Assignment-03-Ranjit-Menon

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##

Complex NetworkAnalysis - Assignment 3

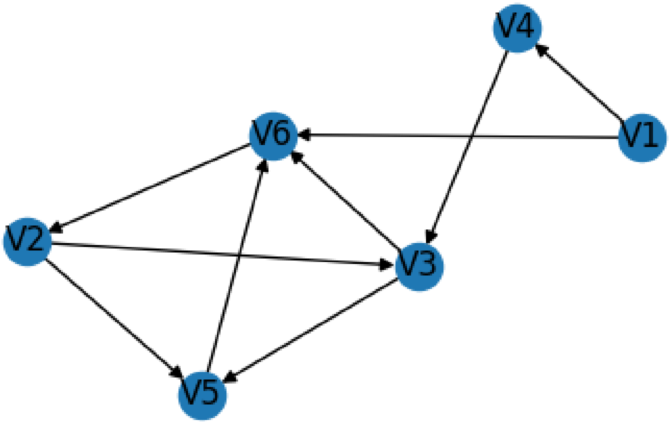
[162]:
```
#import required library
import networkx as nx
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
```

0.0.1 1. Create a directed graph with 6 nodes and 9 directed edges with no self loops. Find the number of common neighbours between any two given nodes

[120]:
```
#find common neighbors
def findCommonNeighbors_between_two_nodes(G,node1,node2):
    #we cannot use common_neigbors for a Digraph, we need to find the␣
  ↪predecessors and successors with the below code
    common_predecessors = set(G.predecessors(node1)).intersection(G.
  ↪predecessors(node2)) #incomming node
    common_successors = set(G.successors(node1)).intersection(G.
  ↪successors(node2)) #outgoing node

    # take a union between the two, it means get the common nodes for the two.
    common_neighbors = common_predecessors.union(common_successors)
    print(f"The common neighbors between nodes {node1} and {node2} are:␣
  ↪{list(common_neighbors)}")

G = nx.DiGraph() # first we are making a directed graph
#we have a clear requirement that we should not be using self loop, example we␣
  ↪should not use ('V1','V1'), this will create a self loop
G.add_edges_from([('V1', 'V6'), ('V1', 'V4'), ('V2', 'V5'), ('V3', 'V5'),␣
  ↪('V5', 'V6'), ('V4', 'V3'), ('V5', 'V6'), ('V6', 'V2'), ('V2', 'V3'),('V3',␣
  ↪'V6')])

print(f"The number of nodes in the graph is: {G.number_of_nodes()}")
print(f"The number of edges in the graph is: {G.number_of_edges()}")

# change the value below, to see the common neighbors between any two nodes
```

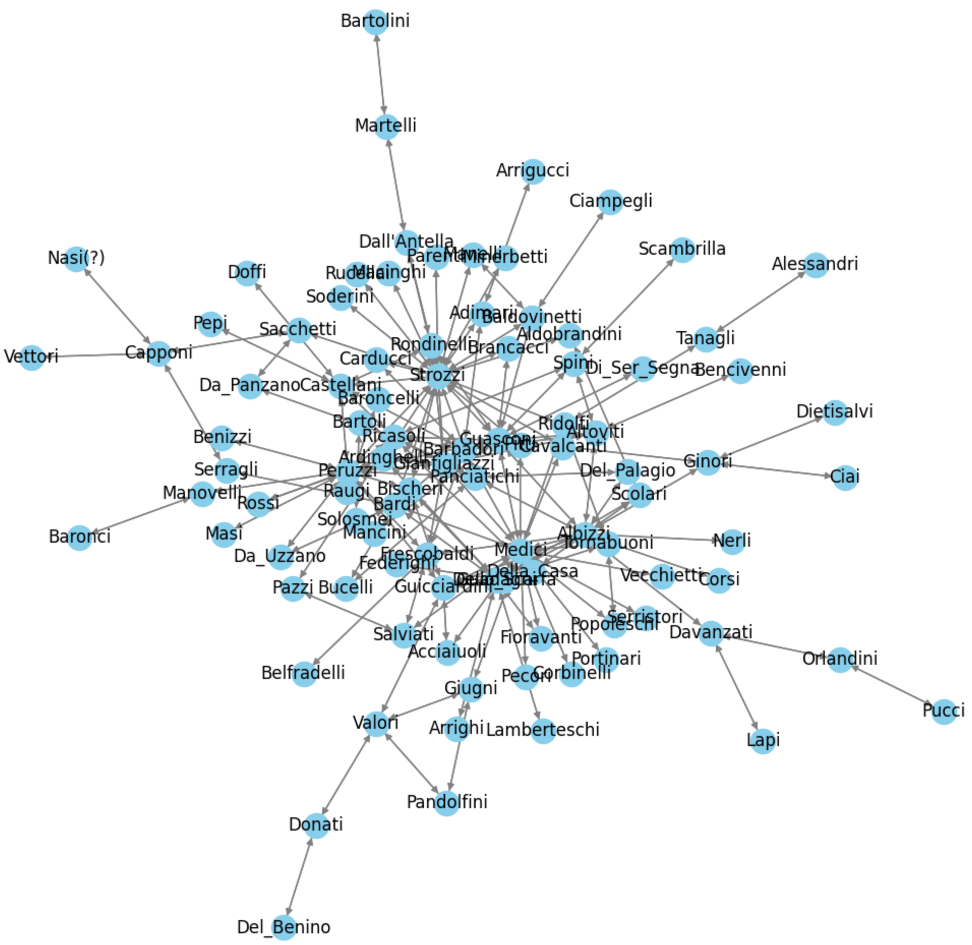
```
common_neighbors = findCommonNeighbors_between_two_nodes(G,'V1','V5')
common_neighbors = findCommonNeighbors_between_two_nodes(G,'V2','V3')

fix,ax = plt.subplots(figsize=(5,3))
pos=nx.kamada_kawai_layout(G)
nx.draw(G,pos=pos,with_labels=True,ax=ax)
```

```
The number of nodes in the graph is: 6
The number of edges in the graph is: 9
The common neighbors between nodes V1 and V5 are: ['V6']
The common neighbors between nodes V2 and V3 are: ['V5']
```



