Lecture 12: Social Media Platforms

Social Network Analysis and Recommendation Algorithms

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3rd semester 1444-2023

Social Media Platforms

- Social media platforms are websites or mobile applications that allow users to create and share content and engage in social networking. These platforms enable users to connect with other users, join communities or groups, share information, and interact with content through likes, comments, and shares.
- Some of the popular social media platforms include: Facebook, Twitter, Instagram, LinkedIn, YouTube and TikTok.
- Overall, social media platforms have become an integral part of modern-day communication and have revolutionized the way people connect and share information.
- Can you think of any events where social media platforms changed the world?

Social Media Platforms

- As a Data Scientist, two important subjects to study from social media platforms are:
  - Social Network Analysis
  - Social Media Recommendation Algorithms

Social Network Analysis SNA

- Definition: SNA is the study of social structures through the use of network and graph theories, it focuses on the relationships among individuals, organizations, or other social entities.
- SNA can be used to analyze communication patterns, social influence, power dynamics, and more.
- Early work in SNA can be traced back to the 1930s with the work of Jacob Moreno. In the 1970s, researchers such as Mark Granovetter and Ronald Burt made significant contributions to the field.
- Since then, SNA has become an interdisciplinary field that includes contributions from sociology, psychology, computer science, and more.

Basic Concepts in SNA

- Nodes (actors): individuals, organizations, or other social entities that are part of the network.
- Edges: the connections between nodes that represent a relationship or interaction. (could be directed (twitter) or undirected(facebook) edges)
- Degree: the number of connections a node has.
- Centrality: measures the importance of a node in the network.
- Clustering: the tendency of nodes to form groups or clusters.

Analyzing Networks

- SNA can be used to answer a variety of research questions, such as:
  - Who are the most influential individuals in a network?
  - What is the structure of a network?
  - How does information flow through a network?
- Common measures used in SNA include
  - centrality measures (e.g., degree, betweenness, closeness) and
  - network measures (e.g., density, clustering coefficient, assortativity).

Centrality Measures

- Degree centrality: number of direct connections of a node
- Betweenness centrality: number of shortest paths that pass through a node (which measures the extent to which people in your network know each other through you, or more precisely whether the shortest paths between them go through you. The idea here is that if you have a high betweenness score, then information probably flows through you.)
- Closeness centrality: average shortest path distance from a node to all other nodes
- Eigenvector centrality: measures a node's influence based on connections to other influential nodes

Community Detection

- Minimum cut algorithm: divides network into communities by removing minimum number of edges
- Girvan-Newman algorithm: iteratively removes edges with highest betweenness centrality
- Modularity metric: measures strength of division of a network into modules

SNA Measures

- Which measure to use?
  - First you have to make sure you are looking at the right network or subnetwork that is related to your problem or research question.
  - Choose the right measure according to the context or social media platform. Something might work with blogs, but when you work with Twitter data, you'll need to get out something entirely different (e.g. twitter bots)
- Another question is which SM to use? Twitter or Facebook?

SNA Tools

- NetworkX (python library)
- NodeXL (excel plugin)
- NetMiner
- Gephi

Applications of SNA

- SNA has been used in a wide range of fields, including:
  - Sociology: to study social structures and patterns of social interaction.
  - Psychology: to study social influence and group dynamics.
  - Public Health: to study the spread of infectious diseases.
  - Business: to study organizational networks and knowledge transfer.
  - Computer Science: to study online social networks and search algorithms.

Challenges in SNA

- SNA can be complex and time-consuming, particularly when dealing with large datasets.
- Data collection can be difficult, especially in cases where the network is not explicitly defined.
- SNA can be prone to biases, particularly when data is incomplete or missing.

Real-world examples of SNA

- Analysis of terrorist networks: Social network analysis has been used to analyze connections between terrorist groups and individuals. By mapping these networks, security agencies can identify key actors, centers of influence, and vulnerabilities.
- Spread of disease: Social network analysis can show how diseases may spread through human contact. By mapping interactions and travel patterns of individuals, public health agencies can identify potential "super-spreaders" and contain epidemics.

