

Review of Methods in TREC from 1992 to 2014

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ABSTRACT

The Text REtrieval Conferences (TRECs) are a series of workshops that encourage research in information retrieval from realistic applications by providing large test collections, uniform scoring procedures, and a forum for organizations interested in comparing results. This paper describes the overview of Text Retrieval conferences (TRECs) from 1992 (TREC-1) to 2014 (TREC-23). The goals the judging procedure of TREC are mentioned for understanding the importance & compounds involved in text retrieval in real time applications. A brief comparative report about the methods, number of tracks and the outcomes are presented in this paper so that researchers working or want to work under this domain get an up to date view regarding Text retrieval process and applications.

Keywords

TRECs (Text REtrieval Conferences).

1. INTRODUCTION

Question answering is gaining a lot of importance due to the vast application that become simpler and easier to handle. QA also plays vital role in life securing areas like Medical diagnosis like symptom analysis of Cancer, Tumor etc. Application may reliably be used by doctor as support systems in many ways. Thus name any application existing can have a thread of QA which makes it more sophisticated and reliable.

The domains in which QA is applicable is varied thus needs a platform where such information is available for resolving the conflicts and to progress. In this regard the reference shows that first time in history. In 1991 NIST has made a very large test collection and proposed to make it public to the research community. Actually, this collection was demanded by DARPA to NIST for its text retrieval project named "DARPA TIPSTER". And in 1992 the NIST formed a group in the name of Text Retrieval Conference (TREC) and the first conference was held in September 1992 in which 25 groups had participated.

Anyone who wants to work in Text retrieval or pure QA. A lot of ideas and concepts get clear through the work published under this conference TREC. This paper is an attempt made to review the techniques, issues handled with the QA. The paper is sectioned starting with understanding the goals of TREC. Then the judging procedure of TREC and finally presenting the review on all tracks from 1992 to 2014.

2. TREC Goals and Judging Procedure

2.1 TRECs GOALS

- i. To encourage research in text retrieval based on large test collection;

- ii. To increase communication among industry, academia, and government by creating an open forum for the exchange of research ideas;
- iii. To speed the transfer of technology from research labs into commercial products by demonstrating substantial improvements in retrieval methodologies on real-world problems; and
- iv. To increase the availability of appropriate evaluation techniques for use by industry and academia, including development of new evaluation techniques more applicable to current systems.

2.2 TREC Judging Procedure

- i. The assessment system presented the judge with 5 queries randomly selected from the test set.
- ii. The judge selects one of the queries; the others were returned to the query pool.
- iii. The judge writes a description and narrates the query, thus creating a standard TREC topic statement.
- iv. The system presented a GOV2 document to the judge and obtained a 3-way judgment (highly relevant, relevant, and not relevant) for it.
- v. The process continued until at least 40 documents were judged. The judge could continue past 40documents if he or she wanted to.

3. METHODS, TRACKS AND PARTICIPANTS IN TREC

3.1 Ad hoc and Routing methods in TREC-1 to TREC-7

From TREC-1 to TREC-7 a lot of modification can be seen on automatic query construction methods. A lot of combination of methods where used the following table number 1 gives a brief name list of those methods displayed in.

Table 1. Ad hoc and Routing methods in TREC-1 to TREC-7

Ad hoc (Automatic Query construction methods)	Routing (Automatic Query Construction Methods)
1992(TREC-1)[2] 1. Term weighting algorithm 2. Ranking algorithm 3. probabilistic term weighting polynomial regression logistic regression term frequency measures	1992(TREC-1)[2] 1. Vector space model 2. Relevance feedback methods 3. Probabilistic model and term weighting 4. Information retrieval methods
1993(TREC-2) [3] 1. Probabilistic Term weighting 2. Probabilistic inference net 3. Polynomial regression 4. Logistic regression semantic indexing 5. Vector Space model 6. latent semantic indexing 7. vector-space models	1993(TREC-2)[3] 5. Vector Space algorithm 6. Logistic regression probabilistic Reweighting 7. Rocchio relevance feedback algorithms 8. logistic regression traditional probabilistic reweighting 10. latent semantic indexing
1994(TREC-3)[4] 1. Term weighting scheme 2. Probabilistic weighting 3. Passage retrieval and phrase thesaurus 4. Vector Space model 5. Local/ Global weighting scheme 6. passage retrieval method using HMMModel 7. Topic expansion method 8. Term matched method 9. Term distribution method 10. Boolean queries 11. Data fusion	1994(TREC-3)[4] 11. Probabilistic technique 12. Thresholding 13. Spreading activation model 14. Term Selection 15. Inference net engine 16. Topic expansion 17. Rocchio relevance feedback expansion 18. Latent semantic indexing 19. Vector Space model 20. Rocchio relevance feedback algorithm 21. Logodds formula 22. Chi-square test 23. Binomial probability distribution 24. Weighting Formula 25. NLP technique 26. Topic expansion
1995(TREC-4) [5] 1. Non-Cosine length	1995(TREC-4) [5] 27. Rocchio Weighting

