FRIENDSHIP NETWORK

A CASE STUDY BY PRANAV M
1NH15CS092

SOCIAL MEDIA AND APPS -

FACEBOOK

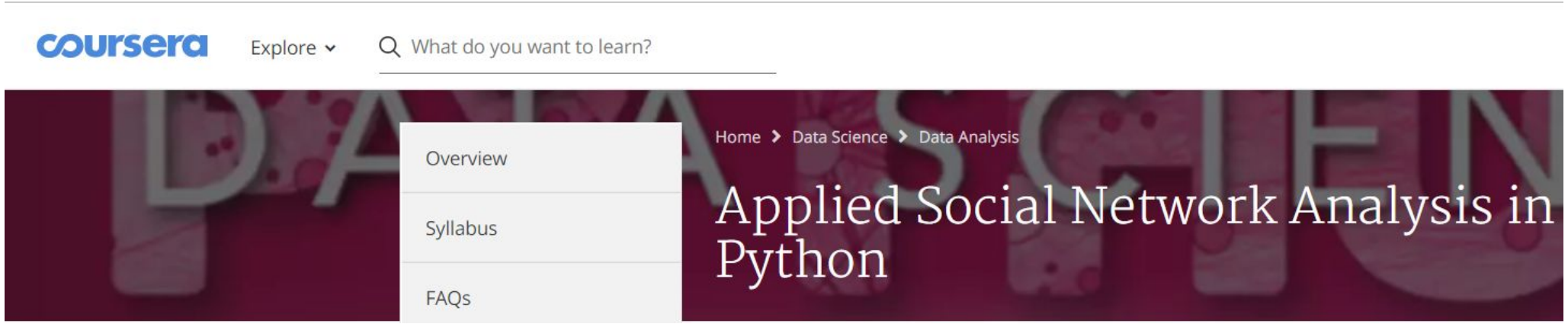
INSTAGRAM

WHATSAPP

SNAPCHAT

LITERATURE SURVEY

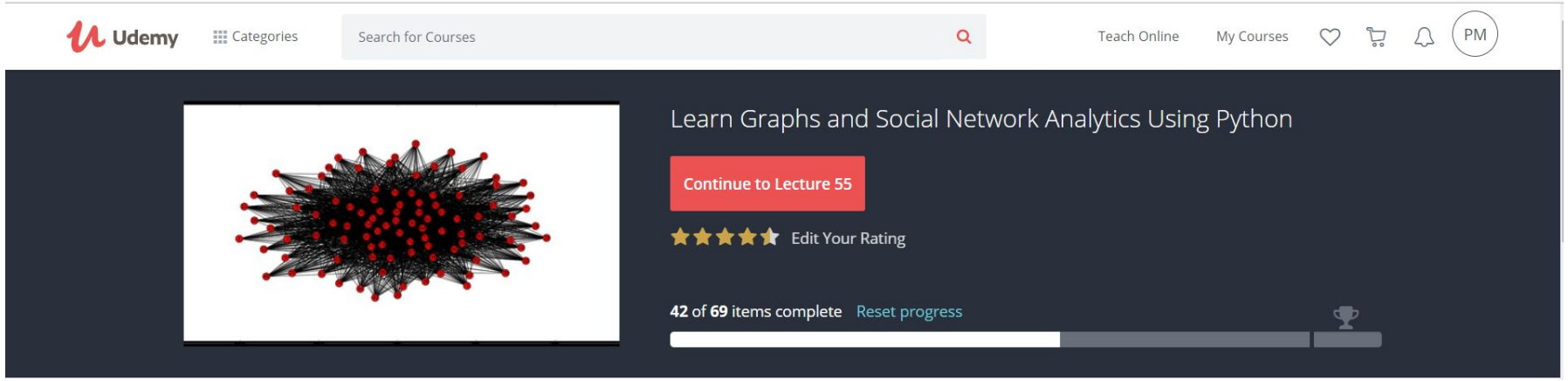
APPLIED SOCIAL NETWORK ANALYSIS IN PYTHON



LITERATURE SURVEY

Udemy

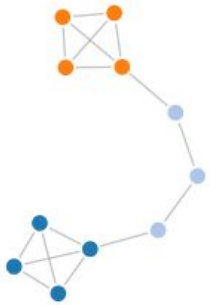
LEARN GRAPHS AND SOCIAL NETWORK ANALYSIS USING PYTHON



LITERATURE SURVEY

stackoverflow

NETWORKX DOCUMENTATION



LET US LOOK AT OUR NETWORKS

BEFORE WE START,

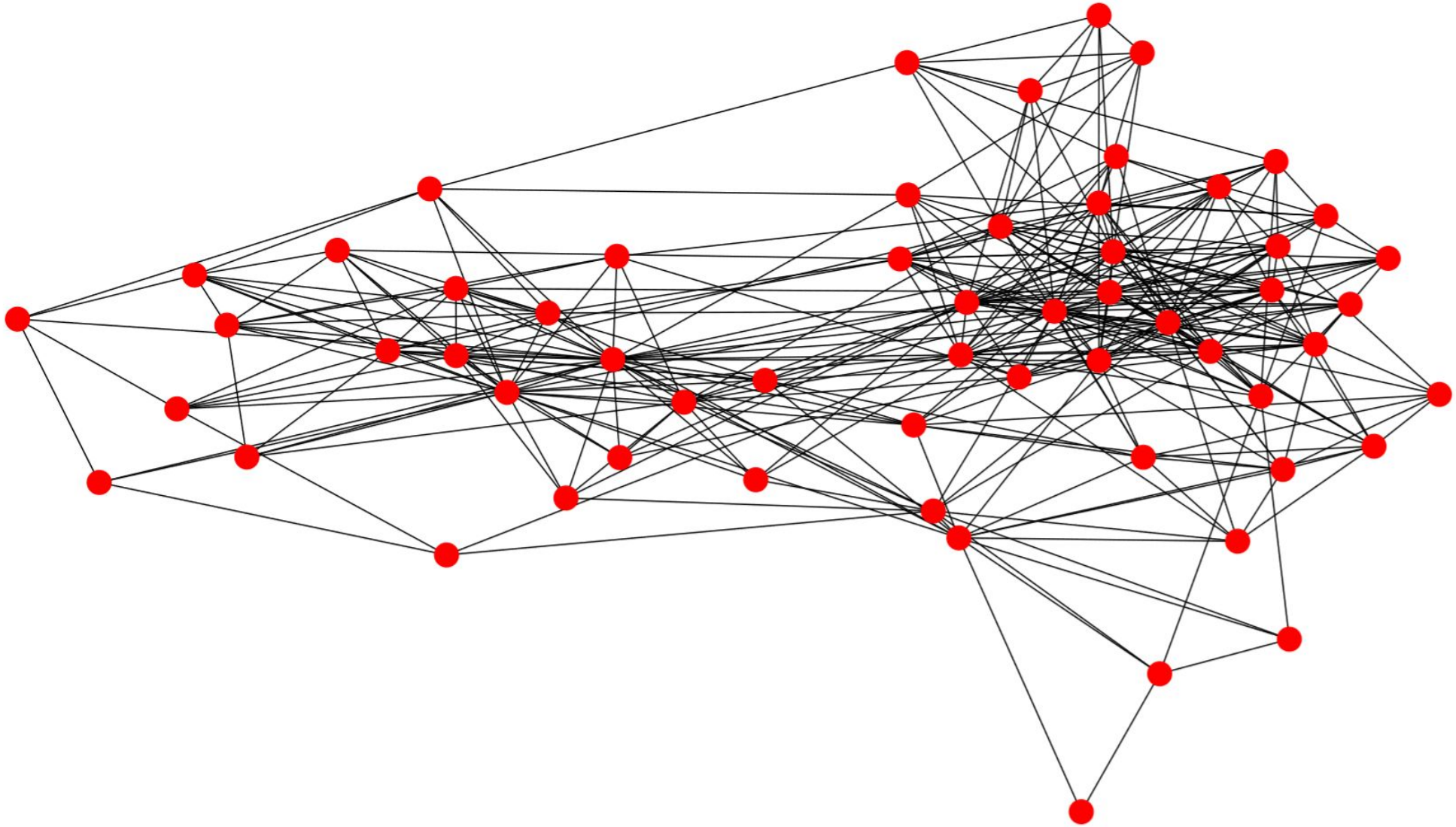
The scope of this study is restricted to SNA class batch 1.

A person may be connected to many people or very less people depending on how the class is shuffled in terms of A, B and C sections.

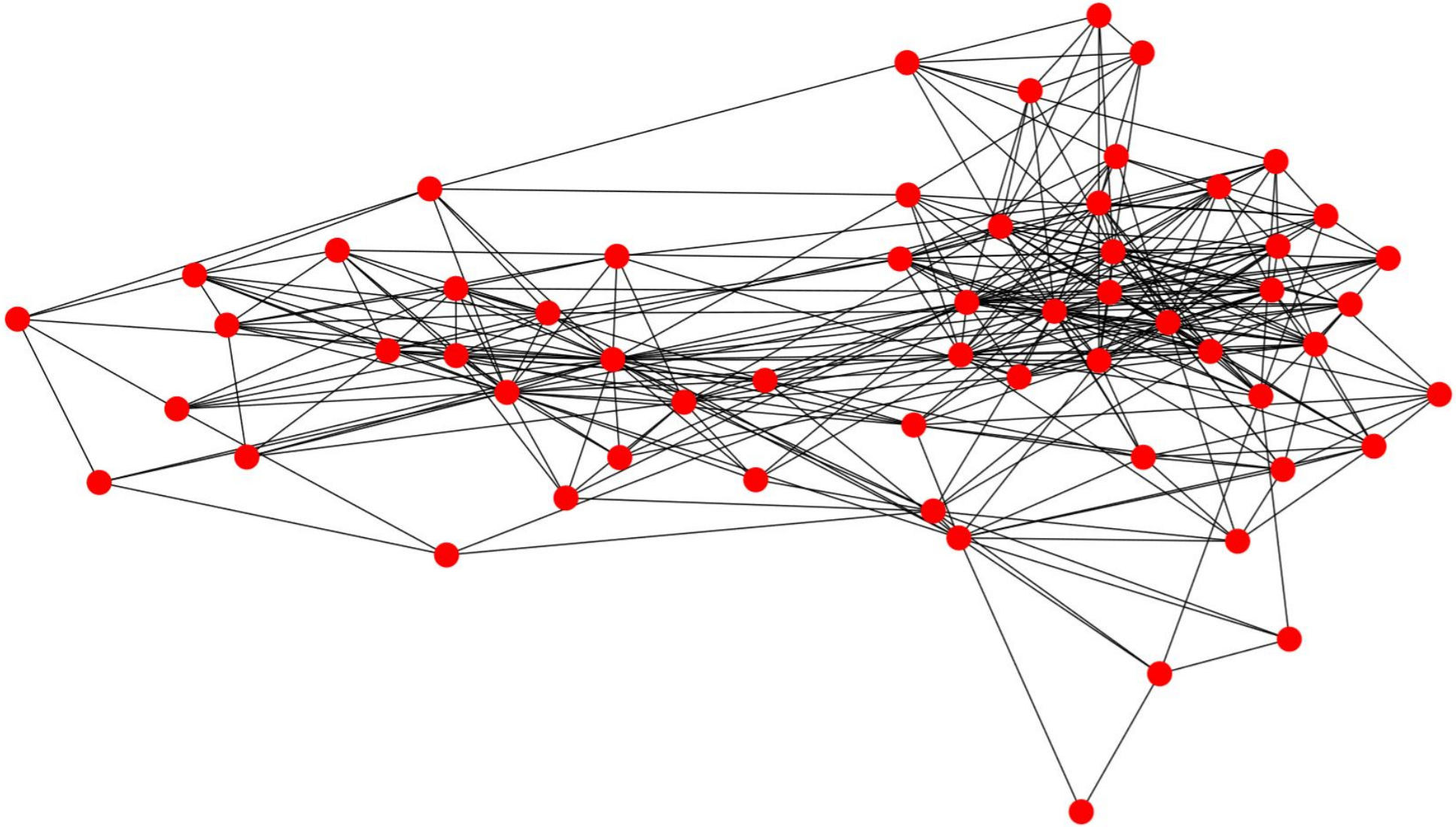
In no way does it convey that a person is entitled to only the number of connections portrayed in these networks. They might have many connections out of the scope of this study (other than the people present in SNA batch 1).

This study is done purely out of academic interest.

CAN YOU GUESS WHICH NETWORK THIS IS?



WHATSAPP NETWORK



WHATSAPP NETWORK

Number of nodes: 59

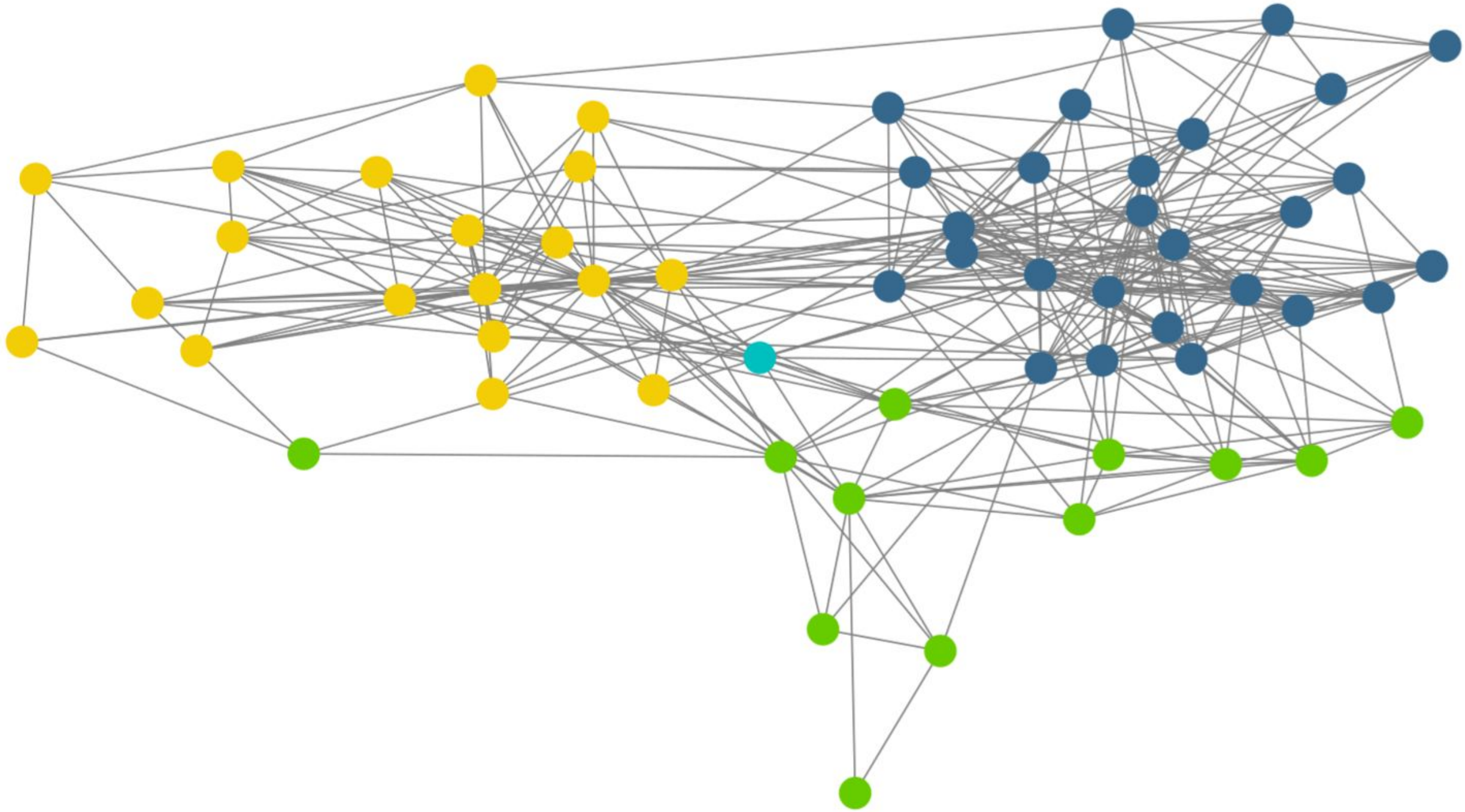
- A section – 27
- B section – 12
- C section – 19
- + NGP sir

Number of edges: 340

Average degree: 11.525

LET'S MAKE IT MORE INFORMATIVE…

1. CHANGE THE COLOUR OF NODES
2. LIGHTEN THE COLOUR OF EDGES



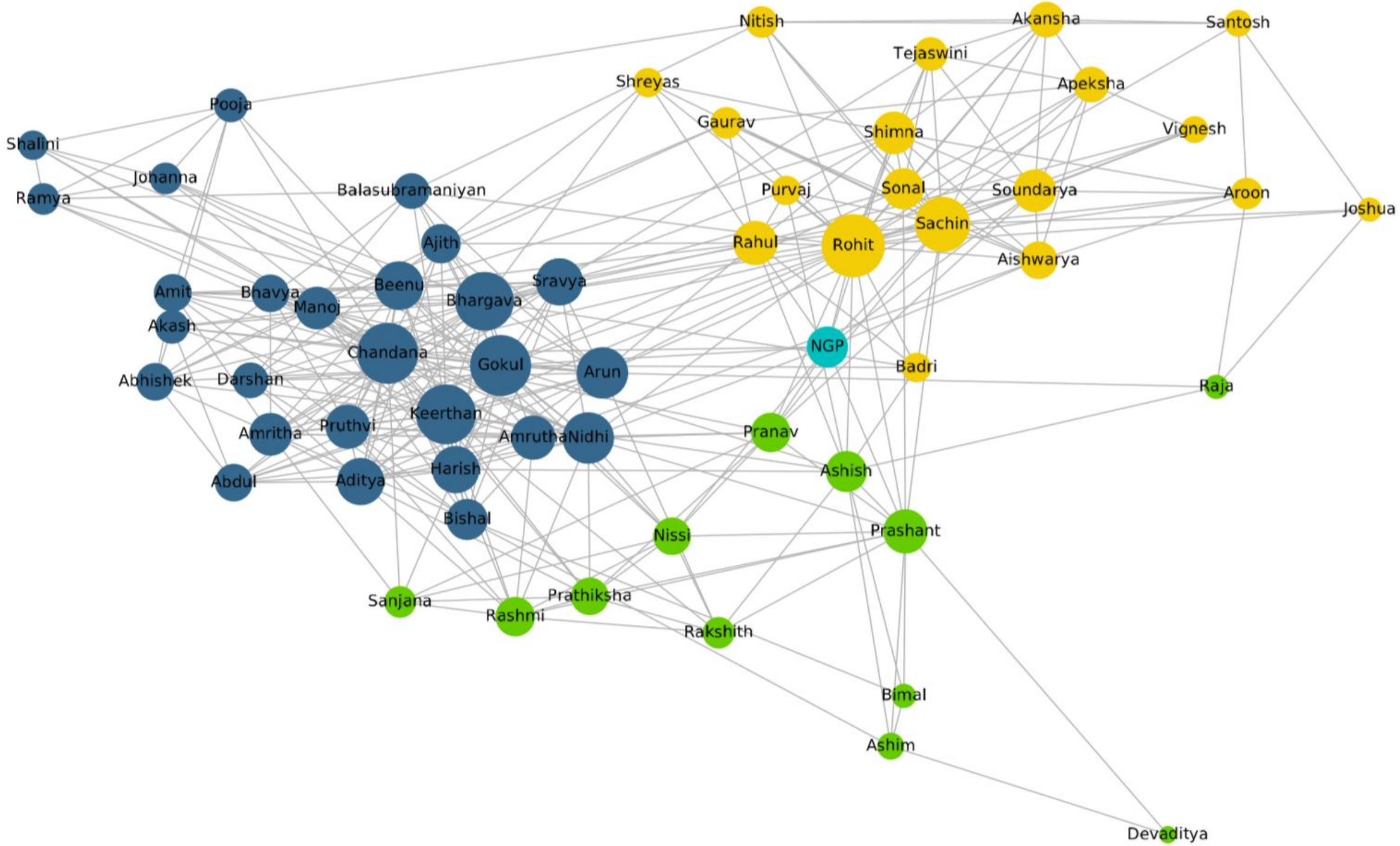
BLUE – A SECTION

GREEN – B SECTION

YELLOW – C SECTION

FINALLY,

- LET US ADD OUR NAMES
- ADJUST THE SIZE OF A NODE ACCORDING TO THE NUMBER OF CONNECTIONS IT HAS.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Santosh
Tejaswini
Shreyas
Apeksha
Pooja
Gaurav
Shimna
Vignesh
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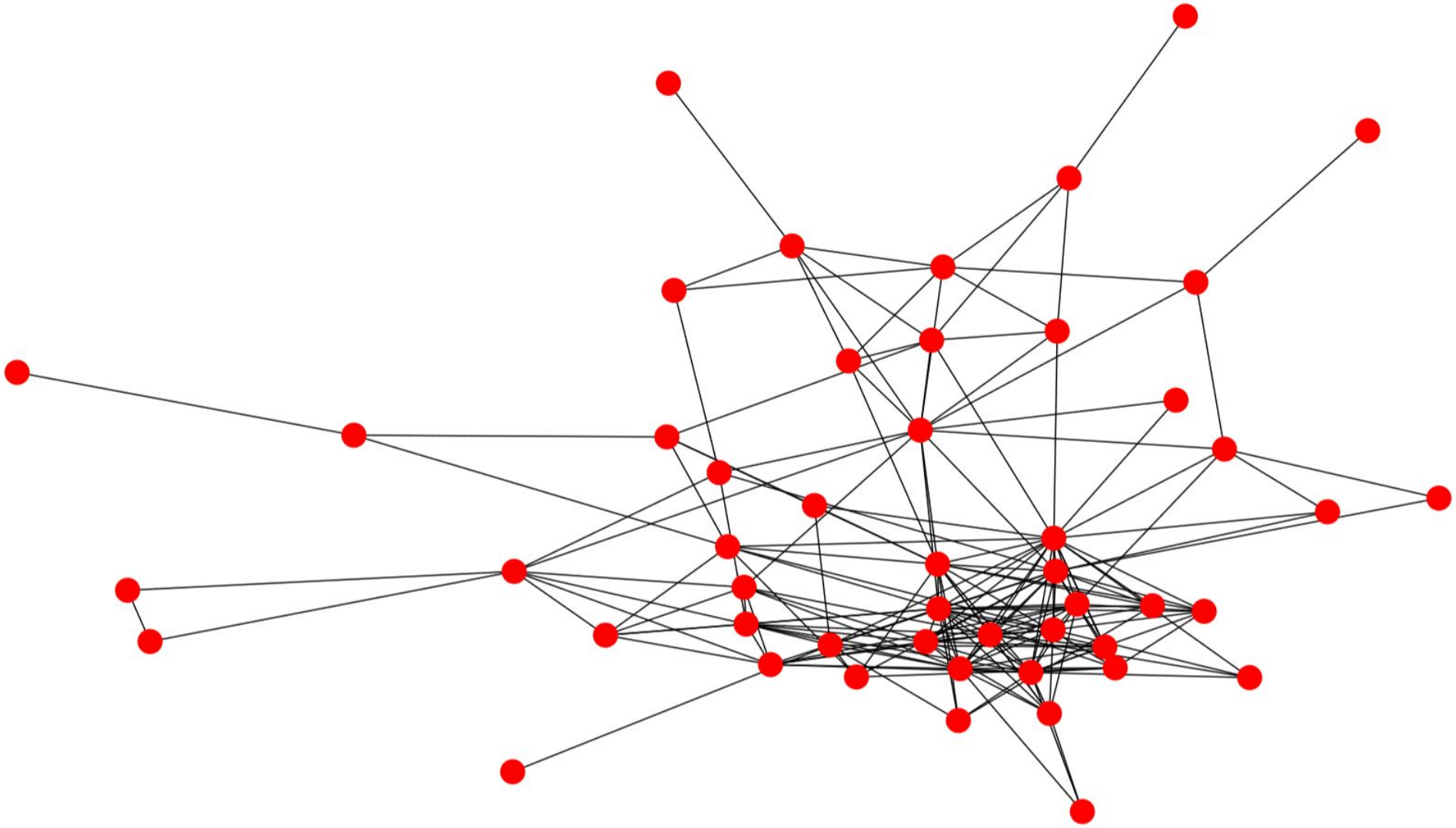
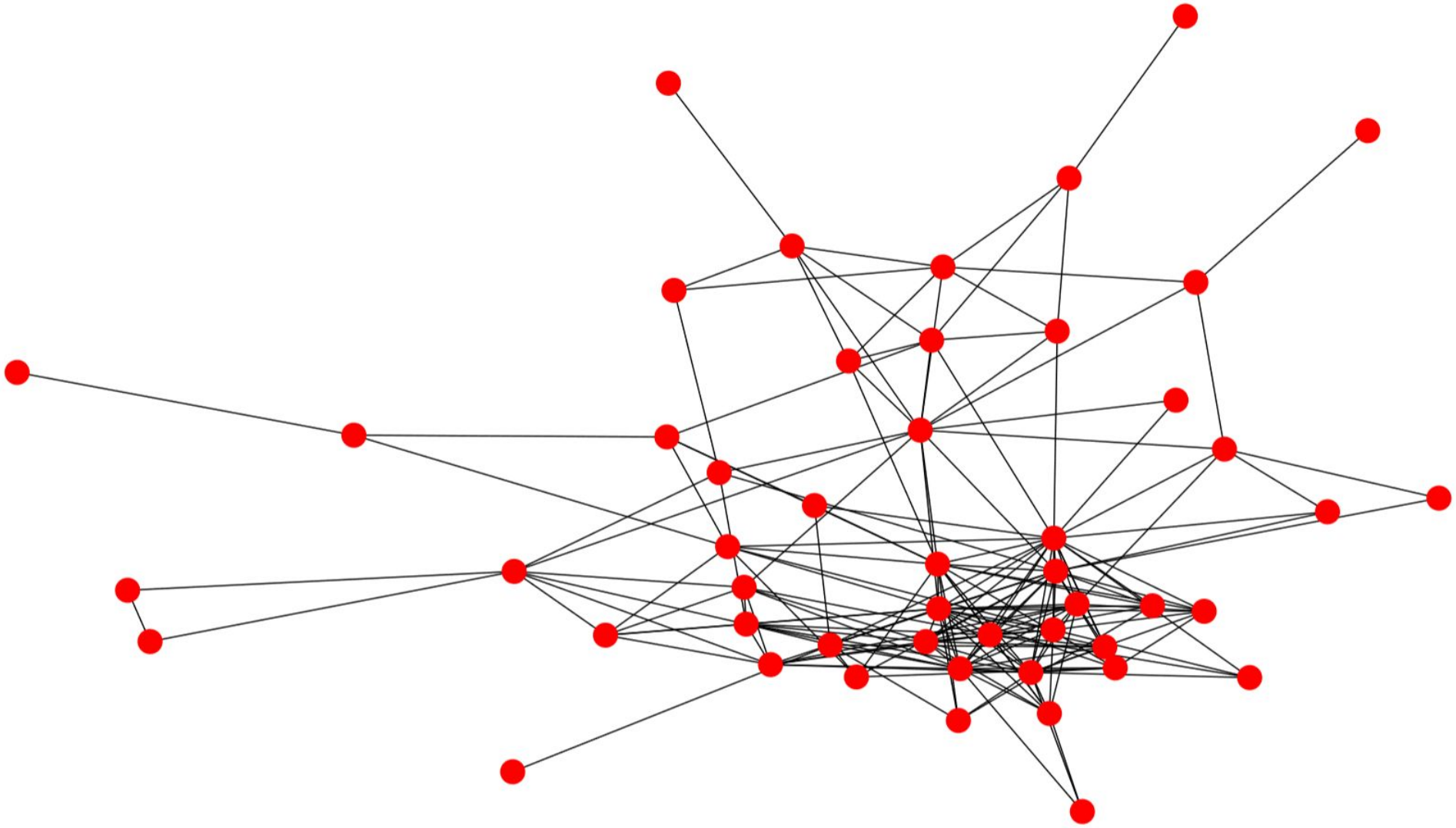
Johanna
Ramya
Balasubramaniyan
Purvaj
Sonal
Soundarya
Aroon
Joshua
Sachin
Rahul
Rohit
Ajith
Aishwarya
Sravya
Amit
Bhavya
Beenu
Bhargava
Manoj
Akash
NGP
Chandana
Gokul
Arun
Badri
Abhishek
Darshan
Raja
Keerthan
Pruthvi
Amritha
AmruthaNidhi
Pranav
Harish
Ashish
Abdul
Aditya
Bishal
Nissi
Prashant
Sanjana
Prathiksha
Rashmi
Rakshith
Bimal
Ashim
Devaditya

NEXT, WHICH NETWORK THIS IS?



