

**The University of Texas at Dallas
CS 6322
Information Retrieval
Spring 2024
Class Project Report**

Project TITLE: Search engine for Memes

TEAM 12

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1. The Problem:

Our objective was to create a search engine tailored for memes, aiming to provide users with easily accessible meme-related information. Our approach involved crawling the web to compile an index comprising approximately 102,920 web pages pertaining to memes. Subsequently, we implemented clustering techniques to organize the contents of these webpages. We further enhanced the search capabilities by applying PageRank and HITS algorithms to prioritize relevant results. Additionally, we experimented with various query expansion methods to gauge their impact on result relevance.

Topic Owners:

Crawling: Chaya Kusi, cwk210030

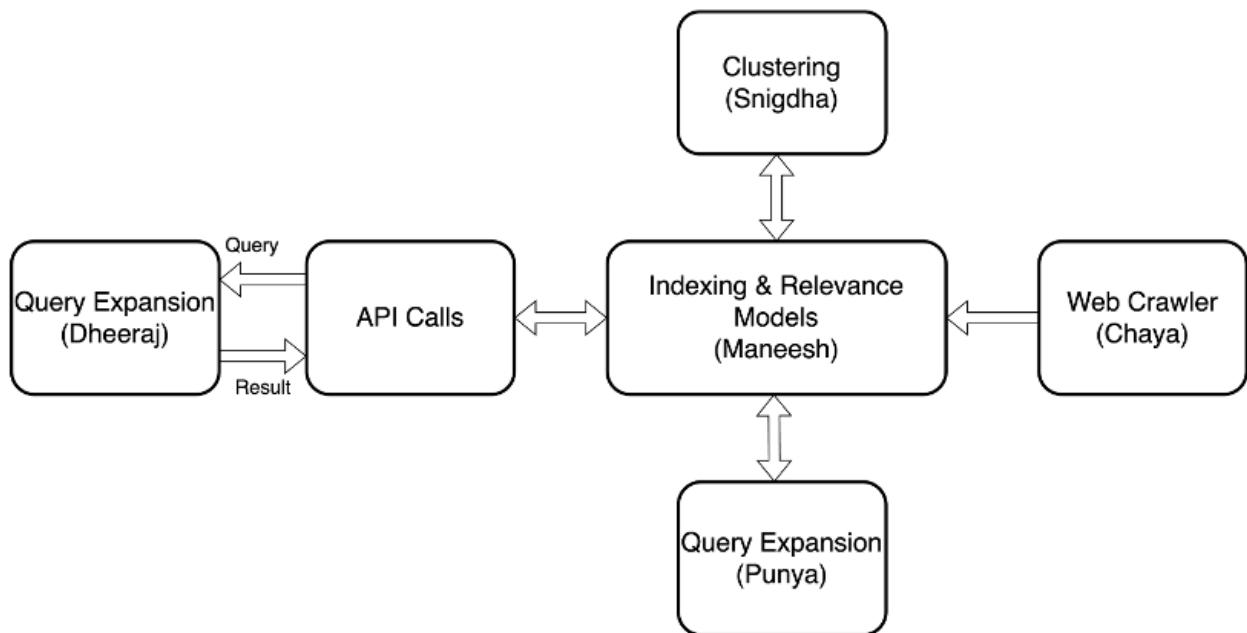
Indexing and Relevance: Maneesh Reddy Polu, mxp220038

User Interface and Comparison with Google & Bing: Dheeraj Chintagumpala, dxc220026

Clustering: Snigdha Gogineni, sxg220194

Query Expansion and Relevance Feedback: Punya Parag Modi, pxm230010

Architecture of Meme Search Engine:



Challenges:

1. Initially using Scrapy for web crawling which turned out to be very time consuming and was not yielding good results. So resolved by moving over to Apache Nutch for crawling and indexing which made the whole process smoother.
2. Also initially we were using clustering to first cluster the results based on assigning a cluster for a given query. This approach seemed infeasible as it was not giving us good results. We instead opted to use Solr's search results using PageRank and HITS score and then refined them further using clustering to get better results.
3. Being able to scale our search engine with the data growth was challenging even though our search engine only dealt with a smaller fraction of web pages in this project.

Learnings:

1. With this search Engine project, we learned how information retrieval works and acquired knowledge on using web crawler (Apache Nutch), indexer (Apache solr), python programming various algorithms for ranked retrieval, clustering and query expansion and building a user-friendly interface for the search engine.
2. Clustering and Query Expansion is certainly a very useful technique to provide relevant page results. From the queries tested we were able to find that the clustering and query expansion results were much more relevant than the initial ones displayed.

Overall, Creating a search engine proved to be a demanding endeavor, yet it proved immensely fulfilling, offering us valuable insights into the intricate nature of information retrieval.

2. Crawling:

We made use of multiple Python libraries like Scrapy, Beautiful Soup, and Selenium for web crawling tasks. After weighing the strengths and weaknesses of different crawlers, we concluded that Apache Nutch was the optimal choice for our project. We then utilized it to crawl around 93 seed URLs, sourced from various search engines such as Google, Bing, and Yahoo...

APACHE NUTCH:

It is an Internet search engine software, web crawler, powerful for vertical search engines.

The Apache Nutch Framework was utilized for

1. Crawling websites containing information on historical artifacts.
 2. For feeding the fetched crawled data to the Solr Framework for indexing.
- The Solr framework which is hosted on localhost:8983 port is used not only for indexing but also for creating web graphs that would later be used in implementing the Page Rank and the HITS algorithms.

STATISTICS FOR CRAWLED DATA:

Statistic	Value
Last Modified	a day ago
Num Docs	166777
Max Doc	171535
Heap Memory	49920
Usage	
Deleted Docs	4758
Version	651
Segment Count	18
Current	✓

Setting	Value
CWD	/mnt/c/Users/chaya/Documents/solr-8.11.3/server
Instance	/mnt/c/Users/chaya/Documents/solr-8.11.3/server/solr/nutch
Data	/mnt/c/Users/chaya/Documents/solr-8.11.3/server/solr/nutch/data
Index	/mnt/c/Users/chaya/Documents/solr-8.11.3/server/solr/nutch/data/index
Impl	org.apache.solr.core.NRTCachingDirectoryFactory

Node	Version	Gen	Size
Leader (Searching)	1714238112908	108	1.58 GB
Leader (Replicable)	-	-	-

SEED LIST OF SOURCE WEBSITES:

1. <https://www.reddit.com/r/memes/>
2. <https://9gag.com/>
3. <https://memes.com/recent>
4. <https://knowyourmeme.com/>
5. <https://www.cheezburger.com/>
6. <https://www.rd.com/funny/memes/>
7. <https://www.pinterest.com/sayingimages/pinterests-funniest-memes/>
8. <https://www.nytimes.com/2022/01/26/crosswords/what-is-a-meme.html>
9. <https://ifunny.co/>
10. <https://www.memedroid.com/>
11. <https://www.tiktok.com/tag/memes?lang=en>
12. <https://forum.inaturalist.org/t/nature-inspired-memes/27300?page=3>
13. <https://www.bu.edu/articles/2023/23-memes-that-got-us-through-2023/>
14. <https://www.esquire.com/entertainment/a30613359/best-memes-2020/>
15. <https://agencyanalytics.com/blog/marketing-memes>
16. <https://www.wired.com/tag/memes/>
17. <https://later.com/blog/trending-memes/>
18. <https://9gag.com/top>
19. <http://www.quickmeme.com/>
20. <https://www.independent.co.uk/topic/memes>
21. <https://www.rd.com/article/best-memes/>
22. <https://www.shutterstock.com/search/sad-meme>
23. <https://www.good.is/Health/memes-about-depression-rp>
24. <https://www.ranker.com/list/funny-and-dark-depressed-memes/erika-valverde>
25. <https://www.delicious.com.au/food-files/gallery/27-of-the-funniest-food-memes/rp8qaoht>
26. <https://www.rollingstone.com/culture/culture-lists/best-memes-2023-1234918358/>
27. <https://thehoneycombers.com/bali/funny-coronavirus-memes/>
28. <https://triad-city-beat.com/50-famous-memes-and-what-they-mean/>
29. <https://time.com/5763852/best-the-office-memes/>
30. <https://www.boredpanda.com/funny/memes/>
31. <https://www.alwayspets.com/s/hilarious-cat-memes-ac9324d114604420>
32. <https://memebase.cheezburger.com/tag/dank-memes>
33. <https://steemit.com/funny/@lauralemons/sad-memes-saturday-weekly-meme-compilation>
34. <https://www.youtube.com/collegehumor>
35. <https://thechive.com/>
36. <https://funnyordie.com/>
37. <https://www.buzzfeed.com/bestoftheinternet/memes>
38. <https://www.dailydot.com/tags/memes/>
39. <https://mashable.com/category/memes>
40. <https://www.pinterest.com/nicolettes93/memes/>
41. <https://www.theverge.com/memes>

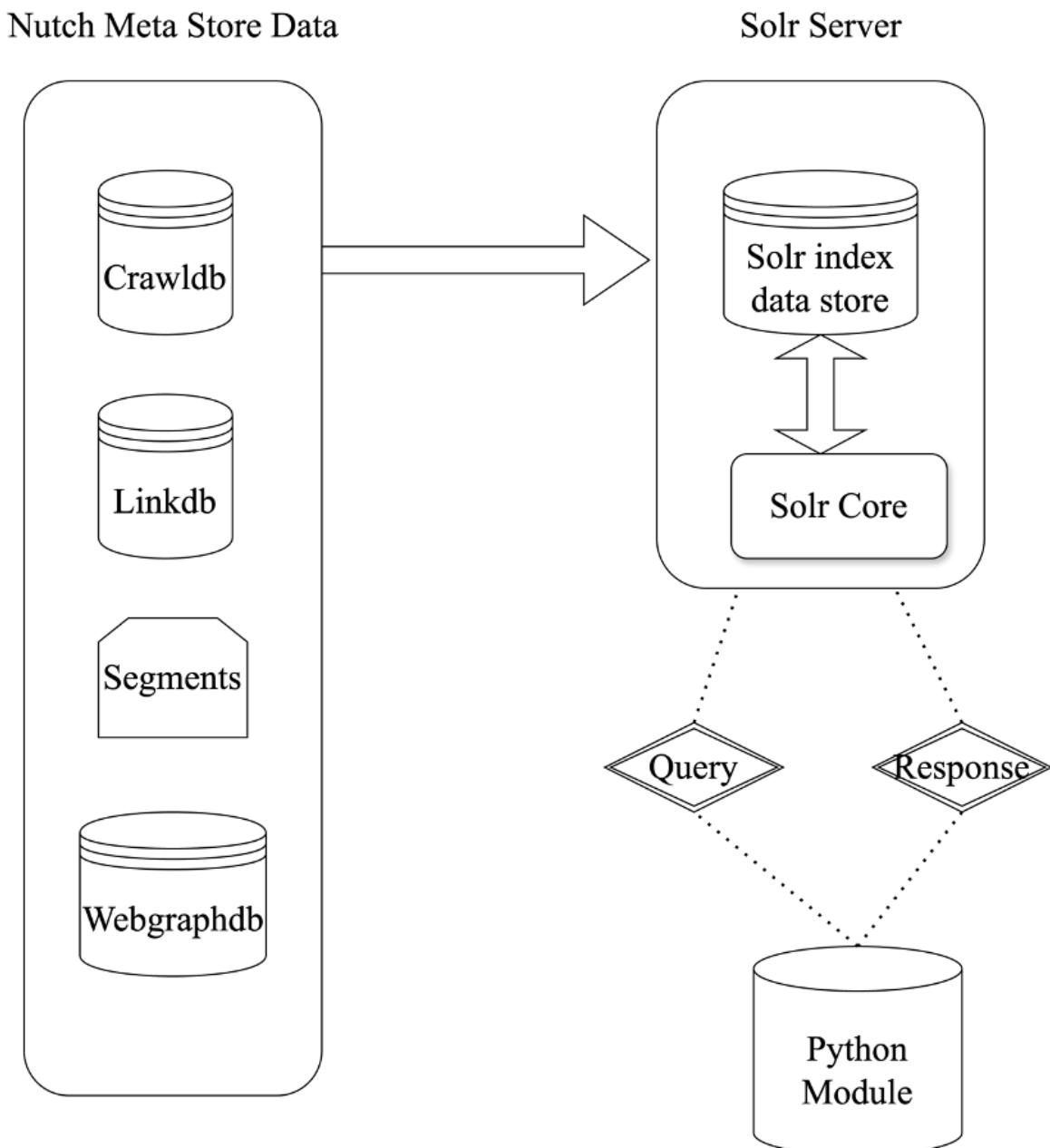
42. <https://www.instagram.com/memes/?hl=en>
43. <https://polygonscan.com/tokens/label/polygon>
44. <https://www.vox.com/2019/11/1/20942599/glad-you-asked-episode-4-memes>
45. <https://www.vice.com/en/topic/memes>
46. <https://www.newyorker.com/cartoons/issue-cartoons>
47. <https://www.newyorker.com/humor/shouts-murmurs>
48. <https://theoatmeal.com/>
49. <https://www.smbc-comics.com/>
50. <https://xkcd.com/>
51. <https://explosm.net/>
52. <https://poorlydrawnlines.com/>
53. <https://theawkwardyeti.com/comic-archive/>
54. <https://www.sarahcandersen.com/>
55. <https://pbfcomics.com/>
56. <https://oglaf.livejournal.com/>
57. <https://twitter.com/shenanigans?lang=en>
58. <https://www.facebook.com/FowlLanguageComics/photos/true-story-i-totally-forgot-i-pasted-a-similar-cartoon-about-memory-last-decembe/1670358146374545/>
59. <https://www.youtube.com/channel/UCYaPDQ8HMi6vOGBvcA4Xbnw>
60. <https://garfieldminusgarfield.net/>
61. <https://www.latimes.com/entertainment-arts/story/2023-11-02/l-a-comics-prepare-to-invade-the-new-york-comedy-festival-ones-to-watch>
62. <https://www.washingtonpost.com/entertainment/comics/>
63. <https://www.nytimes.com/topic/subject/comic-books-and-strips>
64. <https://www.theguardian.com/cartoons/archive>
65. <https://www.bbc.co.uk/programmes>
66. <https://www.lemonde.fr/dessins/>
67. <https://www.tumblr.com/search/memes>
68. <https://elpais.com/noticias/humoristas/>
69. <https://www.spiegel.de/fotostrecke/cartoon-des-tages-fotostrecke-142907.html>
70. <https://www.reddit.com/r/dankmemes/>
71. <https://www.memedroid.com/memes/tag/animals>
72. <https://imgflip.com/memegenerator>
73. <https://tenor.com/>
74. <https://giphy.com/>
75. <https://www.demilked.com/>
76. <https://www.youtube.com/collegehumor>
77. <https://www.theonion.com/>
78. <https://clickhole.com/>
79. <https://imgur.com/t/memes>
80. <https://babylonbee.com/>
81. <https://www.adultswim.com/>
82. <https://www.cc.com/shows>
83. <https://www.cc.com/shows/the-daily-show-with-trevor-noah>

84. <https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/>
85. <https://www.streamscheme.com/twitch-vs-youtube-gaming/>
86. <https://twitter.com/explore/>
87. <https://blog.hootsuite.com/social-media-contest/>
88. <https://discord.com/>
89. <https://www.facebook.com/groups/>
90. <https://tuyadigital.com/best-meme-websites/>
91. <https://9gag.ro/>
92. <https://www.memecenter.com/>
93. <https://memegenerator.net/>
94. <https://www.memecreator.org/>
95. <https://www.mememaker.net/>
96. <https://sayingimages.com/really-funny-memes/>
97. <https://www.polygon.com/22837589/best-memes-2021>
98. <https://bestlifeonline.com/funny-memes/>

3. Indexing and relevance:

To assemble the index, Apache Solr was used as the search indexer. The architecture of the system was designed to leverage the strengths of both Nutch and Solr to efficiently crawl, index, and compute page ranks and HITS scores for the web pages related to memes.

