Higher School of Economics

Faculty of computer science

HW3 For the Course:

Games and Decisions in Data Analysis and Modelling

Presented by:

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1- Introduction

In the following work, I aimed to study Donald J. Trump's network of relations, and I used multiple network centrality measures to deeply understand the key figures that helped such a controversial businessman with a giant network of businesses, investments, and corporate connection become president of United states of America.

2- Dataset and descriptive statistics:

The used dataset: [***https://github.com/BuzzFeedNews/trumpworld***](https://github.com/BuzzFeedNews/trumpworld)

Information about dataset: according to the authors of the article in https://www.buzzfeednews.com/article/johntemplon/help-us-map-trumpworld , the dataset was built in a span of two months from public records , news reports, and other sources on the Trump family, his Cabinet picks, and top advisers.

Describing the dataset:
The given dataset has 3380 objects and 6 attributes, each row in the dataset represents a relation between Entities in Trump's relation network (an edge in the graph).
The Attributes:

- Entity A Type: Relation's first entity (string that could be either an organization or a person)
- Entity A: First entity's name.
- Entity B Type: Relation's first entity (string that could be either an organization or a person or a federal agency)
- Entity B: Second entity's name.
- Connection: Descriptive string which represent the nature of the relation between Entity A and Entity B.
- Source(s): Hyper-Links that shows the validity of the Connection column.

Data Preprocessing:
Since this study is focusing on the public figures that helped Donald J. Trump, I made a data preprocessing steps , where I dropped any relations where either Entity A or Entity B is not a person (I sticked to the relations among people in the
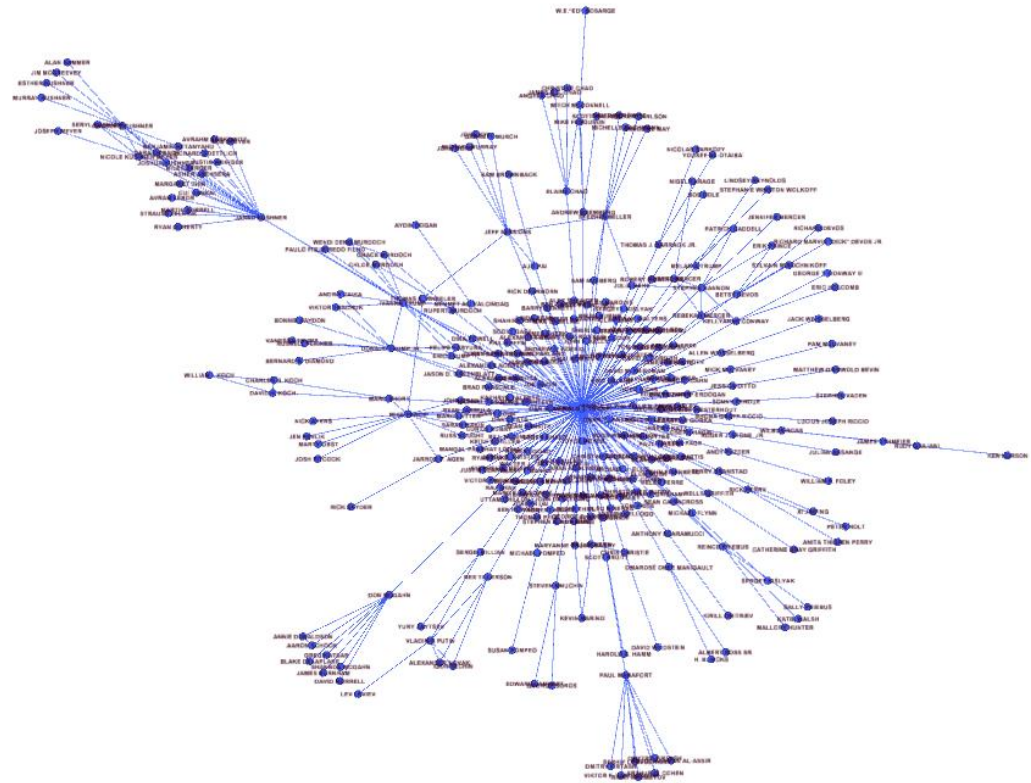
graph and deleted relations among other entities like organizations and federal agencies),after the end of preprocessing stage, I exported a csv file ("Trump_Edges.csv) which would be the backbone for the social network analysis in the following steps (for more details on Preprocessing steps, see the attached python code).

descriptive statistics:

Number of Nodes	326
Number of Edges	381
Average clustering coefficient	0.15289933280558793
Global clustering coefficient	0.011840750486214392
Type of Graph	Undirected (could be directed based on NLP analysis of Connection column, but it would not add much value)
Weighted	No (the dataset does not include weights)
Connectivity	Not Connected
Number of Connected Components	10
Number of Nodes in Largest Connected Component	303
Number of Edges in Largest Connected Component	366
Diameter of Largest Connected Component	6
Radius of Largest Connected Component	3

For more information about the basic statistics in the dataset (degree distribution, clustering coefficient histograms, etc.) see the attached python code.

The following Image is a Visual representation of the above generated graph (for detailed vision see Full_graph.gephi).

All the operations in the forthcoming section would be applied on the largest Connected Component in Trump's worlds graph.

3- Centralities Study:

In this section, I applied multiple Centrality measures on the largest Connecting Component in the above-mentioned graph.

1. Degree Centrality:

Remainder: The degree centrality for a node v is the fraction of nodes it is connected to.

After extracting degree centralities and getting the top 5 nodes with the highest values (except Donald Trump) we got the following graph (for detailed vision see Degree_cen.gephi).

And we get that the top 5 nodes with highest centrality values are:

JARED KUSHNER	- He is a senior adviser for president Trump and he is the married to president Trump Daughter Ivanka. - He connects president Trump with multiple members of Kushner family - He got a real estate company with multiple real estate agents, partners and donors - All the above reasons explain the higher centrality degree (since Jared is connected to multiple nodes).

	- See image 1 and text 1 for detailed information
IVANKA TRUMP	- Daughter of president Trump - Connects to other members of the Trump family - Connects president Trump with multiple trustees and Business partners - Connects president Trump with some Ukrainian Officials (for example ANDRIY ZAIKA, VIKTOR TKACHUK) (because of her visit to Ukraine in 2006) - See image 2 and text 2 for detailed information
MIKE PENCE	- He is the Vice President for President Trump. - Knows multiple members of Donald Trump's Campaign (press secretary, chief of staff) - Also, he connects president Trump to multiple political Teams (people who used to work under pence before the campaign) - See image 3 and text 3 for detailed information
DONALD TRUMP JR.	- He is the son of president Trump - Connects to other members of the Trump family - Connects president Trump with his business partners - Connects president Trump with some Ukrainian Officials (for example ANDRIY ZAIKA, VIKTOR TKACHUK) (because of his visit to Ukraine in 2006)