Real-world examples of SNA

- Online social networks: Analyzing connections between people in online social networks like Facebook and Twitter. This can reveal patterns of information flow, identify influential individuals, and enable targeted marketing.
- Scientific collaboration networks: Mapping connections between scientists, researchers and institutions. These can reveal how new ideas and technologies spread through networks, identify key research hubs, and enable new connections.
- Mobile phone networks: Call data records from mobile phones can show how people are connected and interact with each other. This can be used for applications like targeted advertising, analyzing the spread of information, and even predicting poverty levels.

Real-world examples of SNA

- Human mobility networks: Mapping the movement of individuals using mobile phone or GPS data. This can reveal how people connect communities together through their daily movements, and allow modeling of disease spread or other diffusion processes in the network.
- Corporate networks: Within companies, mapping networks between employees, departments, and roles can identify key knowledge brokers, bottlenecks in information flow, and vulnerabilities to employee churn. This can help guide organizational redesign and succession planning.
- Airline route networks: Mapping the connections between cities through global airline travel routes. This can reveal how closely connected different parts of the world are, and how diseases or other factors can spread rapidly by air travel. Studying how the network topology changes over time can show the effects of geopolitical events, natural disasters, and diseases on global connectivity.

Conclusion

- SNA is a powerful tool for understanding social structures and relationships.
- It can be used to answer a wide range of research questions in a variety of fields.
- While there are challenges associated with SNA, advances in technology and data collection have made it easier to conduct SNA research than ever before.

Social Media Recommendation Algorithms

- Definition: Social media recommendation algorithms are machine learning algorithms used to suggest content to users based on their interests, behavior, and previous interactions on social media platforms.
- They are designed to increase user engagement and retention, as well as promote content that aligns with user preferences.
- Recommendation algorithms started in the e-commerce section before social media platforms (e.g. Amazon and Netflix)

The Role of Recommendation Algorithms in Social Media

- Social media platforms use recommendation algorithms to keep users engaged and interested.
- These algorithms can suggest content such as posts, videos, and ads to users on their feeds and timelines.
- By personalizing content for each user, recommendation algorithms aim to increase user satisfaction and promote user retention.

