Table of Contents

Dataset

Network of people who trade-using Bitcoin on a platform called Bitcoin Alpha. Bitcoin users are anonymous; there is a need to maintain a record of users' reputation to prevent transactions with fraudulent and risky users. (See Stanford 2018).
The second dataset is a completely random graph with same amount of nodes from the first dataset.

Dataset statistics	
Nodes	3,783
Edges	24,186
Range of edge weight	-10 to +10
Percentage of positive edges	93%

Figure 1 – Bitcoin Dataset Statistics

Degree distribution

This captures the difference in the degree of connectivity between nodes in a graph, its really asking the question ‘do all the nodes have roughly the same amount of connections or do some have many whilst others have very few’.

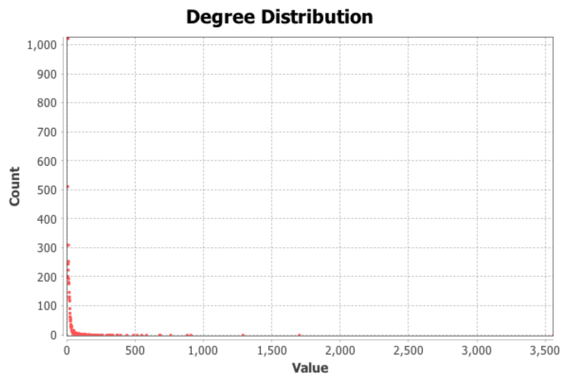

Figure 2i – Degree Distribution Bitcoin

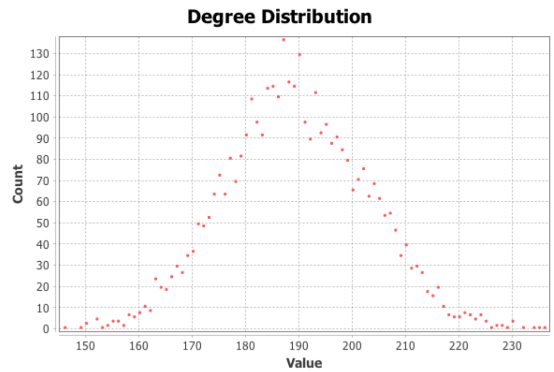

Figure 2ii – Degree Distribution Random

The Bitcoin plot graph shows a highly connected set of nodes that have several connections within each other and are all imbedded into a well-connected core. When we further examine the nodes we see that they are interlinked, following distribution of power law (long tail). This type of distribution exhibits what is called the small world network property such as resistant to node removal.

Since the variables whose distributions are not known in the random dataset, the graph demonstrates this by showing what looks like a normal distribution (bell-curve). Reason being that the nodes are not highly connected within their respective hubs. Consequently, there’ll be some difference in the degree distribution of connectivity amongst the nodes; hence the average degree of this plot is far higher of that of a real network.

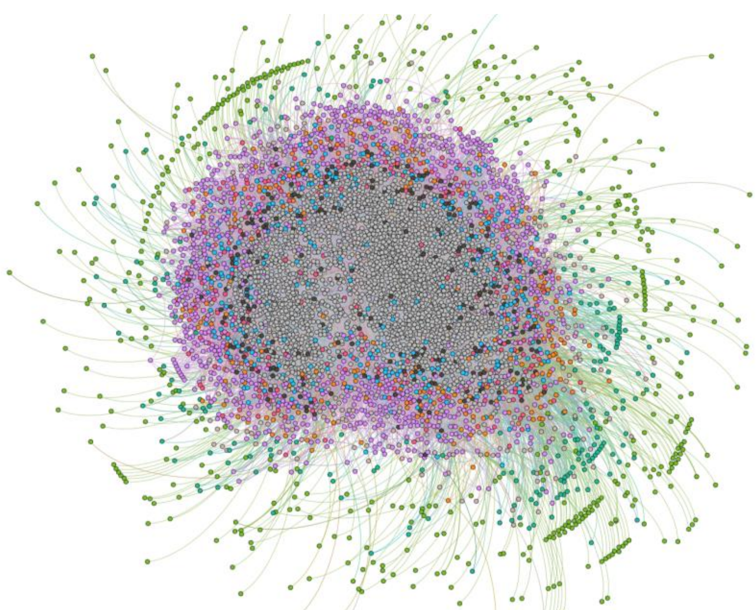

Figure 2iii – Degree Distribution Graph – Bitcoin

Network (Coefficient) Clustering

This measures the degree of clustering of a typical node's neighbourhood; any two nodes with a common neighbour are connected. Example, how many of your friends know your other friends, the more they are interconnected the more clustered (clique) they are.

