Evaluation of IR Models

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Abstract

The purpose of this project is to implement various IR models such as BM25, DFR and LM, then evaluate the IR system using TREC and improve the results by modifying the parameters.

• **Okapi Best Matching 25 Model (BM25)**

b	K1	Map score
0.75	1.2	0.6985
0.55	0.8	0.6952
0.5	1.6	0.6953
0.65	1.5	0.7009

1. Updating the parameters b as 0.65 and k1 as 1.5 and also by adding the synonym file, gives the highest Map Score.
2. Synonyms.txt is added in the conf folder in order to obtain synonyms of the query words, and using them for expansion of the query list.
3. Modifying the parameters helps in increasing the relevance score of the documents.
4. The maximum MAP score obtained was 0.7009

Schema :

```xml
<?xml version="1.0" encoding="UTF-8"?>
<!-- Solr managed schema - automatically generated - DO NOT
<schema name="default-config" version="1.6">
  <uniqueKey>id</uniqueKey>
  <similarity class="solr.BM25SimilarityFactory">
  <float name="b">0.65</float>
  <float name="k1">1.5</float>
  </similarity>
  <fieldType name="_nest_path_" class="solr.NestPathField"
  <fieldType name="ancestor_path" class="solr.TextField">
    <analyzer type="index">
      <tokenizer class="solr.KeywordTokenizerFactory"/>
```

```
runid                        all        bm25
num_q                        all        15
num_ret                      all        280
num_rel                      all        225
num_rel_ret                  all        141
map                          all        0.7009
gm_map                       all        0.6667
Rprec                        all        0.7129
bpref                        all        0.7178
recip_rank                   all        1.0000
iprec_at_recall_0.00         all        1.0000
iprec_at_recall_0.10         all        1.0000
iprec_at_recall_0.20         all        0.9875
iprec_at_recall_0.30         all        0.8619
iprec_at_recall_0.40         all        0.8339
iprec_at_recall_0.50         all        0.8081
iprec_at_recall_0.60         all        0.6637
iprec_at_recall_0.70         all        0.5736
iprec_at_recall_0.80         all        0.4256
iprec_at_recall_0.90         all        0.3000
iprec_at_recall_1.00         all        0.3000
P_5                          all        0.8133
P_10                         all        0.6800
P_15                         all        0.5422
P_20                         all        0.4700
P_30                         all        0.3133
P_100                        all        0.0940
P_200                        all        0.0470
P_500                        all        0.0188
P_1000                       all        0.0094
```

- ## Divergence From Randomness Model (DFR)

Basic model	After effect	Normalization	c	Map score
G	B	H2	7	0.7025

1. Updating the parameters basic model as G, after effect as B, Normalization as H2 and c as gives the Map Score of 0.7025
2. Synonyms.txt is added in the conf folder in order to obtain synonyms of the query words, and using them for expansion of the query list. The Map score hence received was 0.7107
3. Modifying the parameters helps in increasing the relevance score of the documents.
4. The maximum MAP score obtained was 0.7107

Schema :

```xml
<?xml version="1.0" encoding="UTF-8"?>
<!-- Solr managed schema - automatically generated
<schema name="default-config" version="1.6">
  <similarity class="solr.DFRSimilarityFactory">
  <str name="basicModel">G</str>
  <str name="afterEffect">B</str>
  <str name="normalization">H2</str>
  <float name="c">7</float>
  </similarity>
  <uniqueKey>id</uniqueKey>
```

```
runid                      all      dfr
num_q                      all      15
num_ret                    all      280
num_rel                    all      225
num_rel_ret                all      132
map                        all      0.7025
gm_map                     all      0.6344
Rprec                      all      0.6991
bpref                      all      0.7111
recip_rank                 all      1.0000
iprec_at_recall_0.00       all      1.0000
iprec_at_recall_0.10       all      0.9667
iprec_at_recall_0.20       all      0.9286
iprec_at_recall_0.30       all      0.8826
iprec_at_recall_0.40       all      0.8526
iprec_at_recall_0.50       all      0.8143
iprec_at_recall_0.60       all      0.7210
iprec_at_recall_0.70       all      0.5399
iprec_at_recall_0.80       all      0.4437
iprec_at_recall_0.90       all      0.3333
iprec_at_recall_1.00       all      0.3333
P_5                        all      0.8400
P_10                       all      0.6600
P_15                       all      0.5022
P_20                       all      0.4400
P_30                       all      0.2933
P_100                      all      0.0880
P_200                      all      0.0440
P_500                      all      0.0176
P_1000                     all      0.0088
```

- ## **Language Model (LM)**

μ	Map score
2000	0.6299

1. Default value of μ gives the Map Score of 0.6299
2. Synonyms.txt is added in the conf folder in order to obtain synonyms of the query words, and using them for expansion of the query list.
3. Modifying the parameters helps in increasing the relevance score of the documents.

Schema :

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Solr managed schema - automatically generated - DO NC
<schema name="default-config" version="1.6">
  <similarity class="solr.LMDirichletSimilarityFactory">
  </similarity>
  <uniqueKey>id</uniqueKey>
  <fieldType name="_nest_path_" class="solr.NestPathField"
```

```
runid                   all    lm
num_q                   all    15
num_ret                 all    280
num_rel                 all    225
num_rel_ret             all    119
map                     all    0.6299
gm_map                  all    0.5489
Rprec                   all    0.6403
bpref                   all    0.6623
recip_rank              all    1.0000
iprec_at_recall_0.00    all    1.0000
iprec_at_recall_0.10    all    0.9649
iprec_at_recall_0.20    all    0.9067
iprec_at_recall_0.30    all    0.8242
iprec_at_recall_0.40    all    0.7309
iprec_at_recall_0.50    all    0.6962
iprec_at_recall_0.60    all    0.5239
iprec_at_recall_0.70    all    0.5205
iprec_at_recall_0.80    all    0.4078
iprec_at_recall_0.90    all    0.2857
iprec_at_recall_1.00    all    0.2857
P_5                     all    0.7600
P_10                    all    0.5733
P_15                    all    0.4622
P_20                    all    0.3967
P_30                    all    0.2644
P_100                   all    0.0793
P_200                   all    0.0397
P_500                   all    0.0159
P_1000                  all    0.0079
```

Conclusion

BM25 MAP VALUE – 0.7009
DFR MAP VALUE – 0.7025
LM MAP VALUE – 0.6299
The highest MAP value was obtained from the DFR model.