

Complex Networks Homework 3

Koutsoukis Nikolaos

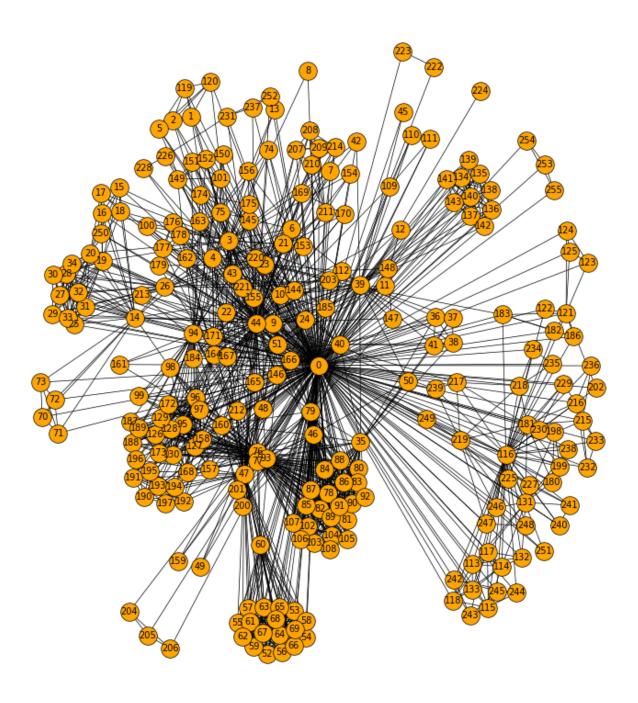
May 4, 2022

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1 Graph

1.1 Authors and Co-authors Graph



1.2 Node index and author's name

0		rice and					
	Thanasis Korakis	65	Alexandros G. Fragkiadaki	130	Eduard Escalona	197	Henrik Lundgren
1	Valentina Nejkovic	66	Pavlos Charalampidis	131	Pei Liu 0001	198	Francesco Verde
2	Filip Jelenkovic	67	Nicolas Seydoux	132	Theodore S. Rappaport	199	Anna Scaglione
3	Nikos Makris	68	Christelle Ecrepont	133	Parisa Amiri-Eliasi	200	George Parisis
4	Virgilios Passas	69	Mengxuan Zhao	134	Hyunwoo Lee 0001	201	Dirk Trossen
5	Milorad Tosic	70	Emmanouil Pissadakis	135	Donghyun Kim	202	Chen Dong
6	Christos Zarafetas	71	Nikolaos Alachiotis	136	Junho Suh	203	Maximilian Ott
7	Alexandros Valantasis	72	Dimitris Theodoropoulos	137	Ted Taekyoung Kwon	204	Hongbin Li
8	Theodoros Tsourdinis	73	Dionisios N. Pnevmatikato	138	Pedro Martinez-Julia Antonio F. Skarmeta	205	Phuoc Tran-Gia
9	Panagiotis Tzimotoudis	74	Pavlos Basaras	140	Taewan You	206	Hong-Shik Park
10	Giannis Kazdaridis	75	Navid Nikaein	141	Loic Baron	207	Giovanni Di Stasi
11	Nikos Sidiropoulos	76	Anna Tzanakaki	142	Serge Fdida	208	Roberto Bifulco
12	Ioannis Zografopoulos	77	Markos P. Anastasopoulos	143	JongWon Kim	209	Stefano Avallone
13	Christos Nanis	78	Ignacio Berberana	144	Harris Niavis	210	Roberto Canonico
14	Panagiotis Skrimponis	79	Dimitris Syrivelis	145	Ioannis Igoumenos	211	Nikolaos Giallelis
15	Sheila Borges Rajguru	80	Ilker Demirkol	146	Max Ott	212	Adamantios Fiamegkos
16	Karen Cheng	81	Jesús Gutiérrez Terán	147	Dimosthenis Delimpasis	213	Georgios Kyriakou
17	Jonatan Ostrometzky	82	Eckhard Grass	148	Konstantinos Chounos	214	Francesco Paolo D'Elia
18	Emily Ford	83	Qing Wei 0001	149	Eryk Schiller	215	Özgü Alay
19	Zoran Kostic	84	Emmanouil Pateromichela	150	Islam Alyafawi	216	Yao Wang 0001
20	Gil Zussman	85	Nikola Vucic	151	Zhongliang Zhao	217	Feilu Liu
21	Vasileios Miliotis	86	Albrecht J. Fehske	152	Torsten Braun	218	Jian Lin
22	Kostas Chounos	87	Michael Grieger	153	Vasilis Maglogiannis	219	Zhifeng Tao
		88	Michael Eiselt	154	Dries Naudts	220	Angelos-Christos G. Anadi
23	Apostolos Apostolaras	89	Jens Bartelt	155	Ingrid Moerman	221	Luis Rodriguez
24	Polychronis Symeonidis	90	Gerhard P. Fettweis	156	Spyros Kechagias	222	Giovanni Pau 0001
25	Dipankar Raychaudhuri	91	George L. Lyberopoulos	157	Yi Shu	223	Ryuji Wakikawa
26	Ivan Seskar	92	Eleni Theodoropoulou	158	Georgios Zervas	224	Sung-Ju Lee
27	Dan Kilper	93	Dimitra Simeonidou	159	Constantine Dovrolis	225	Michael E. Knox
28	Tingjun Chen	94	Kostas Katsalis	160	Vasilis Sourlas	226	George Athanasiou
29	Jakub Kolodziejski	95	Bijan Rahimzadeh Rofoee	161	Thanasis Papapioannou	227	Shashi Raj Singh
30	Michael Sherman	96	Giada Landi	162	Raymond Knopp	228	Özgür Erçetin
31	Xiaoxiong Gu	97	Jordi Ferrer Riera	163	Antonio Maria Cipriano	229	Ozgu Alay
32	Harish Krishnaswamy	98	Kostas Kousias	164	Iordanis Koutsopoulos	220	Van Wang
33				10-		230	Yao Wang
00	Sumit Maheshwari	99	L. Kiraly	165	Thierry Rakotoarivelo		
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2 Exercise 1

