

# Методы выделения сообществ в социальных графах

Спецсеминар "Алгебра над алгоритмами и эвристический поиск закономерностей"

Евгений Никишин

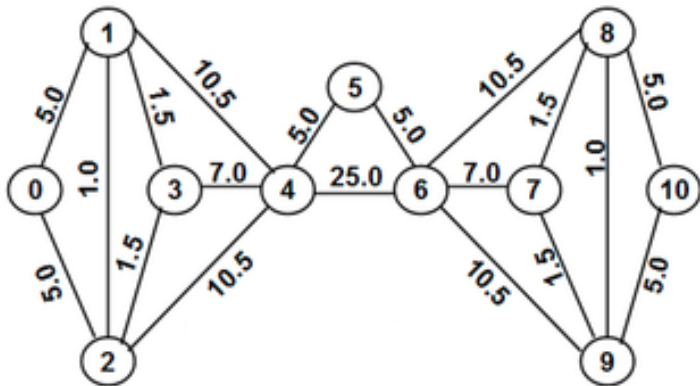
ВМК МГУ

16 мая 2016 г.

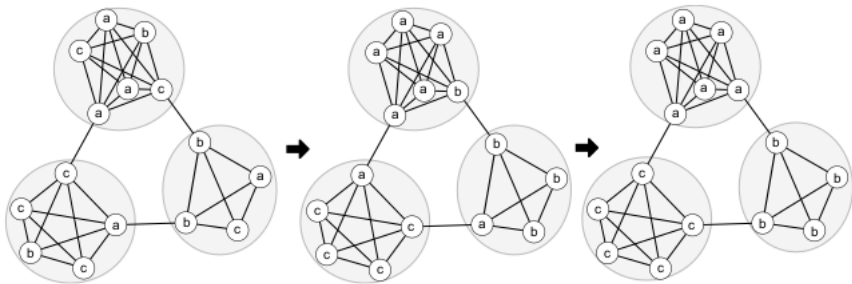
1 Непересекающиеся сообщества

2 Пересекающиеся сообщества

## Edge Betweenness



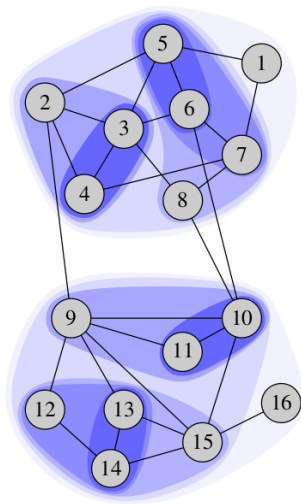
# Label Propagation

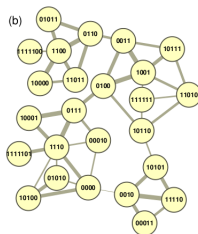
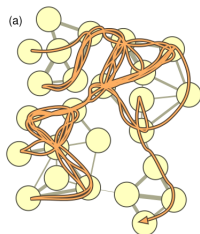


Модулярность

$$Q = \frac{1}{2m} \sum_{i,j} \left( A_{ij} - \frac{d_i d_j}{2m} \right) \delta(C_i, C_j)$$

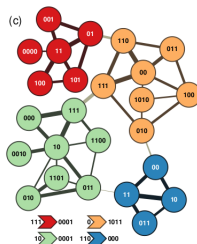
где  $A$  - матрица смежности графа,  $m$  - число ребер,  $d$  - степень,  $C_i, C_j$  - сообщества





