SOCIAL NETWORKS - NPTEL JULY 2024

Week 5

1. Let - denote friendship and + denotes enmity relationship in a social network. Select all the options that represent stable triangular relationship structures?

   (a) $+ + +$

   (b) $+ + -$

   (c) $+ - -$

   (d) $- - -$

   Answer: (c) and (d)

   Explanation:

   In this context, "-" denotes friendship and "+" denotes enmity. According to structural balance theory, a triangular relationship is stable if the relationships result in a positive product. The stable structures are +–, where two friends share a common enemy (a balanced situation), and —, where all three are friends. The structures +++ (all enmity) and ++- (two enemies and a friend) are unstable because they create internal tensions that violate balance theory.

2. It is observed that a friend's friend often becomes a friend, and an enemy's enemy often becomes an ally. What are the reasons behind these phenomena?

   (a) Social influence and clustering, respectively

   (b) Social influence and structural balance, respectively

   (c) Triadic closure and structural balance, respectively

   (d) Triadic closure and clustering, respectively

   Answer: (c)

   Explanation:

   Triadic closure: This concept explains why a friend's friend tends to become a friend. It suggests that if two people have a common friend, they are more likely to become friends themselves to close the triad and form a stronger, more interconnected network.

   Structural balance: This concept explains why an enemy's enemy tends to become an ally. Structural balance theory posits that social networks evolve towards a state where relationships are balanced, meaning that the enemy of my enemy is likely to be my ally to maintain consistency and balance in social relationships.

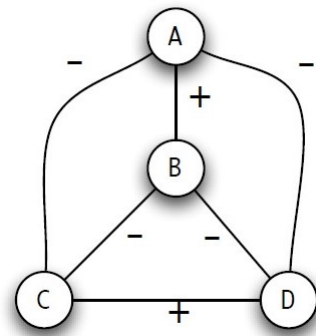3. Which of the following four node Network is balanced?
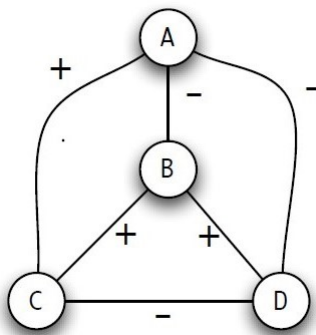
Figure 1: Network A

Figure 2: Network B

(a) A only

(b) B only

(c) Both A and B

(d) Neither A nor B

Answer: (a)

Explanation: The Network A is balanced because each group of three nodes satisfies the Structural Balance Property described earlier. Conversely, Network B is not balanced, as the three nodes A, B, and C have exactly two positive edges, which violates the Structural Balance Property.

4. Given the two dimensional grid in Figure 3, comment if the node in the center of grid A and grid B are satisfied respectively, given threshold t=5.
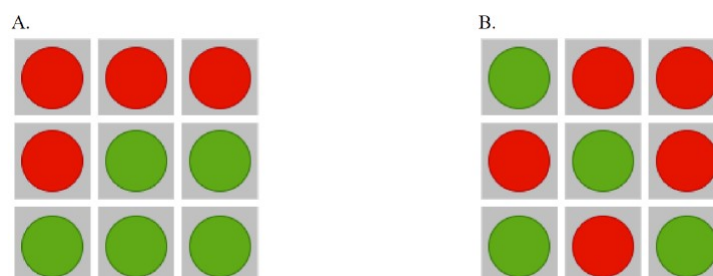

Figure 3: Schelling's Model

(a) satisfied, satisfied

(b) unsatisfied, satisfied

(c) satisfied, unsatisfied

(d) unsatisfied, unsatisfied

Answer: (d)

Explanation: Both central nodes in grids A and B are unsatisfied because, in each case, the number of neighboring nodes that are similar to the central node is less than the threshold $t = 5$

5. For a graph with seven nodes, what is the maximum number of possible triangles in the graph?

   (a) 20
   (b) 30
   (c) 35
   (d) 50

Answer: (c)

Solution: In a graph having n, nodes, there can be nchoose3 triangles, which is equal to $n(n-1)(n-2)/6$

$$\binom{7}{3} = \frac{7\,!}{3\,!(7-3)\,!} = 35$$

6. Which of the following is an invalid threshold value for the two dimensional Schelling model grid?

   (a) 1
   (b) 2
   (c) 4
   (d) 9

Answer: (d)

Solution: In a 2 dimensional grid, each individual has a maximum of 8 neighbours. This means that the tolerance can vary between 0 to 8.

7. The number of internal, corner and boundary nodes in a Schelling grid of dimension 10×10 are

   (a) 64, 4 and 36 respectively
   (b) 81, 0 and 36 respectively
   (c) 81, 4 and 32 respectively
   (d) 64, 4 and 15 respectively

Answer: (a)

Explanation:

These are nodes that are not on the boundary or corner of the grid. Number of internal nodes$=(10-2)(10-2) = 88 = 64$

These are nodes located at the four corners of the grid. For any grid, there are always exactly 4 corner nodes.

These nodes are located on the edges of the grid but not at the corners.
Number of boundary nodes$=4(10-2)+4 = 36$

8. Which social belief does the following signed triad represent?
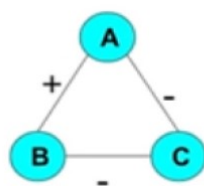
(a) A friend's friend is an enemy

(b) A friend's friend is a friend

(c) An enemy's enemy is a friend

(d) An enemy's enemy is an enemy

Answer:(c)

Explanation: An enemy's enemy is a friend: This belief is a direct application of balance theory, which states that if two people are enemies, their mutual enemy should be a friend, leading to a balanced network.

9. If a complete graph can be divided into two sets of mutual friends, with complete mutual antagonism between the two sets, then it is said to be

(a) balanced

(b) unbalanced

(c) connected

(d) symmetric

Answer: (a)

10. Which of the following statements are True for a graph to exhibit structural balance?

Statement I: A labelled graph where all the nodes are friends with each other.

Statement II: A labelled graph where the nodes can be divided into two groups, X and Y , such that every pair of nodes in X like each other, every pair of nodes in Y like each other, and everyone in X is the enemy of everyone in Y

(a) I only

(b) II only

(c) Both I and II

(d) None

Answer: (c)

Explanation: Both statements I and II are True for a graph to exhibit structural balance. Here's why:

Statement I: A labelled graph where all the nodes are friends with each other.

This statement describes a completely positive cycle. In terms of structural balance, this is a balanced scenario because every relationship is friendly, and there are no negative ties to cause imbalance. Therefore, this scenario satisfies the condition for structural balance.

Statement II: A labelled graph where the nodes can be divided into two groups, X and Y, such that every pair of nodes in X like each other, every pair of nodes in Y like each other, and everyone in X is the enemy of everyone in Y.

This describes a graph that can be partitioned into two sets of nodes where intra-group relationships are positive (friends), and inter-group relationships are negative (enemies).