Appendix A: Evaluation between MOT3.1 and GAT

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Two competing approaches in Authoring Adaptive Hypermedia: MOT versus GAT
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ABSTRACT
Adaptive hypermedia allows content to be personalized according to the user's requirements. However, structuring the content, labeling it and creating adaptive pedagogical strategies can be a difficult task. This poster describes two separate systems that aim to reduce the complexity of the authoring process. The first system allows authors to structure their content into domain maps and goal maps, which can then be used in conjunction with a separately created pedagogical strategy. The second system provides a graphical way of representing learning resources, and allows authors to use a range of pre-designed pedagogical rules to create an adaptive course. The two systems, named MOT and GAT respectively, are described and evaluated based on initial results on actual system usage during October-December 2010.

Categories and Subject Descriptors
H.1 [**Information Systems**] Models and Principles; I.2.4 [**Artificial Intelligence**]: Knowledge Representation Formalisms and Methods; H.5.4 [**Information Interfaces and Presentation**]: Hypertext/Hypermedia - *architectures, navigation, user issues*; H.3.3 [**Data**]: Data Structures - *distributed data structures*, *graphs and networks*; K.3.1 [**Computers and Education**]: Computer Uses in Education - *distance learning.*

General Terms
Measurement, Design, Reliability, Experimentation, Human Factors, Standardization, Languages, Theory.

Keywords
adaptive hypermedia, authoring tools, LAOS, LAG, MOT, AHAM, GAT, GALE.

1. INTRODUCTION

Authoring for Adaptive Educational Hypermedia requires content to be divided (manually or semi-automatically) into standalone fragments that are annotated with sufficient semantically rich metadata [8]. Additionally, the teacher must select an adaptive pedagogical strategy [3] appropriate for her students and the content of the course.

Our research aims to create the ideal authoring system for adaptive hypermedia. The paper describes and compares two different authoring tools, My Online Teacher (MOT) [6] and the GRAPPLE Authoring Toolset (GAT) [4]. In particular, we ask:

1. Do users prefer editing from scratch or reusing large parts of content or strategies?

2. Should the tool limit the number of available metadata labels and relations?

3. *Do users prefer textual or graphical environments?*

2. THE AUTHORING TOOLSETS

2.1 The MOT Toolset

2.1.1 MOT3.1
MOT3.1 allows the creation and labeling of content for reusable content representation. This is done via two processes: creation of domain maps, and creation of goal maps, one describing the content, and the other the pedagogical metadata. A domain map is a hierarchical tree structure of *domain concepts*. Concepts contain a number of *domain attributes*. Attributes point to a *content resource* which is stored as HTML text. A goal map is a hierarchical tree structure of *sublessons*, permitting different pedagogical formations for the final course. Each sublesson links to an attribute in a domain map; it can be labeled with a number of *labels* and *weights* to represent goal-related metadata usable by adaptation strategies. In this way, pedagogical metadata sets are separated from the domain content, allowing reuse and separation of concerns [7].

2.1.2 PEAL
The second part of the MOT toolset is represented by the PEAL tool [2] which allows authors to specify the adaptive behavior of their course. PEAL provides editing features for the LAG language, such as syntax highlighting and code suggestion. PEAL2[1] introduces an alternative visual programming feature,

[1] http://mot.dcs.warwick.ac.uk/peal2/

allowing authors to view the flow of their adaptation strategy using graphical flowchart elements (see Figure 1).

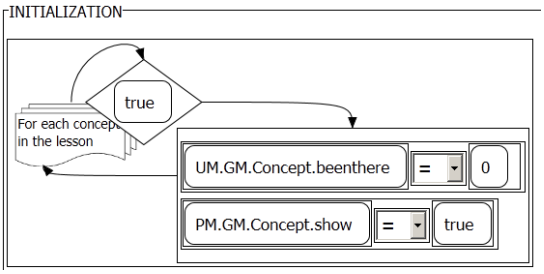

Figure 1. Part of an initialization loop in PEAL2

2.2 The GRAPPLE Authoring Toolset (GAT)

GAT [4] was created as part of the GRAPPLE FP7 EU project. It divides the authoring challenge into three distinct areas.