INSTAGRAM NETWORK



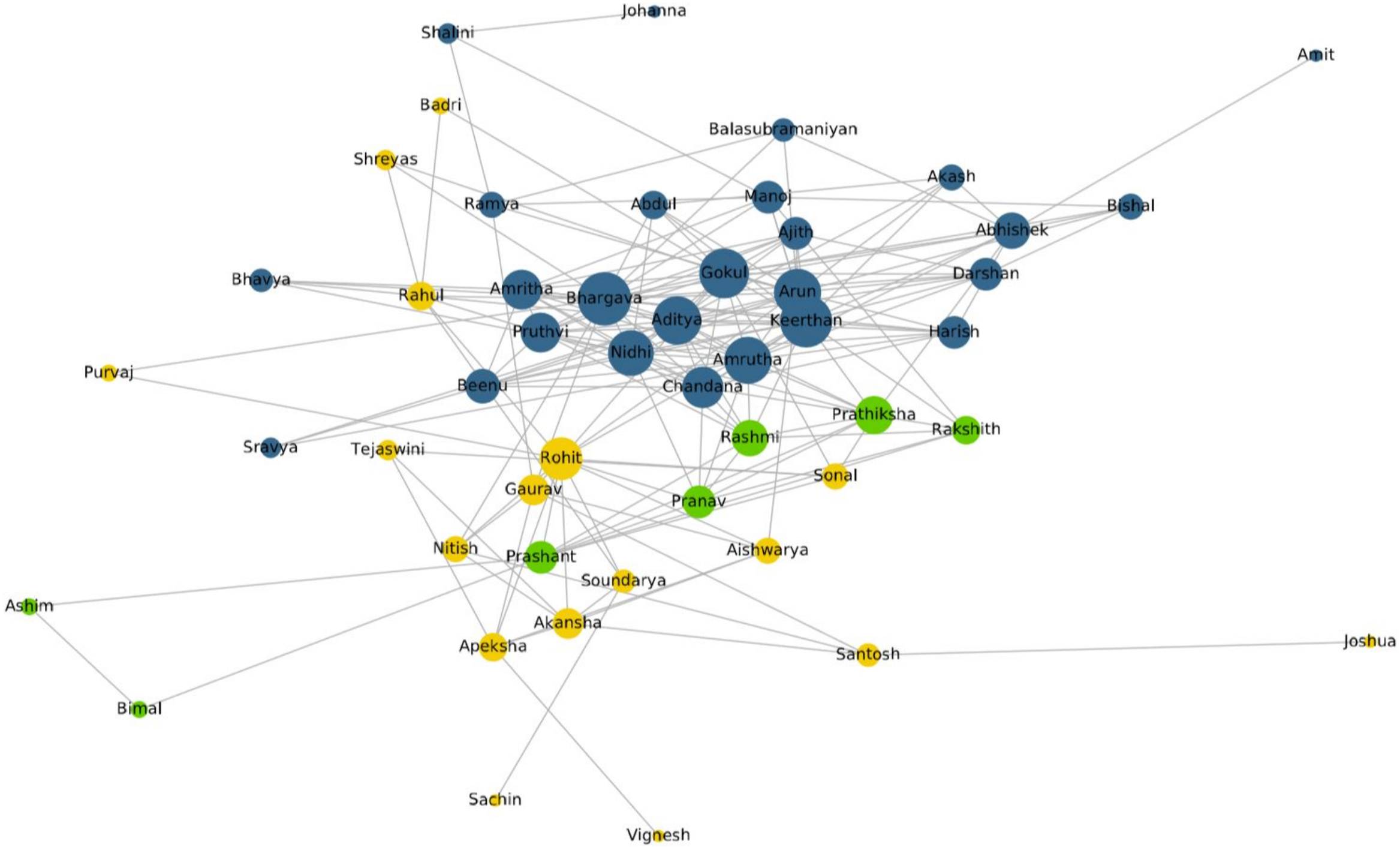
INSTAGRAM NETWORK

Number of nodes: 50

- A section – 26
- B section – 7
- C section – 17

Number of edges: 189

Average degree: 7.56


Johanna
Shalini
Amit
Badri
Balasubramaniyan
Shreyas
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Ramya
Abdul
Manoj
Bishal
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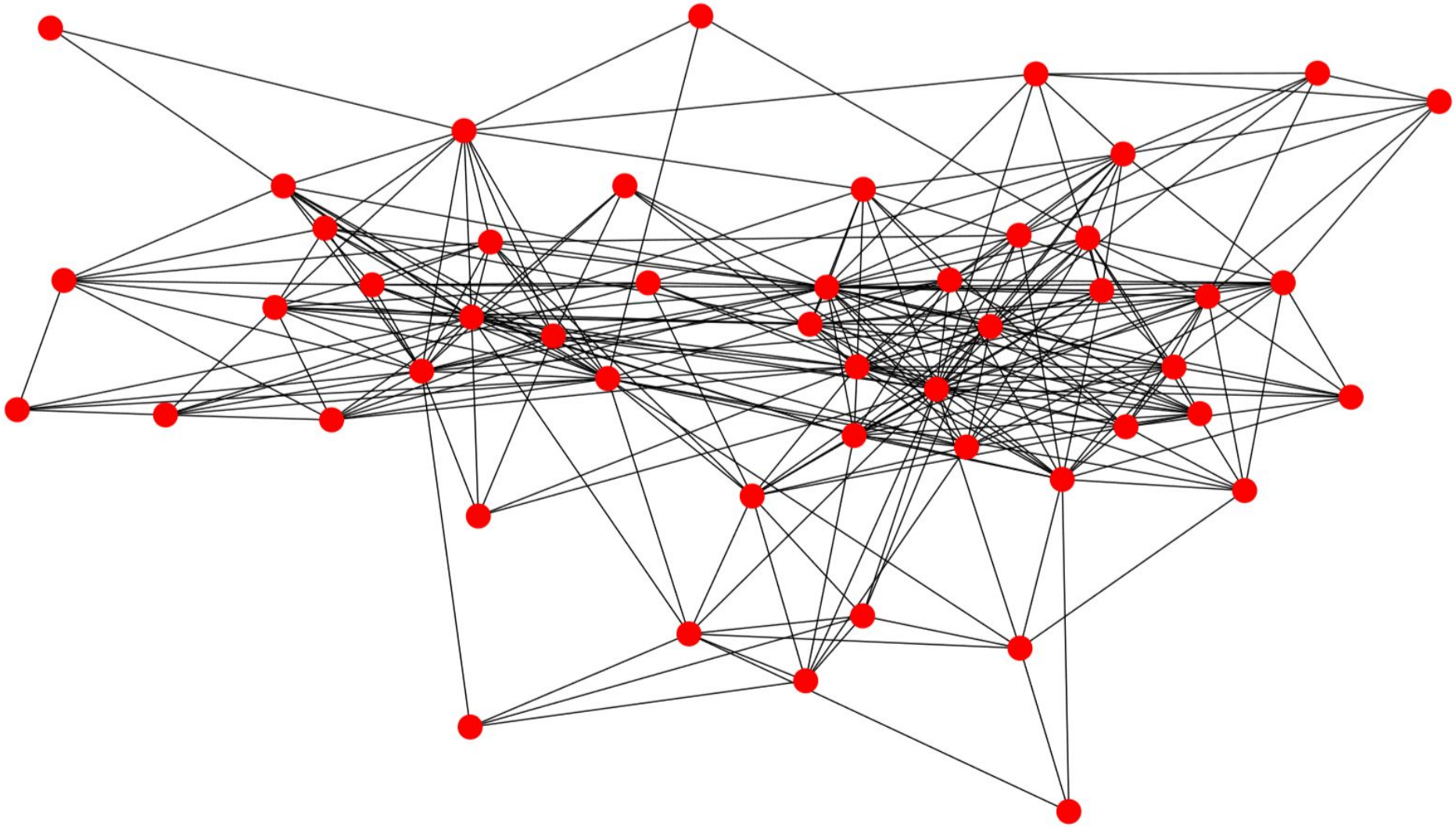
Abhishek
Gokul
Darshan
Bhavya
Rahul
Amritha
Bhargava
Arun
Aditya
Keerthan
Pruthvi
Harish
Nidhi
Amrutha
Purvaj
Beenu
Chandana
Prathiksha
Rakshith
Rashmi
Sravya
Tejaswini
Rohit
Sonal
Gaurav
Pranav
Nitish
Prashant
Aishwarya
Soundarya
Ashim
Akansha
Apeksha
Santosh
Joshua
Bimal
Sachin
Vignesh

FACEBOOK NETWORK



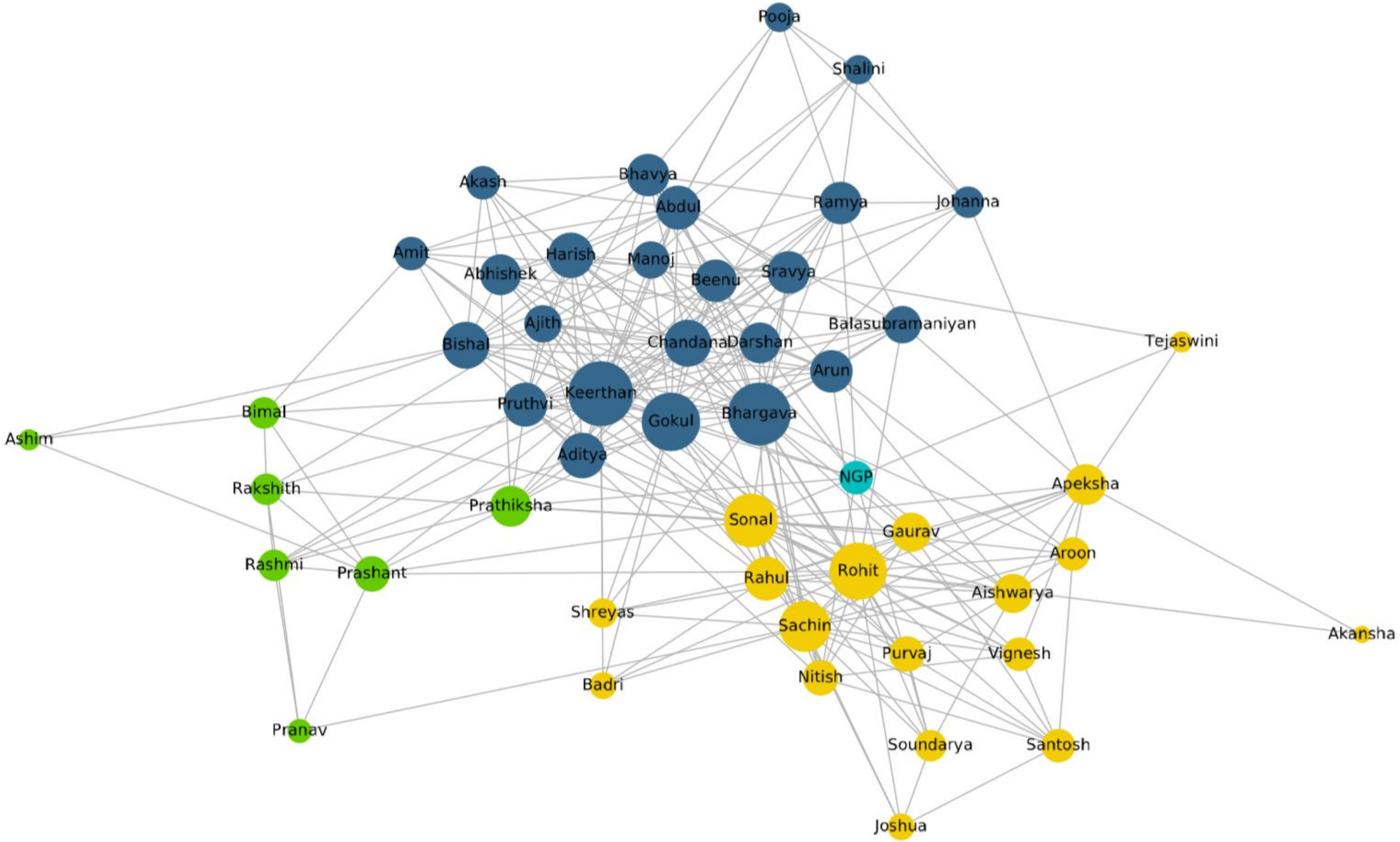
FACEBOOK NETWORK

Number of nodes: 50

- A section – 24
- B section – 7
- C section – 18
- + NGP sir

Number of edges: 284

Average degree: 11.36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Akash
Bhavya
Abdul
Ramya
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Amit
Harish
Manoj
Abhishek
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Balasubramaniyan
Bishal
ChandanaDarshan
Tejaswini
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Pruthvi
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Ashim
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Apeksha
Prathiksha
Sonal
Gaurav
Aroon
Rashmi
Prashant
Rahul
Rohit
Aishwarya
Shreyas
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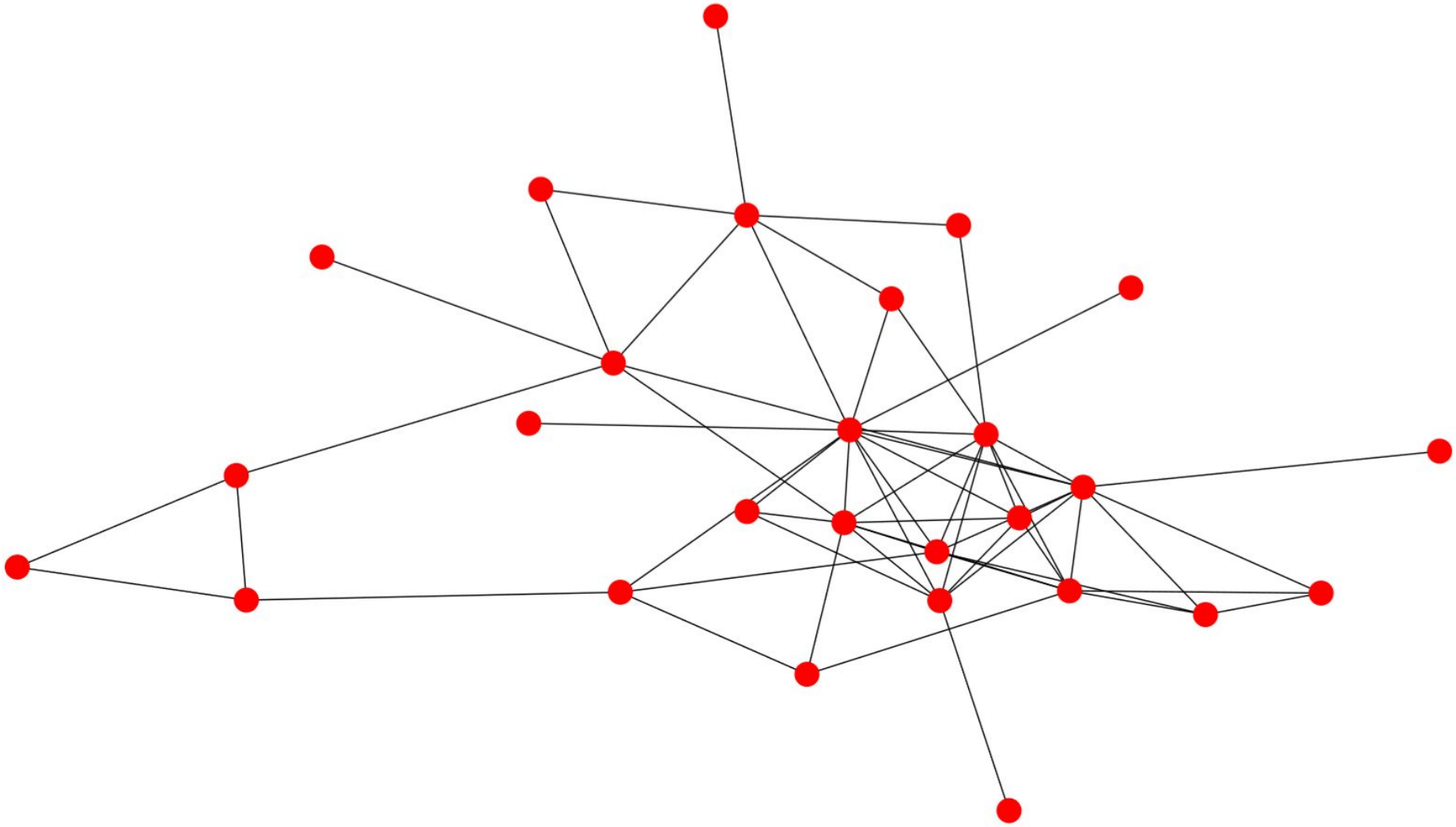
Purvaj
Vignesh
Nitish
Badri
Pranav
Soundarya
Santosh
Joshua

SNAPCHAT NETWORK



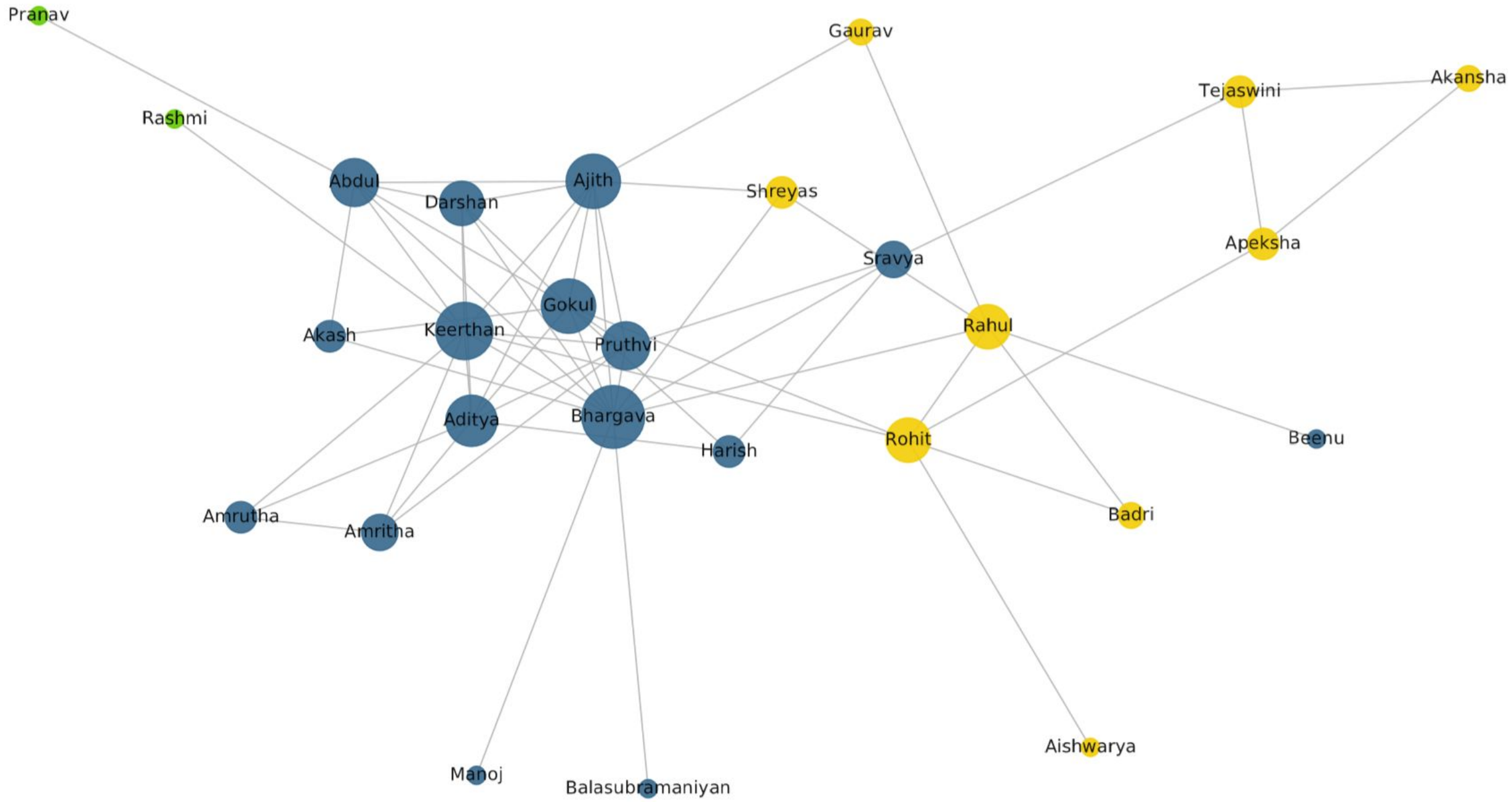
SNAPCHAT NETWORK

Number of nodes: 27

- A section – 16
- B section – 2
- C section – 9

Number of edges: 59

Average degree: 4.37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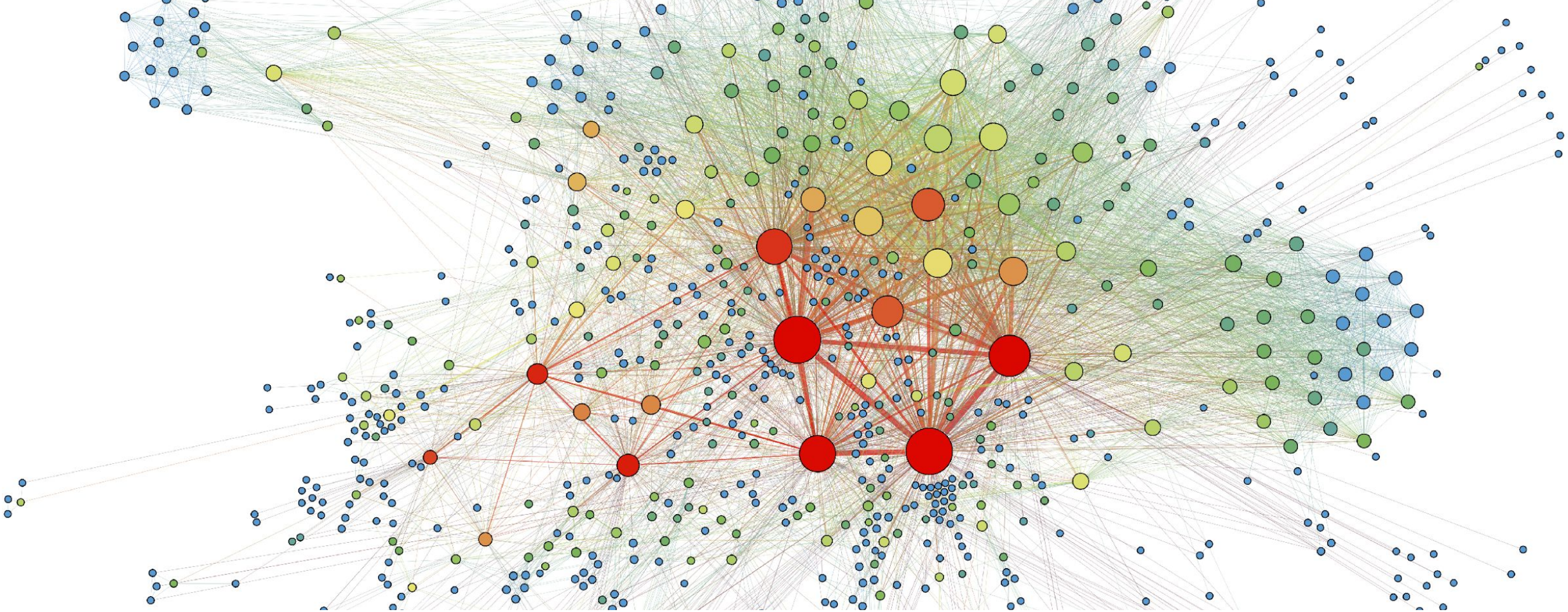


ANALYSING THE NETWORKS | LET'S START!

CENTRALITY MEASURES

In Network Analysis, indicators of **Centrality** identify the most important vertices within a network.

Its applications include identifying, for example,

- the most influential people in a social network,
- key infrastructure nodes in urban networks,
- important pages on the web,

CENTRALITY MEASURES

- nodes that spread information across the network,
- nodes that can cause/prevent epidemics,
- and nodes that are crucial to keep the network from breaking up.

DEGREE CENTRALITY

Assigns an importance score based on the number of ties each actor in the network has.

"More no. of ties = More important"

ANSWERS THE IMMEDIATE QUESTION –
How many people in the network are you directly connected to?

CLOSENESS CENTRALITY

Closeness Centrality is a measure of the degree to which an individual is near all other individuals (the number of hops) in a network.

It is used for finding the individuals who are best placed to influence the entire network most quickly – good 'broadcasters'.

CLOSENESS CENTRALITY

"Close to everyone in the network = More important"

ANSWERS THE QUESTION –

How close are you to every person in the network?

BETWEENNESS CENTRALITY

Betweenness Centrality is the measure of how many times a particular node comes in between the shortest path between any other two nodes.

"People that act as bridges between other people = More important"

BETWEENNESS CENTRALITY

Removal of a node with a high betweenness centrality would result in the disruption of communication across the entire network.

ANSWERS THE QUESTION-

Who is important for the flow of information in a network?

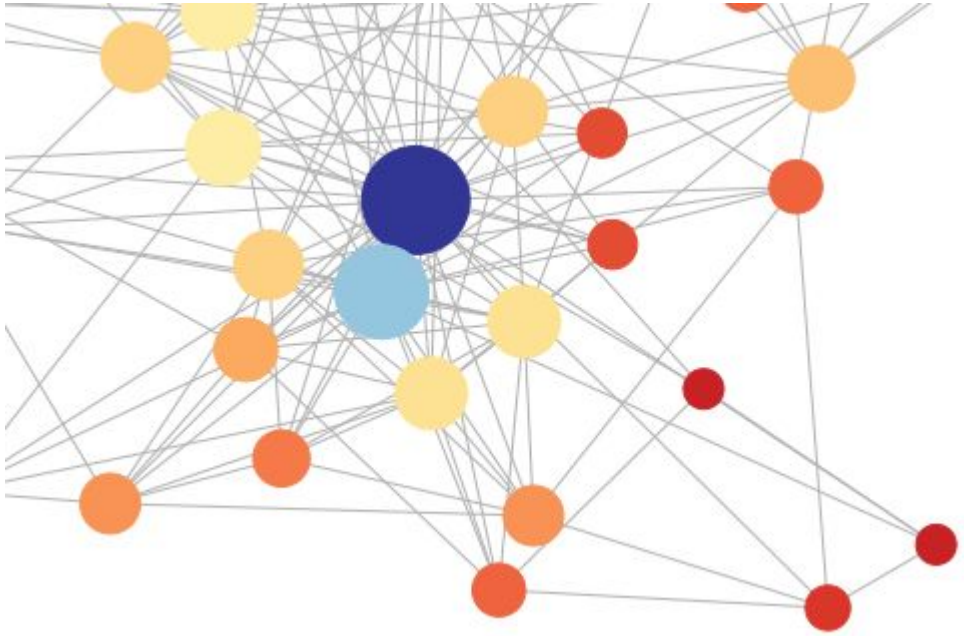
CENTRALITY MEASURES | WHATSAPP

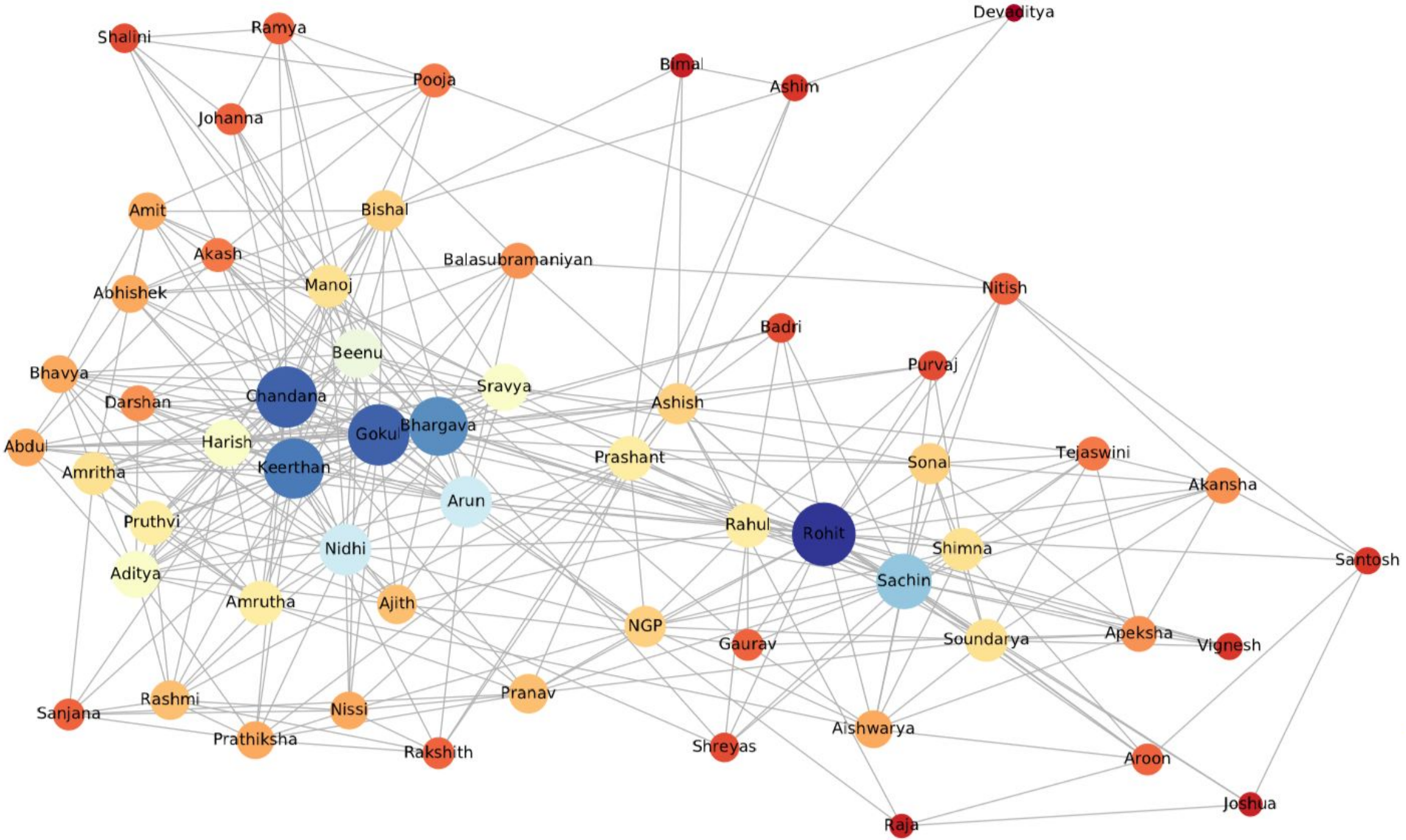
DEGREE CENTRALITY - WHATSAPP

RED (low)

⇩

BLUE (high)

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NGP
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Gaurav
Vignesh
Pranav
Rashmi
Sanjana
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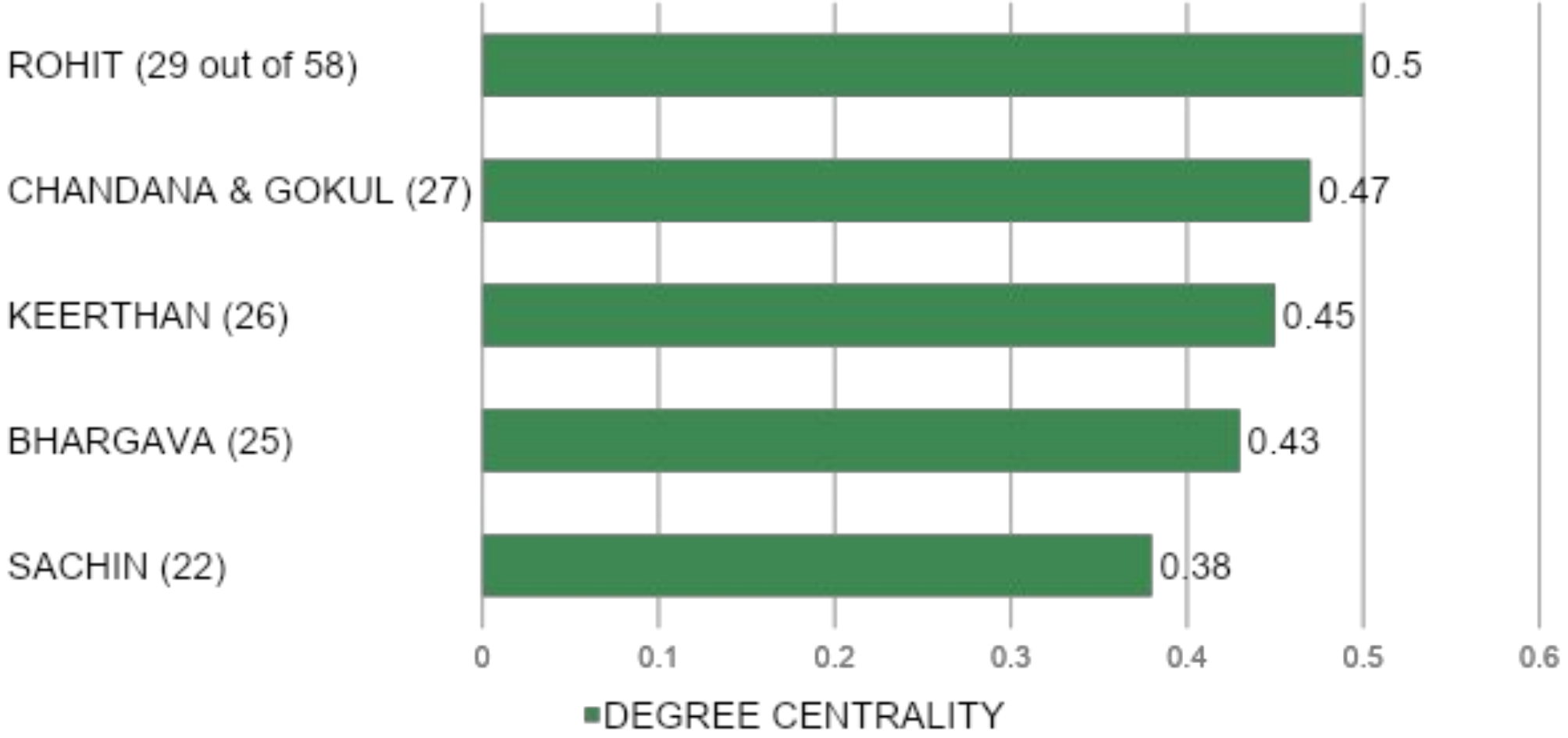
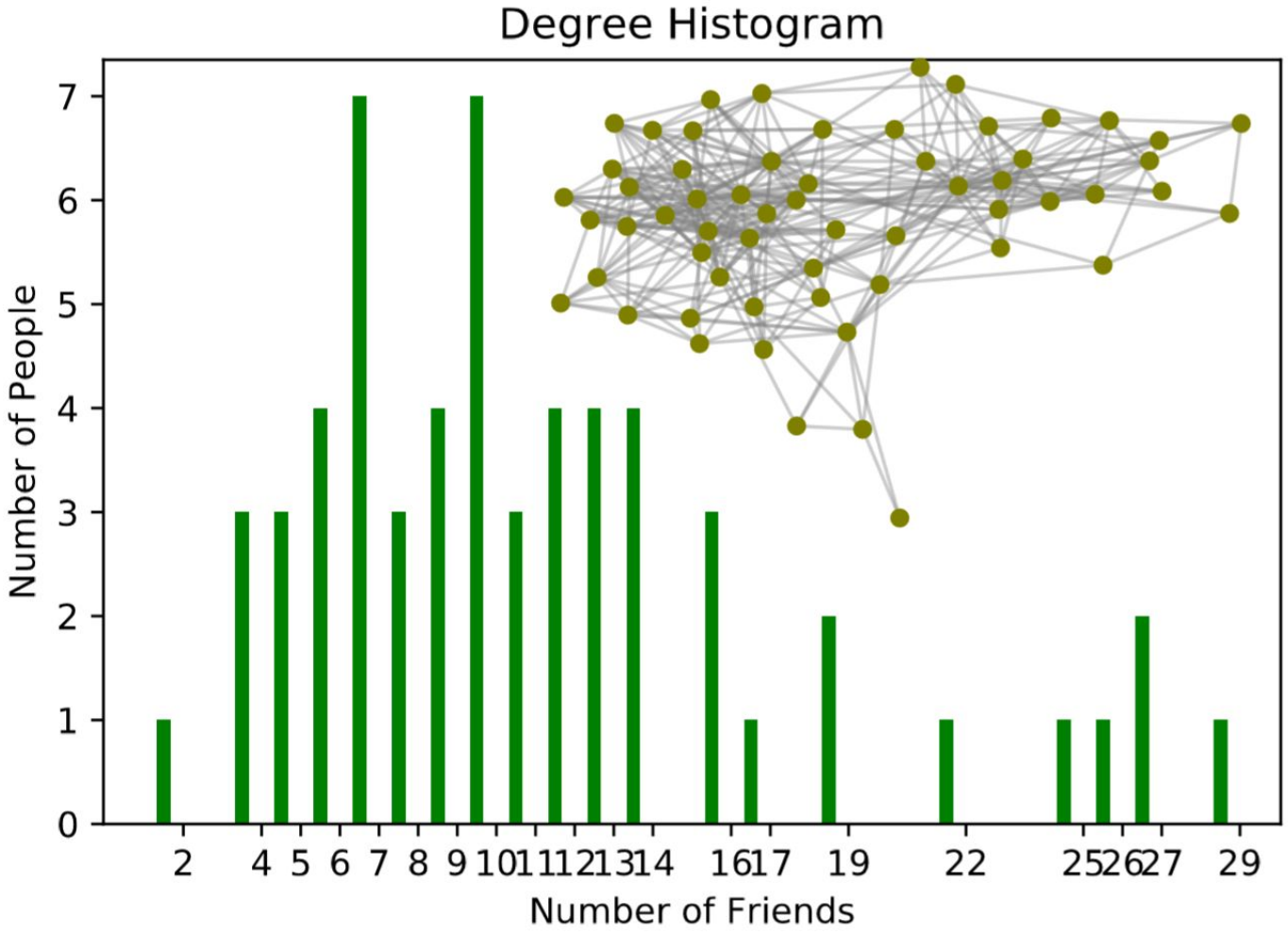
Aishwarya
Prathiksha
Shreyas
Rakshith
Aroon
Joshua
Raja

WHO HAS THE MOST NUMBER OF CONNECTIONS?



