Name: _____ **USC ID:** _____

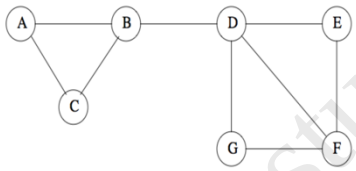
INF 553 - SPRING 2020 QUIZ 11 (10 Points)

1. [1 Point] Explain the concept of "Communities" in **Social Network** Graphs taught in class. Explain this with the help of an example.

   Ans: In Social Networks, communities are groups of people such that people within each group are densely connected to each other internally. For eg, in a facebook social network graph, we can have communities such as a set of people who play squash or a set of people who went to the same college. We can find such groups of people by looking at their common friends etc.

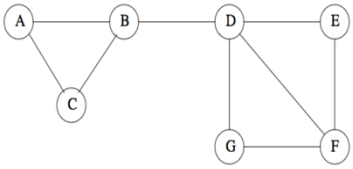
2. [1 Point] Explain Non-Overlapping vs. Overlapping Communities.
   Ans: In overlapping communities, communities can share nodes with other communities where as in non-overlapping communities, communities do not share nodes with other communities.

3. [1 Point] Use the Girvan-Newman algorithm to calculate the betweenness of each edge (do this for Node B only i.e. the starting node is B). Write down the edges and their betweenness values in the format below:
   (Edge1, Edge2) = Betweenness Value
   Eg: (F, E) = 3



   Ans:
   (A, B) = 1
   (B, C) = 1
   (B, D) = 4
   (D, E) = 1
   (D, F) = 1
   (D, G) = 1

4. [1 Point] Write down the adjacency matrix for the graph.



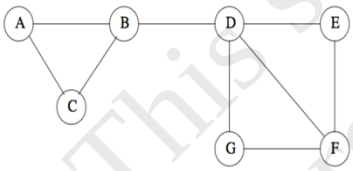
Enter the values for the matrix shown below. Eg. for Row 1, enter [0, 0, 1, 0, 1, 1, 1]

	A	B	C	D	E	F	G
A	Row 1						
B	Row 2						
C	Row 3						
D	Row 4						
E	Row 5						
F	Row 6						
G	Row 7						

Ans:

	A	B	C	D	E	F	G
A	0	1	1	0	0	0	0
B	1	0	1	1	0	0	0
C	1	1	0	0	0	0	0
D	0	1	0	0	1	1	1
E	0	0	0	1	0	1	0
F	0	0	0	1	1	0	1
G	0	0	0	1	0	1	0

5. [1 Point] Write down the degree matrix for the graph.



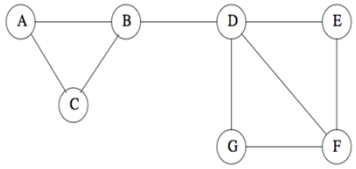
Enter the values for the matrix shown below. Eg. for Row 1, enter [0, 0, 1, 0, 1, 1, 1]

	A	B	C	D	E	F	G
A	Row 1						
B	Row 2						
C	Row 3						
D	Row 4						
E	Row 5						
F	Row 6						
G	Row 7						

Ans:

	A	B	C	D	E	F	G
A	2	0	0	0	0	0	0
B	0	3	0	0	0	0	0
C	0	0	2	0	0	0	0
D	0	0	0	4	0	0	0
E	0	0	0	0	2	0	0
F	0	0	0	0	0	3	0
G	0	0	0	0	0	0	2

6. [1 Point] Write down the Laplacian matrix for the graph.



Enter the values for the matrix shown below. Eg. for Row 1, enter [0, 0, 1, 0, 1, 1, 1]

Ans:

	A	B	C	D	E	F	G
A	2	-1	-1	0	0	0	0
B	-1	3	-1	-1	0	0	0
C	-1	-1	2	0	0	0	0
D	0	-1	0	4	-1	-1	-1
E	0	0	0	-1	2	-1	0
F	0	0	0	-1	-1	3	-1
G	0	0	0	-1	0	-1	2

7. [2 Points] Explain the Affiliation Graph Model (AGM) in detail? And what is the relaxation technique for AGM? Explain.
Ans: AGM is a generative model that produces a network from community affiliation. The model consists of nodes, communities, memberships and probability of each community. Each community has a single probability. For each pair of nodes in a community say community A, we connect them with a probability pA.

In the relaxation technique, memberships have strength. The membership strength of a node to a community should be greater than zero, otherwise there is no membership.

8. [0.5 Point] Is the adjacency matrix of an undirected graph always symmetric? (True/False)
Ans : True

9. [0.5 Point] What is the value of the smallest eigen value for every Laplacian Matrix

a) -2
b) -1
c) 0
d) 1
e) 2
Ans: c

10. [1 Point] Explain briefly the three stages of spectral **partitioning** algorithm.
Ans: Pre-processing: Build Laplacian matrix L of the graph
Decomposition: Find eigenvalues λ and eigenvectors x of the matrix L. Map vertices to corresponding components of λ2
Grouping: Sort components of reduced 1-dimensional vector. Identify clusters by splitting the sorted vector in two