

**CS572 Information Retrieval and Web Search Engines**

**Assignment 4**

**Submission date: 11/13/2017**

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## Part 1: Steps followed to complete this assignment

### Given data:

1. Directory containing html files for **New York daily news website**.
2. Mapping file (**NYD Map.csv**). This file includes the mapping of corresponding given html files with actual New York Daily URL.
3. Solr-php-client containing client-side application for Solr.

**Tools used:** Ubuntu, Eclipse IDE, NetworkX library, Apache, Solr 7.0.1.

**Languages used:** JAVA, PHP, Python

### Steps 1: Installation of solr in ubuntu and indexing pages

- I installed *Solr 7.0.1* in ubuntu as suggested in the homework description.
- Started Solr using the command `$ bin/solr start`
- Created a core named “*myexample*” in Solr using the command “*bin/solr create -c myexample*”
- Indexed all the downloaded *19620 html files* using the command: *bin/post -c myexample -filetypes html /home/devangar/Desktop/hw4/crawl\_data/NYD/NYD/*

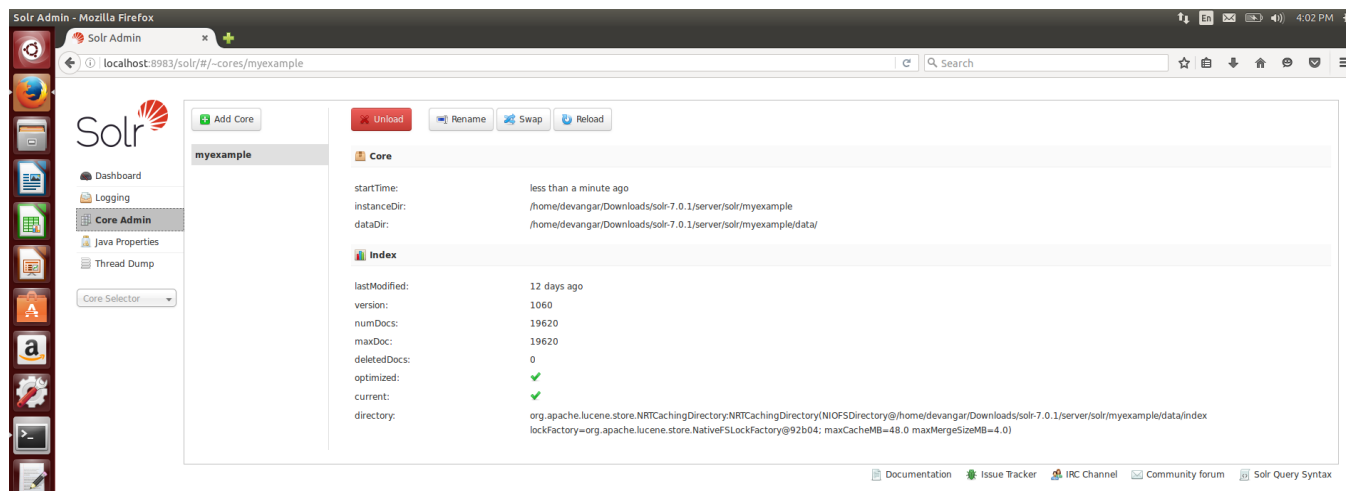


Figure 1: Solr core “myexample”

### Step 2: Creating php client

- I used **PHP** to write client webpage (*main.php – this file is included in the submission*)
- Placed “*main.php*” file in Solr-php-client repository that was suggested in homework description.
- *main.php* program will render the web page with 1 search textbox, 2 radio buttons (1 for Solr lucene and 1 for page rank algorithm) and a submit button. Upon typing the query, choosing radio button and clicking on submit button, result will be displayed on the same page based on chosen algorithm.

