Week 7- Cascading Behavior in Networks

1. Suppose the people in a network have adopted the technology X. Now, a new technology Y comes in the market but the people are finding it risky to adopt technology Y. The inventors of the technology Y are curious to see it flourishing on the network. Consider the following 2 options. Option 1 : Increase the payoff associated with technology Y Option 2 : Choose the set of key people from the network and use them as the initial adopters of technology Y. Which of the following is true in such a case.

   A. Option 1 will help the inventors of technology Y but option 2 will not.
   B. Option 2 will help the inventors of technology Y but option 1 will not.
   C. None of the options will help the inventors of technology Y.
   D. Both the options will help the inventors of technology Y.

   Description : Whenever a new technology/product comes in the market, people are less willing to adopt the new technology. One way to make people adopt this technology is to increase the payoff associated with it. Another is to convince the influential people in the network to adopt this technology/product.

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2. Given two actions A and B. The payoff associated with the action A is 30 while the payoff associated with action B is 10. In such a case, what is the threshold fraction of neighbors which should have adopted A, in order for a node to asopt the action A?

   A. 1/3
   B. 1/4
   C. 1/5
   D. 1/3

   Description : Let a be the payoff for product A and b be the payoff for product B. We have seem that in such a case, the threshold on the fraction of neighbors which should adopt A for it to be adopted by a node, q = b/(b+a) = 10/10+30 = 1/4.

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3. Given a node u in a network. There are 2 possible behaviors in this network- A, having a payoff of 4 and B, having a payoff of 2. u has 10 neighbors, out of which 4 neighbors have adopted A and 6 neighbors have adopted B. Which behavior does the node u adopt?

   A. Only A
   B. Only B
   C. Both A and B
   D. None

   Description : The payoff node u gets if it adopts A $= 4 \times 4 = 16$. The payoff node u gets if it adopts B $= 2 \times 6 = 12$. Since the payoff associated with A is high, u adopts A.

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4. Assume a network where all the nodes have initially adopted behavior B. Then a new behavior A enters the network and the cascade starts. The process runs for a definite period of time and stops. Which of the following is true.

   A. All the nodes in the network should have adopted action B.
   B. All the nodes in the network should have adopted action A.
   C. All the nodes in the network should have either adopted action B or all of them should have adopted action A.
   D. None of the above

Description : Nothing can be said about the final state. We can not say whether everybody will adopt A or B, hence first two options are incorrect. Further, we have seen in the lectures that sometimes, a stability condition is reached where some nodes in the network adopt A while others B, and hence both the actions can co-exist. Hence, third option is also ruled out. So, the answer is - None of the above.

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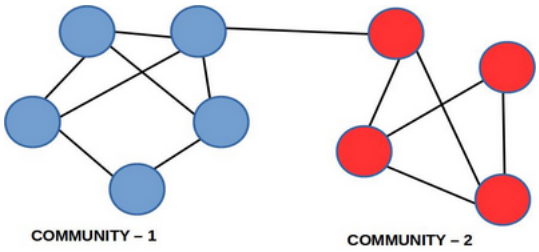
5. What does one mean by complete cascade on a network?

   A. At least half of the nodes in the network adopt the new behavior diffusing on the network.
   B. All the nodes in the network adopt the new behavior diffusing on the network. C. At least one community in the network (all the nodes in this one community) adopts the new behavior diffusing on the network.
   D. All the nodes in the community from where the cascade started adopt the new behavior diffusing on the network.

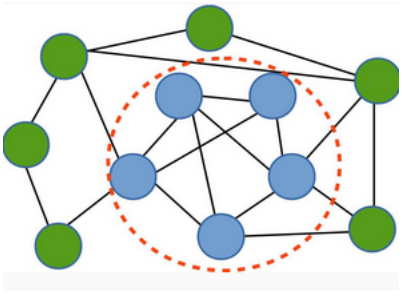
   Description : A complete cascade has nothing to do with the communities. We say that a cascade is complete if each and every node in the network has adopted a particular behavior (which was diffusing on the network.)



6. What are the densities of communities 1 and 2 in the network shown above?

   A. Community 1 - 5/6, community 2- 3/5
   B. Community 1 - 3/5 community 2- 5/6
   C. Community 1 - 6/7, community 2- 5/6
   D. Community 1 - 5/6, community 2- 6/7

   Description : There are 10 possible edges which can exist between the nodes of community -1 while only 7 of them exist. Hence, density of community 1 = 7/10.There are 6 possible edges which can exist between the nodes of community -1 while only 5 of them exist. Hence, density of community 1 = 5/6.



7. In the above Figure, what is the density of the cluster composed of the nodes in the blue color?

A. 1/2
B. 3/4
C. 3/5
D. 1

Description : Two of the nodes have all their neighbors inside the cluster, 2 of the nodes have 3/5 fraction of their neighbors inside the cluster, one node have 3/4 of their neighbors inside the cluster. The least fraction, i.e. 3/5 is the density of the cluster.

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8. Given an action having an adoption threshold of q on a network. Given that the cascade on this network is unable to turn in a complete cascade. Then, which of the following statements is true?

A. There is a cluster of density q or greater in the network.
B. There is a cluster of density q or lesser in the network.
C. There is a community of density q or greater in the network.
D. There is a commmunity of density q or lesser in the network.

Description : We have studied the theorem that - A cascade can not be complete on a network if there exists a cluster of density greater than $1 - q$ in the network; and there exists a cluster of density greater than $1 - q$ in the network if the cascade is incomplete.
