



Social Graph
Term paper Assignment

Graph Theory
(2CSDE56)

Created by,
18BCE135
18BCE250

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Introduction

Social networking is based around the premise that how people meet each other, whether directly or implicitly, has a determinable framework. The notion that individuals can be linked (however unknowingly) by mutual associates has been made popular by concepts such as "six degrees of separation," which states that everyone on Earth is divided from everyone else by no more than six intermediate personal relationships.

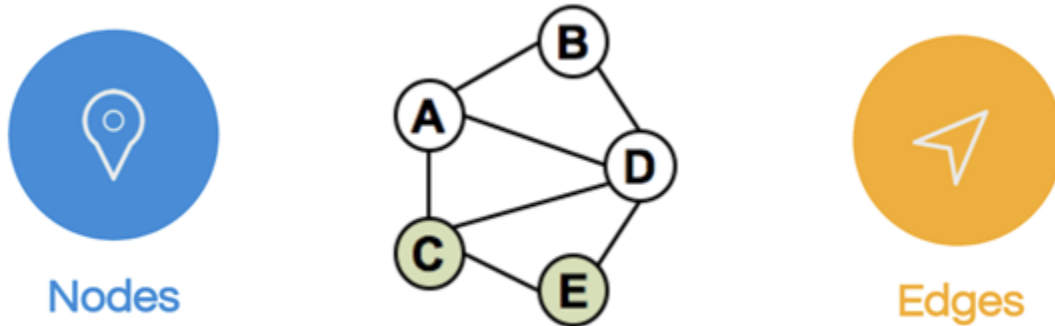
The majority of current lay discussion of social networking seems to focus on online connections through the Internet and mobile devices.

Focus on “hooking up” with others in order to find a career, find a date, or share experiences with others who have the same dog breed as you. Behavioral scientists have been researching social networks of all sizes — “offline” communications (face to face, emails, internet, and so on) as well as online — for decades to figure out how social networks are formed and sustained, and how social-network links influence our lives.

In software development, social networking is becoming increasingly common. Popular preferences, geographical proximity, technical cultures and traditions, and other factors are used to create websites and services. LinkedIn, Friendster, Orkut, Myspace, and Tribe are among the most popular social networking platforms, though successful revenue generation remains elusive.

Network Theory

Example Network



Nodes (in this case, A,B,C,D,E) represent network entities and can store self-properties like weight, length, location, and any other attribute as well as network-based properties like Degree- number of neighbours or Cluster- a connected component the node belongs to etc.

Edges represent the relations between nodes and may also contain objects like weight representing the strength of the connection, direction in case of asymmetric relation or time if applicable.

These two fundamental elements can be used to define a variety of phenomena, including social connections, virtual routing networks, physical power networks, roads networks, biology relations networks, and a variety of other interactions.

Real-world networks

Real-world networks, especially social networks, have a distinct structure that sets them apart from randomly generated mathematical networks:

According to the Small World phenomenon, actual networks often have very short paths (in terms of hops) between some linked network members. This is true with both actual and interactive social networks (the six handshakes theory) as well as physical networks such as airports or web-traffic routing energy.

Scale Free networks with a power-law degree distribution have a distorted population, with a few closely connected nodes (such as social-influences) and a large number of loosely connected nodes.

Homophily is the tendency for people to interact and communicate with people who are close to them, resulting in neighbours with similar characteristics.

Centrality Measures

Highly central nodes are critical components of a network, acting as hubs for various network dynamics. However, the meaning and significance of centrality can vary from case to case, and various centrality metrics can be used:

Degree — the amount of neighbors of the node

EigenVector / PageRank — iterative circles of neighbors

Closeness — the level of closeness to all of the nodes

Betweenness — the amount of short path going through the node

Information Flow

The information flow can be seen as the spread of a virus, with infectious dynamics of hopping from one person to his social neighbours. The following are two common simple models for describing the process:

Linear Threshold is a threshold-based behaviour in which an influence accumulates from multiple neighbours and is activated only when the total influence exceeds a certain threshold. Such behaviour is common in movie recommendations, where a suggestion from a friend may ultimately persuade one to see a film after hearing a lot about it.

v becomes active if

$$\sum_{\text{active } u} w_{uv} \geq \theta_v$$

Independent Cascade model: Each of the node's active neighbours has a probabilistic and independent probability of activating the node in the Independent Cascade model. This is similar to how a virus spreads, such as in Covid-19, where each social contact may cause the infection to spread.

Friendship Paradox

The unusual characteristic of social networks with power law degree distributions is that the friends of most nodes in the network have on average more friends than the node itself [3].

Since nodes preferentially connect with nodes that already have a high degree, this finding is known as the Friendship Paradox.

In real-world social networks, researchers discovered a Generalized Friendship Paradox that applies to many more properties, such as income and satisfaction. On average, a person's friends are wealthier and happier than they are. This is not a function of any scale-free network, unlike the Friendship Paradox, since it refers to properties that are not encoded by the network. It does, however, illustrate certain aspects of how people communicate in real life.

Influence Maximization

The problem of influence maximisation represents a marketing set-up (which can be further extended), where the marketer aims to pick a small set of nodes in the network (seeding set) such that the influence automatically gets as widespread as possible. Consider welcoming a select group of influencers to a prestigious product launch event so that they can spread the message to their whole network.

Conclusion

Network analysis is a sophisticated and useful tool for different domains, especially social networks that scale rapidly. The applications of this research include maximising advertisement effects, detecting fraud or advocacy schemes. There are many methods and strategies which can be used on data sets, but they must be selected carefully keeping the challenge and the special properties of the network into account.

Reference

wikipedia

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