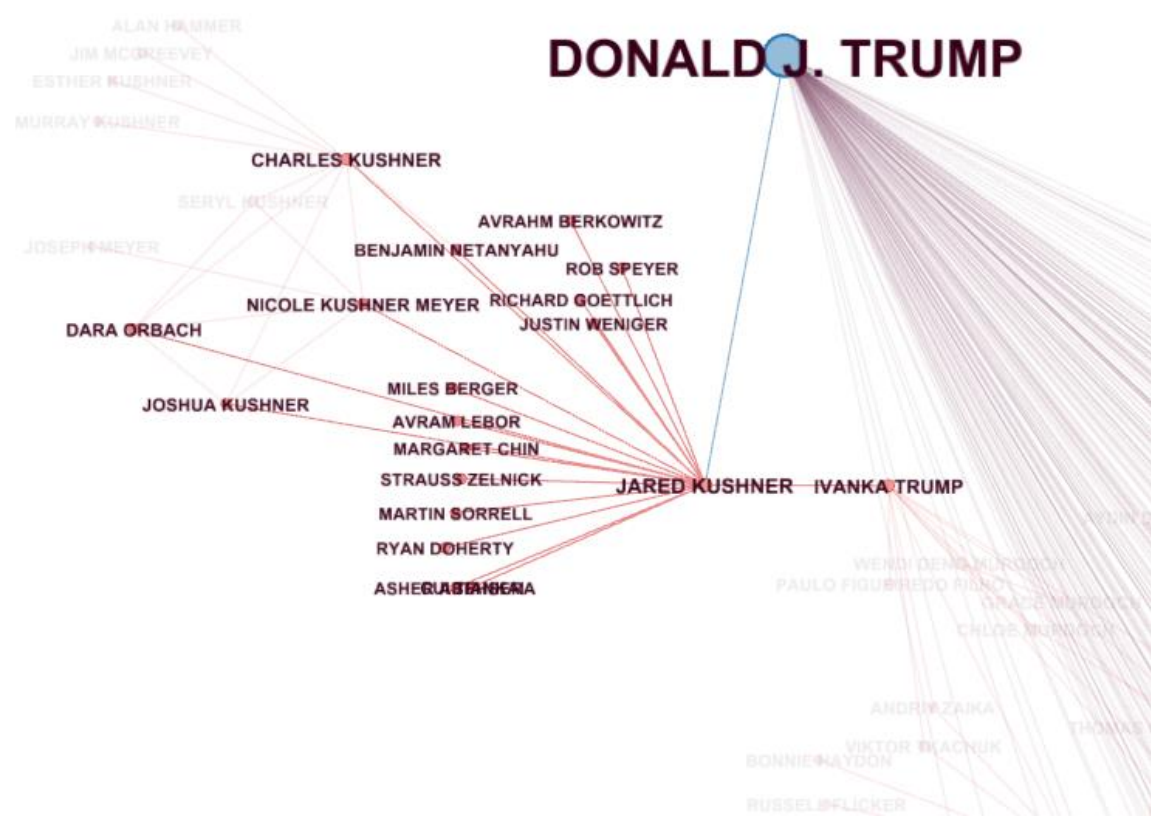|	
	- See image 4 and text 4 for detailed information
CHARLES KUSHNER	- Father of JARED KUSHNER the son-in-law of President Trump - Since he was an Ex-entrepreneur, Charles connects his son with multiple bossiness partners and financial giants (such as JIM MCGREEVEY, ALAN HAMMER) - Connects to the Kushner Family. - See image 5 and text 5 for detailed information

Image 1:Jared Kushner

AVRAM LEBOR JARED KUSHNER Kushner hired him for his real estate company
DONALD J. TRUMP JARED KUSHNER Senior adviser
IVANKA TRUMP JARED KUSHNER Married
JARED KUSHNER ASHER ABEHSERA Partnered with Kushner in Brooklyn projects
JARED KUSHNER AVRAHM BERKOWITZ Assistant
JARED KUSHNER BENJAMIN NETANYAHU Longtime family friends, per Reuters
JARED KUSHNER CHARLES KUSHNER Parent/child
JARED KUSHNER CUI TIANKAI "Kushner and Cui have had an extensive ongoing dialogue that has been positive, according to a White House official,"
JARED KUSHNER DARA ORBACH Siblings
JARED KUSHNER JUSTIN WENIGER Friends
JARED KUSHNER MARGARET CHIN Donor
JARED KUSHNER MARTIN SORRELL Friends
JARED KUSHNER MILES BERGER "business partner of the Kushners," per New York Magazine
JARED KUSHNER NICOLE KUSHNER MEYER Siblings
JARED KUSHNER ROB SPEYER Gave Kushner $50 million to help by a property from his father's company-Tishman Speyer
JARED KUSHNER RYAN DOHERTY Friends
JARED KUSHNER STRAUSS ZELNICK "close with Kushner," per New York Magazine
JOSHUA KUSHNER JARED KUSHNER Siblings
RICHARD GOETTLICH JARED KUSHNER Kushner hired him for his real estate company
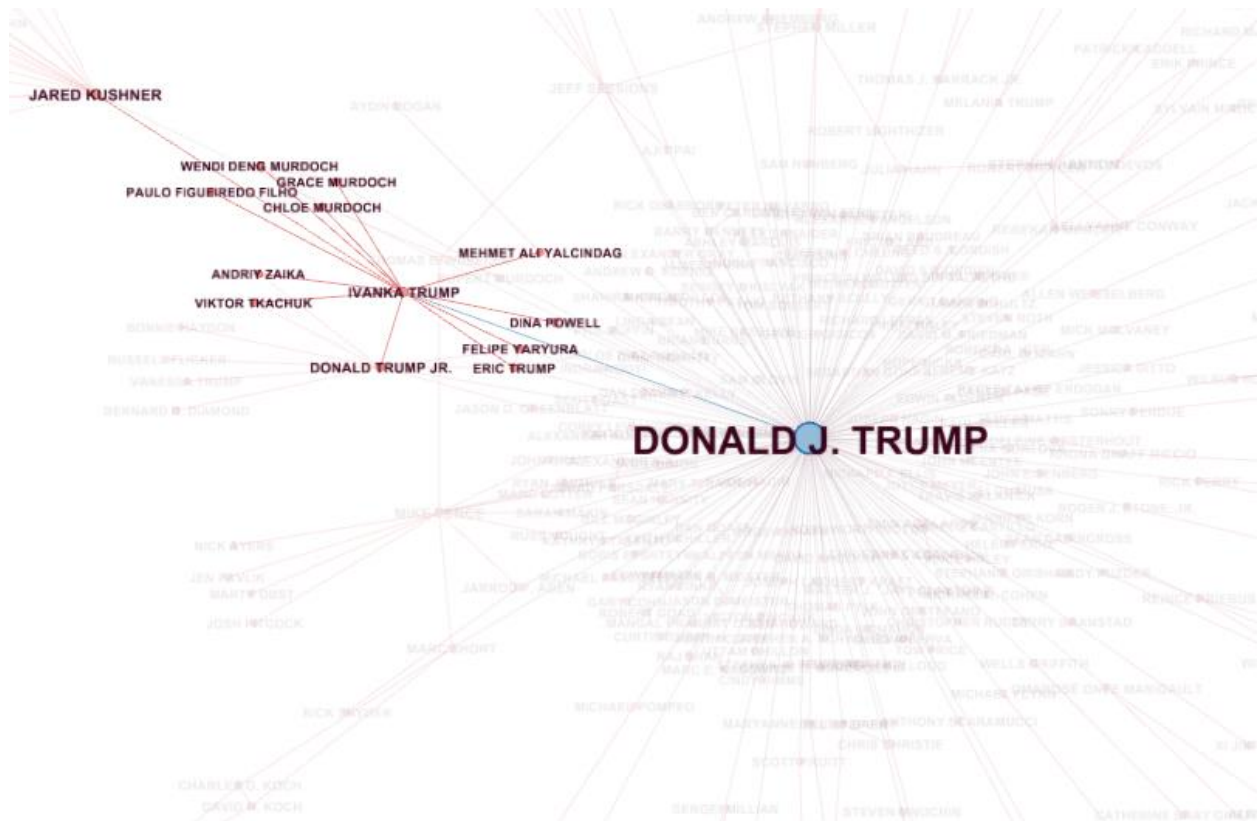
Text 1: Detailed info on Jared Kushner

Image 2:Ivanka Trump

CHLOE MURDOCH IVANKA TRUMP Former trustee
DONALD J. TRUMP IVANKA TRUMP Parent/child
GRACE MURDOCH IVANKA TRUMP Former trustee
IVANKA TRUMP ANDRIY ZAIKA Met in 2006, when Zaika was head of the Ukrainian Construction Consortium
IVANKA TRUMP DINA POWELL Ivanka Trump "has been leaning on [Powell] ... as a top adviser on policy and staffing," per Politico
IVANKA TRUMP DONALD TRUMP JR. Siblings
IVANKA TRUMP ERIC TRUMP Siblings
IVANKA TRUMP FELIPE YARYURA The Argentine real estate developer is said to be friends with the Trump family
IVANKA TRUMP JARED KUSHNER Married
IVANKA TRUMP MEHMET ALI YALCINDAG Business partners
IVANKA TRUMP PAULO FIGUEIREDO FILHO Lunched together, spawning Trump interest in Rio hotel
IVANKA TRUMP VIKTOR TKACHUK Met in 2006, when Tkachuk was an adviser to the Ukrainian president
WENDI DENG MURDOCH IVANKA TRUMP "Close friend," according to the Guardian