DEGREE DISTRIBUTION GRAPH - WHATSAPP

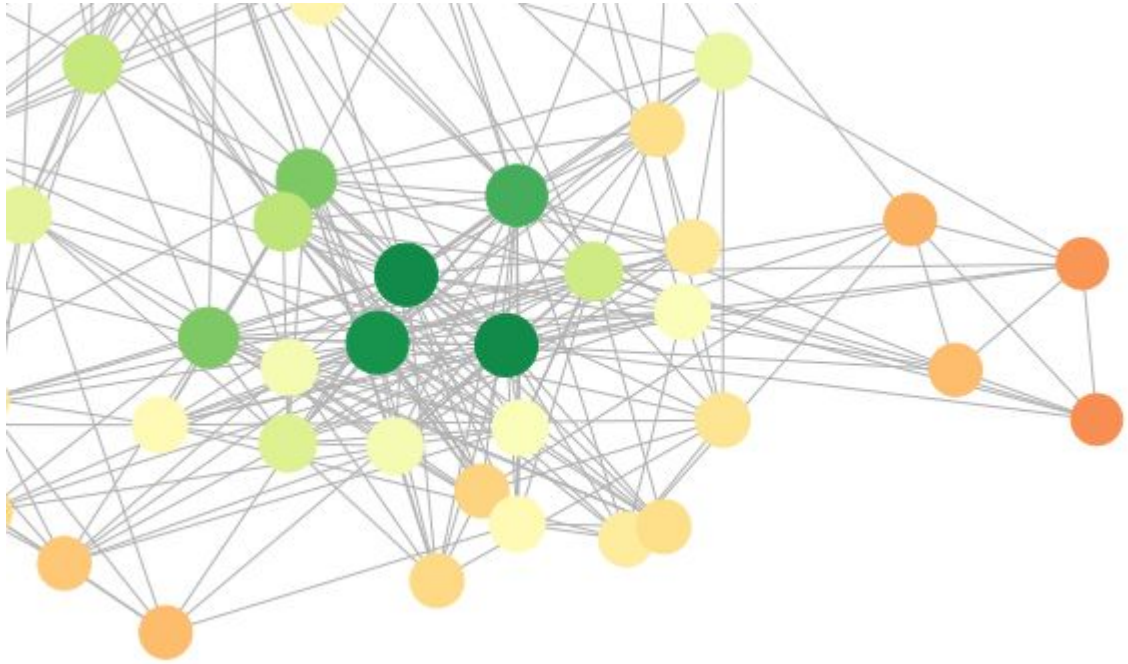


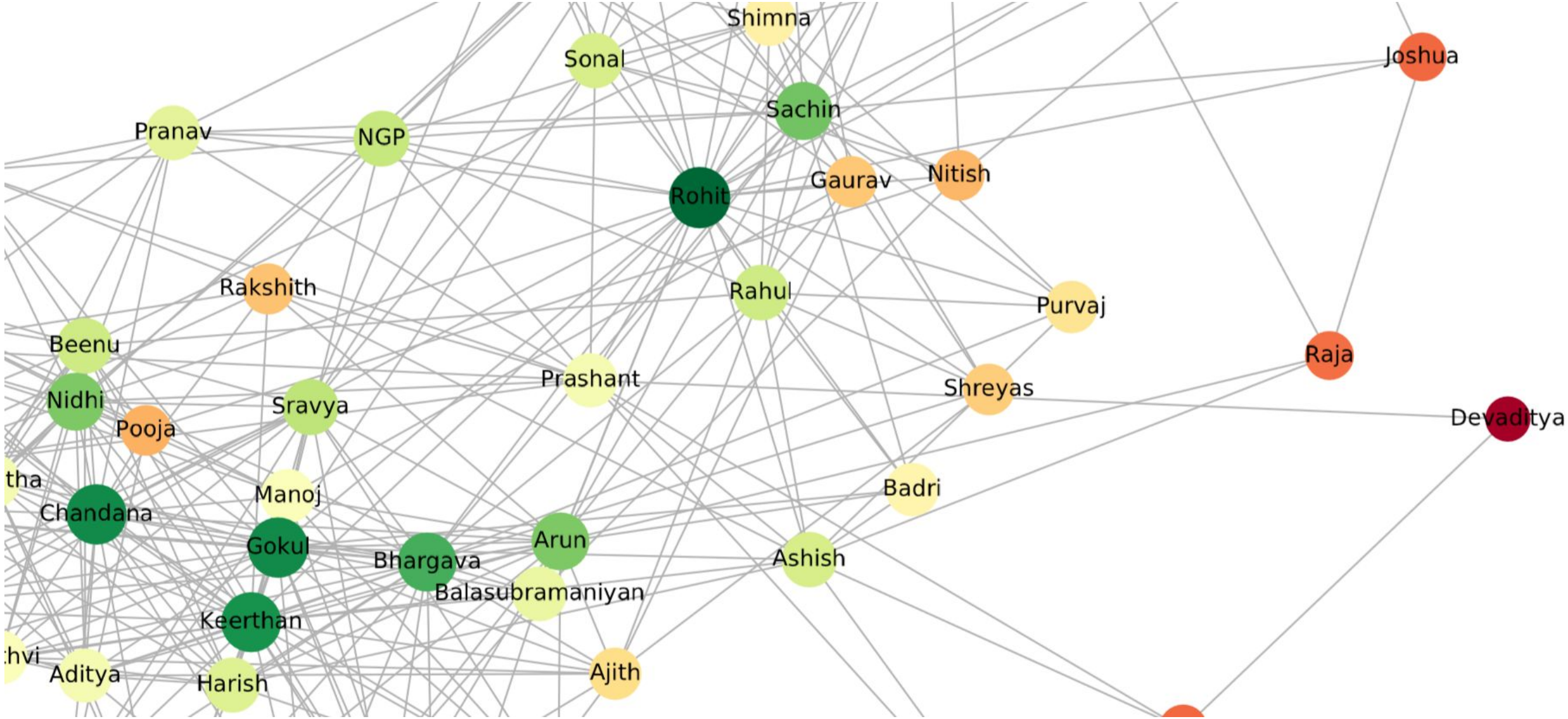
CLOSENESS CENTRALITY - WHATSAPP

RED (low)

⇩

GREEN (high)

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Joshua
Sachin
Pranav
NGP
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Purvaj
Beenu
Raja
Prashant
Shreyas
Nidhi
Sravya
Devaditya
Pooja
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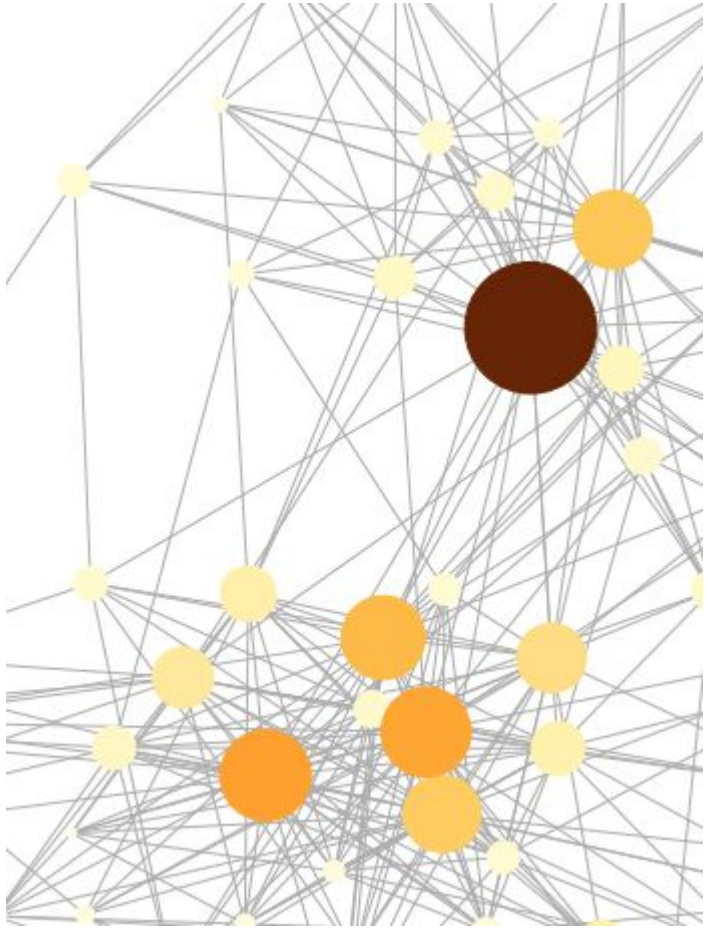
Badri
Manoj
Chandana
Arun
Gokul
Bhargava
Ashish
Balasubramaniyan
Keerthan
hvi
Aditya
Harish
Ajith

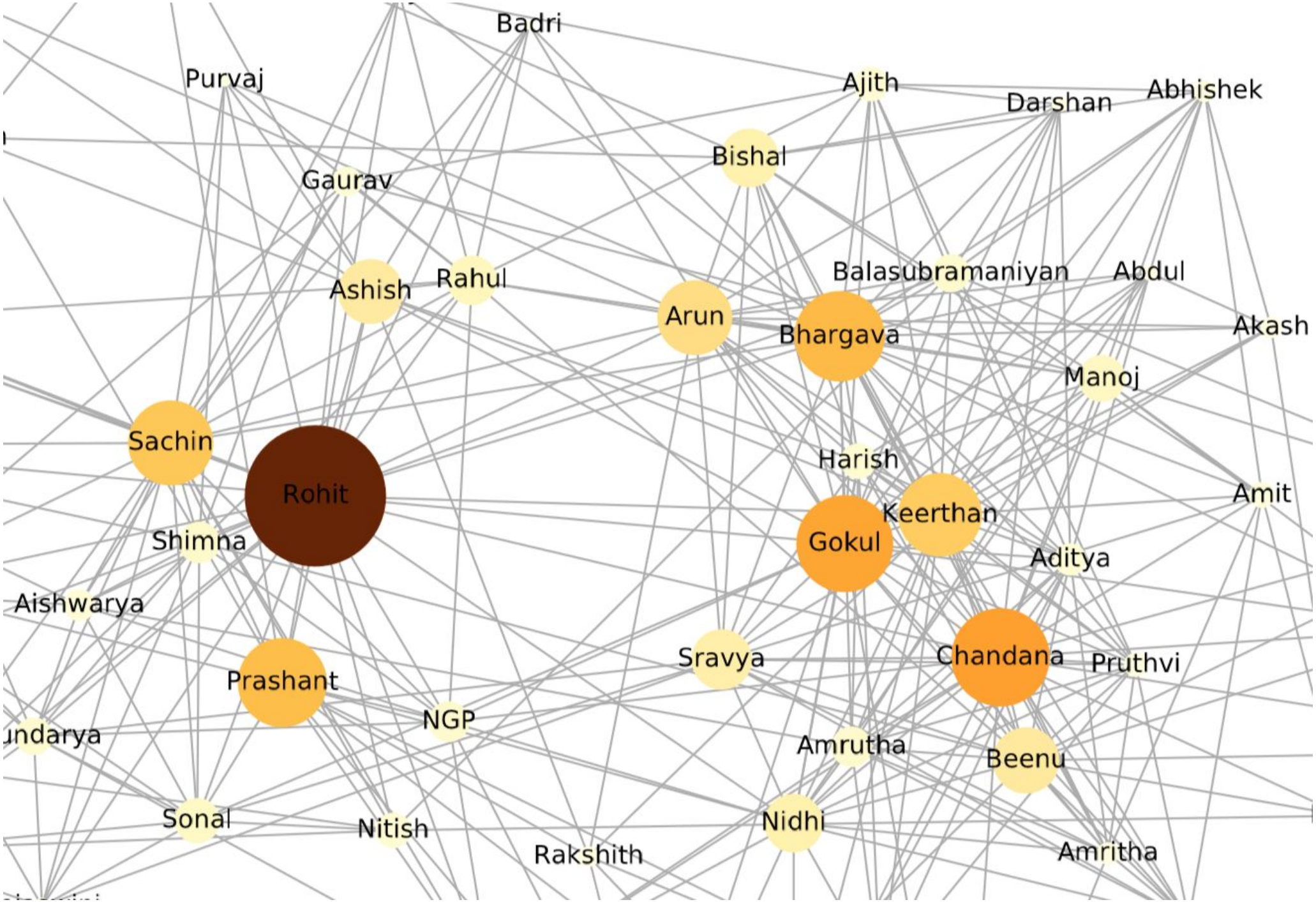
BETWEENNESS CENTRALITY - WHATSAPP

PALE ORANGE (low)

⇩

BROWN (high)

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Pruthvi
Prashant
NGP
Amrutha
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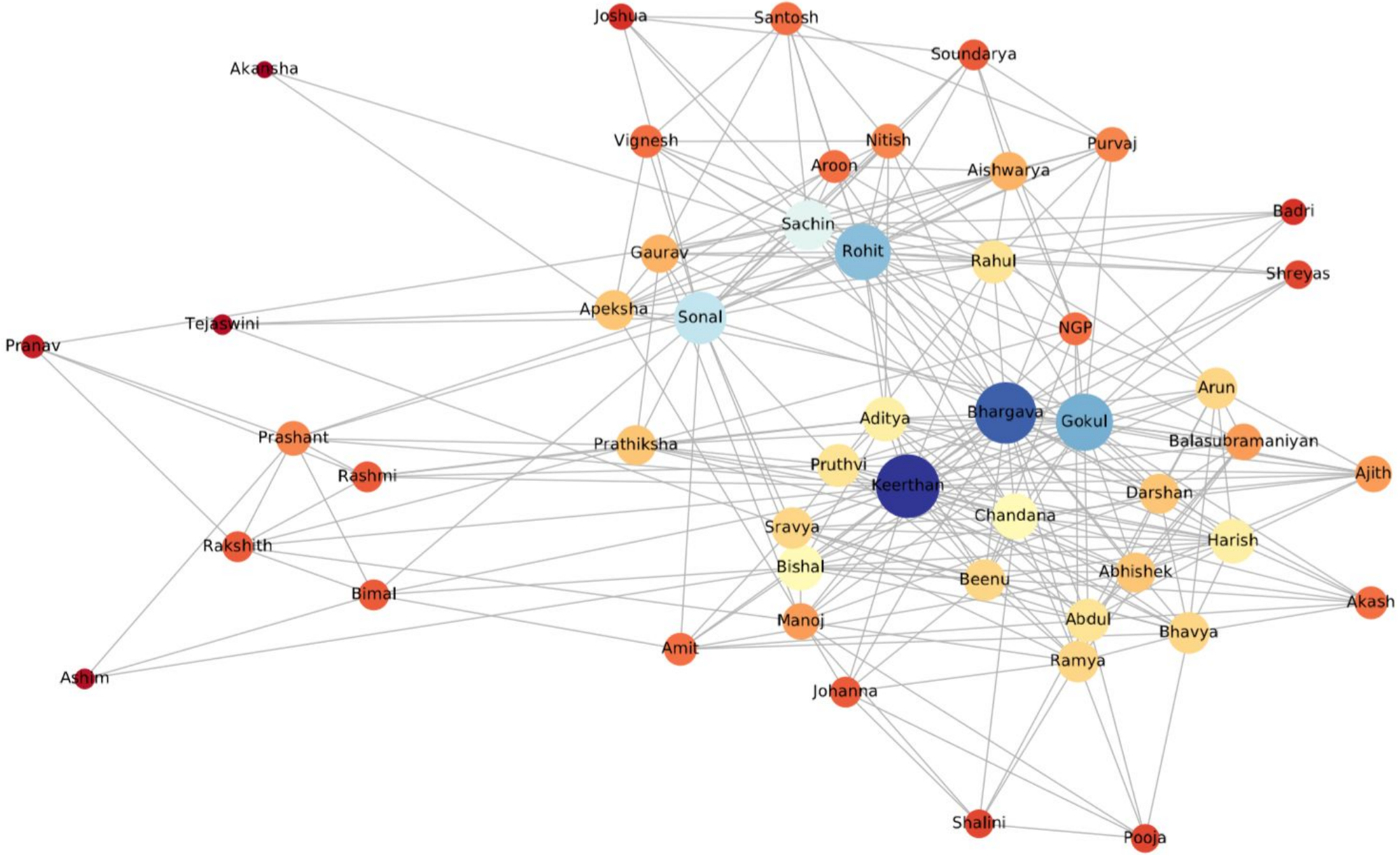
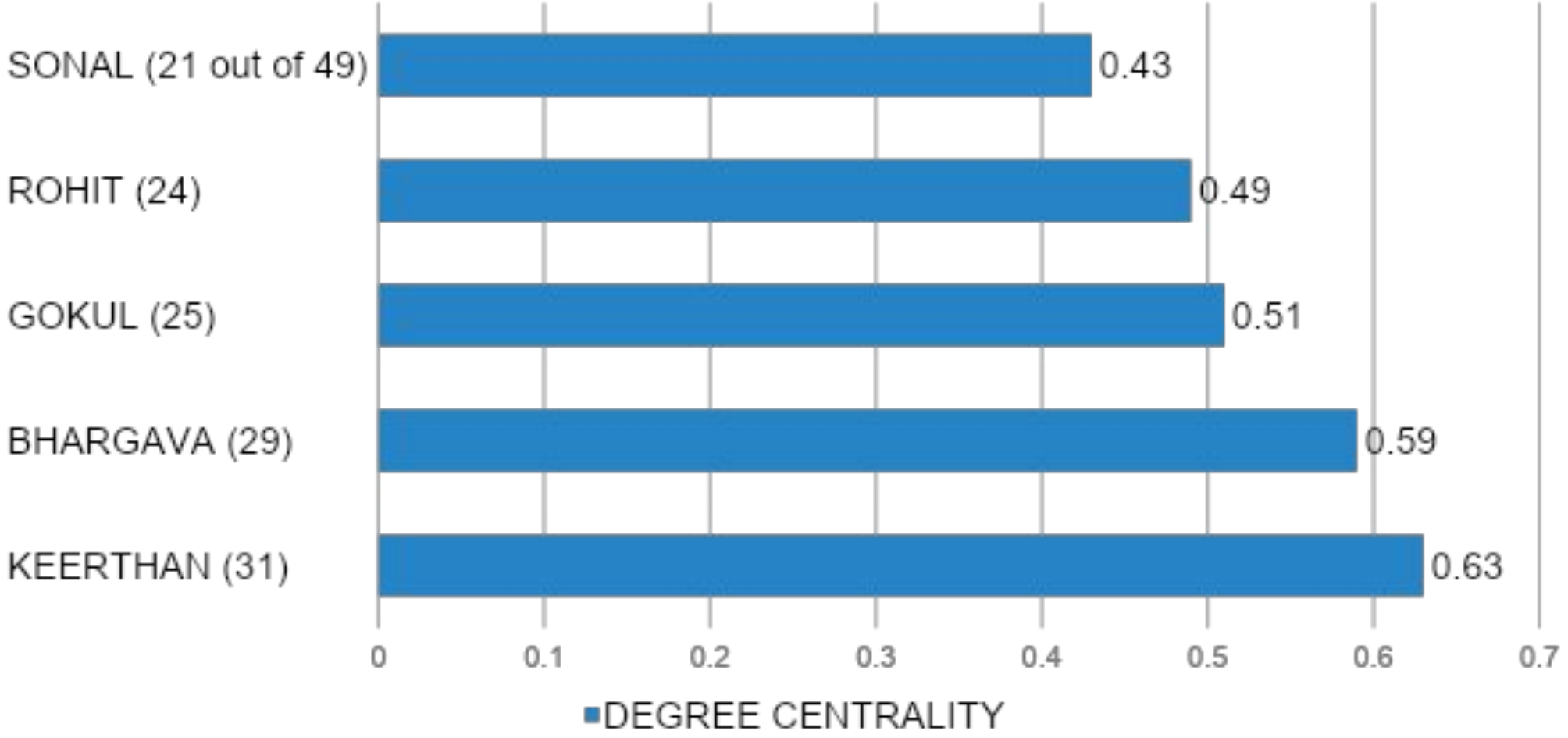
Nidhi
Rakshith
Amritha

CENTRALITY MEASURES | FACEBOOK

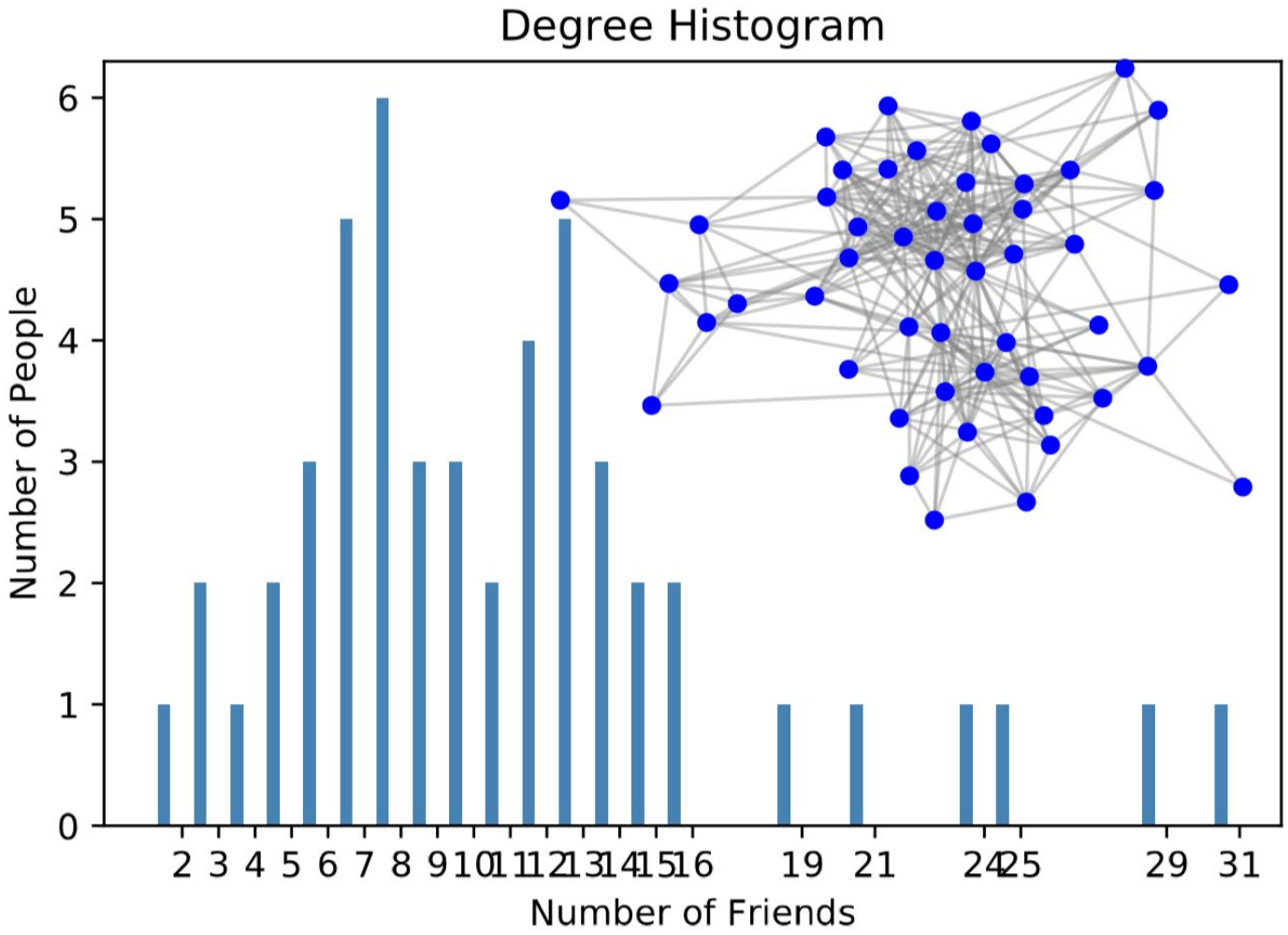
DEGREE CENTRALITY - FACEBOOK



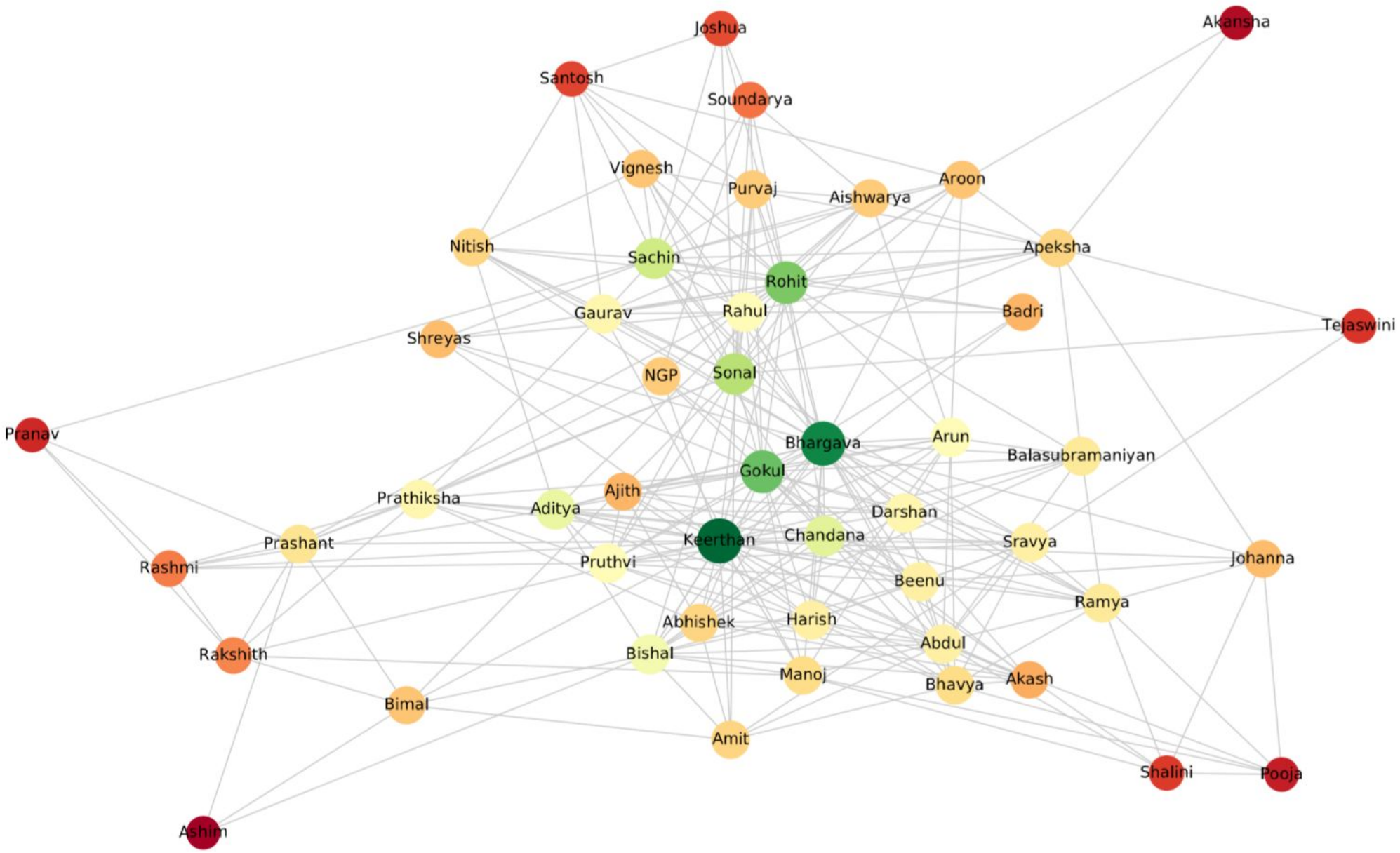
WHO HAS THE MOST NUMBER OF CONNECTIONS?



