**Homework-1-Report**

Analysis of Two Social Network Graphs

**Graph 1: Facebook Ego Networks (Undirected Graph)**

The first dataset represents Facebook ego networks, where each node is a Facebook user, and edges represent friendships between users.

* **Basic Statistics**:
* **Nodes**: 4,039, representing individual users.
* **Edges**: 88,234 connections, indicating the number of friendships between users.
* **Clustering Coefficient**: 0.6055, showing that many users tend to form tightly-knit clusters, where friends of one user are likely to be friends with each other.
* **Graph Density**: 0.01082, suggesting that only about 1% of all possible connections exist, showing sparse global connectivity but strong local clusters.
* **Top 5 Nodes by Degree Centrality**:
* Nodes 107, 1684, 1912, 3437, and 0 were identified as the most "popular" users, with Node 107 having the highest degree centrality at 0.2588. This indicates that these users are hubs within the network, with Node 107 directly connected to about 25.9% of the users.
* **Node Similarity (107 and 3437)**:
* The shortest path distance between these nodes is 2, meaning they are separated by one intermediary node.
* The Jaccard coefficient is low (0.0006285), indicating minimal overlap in their neighbors, while the Adamic-Adar index is 0.2387, suggesting that their shared neighbor has a valuable role in their connectivity.
* **Degree Distribution**:
* The degree distribution exhibits power-law characteristics, where a few nodes have very high degrees (connections), while most have relatively few connections.

**Graph 2: Epinions Trust Network (Directed Graph)**

The second dataset comes from the Epinions website, where users can decide whether to trust others, forming a directed "who-trusts-whom" network.

* **Basic Statistics**:
* The network is sparse, with most potential trust relationships not realized, indicating selective trust behavior among users.
* The average in-degree and out-degree are balanced, meaning users trust and are trusted by similar numbers of others.
* The moderate clustering coefficient shows that some users form tightly-knit trust communities, though these are not widespread.
* **Top 5 Nodes by In-Degree and Out-Degree**:
* **In-Degree**: Nodes 18, 143, 737, 790, and 136 are trusted by the most users, with Node 18 being the most trusted (in-degree centrality: 0.039998).
* **Out-Degree**: Nodes 645, 763, 634, 71399, and 3924 are the most active in trusting others, with Node 645 having the highest out-degree centrality (0.023735).
* **Node Similarity (Nodes 18 and 645)**:
* Jaccard Similarity, Cosine Similarity, and Adamic-Adar index suggest that these nodes, representing high in-degree and out-degree, show the highest similarity within their groups, indicating significant influence.
* **Degree Distribution**:
* Most nodes in the network have a very low degree, but a small subset has a high degree (up to 3,000 connections), indicating the presence of highly influential or active users.

**Insights**

* **Facebook Ego Network**: This graph exhibits strong clustering, where users form tight-knit communities. Nodes with high degree centrality are local influencers within their clusters, but globally, the graph remains sparse.
* **Epinions Trust Network**: Trust relationships are selective, with only a few members accumulating a significant amount of trust. High in-degree nodes are perceived as reliable, while high out-degree nodes actively extend trust to others.

Both networks demonstrate power-law distributions, highlighting the presence of highly influential nodes that play a central role in their respective social structures.