

**CS557**  
**Spring 2011 Midterm Exam**

Take Home Exam

Due At Start of Class on Tuesday 3/8/11

- This exam has 11 pages, including this cover page. Do all your work on these exam sheets, use the backs of the pages if needed.
- Be specific and clear in your answers.
- Show *all* your work if you wish to be considered for partial credit.

Question	Points	Score
1	15	
2	15	
3	10	
4	15	
5	20	
6	25	
Total:	100	

Name: \_\_\_\_\_

EID: \_\_\_\_\_

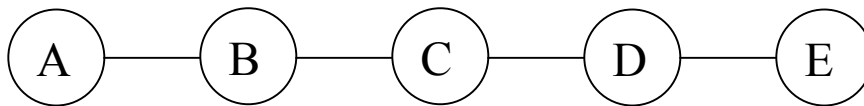
**Problem 1 – Packet Architectures**

A) (3 points) If the single node probability of destruction is 0.1, which redundancy level do you think Paul Baran would recommend? Explain why. If you refer to any figures, be sure to list the figure number and explain why the figure is helpful.

B) (2 points) If the single node probability of destruction is 0.7, which redundancy level do you think Paul Baran would recommend? Explain why. If you refer to any figures, be sure to list the figure number and explain why the figure is helpful.

C) (5 points) Important goals for the DARPA Internet protocols include support for multiple types of communication service and the ability accommodate a variety of networks. List 2 types of communication services and 2 varieties of networks used in today's Internet.

D) (5 points) In the figure below, each link provides perfect reliability and perfect security. In other words, the link will never drop or re-order any packets and packets on the wire cannot be observed or modified.



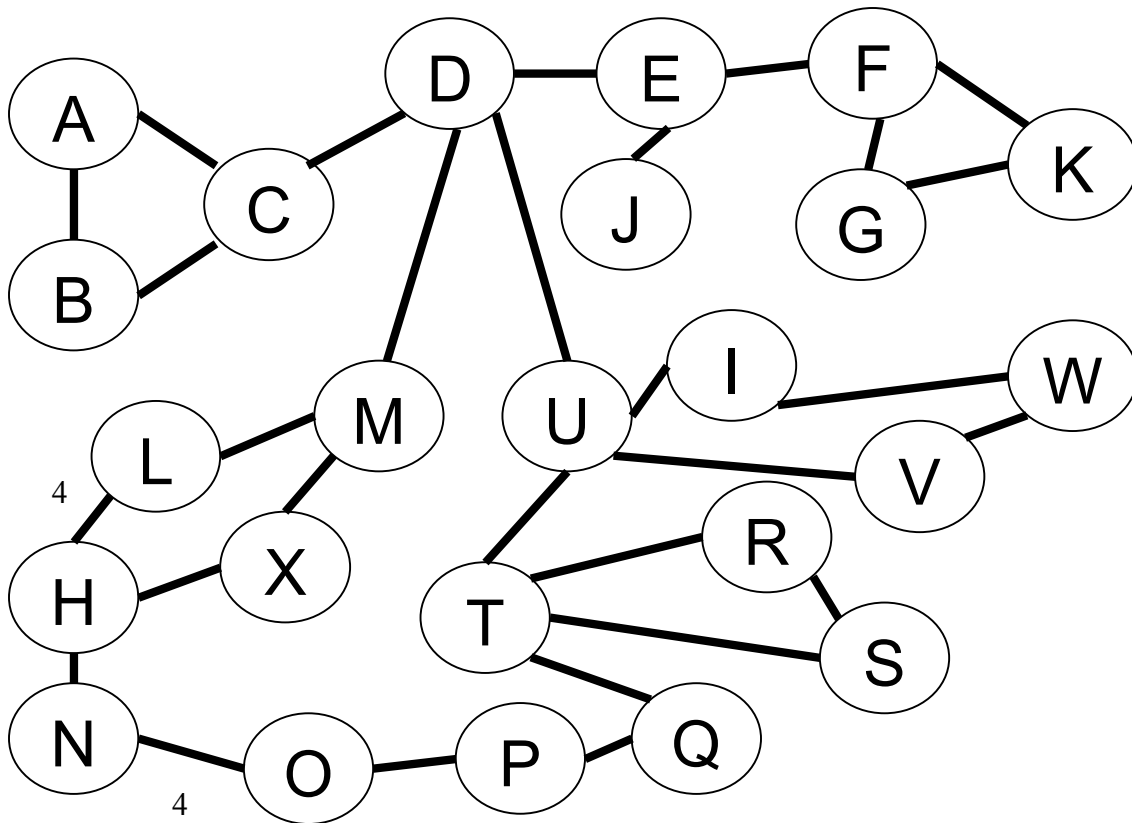
Node A wants to establish a reliable and secure communication channel with node E. Describe how the link properties of perfect reliability and perfect security will (or will not) help in establishing a reliable and secure channel between A and E.

**Problem 2 – Packet Forwarding (15 points).**

A) (5 points) Describe how the FIB, PIT, and Cache are used for forwarding Interest and Data packets in Content Centric Network (CCN = NDN).

B) (10 points). Explain the difference between Level 2 FIB aggregation and Level 4 FIB aggregation. Use an example to illustrate the differences. Be sure to list any advantages Level 4 has over Level 2. And if there are any disadvantages L4 has be sure to list those as well.

**Dan's Sample Network Topology**



Note that link (H,L) has a cost of 4 and link (N,O) also has a cost of 4. All other links have a cost of 1.

### **Problem 3 (10 points)**

Use “Dan’s Sample Network Topology”.