Index Creation Flow Diagram:



The output of the crawler contains three folders, crawldb, linkdb and segments. While creating the index in Solr, all these databases have been fed as the input.

1. **crawldb:** Crawl database is the directory to keep track of every URL known to Nutch, including whether it was fetched and the timestamp of the fetch
2. **linkdb:** The Link database contains the list of known links to each URL, including the source URL and anchor text.
3. **segments:** This is the directory which contains a set of URLs that are fetched as a unit, with each subdirectory holding information about the status of fetching, raw content, parsed text, outlinks, and metadata.

Process followed to index the crawled web pages:

```
$ cd /to-nutch-root-folder (where binary and datastore resides)
```

```
$ bin/nutch invertlinks crawl/linkdb -dir crawl/segments
```

```
$ bin/nutch index crawl/crawldb/ -linkdb crawl/linkdb/ -dir  
crawl/segments/ -filter -normalize -deleteGone
```

bin/nutch is the binary of Apache Nutch. The index command takes the content from one or more segments and passes it to all enabled IndexWriter plugins which sends the documents to Solr.

Webgraph and Statistics:

A web graph has been created from the set of crawled URLs. We have used nutch command to create the webgraph of all the crawled webpages.

Used the `bin/nutch webgraph` command to generate the web graph for a given set of segments in Nutch.

```
$ bin/nutch webgraph -segmentDir crawl/segments/ -webgraphdb  
crawl/webgraphdb
```

The webgraph command of nutch takes multiple segments to process and requires an output directory in which to place the completed web graph components. The webgraph creates three different components: an inlink database, an outlink database and a node database. The inlink database is a listing of url and all of its inlinks. The outlink database is a listing of

url and all of its outlinks. The node database is a listing of url with node meta information including the number of inlinks and outlinks.

The resulting webgraph can be used for a variety of purposes, such as analyzing the structure of the web, identifying communities within the graph, or computing various metrics like PageRank or HITS. We have used the same for PageRank.

Statistics :

Total Number of links = 215637

Total Number of nodes = 146076

The largest number of incoming links = 66

The largest number of outgoing links = 853

Web graph information connected to index:

While creating index in Solr, we have run the LinkRank program of nutch to perform an iterative link analysis with the webgraph. LinkRank is a pagerank-like link analysis program that converges to stable global scores for each url. The LinkRank program starts with a common score for all urls. It then creates a global score for each url based on the number of incoming links and the scores for those links and the number of outgoing links from the page.

Relevance Models:

Vector Space Relevance Model:

Solr provides tf-idf based relevance model to score the webpages and we made use of this model as vector space relevance model. In vector space relevance model, documents and queries are both vectors. Similarity of a document vector to a query vector can be computed by taking the cosine of the angle between them. Cosine similarity measure has been used to get the similarity between document and query.

This scoring model depends on various number of factors, Below are:

1. **TF (Term Frequency):** It Measures the frequency of a term in a document. It increases proportionally to the number of times a word appears in the document.

$$\text{TF-IDF} = \text{TF} \times \text{IDF}$$

2. **IDF (Inverse Document Frequency):** It measures the importance of a term by calculating the inverse of its frequency across the entire corpus (i.e., all documents). It decreases the weight of words that occur very frequently in the corpus and increases the weight of words that occur rarely.

$$W_{d,t} = tf_{d,t} \times idf_t$$

Link Analysis Model:

Graph-based relevance models are also called link analysis models. These models use the structure of the graph formed by hyperlinks between pages to determine the relevance of a page. We implemented two link analysis models which are PageRank and HITS (Hypertext Induced Topic Selection).

Page Rank: To develop the relevance model based on Page Ranking, we used inbuilt nutch command. The damping factor used is 0.80. Following are the steps we followed in order to apply PageRank scores into crawled database so that query results will display web pages in the descending order of page ranking values:

a. Create a web graph from the set of URLs fetched by the crawler:

```
bin/nutch webgraph -segmentDir crawl/segments/  
-webgraphdb crawl/webgraphdb
```

b.Run PageRank algorithm iteratively until the score converges:

```
bin/nutch linkrank -webgraphdb crawl/webgraphdb/
```

c. Update the page rank score into the crawled database:

```
bin/nutch scoreupdater -crawldb crawl/crawldb - webgraphdb  
crawl/webgraphdb/
```

d.Finally, index the updated crawled database:

```
bin/nutch index crawl/crawldb -linkdb crawl/linkdb -dir  
crawl/segments/
```

HITS (Hyperlink-Induced Topic Search):

HITS is a graph-based relevance model that considers both the authority and hub scores of web pages. The idea behind HITS is that web pages that are good hubs link to many good authorities, and web pages that are good authorities are linked to by many good hubs.

Given a query to a Search Engine, the set of highly relevant web pages are called Roots. They are potential Authorities. Pages which are not very relevant but point to pages in the Root are called Hubs. Thus, an Authority is a page that many hubs link to whereas a Hub is a page that links to many authorities

To implement HITS using Solr and Nutch, the web graph can be generated using Nutch's linkRank plugin. We then used a Python program to calculate the Hubs and the Authority scores for each URLs. We used the networkx library to create the graph through the inlinks and outlinks information of all the nodes (urls) and ran the hits algorithm on the graph to generate the hub and the authority scores. To get these inlinks, we used nutch and generated a dump of all the inlinks of crawled pages. With the inlinks dictionary, we created the outlinks as well. Based on the query provided by the user, root set of web pages are collected based on page rank results. The root set is converted to a base set by adding out link and inlinks of the root set. After that, HIT score calculation is done by our python program and based on maximum authority score, relevant web pages are sorted and returned to the User Interface for display.

Among the webpages we crawled:

1. Highest hub score was assigned to : https://theoatmeal.com/blog/coffee_duck and score is 0.03218.

2. Highest authority score was assigned to: <https://bidder.criteo.com/> and score is 0.03103.

Topic-based PageRanks:

For the purpose of testing Topic based page ranking, we have chosen 2 topics among countries:

Results for Fun Memes:

URL : <https://www.memedroid.com/memes/tag/fun+facts+with+joe>

Rank Score : 8.14

URL : <https://www.memedroid.com/memes/tag/fun+fact>

Rank Score : 7.98

URL: <https://www.pinterest.com/ideas/fun-facts-mind-blown/927992726011/>

Rank Score : 7.67

Results for Horror Memes:

URL : <https://www.hulu.com/hub/horror-movies>

Rank Score : 7.69

URL : <https://www.pinterest.com/ideas/classic-horror-movies/945063456918/>

Rank Score : 7.43

URL: <https://www.pinterest.com/ideas/horror-films-list/924645621028/>

Rank Score : 7.19

Collaboration with UI and Testing:

We performed manual testing by using a set of queries to test the relevance models implemented as part of this project. Here are the results of randomly picked 3 queries tested on the UI and showing a contrast in the results of pagerank and HITS relevance model results.

Query 1: Dog Memes

PageRank Result:

The screenshot shows a search interface with the following details:

- Search query: dog memes
- Relevance Model Options:
 - Page Rank
 - HITS
- Clustering Options:
 - Flat Clustering
 - Hierarchical Clustering
- Query Expansion Option:
 - Association
 - Metric
 - Scalar
- Search button

The results list contains several links related to dog memes, such as:

- [The best Dog Memes memes :\) Memedroid](https://www.pinterest.com/cheezburgerpins/dog-memes/)
- [Pinterest Today Watch Shop Explore Log in Sign up Dog Memes Pins d Collection by Cheezburger Share Darling Dog Memes for Canine Enthusiasts April Arf dog dogmeme funnydogmeme](https://www.pinterest.com/cheezburgerpins/dog-memes/)
- [Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Animal Funny dog memes Get ready to laugh out loud with these funny dog memes Discover the most hilarious and relat](https://www.pinterest.com/ideas/funny-dog-memes/949568768074/)
- [The best Dog Meme memes :\) Memedroid](https://www.pinterest.com/laffgaff/funny-animals/)
- [Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Animal Funny dog memes Get ready to laugh out loud with these funny dog memes Discover the most hilarious and relat](https://www.pinterest.com/laffgaff/funny-animals/)
- [Pinterest Today Watch Shop Explore Log in Sign up Funny Animals Funny animal memes and jokes Pins y Collection by LaffGaff Share Crazy Cat Lady Funny Animal Pictures Puppies Dog Cat Cats And K](https://www.pinterest.com/thefunnybeaver/wholesome-memes/)
- [Pinterest Today Watch Shop Explore Log in Sign up Wholesome Memes Pins w Collection by TheFunnyBeaver Com Share Funny Memes Illustrators Funny Fails Funny Internet Memes Funny Tweets You Funn](https://www.pinterest.com/thefunnybeaver/wholesome-memes/)
- [Pinterest Today Watch Shop Explore Log in Sign up Hilarious Dog Memes for Canine Enthusiasts August Dog memes Funny dog memes Animal memes Explore Art Photography Read it Save cheezb](https://www.pinterest.com/pin/177470041558103724/)

HITS Result:

dog memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

Search

[The best Lawyer Dog memes :\) Memedroid](#)
The best Lawyer Dog memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop it he

[The best Dog memes :\) Memedroid](#)
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The best Doggos Are The Bestos memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or

[The best Police Dog memes :\) Memedroid](#)
The best Police Dog memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop it he

[The best Dog Meme memes :\) Memedroid](#)
The best Dog Meme memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop it here

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[The best Atf Shot My Dog memes :\) Memedroid](#)
The best Atf Shot My Dog memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop

Maneesh Reddy Polu(MXP220038)

Query 2: Cat Memes

PageRank Result:

cat memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

Search

<https://www.pinterest.com/ideas/funny-grumpy-cat-memes-hilarious/940370558820/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Memes Funny grumpy cat memes hilarious Get ready to laugh out loud with these hilarious funny grumpy cat memes Discover t

<https://www.pinterest.com/ideas/funny-cat-memes/919282177658/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Animal Humor Funny cat memes Get ready to laugh with these funny cat memes From adorable kittens to mischievous felines

[The best Funny Cat Memes memes :\) Memedroid](#)
The best Funny Cat Memes memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop

<https://www.pinterest.com/ideas/crazy-cat-lady/922143650513/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Quotes Quotes By Genres Quotes By Emotions Crazy Cat Lady Are you a self proclaimed cat lover Embrace your feline obsession with these top id

<https://www.pinterest.com/mearthur0281/cats/>
Pinterest Today Watch Shop Explore Log in Sign up Cats Pins w mcarthur M Collection by Rachel McArthur Share Character Design Kitty Cats Feline Cute Dogs Gatos Cute Cats Cute Animals Cute

<https://www.pinterest.com/ideas/in-memes/948381646345/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Memes In memes Get ready to laugh out loud with our collection of hilarious memes Discover the funniest and most relatabl

<https://www.pinterest.com/ideas/monday-cat/935462271002/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Animals Monday cat Get ready to smile with adorable and hilarious pictures of cats to brighten up your Monday Start your week off right with

HITS Result:

dog memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

[The best Lawyer Dog memes :\) Memedroid](#)
The best Lawyer Dog memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop it he

[The best Dog memes :\) Memedroid](#)
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[The best Atf Shot My Dog memes :\) Memedroid](#)
The best Atf Shot My Dog memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop

Maneesh Reddy Polu(MXP220038)

Query 3: Funny Memes

PageRank Result:

funny memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

<https://www.pinterest.com/ideas/funnies-memes/931204495216/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Magazine Funniest memes Get ready to laugh out loud with the funniest memes on the internet Explore top memes that will brighte

<https://www.pinterest.com/sayingimages/pinterests-funniest-memes/>
Pinterest Today Watch Shop Explore Log in Sign up Pinterest's Funniest Memes Pins y Collection by Saying Images Cool Funny Quotes and others Share Brunch Snacks Desserts Dessert Fo

<https://www.pinterest.com/thefunnybeaver/funny-jokes-and-banter/>
Pinterest Today Watch Shop Explore Log in Sign up Funny Jokes and Banter Pins w Collection by TheFunnyBeaver Com Share Marvel Lord Zooey Deschanel Superman Humour Clark Kent Clark Funny Superm

<https://www.pinterest.com/ideas/lol-so-true/954674783676/>
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HITS Result:

funny memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

<https://www.pinterest.com/ideas/funniest-memes/931294495216/>

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<https://www.pinterest.com/thefunnybeaver/funny-jokes-and-banter/>

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Maneesh Reddy Polu(MXP220038)

Collaboration With Clustering:

1. Clustering required the entire data set from solr to perform offline computations. In order to facilitate this, I provided a json dump of the data in the solr.
2. The solr was hosted so that the indexed results were accessible across devices from any location.
3. The results of the indexing were used by clustering and in most of the cases it was noted that clustering provided better results than Page Ranking and HITS.

Query 1 : Dog Memes

Flat Clustering:

[dog memes]

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

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Hierarchical Clustering(Complete-link):

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

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Maneesh Reddy Polu(MXP220038)

Query 2 : Baby Memes

Flat Clustering:

baby memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

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Hierarchical Clustering(Complete-link):

baby memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

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Query 3 : Funny Memes

Flat Clustering:

funny memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

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<https://www.pinterest.com/ideas/lol-so-true/954674783676/>

Hierarchical Clustering(Complete-link):

funny memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

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4. User interface and comparisons with Google and Bing:

The user interface consists of a search form and multiple iframes to display search results from various sources.

Search Form:

- The search form includes a search bar where users can enter their queries.
- Below the search bar, there are radio buttons to select different ranking methods, such as Page Rank, HITS, Flat Clustering, Hierarchical Clustering, Metric Query Expansion, Association Query Expansion, and Scalar Query Expansion.
- A submit button is provided to initiate the search process

Iframes:

- There are three iframes embedded in the web page, arranged vertically.

1. Custom Search Engine Frame:

- This iframe displays the results of our custom search engine.
- The results are presented based on different relevance models, including page rank, HITS, flat clustering, hierarchical clustering, metric query expansion, association query expansion, and scalar query expansion.

2. Google Frame:

- This iframe displays the results obtained from Google search engine.
- We can compare the results of our custom search engine with those of Google.

3. Bing Frame:

- This iframe displays the results obtained from the Bing search engine.
- We can compare the results of our custom search engine with those of Bing.

