ACMS 80770-03: Deep Learning with Graphs
Homework 1

Handed out: Thursday, September 1, 2022

Due: Tuesday, September 13, 2022 3:00 PM

Notes:

- Software resources for this homework are available on course's GitHub repository.

- Use the provided latex file to submit your written work.

- Gradescope will only accept programming submissions through Bitbucket or GitHub.

- Gradescope uses MOSS to detect similar submissions. Copying and pasting from classmates, once detected, are regarded as violation of the honor code.

Problem 1: Katz centrality is defined as

$$\boldsymbol{c}_{Katz} = \beta(\boldsymbol{I} - \alpha\boldsymbol{A})^{-1}\overrightarrow{\boldsymbol{1}},$$

where $\overrightarrow{\boldsymbol{1}}$ is a vector of ones and $\alpha, \beta > 0$ are constants. What values of α guarantee convergence of the Katz centrality?

Problem 2: Use the concept of walks between two nodes $v_i \in V$ and $v_j \in V$ of graph $G = (V, E)$ to derive a relation to compute the total number of common neighbors $|N(v_i) \cap N(v_j)|$ between nodes v_i and v_j.

Problem 3: For nodes $v_i \in V$ and $v_j \in V$ of graph $G = (V, E)$, Jaccard's local overlap similarity measure is defined as

$$S_{ij}^{\text{Jaccard}} = \frac{|N(v_i) \cap N(v_j)|}{|N(v_i) \cup N(v_j)|}$$

A. Write a program to compute Jaccard's similarity matrix **S**.

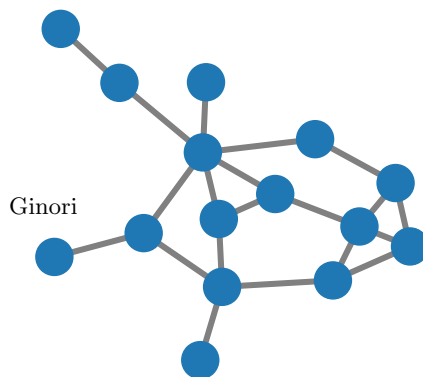B. Plot the similarity between "Ginori" family and other families in the Florentine Families graph (draw an edge colored by the corresponding similarity value).

Figure 1: Florentine Families graph