

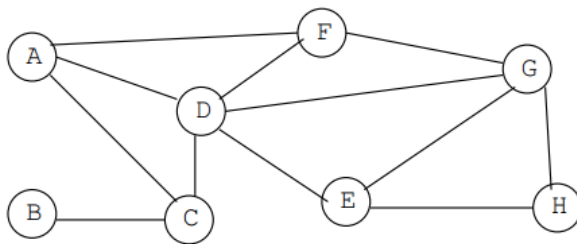
Important Information about the Midterm Exam:

Date/Time: Friday March 3, 2023, from 9:45 am – 11:30 am (During Lecture hours in-class)

Midterm Exam will be a **CLOSED** book exam and will have **20 multiple choice questions and 10 short answer questions**. Exam will be administered on the blackboard and you are required to bring your own laptop. Attendance will be marked during the exam. You are required answer **ALL** questions.

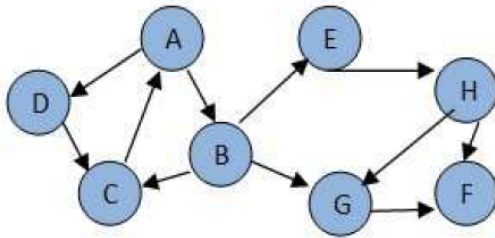
Sample Midterm Exam Questions and Answers

Use the following graph network to answer questions 1-3



1. Number of nodes and edges of the network respectively are
 1. Nodes = 12, Edges = 8
 2. **Nodes = 8, Edges = 12**
 3. Nodes = 10, Edges = 12
 4. Nodes = 12, Edges = 10
2. The graph density of the network is
 1. **0.121212**
 2. 0.212121
 3. 1.011
 4. 2.11
3. The average degree of the graph is
 1. $25/8 = 3.125$
 2. $31/8 = 3.875$
 3. **$23/8 = 2.875$**
 4. $21/8 = 2.625$

Use the following network to answer question 4 and 5.



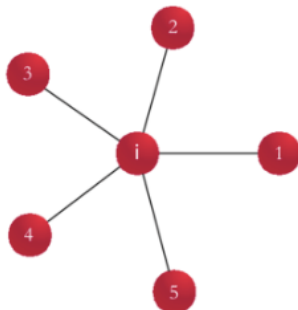
4. Find the order in which nodes are visited in a Breadth First Search.

1. ABCDEGHF
2. ACBDEGHF
3. ABDCEHGF
4. ABDCEGHF

5. Find the order in which nodes are visited in a Depth First Search.

1. ABCDEGHF
2. ABCEHFGD
3. ABDCEHGF
4. ABDCEGHF

6. What is the average clustering coefficient for the following network?



1. $C(i) = 0$
2. $C(i) = 1$
3. $C(i) = 0.5$
4. $C(i) = 0.25$

7. Page rank is the method_____

1. Used in google search engine
2. For rating the importance of web pages objectively and mechanically
3. A simple way to count the number of times a web page is cited
4. All of the above

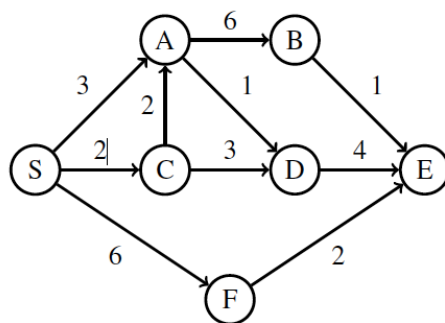
8. Eigenvector centrality is an _____
 1. Centrality of the given central nodes
 2. **An Important nodes has usually important friends**
 3. All of the above
 4. None of the above

9. The number of actors outside the group that are connected to the member of that group is _____
 1. Betweenness centrality
 2. Eigenvector centrality
 3. **Degree centrality of the group**
 4. None

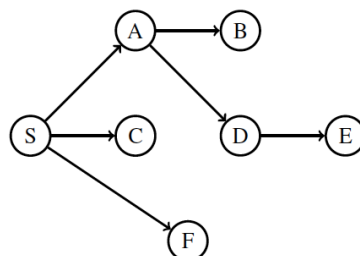
10. Reciprocity can be computed using _____
 1. **Adjacency Matrix**
 2. Simple Matrix
 3. Eigen Vector
 4. All of the above

Provide short answers for the following questions:

1. Run Dijkstra's algorithm on the following directed graph, starting at vertex S. What is the order in which vertices get removed from the priority queue? What is the resulting shortest-path tree?

