

```

import networkx as nx
import community as community_louvain # For Louvain method
from networkx.algorithms.community import
greedy_modularity_communities, asyn_fluidc, girvan_newman
from sknetwork.clustering import Louvain
from sknetwork.clustering import Louvain

# If Propagation is still not available after the upgrade, you can
omit it
# or check other clustering algorithms available in the library

from sknetwork.data import karate_club
from igraph import Graph, plot
import matplotlib.pyplot as plt

# Load Zachary's Karate Club dataset
G = nx.karate_club_graph()

# Visualization function
def plot_graph(G, partition=None):
    pos = nx.spring_layout(G)
    if partition:
        # Color nodes by community
        cmap = plt.get_cmap('viridis')
        for community in set(partition.values()):
            members = [node for node, com in partition.items() if com
== community]
            nx.draw_networkx_nodes(G, pos, members, node_size=300,
node_color=[cmap(community / len(set(partition.values())))]])
            nx.draw_networkx_edges(G, pos, alpha=0.5)
            plt.show()

# 1. Louvain Method (Modularity-based method)
partition_louvain = community_louvain.best_partition(G)
print("Louvain community detection:", partition_louvain)
plot_graph(G, partition_louvain)

# 2. Greedy Modularity Maximization (Modularity-based method)
greedy_communities = list(greedy_modularity_communities(G))
print("Greedy Modularity communities:", greedy_communities)

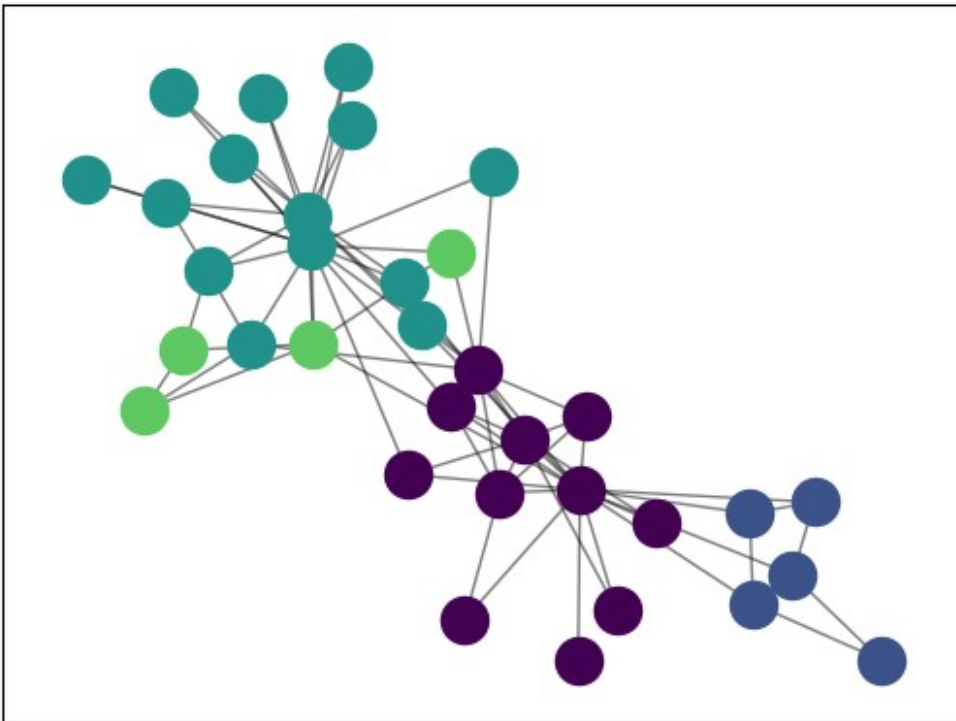
# Assign a community label to nodes
partition_greedy = {node: i for i, community in
enumerate(greedy_communities) for node in community}
plot_graph(G, partition_greedy)

# 3. Girvan-Newman (Edge Betweenness-based method)
comp = girvan_newman(G)
first_level_communities = tuple(sorted(c) for c in next(comp))
print("Girvan-Newman communities:", first_level_communities)

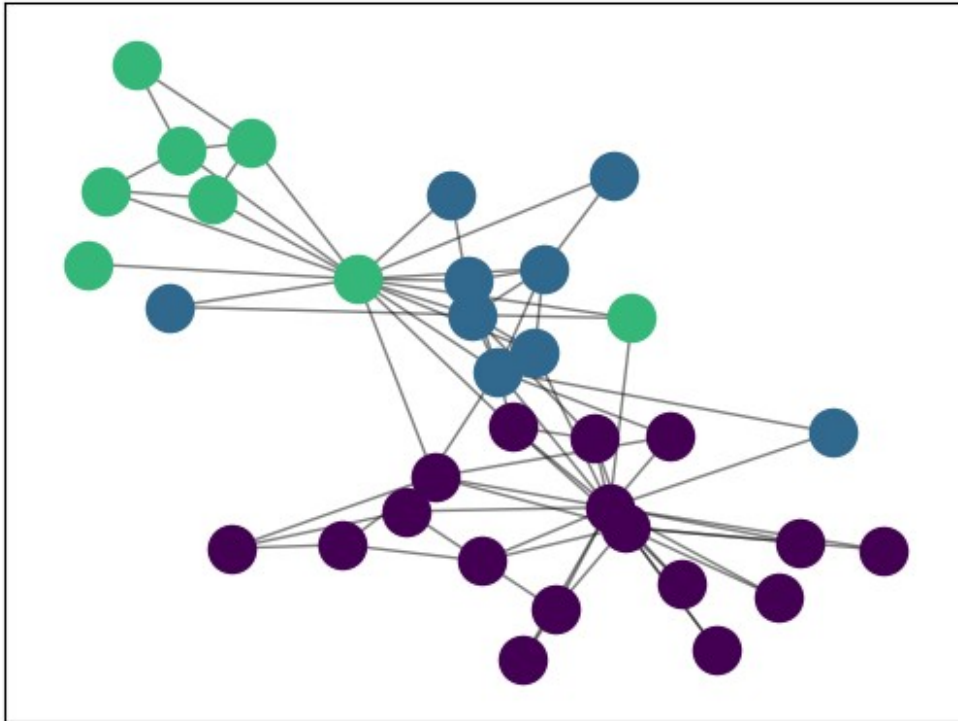
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# 4. Label Propagation (Asynchronous Label Propagation)
communities_fluid = asyn_fluidc(G, k=3)
partition_fluid = {node: i for i, community in
enumerate(communities_fluid) for node in community}
print("Label Propagation communities:", partition_fluid)
plot_graph(G, partition_fluid)
```

```
Louvain community detection: {0: 0, 1: 0, 2: 0, 3: 0, 4: 1, 5: 1, 6:
1, 7: 0, 8: 2, 9: 2, 10: 1, 11: 0, 12: 0, 13: 0, 14: 2, 15: 2, 16: 1,
17: 0, 18: 2, 19: 0, 20: 2, 21: 0, 22: 2, 23: 2, 24: 3, 25: 3, 26: 2,
27: 2, 28: 3, 29: 2, 30: 2, 31: 3, 32: 2, 33: 2}
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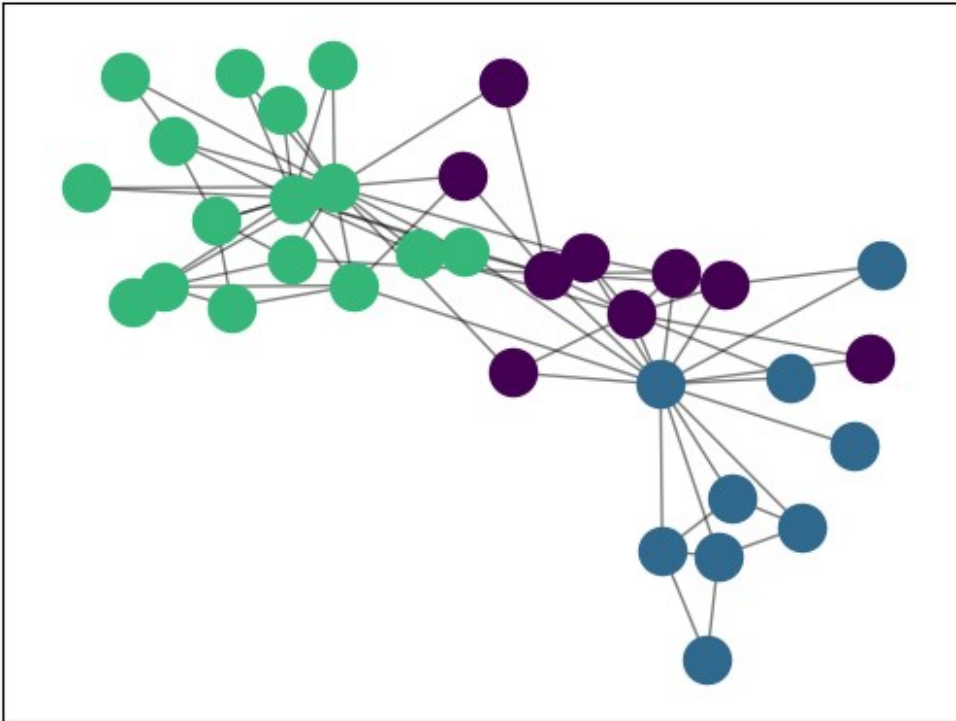


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Greedy Modularity communities: [frozenset({8, 14, 15, 18, 20, 22, 23,
24, 25, 26, 27, 28, 29, 30, 31, 32, 33}), frozenset({1, 2, 3, 7, 9,
12, 13, 17, 21}), frozenset({0, 16, 19, 4, 5, 6, 10, 11})]
```



