```
#Program Code PART 1


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

#Task 1(Loading data of bitcoinotc)
df = pd.read_csv(r"/Users/shivamsharma/Downloads/shivam_csv.csv")
print(df)
df.head()
df.tail()



# (printing information of the Graph)
Hello = nx.from_pandas_edgelist(df,source="From",target="To")
nx.info(Hello)
print(nx.info(Hello))


#(Graph 1)
%matplotlib inline
nx.draw(Hello)


#Graph 2
nx.draw(Hello,
node_size = 1,
node_color = 'C1')
fig.set_facecolor('c')
fig = plt.figure(figsize = (14, 9))
colors = np.linspace(0, 1, len(graph.nodes))


#Graph 3
colors = np.linspace(0, 1, len(Hello.nodes))
layout = nx.kamada_kawai_layout(Hello)
fig = plt.figure(figsize=(14, 9))
nx.draw(Hello,with_labels = True,
node_size = 30,
node_color = colors,
pos = layout,
edge_color = 'c')
fig.set_facecolor('k')
k=1.0
```

```
#Graph 4
nx.draw(Hello, with_labels = True,
        node_size  = 30,
        node_color = colors,
        edge_color = 'g')
fig.set_facecolor('k')
colors = np.linspace(0, 1, len(Hello.nodes))
k = 1.0
layout = nx.spring_layout(Hello, k = k)



#Graph 5
nx.draw(Hello, with_labels = True,
        node_size  = 30,
        node_color = colors,
        edge_color = 'g')
fig.set_facecolor('k')
colors = np.linspace(0, 1, len(Hello.nodes))
k = 1.0
layout = nx.spring_layout(Hello, k = k)
fig = plt.figure(figsize = (14, 9))


m=3
degree_frequency = [val for (node, val) in Hello.degree()]


#Task 4
print(sorted(degree_frequency))
degree_frequency = np.array(degree_frequency, dtype= float)
degree_prob = ((degree_frequency/(Hello.number_of_nodes()-1)))
print(degree_prob)
plt.figure(figsize=(15, 15))

#Task 5
plt.plot(degree_freq[m:], degree_prob[m:],'go-')

plt.xlabel('Degree')
plt.ylabel('Probability P(k)')
plt.show()


#NOTE: ALL OUTPUTS ARE PRINTED BELOW AS THE SEQUENCE IN CODE


OUTPUTS:
```

Task 1:

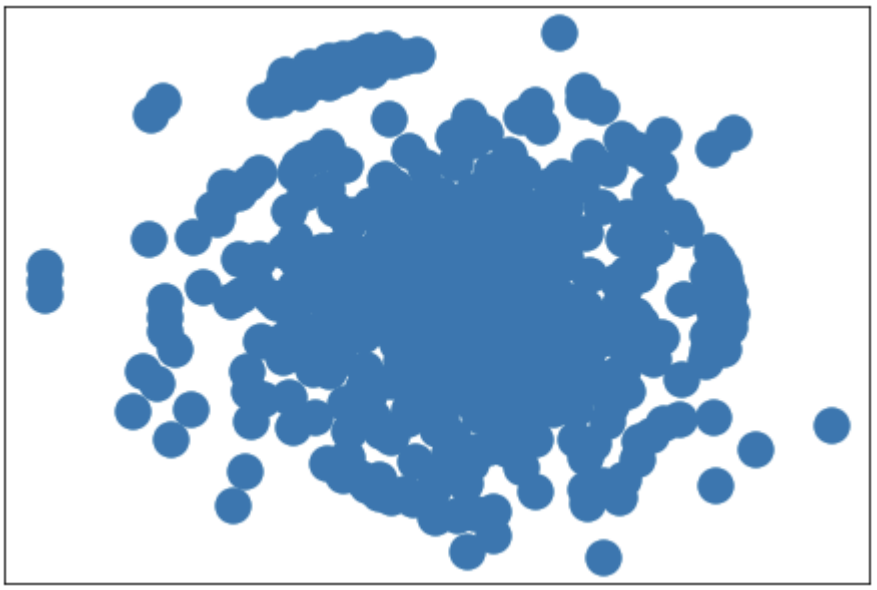
```
     From   To
0       6    2
1       6    5
2       1   15
3       4    3
4      13   16
...    ...  ...
2675   361  481
2676    33   35
2677    96    6
2678   215   33
2679    33  215

[2680 rows x 2 columns]
```