2. normalization method 3. Spreading activation model Probabilistic Term Weighting Scheme 4. Term Weighting 5. Passage retrieval method 6. Standard Vector normalization 7. Rocchio Method 8. Standard Cosine measure 9. OKAPI algorithm 10. Term Weighting and matching function	approach 28. Dynamic feedback optimization 29. Probabilistic technique 30. Intensive method 31. Activation Model 32. Complex routing algorithm 33. LSI technique 34. Minimal query expansion 35. NLP technique 36. Topic expansion
1996(TREC-5) [6] 1. Term weighting scheme 2. Query expansion technique 3. Rocchio weights 4. Query coverage algorithm 5. Local context analysis expansion method 6. Information access toolkit(V-Twin) 7. Weighting function SQR 8. Term weighting scheme 9. Term expansion algorithm 10. OKAPI weighting formula 11. Sigmoid suppression factor 12. Statistical co-occurrence method 13. Term frequency weights 14. Ranking algorithm 15. Query expansion 16. Logistic regression 17. Clustering	1996(TREC-5) [6] 37. Term selection Method 38. Rocchio method 39. DFO algorithm 40. Generic algorithm 41. Massive automatic query expansion 42. Chi-square discrimination measures 43. regression equation 44. Special Query Language(GCL) 45. Feature selection method 46. Chi-square method 47. U method 48. OKAPI RSV value 49. Logistic regression 50. Stream architecture 51. NLP technique
1997(TREC-6)[7] Log (Full topic) runs 1. BM25 term weighting scheme 2. Spreading activation	1997(TREC-6)[7] 1. Machine learning technique 2. DFO optimization 3. Term Weighting 4. Routing query

<ul style="list-style-type: none"> model 3. BM25 weighting technique 4. Probabilistic system 5. Clustering 6. Topic expansion 7. Logistic regression 8. Stemming 9. Passage retrieval method 10. Term expansion <p>Title only runs</p> <ul style="list-style-type: none"> 1. OKAPI weighting 2. OKAPI expansion 3. Same as above long (full topic) runs 	<ul style="list-style-type: none"> 5. Boolean queries 6. Term Selection method 7. Spreading activation model 8. U-measures
<p>1998(TREC-7) [8]</p> <ul style="list-style-type: none"> 1. BM25 weighting algorithm 2. Pseudo-feedback expansion 3. Term weighting 4. Automatic expansion method 5. LCA query expansion 6. Phrase recognition 7. Rocchio relevance feedback 8. OKAPI weighting 9. Cosine similarity function 10. Rocchio expansion 11. Hidden Morkov Model 12. Bigrams 13. Pseudo relevance feedback 14. Vector-space model 15. Weighting algorithm 16. Probabilistic model 17. Spreading activation model 18. Zipf threshold 19. LCA algorithm 20. Clustering methods 21. Pivot weighting function 22. avtf weighting function 23. RSV weighting function 	

In the following section a review of methods used from TREC-1 to TREC-16 is briefed. This shows the overall growth of the processes adopted for betterment in all reports in table number 2.

