# A3-D6

# Testbeds II - Early Prototypes

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A3-D6 delivers demonstrators and prototypes of personalized information systems. In this accompanying report we continue the documentation strategy developed in deliverable A3-D2, were we gave a detailed analysis on use cases of partners in the REWERSE network, and analyzed these use cases. This accompanying report provides an improved version of the questionnaire developed in A3-D2, and gives an overview on current prototypes in both human- and machine-readable form. Guidelines for development of use cases have been incorperated in this documentation. During the development of the prototypes, some key issues on personalization for the Semantic Web have been identified during various discussions and meetings. We summarize these findings in a brief lessons-learnt section, and conclude the report with a roadmap of future work in A3.

**Keyword List**
personalization, semantic web, rules and reasoning for personalization

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# Testbeds II - Early Prototypes

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28 Februar 2006

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A3-D6 delivers demonstrators and prototypes of personalized information systems. In this accompanying report we continue the documentation strategy developed in deliverable A3-D2, were we gave a detailed analysis on use cases of partners in the REWERSE network, and analyzed these use cases. This accompanying report provides an improved version of the questionnaire developed in A3-D2, and gives an overview on current prototypes in both human- and machine-readable form. Guidelines for development of use cases have been incorperated in this documentation. During the development of the prototypes, some key issues on personalization for the Semantic Web have been identified during various discussions and meetings. We summarize these findings in a brief lessons-learnt section, and conclude the report with a roadmap of future work in A3.

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# Contents

# Executive Summary

This deliverable reports about current prototypes and use-cases which demonstrate how to realize personalized access to Semantic Web information. It provides an synopsis of the prototypes and use-cases in a standardized way:

1. A machine-readable description of the prototypes, following the suggestion of the W3C Semantic Web Best Practices and Deployment Working Group `http://www.w3.org/2001/sw/BestPractices/` to describe the use-cases, using the DOAP schema `http://esw.w3.org/topic/SemanticWebDOAPBulletinBoard`.

2. A human-readable add-on, focussing explicitly to the requirements of REWERSE and in particular to reasoning methods. This description is again standardized, by using an improved version of a questionnaire which has been developed in a previous deliverable (A3-D2).

This deliverable also summarizes our achievements for concise descriptions of use-cases, consisting of a machine-readable and a human-readable part (according to which the current use-cases are described in the first part of the deliverable).

Furthermore, this deliverable gives in a lessons-learnt section some insights of personalized access to information in the Semantic Web and the World Wide Web in general.

# 1 Testbeds

In this section the collect a list of currently available testbed prototypes, using a refined questionnaire and providing machine-readable data, followed up by a list of more general Guidelines, appropriate to apply to new testbeds that are going to be developed. For each prototype we collected a machine-readable description of the project, following the suggestion of the W3C Semantic Web Best Practices and Deployment Working Group[1]. Description-of-a-Project, or DOAP, is a RDF Schema to support the easy importing and exchange of projects in software directories, automatic configuration for resources like source code repositories or bug trackers, and to assist maintainers in bundling software for distributors. Figure 1 shows two additional representations created from the DOAP description of the Personal Reader Framework, an HTML description created with hDOAP[2] as a human readable format, and the RDF Graph as a machine readable representation. The RDF document for each project is included in Appendix 4, a visual representation precedes each of the testbed summaries.

Furthermore, for each prototype we collected additional data focusing explicitly on the requirements of REWERSE and in particular the reasoning methods relied upon by the different projects. This description is again standardized, by using an improved version of a questionnaire which has been developed in a previous deliverable (A3-D2).

## 1.1 WLog (University of Torino, Italy)

**Keywords:** e-learning, curriculum sequencing, reasoning about actions

**Main publications:**

M. Baldoni, C. Baroglio, and V. Patti.
Web-based adaptive tutoring: an approach based on logic agents and reasoning about actions.
Artificial Intelligence Review, 22(1):3-39, 2004.