Search Process:

- When the user enters a query and selects a ranking method, JavaScript functions are triggered to handle the search process.
- The query and selected ranking method are sent as parameters in a GET request to an API responsible for executing the search and returning results.
- The API processes the request, retrieves relevant search results, and formats them into JSON files.
- The JSON files containing search results are then displayed in the corresponding iframes on the web page.

Collaboration Details:

Collaboration with Maneesh:

- Worked closely with Maneesh to develop an API for accessing relevance models based on various ranking methods.
- Discussed the requirements for the API, including the types of relevance models needed and the parameters for retrieving results.
- Participated in designing the API endpoints and defining the data format for returning search results.
- Provided feedback and suggestions during the development and testing phases to ensure the API met the requirements of the user interface.
- Conducted testing of the API endpoints to verify functionality and compatibility with the user interface.

Collaboration with Snigdha:

- Collaborated with Snigdha to integrate clustering results into the search engine.
- Discussed the integration process and the format of clustering results that need to be incorporated into the search engine.
- Shared relevant code snippets and documentation to facilitate the integration process.
- Worked together to ensure that clustering results were correctly displayed and utilized in the search engine's ranking algorithm.
- Conducted testing to validate the integration and assess the impact of clustering on search results relevance.

Collaboration with Parag Modi :

- Collaborated with Parag to implement query expansion and obtain corresponding relevance results.
- Engaged in discussions to understand the requirements and objectives of query expansion.
- Provided input on how query expansion functionality could be integrated into the search engine.
- Tested the implementation of query expansion to ensure its effectiveness in improving search result relevance.

Comparison with Google and Bing:

Our custom search engine provides results based on various relevance models, including clustering and query expansion. Compared to Google and Bing, our search engine may not be as reliable due to limited access to webpages and real-time updating mechanisms. For some queries, our search engine may perform comparably or even better than Google or Bing, especially when incorporating clustering or query expansion. Demonstrations focused on queries showing accurate results and improvements with clustering or query expansion.

Below are few results of some queries that we tested :

Results for cat memes:

Relevance model : Page Rank

My search engine results:

The screenshot shows a search interface with the following parameters:

- Search term: cat memes
- Relevance Model Options:
 - Page Rank
 - HITS
- Clustering Options:
 - Flat Clustering
 - Hierarchical Clustering
- Query Expansion Option:
 - Association
 - Metric
 - Scalar

Below the parameters, there is a "Search" button and a list of search results:

- <https://www.pinterest.com/ideas/funny-grumpy-cat-memes-hilarious/>
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- <https://www.pinterest.com/mearthur0281/cats/>
Pinterest Today Watch Shop Explore Log in Sign up Cats Pins w mearthur M Collection by Rachel McArthur Share Character Design Kitty Cats Feline Cute Dogs Gatos Cute Cats Cute Animals Cute
- <https://www.pinterest.com/ideas/in-memes/>
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Google Results:

The screenshot shows a Google search results page for the query "cat memes". The results are displayed in a dark-themed interface:

- Cheezburger** <https://icanhas.cheezburger.com/lolcats>
LOLCATS - LOL at Funny Cat Memes
LOLCATS is the best place to find and submit funny cat memes and other silly cat materials to share with the world. We find the funny cats that make you LOL ...
LOLCATS - Page 2 · LOLCATS - Page 3 · Page 4 · Page 5
- Reader's Digest** <https://www.rd.com/pets-animals/cats/>
71 Hilarious Cat Memes You Will Laugh at Every Time

Bing Results:

Bing Search

Reader's Digest
https://www.rd.com/list/hilarious-cat-memes-youll... ▾

71 Hilarious Cat Memes You Will Laugh at Every Time

Estimated Reading Time: 7 mins

Enjoy these funny **cat memes** that capture the relatable moments and quirks of our feline friends. From **cat naps** and **cat fights** to **cat fashion** and **cat jokes**, these memes are sure to make you smile.

EXPLORE FURTHER

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- 60 Cutest Cat Meme - Meme Central | memocentral.org
- Bored Panda - 50 Funny And Relatable Cat Memes That ... | boredpanda.com
- 66 Funny Cat Memes That Will Never Get Old - BuzzFeed | buzzfeed.com
- 25 Funny Cat Photos You Need to See | Reader's Digest | rd.com

Cute cat memes

When you eat too fast!

50 Cat Memes Created By People Clearly Living With One

71 Hilarious Cat Memes You Will Laugh at Every Time

We can all relate to this funny cat meme after a...
https://www.boredpanda.com/50-funny-and-relatable-c.../

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cute cat meme

Relevance model : HITS My search engine results:

cat memes

Relevance Model Options:
 Page Rank HITS

Clustering Options:
 Flat Clustering Hierarchical Clustering

Query Expansion Option:
 Association Metric Scalar

[Search](#)

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<https://www.pinterest.com/mcarthur0281/cats/>

Google Results:

The screenshot shows a Google search results page for the query "cat memes". The top result is from "Bored Panda" with the title "50 Cute And Funny Memes That Might Make You Want To ...". Below it is a result from "Pinterest" titled "900+ Cat Memes and Posters ideas in 2024". The third result is from "Instagram" with the handle "@softcatmemes". The search bar at the top contains "cat memes".

Bing Results:

The screenshot shows a Bing search results page for the query "cat memes". The top result is a link to "Bored Panda" titled "50 Cat Memes Created By People Clearly Living With One". Below it is a "SUGGESTED" search term "list of cat memes". Further down are other suggested terms like "cat memes funny 2022", "cute funny cat memes", "cat meme crying", and "funny meme cat face". A "More" button is visible. The search bar at the top contains "cat memes".

Clustering : Flat Clustering

My search engine results:

cat memes

Relevance Model Options:
 Page Rank HITS

Clustering Options:
 Flat Clustering Hierarchical Clustering

Query Expansion Option:
 Association Metric Scalar

Search

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Google Results:

Google Search

Google cat memes

Facebook - Cat Memes
1.5M+ followers

Cat Memes
Join group. About this group. This group originally started ... Cat Memes to. Cure Depression. 109K members. Join - Cats & Memes. 236K members.

I Can Has Cheezburger?
<https://icanhascheezburger.com/tag/funny-cat-memes>

funny cat memes
26 Historical Cat Memes To Make This Sunday A Feline Frenzy Full Of Fun. Pawsitively hissterial feline moments. View List. 0

Pinterest - summermoon25
4.2K+ followers

900+ Best Cat Memes ideas
Oct 3, 2022 - Explore Summer Moon's board "Cat Memes", followed by 755 people on Pinterest.
See more ideas about cat memes, crazy cats, funny animals.

Bing Results:

Bing Search

The search results page for "Videos of Cat Memes" on Bing. On the left, there's a sidebar with "Explore" buttons for "Funny Cat Memes", "Bongo Cat Meme", "Hilarious Cat Memes", "Cat Memes 2021", and "Cat Meme Original". The main content area shows a video thumbnail titled "I Found My Cat On Google Maps" by "The Best Cat Memes". The video has 855.9K views and was uploaded 9 months ago. To the right of the video, there's a sidebar with "Related searches" including "cat rofm meme", "panda cat meme", and several other variations like "funny cat meme", "cute funny cat memes", etc.

Results for baby memes:

Reference model : Page Rank

My search engine results:

baby memes

Relevance Model Options:
 Page Rank HITS

Clustering Options:
 Flat Clustering Hierarchical Clustering

Query Expansion Option:
 Association Metric Scalar

[Search]

<https://www.pinterest.com/ideas/funny-baby-memes/952669629022/>

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Google Results:

Google Search

The screenshot shows the Google search interface with the query "baby memes" entered. The results include:

- Pinterest - Cranburyfields**: 5.4K followers. Result: 200 Best Funny baby memes ideas. Description: May 5, 2020 - Explore Cranbury Fields - Kelly Lehman's board "Funny baby memes", followed by 5211 people on Pinterest. See more ideas about funny baby memes ...
- The Bump**: https://www.thebump.com/.../Humor. Result: 15 of the Most Ridiculously Funny Baby Memes on ... Description: 15 of the Most Ridiculously Funny Baby Memes on the Planet! - Your WHAT? - Too. Many. Boobies. - I Give Up, Grandma. - They See Me... A preview shows three baby photos with captions: "THAT WASN'T REALLY AN ACCIDENT", "I OUT OF YOUR MOUTH", and "I LOVE MY GRANDMA".
- Care.com**: https://www.care.com/.../funny-baby-memes. Result: 17 funny baby memes to help you forgive them when they ... Description: Apr 14, 2023 - 17 funny baby memes to help you forgive them when they ... A preview shows four baby photos with captions: "DON'T EVEN KNOW HOW", "DO YOU KNOW WHO IT LOOKED LIKE", "MORE MILK", and "I GOT BACK TO MY CHIL LAST NIGHT".

Bing Results:

Bing Search

The screenshot shows the Bing search interface with the query "memes". The results include:

- Bored Panda**: https://www.boredpanda.com/relatable-funny-memes. Result: 50 of the Best Memes of All Time That Are Icons of ... Description: Enjoy some of the top memes of all time that are icons of internet culture. Learn about the history, science, and psychology of memes, and see examples of ...
- EXPLORE FURTHER**:
 - pinterest.com**: 900+ Best Funny Memes Ideas in 2024 | funny memes, ...
 - boredpanda.com**: 60 Hilarious Memes Most People Will Relate To | Bored ...
- Reddit**: https://www.reddit.com/r/memes. Result: /r/Memes the original since 2008 - Reddit Description: WEB: No videos longer than 15 seconds (and must include captions/meme text overlay). No intentionally loud audio. Videos should not be TikTok, or other non...

Bing Search

The screenshot shows the Bing search interface with the query "funny baby memes". The results include:

- TheBump.com**: https://www.thebump.com/news/15-of-the-most... Result: 15 of the Most Ridiculously Funny Baby Memes on The Planet!
 - Your WHAT?
 - Too. Many. Boobies.
 - I Give Up, Grandma.
 - They See Me Rollin'...
 Description: See full list on thebump.com
- Occupation: Editors**
- Tags: Infant, Funny Baby Memes, Occupation: Editors, Planet**
- Feedback**
- Ask Copilot**
- Try now**
- Related searches**:
 - funny baby face meme
 - cute baby memes
 - baby crying meme
 - funny memes for kids
 - famous baby memes
 - adorable baby meme
 - ridiculous baby meme
 - funny baby memes 2023

Bing Search

Child Insider
https://childinsider.com/funny-baby-memes ▾

60 Funny Baby Memes That'll Improve Your Mood – ...

Tags: Funny Baby Memes | Humour | Child

1. What Do You Mean... The Dog Is Not My Personal Horse?
2. When You've Been Dieting for 2 Whole Hours. But You Haven't Lost Weight.
3. When I Was Born I Was So Mad at My Parents... I Didn't Talk to Them for 2 ...
4. 3 Years in Jail for Stealing My Nose.

See full list on childinsider.com

Tenor
https://tenor.com/search/funny-baby-gifs ▾

Funny Baby GIFs | Tenor

With Tenor, maker of GIF Keyboard, add popular Funny Baby animated GIFs to your conversations. Share the best GIFs now >>>

Tags: Infant | Humour | Graphics Interchange Format | Animated Gifs

Videos of Baby Memes

bing.com/videos

Funny Meme Results:

Relevance Model : Page Rank

Our search engine results:

[funny memes]

Relevance Model Options:
 Page Rank HITS

Clustering Options:
 Flat Clustering Hierarchical Clustering

Query Expansion Option:
 Association Metric Scalar

Search

<https://www.pinterest.com/ideas/funniest-memes/931294495216/>
 Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Magazine Funniest memes Get ready to laugh out loud with the funniest memes on the internet Explore top memes that will brighten your day

<https://www.pinterest.com/saying/images/pinterests-funniest-memes/>
 Pinterest Today Watch Shop Explore Log in Sign up Pinterest's Funniest Memes Pins by Collection by Saying Images Cool Funny Quotes and others Share Brunch Snacks Desserts Dessert Food

<https://www.pinterest.com/thefunnybeaver/funny-jokes-and-banter/>
 Pinterest Today Watch Shop Explore Log in Sign up Funny Jokes and Banter Pins by Collection by TheFunnyBeaver Com Share Marvel Lord Zooey Deschanel Superman Clark Kent Clark Funny Superman

<https://www.pinterest.com/ideas/lol-so-true/954674783676/>
 Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Twitter Humor Lol so true Laugh out loud with these hilariously relatable quotes that perfectly capture life's truths Get ready to LOL

<https://www.pinterest.de/ideas/funny-relatable-memes/948222729313/>
 Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Memes Funny relatable memes Get ready to LOL with a collection of funny relatable memes that will have you nodding your head

<https://www.pinterest.com/ideas/funny-relatable-memes/948222729313/>
 Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Memes Funny relatable memes Get ready to LOL with a collection of funny relatable memes that will have you nodding your head

Google Results:

Google Search

Google search results for "funny memes":

- Memebase** - All Your Memes In Our Base - Funny Memes ...
Funny memes that 'GET IT' and want you to too. Get the latest funniest memes and keep up what is going on in the meme-o-sphere.
Memebase - Page 2 · Random Memes · Page 4 · Page 5
- Pinterest - lolalambchops** 10.3K+ followers
370 Memes, Memes Everywhere ideas in 2024
Apr 21, 2024 - Funny memes, quotes, GIFs, from all fandoms to make you laugh. See more ideas about memes, funny memes, funny.
- Reddit - r/Funnymemes** 828K+ followers
/r/Funnymemes place for memes!
/r/Funnymemes: /r/funnymemes is a place for people to post memes, to bingewatch other peoples memes, and definitely a place to put you in a happy...

Google Search

Google search results for "funny memes":

- Instagram - thetinderblog** 4.1M+ followers
Funny & Relatable Memes! (@thetinderblog)
4M Followers, 1466 Following, 40K Posts - See Instagram photos and videos from Funny & Relatable Memes! (@thetinderblog)
- Reader's Digest** https://www.rd.com/humor ...
700+ Funny Memes for Every Occasion
You'll want to send these funny memes on topics ranging from classic dog and cat memes to happy birthday and Monday memes to your pals ASAP.
80 Funny Work Memes to... · The 22 Funniest Memes of...
- ReachOut Forums** https://forums.au.reachout.com/taking-care-of-myself ...
FUNNY MEMES AND PICTURES - ReachOut Forums
May 1, 2017 - Every morning we pull out our phones and scroll through them and we see many memes. Life without memes is quite hard to imagine nowadays. One of ...

Bing Results:

Bing Search

Bing search results for "funny memes":

- Memedroid** https://www.memedroid.com ...
Memedroid - The best site to see, rate and share funny memes ...
WEB Memedroid is a site and app where you can see, rate and share memes, pics and videos. Browse the latest memes on topics like murder, eclipse, masturbation and more.

Top Day Latest Memes Log in Labor Day

EXPLORE FURTHER

- Meme Generator | meme boeller
- 50 Funny Memes For Today And Beyond eBaum's World
- 36 Really Funny Memes To Cheer You Up ...
- Memes. The best memes on iFunny
- Memes GIFs - Find & Share on GIPHY

Recommended to you based on what's popular · Feedback

Videos of Funny Memes
bing.com/videos

All images

A meme is an idea, behavior, or style that spreads by means of imitation from person to person within a culture and often carries symbolic meaning representing a particular phenomenon or the .

