Comparative Analysis of Web Search and Ranking Algorithms

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May 6, 2014

Introduction

Overview of the Talk

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- Brief History of Search

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- Impact of Web Search Algorithm on our lives

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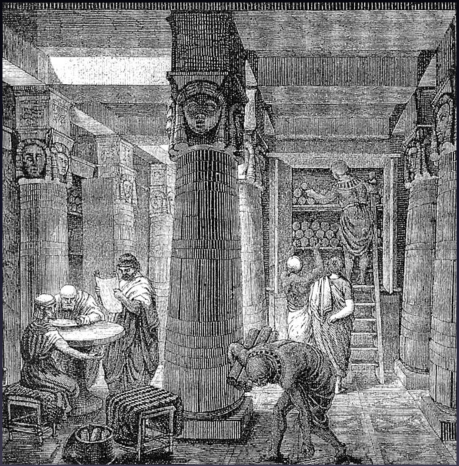
- Facebook’s Edge Rank Algorithm
- Reddit’s Story Ranking Algorithm

Brief History of Search



(a) Search in 300 BC

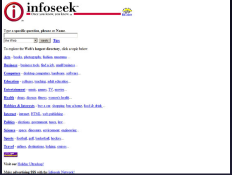
Brief History of Search

(b) Card Catalogs

Brief History of Search

(c) Archie

(d) Wandex



Type a **specific question**, **phrase** or **Name**.

To explore the **Web's largest directory**, click a topic below.

Arts - books, photography, fashion, museums ...

Business - business tools, find a job, small business...

Computers - desktop computers, hardware, software...

Education - colleges, teaching, adult education...

Entertainment - music, games, TV, movies...

Health - drugs, disease, fitness, women's health...

Hobbies & Interests - buy a car, shopping, buy a home, food & drink ...

Internet - intranet, HTML, web publishing...

Politics - elections, government, taxes, law...

Science - space, dinosaurs, environment, engineering...

Sports - football, golf, basketball, hockey...

Travel - airlines, destinations, lodging, cruises...

Visit our Holiday Ultrashop!

Make **advertising $$$** with the Infoseek Network!

(e) Infoseek

Brief History of Search

(f) Altavista

(g) Yahoo Search

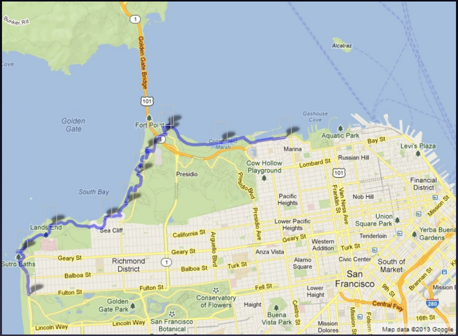
(h) Google Search

(i) Ask

(j) MSN

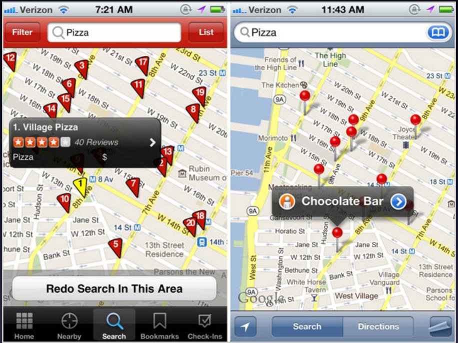
(k) Microsoft Bing

Impact of Search Algorithms



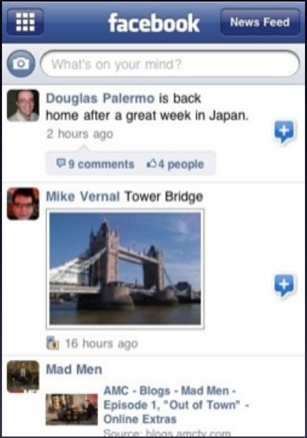
(I) Navigation is essentially using a search

Impact of Search Algorithms



(m) Search Algorithms have a major impact on how you behave

Impact of Search Algorithms



Douglas Palermo is back home after a great week in Japan.
2 hours ago
9 comments 4 people