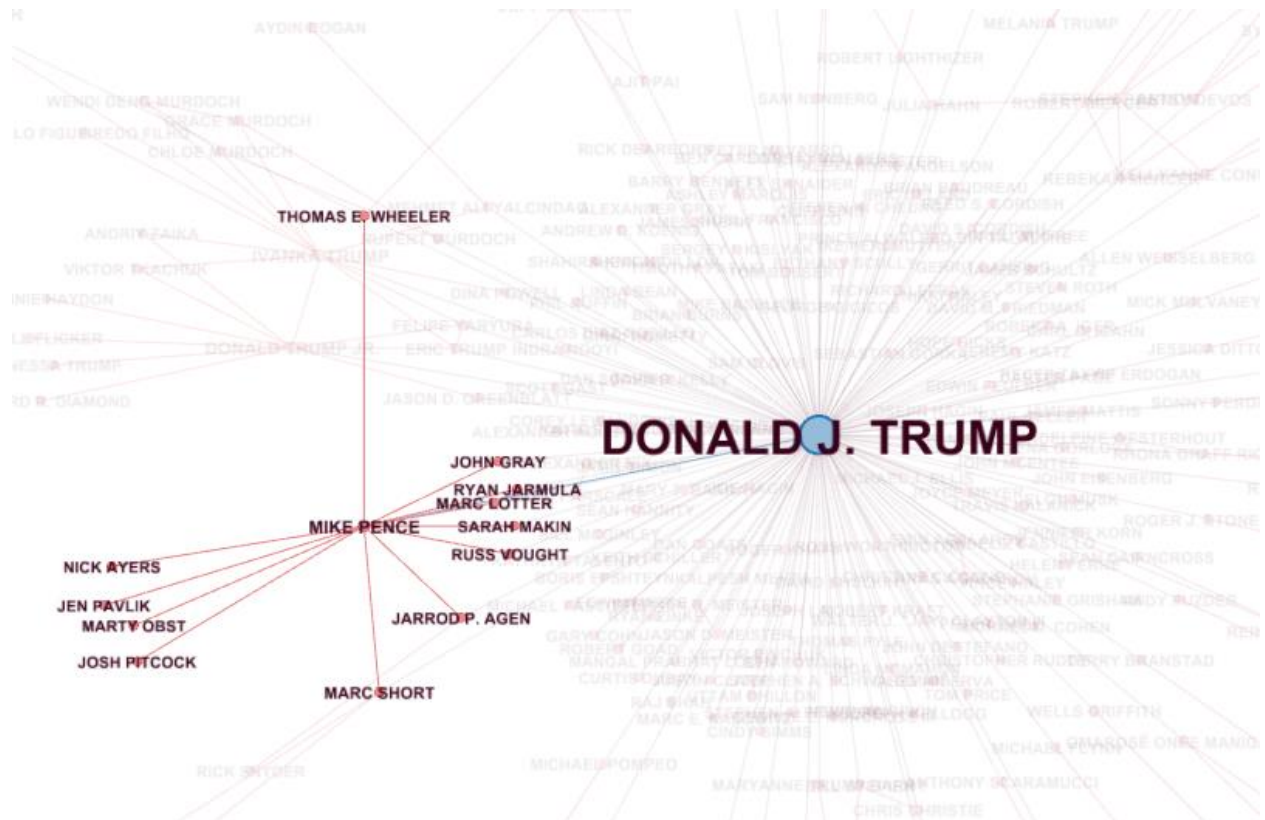*Text 2:Detailed info on Ivanka Trump*

Image 3:Mike Pence

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MIKE PENCE DONALD J. TRUMP Vice President
MIKE PENCE JARROD P. AGEN Director of communications
MIKE PENCE JEN PAVLIK Deputy chief of staff
MIKE PENCE JOHN GRAY Gray worked for Pence
MIKE PENCE JOSH PITCOCK Chief of staff
MIKE PENCE MARC LOTTER Press secretary
MIKE PENCE MARC SHORT "Longtime aide," per CNN
MIKE PENCE MARTY OBST Obst is a "top Pence aide," per Politico
MIKE PENCE NICK AYERS Ayers is "one of [Pence's] top political advsiors," per Politico
MIKE PENCE RUSS VOUGHT Former aide
MIKE PENCE RYAN JARMULA Jarmula "served as a member of [Pence's] staff for a number of years," per the transition team
MIKE PENCE SARAH MAKIN Director of public engagement and intergovernmental affairs
MIKE PENCE THOMAS E. WHEELER Wheeler worked for Pence
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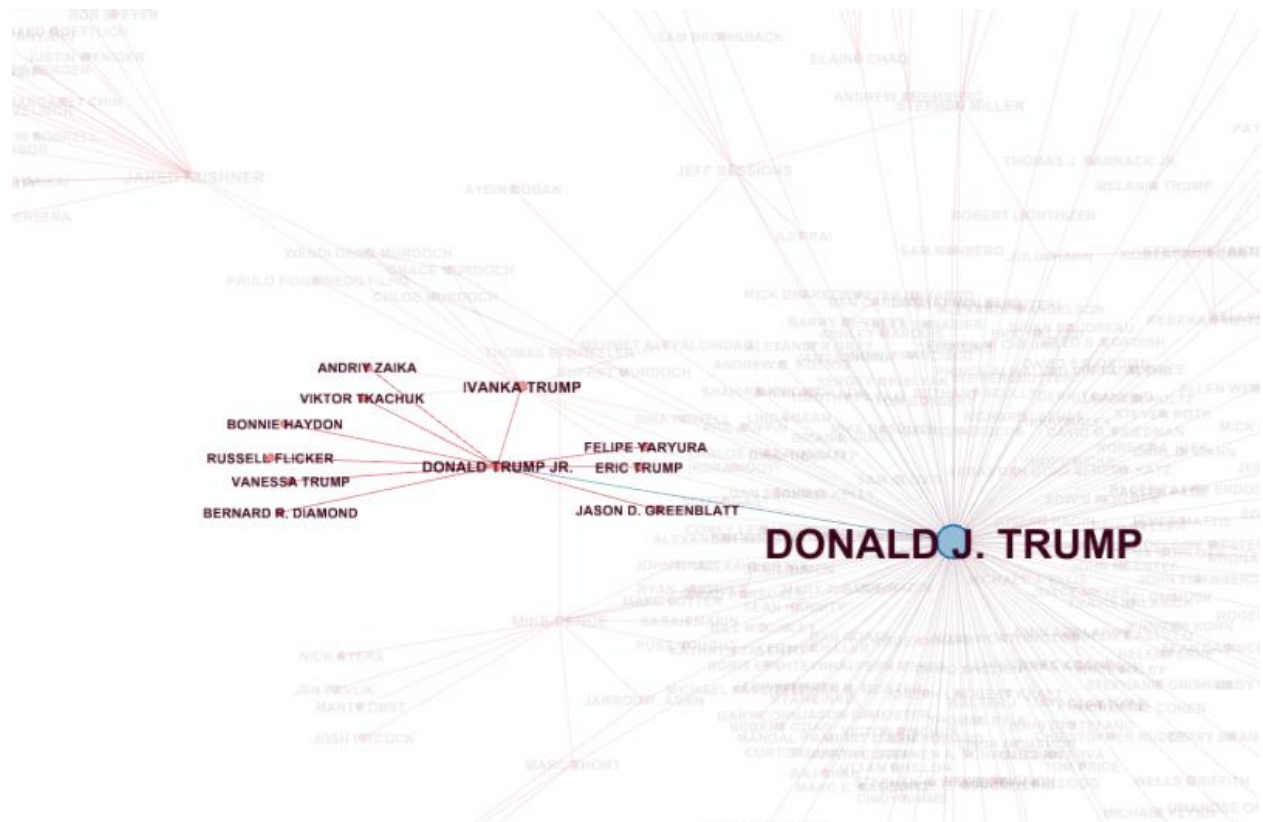
Text 3:Detailed info on Mike Pence

