Andrei-Mihai Nicolae
2147392n
17 February 2017

Information Retrieval
Assessed Exercise - Part I

Q1

Number of Indexed Documents	**Size of Vocabulary**	**Number of Tokens**	**Number of Pointers**
807775	2043788	572916194	177737957

Q2

The formula used in my Java code is the one included in the lecture slides as well:

```
double n = documentFrequency + 0.5;
double d = numberOfDocuments - documentFrequency + 0.5;
return tf * Math.log(d/n);
```

This is the corresponding mathematical formula:

$$w_{kd} = f_{kd}\left(\log\frac{(N - D_k) + 0.5}{D_k + 0.5}\right)$$

In the model shown, we are computing the weight of the kth term in the document (that is wkd). In order to achieve that, we are using its frequency in the document (fkd), the number of documents where the term appears (Dk) as well as the number of documents (N). This model also avoids the case where Dk could be 0, thus we add 0.5 to it.

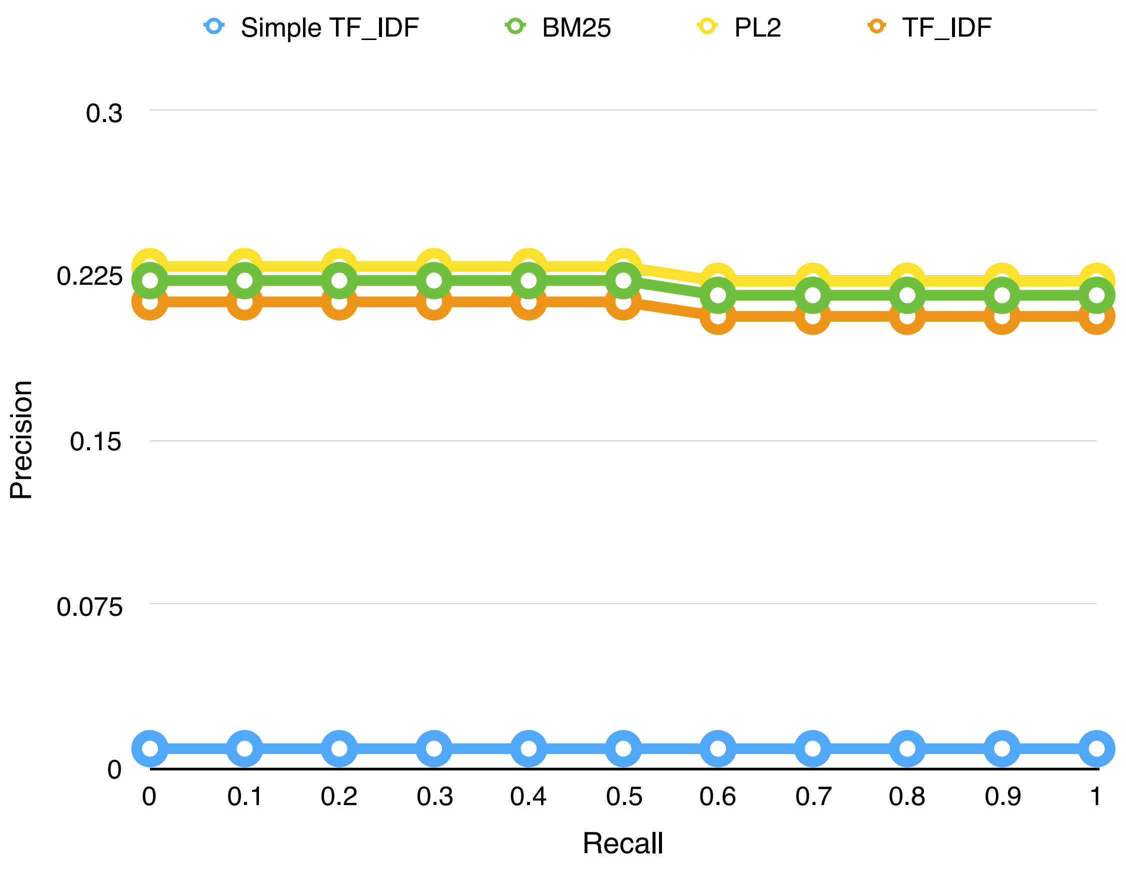
Q3

The following table and graphs show performance across various weighting models (on the three topics provided):

