User Models and User Modeling for Knowledge Management Systems:
An Ontology based User Modeling Approach

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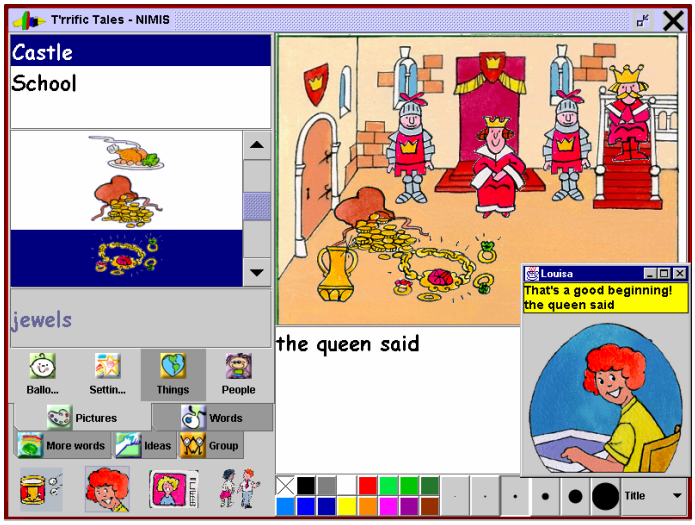
PhD defense, Wednesday the 3rd of December 2003

Content of defense presentation

1. Introduction
   - Context of research: Nimis, I3 project, KInCA a Xerox funded project, Ontologging, an IST, EC funded project;
   - What are the challenges of a next generation of KMSs?
2. Thesis statement
   - Research questions;
3. Related work
4. Thesis contributions
   - Ontology-based user modeling framework- OntobUMf
5. Conclusions

Louisa in Terrific tales



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Introduction

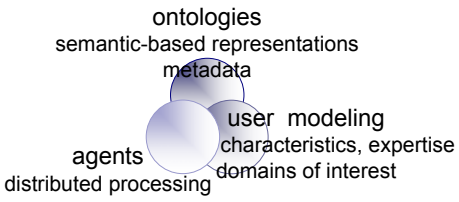
- Context of research: Ontologging project
  - A next generation of KMSs: ontologies, user modeling and agents.
- What are Knowledge Management Systems?
  - Information systems dedicated to manage organizational knowledge. [Leidner and Alavi, 2001]

KMSs aim to integrate complex knowledge processes:

Collaboration between employees;
Learning processes;
Management of tacit knowledge;

Introduction-A next generation of KMSs

- "Content is not correctly organized, not updated or duplicated."
  - to better organize knowledge
- "These tools need major improvement to allow users use Knowledge tools in an easy way, spending few time and don't lose among hundreds of document", "save time when I am looking for a solution"
  - powerful mechanisms to filter relevant knowledge and advanced user support;
- "To know what people know and to make their experience with technology and products accessible".
  - to better manage the tacit knowledge;



Content of defense presentation

1. Introduction
   - Context of research: Ontologging, an IST, EC funded project;
2. Thesis statement
   - Research questions;
3. State of the art
4. Thesis contributions
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Thesis statement

- Knowledge workers are the key element for the management of the tacit knowledge;
  - growing interest in better managing the tacit knowledge;
- User model and user modeling can contribute to enhanced/advanced functionalities of KMS
  - users are different and they have different specific needs;
  - alleviate information overload problem;
  - support for collaboration and learning processes;
- An ontology-based user modeling approach is beneficial not only in the context of an ontology-based KMS.
  - reusable user models implemented using Semantic Web technology.

Research questions

- Why is it important to model users of a KMS?
  - What are the relevant characteristics of the users of a KMS?
  - What type of user's behavior can be distinguished in a KMS?
  - How to track and maintain the user models in a KMS?
- How can a user model improve the interaction with a KMS?
  - What type of intelligent /personalized services can be provided based on the user's characteristics?
- What are the advantages/limitations of applying ontologies in user modeling?
- What are the perspectives of its use in the context of the Semantic Web?

