Exercises for network centralities

1. Given an undirected and unweighted graph, G, write a function that determines the number of walks of length k between any two nodes.

Hint: Implement two versions – the first, naïve version based on for loop to determine the matrix multiplication, and the second, based on a divide and conquer algorithm for matrix multiplication.

2. Write a function that checks whether or not a given directed graph is irreducible.

Hint: Use the definition of irreducibility in terms of strong connectedness. You may want to use the shortest path solution based on Floyd's algorithm from last lecture.

3. Write a function to implement the Katz centrality by using the equivalence

$$C_l\ (u_i) = \sum_{l=1}^{\infty}\sum_{j=1}^{n} \beta^l a_{ji}^l = (((I - \beta A^T)^{-1} - I)\mathbf{1})_i$$

Homework

1. Write a function that determines the Bonacich centrality based on equations provides in the lecture. Is there an association between Bonacich and eigenvalue centrality for a given graph? Test this by using the Pearson correlation between the two vectors in three graphs of your choice.

2. Write a function that checks if the transitivity of a given graph G with n nodes and m edges is larger than the average of the transitivities of 100 realization of Erdos-Renyi graphs with n nodes and m edges. Use your own function to determine transitivity of a graph.