Table 2: The review of methods in TREC-1 to TREC-16

TREC Tracks, Year & Participants	Methods
<p>Ad Hoc, Routing, Interactive & Spanish Track [2] [3] [4] Respectively 1992 (TREC-1), 25 1993 (TREC-2), 31 1994 (TREC-3), 33</p>	<p>Pooling Method Thresholding Recall Precision Method Automatic Query construction method Manual query construction</p>
<p>Confusion, Database Merging, Filtering Track 1995(TREC-4) 36</p> <p>Chinese, NLP Track [5] [6] 1996 (TREC-5) 38</p>	<p>NLP Technique Interactive method Boolean Operation Weighting function Passage determination and searching Routing term selection Term selection algorithm Scoring function OCR method N-grams</p>
<p>Chinese Track CLIR Track Filtering Track HP Track Interactive Track NLP Track SDR Track VLC Track Query Track Speech Track QA Track Web Track</p> <p>Video [7] [8] [9] [10] [11] Respectively</p> <p>1997 (TREC-6) 51 1998 (TREC-7) 56 1999 (TREC-8) 66 2000 (TREC-9) 69 2001 (TREC-10) 87</p>	<p>Sampling method Trec_eval package Weighting algorithm Query expansion Scoring method Indexing method Utility function Query construction method Recall-precision curve</p>
<p>Novelty Track QA Track Video Track Web Track CLIR Track Genome Track HARD Track Robust Track Terabyte Track Enterprise Track Spam Track Legal Track Blog Track [12][13][14][15][16][17]</p>	<p>Pooling method Trec_eval package Recall-precision curve Query construction method Automatic and manual method</p>

<p>Respectively</p> <p>2002 (TREC-11) 93 2003 (TREC-12) 93 2004 (TREC-13) 103 2005 (TREC-15) 117 2006 (TREC-16) 107 2007 (TREC-16) 95</p>	
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3.2 The result achieved from TREC-1 to TREC-16

The outcomes of each TREC for TREC-1 to TREC-16 are briefed.

TREC-1: an attempted at that time for handling large text collection and can be considered as the baseline for the todays retrieval system.

TREC-2: It is viewed as the “best-first-pass” as most groups accomplish on the large set of data.

TREC-3, 4, 5: Actually showed a lot of drop in performance by almost all groups.

TREC-6, 7, 8, 9, 10: Contributed a lot in the improvement based on automatic query generation.

TREC-11 to 16: It has shown significant growth in information and collection contributing 500,000 to 1,000,000 documents approximately 2 to 3 gigabytes of text.

3.3 Briefing of TREC-17 To TREC-23

From TREC-17 there is a seen increase of number of Tracks.. Thus, in this section the methods used in TREC are shown in view of the track runs in the conference.

Table 3. TREC based on the Tracks

TREC Tracks, Year & Participants	Methods
<p>Blog Track [18][19][20]</p> <p>2008 (TREC-17)</p> <p>2009 (TREC-18)</p> <p>2010 (TREC-19)</p>	<ol style="list-style-type: none"> Opinion finding technique Evaluation measures Voting model <p>The methods\techniques are same in the track</p>
<p>Relevance Feedback Track [21]</p> <p>Enterprise Track [22]</p> <p>2008(TREC-17) 89</p>	<ol style="list-style-type: none"> Query expansion method BM25 and language model Novel language model Term weighting scheme Phrase weighting scheme <ol style="list-style-type: none"> Pooling method MQ measures MAP measures Sampling method
<p>Legal Track [23][24][25][26]</p>	<ol style="list-style-type: none"> stateAP method Pooling method Binning method