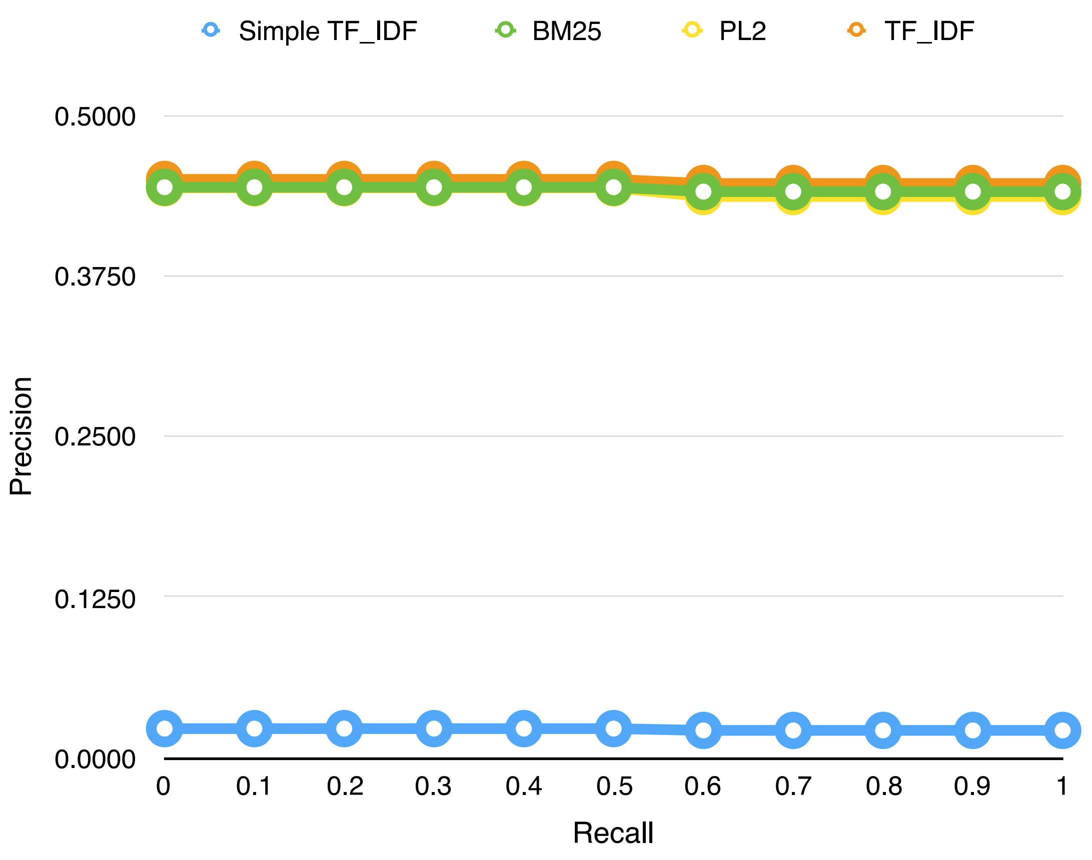
The Mean Average Precision over the 3 topics for different models

	HP_04	NP_04	TD_04	AM
Simple TF-IDF	0.0093	0.0223	0.0078	0.0131
TF-IDF	0.2089	0.4477	0.0698	0.2421
BM25	0.2186	0.4416	0.0703	0.2435
PL2	0.2251	0.4392	0.0695	0.2446

