ΜΥΕ003: Ανάκτηση Πληροφορίας

Διδάσκουσα: Ευαγγελία Πιτουρά

Περιγραφή Εργασίας

Ένα σύστημα αναζήτησης πληροφορίας για επιχειρήσεις

Πληροφορίες για εστιατόρια, και κριτικές τους από το σύστημα Yelp (https://www.yelp.com/).

Ως πρώτο βήμα, δημιουργείστε τη συλλογή σας κατεβάζοντας δεδομένα από το Yelp Open Dataset (https://www.yelp.com/dataset).

Διαλέξτε ένα υποσύνολο των διαθέσιμων δεδομένων τα οποία να αφορούν επιχειρήσεις, κριτικές και υποδείξεις για αυτές.

Ελάχιστες απαιτήσεις:

- 10000 επιχειρήσεις
- 1000000 κριτικές και υποδείξεις

Περιεχόμενα Παρουσίασης

Σύντομη παρουσίαση

- Lucene
- Yelp dataset
- εργασίας

ΜΥΕ003: Ανάκτηση Πληροφορίας

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Lucene

Εισαγωγή

- Open source search software
- Lucene Core provides Java-based indexing and search as well as spellchecking, hit highlighting and advanced analysis/tokenization capabilities
- Let you add search to your application, not a complete search system by itself -- software library not an application
- Written by Doug Cutting

Εισαγωγή

- Used by LinkedIn, Twitter, Netflix, Oracle, …
  - and many more (see http://wiki.apache.org/lucene-java/PoweredBy)

- Ports/integrations to other languages
  - C/C++, C#, Ruby, Perl, PHP
  - PyLucene: a Python port of the Core project

Μπορείτε να την κατεβάσετε από

http://lucene.apache.org/core/

Some features (indexing)

Scalable, high-performance indexing

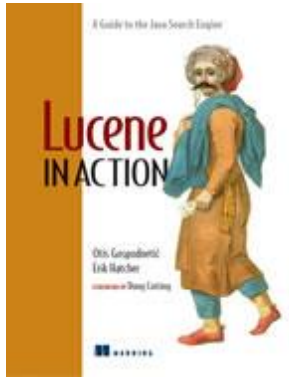
- over 150GB/hour on modern hardware
- small RAM requirements -- only 1MB heap
- incremental indexing as fast as batch indexing
- index size roughly 20-30% the size of text indexed

Some features (search)

Powerful, accurate and efficient search algorithms

- ranked searching -- best results returned first
- many powerful query types: phrase queries, wildcard queries, proximity queries, range queries and more
- fielded searching (e.g. title, author, contents)
- sorting by any field
- allows simultaneous update and searching
- flexible faceting, highlighting, joins and result grouping
- fast, memory-efficient and typo-tolerant suggesters
- pluggable ranking models, including the Vector Space Model and Okapi BM25

Στόχος της παρουσίασης:
Σύντομη εισαγωγή



Περισσότερες πληροφορίες (προσοχή κάποια στοιχεία αναφέρονται σε παλιότερη έκδοση)