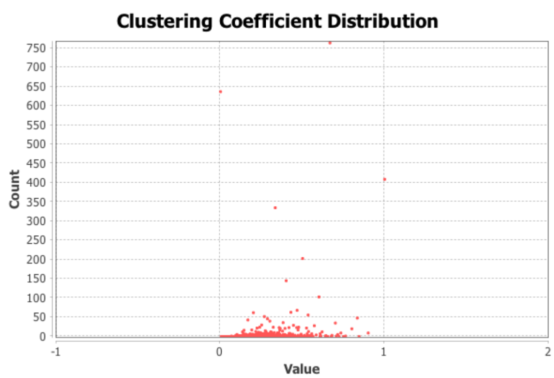

Figure 3i – Clustering Coefficient Bitcoin

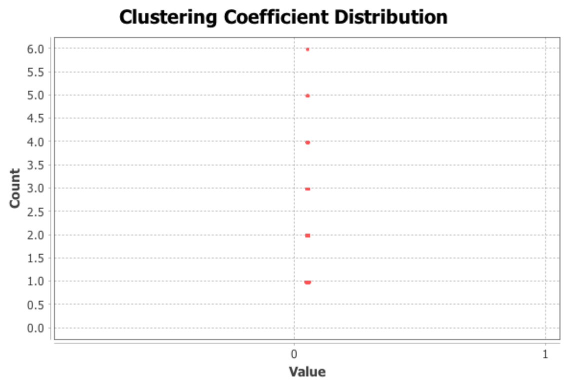

Figure 3ii – Clustering Coefficient Random

The values shown in figure 3i are tightly knit ranging between 0 to 1. This high-density plot has an average clustering coefficient of 0.435; this value is close to 1, which tells us that the nodes in the Bitcoin dataset are strongly grouped (fair amount of triangles) and may have bridges to other parts of the networks.

However, the random distribution shows the opposite. All the values are between 0.04 to 0.05 and an average coefficient of 0.05. The coefficient is close to 0 so it represents something like a star network, a lack of interconnecting common neighbouring nodes, in other words the nodes do not have any major cliques. (See Complexity Labs 2018)

It is evident form the plots above that the clustering coefficient is significantly higher than the clustering coefficient of the random network with the same amount of nodes and edges. So the Bitcoin is cliquish, on the contrary the random network isn't.

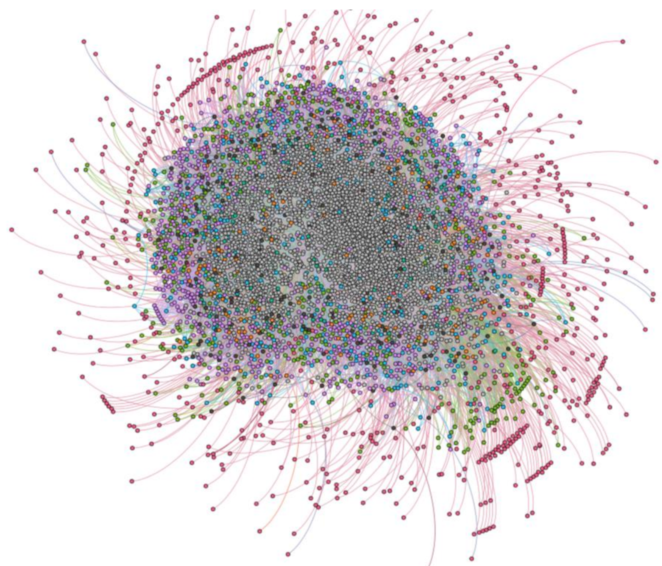

Figure 3iii – Clustering Coefficient Graph – Bitcoin

Modularity

Modularity tells you how coherent a community is, so if a link of some nodes are dense then it will be called a coherent community. The modularity algorithm implemented in Gephi looks for the nodes that are more densely connected together than the rest of the network. (See Wiki 2018).

Figure 4i – Modularity Bitcoin

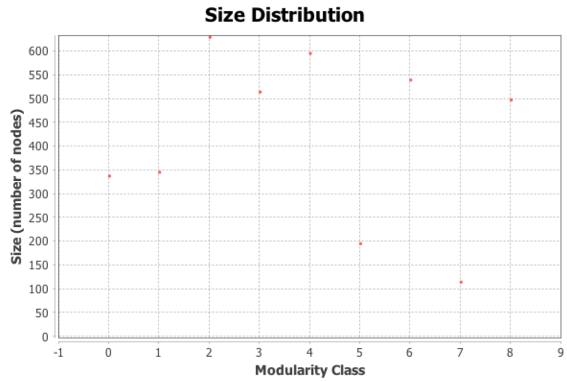

Figure 4ii – Modularity Random

Modularity class represents communities within the dataset while the size represents the number of nodes within that community. There are a total of 13 communities, each community consisting of more than 30 nodes. This network has a medium modularity (0.251) given its dense connections between nodes. The modularity for this network suggests that the connections within each module are numerous, however the connections between modules are sparse.

Differing, the random network has 9 communities with node sizes varying from 0 to 650. So the communities are smaller but more importantly the number of nodes within those communities are even smaller. The medium modularity of this network is 0.061; this represents a random network given that it's closer to 0.

If we look at community 0 in both graphs, Bitcoin has 2,200 nodes while the random network has 350. This further proves the point mentioned in the network coefficient that the Bitcoin is more grouped than the random network.

