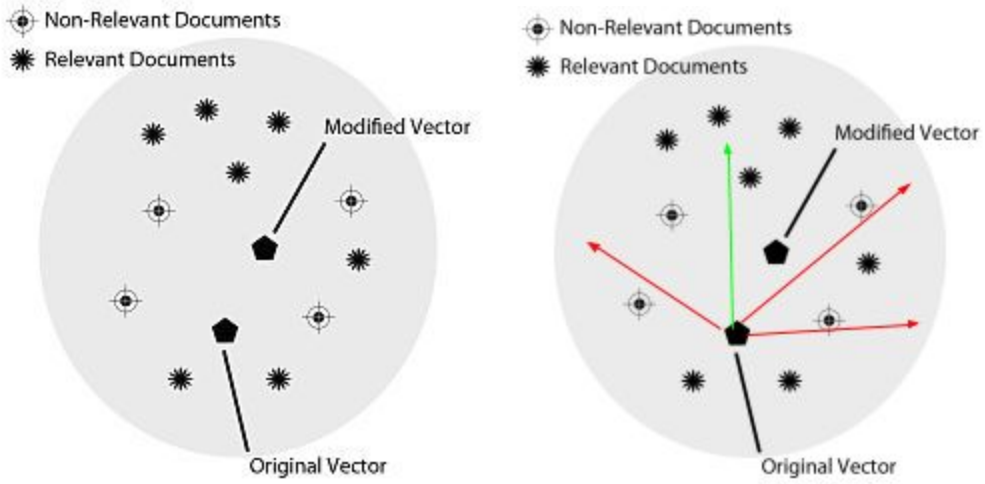
Information Retrieval

End Semester Exam

Question 1

$$\overrightarrow{Q_m} = (a \cdot \overrightarrow{Q_o}) + \left(b \cdot \frac{1}{|D_r|} \cdot \sum_{\overrightarrow{D_j} \in D_r} \overrightarrow{D_j}\right) - \left(c \cdot \frac{1}{|D_{nr}|} \cdot \sum_{\overrightarrow{D_k} \in D_{nr}} \overrightarrow{D_k}\right)$$

(Source: Wikipedia)



(Source: Wikipedia)

Explanation: The new Query vector Qm (coordinates), will move away from the centroid, if **non relevant documents are favoured** over the relevant as you can see from the image above.

- If we **increase** the **weight of non relevant documents (c)**, where **c > b**, the new query vector will move away from the centroid in the vector space model (depicted by the **red arrows)**, because we are essentially giving more weight to the non relevant documents and the general direction of these documents lie away from the centroid.
- If we increase the weight of relevant documents (b) or decrease the weight of non relevant documents (c), the new query vector will move towards the centroid in the vector space model (depicted by the **green arrows)**, because we are essentially giving more weight to the relevant documents and the general direction of these documents lie towards the centroid.

Question 2

Rocchio's Relevance Feedback Algorithm

$$\overrightarrow{Q_m} = (a \cdot \overrightarrow{Q_o}) + \left(b \cdot \frac{1}{|D_r|} \cdot \sum_{\overrightarrow{D_j} \in D_r} \overrightarrow{D_j}\right) - \left(c \cdot \frac{1}{|D_{nr}|} \cdot \sum_{\overrightarrow{D_k} \in D_{nr}} \overrightarrow{D_k}\right)$$

(Source: Wikipedia)

- if we have a lot of trust in the judged documents, high b and c will result in the Query Set to exclude non relevant documents

- Clearly, the RD (relevant documents) = **{D2, D3, D5, D6, D9}** are given a preference (implying, weight of relevant documents **b is close to 1**) in the resulting query = {**D2, D3, D5, D6, D9,** D11, D13, D14, D15} and

- IRD = {D1, D4, D7, D8, D10} are given no preference, therefore they should be removed from the original query. If we give a high value to c, then there is a high negative influence (moving some distance away from the centroid of irrelevant documents) of the irrelevant documents on the new Query Set.

  Ideally, modern IR systems who use Rocchio's feedback algorithm have **c = 0** to keep the vector space model in the first quadrant. Reason is to remove any influence due to irrelevant documents, to keep the vector space model consistent to use.

