WikiFinder

A Wikipedia sourced search engine

Approach and Implementation

Building up the Inverted Index

This search engine uses a Trie as the Inverted Index file which stores the core information for a search engine. The Trie traces a keyword by finding an existing prefix and adding up the remaining characters not present in the path but present in the word.

The urls are stored as Index in an array where an Index stores the url and has a unique id, the nodes in trie contains an Occurrence List which holds the ids of these Indices

A Site is scraped and the text is extracted from the html of the Site after removing html tags, html styles, script tags and other web scripts and we get a Page which contains the title, url, cleaned text and the links to other Site it points to.

The text from a Page is parsed and the stopwords and the punctuations are removed and the keywords are extracted by retrieving the tokens from the cleaned text.

These keywords are then added to the inverted index or the trie with key as the word and the url of the Page as its value.

A Node in the Inverted Index or Trie stores an Occurrence List as the value. This OccurrenceList contains the ids of the Index the keyword occurs in.

Finding results for a query

When we fire a query the query string is parsed and the keywords are extracted after removing the stopwords and the words are looked up in the Inverted Index or the trie, if we find the word in the Trie and take the value of the node which is an Occurrence List which stores the ids of the Index which are stored in an array and return a list of those Index as the result.

When we fire a multi word query we return the Indexes we get from the intersection of the Occurrence Lists of the different nodes we get from each keyword in the query.

The union and intersection algorithm for Occurrence Lists is derived from Algorithm 8.3 (merge) in the textbook.

Custom Data Structures

Patricia Trie (Compressed Trie)

The Patricia or Compressed Trie is made up of adding Nodes to one other. When the words in the list {"bear", "bell", "bid", "bull", "buy", "sell", "stock", "stop", "beat", "sea", "stoop"} are added to the Patricia Trie it would look like

-> [b -> [e -> [a -> [r, t], ll], id, u -> [ll, y]], s -> [e -> [ll, a], to -> [ck, p, op]]]

or the following in json format


```
{
  "#":{
    "b":{
      "e":{
        "a":{
          "r":{},
          "t":{}
        },
        "ll":{}
      },
      "id":{},
      "u":{
        "ll":{},
        "y":{}
      }
    },
    "s":{
      "e":{
        "a":{},
        "ll":{}
      },
      "to":{
```

```
          "ck":{},
          "p":{},
          "op":{}
        }
      }
    }
}
```

Note: # is the root or "" as empty string is prefix of all strings

Occurrence List

This is an array type data structure which implements the union and intersection of two lists based on the Algorithm 8.3 (merge) from the textbook

Custom Data Types and Objects

Index

```
The Index is like a unique node in the www, each web page is a node in the www.
The Index is same as the Page, except Page is more bound to the web page
containing the text of the web page, while Index stores the location of
the node in the www
:param index: Index of the node in the www
:param title: Title of the web page of this node
:param url: URL of the web page or node
:param links_to: other Index this node points to
```

Site

```
A website specifying the url or the location of the html doc of the website
:param url: url of the website
:param html_doc: location of the html_doc of the website
```

Page

```
The web page object containing results after scraping a Site
:param title: The title of the web page
:param url: The url of the web page
:param text: The cleaned text body of the web page
:param links_to: other Page this Page points to
```

Node

```
Basic element of the Trie
:param key: The key of the node
:param children: List of children nodes
:param is_leaf: Is current node leaf or not, default=False
:param value: Value of the node
```

Input

Runtime

The input can be provided as a list of urls at runtime

```
wiki = WikiFinder([ "https://en.wikipedia.org/wiki/New_York_City",
                    "https://en.wikipedia.org/wiki/Bullfighting"])
```

urls.lst

A list of urls can be stored in the urls.lst file in the data folder. If other file is to be used its location should be provided while initializing.

```
wiki = WikiFinder(url_list="custom_file_location.txt")
```

urls.json

A list of urls along with the path of the saved html documents can be stored in the urls.json file in the data folder. It should follow the following format:

