NATIONAL RESEARCH
UNIVERSITY

Network Science

Project 1

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Outline

1. Network Summary
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3. Community Detection
    - Clique search
    - Comminuty detection algorithms

Network Source

The network is a graph of my friends and our mutual friends in VK social network.

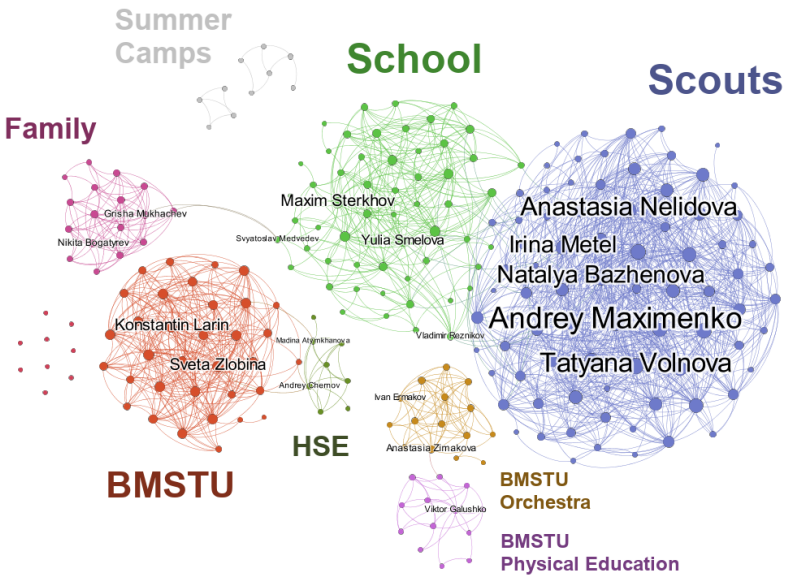
Properties

- Order: 244 nodes
- Size: 1657 edges

Node attributes

- id
- first name
- last name
- city
- university name
- faculty name

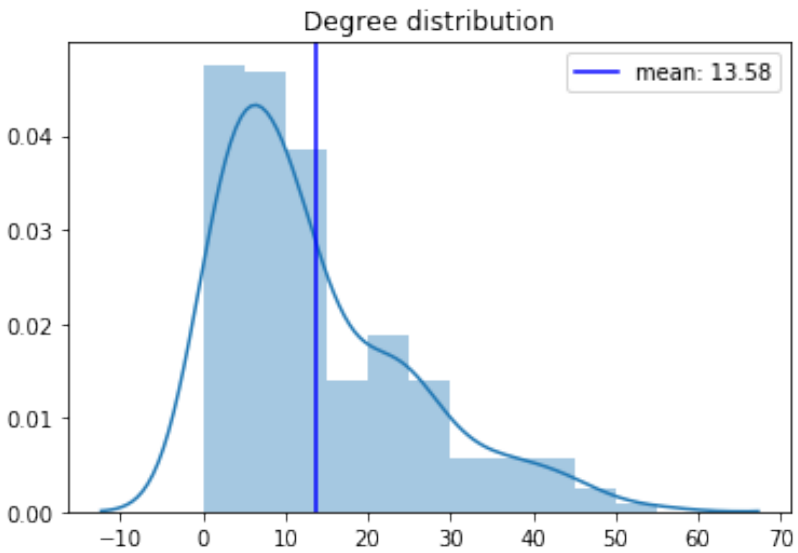
Network Layout



Scouts are members of The Scout movements.

Family, School and Scouts are mostly located in Udmurt republic. Other friends are mostly in Moscow.

