

Centralidade em Redes

Aluno: Pedro Antônio Machado Costa

1. Introdução

O intuito deste relatório é mostrar os resultados obtidos na atividade de centralidade em redes, na disciplina de Redes Complexas. Abaixo está o algoritmo utilizado para a realização da atividade e explicações sobre como o mesmo funciona:

```
import networkx as nx
import matplotlib.pyplot as plt

# Carregar uma rede de exemplo (vou usar um grafo de exemplo)
G = nx.karate_club_graph()

#Exibindo nós e arestas do grafo(rede)
print(f'Nós do grafo: {G.nodes()}')
print(f'Arestas do grafo: {G.edges()}')

# Calcular as centralidades
degree_cent = nx.degree_centrality(G)
closeness_cent = nx.closeness_centrality(G)
betweenness_cent = nx.betweenness_centrality(G)
pagerank_cent = nx.pagerank(G)

# Exibir os vértices mais centrais para cada centralidade
'''sorted(..., key=lambda x: x[1], reverse=True):
sorted() ordena os itens com base em uma chave.
key=lambda x: x[1] é uma função lambda que especifica que estamos ordenando os itens com base no segundo elemento de cada tupla, ou seja, a centralidade do nó.
reverse=True indica que queremos ordenar em ordem decrescente.'''

print("Grau:")
print(sorted(degree_cent.items(), key=lambda x: x[1], reverse=True)[:5])
print("Closeness:")
print(sorted(closeness_cent.items(), key=lambda x: x[1], reverse=True)[:5])
print("Betweenness:")
print(sorted(betweenness_cent.items(), key=lambda x: x[1], reverse=True)[:5])
print("PageRank:")
print(sorted(pagerank_cent.items(), key=lambda x: x[1], reverse=True)[:5])
```

2. Resultados e plotagem

Vamos plotar cada grafo de acordo com a Centralidade:

Obs: para cada plotagem, é necessário mudar no node_size_degree, o tipo de centralidade usada;

GRAU

```
# Plotar a rede com o tamanho dos vértices proporcional à centralidade
plt.figure(figsize=(12, 8))

# Calcular o tamanho dos nós proporcional à centralidade de grau
node_size_degree = [degree_cent[node] * 2000 for node in G.nodes()]

nx.draw(G, with_labels=True, node_size=node_size_degree)
plt.title("Rede com tamanho dos vértices proporcional à centralidade de grau")
plt.show()
```

✓ 0.2s Python

Nós do grafo: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33]

