

Kathmandu University

Department of Computer Science and Engineering

Dhulikhel, Kavre



Lab Report 5

COMP 314

(For partial fulfillment of 3rd Year/ 2nd Semester in Computer Engineering)

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C.E.

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Task 1:

Algorithm:

AVGdegree(G, v):

```
totalDegree = 0
for node in nx.nodes(G):
    count = 0
    for neighbor in nx.neighbors(G, node):
        count += 1
    totalDegree += count
avgDegree = totalDegree/v
print("Average Degree is: ", int(avgDegree))
```

Density(G, v, e):

```
if v > 1:
    print("Density is: ", round((2*e)/(v*(v - 1)), 5))
else:
    print("Density is: 0")
```

Diameter(G, v):

```
sum = []
for v1, v2 in combinations(G.nodes, 2):
    if nx.has_path(G, v1, v2):
        sum.append(nx.shortest_path_length(G, v1, v2, method = "dijkstra"))
    else:
        print("The graph is not connected. Diameter is: infinite")
print("Diameter is: ", max(sum))
```

ClusteringCoefficient(G, v):

```
clusterCoeff = 0
for node in nx.nodes(G):
    Ki, Ei = 0, 0
    for i in G.neighbors(node):
        Ki += 1
    for v1, v2 in combinations(G.neighbors(node), 2):
        if G.has_edge(v1, v2):
            Ei += 1
    if Ki > 1:
        clusterCoeff += (2*Ei)/(Ki*(Ki - 1))
print("Clustering Coefficient is: ", round(clusterCoeff/v, 5))
```

Discussion:

Here is the output for the main code and Test Case done on the same graph, i.e. <http://networkrepository.com/ENZYMES-g196.php> of 50 nodes.

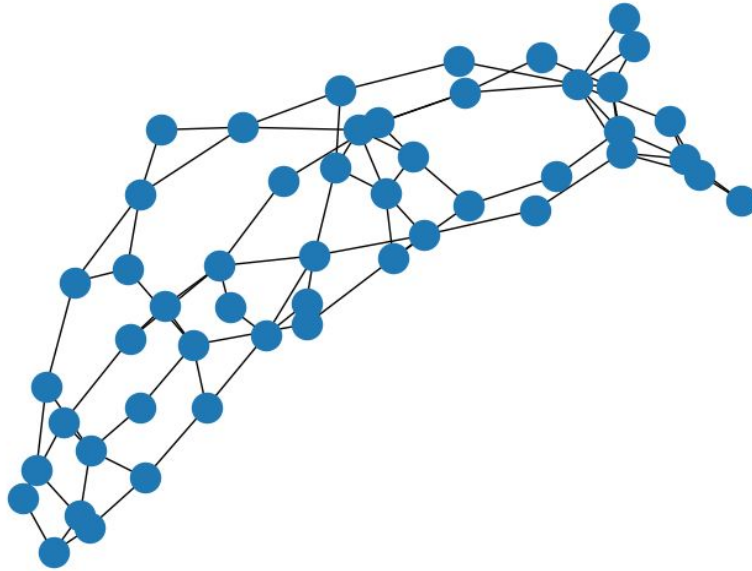
```
C:\Users\neha\Algorhythm\lab5>python graph.py
Number of nodes: 50
Number of edges: 86
Average Degree is: 3
Density is: 0.0702
Diameter is: 10
Clustering Coefficient is: 0.21157

C:\Users\neha\Algorhythm\lab5>python test_graph.py
Number of nodes: 50
Number of edges: 86
Average Degree is: 3
.Number of nodes: 50
Number of edges: 86
Clustering Coefficient is: 0.21157
.Number of nodes: 50
Number of edges: 86
Density is: 0.0702
.Number of nodes: 50
Number of edges: 86
Diameter is: 10
.
-----
Ran 4 tests in 0.115s

OK

C:\Users\neha\Algorhythm\lab5>
```

And here is the graph:



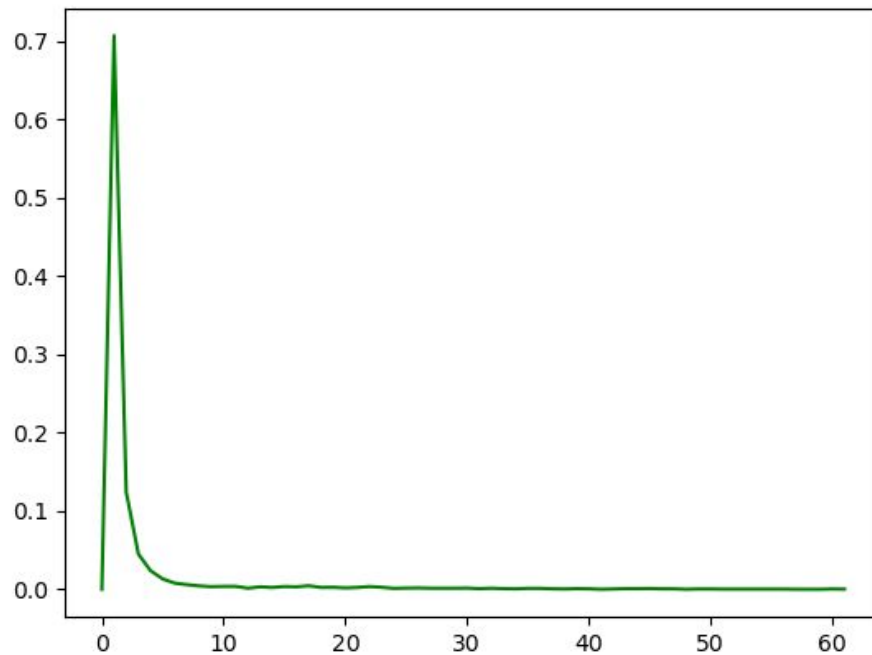
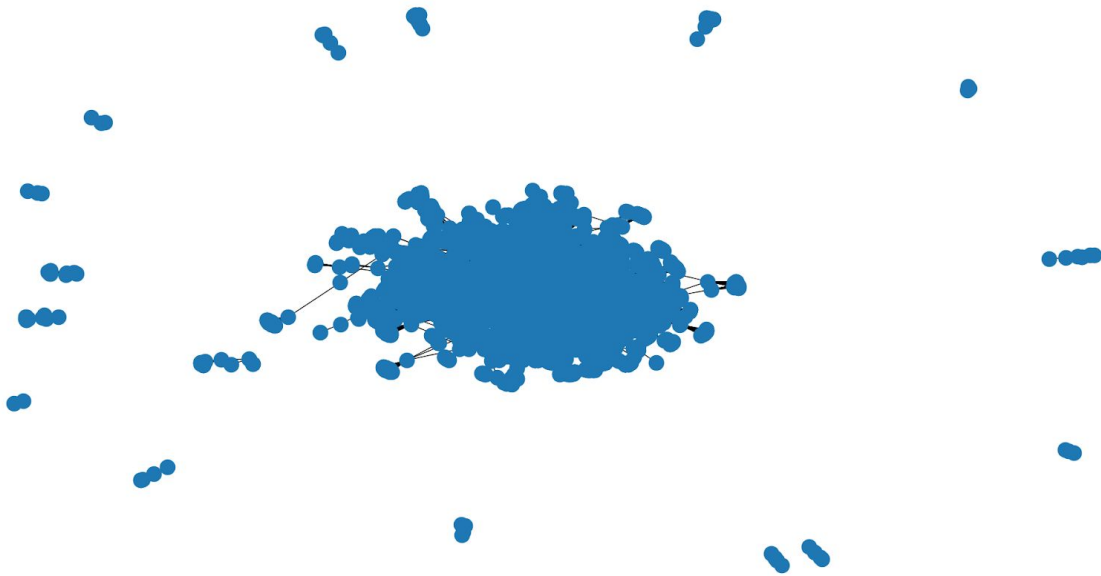
All test cases ran successfully on the four of the methods, as seen on the screenshot provided above.