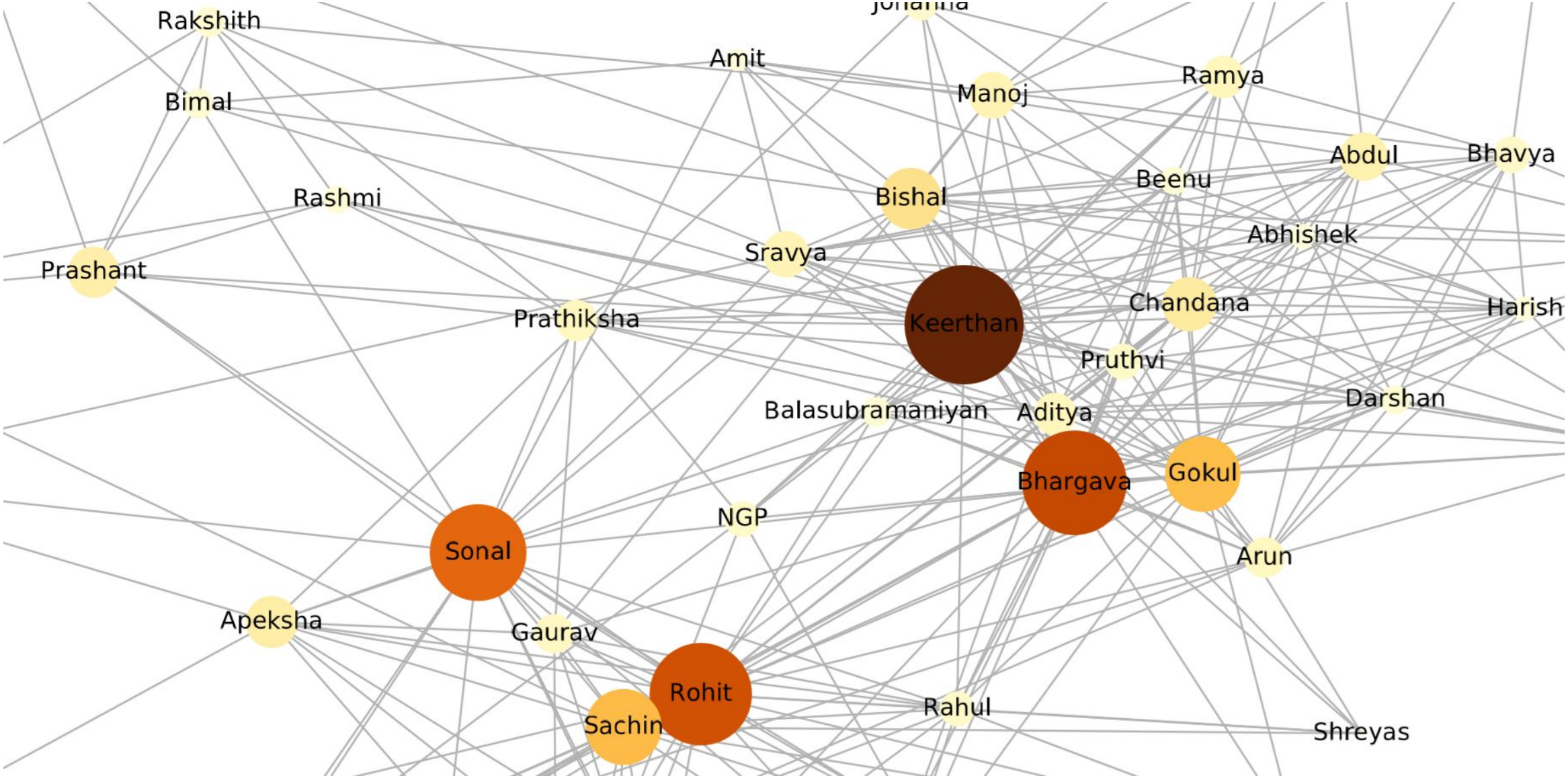
DEGREE DISTRIBUTION GRAPH - FACEBOOK



CLOSENESS CENTRALITY - FACEBOOK

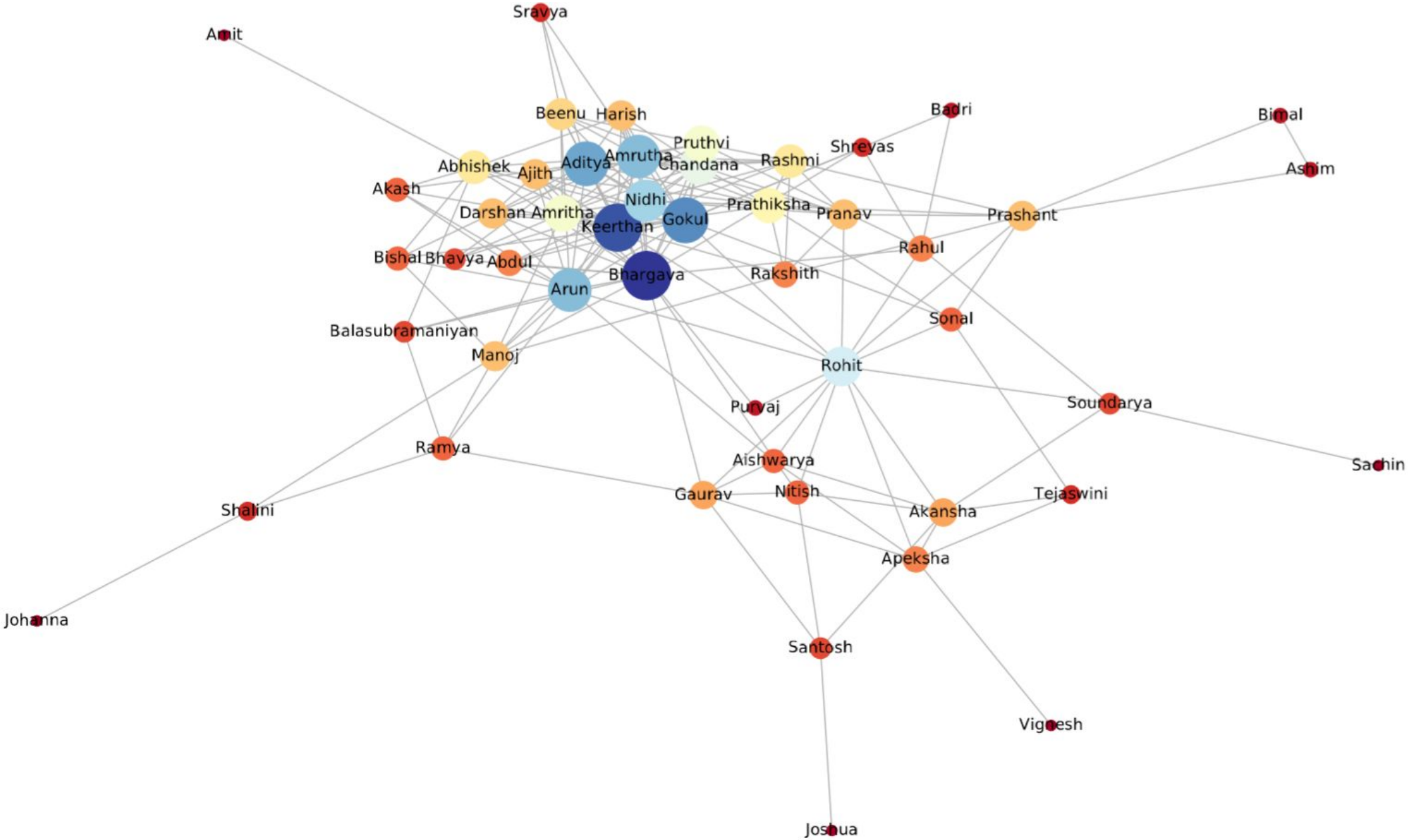


BETWEENNESS CENTRALITY - FACEBOOK

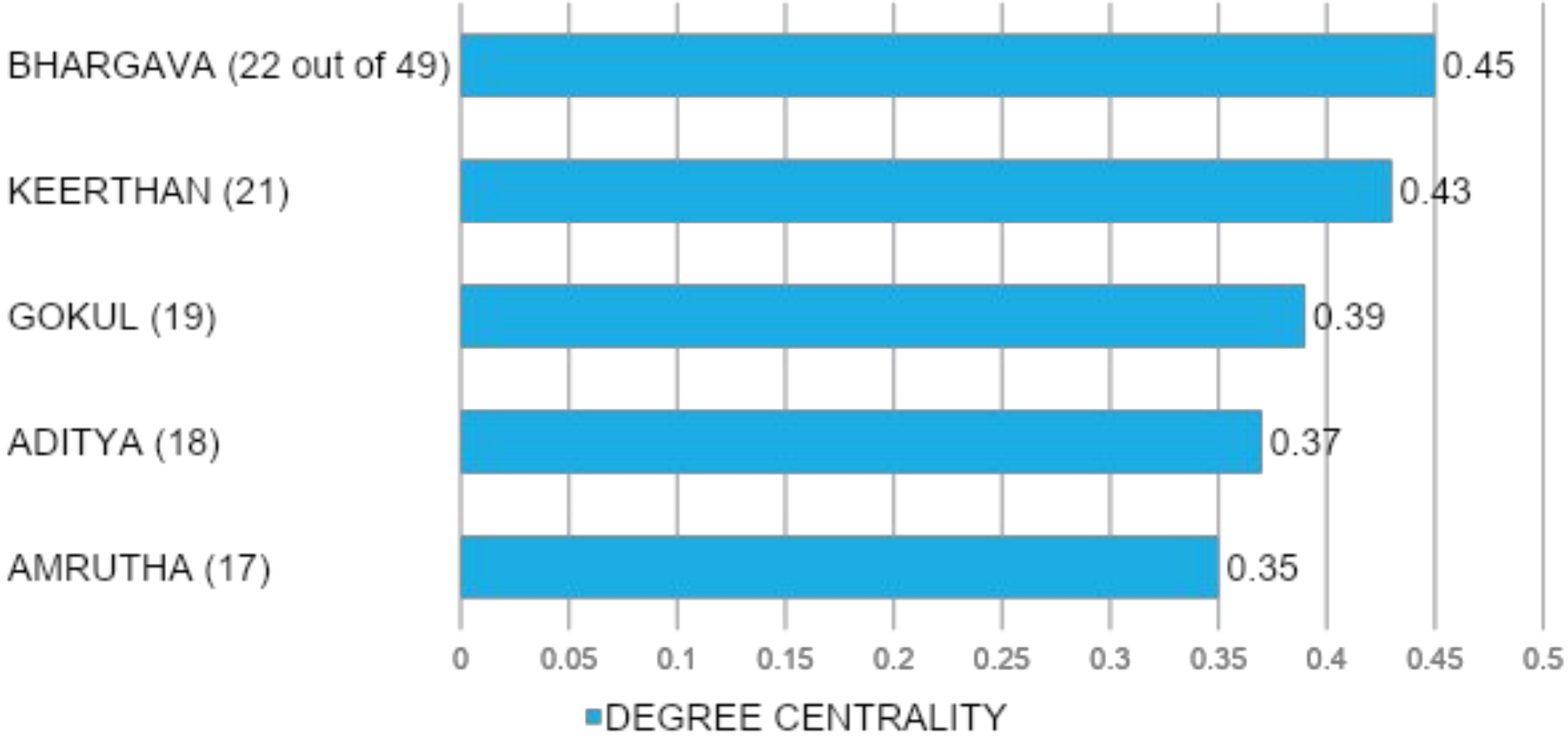


CENTRALITY MEASURES | INSTAGRAM

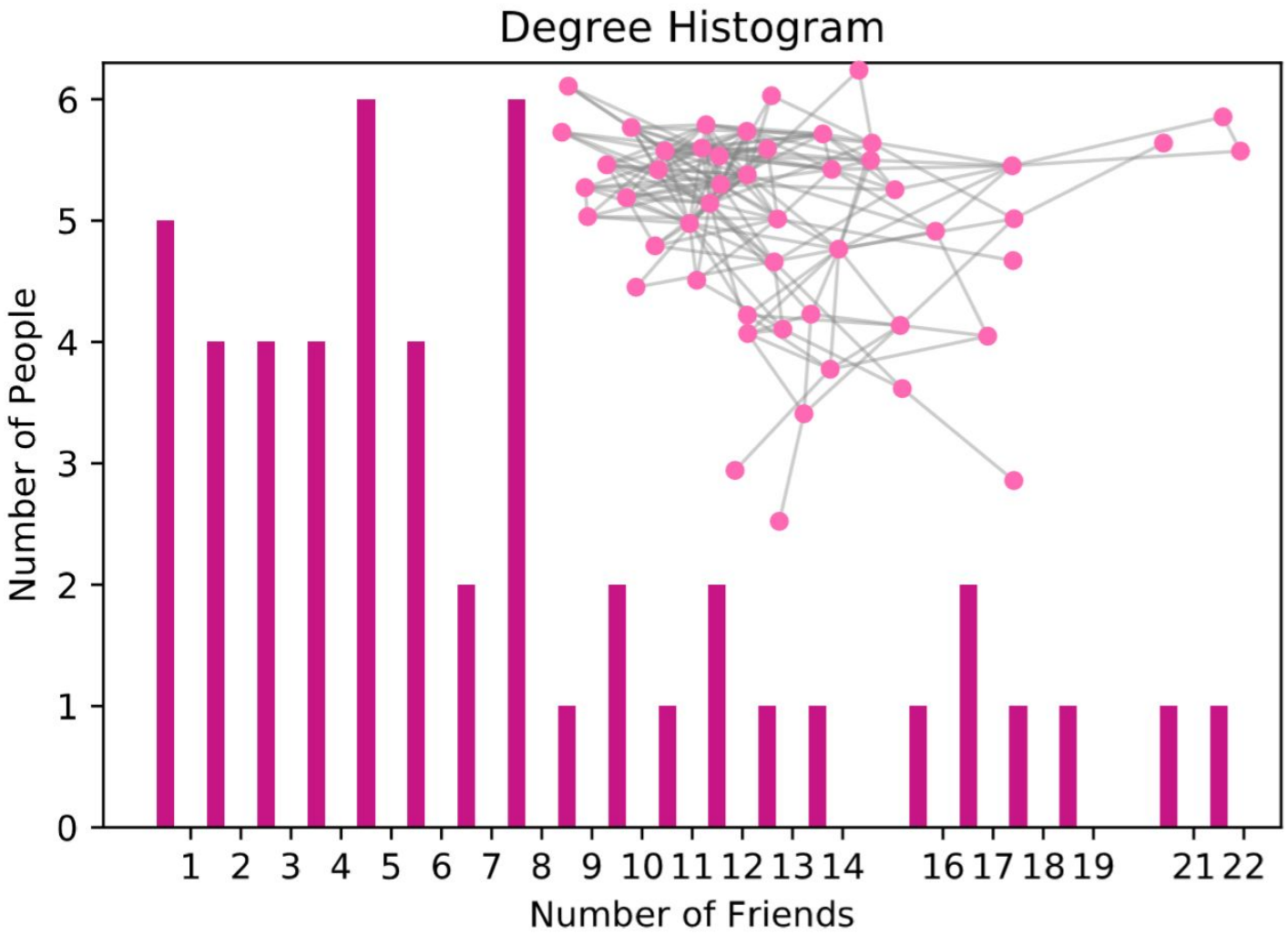
DEGREE CENTRALITY - INSTAGRAM



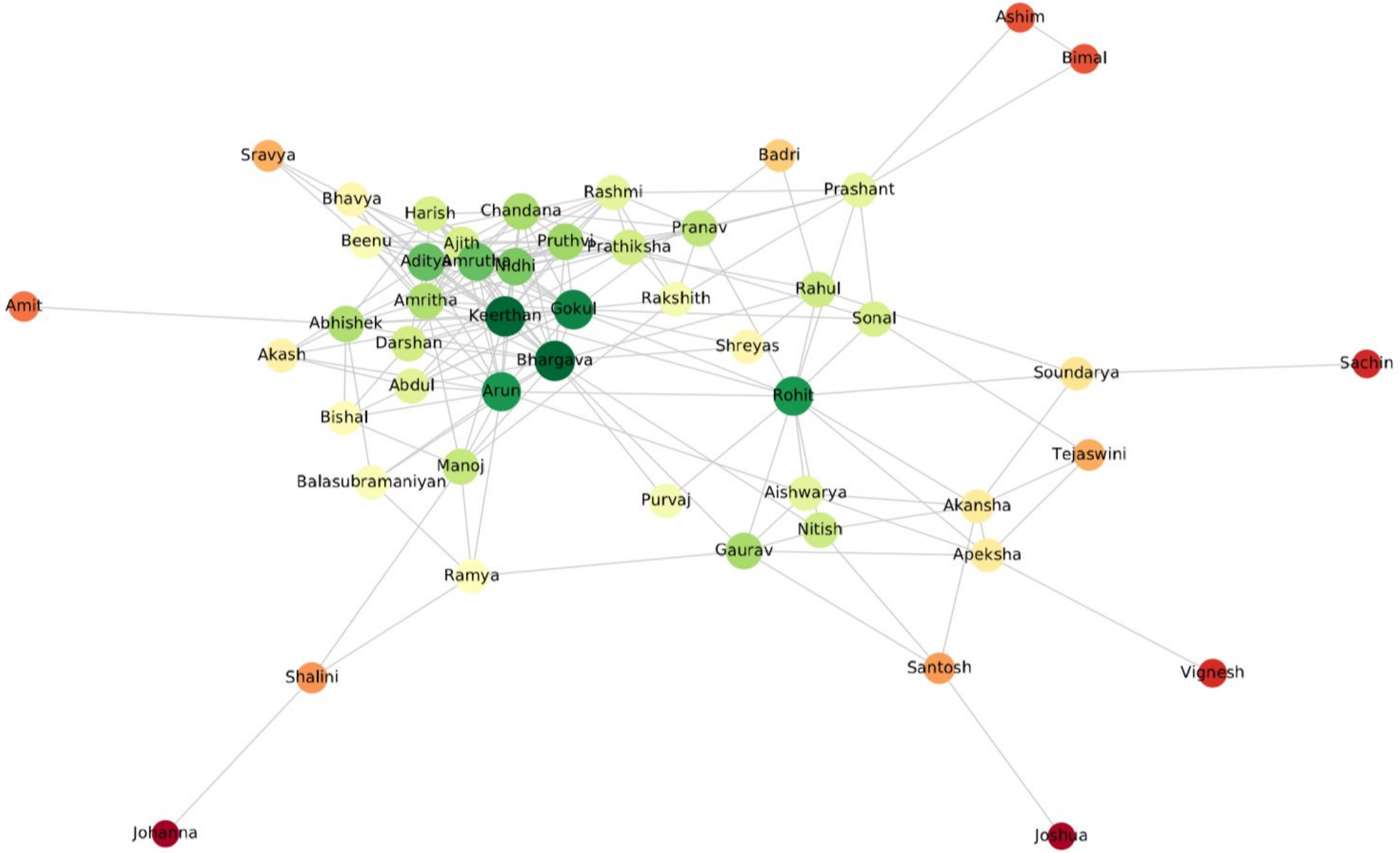
WHO HAS THE MOST NUMBER OF CONNECTIONS?