<p>2008(TREC-17) 89</p> <p>2009 (TREC-18) 91</p> <p>2010 (TREC-19) 80</p> <p>2011(TREC-20) 108</p>	<ol style="list-style-type: none"> Boolean query Ranking method Estimation method
<p>Million Query Track [27] [28]</p> <p>2008(TREC-17) 89</p> <p>2009(TREC-18) 91</p>	<ol style="list-style-type: none"> Minimal Test collection statAP method Pooling method
<p>Chemical IR Track [29] [30] [31]</p> <p>2009(TREC-18) 91</p> <p>2010(TREC-19) 80</p> <p>2011(TREC-20) 108</p>	<ol style="list-style-type: none"> The t-test Randomization test Sampling method Statistical technique Extended inferred average precision (xinfAP) Inferred normalized discounted cumulative gain (infNDCG)
<p>Entity Track [32] [33]</p> <p>2009(TREC-18) 91</p> <p>2010(TREC-19) 80</p>	<ol style="list-style-type: none"> trec_eval package Pooling method Entity List Completion(ELC) Related Entity Finding(REF)
<p>Web Track [34] [35] [36] [37] [38]</p> <p>2009(TREC-18) 91</p> <p>2010(TREC-19) 80</p> <p>2011(TREC-20) 108</p> <p>2012(TREC-21) 129</p> <p>2013(TREC-22) 97</p>	<ol style="list-style-type: none"> Clustering algorithm intent-aware precision Minimal Test collection (MTC) Parsing Document Frequencies BM25 score Span score SALSA score Matching anchor count (MAC) Extraction nDCG method Pooling method Expected Reciprocal Rank (ERR) MAP Precision rank
<p>Session Track [39][40][41][42][43]</p>	<ol style="list-style-type: none"> Pooling method Drifting/Parallel Reformulation Generalizations Specifications Expected Reciprocal Rank(ERR)

2010(TREC-19) 80 2011(TREC-20) 108 2012(TREC-21) 129 2013(TREC-22) 97 2014(TREC-23) 113	6. Average precision (AP) 7. Graded average precision(GAP) 8. nDCG 9. Precision rank 10. ERR 11. Query-likelihood model
Microblog Track [44] [45] [46] 2011(TREC-20) 108 2012(TREC-21) 129 2014(TREC-23) 113	1. Pooling method 2. MAP method 3. nDCG 4. Van Riisberg's F-measure 5. Descending THSU score 6. Tweet timeline generation (TTG) 7. Topic detection and tracking (TDT) and multi-document summarization.
Contextual Suggestion Track [47][48][49] 2012 (TREC-21)129 2013(TREC-22) 97 2014(TREC-23) 113	1. Description rating 2. Geographical relevance 3. Temporal relevance 4. MRR technique 5. Precision rank 6. Time-Biased Gain (TBG)
Crowd Sourcing Track [50][51] 2012 (TREC-21) 129 2013(TREC-22) 97	1. Logistic average misclassification rate (LAM) 2. The true positive rate (TPR) 3. False positive rate(FPR) 4. True negative rate (TNR) 5. False negative rate (FNR) 6. Rank correlation 7. Score accuracy 8. Label quality
KBA Track [52][53][54] 2012 (TREC-21) 129 2013(TREC-22) 97 2014(TREC-23)113	1. Name matching technique 2. Thresholding 3. Bigrams and trigrams 4. CCR metrics 5. Streaming slot filling(SSF) 6. SSF Assessing
Medical Record Track [55] 2012(TREC-21) 129	1. Inferred average precision (infAP) 2. Inferred normalized discounted cumulative gain (infNDCG) 3. Precision at rank

Federated Web Search Track [56][57] 2013(TREC-22) 97 2014(TREC-23)113	1. Normalized discounted cumulative gain (nDCG) 2. Normalized discounted cumulative gain at rank 20 (nDCG@20) 3. Expected Reciprocal Rank (ERR)
Temporal Summarization Track [58][59] 2013(TREC-22)97 2014(TREC-23)113	1. Nugget relevance 2. Latency Discount 3. Verbosity normalization 4. Update Nugget matching 5. Expected Gain metric (nEG (S)). 6. Comprehensiveness metric (C(S)).
Clinical Decision Support Track [60] 2014(TREC-23)113	1. trec_eval 2. Inferred normalized discounted cumulative gain (infNDCG) 3. Recall and Precision

4. CONCLUSION

TREC acts as a guideline as well as a roadmap for anyone who is interested to work in Text Retrieval. Though this paper an attempt is made for abstracting the important aspects of TREC from 1992 [The first TREC] to the present 2014 [TREC-23]. This paper outlines the link to the respective objective, domain, method with equation basic references for anyone who needs to explore its own idea in Text Retrieval based application.

TREC in future will allow to have different tracks depending on new application emerging day by day namely cloud base text processing, biomedical based big data processing.

QA answering in open domain already has gained a lot attention but still there is a need for more exploration where in developments are required. TREC has become a home for all such researcher to dig & put their ideas in front.

A major achievement, the technique evolved along write their performance has been presented from TREC conferences. A tabular comparison is given for easy reference.

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