WikipediaSearch

An application of Personalized PageRank on a Wikipedia subset

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Information Retrieval exam

December 8, 2020

UNIVERSITÀ
DEGLI STUDI DI TRIESTE

DATA SCIENCE &
SCIENTIFIC COMPUTING

Outline

Introduction

Wikipedia dataset

WikipediaSearch implementation

WikipediaSearch evaluation

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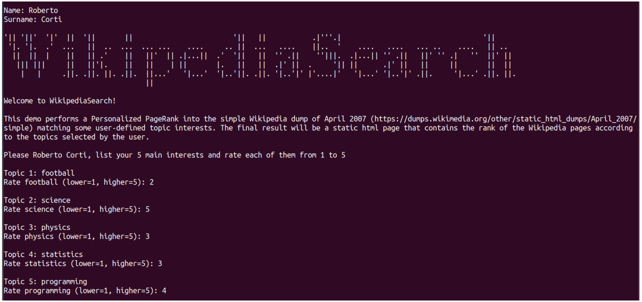
WikipediaSearch

A brief introduction

WikipediaSearch is a user-interactive tool that computes a Personalized (or Topic Specific) PageRank over a Wikipedia corpus.

WikipediaSearch

A brief introduction



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Name: Roberto
Surname: Corti

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Welcome to WikipediaSearch!

This demo performs a Personalized PageRank into the simple Wikipedia dump of April 2007 (https://dumps.wikimedia.org/other/static_html_dumps/April_2007/
simple) matching some user-defined topic interests. The final result will be a static html page that contains the rank of the Wikipedia pages according
to the topics selected by the user.

Please Roberto Corti, list your 5 main interests and rate each of them from 1 to 5

Topic 1: football
Rate football (lower=1, higher=5): 2

Topic 2: science
Rate science (lower=1, higher=5): 5

Topic 3: physics
Rate physics (lower=1, higher=5): 3

Topic 4: statistics
Rate statistics (lower=1, higher=5): 3

Topic 5: programming
Rate programming (lower=1, higher=5): 4
```

Input interface: user specifies the topics in which he/she has more interest

WikipediaSearch

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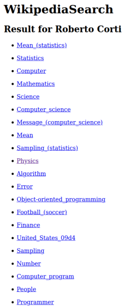

WikipediaSearch

Result for Roberto Corti

- Mean_(statistics)
- Statistics
- Computer
- Mathematics
- Science
- Computer_science
- Message_(computer_science)
- Mean
- Sampling_(statistics)
- Physics
- Algorithm
- Error
- Object-oriented_programming
- Football_(soccer)
- Finance
- United_States_09d4
- Sampling
- Number
- Computer_program
- People
- Programmer

Output page: a rank of Wikipedia articles in which the user would be interested to read

The problem

"Bringing Order to the Web"

Algorithm developed by L. Page and S. Brin (Google co-founders) used to determine the order of web pages

Problem: Is there a rating system that could measure the human interest and attention devoted to web pages?

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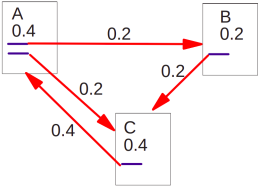
PageRank idea: modeling the behavior of a ”random surfer” in the Web graph.

A recap of PageRank theory

From L.Page and S.Brin (1998)



$\vec{x}$: probability distribution vector of the nodes

M : square, stochastic matrix corresponding to the directed grap where $M_{ij} = 1/N_j$

$\Rightarrow$ Find the stationary probability distribution $\Leftrightarrow$ find the unique stochastic eigenvector of to the eigenvalue 1:

$$M\vec{\pi} = \vec{\pi}$$

$\vec{\pi} =$ PageRank vector

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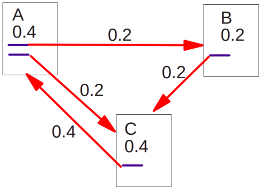

Power method solution:

- Start with $\vec{x}_0 = \texttt{random}()$
- $\vec{x}_i = M\vec{x}_{i-1}$

  until $|\vec{x}_i - \vec{x}_{i-1}| < \epsilon$

A recap of PageRank theory

From L.Page and S.Brin (1998)

Two problems:

- **Dangling nodes**: pages without outgoing edges. How to assign probability to them?
- **Pages without incoming or outgoing links** : node without incoming edges or group of nodes without outgoing edges. For the first ones we have probability 0 of returning to it once we leave it, while for the others we can never leave them once entered

A recap of PageRank theory

From L.Page and S.Brin (1998)

Allow the random surfer to move to a random page of the graph with probability α.

The stochastic matrix will be:

$$\begin{aligned} M' &= (1-\alpha)M + \alpha \left[\frac{1}{N}\right]_{N\times N} \\ &= (1-\alpha)M + \alpha \vec{1}^T \cdot \vec{J} \end{aligned}$$

where $\vec{J} = (1/N, ..., 1/N)$ is the *jump vector*

A recap of Topic-Sensitive PageRank

From Taher H. Haveliwala (2003)

In addition to the PageRank calculation we can *specialize* the scores of the pages by limiting them to a single topic.

For a given topic-specific set of pages S, we allow the random surfer to teleport only to pages that are inside S

A recap of Topic-Sensitive PageRank

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$$M' = (1 - \alpha)M + \alpha\vec{1}^T \cdot \vec{J_S}$$

where the *topic-specific jump vector* is defined as

$$J_{S_i} = \begin{cases} 1/|S|, & \text{if page } i \in S. \\ 0, & \text{otherwise.} \end{cases}$$

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Wikipedia ...

content...

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Standard PageRank

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