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Hierarchical Expansion for Concept-Based Search

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Abstract

Although many digital libraries are indexed using a hierarchical conceptual structure, improving the performance of traditional free text search is not trivial. We present a preliminary evaluation of a novel method of a hierarchical concept based search, as implemented in the Vaidurya search engine, with the innovation of using automated query mapping. Using MetaMap, textual query is mapped into MeSH concepts, which are later abstracted. Preliminary encouraging evaluation results on the TREC Genomics 2004 test collection are presented.

Keywords:

information storage and retrieval, concept based search

Introduction

While the idea of concept based search is researched for several decades, not too many studies shown that it outperforms traditional free text search. Recently we introduced Vaidurya, a search and retrieval tool developed originally within the DeGeL library, which in a rigorous evaluation a significant improvement was observed when concept based search was used. In this study we propose a novel approach, in which the user has to enter only a textual search phrase, which is converted into a concepts using *MetaMap*.

Vaidurya

Vaidurya implements a free text search (FTS) and concept based search (CBS). For the FTS, documents are represented and indexed using the *vector space model* introduced by Salton. The CBS in Vaidurya uses the logical operators *conjunction* (AND) and *disjunction* (OR) at two step of retrieval, called *inner-op* and *outer-op.* All the documents classified along a queried concept and its descendent are retrieved. Based on the *inner* the documents sets are intersected of unified to represent each tree, which then processed similarly based on the *outer* operator.

Methods

Based on the previous evaluation, we concluded that adding a query for concepts at the top levels will enhance FTS results, since the relevant documents commonly share abstract concepts. Our goal was to avoid the need in specifying explicitly the concepts, thus, enabling querying using a normal textual query, while exploiting the CBS. Given a set of *query terms*, a set of concepts at *varying* levels of the hierarchy is extracted using *MetaMap*. Then, the concepts are abstracted to their ancestors at a required level *k*, by climbing up through the MeSH hierarchy. In order to evaluate our method we used the TREC 2004 Genomics Track test collection, which offers 50 queries, and in which the documents are classified along MeSH concepts. As evaluation measures we refer to the precision measured at the top *5, 10 and 100* retrieved documents, and mean average precision (MAP). We report the preliminary evaluation of three important variables: (1) *CBS method (2) abstraction level (3) CBS weight.*

Results

Table 1 shows some of the best runs compared to the baseline. Results for runs which are higher than the baseline are bolded.

Table 1 – The best results compared to the baseline, the algorithm is specified by inner^{op}-outer^{op}/level/weight

Algorithm	MAP	P@5	P@10	P@200
OR-OR/3/0.2	0.228	**0.508**	**0.486**	0.196
AND-AND/2/0.2	0.226	**0.508**	**0.490**	**0.199**
OR-AND/4/0.2	0.222	**0.512**	**0.496**	0.193
Free Text Baseline	*0.231*	*0.488*	*0.480*	*0.198*

The improvement noticed at P@5 for run OR-AND/4/0.2 was significant with p=0.067 and for P@10 with p=0.079.

Discussion

We introduced an extension of Vaidurya which enables CBS through an automatic conversion of textual to conceptual queries using MetaMap. The evaluation done with the TREC-G showed a slight improvement. In the 10 and 15 queries, having the worst FTS performance, a significant relative improvement was observed. These are encouraging results for further development of the method**.**

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