Project 3- Evaluation of IR Models

Information Retrieval(CSE-535)

Name:Aadishesh Sharma

UBID: 50321673

UBNAME: aadishes

EVALUATION OF INFORMATION RETRIEVAL MODELS

Introduction

In this project, various IR models were implemented such as LM,DFR, BM25 on Solr using twitter data and the results of the implemented models are evaluated using TREC_eval software.

A total of 15 training queries were given and 10 test queries in 3 different languages: English, Russian and German. The overall purpose of the project is to improve performance of the IR models in terms of MAP(mean average precision).

Implementation

Initially, all the three models were implemented with their default configuration and their MAP scores were extracted.

BM25:

Best Matching or BM25 is a ranking function based on probabilistic retrieval framework.

Class: *solr.BM25SimilarityFactory*

Parameters : k1,b[default values k1=1.2 and b=0.75]

Implementation Screenshot :

```
<similarity class="solr.BM25SimilarityFactory">
  <str name="b">0.8</str>
  <str name="k1">1.1</str>
</similarity>
```

DFR:

Also known as Divergence from Randomness is a probabilistic model used to test the amount of information carried in the documents.

Class: *solr.DFRSimilarityFactory*

Parameters: basicModel, aftereffect, normalization [default values basicModel=G, AfterEffect = B, Normalisation=H2]

Implementation Screenshot:

```
<similarity class="solr.DFRSimilarityFactory">
  <str name="normalization">Z</str>
  <str name="afterEffect">B</str>
  <str name="basicModel">I(F)</str>
</similarity>
```

LM:

Class : *solr.LMDirilchletSimilarityFactory*

Parameters : Smoothening Parameter (mu)[default value (mu) = 2000]

Implementation Screenshot:

```
<similarity class="solr.LMDirichletSimilarityFactory" >
  <float name="mu">1500</float>
</similarity>
```

Map Values after Default Implementation:

Similarity Model Used	MAP value
BM25	**0.6183**
LM	**0.6133**
DFR	**0.6109**

Our next goal in this project is to improve the MAP values of the corresponding IR models with appropriate implementation and improvements where possible.

Improvements:

1. **Tuning the values of the parameters for each model**

1.1 BM25:

Tuning values of K1 and b in BM25 : A lot of different values of K and b1 were tuned to improve the MAP results of the model. For the default setting, 0.2460 value of MAP was achieved. Later, different combinations of k1 and b were used to get better results. Given table displays the MAP values achieved with respect to change in parameters.

K1	B	MAP
1.8	0.4	0.6170
1.8	0.8	0.6172
1.4	0.8	0.6172
1.1	0.8	0.6177

1.2 DFR

Tuning values of normalization, aftereffect and BasicModel: Quite a few combinations of parameters were tried out. Initially, it was implemented using the default settings given to us which are normalization – H2, Aftereffect – B and Basic model – G. However, it was observed that for normalization – Z, aftereffect – B and basic model – I(F),provided better results than any other combination. So we chose these parameters for the DFR model.
Below table displays the MAP values achieved with respect to change in parameters.

Normalisation	AfterEffect	BasicModel	Model
H2	B	G	0.6115
Z	B	I(F)	0.6148
Z	B	G	0.6123

1.3 LM

Tuning values of (mu): A lot of different values of smoothening parameter(mu) were tried out to achieve a better output of MAP. A value of 1500 observed better value of MAP than rest of the other values.

Smoothening Parameter(mu)	MAP
2000(def)	0.6133
1500	0.6152
1000	0.6148

2. Using Stopword Filter

Implementation Screenshot:

```
<filter class="solr.StopFilterFactory" words="stopwords.txt" ignoreCase="true"/>
```

Adding stopwords filter increases the overall value of the MAP.

Model	Without Stopwords Filter	With Stowords Filter
DFR	0.6148	0.6179
BM25	0.6177	0.6209
LM	0.6152	0.6163

3. Synonyms List

Adding synonyms Filter increases recall value, thus increasing overall value of MAP.

