* Define Hubs and Authorities? Explain Authority Update Rule and Hub Update Rule with an example? Page 403

Hubs matlab ki ek website kitni good websites ki taraf point kar rhi hai or we can say hub score for a website is the summation of inlinks of all websites it is to

Ache hub woh honge jo achi authority ki websites ko point karenge

Achi authorities woh hongi jinke paas ache hubs se link aa rhe hain

* Discuss the PageRank algorithm or page rank update rule with an example

[(1175) Centrality Measures - 20 PageRank Introduction - YouTube](https://www.youtube.com/watch?v=fo3t-TF46II&t=526s)

* Discuss the problem for basic PageRank and explain what is scaled PageRank?

agar kisi node ke kai inlinks hain but koi outlink nhi hai

ya fir koi do links ek doosre ke taraf cycle create kar rhe hain aur ek doosre ke jaane ke alawah aur koi out path nhi hai

s se multiply karo sabko toh fir tmhari page ranks ka net sum 1 ki jagah s hojayega, tab hum hmari bachi hui page rank(1-s) ko equally sabme divide kar dete hain

[(1175) Centrality Measures - 23 Scaled PageRank - Introduction - YouTube](https://www.youtube.com/watch?v=s1WK7hvIjbw)

[(1175) Centrality Measures - 24 Scaled PageRank and Modern Web Search - YouTube](https://www.youtube.com/watch?v=Om-yqjbob8U)

* Explain simple herding experiment in information cascade?
* Explain Bayes model of decision making under uncertainty with an example?
* Discuss Diffusion in networks and modelling diffusion through a network.
* Explain knowledge, thresholds and collective actions in cascading behaviour in networks.
* Discuss six degrees of separations in social network.
* Discuss structure and randomness in networks.
* Explain cluster and Cascading behaviour in social network

IF THRESHOLD for the adoption of a cascade for each node is q, then the cascade will not spread if their is a cluster with density greater than 1-q and vice versa, cluster density means the percentage of friends present in the cluster for each node

[(1175) Cascade and Clusters - YouTube](https://www.youtube.com/watch?v=fj3uamMA1Iw)

* Explain the decentralized search, core-periphery structures and difficulties

in decentralized search.

[(1175) Decentralized Search - I - YouTube](https://www.youtube.com/watch?v=vfENtwdv6Yk)

* Explain the Watts-Strogatz model with an example

[(1175) Social Network Models - 23 Watts and HYPERLINK "https://www.youtube.com/watch?v=4ENtKN96GmE" HYPERLINK "https://www.youtube.com/watch?v=4ENtKN96GmE" HYPERLINK "https://www.youtube.com/watch?v=4ENtKN96GmE"Strogatz HYPERLINK "https://www.youtube.com/watch?v=4ENtKN96GmE" HYPERLINK "https://www.youtube.com/watch?v=4ENtKN96GmE" HYPERLINK "https://www.youtube.com/watch?v=4ENtKN96GmE" Model for Small World Networks - 1 - YouTube](https://www.youtube.com/watch?v=4ENtKN96GmE)

[(1175) Decentralized Search - II - YouTube](https://www.youtube.com/watch?v=2GaxTlTjOEs)

* **Exercise problems on hubs and Authority and Page rank.**

A-4

A simple herding experiment in information cascade is a psychological experiment designed to study how individuals make decisions when they have limited information and rely on the actions of others. The experiment typically involves a series of participants who are asked to make a choice based on incomplete information and the decisions made by previous participants.

Here's a step-by-step explanation of a simple herding experiment:

1. Participants: A group of individuals, typically participants in a research study, are gathered to take part in the experiment. The number of participants can vary depending on the specific design.

2. Limited Information: Each participant is given limited information about a particular decision or task. For example, they might be asked to choose between two options based on only a brief description or a limited set of criteria.

3. Sequential Decision-Making: The participants make their decisions one by one in a sequential manner. The order in which participants make their choices is predetermined by the experimenters.

4. Observing Previous Choices: Before making their decision, participants are informed about the choices made by the previous participants. This information can be presented in different ways, such as through written descriptions or by showing the previous choices on a screen.

5. Influence of Previous Choices: Participants may be influenced by the choices made by others before them. If they observe a pattern where the majority of previous participants have chosen a particular option, they may feel inclined to follow the herd and choose the same option, even if they have personal reservations or doubts.

6. Cascade Effect: As more participants make their choices, there is a potential for an information cascade to occur. An information cascade happens when individuals abandon their own judgments and instead follow the decisions of others, creating a domino effect of conformity.

7. Data Collection: The experimenters collect data on the choices made by each participant, including whether they chose to follow the herd or make an independent decision. This data can be analyzed to determine the frequency and extent of information cascades within the experiment.

By conducting multiple iterations of the herding experiment and varying factors such as the order of participants' decisions or the level of information provided, researchers can gain insights into the dynamics of decision-making and the influence of social cues in information cascades. These experiments help us understand how people's choices can be influenced by the behavior of others, even when the information available to them is limited.

