CSE 4/535-Introduction to Information Retrieval - Fall 2024 Project 1 Requirements

Due Date: 27th September 2024, 11:59 PM EST

Introduction

This project aims to introduce students to data scraping and indexing in SOLR. Before mining and analyzing such content, collecting, cleaning, and storing such data is a crucial step. This project aims to familiarize students with collecting online data and efficiently storing it, making data retrieval and analytics easier for downstream applications. This project will also introduce students to the different technical aspects involved in this course and subsequent projects.

[Caution]: Make sure you SAVE all the data you have collected/ indexed in a secure location; you may need this in your final project.

Part 0: Setup

GCP: For this project (and the forthcoming projects), we will use Google Cloud Platform(GCP) as our default cloud platform. Requirements to get a GCP account with $300 credits:

- A valid Gmail account. Please DO NOT use your buffalo.edu email address.
- A credit/debit card.

[Caution]: Make sure you are not crossing your $300 limit. Otherwise, you may be charged. Please do not keep your instances running unless specifically asked to do so.

How to open a GCP account?
https://www.youtube.com/watch?v=W5mPX1-015o or watch any other YouTube videos.

How to create a VM instance?
https://cloud.google.com/compute/docs/instances/create-start-instance
https://www.youtube.com/watch?v=goIKNBMqQhE or watch any other YouTube videos.

How to open a port?
https://www.youtube.com/watch?v=-RjDWwTZUnc or watch any other YouTube videos.

Apache Solr:
Installation:
https://tecadmin.net/install-apache-solr-on-ubuntu/
NOTE: In the above article the URL to download SOLR installer in 'Step 2' may not work. Please use the following instead:

```
wget https://archive.apache.org/dist/solr/solr/9.0.0/solr-9.0.0.tgz
```

Note: Release 9.4.1 and above should work fine for Solr installation

If wget is not available in VM, use this to install:

```
sudo apt install wget
```

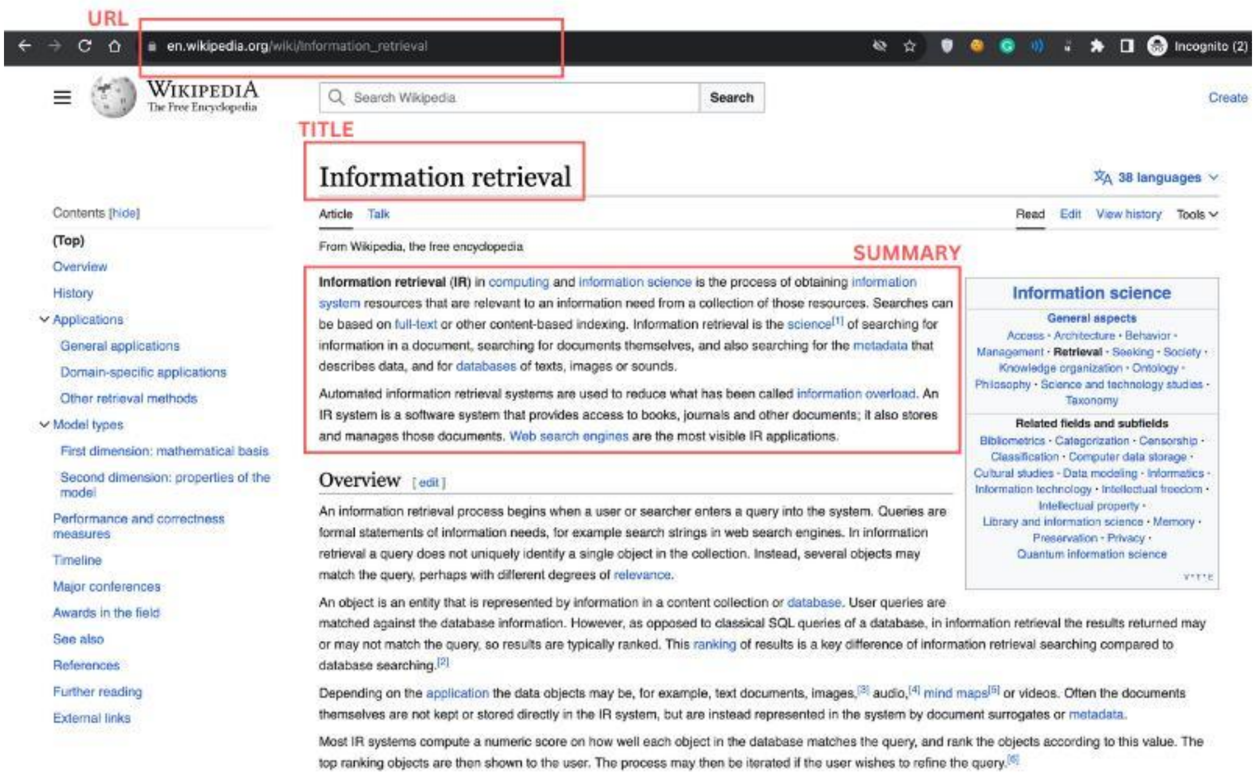
In GCP VMs, Solr runs in localhost, to run Solr which is accessible to public IP follow this link: https://tecadmin.net/configuring-apache-solr-to-accessible-on-public-ip/