0.0.2 2. Create a Digraph from the given edge list file(ties.csv) that shows the marriage ties between various families

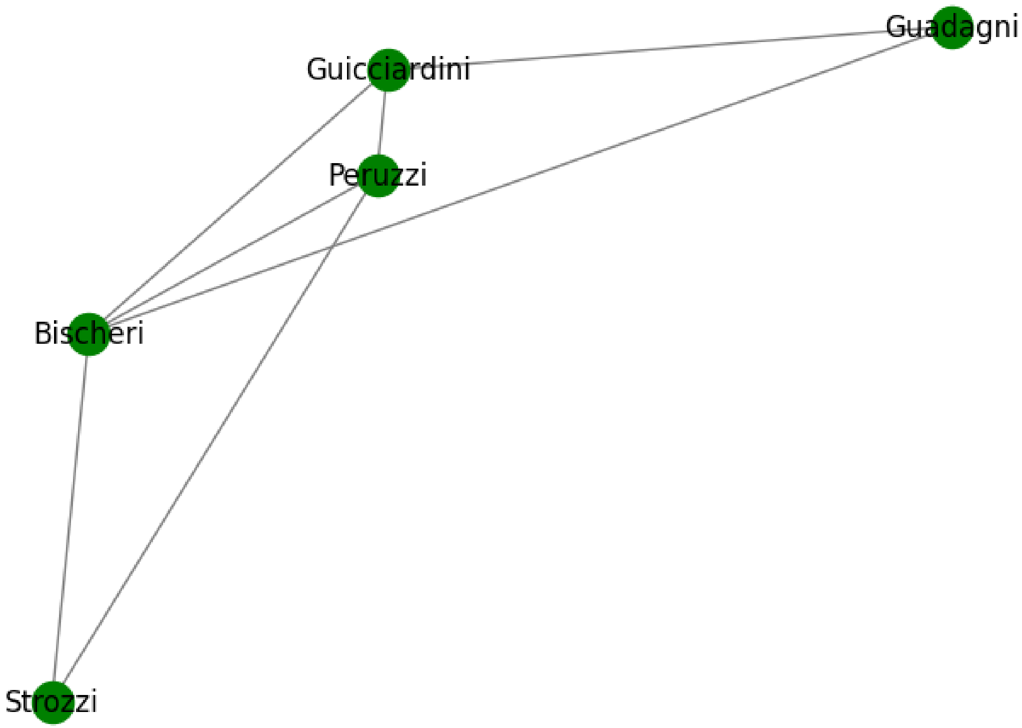
```
[121]: file_path = 'ties.xlsx'
df = pd.read_excel(file_path)

# Convert DataFrame to a list
edge_list = df[['FamilyA', 'FamilyB']].values.tolist()
edge_list

family_graph = nx.DiGraph()
family_graph.add_edges_from(edge_list)

#Draw the network Graph
fix,ax = plt.subplots(figsize=(14,14))
pos = nx.kamada_kawai_layout(family_graph)
nx.draw(family_graph,pos,with_labels=True,ax=ax,node_color='skyblue',␣
 ↪edge_color='gray')
```



