PageRank

Como o Google ranqueia as páginas mais relevantes

Uma breve história sobre algoritmos de busca

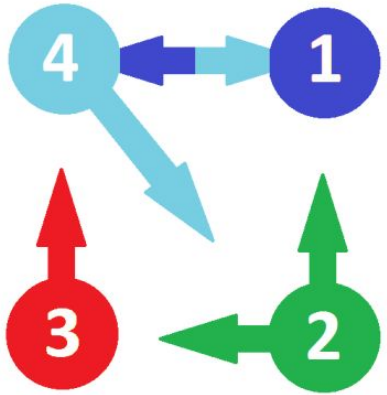
- World Wide Web Worm - WWWW (1994)
- O grau de importância das páginas

Problemas da simulação

- Power method
- Teleportation model
- Dark nodes

Modelo matemático - Cadeias de Markov

- Probabilidade
- Cálculo estocástico
- Sistemas estocásticos
- Cadeias de Markov

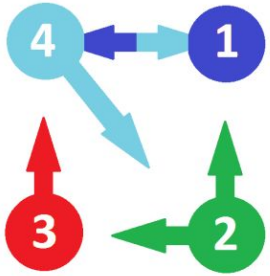


$$A = \begin{matrix} E1 \\ E2 \\ E3 \\ E4 \end{matrix} \begin{pmatrix} 0 & 1/2 & 0 & 1/2 \\ 0 & 0 & 0 & 1/2 \\ 0 & 1/2 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{pmatrix}$$

Modelo matemático - Power Method

$$x(k+1) = Ax(k),\ k \geq 0,\ \text{com}\ x(0) = x_0,$$

$$A = \begin{pmatrix} 0 & 1/2 & 0 & 1/2 \\ 0 & 0 & 0 & 1/2 \\ 0 & 1/2 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{pmatrix} \qquad x^* = \begin{pmatrix} 0.3 \\ 0.2 \\ 0.1 \\ 0.4 \end{pmatrix}$$



Modelo matemático - Teleportation Model

$$M = (1 - m)A + \frac{m}{n}\mathbf{1}\mathbf{1}^T$$

- $m \in (0, 1)$
- $M \in \mathbb{R}^{n \times n}$
- $\mathbf{1} \in \mathbb{R}^{n \times 1}$

Muito bonita essa sua matriz...

Modelo matemático - Modelo distribuído

$$A = \begin{pmatrix} 0 & 1/2 & 0 & 1/2 \\ 0 & 0 & 0 & 1/2 \\ 0 & 1/2 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{pmatrix}$$

$$A = \begin{pmatrix} 0 & 1/2 & 0 & 1/2 \\ 0 & 0 & 0 & 1/2 \\ 0 & 1/2 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{pmatrix}$$

$$A_1 = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix} \quad A_2 = \begin{pmatrix} 1 & 1/2 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 1/2 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

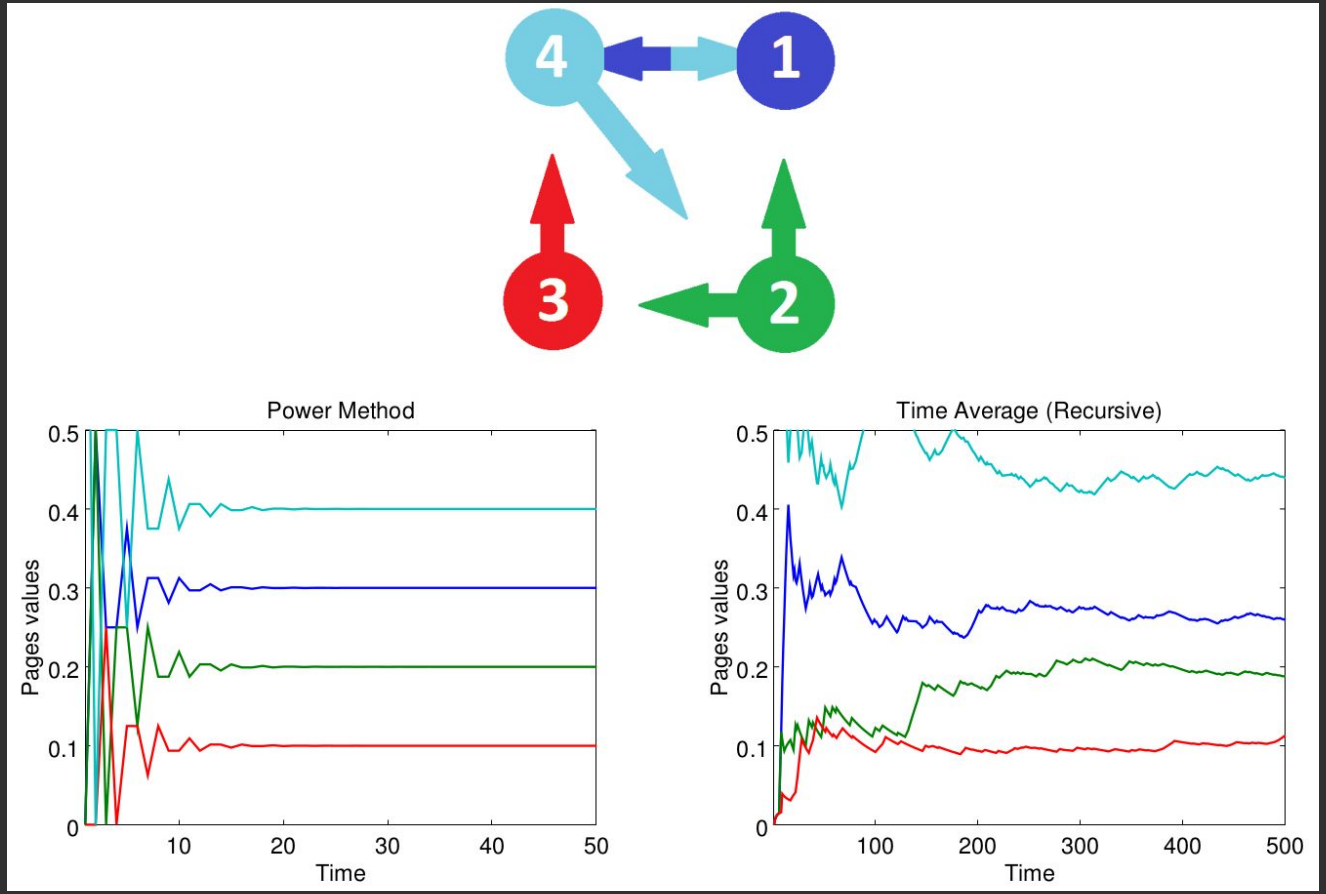
$$A_3 = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 \end{pmatrix} \quad A_4 = \begin{pmatrix} 1 & 0 & 0 & 1/2 \\ 0 & 1 & 0 & 1/2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

Modelo matemático - Modelo distribuído

$$x(k+1) = (1-\hat{m})A_{\theta(k)}x(k) + \frac{\hat{m}}{n}\mathbf{1},$$

- $k \geq 0$,
- com $x(0) = x_0$,
- onde $\hat{m} = \frac{2m}{n-m(n-2)}$,
- $m = 0,15$ [6].

Simulações


4
1
3
2
Power Method
Pages values
Time
0
0.1
0.2
0.3
0.4
0.5
10
20
30
40
50
Time Average (Recursive)
Pages values
Time
0
0.1
0.2
0.3
0.4
0.5
100
200
300
400
500

Obrigado :)