SOLR

Final Presentation
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CS 5604, Fall 2017
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Overview

1. Updates
2. In Theory
3. Process, Improvements & Results
4. Quality Control
5. Geolocation
6. Recommendation
7. Future Work
UPDATES
Changes made to HBase Schema from previous presentation

Fields added:

- topic:topic-displaynames
- cluster:cluster-displaynames
- classification:classification-displaynames
<table>
<thead>
<tr>
<th>Updates - SOLR Fall 2017</th>
<th>Fall 2016</th>
<th>Fall 2017</th>
</tr>
</thead>
</table>
| **schema.xml**           | No geospatial search function  
Copyfields  
#fields = 30 | Feature added  
Copy and geoblacklight fields present  
#fields = 50+  
Using DocValues to speed up faceting  
Index time field boosting |
| **Morphline ETL**        | Datetime, multi-valued field parser, multiple field types | Extraction, cleaning, sanity check of data from HBase  
Timestamp conversion  
Records manipulation |
| **Indexing**             | 1.2 billion tweets | 12,564 web pages and 5.9mil tweets |
| **Incremental Indexing** | Tested on VC | Tested on VC |
| **Recommendation & Ranking** | Didn't use clustering and classification for | Recommendation handler based on clustering and classification results; |
In Theory
SOLR document scoring

1. \( tf : \sqrt{\text{freq}} \)
2. \( idf : \log(\text{numDocs} / (\text{docFreq} + 1)) + 1 \)
3. fieldWeight
4. fieldNorm : \( 1 / \sqrt{\text{numTerms}} \)

Search for all tweets containing terms “vegas”

"914864995565031425": 2.2832668 = (MATCH) weight(text:vegas in 171455), result of: 2.2832668 = fieldWeight in 171455, product of: 1.4142135 = tf(freq=2.0), with freq of: 2.0; 6.4580536 = idf(docFreq=25492, maxDocs=5981684); 0.25 = fieldNorm(doc=171455)
Process, Improvements & Results
Software Packages and Versions

Cloudera CDH (Cloudera's Distribution Including Apache Hadoop) version 5.12.0

Key packages included:

1. hadoop-hdfs (2.6.0)
2. hbase-solr (1.5)
3. hbase (1.2)
4. kite (1.0.0)
5. solr (4.10.3)
6. zookeeper (3.4.5)

For complete list visit:
https://archive.cloudera.com/cdh5/parcels/5.12.0/manifest.json
In Context

● Information
  ○ Tweets and Webpages

● Storage
  ○ Extract
    ■ From Hbase (using morphline)
  ○ Transform
    ■ Into Solr document (using morphline)
    ■ Cleaning (using morphline)
    ■ Deriving new field (using morphline and Hadoop)
  ○ Load
    ■ Indexing

● Retrieval
  ○ Queries from GeoBlackight and Visualization team
  ○ Recommendation
The Process
Solr Schema Challenges & Solutions

Challenges:

- All the data needs to be indexed in a single core
- Support 2 FE clients
- Multiple (2) input formats (webpage, tweet) and single output format

Solution:

- Separate morphline file for each input format
- Separate indexing operation for each input format
- Input format identified by ‘dc_format_s’ field
Better performance using DocValues

**DocValues** are a way of recording field values internally that is more efficient for some purposes, such as sorting and faceting, than traditional indexing.

**Traditional Solr Indexing**

```
Document Terms ← Documents
```

**Indexing with DocValues**

```
Documents ← Terms
```

**Examples**

```xml
<field name="cluster" type="string" indexed="true" multiValued="false" docValues="true"/>

<field name="category" type="string" indexed="true" stored="true" multiValued="true" docValues="true"/>
```
Index time document boosting

1. Using copyField

   Solr provides a functionality to copy values from one field to another during indexing. We can use this feature to copy the field which needs to be boosted in our default search field i.e. ‘text’.

   ```xml
   <field name="keywords_boost" type="text_general" indexed="true" multiValued="true"/>
   <copyField source="*_boost" dest="text"/>
   ```

   This form of boosting works because after copying, the value of the boosted field is present twice as many times as other values.
Index time document boosting

2. Using payloads (available from Solr 6.x)

   Our use cases:
   a. Boosting NER terms
   b. Multivalue boosting of topics, clusters and keyword terms

Example: Below we have 2 documents where content of the field ‘vals_dpf’ is boosted variably based on the words. In document id ‘1’, word ‘one’ has a boosting of 1.0, word ‘two’ has a boosting of 2.0, and so on.