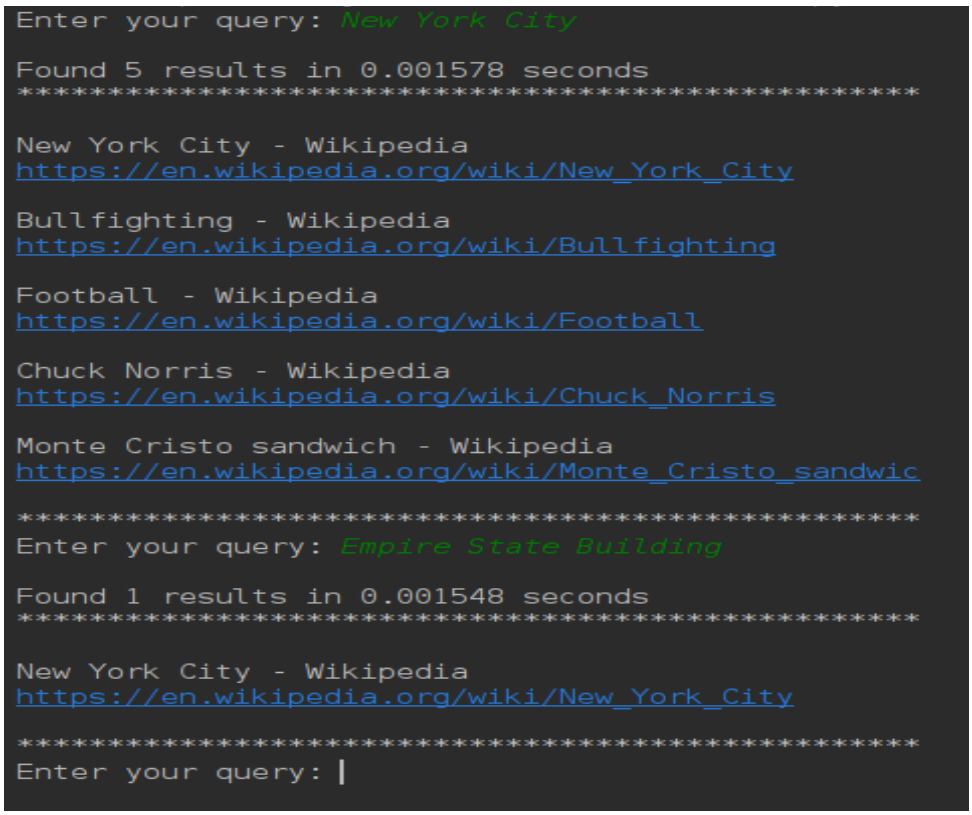
```
{
  "sites": [
    {
      "url": "https://en.wikipedia.org/wiki/New_York_City",
      "html": "New York City - Wikipedia.html"
    },
    {
      "url": "https://en.wikipedia.org/wiki/Bullfighting",
      "html": "Bullfighting - Wikipedia.html"
    }
  ]
}
```

A custom location of the file can also be used and its location needs to be provided during initializing.

```
wiki = WikiFinder(html_docs="custom_file_location.json")
```