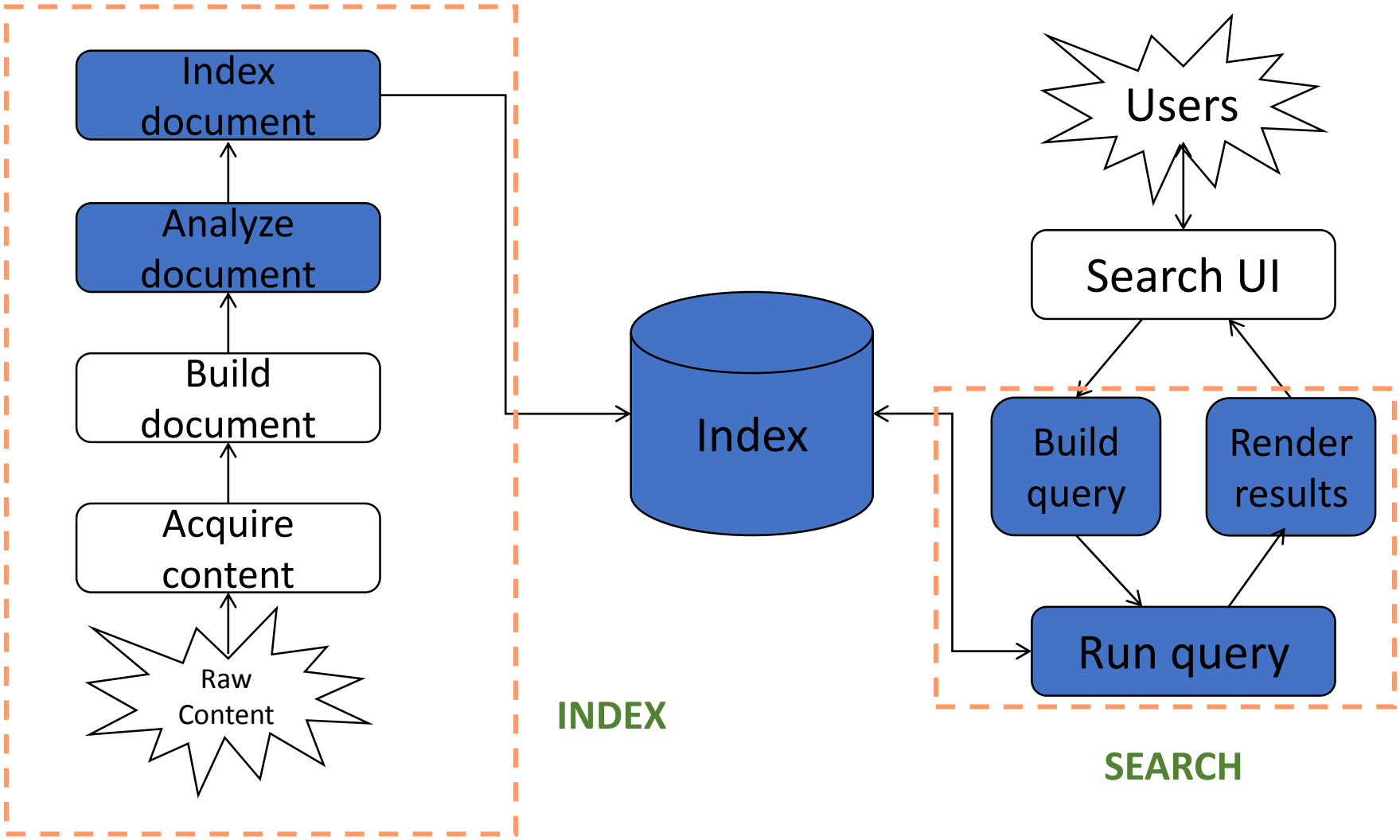
- http://www.lucenetutorial.com/

  https://www.manning.com/books/lucene-in-action-second-edition

- **Lucene 8.0.0** demo API (recommended for more up-to-date code examples)
- offers simple example code to show the features of Lucene
  - http://lucene.apache.org/core/8_0_0/core/overview-summary.html#overview_description
  - http://lucene.apache.org/core/8_0_0/demo/overview-summary.html#overview_description

  Μπορείτε να χρησιμοποιείστε παλαιότερη version αν θέλετε

Βασικές έννοιες



Βασικές έννοιες: document

- The unit of search and index.
- Indexing involves adding Documents to an IndexWriter.
- Searching involves retrieving Documents from an index via an IndexSearcher.

- A document consists of one or more Fields
  - A Field is a name-value pair.
    example: title, body or metadata (creation time, etc)

Βασικές έννοιες: Fields

- You have to translate raw content into Fields
- Search a field using <field-name:term>,
  - e.g., title:lucene

Βασικές έννοιες: index

- Indexing in Lucene
  1. Create documents comprising of one or more Fields
  2. Add these Documents to an IndexWriter.

Βασικές έννοιες: search

Searching requires an index to have already been built.

- It involves
  1. Create a Query (usually via a QueryParser) and
  2. Handle this Query to an IndexSearcher, which returns a list of Hits.