Related work

- User modeling research
  - techniques for adaptive hypermedia and personalized interactions [Kobsa, 2002],[Brusilovsky, 1996, 2001], [DeBra, 1999]
  - Reusable user models Kay [1999; 2001]
- Ontology research
  - Ontology, agents and corporate memory: FRODO [Van Elst & Abecker, 2001], CoMMA [Gandon and Dieng-Kuntz, 2001]
  - Ontology based personalization: EPOS [Schwarz and Roth-Berghofer,2002], Elena [Dolog et. al., 2003];

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What are ontologies?

- "*Ontology is a specification of a conceptualization*" [Gruber, 1993]
- "*The subject of ontologies is the study of the categories that exist or may exist in some domain.*" [Sowa, 2000]
- "*Representation vocabulary typically specialized to some domain or subject matter.*" [Chandrasekaran et al.,1998]
- "*Sort of world view with respect to a given domain* " [Uschold and Gruninger, 1996]

What are ontologies?

Definition

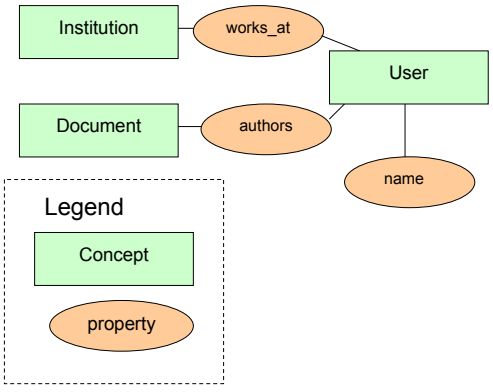
An ontology structure O:={C, R, H^C, r, A^O} consisting of:

- C – concepts, R – relations.
  $C \cap R = \phi$
- H^C - a concept hierarchy or taxonomy.
  $H^C \subseteq C \times C$
  Example: H^C(C1, C2), C1 is a sub concept of C2.
- r: non-taxonomical relations defined between concepts.
  r: $R \rightarrow C \times C$
  dom: $R \rightarrow C$ with dom(R) := $\Pi 1$(rel(R)), domain of R.
  range: $R \rightarrow C$ with range(R) := $\Pi 2$(rel(R)).
- $A^{O:}$ set of axioms.

How can an ontology be formalized?

- Ontology languages
  - CycL [Lenat and Guha, 1990], KIF [Genesereth and Fikes, 1992], Ontolingua [Gruber, 1992]
- Web ontology languages
  - XML is a W3C standards for structuring data and documents
  - RDF/RDFS are W3C standards for representing information and metadata on the web
  - KAON, DAML+OIL,OWL are related to the Semantic Web initiative

User modeling using Resource Description Framework (Schema)




```
<rdfs:Class rdf:ID="User">
   <rdfs:label xml:lang="en">User</rdfs:label>
</rdfs:Class>
<rdfs:Class rdf:ID="Document">
   <rdfs:label
      xml:lang="en">Document</rdfs:label>
</rdfs:Class>
<rdfs:Class rdf:ID="Institution">
   <rdfs:label
      xml:lang="en">Institution</rdfs:label>
</rdfs:Class>
<rdf:Property rdf:ID="works_at">
   <rdfs:label xml:lang="en">works_at</rdfs:label>
   <rdfs:domain rdf:resource="#User"/>
   <rdfs:range rdf:resource="#Institution"/>
</rdf:Property>
<rdf:Property rdf:ID="author">
   <rdfs:label xml:lang="en">author</rdfs:label>
   <rdfs:domain rdf:resource="#User"/>
   <rdfs:range rdf:resource="#Document"/>
</rdf:Property>
```


User ontology building

Methodology developed by [Uschold and Gruninger, 1996]