Wikipedia

Although Richard Dawkins invented the term meme and developed meme theory, he has not claimed that the idea was entirely

Bing Search

The screenshot shows a Bing search results page for the query "memes". The top result is from Bored Panda, titled "50 of the Best Memes of All Time That Are Icons of ...". It features a grid of 10 meme images, each with a caption. Below this, there's a section titled "EXPLORE FURTHER" with links to "900+ Best Funny Memes ideas in 2024 | funny memes, ..." and "50 Hilarious Memes Most People Will Relate To | Bored ...". A sidebar on the left lists related search terms like "absolutely hilarious memes", "most hilarious memes ever", "crying meme", "crying emoji meme", "funny memes for work", and "More". At the bottom, there's a link to "Reddit /r/Memes the original since 2008 - Reddit".

5. Clustering:

Data Collection and Indexing Process:

Chaya was responsible for crawling all the documents, while Maneesh handled the indexing process using Apache Solr. I collaborated with Maneesh and got the **indexed data** generated by Solr for further clustering. The indexed data obtained was in JSON format, that was approximately 1 GB in size.

Sample of Indexed JSON Data:

The indexed data consists of a response key containing JSON values, each containing a list of documents. Each document includes content data within a content key. During pre-processing, the content key's value, representing the plain text data, was extracted from each document, removing DOM and HTML tags. The URL key provides the corresponding website URL. Content from all documents was stored in one list, and URLs were stored in another.

```
{
  "responseHeader": {
    "status": 0,
    "QTime": 150,
    "params": {
      "q": "*:*",
      "rows": "135180",
      "wt": "json"
    }
  },
  "response": {
    "numFound": 135180,
    "start": 0,
    "numFoundExact": true,
    "docs": [
      {
        "tstamp": "2024-04-20T22:28:27.792Z",
        "digest": "c9747634870f39635e49fd28e65b5b4c",
        "boost": 1.1,
        "id": "https://en.wikipedia.org/wiki/Internet_meme",
        "title": "Internet meme - Wikipedia",
        "url": "https://en.wikipedia.org/wiki/Internet_meme",
        "_version_": 1796894558715379712,
        "content": "Internet meme - Wikipedia\nJump to content\nMain menu\nMain menu\nmove to sidebar\nhide\nNavigation\nMain page\nContents\nCurrent events\nRandom article\nAbout Wikipedia\nContact us\nDonate\nContribute\nHelp\nLearn to edit\nCommunity portal\nRecent changes\nUpload file\nSearch\nSearch\nCreate account\nLog in\nPersonal tools\nCreate account\nLog in\nPages for logged out editors learn more\nContributions\nTalk\nContents\nmove to sidebar\nhide\n(Top)\n1 Characteristics\n2 Evolution and propagation\n3 History\nToggle History subsection\n3.1 Origins and early memes\n3.2 Modern memes\n4 By context\nToggle By context subsection\n4.1 Marketing\n4.2 Economics & finance\n4.3 Politics\n4.4 Social movements\n4.5 Religion\n4.6 Healthcare\n5 Copyright\nToggle Copyright subsection\n5.1 United States\n5.1.1 Non-fungible tokens\n6 See also\n7 References\n8 Further reading\n9 External links\nToggle the table of contents\nInternet meme\n62 languages\nالعربية\nAvañe'ẽ\nAzərbaycanca\nবাংলা\nBân-lâm-gú\nБългарски\nCatalà\nČeština\nCymraeg\nDansk\nDeutsch\nEλληνικά\nEspañol\nEsperanto\nEuskarai\nفارسی\nFrançais\nGalego\nگیلکی\n한국어\nՀայերեւն\nHrvatski\nBahasa"
      }
    ]
  }
}
```

Data Pre-processing Steps:

- Iterated through each document to extract the plain text content from the JSON.
- Cleaned the content by removing DOM and HTML tags.
- Stored the content in one list and corresponding URLs in another list.
- Utilized scikit-learn's TF-IDF Vectorizer for vectorizing the data.
- Reduced the dimensionality of TF-IDF document vectors using TruncatedSVD, a technique known as latent semantic analysis(LSA).
- Normalized the SVD results to ensure consistent scaling across features.

Clustering Algorithms:

FLAT CLUSTERING

Flat clustering involves the singular grouping or partitioning of data, aiming to organize observations into distinct sets without hierarchy. In our project, we've implemented flat clustering utilizing the KMeans algorithm.

Objective of KMeans Clustering:

KMeans aims to minimize the within-cluster sum of squares (WCSS) by partitioning observations into k clusters, assigning each to the nearest centroid and updating centroids based on the mean of observations within clusters.

Design and Implementation:

- For our implementation, we preprocess data, typically after dimensionality reduction for efficiency. Scikit-Learn's KMeans library is used, specifying a predetermined k.
- Each document is then associated with a cluster, and this mapping, along with the URL, is converted into a Pandas series.
- The obtained results were stored in a text file flat_clustering.txt in (URL, ClusterID) format.

Selection of Predefined Number of Clusters:

- To determine the optimal k, we used the elbow method and silhouette score. The elbow method identifies the point where WCSS decrease rate slows, while the silhouette score validates clusters.
- We experiment with k values from 3 to 20, selecting where WCSS diminishes initially and silhouette score peaks.
- After experimentation, **k = 10** yielded the most meaningful results, organizing documents into **10 clusters** (IDs 0-9). This ensures comprehensive yet manageable organization, aiding analysis.

Results obtained by KMeans Clustering:

Image shows Sample of clusters by KMeans from the clustering result obtained as text file:

```
https://bowlus.com/,3
https://bowlus.com/blog/configurator/volterra/,6
https://bowlus.com/locations/,6
https://bowlus.com/video/,6
https://bowlus.com/volterra/,3
https://bpv.de/presse-aktuelles/detail/bpv-umfrage-zeigt-digitalisierung/
https://br.gravatar.com/,6
https://br.gravatar.com/site/translations/,6
https://br.pinterest.com/,5
https://br.pinterest.com/ideas/,5
https://br.pinterest.com/ideas/animais/919400683386/,5
https://br.pinterest.com/ideas/kawaii/948739924712/,5
https://br.pinterest.com/pin/blague-sur-fait-sombre-ici-une-femme-qui-veut-que-tu-la-connaisse/,5
https://br.pinterest.com/pin/seksi-mafyam18-in-2024--10093693352236/,5
https://br.pinterest.com/shopping/,5
https://br.pinterest.com/today/,5
https://br.pinterest.com/vanessammuniz/,5
```

Shown are the URL's and their respective Cluster ID's obtained in text file generated after KMeans Clustering.

Snigdha Gogineni(SXG220194)

HIERARCHICAL CLUSTERING:

Hierarchical clustering is an approach to cluster analysis aimed at constructing a hierarchical structure of clusters. It offers the advantage of not needing to predefined the number of clusters, which is especially beneficial when the optimal cluster count is uncertain.

- Hierarchical Clustering has 2 types- Agglomerative clustering and Divisive Clustering.

In this project, we are using Agglomerative clustering with single-link and complete-link for implementing the hierarchical clustering of documents.

AGGLOMERATIVE CLUSTERING:

Agglomerative Clustering, also referred to as hierarchical agglomerative clustering (HAC), is a technique in which clusters are gradually merged together, starting with individual data points and progressing until all data points are combined into a single cluster. Unlike some clustering methods, agglomerative clustering doesn't require the number of clusters to be predetermined, offering flexibility in analysis. The clustering results are typically visualized using a dendrogram.

- When performing agglomerative clustering, various distance metrics, such as Euclidean, or Manhattan, can be chosen for computing the distances between data points.
- Additionally, different linkage criteria, such as maximum or complete link, minimum or single link, unweighted or weighted average link, or ward, can be used to calculate the distance between clusters.
- For our project, we utilized the Euclidean distance metric and conducted two types of hierarchical clustering: single-link and complete-link.

Design & Implementation:

- The preprocessed data, post-dimensionality reduction, served as input for the clustering process.
- We employed Python's fastcluster library, which efficiently computes hierarchical clustering results.
- The library's linkage method facilitated hierarchical, agglomerative clustering on vector data, allowing us to specify parameters like method (single or complete) and metric (distance metric).
- Subsequently, we visualized the clustering results through dendograms and converted the document-cluster mappings, along with corresponding URLs, into Pandas series.
- The results of single-link hierarchical clustering were stored in a text file named `single_hierarchical_clustering.txt`, while those of complete-link hierarchical clustering were stored in `complete_hierarchical_clustering.txt`, both formatted as (URL, ClusterID) pairs.

Results for Single-Link hierarchical clustering:

Image shows Sample of clusters by Single-Link hierarchical clustering from the clustering result obtained as text file:

```
22 https://tl.wikipedia.org/wiki/Meme,1.0
23 https://sco.wikipedia.org/wiki/Meme,3.0
24 https://www.mandatory.com/fun/funny-photos/feed,1.0
25 https://knowyourmeme.com/newsfeed.rss,1.0
26 https://www.pinterest.com/cheezburgerpins/funny-memes-and-images/,1.0
27 https://www.pinterest.com/abigaillutzke/dd/,4.0
28 https://en.m.wikipedia.org/wiki/Self-replication,5.0
29 https://www.si.com/,6.0
30 https://thehive.com/category/video/feed/,7.0
31 https://www.pinterest.com/buzzfeed/generatorsquizzesgames/,7.0
32 https://www.pinterest.com/cheezburgerpins/gaming/,8.0
33 https://loudwire.com/loudwire-lists/,9.0
34 https://amp.knowyourmeme.com/editorials/poll/cast-your-vote-for-february-2024s-meme-of-the-month,10.0
35 https://in.mashable.com/culture.xml,2.0
36 https://www.pinterest.com/ideas/zodiac-sign-for-october/938424123310/,1.0
37 https://www.pinterest.com/traitors_never_win/taylor-swift/,3.0
38 https://de.qz.com/trump-medien-elon-musk-x-tweet-bezahlen-amazon-prime-vi-1851424233,4.0
39 https://ps.wikipedia.org/wiki/%D8%A7%D9%86%D9%BC%D8%B1%D9%86%DB%90%D9%BC%D9%8A_%D9%8A%D8%A7%D8%AF%DA%9
40 https://newsroom.spotify.com/2019-04-30/why-nsyncs-its-gonna-be-me-spikes-every-april-30/,6.0
41 https://www.newscientist.com/definition/schrodingers-cat/,7.0
42 https://creators.snap.com/learn-shine-in-the-spotlight-spotlight-content-best-practices,7.0
43 https://www.bbc.co.uk/cbbc/games/cbbc-creative-lab-fun-art-game,8.0
44 https://www.cnn.com/2023/08/01/media/warner-bros-barbenheimer-japan-scli-intl/index.html,8.0
45 https://www.pinterest.com/cheezburgerpins/marvel/,1.0
46 https://imgflip.com/popular-meme-ids,9.0
47 https://www.pinterest.com/scotshaver/creative-endeavors/,10.0
```

Shown are the URL's and their respective Cluster ID's obtained in text file generated after Single-Link hierarchical clustering.

Number of clusters obtained:

As we can see, **10 clusters** were created from the dataset. Fastcluster's agglomerative clustering algorithm determines the optimal number of clusters by evaluating the input data and employing various distance(euclidean) and linkage(single-link) metrics.

Results for Complete-Link hierarchical clustering:

Image shows Sample of clusters by Complete-Link hierarchical clustering from the clustering result obtained as text file:

```
1 https://pt.wikipedia.org/wiki/Meme_(Internet),2.0
2 https://gl.wikipedia.org/wiki/Meme_(Internet),2.0
3 https://ro.wikipedia.org/wiki/Fenomen_pe_internet,2.0
4 https://www.memedroid.com/memes/tag/internet,2.0
5 https://es.memedroid.com/memes/tag/internet,2.0
6 https://fr.memedroid.com/memes/tag/internet,2.0
7 https://pt.memedroid.com/memes/tag/internet,2.0
8 https://www.memedroid.com/memes/tag/no+internet,2.0
9 https://www.memedroid.com/memes/tag/the+internet,2.0
10 https://www.memedroid.com/memes/tag/explorer,2.0
11 https://it.memedroid.com/memes/tag/internet,2.0
12 https://www.memedroid.com/memes/tag/internet+explorer,2.0
13 https://in.mashable.com/culture/70969/sachin-tendulkars-wicket-by-mun
14 https://su.wikipedia.org/wiki/Meme_Intern%C3%A9t,2.0
15 https://my.wikipedia.org/wiki/%E1%80%A1%E1%80%84%E1%80%BA%E1%80%90%E1%
16 https://knowyourmeme.com/memes/cultures/the-internet,2.0
17 https://ms.wikipedia.org/wiki/Meme_Internet,3.0
18 https://fa.wikipedia.org/wiki/%D9%85%DB%8C%D9%85_%D8%A7%DB%8C%D9%86%D
19 https://ps.wikipedia.org/wiki/%D8%A7%D9%86%D9%BC%D8%B1%D9%86%DB%90%D9%
20 https://jv.wikipedia.org/wiki/Meme_intern%C3%A8t,4.0
21 https://id.wikipedia.org/wiki/Meme_internet,4.0
22 https://de.wikipedia.org/wiki/Meme_(Kulturph%C3%A4nomen),4.0
23 https://hu.wikipedia.org/wiki/Internetes_m%C3%A9m,4.0
24 https://zh-min-nan.wikipedia.org/wiki/B%C4%81ng-1%C5%8D%CD%98_meme,4.
25 https://et.m.wikipedia.org/wiki/Meem,4.0
26 https://et.wikipedia.org/wiki/Meem,4.0
27 https://ckb.wikipedia.org/wiki/%D9%85%DB%8C%D9%85%DB%8C_%D8%A6%DB%8C%
28 https://en.m.wikipedia.org/wiki/Internet_meme,4.0
29 https://en.wikipedia.org/wiki/Internet_meme,4.0
```

Shown are the URL's and their respective Cluster ID's obtained in text file generated after Complete-Link hierarchical clustering.

Number of clusters obtained:

As we can see, **10 clusters** were created from the dataset. Fastcluster's agglomerative clustering algorithm determines the optimal number of clusters by evaluating the input data and employing various distance(euclidean) and linkage(complete-link) metrics.

Integration of Clustering with User Interface:

Incorporating both flat and hierarchical (single-link and complete-link) clustering results into the user interface (UI) enhances user interaction with the system:

- UI Clustering Modes: The UI offers three clustering modes: one for flat clustering (KMeans) and two for hierarchical clustering (Agglomerative - Single link, Agglomerative - Complete Link).
- Backend Interaction: Upon selecting a clustering mode, a GET request is sent to the backend with the corresponding clustering mode as the request type parameter.
- Data Fetching and Clustering: In the backend, if the request type indicates clustering, “relevant results are fetched from the Solr index based on page ranking. Clustering is then applied to these results.
- Precomputed Clusters: Based on the clustering type, precomputed clusters are fetched from text files and loaded into a map, with URLs as keys and cluster IDs as values.
- Result Prioritization: Using the precomputed clusters, the results are prioritized. Results belonging to the same cluster as the top-ranked result are ranked next, following a decreasing order of page rank.
- Optimization: Collaboration with Dheeraj involved optimizing the clustering integration with the UI.

