## 2. Trump's Personal & Business Relationships

Identify the 10 most influential nodes in the network using i) degree, ii) page rank, and iii) betweenness centrality. Visualize the network.

You can extract the nodes and links from the original data file or simply import the graphML file.

You can read more information about the network here: https://www.buzzfeed.com/johntemplon/help-us-map-trumpworld?utm_term=.vaJO0mwvX0#.ifDlvxpM1v

Figure 1a presents the graph that shows Trump and 1513 entities that he has direct or indirect personal and business relationship. Figures 1b through 1d show progressively zoomed in portion of the whole network, which has a low average clustering coefficient of 0.236, and low average shortest path length of 3.800. Most of the entities do not have a relationship with each other. It is clear that most nodes in the same rings of the graph are not connected to each other.

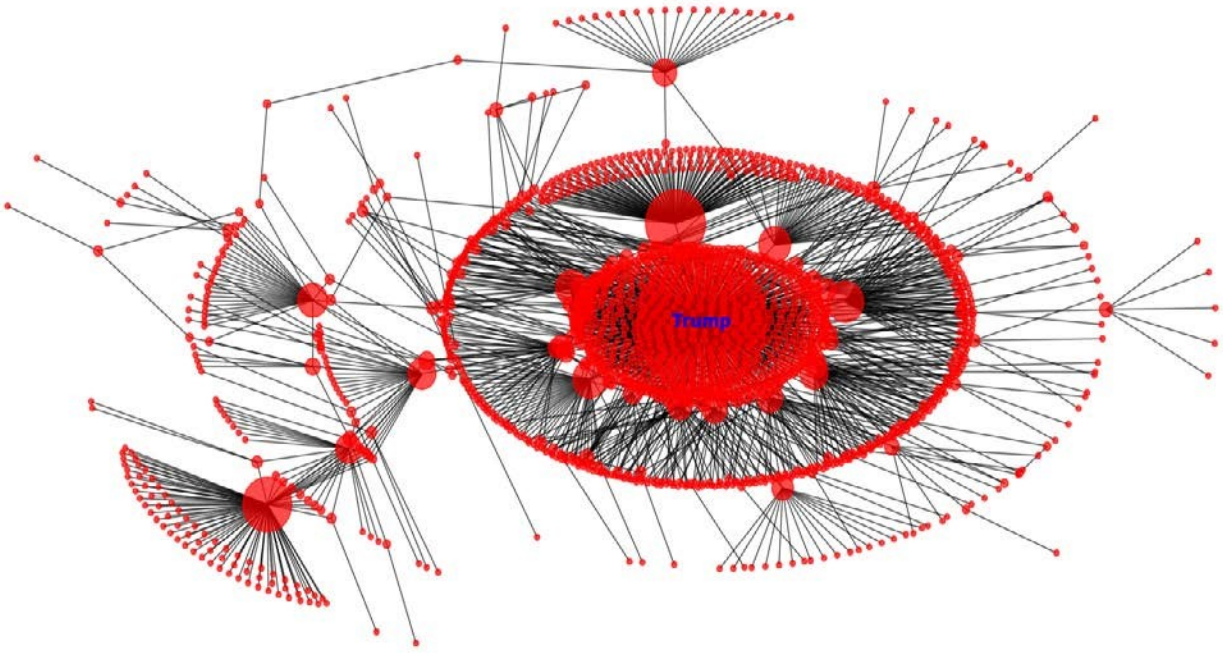



*Figure 1a. Graph Showing Trump's Personal and Business Relationships*

```
Graph name: Trump World
Type: Graph
Number of nodes: 1514
Number of edges: 1857
Average degree:   2.4531
Average clustering coefficient = 0.23631932409465756
Average shortest path length = 3.7999862049817477
```