The source code and test file will be uploaded along with this report.

Task 2: Network properties and Degree Distribution of 5 graphs

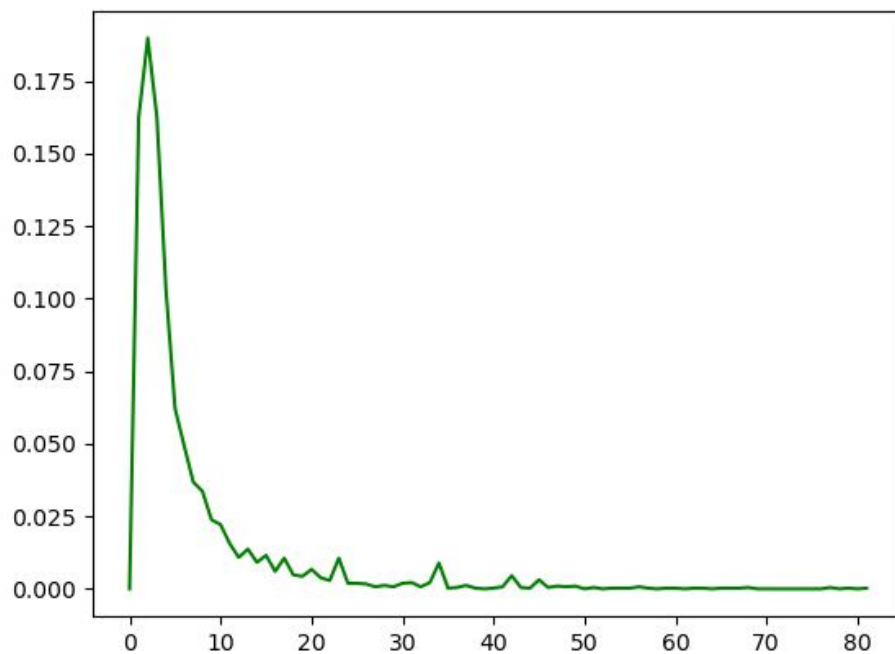
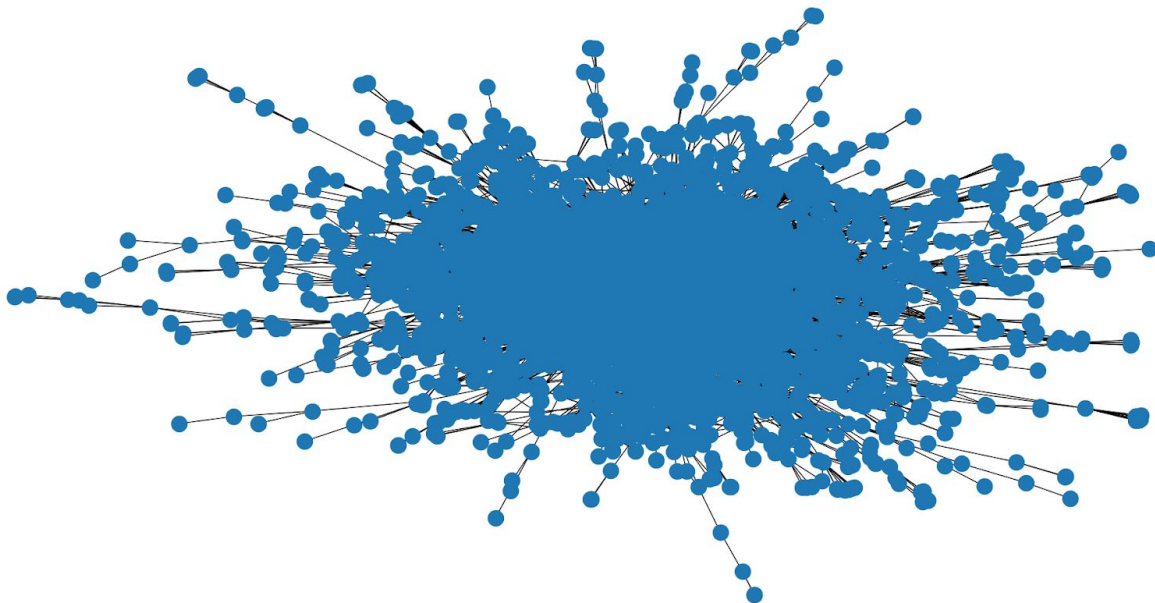
- a. Graph 1 - <http://networkrepository.com/ca-Erdos992.php>

```
C:\Users\neha\Algorhythm\lab5>python graph.py  
Number of nodes: 5094  
Number of edges: 7515  
Average Degree is: 2  
Density is: 0.00058  
The graph is not connected. Diameter is: infinite  
Clustering Coefficient is: 0.08184
```



