Programme	:	**B.Tech** Semester : **Win Sem 21-22**
Course	:	**Web Mining Lab** Code : **CSE3024**
Faculty	:	**Dr.Bhuvaneswari A** Slot : **L7+L8**
Date	:	**14-03--2022** Marks : **10 Points**

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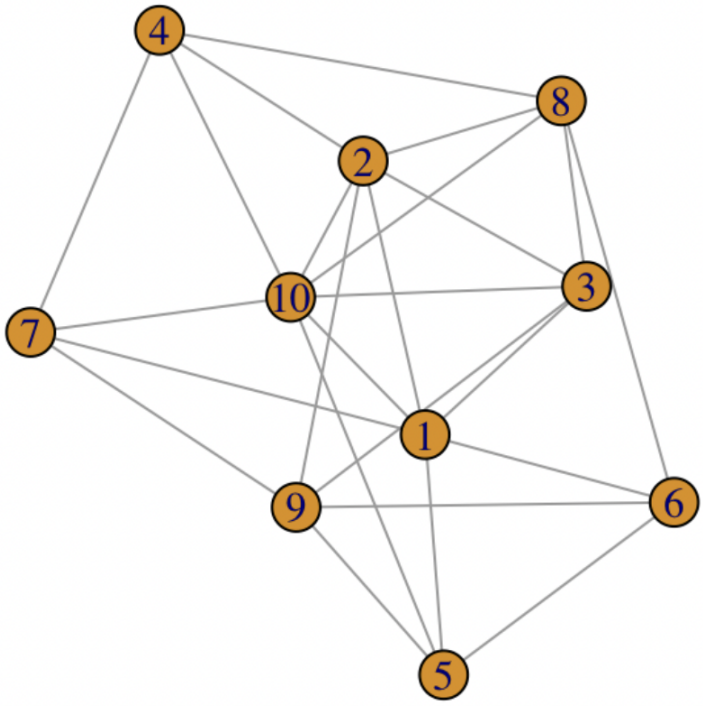
19BCE1413

Exercise 8: **CENTRALITY METRICS – SOCIAL NETWORK ANALYSIS**

Consider the following Facebook friendship network (mutual connection)



1. Find the degree centrality of all nodes
2. Find the neighbors of node 2.
3. Find the average degree of graph
4. Find the density of the graph
5. Find the closeness centrality of Node 10

6. Find all the paths to reach 4 from 6
7. Find the longest shortest path between any two nodes
8. Find the shortest path between any two nodes
9. Find the Betweenness centrality of Node 1.
10. Find the person who has maximum number of connections (friends)

```
G = nx.Graph()
#create a graph
G.add_edge('1','2',relation="neighbour")
G.add_edge('1','3',relation="neighbour")
G.add_edge('1','5',relation="neighbour")
G.add_edge('1','6',relation="neighbour")
G.add_edge('1','10',relation="neighbour")
G.add_edge('2','1',relation="neighbour")
G.add_edge('2','3',relation="neighbour")
G.add_edge('2','4',relation="neighbour")
G.add_edge('2','8',relation="neighbour")
G.add_edge('2','9',relation="neighbour")
G.add_edge('2','10',relation="neighbour")
G.add_edge('3','1',relation="neighbour")
G.add_edge('3','2',relation="neighbour")
G.add_edge('3','8',relation="neighbour")
G.add_edge('3','9',relation="neighbour")
G.add_edge('4','2',relation="neighbour")
G.add_edge('4','7',relation="neighbour")
G.add_edge('4','8',relation="neighbour")
G.add_edge('4','10',relation="neighbour")
G.add_edge('5','1',relation="neighbour")
G.add_edge('5','6',relation="neighbour")
G.add_edge('5','9',relation="neighbour")
G.add_edge('5','10',relation="neighbour")
G.add_edge('6','1',relation="neighbour")
G.add_edge('6','5',relation="neighbour")
G.add_edge('6','8',relation="neighbour")
G.add_edge('6','9',relation="neighbour")
G.add_edge('7','1',relation="neighbour")
G.add_edge('7','4',relation="neighbour")
G.add_edge('7','9',relation="neighbour")
G.add_edge('7','10',relation="neighbour")
G.add_edge('8','2',relation="neighbour")
G.add_edge('8','3',relation="neighbour")
G.add_edge('8','4',relation="neighbour")
G.add_edge('8','6',relation="neighbour")
G.add_edge('9','2',relation="neighbour")
G.add_edge('9','3',relation="neighbour")
G.add_edge('9','5',relation="neighbour")
G.add_edge('9','6',relation="neighbour")
G.add_edge('9','7',relation="neighbour")
G.add_edge('10','1',relation="neighbour")
```

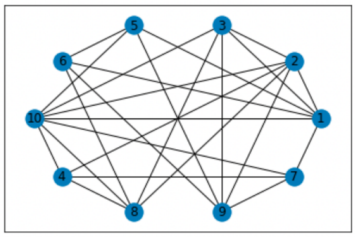
```
G.add_edge('10','3',relation="neighbour")
G.add_edge('10','5',relation="neighbour")
G.add_edge('10','8',relation="neighbour")
G.add_edge('10','4',relation="neighbour")
G.add_edge('10','2',relation="neighbour")
G.add_edge('10','7',relation="neighbour")
G.edges(data=True)
```