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

Label Propagation communities: {1: 0, 2: 0, 3: 0, 7: 0, 9: 0, 13: 0, 17: 0, 19: 0, 28: 0, 0: 1, 4: 1, 5: 1, 6: 1, 10: 1, 11: 1, 12: 1, 16: 1, 21: 1, 32: 2, 33: 2, 8: 2, 14: 2, 15: 2, 18: 2, 20: 2, 22: 2, 23: 2, 24: 2, 25: 2, 26: 2, 27: 2, 29: 2, 30: 2, 31: 2}



```
import networkx as nx
import community as community_louvain # For Louvain method
from networkx.algorithms.community import
greedy_modularity_communities, asyn_fluidc, girvan_newman
from sknetwork.clustering import Louvain # Removed Propagation
from sknetwork.data import karate_club
from igraph import Graph, plot
import matplotlib.pyplot as plt

# Load Zachary's Karate Club dataset
G = nx.karate_club_graph()

# Visualization function
def plot_graph(G, partition=None):
    pos = nx.spring_layout(G)
    if partition:
        # Color nodes by community
        cmap = plt.get_cmap('viridis')
        for community in set(partition.values()):
            members = [node for node, com in partition.items() if com
== community]
            nx.draw_networkx_nodes(G, pos, members, node_size=300,
node_color=[cmap(community / len(set(partition.values())))]])
            nx.draw_networkx_edges(G, pos, alpha=0.5)
            plt.show()

# Louvain Method (Modularity-based method)
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partition_louvain = community_louvain.best_partition(G)