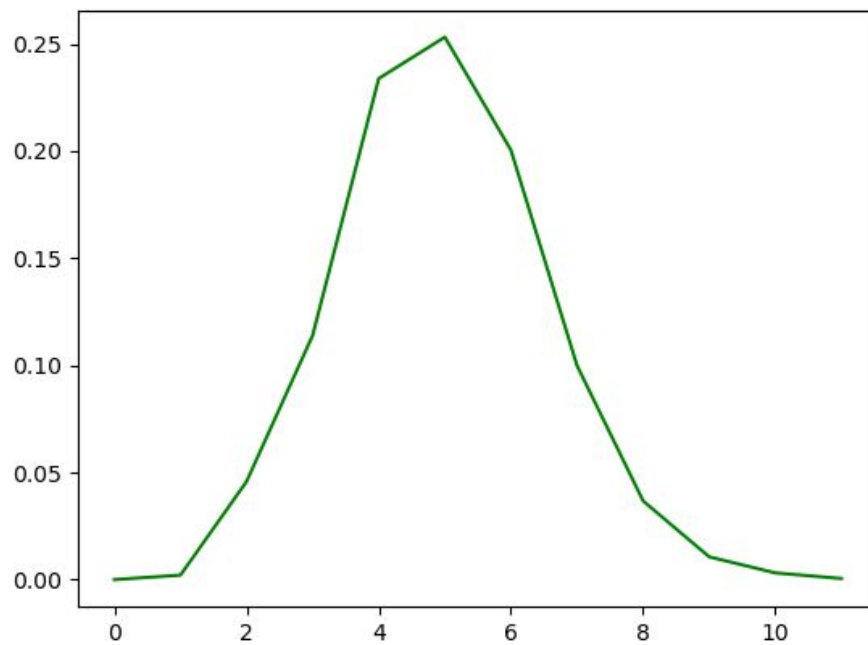
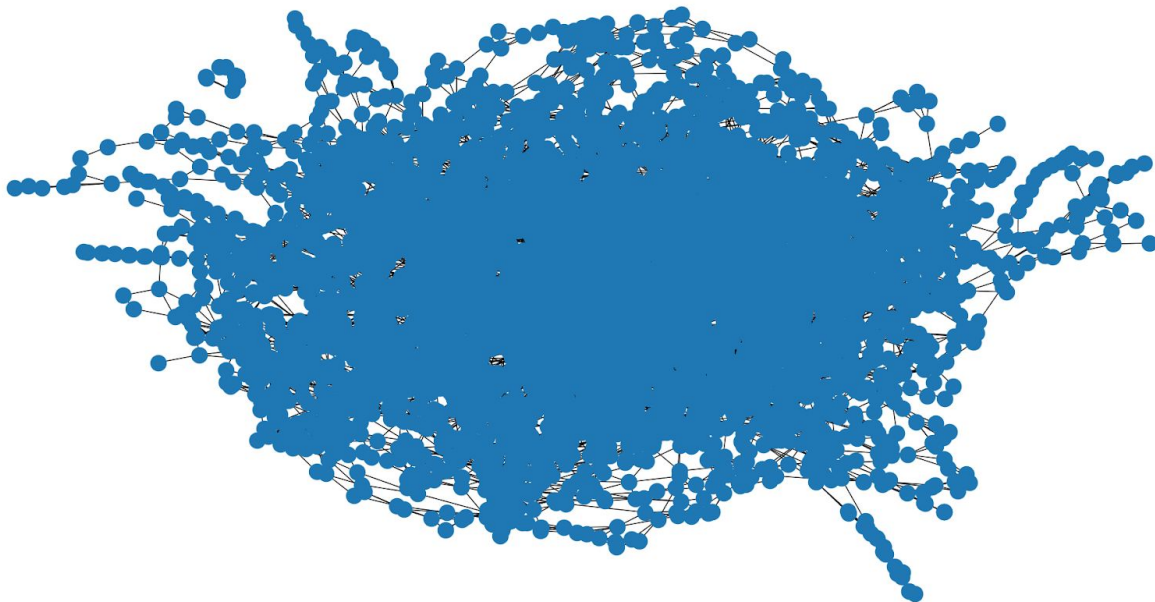
b. Graph 2 - <http://networkrepository.com/ca-GrQc.php>

```
C:\Users\neha\Algorith\lab5>python graph.py  
Number of nodes: 4158  
Number of edges: 13422  
Average Degree is: 6  
Density is: 0.00155  
Diameter is: 17  
Clustering Coefficient is: 0.55688
```