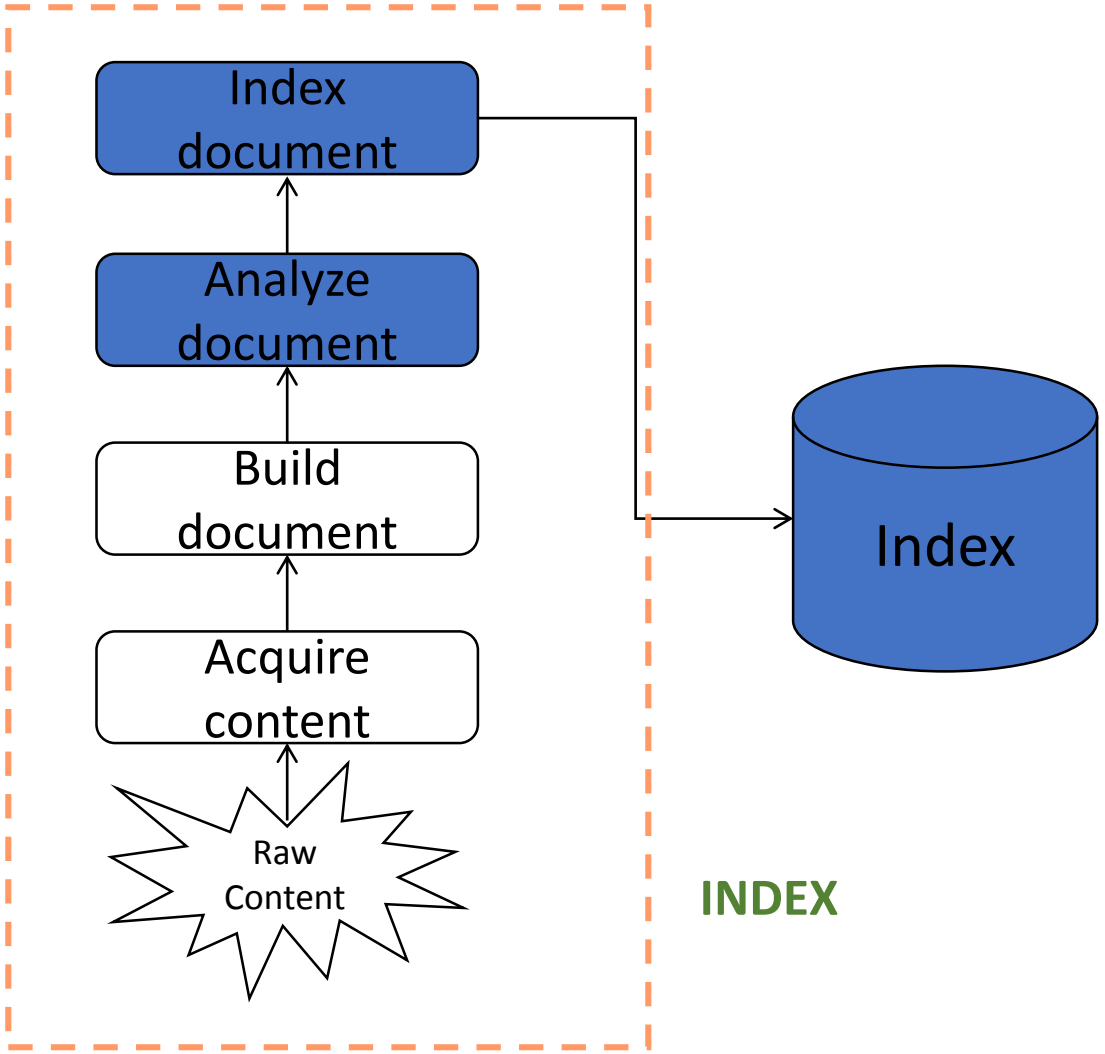
- The Lucene query language allows the user to specify
  - which field(s) to search on,
  - which fields to give more weight to (boosting),
  - the ability to perform boolean queries (AND, OR, NOT) and
  - other functionality.