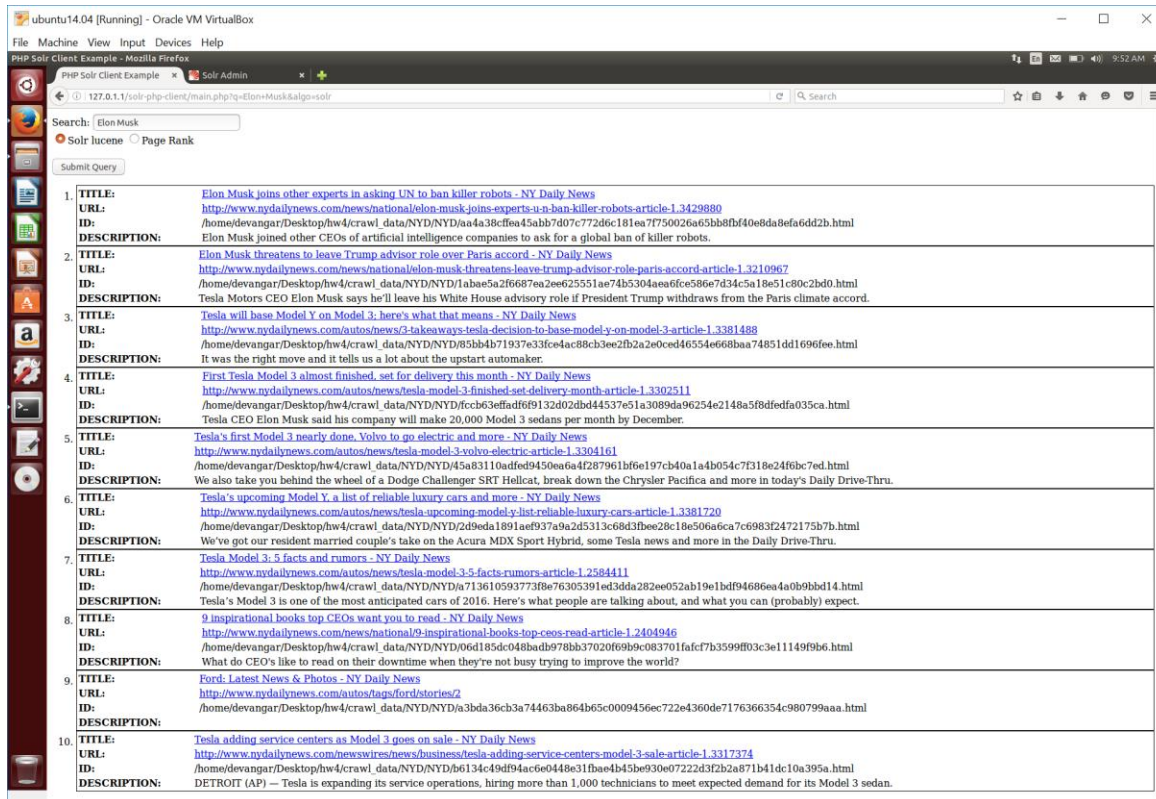


Figure 2: main.php GUI

### Step 3: Creating edgelist.txt file.

- To create a edgelist.txt file, I have used **JAVA**
- I downloaded **JSOUP** library as suggested in homework description, and created java file **“ExtractLinks.java”**.
- **ExtractLinks.java** program will create **“edgelist.txt”** by computing incoming and outgoing links to the web pages by looping through each webpage in the downloaded directory, extracting the outgoing links and with the help of **NYD Map.csv** file.



Figure 3: edgelist.txt file

#### Step 4: Creating page rank file using Page Rank algorithm

- Using *NetworkX* library in python as suggested in the homework description to create Digraph of all the edges and *pageRankFile.txt*.
- I created a Python script taking input parameter as *edgelist.txt* - that was created in previous step to generate a Digraph using NetworkX library and to compute pagerank for each edge list(html files) using pagerank algorithm with below parameters:  
*alpha=0.85, personalization=None, max\_iter=30, tol=1e-06, nstart=None, weight='weight', dangling=None*
- *pageRankFile.txt* file contains document id (html file name) and page rank for each document in the format *path/documentId=page\_rank\_value*



```
1 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/165d74f06cbfd063e7f6c400ec947f66c2a28c21e4e02607057d279b5ce32adb.html=8.133700935270576e-06
2 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/d0223a57fc56b8216d15354f43911ab6f3283830381d7051c3b2ed002cacb30e.html=0.0070977834104430405
3 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/f8b4fa33de35c2f5b3af52362e249c7f66c934087a7d6e6d7e0aa7e0af55cd2a.html=8.133700935270576e-06
4 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/6948b1d2dd2a52ecab4e7a5ab0251b4d7844ebf7dd75e80d3aea71554fa67521.html=1.062988790979847e-05
5 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/4ea62f53a525f771bd8945ba3122bb39afc02a2539481a397af1210b213900b7.html=8.263996592015626e-06
6 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/8dfd7e23fdddef2a87ea7ff8f45716b18f5a49b68565630e0d2d4584b2d4a17a.html=0.0070977834104430405
7 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/67f187bc28265457a424cc4d16bd505387fde33a3202a9a27f0807cb0a70ad15.html=8.36636733872151e-06
8 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/d86f91251dae21be3de9bde338fb40e49e299cbcf7f284f2e91802ea6168e440.html=0.0070977834104430405
9 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/8d2e0207f13af81ed13898aa2dfa442d6048a6d04a12a31dc5a27b2420601fb7.html=9.126694717491739e-06
10 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/654ca6ca5bdd479a6f19b4f451a1523fcaf6ecf72062871772662e32792fe3d2.html=0.0070977834104430405
11 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/95d6e9401dec94030e40b435f346f4a2ff1d674744ae928df0574271952dccc29.html=8.133700935270576e-06
12 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/7d71a611bc22052788632ace9b58220573cc683dae672b5f3dc04700a80484b9.html=0.0070977834104430405
13 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/3662442ab1d3f3b9db51aeada22b9730fa484e788c3c6881dcbdb64aa90f02a3.html=8.133700935270576e-06
14 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/62eea3953493e25feb9f9f3f04dbd6abf7fb615f6038fa014b261fce431eddd.html=0.0070977834104430405
15 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/76f00b20a0774586b5c9b4fcf4693e461a326beaa49504753d88831e7ef737.html=8.133700935270576e-06
16 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/c2096546088b9dd428b01db2466501260b0d727b0e5e95e4f5dd857c764ff38b.html=0.0070977834104430405
17 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/5f7c7a6eba677095163f605e40e3c88ab96018cc0af7465d7e3251bceba86e5f.html=8.252352134441841e-06
18 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/293e85304bf83f5ed5856a1dc6335e983121a3deabb878a2223cadedde53d5a60.html=0.0070977834104430405
19 /home/devangar/Desktop/hw4/crawl_data/NYD/NYD/1ealbd2399f460b7a6d4047562d7fdec91a7a251962e3cac1280486ce3a5f5.html=8.133700935270576e-06
```

