Multilingual User Modeling for Personalized Re-ranking of Multilingual Web Search Results

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Abstract. This paper proposes a novel method to represent user models in a multilingual manner which caters for multilingual Web search users. Furthermore, an evaluation is presented which examines a result re-ranking algorithm that is based upon that model.

Keywords: User Modeling, Personalized Multilingual Information Retrieval.

1 Introduction

Global multilinguality is becoming an important feature of Web users' daily interaction with information. The process of searching for information on the Web has two dimensions: the multilingual Web and a multilingual user. The first dimension has been subject to much research in the literature; many studies have investigated improving various aspects of the accessibility and search-ability of multilingual content, such as machine translation quality [1] or cross-lingual / multilingual[1] search effectiveness [2]. On the other hand, the multilingual user dimension has not been the subject of the same amount of research. Modeling users' interests for personalized search [3] has been studied, but only on a monolingual level.

This research study argues that the user's searches may be influenced by language. For example, a multilingual user may prefer to use his/her native language when searching for certain types of content (e.g. news), yet choose to use English when searching for other types (e.g. technical content). Furthermore, in multilingual search, the user may choose to click on documents coming from certain languages depending on the type of information sought. This kind of behavior may suggest that a multilingual user has multiple behavioral personas in Web search. This paper proposes a novel method for modeling the user's search interests in a multilingual fashion. Instead of traditional methods which store interest terms (keywords) in a single language, this method stores the terms in multiple languages. Such user model representation aims at capturing the multiple personas of a multilingual user. Furthermore, an algorithm for re-ranking and merging multilingual search results is proposed and evaluated.

[1] Multilingual search involves performing cross-language search in multiple target languages and then merging and/or translating the search results before presenting them to the user.

2 Multilingual User Modeling of User's Search Interests

In Personalized Multilingual Information Retrieval (PMIR), documents browsed by the user may come from different languages. Therefore, we propose that for a user model to be more suitable to PMIR, it should store terms which represent the user's interests in multiple languages, where a term is stored in the same language of the document from which it was obtained. The proposed user model, which is an extension to the models presented in [4, 3], maintains a set of weighted-term vectors under each designated language. Multiple vectors in each set represent multiple clusters of interests associated with the language. Interest terms are obtained from the queries submitted by the user and from the snippets of clicked results. The terms are weighted using the TF (term frequency) scheme. Furthermore, each vector is given a weight that indicates the degree of user's interest in the whole cluster. The terms, clusters, and the associated weights are updated with every new search that the user performs.

3 Personalized Result List Adaptation for Multilingual Search

3.1 Experimental Setup

A Web-based framework, designed for the delivery and evaluation of PMIR, was used in the experiment [5]. The framework comprises components that allow interfacing with Web search engines and online machine translation systems in order to orchestrate the elements of delivering a multilingual Web search service. The experiment was conducted online and involved 17 users from different linguistic backgrounds. The multilingual search system provided results from 3 languages: English, French, and German. Upon registration, the users were asked to specify which languages they were familiar with so that the system would translate results where necessary. The experiment took place in two phases. In the first phase, each user was asked to choose two search topics (search tasks) from a list of given topics. The users were allowed to submit any number of queries in each topic. When the user submits a query, the system returns a single merged result list containing 30 results obtained from the 3 languages (round robin merging). The system logged the queries and the clicked results for each task. In the second phase, the last submitted query by the user in each task was reserved for testing (a total of 20 test queries was used in the evaluation). The remaining queries, along with their associated clicked results, were used to construct the user model. Each test query was then automatically submitted to the search system. Two result lists were generated: a *baseline list* and an *adapted list*. The baseline list was generated by merging the results using round robin. The adapted list was generated as follows: each result list was separately re-ranked in its original language using the interest clusters of the corresponding language in the user model; the lists were then merged using round robin. Each user was presented with the last query he/she submitted in each task in the first phase along with the two generated lists. The user was then asked to judge the relevance of each result on a 4-point scale. The results were shown in a randomized order to avoid bias.

3.2 Experimental Results

The precision of the baseline and adapted lists was evaluated using the Normalized Discounted Cumulative Gain metric (NDCG), which is commonly used for evaluating retrieval effectiveness in Web search as it rewards methods where more relevant documents appear at higher positions. Table 1 reports the mean scores for the test queries computed at different positions. The results show that the proposed re-ranking algorithm was able to achieve up to 20% improvement over the baseline (improvements highlighted in bold are statistically significant using T-test with p=0.05).

Table 1. Mean NDCG Scores at various ranks

List Position	Baseline List	Adapted List	Improvement %
NDCG@3	0.456	0.549	**20.3%**
NDCG@5	0.508	0.582	14.6%
NDCG@10	0.575	0.621	7.9%
NDCG@20	0.693	0.738	**6.6%**

4 Conclusions and Future Work

This paper discussed a personalized system that caters for multilingual Web search users. The system comprised modeling the user's multilingual search interests and adapting multilingual search results. The evaluation showed that this personalized system was capable of achieving higher retrieval effectiveness in multilingual search. Future work involves investigating the use of concept-based user models based on multilingual ontologies or Web taxonomies and investigating the mapping of concepts across language groups in the user model. Moreover, future work involves experimenting with other re-ranking and merging techniques for adapting the result list.

Acknowledgements

This research is supported by the Science Foundation of Ireland (grant 07/CE/I1142) as part of the Centre for Next Generation Localisation (www.cngl.ie) at Trinity College, Dublin.

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