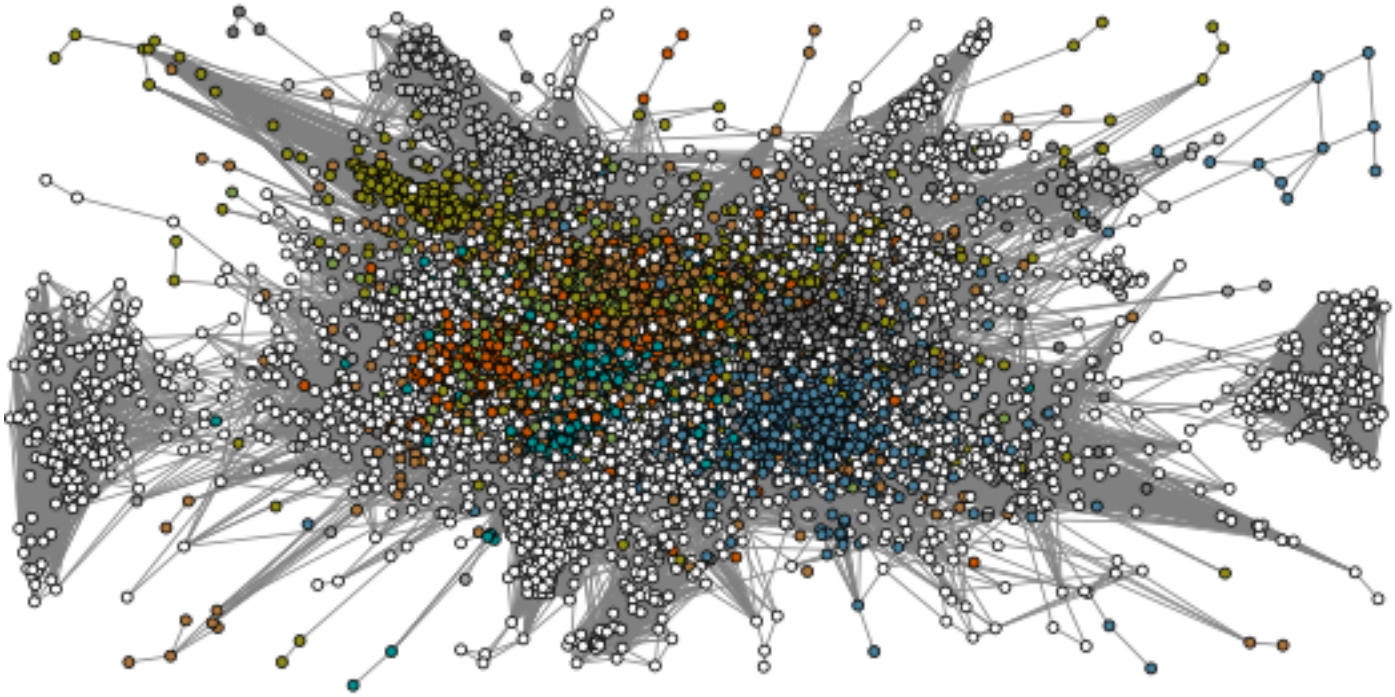
Node position in IMDb actors collaboration network

You are given **IMDb actors collaboration network** in Pajek, edge list and LNA formats. Your task is to find the **most important actors** according to different measures of centrality. You can either use the methods provided by your network analysis library or implement the algorithms by yourself.



I. Degree centrality and clustering coefficients

1. Find the most important actors according to the **degree centrality** $d_i = \frac{k_i}{n-1}$, where n is the number of network nodes and k_i is the degree of node i. What kind of actors have the highest d_i (e.g. Hollywood, Bollywood, international, unknown)?

2. Find the most important actors according to the **clustering coefficient** $C_i = \frac{2t_i}{k_i(k_i-1)}$, where k_i is the degree of node i and t_i is the number of triads including node i. What kind of actors have the highest C_i (e.g. Hollywood, Bollywood, international, unknown)?

3. Find the most important actors according to the **μ-corrected clustering coefficient** $C_i^{\mu} = \frac{2t_i}{k_i \mu}$, where k_i is the degree of node i, t_i is the number of triads including node i and μ is the maximum number of triads over a single link. What kind of actors have the highest C_i^{μ} (e.g. Hollywood, Bollywood, international, unknown)?

II. Closeness and betweenness centrality

1. Find the most important actors according to the **closeness centrality** $\ell_i^{-1} = \frac{1}{n-1} \sum_{j \neq i} \frac{1}{d_{ij}}$, where n is the number of network nodes and d_{ij} is the distance between nodes i and j. What kind of actors have the highest ℓ_i^{-1} (e.g. Hollywood, Bollywood, international, unknown)?

2. Find the most important actors according to the **betweenness centrality** $\sigma_i = \frac{1}{n^2} \sum_{st} \frac{g_{st}^i}{g_{st}}$, where n is the number of network nodes, g_{st} is the number of shortest paths between nodes s and t, and g_{st}^i is the number of such paths including node i. What kind of actors have the highest σ_i (e.g. Hollywood, Bollywood, international, unknown)?

III. Eigenvector centrality and PageRank algorithm

1. Find the most important actors according to the **eigenvector centrality** $e_i = \lambda_1^{-1} \sum_j A_{ij} e_j$, where A is the network adjacency matrix and λ_1 is a normalizing constant. What kind of actors have the highest e_i (e.g. Hollywood, Bollywood, international, unknown)?

2. Find the most important actors according to the **PageRank algorithm** $p_i = \alpha \sum_j A_{ij} \frac{p_j}{k_j} + \frac{1-\alpha}{n}$, where A is the network adjacency matrix, n is the number of network nodes, k_i is the degree of node i and α is the damping factor set to 0.85. What kind of actors have the highest p_i (e.g. Hollywood, Bollywood, international, unknown)?

```
input  graph G, precision ϵ
output eigenvector centrality E
E ← array of ones
do
    U ← array of zeros
    for nodes i ∈ N do
        for neighbors j ∈ Γ_i do
            U[i] ← U[i] + E[j]
    u ← ||U||
    for nodes i ∈ N do
        U[i] ← U[i] · n/u
    Δ ← ||E − U||
    E ← U
while Δ > ϵ
return E
```

```
input  graph G, damping α, precision ϵ
output PageRank ranks P
P ← array of n^−1-s
do
    U ← array of zeros
    for nodes i ∈ N do
        for predecessors j ∈ Γ_i^in do
            U[i] ← U[i] + P[j] · α/k_j^out
    u ← ||U||
    for nodes i ∈ N do
        U[i] ← U[i] + (1 − u)/n
    Δ ← ||P − U||
    P ← U
while Δ > ϵ
return P
```