# Search Engine for Efficient Data Discovery of NYC Open Data

By Data InQuirer


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# Introduction and Problem Formulation

- With the advent of massive datasets available on open data portal like NYC Open Data, Data.Gov, efficient search of repository in real time plays a very crucial role
- As a project, we are determined to build a search engine for NYC Open data which contains almost 1500 datasets ~ 650 GB
- The aim of the project is to build an interactive search engine that helps users to find relevant datasets from a corpus of dataset that satisfies certain keyword conditions specified by the users

# Related work and Background

- Bellman browser : Make use of data summaries that helps in doing quick and crude exploratory analysis of the data
- Many approximate matching algorithms are developed that helps to performs joins based on string distances
- For this project, we make extensive use of the data summaries as they are found to be more efficient during the search time. Users can interactively play with such a browser and mine the data that is more relevant for them.

# Method

- As mentioned above, method of data summary is adopted to build the search engine. The data summary should contain informative features that efficiently and effectively describes each dataset in the repository.
- **Trade-off between speed and accuracy**: Data Summary will lead to loss of information. Hence, there is a trade-off between speed and accuracy
- The trade off between speed and accuracy can be well answered if the features that summarizes the data are very informative and well suited to the task

# Architecture and Design (1/3)

**Stages of Search Engine Building**:

1. **Feature Engineering**: The most important stage of the dataset searching process. During this stage, relevant features that can informatively characterize a dataset are chosen or built.
2. **Extracting Feature and Building Data Summary**
3. **Building query templates to perform diverse and informative search**

# Architecture and Design (2/3)

**Extracting Feature and Building Data Summary:** Pyspark, HPC and parallel computing were used to derive features from ~650 GB of data. The set of features extracted are mentioned below:

| File name | Category | Column Name | Description | Download Count | View Count |
|---|---|---|---|---|---|
| Tags | Word | Column Type | Word Count | Number of Rows | Number of Columns |
| Maximum | Minimum | Nulls | Non-Nulls | Attribution Link | Field Name |

# Architecture and Design (3/3)

**Building query templates to perform diverse and informative search:**

| Sr. | Query |
|---|---|
| 1 | Dataset with certain number of rows and columns |
| 2 | Search for multiple keywords in OR fashion |
| 3 | Search for multiple keywords in AND fashion |
| 4 | Search for files with certain columns in it |
| 5 | Search for files with a certain column and value |
| 6 | Search keywords in meta data and data |

| Sr. | Query |
|---|---|
| 7 | Search for keyword in metadata |
| 8 | Search for a keyword with threshold on number of times it occurs |
| 9 | Search for a keyword with threshold on number of rows in the dataset |
| 10 | Dataset belonging to certain category |
| 11 | See the Schema of Dataset |

# Technical Depth and Innovation

- The data summary is prepared by extracting most useful information from the data and metadata of the files. To compute and extract such features, a spark implementation using SQL and RDD were used.
- Increase Relevance of Search: Similar words to the given keyword are determined using cosine similarity applied over word2vec representation of all the natural occurring words
- To reduce running time, in every possible place, threading is made use to parallelize the execution of code.

**Demo Time!**


OpenData

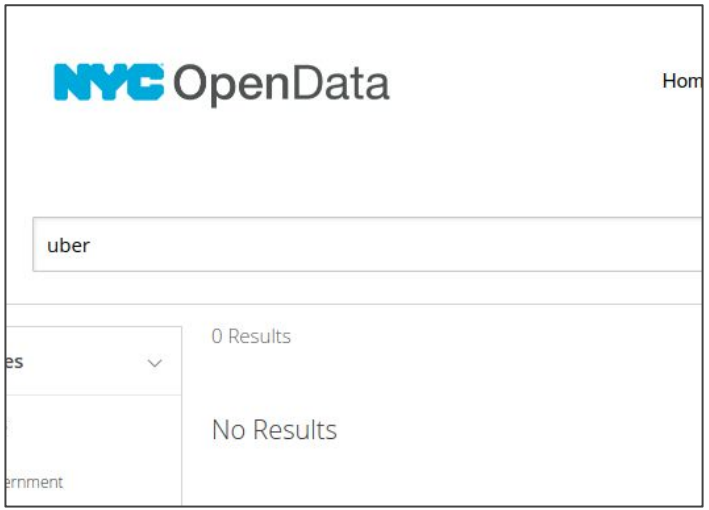
# Results and Evaluation

- 11 different type of advance search capabilities are present in the search engine which are not present in the search engine of NYC Open Data Website
- It is found to give better results than the website's search engine
- Users can tailor the search as per their needs by querying the summary tables in an efficient and easy manner.
- Data summaries have many other applications like finding similar datasets, finding similar column in a table, etc. Data summary tables can easily be leveraged for performing such analysis as well.

# Future Work

- Another possible search methodology could be to find appropriate clusters of dataset to search over and perform search only on those dataset that fall in the cluster
- For above methodology, some kind of clustering algorithm would be needed
- Ranking the search results using some relevance metric