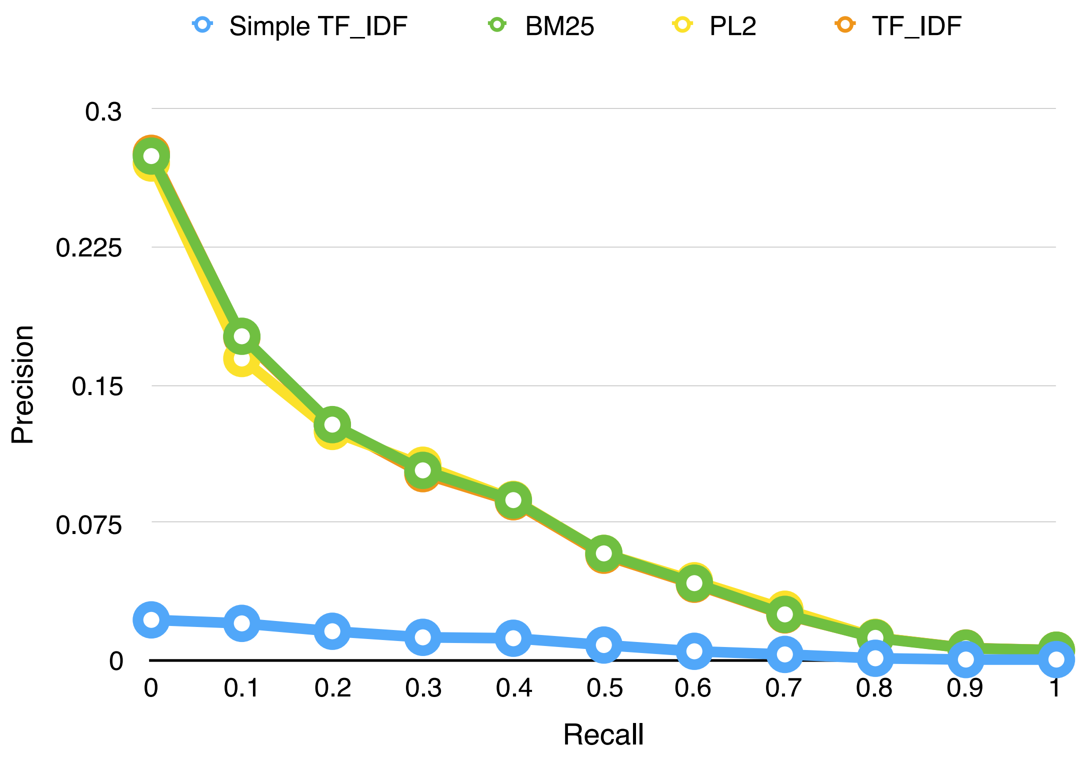
HP04 Precision-Recall Graph



NP04 Precision-Recall Graph



TD04 Precision-Recall Graph



As we can see in the graphs below, the simple TF_IDF that was implemented for Question 2 is far less performant than the other three competitors provided by Terrier.

The differences between BM25, TF_IDF and PL2 are very small, however the minor discrepancies that we can notice are:

- In topic distillation, it is extremely hard to distinguish which performed better; however, the winner seems to be BM25
- In name page findings, TF_IDF looks like the most performant model
- In homepage findings, PL2 was above the other two

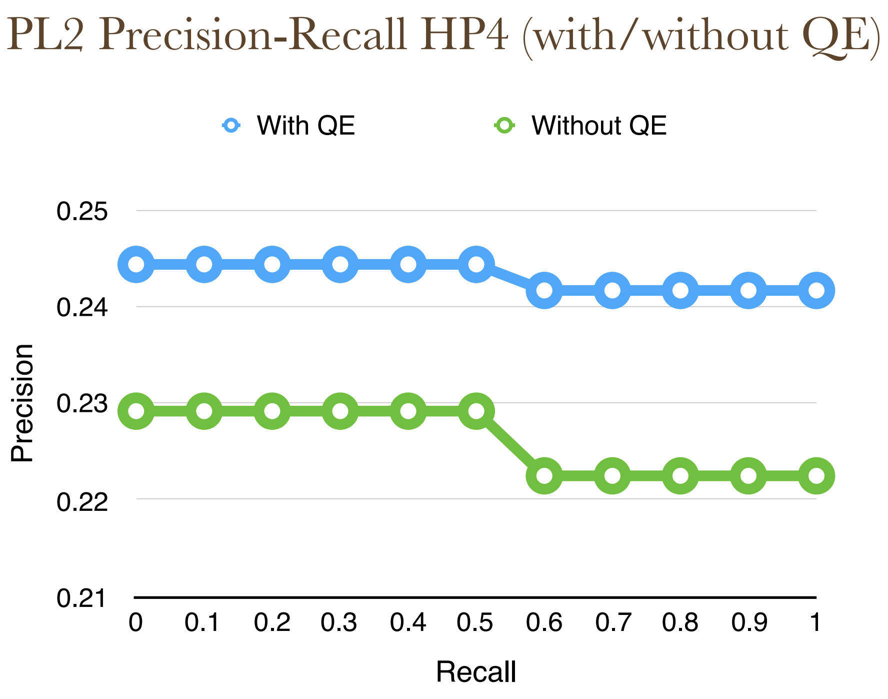
Even though the differences seem extremely small, after careful calculations, it appears that PL2 is the most performant weighting model overall, having an MAP of 0.244, followed by BM25 and TF_IDF (0.243 and 0.242).

