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Foreword

Welcome to Boston. The International Conference on Distributed Multimedia Systems has entered its fourteenth year. For the past thirteen years, the Conference on Distributed Multimedia Systems has covered a wide spectrum of paper presentations, technical discussions and demonstrations in the field of distributed multimedia systems. The main topics of the DMS2008 conference are: network and systems, emergency management and security, situated computing, multimedia software engineering, multimedia and geo-systems, distributed multimedia computing, multimedia information retrieval, digital home and health care. This year's technical program also includes two workshops: International Workshop on Distance Education Technologies (DET2008) and International Workshop on Visual Languages and Computing (VLC'2008) with a special track on sketch computing.

The DMS2008 Program Committee selected papers for publication in the proceedings and presentation at the Conference based upon a rigorous review process. This year, authors from nineteen countries will present papers at the conference: Brazil, Canada, France, Germany, India, Iran, Italy, Japan, Malta, Netherlands, Portugal, Romania, South Korea, Spain, Sweden, Taiwan, United Kingdom, United States and Venezuela.

We appreciate having had the opportunity to serve as the program co-chairs for this conference, and are very grateful for the outstanding efforts provided by the organizers and program committee members of the above mentioned workshops and special sessions and tracks. The Program Committee members and reviewers provided excellent support in promptly reviewing the manuscripts. We are grateful to the authors and sessions chairs for their time and efforts to make DMS2008 a success. The support of the Computer Science Department of the University of Venice in the organization of the special session on multimedia and geosystems is gratefully acknowledged, as well as the support of the University of Salerno in the organization of several special sessions on visual languages, gesture computing and others, and other universities' support of similar efforts. As always, Dr. S. K. Chang of the Knowledge Systems Institute, USA, provided excellent guidance throughout the effort. Last but not least, we all owe a debt of gratitude to the heroic efforts of Mr. Daniel Li, as well as other staff members of Knowledge Systems Institute.

Erland Jungert and Masahito Hirakawa
DMS2008 Program Co-Chairs

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VLC-4 Visual Models and Metaphors for Computational Process Visualization

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Note: (S) means short paper.

Semantic authoring of learning paths with Topic Maps

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Abstract

The rapid development of the World Wide Web in the last few years has brought great opportunities in the way educational materials can be made available to learners. The number of resources available on the Internet is vastly growing, but, on the other hand, some problems emerged as a result of this proliferation of contents, such as the increasingly difficult management and accessibility of these materials. Topic Maps are an ISO standard whose aim is describing knowledge structures and associating them with information resources. Topic Maps are here proposed as a knowledge representation model to describe the semantic relationships among educational resources. Instructional designers and authors could use this model to facilitate the design of learning paths and their delivery in different contexts. In this paper, after a description of Topic Maps standard, a working hypothesis is discussed about its application in the context of learning design and also a short survey of related works is presented.

1 Introduction

The use of Information and Communication Technology (ICT) in learning activities has become so pervasive in the last few years that new models are needed for the process of instructional design, based on environment and tools enabling users to capture represent and share their knowledge [1].

Additionally, more and more often learning management systems are required to have high degree of flexibility, interoperability and personalization of contents and services and, therefore, to provide internal knowledge management and representation systems based on standards for resources, contents, and processes. From a technical point of view, semantic technologies can support both developers and users in achieving such goals.

There are several knowledge representation models, technologies and languages, such as eXtensible Markup Language (XML), Resource Description Framework (RDF), XML Topic Maps (XTM) and Web Ontology Language (OWL) that allow description of resources in a standardized way, enhancing the information sharing, reusability and interoperability.

Topic Maps (TM) [2] is an ISO standard (ISO/IEC 13250) for the representation and interchange of knowledge. It can be regarded both as a promise and a challenge for researchers involved in the learning design as well as in the management of educational resources.

2 ISO Standard 13250: Topic Maps

The TM development process began in 1991 when a UNIX system vendors' consortium founded a research group, known as Davenport Group, to develop a framework that enables the interchange of software documentation. The first attempt at a solution to the problem was called SOFABED (Standard Open Formal Architecture for Browsable Electronic Documents) [3].

