

Networks in Their Surrounding Context and Positive and Negative Relationships

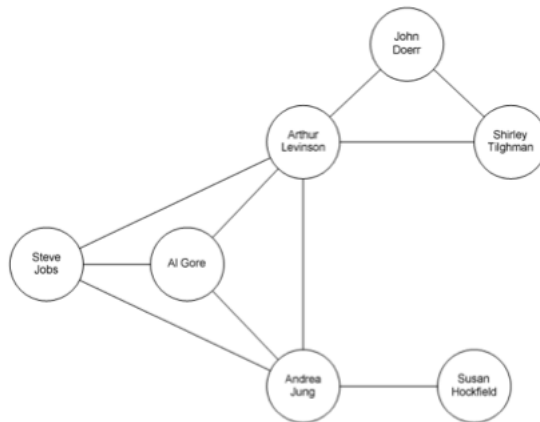
Due: Wednesday, January 28

1. *Networks Crowds and Markets* Section 4.6 Question 1

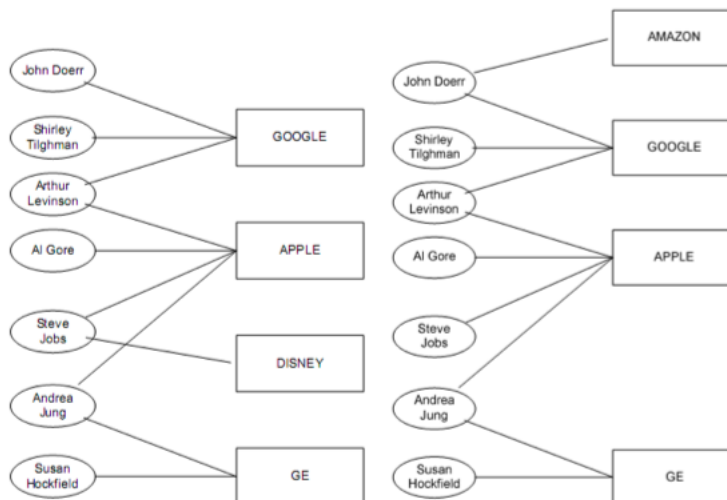
Edge (b,d) is most likely to be form in the future because b and d share 3 friends in common (a, c, e). Vertex a and e, c and e, a and c only have 2 friends in common and therefore are not as likely to form as (b,d).

2. *Networks Crowds and Markets* Section 4.6 Question 2

(a) Projected Graph for Figure 4.4:



(b) The two affiliation graphs below have the same projected graph.



3. *Networks Crowds and Markets* Section 4.6 Question 3

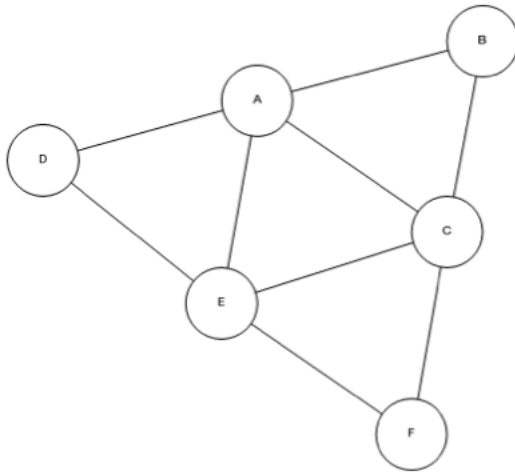
(a) Derived network for Figure 4.21

SOLUTION

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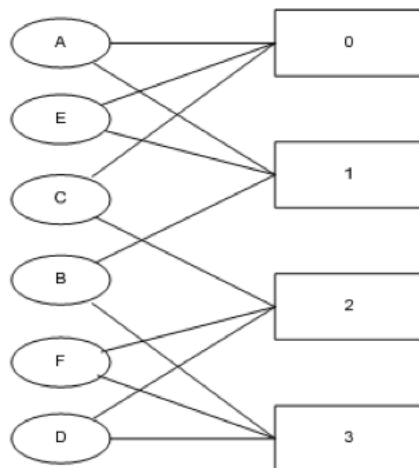
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(b) The Triangle ACE comes from A, C sharing the focus X, and C, E sharing the focus Z, and A, E sharing the focus Y. Therefore, it means if a triangle ACE is formed in a projected graph, it is not necessary that A, C and E share the same focus in the corresponding affiliation graph.

