyway over the direct link A-B

If B gets a copy link C-B too this would mean A-C is shortest path from A to C; otherwise, C would not have sent the message on link C-B under RPF protocol

If B gets a copy of the message from D too, the link E-D should be on the shortest path from D to A. In this scenario, the shortest path from D to A could be either D-E-C-A or D-E-F-C-A

The answer is given by one of the two graphs below





Shortest path to F unknown

Problem P47

Shortest paths from E to the other nodes under the unit cost assumption are the following:

E-C-A

E-C-B (or E-D-B)

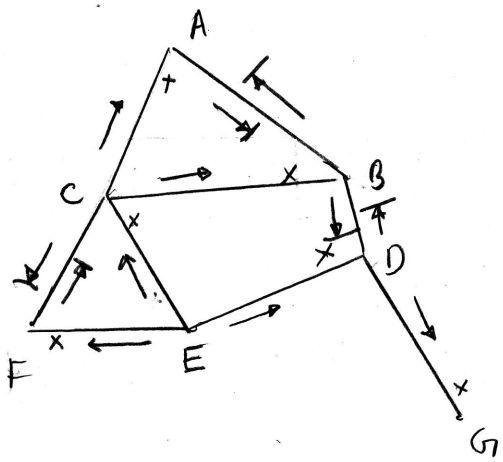
E-C

E-D

E-F

E-D-G

The figure below shows which messages are propagated and which are blocked



Problem P48

In P27 the shortest paths from z to all other nodes were worked out as follows:

To t: zxvt

To u: zxvu

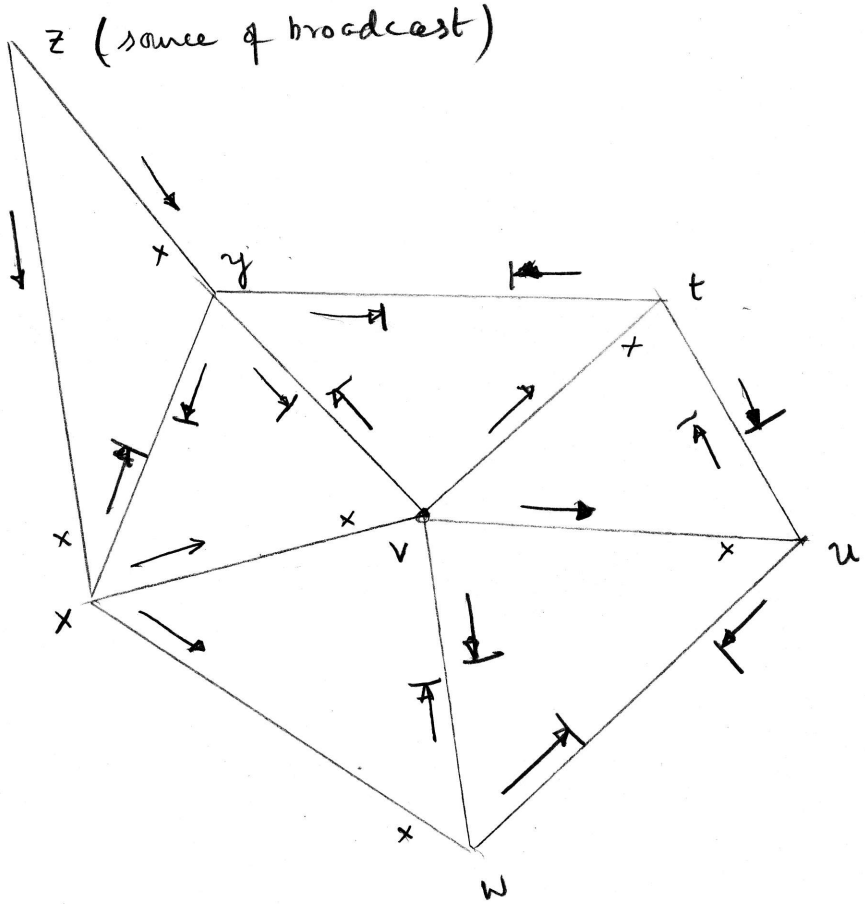
To v: zxv

To w: zxw

To x: zx

To y: zy

Figure below shows which messages are propagated and which are blocked



Problem P49

Shortest paths from the center C to other nodes are the following under the unit cost assumption:

To A: C-A

To B: C-B

To D: C-B-D (or C-E-D)

To E: C-E

To F: C-F

To G: C-B-D-G (or C-E-D-G)

A and F do not send any tree join messages to C since they do not have any hosts forming part of the multicast group.