Arestas do grafo: [(0, 1), (0, 2), (0, 3), (0, 4), (0, 5), (0, 6), (0, 7), (0, 8), (0, 10), (0, 11), (0, 12), (0, 13), (0, 17), (0, 19), (0, 21), (0, 31), (1, 2), (1, 3), (1, 7), (1, 13), (1, 17), (1, 19), (1, 21), (1, 30), (2, 3), (2, 7), (2, 8), (2, 9), (2, 13), (2, 27), (2, 28), (2, 32), (3, 4), (3, 5), (3, 6), (3, 7), (3, 8), (3, 9), (3, 10), (3, 11), (3, 12), (3, 13), (3, 14), (3, 15), (3, 16), (3, 17), (3, 18), (3, 19), (3, 20), (3, 21), (3, 22), (3, 23), (3, 24), (3, 25), (3, 26), (3, 27), (3, 28), (3, 29), (3, 30), (3, 31), (3, 32), (3, 33), (4, 5), (4, 6), (4, 7), (4, 8), (4, 9), (4, 10), (4, 11), (4, 12), (4, 13), (4, 14), (4, 15), (4, 16), (4, 17), (4, 18), (4, 19), (4, 20), (4, 21), (4, 22), (4, 23), (4, 24), (4, 25), (4, 26), (4, 27), (4, 28), (4, 29), (4, 30), (4, 31), (4, 32), (4, 33), (5, 6), (5, 7), (5, 8), (5, 9), (5, 10), (5, 11), (5, 12), (5, 13), (5, 14), (5, 15), (5, 16), (5, 17), (5, 18), (5, 19), (5, 20), (5, 21), (5, 22), (5, 23), (5, 24), (5, 25), (5, 26), (5, 27), (5, 28), (5, 29), (5, 30), (5, 31), (5, 32), (5, 33), (6, 7), (6, 8), (6, 9), (6, 10), (6, 11), (6, 12), (6, 13), (6, 14), (6, 15), (6, 16), (6, 17), (6, 18), (6, 19), (6, 20), (6, 21), (6, 22), (6, 23), (6, 24), (6, 25), (6, 26), (6, 27), (6, 28), (6, 29), (6, 30), (6, 31), (6, 32), (6, 33), (7, 8), (7, 9), (7, 10), (7, 11), (7, 12), (7, 13), (7, 14), (7, 15), (7, 16), (7, 17), (7, 18), (7, 19), (7, 20), (7, 21), (7, 22), (7, 23), (7, 24), (7, 25), (7, 26), (7, 27), (7, 28), (7, 29), (7, 30), (7, 31), (7, 32), (7, 33), (8, 9), (8, 10), (8, 11), (8, 12), (8, 13), (8, 14), (8, 15), (8, 16), (8, 17), (8, 18), (8, 19), (8, 20), (8, 21), (8, 22), (8, 23), (8, 24), (8, 25), (8, 26), (8, 27), (8, 28), (8, 29), (8, 30), (8, 31), (8, 32), (8, 33), (9, 10), (9, 11), (9, 12), (9, 13), (9, 14), (9, 15), (9, 16), (9, 17), (9, 18), (9, 19), (9, 20), (9, 21), (9, 22), (9, 23), (9, 24), (9, 25), (9, 26), (9, 27), (9, 28), (9, 29), (9, 30), (9, 31), (9, 32), (9, 33), (10, 11), (10, 12), (10, 13), (10, 14), (10, 15), (10, 16), (10, 17), (10, 18), (10, 19), (10, 20), (10, 21), (10, 22), (10, 23), (10, 24), (10, 25), (10, 26), (10, 27), (10, 28), (10, 29), (10, 30), (10, 31), (10, 32), (10, 33), (11, 12), (11, 13), (11, 14), (11, 15), (11, 16), (11, 17), (11, 18), (11, 19), (11, 20), (11, 21), (11, 22), (11, 23), (11, 24), (11, 25), (11, 26), (11, 27), (11, 28), (11, 29), (11, 30), (11, 31), (11, 32), (11, 33), (12, 13), (12, 14), (12, 15), (12, 16), (12, 17), (12, 18), (12, 19), (12, 20), (12, 21), (12, 22), (12, 23), (12, 24), (12, 25), (12, 26), (12, 27), (12, 28), (12, 29), (12, 30), (12, 31), (12, 32), (12, 33), (13, 14), (13, 15), (13, 16), (13, 17), (13, 18), (13, 19), (13, 20), (13, 21), (13, 22), (13, 23), (13, 24), (13, 25), (13, 26), (13, 27), (13, 28), (13, 29), (13, 30), (13, 31), (13, 32), (13, 33), (14, 15), (14, 16), (14, 17), (14, 18), (14, 19), (14, 20), (14, 21), (14, 22), (14, 23), (14, 24), (14, 25), (14, 26), (14, 27), (14, 28), (14, 29), (14, 30), (14, 31), (14, 32), (14, 33), (15, 16), (15, 17), (15, 18), (15, 19), (15, 20), (15, 21), (15, 22), (15, 23), (15, 24), (15, 25), (15, 26), (15, 27), (15, 28), (15, 29), (15, 30), (15, 31), (15, 32), (15, 33), (16, 17), (16, 18), (16, 19), (16, 20), (16, 21), (16, 22), (16, 23), (16, 24), (16, 25), (16, 26), (16, 27), (16, 28), (16, 29), (16, 30), (16, 31), (16, 32), (16, 33), (17, 18), (17, 19), (17, 20), (17, 21), (17, 22), (17, 23), (17, 24), (17, 25), (17, 26), (17, 27), (17, 28), (17, 29), (17, 30), (17, 31), (17, 32), (17, 33), (18, 19), (18, 20), (18, 21), (18, 22), (18, 23), (18, 24), (18, 25), (18, 26), (18, 27), (18, 28), (18, 29), (18, 30), (18, 31), (18, 32), (18, 33), (19, 20), (19, 21), (19, 22), (19, 23), (19, 24), (19, 25), (19, 26), (19, 27), (19, 28), (19, 29), (19, 30), (19, 31), (19, 32), (19, 33), (20, 21), (20, 22), (20, 23), (20, 24), (20, 25), (20, 26), (20, 27), (20, 28), (20, 29), (20, 30), (20, 31), (20, 32), (20, 33), (21, 22), (21, 23), (21, 24), (21, 25), (21, 26), (21, 27), (21, 28), (21, 29), (21, 30), (21, 31), (21, 32), (21, 33), (22, 23), (22, 24), (22, 25), (22, 26), (22, 27), (22, 28), (22, 29), (22, 30), (22, 31), (22, 32), (22, 33), (23, 24), (23, 25), (23, 26), (23, 27), (23, 28), (23, 29), (23, 30), (23, 31), (23, 32), (23, 33), (24, 25), (24, 26), (24, 27), (24, 28), (24, 29), (24, 30), (24, 31), (24, 32), (24, 33), (25, 26), (25, 27), (25, 28), (25, 29), (25, 30), (25, 31), (25, 32), (25, 33), (26, 27), (26, 28), (26, 29), (26, 30), (26, 31), (26, 32), (26, 33), (27, 28), (27, 29), (27, 30), (27, 31), (27, 32), (27, 33), (28, 29), (28, 30), (28, 31), (28, 32), (28, 33), (29, 30), (29, 31), (29, 32), (29, 33), (30, 31), (30, 32), (30, 33), (31, 32), (31, 33), (32, 33)]

