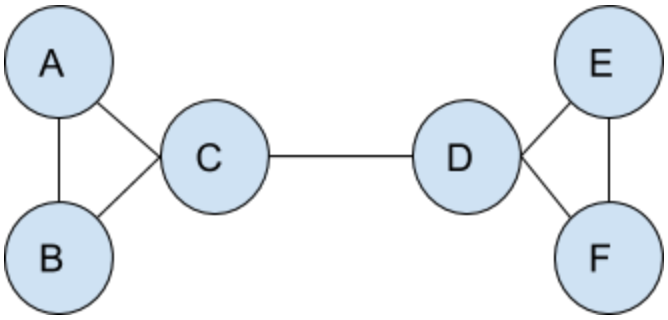
**Definitions and clarifications**

- Complete graph: All pair of nodes have an edge between them
- Bipartite graph: Two sets of nodes, with all connections across groups
- Bridges - removing the edge makes the graph unconnected
- Local bridges - removing the edge increases the distance to more than 2. All bridges are local bridges. If Strong Triadic Closure is satisfied and the node has at least one more strong tie, then the local bridge must be a weak tie.

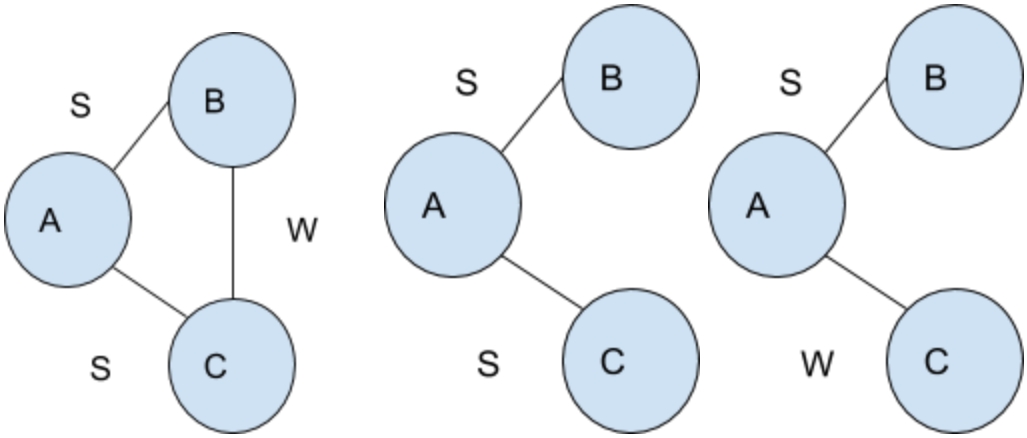
**Distance and Clustering Coefficient**

1. For the network below, answer the following questions:




I. What is the distance between nodes A and E? Can you suggest an edge addition that would reduce the distance between A and E?
II. What is the number of open triads?
III. What is the number of closed triads?
IV. What is the transitivity?
V. What is the local clustering coefficient of each node?
VI. What is the MCC?

**Strong triadic closure**

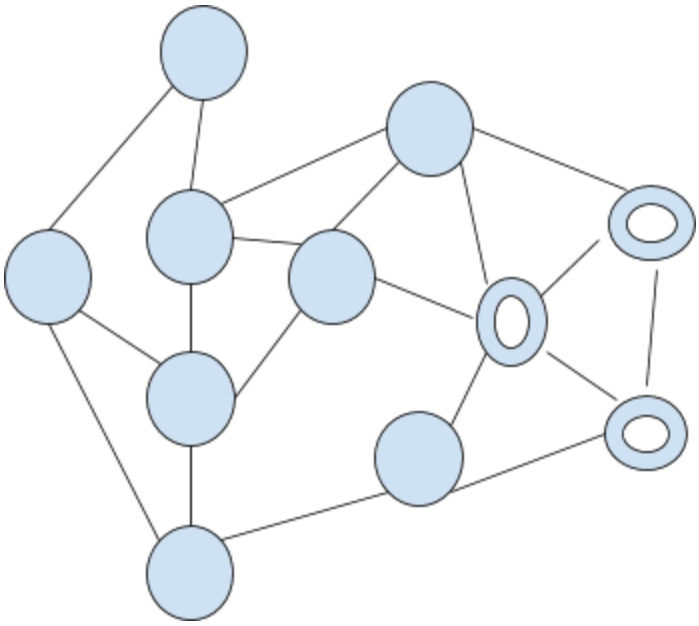



Which of these networks violate the strong triadic closure property?

- Note: If two strong ties do not exist, then the node automatically satisfies the strong triadic closure property.
- Another point to note is that here node A satisfies or violates the STC property and not the triad ABC.

**Homophily**

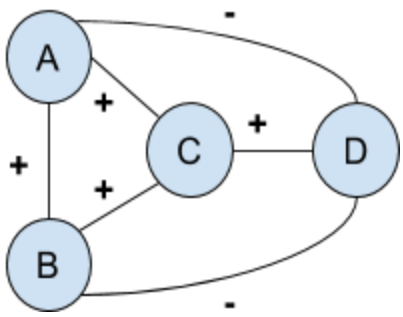
1. Consider the following trade network, where the circle nodes represent developing countries and the disc nodes represent developed countries. A link between two nations represents that there is trade happening between the countries. Does homophily exist in the network? Answer yes or no, and give a quantitative reasoning to support your answer.



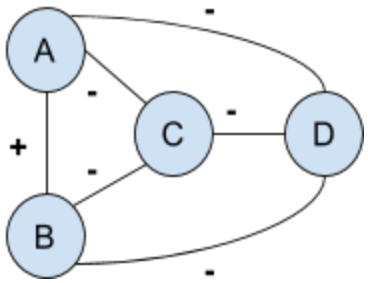
**Structural balance**

1.Are each of the following networks i) structurally balanced? ii) weakly balanced?

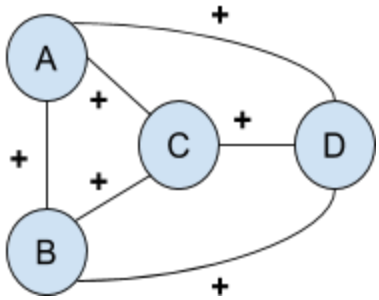
a)




b)




c)




2. Use balance theorem to argue about these

a) There are two football teams - UMich and Ohio State, where the players like all other players in their team and no other player in other teams. Is this network balanced? Is it weakly balanced?

b) Now, consider a third football team MSU, which also follows the same rule. Now is the network balanced? Is it weakly balanced?

**Mixed strategy**

1. Find all (pure and mixed) NE of this game

| | C | D |
|---|---|---|
| A | 1,4 | 2,0 |
| B | 2,8 | 3,9 |

**Note:** The notation for representing a Nash Equilibrium is the strategy of row player first and column player next.

**Auctions**

**Sample Midterm question:**

1. Consider a second-price sealed-bid auction with 3 bidders, A, B, and C. Assume that bidder A has a private value of 2 and bidders B and C have independent, private values that are either 1 or 3. For bidders B and C, the probability of having private value of 1 is ½ and the probability of having private value of 3 is also ½.

   a) If bidders bid according to their dominant strategies, what's the seller's expected revenue? Show your work.
   b) What happens when there are more players like B and C? Why?