Output

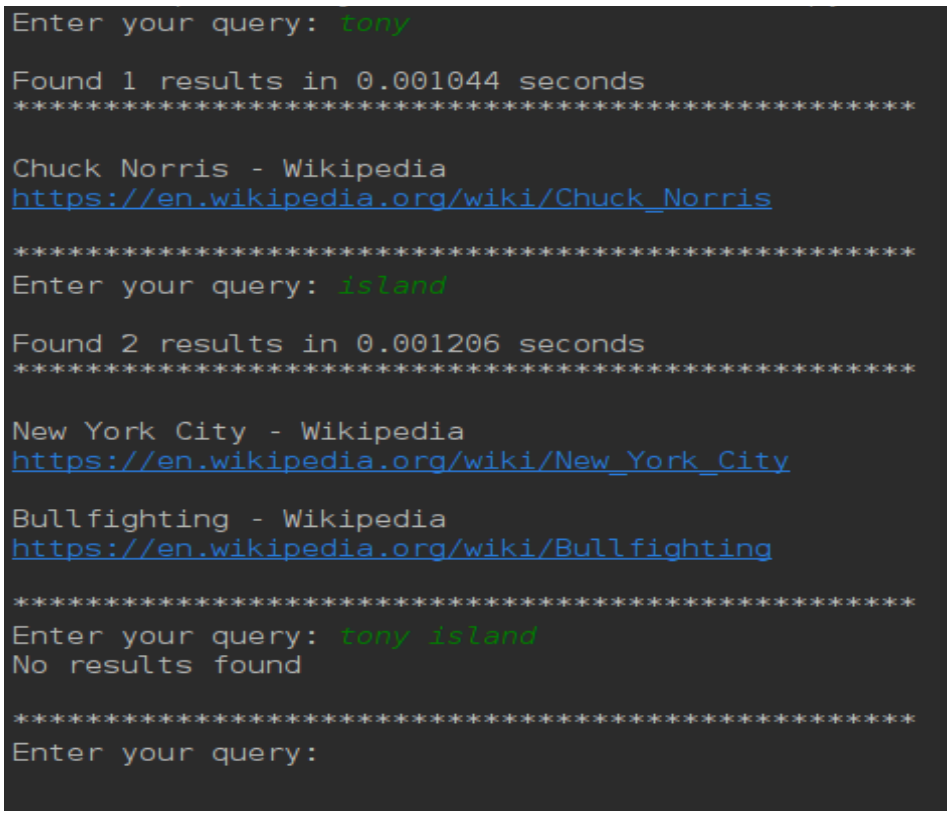
The output is as seen



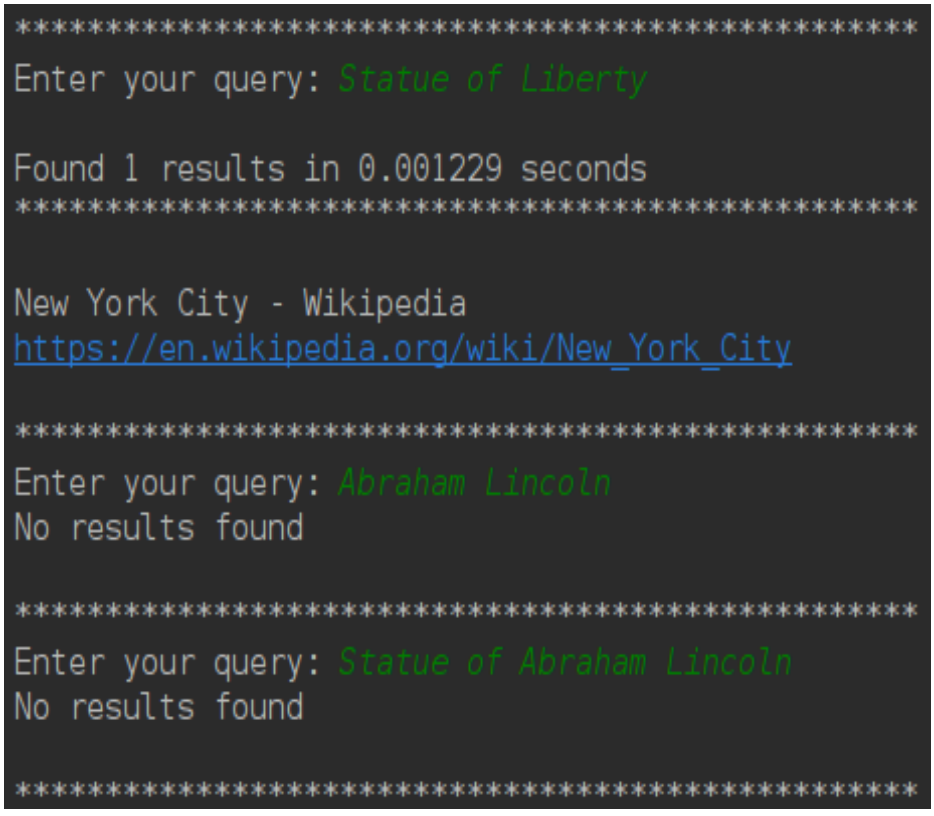
Edge Cases

Intersection of two different results

As we can see the output of tony and island have nothing in common and thus we didn't find any result when querying for tony island