Model	Without Synonym Filter	With Synonym Filter
DFR	0.6179	0.6209
BM25	0.6209	0.6276
LM	0.6163	0.6185

Conclusion:

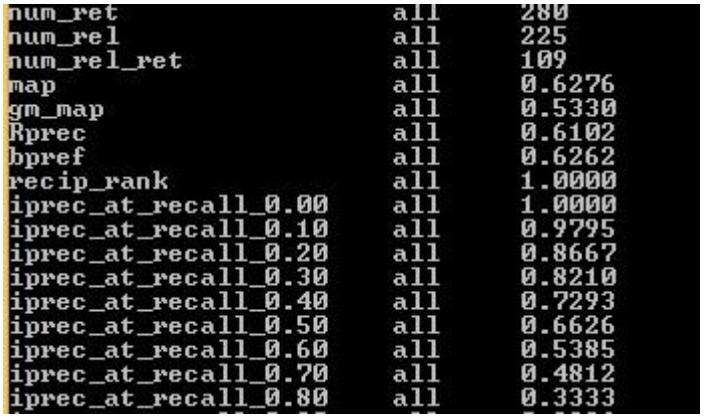
Upon implementing the improvement techniques, it is observed that it affects the MAP value in a positive way. The overall MAP value increases when improvement techniques are implemented.

Following changes were implemented:

1. Tuning of the parameters
2. Stop words filter included
3. Synonym Filter included

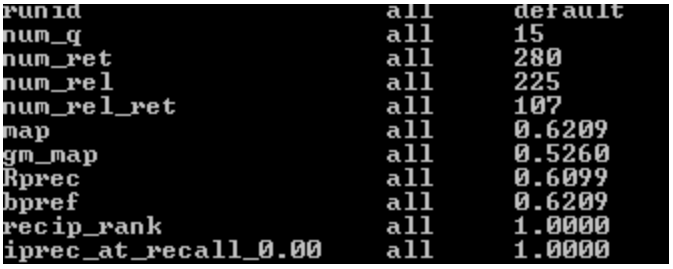
Final Outputs:

BM25:



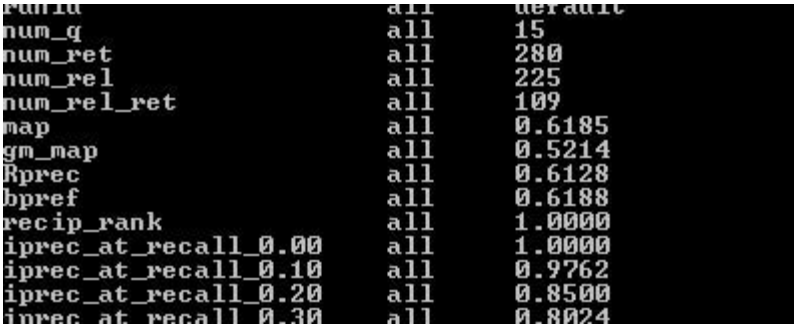
num_ret	all	280
num_rel	all	225
num_rel_ret	all	109
map	all	0.6276
gm_map	all	0.5330
Rprec	all	0.6102
bpref	all	0.6262
recip_rank	all	1.0000
iprec_at_recall_0.00	all	1.0000
iprec_at_recall_0.10	all	0.9795
iprec_at_recall_0.20	all	0.8667
iprec_at_recall_0.30	all	0.8210
iprec_at_recall_0.40	all	0.7293
iprec_at_recall_0.50	all	0.6626
iprec_at_recall_0.60	all	0.5385
iprec_at_recall_0.70	all	0.4812
iprec_at_recall_0.80	all	0.3333

DFR:



runid	all	default
num_q	all	15
num_ret	all	280
num_rel	all	225
num_rel_ret	all	107
map	all	0.6209
gm_map	all	0.5260
Rprec	all	0.6099
bpref	all	0.6209
recip_rank	all	1.0000
iprec_at_recall_0.00	all	1.0000

LM:


runid all default
num_q all 15
num_ret all 280
num_rel all 225
num_rel_ret all 109
map all 0.6185
gm_map all 0.5214
Rprec all 0.6128
bpref all 0.6188
recip_rank all 1.0000
iprec_at_recall_0.00 all 1.0000
iprec_at_recall_0.10 all 0.9762
iprec_at_recall_0.20 all 0.8500
iprec_at_recall_0.30 all 0.8024