Analiza kompleksnih omrežij s primeri uporabe

Avtorja:

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Mentor:

Marko Bajec: marko.bajec@fri.uni-lj.si

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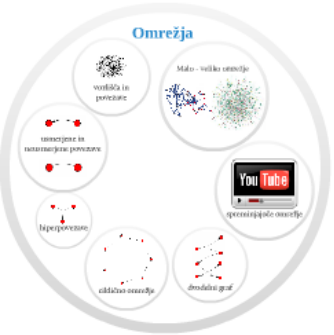
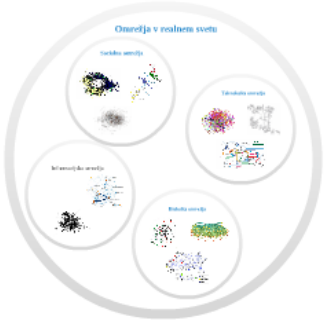
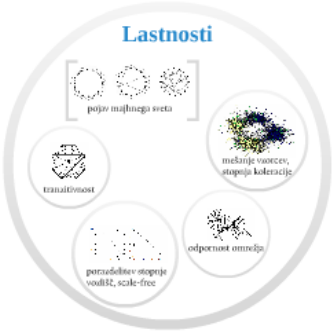
Laboratorij za podatkovne tehnologije

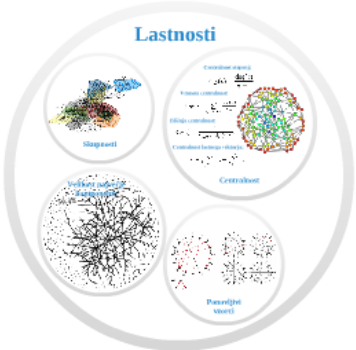
Literatura

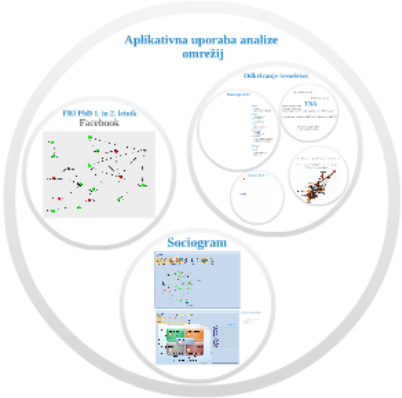
- U.K. Wiil, J. Gniadek, N. Memon, Measuring Link Importance in Terrorist Networks, v zborniku "Advances in Social Networks Analysis and Mining, 2010 International Conference", str. 225-232, 2010
- Primer največje komponente: http://monkeysuncle.stanford.edu/?p=223
- R. Milo, S. Shen-Orr, S. Itzkovitz, N. Kashtan, D. Chklovskii, U. Alon, Network motifs: simple building blocks of complex networks, v zborniku "Science", št. 298, str. 824, 2002
- M. E. J. Newman, "The structure and function of complex network," SIAM Review, vol. 45, no. 2, pp. 167-256, 2003.
- C. T. Bergstrom M. Rosvall, "Maps of random walks on complex networks reveal community structure," Proceedings of the National Academy of Sciences, vol. 105, no. 4, pp. 1118-1123, 2008.
- D. J. Watts, "The "New" Science of Networks," Annual Review of Sociology, vol. 30, pp. 243-270, 2004.
- M. E. J. Newman, Networks: An Introduction. United States of America: Oxford University Press, 2010.
- Šubelj L., Bajec M., On the robustness of label propagation for community detection in complex nets., subbmited to European Physics J. B.











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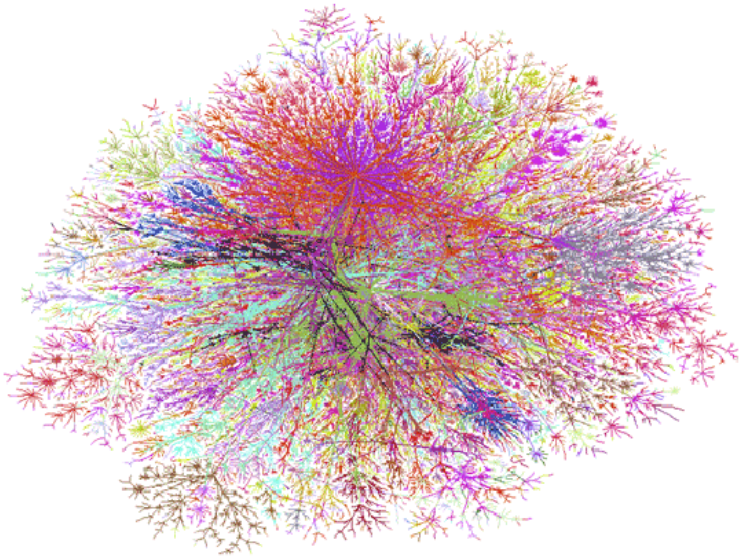

Univerza v Ljubljani
Fakulteta za računalništvo in informatiko

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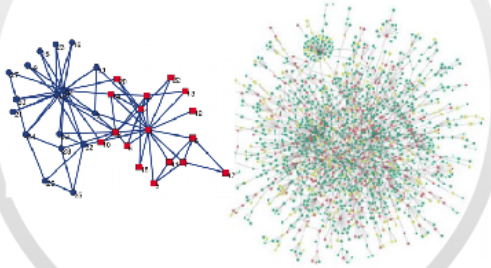
Omrežja

vozlišča in povezave

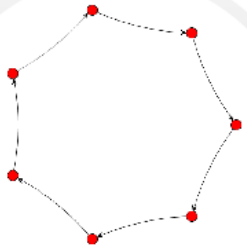
Malo - veliko omrežje



usmerjene in neusmerjene povezave

spreminjajoče omrežje

hiperpovezave



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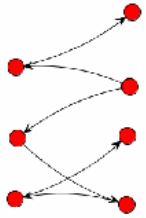

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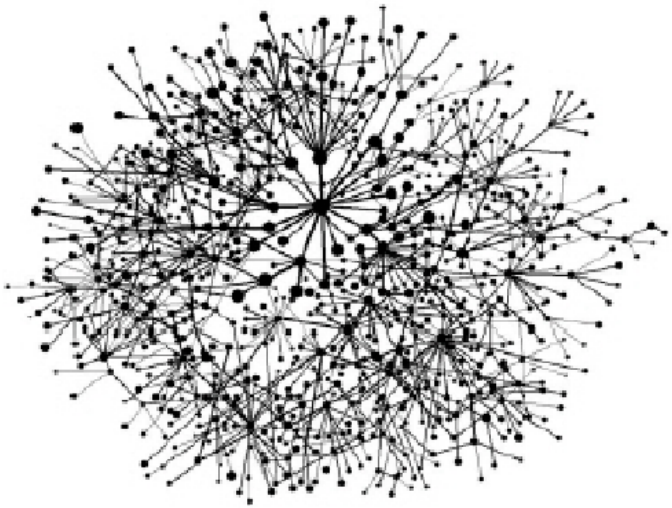
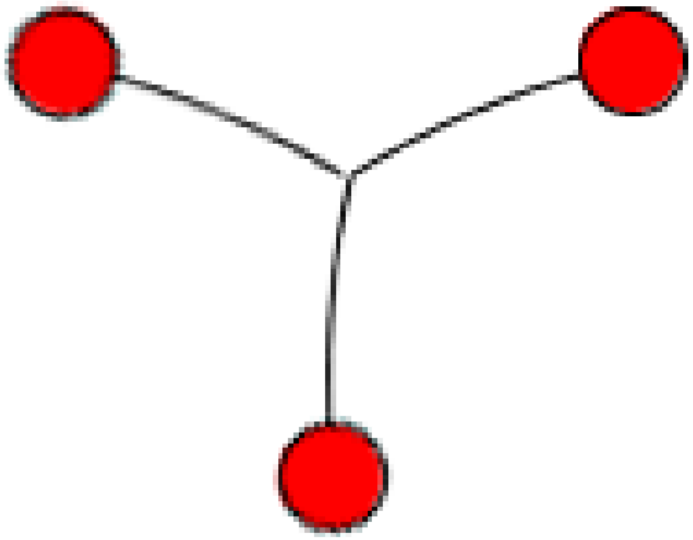


vozlišča in povezave

usmerjene in neusmerjene povezave



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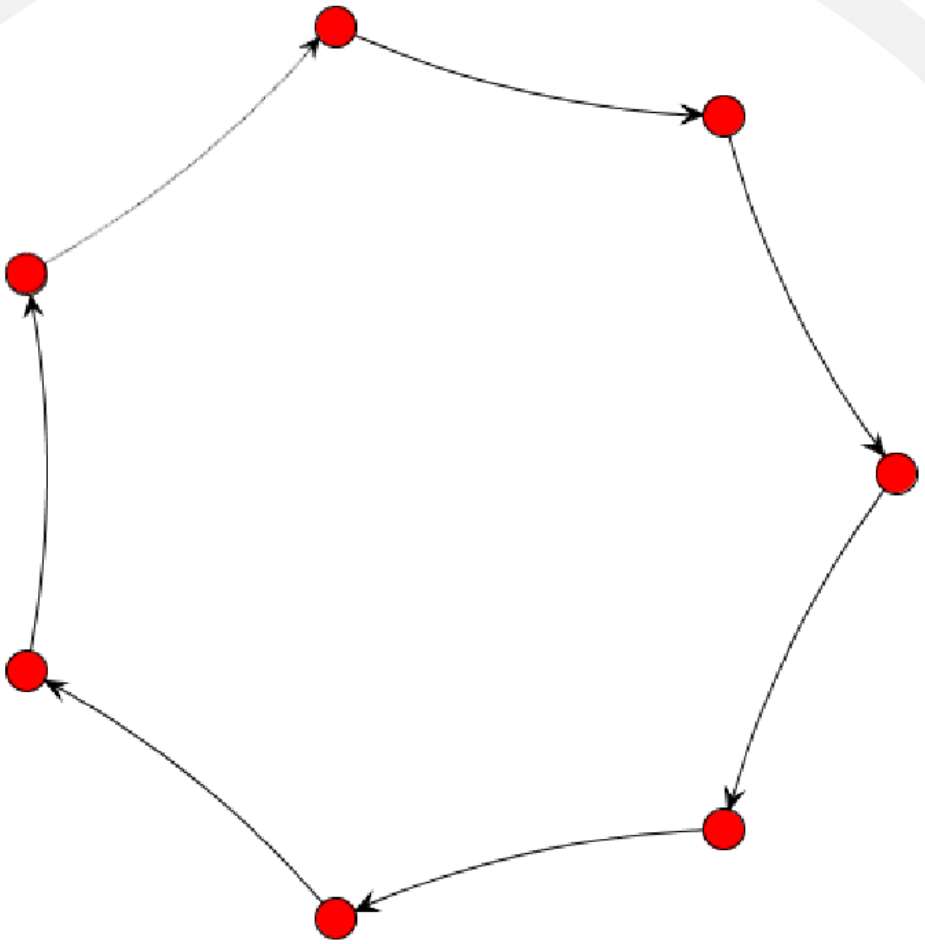