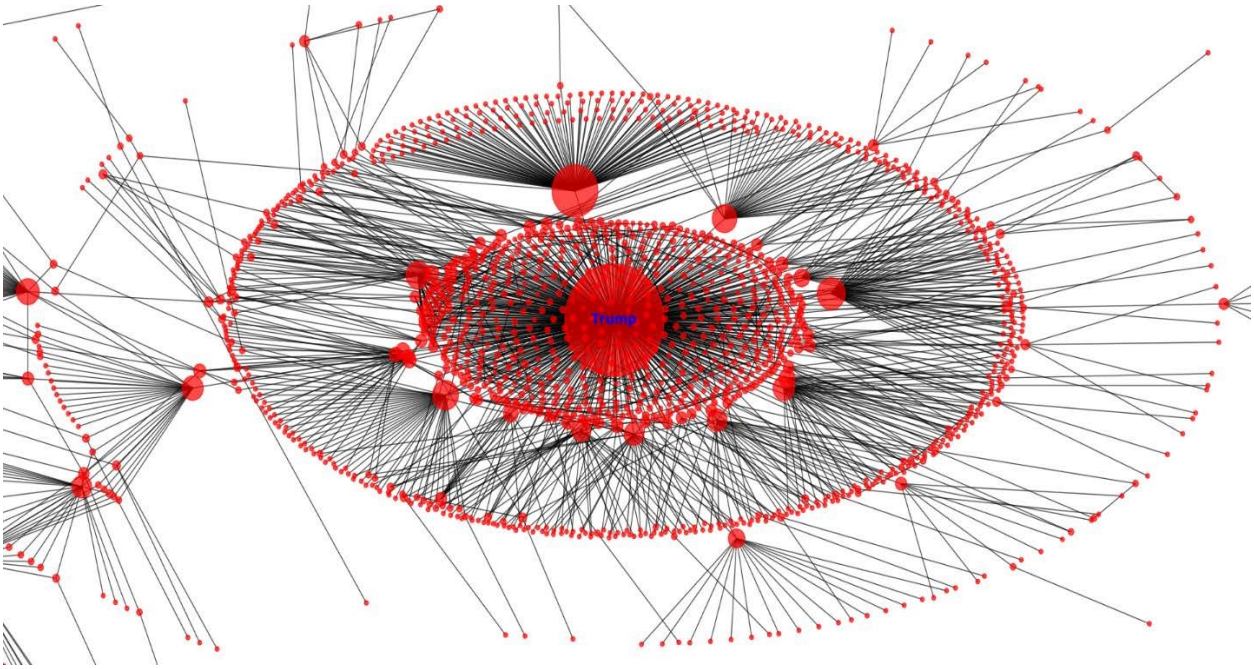



*Figure 1b. Graph Showing Trump's Personal and Business Relationships – Zoomed In 2nd Ring*

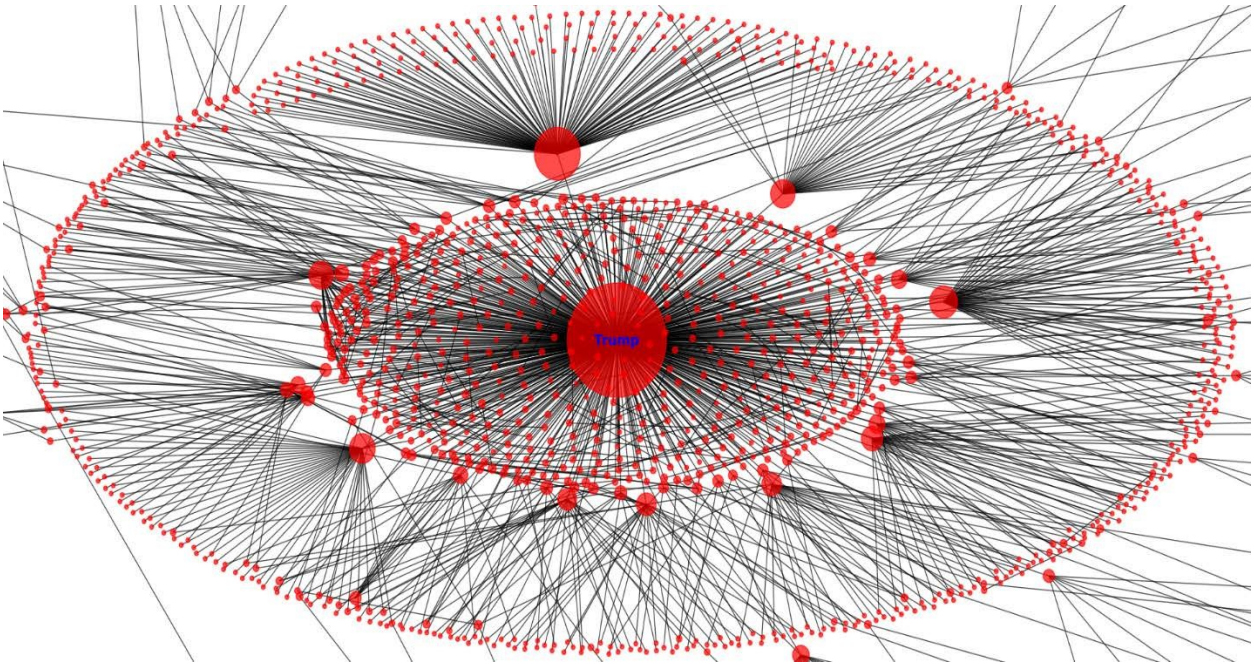



*Figure 1c. Graph Showing Trump's Personal and Business Relationships – Zoomed In 1st Ring*