In 1993 a new group was created, the CApH (Conventions for the Application of HyTime), whose activity was hosted by the GCA Research Institute. This group elaborated the SOFABED model as topic maps. By 1995, the model was accepted by the ISO/JTC1/SC18/WG8 as basis for a new international standard. In 2000 the Topic Maps specification was ultimately published as ISO/IEC 13250 [4].

In the same year a new independent consortium, TopicMaps.Org, was founded with the goal of specifying topic maps based on the W3C recommendations XML (to enable the applicability of the TM paradigm to the World

Wide Web). The XTM 1.0 specification was published in 2001; then it was passed over to ISO, which approved a Technical Corrigenda of ISO/IEC 13250 making the XTM notation part of the standard [4]. In the following years the TM development process has proceeded in different ways. Three OASIS Technical Committees were formed to promote the use of published subjects (element conceived to identify a single subject in a topic map), while a ISO committee JTC1/SC34 started two further standard initiatives: Topic Map Query Language (TMQL, ISO/IEC 18048), a query language for topic maps, and Topic Map Constraint Language (TMCL, ISO/IEC 19756), a constraint language for topic maps. In 2003 the second edition of ISO/IEC 13250 was released while, three years later, JTC1/SC34 published ISO/IEC IS 13250-2:2006 that specifies the Topic Maps Data Model.

Finally, in 2007, the same committee released XTM 2.0 (a revision of the XTM 1.0 vocabulary) whose syntax is defined through a mapping from the syntax to the Topic Maps Data Model. Thus the ISO standard is now a multi-part standard that consists of the following parts [5]:

Part 1 - Overview and Basic Concepts: provides an overview of each part and how the parts fit together. It also describes and defines the fundamental concepts of Topic Maps (standard under development);

Part 2 - Data Model (TMDM): specifies a data model for topic maps (it defines the abstract structure of topic maps). The rules for merging in topic maps are also defined, as well as some fundamental published subjects (published standard);

Part 3 - XML Syntax (XTM): defines the XML Topic Maps interchange syntax for topic maps (published standard);

Part 4 - Canonicalization (CXTM): defines a means to express a topic map processed according to the processing rules defined in the TMDM in a canonical form (project deleted on December 2007);

Part 5 - Reference Model (TMRM): provides a basis for evaluating syntaxes and data models for Topic Maps (standard under development);

Part 6 – Compact Syntax: defines a simple text-based notation for representing topic maps, it can be used to manually author topic maps, to provide human-readable examples in documents and to serve as a common syntactic basis for TMCL and TMQL (standard under development);

Part 7 – Graphical Notation: defines a graphical notation used to define ontologies and represent TM instance data (standard under development).

As previously said, Topic Maps define a model for encoding knowledge and connecting this encoded knowledge to relevant information resources [6]; in this paradigm emphasis is on information retrieval, not on logical reasoning and this is one of the most relevant difference between topic maps and formal ontologies. Moreover, TM standard defines an XML-based interchange syntax called XTM; the specification provides a model, a vocabulary and a grammar for representing the structure of information resources used to define topics and the associations between topics.

The main elements in the TM paradigm are often referred to by the acronym TAO which stands for *Topic*, *Association* and *Occurrence* [7]. According to ISO definition a topic is a symbol used within a topic map to represent one (and only one) *subject*, in order to allow *statements* to be made about the subject, that can be "*anything whatsoever, regardless of whether it exists or has any other specific characteristics, about which anything whatsoever may be asserted by any means whatsoever*". In substance a subject is anything about which the creator of a topic map chooses to discourse [6]; for instance an object, an event, a place, a name, a concept, etc.

An association represents a relationship between two or more topics. An occurrence is a representation of a relationship between a subject and an information resource. The subject in question is the one represented by the topic which contains the occurrence (for instance an occurrence can be a webpage, a book, an image, a movie depicting the subject).