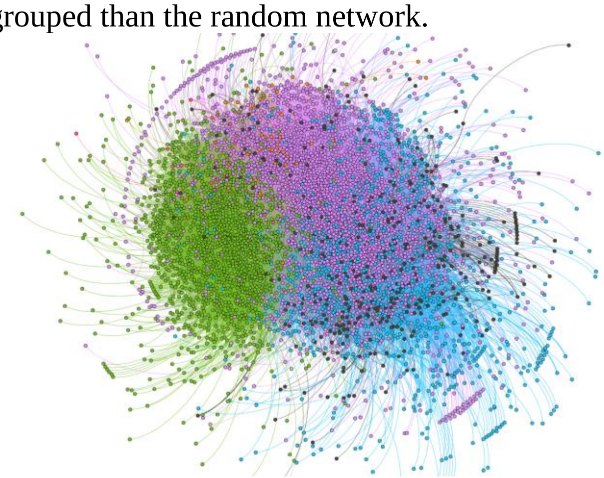

Figure 4iii – Modularity Graph – Bitcoin

Centrality Betweenness

Centrality is a measure that tells us how influential or significant a node is within the overall network. The centrality metric that is being compared is the betweenness, which measures the roles as a connector or bride between other groups of nodes.

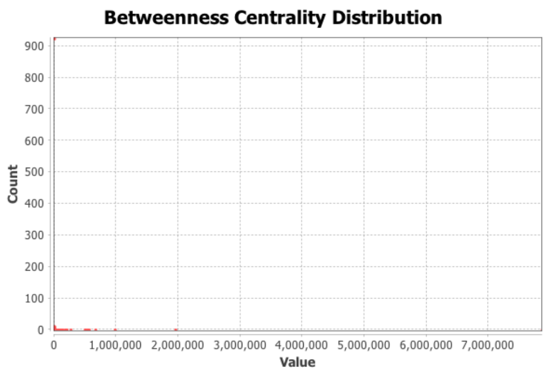

Figure 5i – Centrality Betweenness Bitcoin

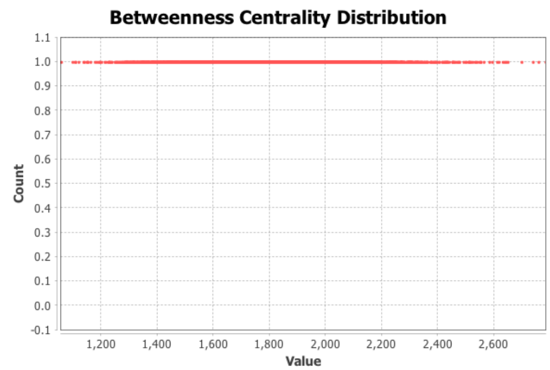

Figure 5ii – Centrality Betweenness Random

In Figure 5i the values are extremely high, ranging from 0 to 2,000,000. This suggests that the vertices may have considerable influence within the network by virtue of their control over information passing between others. They also are the ones whose removal from the network will most disrupt communications between other vertices because they lie on the largest number of paths taken by messages. (See Sci 2018).

Due to the nature of random graphs, no particular nodes stand out. Hence, the betweenness centralization occupies very small values. This is shown in figure 5ii where the graph displays a stationary count of values varying from 0 to 2,800. (See Stanford 2018).

The Diameter measures the maximum distance between any pair of nodes in the graph. Bitcoin has a diameter of 6 while the random network has 3. This shows that the Bitcoin is less linked in comparison to the random network. This is because a random network is consistent leading to a lower diameter.

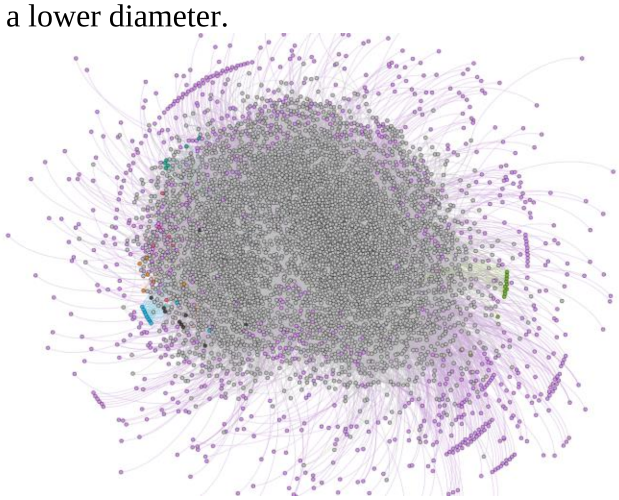

Figure 5iii – Centrality Betweenness Graph – Bitcoin

Reference

Unknown. (2018). Sci [online] Available at: https://www.sci.unich.it/~francesc/teaching/network/betweeness.html [Accessed 09 Feb. 2018].

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Unknown. (2018). Wiki [online] Available at: https://en.wikipedia.org/wiki/Modularity_(networks) [Accessed 09 Feb. 2018].