Python: Versions > = 3.9.10 is recommended

Tutorials:
https://www.youtube.com/watch?v=y2TqbjTc1GE&list=PLBrWqg4Ny6vXPalbTc_QqPiW1_G01AE2a

Part 1: Scraping Wiki pages

Understanding the Data:


URL
en.wikipedia.org/wiki/Information_retrieval
Incognito (2)
WIKIPEDIA
The Free Encyclopedia
Search Wikipedia
Search
Create
TITLE
38 languages
Contents [hide]
(Top)
Overview
History
Applications
General applications
Domain-specific applications
Other retrieval methods
Model types
First dimension: mathematical basis
Second dimension: properties of the model
Performance and correctness measures
Timeline
Major conferences
Awards in the field
See also
References
Further reading
External links
Article
Talk
Read
Edit
View history
Tools
SUMMARY
Information science
General aspects
Access · Architecture · Behavior · Management · Retrieval · Seeking · Society · Knowledge organization · Ontology · Philosophy · Science and technology studies · Taxonomy
Related fields and subfields
Bibliometrics · Categorization · Censorship · Classification · Computer data storage · Cultural studies · Data modeling · Informatics · Information technology · Intellectual freedom · Intellectual property · Library and information science · Memory · Preservation · Privacy · Quantum information science
V·T·E

Information retrieval

From Wikipedia, the free encyclopedia

Information retrieval (**IR**) in computing and information science is the process of obtaining information system resources that are relevant to an information need from a collection of those resources. Searches can be based on full-text or other content-based indexing. Information retrieval is the science[1] of searching for information in a document, searching for documents themselves, and also searching for the metadata that describes data, and for databases of texts, images or sounds.

Automated information retrieval systems are used to reduce what has been called information overload. An IR system is a software system that provides access to books, journals and other documents; it also stores and manages those documents. Web search engines are the most visible IR applications.

Overview [edit]

An information retrieval process begins when a user or searcher enters a query into the system. Queries are formal statements of information needs, for example search strings in web search engines. In information retrieval a query does not uniquely identify a single object in the collection. Instead, several objects may match the query, perhaps with different degrees of relevance.

An object is an entity that is represented by information in a content collection or database. User queries are matched against the database information. However, as opposed to classical SQL queries of a database, in information retrieval the results returned may or may not match the query, so results are typically ranked. This ranking of results is a key difference of information retrieval searching compared to database searching.[2]

Depending on the application the data objects may be, for example, text documents, images,[3] audio,[4] mind maps[5] or videos. Often the documents themselves are not kept or stored directly in the IR system, but are instead represented in the system by document surrogates or metadata.

Most IR systems compute a numeric score on how well each object in the database matches the query, and rank the objects according to this value. The top ranking objects are then shown to the user. The process may then be iterated if the user wishes to refine the query.[6]

We can see a wiki page about ‘Information Retrieval’. You will use an API to retrieve the information as given in the red box.

Scraping Requirements:

- Scrape data from Wiki related to the following Topics. Some subtopics are provided as suggestions.
    a. **Health**: Common diseases, global health statistics, mental health trends…
    b. **Environment**: Global warming, endangered species, deforestation rates…
    c. **Technology**: Emerging technologies, AI advancements…
    d. **Economy**: Stock market performance, job markets, cryptocurrency trends…
    e. **Entertainment**: Music industry, popular cultural events, streaming platforms...
    f. **Sports**: Major sporting events, sports analytics...
    g. **Politics**: Elections, public policy analysis, international relations…
    h. **Education**: Literacy rates, online education trends, student loan data…
    i. **Travel**: Top tourist destinations, airline industry data, travel trends…
    j. **Food**: Crop yield statistics, global hunger and food security…
- Get a minimum of 500 documents for each of these topics listed above
- Make sure all the 500 documents from each topic are unique
- Not more than 5% of documents of length less than 200 characters in the summary

API usage:

Endpoint: https://www.mediawiki.org/wiki/API:Main_page

Suggested Wrapper: https://pypi.org/project/wikipedia/

Colab Notebook - Wiki API usage

Part 2: Indexing

Before we describe the indexing process, we introduce some terminologies.

