SOCIAL NETWORKS - NPTEL July 2024

Week 8

1. In an academic research network, where researchers cite other researchers' work and are cited by others, which of the following is correct?

   (a) Researchers who cite other researchers are represented by hubs, and researchers whose work is cited are represented by authorities

   (b) Researchers who are cited by others are represented by hubs, and researchers who cite others are represented by authorities

   (c) Both researchers who cite others and researchers who are cited act as hubs

   (d) Both researchers who are cited and researchers who cite others act as authorities

   Answer: (a)

   Explanation: In an academic research network: Researchers who cite other researchers act as hubs because they are creating links to other researchers' work. Researchers whose work is cited act as authorities because their work is being referenced by many other researchers.

2. In the graph G shown in the following figure, assume that the current pagerank values of A, B and C are 0.5, 0.4 and 0.1 respectively. What will be their pagerank values after one iteration?

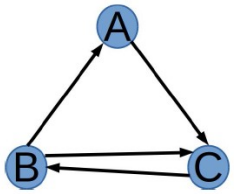

Figure 1: Graph G

   (a) A: 0.2,B: 0.4,C: 0.4

   (b) A: 0.2,B: 0.1,C: 0.7

   (c) A: 0.1,B: 0.2,C: 0.7

   (d) A: 0.7,B: 0.2,C: 0.1

   Answer: (b)

   Explanation: A gets half of points of B, B gets all points of C and C gets half points of B + all points of A

3. Given a network P with 8 nodes with an initial page rank value of 1/8 each. What is the page rank value at the end of 2 iterations?

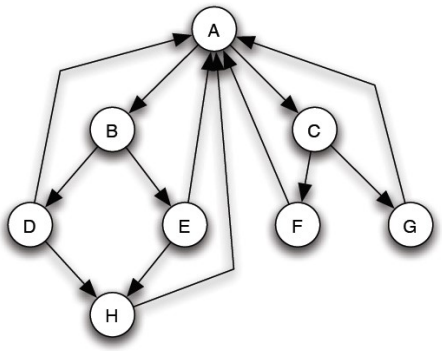

Figure 2: Network P

(a) 1/8
(b) 1/4
(c) 1/32
(d) 1/64

Answer: (b)

Explanation:

In the first iteration, B' = A/2 = 1/16. A' = 1/16 + 1/16 + 1/8 + 1/8 + 1/8 = 1/2 In the second iteration, B" = A'/2 = 1/4

4. Assume we perform a sequence of k hub-authority updates. Each update works as follows: First apply the Authority Update Rule to the current set of scores.Then apply the Hub Update Rule to the resulting set of scores. At the end, the hub and authority scores may involve numbers that are very large. Select all that is TRUE.

(a) We care only about their relative sizes
(b) we can normalise them
(c) we can simply reduce each value by a fixed value in every iteration
(d) we care only about their absolute values

Answer: (a) and (b)

Explanation: a. In the HITS algorithm, the exact values of hub and authority scores are less important than their relative sizes. The algorithm aims to identify the relative importance of each node, and scaling the scores or normalizing them does not affect the ranking of nodes. The focus is on the relative ranking rather than the absolute magnitude of the scores. b. Normalization is a common practice to ensure that the scores remain manageable and comparable. By normalizing the hub and authority scores (e.g., dividing by the maximum score or ensuring that the sum of scores is 1), we can avoid issues with very large numbers and maintain the relative rankings of the nodes. c. This approach might not preserve the relative importance and could lead to inaccurate results. d. The HITS algorithm is designed to identify the most influential hubs and authorities based on their relative scores, not their absolute magnitudes.

5. Assume the hub and authority score for each node in the given graph J as 1. What is the hub and authority score of node 3 in the given graph J in iteration k=1?

(a) a(1)= 1,h(1)= 2
(b) a(1)= 2,h(1)= 1
(c) a(1)= 3,h(1)= 2
(d) a(1)= 2,h(1)= 3

Answer: (a) Explanation: Authority Update Rule: For each page p, update auth(p) to be the sum of the hub scores of all pages that point to it. Hub Update Rule: For each page p, update hub(p) to be the sum of the authority scores of all pages that it points to.

For node 3: only node 1 points to node 3, so a(1) =1. node 3 points to nodes 4 and 5 which implies that h(1) = 2.

6. Consider the following bipartite graph, which of the following is/are correct for repeated improvement?

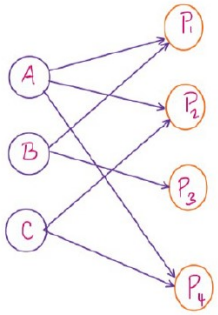

Figure 3: Graph B

(a) B = P1 + P3
(b) C = P3 + P4
(c) P2 = A + B
(d) P3 = B

Answer: (a), (d)

7. Which of the following is TRUE for a Markov Matrix?

Statement I - The sum of elements in every column is 1.
Statement II - Highest eigenvalue of a Markov matrix is 1.

(a) I only
(b) II only
(c) Both
(d) None

Answer: (c)

8. For the given network H, what are the values after say 10 iterations of Page rank updates for the initial value of 1/3 for every node in the network?

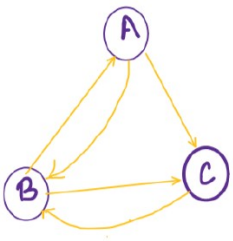

Figure 4: Network H

(a) 0.17,0.50,0.33
(b) 0.33,0.33,0.33
(c) 0.50,0.17,0.33
(d) 0.22,0.44,0.33

Answer: (d)

Explanation:

Try this in any Excel-like application. The update values for each node are given as follows:
A'= B/2, B'= A/2 + C, C'= A/2 + B/2

Iteration	A	B	C
1	0.33	0.33	0.33
2	0.17	0.50	0.33
3	0.25	0.42	0.33
4	0.21	0.46	0.33
5	0.23	0.44	0.33
6	0.22	0.45	0.33
7	0.22	0.44	0.33
8	0.22	0.45	0.33
9	0.22	0.44	0.33
10	0.22	0.44	0.33

9. Which of the following best describes the process for updating the authority scores of web pages in the Hubs and Authorities Algorithm?

   (a) Update the authority score of a page p by aggregating the hub scores of all pages with hyperlinks pointing to p.

   (b) Update the authority score of a page p by summing the authority scores of all pages to which p has outbound hyperlinks.

   (c) Update the authority score of a page p by aggregating the hub scores of all pages to which p has outbound hyperlinks.

   (d) Update the authority score of a page p by summing the authority scores of all pages that p points to.

   Answer: (a)

   Explanation:

   In the Hubs and Authorities algorithm (HITS algorithm):

   1. Authority Update Rule: The authority score of a page p is updated to be the sum of the hub scores of all pages that link to it.

   2. Hub Update Rule: The hub score of a page p is updated to be the sum of the authority scores of all pages it links to.

10. Let C be a unit circle with center at (0,0) in the XY-plane. Then H, the point at which the vector(4,3) intersects C is

    (a) (0,0)

    (b) (3,4)

    (c) (0.6,0.8)

    (d) (0.8,0.6)

    Answer: (d)

    Solution: The magnitude $\|(4,3)\|$ is calculated as:

$$\|(4,3)\| = \sqrt{4^2 + 3^2} = \sqrt{16+9} = \sqrt{25} = 5$$

    To normalize the vector, we divide each component by the magnitude:

$$\mathbf{v}_{\text{normalized}} = \left(\frac{4}{5}, \frac{3}{5}\right) = (0.8, 0.6)$$