Step1 Specification phase

- Extends IMS LIP-upper ontology

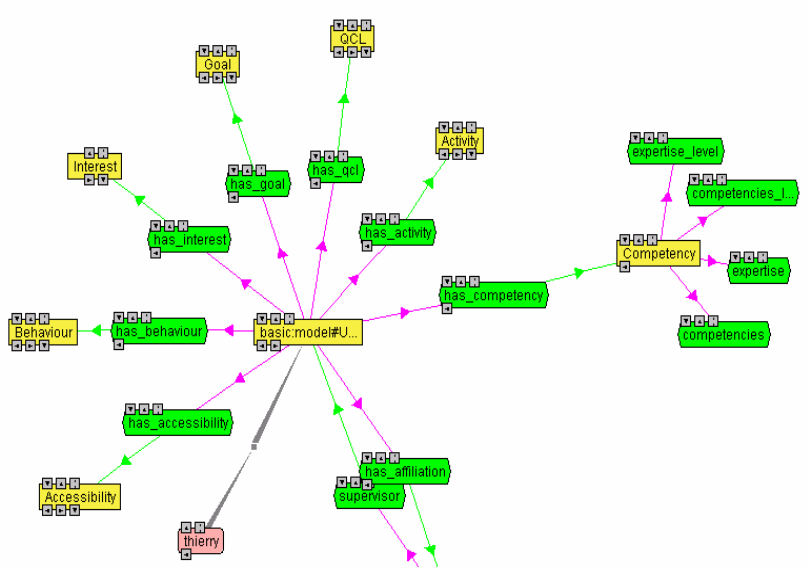
Step 2 The process of coding

- KAON comprises a set of tools for ontology management and an ontology API for developing ontology-based applications
- Web ontology language extending RDF/RDFS
- OWL was not available

Step 3 The process of integrating with existing ontologies

- The definition of similar concepts as synonyms
- Different representation languages