- The new query Qm differs from Qo by almost half the margin or significant change from the original query set, there **a should be approximately 0.5 or 5 / 9** where 5 is the number of documents from the original query set and 9 is the total vector length of the new Query Set**.**

- Note that to take into account the normalization done in the formula by using the lengths of the RD and IRD vectors.

The equation with weights now look like,

Qm = {D2, D3, D5, D6, D9} + new_documents

Therefore, approximately **a = 0.5 b = 1 and c = 0**.

Question 3

Query	Tf-idf score (Rank, docID, Score)			BM25 score		
Portable operating system	1	3127	0.100407969844	1	1461	0.851006812757
	2	2246	0.0708559728367	2	2311	0.687930173134
	3	2311	0.064183214871	3	1755	0.622014102817
	4	1461	0.0632713808896	4	2796	0.453938760767
	5	1930	0.0555786634273	5	2735	0.451699246445
	6	1591	0.0550802009696	6	379	0.448616149363
	7	1680	0.0535106101622	7	2405	0.448004964973
	8	1755	0.0479328643103	8	190	0.441278232247
	9	1033	0.0470590258644	9	2689	0.435751294307
	10	3068	0.0448056870588	10	2984	0.429667863582
Parallel algorithm	1	2664	0.0645439161889	1	371	0.744376551823
	2	2714	0.0616798930983	2	199	0.735161851255
	3	2973	0.0598187298652	3	2509	0.654823450718
	4	141	0.0576284965972	4	2430	0.607454389368
	5	1262	0.0556413070594	5	1990	0.58833331617
	6	950	0.0542565137961	6	1560	0.58833331617
	7	1302	0.0537865968241	7	2510	0.568662172959
	8	392	0.0537865968241	8	2090	0.534994249906
	9	2266	0.0525970507947	9	2472	0.499990935839
	10	2685	0.0514978054698	10	1559	0.49403234759
Applied stochastic process	1	1696	0.0898707874579	1	394	0.392657186535
	2	268	0.0808837087122	2	2727	0.385906806263
	3	2065	0.0518931125567	3	141	0.376993238507
	4	2999	0.0510098205023	4	2999	0.368286007248
	5	2727	0.0479110930886	5	268	0.355162757724
	6	293	0.0430100811133	6	597	0.34869728607
	7	927	0.0405523621925	7	392	0.34869728607
	8	3043	0.0386176042221	8	198	0.34869728607
	9	1588	0.0374196128503	9	1085	0.323845936806
	10	3120	0.0357950009045	10	293	0.31693699368
Perform evaluation and model of computer system	1	2318	0.235739430528	1	2318	1.63724603745
	2	2984	0.126055948741	2	2984	1.03064316654
	3	3048	0.103765515637	3	2504	0.895010624175
	4	3070	0.100157984655	4	2311	0.852088854327
	5	1938	0.0989886772492	5	2553	0.851572922419
	6	3089	0.0971103033211	6	2502	0.80739528562
	7	2542	0.0931604199867	7	2743	0.76941173037
	8	1344	0.0925794833052	8	2255	0.73432629124
	9	3136	0.0911233439483	9	3089	0.699609279397
	10	1653	0.0821952703005	10	3136	0.666134254018

Parallel process in information retrieval	1	2288	0.106731788073	1	2278	0.796434597543
	2	2278	0.103726491703	2	141	0.7599176833
	3	891	0.0918639442258	3	392	0.702939875336
	4	141	0.0881432999334	4	651	0.678469319036
	5	1457	0.0847858962943	5	275	0.678469319036
	6	1830	0.083495831255	6	2070	0.654159939246
	7	392	0.0822670799379	7	1085	0.649802186093
	8	651	0.0771451285634	8	1830	0.641047395313
	9	275	0.0771451285634	9	1251	0.601104918492
	10	2070	0.0747343432958	10	239	0.55203179303

Extra Credit

I have updated the Assignment 1 and 3 code to use the Query Relevance feedback with the choice of parameters **a = 1, b = 1, c = 0**. Therefore, any **irrelevant documents will be removed** and **relevant documents** will be used to find new results.

Output