Grau:

```
[(33, 0.5151515151515151), (0, 0.48484848484848486), (32, 0.36363636363636365), (2, 0.30303030303030304), (1, 0.2727272727272727)]
```

Closeness:

```
[(0, 0.5689655172413793), (2, 0.559322033898305), (33, 0.55), (31, 0.5409836065573771), (8, 0.515625)]
```

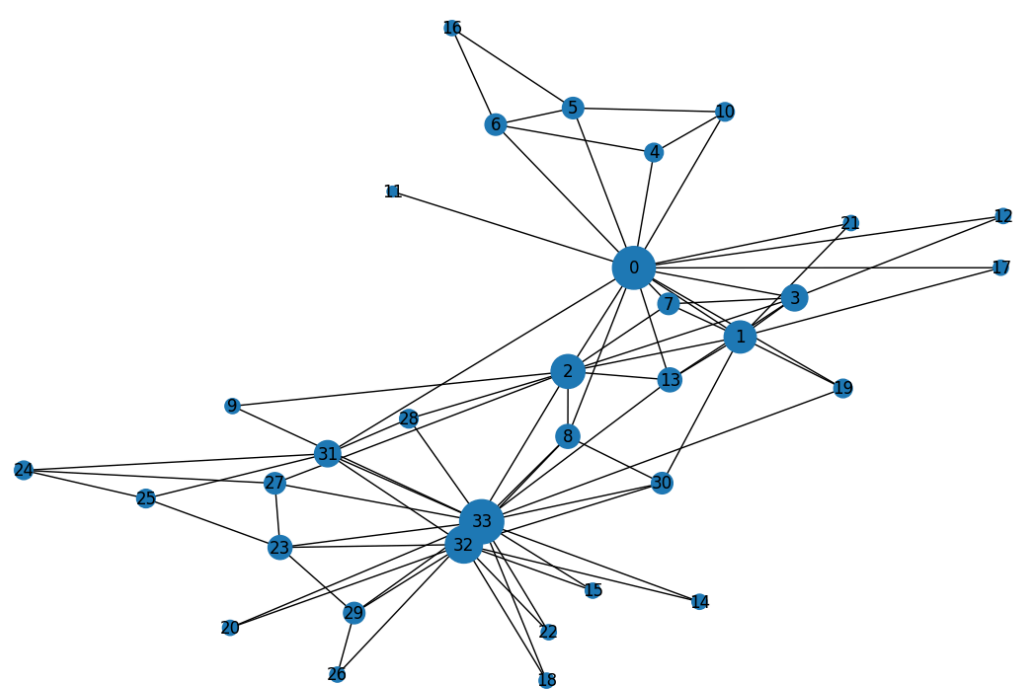
Betweenness:

```
[(0, 0.43763528138528146), (33, 0.30407497594997596), (32, 0.145247113997114), (2, 0.14365680615680618), (31, 0.13827561327561325)]
```