4. Networks Crowds and Markets Section 4.6 Question 4

(a) Affiliation network for projected network shown in Figure 4.22:



(b) The corresponding affiliation network must have at least 4 foci because there are 4 triangles ABE, AEC, BFD and DFC in the projected graph, and none of them can be formed by the other 3 triangles.

5. Networks Crowds and Markets Section 5.6 Question 1

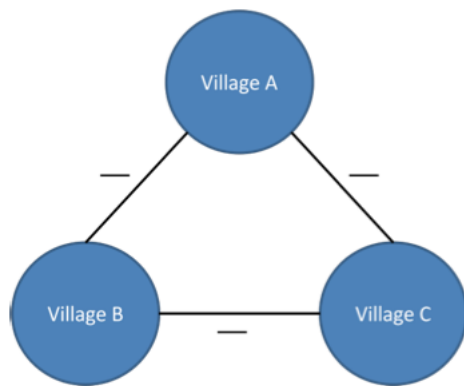
The network is not balanced. As shown in the following graph, there are triangles with 3 negative edges.

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6. Networks Crowds and Markets Section 5.6 Question 2

Positive Edges:

Edge AB

ABC: ++- unbalanced

ABD: ++- unbalanced

ABE: +- balanced

In a similar way, all the positive edges, including AB, BD, DE, EC, CA, have two unbalanced triangles and one balanced triangle.

Negative Edges:

Edge BC

BCA: -++ unbalanced

BCD: -+ balanced

BCE: -+ balanced

In a similar way, all the negative edges, including BC, CD, DA, AE, EB, have one unbalanced triangle and two balanced triangles.

7. Networks Crowds and Markets Section 5.6 Question 3

(a) Its impossible to find a way so that the new node D doesnt become involved in any unbalanced triangle. Lets consider the 3 new edges, DA, DB and DC.

Case +++: Obviously, 3 new triangles are ++- unbalanced

Case ---: Obviously, 3 new triangles are --- unbalanced

Case +-: Lets say DB, DC are negative edges. And BC is also a negative edge. Therefore, the new triangle DBC --- is unbalanced.

Case ++-: Lets say DA, DB are positive edges. And AB is a negative edge. Therefore, the new triangle DAB ++- is unbalanced.

Based on the above analysis, there is not any case that the new node D can join the network without being involved in any unbalanced triangles.

(b) Its also impossible to find a way so that the new node D doesnt become involved in any unbalanced triangle. Lets consider the 3 new edges, DA, DB and DC.

Case +++: the new triangle DBC is ++- unbalanced

Case ---: the new triangle DBC is --- unbalanced

Case +-: the new triangle DBC is --- unbalanced

Case ++-: the new triangle DAB is ++- unbalanced

Case -+-: the new triangle DAC is ++- unbalanced

Case -++: the new triangle DBC is ++- unbalanced

SOLUTION

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Case $+-+$: the new triangle DAB is $++-$ unbalanced

Case $++-$: the new triangle DAC is $++-$ unbalanced

Based on the above analysis, there is not any case that the new node D can join the network without being involved in any unbalanced triangles.

(c) Based on the (a) and (b), we know if the triangle is unbalanced, no matter — case or $++-$ case, its impossible for a new node X to join the triangle without being involved any unbalanced triangles. Therefore, if we are given a label complete graph which contains at least one unbalanced triangle, its impossible for a new node X to join the graph without being involved in any unbalanced triangles. Its because the original graph has at least one unbalanced triangle.

8. Networks Crowds and Markets Section 5.6 Question 4

The social network is unbalanced. Take the following graph as an example. The farmer 1 and farmer 20 are friends because they live with 20 miles away. The farmer 20 and farmer 40 are friends because they live within 20 miles away. But the farmer 40 and farmer 1 are enemies because they live more than 20 miles away. Therefore, a triangle with $+-+$ is formed, which is an unbalanced triangle.