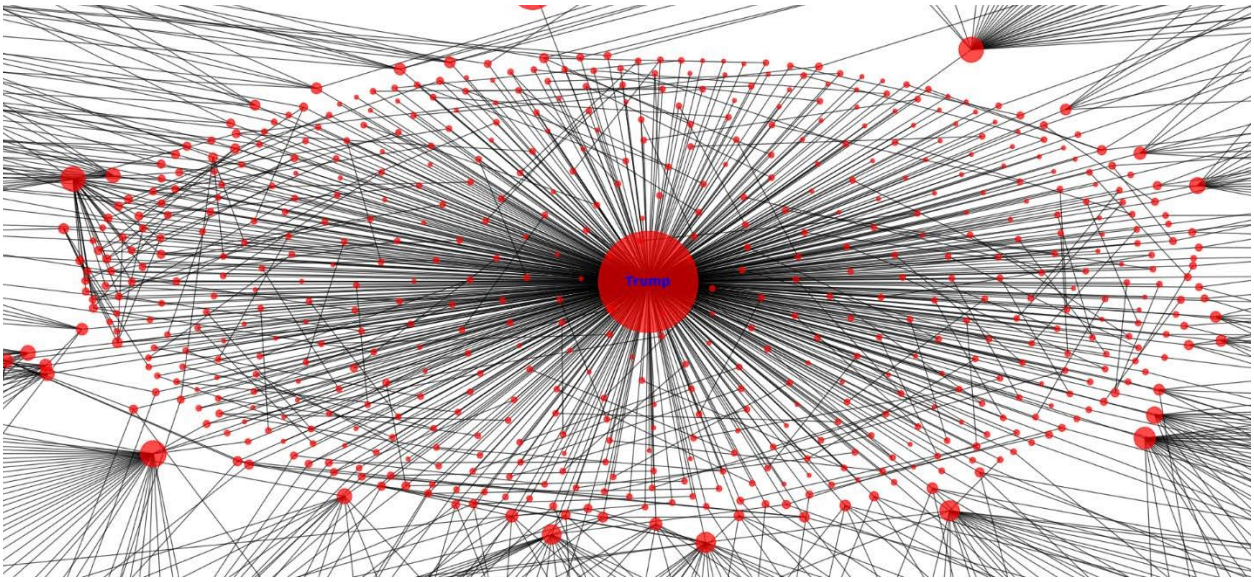



*Figure 1d. Graph Showing Trump's Personal and Business Relationships – Zoomed in the Center*

Figure 2 is a subgraph showing Trump and 604 entities who have direct personal and business relationship with Trump. The average clustering coefficient of this subgraph is 0.595 while the average shortest path length is 1.995, which shows that the sub-network is a high clustered small world. As shown in the Figure 2, most of the entities are interconnected in some degrees.

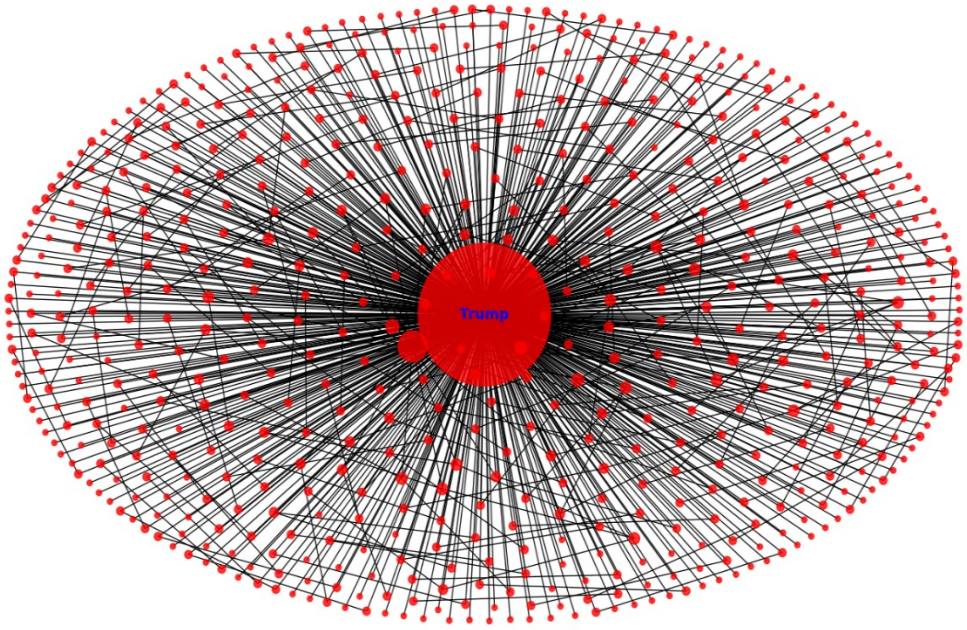



*Figure 2. Subgraph: Trump and 605 Entities with Direct Personal and Business Relationships*