print("Louvain community detection:", partition_louvain)
plot_graph(G, partition_louvain)

# Greedy Modularity Maximization (Modularity-based method)
greedy_communities = list(greedy_modularity_communities(G))
print("Greedy Modularity communities:", greedy_communities)

# Assign a community label to nodes
partition_greedy = {node: i for i, community in
enumerate(greedy_communities) for node in community}
plot_graph(G, partition_greedy)

# Girvan-Newman (Edge Betweenness-based method)
comp = girvan_newman(G)
first_level_communities = tuple(sorted(c) for c in next(comp))
print("Girvan-Newman communities:", first_level_communities)

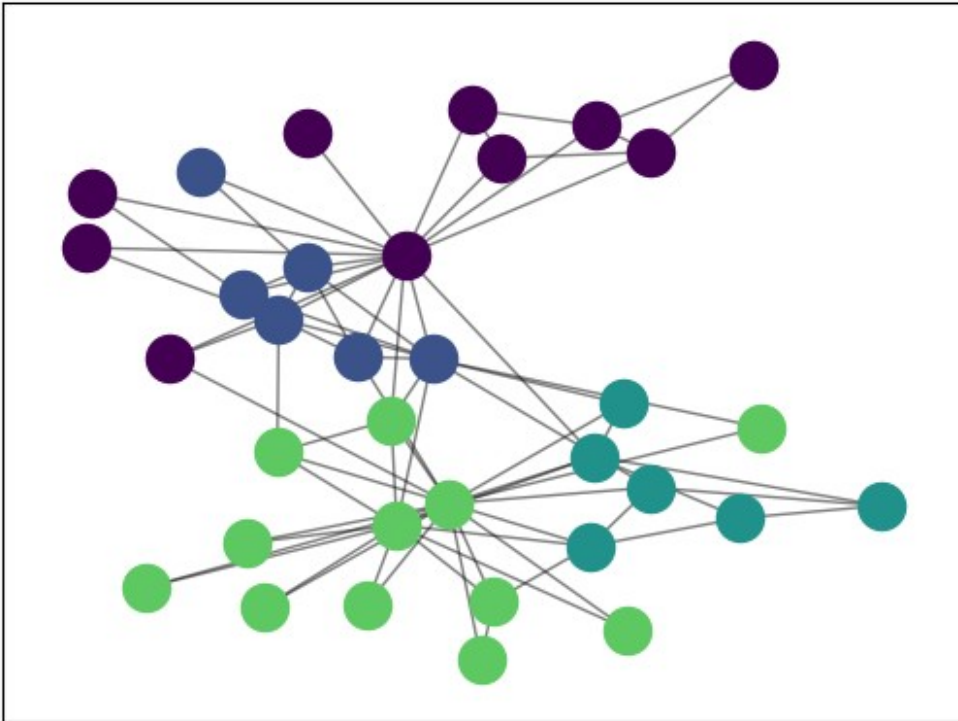
# Label Propagation (Asynchronous Label Propagation)
communities_fluid = asyn_fluidc(G, k=3)
partition_fluid = {node: i for i, community in
enumerate(communities_fluid) for node in community}
print("Label Propagation communities:", partition_fluid)
plot_graph(G, partition_fluid)

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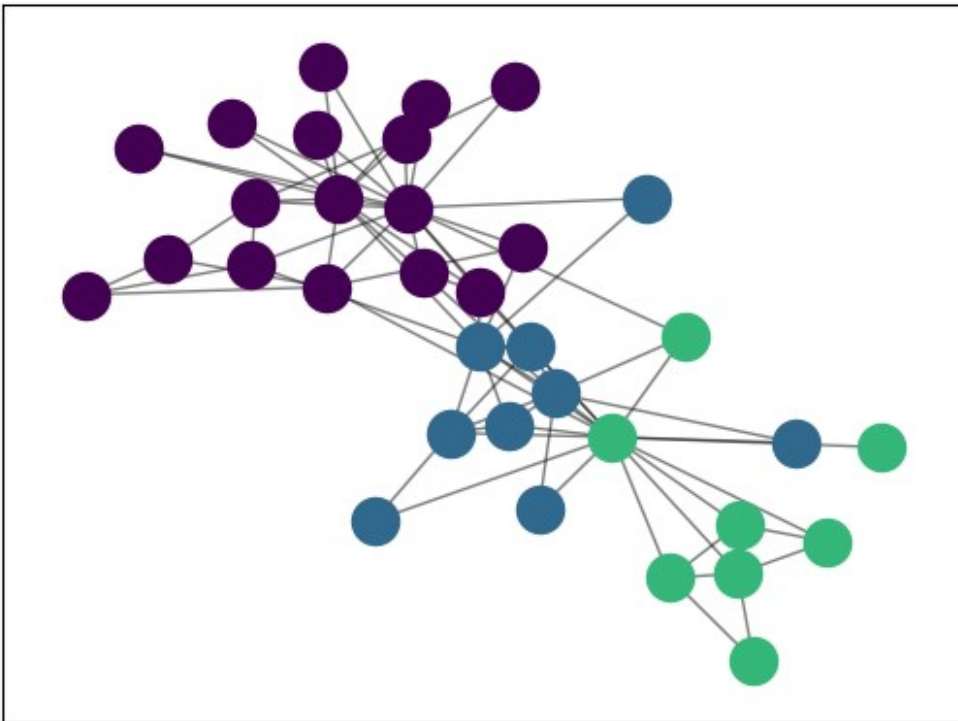
```

Louvain community detection: {0: 0, 1: 1, 2: 1, 3: 1, 4: 0, 5: 0, 6:
0, 7: 1, 8: 3, 9: 3, 10: 0, 11: 0, 12: 1, 13: 1, 14: 3, 15: 3, 16: 0,
17: 0, 18: 3, 19: 0, 20: 3, 21: 0, 22: 3, 23: 2, 24: 2, 25: 2, 26: 3,
27: 2, 28: 2, 29: 3, 30: 3, 31: 2, 32: 3, 33: 3}

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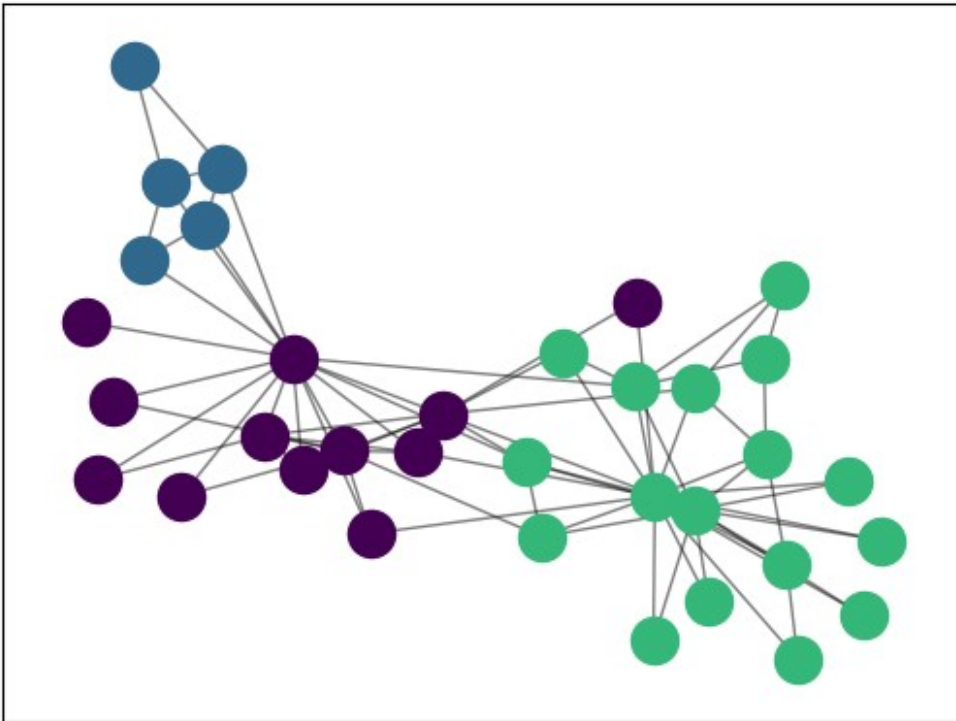