Image 4: Donald Trump Jr

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DONALD J. TRUMP DONALD TRUMP JR. Parent/child
DONALD TRUMP JR. ANDRIY ZAIKA Met in 2006, when Zaika was head of the Ukrainian Construction Consortium
DONALD TRUMP JR. BERNARD R. DIAMOND Business partners
DONALD TRUMP JR. BONNIE HAYDON Father-in-law/son-in-law
DONALD TRUMP JR. ERIC TRUMP Siblings
DONALD TRUMP JR. FELIPE YARYURA The Argentine real estate developer is said to be friends with the Trump family
DONALD TRUMP JR. JASON D. GREENBLATT Business partners
DONALD TRUMP JR. RUSSELL FLICKER Business partners
DONALD TRUMP JR. VANESSA TRUMP Married
DONALD TRUMP JR. VIKTOR TKACHUK Met in 2006, when Tkachuk was an adviser to the Ukrainian president
IVANKA TRUMP DONALD TRUMP JR. Siblings
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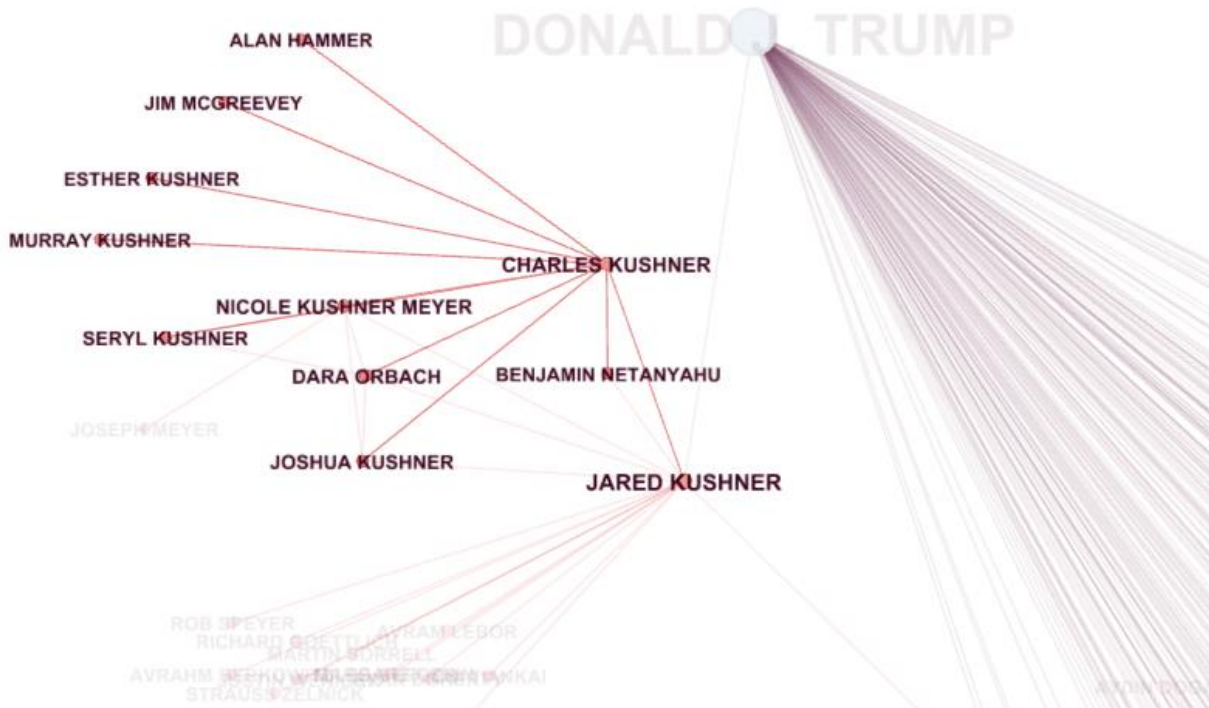*Text 4:detailed info on Donald Trump Jr*

Image 5:Charles Kushner

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CHARLES KUSHNER ALAN HAMMER "has long worked with" Kushner, per New York Magazine
CHARLES KUSHNER BENJAMIN NETANYAHU Longtime family friends, per Reuters
CHARLES KUSHNER DARA ORBACH Parent/child
CHARLES KUSHNER ESTHER KUSHNER Siblings
CHARLES KUSHNER JIM MCGREEVEY "the financial force" behind the former governor's campaign, per New York Magazine
CHARLES KUSHNER JOSHUA KUSHNER Parent/child
CHARLES KUSHNER MURRAY KUSHNER Siblings
CHARLES KUSHNER NICOLE KUSHNER MEYER Parent/child
CHARLES KUSHNER SERYL KUSHNER Married
JARED KUSHNER CHARLES KUSHNER Parent/child
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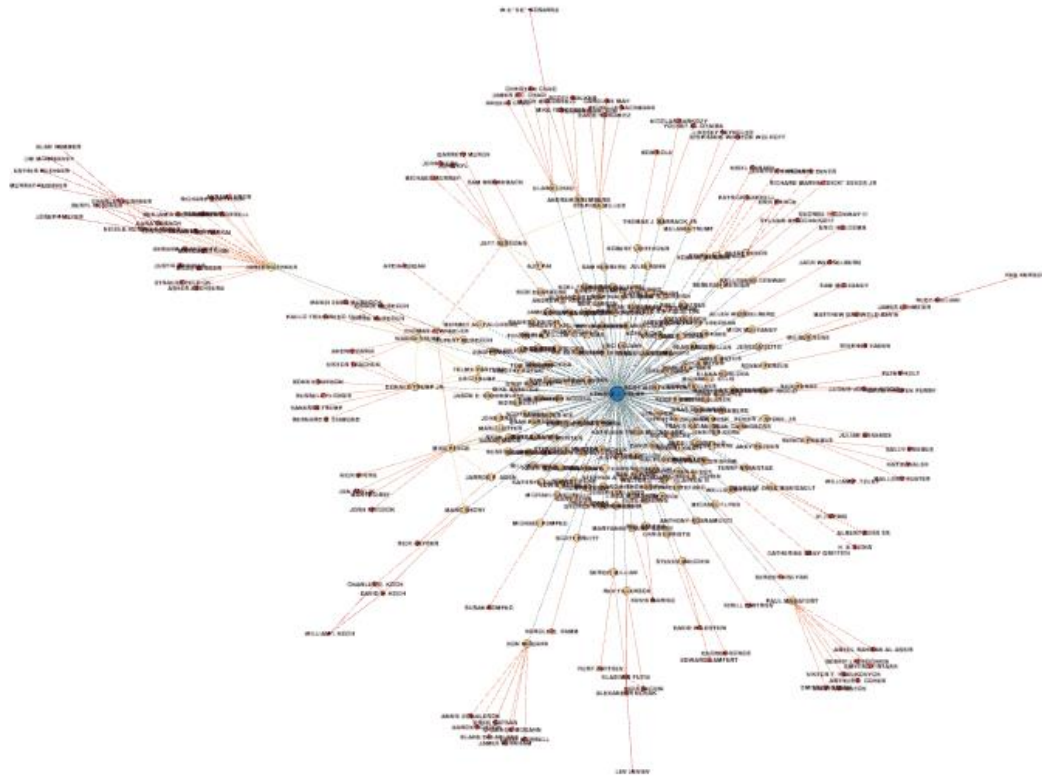
Text 5: detailed info on Charles Kushner

As we can see from the above information, the above-mentioned figures have a relatively more connections than other nodes, which will yield a higher value for Degree centrality.