Calculating all (overlapping and non-overlapping) communities with the algorithm Clique Percolation Method (**CPM**). Using the CFinder software I got the following results:

- k = 3: 4 communities
- $\mathbf{k} = \mathbf{4}$: 10 communities
- $\mathbf{k} = \mathbf{5}$: 16 communities
- $\mathbf{k} = \mathbf{6}$: 26 communities
- k = 7: 20 communities
- k = 8: 16 communities
- $\mathbf{k} = 9$: 13 communities
- k = 10: 6 communities
- k = 11: 6 communities
- k = 12: 6 communities
- k = 13: 5 communities
- k = 14: 6 communities
- k = 15: 3 communities
- k = 16: 3 communities
- k = 17: 3 communities
- k = 18: 3 communities
- k = 19: 3 communities
- $\mathbf{k} = 20$: 3 communities
- k = 21: 1 community

(For more information you can see the 1_exercise/output_cfinder folder)

3 Exercise 2

The tree of the communities was calculated based on the algorithm Girvan-Newman in two ways:

- With the recalculating the edge betweenness centrality in every node of the tree
- Without recalculating the edge betweenness centrality in every node of the tree

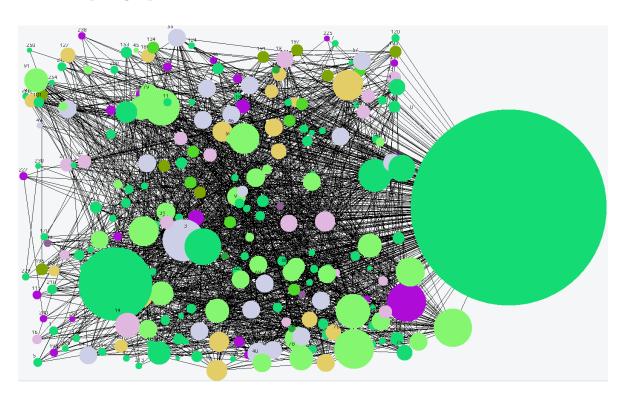
But, because the output files are too large, you can see that on 2_exercise/with_ebc.txt, and 2_exercise/without_ebc.txt for more information.

There is a difference between the trees, which is logical because calculating the edge betwenness centrality each time, changes the structure of the tree. Having different height at the end.

4 Exercise 3

Calculating all the communities with the CiBC algorithm, using the AviNet software. And take the following results:

4.1 Output graph of AviNet

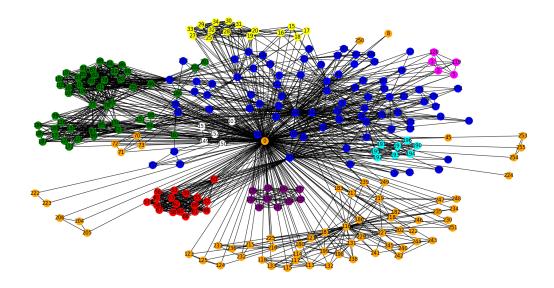


4.2 Communities of AviNet

Community	Nodes
1	15, 14, 16, 17, 18, 19, 20, 156, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34
2	70, 71, 72, 73
3	134, 135, 136, 137, 138, 139, 140, 141, 142, 143
4	157, 127, 158, 168, 126, 128, 129, 130, 187, 188, 189, 172, 173, 99, 94, 95, 96, 97, 98
5	185, 45, 36, 35, 37, 38, 39, 40, 41, 102, 103, 104, 105, 106, 107, 108, 50, 46, 21, 80, 76, 77, 78, 79, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93
6	190, 191, 192, 193, 194, 195, 196, 197
7	212, 49, 47, 48, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69
8	232, 215, 216, 233, 225, 180, 181, 198, 199, 240, 227, 241, 251, 246, 238, 132, 131, 236, 202, 115, 113, 114, 116, 117, 118, 133
9	242, 243, 244, 245
10	253, 254, 255, 204, 205, 206, 122, 121, 123, 124, 125, 207, 208, 209, 210, 211, 214, 119, 1, 2, 5, 120, 182, 183, 186, 110, 109, 111, 234, 218, 235, 213, 149,

5 Exercise 4

Calculating all the communities, using the modularity optimization algorithm.



6 Exercise 5

Used the Louvain algorithm, which is located at link louvain.

```
Begin: Sat Apr 30 23:07:45 2022
Computation of communities with the Newman-Girvan Modularity quality function
level 0:
  start computation: Sat Apr 30 23:07:45 2022
  network size: 255 nodes, 3368 links, 3368 weight
  quality increased from -0.0115686 to 0.555425
  end computation: Sat Apr 30 23:07:45 2022
level 1:
  start computation: Sat Apr 30 23:07:45 2022
  network size: 28 nodes, 154 links, 3368 weight
  quality increased from 0.555425 to 0.599066
  end computation: Sat Apr 30 23:07:45 2022
level 2:
  start computation: Sat Apr 30 23:07:45 2022
  network size: 8 nodes, 42 links, 3368 weight
  quality increased from 0.599066 to 0.599066
  end computation: Sat Apr 30 23:07:45 2022
End: Sat Apr 30 23:07:45 2022
Total duration: 0 sec
0.599066
```

Number of levels: 3 level 0: 255 nodes level 1: 28 nodes level 2: 8 nodes