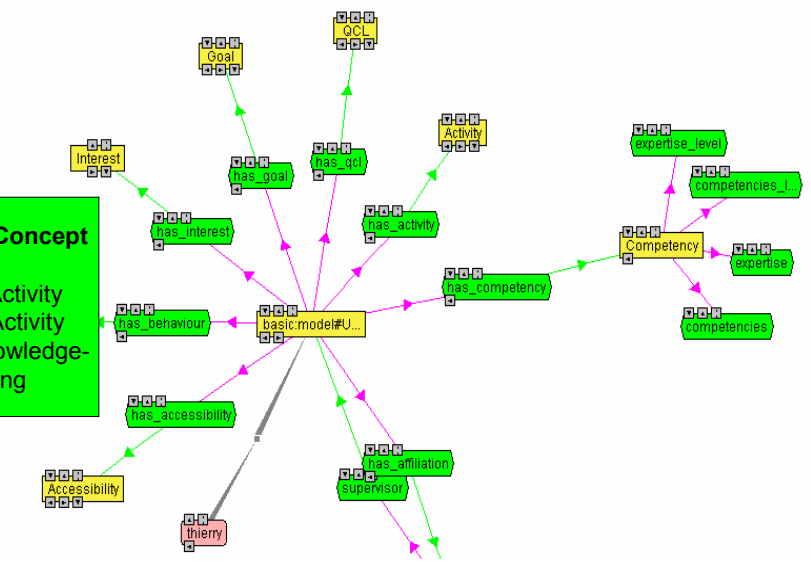
User Ontology



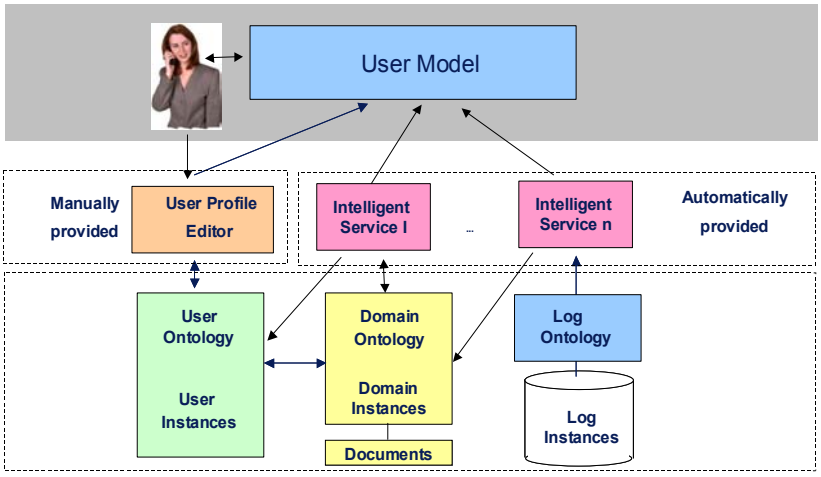
User Ontology

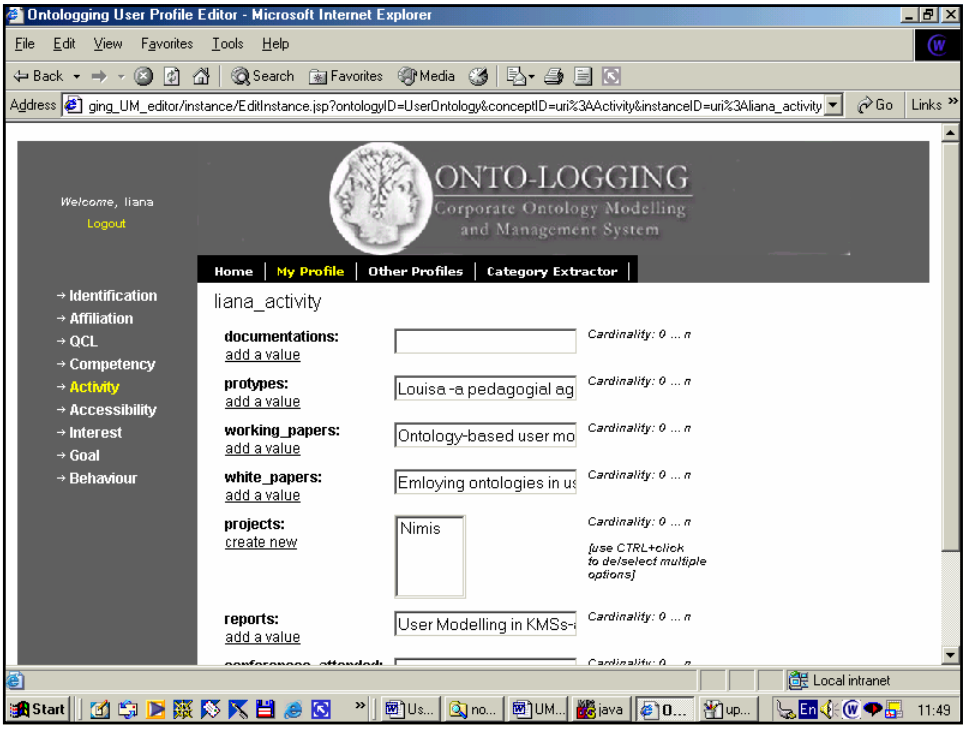
Behavior Concept

TypeOfActivity
LevelOfActivity
LevelOfKnowledge-Sharing

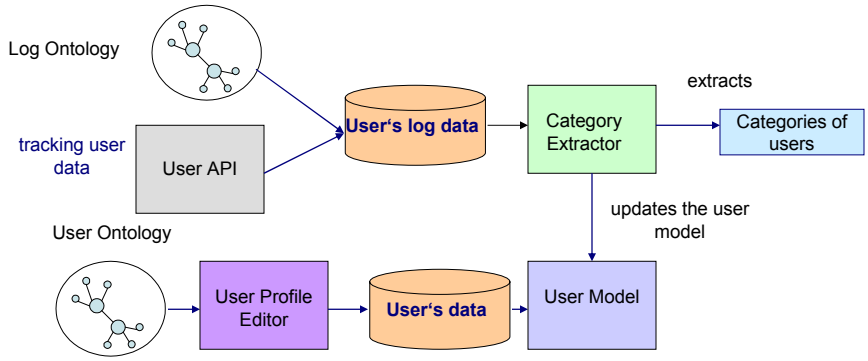


Ontology-based user modeling framework (OntobUMf)





