

# Graph Social Network

## Major Project Goal

In the scope of this project, We have to implement the Betweenness and Closeness centrality metrics and rank the nodes of the given two graph datasets which are Zachary Karate Club Network and Facebook Social Network.

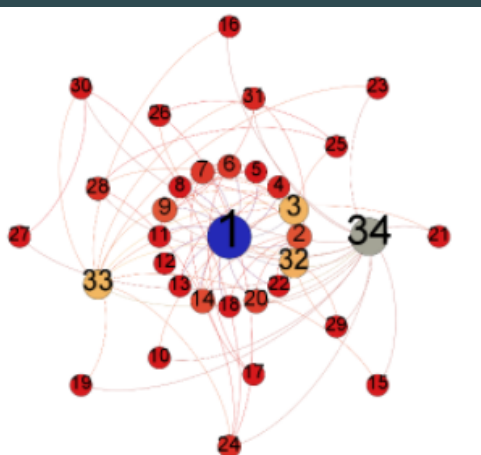
## Explanation of Centrality Metrics

Centrality metrics are used to identify the most important nodes within a graph. There are various centrality metrics including Degree, Closeness, Betweenness, Eigenvector, Katz, PageRank, etc. In the scope of this project, We are going to implement the following two centrality metrics and test on the given two graph datasets.

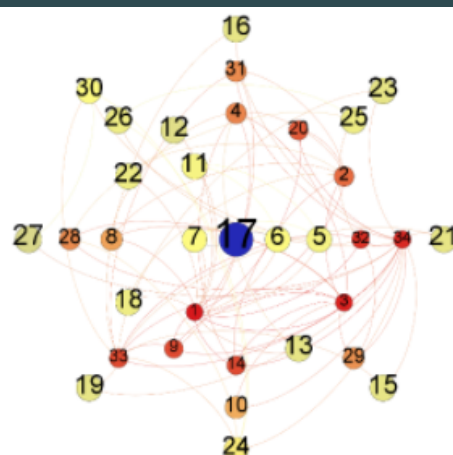
# Betweenness Centrality

Betweenness centrality shows the strategic location of a node in a graph. Betweenness centrality of a node  $n$  is defined as the number of shortest paths going through the node  $n$ . For each pair of nodes, shortest paths between them are computed and the fraction of shortest paths passing through  $n$  is calculated. The betweenness of node  $n$  is obtained by summing this fraction for all pairs of nodes as defined in the following equation.

$$C_B(n) = \sum_{s \neq n \neq t \in V} \frac{\sigma_{st}(n)}{\sigma_{st}}$$



Betweenness Centrality



Closeness Centrality

# Closeness Centrality

Closeness centrality depends on the measure of how close a node is to the other nodes in the graph. A node in a more central location is considered closer to all other nodes. Closeness is calculated by taking the average length of the shortest paths between node  $n$  and all other nodes as given in the following equation.

$$C_C(n) = \frac{1}{\sum_{i \neq n \in V} \text{dist}(i, n)}$$

where  $\text{dist}(i, n)$  is the minimum distance between nodes  $i$  and  $n$ .

## Graph Datasets

### Zachary Karate Club Network

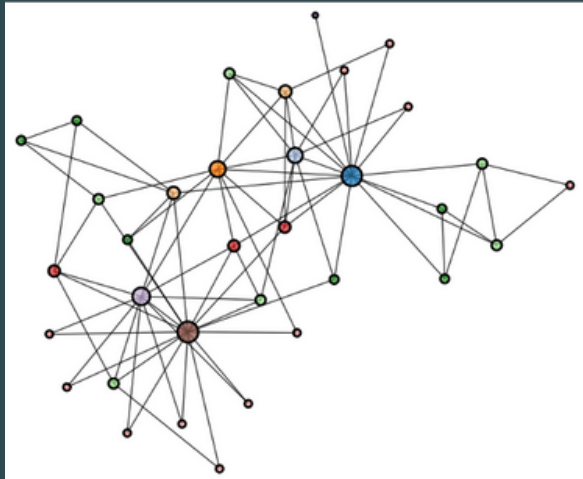
# of Nodes	# of Edges	Format	Edge weights
34	78	Undirected	Unweighted

### Facebook Social Network

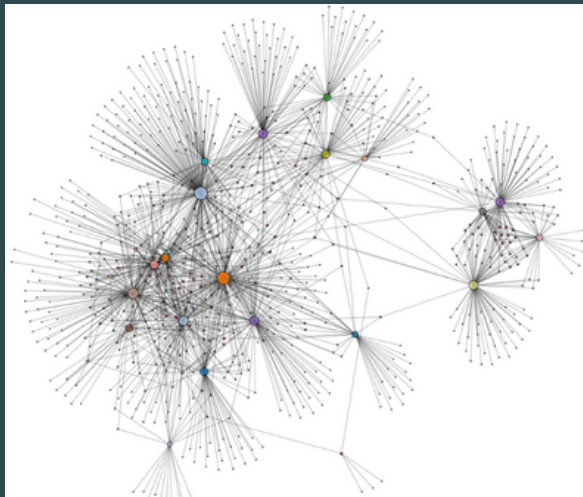
# of Nodes	# of Edges	Format	Edge weights
1518	32988	Undirected	Unweighted

# Visualizations of these datasets

## Zachary Karate Club Network



## Facebook Social Network



## Output

.txt name	Higher Betweenness	Higher Closeness
->Karate	Name --> 1 Value --> 283.0	Name --> 1 Value --> 0.017241379310344827
->Facebook	Name --> 223 Value --> 73107.0	Name --> 418 Value --> 3.4352456200618345E-4

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