FINAL EXAM (5/1/01)

COT 5930 Internet Routing Protocols

Open books and notes

Name ——————————————- SSN ——————————————-

1. (30 pts) For the given network with a given multicast set $\{A, B, C, D\}$, do the following:

   (a) SPT (rooted at A) (for all nodes)

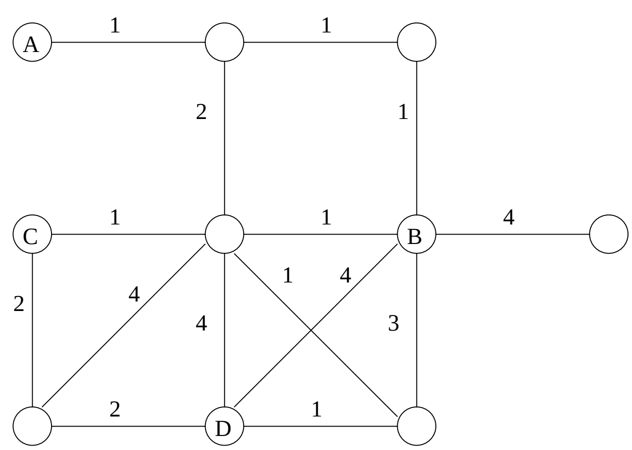
   (b) MST (for all nodes)

   (c) RPF and prunes (rooted at C)

   (d) Steiner tree

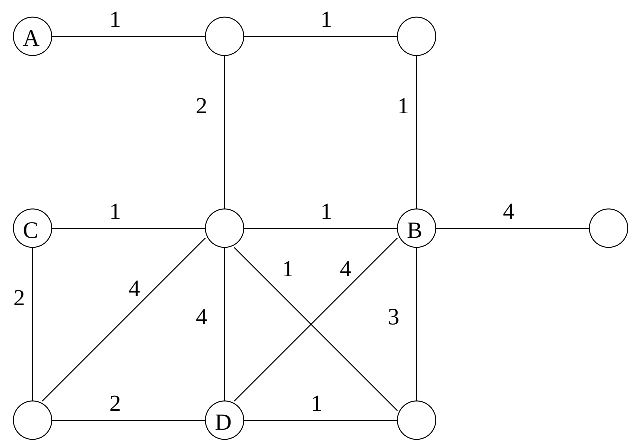
   (e) Core tree (with core B)

(a)

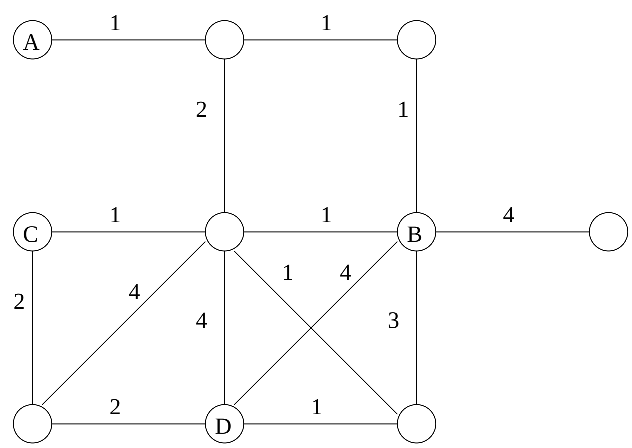


1. (continue)

(b)

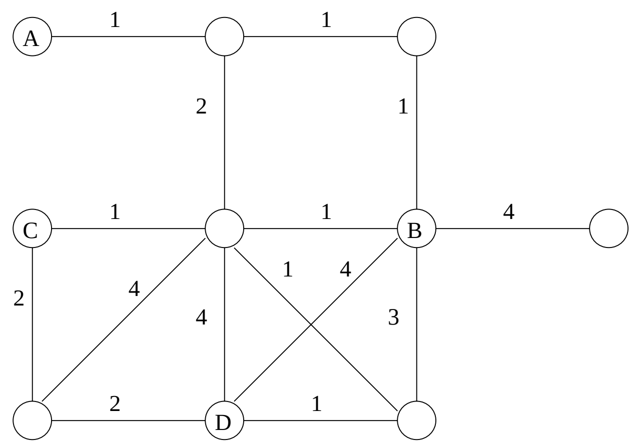


(c)

