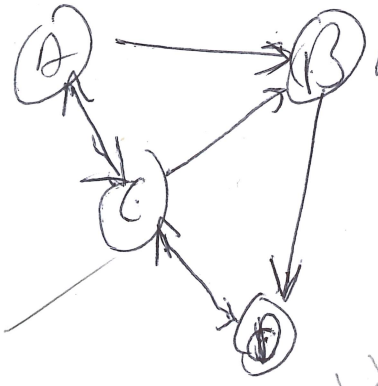
PageRank Algorithm Example

	Iteration 0	Iteration 1	Iteration 2	PageRank
A	1/4	~~1/3~~ $= \frac{1}{12}$	$\frac{1.5}{12}$	1
B	1/4	$\frac{2.5}{12}$	$\frac{2}{12}$	2
C	1/4	$\frac{4.5}{12}$	$\frac{4.5}{12}$	4
D	1/4	$\frac{4}{12}$	$\frac{4}{12}$	3

$\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$

Least important



Most important

Second most important

Iteration 0

$D = \frac{\frac{1}{4}}{3} = \frac{1}{12}$

$B = \frac{\frac{1}{4}}{2} + \frac{\frac{1}{4}}{3} = \frac{2.5}{12}$

$D = \frac{\frac{1}{4}}{1} + \frac{\frac{1}{4}}{3} = \frac{4}{12}$

$C = \frac{\frac{1}{4}}{1} + \frac{\frac{1}{4}}{1} + \frac{\frac{1}{4}}{2}$

$C = \frac{\frac{1}{4}}{2} + \frac{\frac{1}{4}}{1} = \frac{4.5}{12}$

Iteration 2

$A = \frac{\frac{4.5}{12}}{3} = \frac{1.5}{12}$

$B = \frac{\frac{1}{12}}{2} + \frac{\frac{4.5}{12}}{3} = \frac{2}{12}$

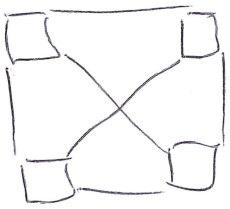
$C = \frac{\frac{1}{12}}{2} + \frac{\frac{6}{12}}{1} = \frac{4.5}{12}$

$D = \frac{\frac{2.5}{12}}{1} + \frac{\frac{4.5}{12}}{3} = \frac{4}{12}$

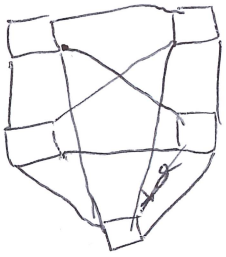
Clique Percolation Method (CPM) Algorithm

3-Clique — no of edges: 3

One community, one clique of size 3



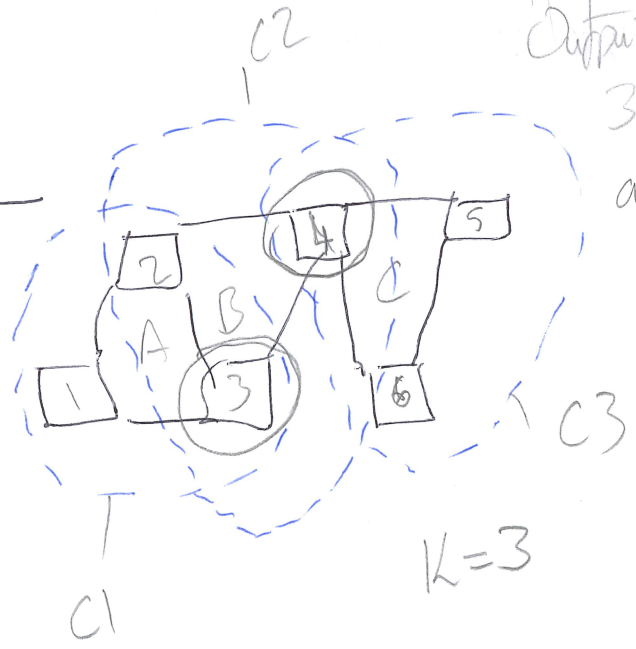
4-Clique — " , " 4



5-Clique — " , " 5

Adjacent K-Cliques

2 cliques are adjacent if they share (K-1) nodes



Output (or Page Rank) of 3 is dependent on B and similarly to C

Algorithm

Input: The social graph as representing a network of clique size, K

Output: A set of discovered communities, C.

Steps

1- All k-cliques present in the graph are extracted

2- A new graph, the clique-graph, G_C is formed where each node represents an identified clique & 2 vertices in G_C are connected by an edge, if they have $(k-1)$ common vertices.