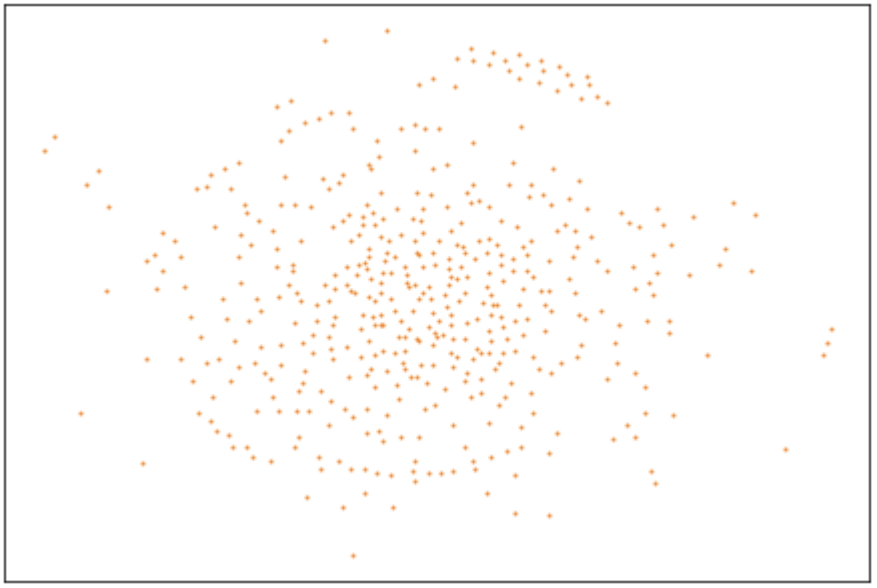
Out[29]:

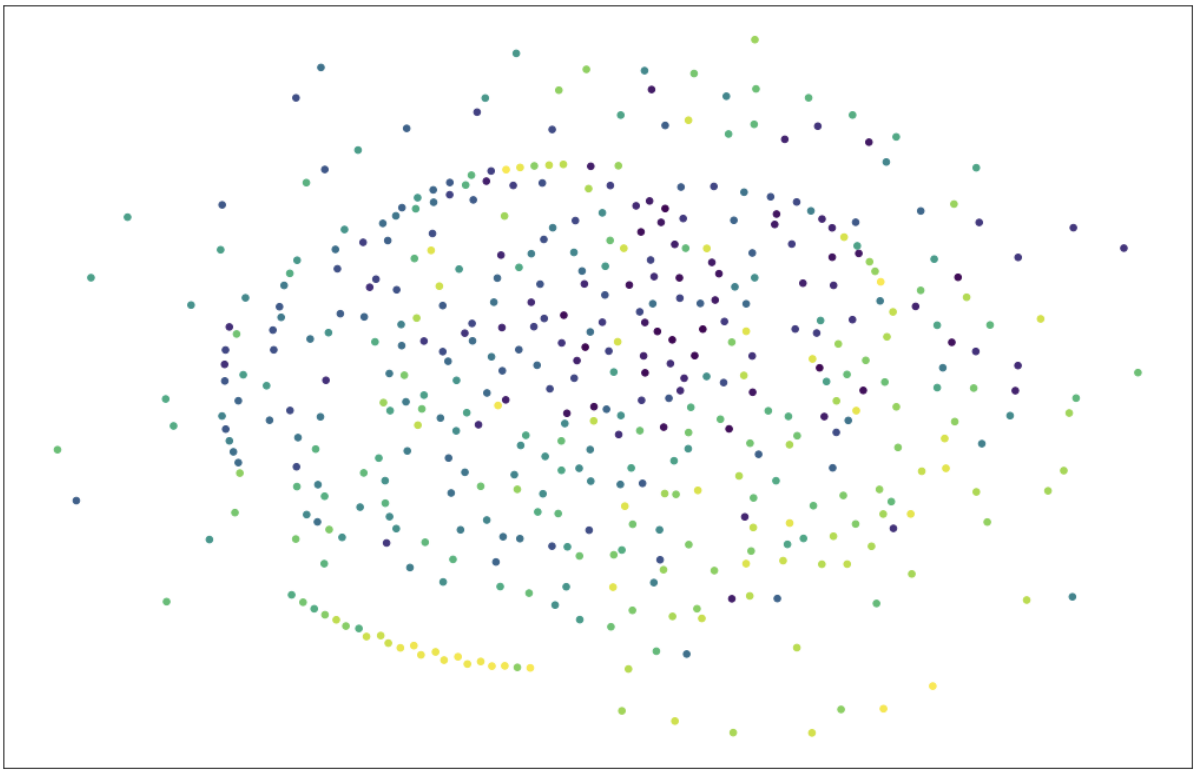
	From	To
2675	361	481
2676	33	35
2677	96	6
2678	215	33
2679	33	215