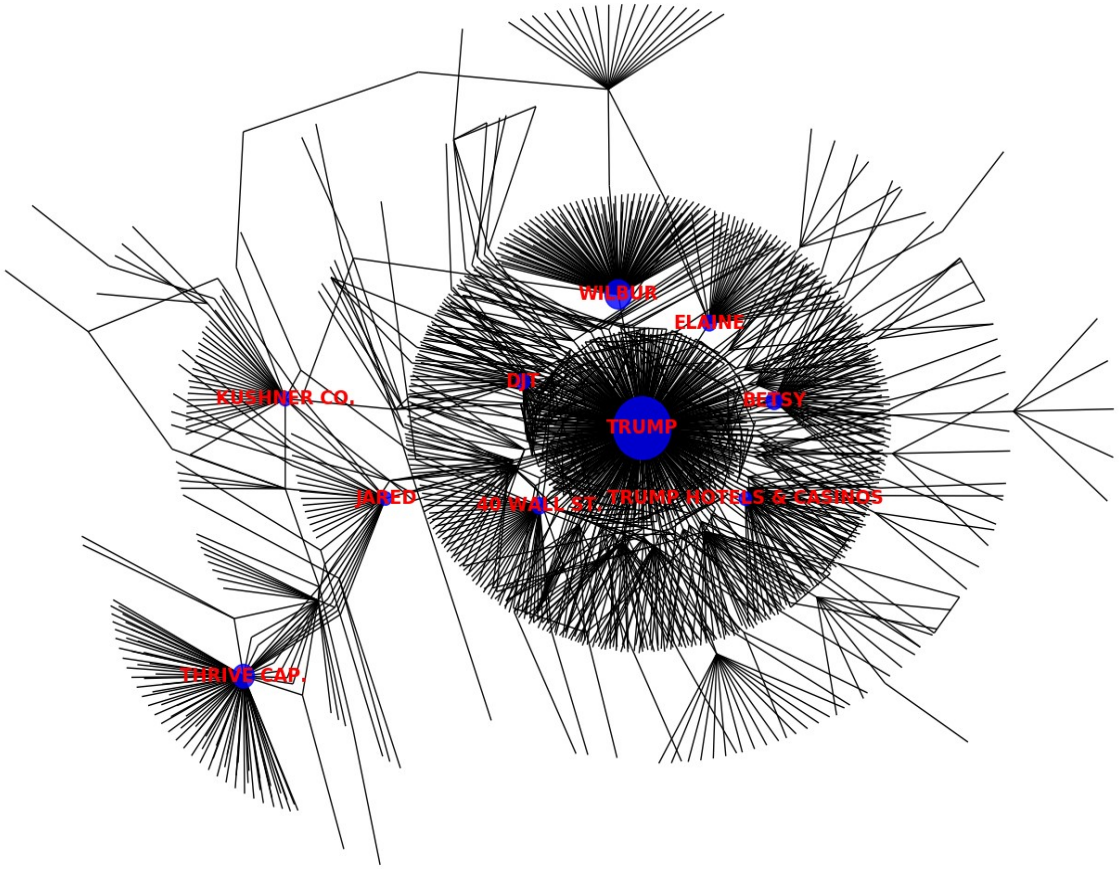
```
Type: SubGraph
Number of nodes: 605     Number of edges: 847     Average degree:   2.8000
Average clustering coefficient = 0.5945555310618618
Average shortest path length = 1.995364238410596
```

From the original network, top 10 most influential entities are identified in terms of degree centrality, page rank and betweeness centrality (see Table 1). Figures 3, 5 and 7 show the positions of these top 10 entities in the network. Note that while these top 10 entities are influential in the network in these centrality, most of them are not directly related to others (Figures 4, 6 and 9). Trump is the only entity that has a high degree of 5 or 6 in each of the subgraph. The same 10 entities rank top 10 in both degree centrality and page rank, but in different orders. Ivanka Trump and Goldman Sachs (underlined below) made it in the list for top 10 entities with highest betweenness, in place of Trump Hotels and Casino Resorts and DJT Holdings, LLC. Even though Ivanka Trump (degree = 10) and Goldman Sachs (degree = 9) do not have as many connections, more entities have to go through them than Trump Hotels and Casino Resorts and DJT Holdings, LLC in order to reach others. Figure 8 visualizes how Ivanka Trump and Goldman Sachs are between Trump's inner core network and those in the outer rings.