0.0.3 3. Write a function that takes a family name as input and find all the direct ties it has with other families. Visualize it suitably

[122]:
```
#method to show a relationship between a family name to all the other family it␣
↪is related to
def findDirectTies_with_otherFamilies(G, family_name):
    neighbors = list(G.neighbors(family_name))
    subgraph_nodes = [family_name] + neighbors

    subgraph = G.subgraph(subgraph_nodes)
    pos = nx.random_layout(subgraph)
    nx.draw(subgraph, pos, with_labels=True, node_color='Green',␣
↪edge_color='gray')
```

```
family_name_graph = nx.Graph()
family_name_graph.add_edges_from(edge_list)
findDirectTies_with_otherFamilies(family_name_graph,"Bischeri")
```

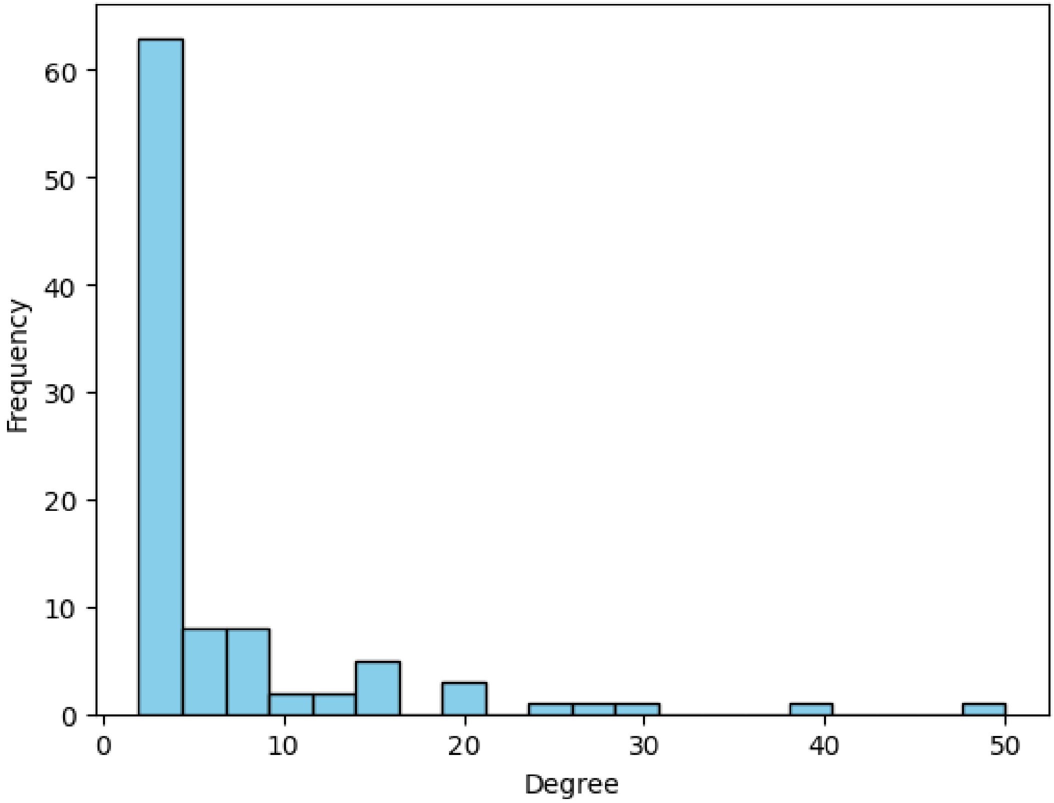


0.0.4 4. Find the family with most number of direct ties (Use degree centrality). Find their degree distribution.

[123]:

```
#find the degree centraility
def find_family_with_max_direct_ties(G):
    degree_centrality = nx.degree_centrality(G)
    max_family = max(degree_centrality, key=degree_centrality.get)
    max_degree = degree_centrality[max_family]

    return (max_family,max_degree)

def plot_degree_distribution(G):
    degrees = dict(G.degree())
    #print(degrees)
    degree_values = list(degrees.values())
    #print(degree_values)

    plt.hist(degree_values, bins=20, color='skyblue', edgecolor='black')
    plt.xlabel('Degree')
    plt.ylabel('Frequency')
    plt.show()


# Find the family with the most direct ties using degree centrality, we will reutrn tuple and print
(max_family,max_degree) = find_family_with_max_direct_ties(family_graph)
print(f"The family with the most direct ties is {max_family} with a degree centrality of {max_degree:.2f}")

# plotinng degree distribution
plot_degree_distribution(family_graph)
```

