

HOMEWORK 5

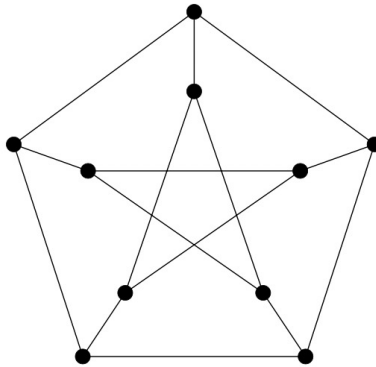
NAME:

STUDENT ID:

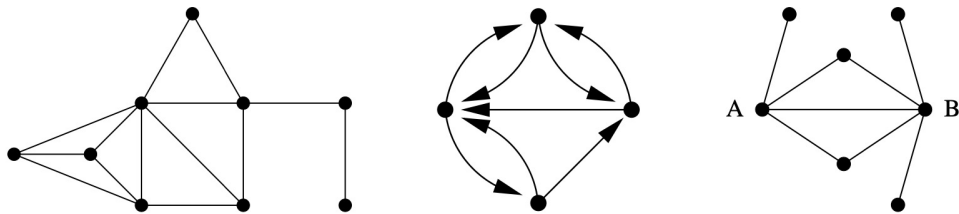
- Reasoning and work must be shown to gain partial/full credit
- Please include the cover-page on your homework PDF with your name and student ID. Failure of doing so is considered bad citizenship.

1. (1–4 points) **Lecture 7 Questions:** Consider the following networks:

(a) (25%) Calculate the closeness centrality of each of the nodes in this network:

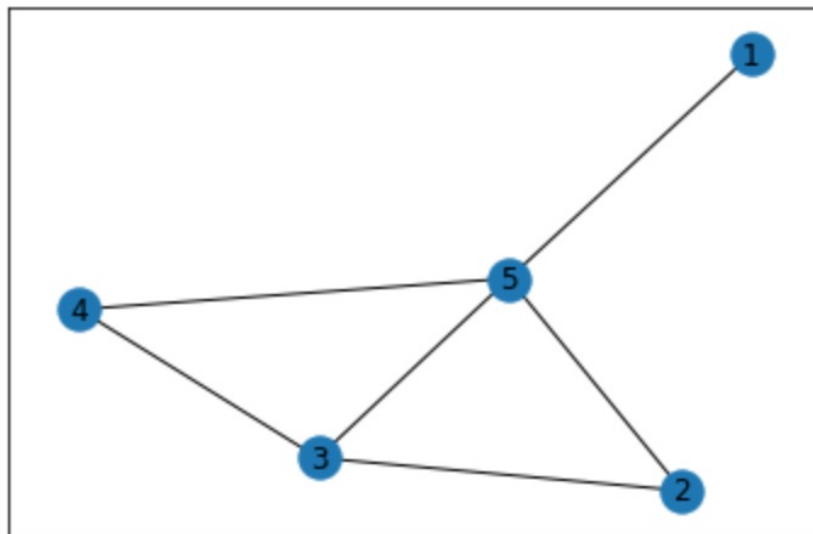


(b) (50%) Consider these three networks:



1. Find a 3-core in the first network.
2. What is the reciprocity of the second network?
3. What is the cosine similarity of nodes A and B in the third network?

(c) (25%) Calculate the local clustering coefficient of each node in this network:



2. (1–4 points) **Lecture 8 Questions:** Consider the random graph $G(n, p)$ with n large.
- (a) (25%) If the network has a giant component that fills exactly half of the network, what is the average degree of a node?
 - (b) (25%) For this same random graph what is the probability that a node has degree exactly 5?
 - (c) (25%) What is the probability that a node belongs to the giant component if it has degree exactly 5?
 - (d) (25%) Hence or otherwise, calculate the fraction of nodes in the giant component that have degree exactly 5.
3. (1–4 points) **NetworkX Coding:** Consider the Erdős-Rényi graph or a binomial graph in NetworkX with the number of nodes $n = 20$ and probability for edge creation $p = 0.2$ (hint: $G = nx.gnp_random_graph(20, 0.2, seed = 1096)$).
- (a) Draw this graph and compute transitivity of this graph.
 - (b) Compute the clustering coefficient for each node and the average clustering coefficient for the graph.
 - (c) Plot the graph with the colormap of the various metrics of centrality, including Degree Centrality, Eigenvector Centrality and Closeness Centrality. (See examples of Week4_tutorials.ipynb in the Canvas.)
 - (d) Compute degree assortativity of graph.
 - (e) If $p = 0.1$, what are the above metrics and what is the minimum p for which you have a giant component?