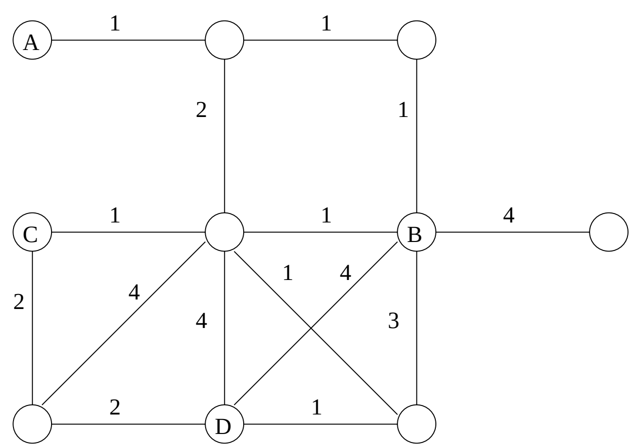


1. (continue)

(d)



(e)



2. (25 pts) For a given network, link reversal A is no worse than link reversal B if (a) *both the number of rounds involved and (b) the total number of links that are reversed* by A are no more than those of B. In addition, either (a) of A is strictly less than (a) of B or (b) of A is strictly less than (b) of B.

   (a) Show an example of six nodes where partial link reversal is no worse than full reversal.

   (b) Show an example of six nodes where full reversal is no worse than partial reversal.

   (c) Show the number of rounds involved and the total number of links that are reversed for each of the above cases.

3. (25 pts) The following questions are related to distance vectors of type (last-hop, distance):

   (a) Does a table of vectors (last-hop, distance) contain more information than a table of vectors (next-hop, distance)? and why?

   (b) Why no one adopt a distance vector approach by keeping (last-hop, distance)?

   (c) Can a table of vectors (last-hop, distance) support both source routing and distributed routing? and why?

   (d) Is it possible to deduct the shortest path for some other source S' (if not all) to destination D at node S based on the associated table of vectors (last-hop, distance)? and why? Assume that S has no knowledge of tables of its neighbors.

4. (15 pts) Suppose source S has the link-state database of the whole network and needs to determine a shortest path from S to D. In addition, S knows that host I is along the shortest path from S to D.

   (a) How will you apply and/or modify the Dijkstra's algorithm so that S can determine the path quickly?

   (b) Show by an example to back up your approach.

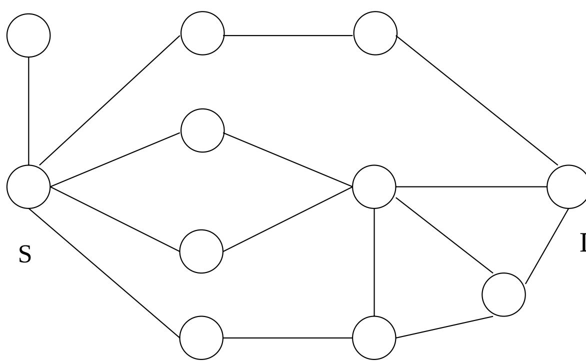
   (c) How will you extend your approach when $I_1, I_2, ..., I_k$ are known a priori as some intermediate nodes along the shortest path from S to D. Note that I_i and I_{i+1} may or may not be adjacent along the shortest path.

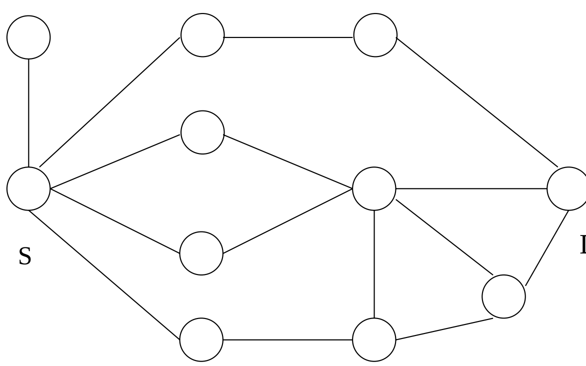
5. (15 pts) Jack proposes a routing protocol for ad hoc wireless networks through flooding. In this protocol, nodes and only nodes that are on shortest paths from source S to destination D can forward the data message. (In ad hoc wireless networks, a shortest path is one with a minimum number of hops from souce to destination.)

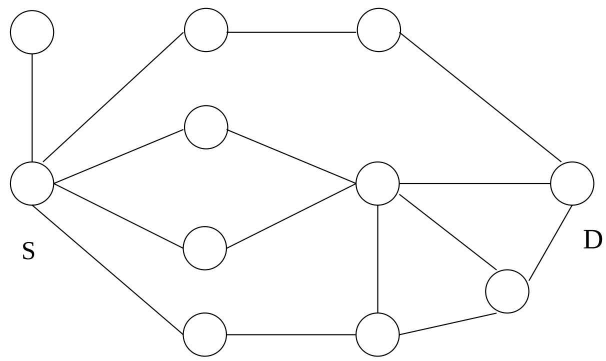
   To identify these intermediate nodes, S first floods the network by sending out a QRY message (node can forward the QRY message). Each QRY message can carry route information, but it is limited only *one route plus distance information*. Destination D will flood a RPY message upon receiving the first QRY message. Intermediate nodes are marked during the reply phase. Each node has limited cache memory and it is limited to Δ routes, with Δ being the maximum node degree. Each message travels at the same speed (one hop per time unit). Each host can send, receive, and process unlimited number of messages at each time unit.