M. Baldoni, C. Baroglio, and V. Patti.
Applying logic inference techniques for gaining flexibility and adaptivity in tutoring systems.
In C. Stephanidis, editor, Proceedings of the 10th International Conference on Human-Computer Interaction (HCII 2003), Symposium on Human Interfaces 2003, 5th Intrnational Conference on engineering Psychology and Cognitive Ergonomics, 2th International Conference in Human-Computer Interaction, volume 4, pages 517-521, Crete, Greece, June 2003.
Lawrence Erlbaum Associates, Inc.

M. Baldoni, C. Baroglio, V. Patti, and L. Torasso.
Using a rational agent in an adaptive web-based tutoring system.
In P. Brusilovsky, N. Henze, and E. Millán, editors, Proc. of Workshop on Adaptive

[1]`http://www.w3.org/2001/sw/BestPractices/`
[2]`http://dannyayers.com/xmlns/hdoap/profile/`

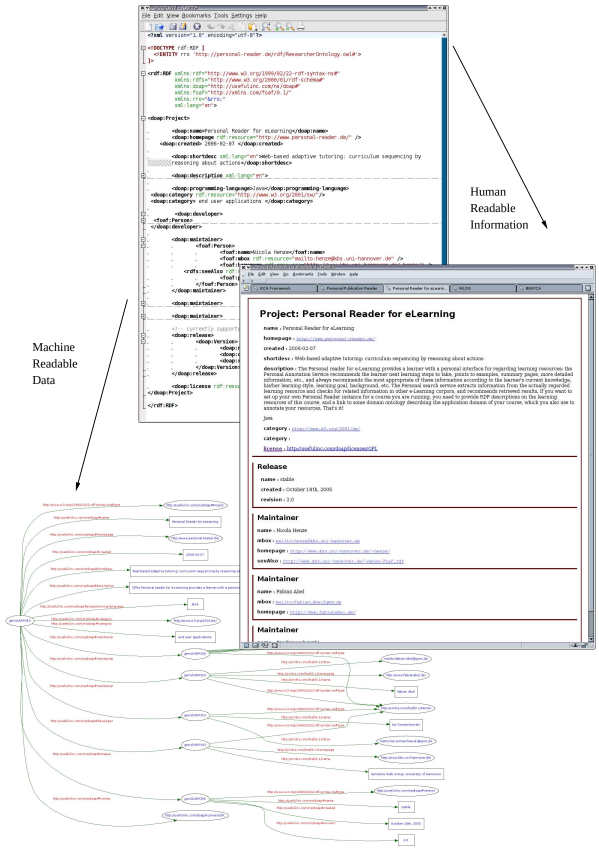


Figure 1: DOAP Data

System for Web-based Education, AH'2002, pages 43-55, Malaga, Spain, May 2002.

1. Reasoning and Rules:
   (a) Which reasoning techniques do you currently use?
   (b) Are you currently using a rule-based approach for enabling personalization functionalities?
   (c) If yes, how deduction rules are used for performing personalization?
   (d) Is there any exchange of rule sets in your application?
   (e) Does your application offer some explanation of the reasoning behind your personalization features?

   *WLog exploits goal-driven techniques for reasoning about actions and change for enabling personalization functionalities. In particular procedural planning*


Figure 2: DOAP: W-Log

*is used for building personalized study plans w.r.t the user learning goal, temporal projection for verifying the correctness of a linear plan built by the user, and temporal explanation for explaining to the user the reasons of the possible incorrectness. We are currenly using a rule-based approach. Indeed, the WLog reasoners, that are actually performing the reasoning-based personalization, have been implemented in DyLOG which is logic a programming language based on a modal action logic. The above-mentioned reasoning techniques are based on the proof procedure of the language DyLOG, whose rules have the form of sequent-like derivation rules.*

2. Knowledge representation:

   (a) Which techniques/languages do you use?