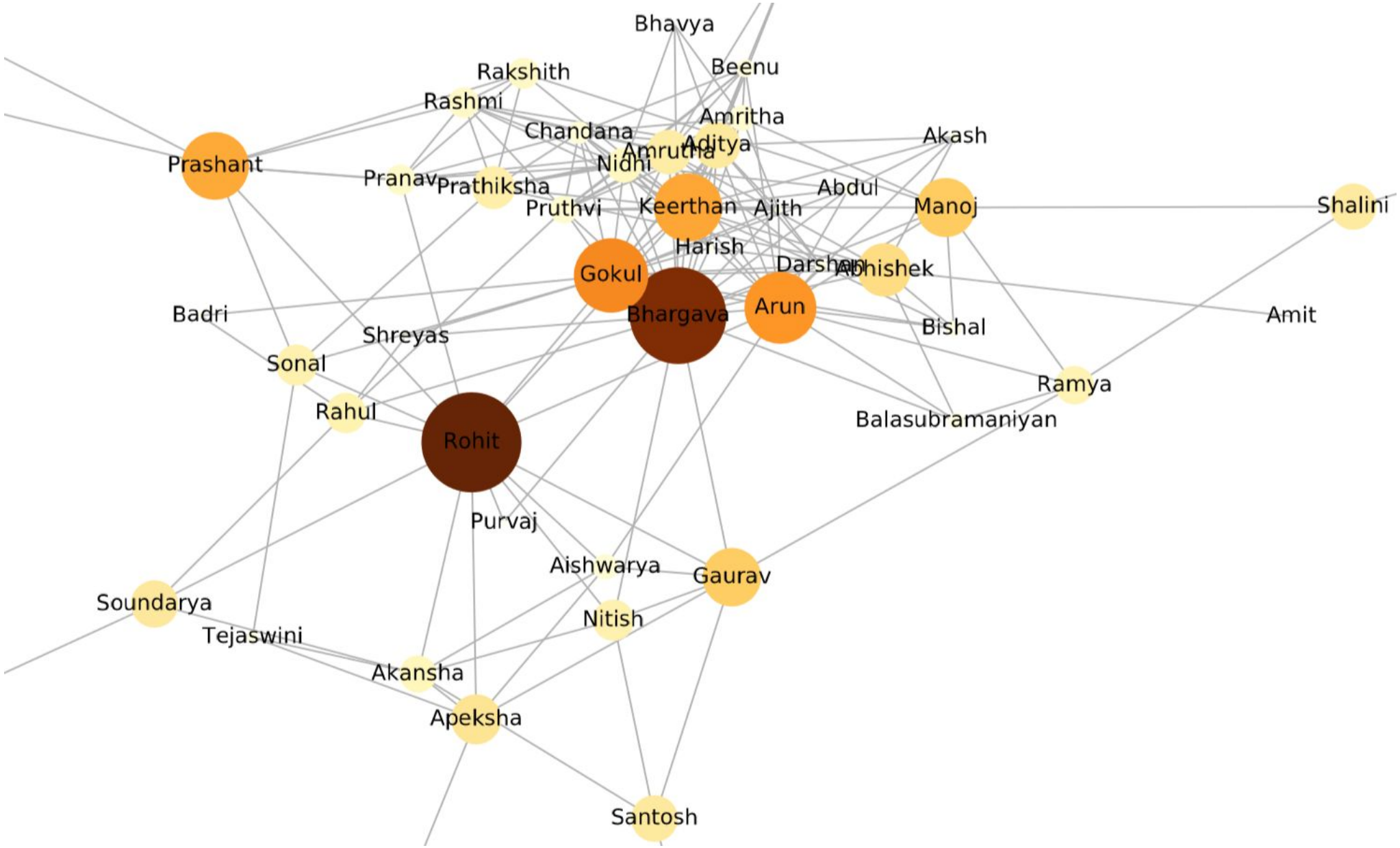
DEGREE DISTRIBUTION GRAPH - INSTAGRAM



CLOSENESS CENTRALITY - INSTAGRAM

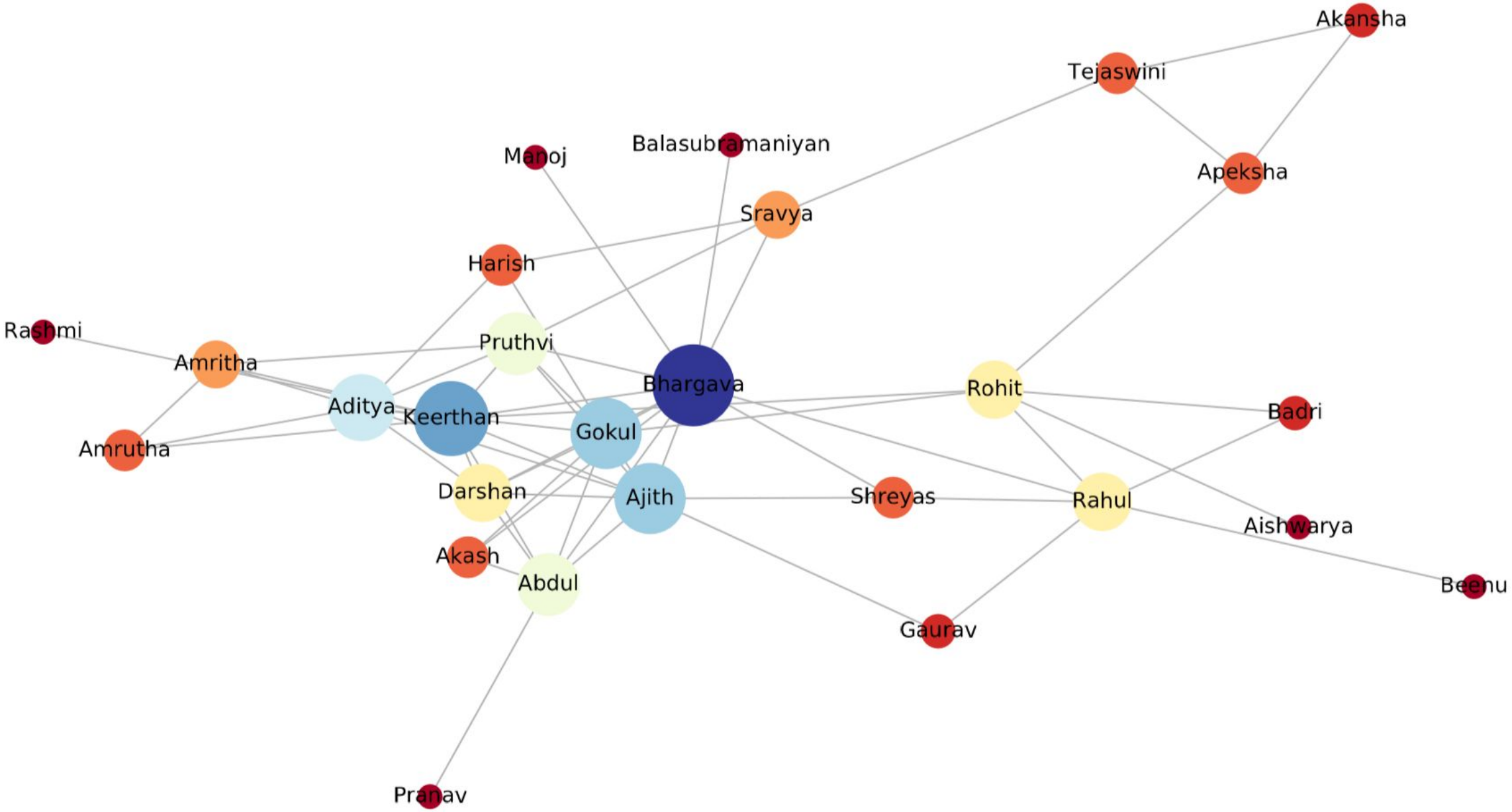


BETWEENNESS CENTRALITY

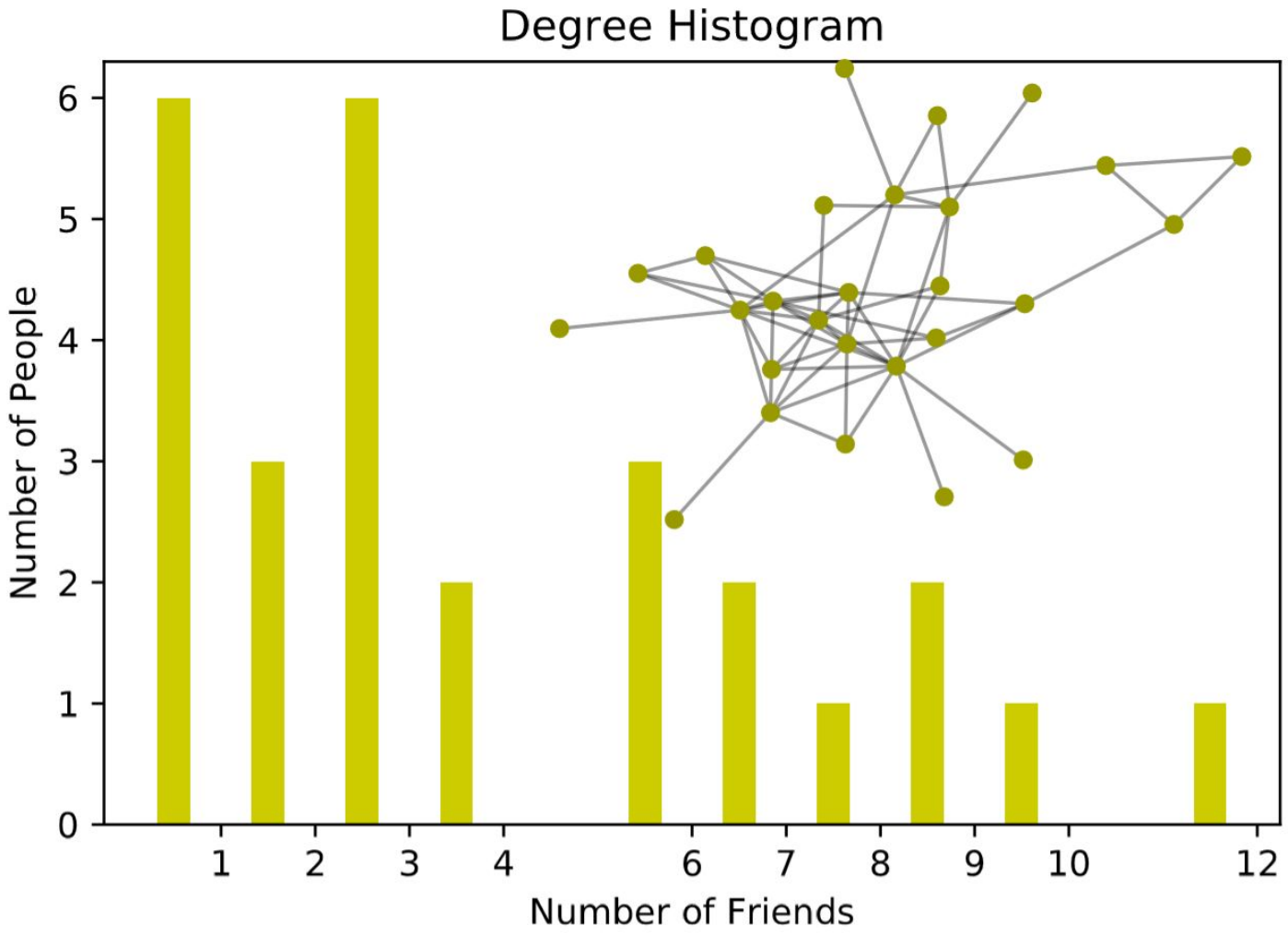


CENTRALITY MEASURES | SNAPCHAT

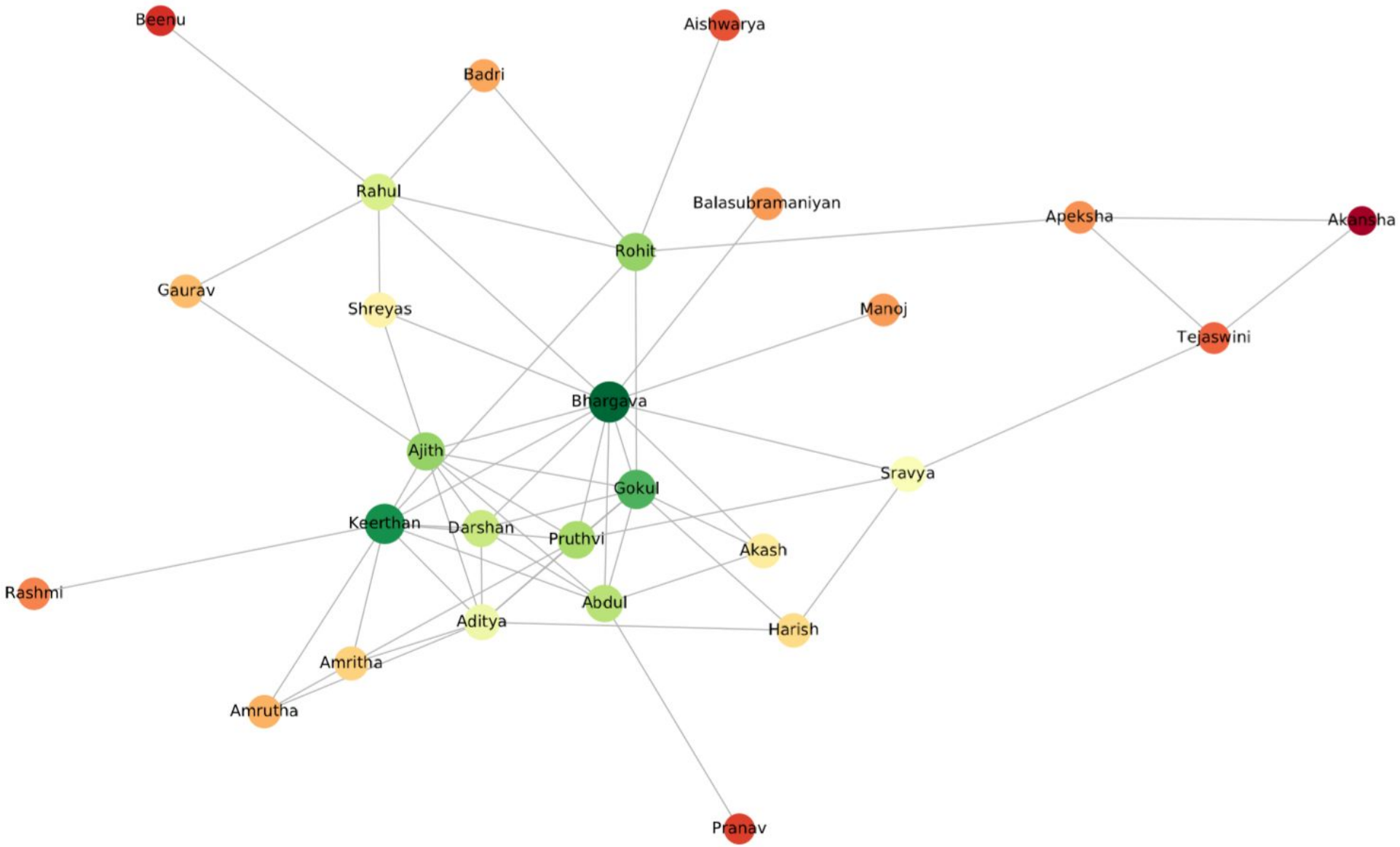
DEGREE CENTRALITY - SNAPCHAT



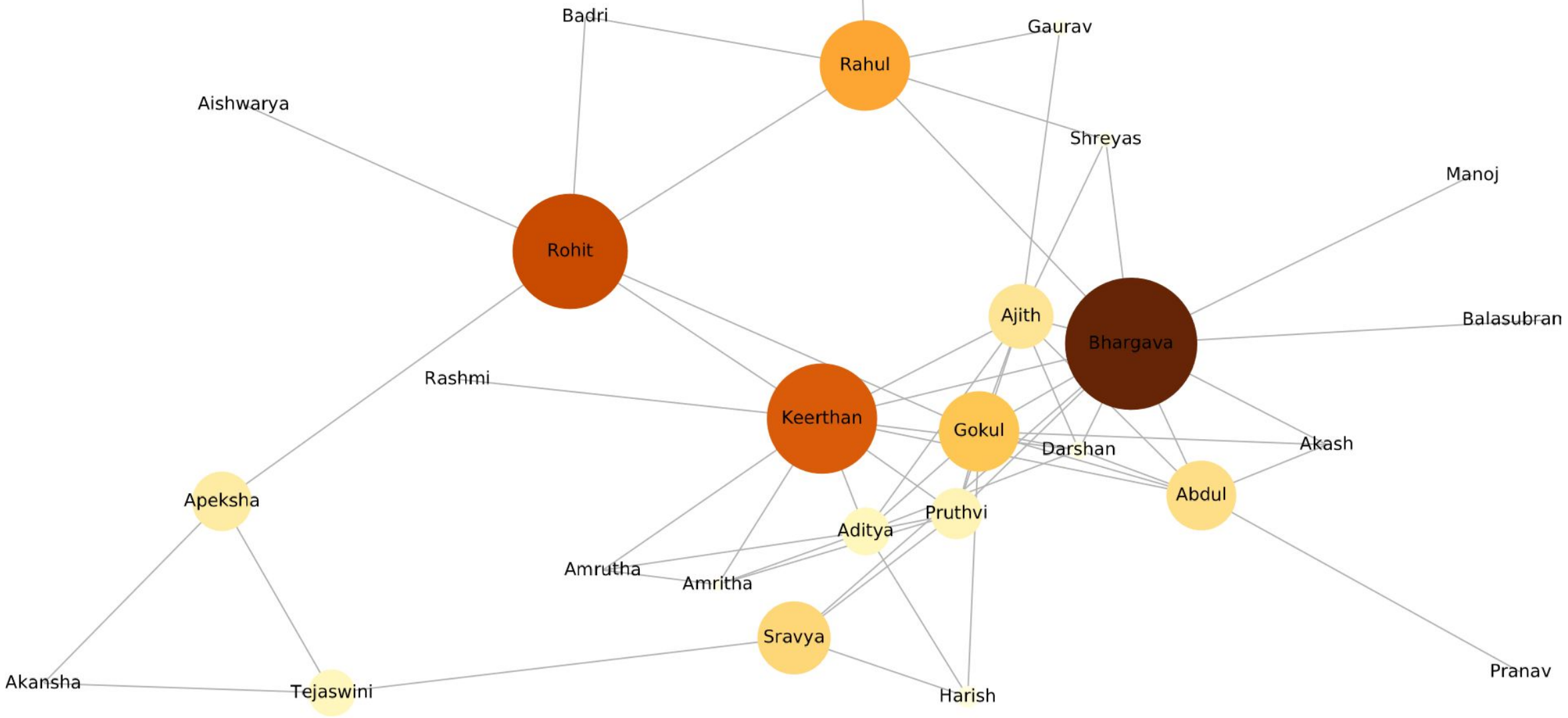
DEGREE DISTRIBUTION GRAPH - SNAPCHAT



CLOSENESS CENTRALITY - SNAPCHAT



BETWEENNESS CENTRALITY - SNAPCHAT



VARYING CENTRALITIES

DEGREE AND CLOSENESS CENTRALITY - WHATSAPP

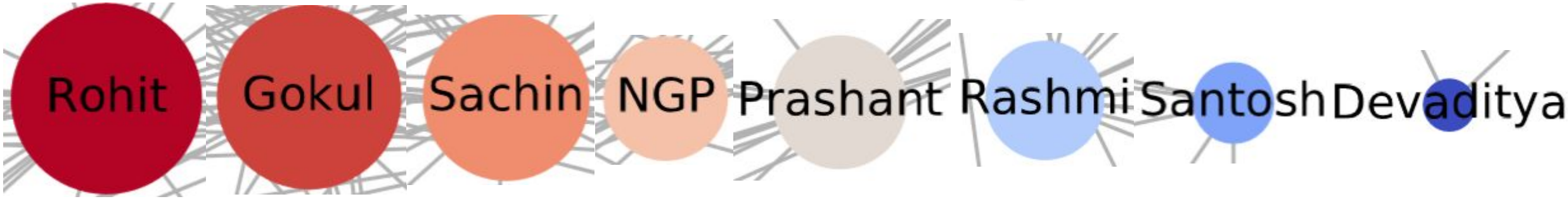
RED – HIGHER CLOSENESS CENTRALITY

BLUE – LOWER CLOSENESS CENTRALITY

BIGGER SIZE – HIGHER DEGREE

SMALLER SIZE – LOWER DEGREE

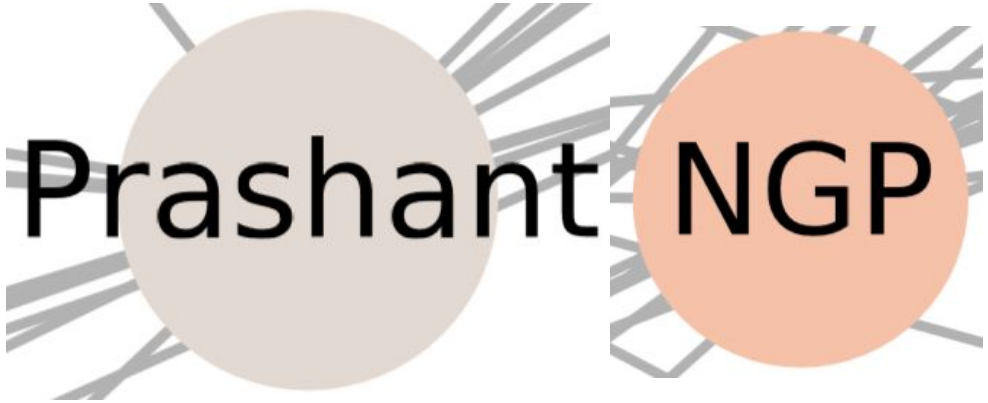
DO YOU NOTICE SOMETHING UNUSUAL?



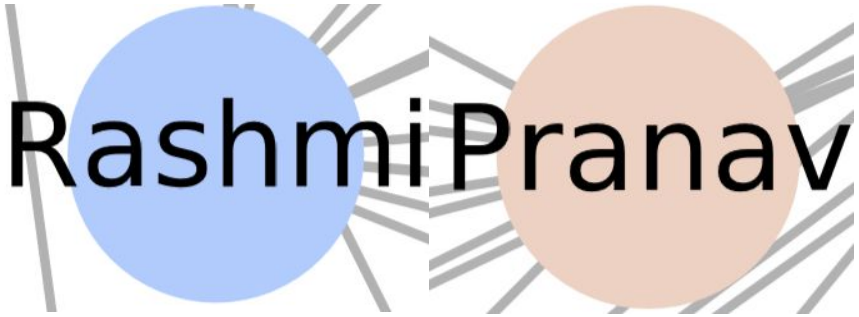
WHAT HAPPENS WHEN AN ACTOR HAS HIGH CLOSENESS AND LOW DEGREE CENTRALITY?

Prashant is connected to more people in the network, whereas Guruprasad sir is connected to key players in the network – such as Chandana, Rohit, Gokul & Sachin.

Through them, Guruprasad sir can cover the entire network faster than Prashant, even though Prashant has more number of connections.



CLUSTERING



- Rashmi and I have the same degree – 11.
- Rashmi – BLUE NODE, Me – RED NODE
- Rashmi has a lower closeness centrality than me but we both have the same degree centrality. This means that she is a part of a cluster. In this case, she is connected to only A and B section students.

HIGH BETWEENNESS CENTRALITY

PERSON	BETWEENNESS CENTRALITY	DEGREE
PRASHANT	0.067	14
BHARGAVA	0.069	25

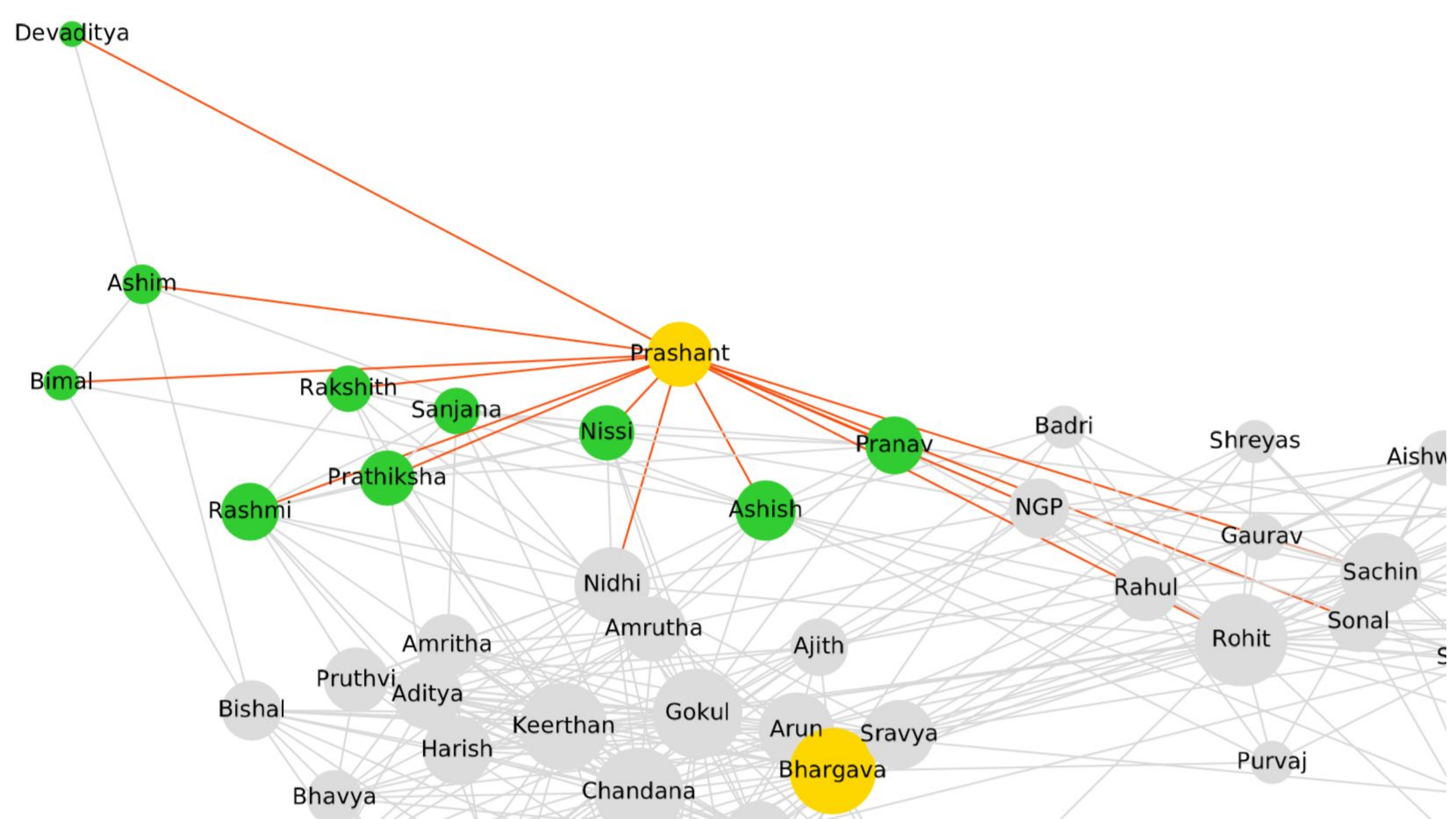
Bhargava has almost double the connections Prashant has. However, Prashant and Bhargava have similar Betweenness Centrality.

What makes Prashant have a betweenness centrality as good as Bhargava's?

HIGH BETWEENNESS CENTRALITY

It turns out that Prashant has the highest degree in B section and this helps him act as the shortest path between some B section students to C section students.

This also may be because he is the CR.


Devaditya
Ashim
Prashant
Bimal
Rakshith
Sanjana
Nissi
Pranav
Badri
Shreyas
Prathiksha
Rashmi
Ashish
NGP
Gaurav
Sachin
Nidhi
Rahul
Sonal
Amrutha
Rohit
Amritha
Ajith
Pruthvi
Aditya
Bishal
Gokul
Keerthan
Arun
Sravya
Harish
Bhargava
Purvaj
Bhavya
Chandana

FRIENDSHIPS BASED ON GENDER

MALE-FEMALE FRIENDSHIPS

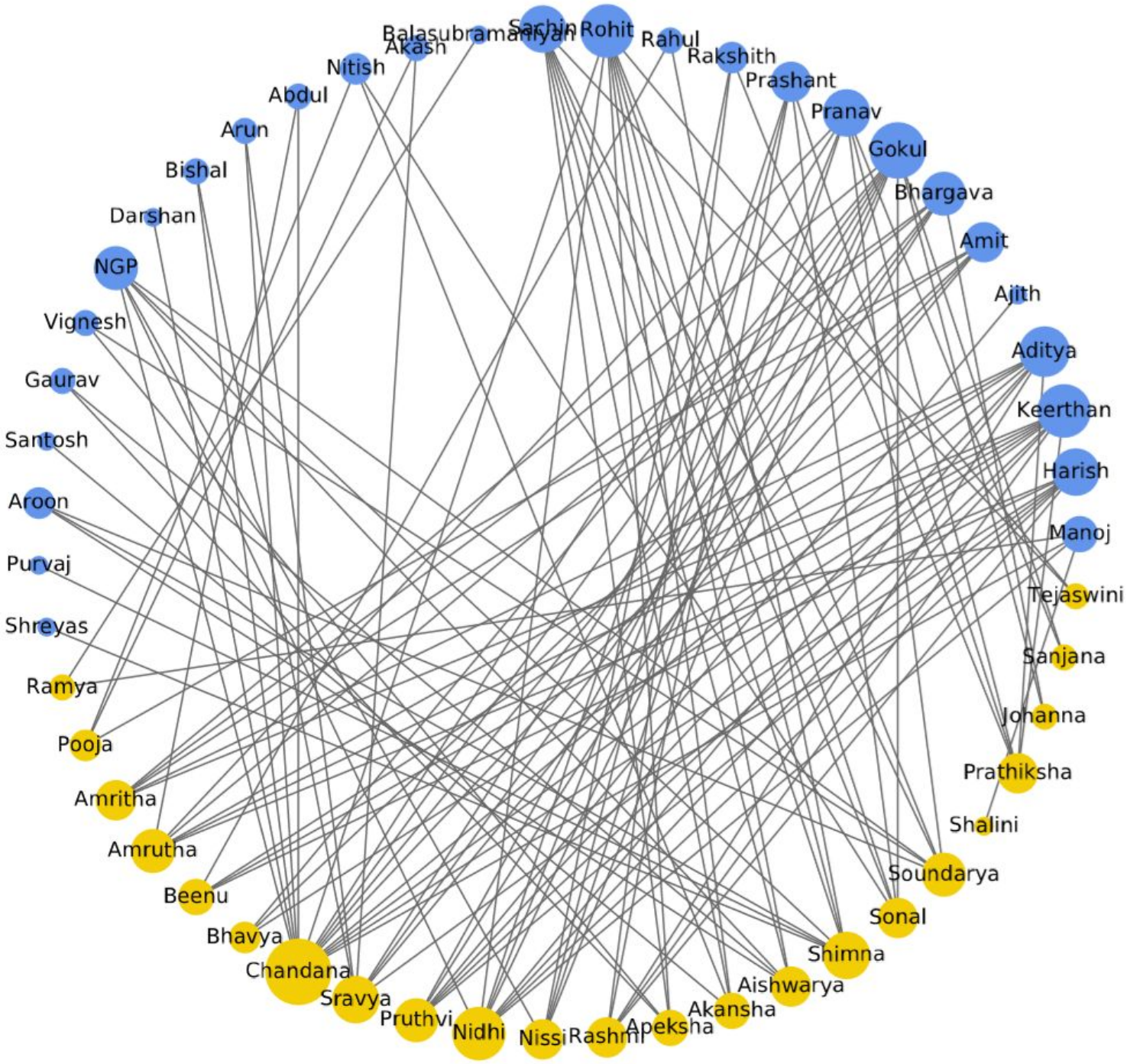
The next set of networks depict male-female friendships in our network.

There exists an edge between two actors- male and female, if they are connected.

There does not exist an edge between two males or two females.

Let us look at what we can analyse from this data…

MALE-FEMALE FRIENDSHIPS | WHATSAPP



Out of 340 edges in the WhatsApp Network, only **112 edges** constitute the male-female friendship network.

Out of 59 nodes, **51 nodes** constitute the male-female friendship network.

This means that only **33%** of friendships are male-female.

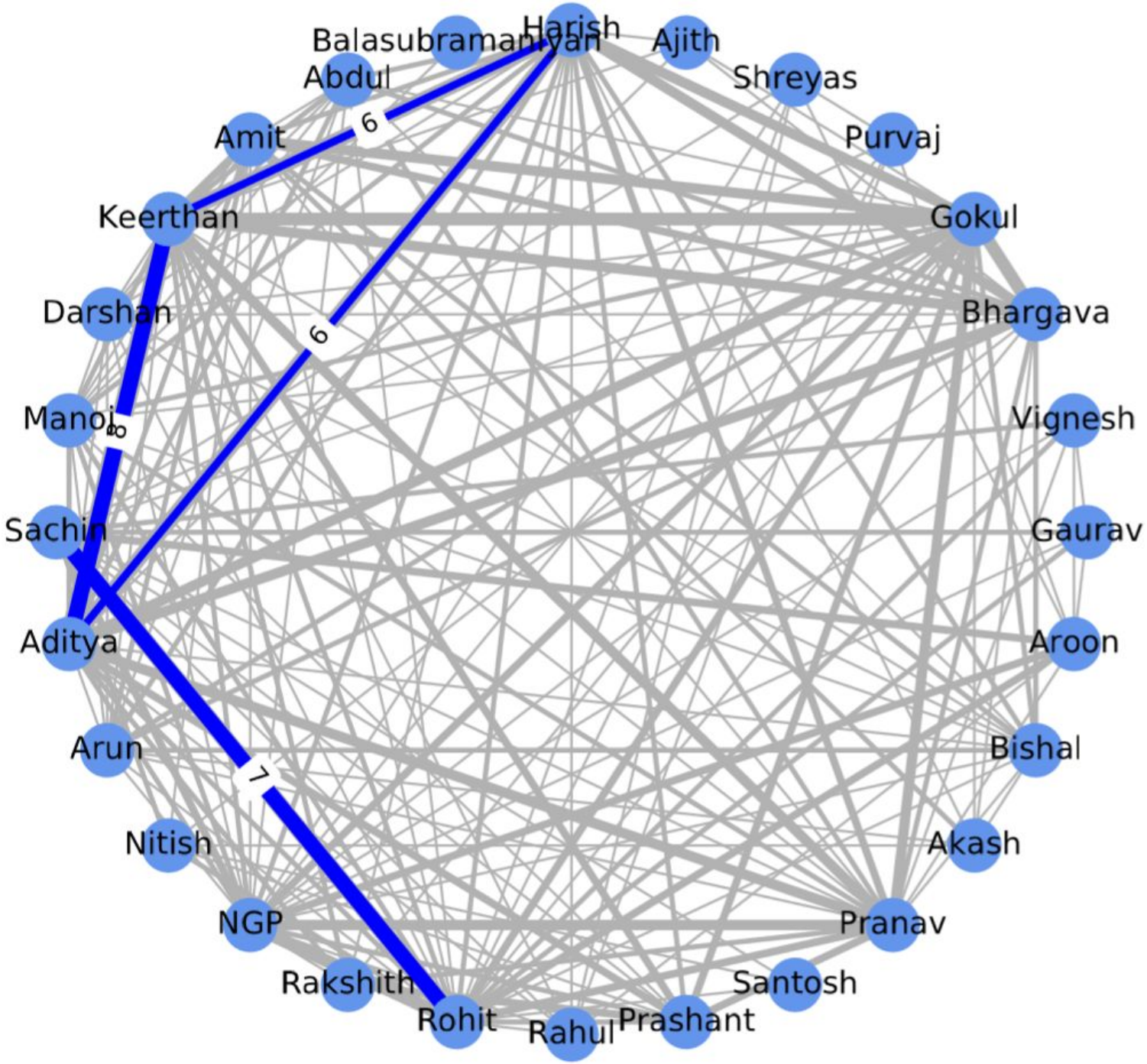
The rest, **67%** of friendships are either male-male or female-female.

Gokul, Keerthan, Rohit among those with highest no. of female friends.

Chandana, Nidhi, Sravya among those with highest no. of male friends.

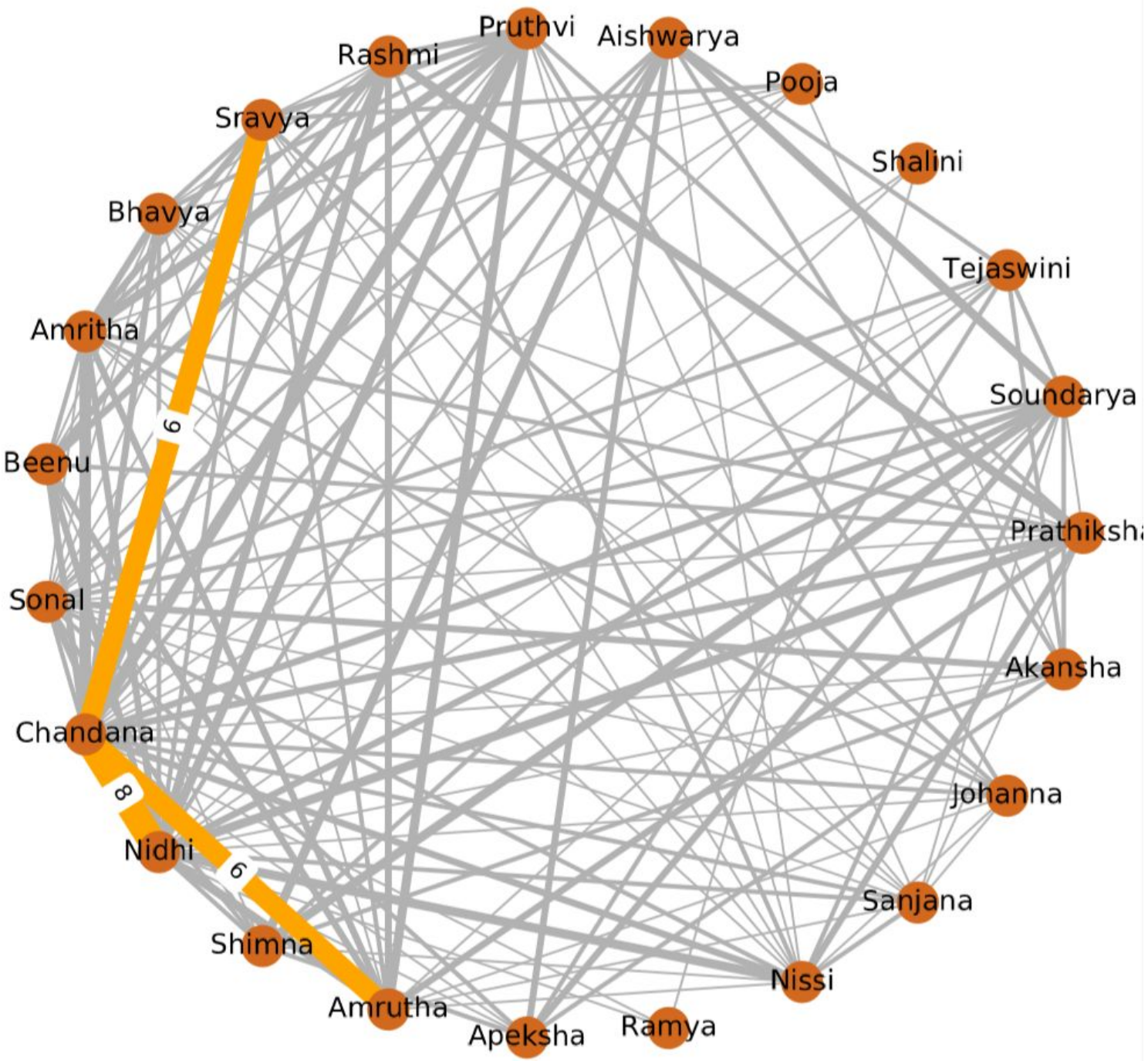
COMMON FEMALE FRIENDS

An edge between two boys denotes that they have one or more female friends in common.

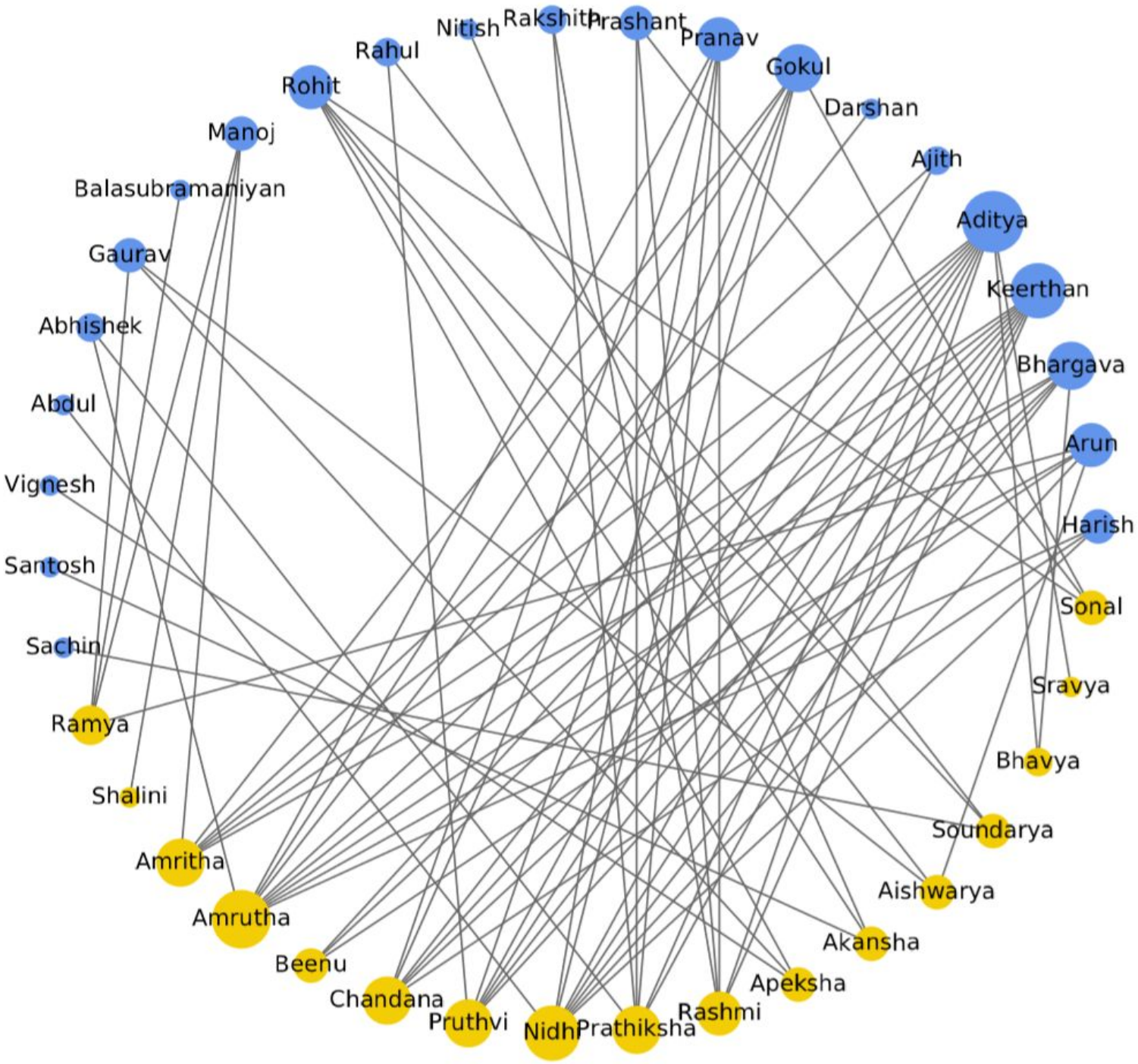


COMMON MALE FRIENDS

An edge between two girls denotes that they have one or more male friends in common.



MALE-FEMALE FRIENDSHIPS | INSTAGRAM



Out of 189 edges in the Instagram Network, only **72 edges** constitute the male-female friendship network.

Out of 50 nodes, **39 nodes** constitute the male-female friendship network.

38% of friendships are male-female.

