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19CSE337 Social Networking and Security

Lecture 17

Topics to Discuss

- Complex Contagion

Complex Contagion

- More number of participants are needed to influence a node and thereby a community.

Threshold Model

- One of the simplest and popular model.
- Each participant in the network follows a threshold rule.
- If enough neighbours adopted a behaviour, the adjacent nodes will also adopt the same behaviour.
- A small amount of randomness or uncertainty will disrupt the information spread.

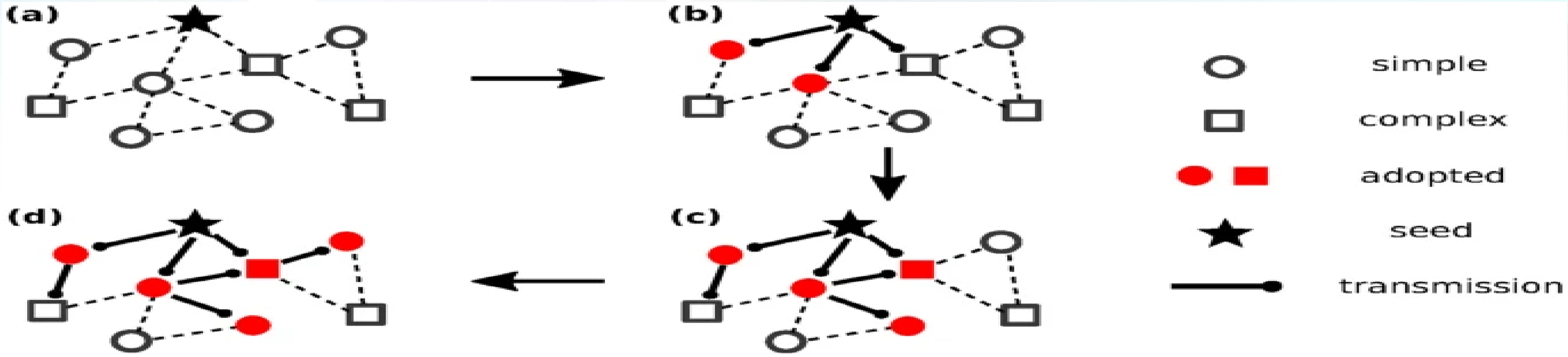
Threshold Model

- A contagion is a behaviour that somebody might adopt and the threshold captures the risk or uncertainty associated with that behaviour.
- The more the uncertainty, the higher the threshold.
- Complex contagion will spread very fast in some cases. eg; disease spread, news etc.
- But in some cases it will take more time to establish a trend. eg; business, fashion, marketing etc.

Threshold Model

- The threshold t indicates the fraction of an agents neighbours who must be active in order for a node to become active.
- If an agent has 5 neighbours and their t=3, then they will be active only if 3 or more neighbours are active (adopted a trend) and inactive if 2 or less neighbours are active.

Threshold Model



An example model of contagion processes is given. In this example, five nodes (circles) out of nine nodes follow simple contagion and three nodes (squares) follow complex contagion requiring two exposures to be adopted. Spreading starts from a seed (star symbol) and susceptible nodes (open symbols) become adopted (filled symbols) when the number of successful exposures exceeds or equates its assigned adoptability either 1 for simple contagion or 2 for complex contagion.

Threshold Model

- If the threshold for adopting a trend is fixed as K, then the mechanism is called as K-Complex contagion, provided k>1.
- When K=1, it is a simple contagion.

Threshold Model

- Threshold can be of different types.
  - Homogeneous threshold: all nodes a network activated by same threshold value.
  - Heterogeneous threshold: each nodes have different threshold values to get activated.
  - Relative threshold: The threshold value may vary depend on the situation.