*Table 1. Top 10 most Influential Entities in the Trump World*

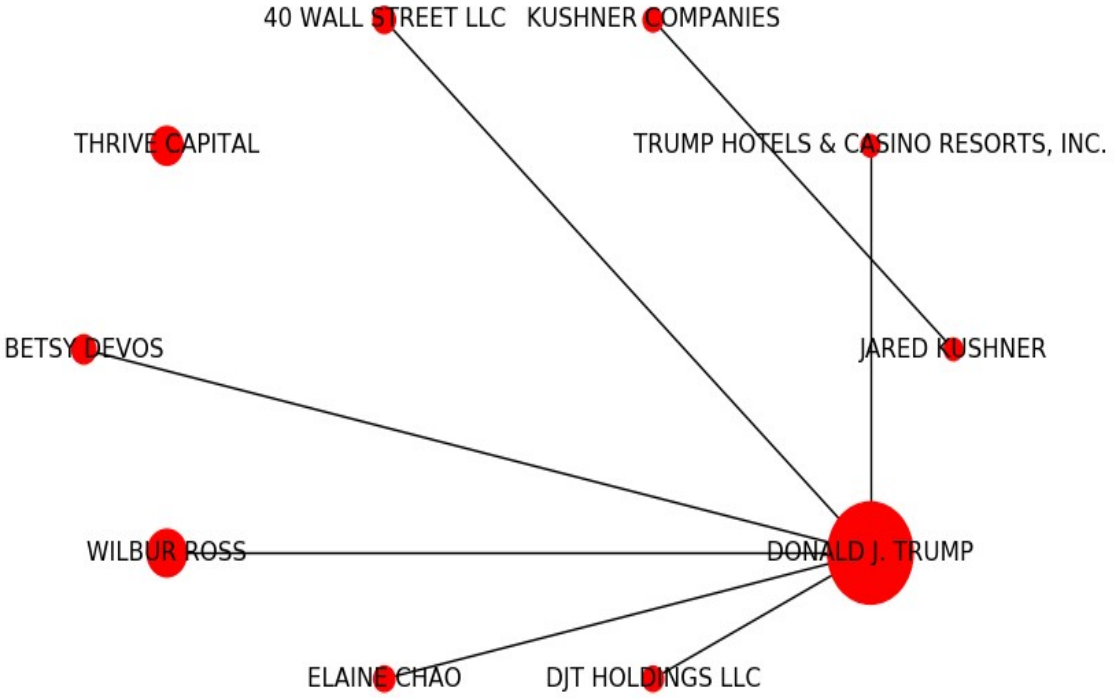
| **Top 10 by degree centrality:** | **Top 10 by page rank:** | **Top 10 by betweenness centrality:** |
|---|---|---|
| DONALD J. TRUMP, 0.3992 | DONALD J. TRUMP, 0.1301 | DONALD J. TRUMP, 0.9452 |
| WILBUR ROSS, 0.0853 | WILBUR ROSS, 0.0385 | WILBUR ROSS, 0.1733 |
| THRIVE CAPITAL, 0.0568 | THRIVE CAPITAL, 0.0232 | IVANKA TRUMP, 0.1488 |
| BETSY DEVOS, 0.0317 | BETSY DEVOS, 0.0140 | JARED KUSHNER, 0.1456 |
| 40 WALL STREET LLC, 0.0271 | ELAINE CHAO, 0.0107 | THRIVE CAPITAL, 0.0908 |
| ELAINE CHAO, 0.0245 | 40 WALL STREET LLC, 0.0105 | BETSY DEVOS, 0.0650 |
| DJT HOLDINGS LLC, 0.0238 | KUSHNER COMPANIES, 0.0085 | ELAINE CHAO, 0.0566 |
| KUSHNER COMPANIES, 0.0212 | TRUMP HOTELS & CASINO RESORTS, INC., 0.0082 | GOLDMAN SACHS, 0.0516 |
| JARED KUSHNER, 0.0185 | JARED KUSHNER, 0.0069 | 40 WALL STREET LLC, 0.0471 |
| TRUMP HOTELS & CASINO RESORTS, INC., 0.0185 | DJT HOLDINGS LLC, 0.0065 | KUSHNER COMPANIES, 0.04687 |