Greedy Modularity communities: [frozenset({8, 14, 15, 18, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33}), frozenset({1, 2, 3, 7, 9, 12, 13, 17, 21}), frozenset({0, 16, 19, 4, 5, 6, 10, 11})]



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

Label Propagation communities: {0: 0, 1: 0, 2: 0, 3: 0, 7: 0, 9: 0, 11: 0, 12: 0, 13: 0, 17: 0, 19: 0, 21: 0, 4: 1, 5: 1, 6: 1, 10: 1, 16: 1, 32: 2, 33: 2, 8: 2, 14: 2, 15: 2, 18: 2, 20: 2, 22: 2, 23: 2, 24: 2, 25: 2, 26: 2, 27: 2, 28: 2, 29: 2, 30: 2, 31: 2}



```
import networkx as nx
from networkx.algorithms.community import girvan_newman
import matplotlib.pyplot as plt
import numpy as np
# Function to plot the graph with communities
def plot_communities(G, communities):
    pos = nx.spring_layout(G) # Layout for node positioning
    colors = plt.cm.rainbow(np.linspace(0, 1, len(communities)))

    for color, community in zip(colors, communities):
        nx.draw_networkx_nodes(G, pos, nodelist=community,
                               node_color=[color], node_size=300)

    nx.draw_networkx_edges(G, pos, alpha=0.5)
    nx.draw_networkx_labels(G, pos)
    plt.show()

# Step 1: Create a sample graph (Zachary's Karate Club, for example)
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G = nx.karate_club_graph()

# Step 2: Apply the Girvan-Newman algorithm
def girvan_newman_communities(G):
    comp = girvan_newman(G)
    return comp

# Step 3: Run the Girvan-Newman algorithm
community_generator = girvan_newman_communities(G)

# Get the first few communities (you can adjust the number of
iterations as needed)
first_level_communities = next(community_generator)
print("Communities after the first iteration:",
first_level_communities)

# Visualize the communities after the first iteration
plot_communities(G, first_level_communities)

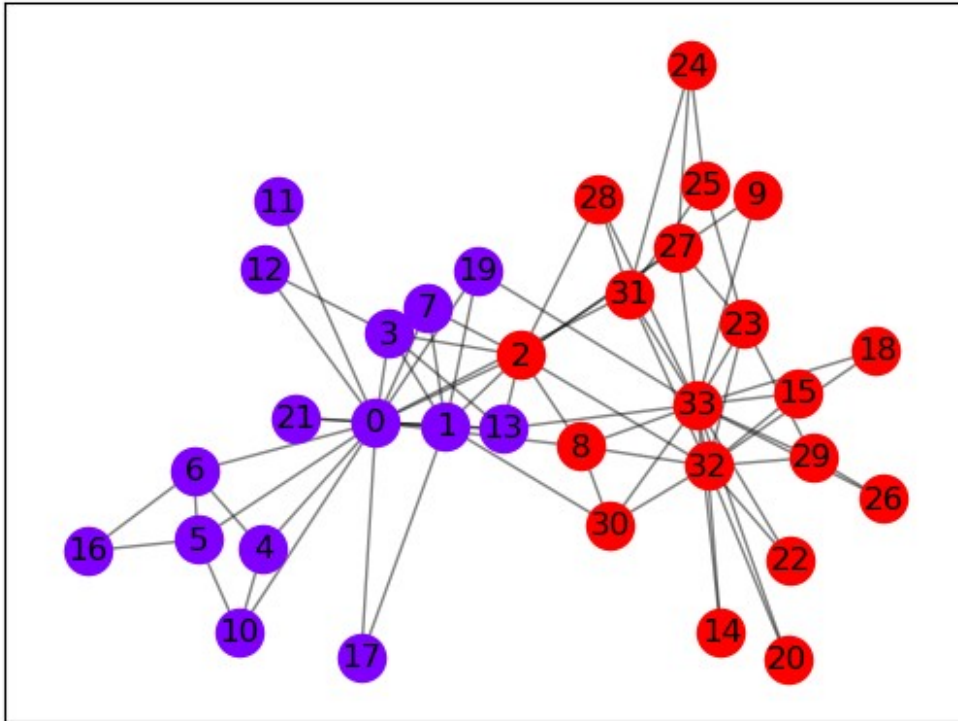
# Iterate further to get more granular communities (optional)
second_level_communities = next(community_generator)
print("Communities after the second iteration:",
second_level_communities)

# Visualize the communities after the second iteration
plot_communities(G, second_level_communities)

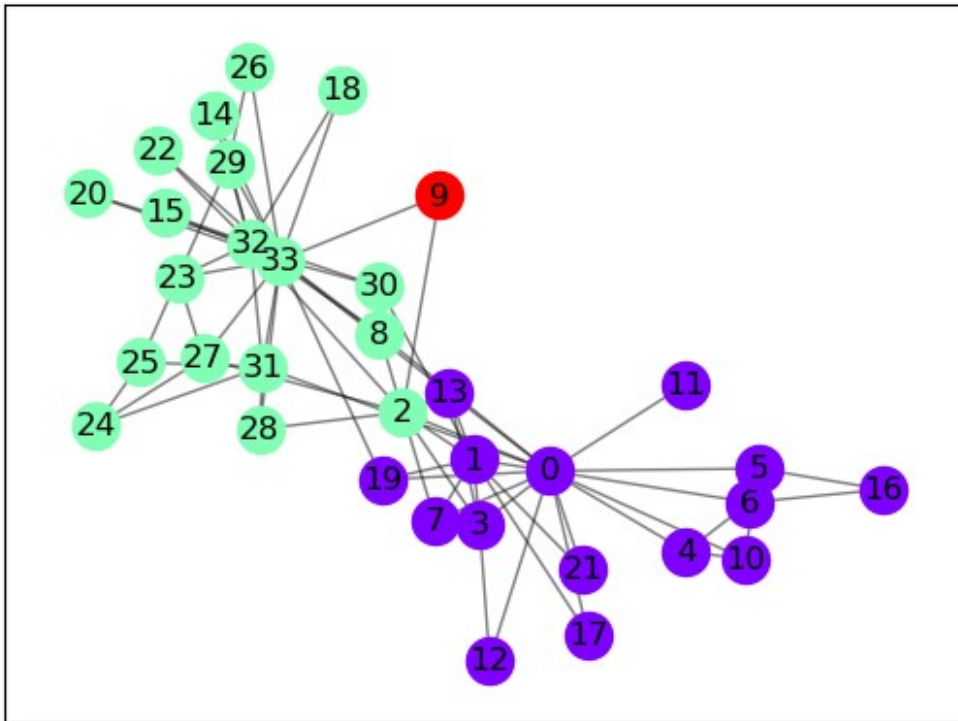
Communities after the first iteration: ({0, 1, 3, 4, 5, 6, 7, 10, 11,
12, 13, 16, 17, 19, 21}, {2, 8, 9, 14, 15, 18, 20, 22, 23, 24, 25, 26,
27, 28, 29, 30, 31, 32, 33})