Therefore two layers can be identified (Figure 1) into TM paradigm: a *knowledge layer* that represents topics and their relationships and an *information layer* that describes information resources [7].

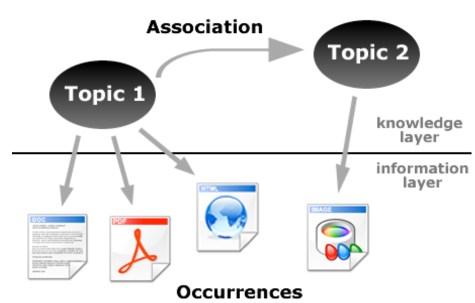

Fig. 1. Topic Maps paradigm: knowledge layer and information layer.

The existence of two different layers is one of the most interesting feature of this model; in fact the same topic map could be used to represent different sets of information resources, or different topic maps could be used to represent the same resource repository, for instance to provide different "views" to different users [7].

Each topic can be featured by any number of *names* (and variants for each name); by any number of *occurrences* and by its *association role*, that is a representation of the involvement of a subject in a relationship represented by an association. All these features are statements and have a *scope* that represents the context within which a statement is valid (outside the context represented by the scope, the statement is not known to be valid). According to ISO the unconstrained scope is the scope used to indicate that a statement is considered to have unlimited validity [6]. Using scopes it is possible to remove ambiguity about topics; to provide different points of view on the same topic (for example, based on users' profile) and/or to modify each statement depending on users' language, etc. [7]. Topics, topic names, occurrences, associations and associations' roles require a *type* element (becoming instances of classes). These classes are also topics, which might, again, be instances of other classes.

Therefore, to solve ambiguity issues, each subject, represented by a topic, is identified by a *subject identifier* (usually a URI, similarly to RDF). This unambiguous identification of subjects is also used in TM to merge topics that, through these identifiers, are known to have the same subject (two topics with the same subject are replaced by a new topic that has the union of the characteristics of the two originals) [8]. This feature could be used in order to share the knowledge and to solve redundancy issues.

3 Use of Topic Maps to design learning paths

Recent evolutions, in education as well in ICT, are leading designers and developers of e-learning systems and services towards the adoption of new criteria and models in the process of instructional design. The proposed scenario is featured by the use of the Topic Maps paradigm as a model for the design of learning paths, exploiting the flexibility and the expressivity of such a paradigm.

Currently, the design of educational paths in the context of web-based courses is mainly oriented to the serialization of teaching materials with the aim of creating self-contained learning objects (according to the standard SCORM) [9]. Despite assets and learning objects are designed with the aim of allowing great reusability, accessibility and interoperability, it is a common users' experience that some criticism may reveal itself, depending on the development process.

In the daily practice, teachers as well as instructional designers have to deal with synopsis definition of their courses, by outlining main subject matters which drive the structure of the lectures and single learning units [10].

Several research projects have been developed to investigate the use of repository systems for collecting and sharing learning objects with characteristics of being standard, re-usable, and searchable by means of suited semantic services based on the use of metadata associated to each of them. Despite good practices and the above criteria are used, depending on the specific needs of teachers, or students, or even of the course itself, it may happen that produced materials are not suitable for different applications. To face to this problem, the possibility of moving the generalization level from the contents to the definition of the contents' scheme is here investigated. It is worth noting that the inner architecture of topic maps is multilayered and thus it implements the same principle so that, within a semantic environment, different resources can be associated to the same concept and in different scenarios the same course can have different contents for even different targets, according to the scope defined within the description of the TM itself [10].

In our opinion, Topic Maps can be profitably considered as a means for describing the structure of a course as well as the outline of a lesson according to the logical structure of the course itself.