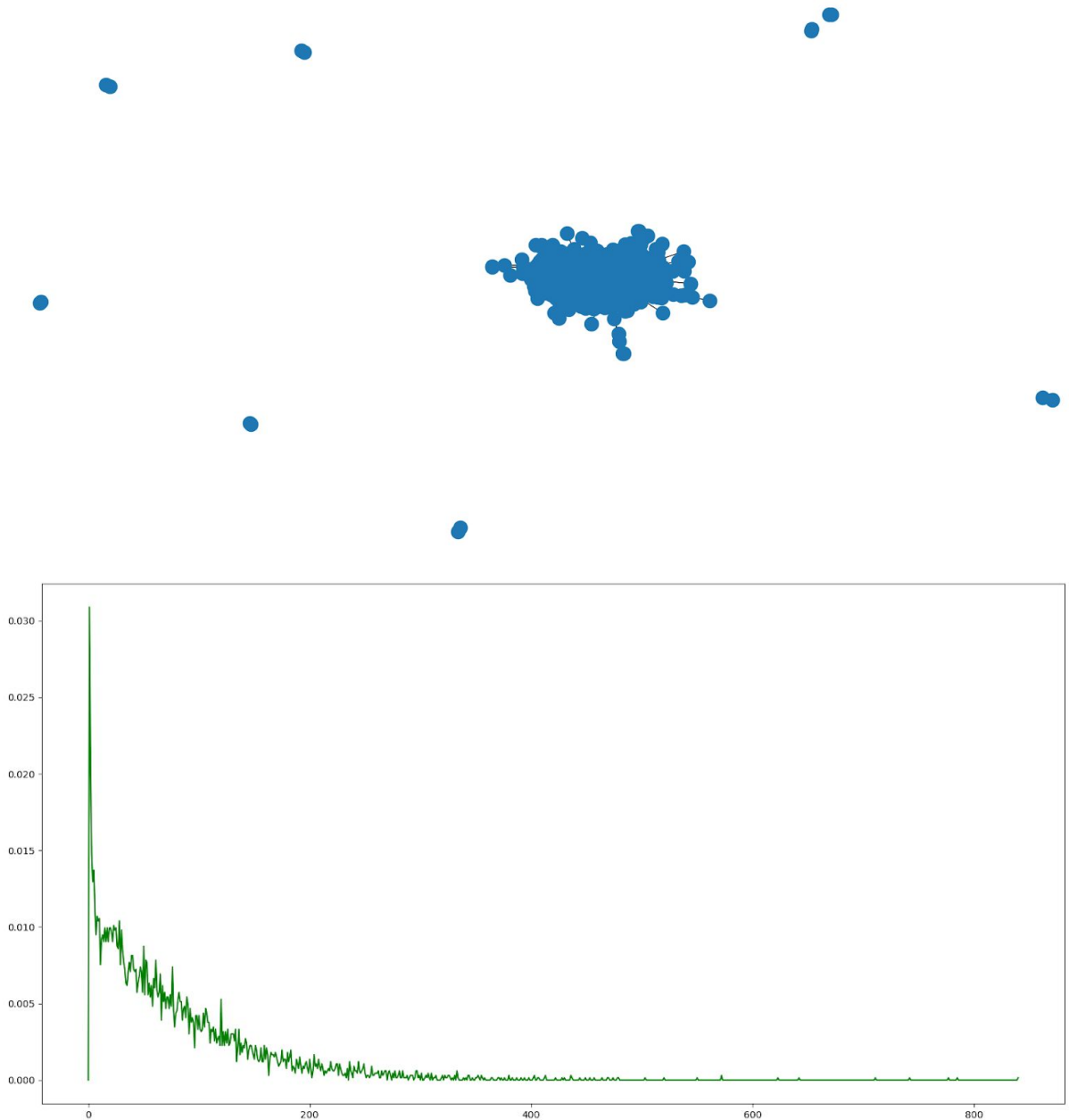
c. Graph 3- <http://networkrepository.com/DD21.php>

```
C:\Users\neha\Algorhythm\lab5>python graph.py  
Number of nodes: 5748  
Number of edges: 14267  
Average Degree is: 4  
Density is: 0.00086  
The graph is not connected. Diameter is: infinite  
Clustering Coefficient is: 0.45842
```