Figure 4: pageRankFile.txt

#### Step 5: Configuring Solr to use external page rank file.

- I placed the *pageRankFile.txt* file in *data folder* of the core which is present in path *solr-7.0.1/server/solr/myexample/* with the name *external\_pageRankFile*.
- Then I add field in *managed-schema* file as mentioned in the homework description:  
`<fieldType name="external" keyField="id" defVal="0" class="solr.ExternalFileField"/>`  
`<field name="pageRankFile" type="external" stored="false" indexed="false"/>`
- Later I add listeners to *solrConfig.xml* file as mentioned in the homework description:  
`<listener event="newSearch" class="org.apache.solr.schema.ExternalFileFieldReloader"/>`  
`<listener event="firstSearch" class="org.apache.solr.schema.ExternalFileFieldReloader"/>`
- In Solr query UI, by giving parameter as *pageRankFile desc* for *Sort* field, the result from pageRankFile was displayed.

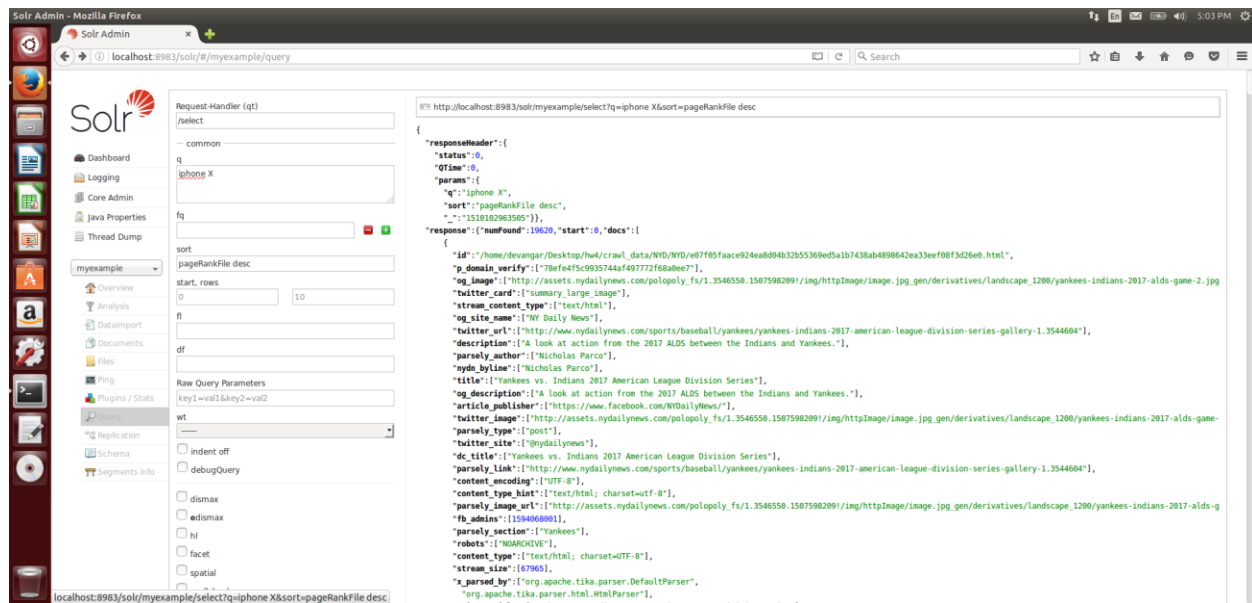


Figure 5: Result in Solr query GUI for pageRankFile desc parameter

## **Part 2: Why Some pages have high page rank than others?**

PageRank computes weight for each page based on the number of links that points to the page and quality of links to a page to tell how important the website is. The reason why certain pages have higher page rank than others may be because of some factors mentioned below:

1. Number of links pointing to the page are more.
2. Say, Page A may be ranked higher than Page B even though there are few links to page A compared to page B. This may be because the link to page A is coming from more important page with high value.
3. In some cases, a well-structured website with proper design strengthens the Page rank of that page.



## Part 3: Screenshot showing the flow of my program “main.php”:

1. **Initial page:** Showing the GUI on localhost containing search text field, two radio buttons for algorithm selection and a submit query button.

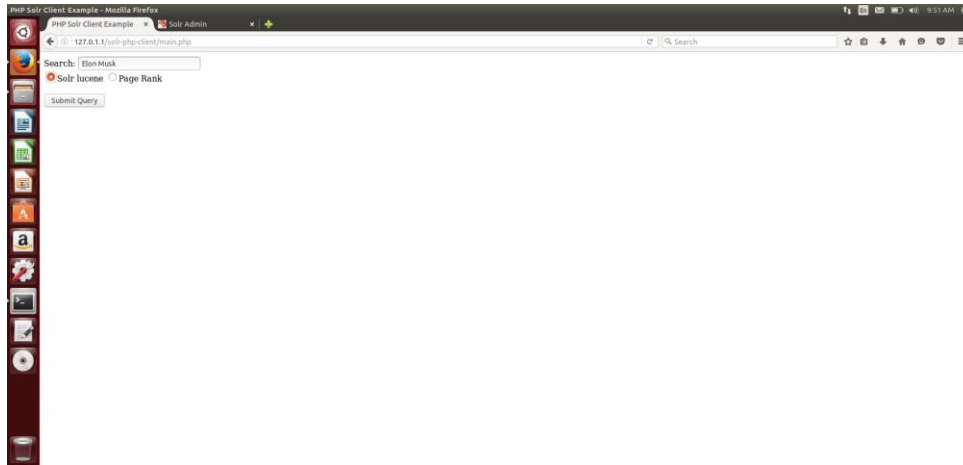


Figure 6: Initial client web page

2. **Result of Lucene and actual webpage on clicking URL:** Upon entering the search text “Elon Mask” with Solr lucene algorithm the result is displayed in the same page in table format, where Title and URL are clickable which takes to the actual page of New York daily website.

