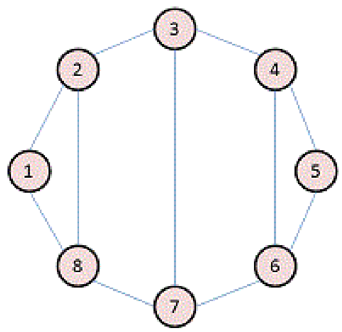
Communities

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.

(1) Adjacency matrix :

$$
\begin{array}{c|cccccccc}
 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\
\hline
1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\
2 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 \\
3 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 \\
4 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 \\
5 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\
6 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 \\
7 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 \\
8 & 1 & 1 & 0 & 0 & 0 & 0 & 1 & 0.
\end{array}
$$

No. of non zero entities = 22.

Sum of all entries = 22.

Degree matrix

$$
\begin{array}{c|cccccccc}
 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\
\hline
1 & 2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
2 & 0 & 3 & 0 & 0 & 0 & 0 & 0 & 0 \\
3 & 0 & 0 & 3 & 0 & 0 & 0 & 0 & 0 \\
4 & 0 & 0 & 0 & 3 & 0 & 0 & 0 & 0 \\
5 & 0 & 0 & 0 & 0 & 2 & 0 & 0 & 0 \\
6 & 0 & 0 & 0 & 0 & 0 & 3 & 0 & 0 \\
7 & 0 & 0 & 0 & 0 & 0 & 0 & 3 & 0 \\
8 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 3.
\end{array}
$$

No. of. non-zero entries = 8.

Sum of all entries = 8.

laplacian Matrix (L=D−A).

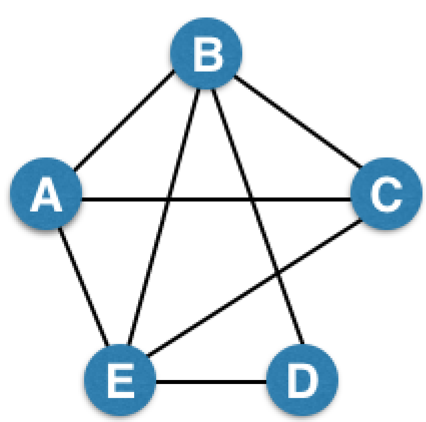
	1	2	3	4	5	6	7	8	
1	2	-1	0	0	0	0	0	-1	
2	-1	3	-1	0	0	0	0	-1	
3	0	-1	3	-1	0	0	-1	0	
4	0	0	-1	+3	-1	-1	-1	0	0
5	0	0	0	-1	2	-1	0	0	
6	0	0	0	-1	-1	3	-1	0.	
7	0	0	-1	0	0	-1	3	-1	
8	-1	-1	0	0	0	0	-1	3	

→ No.of non zero entries = 30.

→ Sum of all entries = 0

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.

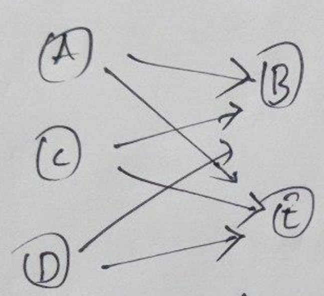
(2) from the given graph

$A = \{B, C, E\}$ $B = \{A, C, D, E\}$ $C = \{A, B, E\}$

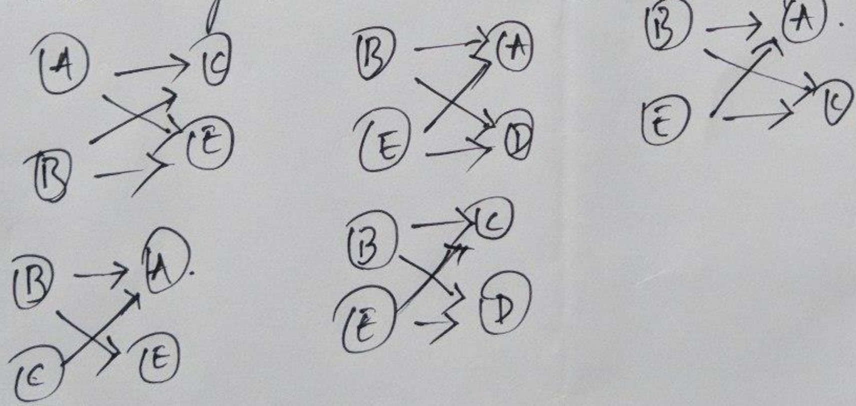
$D = \{B, E\}$ $E = \{A, B, C, D\}$

so, B and E have support more than 3

$\therefore$ Bipartite subgraph of $K_{3,2}$

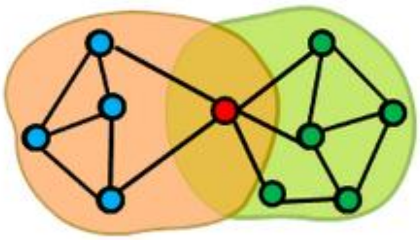


Bipartite subgraph of $K_{2,2}$.

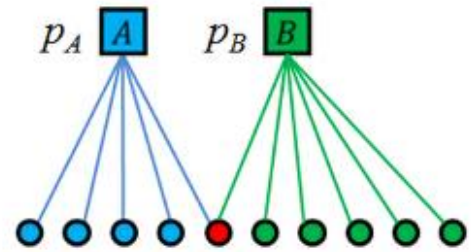


Question 3:

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.

(3) ans. a) $P_a = \dfrac{\text{No.of edges in the network.}}{\text{Total Possible no.of edges}}$

$= \dfrac{7.}{{}^5C_2} = \dfrac{7.}{10} = 0.7.$

(b) $P_b = \dfrac{\text{No.of edges in the network.}}{\text{Total Possible no.of edges}}$

$= \dfrac{9.}{{}^6C_2} = \dfrac{9.}{15} = 0.6.$