IDIUMS: sharing user models through application attributes

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Abstract. IDIUMS is a framework for sharing data between user models in adaptive applications which use different attributes to record the user’s interactions. This paper and the accompanying demonstration illustrates the architecture of IDIUMS, a prototype reference implementation and the experimental setup constructed to test the underlying hypothesis: using rules to map attributes between different types of application allows those applications to make better adaptations.

Keywords: shared user model, adaptive game, adaptive hypermedia, adaptive assessment, attribute, overlay model

1 Introduction

In 2009, we presented early investigations into sharing user model data between two different systems with adaptive elements: hypermedia and computer games [3]. Since this work, the scope of the project has been generalised, to cope with a variety of applications.

The overlay user model [2][5] consists of a graph of the concepts within the application’s domain. Attached to each concept are one or more attributes, and to these attributes the user is assigned values. These attributes give the value meaning. If the attribute layer were left out, the value could be assigned to a concept, but would it mean the user likes that concept, has knowledge of the concept or simply viewed it?

With this understanding of the role of attributes, it becomes clear that even if they share a concept graph (there are examples of mapping between concept graphs [4]), each application reasons on different attributes. An adaptive hypermedia tracks the number of page views a user has made. An adaptive game records the number of levels played and the player’s success levels. An adaptive assessment stores the number of questions attempted and the number of correct answers. A recommender system registers interest. On their own, these systems cannot share their user model values because they adapt on different attributes.

IDIUMS is a framework to solve this problem, and the reference implementation is described in this paper. Currently, an experiment is being set up to test the hypothesis that using rules to map between the attributes in different types of adaptive application results in improved adaptations within those applications, over starting with no data about the user.
2 IDIUMS: the Interactionally-Diverse Intermediary User Model System

A prototype reference model of IDIUMS has been written in Java and packaged as a JAR for ease of deployment.

IDIUMS requires a rule engine to enable translations of values. It uses a computer algebra system called Jasymca, which allows symbolic algebra to be used to represent the rules. In addition to evaluating the rules between two applications, IDIUMS traverses the graph of all rules connecting applications within the system, so that if there is no rule directly connecting two applications, a translation between the attributes may be performed via rules connecting a third, intermediary application.

New and existing adaptive applications may integrate with IDIUMS by utilising the simple REST interface. The query string identifies which user, application, concept and attribute is being accessed, the HTTP GET method used for retrieval and POST used for setting a value (with the value in the request body) and the return format is determined by the file extension (.xml or .json).

3 Experimental System

The underlying hypothesis behind IDIUMS is that user model data can be converted at an attribute level: that is, assuming the data is about the same concept (or has been mapped appropriately), then values unique to one application can be translated to those in another. To test this hypothesis, an experimental framework and methodology have been developed, which are described below.

3.1 Applications

Three adaptive applications, which record different attributes, have been selected to test the effectiveness of translating attributes: an adaptive game, an adaptive hypertext and an adaptive assessment. The domain of these applications is similar, to remove that as a variable in the experiment. This common topic is learning looping in the Java programming language.

The adaptive hypertext is a digital textbook, built in the GRAPPLE Adaptive Learning Environment (GALE), which provides adaptive navigation within the textbook, so the learner can choose the most appropriate thing to read next.

The adaptive game is inspired by a learning object [1], in which the learner studies some Java code consisting of a loop and attempts to predict what will happen. The next screen displays a submarine which moves as per the commands in the code. The adaptive game implements this learning object, but allows the learner to write, compile and run real Java code to control the animation. The learner can play with the code until they have solved the puzzle. The game presents multiple scenarios to test the player’s knowledge of all the concepts.

1 http://webuser.hs-furtwangen.de/dersch/jasymca2/indexEN.html
The adaptive assessment consists of a database of questions encoded in the QTI XML format. The engine selects an appropriate question, based on the state of the user model, and uses the QTIengine2 REST interface to render the question.

3.2 Methodology

The participants of the experiment will be led through using each of the applications in turn. At the start, and then following the use of each application, the participants will be asked to complete a questionnaire asking them to self-assess their knowledge of various aspects of Java loops, and to rate whether the level of challenge in the application was appropriate for them. By having IDI-UMS provide translations of their user model data, it is hoped they will rate the adaptations as more appropriate compared to the control group who will start each application with no initial user model data.

4 Conclusion

IDIUMS is an intermediary user model system with a REST-like interface for interrogating and modifying the data. It provides a method for sharing a user's data between applications that are interactionally-diverse, by maintaining a graph of rules between the attributes in different applications.

It will be demonstrated in the context of an experiment to test the hypothesis that sharing data at an attribute level improves adaptations. Conducting this experiment is the next stage of this work.

References


2 http://www.qtitools.org/landingPages/QTIEngine/