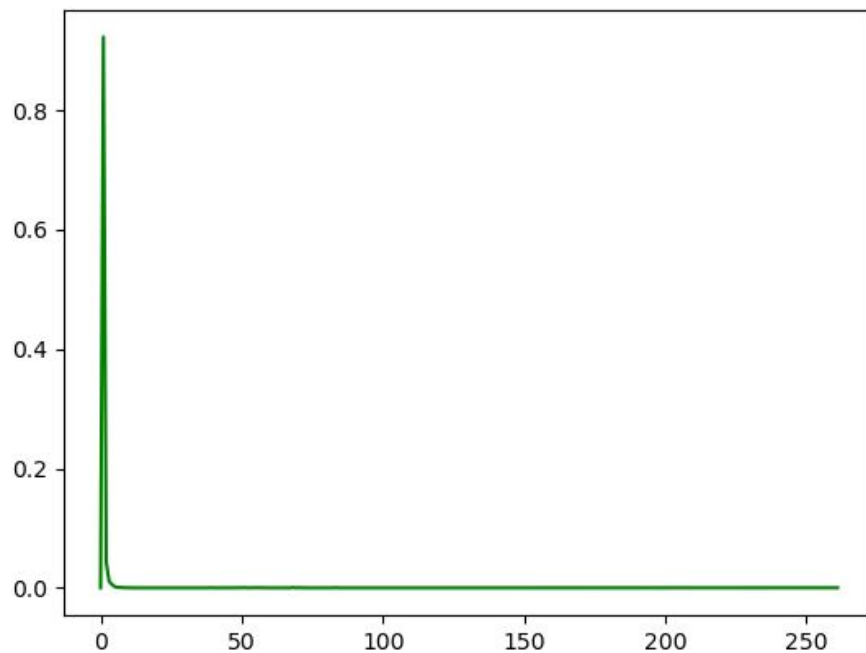
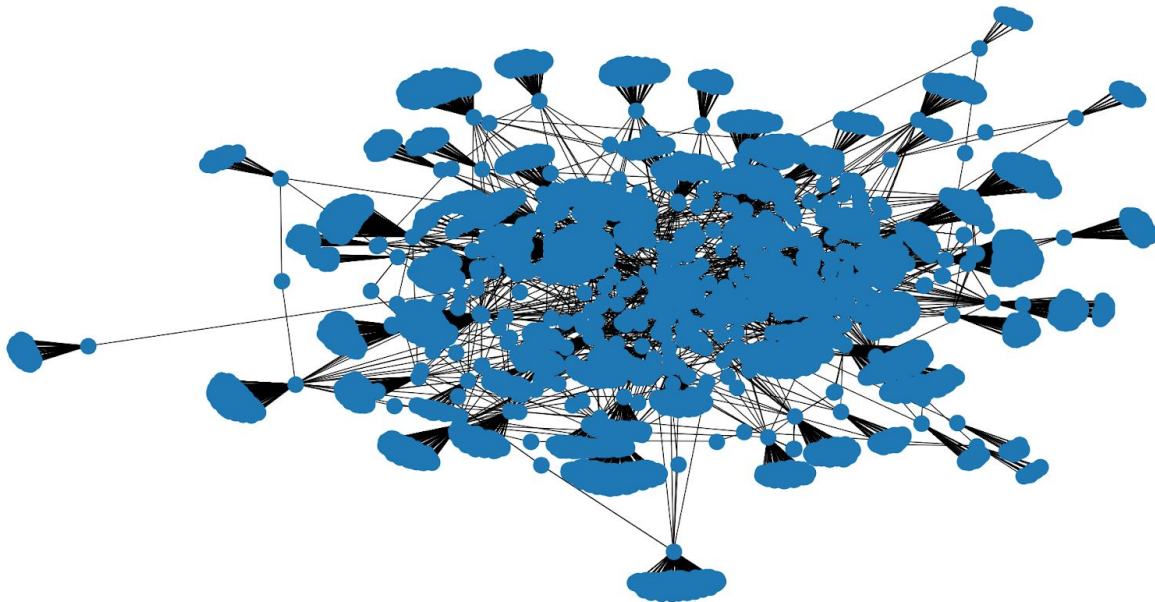
d. Graph 4 - <http://networkrepository.com/fb-CMU-Carnegie49.php>

```
C:\Users\neha\Algorhythm\lab5>python graph.py  
Number of nodes: 6637  
Number of edges: 249967  
Average Degree is: 75  
Density is: 0.01135  
The graph is not connected. Diameter is: infinite  
Clustering Coefficient is: 0.2781
```