Optimization through Query Selection:

Query selection plays a crucial role in optimizing clustering results and improving relevancy:

- Criteria for Query Selection: Queries are selected based on the types of clusters formed from all clustering methods. These queries are manually created, considering results from relevance models, page rank, and HITS.
- Experimentation with Queries: Around 50 queries are used for each type of clustering (flat and hierarchical - single-link and complete-link) to assess the impact of clustering on results. Examples include events related to memes.
- Results Improvement: After clustering is applied, similar results among the relevant ones are grouped together in the UI. Non-relevant or dissimilar results are deprioritized, enhancing user experience.

Experimentation with Query Impact:

- The experiment involves testing various queries with different clustering methods to gauge their impact on result relevancy.
- Approximately 50 queries are tested for each clustering type, aiming to refine clustering results and improve user satisfaction.
- The process involves analyzing the impact of clustering on result organization and relevancy through screenshots and performance metrics.

Examples of Queries with Clustering:

- A subset of queries used for testing flat clustering and hierarchical clustering are showcased.
- Each query is accompanied by snapshots illustrating the results after page ranking, flat clustering, and hierarchical clustering, highlighting the evolution of result organization and relevancy.

Query1: Dog Memes

PageRanking

The screenshot shows a search interface with the following components:

- Search Bar:** dog memes
- Relevance Model Options:** Page Rank HITS
- Clustering Options:** Flat Clustering Hierarchical Clustering
- Query Expansion Option:** Association Metric Scalar
- Search Button:** Search
- Results Area:** Displays search results for 'The best Dog Memes memes :) Memedroid'. The results include:
 - [The best Dog Memes memes :\) Memedroid](https://www.pinterest.com/cheezburgerpins/dog-memes/)
 - Pinterest Today Watch Shop Explore Log in Sign up Dog Memes Pins d Collection by Cheezburger Share Darling Dog Memes for Canine Enthusiasts April Arf dog dogmeme funnydogmeme <https://www.pinterest.com/ideas/funny-dog-memes/949568768074/>
 - Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Animal Funny dog memes Get ready to laugh out loud with these funny dog memes Discover the most hilarious and relat <https://www.pinterest.com/laffgaff/funny-animals/>
 - [The best Dog Meme memes :\) Memedroid](https://www.pinterest.com/thefunnybeaver/wholesome-memes/)
 - Pinterest Today Watch Shop Explore Log in Sign up Funny Animals Funny animal memes and jokes Pins y Collection by LaffGaff Share Crazy Cat Lady Funny Animal Pictures Puppies Dog Cat Cats And K <https://www.pinterest.com/thefunnybeaver/wholesome-memes/>
 - Pinterest Today Watch Shop Explore Log in Sign up Wholesome Memes Pins w Collection by TheFunnyBeaver Com Share Funny Memes Illustrators Funny Fails Funny Internet Memes Funny Tweets You Funn

Flat Clustering

dog memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

Search

[The best Dog Memes memes :\) Memedroid](#)

The best Dog Memes memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop it her

[The best Dog Meme memes :\) Memedroid](#)

The best Dog Meme memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop it here

[The best Police Dog memes :\) Memedroid](#)

The best Police Dog memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop it he

[The best Lawyer Dog memes :\) Memedroid](#)

The best Lawyer Dog memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop it he

[The best Dog memes :\) Memedroid](#)

The best Dog memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop it here ima

[The best Dog memes :\) Memedroid](#)

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Hierarchical Clustering(Complete-link)

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

Search

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Query2: Funny Memes

PageRanking

funny memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

<https://www.pinterest.com/ideas/funniest-memes/931294495216/>
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<https://www.pinterest.com/sayingimages/pinterests-funniest-memes/>
Pinterest Today Watch Shop Explore Log in Sign up Pinterest's Funniest Memes Pins by Collection by Saying Images Cool Funny Quotes and others Share Brunch Snacks Desserts Dessert Fo

<https://www.pinterest.com/thefunnybeaver/funny-jokes-and-banter/>
Pinterest Today Watch Shop Explore Log in Sign up Funny Jokes and Banter Pins by Collection by TheFunnyBeaver Com Share Marvel Lord Zooey Deschanel Superman Humour Clark Kent Clark Funny Superm

<https://www.pinterest.com/ideas/lol-so-true/954674783676/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Twitter Humor Lol so true Laugh out loud with these hilariously relatable quotes that perfectly capture life's truths Get

<https://www.pinterest.de/ideas/funny-relatable-memes/948222729313/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Memes Funny relatable memes Get ready to LOL with a collection of funny relatable memes that will have you nodding your he

<https://www.pinterest.com/ideas/funny-relatable-memes/948222729313/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Memes Funny relatable memes Get ready to LOL with a collection of funny relatable memes that will have you nodding your he

<https://www.pinterest.com/dnakale/my-saves/>

Flat Clustering

funny memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

<https://www.pinterest.com/ideas/funniest-memes/931294495216/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Magazine Funniest memes Get ready to laugh out loud with the funniest memes on the internet Explore top memes that will brighte

<https://www.pinterest.com/ideas/clean-funny-memes/941617313049/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Memes Clean funny memes Get ready to laugh out loud with our collection of clean funny memes Discover the funniest and mo

<https://www.pinterest.com/ideas/funny-movie-memes/897897332450/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Movie Humor Funny movie memes Get ready to laugh with these funny movie memes From iconic quotes to hilarious scenes the

<https://www.pinterest.com/ideas/beat-memes/914110104720/>
Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Music Beat memes Discover Pinterest's best ideas and inspiration for Beat memes Get inspired and try out new things Picture m

<https://www.pinterest.com/sayingimages/pinterests-funniest-memes/>
Pinterest Today Watch Shop Explore Log in Sign up Pinterest's Funniest Memes Pins by Collection by Saying Images Cool Funny Quotes and others Share Brunch Snacks Desserts Dessert Fo

<https://www.pinterest.com/thefunnybeaver/funny-jokes-and-banter/>
Pinterest Today Watch Shop Explore Log in Sign up Funny Jokes and Banter Pins by Collection by TheFunnyBeaver Com Share Marvel Lord Zooey Deschanel Superman Humour Clark Kent Clark Funny Superm

<https://www.pinterest.com/ideas/lol-so-true/954674783676/>

Hierarchical Clustering(Complete-link)

funny memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

<https://www.pinterest.com/ideas/funniest-memes/931294495216/>

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<https://www.pinterest.com/thefunnybeaver/funny-jokes-and-banter/>

Pinterest Today Watch Shop Explore Log in Sign up Funny Jokes and Banter Pins w Collection by TheFunnyBeaver Com Share Marvel Lord Zooey Deschanel Superman Humour Clark Kent Clark Funny Superm

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<https://www.pinterest.com/ideas/funny-crush-memes/934102301970/>

Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Memes Funny crush memes Get ready to laugh with these funny crush memes that perfectly capture the awkward and relatable m

<https://www.pinterest.de/ideas/funny-relatable-memes/948222729313/>

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<https://www.pinterest.com/ideas/funny-relatable-memes/948222729313/>

Query3: Baby Memes

PageRanking

baby memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

<https://www.pinterest.com/ideas/funny-baby-memes/952669629022/>

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<https://www.pinterest.com/pin/161496336625637557/>

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[The best Sweet Baby Inc memes :\) Memedroid](#)

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<https://www.pinterest.com/ideas/baby-jokes/909513645307/>

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Flat Clustering

baby memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

<https://www.pinterest.com/ideas/funny-baby-memes/952669629022/>

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<https://www.pinterest.com/pin/161496336625637557/>

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<https://www.pinterest.com/ideas/angry-baby-face/911053600886/>

Pinterest Today Watch Shop Explore Log in Sign up Explore Parenting Baby Supplies Angry baby face Discover Pinterest's best ideas and inspiration for Angry baby face Get inspired and try out new thi

<https://www.pinterest.com/ideas/baby-funny-videos/951448689360/>

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Hierarchical Clustering(Complete-link)

baby memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

<https://www.pinterest.com/ideas/funny-baby-memes/95266962902/>

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<https://www.pinterest.com/ideas/baby-funny-videos/951448689360/>

Pinterest Today Watch Shop Explore Log in Sign up Explore Parenting Family Activities Baby funny videos Get ready for a good laugh with these funny baby videos Watch adorable babies do the funniest t

<https://www.pinterest.com/justme/funny-kids/>

Pinterest Today Watch Shop Explore Log in Sign up funny kids funny photos of kids memes of kids posts about kids you get the idea kids are funny as hell p s just because this board is all abo

[The best Baby Yoda memes - Memedroid](#)

The best Baby Yoda memes Memedroid Sign in Remember me Log in Did you forget your password Click here Sign in with Facebook Register now Upload Meme Click to select a file or drop it here

[The best Sweet Baby Inc memes - Memedroid](#)

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<https://www.pinterest.com/ideas/baby-jokes/909513645307/>

Pinterest Today Watch Shop Explore Log in Sign up Explore Entertainment Humor Jokes For Kids Baby jokes Looking for a good laugh Check out these hilarious baby jokes that will leave you in stitches

The provided results showcase the outcomes of three queries following page ranking and various clustering methodologies.

6. Query expansion and relevance feedback:

We have implemented the following

- 1) Relevance Feedback
 - a) Roccio Algorithm
- 2) Pseudo Relevance Feedback
 - a) Association cluster
 - b) Metric cluster
 - c) Scalar cluster

Relevance Feedback

Roccio Algorithm:

Formula used to calculate the new query vectors is :–

$$\vec{q}_m = \alpha \vec{q}_0 + \beta \frac{1}{|D_r|} \sum_{\vec{d}_j \in D_r} \vec{d}_j - \gamma \frac{1}{|D_{nr}|} \sum_{\vec{d}_j \in D_{nr}} \vec{d}_j$$

\vec{q}_m = new query vector

\vec{q}_0 = original query vector

D_r = set of Relevant Document vectors

D_{nr} = set of not Relevant Document vectors

Parameters = (α, β, γ)

Parameters given:

$\alpha = 0.75$

$\beta = 0.35$

$\gamma = 0.1$

We used 20 queries to test the Roccio Algorithm which were –

1. cat
2. dog
3. funny
4. sad
5. game
6. movie
7. car
8. weird
9. inspiring
10. football
11. people memes
12. fish memes
13. birds memes
14. interesting memes
15. favorite meme
16. popular memes
17. best memes
18. meme history
19. dumb memes
20. formula memes

Example for relevant and irrelevant webpages for queries –

- 1) Query – ‘people memes’

Relevant Webpages –

```
[https://www.pinterest.com/ideas/funny-grumpy-cat-memes-hilarious/94037055820/, https://www.pinterest.com/ideas/funny-cat-memes/919282177658/,  
https://www.memedroid.com/memes/tag/funny+cat+memes',  
https://www.pinterest.com/ideas/crazy-cat-lady/922143650513/,  
https://www.pinterest.com/mcarthur0281/cats/,  
https://www.pinterest.com/ideas/in-memes/948381646345/,  
https://www.pinterest.com/ideas/monday-cat/935462271002/,  
https://www.pinterest.com/ideas/good-morning-cat/947404297664/,  
https://www.pinterest.com/ideas/cat-pics/961071937800/,  
https://www.pinterest.com/ideas/happy-cat/958268496043/]
```

Irrelevant Webpages –

[<https://www.bbc.com/business>,
<https://www.memedroid.com/blog/post/304/Meme-News-Top-headlines-from-March-2024>,
<https://www.latimes.com/opinion/story/2024-04-10/california-work-life-balance-right-to-disconnect-matt-haney>,
<https://developers.google.com/youtube/analytics/metrics>,
<https://nl.mashable.com/tech-2/9671/elon-musk-gaat-grok-zijn-rivaal-van-chatgpt-open-source-maken>,
<https://www.pinterest.com/pin/programming-memes-to-laugh-at-while-your-code-is-compiling--580894051948811541/>,
<https://pt.memedroid.com/memes/tag/2024>,
<https://elpais.com/noticias/guyana/>,
<https://www.spiegel.de/karriere/mobilitaet-was-ist-ein-mobilitaetsbudget-und-wie-profitiert-das-klima-davon-a-c0bf9f01-566a-4e30-8595-0e99ad01fe1d>,
<https://www.manager-magazin.de/unternehmen/tech/microsoft-investiert-in-arabisches-ki-unternehmen-a-ef05715a-ca61-4755-9ce7-27dc08da77fa>]

2) Query – ‘fish memes’

Relevant Webpages –

[<https://www.memedroid.com/memes/tag/dog+memes>,
<https://www.pinterest.com/cheezburgerpins/dog-memes/>,
<https://www.pinterest.com/ideas/funny-dog-memes/949568768074/>,
<https://www.memedroid.com/memes/tag/dog+meme>,
<https://www.pinterest.com/laffgaff/funny-animals/>,
<https://www.pinterest.com/thefunnybeaver/wholesome-memes/>,
<https://www.pinterest.com/pin/177470041558103724/>,
<https://www.memedroid.com/memes/tag/police+dog>,
<https://it.memedroid.com/memes/tag/lawyer+dog>,
<https://it.memedroid.com/memes/tag/dog>]

Irrelevant Webpages –

[<https://moonriver.moonscan.io/address/0xf51610da87c5c594d09379f948eb5cd96ef0c63a>,
<https://es.statista.com/sectores/1174/tema/1530/estado-de-salud/>,
<https://www.pinterest.com/skflore/food-love/>,
<https://www.theverge.com/23780036/game-boy-camera-mini-mod-christopher-graves>, <https://www.gehalt.de/beruf/kunsthistoriker>,
<https://elpais.com/noticias/sindicatos/>,

'<https://elpais.com/espana/2024-04-04/el-gobierno-denunciara-ante-la-onu-y-la-ue-la-ofensiva-autonomica-del-pp-y-vox-contra-las-leyes-de-memoria.html>',
'<https://support.google.com/youtube/answer/14106258>',
'<https://mzn.wikipedia.org/wiki/%D9%BE%D9%88%D8%B1%D8%AA%D8%A7%D9%84%D8%A7%D8%B3%D8%A7%DB%8C%DB%8C%D8%AF%DA%A9%D8%AA%D9%87%E2%80%8C%D8%A6%D9%88%D9%86>',
'<https://www.hootsuite.com/en-gb/platform/advertising>']

3) Query – ‘bird memes’

Relevant Webpages –

['<https://www.pinterest.com/ideas/funniest-memes/931294495216>',
'<https://www.pinterest.com/sayingimages/pinterests-funniest-memes>',
'<https://www.pinterest.com/thefunnybeaver/funny-jokes-and-banter>',
'<https://www.pinterest.com/ideas/lol-so-true/954674783676>',
'<https://www.pinterest.de/ideas/funny-relatable-memes/948222729313>',
'<https://www.pinterest.com/ideas/funny-relatable-memes/948222729313>',
'<https://www.pinterest.com/dnakale/my-saves>',
'<https://www.pinterest.com/ideas/funny-crush-memes/934102301970>',
'<https://www.pinterest.com/ideas/fresh-memes/919102139117>',
'<https://www.pinterest.com/ideas/best-memes/955827966489>']

