User Modeling and Personalization of Advanced Information Systems

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INTRODUCTION

Enterprise information systems are among the key enablers of the leadership agility on competitive market places and therefore the design of advanced information systems (IS) is a continuous challenge for modern organizations. IS can include knowledge management systems (KMS), customer relationship management solutions, business-to-business applications, e-commerce, e-government or e-learning systems. Advanced IS featuring intelligence have recently implemented as complex applications with modular architecture relying on Web services, Semantic Web technology integrating user modeling, machine learning approaches, and/or agent-based technology. Personalization and more recently contextualization have emerged as key issues for achieving intelligent features in advanced IS.

In general, the goal of personalization is to improve the efficiency of interaction with the users, to simplify the interaction, and to make complex systems more usable. Blom (2000) distinguishes between two main roles of personalization: (1) to facilitate work and (2) to accommodate social requirements. In the first category he includes enabling access to information content, accommodating work goals, and accommodating individual differences, while the second category contains eliciting an emotional response and expressing identity.

This chapter presents a set of personalization techniques for IS. The second section provides background information related to personalization of IS, and it proposes a set of personalization mechanisms. In the third section, these personalization mechanisms are exemplified in the context of KMS. The fourth section outlines future work related to personalization of IS. Finally, the fifth section summarizes the main ideas presented in this article.

BACKGROUND

Personalization techniques enable IS to adapt their structure and content to match the needs and preferences of users based on a user model, which is stored, inferred, or updated dynamically. A simplified form of a user modeling system including personalization mechanisms is represented in Figure 1.

The user modeling server acquires and maintains the user's data through a user profile editor (explicitly) and through different user modeling techniques (implicitly). Among the most used techniques for implicitly constructing user models, acquiring user data, and deriving new facts are: logic-based techniques, stereotype-based reasoning, machine learning techniques, and reasoning with uncertainty (using either Bayesian networks or fuzzy logic techniques). User modeling techniques for personalization mechanisms are extensively overviewed in Razmerita (2003).

The following definition is proposed for personalization of IS: "Personalization of Information Systems is the process that enables interface customization, adaptation of the functionality, structure, content or/and presentation and modality in order to increase its relevance for its individual users." ISs can include customization and/or adaptive personalization features.

- **Customization is usually initiated by the user.** The user decides to select or exclude certain options from the interface. It is usually associated with interface customization. Many of the actual IS include customization features based on the user's preferences.
- **Adaptive personalization.** These features are triggered by the system, based on the user's interaction with the system, or based on the user's data available in the system. User's data are usually addressed as user profiles or user models. User models can be created by the users, who enter their data explicitly, or they can be inferred by the system. In the later case, the system tracks the user's activity with the system and infers characteristics of the user interacting with the system. These characteristics (e.g., domains of interest, goal) are further used for providing personalized interaction.

Agent-based systems can be used beyond adaptive personalization with different objectives. Agents can support users to perform different tasks, or they can perform tasks delegated by the users (e.g., intelligent information agents, personal assistants); they can search and guide users to find different knowledge assets (e.g., information filtering agents), or they can enhance learning processes (e.g., pedagogical agents) (Brna, Cooper, & Razmerita, 2001; Greer et al., 2001; Maes, 1998).

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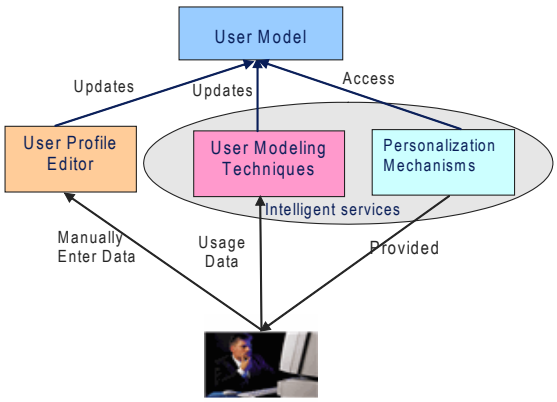
Figure 1. User modeling and personalization mechanisms



Important application areas of personalization include customer relationship management (Alpert, Karat, Karat, Brodie, & Vergo, 2003; Ardissono & Goy, 2002; Kobsa, Koenemann, & Pohl, 2001; Schafer, Konstan, & Riedl, 2001), educational software (Brusilovsky, 2001; Clark & Mayer, 2003), and information search and retrieval (Ardissono, Goy, Petrone, & Segnan, 2003; Kurki, Jokela, Sulonen, & Turpeinen, 1999; Tanudjaja & Mui, 2002; Waern, 2004,). Personalization has already proven its utility in e-commerce and e-learning. Fink and Kobsa (2001) provide data from communication reports showing that personalization based on purchased data and personal data has a considerable payoff in customer relationship management. Techniques for selection of relevant items according to the user's profiles in e-commerce are described by Ardissono and Goy (2000). In the following, a set of adaptive features that can be integrated in IS are identified and classified. Adaptation techniques can be classified in three categories: (1) adaptation of structure, (2) adaptation of content, and (3) adaptation of modality and presentation (Kobsa et al., 2001). These personalization techniques enable users to spend less time to search and retrieve relevant knowledge.

Adaptation of Structure

Adaptation of structure refers to the way in which the hypermedia space is structured and presented to the different groups of users. Fischer (2001) provides some insights in the design of human-centered systems supported by user modeling techniques. He emphasizes that high functionality applications must address three problems: (1) the unused functionality must not get in the way; (2) unknown existing functionality must be accessible or delivered at times when it is needed; and (3) commonly used functionality should not be too difficult to be learned, used, and remembered. Taking into account these principles, apart of a global view or a default view of an IS, several types of personalized views and layouts can be designed and integrated into the system. "Personalized views are a way to organize an electronic workplace for the users who need an access to a reasonably small part of a hyperspace for their everyday work" (Brusilovsky, 1998, p.).

Adaptation of Content

The users give different relevance to information/knowledge assets according to their goals, interests, background, or hobbies. Adaptation of content refers to the process of dynamic tailoring the information that is presented to the different users according to their specific profiles (e.g., needs, interests, level of expertise, etc). It enables the user to filter, retrieve, or rank relevant documents according to the user's characteristics. Adaptation of content relies on techniques for information filtering, information retrieval, information visualization, and adaptive hypermedia. Adaptation of content can include: filtering of content; personalized recommendations; personalized hints or automatic summarization; and optional detailed information. These techniques are further exemplified in the context of KMS.

Adaptation of Presentation and Modality

Adaptation of presentation empowers the users to choose between different presentation styles such as different layouts, skins, or fonts. Other preferences can include the presence or absence of anthropomorphic interface agents, the preferred languages, and so forth. Different types of sorting, bookmarks, or shortcuts can also be included in a highly functional system. Adaptation of presentation traditionally overlaps

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