MAE 298, Understanding Networks

Spring Quarter 2006

Problem Set # 1, Due Tuesday April 25

Here is the data compiled from the in-class questionnaire (A "-" means data not available). From it we can construct 1) the graph of acquaintances between people, also 2) the bipartite graph mapping people onto research interests, and 3) the bipartite graph mapping people onto academic programs. (Note, we can also map research topic to academic departments).

#	Name	who they know	research interest	Dept
1	Bell, Adrian	2, 10	-	GECL
2	Bird, Christian	1, 4, 8, 11	collaboration and software networks	GCSI
3	Ching, Irvin	16	optimization and control	GECE
4	Das, Ananya	7, 8, 14, 19, 14, 24	-	GCSI
5	Fonda, Peter	9	1) machine tools, 2) automation	GEMA
6	Henry, Adam	10, 12	political science/political networks	GTTP
7	Muelder, Christopher	2, 8, 11	visualization	GCSI
8	Ogawa, Michael	14, 4, 11, 7, 2	-	GCSI
9	Rapetti, Ryan	5	neural networks	GEMA
10	Rowan, Dana	1, 6, 12	economic and policy networks	GECL
11	Shen, Zeqian	2, 7, 8, 14	visualization	GCSI
12	Silvis, Julia	6, 10	social networks and transportation	GTTP
13	Tang, Hong-Yue	-	1) power grid, 2) communication networks	GEMA
14	Tikhonova, Anna	4, 8, 11	Markov chains	GCSI
15	Van Aalsburg, Jordan	20	general interest	GPHY
16	Wen, Haoran	3, 18	computer and software networks	GEMA
17	de Mello, Phillip	-	1) power grid, 2) economic networks	GEMA
18	Chau, Yucheng	3, 16	-	-
19	Yu, Hua	4, 16, 24	wireless networks	-
20	Pellett, Braden	15	self-organizing networks	-
21	Keralapura, Ram	-	interactions of multiple networks	GCSI
22	Paul, Debashis	23	random graphs and matrices	STAT
23	Peng, Jie	22	random graphs	STAT
24	Gupta, Dhurv	-	wireless networks	GCSI
25	Pellette, Phillip	-	1) automation, 2) power grid	GEMA

You can also download this same table from the class web site.

1). Construct the adjacency matrix for the network of acquaintances between people. And now make it symmetric (if there is a link from i to j, then also include a link from j to i). Call this matrix **A**. Draw a picture of this network using any means you like (i.e., graph drawing software, pencil and paper, etc). Label the nodes by the id number assigned to them above.

2). It will be most easy to do the following calculations using a computer — you can feed the adjacency matrix into Mathematica, Matlab, R, etc. You can also do the calculations by hand, though it might get tedious! Find the following:

(a) The numbers n and m of vertices and edges in the acquaintance network.

(b) The degree of each vertex.

(c) The number k of components, and the size s_k of each component.

(d) The clustering coefficient of each vertex in the network. And the average clustering coefficient for the network.

The clustering coefficient C_i for a vertex i is the proportion of links between the vertices within its neighborhood divided by the number of links that could possibly exist between them:

C_i = (# number of links between neighbors of i, excluding i) / (total number of links that could exist between neighbors).

In more formal terms: $C_i = 2|e_{jk}|/k_i(k_i - 1)$,

where $|e_{jk}|$ is the total number of links between all nodes j and k that are connected to node i (NOT including i), and k_i is the degree of node i. Note the factor of 2 comes from the fact we are considering undirected edges, so the total number of edges that could exist between neighbors of i is $k_i(k_i - 1)/2$. For more information on the clustering coefficient, see for instance,
`http://en.wikipedia.org/wiki/Clustering_coefficient`

3) Now consider the bipartite graph linking people and research topics. Assign each topic a unique letter (A, B, C, etc). Now draw the graph linking people and topics, again using any means you wish. Note some people are interested in more than one topic. They will contribute one link for each topic of interest.

4) Is there a strong correlation between people connected by the adjacency graph and people connected by interest in common research topics? What is a measure you would propose to quantify this?