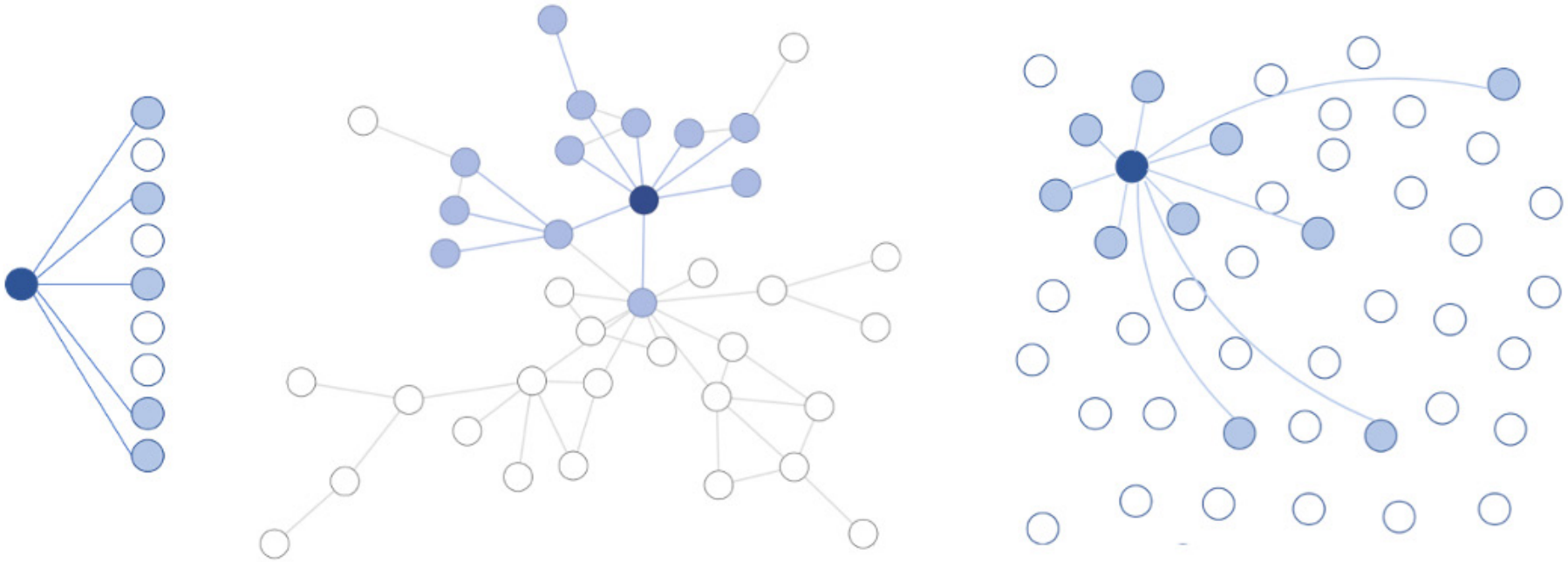
Information Propagation

- Information propagation is the process by which information spreads and disseminates through a network or system. It refers to the way in which information is transmitted from one source to many others, often through a series of intermediaries.
- Information propagation in social media platforms refers to the way information spreads through these platforms among users.
- Three types of Information Propagation:
  - Subscription
  - Network
  - Algorithm

Information Propagation

	Subscription	**Network**	**Algorithm**
What a user sees	Posts by those they've subscribed to	Posts by (or shared by) those they've subscribed to	Posts the algorithm predicts the user will like best
Examples	Newspapers, Substack, FB pre-2009, IG pre-2022	Word of mouth, the web, Twitter pre-2016, Mastodon	TikTok, Google Discover, YouTube
What impacts a post's reach	Poster's subscriber count	Both subscriber count and content	The content of the post

Information Propagation



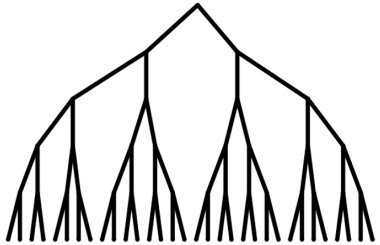
Networks Enable Virality

Jameel Jaffer
@JameelJaffer

Here's something quite amazing. The OLC wrote a powerful memo explaining why the Attorney General's independence is vital to our constitutional system. It reads as if it had been drafted this morning, in response to today's political landscape, but …. /1
knightcolumbia.org/documents/jwhw…

9:07 AM · Sep 19, 2022 · Twitter Web App

571 Retweets **52** Quote Tweets **1,338** Likes

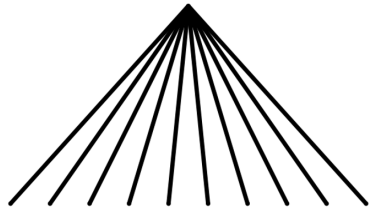


Joe Biden
@JoeBiden
United States government official

This November, we have a choice to be a nation of hope, unity, and optimism, or a nation of fear, division, and darkness.