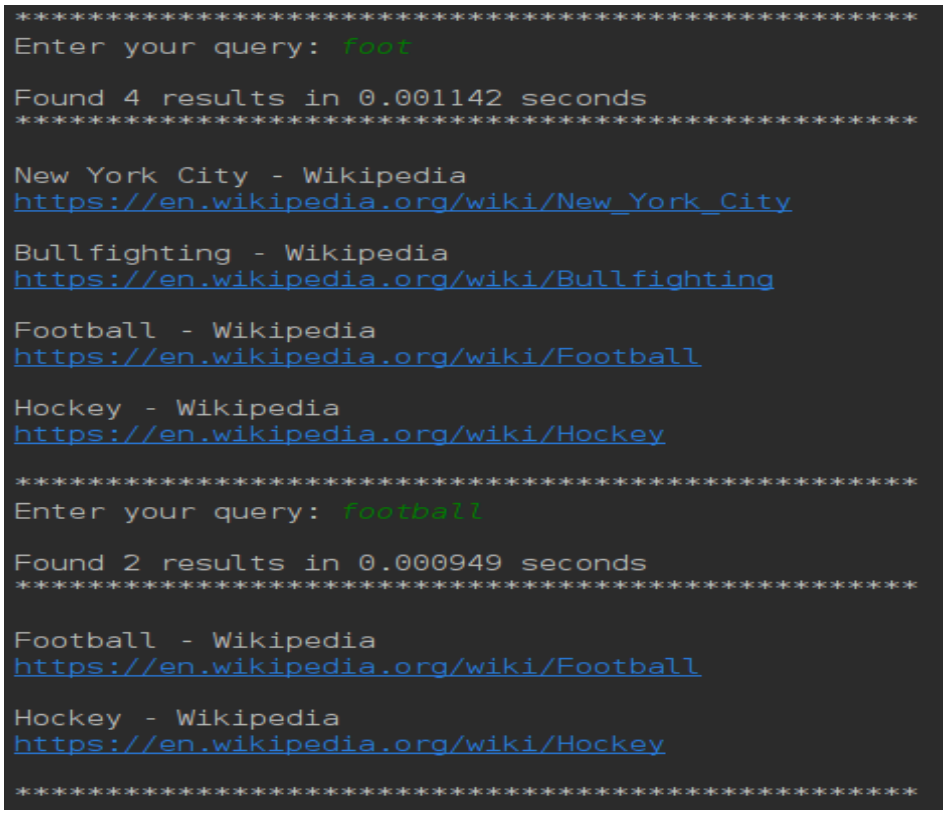


Here the word statue is common in the first and last query however we didn't find any result for Abraham Lincoln thus it explains why we didn't find any result for the last query



Matching prefix from different queries

Here the prefix foot matches in both the queries however the result varies in both cases.



Here each query is a prefix of the next next query ie. ma is a prefix of mat and mat is a prefix of matador, however the result is different in all the three cases, as well as the intersection of the first three query has nothing in common as can be seen in the result of the last query

```
**********************************************************
Enter your query: ma
No results found

**********************************************************
Enter your query: mat

Found 1 results in 0.001124 seconds
**********************************************************

New York City - Wikipedia
https://en.wikipedia.org/wiki/New_York_City

**********************************************************
Enter your query: matador

Found 1 results in 0.000983 seconds
**********************************************************

Bullfighting - Wikipedia
https://en.wikipedia.org/wiki/Bullfighting

**********************************************************
Enter your query: ma mat matador
No results found

**********************************************************
```

Demo