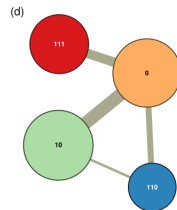
```

1111100 1100 0110 11011 10000 11011 0110 0011 10111 1001
0011 1001 0100 0111 10001 1110 0111 10001 0111 1110 0000
1110 10001 0111 1110 0111 1110 1111101 1110 0000 10100 0000
1110 10001 0111 0100 10110 11010 10111 1001 0100 1001 10111
1001 0100 1001 0100 0011 0100 0011 0110 11011 0110 0011 0100
1001 10111 0011 0100 0111 10001 1110 10001 0111 0100 10110
111111 10110 10101 11110 00011
    
```



```

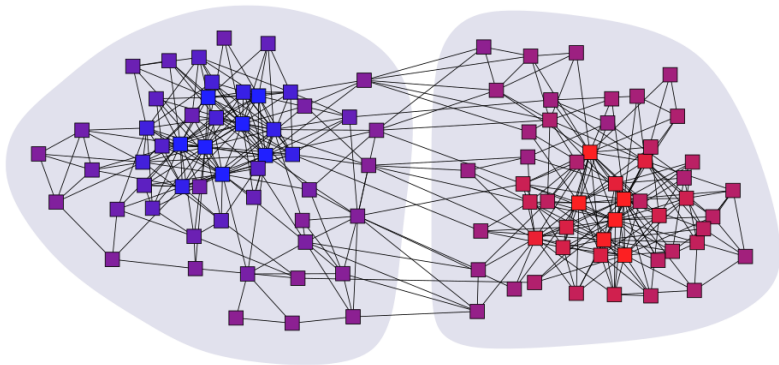
111 0000 11 01 101 100 101 01 0001 0 110 011 00 110 00 111
1011 10 111 000 10 111 000 111 10 011 10 000 111 10 111 10
0010 10 011 010 011 10 000 111 0001 0 111 010 100 011 00 111
00 011 00 111 00 111 110 111 110 10011 111 01 101 01 0001 0 110
111 00 011 110 111 1011 10 111 000 10 000 111 0001 0 111 010
1010 010 1011 110 00 10 011
    
```



```

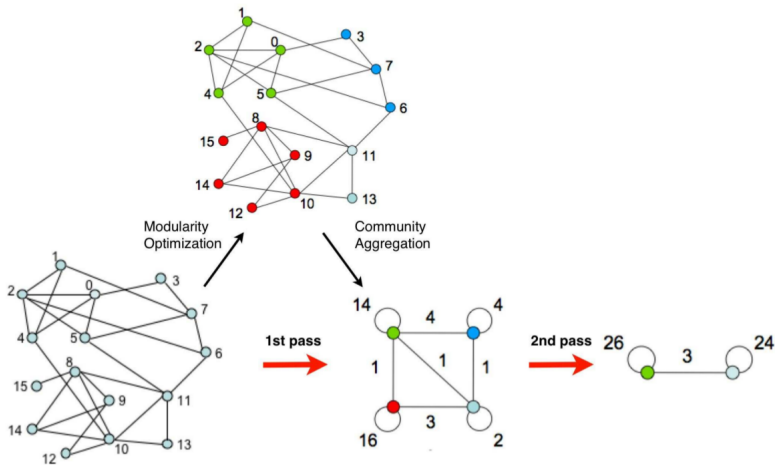
111 0000 11 01 101 100 101 01 0001 0 110 011 00 110 00 111
1011 10 111 000 10 111 000 111 10 011 10 000 111 10 111 10
0010 10 011 010 011 10 000 111 0001 0 111 010 100 011 00 111
00 011 00 111 00 111 110 111 110 10011 111 01 101 01 0001 0 110
111 00 011 110 111 1011 10 111 000 10 000 111 0001 0 111 010
1010 010 1011 110 00 10 011
    
```