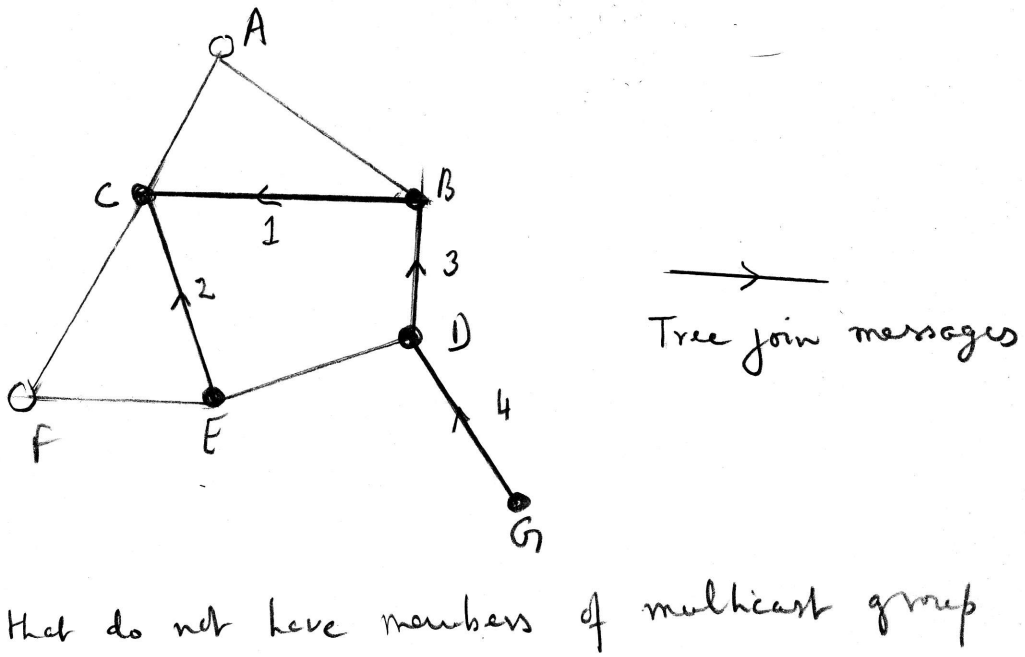
B will send a tree join message on B-C

E will send a tree join message on E-C

D will send a tree join message on D-B-G ; when it reached B the link D-B will be grafted to B-C

G will send a tree join message on G-D-B-C and when it reaches D it will be grafted to the tree

The resulting center based tree is shown below:



Another minimal tree can be developed using node E instead of node B since there was a tie between these two nodes. The two trees have the same total cost

Problem P50

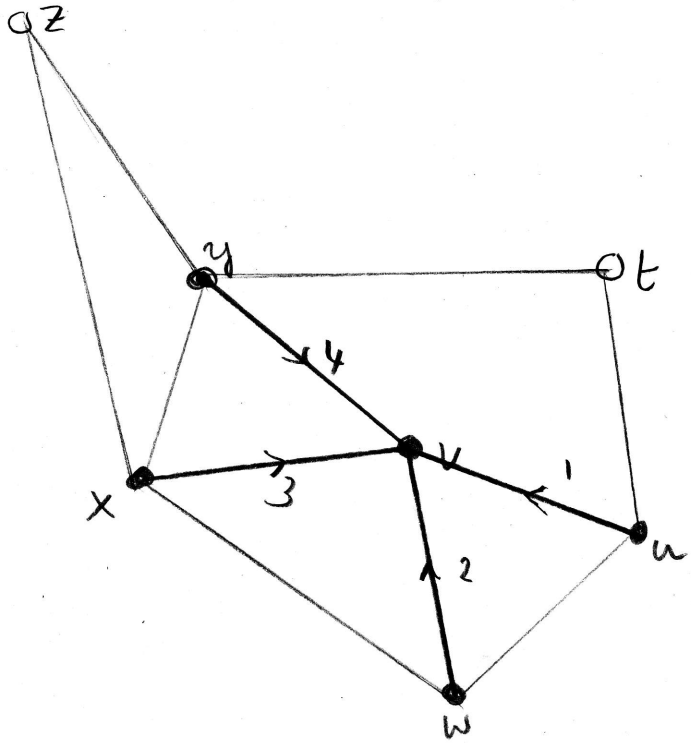
First work out the least cost paths from v to all other nodes using link state:

Iteration	Set M	To t	To u	To w	To x	To y	To z
1	v	vt(4)	vu(3)	vw(4)	vx(3)	vy(8)	∞
2	vu						
3	vux						vxz(11)
4	vuxt						
5	vuxtw						
6	vuxtwy						
7	vuxtwyz						

t and z do not send any tree join message since they do not have any hosts forming part of the multicast group

u,w,x,y each send a tree join message directly to v without involving any grafting

Resulting center based multicast tree is shown below



Tree join messages

○ Nodes that do not have members of multicast group