   *The WLog knowledge base is written in DyLOG and includes knowledge about the users expertise, knowledge about the single courses, and a set of curriculum schemas.*

*Courses: Each course is represented as an atomic action, on the basis of prerequisites (what the student should know for understanding the course contents) and effects (what the student is supposed to learn by attending the course). More precisely, the course is interpreted as the action of attending the course.*

*Competences: Prerequisites and effects of courses are expressed by means of 'knowledge entities', i.e. ontology terms. We call such terms competences.*

*Schema of curricula: We also exploit the concept of complex action for representing more abstract competences, defined as a combination of other competences. This concept allows the definition of schemas of curricula that make sense from a pedagogical point of view. Each schema, actually, allows many different solutions to be built, depending on the available courses and on the specific desires of the user.*

*User's competence: Is represented by DyLOG facts. Knowledge about the users learning goal is encoded in DyLOG queries.*

3. Adaptation / Personalization:

   (a) Which kind of adaptation do you currently use?

   (b) Which techniques do you use?

   (c) What is the goal of the adaptation?

   (d) In which phase the information is filtered according to the user's particulars (context, preferences, goal,...)? During the information request phase? During the information retrieval phase? During the information selection phase? Or, finally, during the information shipping phase?

   *Our application mainly enables curriculum sequencing , i.e., building a study plan, and validation of a student-given study plan.*

   *Curriculum sequencing: It is a multi-step sequencing (and not a suggestion of the next step only) and conditional plans can be returned, not only linear plans. The goal of adaptation is to produce sequences of courses that fit on the one hand the specific user characteristics (users with different initial knowledge will be suggested different solutions), on the other hand the users learning goal. Adaptation occurs at the level of the reading sequence rather than at the level of page contents, and it is done w.r.t. the users goal rather than w.r.t. a user model. No techniques of link hiding nor a semaphore annotation are used.*

   *Validation: Given a study plan compiled by a student according to his personal taste and interests, a validation process can be enabled for checking if the plan satisfies the learning dependencies of the domain, allowing to achieve some desired learning goal.*

4. User Model:

   (a) Dynamics of the user model:

      i. are there updates? If yes, which kind of updates?

ii. are there changes of the user model? If yes, of which kind?

iii. do these changes trigger automatically reactions? If yes, how, and what kind of reactions?

*The application does not deal with user-model updates.*

5. Data:

(a) Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations? ). Is your data distributed?

*It is a knowledge base, written in Prolog and it is **not distributed**.*

6. Architectures:

(a) Which kind of architecture and technological solutions did you choose for implementing your appplication (Web services architecture, agent tecnology, other solutions...)?

*Wlog is a multi-agent architecture. Agent technology allows complex systems to be easily assembled by means of the creation of distributed artifacts, that can accomplish their tasks through cooperation and interaction. Wlog consists mainly of two kinds of agents: reasoners and executors. Reasoners are written in DyLOG, whereas executors are Java servlets embedded in a Tomcat web server. Executors are the interface between the rational agents and the users; they mainly produce HTML pages, driven by the directives sent by reasoners, and they forward the collected data to the reasoners themselves. Reasoners collect inputs from the users (preferences, goals, information about the current educational situation) and invoke the inference mechanism of the DyLOG language on the domain knowledge model in order to accomplish one of the possible adaptive services.*

7. Comments, important aspects that you would like to highlight?

### 1.2 PR-el: the Personal Reader for e-Learning

**Keywords:** e-Learning, adaptive annotation support, Standards for describing e-Learning resources, personalization services

**Main publications:**

Nicola Henze: Personal Readers: Personalized Learning Object Readers for the Semantic Web. 12th International Conference on Artificial Intelligence in Education, AIED'05, 18-22 July 2005, Amsterdam, The Netherlands.

Nicola Henze: Personalization Services for the Semantic Web: The Personal Reader Framework. Framework 6 Project Collaboration for the Future Semantic Web Workshop at European Semantic Web Conference ESWC 2005, Heraklion, Greece, May 29 - June 1 2005.

