Adaptive Hypermedia Systems:

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INTRODUCTION

With the growth of access to technology, the limitation of the traditional hypermedia applications has become evident: it provides the same contents and links to all users, disregarding their profiles and individual characteristics. Considering a diverse user population, the traditional system is not able to be "all things to all people", since students with different goals will need different explanations, readers with different interests will enjoy different books and visitors with different knowledge will avail different curiosities about a place (Brusilovsky, 2001). An attempt to bypass the negative effects of the "one-size-fits-all" approach is in providing these systems the ability to adapt themselves according to the needs of the individual user (Brusilovsky et al., 1998).

Based on that, Adaptive Hypermedia (AH) systems are all hypertext or hypermedia systems that reflect some features of the user (e.g., goals, preferences and knowledge) in a user model and modify their various visible aspects according to this model (Brusilovsky, 1996). When hypermedia records and stores learners' preferences, individual needs and learning goals, using them throughout interaction in order to meet their personal needs and to promote a better learning, then hypermedia becomes AH (Turel, 2015). To be considered an AH, the system should satisfy three criteria: being a hypermedia (or hypertext) system, having a user model and using this model to adapt the hypermedia (Brusilovsky, 1996).

In order to meet the first criterion, the system should store all information into small units (usually called nodes) containing text (hypertext) or other forms of information (hypermedia). These units are presented one per window, being interconnected by links that allow users to navigate in a predefined way (Akscyn et al., 1988). To meet the second criterion, it must have a model where data about the users (e.g., knowledge, interests, goals and individual traits) are stored (Brusilovsky & Millán, 2007). Finally, the AH system must adjust its presentation – content (defining the most relevant contents to each user and how to structure them) and interface (making a presentation more efficient and meaningful to the user) (Bunt et al., 2007) – and navigation (guiding the user in the hyperspace through the selection and presentation of the most important links in order to continue the navigation system) (Brusilovsky, 2007) based on the data to be stored in the user model.

There are different application areas to AH systems, e.g.: Educational Hypermedia, On-line Information, On-line Help, Information Retrieval,

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Institutional Information, Personalized Views, etc. The AH educational systems goal is to create an instructionally sound and flexible environment that supports learning for students with a range of abilities, disabilities, interests, backgrounds, and other characteristics, enabling students to learn as much as possible on the available material (Shute & Zapata-Rivera, 2012).

The aim of this chapter is to present Adaptive Hypermedia Systems fundamentals and trends. To achieve it, section 2 introduces the background about user modeling. Section 3 describes some methods and techniques that allow adaptation. Section 4 illustrates some of the existing AH systems. Section 5 points out trends and future directions and Section 6 concludes this work.

BACKGROUND

User model is the representation of information about an individual user, which is essential to make the AH system behave differently according to each user. Based on this model, the AH system can prioritize the most relevant results of a search, manipulate links to facilitate the navigation and present the content adaptively. During the user modeling, the amount and nature of the sorted user information depends on the kind of adaptation effect the AH system has to deliver (i.e., content, presentation and/or navigation) (Brusilovsky & Millán, 2007). The most common stored data are described below based on Brusilovsky & Millán (2007) and Schiaffino & Amandi (2009).

- Knowledge about the application domain enables proper assistance or content adaptation. The users' knowledge is a changeable feature that can increase (i.e., learning) or decrease (i.e., forgetting) from time to time. The AH system must recognize this change and update the user model to provide a more reliable and assertive adaptation. The knowledge about each element can be represented in binary form (i.e., knowing or not) or in scalar form, either quantitative (e.g., from zero to ten) or qualitative (e.g., beginner, intermediate, expert).
- Interests can represent news, web pages, documents, work-related or hobbies-related topics that can be classified as short-term or long-term interests. These interests can be stored in several ways: through weighed vector of keywords (weights usually represent the relevance of each keyword), topic hierarchies (each node in the hierarchy represents a topic of interest, defined by a set of representative words) and topic ontology (an human-understandable, but machine-readable format).
- Goals and Tasks represent the immediate purpose or objective for a user's work within the system, usually being a learning goal in educational AH systems. The goal or task is almost always changing from session to session or even several times within one single session, being the most changeable user feature. Plan recognition is not trivial but it is a useful technique that helps discovering the user' intention by observing the set of input tasks and inferring the next (most probable) one and, hence, the user's goal. Goals or tasks can be represented in the user model with the same patterns of the knowledge, but also as a Bayesian network where nodes represent user tasks and arcs represent probabilistic dependencies between them.
- Background and Skills are a set of features related to the user's previous experience outside the core domain of the system (e.g., profession, work experience or language) and they are used most frequently for content adaptation. They are very similar to user' knowledge and they can be also stored as binary or scalar form, but their update is typically explicitly (requesting