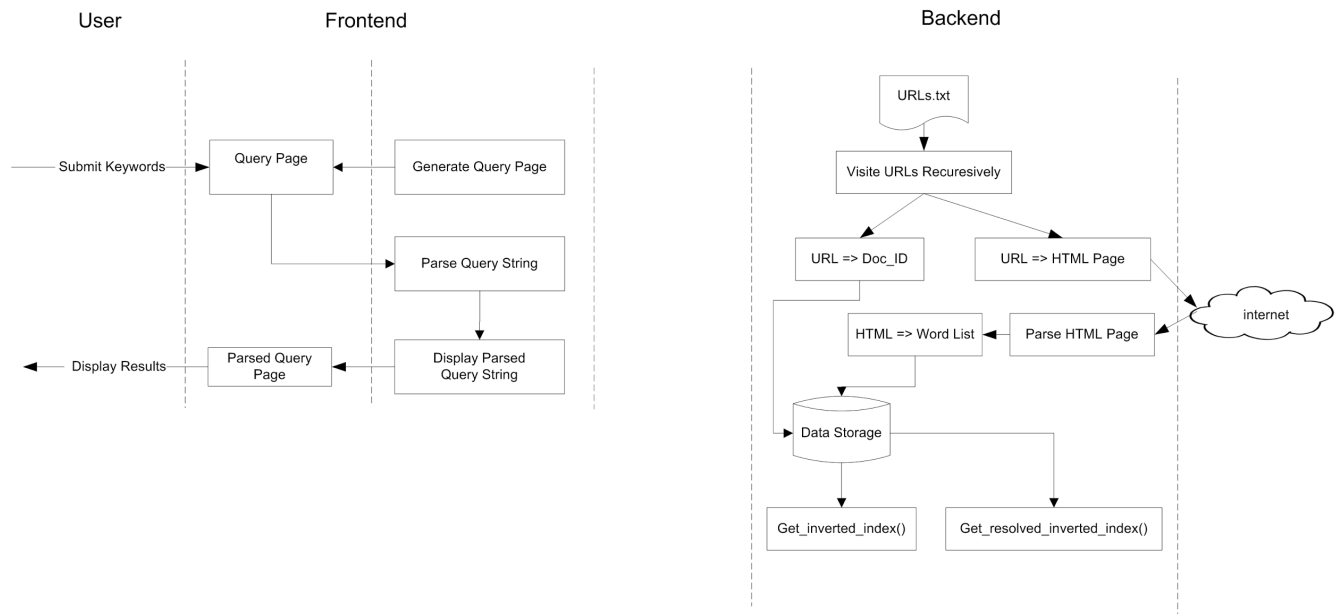


# Lab 1 - Development Phase 1



Example of search engine architecture for Lab 1

# Frontend

## F1. Simple Query Interface

In this lab, you will implement a simple query interface that asks for a query string (can be a single keyword or more) from the web users. Your interface should include at least the following components:

- an input box for typing a keyword string
- a button that submits the keyword
- the name and logo of your search engine (Try to be creative)

Using CSS and Javascript is optional for this lab.

## F2. Query Data Processing

Your frontend should be able to recognize the number of words in the query submitted by the user, and should ignore white spaces in the query.

In this lab, your frontend should display the number of words that have been submitted in a phrase, and display the number of appearances for each word.

Example:

User submits the following string in the text box:

*The lab 1 of CSC326 lab is the first lab*

You frontend should display following information in the result page:

Search for "*The lab 1 of CSC326 lab is the first lab*"

Word	Count
the	2
lab	3
1	1
of	1
csc326	1
is	1
first	1

## F3. The Bottle web framework

To host your web service, you should use the Bottle web framework, which is a single file module, and has no dependencies other than the Python Standard Library. The documentation of Bottle can be found on <http://bottlepy.org>. Below is a simple example to install and setup the server.

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```
$ cd <YOUR-PROJECT-DIRECTORY>
$ wget https://pypi.python.org/packages/source/b/bottle/bottle-0.12.7.tar.gz
$ tar -zxvf bottle-0.12.7.tar.gz
$ cd bottle-0.12.7
$ python setup.py install --user
```

Create a file named HelloWorld.py with following lines.

