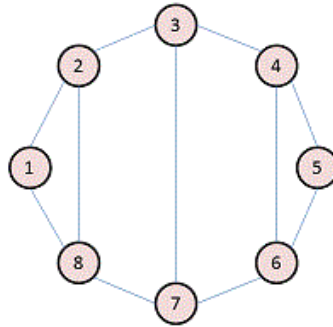


# Communities

## Question 1:

For the following graph:



Write the adjacency matrix  $A$ , the degree matrix  $D$ , and the Laplacian matrix  $L$ . For each, find the sum of all entries and the number of nonzero entries.

Solution:

5th Assignment

Adjacency matrix

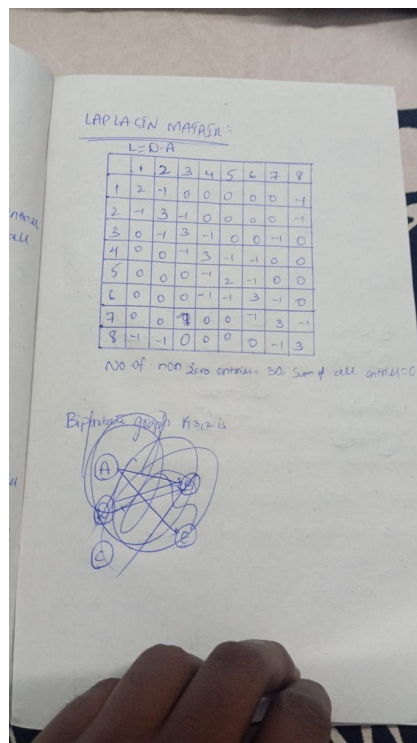
	1	2	3	4	5	6	7	8
1	0	1	0	0	0	0	0	1
2	1	0	1	0	0	0	0	1
3	0	1	0	1	0	0	1	0
4	0	0	1	0	1	1	0	0
5	0	0	0	1	1	0	0	0
6	0	0	0	1	1	0	1	0
7	0	0	1	0	0	1	0	1
8	1	1	0	0	0	0	1	0

no of non-zero entries = 22, sum of all entries = 22

Degree matrix

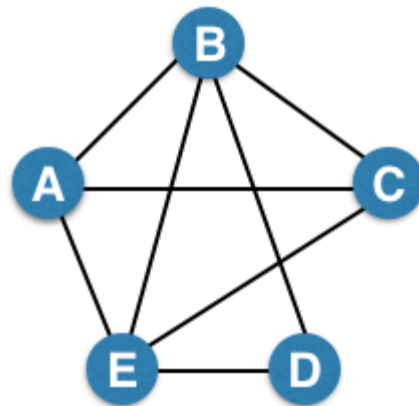
	1	2	3	4	5	6	7	8
1	2	0	0	0	0	0	0	0
2	0	3	0	0	0	0	0	0
3	0	0	3	0	0	0	0	0
4	0	0	0	3	0	0	0	0
5	0	0	0	0	2	0	0	0
6	0	0	0	0	0	3	0	0
7	0	0	0	0	0	0	3	0
8	0	0	0	0	0	0	0	3

no of non-zero entries = 8  
sum of all entries = 8



**Question 2:**

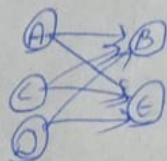
Consider the following undirected graph (i.e., edges may be considered bidirectional):



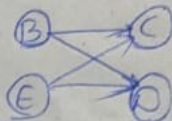
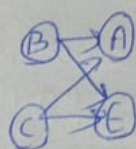
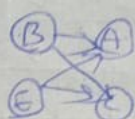
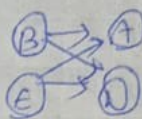
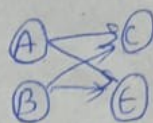
Run the "trawling" algorithm for finding dense communities on this graph and find all complete bipartite subgraphs of types  $K_{3,2}$  and  $K_{2,2}$ . Note: In the case of  $K_{2,2}$ , we consider  $\{\{W, X\}, \{Y, Z\}\}$  and  $\{\{Y, Z\}, \{W, X\}\}$  to be identical.



Bipartite  $K_{3,2}$ :



Bipartite  $K_{2,2}$ :



7<sup>th</sup> Ass

9.1)

Average

Average

Average

Subtra

A
B
C

AV

AU

AU

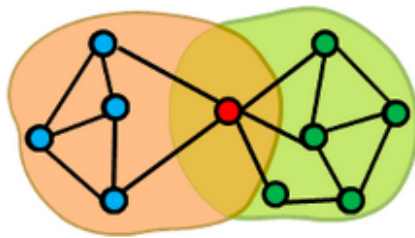
AV

A

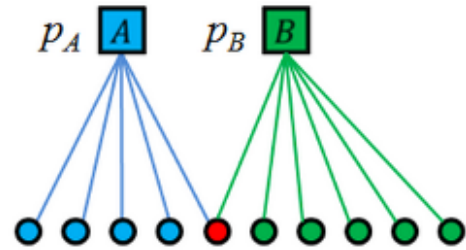
A

### Question 3:

We fit AGM to the network on the left, and found the parameters on the right:



Network



Learned AGM parameters

Find the optimal values for  $p_A$  and  $p_B$ .

Solution:

**$p_A$  = Number of edges in the network / Total possible number of edges  
=  $7 / 5c^2 = 7/10$ .**

**$p_B$  = Number of edges in the network / Total possible number of edges  
=  $9 / 6c^2 = 9/15$ .**