2. Closeness Centrality:

Remainder: Closeness centrality of a node u is the reciprocal of the average shortest path distance to u over all n-1 reachable nodes.

After extracting Closeness centralities and getting the top 5 nodes with the highest values (except Donald Trump) we got the following graph (for detailed vision see Closeness_cen.gephi).

And we get that the top 5 nodes with highest centrality values are:

JARED KUSHNER , IVANKA TRUMP MIKE PENCE, DONALD TRUMP JR	As mentioned above those figures connect President Trump with multiple other nodes in the Graph (business partners, financial teams, political teams, family members) and those nodes are mostly connected, which explains why the average shortest path distance to those nodes from all other nodes is relatively high.
JEFF SESSIONS	- Was the Attorney General of President Trump - He has multiple connections with multiple political figures and deputies

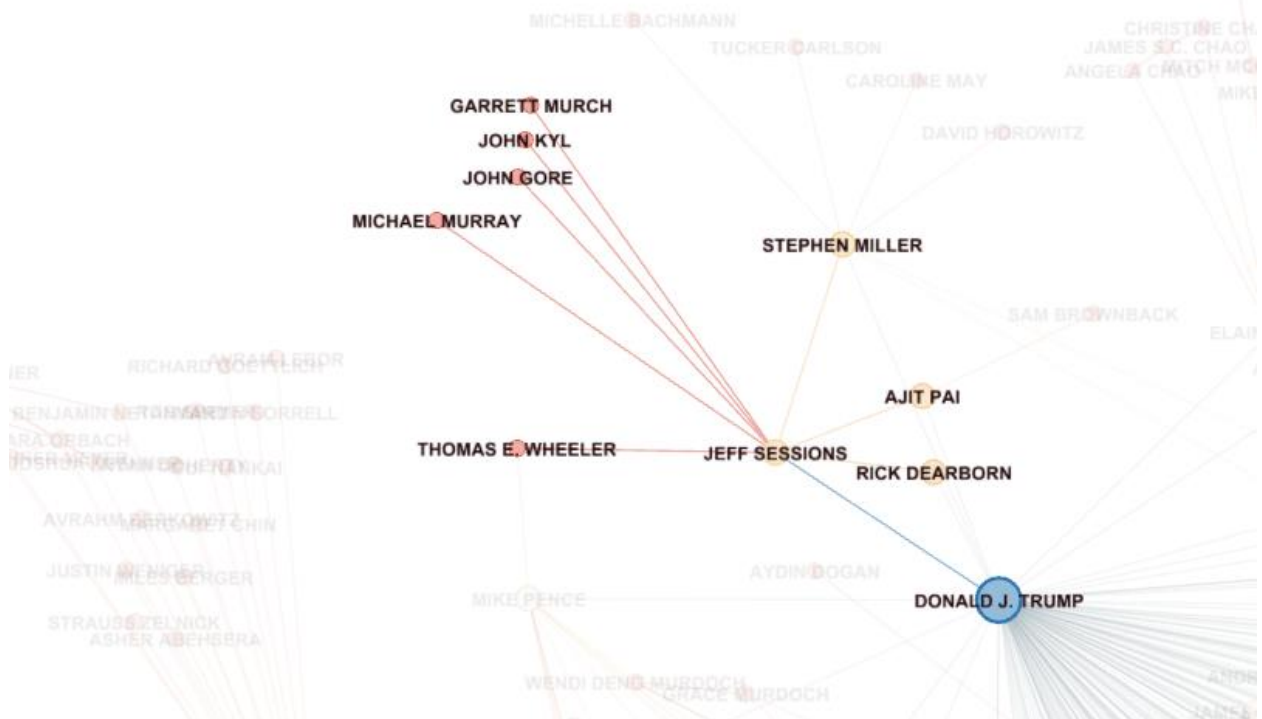|	
	- He can serve as a shortcut to get from nodes that are connected to "Stephan Miller"(political advisor for president Trump and an Ex communication director to Jeff Sessions) into nodes that are connected to Jeff Sessions (instead of passing by President Trump Node), Thus higher Closeness Centrality. - See image 6 and text 6 for detailed information

Image 6:Jeff Sessions

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JEFF SESSIONS
DONALD J. TRUMP JEFF SESSIONS Attorney General
JEFF SESSIONS AJIT PAI Former deputy chief counsel
JEFF SESSIONS GARRETT MURCH Former communications advisor
JEFF SESSIONS JOHN GORE Deputy assistant AG for Civil Rights
JEFF SESSIONS JOHN KYL Kyl was Sessions's "sherpa" for confirmation hearings
JEFF SESSIONS MICHAEL MURRAY Counsel to the Deputy Attorney General
JEFF SESSIONS RICK DEARBORN Former chief of staff
JEFF SESSIONS THOMAS E. WHEELER Sessions appointed Wheeler to Deputy Assistant Attorney General.
STEPHEN MILLER JEFF SESSIONS Former chief of communications
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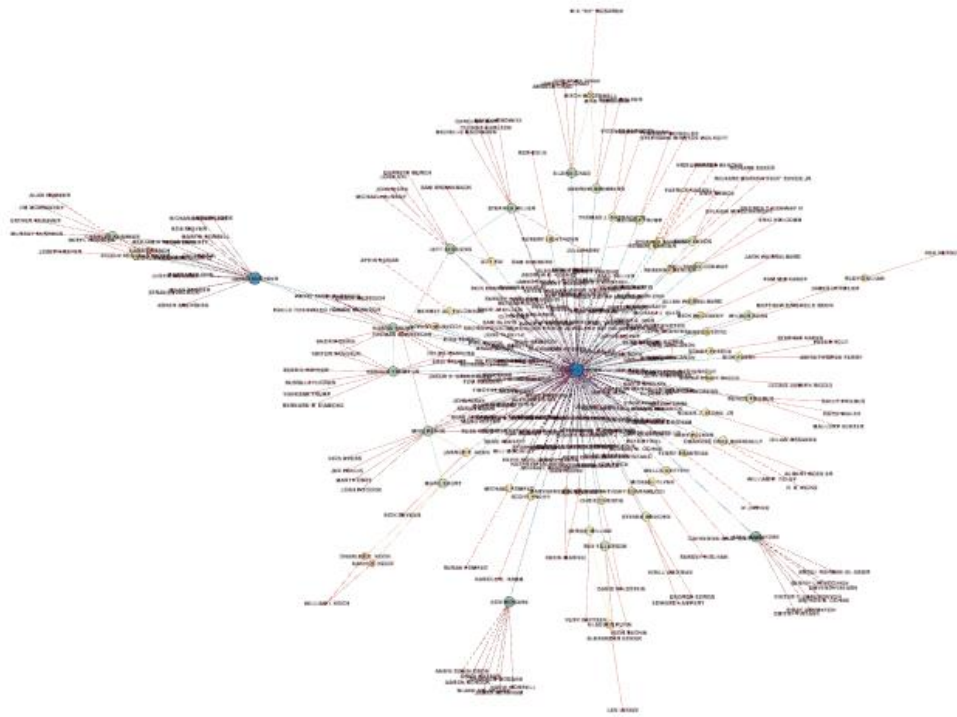
Text 6:detailed info on J.eff Sessions

As we can see from the above information, the above-mentioned figures have a relatively more connections than other nodes, and they also connect multiple communities together, which in turn would yield a shorter path than going through the most essential node in the Graph (President Trump's Node) which will yield a higher value for closeness centrality

3. Betweenness Centrality:

Remainder:
Betweenness centrality of a node v is the sum of the fraction of all-pairs shortest paths that pass-through v.

After extracting Betweenness centralities and getting the top 5 nodes with the highest values (except Donald Trump) we got the following graph (for detailed vision see Betweenness_cen.gephi).