*Figures 3. Original Graph with Top 10 Influential Nodes by Degree Centrality*

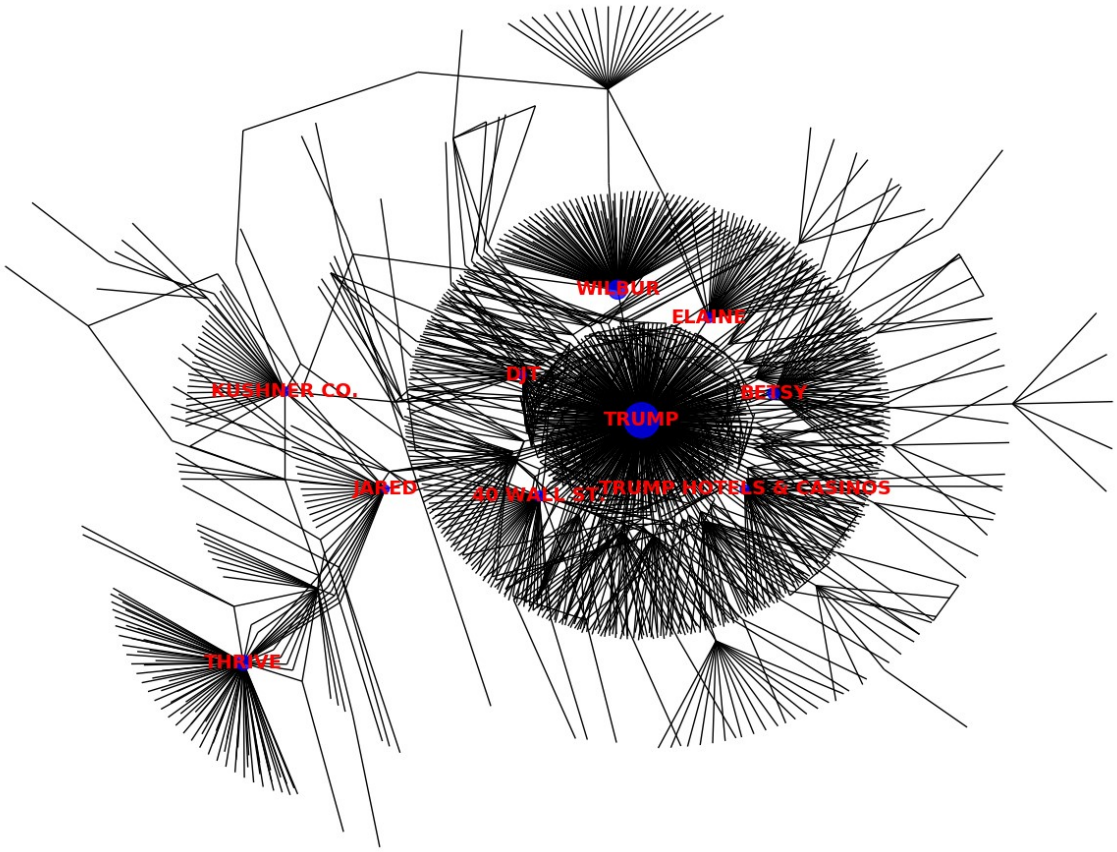



**Nodes sorted by degree centrality:**

```
('DONALD J. TRUMP', 0.3992068737607402)
('WILBUR ROSS', 0.085261070720423)
('THRIVE CAPITAL', 0.05684071381361533)
('BETSY DEVOS', 0.03172504957038995)
('40 WALL STREET LLC', 0.02709847984137475)
('ELAINE CHAO', 0.024454725710508923)
('DJT HOLDINGS LLC', 0.023793787177792465)
('KUSHNER COMPANIES', 0.021150033046926635)
('JARED KUSHNER', 0.018506278916060805)
('TRUMP HOTELS & CASINO RESORTS, INC.', 0.018506278916060805)
```




*Figures 4. Subgraph: Top 10 Influential Nodes by Degree Centrality*




*Figures 5. Original Graph with Top 10 Influential Nodes by Page Rank*

**Nodes sorted by page rank:**

```
('DONALD J. TRUMP', 0.13013174597007712)
('WILBUR ROSS', 0.03847738345722221)
('THRIVE CAPITAL', 0.023248572406997688)
('BETSY DEVOS', 0.013962852313231746)
('ELAINE CHAO', 0.010702630459283678)
('40 WALL STREET LLC', 0.010487462008664914)
('KUSHNER COMPANIES', 0.008484919781768241)
('TRUMP HOTELS & CASINO RESORTS, INC.',
0.008166537779596172)
('JARED KUSHNER', 0.00688423582975088)
('DJT HOLDINGS LLC', 0.006530631471853009)
```