A 5

The Bayes model of decision making under uncertainty is a mathematical framework that allows individuals to make rational decisions when they have incomplete or uncertain information. It is based on Bayesian probability theory, which involves updating beliefs based on prior knowledge and new evidence.

Here's an example to illustrate the Bayes model of decision making:

Let's say you are a doctor trying to diagnose a patient with a rare disease. The disease occurs in only 1% of the population, so there is a lot of uncertainty involved. You perform a diagnostic test, which is not perfect but has known accuracy rates.

1. Prior Probability: Before conducting the test, your prior knowledge or belief is that the patient has a 1% chance of having the rare disease and a 99% chance of not having it. This prior probability is based on general information about the disease prevalence.

2. Test Accuracy: You know from previous research that the diagnostic test has a 95% sensitivity and a 90% specificity. Sensitivity refers to the ability of the test to correctly identify individuals with the disease, while specificity refers to the ability to correctly identify individuals without the disease.

3. Test Result: The test result comes back positive, indicating that the patient has tested positive for the disease.

4. Posterior Probability: Using the Bayes model, you update your belief about the patient's condition based on the test result. You calculate the posterior probability, which is the probability of the patient having the disease given the positive test result.

To calculate the posterior probability, you need to use Bayes' theorem:

Posterior Probability = (Prior Probability \* Test Sensitivity) / [(Prior Probability \* Test Sensitivity) + [(1 - Prior Probability) \* (1 - Test Specificity)]]

In this case, plugging in the numbers:

Posterior Probability = (0.01 \* 0.95) / [(0.01 \* 0.95) + [(1 - 0.01) \* (1 - 0.90)]]

Posterior Probability = 0.087 / (0.087 + 0.099)

Posterior Probability ≈ 0.468

The posterior probability indicates that there is approximately a 46.8% chance that the patient actually has the rare disease, given the positive test result.

5. Decision: Based on the posterior probability, you make a decision about the patient's diagnosis. In this case, you might consider further tests or consultations with specialists to gather more information and make a more informed decision.

The Bayes model of decision making under uncertainty allows you to update your beliefs and make rational decisions by incorporating both prior knowledge and new evidence. It provides a systematic way to handle uncertain situations and is widely used in various fields, including medicine, finance, and artificial intelligence.

A6

Diffusion in networks refers to the process of spreading information, behaviors, or influences through interconnected nodes in a network. It can occur in various contexts, such as the spread of ideas in social networks, the propagation of diseases in contact networks, or the adoption of innovations in technological networks.

Modelling diffusion through a network involves constructing mathematical or computational models that capture the dynamics of information or influence propagation. These models aim to understand how diffusion occurs, predict its patterns, and identify factors that influence the spread.

To model diffusion through a network, researchers typically define the network structure, specify the rules governing diffusion, and simulate the spread using computational methods. They often validate the models against empirical data and use them to study various phenomena, such as identifying influential nodes, evaluating intervention strategies, or predicting the reach of information or diseases.

Overall, modelling diffusion in networks provides valuable insights into the dynamics of information, influence, and behaviors in interconnected systems, helping us understand and navigate complex processes of diffusion in diverse domains.

A7

In cascading behavior in networks, knowledge, thresholds, and collective actions play significant roles in understanding how information or influence spreads through interconnected nodes. Let's explore each of these concepts:

1. Knowledge: Knowledge refers to the information or awareness that individuals possess about a particular phenomenon, event, or decision. In cascading behavior, the level of knowledge among individuals in a network influences their actions and the spread of information or influence. Individuals with more knowledge may have a greater likelihood of making informed decisions and influencing others in the network.

2. Thresholds: Thresholds are decision rules or criteria that individuals adopt to determine whether to adopt or reject certain behaviors, opinions, or information. In cascading behavior, thresholds represent the minimum level of influence or agreement required for an individual to adopt a particular behavior. These thresholds can vary among individuals, and they influence the cascading effect in the network.

- Cascading Thresholds: In some cascading models, individuals may have cascading thresholds. When the number of neighbors adopting a behavior or the intensity of influence surpasses their personal threshold, they also adopt the behavior. This can trigger a cascade where more individuals start adopting the behavior, leading to widespread adoption.

- Activation Thresholds: Activation thresholds are another type of threshold commonly used in models of cascading behavior. In this case, individuals are activated or influenced to adopt a behavior once a certain number or fraction of their neighbors have already adopted it.

3. Collective Actions: Collective actions refer to the behavior or decisions taken by a group of individuals as a result of the cascading effect. In cascading behavior, when individuals observe others adopting a behavior or receiving information, they may be more likely to follow suit due to social influence, resulting in collective actions. These collective actions can lead to significant changes in the network, such as the adoption of new behaviors, the spread of information, or the formation of consensus.

Understanding the interplay between knowledge, thresholds, and collective actions helps in studying the dynamics of cascading behavior in networks. Researchers utilize mathematical models and simulations to analyze how different thresholds, the level of knowledge, and the structure of the network impact the likelihood and extent of cascades. These insights are crucial for understanding the spread of information, behaviors, or influence in various domains, including social networks, opinion dynamics, diffusion of innovations, and the propagation of diseases.