Intelligent service Category Extractor



Category extractor –extracting characteristics of users

- Categories of users obtained by processing the logs (heuristics + fuzzy logic);
  - **Type of Activity**: Readers/ Writers/ Lurkers;

    If (nb_of_read_papers>NR) and (nb_of_contributions <NC)
    then user(x) =”reader” (during timeframe)
    If (nb_of_contributions>=NC) then user(x) =”writer” (during timeframe)
    ….
  - **Level of Activity**: Very Active/Active/Visitor/Inactive;

    If (nb_of_read_papers > NR) and (nb_of_contributions >=NC+1) then user(x) = “very active“

    ….

    If (nb_of_read_papers =0) and (nb_of_contributions =0) Then user(x) = “inactive” (during timeframe)

Category extractor –extracting characteristics of users

- **Level of Knowledge Sharing**:

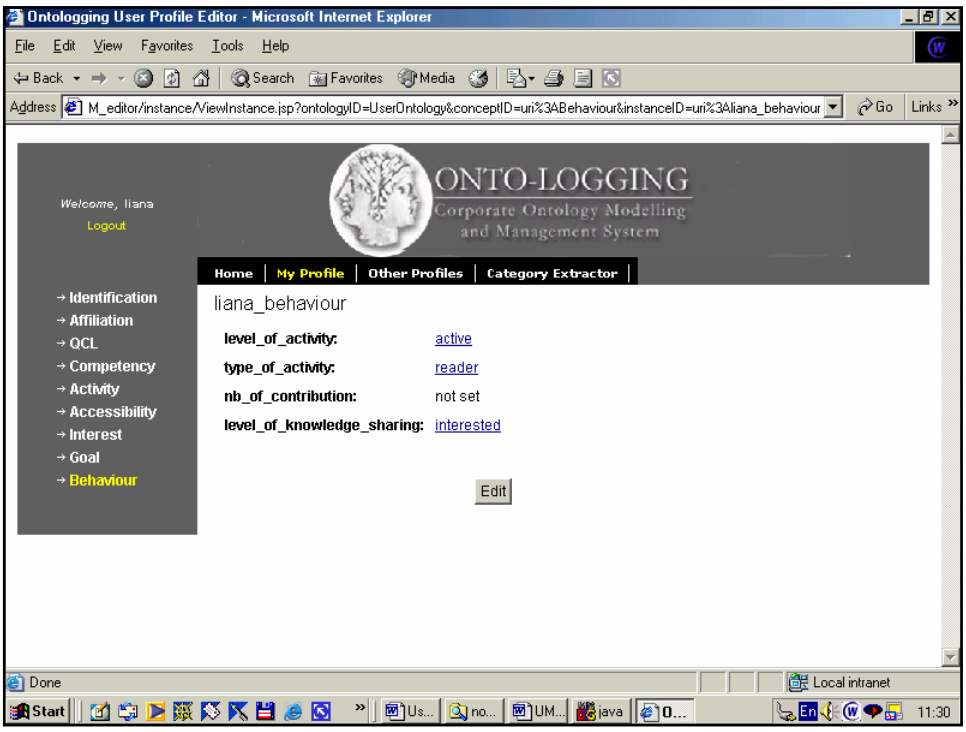
  Y=f(x1, x2)– [very high, high, medium, low, very low]

  x1 the type of activity: [high, medium, low]

