Homework 2: This assignment is due on 04/05/2016 11:00 AM. Please hand in your homework in class, NO emails!

1: Centrality & Clustering (25%)

Consider a complete graph with $n$ nodes.

(a) Compute the degree centrality of each node as a function of $n$.

(b) Compute the closeness centrality of each node as a function of $n$.

(c) Compute betweenness centrality of each node as a function of $n$.

2: Homophily & Network Formation (25%)

Given an affiliation network $G$, we define a match $M$ in $G$ as a subset of the edges in which no two edges share a common vertex. For example, $M=\{A-X, C-Z, D-Y\}$ is a match obtained from the graph in question 3(a).

Let’s assume that you are given an affiliation network with weighted edges where weights indicate the strength of the membership. The weight of a match $M$ is defined as the sum of the weights of its edges. Give an algorithm that can find a match with the maximum weight in a weighted affiliation network.

3: Homophily & Network Formation (25%)

Given a an affiliation network, showing the membership of people in different social foci, researchers sometimes create a projected graph on just the people, in which we join two people when they have a focus in common.

(a) Draw a projected graph for the following membership graph treating nodes A-F as people and nodes X-Z as social foci.

![Projected Graph](image-url)
(b) Suppose that you are trying to infer the structure of a bipartite affiliation network using the projected network on just the set of people shown in the following network. Explain why any affiliation network capable of producing this projected network must have at least four foci?

4: Structural Balance (25%)

Together with some anthropologists, you’re studying a sparsely populated region of a rain forest, where 50 farmers live along a 50-mile-long stretch of river. Each farmer lives on a tract of land that occupies a 1-mile stretch of the river bank, so their tracts exactly divide up the 50 miles of river bank that they collectively cover. (The numbers are chosen to be simple and to make the story easy to describe.) The farmers all know each other, and after interviewing them, you’ve discovered that each farmer is friends with all the other farmers that live at most 20 miles from him or her, and is enemies with all the farmers that live more than 20 miles from him or her.

You build the signed complete graph corresponding to this social network, and you wonder whether it satisfies the Structural Balance property. Is this network structurally balanced or not? Provide an explanation for your answer.