In order to support learning paths design process, we propose an ontological model (Figure 2) intended to be implemented in e-learning content authoring environments. In a preliminary step, the following requirements have been defined: formalisation (the model must describe course structure in a formal way, so that automatic processing is possible) [11]; pedagogical flexibility (the model must be able to describe learning contents that are based on different theories and models of instruction) [11]; centrality of student (the process of learning paths design must be based on learners' profile);

centrality of learning objectives (the process of learning paths design must be based also on preliminary specification of instructional objectives); personalization (the model must be able to define learning paths which can be adaptively matched to users' profile); domain-independent (the model must be able to represent learning paths regardless of content domain); reusability (the model must be able to describe contents structures reusable in other contexts); interoperability (the ontological model definition must be independent of specific particular knowledge representation languages, so that it can be applied in different e-learning tools and environments); medium neutrality (the model must be able to describe learning contents regardless of publication formats) [11]; compatibility (the model must be compliant to available learning objects standards) [11].

The *Learner* is the root element of the model. Firstly, it is required to identify all the students that attend a course; they can be defined as individuals or groups (the specification of learners depends on a process of user profiling not described into the ontology).

For each learner, it is necessary to specify the *OverallGoal*, the general learning aim of the *Course*. The learning objectives can be organized into a taxonomical structure (*OverallGoal*, *Objective* and *SubObjective*) which match with a hierarchical structure of the contents (*Course*, *Module*, *UnitOfLearning*). It is important to note that is possible to define propaedeutic relationships among objectives and, as a consequence, among modules and units of learning.

For each unit of learning, it is possible to identify the map of concepts, founded on topics and a limited set of relationships. The model defines two different *TopicType*: *PrimaryType* and *SecondaryType*. The first one includes the concepts that are considered requirement of the unit of learning and that, as a consequence, have no learning resources associated. The second one includes the key-concepts of the unit of learning that have specific learning resources associated. Among these secondary topics, it is possible to establish the followings relationships: *isPartOf* (a part-whole relation that may be used to represent, for instance, a paragraph and its sub-paragraphs within a learning object), *isRequirementOf* (a propaedeutic relation that may be used, for example, to organize the sequence of learning objects), *isRelatedTo* (defines a close-relation among two or more topics that can be used, for instance, to establish a connection among different course contents), *isSuggestedLink* (defines an indirect association among two or more topics that may be used, for example, to connote in-depth link).

Moreover, for each secondary topic we can specify a value of *Effort* (a generic element that may be useful to define informative data, such as the expected learning time, the difficulty, university credits, etc.).

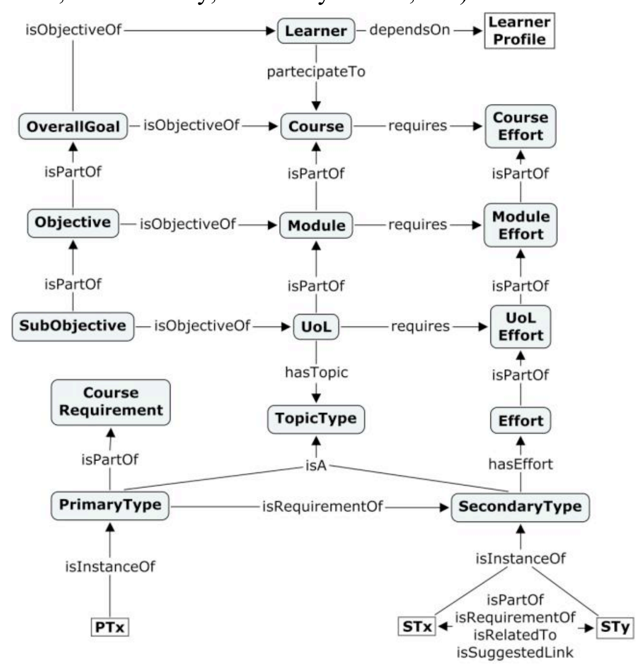

Fig. 2. The learning paths design model.

This structure of instructional content can be stored within a topic map in a well formed form and in a standard language, thus, it can be easily exported over the Internet and many systems can re-use and interoperate with the XTM representation of the topic map.

Moreover, the layered structure also enables authors to define different maps based on a common repository or archive of resources so that personalized learning paths can be defined while the contents at the occurrence level remain the same and different educational strategies can be implemented.