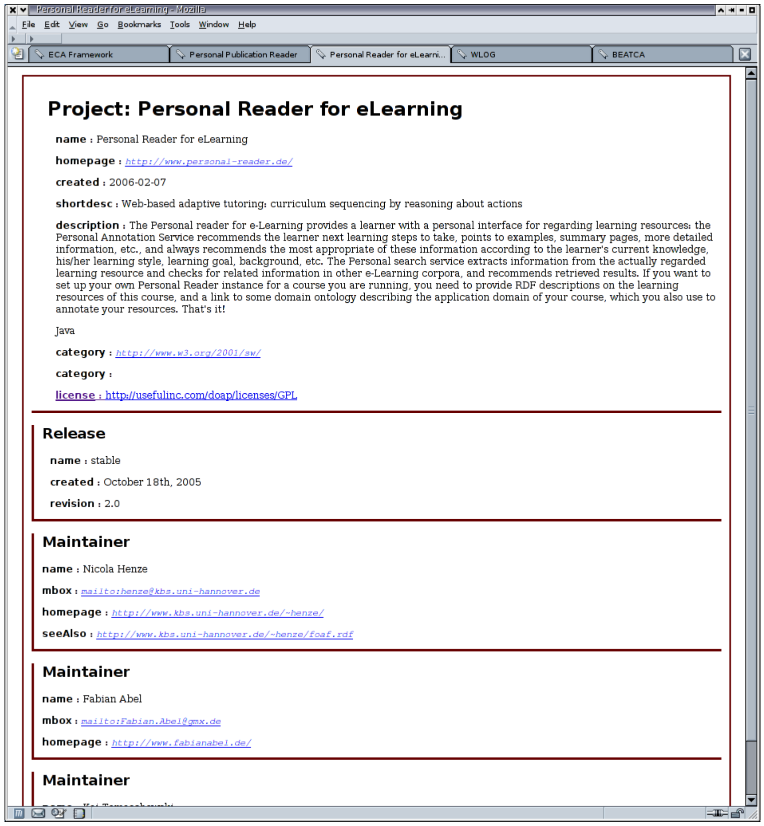


Figure 3: DOAP: Personal Reader for eLearning

1. Reasoning and Rules:
   (a) Which reasoning techniques do you currently use?

       *Triple.*

   (b) Are you currently using a rule-based approach for enabling personalization functionalities?

       *Yes, several so-called personalization rules infer relations between resources with user-specific constraints.*

   (c) If yes, how deduction rules are used for performing personalization?
   (d) Is there any exchange of rule sets in your application?

       *No.*

   (e) Does your application offer some explanation of the reasoning behind your personalization features?

       *No.*

2. Knowledge representation:

(a) Which techniques/languages do you use?

*Currently, we use RDF descriptions of e-learning materials, user profiles, and for expressing requests to the Personalization Services / the Web Services. E-learning materials are described according to Standards for e-learning materials: LOM.*

3. Adaptation / Personalization:

   (a) Which kind of adaptation do you currently use?

   (b) Which techniques do you use?

   *Adaptive navigation support, adaptive context provision.*

   (c) What is the goal of the adaptation?

   *Embed a learning resource into a context: e.g. more details related to the topics of the learning resource, the general topics the learner is currently studying, examples, summaries, quizzes, etc. are generated and enriched with personal recommendations according to the learner's current learning state.*

   (d) In which phase the information is filtered according to the user's particulars (context, preferences, goal,...)? During the information request phase? During the information retrieval phase? During the information selection phase? Or, finally, during the information shipping phase?

   *At request time: by determining which query to send*

4. User Model:

   (a) Dynamics of the user model:

      i. are there updates? If yes, which kind of updates?

      *The user models consists mainly of a log of a user's history.*

      ii. are there changes of the user model? If yes, of which kind?

      *Yes, whenever a learner accesses some page, this event is triggered to the User Model Component which updates the user profile.*

      iii. do these changes trigger automatically reactions? If yes, how, and what kind of reactions?