A) (5 points) Assume the network uses a distance vector routing algorithm *with poison reverse*. The network has converged and all nodes have learned the correct shortest path. Then link H-N fails. Describe how a loop may form.

**Your description must consist only of the statements**

“At time \_\_\_\_\_, node \_\_\_\_\_ sends an update to \_\_\_\_\_ containing destination \_\_\_\_\_ and distance \_\_\_\_\_”

“At time \_\_\_\_\_, node \_\_\_\_\_ updates its routing table for destination \_\_\_\_\_; dist \_\_\_\_\_ and next hop \_\_\_\_\_”

You may use the any of the above statements as many times as you like and use them in any order that correctly explains how a loop forms.

B) (5 points) Suppose JJ Garcia’s path finding algorithm is used. Indicate whether path finding will or will not prevent the loop above. If path finding does not prevent the loop, explain why. If path finding does prevent the loop, show the steps a router would take to prevent the loop from forming.

**Problem 4 (15 points)**

A Landmark Routing Algorithm is applied to “Dan’s Sample Network Topology”. A three level Landmark Hierarchy is used on this network.

Node W is the only level two landmark and has a radius of 8.

Nodes W, D, and T are all level one landmarks and each has a radius of 4.

All nodes are level zero landmarks and each has a radius of 2.

A) (5 points) Assign Landmark label (or multiple labels if appropriate) to every node in the graph. The label for node W has been filled in for you.

Node Name	Landmark Label	Node Name	Landmark Label
A		M	
B		N	
C		O	
D		P	
E		Q	
F		R	
G		S	
H		T	
I		U	
J		V	
K		W	W.W.W
L		X	

B) (5 points) Fill in the routing table stored at Node H. The entry for node W.W.W. has been filled in for you. You may need to add lines to the table (or you may not use all the lines in the table).

Landmark	Level	Next Hop
W.W.W	6	X

C) (5 points) List the path of nodes that will be followed when a packet is sent from H to G.

## **Problem 5 (20 points)**

The following questions ask how BGP router 129.82.100.10 will select its best path to a destination. BGP Router 129.82.100.10 has two neighbors, router 1.2.3.4 and router 6.7.8.9. You may find the BGP slides by Tim Griffin and the paper Lixin Gao helpful in understanding the policy configuration syntax.

The policy configuration file at 129.82.100.10 is:

```
router bgp 65503
access-list 1 permit 0.0.0.0 255.255.255.255
neighbor 1.2.3.4 remote-as A1
neighbor 1.2.3.4 route-map isp1 in
route-map isp1 permit
  match ip address 1
  set local-preference P1
neighbor 6.7.8.9 remote-as A2
neighbor 6.7.8.9 route-map isp2 in
route-map isp2 permit
  match ip address 1
  set local-preference P2
```

- A) (5 points) In the configuration above, suppose  $A1 = 65111$   $A2 = 65222$ ,  $P1 = 100$ ,  $P2 = 100$ .  
Router 1.2.3.4 announces a path to 10.0.0.0/8 with  
AS Path = (65111, 65111, 65333) and Med = 50.  
Router 6.7.8.9 announces a path to 10.0.0.0/8 with  
AS Path = (65222, 65333) and Med = 40.

Will router 129.82.100.10 choose the route from neighbor 1.2.3.4 or the route from neighbor 6.7.8.9? Explain why.

- B) (5 points) In the configuration above, suppose  $A1 = 65111$   $A2 = 65222$ ,  $P1 = 100$ ,  $P2 = 90$ .  
Note that all parameters are the same as problem A, except  $P2$  has changed to 90.

Router 1.2.3.4 announces a path to 10.0.0.0/8 with

AS Path = (65111, 65111, 65333) and Med = 50.

Router 6.7.8.9 announces a path to 10.0.0.0/8 with

AS Path = (65222, 65333) and Med = 50.

Will router 129.82.100.10 choose the route from neighbor 1.2.3.4 or the route from neighbor 6.7.8.9? Explain why.

- C) (5 points) In the configuration above, suppose  $A1 = 65111$   $A2 = 65111$ ,  $P1 = 100$ ,  $P2 = 100$ .  
Note that all parameters are the same as problem A, except router 6.7.8.9 has increased its AS Path and  $A2$  has changed to 65111 (this implies router 1.2.3.4 and 6.7.8.9 are in the same AS)

Router 1.2.3.4 announces a path to 10.0.0.0/8 with

AS Path = (65111, 65111, 65333) and Med = 50.

Router 6.7.8.9 announces a path to 10.0.0.0/8 with

AS Path = (65222, 65222, 65333) and Med = 40.

Will router 129.82.100.10 choose the route from neighbor 1.2.3.4 or the route from neighbor 6.7.8.9? Explain why.

- D) (5 points) In the configuration above, suppose  $A1 = 65111$   $A2 = 65222$ ,  $P1 = 100$ ,  $P2 = 100$ .  
Note that all parameters are the same as problem A, except router 6.7.8.9 has increased its AS Path and  $A2$  has changed to 65222 (this implies router 1.2.3.4 and 6.7.8.9 are NOT in the same AS)

Router 1.2.3.4 announces a path to 10.0.0.0/8 with

AS Path = (65111, 65111, 65333) and Med = 50.

Router 6.7.8.9 announces a path to 10.0.0.0/8 with

AS Path = (65222, 65222, 65333) and Med = 40.

Will router 129.82.100.10 choose the route from neighbor 1.2.3.4 or the route from neighbor 6.7.8.9? Explain why.



