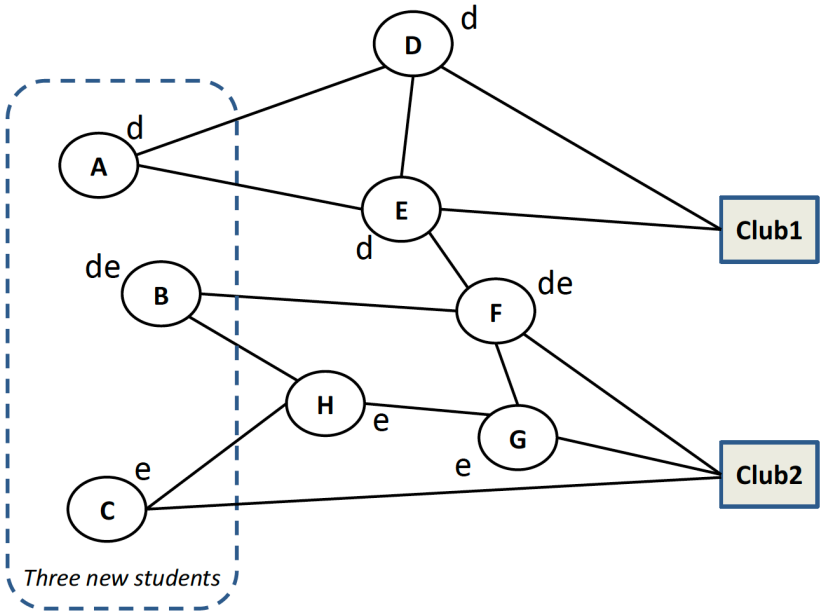
Assignment – Exam #1

1) Suppose a node A in some network satisfies the Strong Triadic Closure property. Is it possible to have a local bridge that is a strong tie? Explain your answer. Cite some reasons that lead to triadic closure formation in social networks.

2) Consider the following social-affiliation network consisting of some college friends and two clubs in their college town that they like to (predominately) frequent on Friday evenings. Three new students, Alice (A), Bikash (B) and Claire (C), have just transfered to the college. Alice and Bikash each have a friend or two in the group already, but know little about the clubs; Claire has already decided to hang out at Club 2 based on a trip to scope out the town before she transferred. List all possible links that could be involve A, B or C. Furthermore, classify one of them in triadic closure, focal closure or membership closure.



3) We discussed some important topological metrics, such as degree distribution and clustering coefficient. How we can map these metrics into social network metrics?

4) Given the degree distribution measure, explain how are the main differences among random networks, small-world networks and preferential attachment networks.

5) In the basic “six degrees of separation” question, one asks whether most pairs of people in the world are connected by a path of at most six edges in the social network, where an edge joins any two people who know each other on a first-name basis.
Now let’s consider a variation on this question. Suppose that we consider the full population of the world, and suppose that from each person in the world we create a directed edge only to their ten closest friends (but not to anyone else they know on a first-name basis). In the resulting “closest-friend” version of the social network, is it possible that for each pair of people in the world, there is a path of at most six edges connecting this pair of people? Explain.

6) Explain how the small-world model is able to provide a network with high clusterization coefficient and small diameter.

7) The classical PageRank algorithm assumes that the random walker chooses the next hop uniformly randomly from the available outgoing links. However, in practice Google does not treat all links equally and uses several proprietary heuristics to determine the importance of a link. Assume that the weight (a positive real) of each link is known and the random walker chooses the next hop with the probability proportional to the outgoing link's weight. What modifications need to be made to the PageRank random walker model to take the link weights into account?

8) What are the main differences of the HITS algorithm implementation and the Page-Rank algorithm implementation?

9) Consider a star network, where a single node is connected to N-1 degree-one nodes. Assume that $N >> 1$. Is this network assortative or disassortative? Explain why.

10) Does the concept of homophily more general than the concept of assortativity? Explain why.

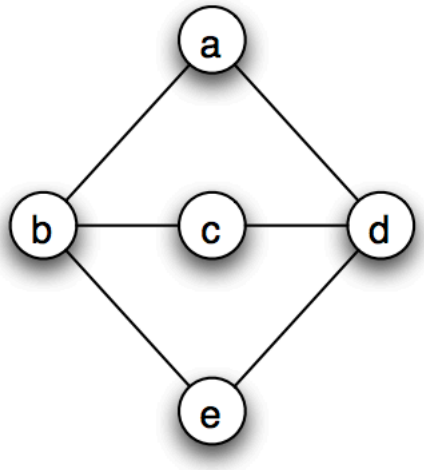
11) Explain the possible range of values for the degree correlation coefficient with respect to the assortative and disassortative networks definitions.

12) Is it possible to identify if homophily is a result of selection or Social Influence, without looking to the temporal evolution of the network? Explain why.

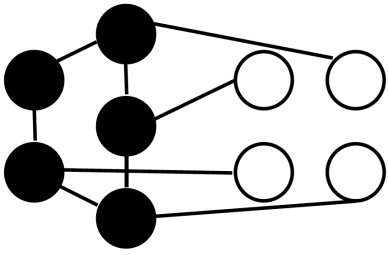
13) Describe the homophily test approach.

14) Give one example of perfectly assortative network.

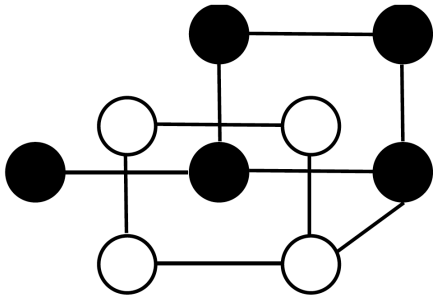
15) Consider the social network represented in the figure bellow. Suppose that this social network was obtained by observing a group of people at a particular point in time and recording all their friendship relations. Now suppose that we come back at some point in the future and observe it again. According to the theories based on empirical studies of triadic closure in networks, which new edge is most likely to be present? (I.e. which pair of nodes, who do not currently have an edge connecting them, are most likely to be linked by an edge when we return to take the second observation?) Also, give a brief explanation for your answer.



16) Which of the following networks exhibit the higher extent of homophily? Justify your answer with the relevant numerical computations.

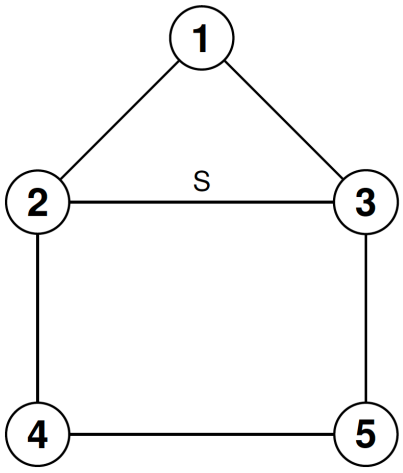


Network A



Network B

17) Consider the following network:



Assume that the nodes obey the strong triadic closure property and the only edge weight known is a strong connection between nodes 2 and 3. List all the valid configurations of the other edge weights.