```
from bottle import route, run
@route('/')
def hello():
    return "Hello World"
run(host='localhost', port=8080, debug=True)
```

When the server is running, you can access your web page in the browser with address <http://localhost:8080/>

### F4. Requirements

- Your frontend should present a simple interface for user to submit a keyword or a phrase.
- In response, your frontend should show the keyword on a result web page. In the case when a phrase (i.e. more than one word) is submitted in the query, your frontend should list the number of keywords in the phrase and the number of appearances for each keyword in the phrase as specified in Part F2.
- Store the history of the top 20 most popular **keywords** searched since the server is launched. At the time when the server is launched, it should have no record for any keyword.
- Display the top 20 keywords on the query page, and the total number of times that these words have been searched.

### F5. HTML Format

- Query submission must be placed in an HTML form using HTTP GET method
- Query submission form and result page must be processed at the root path of the website, i.e. <http://hostname:port/>
- The keyword string must be submitted using an HTML form input with name “keywords” and type “text”
- Results for the word counts must be placed in an HTML table with name “results”
- Results for the top 20 keywords must be placed in an HTML table with name “history”

Example of an expected HTML table for the results:

```
<table id="results">
  <tr>
    <td>the</td>
    <td>2</td>
  </tr>
  <tr>
    <td>lab</td>
    <td>3</td>
  </tr>
</table>
```

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**Note that failure to follow the exact requirements for the HTML formats for input and output may result a grade of zero for the correctness of the implementation for the frontend.**

# Backend

## B1. Inverted Index

An inverted index stores a mapping from content to its locations. For example, it maps a word to a list of documents that contain the word. In a search engine, the inverted index is used to look up a list of URLs given a keyword.

For search engine, a crawler is used to visit a repository of web pages, and generate the document index, lexicon, hit lists, forward index, and inverted index.

## B2. Reference Implementation of a Crawler ([crawler.py](#))

The crawler recursively traverses a list of URLs specified in the "urls.txt".

- A document id is created for each new URL visited, and the URL is cached such that a new document id will not be generated for next visit.
- If the URL has been visited, then move to the next URL on the list.
- For URLs that have not been visited, BeautifulSoup APIs are called to load the content of the page specified by the URLs.
- Once a page is loaded, the crawler traverses the document in depth-first order and processes the text between tags.
- Text statements will be parsed by the crawler, and each new word is added to the index with a unique word id. Also, html tags that are not interested will be ignored by the crawler, e.g. '<meta>', '<script>', etc.
- After a list of words is created for a page, all the words should map to the document id of the page.

To run the crawler, execute the following command in terminal

```
$ python crawler.py
```

## B3. Requirements

After the crawler finishes processing a list of URLs, your data structure should maintain the following information in memory:

- Document Index, that keeps information about each document. This document should be ordered by document id.
- Lexicon, that keeps a list of words.
- Inverted Index, that returns a list of document ids given a word id

In the crawler class, you should provide a function, ***crawler.get\_inverted\_index()***, which returns the inverted index in a dict(). You should use the word id as the key, and the list of document ids as the value. The list of document ids should be stored in a set().

Also, you should provide a function, ***crawler.get\_resolved\_inverted\_index()***, where word ids are replaced by the word strings, and the document ids are replaced by URL strings in the inverted index. `get_resolved_inverted_index()` should also return data in a dict().

Example

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```
>>> from crawler import crawler
>>> crawler = crawler(None, 'urls.txt')
>>> inverted_index = crawler.get_inverted_index()
>>> print inverted_index
{ '1': set([1, 2]),
  '2': set([1, 3])}
>>> resolved_inverted_index = crawler.get_resolved_inverted_index()
>>> print resolved_inverted_index
{'google': set(['http://google.ca', 'http://google.com']),
 'search': set(['http://google.ca', 'http://bing.com'])}
```

In the above example, word id of “google” and “search” are ‘1’, and ‘2’ respectively. The document id for “http://google.ca”, “http://google.com”, and “http://bing.com” are ‘1’, ‘2’, and ‘3’ respectively.

### Hints

You may find the following features useful for your future development of the labs, however these implementations will not be graded for this lab:

1. Store the title for each web page and a short description of each web page, i.e. first 3 lines on the page, in the document index
2. Provide an API that returns the title, and short description for each web page given a document id

# Deliverables

## Frontend

- Source code of the frontend

## Backend

- Source code of the modified crawler
- Test cases for testing the correctness of the crawler

\* All source code must be well commented, and explicit instructions must be provided to run your application. If your code is not simple to run, it will cost you.

# Submission

## Code

Place all your files in a directory named **lab1\_group\_<group\_number>**, and compress it to **lab1\_group\_<group\_number>.tar.gz**.

For example, for group 4, use the following command.

```
$ tar -zcvf lab1_group_4.tar.gz lab_1_group_4/
```

To submit your package, use the following command on EEGC machine:

```
$ submitcsc326f-lab 1 lab1_group_<group_number>.tar.gz
```

# Group Number

You should be working in a group of two for the course project. To receive your group number, one member of your group should send your names and UTORIDs to the lab TA through hshrad at ece.utoronto.ca.

To work alone or in a group of more than two members, you must obtain the approval from the instructor.