Chapter V
Modeling Users for Adaptive Information Retrieval by Capturing User Intent

Eugene Santos, Jr.
Dartmouth College, USA

Hien Nguyen
University of Wisconsin - Whitewater, USA

ABSTRACT

In this chapter, we study and present our results on the problem of employing a cognitive user model for Information Retrieval (IR) in which a user's intent is captured and used for improving his/her effectiveness in an information seeking task. The user intent is captured by analyzing the commonality of the retrieved relevant documents. The effectiveness of our user model is evaluated with regards to retrieval performance using an evaluation methodology which allows us to compare with the existing approaches from the information retrieval community while assessing the new features offered by our user model. We compare our approach with the Ide dec-hi approach using term frequency inverted document frequency weighting which is considered to be the best traditional approach to relevance feedback. We use CRANFIELD, CACM and MEDLINE collections which are very popular collections from the information retrieval community to evaluate relevance feedback techniques. The results show that our approach performs better in the initial runs and works competitively with Ide dec-hi in the feedback runs. Additionally, we evaluate the effects of our user modeling approach with human analysts. The results show that our approach retrieves more relevant documents to a specific analyst compared to keyword-based information retrieval application called Verity Query Language.

INTRODUCTION

We studied the problem of employing a user model for Information Retrieval (IR) in which knowledge about a user is captured and used for improving a user's performance. A user model addresses the "one size fits all" problem of the traditional IR system (Brusilovsky & Tasso, 2004). It takes into consideration a user's knowledge, preferences, interests, and goals of using an IR system to deliver corresponding documents that are relevant to an individual and to present different parts of the same documents to a user according to his/her preferred ways of perceiving information. Modeling a user in an information seeking task also addresses the gap between what a user thinks as relevant versus what an IR system assumes that any user would think as relevant (Saracevic et al., 1997). The main purpose of user modeling for IR is to determine what the user intends to do within a system's environment for the purpose of assisting the user to work more effectively and efficiently (Brown, 1998). The common approach for an IR application that employs a user model usually consists of two main steps: (i) to construct a static, or a dynamic user profile; and (ii) to adapt the target IR application to the user's profile. An example of a static user profile is his/her demographic data such as gender, age, profession, and zip code. An example of a dynamic user profile is his domain knowledge, goals, and preferences. The first step is referred to as elicitation and the second step is referred to as adaptation. Elicitation of user models is a knowledge acquisition process. It is well-known in the artificial intelligence (AI) community that knowledge acquisition is the bottleneck of intelligent system design (Murray, 1997). Determining when and how to elicit the user's knowledge is a domain and application-dependent decision. Adaptation involves how to retrieve documents that are relevant to the user's profile and how to present these relevant documents according to the user's preferred ways of perceiving information.

User modeling techniques have been used to improve a user's performance in information seeking since the late 80s (examples of some early works are (Allen, 1990; Brajnik et al., 1987; Saracevic et al., 1997)). Modeling a user for information seeking poses many challenges to both the information retrieval and the user modeling communities. We have identified five main challenges as follows:

(i) the partial-observability of a user's knowledge (e.g. as identified in (Wilson, 1981)). A user's information needs is a subjective experience that only exists in a user's mind and therefore, it is not directly accessible to outsiders (Case, 2002; Wilson, 1981).

(ii) the uncertainty when modeling a user (e.g. as identified in (Greenberg & Witten, 1985; Chin, 1989)). Even within a very small domain, the number of possible actions that a user can perform may increase exponentially over time. To make matters worse, modeling every possible action in the user's world unfortunately does not lead to the most accurate model (DeWitt, 1995).

(iii) the vagueness of an individual's information needs (e.g. as identified in (Case, 2002; Wilson, 1981;)). These challenges are caused by a user's inexperience in problem solving, a user's unfamiliarity with the search subjects, or a user's lack of required computer skills. If a user does not know exactly what he/she is looking for, he/she often constructs queries with terms that are either too broad or too specific and are not closely related to what he/she actually needs.

(iv) the dynamics of a user's knowledge which changes over time as a result of new information (e.g. as identified in (Belkin, 1993; Ingwersen, 1992)). The traditional IR framework assumes that a user's information needs are static. This means that the content of retrieved documents did not have any effect on a user. However, studies have