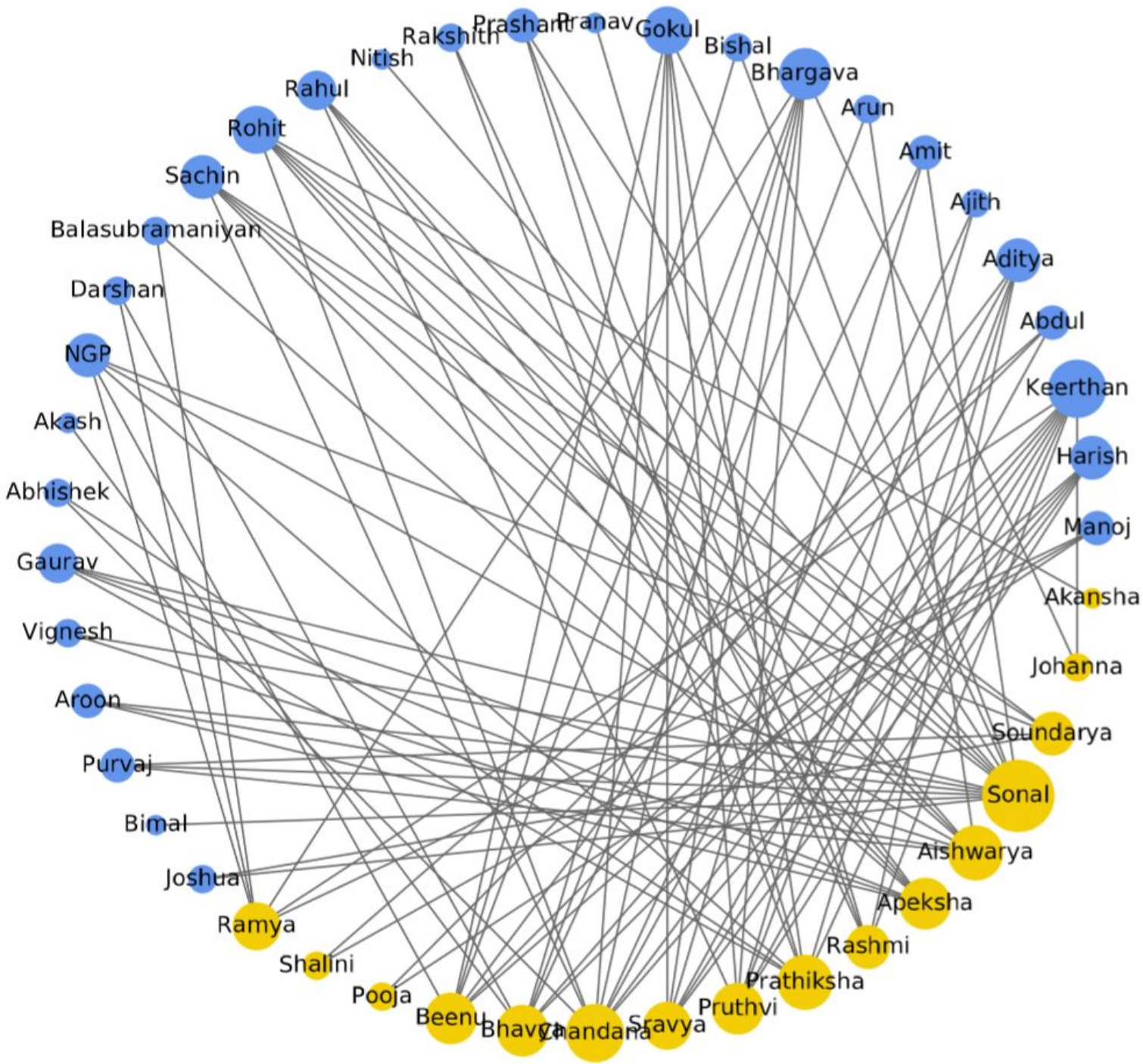
62% of friendships are either male-male or female-female.

22% of the people are not connected to the opposite gender.

Aditya – highest no. of female friends. (10)

Amrutha – highest no. of male friends. (9)

MALE-FEMALE FRIENDSHIPS | FACEBOOK



Out of 284 edges in the Facebook Network, only **96 edges** constitute the male-female friendship network.

Out of 50 nodes, **45 nodes** constitute the male-female friendship network.

34% of friendships are male-female.

66% of friendships are either male-male or female-female.

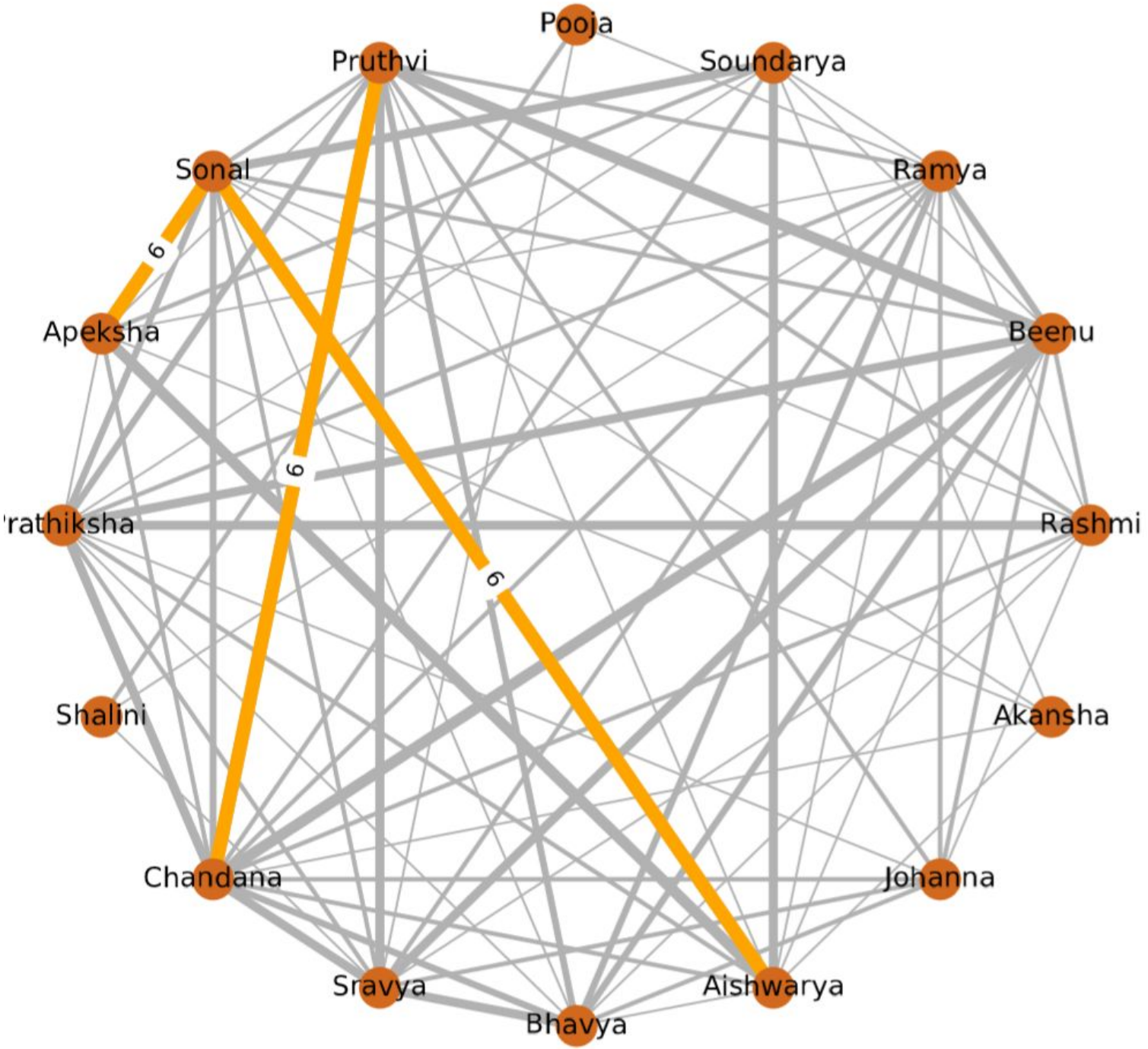
10% of the people are not connected to the opposite gender.

Keerthan – highest no. of female friends. (10)

Sonal – highest no. of male friends. (9)

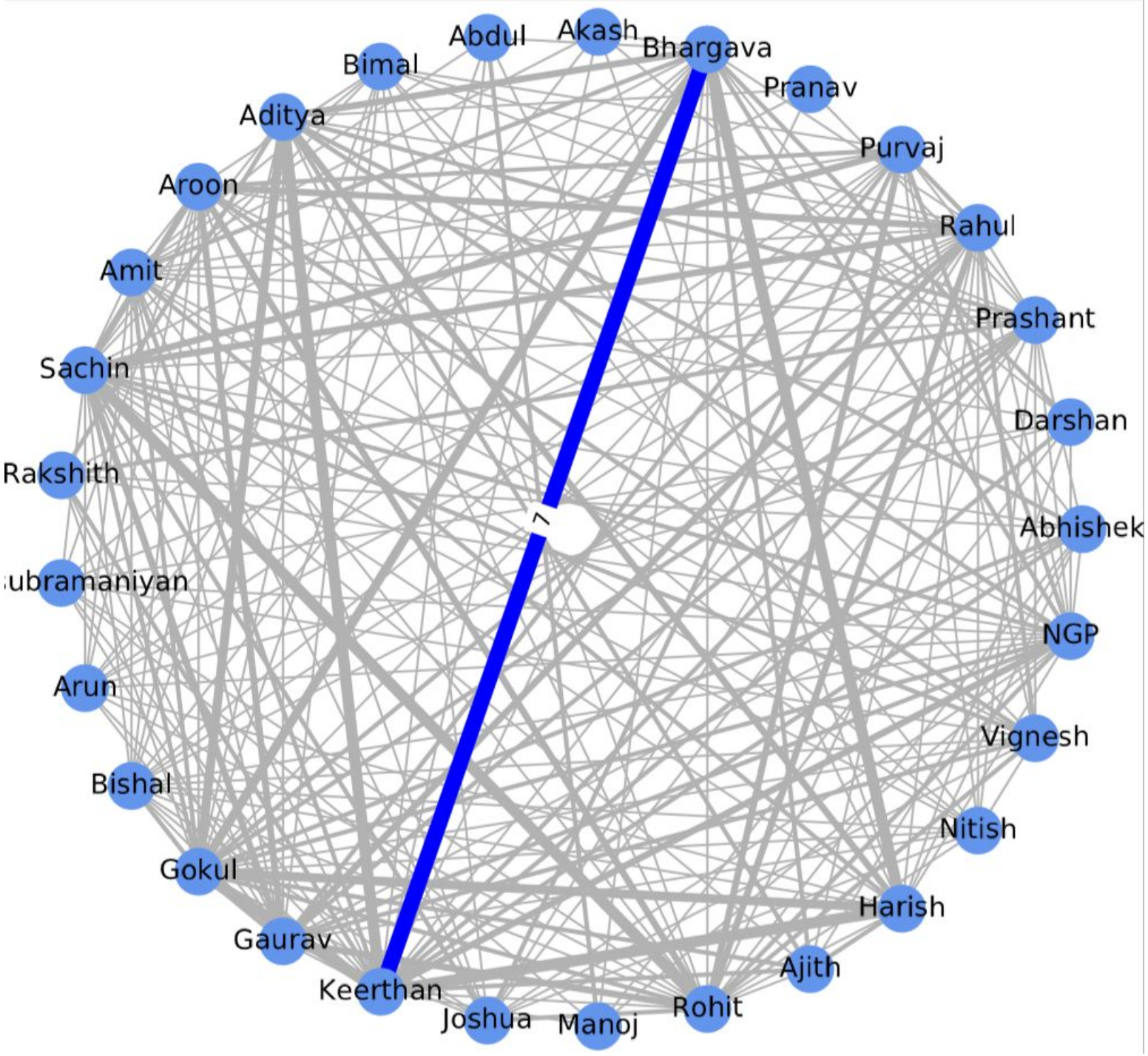
COMMON MALE FRIENDS

Apeksha and Sonal, Chandana and Pruthvi, Sonal and Aishwarya have 6 male friends in common.

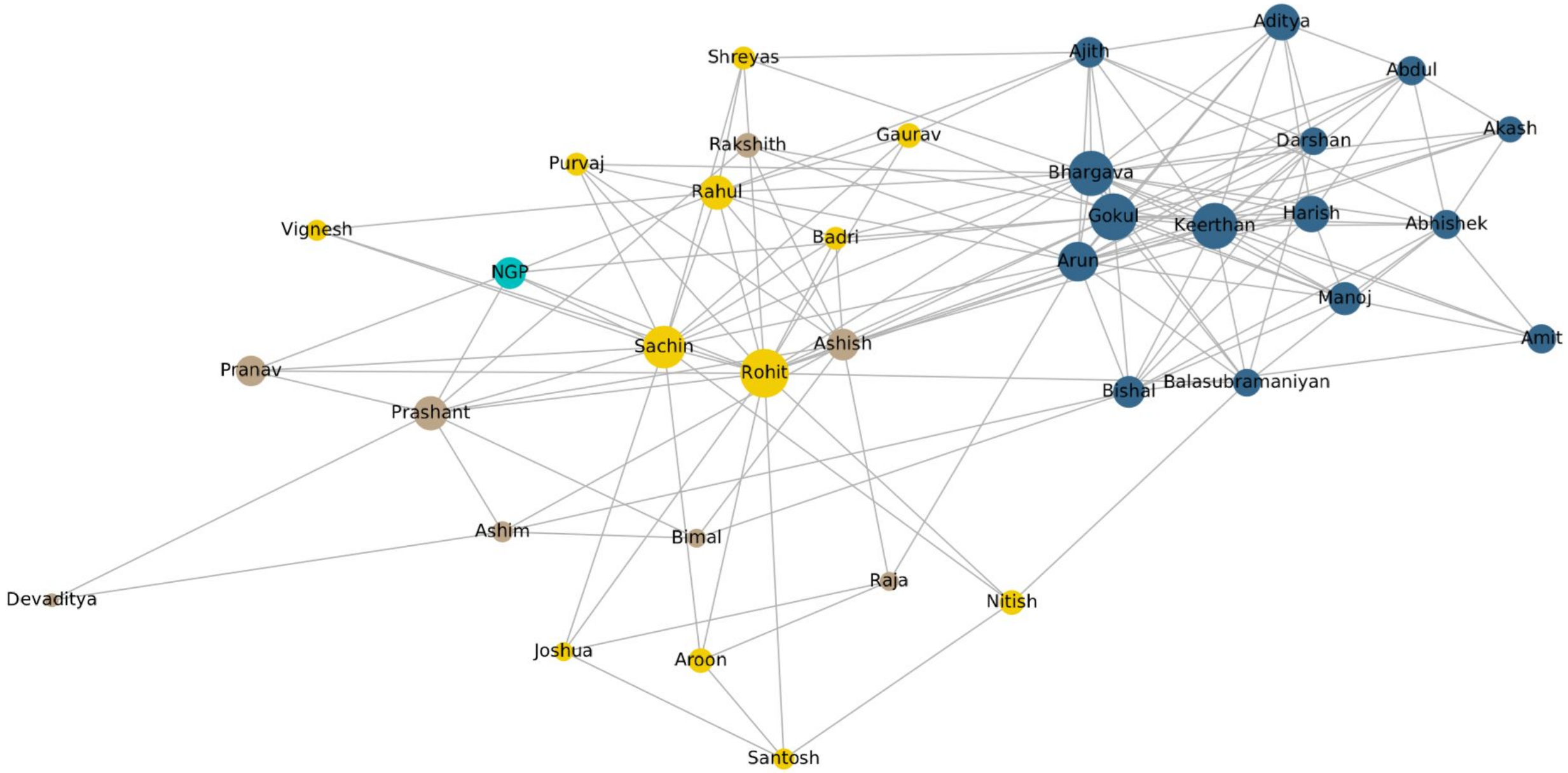


COMMON FEMALE FRIENDS

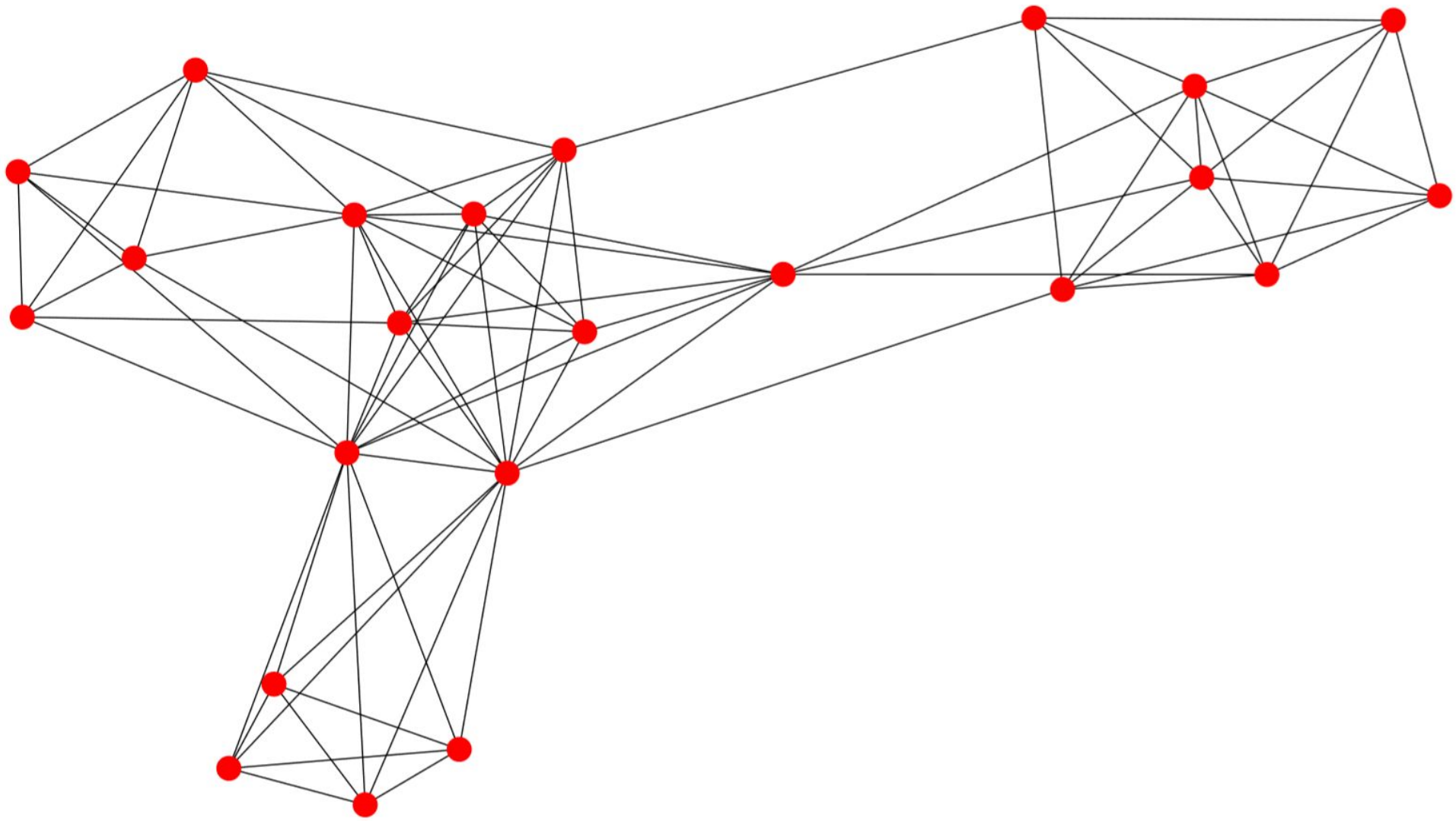
Keerthan and Bhargava have 7 common female friends.

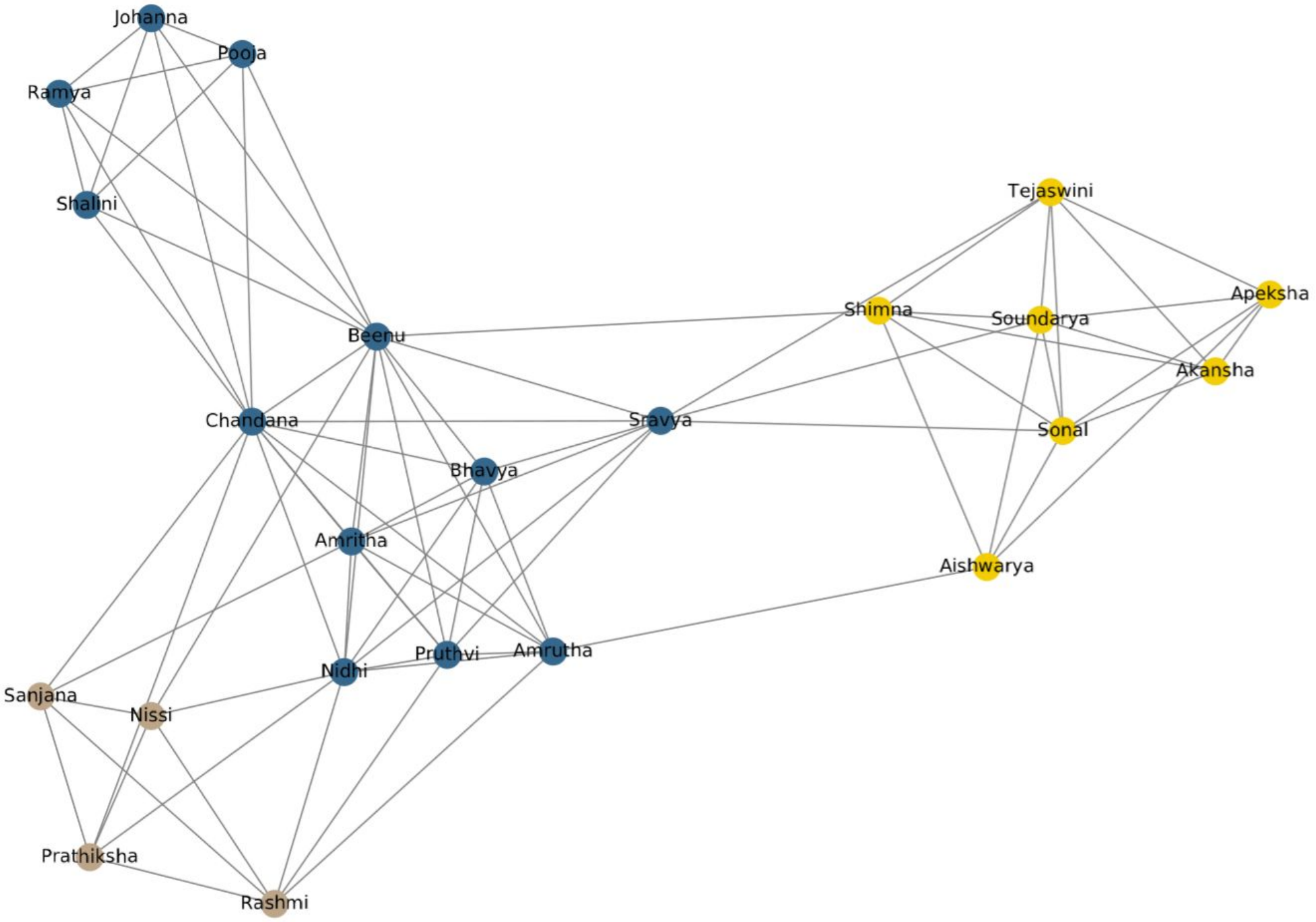


MALE FRIENDSHIPS - WHATSAPP

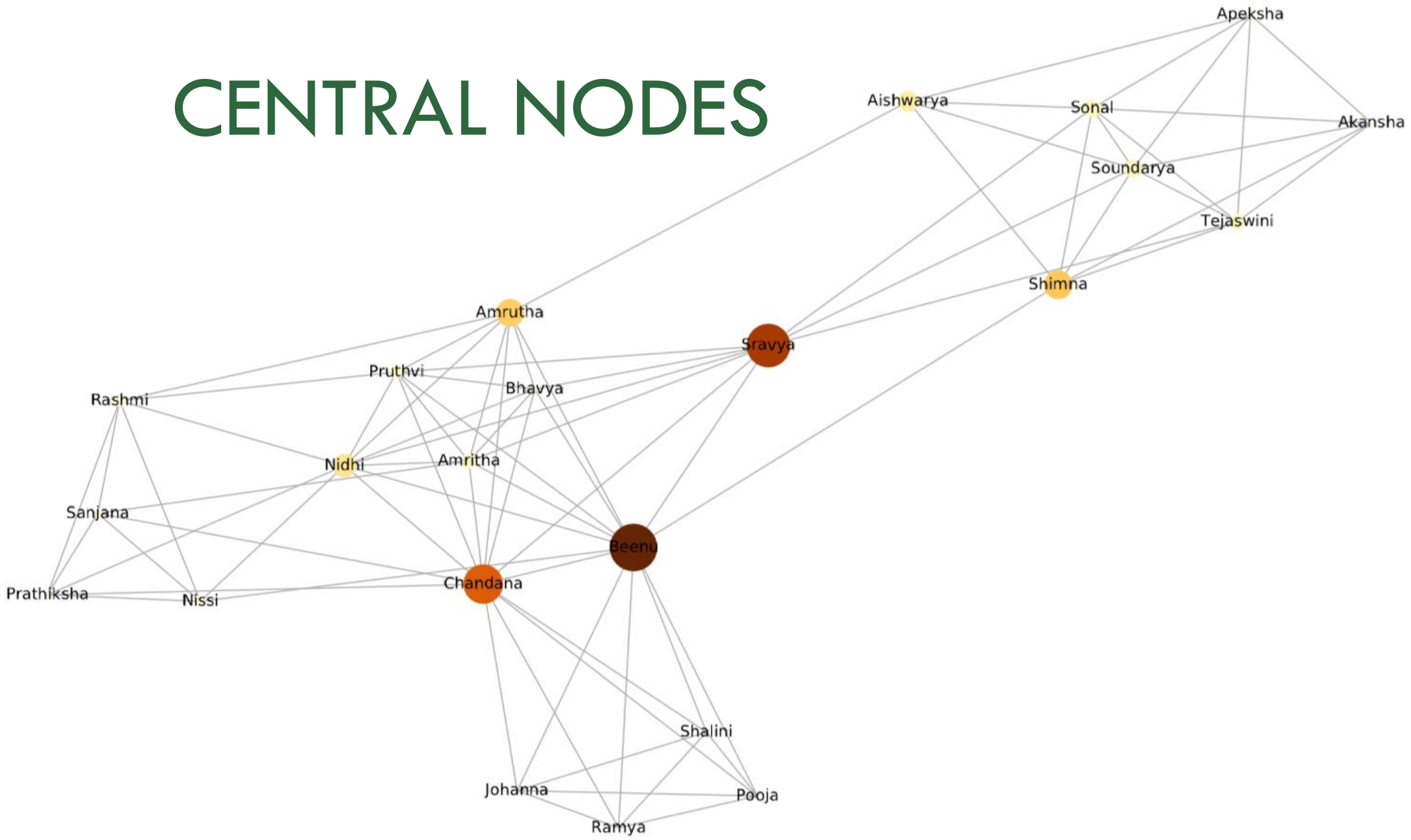


FEMALE FRIENDSHIPS - WHATSAPP

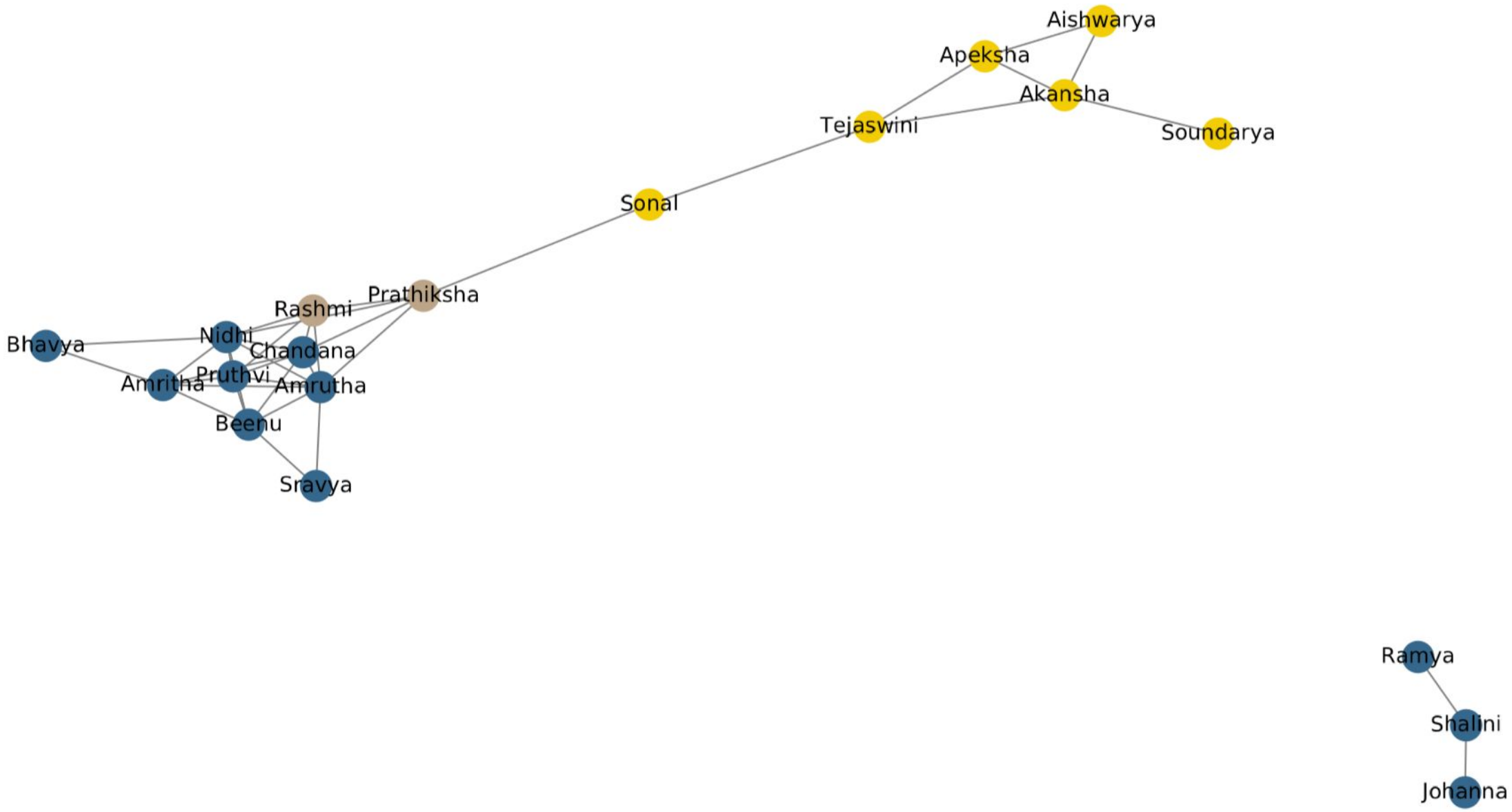



Johanna
Pooja
Ramya
Shalini
Tejaswini
Apeksha
Shimna
Soundarya
Beenu
Akansha
Chandana
Sravya
Sonal
Bhavya
Amritha
Aishwarya
Pruthvi
Amrutha
Nidhi
Sanjana
Nissi
Prathiksha
Rashmi