2.2.1 Domain Tool

The main elements of the domain model in GAT are similar to those in MOT. However, in GAT, *domain concepts* can be arranged using a graph structure, and not a hierarchy as in MOT. Each edge of the graph represents a *semantic relationship* between two concepts, such as "is-a" or "belongs-to".

2.2.2 Course Tool

The course tool provides a graphical way for the author to structure their course. He can insert *pedagogical rules* into the course, to describe its adaptation. He can select from a set of predefined rules, each containing at least one *socket*. Each socket must contain at least one concept. The rule describes the adaptation to be applied to the concepts in its sockets. Figure 2 shows an example of the simplest rule, the *G-Prerequisite* rule, stating that the concept(s) in the target (Mars) should not be recommended to the learner until the concept(s) in the source (Planet) have been visited.

Figure 2. A G-Prerequisite rule

GAT contains a library of predefined pedagogical rules that can be used to create a course. Beginner authors, without programming experience, can use rules from this library to create a course. Some of the more common ones are outlined below:

- `G-Layout`*:* Specifies which concepts should be displayed in the course's navigation menu.
- `G-Start`*:* Specifies which concept should be shown when the user first registers onto the course.
- `G-Hide`: Removes the target concept from the navigation menu when the source concept is visited.
- `G-Unhide`*:* Shows the target concept in the navigation menu when the source concept is visited.

Using predefined rules allows authors to piece together their adaptive course using small granularity pieces of adaptation.

2.2.3 Pedagogical Relationship Type Tool

Some authors may want to define their own adaptation from scratch. The Pedagogical Relationship Type Tool [1] allows advanced authors to define their own type of pedagogical rules. The author can specify some GALE [5] code to describe how the rule will interact with the concepts that are placed in the sockets.

3. EVALUATION AND DISCUSSION

To ascertain which approach to authoring is easier for authors to use, an evaluation was carried out with 20 4th year students.

3.1 Editing or Reusing?

63% of students preferred to work on pre-existing content which can be further edited, with a further 31% preferring to edit from scratch (both of these features are supported by MOT). This suggests that users prefer editing from scratch, or at least being able to edit the content within the system (as in MOT). They also preferred to use fine granularity (small fragments) of content (42%, with 26% having no specific preference). There was also a small preference for a fine granularity of strategies (36%), as in GAT, instead of authoring whole strategies as in MOT (27%).

3.2 Unlimited Relations and Labels?

In terms of domain model relations, providing a greater number of options (multiple relations, as in GAT) is preferable (50%), with 25% undecided. Also, allowing multiple properties (as in GAT) is considered useful (50%). Moreover, having multiple labels for adaptation (as in MOT) is slightly preferable (50%).

3.3 Textual or Visual?

Overall, the students felt that the GAT approach provided a shallower learning curve (50%, compared with 30% for MOT), a more familiar interface and better visualizations. It is clear that a visual, graphical drag & drop approach is easy to learn and thus preferable.

More support is desired for content, domain relations, strategies or parts thereof, code (as in MOT) as well as concept properties (as in GAT). Overall, functionality must be quick, and responsive.

It should be noted that the evaluations were performed with computer science students, who like flexibility. The place to ensure such high level of flexibility would be, for instance, the advanced authoring mode.

4. CONCLUSIONS

Our research shows that for authoring of adaptive hypermedia, flexibility, fine granularity and multiple metadata options for both content and adaptation is favored. On the other hand, obviously, a simple visual interface, with a lot of support, is clearly preferred. In order to allow for these potentially conflicting requests to coexist, we envision that different authoring roles have to be further extended and clearly defined.

5. ACKNOWLEDGEMENTS

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