Lucene in a search system:
index

Lucene in a search system: index

Steps

1. Acquire content
2. Build document
3. Analyze document
4. Index documents



Step 1: Acquire and build content

Not supported by core Lucid

Collection depending on type may require:

- Crawler or spiders (web)
- Specific APIs provided by the application (e.g., Twitter, FourSquare, imdb)
- Scrapping
- Complex software if scattered at various location, etc

Complex documents (e.g., XML, JSON, relational databases, pptx etc)

Solr high performance search server built using Lucene Core, with XML/HTTP and JSON/Python/Ruby APIs, hit highlighting, faceted search, caching, replication, and a web admin interface.
https://lucene.apache.org/solr/

Competitor: Elasticsearch

Tika the Apache Tika™ toolkit detects and extracts metadata and text from over a thousand different file types (such as PPT, XLS, and PDF)
For example latest release automating image captioning
http://tika.apache.org/

Step 2:Build Documents

Create documents by adding fields

Fields may be

- indexed or not
  - Indexed fields may or may not be analyzed (i.e., tokenized with an `Analyzer`)
    - *Non-analyzed fields view the entire value as a single token* (useful for URLs, paths, dates, social security numbers, ...)
- stored or not
  - Useful for fields that you'd like to display to users
- Optionally store term vectors and other options such as positional indexes

Step 2:Build Documents

Create documents by adding fields

Step 1 – Create a method to get a Lucene document from a text file.

Step 2 – Create various fields which are key value pairs containing keys as names and values as contents to be indexed.

Step 3 – Set field to be analyzed or not, stored or not

Step 4 – Add the newly-created fields to the document object and return it to the caller method.

Step 2:Build Documents

```
private Document getDocument(File file) throws IOException {
Document document = new Document();

 //index file contents
Field contentField = new Field(LuceneConstants.CONTENTS,
new FileReader(file))
//index file name
Field fileNameField = new Field(LuceneConstants.FILE_NAME, file.getName(), Field.Store.YES,Field.Index.NOT_ANALYZED);

//index file path
 Field filePathField = new Field(LuceneConstants.FILE_PATH, file.getCanonicalPath(),  Field.Store.YES,Field.Index.NOT_ANALYZED);

document.add(contentField);
document.add(fileNameField);
 document.add(filePathField);

return document;
}
```

Step 3:analyze and index

Create an IndexWriter and add documents to it with addDocument();

Core indexing classes

- Analyzer
  - Extracts tokens from a text stream
- IndexWriter
  - create a new index, open an existing index, and
  - add, remove, or update documents in an index
- Directory
  - Abstract class that represents the location of an index

```
 Analyzer analyzer = new StandardAnalyzer();

 // INDEX: Store the index in memory: (για την εργασία θα το αποθηκεύστε στο δίσκο – θα δημιουργηθεί μια φορά στην αρχή)
 Directory directory = new RAMDirectory();
// To store an index on disk, use this instead:
//  Directory directory = FSDirectory.open("/tmp/testindex");
 IndexWriterConfig config = new IndexWriterConfig(analyzer);
 IndexWriter iwriter = new IndexWriter(directory, config);
 Document doc = new Document();
 String text = "This is the text to be indexed.";
 doc.add(new Field("fieldname", text, TextField.TYPE_STORED));
 iwriter.addDocument(doc);
 iwriter.close();

// SEARCH: Now search the index:
   DirectoryReader ireader = DirectoryReader.open(directory);
   IndexSearcher isearcher = new IndexSearcher(ireader);
    // Parse a simple query that searches for "text":
    QueryParser parser = new QueryParser("fieldname", analyzer);
    Query query = parser.parse("text");
    ScoreDoc[] hits = isearcher.search(query, null, 1000).scoreDocs;
// Iterate through the results:
    for (int i = 0; i < hits.length; i++) {
     Document hitDoc = isearcher.doc(hits[i].doc);
}
    ireader.close();
    directory.close();
```

Using `Field` options

Index	Store	TermVector	Example usage
NOT_ANALYZED	YES	NO	Identifiers, telephone/SSNs, URLs, dates, ...
ANALYZED	YES	WITH_POSITIONS_OFFSETS	Title, abstract
ANALYZED	NO	WITH_POSITIONS_OFFSETS	Body
NO	YES	NO	Document type, DB keys (if not used for searching)
NOT_ANALYZED	NO	NO	Hidden keywords

Analyzers

Tokenizes the input text

- Common Analyzers
  - WhitespaceAnalyzer
    Splits tokens on whitespace
  - SimpleAnalyzer
    Splits tokens on non-letters, and then lowercases
  - StopAnalyzer
    Same as SimpleAnalyzer, but also removes stop words
  - StandardAnalyzer
    Most sophisticated analyzer that knows about certain token types, lowercases, removes stop words, ...