```





Communities after the second iteration: ( $\{0, 1, 3, 4, 5, 6, 7, 10, 11, 12, 13, 16, 17, 19, 21\}$ ,  $\{32, 33, 2, 8, 14, 15, 18, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31\}$ ,  $\{9\}$ )



```

import matplotlib.pyplot as plt
import networkx as nx
from igraph import Graph

# Create a sample graph (Zachary's Karate Club graph)
G = Graph.Famous("Zachary")

# 1. Walktrap community detection
communities_walktrap = G.community_walktrap().as_clustering()
print("Walktrap communities:", communities_walktrap)

# Convert iGraph to NetworkX for visualization using Matplotlib
nx_graph = nx.Graph(G.get_edgelist())

# Assign community labels as node attributes
community_dict = {}
for i, community in enumerate(communities_walktrap):
    for node in community:
        community_dict[node] = i

# Set community as node attribute in NetworkX graph
nx.set_node_attributes(nx_graph, community_dict, 'community')

# Draw the graph using NetworkX and Matplotlib
pos = nx.spring_layout(nx_graph) # Spring layout for better
visualization
colors = [community_dict[node] for node in nx_graph.nodes()]

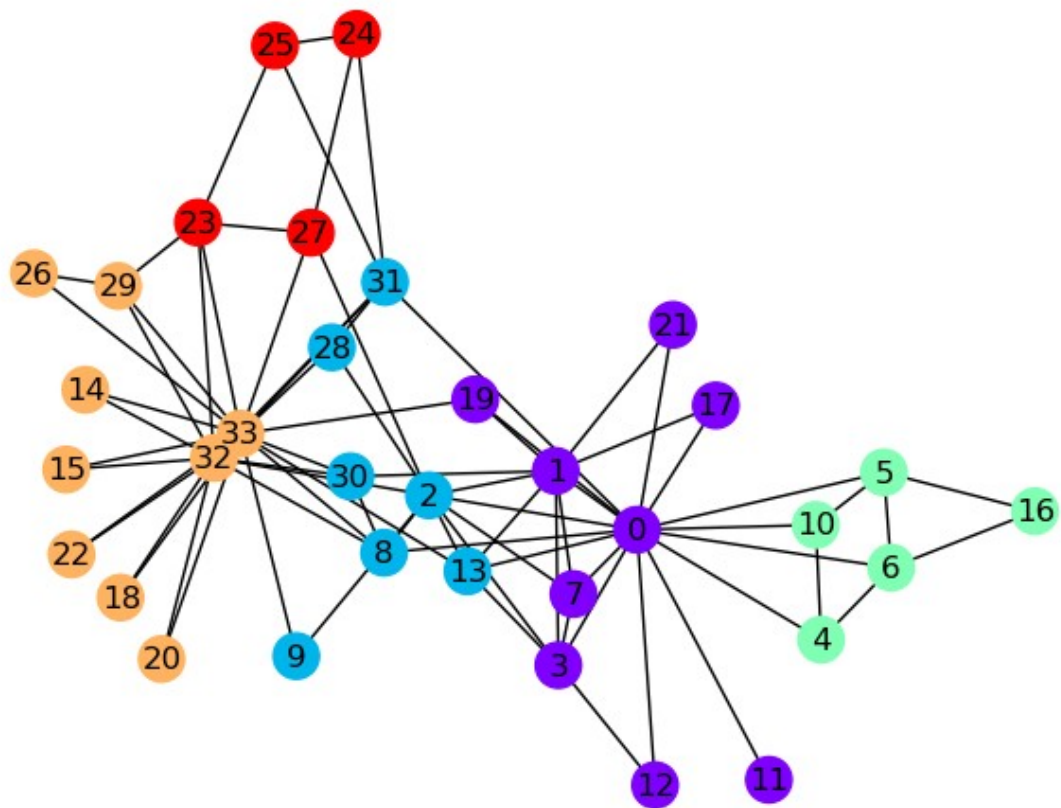
nx.draw(nx_graph, pos, node_color=colors, with_labels=True,
node_size=300, cmap=plt.cm.rainbow)
plt.show()

```

```

Walktrap communities: Clustering with 34 elements and 5 clusters
[0] 0, 1, 3, 7, 11, 12, 17, 19, 21
[1] 2, 8, 9, 13, 28, 30, 31
[2] 4, 5, 6, 10, 16
[3] 14, 15, 18, 20, 22, 26, 29, 32, 33
[4] 23, 24, 25, 27