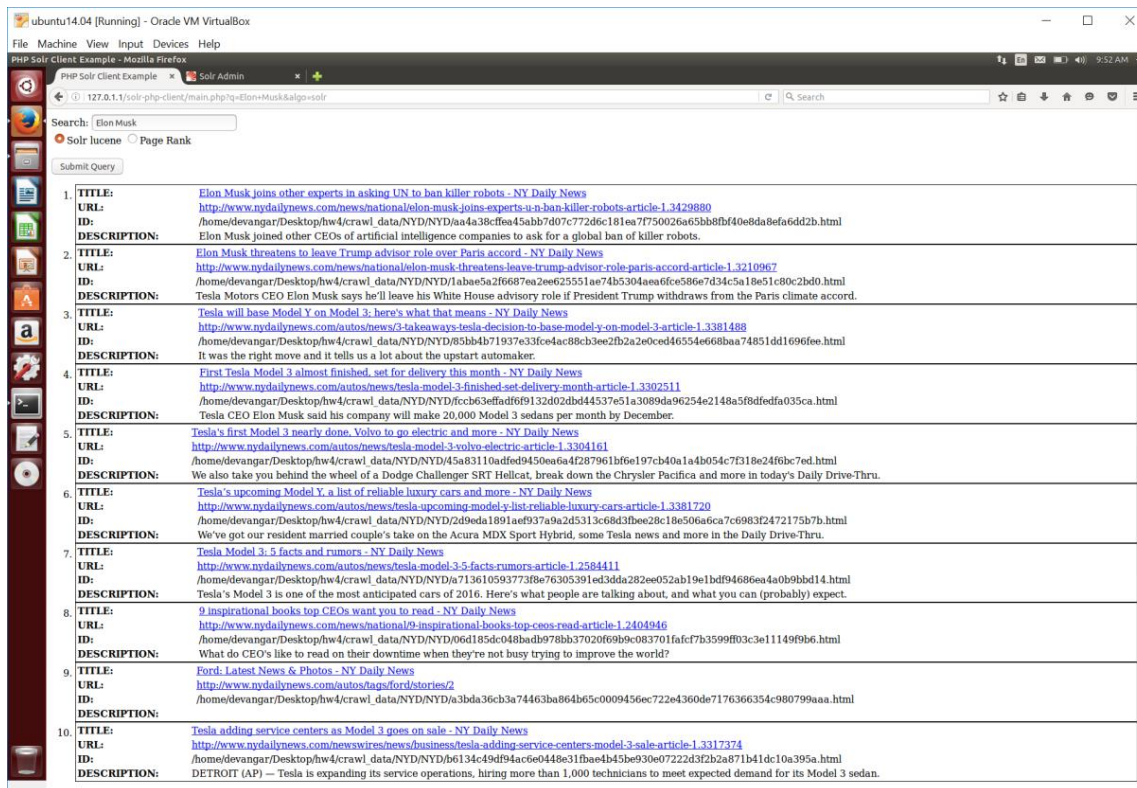


Figure 7: Result of Lucene on query Elon Mask



Figure 8: Actual webpage when clicked on first link

3. **Result of PageRank and actual webpage:** Upon entering the search text "Elon Mask" with Page Rank algorithm the result is displayed in the same page in table format, where Title and URL are clickable which takes to the actual page of New York daily website

Search:

☐ Solr lucene ☒ Page Rank

Submit Query

1.	<b>TITLE:</b>	<a href="#">Google to provide cell service for Puerto Rico using balloons - NY Daily News</a>
	<b>URL:</b>	<a href="http://www.nydailynews.com/news/national/google-provide-cell-service-puerto-rico-balloons-article-1.3546810">http://www.nydailynews.com/news/national/google-provide-cell-service-puerto-rico-balloons-article-1.3546810</a>
	<b>DESCRIPTION:</b>	/home/devangar/Desktop/hw4/crawl_data/NYD/NYD/bbd136265098090a693a269bf00e64ee980fde1aeb39052c568e68c5ec0e0c1.html The data giant has been refining the futuristic tech since at least 2013.
2.	<b>TITLE:</b>	<a href="#">2016 Porsche Cayenne S e-Hybrid - NY Daily News</a>
	<b>URL:</b>	<a href="http://www.nydailynews.com/autos/porsche/porsche-cayenne-s-e-hybrid-2016-1.2412043">http://www.nydailynews.com/autos/porsche/porsche-cayenne-s-e-hybrid-2016-1.2412043</a>
	<b>DESCRIPTION:</b>	/home/devangar/Desktop/hw4/crawl_data/NYD/NYD/6f00955160352d67fb7c4a5f5341c1539301d4c5371925945209cd5bc82347a9.html Green Porsches are rare, and we're not talking about paint colors. Instead, we're talking about the Cayenne S e-Hybrid, a plug-in performance SUV.
3.	<b>TITLE:</b>	<a href="#">Tesla's autonomous hardware. Nissan acquires Mitsubishi and more - NY Daily News</a>
	<b>URL:</b>	<a href="http://www.nydailynews.com/autos/news/tesla-autonomous-hardware-nissan-acquires-mitsubishi-article-1.2838234">http://www.nydailynews.com/autos/news/tesla-autonomous-hardware-nissan-acquires-mitsubishi-article-1.2838234</a>
	<b>DESCRIPTION:</b>	/home/devangar/Desktop/hw4/crawl_data/NYD/NYD/6f00955160352d67fb7c4a5f5341c1539301d4c5371925945209cd5bc82347a9.html We've also got a pair of performance concepts from Chevrolet, a U.S.bound Chinese SUV and more in today's Daily Drive-Thru.
4.	<b>TITLE:</b>	<a href="#">Jim Boehelm: Latest News &amp; Photos - NY Daily News</a>
	<b>URL:</b>	<a href="http://www.nydailynews.com/tags/jim-boehelm">http://www.nydailynews.com/tags/jim-boehelm</a>
	<b>DESCRIPTION:</b>	/home/devangar/Desktop/hw4/crawl_data/NYD/NYD/b510ff458429cf52d95510dd8ee96153af91e02dc3c1264ab9451f32dbde345d.html
5.	<b>TITLE:</b>	<a href="#">Trump reportedly plans to withdraw from Paris climate deal - NY Daily News</a>
	<b>URL:</b>	<a href="http://www.nydailynews.com/news/politics/trump-plans-withdraw-paris-climate-deal-article-1.3209157">http://www.nydailynews.com/news/politics/trump-plans-withdraw-paris-climate-deal-article-1.3209157</a>
	<b>DESCRIPTION:</b>	/home/devangar/Desktop/hw4/crawl_data/NYD/NYD/881c449bc789b69e1bf2a7bfcfb615d3b4b133d136c9f0c3675dceef028cbcc.html It would be Trump's biggest sign yet that his United States will make no major effort to combat climate change.
6.	<b>TITLE:</b>	<a href="#">9 inspirational books top CEOs want you to read - NY Daily News</a>
	<b>URL:</b>	<a href="http://www.nydailynews.com/news/national/9-inspirational-books-top-ceos-read-article-1.2404946">http://www.nydailynews.com/news/national/9-inspirational-books-top-ceos-read-article-1.2404946</a>
	<b>DESCRIPTION:</b>	/home/devangar/Desktop/hw4/crawl_data/NYD/NYD/06d185dc048badb978bb37020f69b9c083701fafcf7b3599ff03c3e11149f9b6.html What do CEOs like to read on their downtime when they're not busy trying to improve the world?
7.	<b>TITLE:</b>	<a href="#">Trump says U.S. will withdraw from Paris climate agreement - NY Daily News</a>
	<b>URL:</b>	<a href="http://www.nydailynews.com/news/politics/trump-u-s-withdraw-paris-climate-agreement-article-1.3213184">http://www.nydailynews.com/news/politics/trump-u-s-withdraw-paris-climate-agreement-article-1.3213184</a>
	<b>DESCRIPTION:</b>	/home/devangar/Desktop/hw4/crawl_data/NYD/NYD/563f922712ee99a99347573a018c36d0789fe9cb91892b5f5906890799b2bd3.html President Trump announced Thursday he's pulling the U.S. out of the Paris Climate Accord.
8.	<b>TITLE:</b>	<a href="#">First Drive: 2018 Infiniti Q50 - NY Daily News</a>
	<b>URL:</b>	<a href="http://www.nydailynews.com/autos/latest-reviews/first-drive-2018-infiniti-q50-road-test-article-1.3345563">http://www.nydailynews.com/autos/latest-reviews/first-drive-2018-infiniti-q50-road-test-article-1.3345563</a>
	<b>DESCRIPTION:</b>	/home/devangar/Desktop/hw4/crawl_data/NYD/NYD/dea51aa506e6577982699c1152ec96e0debc013bd491b8b5e8e62aed1bc75d7.html Infiniti made a few improvements to the Q50 for 2018 but a few needs were left only partially addressed.
9.	<b>TITLE:</b>	<a href="#">Trump's Paris accord pullout criticized by Obama, Gore &amp; DiCaprio - NY Daily News</a>
	<b>URL:</b>	<a href="http://www.nydailynews.com/news/politics/trump-paris-accord-withdrawal-criticized-environmentalists-article-1.3213331">http://www.nydailynews.com/news/politics/trump-paris-accord-withdrawal-criticized-environmentalists-article-1.3213331</a>
	<b>DESCRIPTION:</b>	/home/devangar/Desktop/hw4/crawl_data/NYD/NYD/0f5fd6204e21d1c7f5005fec1b5e6b407593316bf7cb7ee5571045a4d55821.html President Trump's decision to withdraw from the Paris climate accord has been condemned by his predecessor and environmental groups alike.
10.	<b>TITLE:</b>	<a href="#">SEE IT: France mocks U.S. decision to pull out of climate deal - NY Daily News</a>
	<b>URL:</b>	<a href="http://www.nydailynews.com/news/world/france-mocks-decision-pull-climate-deal-article-1.3217769">http://www.nydailynews.com/news/world/france-mocks-decision-pull-climate-deal-article-1.3217769</a>
	<b>DESCRIPTION:</b>	/home/devangar/Desktop/hw4/crawl_data/NYD/NYD/a47be4780490044fd3da768fbc35bdf8d224e1fe6028e1b25dc1f800ae1402.html The French taunted the United States with an edited version of a White House video detailing reasons to leave the Paris Accord.