<table>
<thead>
<tr>
<th>id, vals_dpf</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, one</td>
</tr>
<tr>
<td>2, weighted</td>
</tr>
</tbody>
</table>
## Key Stats & Figures

<table>
<thead>
<tr>
<th>Collection Type</th>
<th>Document Count</th>
<th>Time</th>
<th>Memory (Heap Usage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Webpage</td>
<td>12,564</td>
<td>Map: 88 sec</td>
<td>789 MB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduce: 531 sec</td>
<td></td>
</tr>
<tr>
<td>Tweets</td>
<td>5,969,120</td>
<td>Map: 780 sec</td>
<td>3 GB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduce: 5300 sec</td>
<td></td>
</tr>
</tbody>
</table>
Quality Control
Index Quality Control

Validation and conversion of indexed data through morphline process in lily indexer.

- Fix records that are not formatted well in HBase
- Timestamp conversion: According to Solr datetime format
- Geo-data conversion: from string to double
- URL status code check: depends on given status code, decide whether to drop records
- Sanitize unknown Solr fields: remove fields that could not be recognized by Solr to avoid Solr errors
- Drop invalid and unnecessary records
- Log record at debug level to SLF4J: Log record content to log file or screen for debug and test
Examples

- Remove unrelated categories

```java
removeValues {
    nameBlacklist : ["literal:category"]
}
```

- Use regex to validate geo coordinates format

```java
List<String> geo = record.get("geo_0");
for (String loc : geo){
    if(!loc.matches("\-?\d*\.\d*"))
        {
            logger.debug("geo_1 format error")
        }
}
```
Example for fixing data format:

Input from HBase:

"<a href="https://about.twitter.com/products/tweetdeck" rel="nofollow">TweetDeck</a>"

Output for Solr records:

TweetDeck

This practice could be extended to many kinds of data format issues in HBase.
Example for dropping specific records

Drop webpage records that contain bad status code: 0404, 0400 etc.

```java
if {
    conditions : [
        { contains { status_code : [2001,0204,0404,0403,0400] } }
    ]
    then : [
        { logTrace { format : "Ignoring record because it bad web-page status code", args : [@{ }] } }
        { dropRecord {} }
    ]
}
```

This is a good practice showing that any data related teams could use customized indicators in HBase and then Solr team could recognize it to ensure the indexed data quality.
Other things could be done

- Remove fields
- Add/Remove values to/from fields
- Index certain amount of records
- Find and replace fields

More complex:

- Use Grok to extract information through regex (E.g., log data)
- Produce GeoIP from IP Addresses
- Etc.
Geolocation
Document Geolocation

Determine bounding box for place names from SNER-location
Primarily for FE/visualization, additionally for indexing/searching

Data from Mapzen, OpenStreetMap, OpenAddresses.io
Countries, States, Counties, Cities, Parks, Bodies of Water, etc...
>4,500,000 place names

Using map-reduce and suffix arrays, each NER location name was matched to a location name from the bounding box data. The corresponding bounding box was then added to each document.

Populated solr_geom field for 324714 tweets and 4442 webpages

Considered using Google maps API but would have been slow due to rate-limiting
Geospatial Search

- Indexed geolocation as **SpatialRecursivePrefixTreeFieldTypelocation_rpt** instead of string
- This gives us ability to search in following ways
  - **Geofilt**
    - Input [centre lat,lon and radius of circle]
  - **Bbox**
    - Input [centre lat,lon and radius of circle]
  - **Range query on a rectangular box**
    - Input [lower left lat,lon TO top right lat,lon]
Recommendation
Recommendation System

1. MoreLikeThis Handler (MLT)

   Based on text similarity, we made MoreLikeThis Handler recommend more similar documents to users when they are viewing one document. -------- (Specific recommendation)

2. Cluster_Classification Recommend Handler

   Based on Clustering and Classification results, we made a Handler which can recommend documents belong to same cluster and class. -------- (More general recommendation)

   In order to avoid large cluster or large class problems, we first will recommend documents belonging to the same cluster and class. This can make the recommendation more accurate.
Recommendation System

3. Personal Recommendation System

When users share common search interests they will be recommended documents they haven’t searched but were searched by user with common search interest.

E.g. A : Hurricane,Houston,safety,shooting - Recommendation - vegas,hospitals

B : Houston,safety,vegas,hospitals, - Recommendation - Hurricane,shooting

Image below shows a SQLite table (columns separated by |), The first column is user id, second is keywords and third column are recommended items for the user.
Future Work

1. Collect more user data, implement more complex recommendation handler.
2. Configure Live Indexing mode on Hadoop cluster.
3. Load testing
ACKNOWLEDGMENTS

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