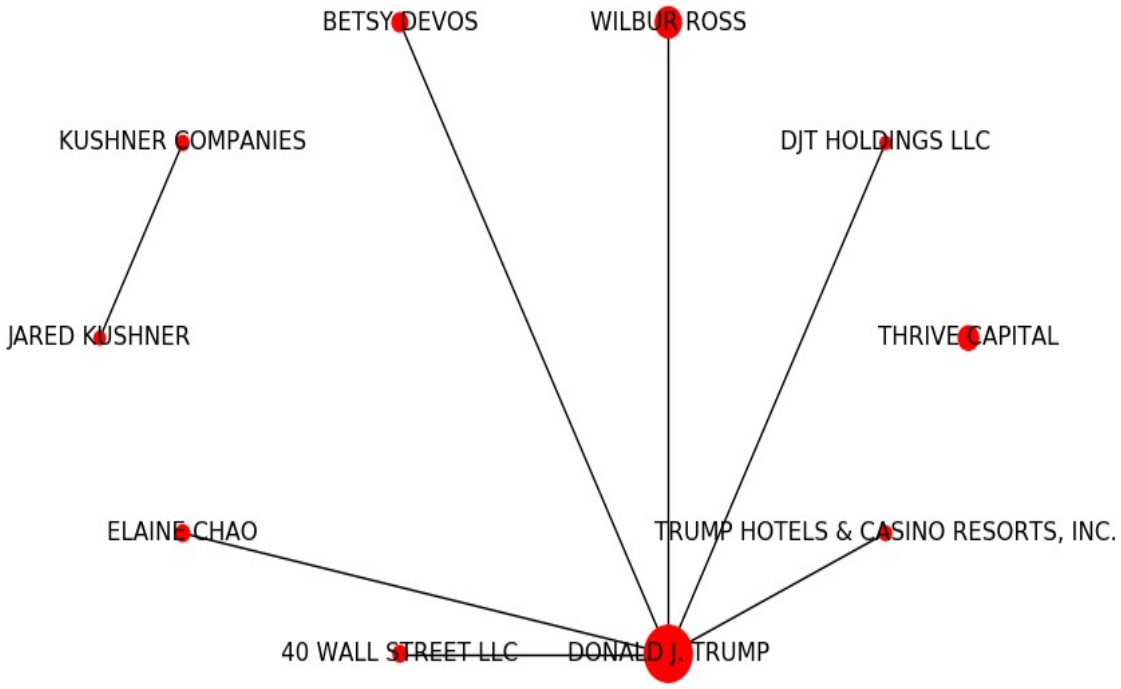
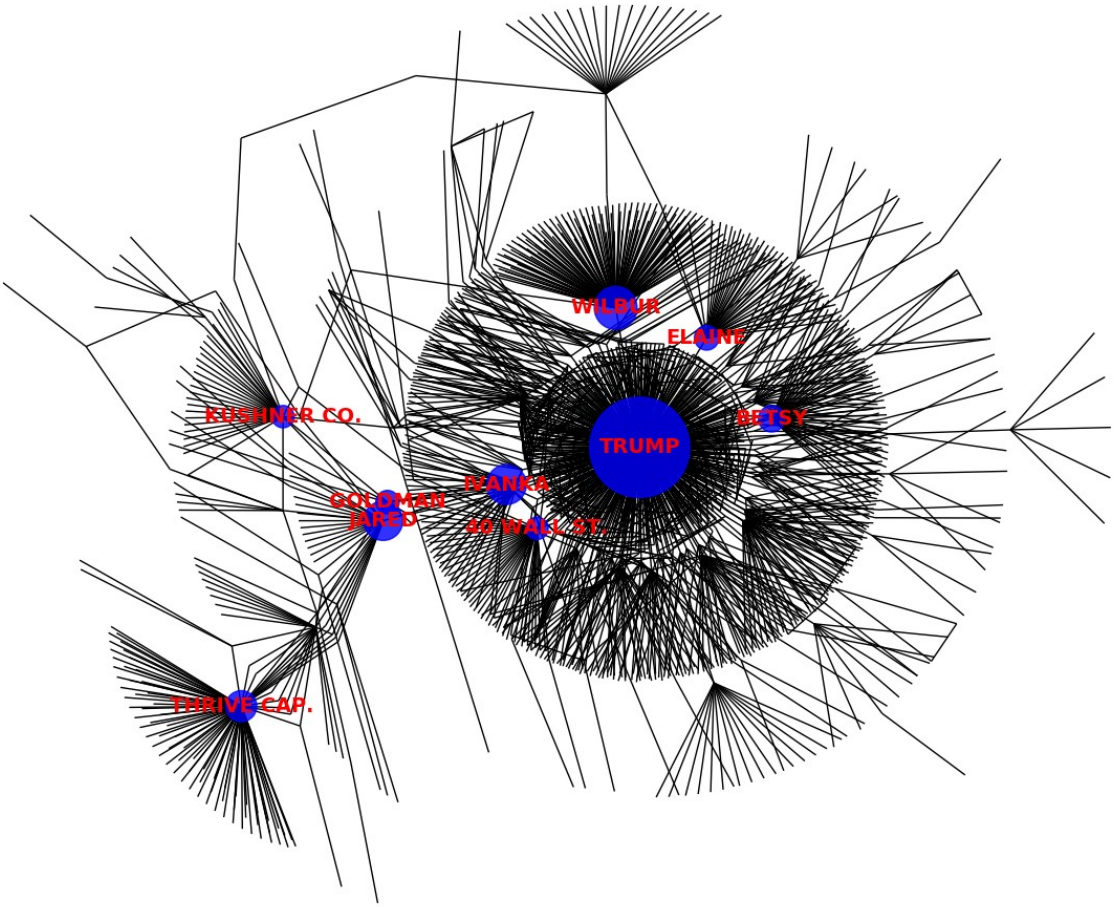