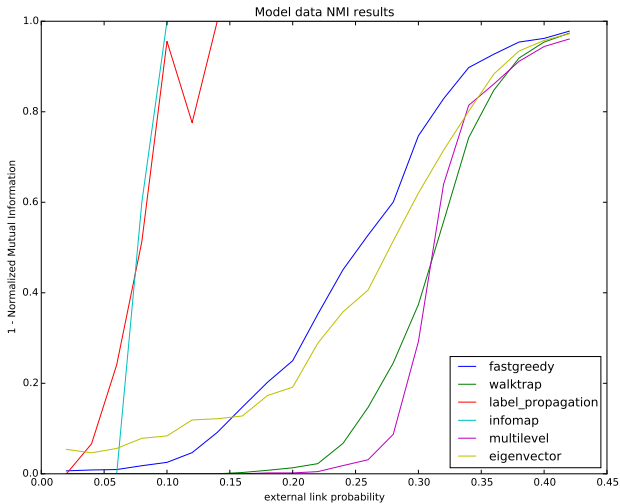
# Leading Eigenvector

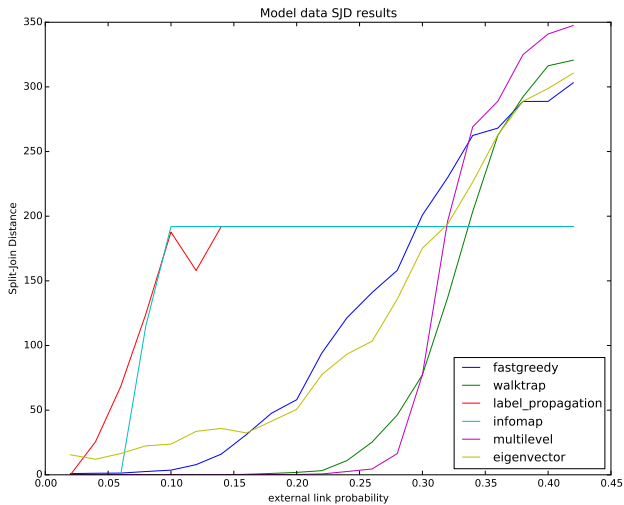


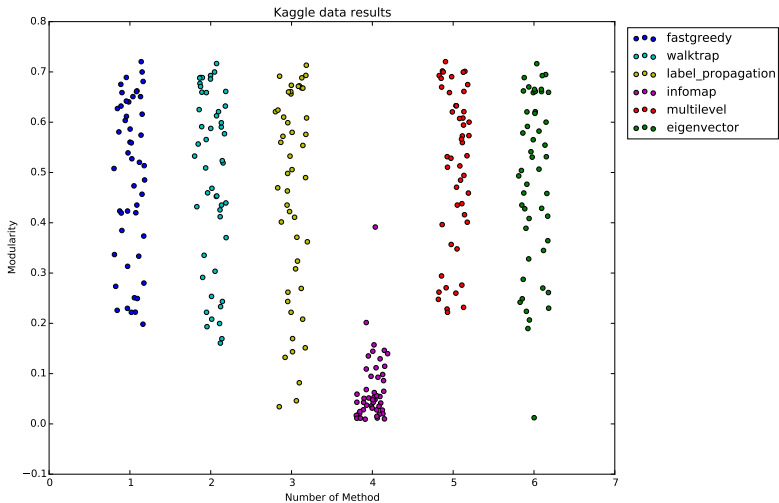


# Multilevel







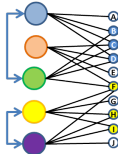
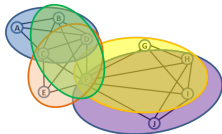


1 Непересекающиеся сообщества

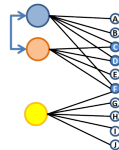
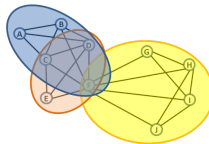
2 Пересекающиеся сообщества

# Clique Perlocation

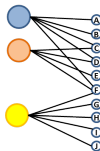
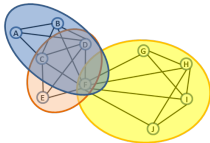
Step 2: Combine adjacent cliques (with  $K-1 = 3$  shared nodes)



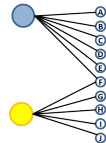
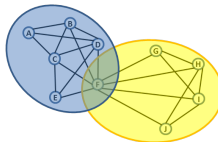
Step 3: Combine adjacent cliques (with  $K-1 = 3$  shared nodes)

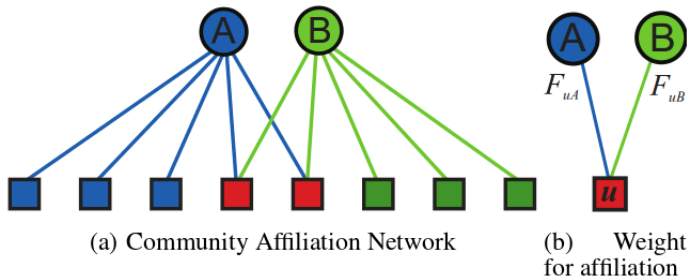


After merging adjacent cliques



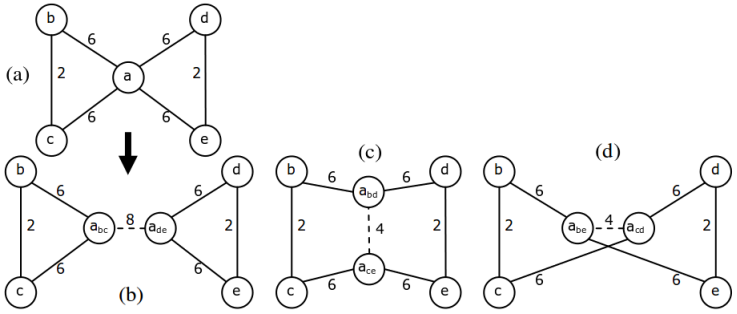
After merging adjacent cliques, there are 2 overlapping communities











Различные эго-сети		1-NMI			
# вершин	# рёбер	BigCLAM	CPM	CONGO	DEMON
59	146	0.2497	<b>0.2975</b>	0.1703	0.2315
66	270	0.3580	<b>0.4305</b>	0.3513	<b>0.4305</b>
159	1693	0.2898	0.3454	0.3278	<b>0.4057</b>
170	1656	0.1460	<b>0.2730</b>	0.1381	0.1585
227	3192	0.2342	<b>0.2700</b>	0.2366	0.2408
347	2519	<b>0.0501</b>	0.0476	0.0477	0.0489
547	4813	0.0120	0.0157	0.0241	<b>0.0400</b>
755	30025	0.1207	Memory	Time	<b>0.1821</b>
792	14024	0.2401	Memory	Time	<b>0.3620</b>
1045	26749	<b>0.1382</b>	Memory	Time	0.1245

Различные эго-сети		Omega Index			
# вершин	# рёбер	BigCLAM	CPM	CONGO	DEMON
59	146	0.1058	<b>0.1835</b>	0.1299	0.0939
66	270	0.3307	0.3001	<b>0.4413</b>	0.3001
159	1693	0.3266	0.2622	<b>0.3376</b>	0.1521
170	1656	0.0521	<b>0.0914</b>	0.0749	0.0319
227	3192	0.0000	0.1793	0.0488	<b>0.1817</b>
347	2519	0.1257	<b>0.2424</b>	0.0619	0.1681
547	4813	<b>0.0518</b>	0.0080	0.0045	0.0043
755	30025	<b>0.3917</b>	Memory	Time	0.0000
792	14024	<b>0.3378</b>	Memory	Time	0.0181
1045	26749	<b>0.1936</b>	Memory	Time	0.0000

Конец!