A8

The concept of "six degrees of separation" in social networks suggests that any two people in the world are connected by, on average, a chain of no more than six intermediate connections. In other words, it implies that individuals are socially connected to each other through a relatively small number of acquaintances.

Here are some key points about the six degrees of separation phenomenon:

1. Small World Networks: The idea of six degrees of separation stems from the study of small world networks. Small world networks are characterized by a high clustering of connections between individuals (i.e., people tend to be connected to others who are also connected to each other) and short average path lengths (i.e., the number of connections between any two individuals is relatively small). This combination of properties facilitates efficient information flow and social connections within the network.

2. Stanley Milgram's Experiment: The notion of six degrees of separation gained prominence through a famous social psychology experiment conducted by Stanley Milgram in the 1960s. Milgram asked participants to send packages to a target person they did not know, but could only forward the package to someone they knew personally. The study found that, on average, the packages reached the target person in approximately six steps.

3. Small World Phenomenon: The small world phenomenon is not limited to physical proximity or geographic distance. It is based on the idea that social connections can transcend geographical boundaries due to various factors, such as communication technology, transportation, and social networks. With the advent of the internet and social media, it has become even easier to establish connections across vast distances.

4. Network Structure: The structure of social networks plays a crucial role in enabling the six degrees of separation. Networks with high clustering and short path lengths facilitate the efficient transmission of information, ideas, and influence between individuals. Nodes with a high number of connections, known as hubs, often act as important bridges in these networks.

5. Strength of Ties: Not all connections between individuals are of equal strength or significance. Some connections, referred to as strong ties, are close relationships like family members or close friends, while others, known as weak ties, are more casual acquaintances or friends of friends. Weak ties tend to be particularly important in bridging different social groups and facilitating long-range connections.

6. Application and Impact: The concept of six degrees of separation has had a profound impact on various fields, including sociology, social psychology, network science, and online social networks. It has helped researchers understand the dynamics of social connections, diffusion of information, and the spread of behaviors. Additionally, it has influenced the design of communication systems, search algorithms, and the development of social media platforms, which aim to leverage and explore the small world phenomenon.

While the exact average path length may vary depending on the specific network and population studied, the concept of six degrees of separation underscores the interconnectedness and potential reach of social networks, highlighting the idea that we are all more closely connected than we might initially perceive.

A9

Structure and randomness are two key aspects that characterize the properties and behavior of networks. Let's discuss each of these concepts in the context of networks:

1. Structure in Networks: Structure refers to the pattern or organization of connections between nodes in a network. It provides insights into how nodes are linked and the overall architecture of the network. Key structural properties of networks include:

- Degree Distribution: The degree of a node represents the number of connections it has. Degree distribution refers to the pattern of node degrees across the network. Networks can exhibit various degree distributions, such as power-law distributions (scale-free networks), exponential distributions, or Gaussian distributions.

- Clustering Coefficient: Clustering coefficient measures the degree to which nodes in a network tend to form clusters or groups. It quantifies the extent of local connectivity and indicates the presence of triangles or tightly-knit communities.

- Small World Phenomenon: Networks that exhibit a small average path length between nodes while maintaining a high level of clustering are referred to as small world networks. They combine local clustering with short paths, enabling efficient information flow and quick connections between distant nodes.

- Network Hierarchy: Hierarchy in networks refers to the presence of nodes that act as hubs, with a disproportionately high number of connections compared to other nodes. These hubs play a crucial role in information dissemination and influence propagation.

2. Randomness in Networks: Randomness refers to the absence of specific patterns or organization in the network connections. Random networks provide a baseline against which other networks can be compared. Randomness is often used as a null model to evaluate the significance of structural properties observed in real-world networks. Key aspects of randomness in networks include:

- Erdős-Rényi Model: The Erdős-Rényi model is a classic random network model where each pair of nodes is connected with a certain probability. In this model, connections are formed randomly, resulting in a network with no specific structural properties.

- Random Walks: Random walks involve traversing a network by moving from one node to another randomly selected neighboring node. Random walks are often used to study information diffusion, search algorithms, and navigation processes on networks.

- Random Errors: In some cases, random errors or noise can affect the connections in a network. These errors can introduce randomness and disrupt the network's original structure, leading to changes in network behavior.

3. Interplay between Structure and Randomness: While networks can exhibit varying degrees of structure and randomness, they are not mutually exclusive. Real-world networks often possess both structured and random elements. For example:

- Scale-Free Networks: Scale-free networks exhibit a highly structured degree distribution, characterized by a few highly connected hubs and many nodes with relatively few connections. However, the attachment of new nodes in these networks can be random, leading to the growth of the network in a preferential attachment manner.

- Small World Networks: Small world networks combine a high level of clustering (structure) with short average path lengths (randomness). They demonstrate both local clustering and long-range connections, facilitating efficient information transfer.

The interplay between structure and randomness in networks is a rich area of research. It helps us understand the emergence of complex phenomena in various domains, including social networks, biological networks, transportation networks, and technological networks. By studying the structural properties and random elements of networks, researchers gain insights into network behavior, information diffusion, robustness, and resilience.