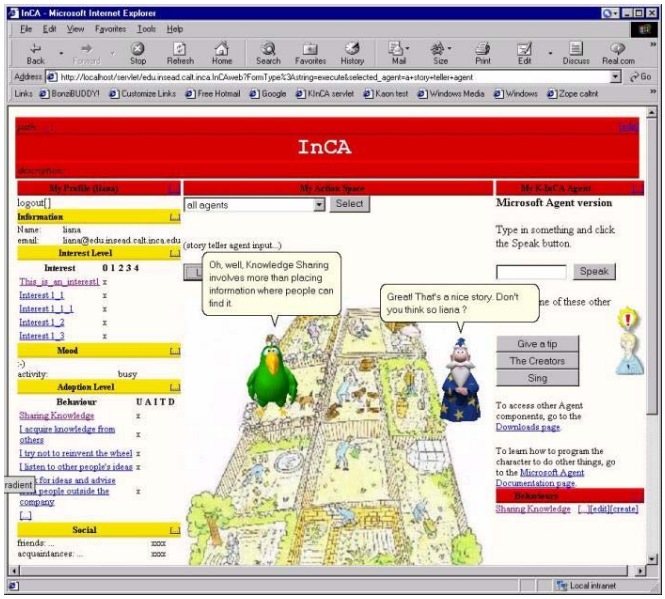
  x2 the level of activity: [high, medium, low, very low]

$Y=f(x_1, x_2)$	high	medium	low	very low
high	very high	very high	medium	
medium	high	medium	low	
low			very low	very low

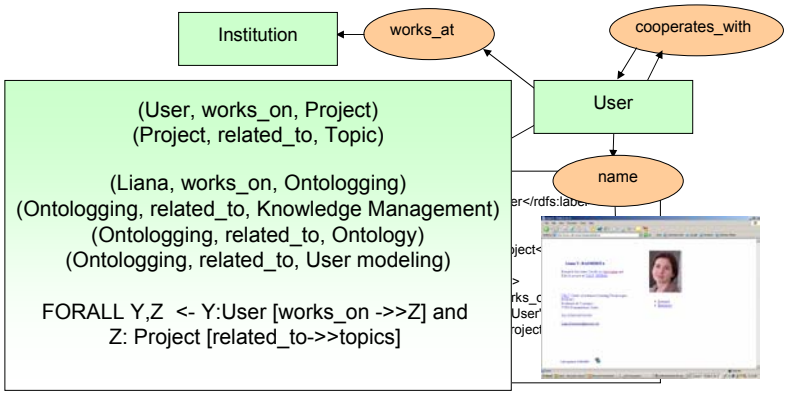
The calculus of the level of knowledge sharing



KInCA - Story telling agents



Ontology-based user modeling- expertise modeling application scenario



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5. Conclusions, evaluation results and future work

Conclusions

- User ontology extending IMS LIP package
- Ontology-based user modeling
  - Traditional knowledge representation mechanisms for user models are: semantic networks, conceptual graphs, object
  - Ontology facilitates knowledge sharing and building reusable user model
  - Metadata can be used to infer characteristics of the knowledge workers: (e.g. the expertise of the user, the activity etc.)

Evaluation results and conclusions

- OntobUMf- CE models the Behavior of the users
  - the level of knowledge sharing;
  - the type of activity;
  - the level of activity;
- Recognition and promotion are key incentive for knowledge sharing for the Indra knowledge workers;
- Certain users are concerned with privacy and trust issues
  - User's profile should be only partial available in a KMS;
  - Users want to be in control and to maintain their profiles;
  - The use of combo box would facilitate the acquisition of the user's data and the consistency of the terminology;

Evaluation results and conclusions

- Personalization is an important issue due to "information overload" problem and heterogeneity of the users
  - Adaptation of content (templates), notifications through knowledge distribution agents
- Expertise modeling is important element for KMS
  - User modeling a better management of the tacit knowledge
  - User modeling techniques can be employed to maintain characteristics of the users

Future work

- Privacy issues but it opens perspectives related to personalization, collaboration, learning, etc. all around the web
- Extension of the user ontology
- An extended e-learning scenario
- An ubiquitous computing scenario