Analysis examples

"The quick brown fox jumped over the lazy dog"

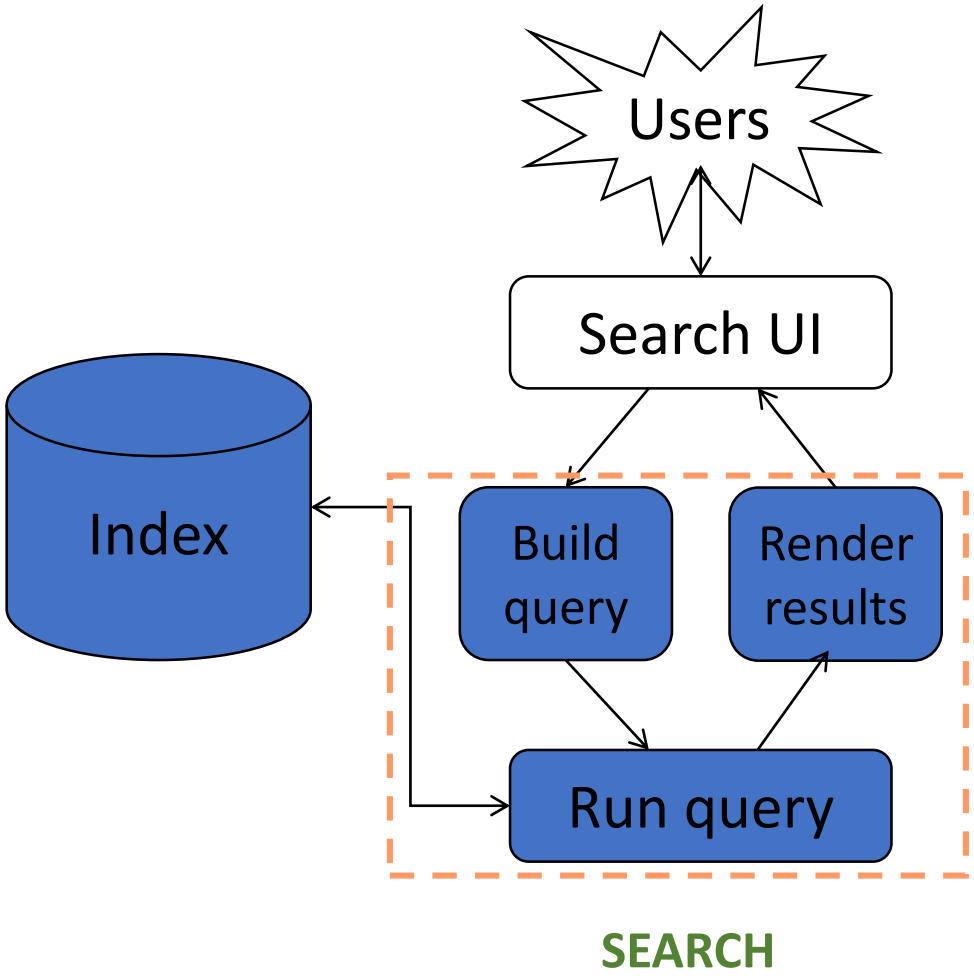
- `WhitespaceAnalyzer`
  - [The] [quick] [brown] [fox] [jumped] [over] [the] [lazy] [dog]
- `SimpleAnalyzer`
  - [the] [quick] [brown] [fox] [jumped] [over] [the] [lazy] [dog]
- `StopAnalyzer`
  - [quick] [brown] [fox] [jumped] [over] [lazy] [dog]
- `StandardAnalyzer`
  - [quick] [brown] [fox] [jumped] [over] [lazy] [dog]

More analysis examples

- “XY&Z Corporation – xyz@example.com”
- `WhitespaceAnalyzer`
  - [XY&Z] [Corporation] [-] [xyz@example.com]
- `SimpleAnalyzer`
  - [xy] [z] [corporation] [xyz] [example] [com]
- `StopAnalyzer`
  - [xy] [z] [corporation] [xyz] [example] [com]
- `StandardAnalyzer`
  - [xy&z] [corporation] [xyz@example.com]

Lucene in a search system: search

Lucene in a search system: search



Search User Interface (UI)

No default search UI, but many useful modules

General instructions

- Simple (do not present a lot of options in the first page)
  search box better than 2-step process
- Result presentation is very important
  - highlight matches
  - make sort order clear, etc