e. Graph 5 - <http://networkrepository.com/ia-reality.php>

```
C:\Users\neha\Algorhythm\lab5>python graph.py  
Number of nodes: 6809  
Number of edges: 7680  
Average Degree is: 2  
Density is: 0.00033  
Diameter is: 8  
Clustering Coefficient is: 0.01777
```



Discussion:

- a. From the network properties, what can you say about the networks you have selected?
 - All graphs are of large size (of around 5K nodes or more), and though some nodes are highly dense, there are a few number of those, thus the average degree is really less of around 2 to 10 in most of them.
 - Since all the nodes aren't connected to each of the other nodes, the graph is not dense, resulting in low density in all of these 5 above graphs.
 - Since 4 of the above graphs were not connected, the diameter couldn't be calculated, thus returning the message for so, as infinite length to the diameter. But one of the graphs was connected and the diameter was found to be 8.
 - As said earlier, all the nodes aren't connected to all the other nodes, thus the clustering coefficient is low.
- b. Did you find any pattern in the degree distributions of the networks? In any case, can you come to any conclusion about the networks from their degree distribution?
 - The maximum degree of node seems to be of around 60 to 800 on 4 of those above graphs; these highly dense nodes seem to be in less number than the nodes which have low degree. Thus the degree distribution graph is positively skewed.
 - Except for the 3rd graph which has the highest degree to be 11 and the average degree 4, so with this small range of degree the graph obtained seems to be almost symmetrically distributed.