Network Characteristics

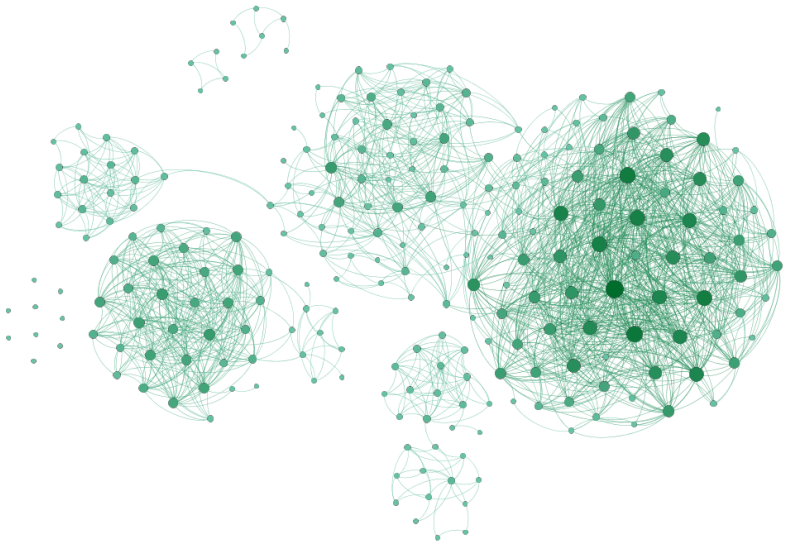


- Number of connected components: 14
- Diameters of connected components: 7, 5, 6, 3, 2, 0...
- Mean Clustering Coefficient: 0.5712

Centralities

1. Degree Centrality
2. Closeness Centrality
3. Betweenness Centrality

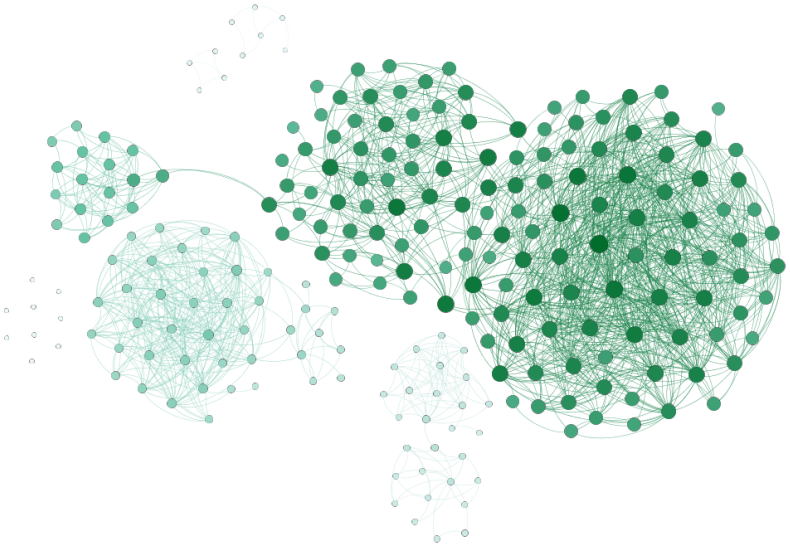
Degree Centrality



Top nodes

1. Andrey Maximenko:
   Formal and informal leader of Udmurtian Scouts
   (55 mutual friends)
2. Tatyana Volnova:
   Formal leader of Udmurtian Scouts
   (49 mutual friends)
3. Anastasia Nelidova:
   An experienced scout
   (47 mutual friends)