And we get that the top 5 nodes with highest centrality values are:

JARED KUSHNER	As we can see from the above image1, Jared Kushner has multiple relations inside and outside the political field, and he directly connects multiple nodes to president Trump. Thus, the highest betweenness centrality
PAUL MANAFORT	- Was a Former campaign manager for president Trump. - He is the only connection between president Trump and multiple isolated (in the graph) foreign figures (since he was involved in multiple cases like managing foreign campaign for the previous president of Ukraine, buying sites of the Drake Hotel on Park

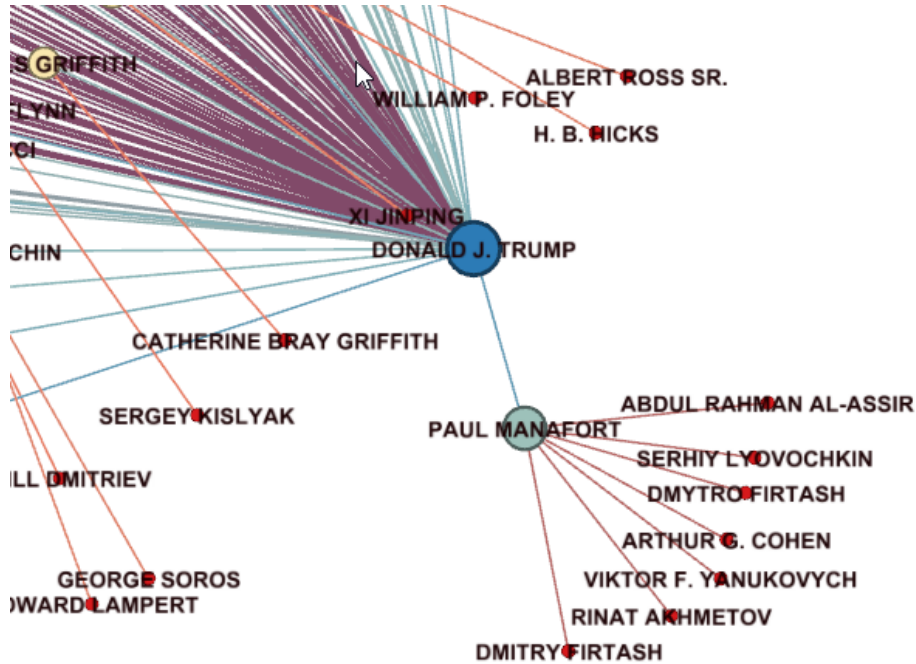|	
	Avenue in Manhattan with foreign money), thus the high betweenness centrality. - See image 7 and text 7 for detailed information
DON MCGAHN	- Was a white house Counsel - he is the only way to connect President Trump with assistants, legal service providers and deputies of the white house counsel (connect isolated node with the rest of the graph, thus a higher betweenness centrality) - see image 8 and text 8 for detailed information.
DONALD TRUMP JR and IVANKA TRUMP	For the same reasons of JARED KUSHNER, Ivanka and Donald Trump JR have a high betweenness centrality.

Image 7:Paul Manafort

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PAUL MANAFORT
DONALD J. TRUMP PAUL MANAFORT Former campaign manager
PAUL MANAFORT ABDUL RAHMAN AL-ASSIR Manafort secured a loan from al-Assir
PAUL MANAFORT ARTHUR G. COHEN "negotiated a deal to buy the site of the Drake Hotel on Park Avenue in Manhattan," per the New York Times
PAUL MANAFORT DMITRY FIRTASH Worked together in bid for site of Drake Hotel in NYC
PAUL MANAFORT DMYTRO FIRTASH Manafort and Firtash, "an oligarch who made billions as a middleman for Gazprom," were partners in "a deal
PAUL MANAFORT RINAT AKHMETOV Manafort worked to improve image of Akhmetov's companies
PAUL MANAFORT SERHIY LYOVOCHKIN Manafort ran PR for Lyovochkin's campaign
PAUL MANAFORT VIKTOR F. YANUKOVYCH Manafort ran PR for Yanukovych's campaign
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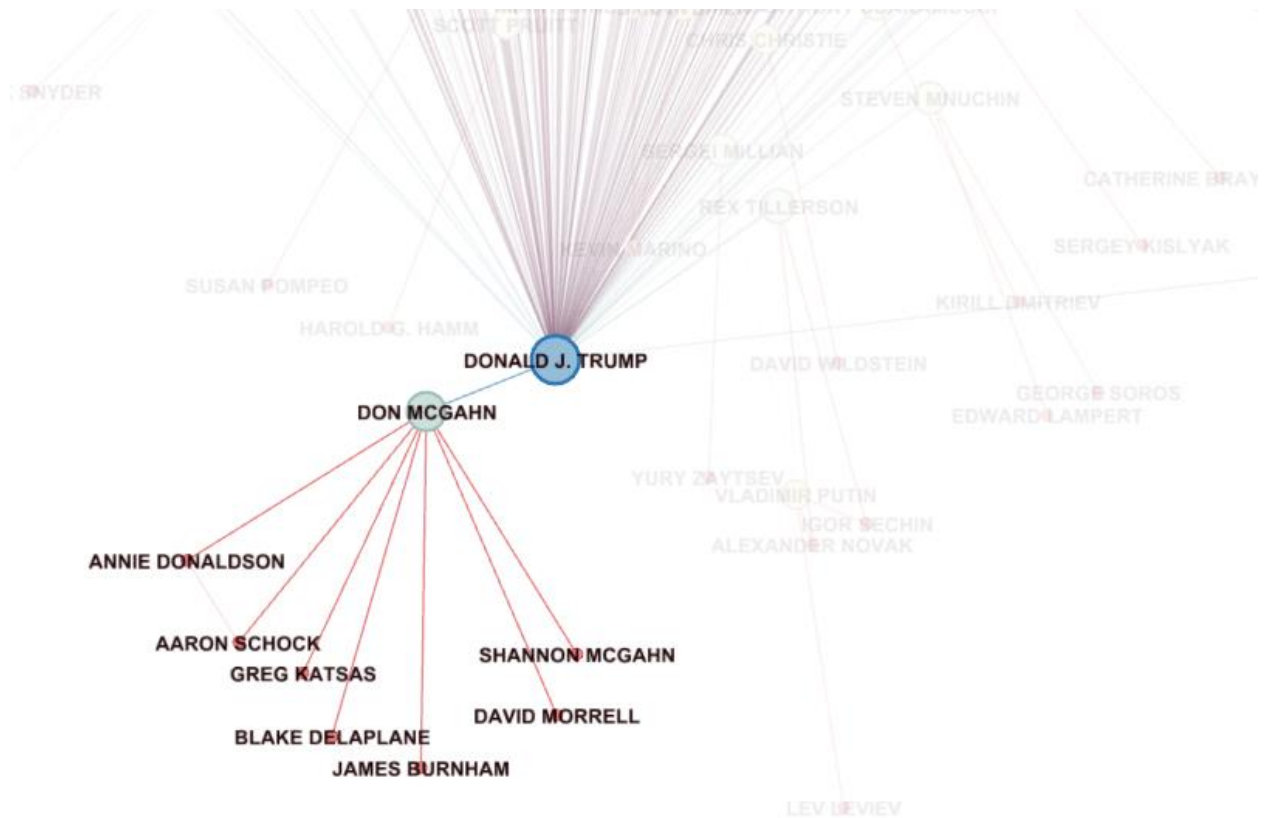*Text 7:Paul Manafort detailed info*