Irrelevant Webpages –

['<https://elpais.com/espana/madrid/2024-04-04/ayuso-se-apunta-al-y-tu-mas-para-defender-a-su-pareja-si-empezamos-con-inspecciones-en-la-izquierda-se-caen-abajo-la-mitad.html>', '<https://www.bbc.co.uk/programmes/p05sc368>',
'https://cookiedatabase.org/cookie/shopify/_shopify_y',
'<https://fr.memedroid.com/memes/tag/india>',
'<https://www.memedroid.com/memes/tag/rednecks>',
'<https://www.cc.com/episodes/foael1/reno-911-the-tanning-booth-incident-seas-on-5-ep-11>', '<https://www.memedroid.com/user/view/llewww>',
'<https://elpais.com/cultura/2024-01-26/ernest-urtasun-ministro-de-cultura-las-mujeres-que-trabajan-en-este-sector-saben-que-tienen-a-este-ministerio-para-defenderlas.html>', '<https://elpais.com/hemeroteca/2023-08-12>',
'<http://nginx.org/2011.html>']

After running the Roccio Algorithm on these 20 queries we got the following modified queries -

Original Query	Expanded Query
cat	cat funny meme
dog	dog meme funny
funny	funny meme laugh
sad	sad meme cat
game	game funny meme
movie	movie meme funny
car	car meme electric
weird	weird cat fernanolol
inspiring	inspiring quote mom
football	football fifa meme
people memes	people meme quote funny
fish memes	fish meme memedroid upload
bird memes	bird meme angry por
interesting memes	interesting meme por woah
favorite meme	favorite meme app recent
popular memes	popular meme funny maker
best memes	best meme upload notification
meme history	meme history funny ginnypig
dumb memes	dumb meme meowzelbulb deafkitten
formula memes	formula meme internet wikipedia

The results obtained from the Roccio Algorithm lead us to the following conclusions –

- The algorithm provided varied results for different queries some queries returned relevant documents while other returned irrelevant documents for example popular memes, people memes returned more relevant documents but some of them such as inspiring, formula meme returned more irrelevant documents
- In essence, some queries benefitted from Roccio Expansion while others did not. This highlight the difficulty of finding a universal method that works effectively for all queries
- As a result, it's important to carefully evaluate the performance of the algorithm on a case- by-case basis and refine the approach accordingly. Due to the above issues, it was decided not to include the code for Rocchio algorithm for expanding the query, rather the results of the observations were used in the project report

Pseudo Relevance Feedback:

Pseudo Relevance Feedback (PRF) enhances search queries by adding terms from top-ranked documents presumed relevant. It assumes these documents contain valuable terms reflecting the user's intent, thus expanding the query to improve retrieval in subsequent searches.

Association Clustering -

Association clustering links terms that frequently co-occur within documents, suggesting a semantic similarity. For example, "computer" and "software" often appear together, indicating a relationship. This concept is used in query expansion to include associated terms, aiming to retrieve more pertinent documents.

Metric Clustering

Metric clustering evaluates the proximity of terms within documents, asserting that terms closer to each other are more related. This proximity-based relevance can be leveraged in query expansion by including nearby terms to the original query terms, enhancing the precision of search results.

Scalar Clustering

Scalar clustering analyzes terms based on the similarity of their contextual environments across documents. Terms appearing in similar contexts are considered more related, helping refine queries by including terms that, while not co-occurring directly, share contextual similarities with the query terms.

Included below is a list of 30 queries that we have run association, scalar and metric clustering –

S No	Original Query	Association Expanded Query	Scalar expanded Query	Metric Expanded Query	Clustering Method to be used
1	cat memes	cat memes following follow stream funny post image com	cat memes funny animal get day	cat memes pfps kevin20058 moldy smelling calica	Association,
2	dog memes	dog memes funny puppy cute launch presale 2024	dog memes funny cat video get	dog memes tattooa holloween handler 524 giles	Association, Scalar
3	funny memes	funny memes quote joke humour humor video hilarious	funny memes log sign humor today get	funny memes arishfa surmava macy elrod quptes	Association
4	sad memes	sad memes 2024 top 4k hd 04 por 2023	sad memes facebook 10 video 2024	sad memes 162 brunosacorzy 167 thirtysouls cientfica	Association, Metric, scalar
5	game memes	game memes funny share video gaming vote arrow comment list	game memes gaming video get funny	game memes teach mini cesarano hawketrash increase	Association, Scalar
6	movie memes	movie memes funny horror barbie film 2023 fnaf	movie memes sign film video day humor	movie memes worth lego 573 checklist watchworthy	Association, Scalar, metric
7	car memes	car memes electric funny 2024 birthday 2023 top	car memes log sign video	car memes plot sober boobiez wing fam	Association, scalar
8	weird memes	weird memes internet 2024 03 original 05 top	weird memes get 18 10 17 19 14 3 facebook	weird memes 279 doofenshmirtz cboz97 496 1000	Association, metric
9	inspiring memes	inspiring memes oppenheimer barbie barbenheimer row gosling poster long front ken	inspiring memes contact newsletter twitter news policy know video	inspiring memes oct mareep cinematic gifs	Association, metric
10	football memes	football memes 2024 por de top futbol fifa funny	football memes 30 0 top video ranking	football memes liverpool interesting 775 355 elpatofeo	Association, metric

11	baby memes	baby memes funny joke humour 2024 parenting	baby memes log sign get	baby memes stupid beautiful tell main gonzales	Association, scalar
12	top memes	top memes 2023 share view upvotes image	top memes facebook app video 2024	top memes 2018 2017 2016 2015 2014	Association, scalar
13	meme use	meme use search image entry site operator forum result	meme use image privacy trending people	meme use gamers entrytype modality origin format	Association,
14	meme origin	meme origin rage comic uploaded used face like character popular entry	meme origin video image upload know site trending collection contact	meme origin although 299 point sigma kruegernapoleon	Association, scalar
15	meme art	meme art cat woman yelling favorite add	meme art like sign site time top	meme art guardian schizoidman subjective 661 comedy	Association, scalar
16	good memes	good memes morning funny quote day	good memes morning funny day	good memes dankest caption generator keep rachel	Association, scalar, metric
17	bad memes	bad memes luck brian uploaded	bad memes video chat like facebook	bad memes db school roblox relatable thoroughly	Association, scalar, metric
18	meme spots	meme spots maker imgflip view gif gifs made w tagged	meme spots day yeah video	meme spots overpacking amazing tourist fron mushy	Association, scalar
19	ranked memes	ranked memes fluffypuppy 2023 top gif chive image imgflip video maker	ranked memes day 1 time u	ranked memes losing difficulty hole 32 item	Association,
20	healthy memes	healthy memes 2023 01 food 00 11 top funny	healthy memes facebook privacy term food	healthy memes programming smudge ngora smartphone breakfast	Association,
21	meme type	meme type 2023 year hoax de top like troll	meme type image facebook 2024 make	meme type might secondary rock dragon deux	Association, scalar

22	meme format	meme format drake cat yelling uploaded woman upload	meme format image like 2024 privacy	meme format equally include common thatoneweaboo communism	Association, scalar
23	written memes	written memes whedon joss adam like twitter uploaded parody video entry	written memes day popular know make people	written memes adam joss uploaded screenplay retweeted	Association,
24	meme template	meme template image yes imgflip text	meme template imgflip generator gif make 95 upload text add	meme template start however uploaded empty upload	Association, scalar
25	meme creators	meme creators nfts nft cat instagram nbc news like	meme creators time content 2024 medium	meme creators li backing pixel contacted human	Association, scalar
26	golf memes	golf memes 24 disliked liked 0 sport 2024 stephen photo	golf memes sign 20 video 15	golf memes tip drill training lesson practice	Association, scalar
27	driving memes	driving memes funny quote 2024 driver drunk	driving memes log sign rule day	driving memes class lesson sticker scare scary	Association, scalar
28	cooking memes	cooking memes via food top funny 2024 reply	cooking memes 2024 funny food 3	cooking memes 413 bagel relatablememes youtubers cookingmemes	Association, scalar, metric
29	singing memes	singing memes oi 30 01 larva red 03 sing	singing memes video sign day image	singing memes keyboard lille lidija band teacher	Association, scalar, metric
30	dancing memes	dancing memes raccoon tiktok baby dance pedro view video image	dancing memes video facebook u new	dancing memes db explained pole main generator	Association, scalar,

After analyzing the outcomes, we have come to realize that while implementing pseudo-relevance feedback often association clustering seems to be the most efficient as it often gives the most relevant queries but is also the fastest in computing

Both Scalar and Metric Clustering seem to take longer to compute. In fact Metric Clustering sometimes takes an excessive amount of time making it difficult to execute effectively. Scalar Clustering also faces difficulty in computation in certain scenarios

Query 1 –

Query – ‘cat memes’

Local ids set –

[<https://www.pinterest.com/ideas/funny-grumpy-cat-memes-hilarious/940370558820/>,
<https://www.pinterest.com/ideas/funny-cat-memes/919282177658/>,
<https://www.memedroid.com/memes/tag/funny+cat+memes>,
<https://amp.cheezburger.com/25492997/start-this-caturday-with-some-serious-self-care-by-smiling-at-the-silliest-cat-memes-of-this-week>,
<https://cheezburger.com/25547013/a-bundle-of-cute-and-wholesome-cat-memes-to-curl-up-next-to-this-cozy-caturday>,
<https://cheezburger.com/25487621/delicious-cat-memes-to-start-the-meowrning-off-on-a-tasty-note>,
<https://cheezburger.com/25523205/top-20-cat-memes-of-the-week-cheezburger-users-edition-341>,
<https://cheezburger.com/9362015744/contemplating-life>,
<https://sayingimages.com/cute-cat-memes/>,
<https://www.pinterest.com/ideas/monday-cat/935462271002/>,

<https://cheezburger.com/25515269/26-fabulously-funny-cat-memes-for-a-witty-wednesday-full-of-feline-frolics>,

<https://www.pinterest.com/pin/433330795413924239/>,
<https://www.pinterest.com/ideas/cat-crying/920893443328/>,
<https://www.pinterest.com/ideas/funny-looking-cats/953342105202/>,
<https://www.pinterest.com/ideas/silly-cats/919699811793/>,
<https://cheezburger.com/9909136896/physics>,
<https://cheezburger.com/9912877312/thats-no-bull>,
<https://www.mememaker.net/meme/cute-valentines-day-cards/>,
<https://www.mememaker.net/meme/touch-sir/>,
<https://www.mememaker.net/meme/touch/>,
<https://www.pinterest.com/ideas/funny-cat-pics/954602667286/>,
<https://www.mememaker.net/meme/now-youre-taxing-all-printed-materials/>,
<https://www.mememaker.net/meme/shabu-pa-shatol-pa-sapatos-pa/>,
<https://icanhas.cheezburger.com/>,
<https://cheezburger.com/25595909/monday-meowtivation-with-29-cat-memes-to-start-the-week-with-pawsitive-purrfection>,
<https://www.mememaker.net/meme/me-in-math-when-i-not-in-the-top-5-in-gimkit/>,
<https://www.mememaker.net/meme/my-face-when-you-say-its-too-early-to-decorate-for-christmas/>,
<https://www.mememaker.net/meme/when-i-cant-decide-the-right-colors-for-a-prime-spread/>,
<https://www.mememaker.net/meme/when-i-cant-decide-the-right-font-for-a-prime-spread/>,
<https://www.mememaker.net/meme/when-i-cant-figure-find-the-right-font-for-a-prime-spread/>,
<https://www.mememaker.net/meme/end-of-our-presentation-it-would-be-nice-if-u-clap-now/>,
<https://www.mememaker.net/meme/when-diane-is-getting-her-ass-stomped-in-phase-10/>,
<https://www.mememaker.net/meme/oh-your-planning-to-study-for-engr-202-how-is-elec-364-going/>,
<https://www.mememaker.net/meme/you-say-i-hate-percy-jackson-i-say-die-you-piece-of-schist/>,
<https://cheezburger.com/9338779392>,

'<https://cheezburger.com/25564165/27-feline-funny-cat-memes-for-a-caturday-full-of-smiles>',

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Local Vocab set –

Size of Vocabulary Set: 22635

{'walter', 'host', 'umoonsun', 'sees', 'datafocalregionxyxy', 'incorrect', 'griffin', 'hilariousmemes', 'meso', 'postsmemes', 'landschaftsbilder', 'im', 'shownnbsp', 'supplies', 'dpi', 'progressed', 'supplements', 'catmemesco', 'tacocat', 'rodents', 'curled', 'picked', 'gkwgeethma', 'environments', 'passengers', 'twilight', 'adorn', 'bastards', 'grown', 'wholesome', 'hrefhttpsmashablecombestcatmemesevervs cumhtmqfsince', 'sonia', 'positively', 'ignores', 'verbatim', 'forget', 'dull', ' lulled', 'methods', 'violent', 'africanamericans', 'antitiktok', 'yearsjust', 'wiccan', 'edginess', 'yall', 'avoid', 'lunchmeat', 'brits', 'template', 'deygetty', 'heck', 'aluxumistock', 'guten', 'convoluted', 'uhobomerlin', 'ela', 'plantas', 'prehistoric', 'substance', 'eveelutionsquad', 'kutikova', 'often', 'pin', 'particularly', 'postmodern', 'resolution', 'mythology', 'photographer', 'josef', 'textures', 'sunflowerskies', 'binrm', 'alarm', 'netiniyomgetto', 'gru', 'hamilton', 'offthewall', 'solidarity', 'velvet', 'blakekelly', 'olipoli', 'warmis', 'fawn', 'chambers', 'fireford', 'blacklamb', 'ailurophile', 'reminded', 'graduate', 'spoiled', 'hoppy', 'classical', 'jumping', 'turns', 'aughts', 'thorough', 'ageverification', 'alexander', 'quirky', 'monikers', 'lasso', 'autieradig', 'ingame', 'cheap', 'tiktokcom', 'violations', 'garfiel', 'jodie', 'compiled', 'photonot', 'excel', 'rsvp', 'onlinep', 'impresses', 'after', 'total', 'hyperlink', 'nada', 'afterlife', 'energy', 'eatsoupydiarrhea', 'slander', 'toletole', 'furrever', 'tothepointperfect', 'titanic', 'accelexd', 'senses', 'racial', 'tenacious', 'ojaghi', 'samorugas', 'tenet', 'faeriecon', 'rd', 'gli', 'whenever', 'stevew', 'edition', 'edt', 'texto', 'hownbspounce', 'magawa', 'hreal', 'sleepers', 'sigourney', 'sheltered', 'warning', 'assignment', 'receipts', 'returns', 'cinema', 'offended', 'awaited', 'keith', 'politcized', 'companionpounce', 'admiration', 'outcomep', 'chase', 'httpsbitlyantizooophilearmyhandbook', 'unjustified', 'cycles', 'douchebags', 'stray', 'resident', 'httpscreativecommonsorglicensesbyncrfchooserv', 'ueuellgibbons', 'dump', 'whatcha', 'malone', 'remarkably', 'zeldas', 'huddling', 'mild', 'aidan', 'mobilewallpapers', 'scenes', 'memesbut', 'nuggets', 'wiley', 'weekendcatnip', 'autotune', 'uedenekho', 'elle', 'homewe', 'repeated', 'resizing', 'ufreemoney', 'washing', 'douche', 'legendary', 'uthalia', 'farooq', 'sparkling', 'holds', 'burnout', 'picture', 'prprios', 'celebrating', 'bounds', 'complicated', 'rate', 'boots', 'lowest', 'hating', 'saaame', 'moderation', 'ellie', 'slogans', 'animalsazcom', 'bentley', 'submits', 'godlike', 'jumped', 'tendonan', 'officers', 'sincerity', 'interviewed', 'nash', 'perfectly', 'disasters', 'alexjc', 'adulthood', 'distract', 'freaking', 'morrow', 'nosethis', 'japan', 'relating', 'meantime', 'jacinthe', 'futurama', 'moreno', 'tie', 'layna', 'mems', 'lpez', 'fluffycrumble', 'stomachsit', 'camp', 'halloungetto', 'ryker', 'dewey', 'sauce', 'cattlelogs', 'aviva', 'restful', 'babysit', 'mandybean', 'fig', 'defense', 'hypnoidz', 'absurd', 'aleksandar', 'editorial', 'roadmen', 'takeoff', 'nocturnal', 'marnie', 'length', 'abraham', 'brainnbspspeaking', 'acevedogetto', 'lauren', 'sake', 'instrument', 'jehovah', 'nonfiction', 'tuck', 'suspended', 'sleepykedy', 'donuts', 'humor', 'cut', 'raven', 'vivi', 'aoi', 'bonjour', 'cravens', 'microphone', 'based', 'layer', 'content', 'mold', 'jo', 'tomlin', 'cisto', 'legally',