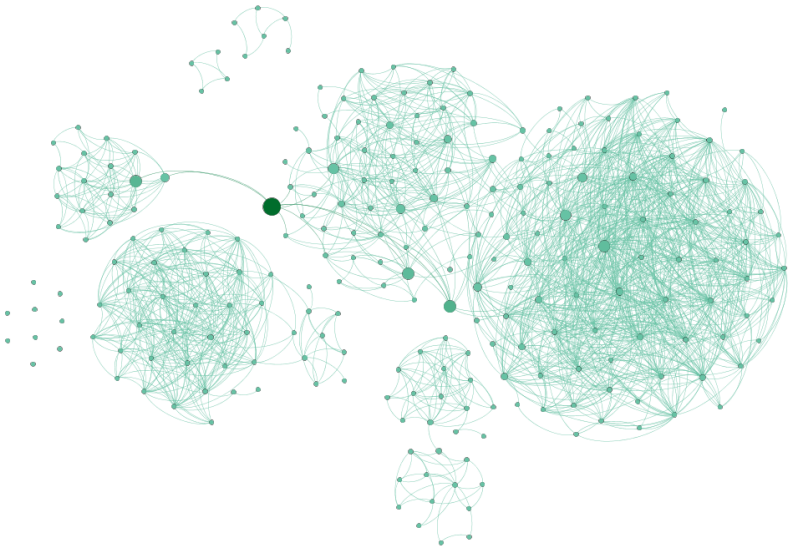
Closeness Centrality



Top nodes

1. Natalya Bazhenova:
   Formal leader of Udmurtian Scouts who now works in my school
   (avg. 2.18 handshakes)
2. Irina "Metel":
   A scout leader who lives close to my school
   (avg. 2.23 handshakes)
3. Anastasia Nelidova:
   An experienced scout
   (avg. 2.3 handshakes)

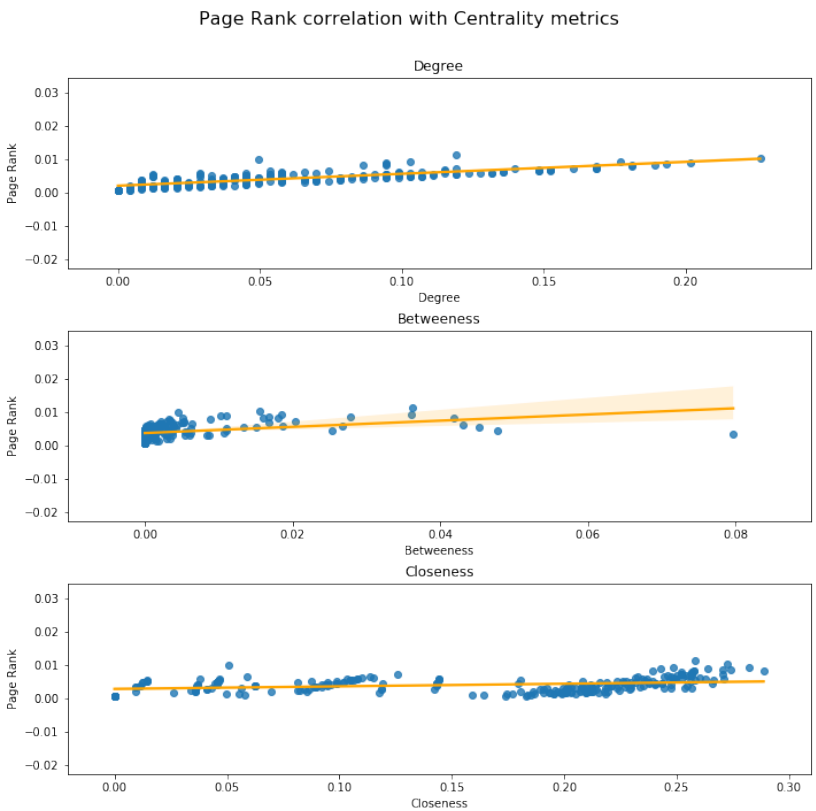
Betweenness Centrality



Top nodes

1. Svyatoslav Medvedev: Played in a school orchestra, knows some of my family (8% smallest paths)
2. Vladimir Reznikov: Played in a school orchestra, has a blog (4.8% smallest paths)
3. Grisha Mukhachev: Family, knows Svyatoslav Medvedev (4.5% smallest paths)