PageRank:

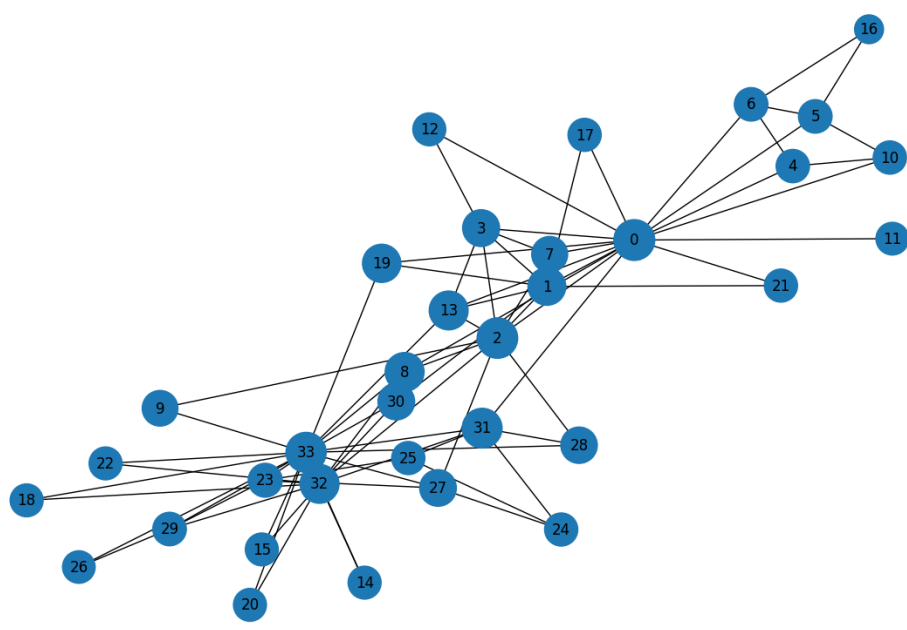
```
[(33, 0.09698041880501741), (0, 0.08850807396280012), (32, 0.07592643687005646), (2, 0.06276686454603017), (1, 0.057414840497110056)]
```

