CSC 641 Network Science
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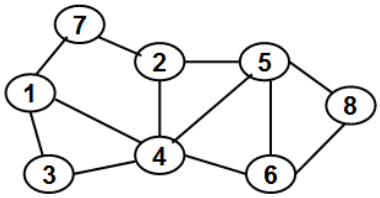
Sample Questions

Module 1: Graph Theory for Network Science

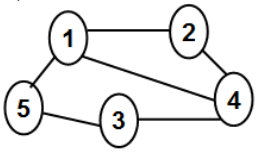
1) For the graph given below, find the probability distribution for the degree of the vertices and use the distribution to determine the average degree of the vertices in the graph.



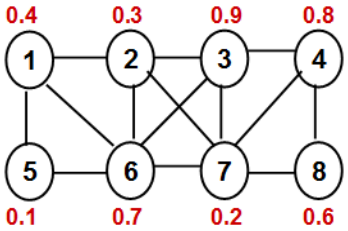
2) Find the average degree of the vertices in each of the networks below.

Network Name	Nodes	Links	Directed / Undirected	# Nodes, N	# Links, L	Average Degree, <K>
E. Coli Metabolism	Metabolites	Chemical reactions	Directed	1,039	5,802	
Yeast Protein Interactions	Proteins	Binding interactions	Undirected	2,018	2,930	
Power Grid	Power plants, Transformers	Cables	Undirected	4,941	6,594	
Science Collaboration	Scientists	Co-authorships	Undirected	23,133	186,936	
Mobile Phone Calls	Subscribers	Calls	Directed	36,595	91,826	
Email	Email addresses	Emails	Directed	57,194	103,731	
Internet	Routers	Internet connections	Undirected	192,244	609,066	
Actor network	Actors	Co-acting	Undirected	212,250	3,054,278	
WWW	Web pages	Links	Directed	325,729	1,497,134	
Citation network	Papers	Citations	Directed	449,673	4,707,958	

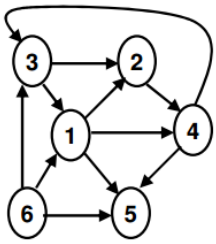
4) Determine the assortative index of the following graph.



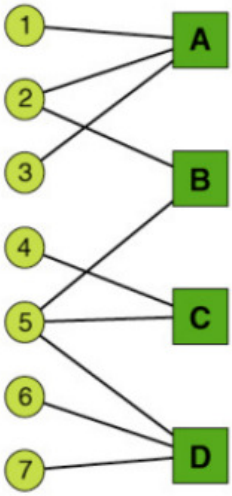
5) Determine the maximal node matching, maximal assortative matching and maximal dissortative matching for the following graph. Determine the following for each of the above: (i) the set of edges constituting the matching (ii) the % of node matches (iii) assortative index of the matching.



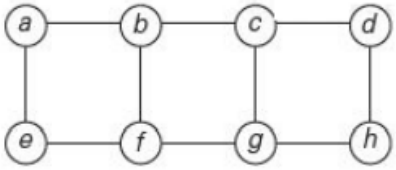
6) Determine the cocitation and bibliographic coupling matrices of the following directed graph:



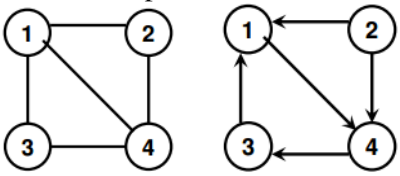
7) Find the vertex projection and group projection of the following bipartite graph. The vertices are identified with a numerical ID whereas groups are identified with an alphabetical ID.



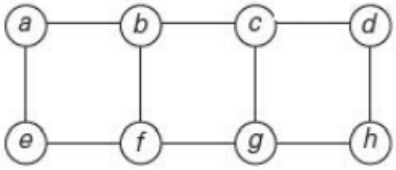
8) Determine whether the following graph is bipartite or not using the Breadth First Search algorithm. If the graph is bipartite, determine the two partitions.



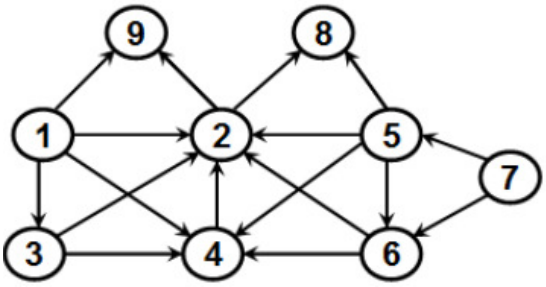
9) Find the number of walks of lengths 2 and 3 in the following graphs using the method of adjacency matrix multiplication.

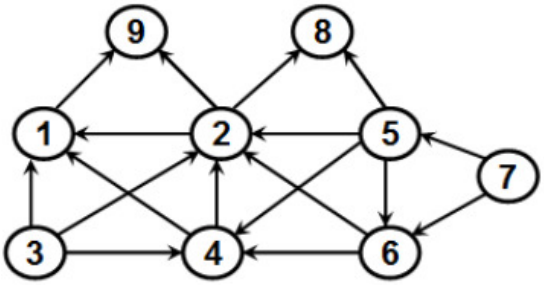


10) Determine the following for the graph below: (i) Diameter (ii) Radius (iii) Weiner Index (iv) Average Path Length and (v) Set of vertices constituting the "center" of the graph.



11) For each of the graphs below, determine
(i) Whether the graph is a DAG? If the graph is DAG, determine a topological sort of the vertices of the graph.
(ii) Whether or not there exists at least one strongly connected component with more than one vertex? If the graph has a strongly connected component involving more than one vertex, determine each of such strongly connected components.





12) Consider the undirected versions of the graphs in Q11. Determine the local clustering coefficient of each of the vertices in these graphs.