A comparison between diffusion and contagion

Diffusion	Contagion
Spreading more widely. Eg; rumour, idea, technology etc.	Disease spreading pattern. Mostly, limited to a locality. Eg; HIV, COVID-19, etc.
Initiated by a word of mouth, advertising etc.	Initiated by an exposure to an infection.
Part of social or professional network.	Physical proximity or contacts.
Decision making is involved.	No decision making is involved.
Need to decide whether want to forward or not.	It is a random natural process.

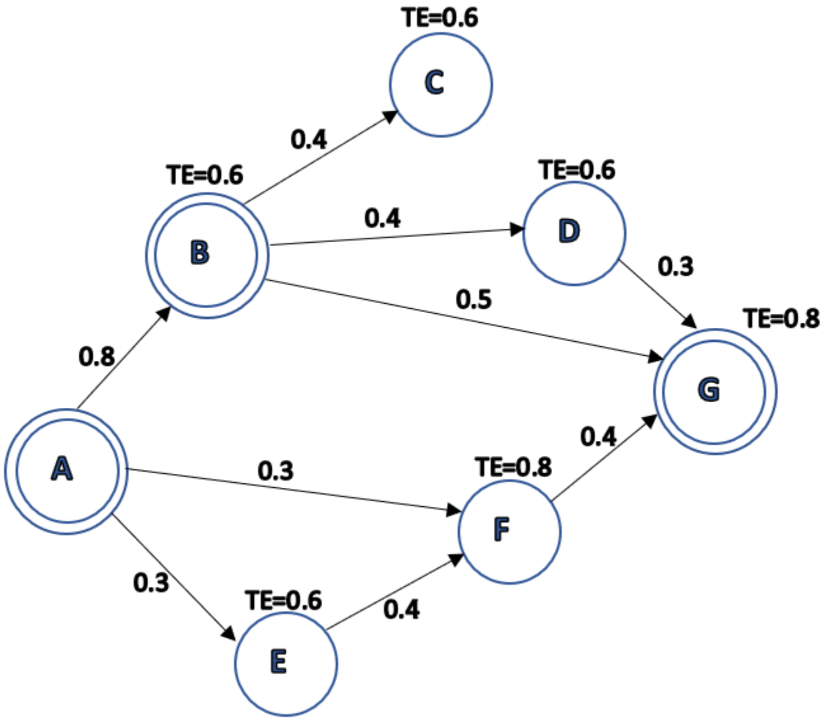
Linear Threshold Model

- One of the simple diffusion model.
- A node will be activated when the sum of influence of its neighbours are greater than or equal to threshold.
- $\Sigma w_{u,v} \geq \theta$, where $w_{u,v}$ is the activation probability that node v is activated by node u.
- The value is marked as an edge weight in the graph.

Linear Threshold Model

- It can be computed based on trust, belief, blind imitation, etc.
- Threshold of Exposure (TE): minimum threshold required for a node to get activated.
- It is computed from the activation probability of its neighbours.

Linear Threshold Model



Linear Threshold Model

- In the above given graph TE for node B is 0.6.
- A is its only neighbour.
- B is getting 0.8 itself from A.
- Similarly, for G, it needs TE=0.8. Its neighbours are B, D and F.

  Therefore, expected value is $\Sigma w_{u,v} \geq 0.8$

  $\Sigma w_{u,v}$=score from B+ score from D+ score from F.

  $\Sigma w_{u,v} = 0.5+0.4+0.3=1.2 \geq 0.8$
- So, the node G definitely will be activated through its neighbours.

Linear Threshold Model

- But node E will never get activated since its TE=0.6 and its only neighbour A will contribute only 0.3 to its TE.
- It is possible only if A increase its influence on E or E itself agreed to reduce its TE score.

Influence Maximization

- The process of gaining maximum reach or spread or popularity in certain campaigns.
- It is decided on the influence of seed nodes.
- If the seed nodes are highly influencing then maximum success may be expected.
- In real world networks, seed nodes can be a celebrity, brand ambassador, political leader, etc.
- There are specialized algorithms to choose seed nodes known as influence maximization algorithms.

Thanks…………