Figure 9: Result of Page rank algorithm for Elon Mask query

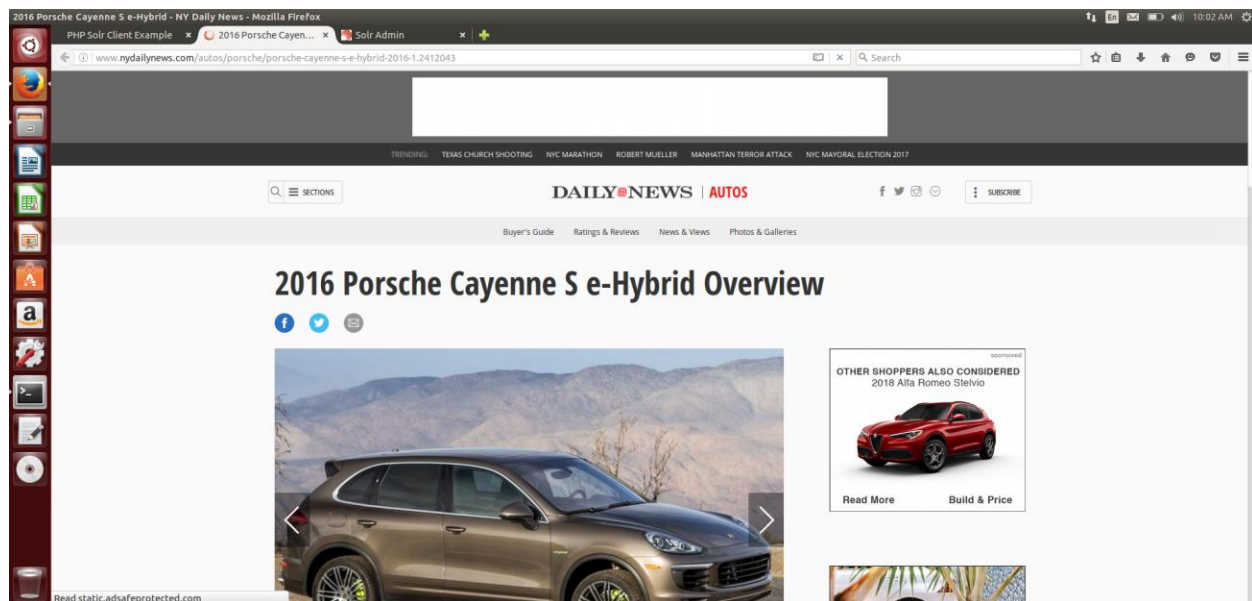


Figure 10: Actual webpage when clicked on second link from the results.

## Part 4: Result table for 8 queries

### Query 1: Elon Musk

Solr	Page Rank
<a href="http://www.nydailynews.com/news/national/elon-musk-joins-experts-u-n-ban-killer-robots-article-1.3429880">http://www.nydailynews.com/news/national/elon-musk-joins-experts-u-n-ban-killer-robots-article-1.3429880</a>	<a href="http://www.nydailynews.com/news/national/google-provide-cell-service-puerto-rico-balloons-article-1.3546810">http://www.nydailynews.com/news/national/google-provide-cell-service-puerto-rico-balloons-article-1.3546810</a>
<a href="http://www.nydailynews.com/news/national/elon-musk-threatens-leave-trump-advisor-role-paris-accord-article-1.3210967">http://www.nydailynews.com/news/national/elon-musk-threatens-leave-trump-advisor-role-paris-accord-article-1.3210967</a>	<a href="http://www.nydailynews.com/autos/porsche/porsche-cayenne-s-e-hybrid-2016-1.2412043">http://www.nydailynews.com/autos/porsche/porsche-cayenne-s-e-hybrid-2016-1.2412043</a>
<a href="http://www.nydailynews.com/autos/news/3-takeaways-tesla-decision-to-base-model-y-on-model-3-article-1.3381488">http://www.nydailynews.com/autos/news/3-takeaways-tesla-decision-to-base-model-y-on-model-3-article-1.3381488</a>	<a href="http://www.nydailynews.com/autos/news/tesla-autonomous-hardware-nissan-acquires-mitsubishi-article-1.2838234">http://www.nydailynews.com/autos/news/tesla-autonomous-hardware-nissan-acquires-mitsubishi-article-1.2838234</a>
<a href="http://www.nydailynews.com/autos/news/tesla-model-3-finished-set-delivery-month-article-1.3302511">http://www.nydailynews.com/autos/news/tesla-model-3-finished-set-delivery-month-article-1.3302511</a>	<a href="http://www.nydailynews.com/tags/jim-boeheim">http://www.nydailynews.com/tags/jim-boeheim</a>
<a href="http://www.nydailynews.com/autos/news/tesla-model-3-volvo-electric-article-1.3304161">http://www.nydailynews.com/autos/news/tesla-model-3-volvo-electric-article-1.3304161</a>	<a href="http://www.nydailynews.com/news/politics/trump-plans-withdraw-paris-climate-deal-article-1.3209157">http://www.nydailynews.com/news/politics/trump-plans-withdraw-paris-climate-deal-article-1.3209157</a>
<a href="http://www.nydailynews.com/autos/news/tesla-upcoming-model-y-list-reliable-luxury-cars-article-1.3381720">http://www.nydailynews.com/autos/news/tesla-upcoming-model-y-list-reliable-luxury-cars-article-1.3381720</a>	<a href="http://www.nydailynews.com/news/national/9-inspirational-books-top-ceos-read-article-1.2404946">http://www.nydailynews.com/news/national/9-inspirational-books-top-ceos-read-article-1.2404946</a>
<a href="http://www.nydailynews.com/autos/news/tesla-model-3-5-facts-rumors-article-1.2584411">http://www.nydailynews.com/autos/news/tesla-model-3-5-facts-rumors-article-1.2584411</a>	<a href="http://www.nydailynews.com/news/politics/trump-u-s-withdraw-paris-climate-agreement-article-1.3213184">http://www.nydailynews.com/news/politics/trump-u-s-withdraw-paris-climate-agreement-article-1.3213184</a>
<a href="http://www.nydailynews.com/news/national/9-inspirational-books-top-ceos-read-article-1.2404946">http://www.nydailynews.com/news/national/9-inspirational-books-top-ceos-read-article-1.2404946</a>	<a href="http://www.nydailynews.com/news/politics/trump-paris-accord-wthdrawal-">http://www.nydailynews.com/news/politics/trump-paris-accord-wthdrawal-</a>