Core searching classes

- QueryParser
  - Parses a textual representation of a query into a Query instance
  - Constructed with an analyzer used to interpret query text in the same way as the documents are interpreted
- Query
  - Contains the results from the QueryParser which is passed to the searcher
  - Abstract query class
  - Concrete subclasses represent specific types of queries, e.g., matching terms in fields, boolean queries, phrase queries, …
- IndexSearcher
  - Central class that exposes several search methods on an index
  - Returns TopDocs with max n hits

```
Analyzer analyzer = new StandardAnalyzer();

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Document doc = new Document();
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```

QueryParser syntax examples

Query expression	Document matches if…
java	Contains the term *java* in the default field
java junit java OR junit	Contains the term *java* or *junit* or both in the default field (*the default operator can be changed to* AND)
+java +junit java AND junit	Contains both *java* and *junit* in the default field
title:ant	Contains the term *ant* in the title field
title:extreme - subject:sports	Contains *extreme* in the title and not *sports* in subject
(agile OR extreme) AND java	Boolean expression matches
title:”junit in action”	Phrase matches in title
title:”junit action”~5	Proximity matches (within 5) in title
java*	Wildcard matches
java~	Fuzzy matches
lastmodified:[1/1/09 TO 12/31/09]	Range matches

Scoring

- Scoring function uses basic *tf-idf* scoring with
  - Programmable boost values for certain fields in documents
  - Length normalization
  - Boosts for documents containing more of the query terms
- IndexSearcher provides a method that explains the scoring of a document

Summary

To use Lucene

1. Create Documents by adding Fields;
2. Create an IndexWriter and add documents to it with addDocument();

3. Call QueryParser.parse() to build a query from a string; and
4. Create an IndexSearcher and pass the query to its search() method.

Summary: Lucene API packages

- *org.apache.lucene.analysis* defines *an abstract Analyzer API* for converting text from a Reader into a TokenStream, an enumeration of token Attributes.
- *org.apache.lucene.document* provides a simple Document class. A Document is simply a set of named Fields, whose values may be strings or instances of Reader.
- *org.apache.lucene.index* provides two primary classes: IndexWriter, which creates and adds documents to indices; and IndexReader, which accesses the data in the index.
- *org.apache.lucene.store* defines an abstract class for storing persistent data, the Directory, which is a collection of named files written by an IndexOutput and read by an IndexInput. Multiple implementations are provided, including FSDirectory, which uses a file system directory to store files, and RAMDirectory which implements files as memory-resident data structures.

Summary: Lucene API packages

- *org.apache.lucene.search* provides
  - data structures to represent queries (ie TermQuery for individual words, PhraseQuery for phrases, and BooleanQuery for boolean combinations of queries) and
  - the IndexSearcher which turns queries into TopDocs.
  - A number of QueryParsers are provided for producing query structures from strings or xml.

- *org.apache.lucene.codecs* provides an abstraction over the encoding and decoding of the inverted index structure, as well as different implementations that can be chosen depending upon application needs.
- *org.apache.lucene.util* contains a few handy data structures and util classes, ie FixedBitSet and PriorityQueue.

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Yelp dataset και απαιτήσεις εργασίας

Yelp dataset

Download from

https://www.yelp.com/dataset

(JSON, SQL)

Documentation

https://www.yelp.com/dataset/documentation/json

Yelp dataset: Businesses I

{ // string, 22 character unique string business id
"business_id": "tnhfDv5Il8EaGSXZGiuQGg",