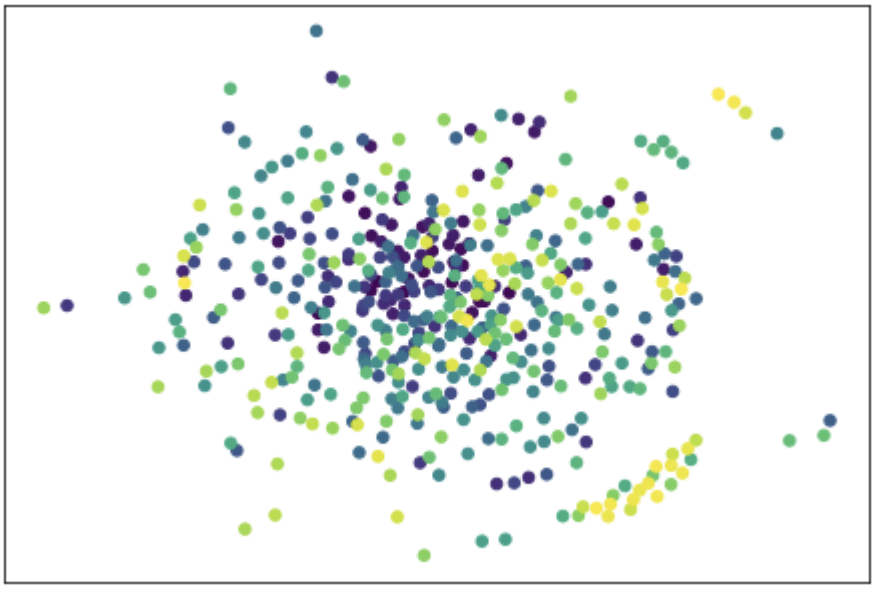
Task 2:

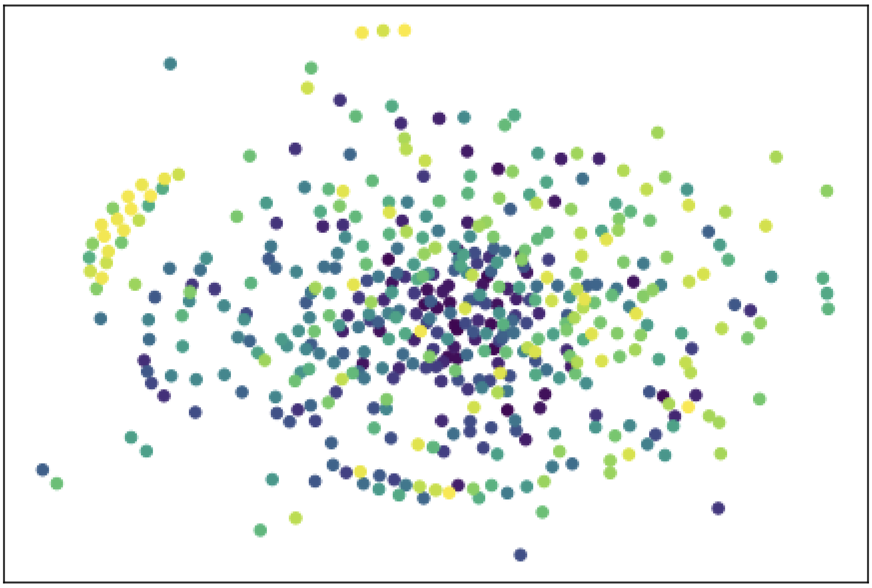
Name:
Type: Graph
Number of nodes: 460
Number of edges: 1546
Average degree: 6.7217











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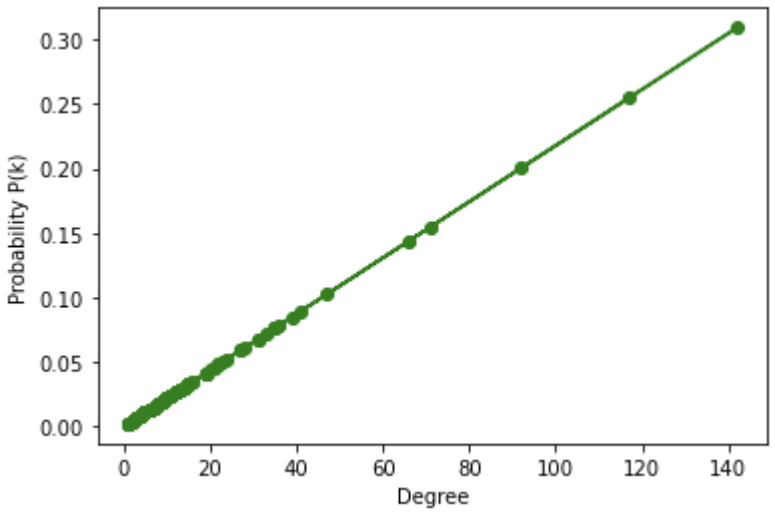
Out[28]:

<Figure size 1296x1080 with 0 Axes>
<Figure size 1296x1080 with 0 Axes>



PART 1, OPTION 4:

According to my output`, the most notable characteristic is the relative commonness of vertices with a degree that greatly exceed the average. The highest-degree nodes are often called “hubs”, and are thought to serve specific purpose in their network, meanwhile this depends majorly on the domain.
SCALE-FREE NETWORK

A scale free network is a network whose degree distribution act in accordance with power law . There are two prime components that explain the appearance of the scale-free property in a complex networks: the growth and the preferential attachment. Growth- Over an period of time new nodes will join to existing system. Preferential attachment meant that new nodes prefer to connect to nodes that already have a high number of connections with others.

Clustering Another important characteristic of scale-free networks is the clustering coefficient distribution, which decreases as the node degree increases. This distribution also follows a power law. This implies that the low-degree nodes belong to very dense sub-graphs and those sub-graphs are connected to each other through hubs. Consider a social network in which nodes are people and links are acquaintance relationships between people. It is easy to see that people tend to form communities, i.e., small groups in which everyone knows everyone (one can think of such community as a complete graph. In addition, the members of a community also have a few acquaintance relationships to people outside that community. Some people, however, are connected to a large number.
The distance in scale free network A further characteristic concerns the average distance between two vertices in a network. As with most disordered networks, such as the small world network model, this distance is very small relative to a highly ordered network such as a lattice graph. Thus, the diameter of a growing scale-free network might be considered almost constant in practice.