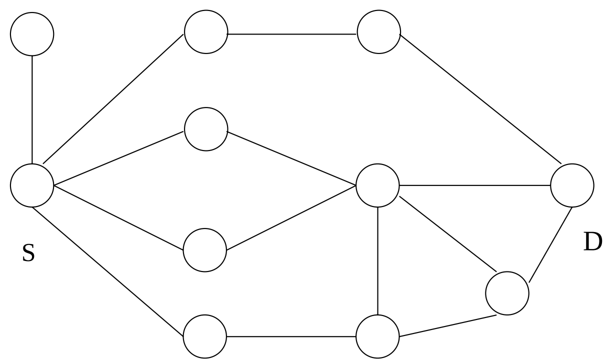
   (a) Complete Jack's design. Make reasonable assumptions as needed.

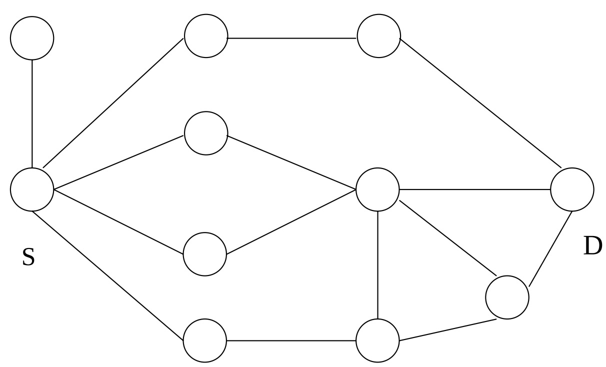
   (b) Describe how intermediate nodes are identified in the following graph. Show how route and cache information is collected and stored in the query phase and in the reply phase.

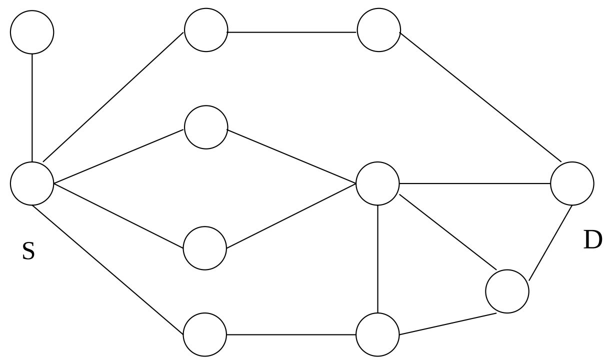


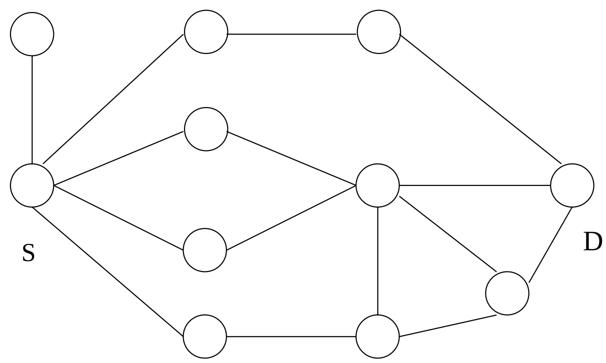


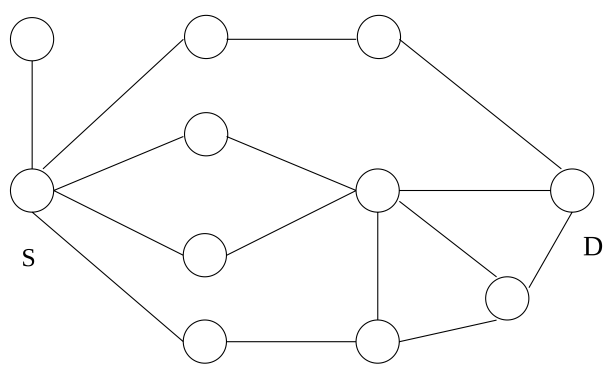

S
D


S
D


S
D


S
D


S
D


S
D