```



```
import igraph
# Apply multiple techniques on Facebook Social Circle Dataset
# Load Facebook Social Circles
facebook_graph = nx.read_edgelist('facebook_combined.txt',
create_using=nx.Graph(), nodetype=int)
import networkx as nx
from networkx.algorithms.community import kernighan_lin_bisection #
Import the min-cut algorithm

# Load Facebook Social Circles dataset
facebook_graph = nx.read_edgelist('facebook_combined.txt',
create_using=nx.Graph(), nodetype=int)

# Min-Cut using Kernighan-Lin algorithm
min_cut_communities = kernighan_lin_bisection(facebook_graph)
print("Min-Cut Communities:", min_cut_communities)

# CNM
G_igraph = Graph.TupleList(facebook_graph.edges(), directed=False)
cnm_communities = G_igraph.community_fastgreedy().as_clustering()
print("CNM Communities:", cnm_communities)
```

```
# Walktrap
walktrap_communities = G_igraph.community_walktrap().as_clustering()
print("Walktrap Communities:", walktrap_communities)
```

```
Min-Cut Communities: ({0, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14,
15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32,
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```

import networkx as nx
from igraph import Graph
import matplotlib.pyplot as plt
from networkx.algorithms.community import kernighan_lin_bisection

# Load Facebook Social Circles dataset
facebook_graph = nx.read_edgelist('facebook_combined.txt',
create_using=nx.Graph(), nodetype=int)

# Min-Cut using Kernighan-Lin algorithm
min_cut_communities = kernighan_lin_bisection(facebook_graph)
print("Min-Cut Communities:", list(min_cut_communities))

# CNM (Clauset-Newman-Moore method)
G_igraph = Graph.TupleList(facebook_graph.edges(), directed=False)
cnm_communities = G_igraph.community_fastgreedy().as_clustering()
print("CNM Communities:", cnm_communities)

# Walktrap
walktrap_communities = G_igraph.community_walktrap().as_clustering()
print("Walktrap Communities:", walktrap_communities)

```

```

# Function to draw the graph with communities colored
def draw_communities(graph, communities, title):
    # Create a color map based on community membership
    color_map = []
    for node in graph.nodes():
        for i, community in enumerate(communities):
            if node in community:
                color_map.append(i)
                break

    plt.figure(figsize=(10, 6))
    pos = nx.spring_layout(graph) # Layout for visualization
    nx.draw(graph, pos, node_color=color_map, with_labels=True,
node_size=50, cmap=plt.cm.rainbow)
    plt.title(title)
    plt.show()

# Draw communities detected by Min-Cut
draw_communities facebook_graph, [min_cut_communities], "Communities
Detected by Min-Cut")

# Draw communities detected by CNM
draw_communities facebook_graph, cnm_communities, "Communities
Detected by CNM")

# Draw communities detected by Walktrap
draw_communities facebook_graph, walktrap_communities, "Communities
Detected by Walktrap")

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CNM Communities: Clustering with 4039 elements and 13 clusters

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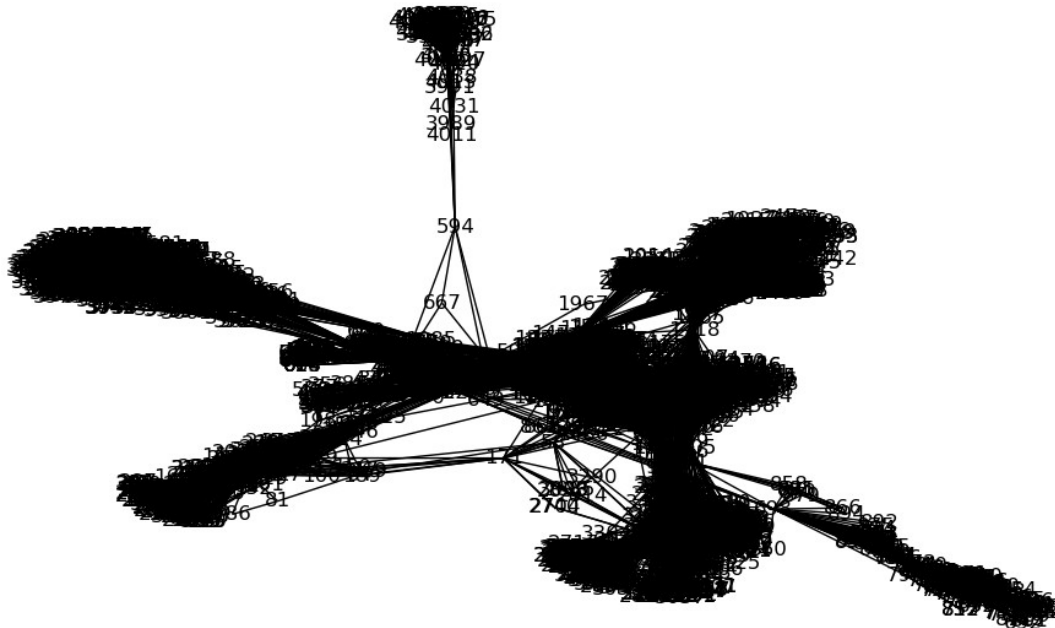
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[63] 3479, 3481, 3516, 3523, 3562, 3581, 3594, 3613, 3639, 3649, 3695,  
3883,  
3898, 3919  
[64] 3502, 3669, 3700, 3813, 3864, 3911  
[65] 3653, 3720, 3749, 3751, 3787, 3789, 3807, 3923  
[66] 3746, 3846  
[67] 3987, 4012  
[68] 3990, 4007, 4016, 4025  
[69] 4001, 4029  
[70] 686, 687, 688, 690, 692, 693, 694, 695, 696, 697, 700, 701, 703,  
704,  
705, 706, 708, 709, 710, 711, 713, 715, 716, 718, 719, 720, 721,  
722,  
723, 724, 726, 727, 728, 730, 731, 734, 737, 738, 739, 740, 741,  
744,  
745, 747, 748, 750, 751, 752, 754, 755, 756, 758, 759, 760, 761,  
762,  
763, 764, 765, 766, 770, 772, 773, 774, 777, 778, 779, 780, 781,  
783,  
784, 785, 787, 790, 792, 793, 794, 795, 797, 799, 800, 801, 803,  
805,  
807, 808, 809, 810, 812, 813, 814, 815, 817, 819, 820, 821, 823,  
824,  
826, 827, 828, 829, 830, 831, 832, 834, 835, 836, 837, 838, 840,  
841,  
842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 853, 854, 880  
[71] 689, 691, 699, 702, 707, 712, 714, 725, 732, 733, 736, 742, 743,  
746,  
767, 768, 771, 782, 786, 788, 789, 791, 796, 802, 806, 816, 818,  
822,  
833, 839  
[72] 717, 798, 852, 855  
[73] 729, 804, 861, 863, 876, 878, 882, 886, 888, 889  
[74] 749, 757, 775

