Research Networking Programmes

Short Visit Report – Modeling and Evaluating User Interaction in IR

1 Introduction

This short report contains a brief overview of the work performed as part of the ELIAS Short-Vist undertaken by Tuan Vu Tran at the University of Glasgow, UK. The short visit took place from the 23th February to the 6th March, 2015. Work was undertaken under the supervision of Dr. Leif Azzopardi, with collaboration from David Maxwell. The researchers are part of the information retrieval group in the School of Computing Science, University of Glasgow.

2 Purpose and Motivation

The Interactive Probability Ranking Principle (IPRP) [1] is a probabilistic framework model for interactive retrieval. This model assumes that a user moves between situations s_i, in each of which the system presents a list of choices, about which the user has to decide, and the first accepted choice moves the user to a new situation. Each choice c_{ij} is associated with three parameters: the effort e_{ij} for considering this choice, the acceptance probability p_{ij}, and the benefit a_{ij} resulting from the acceptance.

Based on the IPRP we developed a new methodology for analysing interactive IR [4] using log and eyetracking data from the INEX 2010 interactive track [3] (12 retrieval sessions, 84 queries). Based on this data, we represent the user's interaction as a Markov model (MM, see (Figure 1). After formulating a *query*, the user looks at one *result item* after the other, possibly regards its *details* and puts items found relevant into the *basket* (for further explanation on our interface, see [4]). The timings correspond to the effort e_{ij} for evaluating a choice c_{ij}, while the transition probabilities give the chances p_{ij} of accepting it. As a possible approach for quantifying the benefit a_{ij} of a decision, we regard the time needed for finding the first (next) relevant document.

The application of MMs to interactive retrieval can be used to evaluate the search behaviour of users. However, the available eyetracking-based data is very limited. Therefore we aim to apply the methodology to regular observation data, as of logging data of experimentations or operational search systems. This visit to Glasgow was a great opportunity to evaluate the search behaviour of users when performing ad-hoc topic search under various conditions based on the logging data of performed experiments.

3 Undertaken Work

3.1 Generating Markov Models from Log Data

We extracted data from a user study conducted by Maxwell and Azzopardi [2]. It was a laboratory study with 48 undergraduate subjects who were allocated to one of four conditions where differing delays were imposed. Subjects were randomly assigned to one of four conditions that varied the type of delay experienced, namely no delay, query delay, document delay and document & query delay.

We implemented a framework to extract the relevance informations from log data and generate markov models automatically. The visualization was built based on the JUNG framework [1]. With this framework, we were not only able to create several markov models for the different experimental conditions, but also models for different types of query. Figure 2 shows user interactions on performant queries (p@10 $>$ 5) and poor queries (p@10 $=$ 0). Those models are clearly distinct in term of times on each states and the transition probabilities, thus give us a number of observations:

- Times for query formulation are roughly the same.
- Users spent much less time on snippet and document on performant queries (4.53 seconds to 11.07 and 18.43 to 28.68) in compare to poor queries.
- With a "good" query, the time needed for finding the first (next) relevant document is much shorter than with a poor query.
- The transition probabilities from document to relevant are pretty much the same on the two models.

Although these observations are very interesting, future work is needed to concrete evidences for query performance and thus encourage further research in this direction.

[1] http://jung.sourceforge.net/

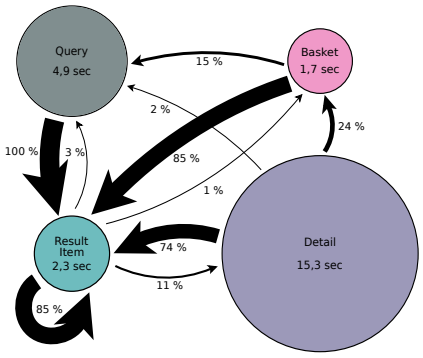

Figure 1: Transition probabilities and user efforts

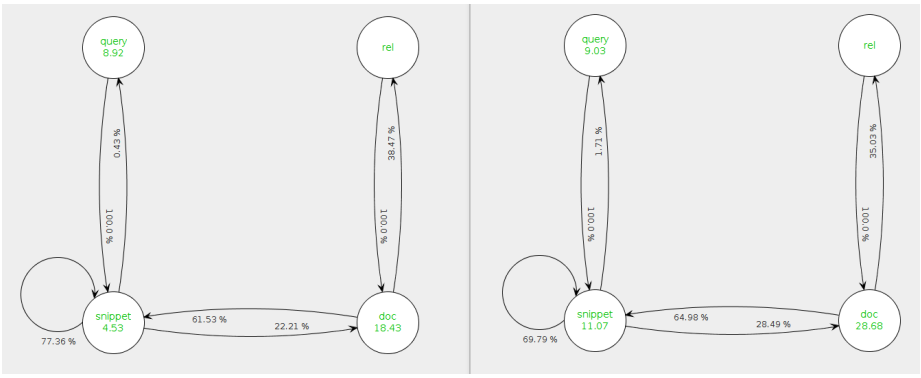

Figure 2: User's Interactions on performant queries (left) and poor queries (right)

3.2 Talks and Presentation

During my visit to the University of Glasgow, I presented a talk on the work undertaken towards my PhD thus far to the IR reading group – including a review of the work conducted in [4]. The talk with engaging discussion lasted approximately 60 minutes, and was well received by the group.

I also had the opportunity to talk and discuss personally with Dr Craig Macdonald[2] and many PhD students from the group about my thesis and future work.

4 Future Work

From log data, we represented user interactions with Markov Models with promising evidence but work is still required to develop this concept into submissible work for a major Information Retrieval conference. Therefore, I would like to continue working with David Maxwell on this topic. Together, we aim to achieve the following:

- Develop further Markov Models, with different (or a combination thereof) states from the two simplistic ones that we previously derived;
- Develop a series of hidden Markov Models, where the probability of interaction with components like a Search Engine Results Page (SERP) or document varies depending on other aspects, such as the performance
- Produce a series of predictions on aspects such as interaction times (e.g. time to mark a document, time to the next query) from each of the produced Markov Models - with validation of these predictions then performed from the real-world log data collected from previous studies.

[2]http://www.dcs.gla.ac.uk/ craigm/

References

[1] N. Fuhr. A probability ranking principle for interactive information retrieval. *Information Retrieval*, 11(3):251–265, 2008.

[2] D. Maxwell and L. Azzopardi. Stuck in traffic: How temporal delays affect search behavior. In *Proceedings of the 5th Information Interaction in Context Symposium, IIiX '14*, pages 1165 – 1166, 2014.

[3] N. Pharo, T. Beckers, R. Nordlie, and N. Fuhr. Overview of the inex 2010 interactive track. In *INEX*, Lecture Notes in Computer Science, pages 227–235. Springer, 2011.

[4] V. T. Tran and N. Fuhr. Using eye-tracking with dynamic areas of interest for analyzing interactive information retrieval. In W. R. Hersh, J. Callan, Y. Maarek, and M. Sanderson, editors, *Proceedings of the 35th international ACM SIGIR conference on Research and development in Information Retrieval*, pages 1165–1166. ACM, 2012.