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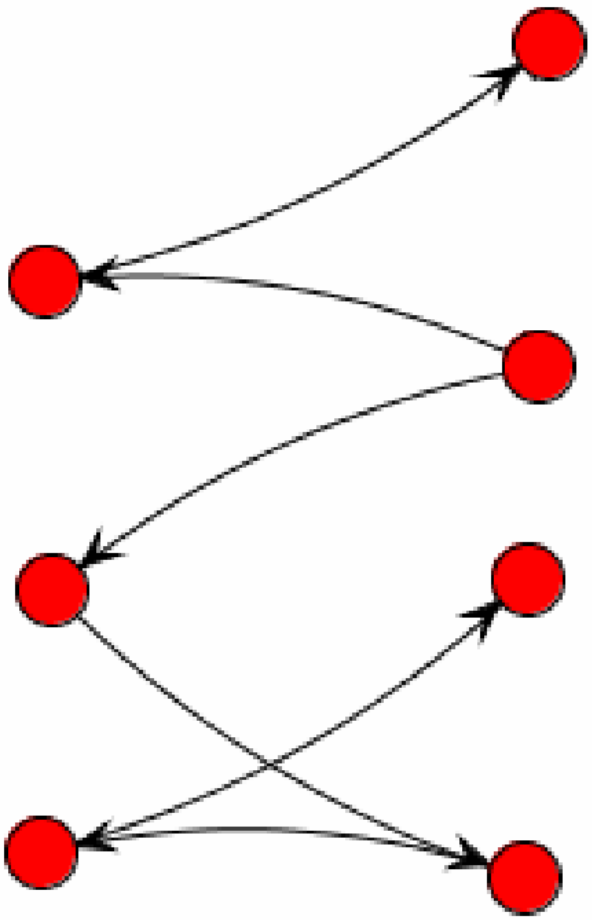

dvodelni graf

spreminjajoče omrežje

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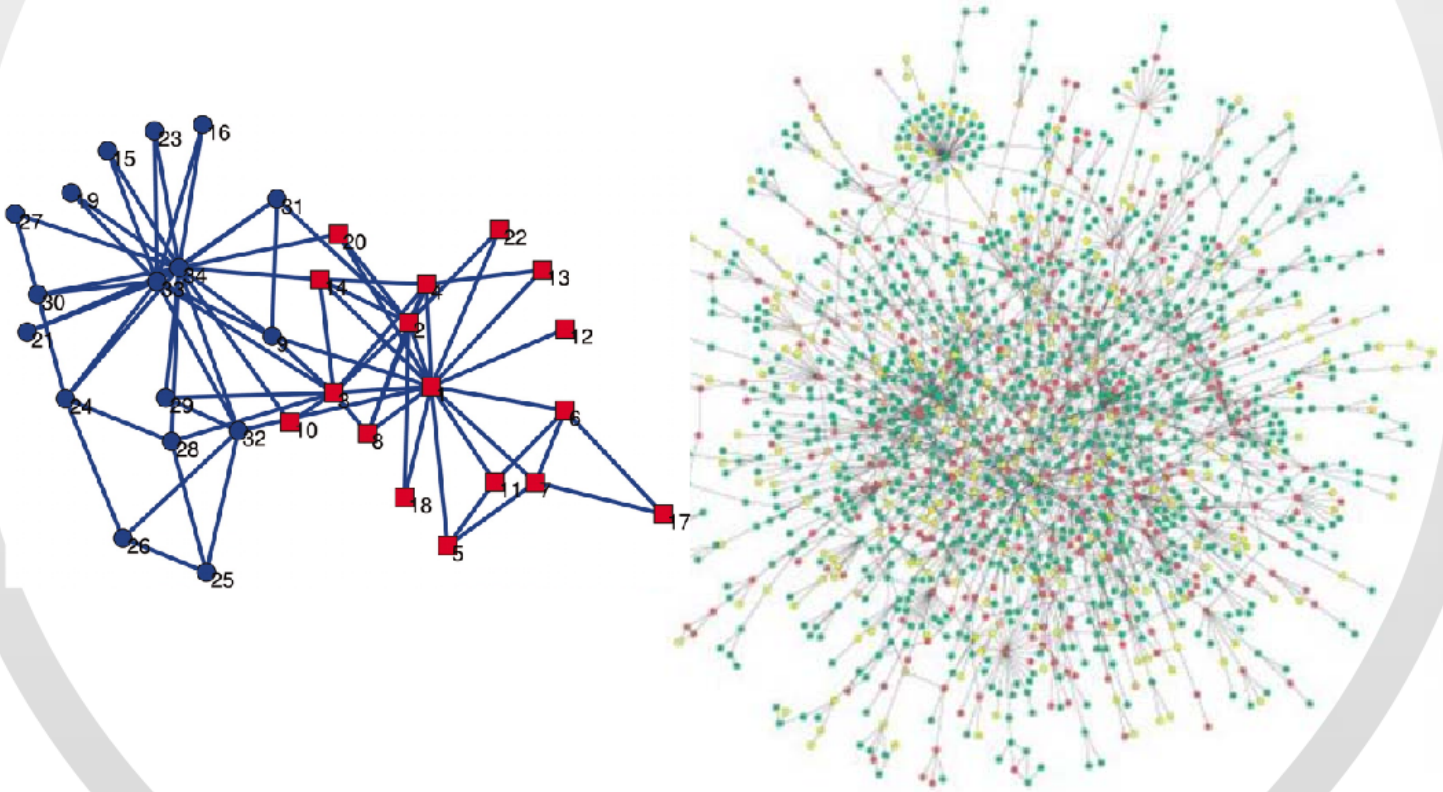
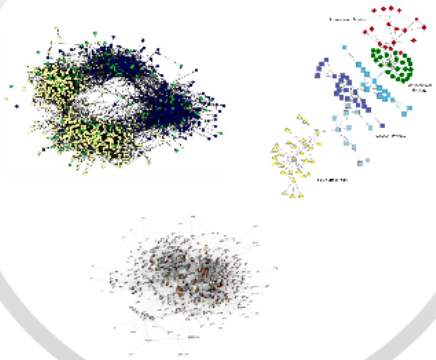


Omrežja v realnem svetu

Socialna omrežja



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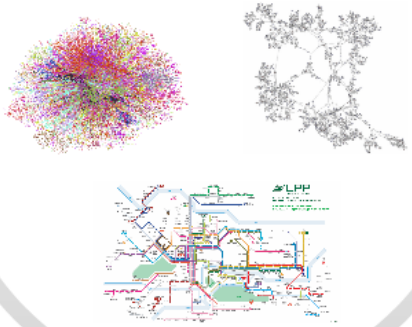
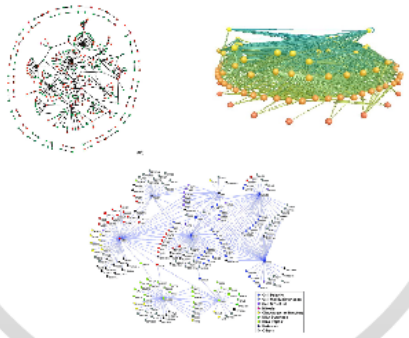


Informacijska omrežja

Biološka omrežja



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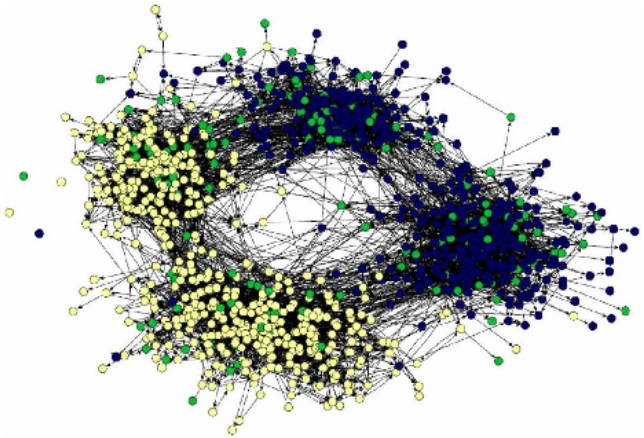

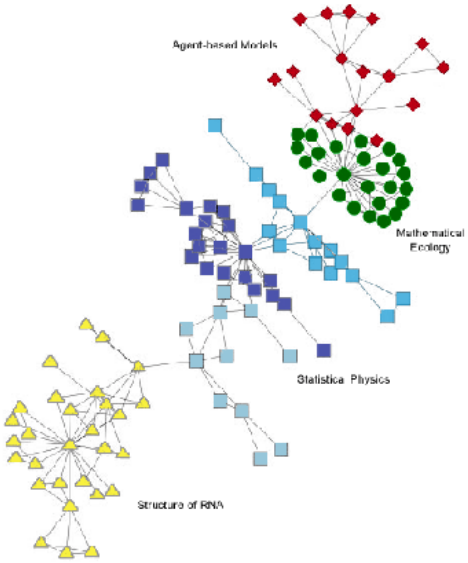

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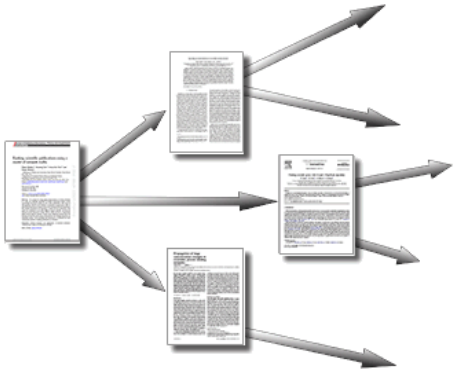