```
[75] 776, 859, 867, 872, 873, 874, 877, 885, 887  
[76] 858, 866, 870, 871, 879, 881, 894, 895
```

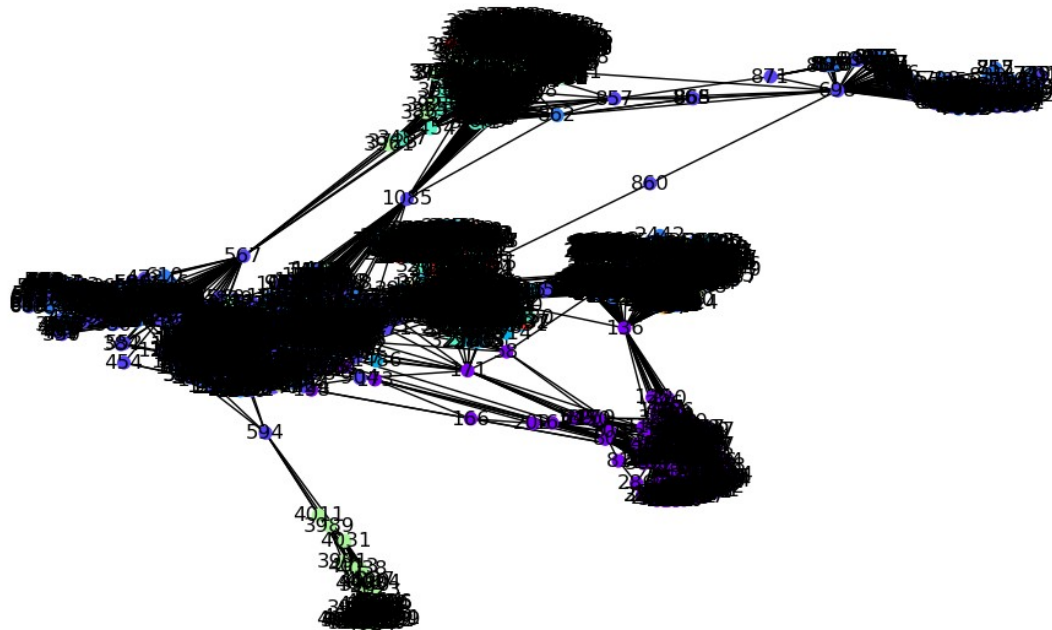
```
C:\Users\Medhavi\anaconda3\Lib\site-packages\networkx\drawing\  
nx_pyplot.py:433: UserWarning: No data for colormapping provided via  
'c'. Parameters 'cmap' will be ignored  
node_collection = ax.scatter(
```

Communities Detected by Min-Cut

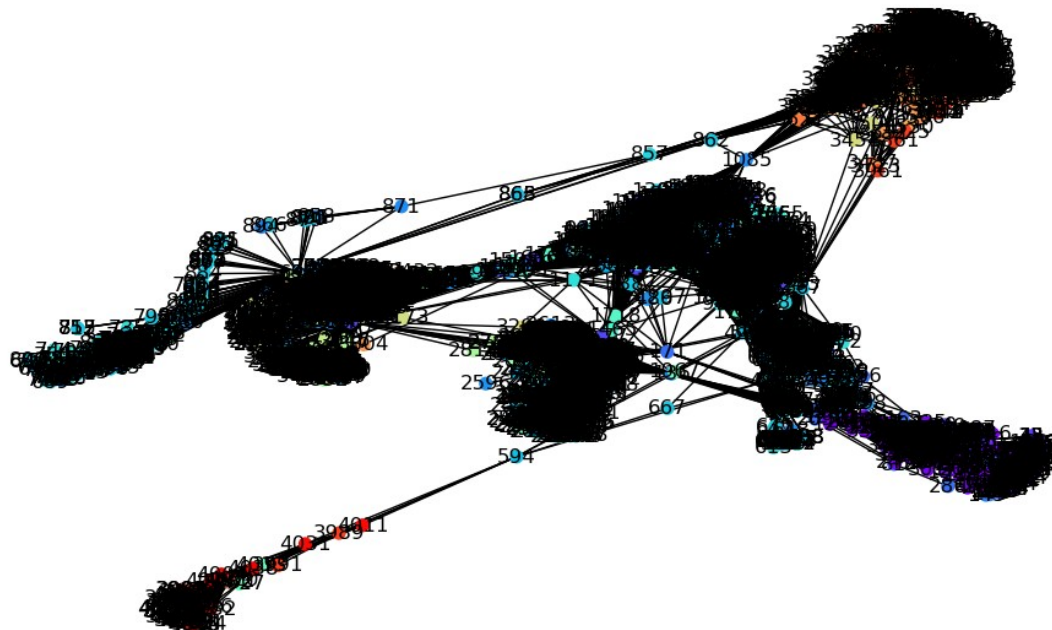




Communities Detected by CNM



Communities Detected by Walktrap



```
import numpy as np
import matplotlib.pyplot as plt
```

```

import networkx as nx
import community as community_louvain # For Louvain method
# For Markov Clustering
from networkx.algorithms.community import (
    greedy_modularity_communities,
    label_propagation_communities
)

# Create a random graph for demonstration (you can load your own
dataset)
facebook_graph = nx.erdos_renyi_graph(n=100, p=0.05) # A random graph
with 100 nodes

# Draw the graph
plt.figure(figsize=(10, 6))
nx.draw(facebook_graph, node_size=50, with_labels=False)
plt.title("Generated Random Graph")
plt.show()