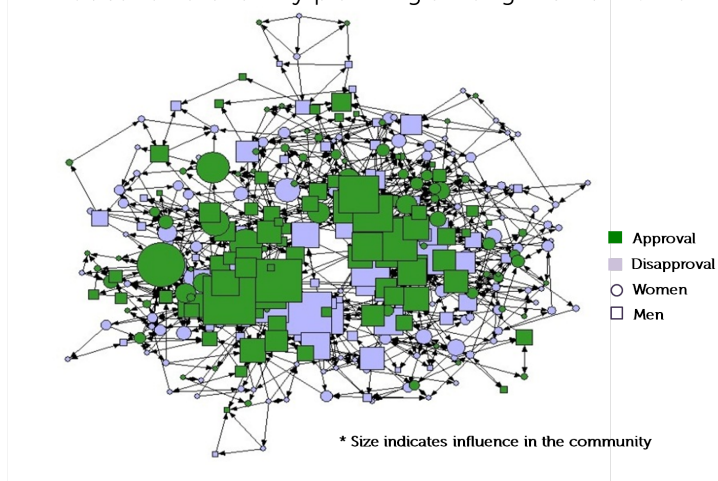


Answer: Dijkstra will visit the vertices in the following order: S, C, A, D, F, E, B.
 Dijkstra will relax the edge from D to E before the edge from F to E, since D is closer to S than F is. As a result, the parent of each node is:



2. Social network maps provide both a visual and a quantitative snapshot of human relationships, as they illustrate how people are connected and share information with each other. In the following social network (map B), are men or women more influential? How might this affect family planning programs? Provide reasons for your answers.

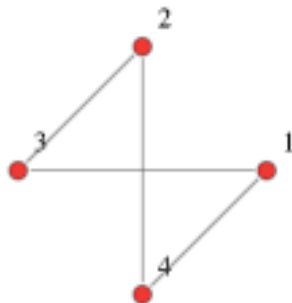
Social Network Map B:
Attitudes toward family planning among men & women



Answer: Men are more connected and more influential.

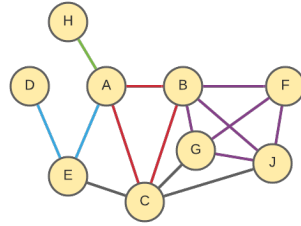
Explanation: Men are represented by squares, and women by circles. The size of their shapes indicates how connected they are. Since the majority of squares (men) are larger than the majority of circles (women), men are more connected than women.

3. Find the adjacency matrix of the following undirected graph.



Answer:
$$\begin{pmatrix} 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 \end{pmatrix}$$

4. Consider the following simple person network.



4.1 What does degree of the person network represent?

4.2 Calculate the degree distribution of the network.

Answers:

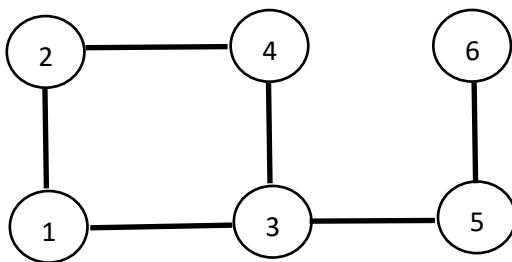
4.1 the degree is the number of people linked from that person's profile (in other words, the total number of parents, siblings, spouses and children).

4.2 Degree Distribution

Degree	%Nodes
1	$2/9 = 22\%$
2	$0/9 = 0\%$
3	$2/9 = 22\%$
4	$3/9 = 33\%$
5	$2/9 = 22\%$

5.

- What do you mean by a diameter of graph network?
- Calculate the diameter of the following graph.
- How do you reduce the diameter of the graph by 1.



Answers:

- The diameter of a graph is the length of the shortest path between the most distanced nodes.
- Diameter = 4
- Adding a link between nodes 4 and 6 reduced the diameter by 1