*Figure 6. Subgraph: Top 10 Influential Nodes by Page Rank*




*Figures 7. Original Graph with Top 10 Influential Nodes by Betweenness Centrality*

**Nodes sorted by betweenness centrality:**

```
('DONALD J. TRUMP', 0.9452682400221283)
('WILBUR ROSS', 0.17326048223771057)
('IVANKA TRUMP', 0.14881006807417613)
('JARED KUSHNER', 0.14557025982876173)
('THRIVE CAPITAL', 0.09080055451227514)
('BETSY DEVOS', 0.06501443690251797)
('ELAINE CHAO', 0.05655362364570866)
('GOLDMAN SACHS', 0.05162062543111188)
('40 WALL STREET LLC', 0.04710498535660623)
('KUSHNER COMPANIES', 0.046866141283716606)
```

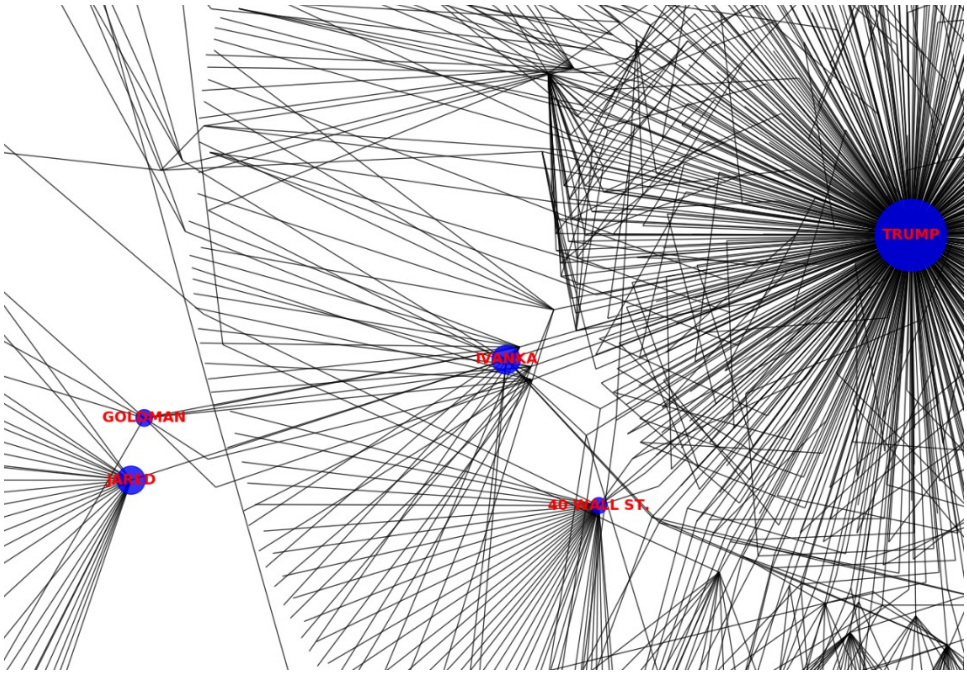



*Figure 8. Betweeness of Ivanka Trump and Goldman Sachs*

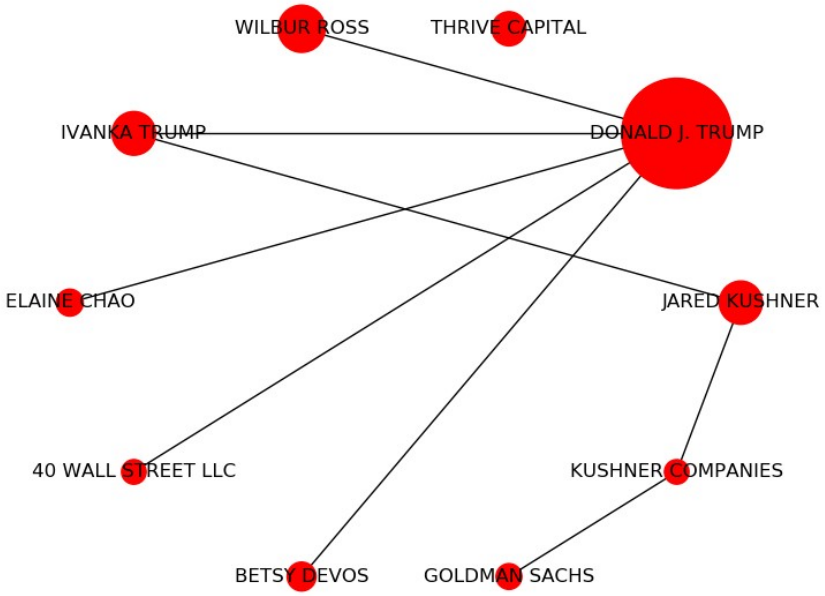



*Figure 9. Subgraph: Top 10 Influential Nodes by Betweeness Centrality*