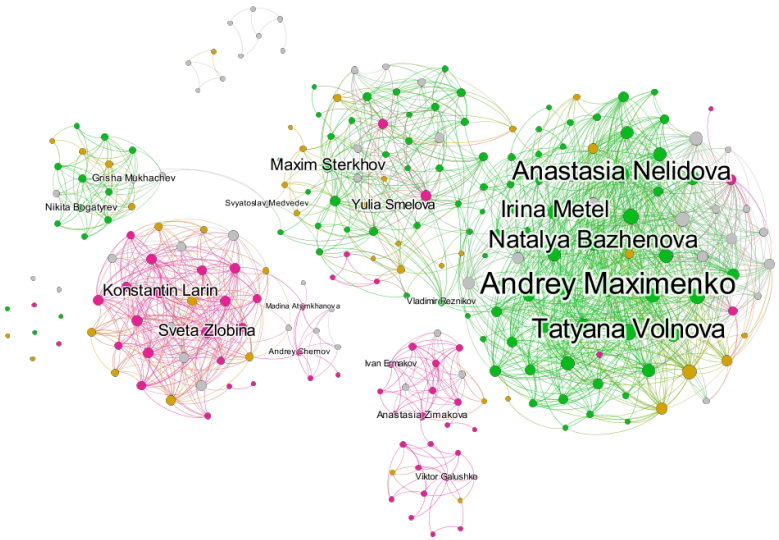
Page Rank



Top nodes

1. Maxim Sterkhov:
   Played in a school orchestra, knows some of my family
   (1.13% smallest paths)
2. Andrey Maximenko:
   Formal and informal Scout Leader
   (1.03% smallest paths)
3. Viktor Galushko:
   BMSTU PE teacher
   (1.01% smallest paths)