Python

```
EdgeDataView([('1', '2', {'relation': 'neighbour'}), ('1', '3', {'relation': 'neighbour'}), ('1', '5', {'relation': 'neighbour'}), ('1', '6', {'relation': 'neighbour'}), ('1', '10', {'relation': 'neighbour'}), ('1', '7', {'relation': 'neighbour'}), ('2', '3', {'relation': 'neighbour'}), ('2', '4', {'relation': 'neighbour'}), ('2', '8', {'relation': 'neighbour'}), ('2', '9', {'relation': 'neighbour'}), ('2', '10', {'relation': 'neighbour'}), ('3', '8', {'relation': 'neighbour'}), ('3', '9', {'relation': 'neighbour'}), ('3', '10', {'relation': 'neighbour'}), ('5', '6', {'relation': 'neighbour'}), ('5', '9', {'relation': 'neighbour'}), ('5', '10', {'relation': 'neighbour'}), ('6', '8', {'relation': 'neighbour'}), ('6', '9', {'relation': 'neighbour'}), ('10', '4', {'relation': 'neighbour'}), ('10', '7', {'relation': 'neighbour'}), ('10', '8', {'relation': 'neighbour'}), ('4', '7', {'relation': 'neighbour'}), ('4', '8', {'relation': 'neighbour'}), ('9', '7', {'relation': 'neighbour'})])
```

```
nx.draw_networkx(G, pos=nx.circular_layout(G),with_labels=True)
plt.show()
```

Python



1) Find the degree centrality of all the nodes

```
degree_centrality = nx.degree_centrality(G)
degree_centrality
```

Python

```
{'1': 0.6666666666666666,
 '10': 0.7777777777777777,
 '2': 0.6666666666666666,
 '3': 0.5555555555555556,
 '4': 0.4444444444444444,
 '5': 0.4444444444444444,
 '6': 0.4444444444444444,
 '7': 0.4444444444444444,
 '8': 0.5555555555555556,
 '9': 0.5555555555555556}
```

2) Find the neighbors of node 2

```
print("Number of neighbors of node 2:")
G['2']
```

Python

```
Number of neighbors of node 2:

AtlasView({'1': {'relation': 'neighbour'}, '3': {'relation': 'neighbour'}, '4': {'relation': 'neighbour'}, '8': {'relation': 'neighbour'}, '9': {'relation': 'neighbour'}, '10':
{'relation': 'neighbour'}})
```

+ Code + Markdown

3) Find the average degree of graph

```
print("Average degree of graph is:")
2*G.number_of_edges() / float(num_of_vertices)
```

Python

```
Average degree of graph is:

5.0
```

4) Find the density of the graph

```
print("Density of graph is:")
nx.density(G)
```

Python

```
Density of graph is:

0.5555555555555556
```

+ Code + Markdown

5) Find the closeness centrality of node 10

```
print("Closeness centrality of node 10 is:");
closeness_centrality = nx.closeness_centrality(G)
closeness_centrality['10']
```

Python

```
Closeness centrality of node 10 is:

0.8181818181818182
```

6) Find all the paths to reach 4 from 6

```
print("All paths from node 4 to 6 are:");
path=nx.all_simple_paths(G,source='4',target='6')
print(list(path))
```

Python

```
All paths from node 4 to 6 are:
[['4', '2', '1', '3', '8', '6'], ['4', '2', '1', '3', '8', '10', '5', '6'], ['4', '2', '1', '3', '8', '10', '5', '9', '6'], ['4', '2', '1', '3', '8', '10', '7', '9', '5', '6'], ['4',
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7) Find the longest shortest path between any two nodes

```
def max_length_list(input_list):
    max_length = max(len(x) for x in input_list )
    for i in input_list:
      print(i)
      if len(i) == max_length:
        return(max_length,i)
ShortestPaths=[]
print("Longest Shortest path between any two nodes:");
for i in range(num_of_vertices) :
  for j in range(num_of_vertices):
    ShortestPaths.append(nx.shortest_path(G,source=vertices_list[i],target=vertices_list[j]))
print(max_length_list(ShortestPaths))
```

[ ] Python

```
Longest Shortest path between any two nodes:
['1']
['1', '2']
['1', '3']
['1', '2', '4']
(3, ['1', '2', '4'])
```

8) Find the shortest path between any two nodes

```
print("Shortest path between any two nodes:");
for i in range(num_of_vertices) :
    for j in range(num_of_vertices) :
        print(nx.shortest_path(G,source=vertices_list[i],target=vertices_list[j]))
```

Python

```
Shortest path between any two nodes:
['1']
['1', '2']
['1', '3']
['1', '2', '4']
['1', '5']
['1', '6']
['1', '7']
['1', '2', '8']
['1', '2', '9']
['1', '10']
['2', '1']
['2']
['2', '3']
['2', '4']
['2', '1', '5']
['2', '1', '6']
['2', '4', '7']
['2', '8']
['2', '9']
['2', '10']
['3', '1']
['3', '2']
['3']
['3', '2', '4']
```

show more (open the raw output data in a text editor) ...

```
['10', '1', '6']
['10', '7']
['10', '8']
['10', '2', '9']
['10']
```

9) Find the betweeness centrality of Node 1

```
print("Betweeness centrality of node 1:");
betweenness_centrality=nx.betweenness_centrality_source(G,normalized=True, weight=None, sources=None)
betweenness_centrality['1']
```

Python

```
Betweeness centrality of node 1:

0.08564814814814814
```

10) Find the person who has maximum number of connections

+ Code + Markdown

```
print("Person who has maximum number of connections:");
max(dict(G.degree()).items(), key = lambda x : x[1])
```

Python

```
Person who has maximum number of connections:

('10', 7)
```