The conclusion that needs to be drawn here is, however, that a simple model will never be more performant than the more complex, well-built models such as the ones provided by the Terrier platform.

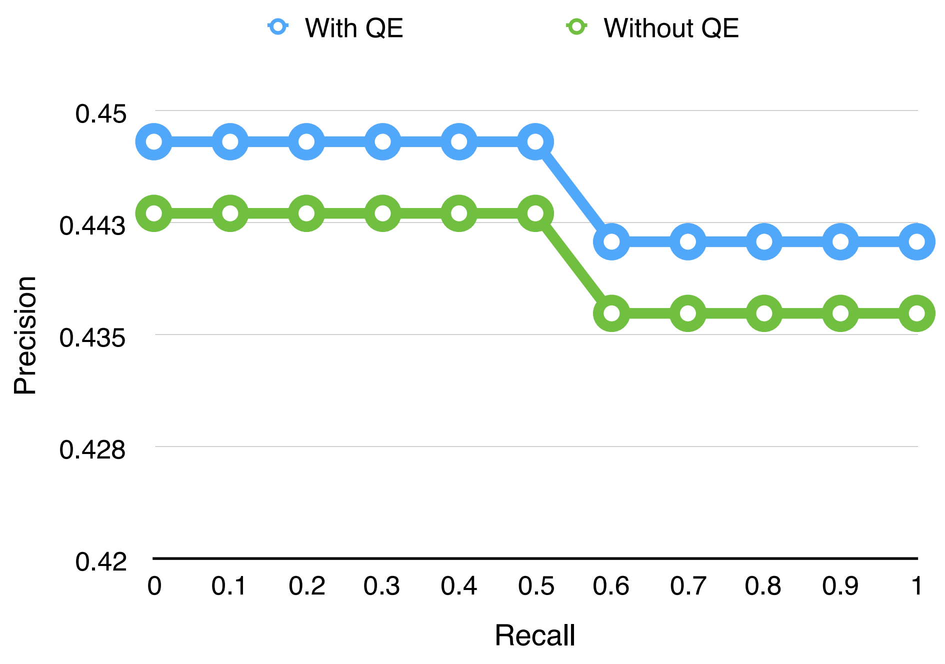
Q4

After concluding that PL2 was the most performant model overall, we will analyse below how it performs with/without the Query Expansion.

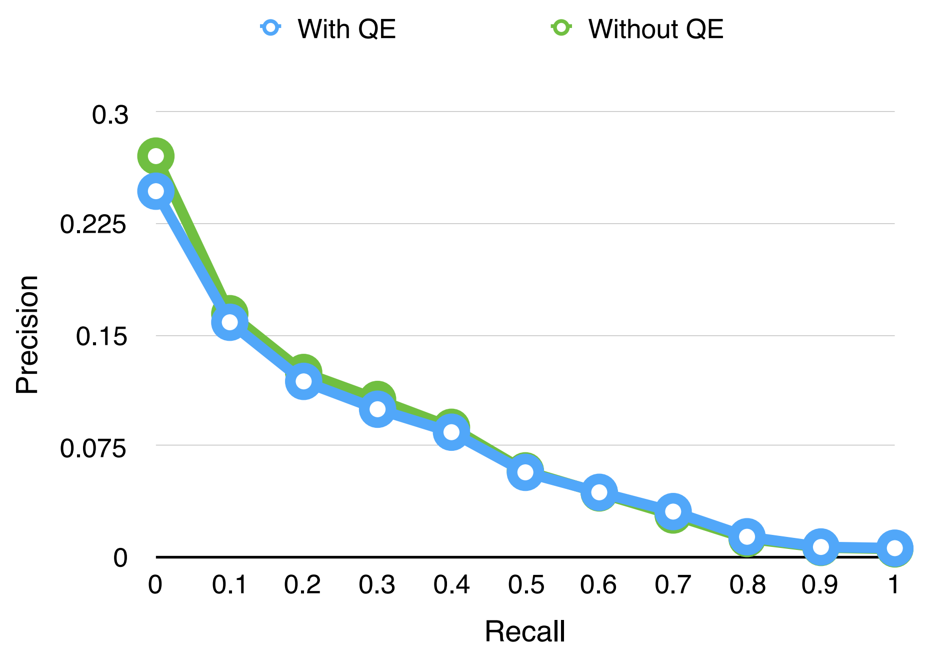
	HP04	NP04	TD04	Average (Overall)
Without QE	0.2251	0.4392	0.0695	0.2444
With QE	0.2423	0.4442	0.0671	0.2512



