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19CSE337 Social Networking and Security

Lecture 18

Topics to Discuss

- Opinion Formation

What is opinion?

- An opinion is a belief or attitude about something that's not necessarily based on facts.
- An opinion is a belief or judgement or belief based on experience and on certain facts but not amounting to sure knowledge.
- Information diffusion makes opinion formation.
- Social network users will form opinion based on the information and contribution available in social networks plus their own ideas or beliefs.

Key components of opinion formation

- User : share information or forms information.
- Network: group of connected people.
- Message : information to be shared.

Characteristics of opinion

- Active users only makes opinion not everyone.
- Opinion may be positive, negative or neutral.
- Opinions are influenced by their social network.
- Opinions are highly time variant or evolving.

DeGroot Model

- It is a simple and earliest model introduced by DeGroot to model opinion formation.
- A model based on repeated communication where people communicate with each other and take weighted averages of information.
- The people start with their initial beliefs and successive repeated communication will update their belief using weighted average.
- Existing beliefs may be updated.

DeGroot Model

- The agents in this model are boundedly rational (they fail to adjust repetitions and dependencies in information).
- This will lead to duplication of information which is a shortcoming of the DeGroot model.
- Analysis of convergence is very easy in DeGroot model.
- Consensus belief is a weighted average of the agents initial beliefs and these beliefs provide a measure of agent’s influence or social importance.

DeGroot Model

- Consider an example: someone may ask or post a question in social network, say for example, Is Taj mahal beautiful?
- The consensus can be yes!
- We need to produce a weighted average corresponding to Yes.

DeGroot Model

- Consider a group of agents, V={1,2,3,4….n}.
- At time t=0, each agent iϵV has his own initial belief or opinion xi(t)ϵ[0,1] concerning some topic (Is Taj Mahal beautiful?).
- This initial weight will be updated at each time tϵ{1,2,…n}.
- The weight updating may lead to Yes or No [0 or 1].

DeGroot Model

- Agents exchange information about their beliefs with their neighbours.
- This interaction may be represented using a $n \times n$ non-negative matrix $w=[w_{ij}]$, $w_{ij}>0$ means i listen to j.
- w is strongly connected means every two individual can communicate with each other.
- At any time $t>1$, agent i update his belief according to $x_i(t)=\Sigma_j\, w_{ij}\, x_i(t-1)$.

DeGroot Model

- Agent i update their belief by taking weighted average of the current beliefs of agent j forming his own belief for the next period.
- X(t) is a column vector of beliefs.
- Initial beliefs at t=0,

$$X(0)=\begin{pmatrix} X1(0) \\ X2(0) \\ .. \\ .. \\ Xn(0) \end{pmatrix}, \quad w=\begin{pmatrix} w11\ w12\ \ldots\ldots\ldots \\ w21\ w22\ \ldots\ldots\ldots \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ Wn1\ldots\ldots\ldots\ wnn \end{pmatrix}$$

DeGroot Model

- This process will repeat till it converges to a limiting belief (t->∞).
- The necessary and sufficient condition for convergence is that every nodes should be strongly connected and closed is aperiodic.

DeGroot Model

Example:

$$W = \begin{pmatrix} 1/3 & 1/3 & 1/3 \\ ½ & ½ & 0 \\ 0 & ¼ & ¾ \end{pmatrix}$$

- Agent 1 listen to everybody equally.
- Agent 2 don’t believe agent 3’s opinion.
- Agent 3 don’t listen to Agent 1 and trust on his own beliefs.

DeGroot Model

- Suppose the initial belief of 3 agents on certain issue (Is Taj Mahal beautiful?) is as follows

$$X(0)=\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$

[Agent 1: Yes, Agent 2: No, Agent 3: No]

DeGroot Model

- Updating may change the opinion.
- Using $x_i(t)=\Sigma_j\, w_{ij}\, x_i(t-1)$.

$X(1)=WX(0)$

$$= \begin{pmatrix} 1/3 & 1/3 & 1/3 \\ ½ & ½ & 0 \\ 0 & ¼ & ¾ \end{pmatrix} \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 1/3 \\ 1/2 \\ 0 \end{pmatrix}$$

DeGroot Model

- X(2)=WX(1)

$$= \begin{pmatrix} 1/3 & 1/3 & 1/3 \\ ½ & ½ & 0 \\ 0 & ¼ & ¾ \end{pmatrix} \begin{pmatrix} 1/3 \\ 1/2 \\ 0 \end{pmatrix} = \begin{pmatrix} 5/18 \\ 5/12 \\ 1/8 \end{pmatrix}$$

DeGroot Model

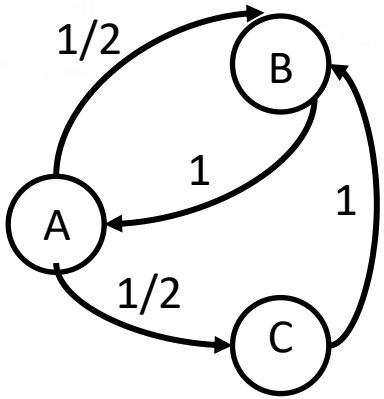
- At some point in time it will converge at

$$X = \begin{pmatrix} 3/11 \\ 3/11 \\ 3/11 \end{pmatrix}$$

When all the agents agrees on a common opinion.

DeGroot Model

- Calculate common belief of the following network.



Form weight matrix and assume the initial belief $X(0)=[1\ 0\ 0]^T$

Thanks……