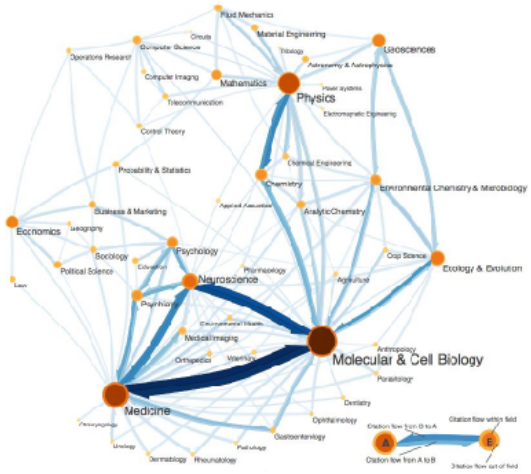

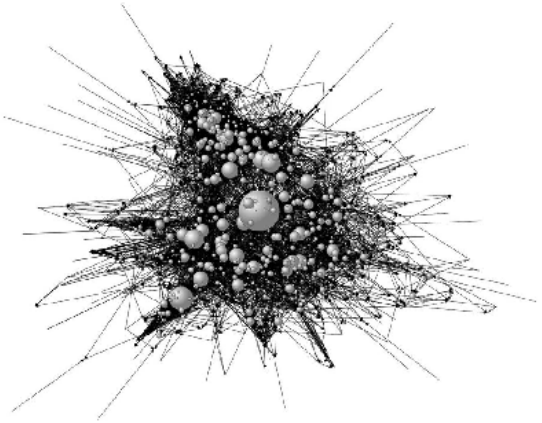

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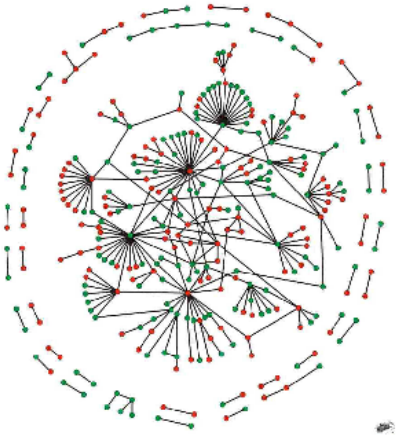
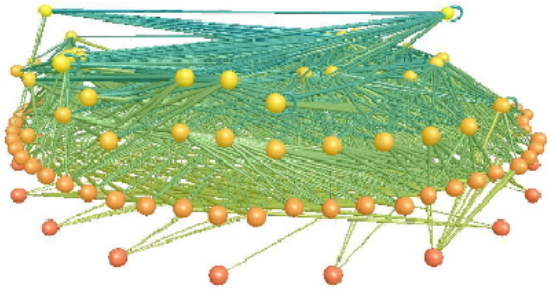
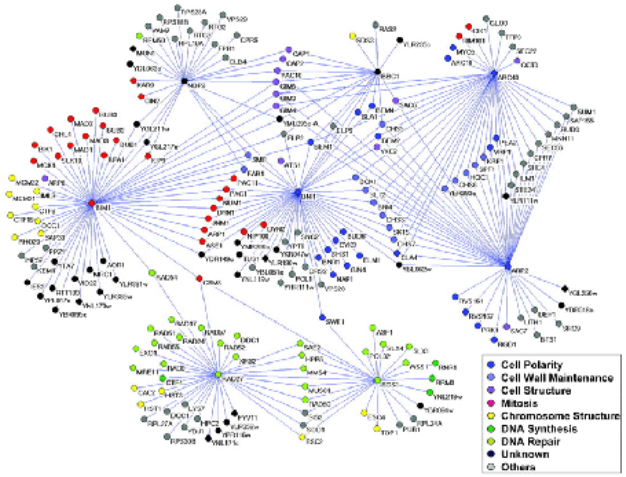
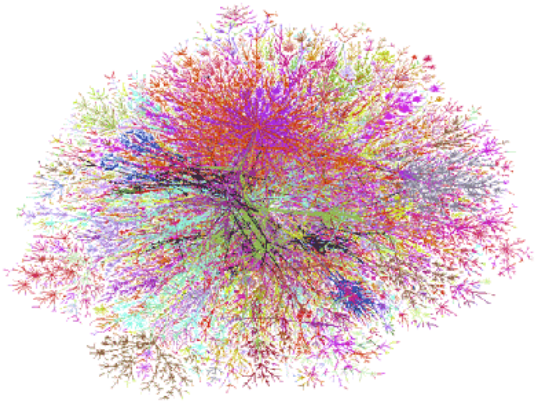
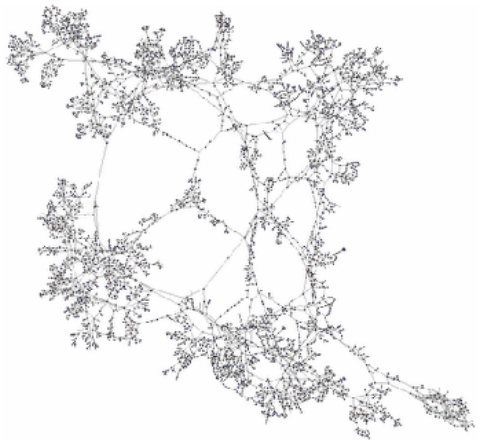


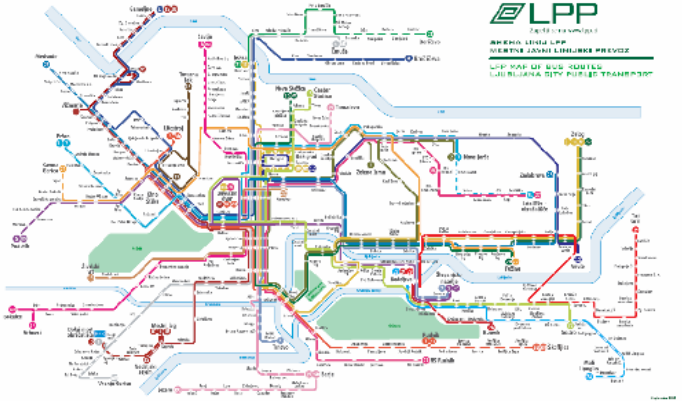




Tehnološka omrežja







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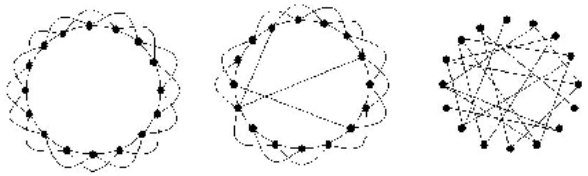

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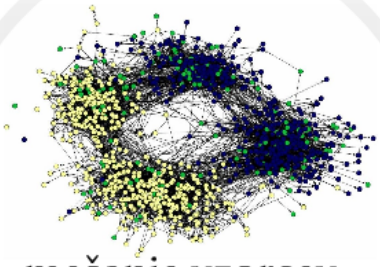
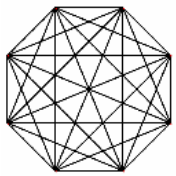


mešanje vzorcev,
stopnja koleracije



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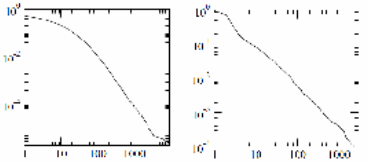

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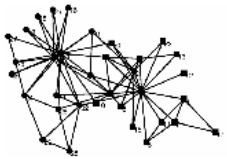

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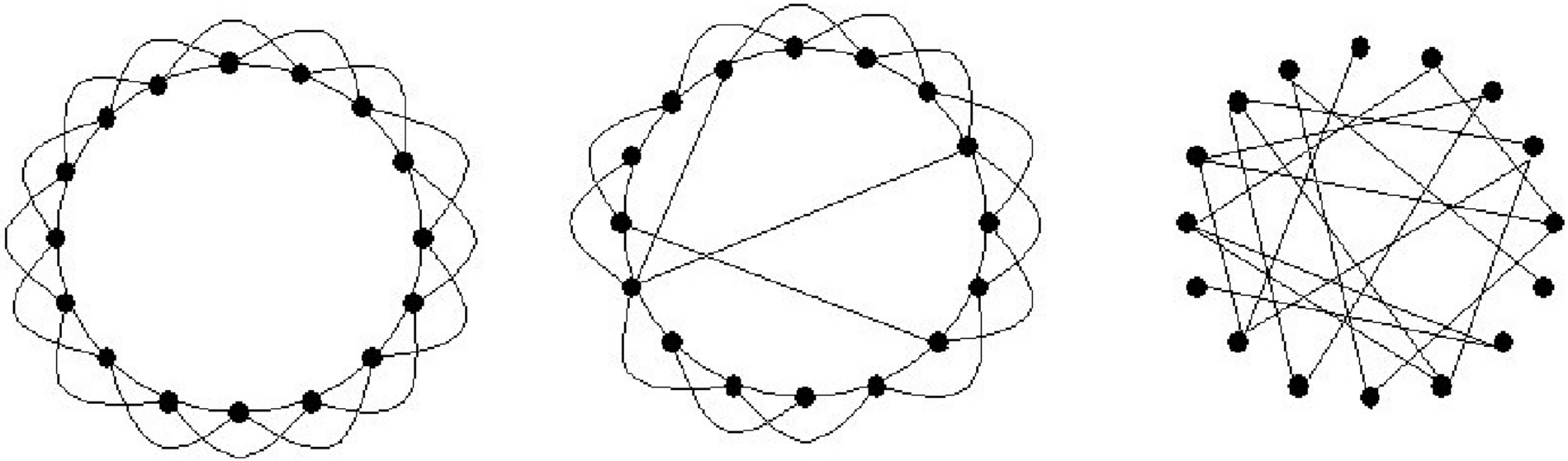