# Appendix



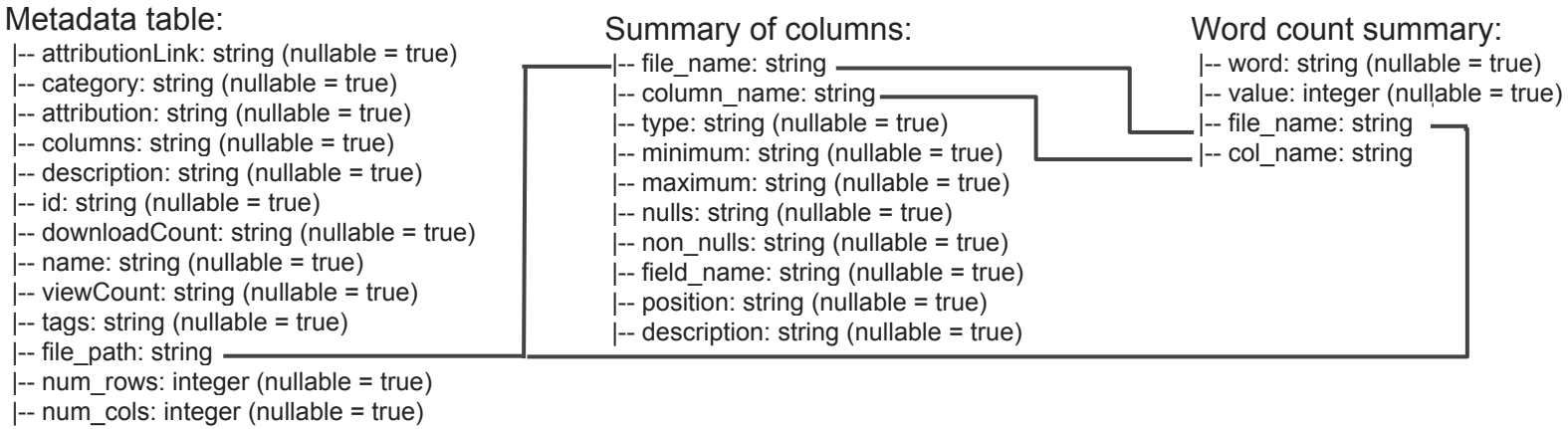

uber

| name | file_path |
|---|---|
| FHV Base Aggregate Report | /user/bigdata/nyc_open_data/2v9c-2k7f.json |
| 2013-2017 School Math Results - SWD | /user/bigdata/nyc_open_data/7k5d-rk33.json |
| 2016-17 Physical Education - MTI All- Star Schools | /user/bigdata/nyc_open_data/g9wv-7n2m.json |
| 2013-2017 School ELA Results - All | /user/bigdata/nyc_open_data/kdm9-vp7d.json |
| 2013-2017 School Math Results - All | /user/bigdata/nyc_open_data/kha6-7i9i.json |
| 2013-2017 School ELA Results - Gender | /user/bigdata/nyc_open_data/m8nr-4ivu.json |
| 2013-2017 School ELA Results - EvELL | /user/bigdata/nyc_open_data/mib5-bwqy.json |
| 2013-2017 School Math Results - EvELL | /user/bigdata/nyc_open_data/rqjq-29wc.json |
| 2013-2017 School Math Results - Gender | /user/bigdata/nyc_open_data/x4ai-kstz.json |
| 2013-2017 School Math Results - Ethnic | /user/bigdata/nyc_open_data/xx92-6788.json |
| 2013-2017 School ELA Results - SWD | /user/bigdata/nyc_open_data/ybcb-4665.json |
| 2013-2017 School ELA Results - Ethnic | /user/bigdata/nyc_open_data/ynau-kwze.json |

**Comparison of Search for word ‘uber’**

# Appendix

## Schema of summary tables:



# Appendix

Query 9: Find the datasets that contains '**income**' in the column name:

| path | name |
|---|---|
| /user/bigdata/nyc_open_data/gffu-ps8j.json | Income By Type Of Income And AGI Range |
| /user/bigdata/nyc_open_data/nwet-nc6h.json | Tax Credits By Agi Range |
| /user/bigdata/nyc_open_data/3vvi-fwjs.json | Tax Liability By AGI Range |
| /user/bigdata/nyc_open_data/ipc3-2nbm.json | Personal Income By AGI Range |
| /user/bigdata/nyc_open_data/9ay9-xkek.json | Local Law 44 - Unit Income Rent |

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# Appendix

Query 10: Find datasets with a column that contain a keyword **‘address’** with keyword ‘**building**’ in it **:**

| path | name |
|---|---|
| /user/bigdata/nyc_open_data/9a87-6m4x.json | SBS ICAP Contract Opportunities |
| /user/bigdata/nyc_open_data/u35m-9t32.json | DCLA Cultural Organizations |
| /user/bigdata/nyc_open_data/m3fi-rt3k.json | New York City Council Discretionary Funding (2009-2013) |
| /user/bigdata/nyc_open_data/un8d-rbed.json | SBS ICAP Contract Opportunities - Historical |
| /user/bigdata/nyc_open_data/ye3c-m4ga.json | Civil List |

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# Appendix

Query 2: Find datasets that contains word **‘classroom’** at least 50 times:

| file_name | name |
|---|---|
| /user/bigdata/nyc_open_data/8gpu-s594.json | Application for State Aid |
| /user/bigdata/nyc_open_data/tm6d-hbzd.json | Incidents Responded to by Fire Companies |
| /user/bigdata/nyc_open_data/gshi-yqza.json | Transportable Classroom Units- Buildings & Schools |

Query 7: Find the datasets that contains ‘**alcohol**’ in it:

```
['alcohol']
['drinking', 'marijuana', 'alcohol']
```

| file_name | name |
|---|---|
| /user/bigdata/nyc_open_data/tm6d-hbzd.json | Incidents Responded to by Fire Companies |
| /user/bigdata/nyc_open_data/8sdw-8vja.json | Asset Management Parks System (AMPS) - Work Orders |
| /user/bigdata/nyc_open_data/m3fi-rt3k.json | New York City Council Discretionary Funding (2009-2013) |
| /user/bigdata/nyc_open_data/6r4h-c2y6.json | Sustainability Indicators (2012) |
| /user/bigdata/nyc_open_data/8nqg-ia7v.json | Mental Health Service Finder Data |