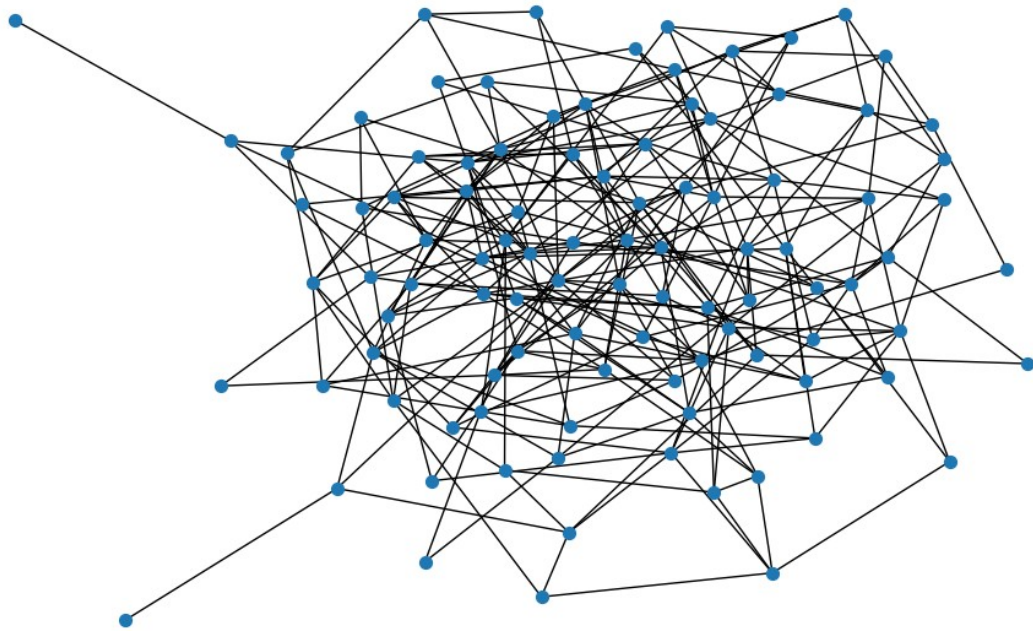
# Louvain Method
louvain_communities = community_louvain.best_partition(facebook_graph)
louvain_community_labels = set(louvain_communities.values())
print("Louvain Communities:", louvain_community_labels)

# Greedy Modularity Communities
greedy_communities = greedy_modularity_communities(facebook_graph)
print("Greedy Modularity Communities:", list(greedy_communities))

# Label Propagation
label_prop_communities = label_propagation_communities(facebook_graph)
print("Label Propagation Communities:", list(label_prop_communities))

```

Generated Random Graph



```
Louvain Communities: {0, 1, 2, 3, 4, 5, 6, 7}
Greedy Modularity Communities: [frozenset({0, 2, 69, 70, 71, 7, 10,
75, 12, 20, 86, 24, 89, 25, 29, 95, 35, 41, 43, 50}), frozenset({1,
67, 5, 13, 79, 80, 84, 21, 88, 93, 30, 31, 96, 33, 38, 45, 55, 59,
62}), frozenset({64, 36, 40, 74, 44, 15, 18, 19, 85, 56, 26, 28, 61,
94, 63}), frozenset({65, 39, 8, 9, 76, 77, 14, 17, 49, 52, 53, 54, 23,
92}), frozenset({32, 66, 99, 68, 6, 72, 78, 46, 47, 51, 58, 91}),
frozenset({98, 4, 37, 73, 42, 11, 48, 83, 22, 57, 27}), frozenset({97,
34, 3, 16, 81, 82, 87, 90, 60})]
Label Propagation Communities: [{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, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45,
46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62,
63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79,
80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96,
97, 98, 99}]

import numpy as np
import matplotlib.pyplot as plt
import networkx as nx

import community as community_louvain # For Louvain method

from networkx.algorithms.community import (
    greedy_modularity_communities,
    label_propagation_communities,
```

```

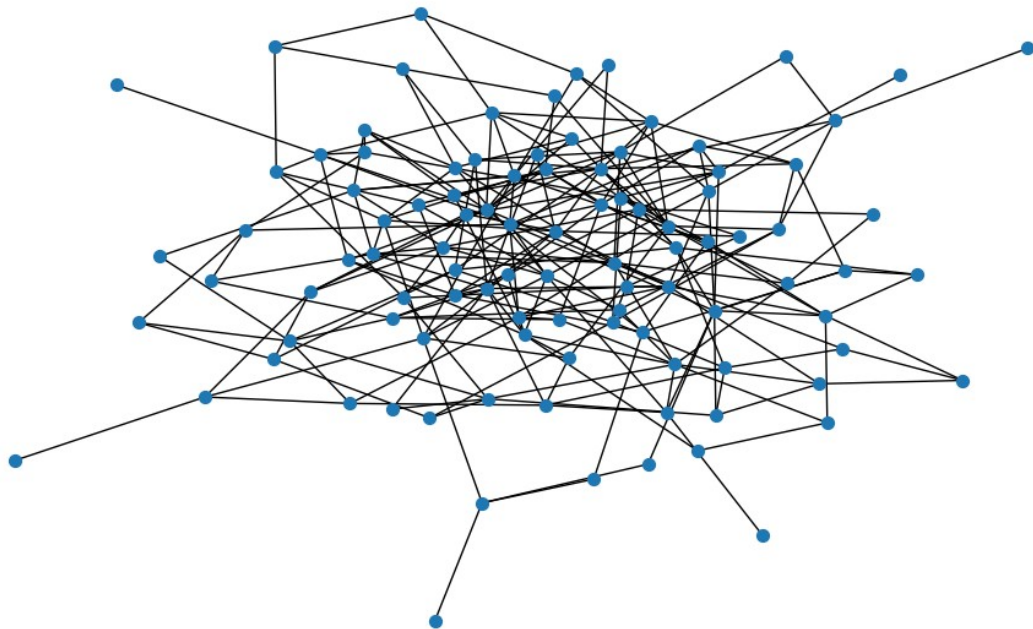
    k_clique_communities
)

# Create a random graph for demonstration (you can load your own
dataset)
facebook_graph = nx.erdos_renyi_graph(n=100, p=0.05) #
# Draw the graph
plt.figure(figsize=(10, 6))
nx.draw(facebook_graph, node_size=50, with_labels=False)
plt.title("Generated Random Graph")
plt.show()

# Markov Clustering
# Convert the graph to an adjacency matrix
adj_matrix = nx.to_numpy_array(facebook_graph)
# k-Clique Percolation
k = 3 # Set the size of the clique
k_clique_communities_result =
list(k_clique_communities(facebook_graph, k))
print("k-Clique Communities:", k_clique_communities_result)

```

Generated Random Graph



```

k-Clique Communities: [frozenset({2, 35, 36, 15, 88, 28}),
frozenset({64, 29, 5}), frozenset({5, 69, 39, 27}), frozenset({16, 3,
51, 75, 43}), frozenset({48, 56, 27}), frozenset({40, 74, 46, 83, 30,
62, 63}), frozenset({97, 53, 47})]

```