Image 8:Don Mcgahn

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DON MCGAHN
AARON SCHOCK DON MCGAHN McGahn provided legal services for Schock
DON MCGAHN ANNIE DONALDSON Special Counsel to the President, Chief of Staff to the White House Counsel
DON MCGAHN BLAKE DELAPLANE Special assistant to the White House Counsel
DON MCGAHN DAVID MORRELL Associate Counsel to the President
DON MCGAHN GREG KATSAS Deputy Counsel to the President
DON MCGAHN JAMES BURNHAM Senior associate counsel
DONALD J. TRUMP DON MCGAHN White House Counsel
SHANNON MCGAHN DON MCGAHN Married
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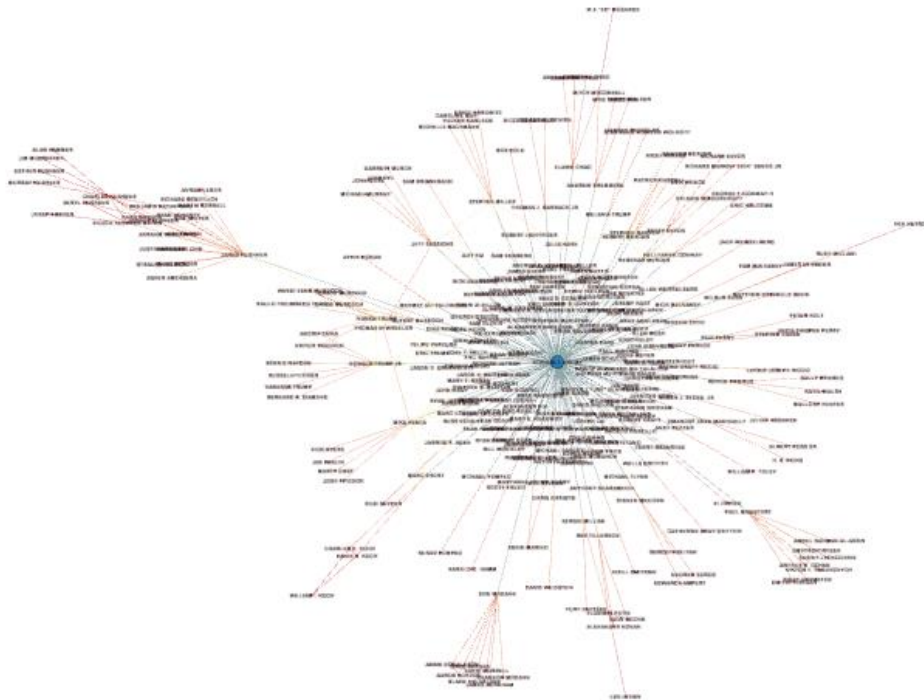
Text 8: detailed info on Don Mcgahn

As we can see from the above information, the above-mentioned figures connects either isolated figures (graph-wise) or a lot of the graph shortest path pass through them, which in turn would yield higher value for betweenness centrality

4. Eigenvector Centrality:

Reminder: Eigenvector centrality computes the centrality for a node based on the centrality of its neighbors, based on the network structure.

After extracting Eigenvector centralities and getting the top 5 nodes with the highest values (except Donald Trump) we got the following graph (for detailed vision see EgienVec_cen.gephi).

And we get that the top 5 nodes with highest centrality values are:

IVANKA TRUMP, MIKE PENCE and 'DONALD TRUMP JR	For the same detailed explain above we get the high Eigenvector centrality for such nodes.
STEPHEN BANNON	- Was the white house chief strategist and senior advisor for president Trump - Worked on many political project and bills with a lot of influential political figures in USA political scene such as (Erick Prince , Rebekah Mercer, Julia Hahn , Robert Mercer and so on). - see image 9 and text 9 for detailed information.

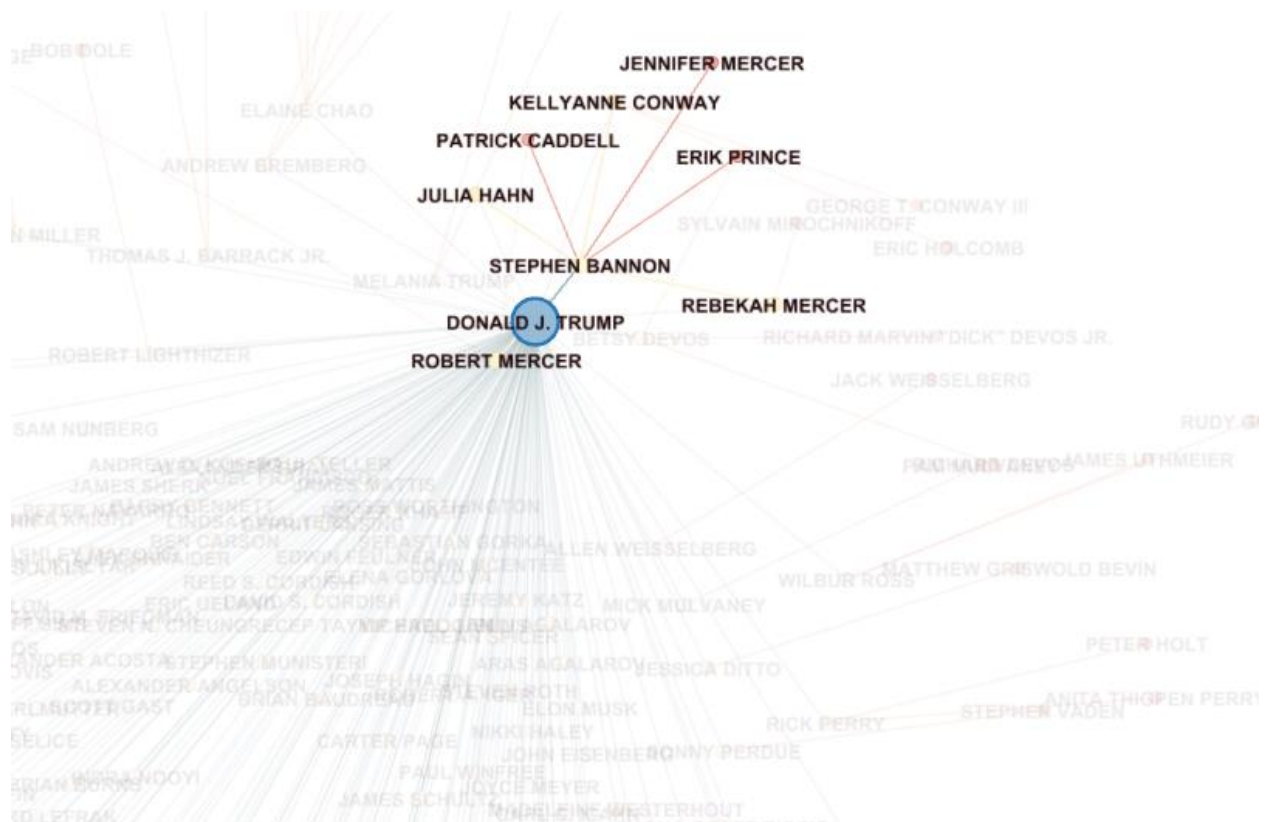| FELIPE YARYURA	He is an Argentinian real estate developer that has a really strong tides with the Trump family members, making hem connected to multiple nodes with high centrality, thus the higher value for Eigenvector centrality (check image 10).