The same application can be investigated looking at the inner structure of a SCORM compliant learning object. One *Organization* can be here considered; the tree shaped structure composed by single items is equivalent to the one that will be represented within the related teaching unit; the hierarchical structure will be translated in terms of a Lesson, divided into Sections, sub-Sections, and so on. Topics and resources will be associated to these elements. The given sketch of this structure is written inside the related Learning Object in the manifest file (imsmanifest.xml file in SCORM).

Based on this standardized layout, the design of Learning Objects can be partially automated when the relevant resources for the educational objectives can be retrieved at the occurrence level of a suited topic map. Moreover, in default of relevant resources at the occurrence layer, a semantic representation of the relationships among educational contents could help the instructional designer to retrieve other materials linked to super-topics (*isPartOf* relation) or to other topics semantically related (*isRelatedTo* relation), facilitating the Learning Objects design.

By means of TM and XTM, and looking at the associations, the designer can build a sequence for the occurrences and the related topics; hence, reasoning (i.e. browsing a TM and making queries at a semantic level) on a given argument is made possible by simply looking at its description and thus automating the production process of retrieval of related contents (trough metadata) into SCORM objects [10].

4 Related Works

In the last years some research projects have been developed to investigate the use of Topic Maps paradigm in e-learning context.

QUIS (QUality, Interoperability and Standards in e-learning) is an EU funded project whose activities are directed towards quality in e-learning, interoperability and reusability of learning material. In the course of project development, a repository of standards in e-learning has been created and a requirement specification for a next generation of e-learning system has been produced. This requirement specification has a holistic pedagogical approach and requires an on-line learning environment that provides possibilities for personalization. The researchers suggest that TM could be used to achieve a personalized user interface, and present a prototype of a Personal Learning Environment (PLE) based on Topic Maps model [12].

According to Koper [13] "*an important question related to the educational semantic web, is how to represent a course in a formal, semantic way so that it can be interpreted and manipulated by computers as well as humans*". The semantic representation of learning courses opens the possibility to solve some problems like the development of flexible, problem-based, non-linear and personalized web-based courses; the building and sharing catalogues of learning and teaching patterns; the adaptation to learners' profile and the semantic research capabilities.

TM4L (Topic Maps For e-Learning) is an e-learning environment that provide authoring and browsing support for creating ontology-based learning content and/or structuring digital repositories. It uses topic map-based overlay structures for encoding domain knowledge and connecting it to instructional resources, which are considered relevant to a specific domain [14].

Ouziri [15] has proposed a TM-based approach to represent learning resources and associated semantics such as metadata. The main goal of his work is to enable more efficient accessibility and reusing of web-based learning resources, given in a common ontology. Karabeg et. al. [16] have proposed an information structuring methodology, called Polyscopic Topic Maps, as basis for flexible and exploratory learning. It consists of a framework for structuring information based on TM data model and the concept of scope. One of the most interesting features of this project is the chance to design personal learning path taking care of the prerequisites.

5 Conclusions

In this paper the Topic Maps standard and a semantic model for learning paths design has been presented. The main goals to achieve are interoperability of educational contents, reusability of both the contents and their knowledge structures, personalization of contents and services.

In order to test the ontology and to verify requirements (especially the compatibility with e-learning standards), currently, we are using it to model some courses at the University of Genoa. At the same time, we are investigating other approaches that use semantic technologies for learning paths design, in order to compare our model with them. One of the most interesting solutions is that implemented into Intelligent Web Teacher (IWT), a learning platform that enables users to create their own personalised learning paths exploiting a knowledge representation tool which allows teachers to define and structure disciplinary domains, by constructing domain dictionaries and ontologies. [17].