Mike Vernal Tower Bridge
16 hours ago

Mad Men
AMC - Blogs - Mad Men - Episode 1, "Out of Town" - Online Extras
Source: blogs.amctv.com

(n) Facebook's search feature actually modifies the stories that you see on top

The Google Page Rank Algorithm

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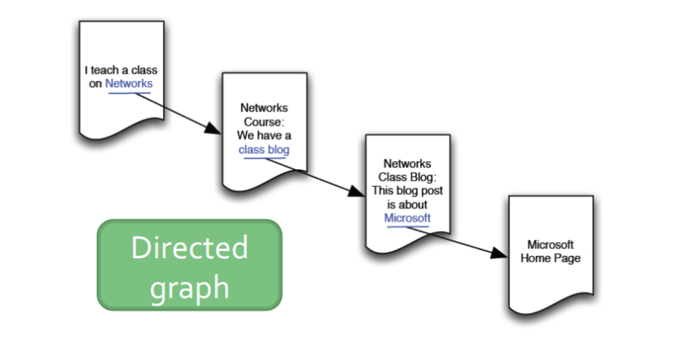
- Not all pages on the internet are equally "important"
- The more important pages you "cite" your page’s content becomes that much more "credible and important"

The Google Page Rank Algorithm


I teach a class on Networks
Networks Course: We have a class blog
Networks Class Blog: This blog post is about Microsoft
Microsoft Home Page
Directed graph

(o) A page links to various other pages, this forms an directed graph

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- www.stanford.edu has about 24000 incoming links whereas www.notdecided.com has just 1.
- Think of the incoming link as a sort of "commendation". So, an incoming link from different pages has different weights associated with it. The more important the source page, the more weight its outgoing link carries

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- **PR(A) = (1 - d) + d(PR(T$_1$) / C(T$_1$) + ... PR(T$_n$) / C(T$_n$))**

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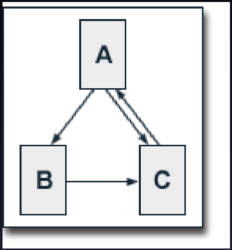
- *PR(A) is the notation for page rank of A*
- *PR(T$_i$) - Page Rank of pages Ti which link to page A*
- *C(T$_i$) - Number of outbound links on Page T$_i$*
- *d - dampling factor which can have values between the range 0 and 1*

The Google Page Rank Algorithm



(p)

- PR(A) = 0.5 + 0.5 PR(C)
- PR(B) = 0.5 + 0.5 (PR(A) / 2)
- PR(C) = 0.5 + 0.5 (PR(A) / 2 + PR(B))

The Google Page Rank Algorithm

- Because of the size of the actual web, Google uses an approximative, iterative computation of PageRank values.

Iteration	PR(A)	PR(B)	PR(C)
0	1	1	1
1	1	0.75	1.125
2	1.0625	0.765625	1.1484375
3	1.07421875	0.76855469	1.15283203
4	1.07641602	0.76910400	1.15365601
5	1.07682800	0.76920700	1.15381050
6	1.07690525	0.76922631	1.15383947
7	1.07691973	0.76922993	1.15384490
8	1.07692245	0.76923061	1.15384592
9	1.07692296	0.76923074	1.15384611
10	1.07692305	0.76923076	1.15384615

The Hyperlink Induced Topic Search Algorithm

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- A hub is a page that links to many authorities.

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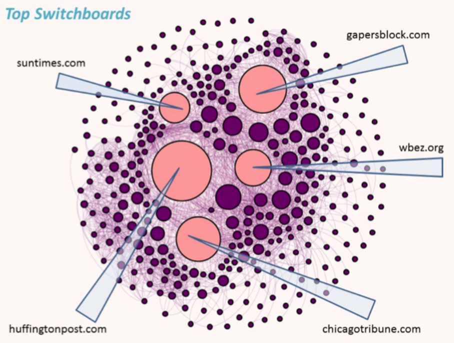

(q) News Websites in the Chicago area represented as Hubs and Authorities

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- The values are normalized to make sure that they remain converging.