Image 9:Stephen Bannon

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STEPHEN BANNON
DONALD J. TRUMP STEPHEN BANNON White House Chief Strategist and Senior Advisor
ERIK PRINCE STEPHEN BANNON "Prince has a close relationship with Breitbart News and Steve Bannon," per The Intercept
REBEKAH MERCER STEPHEN BANNON "Tied at the hip," per a source to The Hill
STEPHEN BANNON JENNIFER MERCER Bannon served as the Mercer family's "political advisor," per the Washington Post
STEPHEN BANNON JULIA HAHN "Hahn is a protégée of Stephen Bannon," per The New Yorker
STEPHEN BANNON KELLYANNE CONWAY Conway is "buddies" with Bannon, per Elle
STEPHEN BANNON PATRICK CADDELL Bannon and Caddell have "partnered on numerous projects," per The New Yorker
STEPHEN BANNON ROBERT MERCER Bannon served as the Mercer family's "political advisor," per the Washington Post
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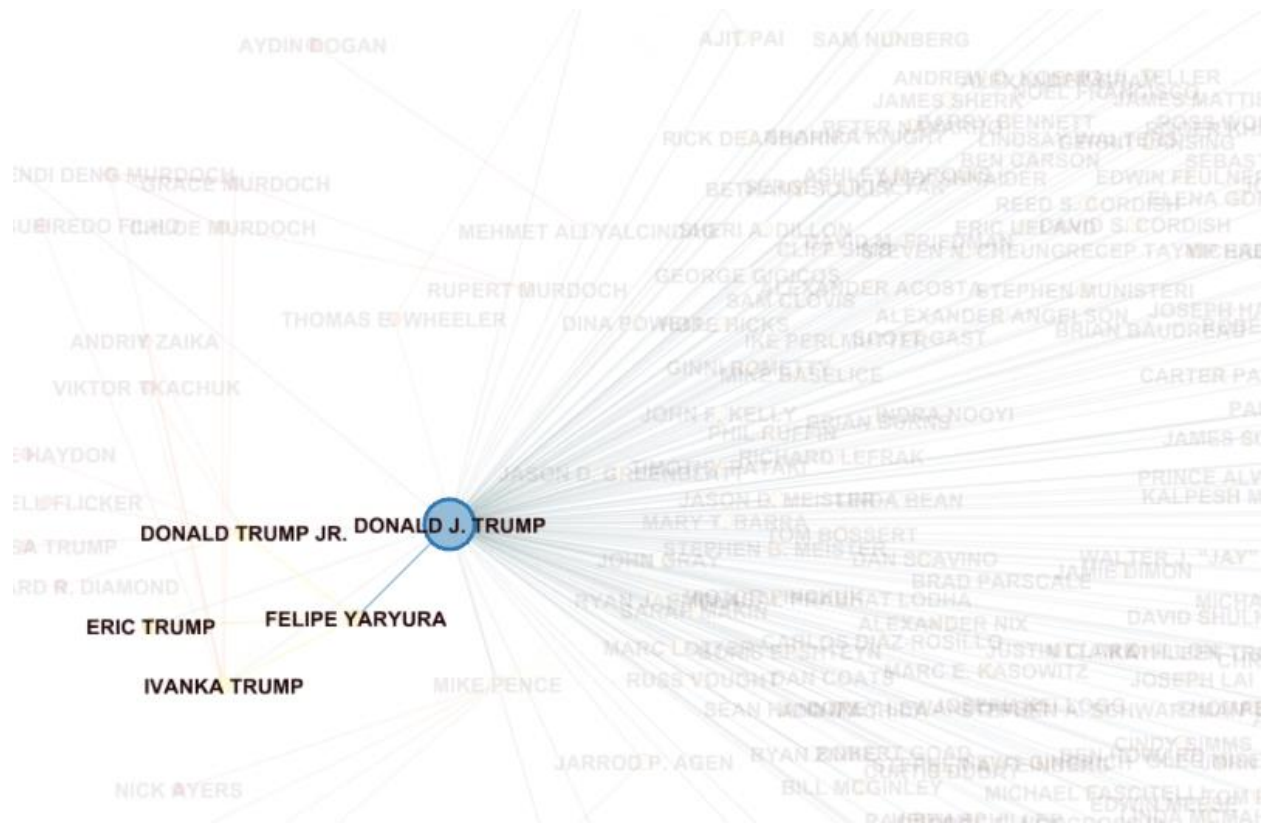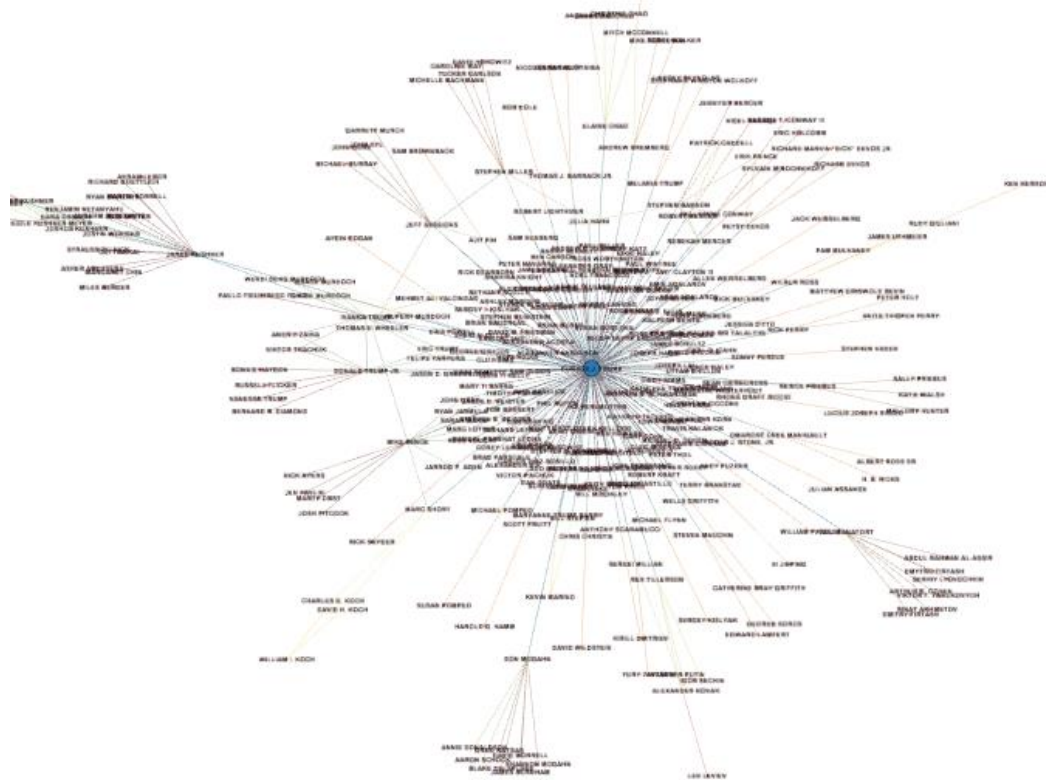*Text 9:Detailed info on Stephen Bannon*

Image 10:Felipe Yaryura

As we can see from the above information, the above-mentioned figures are connected to nodes with a relatively high Centrality values, which in turn would yield higher value for Eigenvector centrality

5. Page Rank:

Remainder: a ranking of the nodes in the graph G based on the structure of the incoming links. It was originally designed as an algorithm to rank web pages.

After extracting PageRank scores (we determine the value of Alpha parameter through a steps of trial and error, to know more about this please check the python code) and getting the top 5 nodes with the highest values (except Donald Trump) we got the following graph (for detailed vision see PageRank_cen.gephi).

And we get that the top 5 nodes with highest centrality values are:

JARED KUSHNER, MIKE PENCE, IVANKA TRUMP, DONALD TRUMP JR., PAUL MANAFORT	For the same detailed reasons explained above we get the high PageRank score for those nodes (multiple connections, involvement in financial, political and foreign scenes of USA).

4- Conclusions:

In this project, I studied the connections in President Trump's network, and found some of the influential figures based on various classical centrality measures. Based on the previous results, we got that figure such as (Jared Kushner, Mike Pence, Ivanka Trump, Donald Trump JR) did not just have a family tie with president Trump, but they also added some financial, political and foreign influence on his relation network by connecting the president with other figures. Other figures like (Stephane Bannon, Jeff Sessions and Stephan Miller) added a lot of political influence to the president campaign because of high connectivity with giant political powers in the USA. Other figures like Don McGahan connected the president with a strong team of

assistants, legal service providers and deputies. And finally, figures like (Paul Manafort) tied the president with the foreign political scene.

From the above analysis we got some good information about which figures influence the network most, but this work could be extended by many ways, for example we can use NLP technologies to analyses the Connection column and thus convert the pure text (attribute for edge) to directed edge with relations, and then we can apply even more than just classical centrality measures (Copeland influence, Bundle Influence, Pivotal Influence, LRIC and SRIC).

We can also extend the work to more than just persons (meaning we don't drop the Organizations and Federal Agencies from the graph), and thus obtaining even more information.