Homework # 1

Due date: February 20, 2020 (before the lecture begins)

Problem 0 (0 points) The following chapters in **Newman** are related to this homework and are encouraged to be read as part of this homework:

- Chapter 6 Mathematics of networks

- Chapters 7.1-7.3 Measures and metrics

- Chapter 10 The structure of real-world networks

Problem 1 (10 points) Solve Problem 10.2 from **Newman**

Problem 2 (20 points) Solve Problem 10.3 from **Newman**

Problem 3 (20 points) Solve Problem 7.3 from **Newman**

Problem 4 (10 points) Solve Problem 7.5 from **Newman**

Problem 5 (20 points)
Download the citation data set from `http://networksciencebook.com/translations/en/resources/data.html` (see file citation.edgelist.txt). Use this data to:

- Build a node degree distribution, compute its parameters and and visualize it (in both power law and log-log forms)

- Compute the eigenvalue, Katz and PageRank centralities for this network.

Problem 6 (20 points)
Consider the random graph $G(n, p))$ and assume that the mean degree of this graph is c. Show the following:

- A probability that a node of degree k belongs to a small component is given by $(1 - S)^k$, where S is a fraction of the network given by the giant component

- A fraction of the nodes with degree k in **all** small components is $\frac{e^{-c}c^k(1-S)^{k-1}}{k}$