Moreover, we are interested in methodologies that allow formalizing the knowledge acquisition process and, as a consequence, the ontology-driven conceptual analysis. In regard to this issue, we are exploring OntoClean, a formal methodology that applies domain-independent notions,

used for ontological analysis in philosophy (such as, essence, identity, and unity), to analyze conceptual modelling process. These notions are exploited to define a set of meta-properties which permit to characterize relevant aspects of the intended meaning of the properties, classes, and relations that make up an ontology [18].
Nevertheless, the proposed scenarios have to be carefully considered about the risk of over-engineering of the knowledge and about a possible wrong interpretation of education which has not to be considered a mere summing of learning contents. Learning is a social process first of all and it cannot be limited with technical and/or formal boundaries [11]. Based on these considerations, it is worthwhile noticing that the proposed approach must be accompanied with the design of well suited educational strategies and supporting services, also in fulfillment of the recent results in the field of socio-constructivist theory.

References

1. C. Petrucco, *Le prospettive didattiche del Semantic Web*, Atti Didamatica 2003, pp.168-176.

2. J. Park and S. Hunting (Eds), *XML Topic Maps: Creating and Using Topic Maps for the Web* (Addison Wesley, Boston MA, 2002).

3. S. Newcomb, *A Perspective on the Quest for Global Knowledge Interchange*, in: Park J., Hunting S. (Eds), *XML Topic Maps: Creating and Using Topic Maps for the Web* (Addison Wesley, Boston MA, 2002).

4. H. Holger Rath, *The Topic Maps Handbook*, 2003 (unpublished), p.45; http://www.empolis.com/downloads/empolis_TopicMaps_Whitepaper20030206.pdf.

5. ISO/IEC JTC1/SC34/WG; http://www.isotopicmaps.org/.

6. ISO/IEC IS 13250-2:2006: Information Technology - Document Description and Processing Languages - Topic Maps - Data Model. International Organization for Standardization, Geneva, Switzerland; http://www.isotopicmaps.org/sam/sam-model/.

7. S. Pepper, *The TAO of Topic Maps*, Proceedings of XML Europe 2000, Paris France (2000); http://www.ontopia.net/topicmaps/materials/tao.html.

8. L.M. Garshol, What are topic maps?, 2002 (unpublished); http://www.xml.com/pub/a/2002/09/11/topicmaps.html.

9. ADL Advanced Distributed Learning, Sharable Content Object Reference Model (Scorm); http://www.adlnet.org.

10. G. Adorni, M. Coccoli, G. Vercelli, and G. Vivanet, *Topic Maps e XTM per l'e-learning*, Journal of e-Learning and Knowledge Society, n°3 September 2007.

11. R. Koper, *Modeling Units of Study from a Pedagogical Perspective: the pedagogical meta-model behind EML*, Heerlen: Open Universiteit Nederland, (2001); http://dspace.learningnetworks.org/handle/1820/36?mode=simple.

12. L. Kolås, A. Staupe, *The PLExus Prototype: A PLE Realized as Topic Maps*, Seventh IEEE International Conference on Advanced Learning Technologies (2007).

13. R. Koper, *Use of the Semantic Web to Solve Some Basic Problems in Education*, Journal of Interactive Media in Education (1), Special Issue on the Educational Semantic Web (2004).

14. D. Dicheva, C. Dichev, *TM4L: Creating and Browsing Educational Topic Maps*, British Journal of Educational Technology - BJET, 37(3), 391-404 (2006).

15. M. Ouziri, *Semantic integration of Web-based learning resources: A Topic Maps-based approach*, The 6th IEEE International Conference on Advanced Learning Technologies, (ICALT), Kerkrade, The Netherlands, July 4-7, pages 875-879 (2006).

16. D. Karabeg, R. Guescini, and T. Nordeng, *Flexible, Exploratory Learning by Polyscopic Topic Maps*, Proc. of the 5th IEEE International Conference on Advanced Learning Technologies ICALT 2005, Kaohsiung, Taiwan, July 2005.

17. G. Albano G., M. Gaeta, and P. Ritrovato, P., IWT: an innovative solution for AGS e-learning model, Int. J. Knowledge and Learning, Vol. 3, Nos. 2/3, pp.209–224 (2007).

18. N. Guarino and C. Welty, An Overview of OntoClean, in S. Staab and R. Studer, eds., The Handbook on Ontologies, pp. 151-172, Berlin:Springer-Verlag (2004).