// string, the business's name
"name": "Garaje",
// string, the neighborhood's name
"neighborhood": "SoMa",
// string, the full address of the business
"address": "475 3rd St",
// string, the city "city": "San Francisco",
// string, 2 character state code, if applicable
"state": "CA",
// string, the postal code
"postal code": "94107",
// float, latitude
"latitude": 37.7817529521,
// float, longitude "longitude": -122.39612197,

location

Yelp dataset: Businesses II

// float, star rating, rounded to half-stars
"stars": 4.5,
// interger, number of reviews
"review_count": 1198,
// integer, 0 or 1 for closed or open, respectively
"is_open": 1,
// object, business attributes to values. note: some attribute values might be objects
"attributes": { "RestaurantsTakeOut": true, "BusinessParking": { "garage": false, "street": true, "validated": false, "lot": false, "valet": false }, },
// an array of strings of business categories
"categories": ["Mexican", "Burgers", "Gastropubs"],
// an object of key day to value hours, hours are using a 24hr clock
"hours": { "Monday": "10:00-21:00", "Tuesday": "10:00-21:00", "Friday": "10:00-21:00", "Wednesday": "10:00-21:00", "Thursday": "10:00-21:00", "Sunday": "11:00-18:00", "Saturday": "10:00-21:00" } }

Yelp dataset: Reviews

{ // string, 22 character unique review id
"review_id": "zdSx_SD6obEhz9VrW9uAWA",
// string, 22 character unique user id, maps to the user in user.json
"user_id": "Ha3iJu77CxlrFm-vQRs_8g",
// string, 22 character business id, maps to business in business.json
"business_id": "tnhfDv5Il8EaGSXZGiuQGg",
// integer, star rating
"stars": 4,
// string, date formatted YYYY-MM-DD
"date": "2016-03-09",
// string, the review itself
"text": "Great place to hang out after work: the prices are decent, and the ambience is fun. It's a bit loud, but very lively. The staff is friendly, and the food is good. They have a good selection of drinks.",
// integer, number of useful, funny, cool votes received
"useful": 0,
"funny": 0,
"cool": 0 }

Yelp dataset

Tips written by a user on a business. Tips are shorter than reviews and tend to convey quick suggestions.

Other data

User data including the user's friend mapping and all the metadata associated with the user.

Checkins on a business.

Photos

Εργασία

Ανάλυση και κατασκευή ευρετηρίου

Η Lucene παρέχει τη δυνατότητα για stemming, απαλοιφή stop words, επέκταση συνωνύμων, κλπ.

Επίσης, κάποιες λειτουργίες, όπως η διόρθωση τυπογραφικών λαθών, ή η επέκταση ακρωνύμων, μπορούν να γίνουν εναλλακτικά κατά τη διάρκεια της αναζήτησης (τροποποιώντας το ερώτημα).

Επιλέξτε το είδος της ανάλυσης που θεωρείτε κατάλληλο και εξηγείστε την επιλογή σας.

Εργασία

Αναζήτηση

Το σύστημα σας θα πρέπει να επιτρέπει αναζήτηση επιχειρήσεων *τουλάχιστον* με βάση:

- Το όνομα της επιχείρησης,
- Την κατηγορία της επιχείρησης,
- Λέξεις κλειδιά και φράσεις (phrase queries) που εμφανίζονται:
  - στο *πλήρες κείμενο* των κριτικών για την επιχείρηση (για παράδειγμα επιχειρήσεις των οποίων οι κριτικές περιλαμβάνουν τη λέξη «sesame»),
  - στο *πλήρες κείμενο* των υποδείξεων για την επιχείρηση (για παράδειγμα επιχειρήσεις των οποίων οι υποδείξεις περιλαμβάνουν τη λέξη «sesame»),
- Συνδυασμό των παραπάνω με χρήση Boolean queries.

Εργασία

Παρουσίαση Αποτελεσμάτων

Διάταξη αποτελεσμάτων

Εξηγείστε τον τρόπο με τον οποίο γίνεται η διάταξη των αποτελεσμάτων.

Επίσης, να παρέχετε *η δυνατότητα διάταξης με βάση τον αριθμό των αστεριών*. Σε περίπτωση ισοβαθμίας στον αριθμό των αστεριών, να προηγείται η επιχείρηση *με το μεγαλύτερο αριθμό κριτικών.*

Άλλες Απαιτήσεις

Στο αποτέλεσμα, να γίνεται επισήμανση (highlight) των όρων αναζήτησης.

Εργασία

Επιπρόσθετη λειτουργικότητα

Το σύστημα σας θα πρέπει να διατηρεί πληροφορία για την ιστορία των αναζητήσεων (π.χ., clickthrough-rate, δημοφιλείς ερωτήσεις, κλπ).

Χρησιμοποιείστε αυτήν την πληροφορία για:

- να αναδιατάξετε τα αποτελέσματα της αναζήτησης, και
- να προτείνετε εναλλακτικά ερωτήματα.

Ερωτήσεις;