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Diffusion in Networks

Following each other is a network phenomenon that can be modeled as a network where every person is represented as a node and an edge is placed between two people if they follow each other.

Products or information can diffuse through a network by spreading from one person to another.

Diffusion starts from somewhere, hits some people, hits some more people, and so on. This process is branching and not just a single path.

Diffusion can sweep the entire population or die away quickly depending on the product or information being diffused.

Quantifying the process of diffusion in a network can be done using mathematical notations and conceptual entities.

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Modeling Diffusion

A game theoretical approach to modeling the process of diffusion, where individuals make decisions based on their payoffs and the choices of their friends. This approach can be used to understand how ideas or behaviors spread through a population.

In this approach, each individual has a certain payoff associated with a particular behavior, and their decisions are influenced by the behaviors of their friends. The total payoff an individual receives depends on the behavior they choose and the behaviors of their friends.

To apply this approach, we can create a network of individuals and the connections between them. Each node in the network represents an individual, and the edges between nodes represent social ties. Then, we can assign payoffs to different behaviors and calculate the total payoff for each individual based on their own behavior and the behaviors of their connected friends.

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Impact of Communities on Diffusion

Communities can have a significant impact on the diffusion of information, ideas, and innovations. The term "community" refers to a group of people who share common interests, values, and beliefs, and who interact with each other in various ways.

When a new idea or innovation is introduced into a community, its members are likely to share information about it with each other, and to discuss its potential benefits and drawbacks. This can create a sense of excitement and momentum around the idea, which can help to drive its diffusion and adoption within the community.

At the same time, communities can also serve as a barrier to diffusion if they are resistant to change or if they have strong cultural or social norms that discourage the adoption of new ideas or technologies. In such cases, it may be necessary to overcome these barriers through targeted interventions, such as education campaigns or the involvement of influential community members.

Overall, the impact of communities on diffusion depends on a variety of factors, including the nature of the innovation or idea, the characteristics of the community itself, and the specific strategies used to promote diffusion. As such, understanding the dynamics of communities and their role in diffusion is an important area of research and practice for those interested in promoting positive social change.By simulating this process over time, we can observe how behaviors spread and how they are influenced by the social network. This approach has been used to study a wide range of phenomena, from the spread of infectious diseases to the diffusion of new technologies and innovations.

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Cascade and Clusters

To analyze the impact of communities on diffusion, we refine our scenario and revise our definitions. Instead of having just two communities, we consider a network with multiple small clusters. The question we ask is whether an idea or decision, such as going outside and having fun, would quickly spread throughout the entire network or if there would be a bunch of people who would not be convinced to adopt the idea or decision. We call this the cascade.

To analyze this scenario, we need to revise our definitions. We have previously seen that a person's decision to adopt an idea or decision is based on the payoff functions and the number of friends adopting that decision. We have also introduced the concept of threshold, denoted by q, which is the minimum fraction of a person's friends who need to adopt a decision for that person to adopt the same decision.

In the current scenario, each node in the network has a threshold value q, and we assume that every node in each cluster has the same threshold value. We also define the density of a cluster as D, which is the fraction of a person's friends in the same cluster. For example, if a cluster has five people, and each person has ten friends, the density of the cluster is 0.3 if at least 30% of each person's friends are also in the same cluster.

The density of a cluster plays a crucial role in determining the impact of communities on diffusion. A cluster with high density, where a person's friends are mostly within the same cluster, is more likely to resist the diffusion of an idea or decision. This is because the threshold value for each person is based on the number of friends adopting the decision, and if most of a person's friends are in the same cluster, it is less likely that they will adopt the decision. On the other hand, a cluster with low density, where a person's friends are mostly outside the cluster, is more likely to adopt the diffusion of an idea or decision. This is because the threshold value is based on a larger pool of friends outside the cluster, making it easier for the decision to be adopted.

Therefore, the density of a cluster can either facilitate or inhibit the diffusion of an idea or decision. A cluster with high density can act as a barrier to diffusion, while a cluster with low density can act as a facilitator.

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Knowledge, Thresholds, and the Collective Action

Collective decision making is an important aspect of human societies, and it can be modeled in various scenarios. In the discussed scenario of a multinational company, people exist in clusters and do not communicate much with each other, which makes it difficult for them to revolt against a manager's decision, even if they all have a problem with it. This is because they are suspicious about whether the other clusters are ready to revolt or not, and if they go ahead and revolt alone, it can be dangerous for them. This scenario is an example of a collective action problem, where people need to act together to achieve a common goal but face barriers to coordination.

To model this scenario, we assume that every person has an intrinsic threshold for the number of people needed to take action. For example, a person may have an intrinsic threshold of 8, meaning that they will go ahead and revolt if there are at least 8 people, including themselves, ready to revolt. Each person will have a different threshold. To decide what to do, people will consider their own threshold as well as the threshold of their close friends. Based on this information, they will decide whether to revolt or not.

The importance of collective decision making can also be seen in other scenarios, such as government policies or funding decisions for equipment in an institute. In such cases, people need to act together to achieve a common goal, and their success depends on their ability to coordinate and make collective decisions.