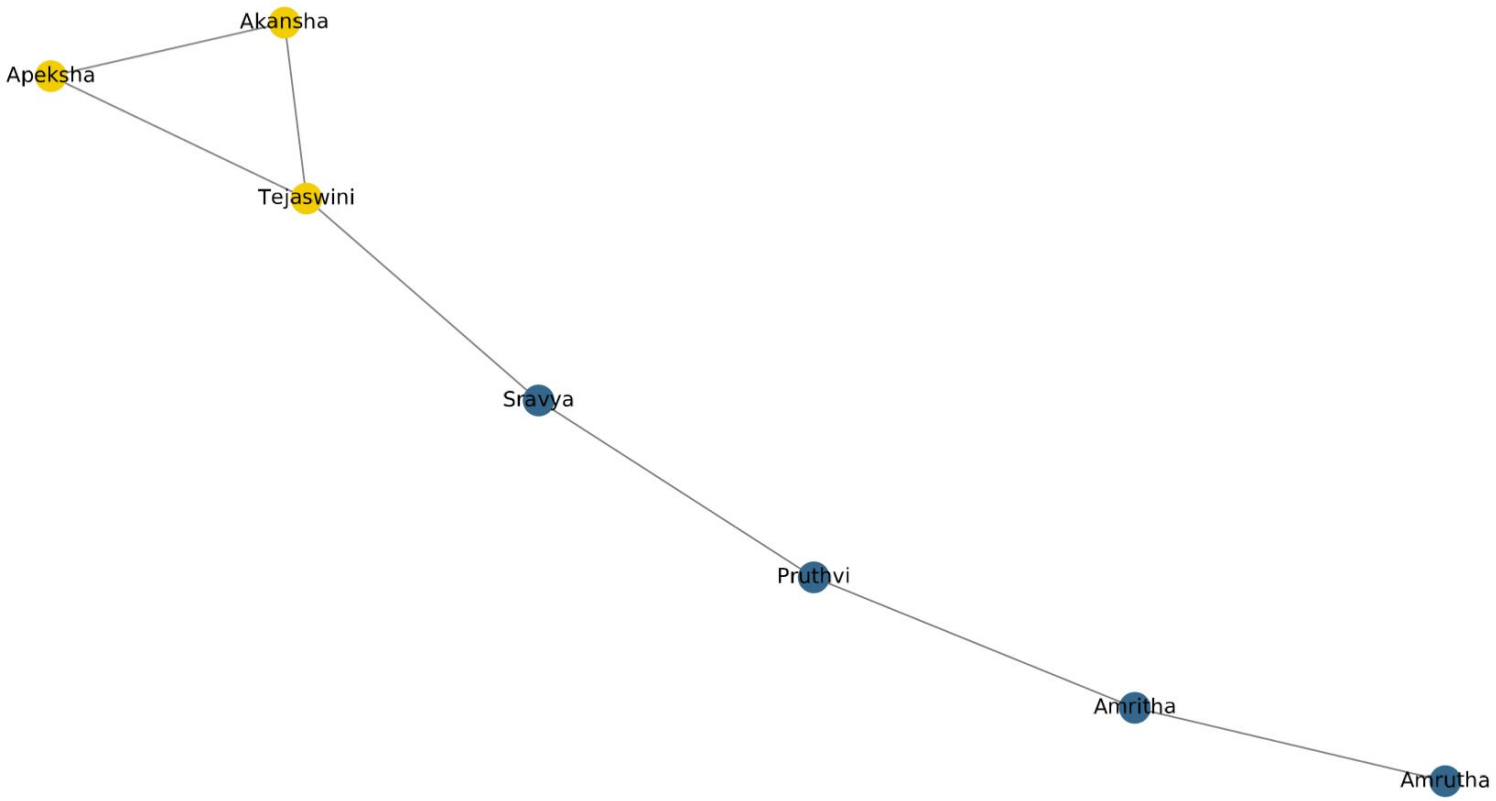
CENTRAL NODES



FEMALE FRIENDSHIPS - INSTAGRAM



FEMALE FRIENDSHIPS - SNAPCHAT



SHORTEST PATHS

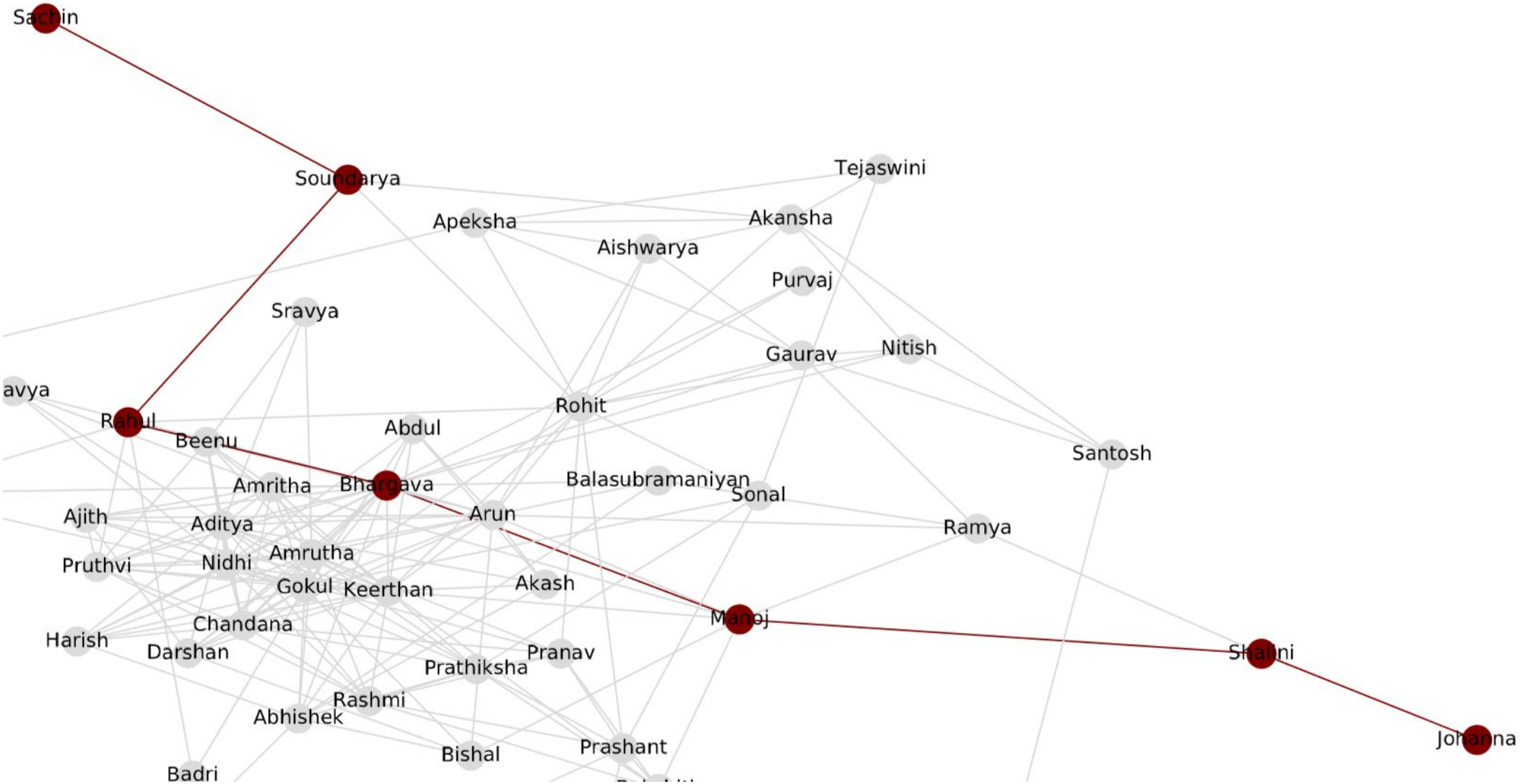
SHORTEST PATHS

- The shortest path between two nodes is the minimum number of hops required to go from the source node to the destination node.
- The biggest shortest path in the entire network is known as the diameter of the network. This tells us which two nodes are the farthest in the network.

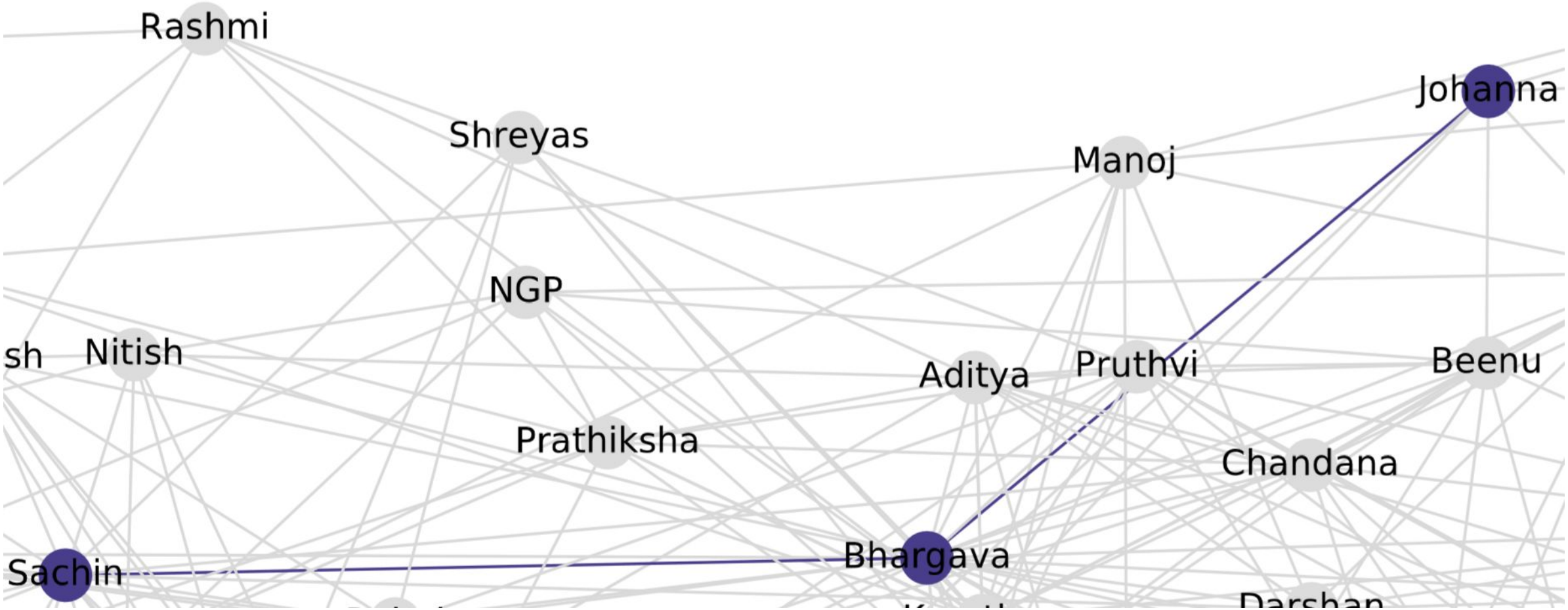
SHORTEST PATHS

- Taking the Instagram network as an example, we'll see that the diameter of the network is **6**.
- We'll also see the central and peripheral nodes in the WhatsApp network.
- Central nodes are the ones with minimum eccentricity, while peripheral nodes are the ones with maximum eccentricity.

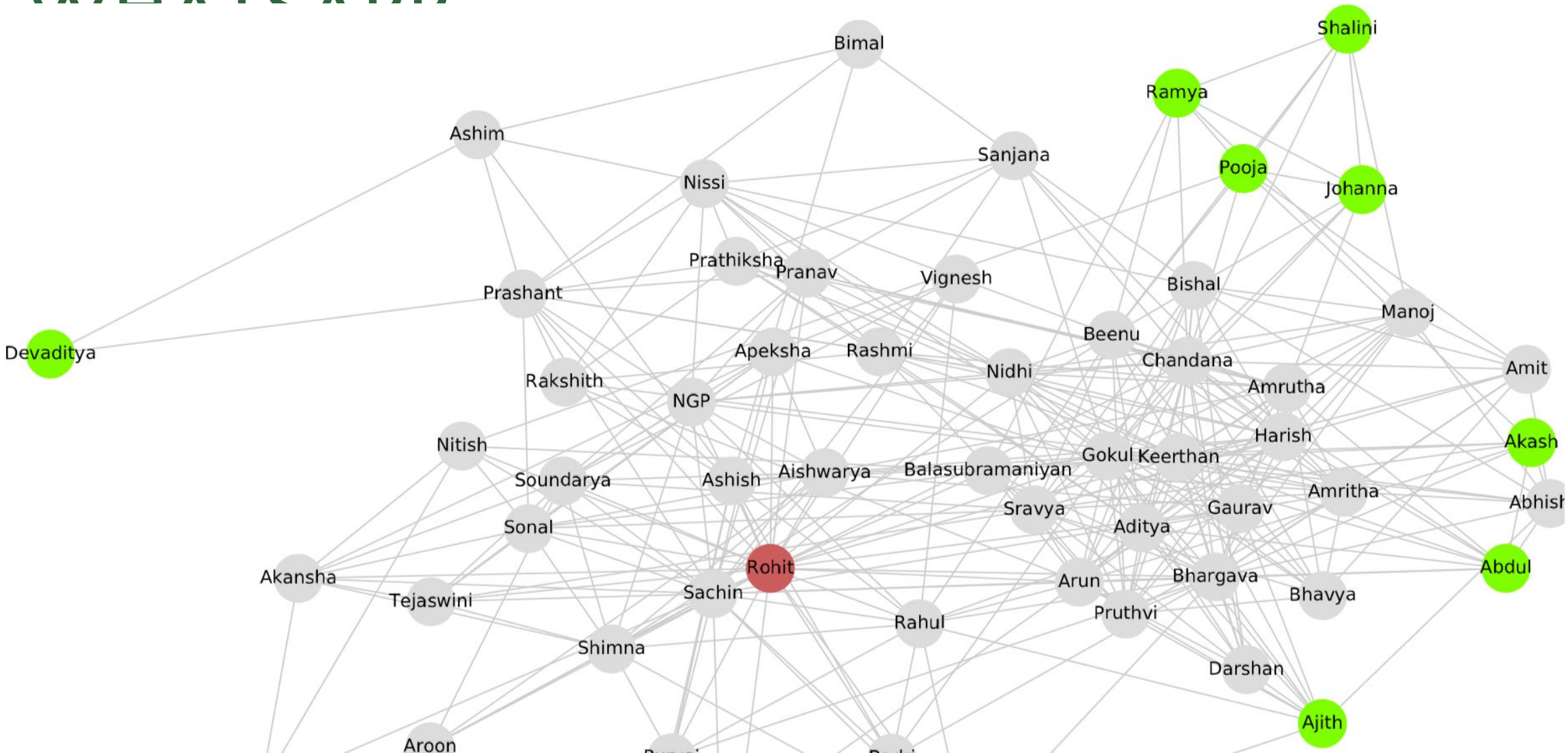
DIAMETER OF INSTAGRAM NETWORK



SHORTEST PATH IN FACEBOOK NETWORK



PERIPHERAL AND CENTRAL NODES - WHATSAPP



SHORTEST DISTANCE TREE FOR ME ON WHATSAPP

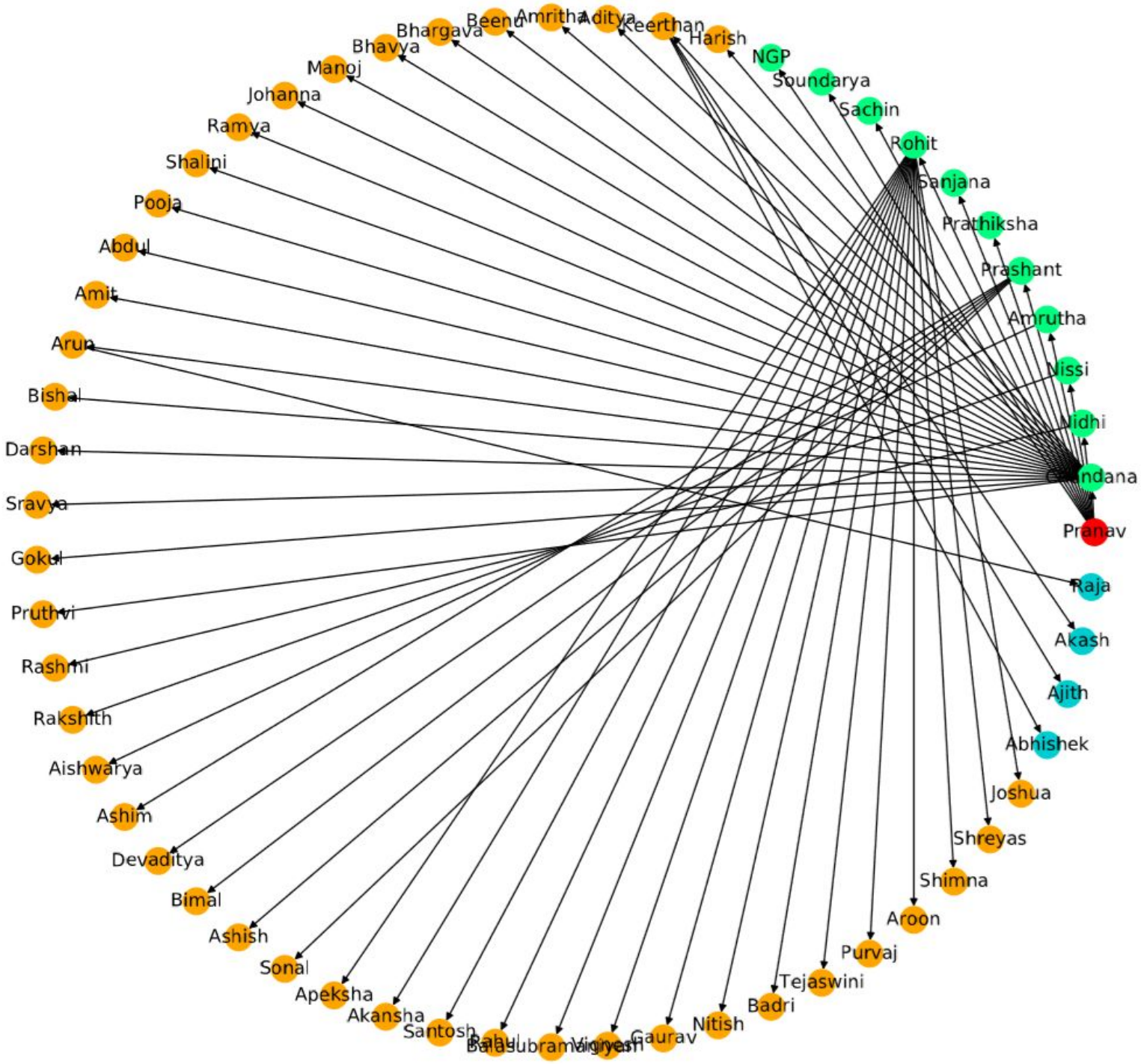
I am directly connected to 11 people.

A few people are 1 hop away.

Most of the class is 2 hops away.

Very few are 3 hops away.

Maximum number of hops to cover the entire network - **3**

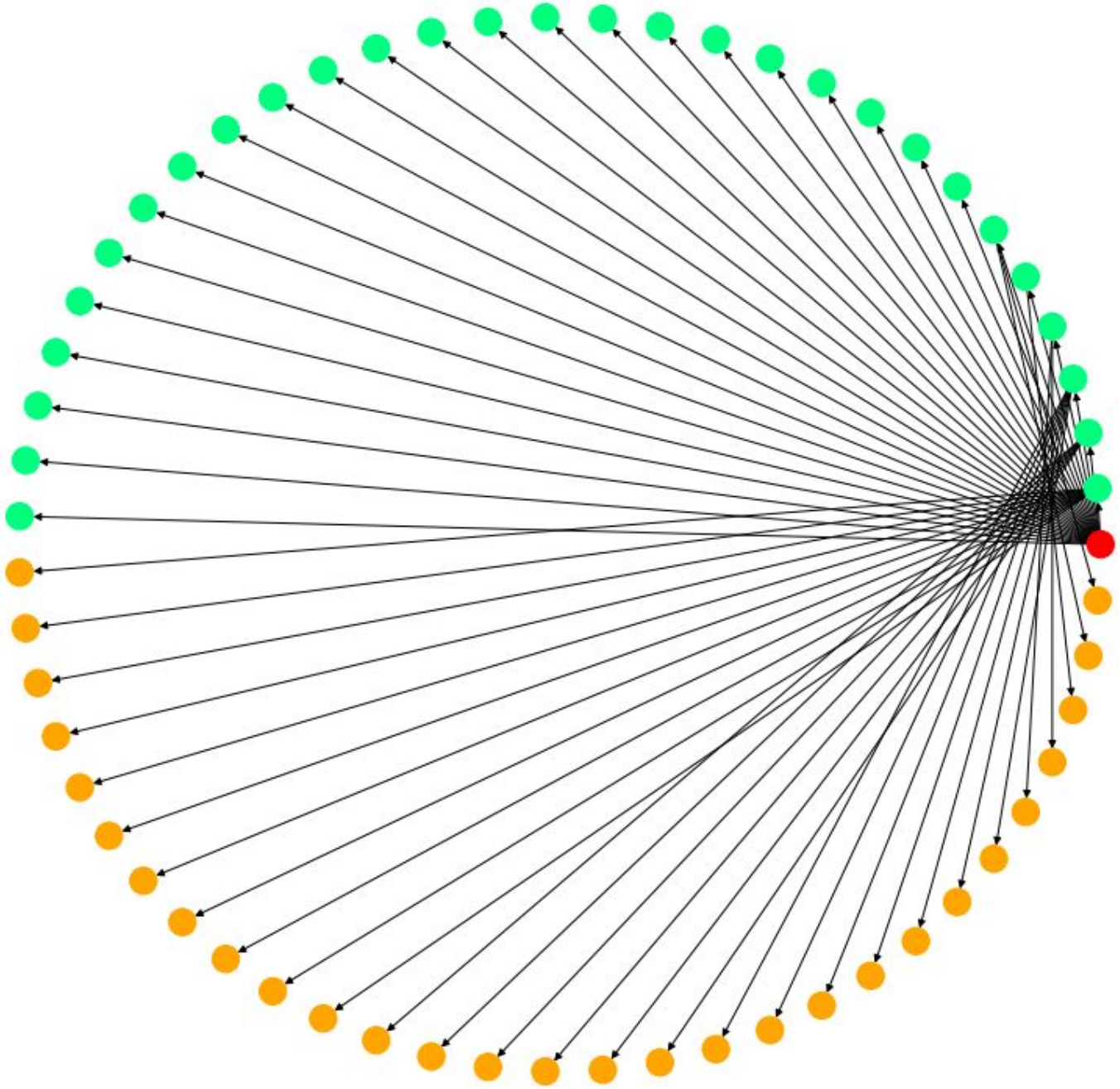


SHORTEST PATHS FOR A CENTRAL ACTOR - WHATSAPP

Half of the class is 1 hop away.

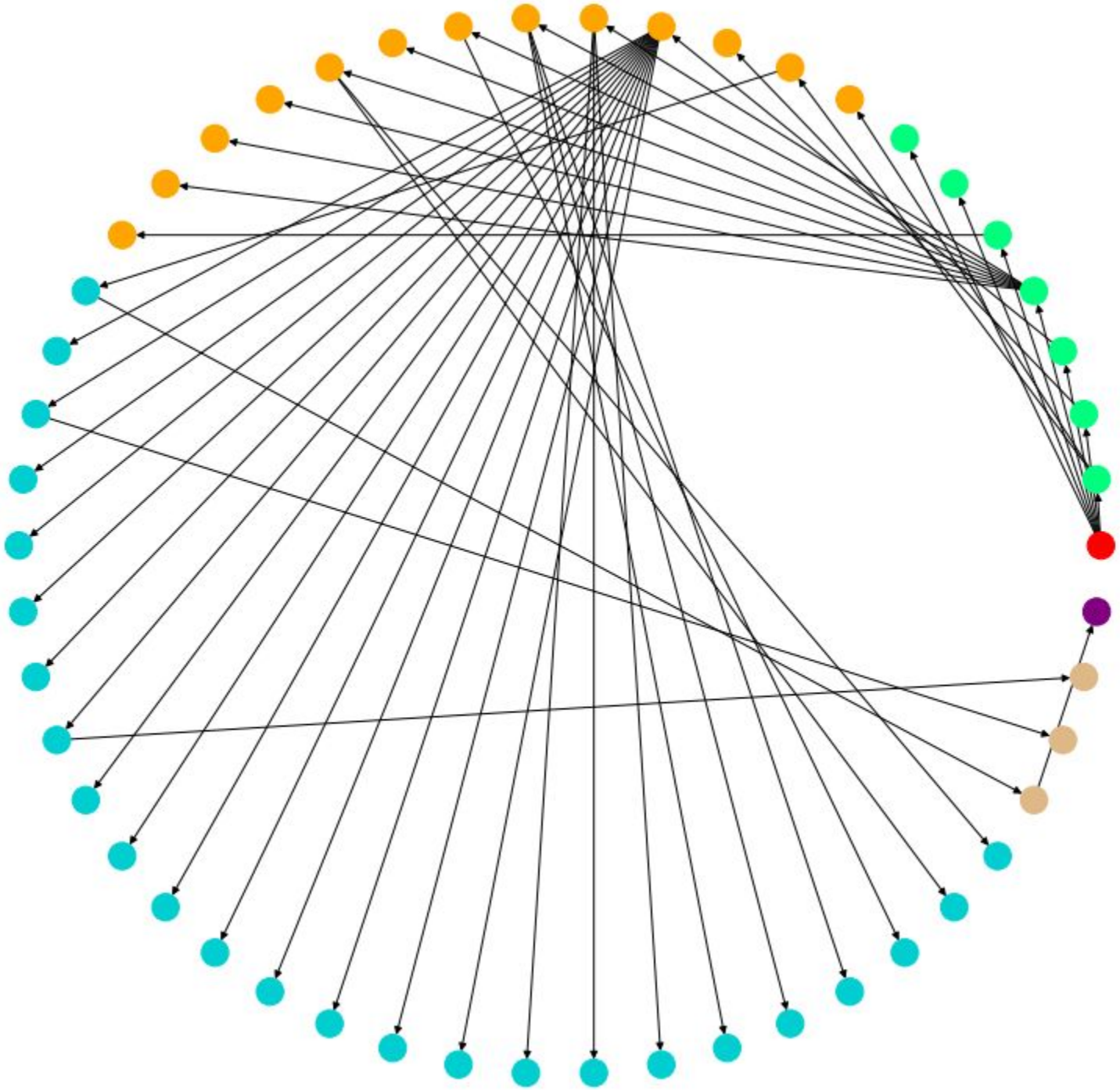
The other half of the class is just 2 hops away.

Maximum number of hops to cover the entire network - **2**

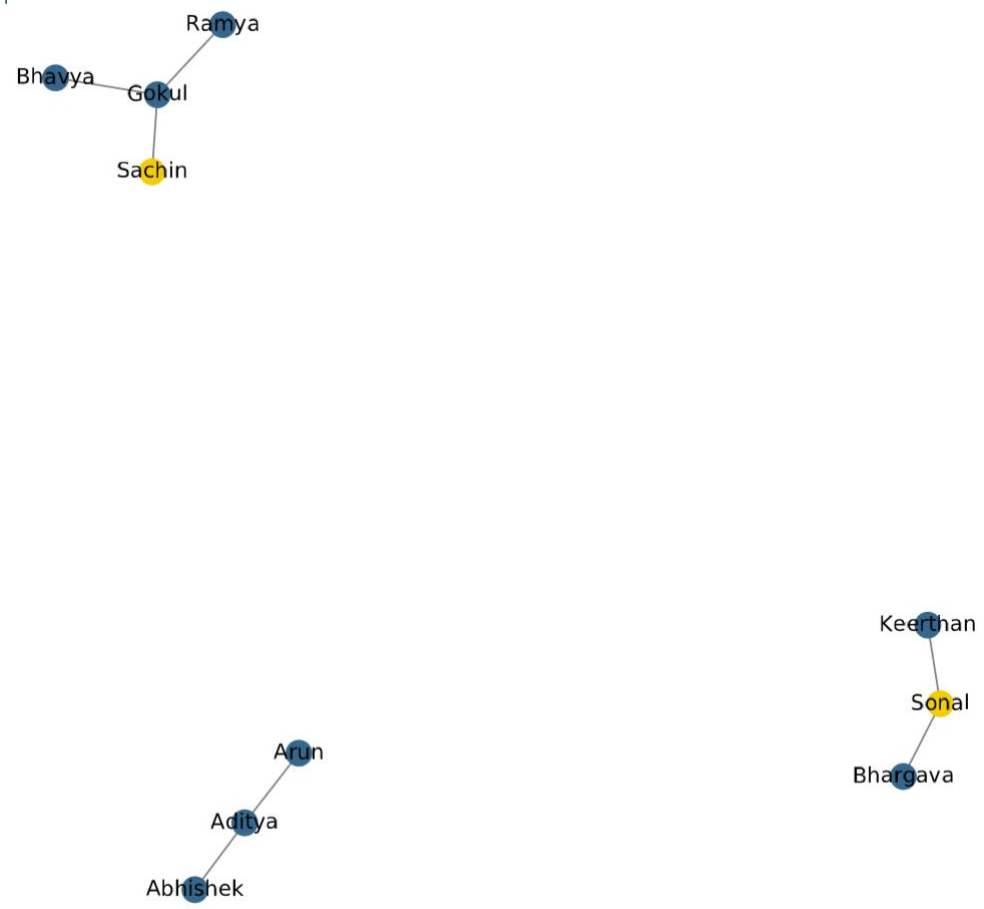


SHORTEST PATHS FOR A PERIPHERAL ACTOR - INSTAGRAM

Maximum number of hops to cover the entire network - **5**



LINK PREDICTION – BASED ON 9+ MUTUAL CONNECTIONS ON WHATSAPP



CLIQUES

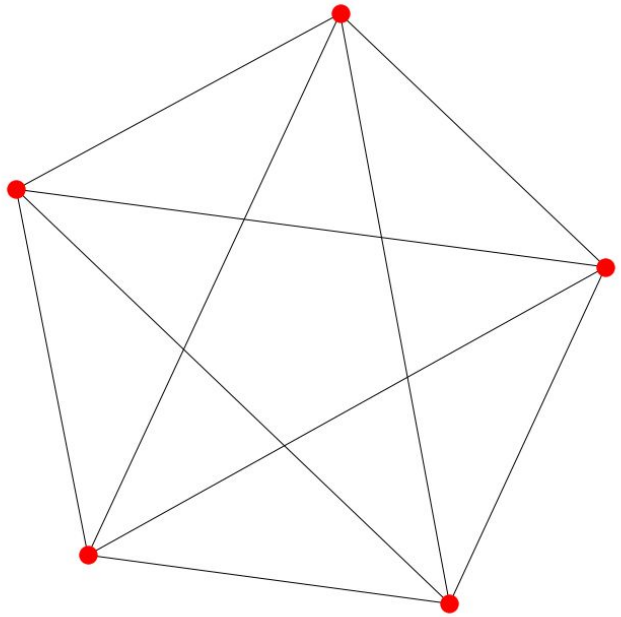
CLIQUES

- A clique, in the social sciences, is a group of individuals who interact with one another and share similar interests.
- Similarly, a clique in social networks is a group of actors in a network where every actor in the group is directly connected to another actor in the group.

CLIQUES

- Thus, a clique is a subgraph of the network, and it forms a complete graph.
- In a given network, the clique formed with the largest number of individuals is known as the maximum clique.