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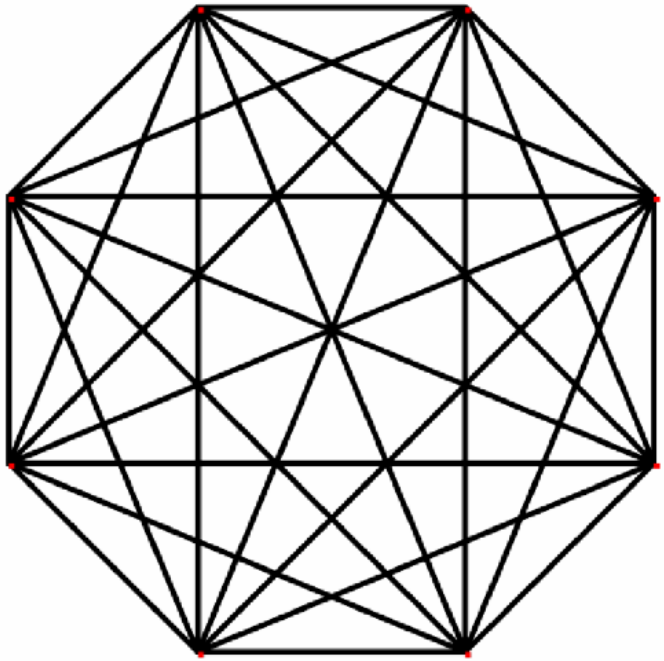

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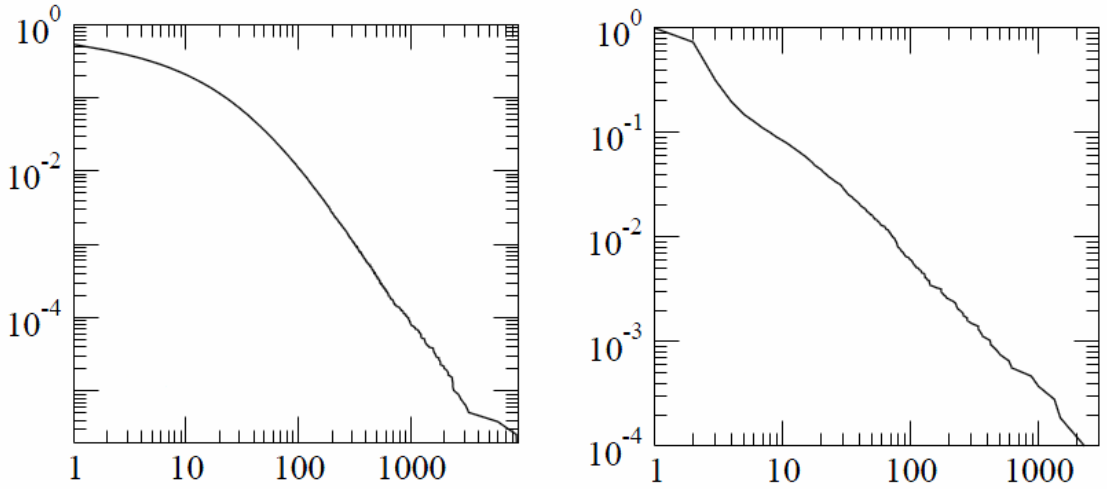

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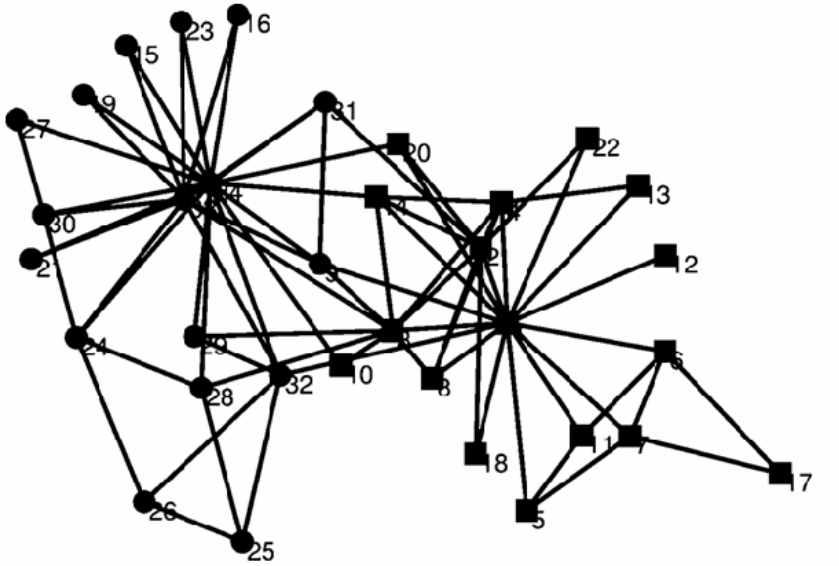

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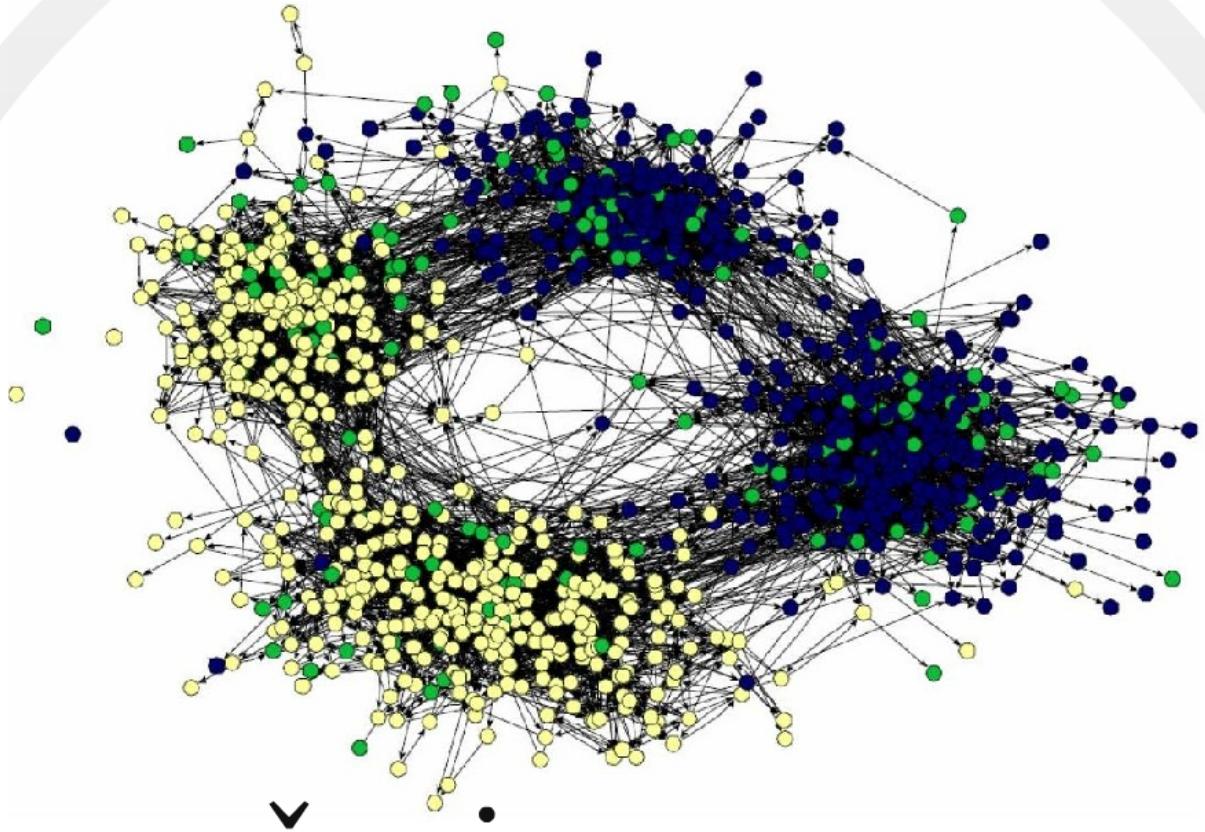
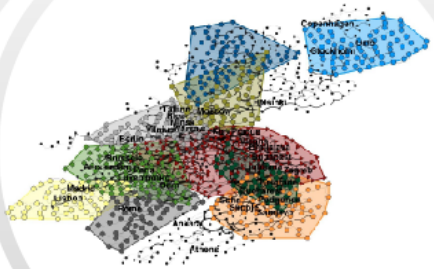


mešanje vzorcev, stopnja koleracije

Lastnosti



Skupnosti

Centralnost stopenj:

$$C_D(v) = \frac{\deg(v)}{n-1}$$

Vmesna centralnost:

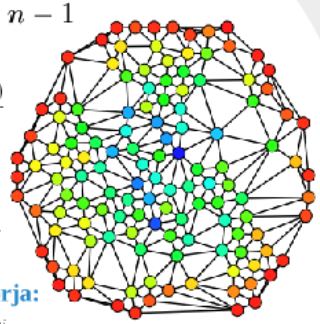
$$C_B(v) = \sum_{s \neq v \neq t \in V} \frac{\sigma_{st}(v)}{\sigma_{st}}$$

Bližnja centralnost:

$$C_C(v) = \frac{1}{\sum_{t \in V \setminus v} d_G(v,t)}.$$

Centralnost lastnega vektorja:

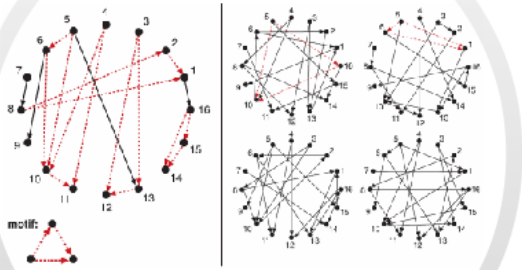
$$x_i = \frac{1}{\lambda} \sum_{j \in M(i)} x_j = \frac{1}{\lambda} \sum_{j=1}^{N} A_{i,j} x_j$$



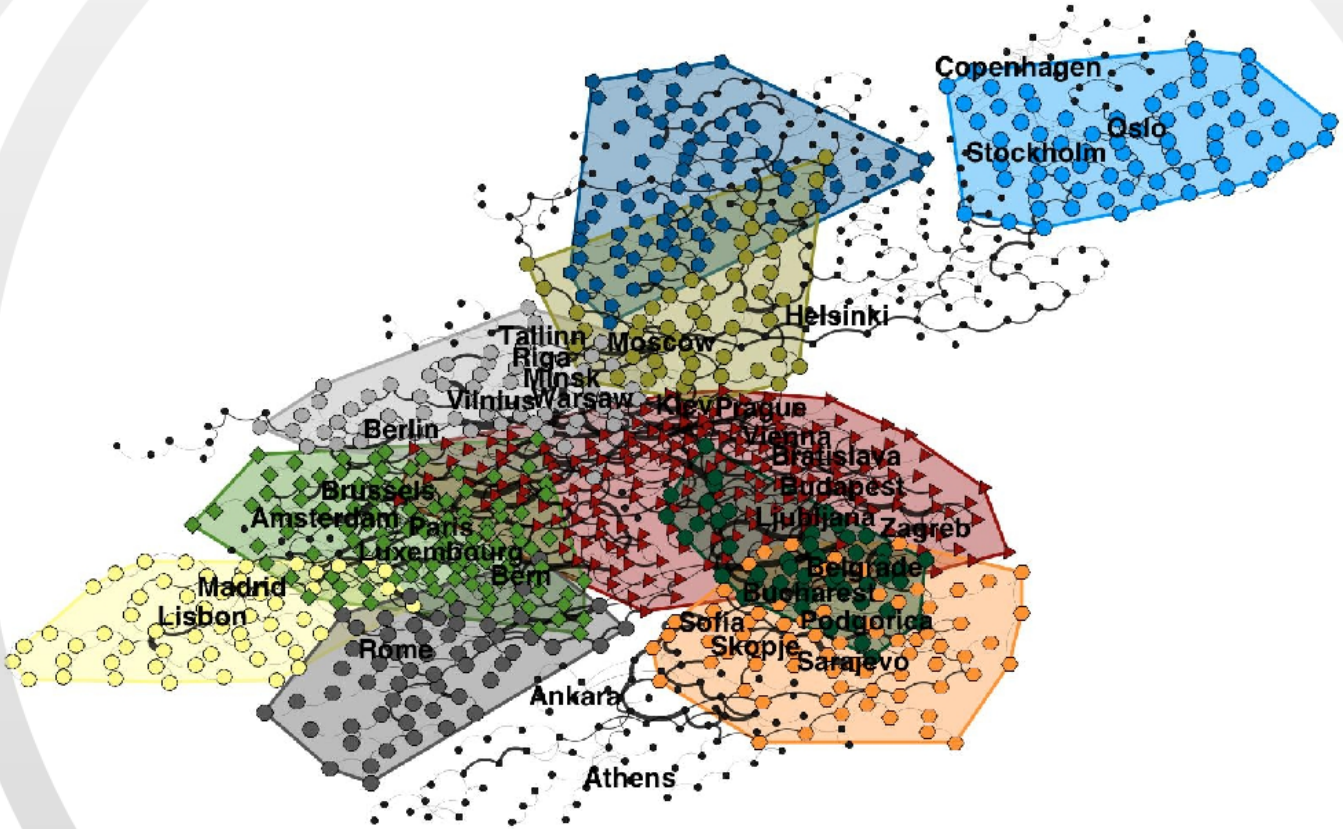
Centralnost

Velikost največje komponente

59,4%



Ponovljivi vzorci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Helsinki
Tallinn
Riga
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Vilnius
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Kiev
Prague
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Budapest
Ljubljana
Zagreb
Belgrade
Bucharest
Sofia
Podgorica
Skopje
Sarajevo
Berlin
Brussels
Amsterdam
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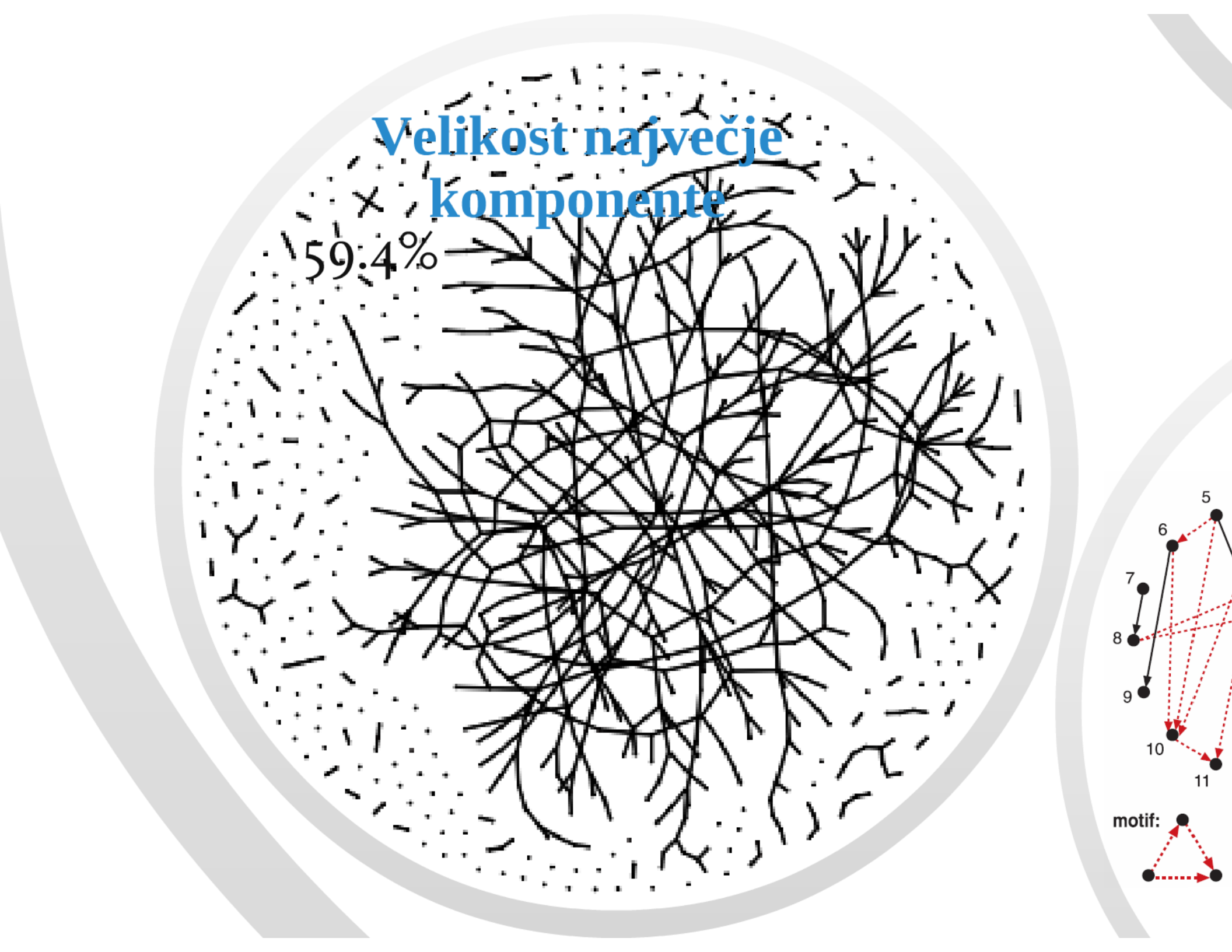
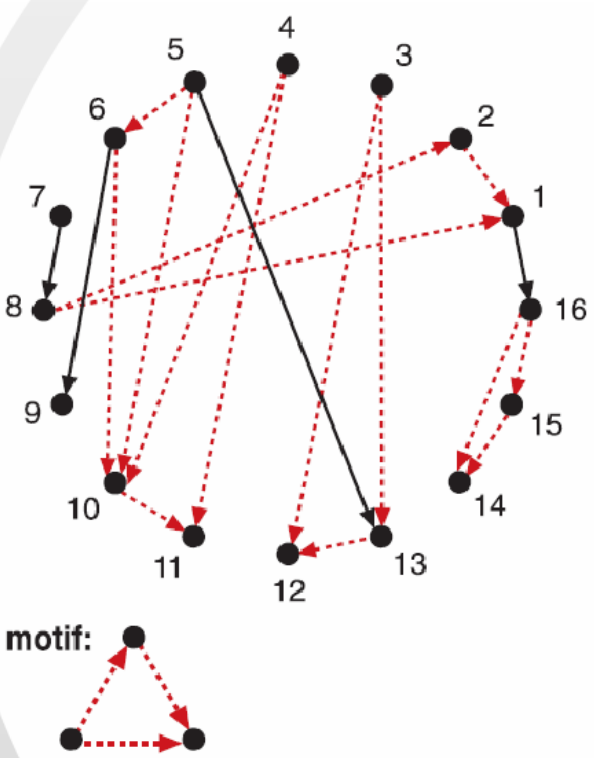
Luxembourg
Bern
Madrid
Lisbon
Rome
Ankara
Athens