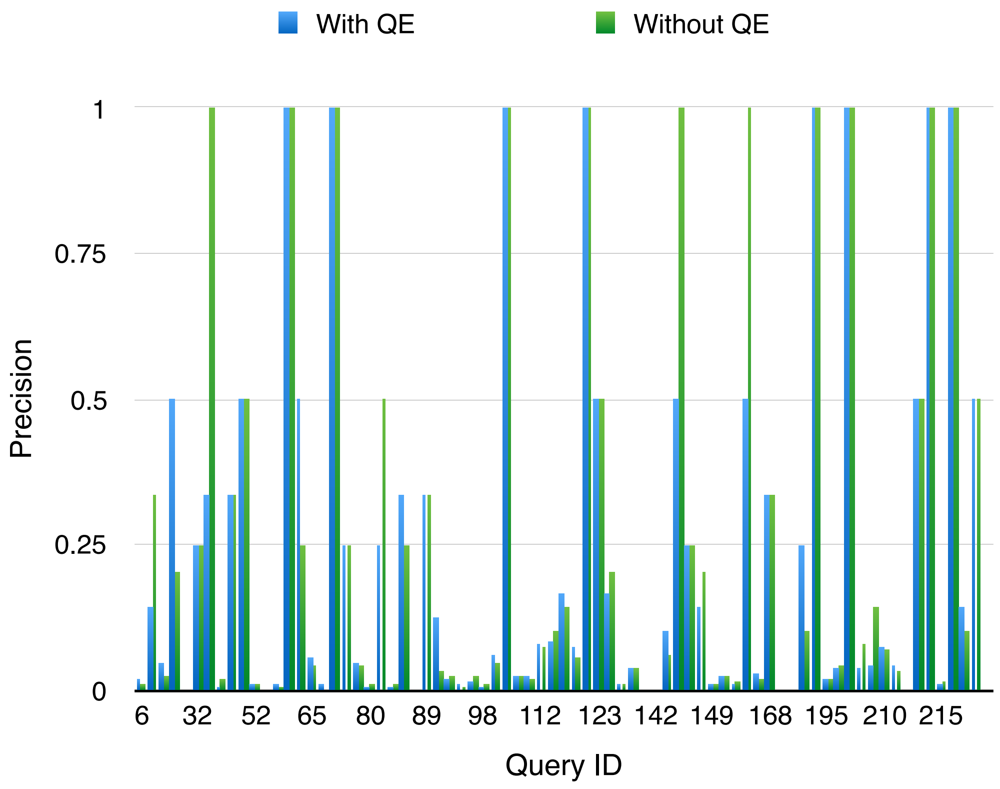
PL2 Precision-Recall NP4 (with/without QE)



