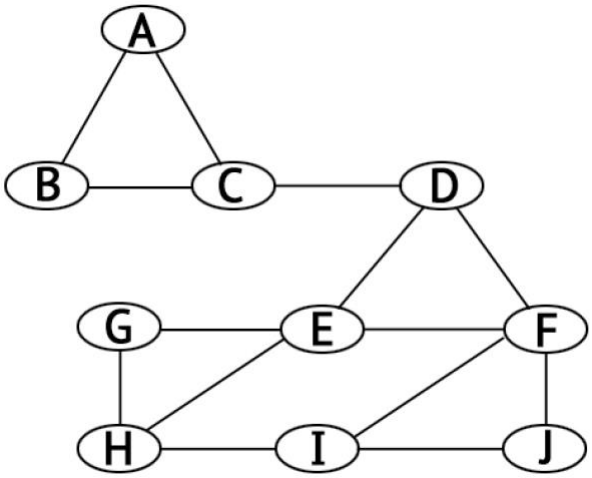
1 Social Networks (25%)

Identify two social networks that you think are interesting. Describe them in terms of nodes and edges in the networks, and their main characteristics.

2 Graph Theory (25%)

Consider the following network:



1. How many connected components are in this graph? Give a brief explanation for your answer.
2. List all node(s) and edge(s) that their deletion would result in a graph with several connected components.
3. In the BFS traversal of this graph that starts at node E, what are the level-3 nodes? What is the distance between nodes E and C based on BFS traversal?

3 Graph Theory (25%)

When we think about a single aggregate measure to summarize the distances between nodes in a given graph, there are two natural quantities that come to mind. One is the diameter, which we define to be the maximum distance between any pair of nodes in the graph. Another is the average distance, which, as the term suggests, is the average distance over all pairs of nodes in the graph. In many graphs, these two quantities are close to each other in value. But there are graphs where they can be very different.

1. Describe an example of a graph where the diameter is more than three times as large as the average distance.
2. Describe how you could extend your construction to produce graphs in which the diameter exceeds the average distance by as large a factor as you'd like. (That is, for every number c, can you produce a graph in which the diameter is more than c times as large as the average distance?)

4 Strong and Weak Ties (25%)

Consider the following network, in which each edge, except the edge connecting nodes b and c, is labeled as a strong tie (S) or a weak tie (W).

1. According to our discussion about strong and weak ties, with the strong triadic closure assumption, how would you expect the edge connecting b and c to be labeled? Give a brief (1-3 sentence) explanation for your answer.

2. What are the differences between weak and strong ties in social networks. Use the above comparison to explain the strength of weak ties in social networks.