Assortative Mixing



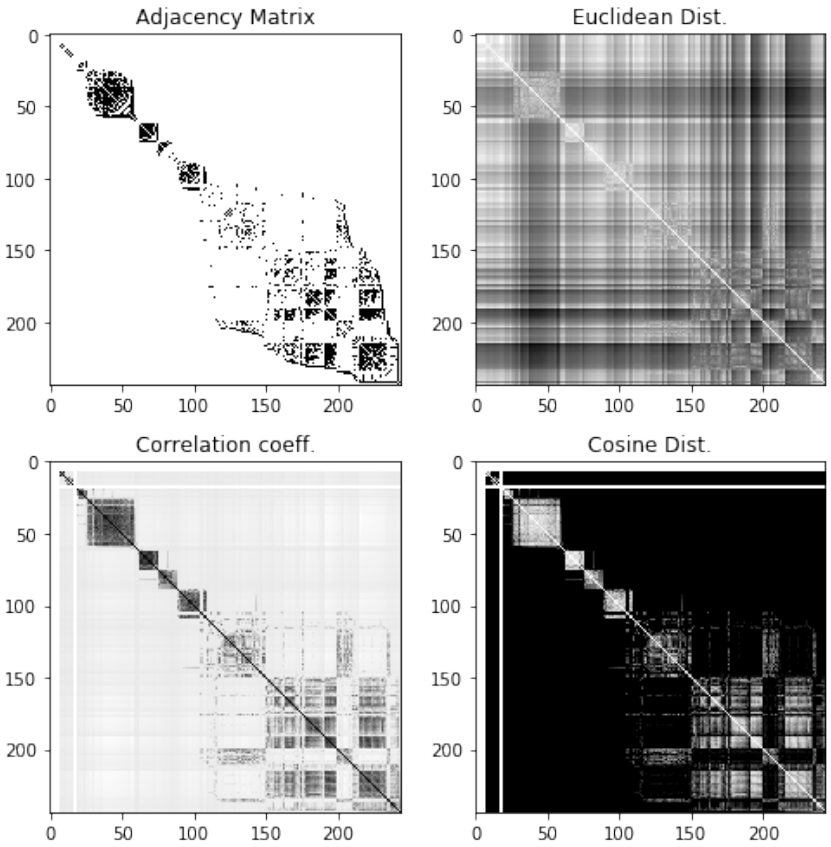
Assortativity Coefficients

1. City: 0.21
2. University: 0.1
3. Faculty: 0.07

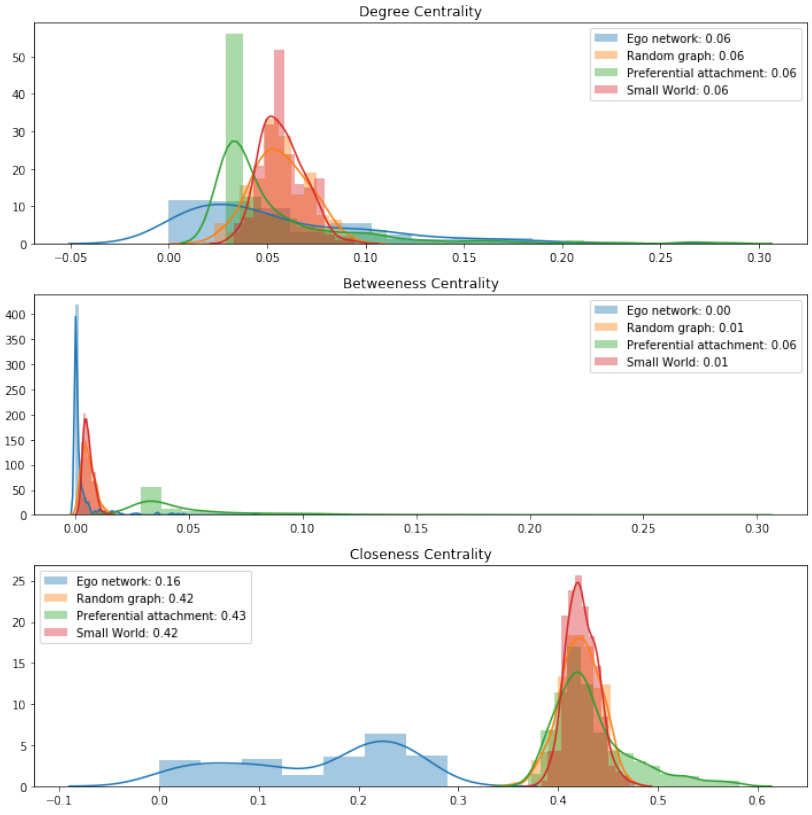
Colors

- Green: Izhevsk
- Red: Moscow
- Orange: Saint-Petersburg
- Grey: Others

Node structural equivalence



Closest Random Graph model



Comparing random graph models and Ego network centralities, we obtain ranks of the differences.

Mean difference rank

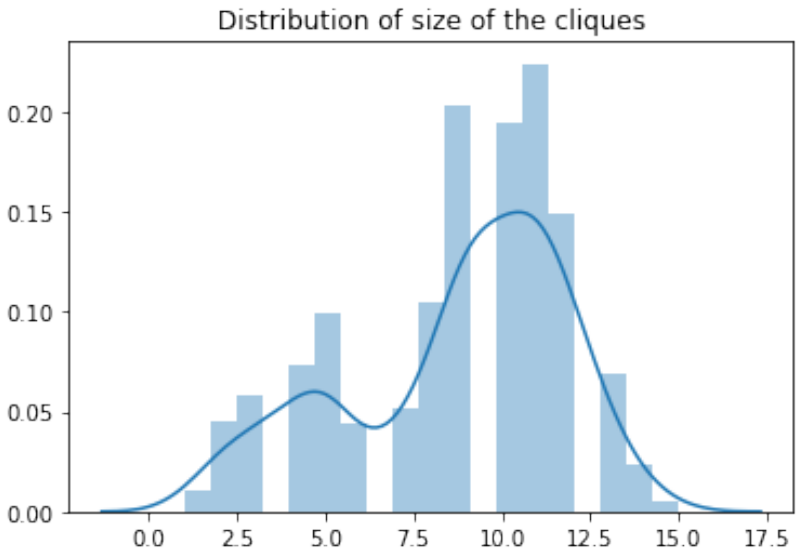
1. Ego: 1
2. Pref. attachment: 2.67
3. Random graph: 3
4. Small World: 3.33

Therefore the closest random graph model in my case is Preferential attachemnt.

Community Detection

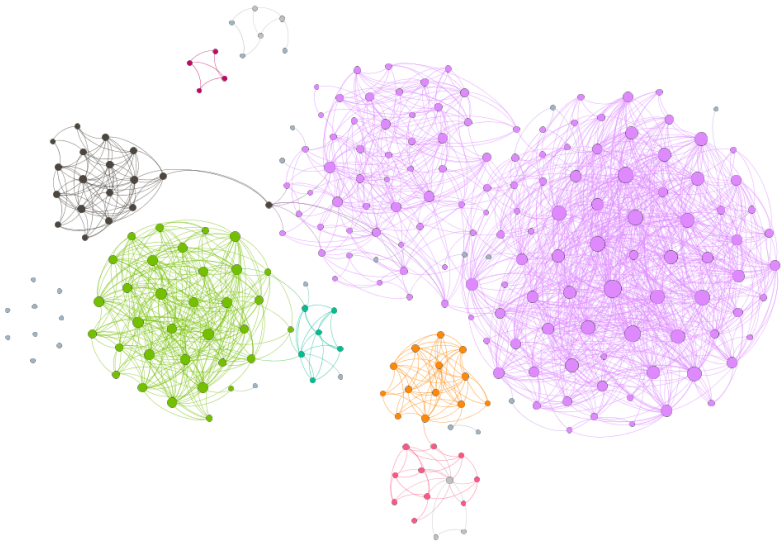
1. Clique Search
2. Community detection algorithms
    - k-clique communities
    - Modularity based communities
    - Girvan-Newman