Rede com tamanho dos vértices proporcional à centralidade de grau



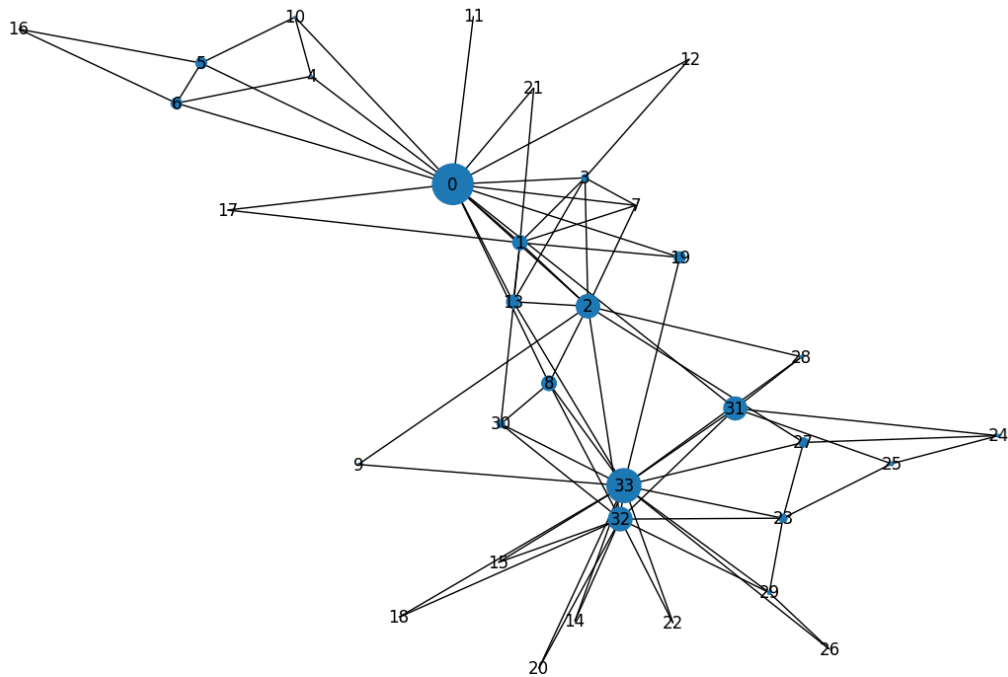
CLOSENESS

Rede com tamanho dos vértices proporcional à centralidade de closeness



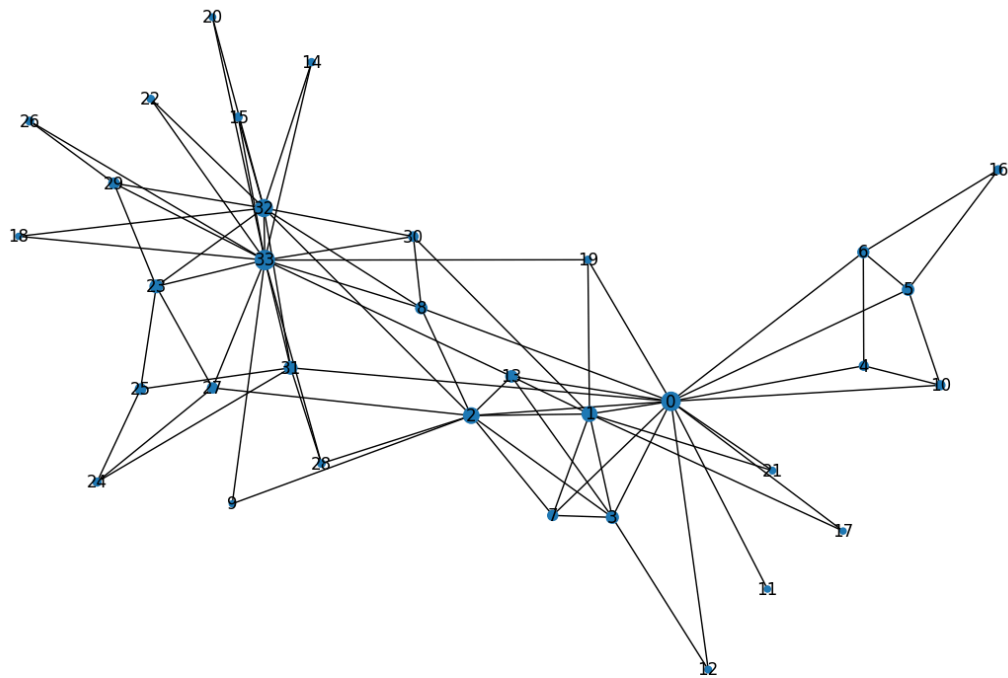
BETWEENNESS

Rede com tamanho dos vértices proporcional à centralidade de betweenness



AUTOVETOR/PAGERANK

Rede com tamanho dos vértices proporcional à centralidade de pagerank



3. Explicação do algoritmo

Além da explicação que está dentro do algoritmo como comentário, vamos ressaltar o que cada centralidade faz, com um exemplo:

Grau: Os valores representam a centralidade de grau de cada nó na rede.

Por exemplo, para o nó 33, a centralidade de grau é 0.515, o que significa que cerca de 51,5% das arestas da rede estão conectadas a esse nó.

Closeness: Os valores representam a centralidade de closeness de cada nó na rede.

Por exemplo, para o nó 0, a centralidade de closeness é 0.569, o que significa que, em média, esse nó está a uma distância de cerca de 0,569 unidades de distância de todos os outros nós na rede.

Betweenness: Os valores representam a centralidade de betweenness de cada nó na rede.

Por exemplo, para o nó 0, a centralidade de betweenness é 0.438, o que significa que aproximadamente 43,8% de todos os caminhos mais curtos entre todos os pares de nós na rede passam por esse nó.

PageRank: Os valores representam a pontuação de PageRank de cada nó na rede.

Por exemplo, para o nó 33, a pontuação de PageRank é 0.097, o que indica sua importância relativa na rede com base na importância de seus vizinhos e de outros nós importantes que se conectam a ele.