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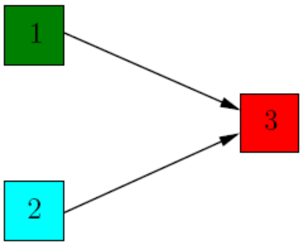

(r)

The Adjacency matrix for this graph can be represented as follows:

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

The Hyperlink Induced Topic Search Algorithm

A = $\begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$ hence A^{t} = $\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 1 & 1 & 0 \end{pmatrix}$.

Also Assume that the initial hub vector is u = $\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$.

The Hyperlink Induced Topic Search Algorithm

We compute the Authority weight vector as A^t.u

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

We compute the Hub weight vector as A.A^t.u

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This somewhat already corresponds with our intuition that node 3 must be authoritative

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- The entire userbase of social media websites can be visualized as a directed graphs with users as nodes and internatctions between them as edges
- The deciding factor about which stories should significantly appear on your news feed is how often you "interact" with the person who is the source / participant in the story.

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- Time Decay : represented as T_d

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- Affinity can however also be directly decalred, by lising someone as directly related to you. Eg. A Brother, A parent or a spouse.

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Explanation of Weight : *W*

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- An interaction like commenting has a higher weight over an interaction like simply liking the story since commenting needs the user to be more involved in the story in general
- As a generalization, the more time consuming a method of interaction, the more weight it carries

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Explanation of Time Decay : T_d

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- Thus for someone who logs in very irregularly, older stories still appear as Top Ranked stories. However for someone who logs in frequently, top ranked stories change faster.

Reddit's Story Ranking Algorithm

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- The value of a fourth parameter z is max (|x| , 1)

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  f(T_s, y, z) = Log(z) + yT_s / 45000.

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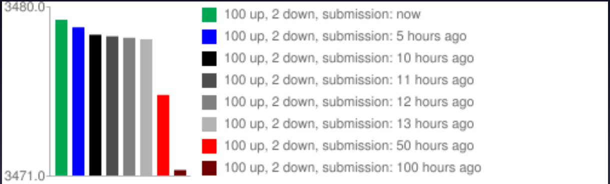
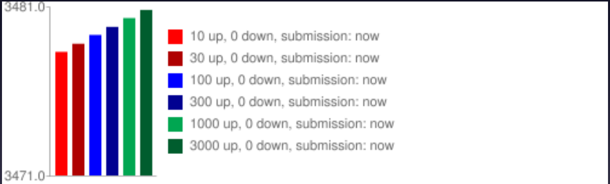


Reddit's Story Ranking Algorithm

- The Ranking function uses Logarithm to weight the total number of upvotes. I believe that this is done so to make sure that the initial few votes count higher than the rest.



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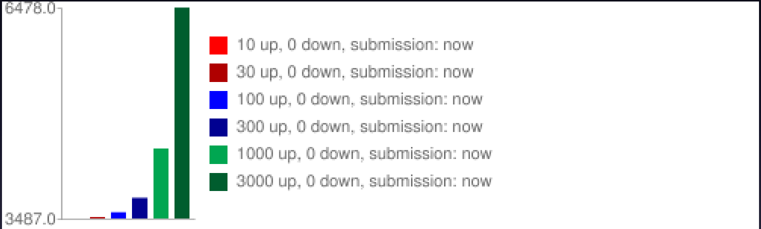
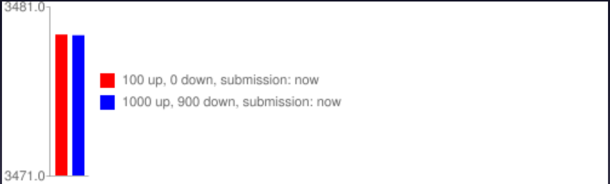


Reddit's Story Ranking Algorithm

- Reddit is one of the few sites which have the brutal downvote button. Downvotes can significantly affect a story's rank



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- The first 10 upvotes count as high as the next 100. E.g. a story that has 10 upvotes and a story that has 50 upvotes will have a similar ranking
- Controversial stories that get similar amounts of upvotes and downvotes will get a low ranking compared to stories that mainly get upvotes

Sources and Citations

- The PageRank Citation Ranking:Bringing Order to the Web
- Authoritative Sources in a Hyperlinked Environment
- Reddit Engineering Blog