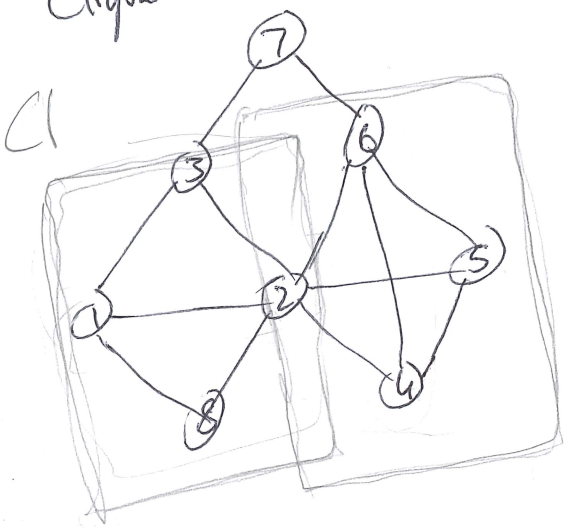
3- Connected components in G_C are identified

4- Each connected component in G_C represents a community

5- Set C_i be the set of ith communities formed for G.

For graph below use Clique Percolation method (Solved Problem)

Clique Percolation method and find all communities



C1

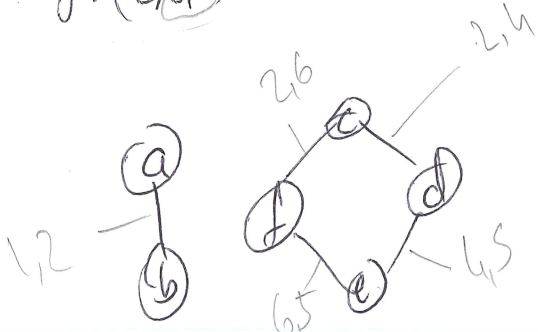
6 different cliques of size 3 (6 × 3-cliques)

Group them into different categories

a: (1,2,3)] C1
b: (1,2,8)
c: (2,4,6)
d: (2,4,5)] C2
e: (4,6,5)
f: (2,6,5)

C1: 3-Clique {1,2,3}
C2: 3-Clique {1,2,8}
C3: 3-Clique {2,6,4}
C4: 3-Clique {6,5,4}
C5: 3-Clique {2,6,5}
C6: 3-Clique {2,5,4}

C1 = (1,2,3,8)
C2 = (2,4,5,6)



Gc

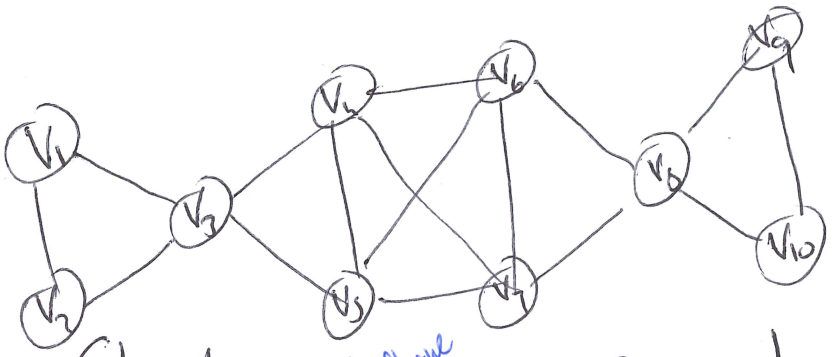
Identifying Communities

C = {C1, C2}

12-1
3-1 = 2 (1&2)
(6&4)
(2&5)

L2 is global throughout the problem

Community Detection



8 different cliques of size 3.
(8 × 3-Clique)

Group them into different categories

Cliques

C1: (V_1, V_2, V_3) Disjoint Clique

C2: (V_2, V_4, V_5)

C3: (V_4, V_5, V_7)

C4: (V_4, V_6, V_7)

C5: (V_5, V_4, V_6)

C6: (V_5, V_7, V_6)

C7: (V_6, V_7, V_8)

C8: (V_8, V_9, V_{10}) Disjoint Clique

Connected Cliques

Communities

$C_1 = (V_1, V_2, V_3)$ — (A)

$C_2 = (V_3, V_4, V_5, V_6, V_7, V_8)$ — (B)

$C_3 = (V_8, V_9, V_{10})$ — (C)

(A) (B) (C)

C_c

$k-1$

$3-1=2$

(V_4, V_5)

(V_6, V_7)

(V_4, V_7)

(V_5, V_6)