Let us look at all groups of people in our networks who are completely connected and form cliques…

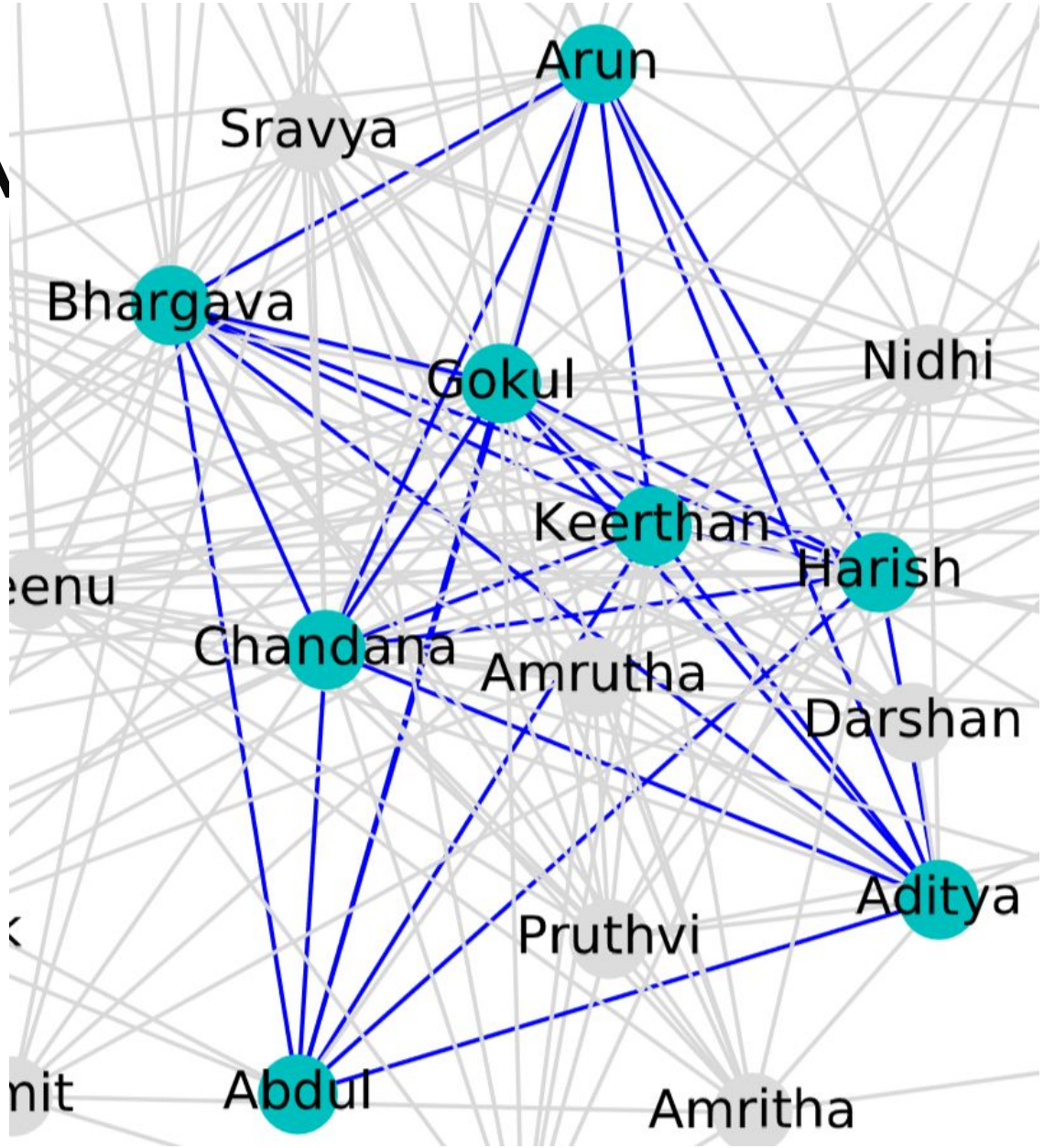


CLIQUES - WHATSA

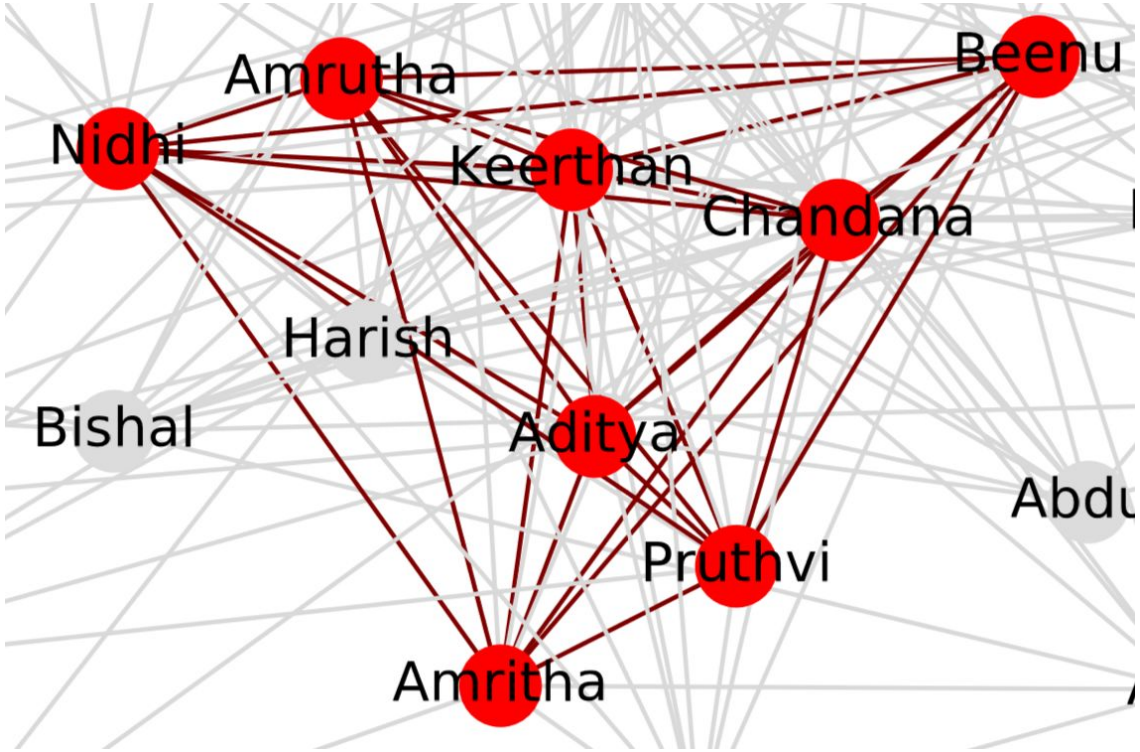
There are 4 maximum cliques in the network.

That is, there exist 4 cliques which consist of **8** people in it.

One such clique is shown here.



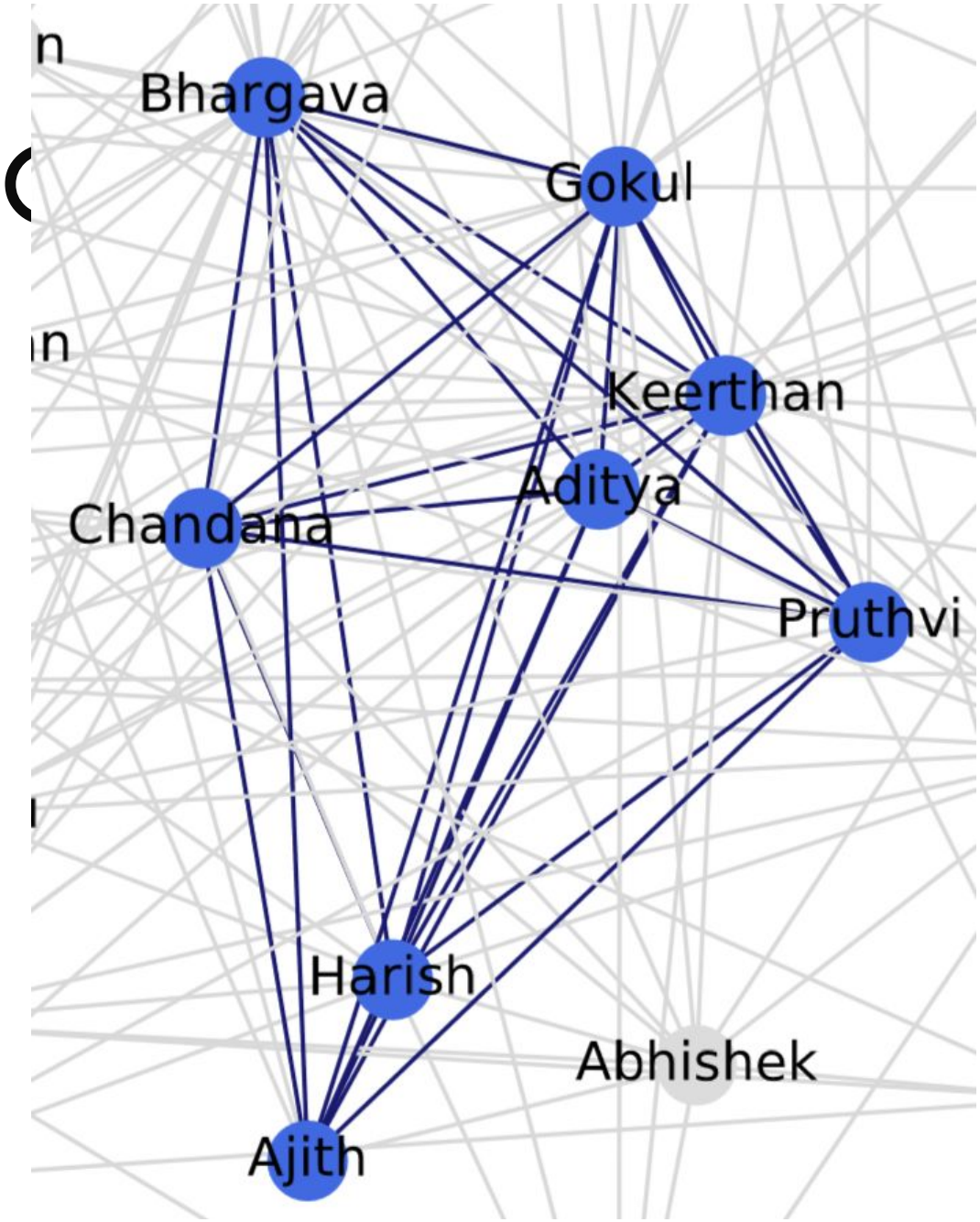
CLIQUES - WHATSAPP



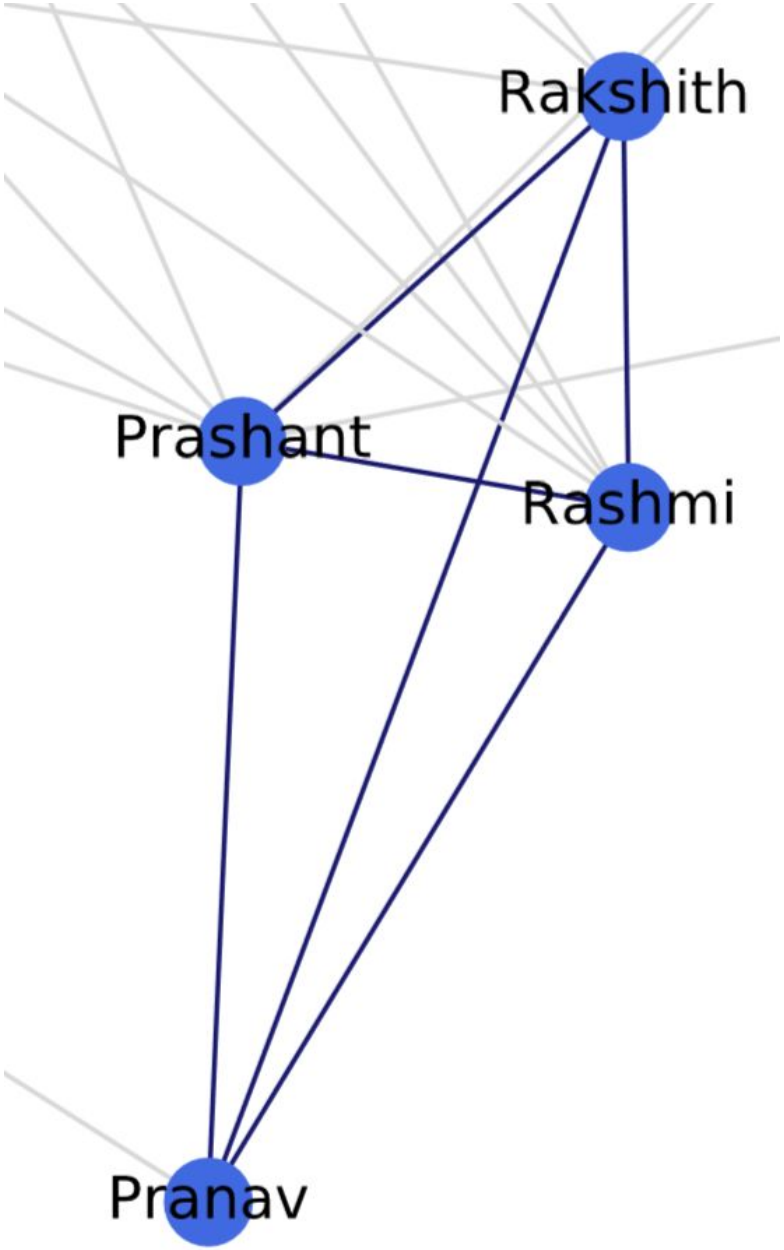
Another such clique which consists of 8 actors.

FACEBOOK – A SECTIO

In Facebook, there are 8 people from A section who form a clique.



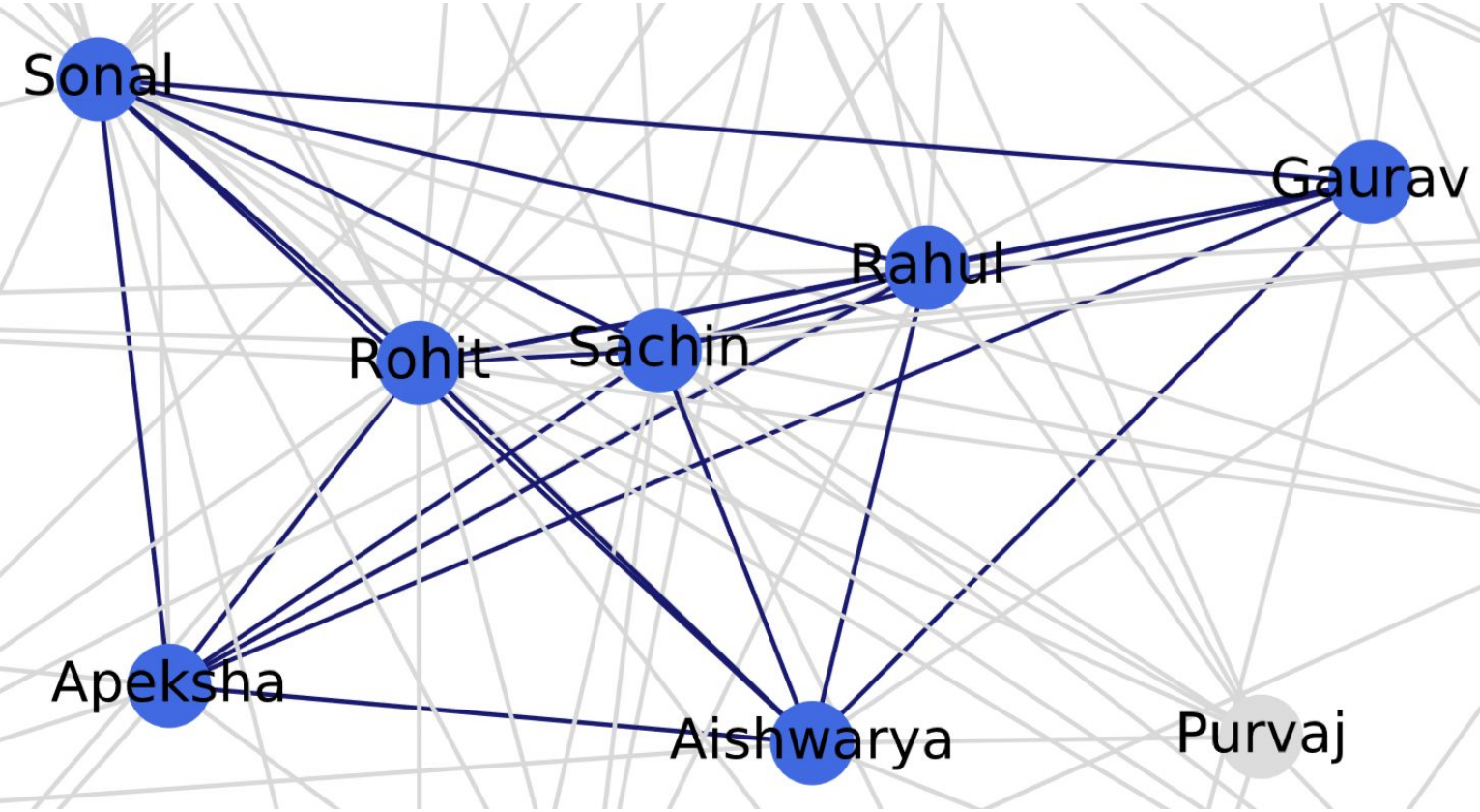
FACEBOOK – B SECTION



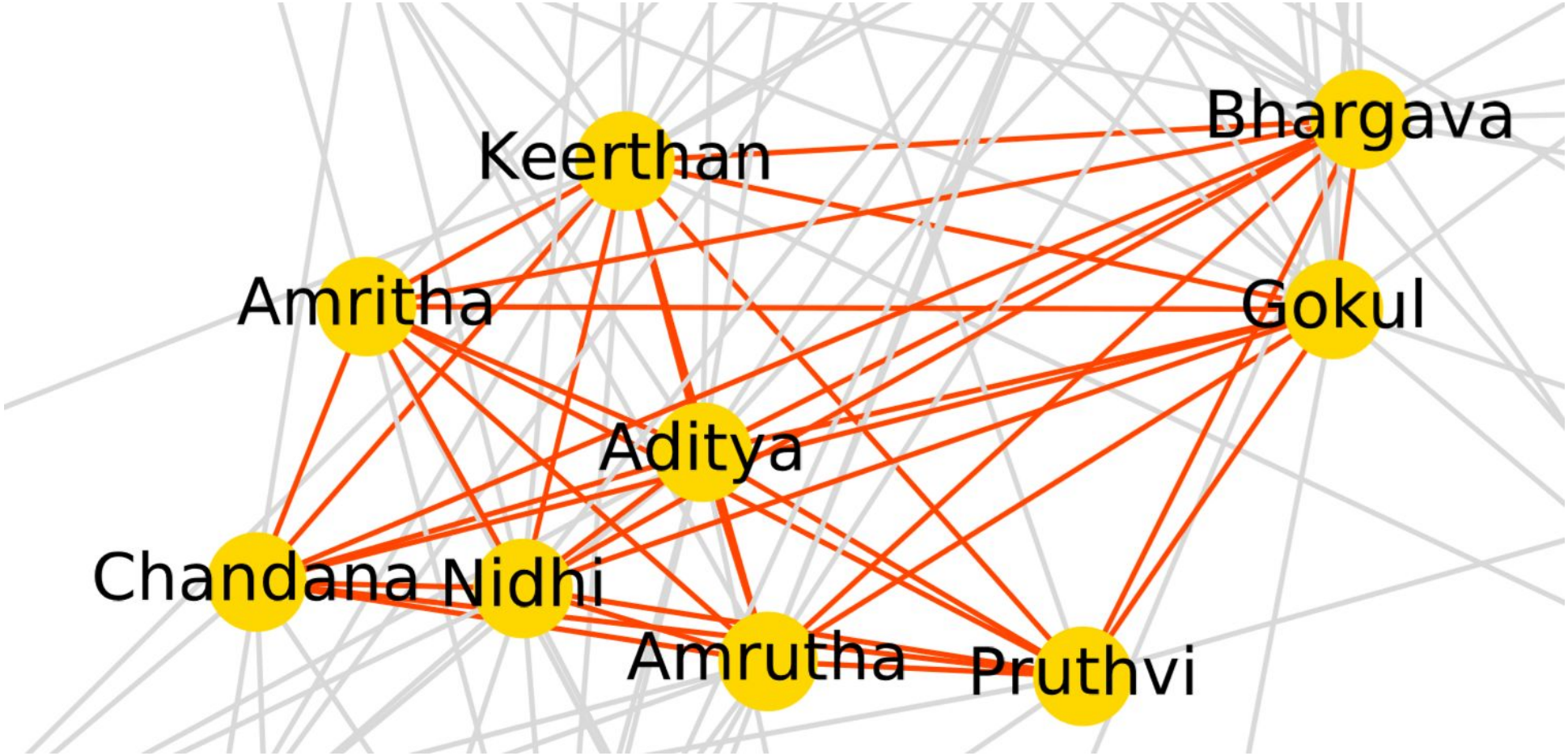
From B section, 4 people form the maximum clique.

FACEBOOK – C SECTION

From C section, 7 people form a maximum clique on Facebook.



INSTAGRAM – ONLY ONE MAXIMUM CLIQUE



NETWORK ROBUSTNESS

How robust are we as a network?

A network is robust if a large number of nodes should be removed from the network in order for it to become disconnected.

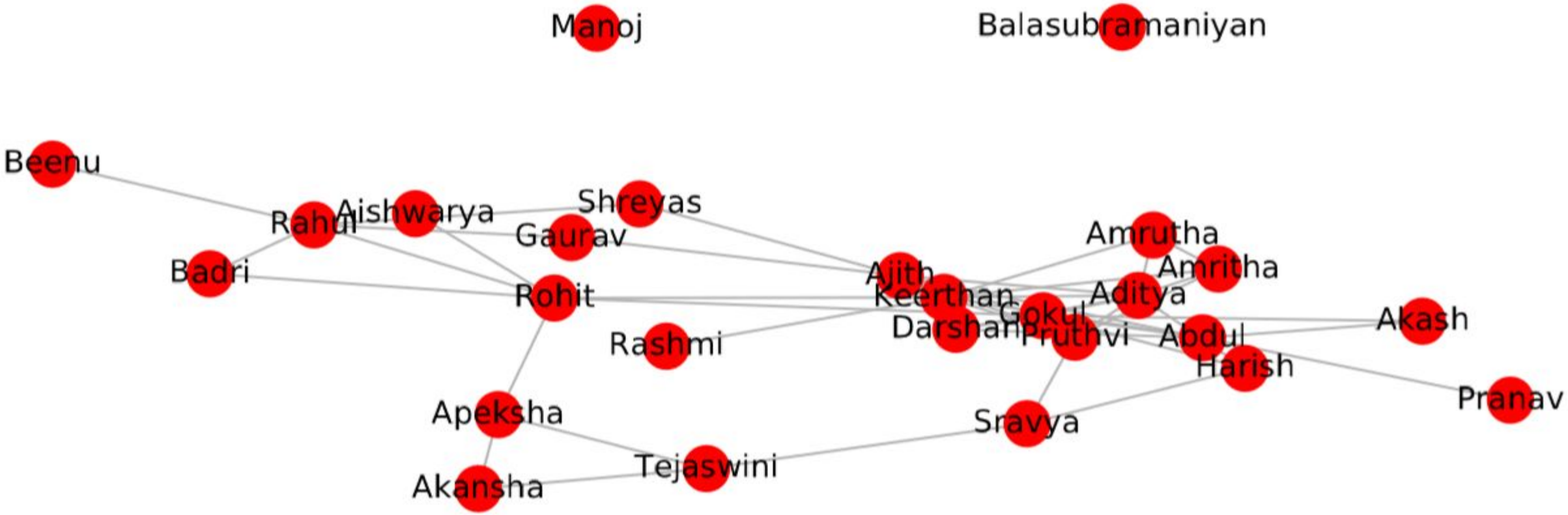
WHATSAPP NETWORK – 2 nodes [Ashim, Prashant]

FACEBOOK NETWORK – 2 nodes [Apeksha, Rohit]

INSTAGRAM NETWORK – 1 node [Shalini]

SNAPCHAT NETWORK – 1 node [Bhargava]

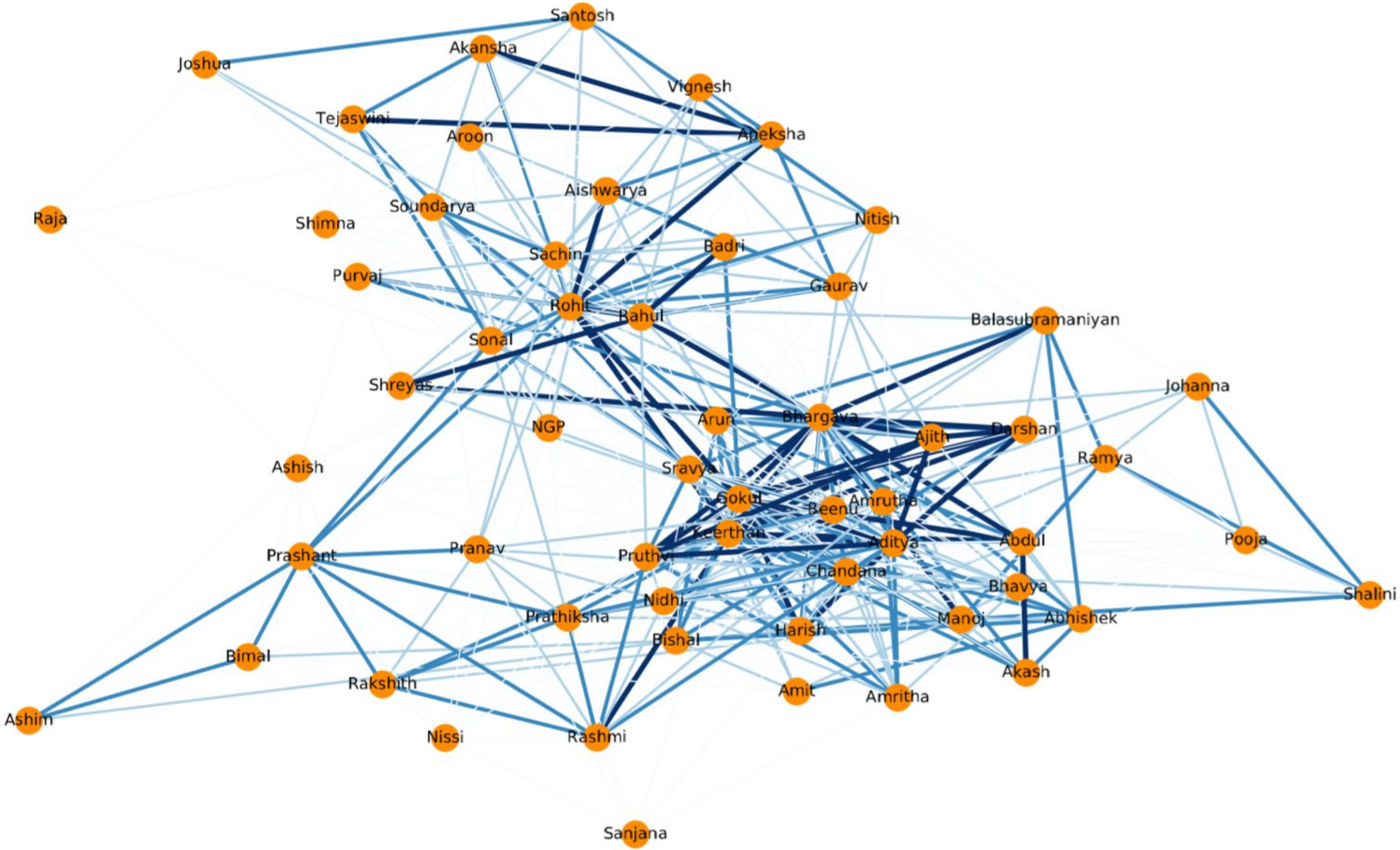
DISCONNECTED SNAPCHAT NETWORK

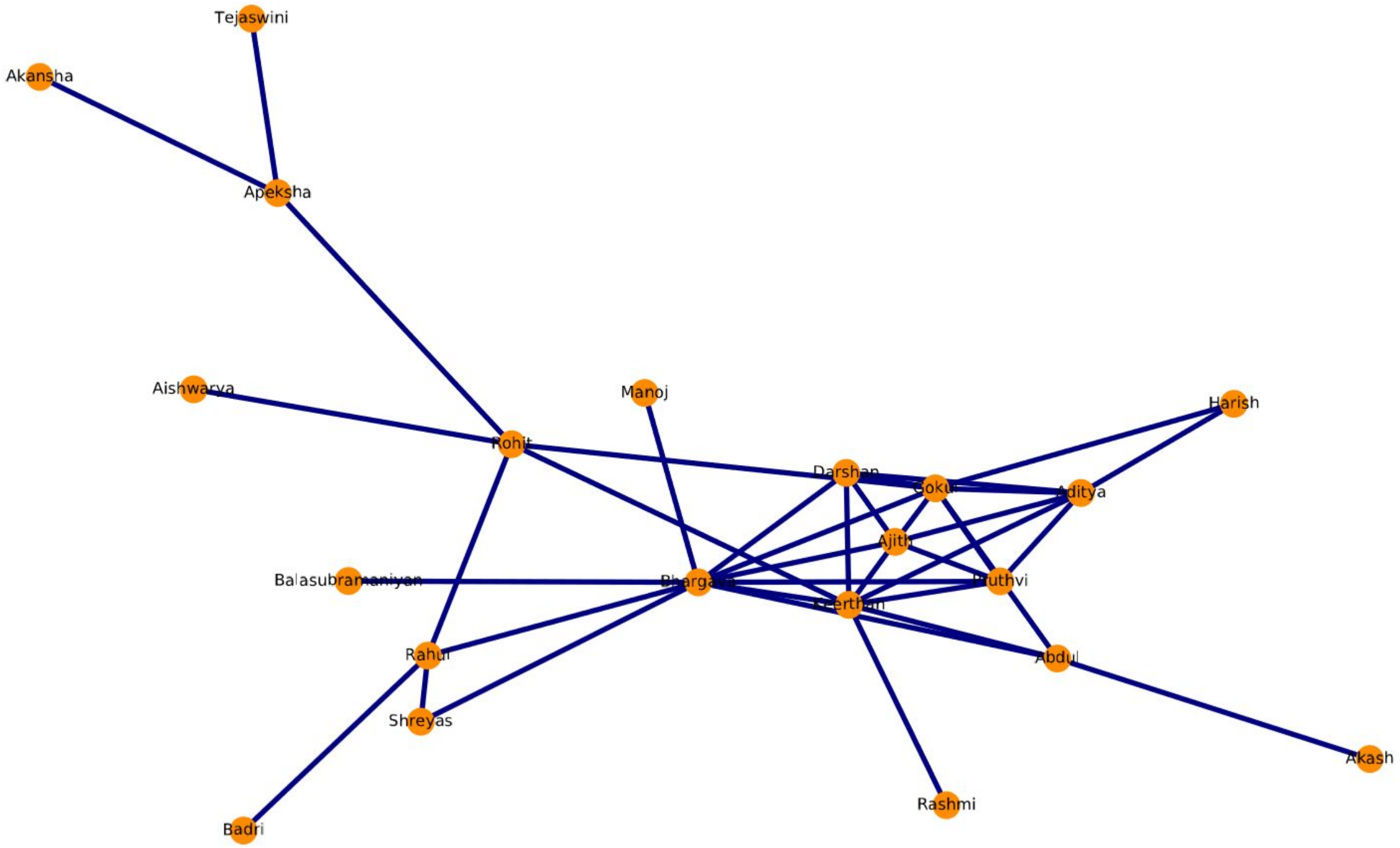


FINALLY,

Are there people in our class who are connected on all 4 social media?

YES, there exists 38 pairs of friends who are connected to each other on all 4 social media.


Santosh
Akansha
Joshua
Vignesh
Tejaswini
Aroon
Apeksha
Aishwarya
Soundarya
Raja
Shimna
Nitish
Badri
Sachin
Purvaj
Gaurav
Rohit
Rahul
Balasubramaniyan
Sonal
Shreyas
Johanna
Arun
Bhargava
NGP
Darshan
Ajith
Ramya
Ashish
Sravya
Gokul
Amrutha
Beenu
Keerthan
Aditya
Abdul
Pooja
Prashant
Pranav
Pruthvi
Chandana
Bhavya
Shalini
Nidhi
Prathiksha
Manoj
Abhishek
Harish
Bishal
Bimal
Akash
Rakshith
Amit
Amritha
Ashim
Nissi
Rashmi
Sanjana


Tejaswini
Akansha
Apeksha
Aishwarya
Manoj
Harish
Rohit
Darshan
Gokul
Aditya
Ajith
Balasubramaniyan
Bhargava
Pruthvi
Keerthan
Rahul
Abdul
Shreyas
Akash
Rashmi
Badri

THANK YOU

- I would like to immensely thank all of you for taking the time and sharing your information, without which I could not have done this.
- I would be more than happy to do even more relevant analyses with any type of network in the future.

thank you!