Clique search



People are actively communicate in groups of 5 and 10 persons.
This is totaly coherent with the basic theory of amount of people in small in medium size teams.

k-clique communities

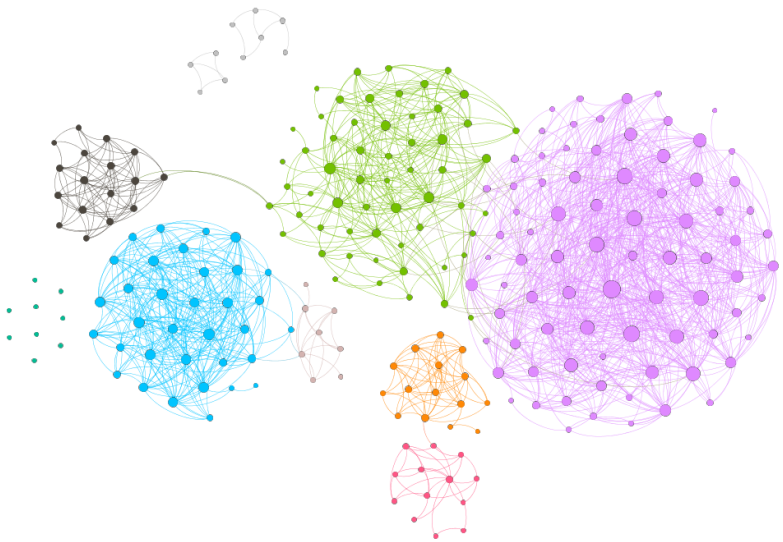


Coefficient $k = 3$

Results are not well suited for the graph:

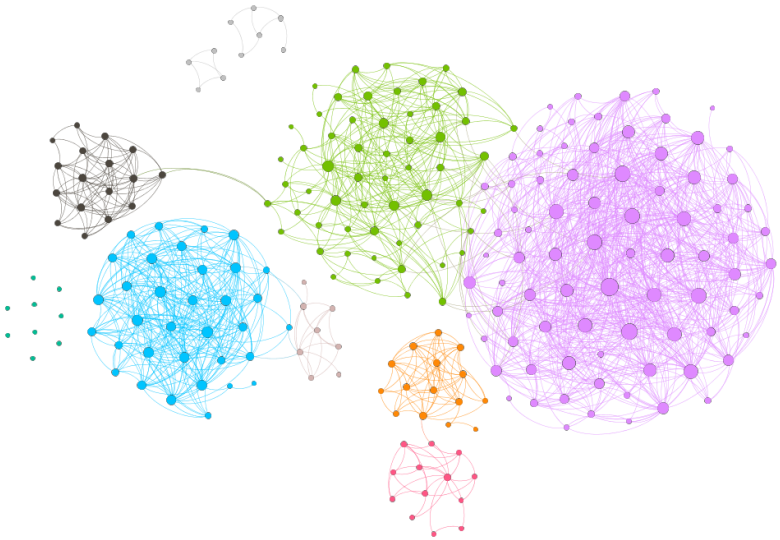
- Scouts and School communities are not splitted
- There are unclassified grey points in almost every community.

Modularity based communities



The results perfectly lie on the network.

Girvan-Newman communities



The results perfectly lie on the network.
And they look much the same as Mularity based communities.

These results were taken as ground truth and were shown in the very first network layout.

Thank you for your attention!

Network Science

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