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Local Stem set –

Size of Stem Set: 17540

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{'publicly'})}
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Values of the correlations computed for the query :-

Association values:

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[0.001983314047899561, 0.0015589204406442532, 0.0011967384470253119,  
0.0011909712296006355, 0.0011228220130725924, 0.0009339870089725737,  
0.0008279436886227554, 0.0007874778060776816, 0.0007426138971174457,  
0.0006936781886117561, 0.0006162343421879612, 0.0005763054704295823,  
0.000572270879122782, 0.0005663323073249694, 0.0005651407289335292,  
0.0005309905042352459, 0.0005277792140409568, 0.0005203921387841731,  
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0.00046525730934744085, 0.0004560870391998834, 0.00045229615484630107,  
0.00044550442630676685, 0.00043932445025193854, 0.00043932445025193854,  
0.0004386136160700439, 0.0004280756207824296, 0.00042215919163091927]
```

Query Expansion through association clustering - cat memes following stream funny

Scalar values:

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[1.0, 1.0, 0.9583762024401027, 0.9583762024401027, 0.9357443369910269,  
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0.9030149231813415, 0.8978140541435955, 0.8963307656935809,  
0.8927820532565256, 0.8900704478563243, 0.890012457891643,  
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0.8764567191919211, 0.8746030279622617, 0.8698872519873247,
0.8657735765113718, 0.8654918966830114, 0.8648301514552,
0.8626097791876578]

Query Expansion through scalar clustering - cat memes funny animal get

Metric Association values:

[0.00040624868417705356, 0.0003956803093626188, 0.0003946065841934161,
0.0003906733838977261, 0.0003821998598308039, 0.0003732249177266703,
0.0003654190072692153, 0.0003618020717311146, 0.00035279464661850903,
0.0003490871437797815]

Query Expansion through metric clustering - cat memes pfps kevin20058 moldy
smelling calica

Query 2 –

Query – ‘dog memes’

Local ids set –

['<https://www.pinterest.com/cheezburgerpins/dog-memes/>',
'<https://www.memedroid.com/memes/tag/dog+memes>',
'<https://www.pinterest.com/ideas/funny-dog-memes/949568768074/>',
'<https://www.pinterest.com/pin/50-hilarious-and-relatable-dog-memes-for-national-dog-day--3940718410173214/>',
'<https://www.pinterest.com/pin/16-dog-memes-that-are-exactly-what-you-need-if-youre-having-a-bad-day--842595411507576935/>',
'<https://www.pinterest.com/ideas/dog-days/911675589334/>',
'<https://cheezburger.com/25521669/sweet-n-smiley-dog-memes-for-your-mid-morning-mood-booster>',
'<https://cheezburger.com/25590277/a-doggo-dish-of-34-cute-canine-memes-for-employees-howling-their-way-to-a-holiday>',
'<https://www.pinterest.com/pin/177470041558701116/>',
'<https://cheezburger.com/25510661/20-sweet-and-soft-dog-memes-to-help-you-shake-off-the-weight-of-the-work-week>',
'<https://www.pinterest.com/pin/177470041558124759/>',
'<https://www.rd.com/list/dog-memes/>',
'<https://cheezburger.com/25481477/20-hilarious-dog-memes-to-help-lighten-the-load-of-being-a-hardworking-hooman-who-brings-home-the>',
'<https://cheezburger.com/25639941/25-darling-dog-memes-for-canine-enthusiasts-april-25-2024>',
'<https://www.rd.com/list/smiling-dog-meme/feed/>',
'<https://cheezburger.com/25511173/relatable-dog-memes-filled-with-that-saturday-morning-vibe-to-get-you-in-the-right-mood-to-celebrate>']

'<https://www.pinterest.com/dnakale/funny-dogs/>',
'<https://www.pinterest.com/ideas/funny-animal-memes/956253412199/>',
'<https://www.memedroid.com/memes/tag/doggos+are+the+bestos>',
'<https://imgflip.com/mememplate/494393937/Confused-dog>',
'<https://memebase.cheezburger.com/tag/animals/page/2>',
'<https://www.pinterest.com/laffgaff/funny-animals/>',
'<https://www.memedroid.com/memes/tag/flamethrower+robot+dog>',
'<https://cheezburger.com/25529093/doting-dog-owners-discuss-what-fun-games-their-canines-love-the-most>',

'<https://cheezburger.com/7589405440/just-brushing-myself>',
'<https://www.pinterest.com/ngc67203777/f3/>',
'<https://www.pinterest.com/ngc67203777/f7/>',
'<https://www.pinterest.com/pin/19140367160861442/>',
'<https://www.pinterest.com/pin/159385274303010528/>',
'<https://cheezburger.com/25493253/a-delightful-dump-of-peaceful-puppers-perfectly-tucked-in-to-pawsitively-puplift-your-midweek-morale>',
'<https://animalcomedy.cheezburger.com/page/2>',
'<https://cheezburger.com/4636510464/surrender-to-the-eyes>',
'<https://cheezburger.com/4854155008/acting-like-animals-epic-yawn>']

Local Vocab set –

Size of Vocabulary Set: 15483

{'unforgettable', 'crisis', 'learned', 'lowkey', 'timothy', 'xu', 'weddingshamed', 'dallas', 'derpy', 'impawsible', 'centennials', 'huffing', 'powerful', 'tho', 'offering', 'isgetty', 'window', 'checking', 'sequels', 'master', 'janicenewman', 'support', 'incgetty', 'tumbling', 'httpsxcomginoassereto', 'brain', 'danywigle', 'zkevm', 'duh', 'saying', 'oblivious', 'ironic', 'dalmatian', 'xaugustx', 'highlighting', 'everythingaboutgirls', 'lambriexgetty', 'google', 'osobystistgetty', 'froggy', 'await', 'elsas', 'parade', 'customerservice', 'meat', 'making', 'net', 'preoccupied', 'moderar', 'alfred', 'catsarelife', 'worlds', 'stupendous', 'machines', 'mississippi', 'ai', 'bananas', 'palace', 'twerk', 'closer', 'ucrochetology', 'lemur', 'telescope', 'welcometochilis', 'impress', 'kravitz', 'soooo', 'scusate', 'updates', 'jacobiistock', 'dogdance', 'month', 'tobida', 'torresgetty', 'playlists', 'long', 'selection', 'makings', 'hire', 'slang', 'perform', 'takes', 'glonk', 'chatbots', 'carpente', 'holder', 'catsby', 'parentfriendly', 'sweetlujziana', 'adored', 'dine', 'trad', 'galaxy', 'ducksbeingdumb', 'isidora', 'girls', 'verymoisturized', 'everpresent', 'sleeveor', 'genz', 'na', 'phototripgetty', 'gator', 'early', 'therealblitzo', 'weirds', 'strate', 'terrifying', 'rdcom', 'physics', 'winning', 'ualtruisticbeat', 'cringiest', 'titan', 'tarik', 'socksnnbspjustnbspto', 'flat', 'katarina', 'placeholder', 'keeping', 'seriously', 'outdoors', 'innovation', 'missourrr', 'memescom', 'reichl', 'cancel', 'essentially', 'borderline', 'moms', 'submits', 'bran', 'remember', 'cg', 'seamus', 'clear', 'illusions', 'sunflower', 'catscuddling', 'succession', 'hazel', 'lafaucigetty', 'him', 'sniffing', 'rounded', 'worrywe', 'yuuuuup', 'est', 'yogyakarta', 'shamrocks', 'pastel', 'scarlett', 'jaws',

'bizzarely', 'panzerbirdisback', 'nerd', 'walks', 'worldmashablecom', 'nytimes', 'encountered',
'bergamaschigetty', 'executed', 'overlook', 'decoupage', 'catnip', 'gallery', 'individual', 'tension', 'relaxation',
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'reads', 'canceled', 'chihuahuas', 'barkin', 'duckhaven', 'sayingimages', 'cycle', 'marbles', 'fun', 'cane',
'royotathon', 'netiniyomgetty', 'pjs', 'five',

'memeatization', 'dinosol', 'hilariousdogtweets', 'earth', 'mask', 'higher', 'leemos', 'intended', 'anarkitty', 'bahaha', 'riposa', 'aristosrevenge', 'kylie', 'sensation', 'clearly', 'sportsbook', 'dri', 'moods', 'fianc', 'decor', 'waver', 'charlesadulting', 'ita', 'somethingthey', 'have', 'spilling', 'whatever', 'chargeback', 'pow', 'doggos', 'highly', 'cletus', 'cavalierpoodle', 'production', 'account', 'smidge', 'pump', 'inhale', 'satanic', 'skydiving', 'walruses', 'through', 'crusts', 'creeps', 'digitally', 'entertains', 'eyore', 'spritetimelesssolid', 'feta', 'blameless', 'heinz', 'wholesomememes', 'folks', 'afford', 'dogossauris', 'offered', 'straightup', 'trait', 'biting', 'tzu', 'garylarson', 'mothernbspnature', 'charting', 'deadlines', 'gerg', 'treasure', 'voice', 'african', 'prohibited', 'wilddigaf', 'considered', 'mansion', 'possibly', 'doki', 'caring', 'pawsitivity', 'woes', 'admit', 'hypothetical', 'sporting', 'vdeo', 'ujdub', 'junglejournalss', 'harmless', 'eversubscribe', 'crownsville', 'richland', 'walrus', 'bulldog', 'dwarfs', 'heartfelt', 'accident', 'whole', 'dos', 'addictions', 'locuras', 'cotina', 'achievements', 'argyle', 'strange', 'watercolour', 'whimsical', 'pest', 'laufeyson', 'boomerwisdom', 'reserved', 'log', 'evening', 'camp', 'couples', 'ueinyrki', 'sneaks', 'lessthanintelligent', 'cooking', 'itzmemichael', 'knowitalls', 'futurama', 'wellcat', 'present', 'philwithrubbishcontent', 'accompanies', 'dealheat', 'adelaidepollinationproject', 'secuela', 'programming', 'expenses', 'hasbulla', 'sidetracked', 'bedtime', 'cozykitty', 'substitutions', 'equipment', 'sec']

Local Stem set –

Size of Stem Set: 12268

```
'courag': {'courageous', 'courage'}, 'the': {'the'}, 'solbird':
{'solbird'}, 'nobleblock': {'nobleblocks'}, 'illuminati':
{'illuminati'}, 'florkbnb': {'florkbnb'}, 'mouski': {'mouski'}, 'chh':
{'chh'}, 'solgoku': {'solgoku'}, 'cirqu': {'cirque'}, 'alan': {'alan'},
'solep': {'solepe'}, 'rosewifhat': {'rosewifhat'}, 'sloki': {'sloki'},
'cleanlambowiftaxbil': {'cleanlambowiftaxbills'}, 'eg': {'eg'},
'bscethavaxftm': {'bscethavaxftm'}, 'xbefceccbbddac':
{'xbefceccbbddaced'}, 'bcqmkraqpdrvftdxjpvzveldpwnwkldfjt':
{'bcqmkraqpdrvftdxjpvzveldpwnwkldfjt'}, 'apeoclockcom':
{'apeoclockcom'})})
```

Values of the correlations computed for the query :-

Association values:

```
[0.002692598616568702, 0.00135256208628845, 0.0012437307554999282,
0.001157755220043703, 0.0011268044795372954, 0.001122907749839014,
0.0011104365145460898, 0.0011027575536277587, 0.001010961803985867,
0.0009947409969151102, 0.0009597705124582765, 0.0009458376498178624,
0.0009400045953961752, 0.0009280586051626811, 0.0008996635519719078,
0.0008328077984189002, 0.0008091989925955815, 0.0007482557937372751,
0.0007427778770027155, 0.000725445539909291, 0.0007228892981915901,
0.0007130177440671577, 0.0007110539255547303, 0.0007103729879276165,
0.0007005824688891809, 0.0007000492130909561, 0.0006841271921807229,
0.0006690611029150349, 0.0006622478073936696, 0.0006606301523411112]
```

Query Expansion through association clustering - dog memes funny puppy
cute launch

Scalar values:

```
[1.0, 0.9999999999999999, 0.9542933521014662, 0.9542933521014662,
0.9348202305329236, 0.9288007157453695, 0.9203427310475153,
0.9188645091143637, 0.9179344878861341, 0.9167521974702236,
0.9110478749775412, 0.9059918447673804, 0.9058064085144046,
0.9054759070814375, 0.9050876174366831, 0.9028725061959626,
0.9014293945511888, 0.8986774694920739, 0.8903068271684842,
0.8881666374249125, 0.8867805045212916, 0.8841632175884364,
0.8813012509941311, 0.8788063679472449, 0.871728491177986,
0.8713475608520505, 0.8630630200621965, 0.8595262119444617,
0.8547058568730701, 0.8539525349731178]
```

Query Expansion through scalar clustering dog memes funny cat video

Metric Association values:

```
[0.0012309625964990727, 0.0010354014854552429, 0.0009336519372146417,
0.0008462120925822688, 0.000840839500149388, 0.0008247644425017881,
```

Punya Parag Modi (PXM230010)

`0.0008234196738965454, 0.0007885137810934278, 0.0007736476166841891,
0.0007622691340802802]`

Query Expansion through metric clustering - dog memes tattooa halloween
handler 524 giles

Query 3 –

Query – ‘weird memes’

Local ids set –

[<https://it.memedroid.com/memes/tag/weird>,
<https://www.memedroid.com/memes/tag/weird>,
<https://sea.mashable.com/a-star-is-born>,
<https://sea.mashable.com/detective-pikachu>,
<https://es.memedroid.com/memes/tag/dr+weird>,
<https://es.memedroid.com/memes/tag/weird>,
<https://www.dailydot.com/author/jay-hathaway/>,
<https://www.memedroid.com/memes/tag/ohio>,
<https://www.dailydot.com/unclick/gritty-memes/>,
<https://thehive.com/category/humor/weird>,
https://jv.wikipedia.org/wiki/Meme_intern%C3%A8t,
<https://knowyourmeme.com/memes/%CD%A1-%CD%9C%CA%96-%CD%A1-lenny-face>,
https://id.wikipedia.org/wiki/Meme_internet,
<https://knowyourmeme.com/memes/slender-man>,

https://ko.wikipedia.org/wiki/%EC%9D%B8%ED%84%B0%EB%84%B7_%EB%B0%88,
https://en.m.wikipedia.org/wiki/Internet_meme,
https://en.wikipedia.org/wiki/Internet_meme,
<https://www.vulture.com/article/stoner-canon-101-best-trippy-movies-albums-books.html>]

Local vocab set –

Size of Vocabulary Set: 8326

{'efforts', 'kontribusi', 'fring', 'mario', 'phillip', 'tentaclelike', 'mediabased', 'watershed', 'built', 'feel', 'cyberx', 'visible', 'allanasan', 'complies', 'yolo', 'favorited', 'ta', 'frank', 'wanders', 'activities', 'hail', 'future', 'altman', 'significant', 'te', 'summery', 'nne', 'pernyataan', 'frustrating', 'tinder', 'present', 'concern', 'centers', 'vip', 'submeme', 'info', 'ilmu', 'activarlas', 'wor', 'closely', 'papers', 'higher', 'ran', 'waiting', 'attire', 'opposable', 'akademis', 'grandly', 'siji', 'farms', 'hathaway', 'before', 'wild', 'will', 'thaaaat', 'part', 'ease', 'propagation', 'informing', 'actions', 'sky', 'stage', 'nhl', 'encouraging', 'elena', 'peter', 'cosmic', 'partook', 'arxiv', 'brands', 'heidi', 'accurate', 'sxsw', 'mutantes', 'mewakili', 'received', 'oscar', 'knock', 'hed', 'lurked', 'competitor', 'nicholas', 'generalities', 'someone', 'ridiculousness', 'linklater', 'idea', 'mazur', 'pancapilar', 'gawker', 'joyous', 'light', 'dokie', 'basulto', 'events', 'device', 'land', 'sisters', 'submit', 'episode', 'orchestra',

'joking', 'origdate', 'spiritdrug', 'vidding', 'myhive', 'love', 'gal', 'literatures', 'marco', 'couple', 'marine', 'lacked', 'seedy', 'photos', 'version', 'anxiety', 'harder', 'cable', 'chapter', 'regarding', 'khalayak', 'evolution', 'already', 'maret', 'guides', 'caption', 'appalled', 'loinclothed', 'hinted', 'kemonbokamonterey', 'surrealism', 'punsl', 'inked', 'ss', 'trio', 'newsworthy', 'chandleresque', 'censored', 'appropriate', 'dhw', 'receive', 'sites', 'unabashed', 'satire', 'confirming', 'video', 'stirling', 'anderson', 'hornets', 'gangsters', 'having', 'characteristics', 'bruce', 'related', 'routledge', 'nuclear', 'answer', 'italiano', 'unimpaired', 'provocateur', 'sin', 'wot', 'resigned', 'ruin', 'colours', 'makes', 'bonus', 'apt', 'spaceships', 'diulangulang', 'diperoleh', 'proverbial', 'whole', 'newly', 'minangka', 'clutter', 'pundit', 'newborn', 'tandha', 'limited', 'azrbaycanca', 'select', 'creativitydistinguished', 'j', 'touched', 'dning', 'eksklusif', 'dealer', 'protected', 'contained', 'entries', 'beauty', 'edgelord', 'speculated', 'ponder', 'sumebar', 'manifesto', 'unearthing', 'born', 'confused', 'jh', 'perpetuate', 'synecdoche', 'tren', 'covid', 'malware', 'harms', 'hair', 'mengenalnya', 'let', 'yoshi', 'names', 'slacker', 'yetis', 'cymraeg', 'dzulfaroh', 'humornya', 'literature', 'visual', 'sensasi', 'feral', 'immortal', 'statistically', 'meanders', 'daftar', 'marcus', 'quests', 'wonder', 'besut', 'ltimos', 'deeply', 'blows', 'adapted', 'diaries', 'crime', 'southern', 'texttospeech', 'inspired', 'unless', 'notificaciones', 'girls', 'andersons', 'mixing', 'tingkat',
},.....

,.....'eternal', 'masters', 'inventive',
'refers', 'appear', 'venture', 'gorgeously', 'visceral', 'casino', 'maintenance', 'welcoming', 'insects',
'couchlock', 'texture', 'narcotic', 'duck', 'intact', 'health', 'stocks', 'be', 'kellen', 'nani', 'synth', 'diowahi',
'abstract', 'drawn', 'pynchons', 'planets', 'instance', 'broy', 'liked', 'started', 'knievele', 'cat', 'jane', 'dvd', 'roth',
'can', 'committed', 'deadpan', 'italy', 'philip', 'ozbekcha', 'addenda', 'sample', 'computermediated', 'intention
'highlights', 'interaksi', 'stretch', 'points', 'fauxparanormal', 'bass', 'buat', 'lengthy', 'bees', 'detective', 'ars',
'ridley', 'erstwhile', 'tribute', 'corporate', 'bans', 'dozen', 'rich', 'wildass', 'halt', 'value', 'heaviosity', 'masalah',
'adalah', 'divided', 'denisova', 'marleylike', 'zilch', 'jungster', 'marina', 'utilized', 'scene', 'internet', 'bros',
'dilebokake', 'instan', 'link', 'somehow', 'sell', 'warm', 'innocent', 'know', 'supplement', 'ngenalake',
'outage', 'revisit', 'gleeson', 'lyrics', 'checks', 'recovering', 'preying', 'memescape', 'pilgrim', 'guitars', 'stare',
'mesmerized', 'traditionally', 'riveting', 'clock', 'shredding', 'sea', 'setatistik', 'vaccine', 'particularly',
'notions', 'obsessed', 'kerckhoven', 'fatto', 'amanda', 'scandal', 'canonically', 'anywhere', 'straightforward',
'boomers', 'film', 'scott', 'trauma', 'maxwell', 'ferociously', 'mythmaking', 'democracy', 'inconsequential',
'trke', 'immensely', 'beggar', 'proceed', 'hold', 'lively', 'ellisby', 'layak', 'ambient', 'search', 'prelapsarian',
'registered', 'bangerz', 'corban', 'satu', 'offering', 'buah', 'birke', 'jesus', 'overdrive', 'propagating', 'tumble',
'demokrasi', 'riff', 'allowing', 'max', 'motion', 'evolved', 'endless', 'venmo', 'earns', 'herrings', 'jejak', 'hope',

'spike', 'nicky', 'ross', 'administrators', 'released', 'convincing', 'cp', 'devil', 'pioneervi', 'robert', 'riffraff', 'causality', 'splattered', 'organist', 'filem', 'submits'}

Local Stem set –

Size of Stem Set: 6793

```
{
  'random': { 'subscript': { 'subscription': 'subscriptions' }, 'favorit': 'favorited', 'favorites': 'favorite' }, 'chat': { 'chat' }, 'rank': { 'ranked', 'ranking', 'ranks' }, 'mobil': { 'mobile' }, 'app': { 'app' }, 'contact': { 'contact' }, 'us': { 'us' }, 'site': { 'sites', 'site' }, 'term': { 'terms', 'term', 'termed' }, 'of': { 'of' }, 'servic': { 'services', 'service' }, 'privaci': { 'privacy' }, 'non': { 'non' }, 'so': { 'so' }, 'che': { 'che' }, 'scriver': { 'scrivere' }, 'nel': { 'nel' }, 'titolo': { 'titolo' }, 'genio': { 'genio' }, 'giusepp': { 'giuseppe' }, 'lhai': { 'lhai' }, 'appena': { 'appena' }, 'fatto': { 'fatto' }, 'by': { 'by' }, 'giuseppelist': { 'giuseppelist' }, 'sigla': { 'sigla' }, 'see': { 'see', 'seeing' }, 'commun': { 'communitys', 'communities', 'communication', 'communicate', 'communicated', 'overnight' }, { 'overnights' }, 'strateg': { 'strategically' }, 'vomit': { 'vomit' }, 'belov': { 'beloved' }, 'sexyhistori': { 'sexyhistory' }, 'amp': { 'amps' }, 'nailbit': { 'nailbiting' }, 'subtl': { 'subtle' }, 'wallen': { 'wallen' }, 'feloni': { 'felony' }, 'chair': { 'chair' }, 'roof': { 'roof' }, 'amend': { 'amends' }, 'proud': { 'proud' }, 'behavior': { 'behavior' }, 'inbox': { 'inbox' }, 'correspond': { 'correspondence' }, 'recaptcha': { 'recaptcha' }, 'valid': { 'valid' }, 'lower': { 'lower' }, 'az': { 'az' }, 'upper': { 'upper' }, 'anytim': { 'anytime' }, 'kit': { 'kit' }, 'hire': { 'hiring' } })
}
```

Values of the correlations computed for the query :-

Association values:

```
[0.06784289014912834, 0.05690253129285007, 0.04587823273214091, 0.04114312318870732, 0.040517384334752084, 0.04030864908441783, 0.034924330616996506, 0.033941306355769266, 0.03255273210430161, 0.03153388326198183, 0.029520310452991912, 0.028148275379643647, 0.028122415219189414, 0.02796617265343716, 0.027374691084215197, 0.027271851209405416, 0.02694647057922307, 0.026648317277617916, 0.026552344074125295, 0.026212458877215326, 0.0261665505919809, 0.026000212246630586, 0.025867616146883446, 0.025270454755223465, 0.024987337497889582, 0.024806004325149473, 0.022904688449492824, 0.02288570301196896, 0.022468904640898756, 0.02243992296742862]
```

Query Expansion through association clustering -weird memes internet 2024 03
original 05 top

Scalar values:

```
[1.0000000000000002, 1.0, 0.9705707880871176, 0.9695999457508261, 0.9660169976181803, 0.9624726843990787, 0.9598981024634707, 0.9592002073014749, 0.9581558000896022, 0.9581501675510435,
```

0.95642590625393, 0.9563886023160802, 0.9550896084875513,
 0.9549129188206628, 0.9546569966276595, 0.9539270857455179,
 0.9532258768017887, 0.9516971582034475, 0.951155496857269,
 0.9510875817477318, 0.9497779419961205, 0.9493748715989683,
 0.9490932062757644, 0.9488938679765658, 0.946603795114329,
 0.9454788735178302, 0.9447203699727164, 0.9447072266038058,
 0.9419417110638979, 0.9412660707150692]

Query Expansion through scalar clustering - weird memes get 18 10 17 19 14 3
 facebook

Metric Association values:

[0.026098336141924718, 0.026014682168632616, 0.02336127846022408,
 0.022903560262184423, 0.02254524338682433, 0.02237281736342548,
 0.02221977699523483, 0.022087716093946382, 0.021821678264338257,
 0.0217124470585107]

Query Expansion through metric clustering - weird memes 279 doofenshmirtz cboz97
 496 1000

Query Results –

Query – ‘cat memes’

1) Association Clustering Search Engine Result

Relevance Model Options:
 Page Rank HITS

Clustering Options:
 Flat Clustering Hierarchical Clustering

Query Expansion Option:
 Association Metric Scalar

Search

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2) Scalar Clustering Search Engine Result

cat memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

Search

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<https://www.pinterest.com/saamzub/cats/>
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3) Metric Clustering Search Engine Result

cat memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

Search

<https://www.pinterest.com/ideas/happy-cat/958268496043/>
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<https://www.pinterest.com/saamzub/cats/>
Pinterest Today Watch Shop Explore Log in Sign up Cats Pins d Collection by S Zubair Share Humour Book Nerd Writer Humor Writer Memes A Writer's Life Book Humor Authorship Book Jokes Book Memes
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<https://www.pinterest.com/ideas/funny-grumpy-cat-memes-hilarious/940370558820/>
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Query – ‘dog memes’

1) Association Clustering Search Engine Result

cat memes

Relevance Model Options:
 Page Rank HITS

Clustering Options:
 Flat Clustering Hierarchical Clustering

Query Expansion Option:
 Association Metric Scalar

Search

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2) Scalar Clustering Search Engine Result

dog memes

Relevance Model Options:
 Page Rank HITS

Clustering Options:
 Flat Clustering Hierarchical Clustering

Query Expansion Option:
 Association Metric Scalar

Search

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3) Metric Clustering Search Engine Result

dog memes

Relevance Model Options:
 Page Rank HITS

Clustering Options:
 Flat Clustering Hierarchical Clustering

Query Expansion Option:
 Association Metric Scalar

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Query – ‘weird memes’

1) Association Clustering Search Engine Result

weird memes

Relevance Model Options:
 Page Rank HITS

Clustering Options:
 Flat Clustering Hierarchical Clustering

Query Expansion Option:
 Association Metric Scalar

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2) Scalar Clustering Search Engine Result

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Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

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3) Metric Clustering Search Engine results

weird memes

Relevance Model Options:

Page Rank HITS

Clustering Options:

Flat Clustering Hierarchical Clustering

Query Expansion Option:

Association Metric Scalar

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Collaboration with other team members

- received the original query and the cluster method type via an API call from the GUI.
- used the documents provided to form a local vocabulary and stem sets, essential for understanding the key themes and terms within the documents.
- executed the chosen cluster method (association, metric, or scalar) to expand the original query based on the local vocabulary and document context.
- sent the expanded query to the relevance model, which utilizes Apache Solr to fetch search results for the expanded query.
- ensured the results of the expanded query are passed back to the GUI for display, showing both the original and expanded queries and their results for user comparison.
- collaborated with the indexing team to monitor and analyze the performance of the relevance models to continually improve the effectiveness of the search engine.
-

Query selection for demo:

For the demo, the query “cat memes”, “funny memes” will be used since it has two words and can be enhanced with other words. It is tested for association cluster method and scalar cluster.

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7. Discussion:

Through this project, we gained knowledge on creating a functional search engine using various techniques learned in class. We were able to build a search engine that crawls web pages and provides relevant results. This project highlighted the practical skills required to construct a search engine and highlighted how much more there is to learn in information retrieval. Comparing our results to leading search engines like Google and Bing showed us the potential to create a popular search engine with minimal effort.

8. Conclusion:

In conclusion, our project focused on creating a search engine for memes by utilizing team member's skills and open source tools. Each member handled a key task, leading to the development of a functional search engine that provides accurate memes related information. Despite facing challenges, the team effectively collaborated to overcome obstacles and produce a strong final product. The project

also allowed the team to apply classroom knowledge to practical situations, enhancing their understanding of the subject.