Solr Terminologies

- Solr indexes every document subject to an underlying schema.
- A schema, much akin to a database schema, defines how a document must be interpreted.
- Every document is just a collection of fields.
- Each field has an assigned primitive (data) type int, long, String, etc.
- Every field undergoes one of three possible operations: analysis, index, or query.
- The analysis defines how the field is broken down into tokens, which tokens are retained, and which ones are dropped, how tokens are transformed, etc.
- Both indexing and querying at a low level are determined by how the field is analyzed.

Thus, the crucial element is configuring the schema to correctly index the collected docs per the project requirements. Every field is mapped to a type, and each type is bound to a specific tokenizer, analyzer, and filters. The *schema.xml* is responsible for defining the full schema, including all fields, and their types, and analyzing indexing directives.

Although a full description of each analyzer, tokenizer, and filter is out of the scope of this document, a great starting point is at the following page: https://cwiki.apache.org/confluence/display/SOLR/AnalyzersTokenizersTokenFilters where you can find tips and tricks for all important elements you might want to use for this project. You are encouraged to start either in a schemaless mode or with the default schema, experiment with different filters, and work your way from there.

Prepocessing strategies

This is where students need to figure out the appropriate way to preprocess their collected data. Overall, there are two overarching strategies that you must consider:

- Using out-of-the-box components and configuring them correctly. For example, the StopFilter can filter out stopwords as specified by a file listed in the schema. Thus, at the very minimum, you would be required to find language-specific stopword lists and configure the filters for corresponding type fields to omit these stopwords.
- Preprocessing data before indexing to extract the needed fields. For example, you could preprocess the pages to introduce new fields in the JSON response as per project requirements. Here again, it is left to your choice of programming language and/or libraries to perform this task. Solr supports a variety of data formats for importing data (XML, JSON, CSV, etc.). You would thus need to transform your queried data into into one of the supported formats (JSON recommended) and POST this data to Solr to index.

Solr Schema API and PySolr

We will use Solr programmatically using Solr Schema API and PySolr, some

documentation: https://solr.apache.org/guide/6_6/schema-api.html

https://github.com/django-haystack/pysolr

Indexing Requirements

Create a core named `**IRF24P1**`. We will use the same core to index the documents.

Field name	**Description**	**Field Type**	**Is Custom?**
revision_id	Revision Id of the page	string	
title	Title of the page	string	

summary	Summary of the page	text_en	
url	URL of the page	string	
topic	Topic the page is related to	string	Yes

Colab Notebook - SOLR Indexing Demo

Submission

You are required to submit a .json file containing the IP address of your GCP instance, port in which Solr is running and the core name. The file should be named [ubit]_p1.json (example: nasrinak_p1.json)

Example file contents:

```
{
        "ip": "60.42.48.55",
        "port": "8983",
        "core": "IRF24P1",
        "ubit": "nasrinak"
}
```

[Caution]: Please check the validity of the JSON file (Tool to check validity: https://jsonlint.com/) before you submit. If you submit an invalid JSON file, a ZERO score is guaranteed (We mean it).

Steps for submission:

You should upload everything in UB Learns. You need to create a zip file containing the following

1. The JSON file (described above)
2. The codebase in a directory named ‘src’.
    a. It should contain the code used for scraping, pre-processing, and indexing the data in SOLR.
    b. The data which was indexed in JSON format.

The zip file that you submit should be named [ubit].zip (example: nasrinak.zip).

Grading

This project is worth **10 points**, and these are distributed as follows:

Criterion	**Description**	**Points**
Docs volume	Get a minimum of 5000 docs	3
Min docs per topic	Get a minimum of 500 docs	2
Summary length	Not more than 5% of documents of length less than 200 characters in the summary	2
Preprocessing	Not more than 5% of documents should have any other characters other than alphanumeric.	1
Solr schema validation	All fields are named as required, contain values as required, etc.	2

Academic Integrity

Academic integrity policies will be taken very seriously. We will check the pattern of your indexed data, and if similarities are found more than a threshold value (which will not be disclosed) with other submissions, you will get a **ZERO** score.

Late Policy

Late homework will be accepted up to 1 day late for a penalty of 25% of the total points. For example, if the homework is worth 10 points and you submit it one day late, you will receive the maximum of (your score earned minus 2.5 points) and 0 points.