<a href="http://www.nydailynews.com/autos/tags/ford/stories/2">http://www.nydailynews.com/autos/tags/ford/stories/2</a>	<a href="http://www.nydailynews.com/autos/latest-reviews/first-drive-2018-infiniti-q50-road-test-article-1.3345563">criticized-environmentalists-article-1.3213331</a> <a href="http://www.nydailynews.com/autos/latest-reviews/first-drive-2018-infiniti-q50-road-test-article-1.3345563">http://www.nydailynews.com/autos/latest-reviews/first-drive-2018-infiniti-q50-road-test-article-1.3345563</a>
<a href="http://www.nydailynews.com/newswires/news/business/tesla-adding-service-centers-model-3-sale-article-1.3317374">http://www.nydailynews.com/newswires/news/business/tesla-adding-service-centers-model-3-sale-article-1.3317374</a>	<a href="http://www.nydailynews.com/news/world/france-mocks-decision-pull-climate-deal-article-1.3217769">http://www.nydailynews.com/news/world/france-mocks-decision-pull-climate-deal-article-1.3217769</a>

## Query 2: Star Wars

Solr	Page Rank
<a href="http://www.nydailynews.com/entertainment/star-wars-movie-posters-years-gallery-1.2403042">http://www.nydailynews.com/entertainment/star-wars-movie-posters-years-gallery-1.2403042</a>	<a href="http://www.nydailynews.com/entertainment">http://www.nydailynews.com/entertainment</a>
<a href="http://www.nydailynews.com/autos/photos-illustrations/designers-create-star-wars-themed-cars-gallery-1.2439257">http://www.nydailynews.com/autos/photos-illustrations/designers-create-star-wars-themed-cars-gallery-1.2439257</a>	<a href="http://www.nydailynews.com/entertainment/tv">http://www.nydailynews.com/entertainment/tv</a>
<a href="http://www.nydailynews.com/entertainment/movies/star-wars-force-awakens-hits-2-billion-worldwide-article-1.2523295">http://www.nydailynews.com/entertainment/movies/star-wars-force-awakens-hits-2-billion-worldwide-article-1.2523295</a>	<a href="http://www.nydailynews.com/latino">http://www.nydailynews.com/latino</a>
<a href="http://www.nydailynews.com/tags/star-wars/stories/2">http://www.nydailynews.com/tags/star-wars/stories/2</a>	<a href="http://www.nydailynews.com/life-style/eats">http://www.nydailynews.com/life-style/eats</a>
<a href="http://www.nydailynews.com/tags/star-wars/stories/3">http://www.nydailynews.com/tags/star-wars/stories/3</a>	<a href="http://www.nydailynews.com/entertainment/theater-arts">http://www.nydailynews.com/entertainment/theater-arts</a>
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## Query 3: North Korea

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#### Query 4: LA Dodgers

Solr	Page rank
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### Query 5: Puerto Rico

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**Query 6: Hurricane Harvey**

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**Query 7: iPhone X**

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#### Query 8: Paris Climate Deal

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### **Part 5: Overlap graph:**

Query	Overlap count
Elen Musk	1
Star Wars	0
North Korea	0
LA Dodgers	0
Puerto Rico	0
Hurricane Harvey	0
iPhoneX	0
Paris Climate Deal	0