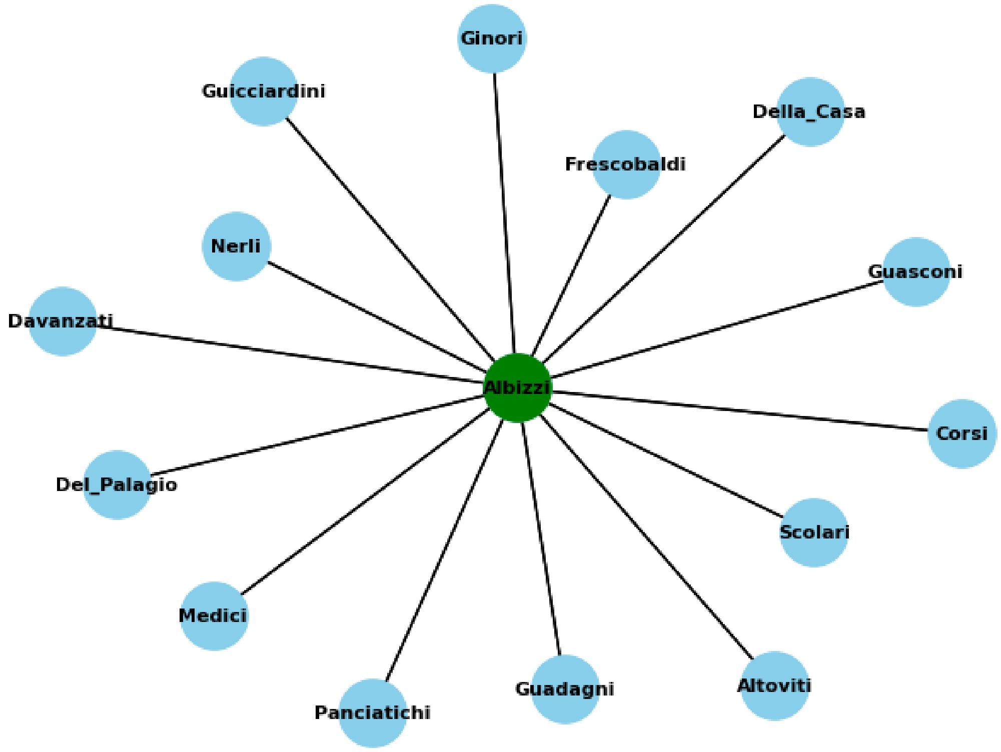
```
The family with the most direct ties is Strozzi with a degree centrality of 0.53
```



0.0.5 5. Write a function that takes a family name F, as the parameter and find how important is F in maintaining efficient relationship in the marriage network(Use betweenness centrality) Visualize it suitably.

[147]:

```
#method to calculate the importance of a Family A person with Family B person.
def calculate_betweenness_centrality(family_data, family_name):

    G = nx.Graph()

    # Add edges to the graph
    for edge in family_data:
        if edge[0] == family_name:
            G.add_edge(edge[0], edge[1])

    # Calculate betweenness centrality
    betweenness_centrality = nx.betweenness_centrality(G)

    # Get the betweenness centrality of the specified family
    family_betweenness = betweenness_centrality.get(family_name, 0)

    # Visualize the network
    pos = nx.spring_layout(G)
    nx.draw(G, pos, with_labels=True, font_weight='bold', node_size=800,␣
 ↪node_color='skyblue', font_size=8)

    # Add one more graph to display the main node in green color
    nx.draw(G, pos, nodelist=[family_name], node_size=800, node_color='green')


family_name_to_check = 'Albizzi'
betweenness = calculate_betweenness_centrality(edge_list, family_name_to_check)
```



0.0.6 6. Find a node that is most efficient in spreading the news of families. (Use closeness centrality)

[161]:

```
#method to find the closeness centraility, this will identify the closeness of␣
 ↪a node with other node
def find_closeness_score_node(family_data):

    G = nx.Graph()

    # Add edges to the graph
    for edge in family_data:
        G.add_edge(edge[0], edge[1])

    # Calculate closeness centrality
    closeness_centrality = nx.closeness_centrality(G)

    # Find the node with the highest closeness centrality, this will take hte␣
 ↪the max value
    most_efficient_node = max(closeness_centrality, key=closeness_centrality.
 ↪get)
```

```
    #populate the centraility score for the efficient node identified
    centrality_score = closeness_centrality[most_efficient_node]

    return (most_efficient_node,centrality_score) #return tuple

(most_efficient_node,centrality_score) = find_most_efficient_node(edge_list)

print(f"The most efficient node in spreading news is: {most_efficient_node}␣
 ↪with centrality score : {centrality_score}")
```

```
The most efficient node in spreading news is: Strozzi with centrality score :
0.4275843454790823
```