

# Retrieval Optimization of Pertinent Answers for NL Questions with the E-Librarian Service

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Although educational content in the WWW is increasing dramatically, its usage in an educational environment is poor, mainly due to the fact that there is too much of (unreliable) redundant and not relevant information. Finding appropriate answers is a rather difficult task being reliant on the user filtering the pertinent information from the noise [2, 4]. Turning the WWW into useful educational resources requires to identify correct, reliable, and machine understandable information, as well as to develop simple but efficient search tools with the ability to perform logical inferences over this information.

We present the web-based e-Librarian Service CHESt<sup>1</sup> that is able to understand a user's questions given in natural language (NL) and to retrieve semantically pertinent *Learning Objects* (LOs). By LO we refer to an entity about a precise subject that may be used for learning, education or training [5] such as a video clip including machine processable metadata. The basic building block of CHESt is a domain ontology, which is used for the translation of the NL user questions into Description Logics (DLs) and to provide semantic metadata for the LOs. CHESt implements a retrieval algorithm, which is based on the *concept covering problem*. Among all the LOs that have some common information with the user query, CHESt identifies the most pertinent match(es), keeping in mind that the user expects an exhaustive answer while preferring a concise answer with only little or no information overhead.

In difference to Question Answering [3], our approach is not targeted to compute a coherent answer in NL. CHESt simply provides a set of interrelated LOs that contain the information necessary to answer the user's question. The translation of a NL user question into a DLs expression (including two non-standard DLs inferences such as the least common subsumer and the difference operation) is described in [1]. By *LO retrieval* we refer to answering a user's question by identifying only the semantically most pertinent LOs. In addition, our system quantifies the quality of the yielded results by measuring the semantic distance between the user's query and the identified LOs. Our retrieval algorithm is based on the *concept covering problem* and on the quantification of the *semantic difference*. The novelty of our approach is that it always proposes a solution to the user, even if the system concludes that there is no exhaustive answer. By quantifying the missing and supplementary information, the system is able to compute and visualize the quality and pertinence of the yielded LO(s).

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<sup>1</sup> <http://www.linckels.lu/chest>

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We define a *cover* as a concept description  $C$  w.r.t. a terminology  $\mathcal{T}$  that shares some information with another concept description  $Q$  w.r.t.  $\mathcal{T}$ . The *best cover* is defined based on the remaining information in the query (*Miss*) and in the cover (*Rest*). The *Miss* is the part of the query that is not part of the cover, and the *Rest* is the information that is part of the cover but not required by the query. The best cover can be assumed as being the cover with the smallest *Miss* and *Rest*. By choosing a lexicographical order we give preference to a minimized *Miss*. CHESt aims to give an exhaustive answer in the first place, i.e., to yield an answer that covers the user's query as much as possible, even if there is more information in the answer than required. In the second place, the *Rest* is considered in order to rank the results with equal *Miss*.

Our algorithm was compared with a keyword-based search engine. For evaluation we selected a lecture on Internetworking (30 units with 38 hours of recording in total) from the online tele-TASK archive<sup>2</sup>. We split the 30 units into 1000 smaller LOs. A set of 123 NL questions has been created. We also indicated for each question the relevant answer(s) to be delivered. An answer is called a *perfect hit*, if it covers the query completely ( $Miss=Rest=0$ ) and a *sufficient hit*, if it covers the query completely, but contains more information than necessary ( $Miss=0, Rest>0$ ).

	perfect hits	sufficient hits	total queries
e-Librarian Service	93 (76%)	112 (91%)	123 (100%)
Keyword search	9 (7%)	103 (84%)	123 (100%)

The precision of CHESt is confirmed by the fact that in average less than 0.7 LOs are delivered in addition to the perfect answer (compared to 6 LOs for keyword-based search). CHESt usually is achieving the correct answer with no additional information (93 out of 123), and in a few cases one (12 out of 123) or two (6 out of 123) supplementary LOs. The keyword-based search in general delivers much more secondary LOs. This result is an important evidence for the pertinence of our tool in an educational environment.

## References

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