4:15 PM · Sep 26, 2022 · Sprout Social

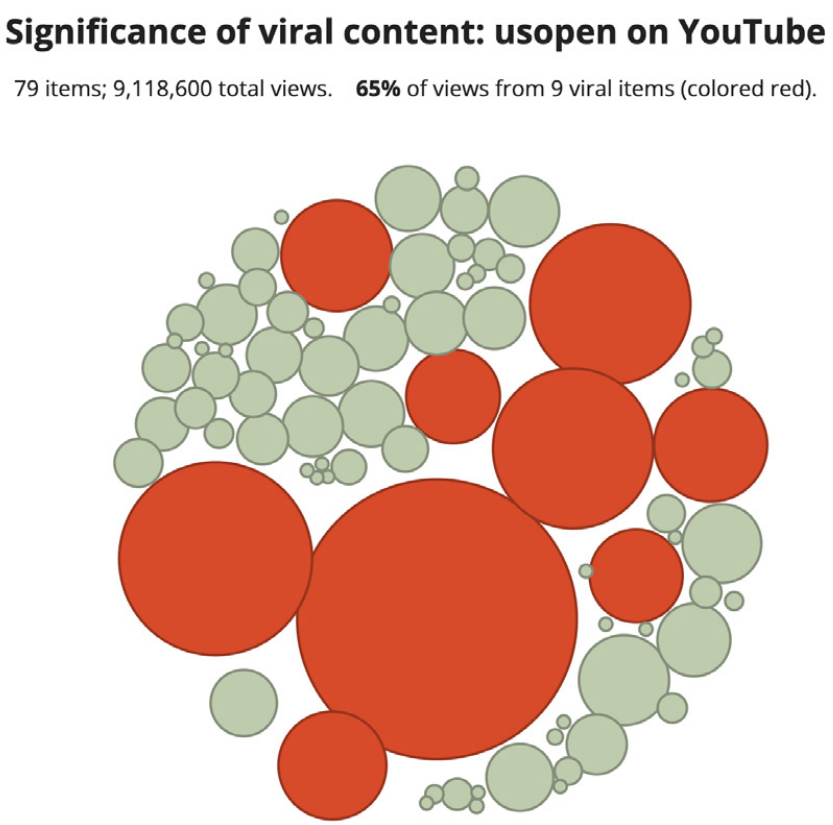
1,864 Retweets **215** Quote Tweets **9,235** Likes



Virality

- Virality is not popularity: It's about whether the piece of content spread in the manner of a virus, that is, from person to person in the network, rather than as a broadcast.
- It turns out that this can be measured, and we can assign a single number called structural virality that captures how viral something is.

Significance of Virality



The core of the Algorithm:Engagement

- Engagement: any score that is defined only in terms of the moment-to-moment actions of the user. (differs form platform to another)
- For every single post in the user's feed, the algorithm receives feedback about whether and how the user engaged with it.
- That is why the primary objective of almost every recommendation algorithm on social media platforms is to rank the available content according to how likely it is that the user in question will engage with it.

Engagement Optimizations

- Facebook optimizes for “Meaningful Social Interactions,” a weighted average of Likes, Reactions, Reshares, and Comments.
- Twitter,similarly,combinesallthetypesofinteractionthatausermight have with a tweet.
- YouTube optimizes for expected watch time, that is, how long the algorithm predicts the video will be watched. If a user sees a video in their recommendations and doesn’t click on it, the watch time is zero. If they click on it and hit the back button after a minute, the watch time is one minute.
- Less is known about TikTok’s algorithm than those of the other major platforms, but it appears broadly similar: a combination of liking, commenting, and play time.

Challenges in Recommendation Algorithms

- Filter Bubbles: Recommendation algorithms may limit users' exposure to diverse viewpoints and promote content that aligns with their existing beliefs.
- Bias: Recommendation algorithms can perpetuate biases and inequalities if the data used to train them is biased.
- Privacy: Recommendation algorithms may collect and use user data without their consent, raising concerns about privacy and data protection.

Ethical Considerations in Recommendation Algorithms

- Transparency: Users should be informed about how recommendation algorithms work and how their data is being used.
- Fairness: Recommendation algorithms should be designed to promote fair and equal treatment of all users, regardless of their race, gender, ethnicity, or other factors.
- Accountability: Social media platforms should be accountable for the impact of their recommendation algorithms on users and society as a whole.

Conclusion

- Social media recommendation algorithms play a critical role in keeping users engaged and interested in social media platforms.
- These algorithms rely on data to make accurate predictions, but they also face challenges related to bias, privacy, and filter bubbles.
- Ethical considerations are crucial in the development and use of recommendation algorithms to ensure fairness, transparency, and accountability.