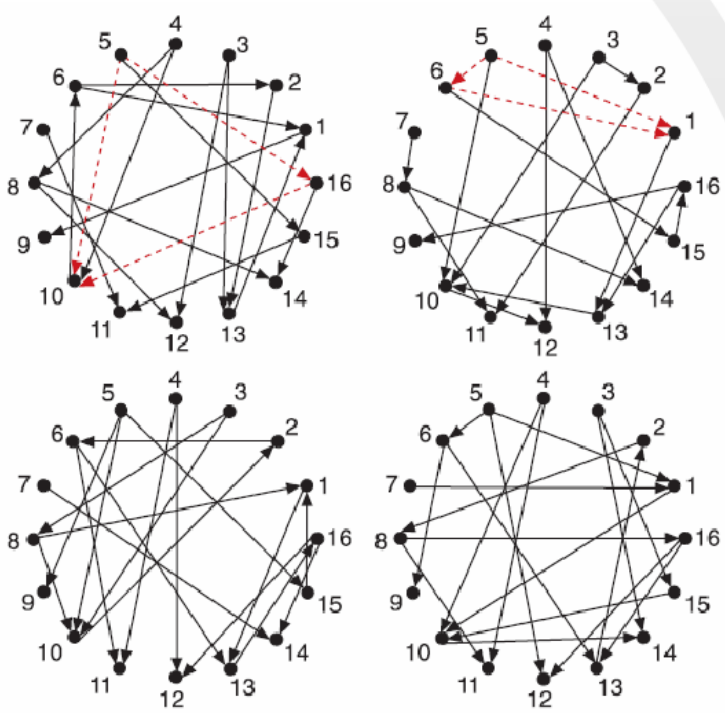
Skupnosti

Velikost največje komponente

59.4%







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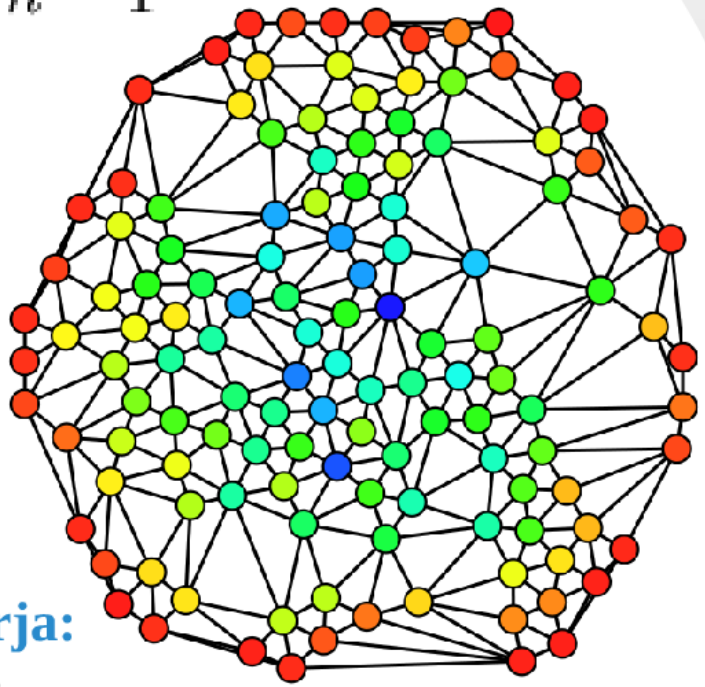

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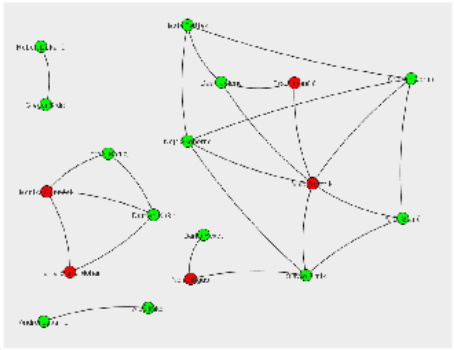
Centralnost

Aplikativna uporaba analize omrežij

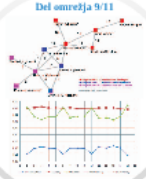
FRI PhD 1. in 2. letnik
Facebook



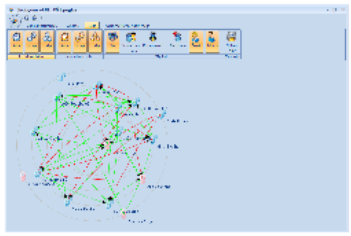
Odkrivanje teroristov

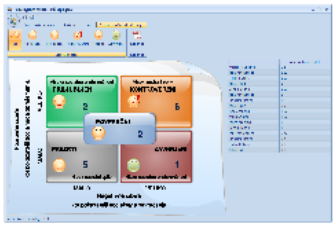
Omrežje 9/11

Del omrežja 9/11



Sociogram





Skrita (covert) omrežja

Destabilizacija omrežja

TNA

efektivnost (efficiency)
povprečna efektivnost =
(inverz vsote najkrajših razdalj med vsemi pari)/(število parov)

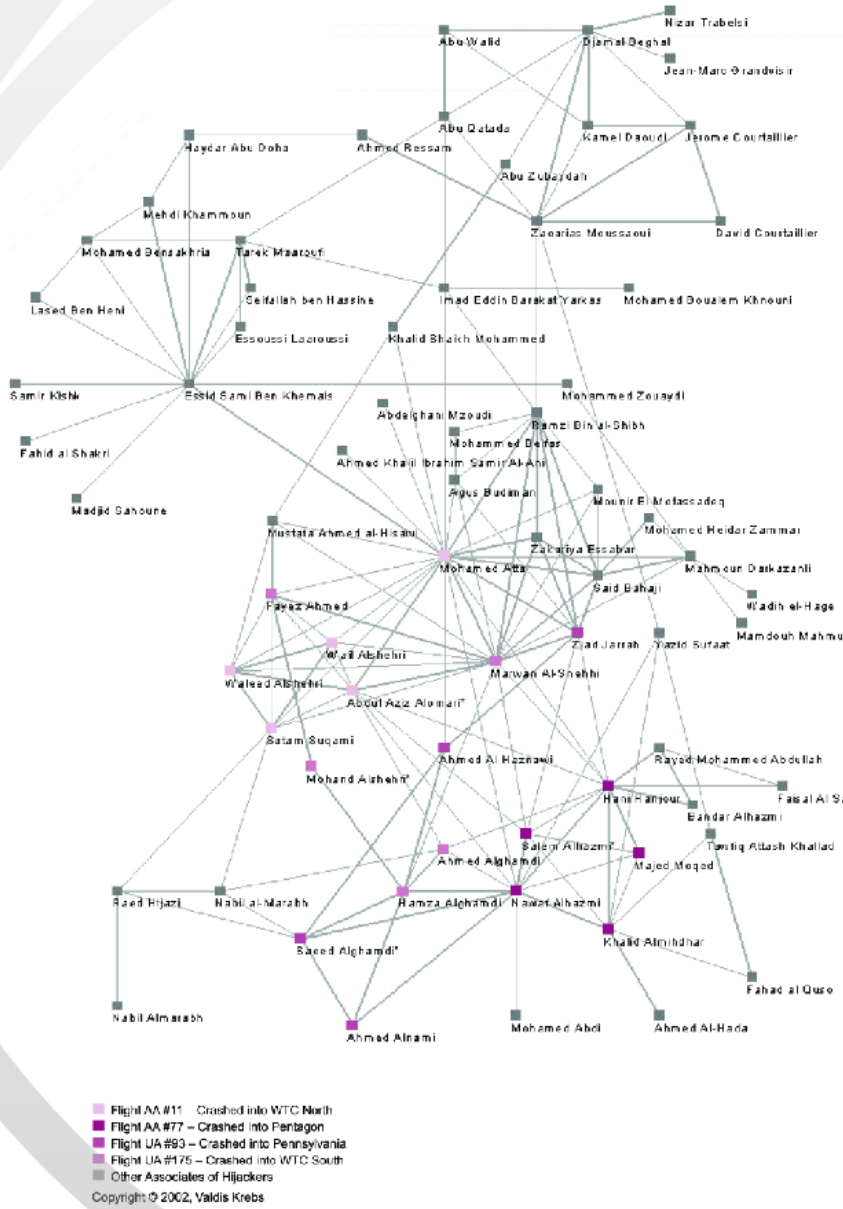
tajnost (secrecy = exposure probability + link detection probability)

optimalno razmerje med
tajnostjo in efektivnostjo

nah

bitvah
na

Omrežje 9/11



Velikost:

62 oseb
jedro 19 oseb v 4 skupinah

Gostota:

zelo nizka, 0.08

Stopnje vozlišč:

povprešno 4.9

Gruče:

jedro z gostoto 0.585

Najkrajša pot:

najdaljša 5
povprečna 2.92

Centralnosti:

prvi 4 v različnih ugrabitvah
naslednja 2 povezovalna

Efektivnost:

0.395

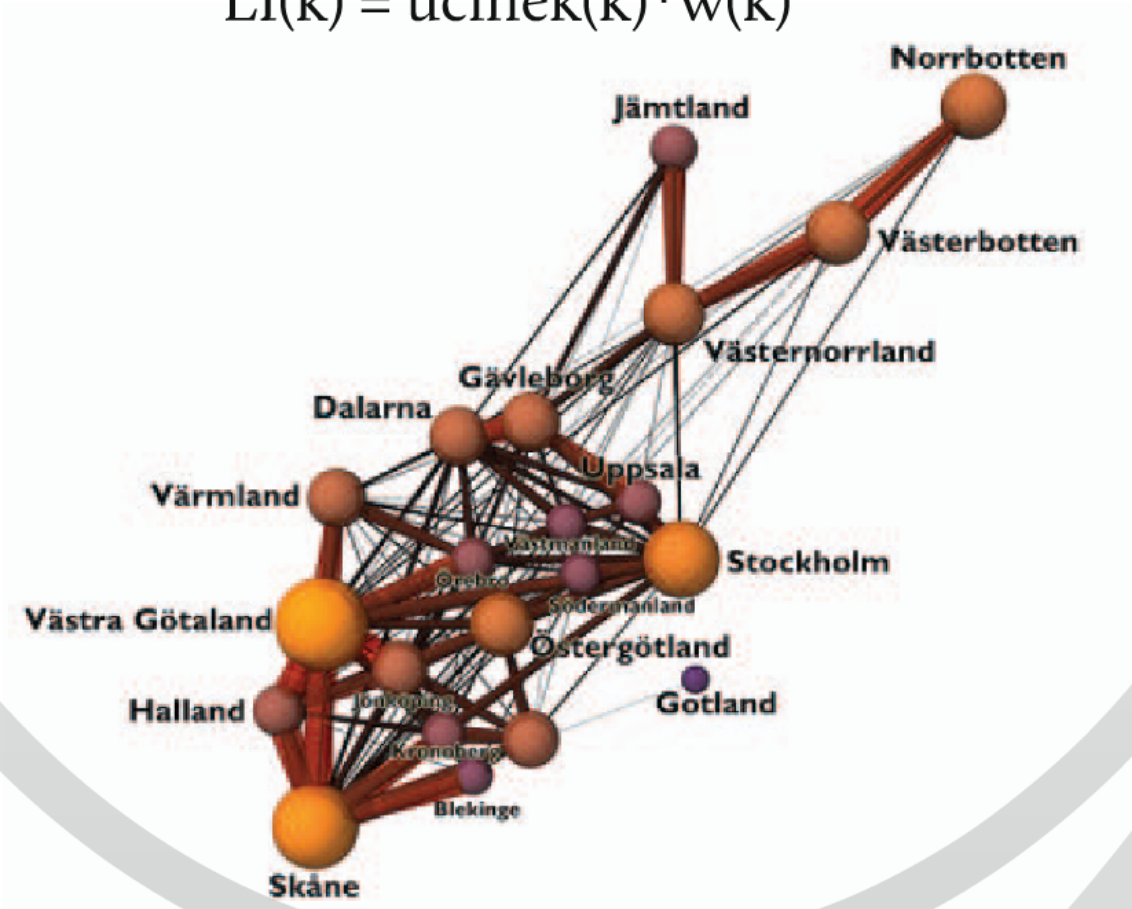
Tajnost:

celo omrežje: 0.86
jedro: 0.77

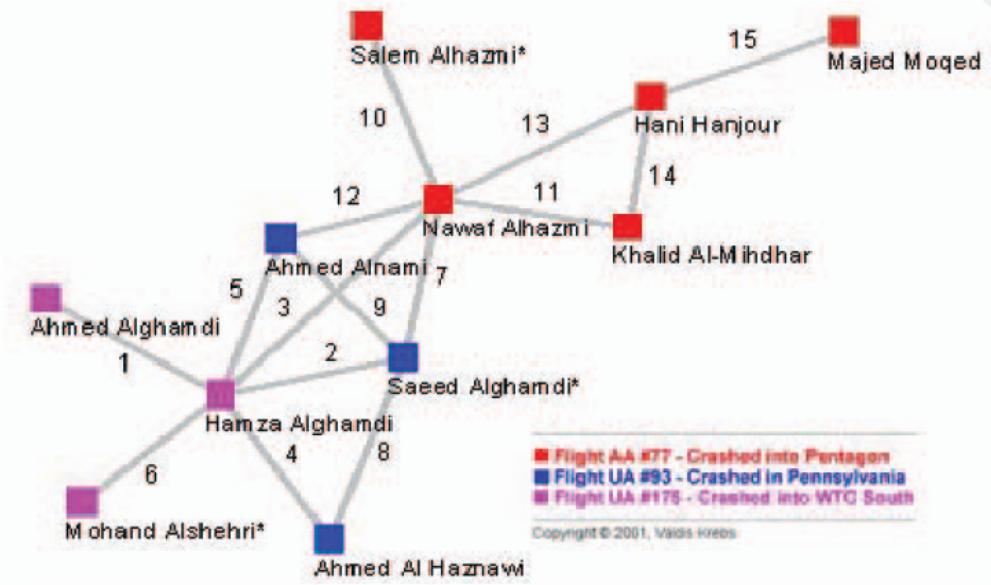
učinek (performance) = tajnost * efektivnost

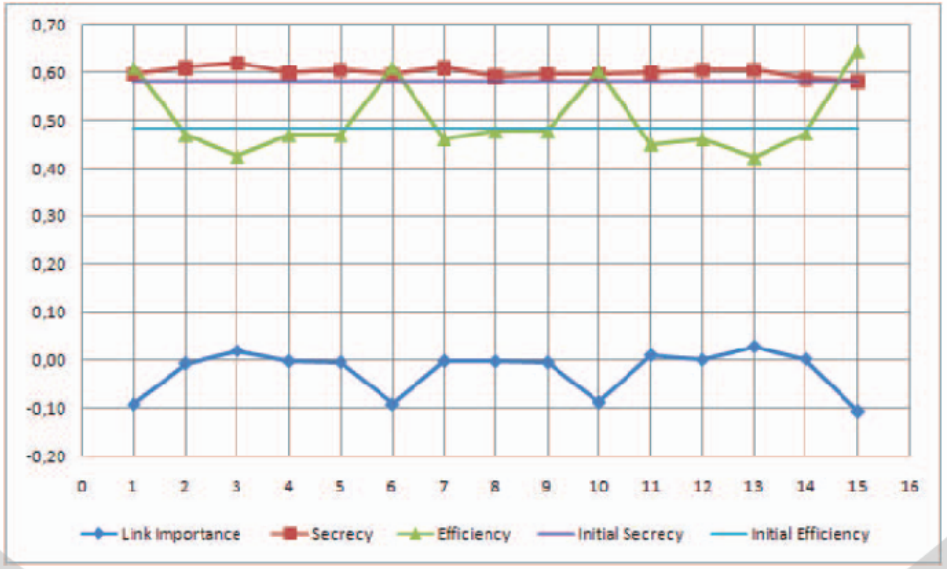
pomembnost povezave (link importance)

LI(k) = učinek(k)*w(k)