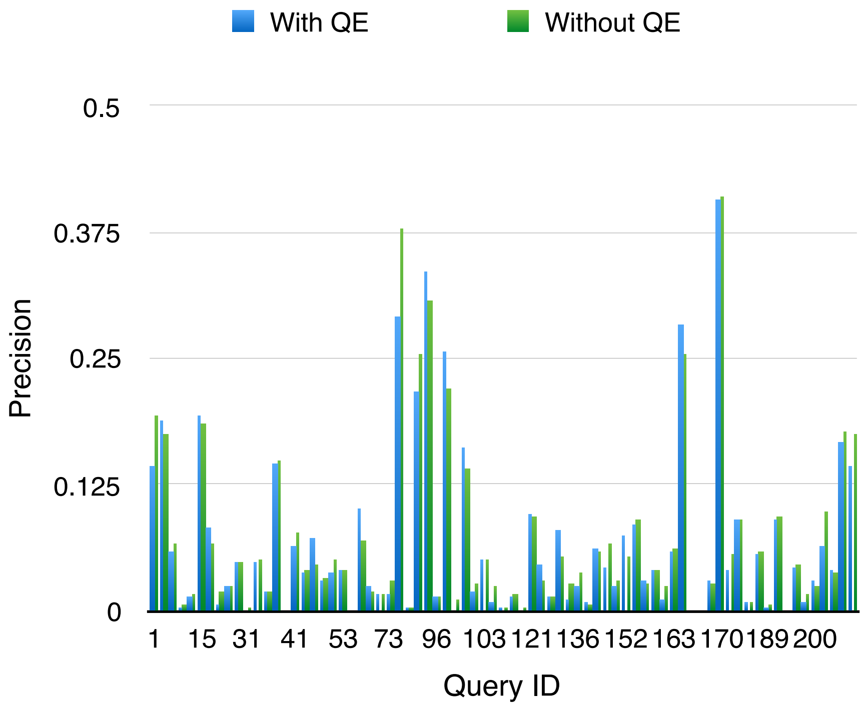
PL2 Precision-Recall TD4 (with/without QE)



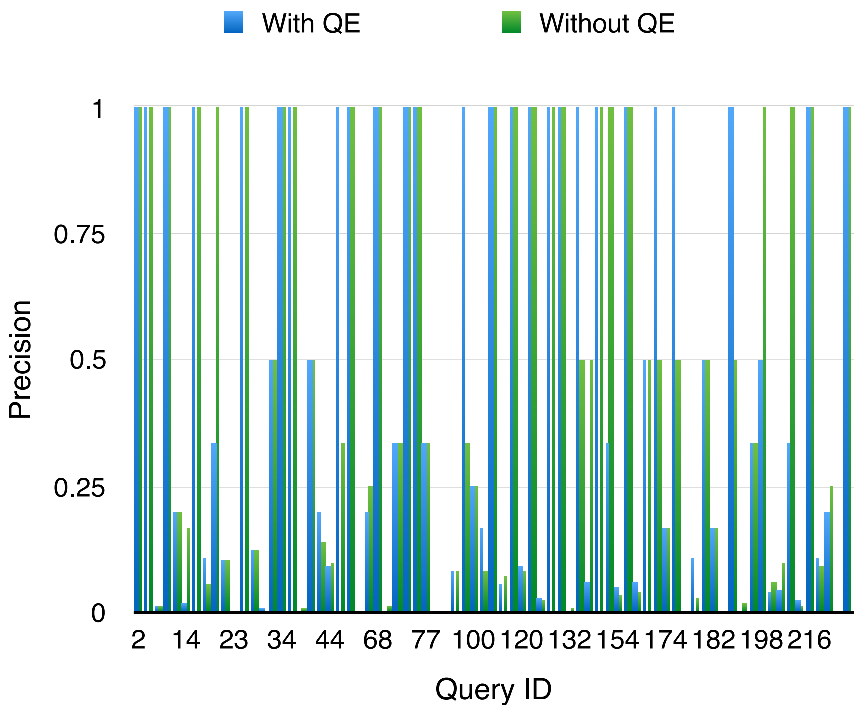
PL2 Avg. Precision Per-Query HP4 (with/without QE)



PL2 Avg. Precision Per-Query TD4 (with/without QE)



PL2 Avg. Precision Per-Query NP4 (with/without QE)



There can be many variations seen and, sometimes surprisingly, some values can be favourable when not using query expansion.

Big differences in the above graphs are noticeable as the PL2 performed quite bad on the TD topic, but much better on NP and HP.

In the end, the algorithm worked better with the query expansion as seen in the graphs than without it.