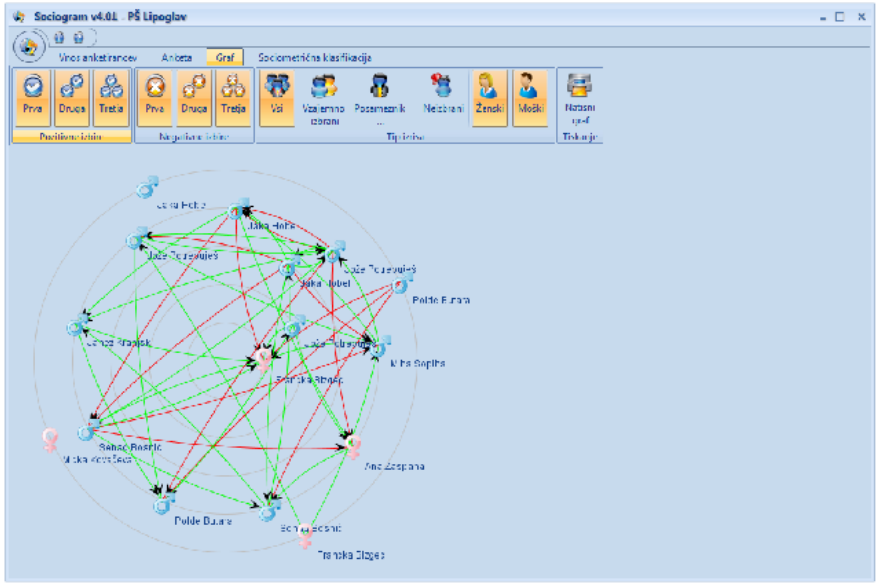


Del omrežja 9/11



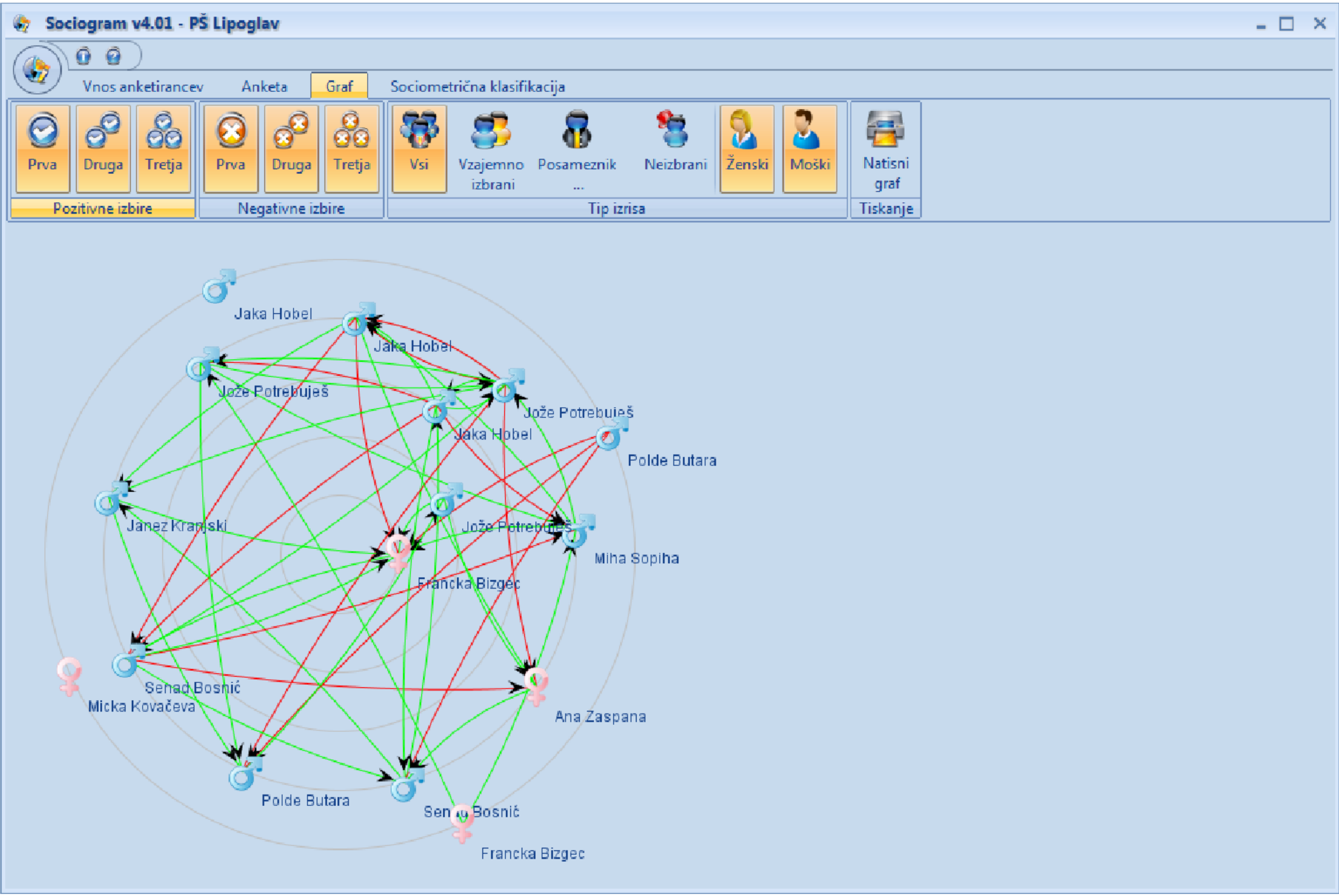


Sociogram



Sociometrični indeks

$$SSa = 1 + \frac{\sum Izbir - Mizbir}{N-1}$$



Sociogram v4.01 - PŠ Lipoglav

Sociogram v4.01 - PŠ Lipoglav

Vnos anketirancev | Anketa | Graf | Sociometrična klasifikacija

Vsi | Povprečni | Priljubljeni | Kontroverzni | Prezrti | Zavrnjeni | Legenda

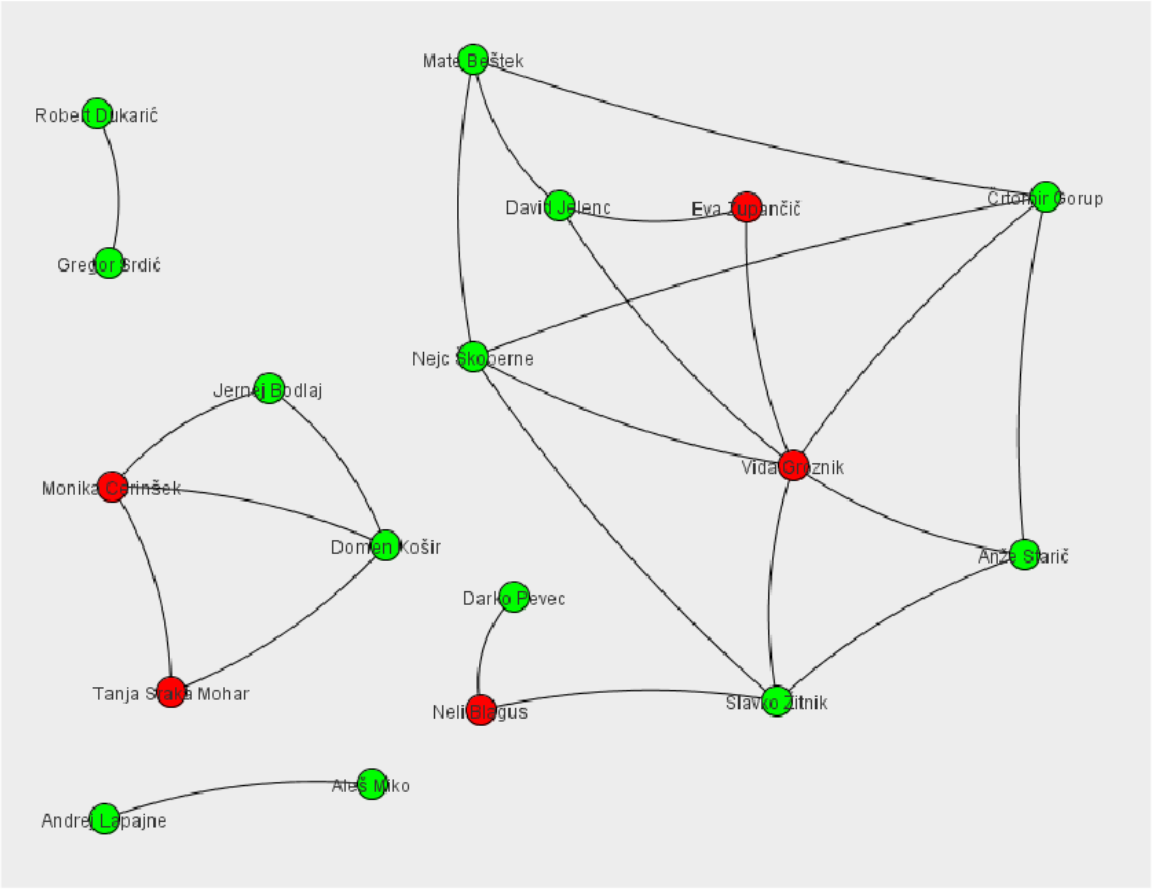
Izbira prikaza | Legenda

	Sociometrični indeks
Micka Kovačeva	0,8
Jože Potrebuješ	1,13
Polde Butara	1,07
Jaka Hobel	1
Senad Bosnić	1,07
Jože Potrebuješ	1
Francka Bizgec	1,2
Jaka Hobel	0,93
Ana Zaspana	1,07
Miha Sopiha	1,07
Janez Kranjski	1
Senad Bosnić	1
Jože Potrebuješ	0,87
Francka Bizgec	0,8
Polde Butara	0,8
Jaka Hobel	0,8

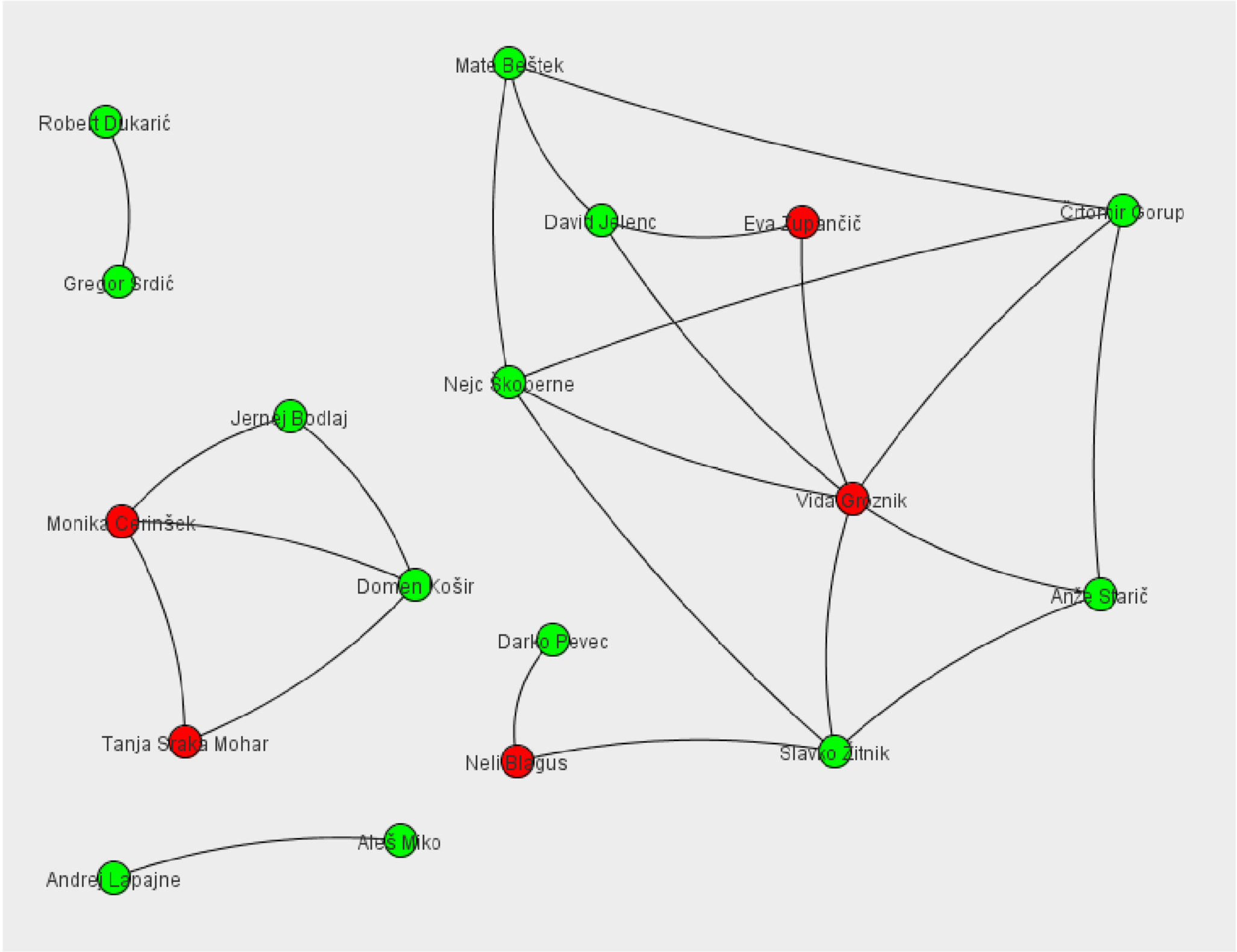
Indeks kohezivnosti je: 0,21

FRI PhD 1. in 2. letnik

Facebook



Sociog


Mate Beštek
Robert Dukarić
David Jelenc
Eva Tupančič
Črtomir Gorup
Gregor Srdić
Nejc Skoberne
Jernej Bodlaj
Vida Groznik
Monika Cerinšek
Domen Košir
Anže Starič
Darko Pevec
Tanja Straka Mohar
Neli Blagus
Slavko Žitnik
Aleš Miko
Andrej Lapajne

Raziskovalne smernice

Information retrieval

Ranking

Ontologies

Entity Resolution

Entity Extraction

Redundancy elimination

Link analysis

Structural prediction

Classification

Network analysis

Abstraction

Scale-freeness

Random models