      *Yes: update the user profile by including the page related to the event into the set of visited pages of a learner.*

5. Data:

   (a) Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations? ). Is your data distributed?

   *Metadata annotations in RDF, no further data, no database.*
   *The RDF descriptions of the courses, e-learning resources, and the users are **distributed**.*

6. Architectures:

(a) Which kind of architecture and technological solutions did you choose for implementing your appplication (Web services architecture, agent tecnology, other solutions...)?

*Service-oriented architecture, using UDDI and WSDL, currently moving to Semantic Web Services. In the Personal Reader Framework, we are experimenting with Personalization Services on the Web. With the data in the e-Learning domain, we plan to investigate how Personalization Services can be*

- *implemented*
- *orchestrated*
- *powered by different reasoning techniques*

7. Comments, important aspects that you would like to highlight?

### 1.3 PPR - the Personal Publication Browser: A Personal Reader Application

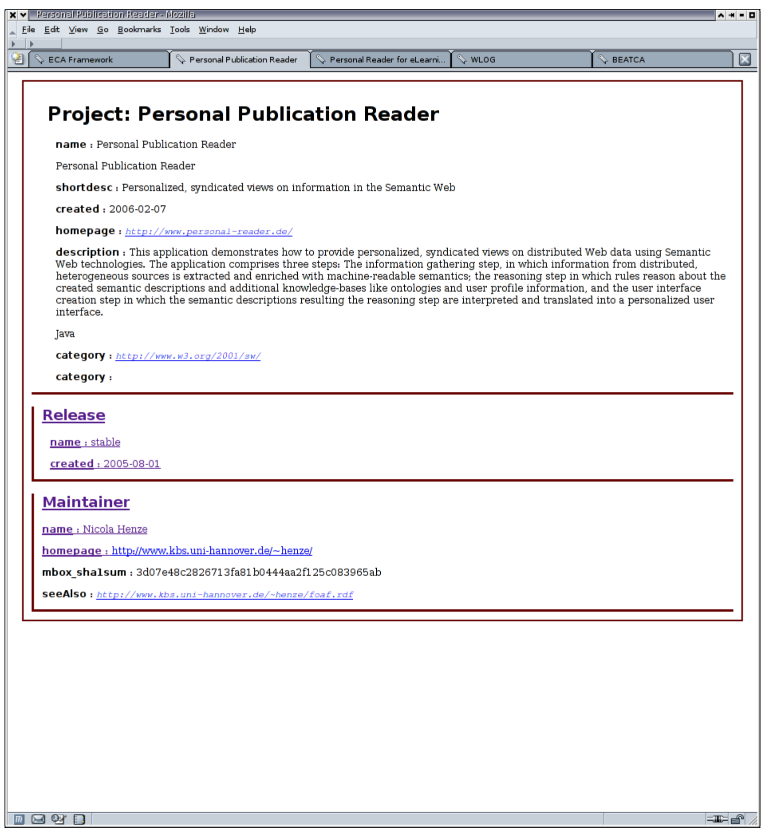


Figure 4: DOAP: Personal Publication Reader

**Keywords:** Personal Context Provision, Personalization Service, Personal Reader

**Main publications:**

Fabian Abel, Robert Baumgartner, Adrian Brooks, Christian Enzi, Georg Gottlob, Nicola Henze, Marcus Herzog, Matthias Kriesell, Wolfgang Nejdl, Kai Tomaschewski: The Personal Publication Reader. Semantic Web Challenge, 4th International Semantic Web Conference, November 6-10 2005, Galway, Ireland.

Robert Baumgartner, Nicola Henze, and Marcus Herzog: The Personal Publication Reader: Illustrating Web Data Extraction, Personalization and Reasoning for the Semantic Web. European Semantic Web Conference ESWC 2005, Heraklion, Greece, May 29 - June 1 2005.

1. Reasoning and Rules:
   (a) Which reasoning techniques do you currently use?

   *Triple, and Jena's RDQL Language.*

   (b) Are you currently using a rule-based approach for enabling personalization functionalities?

   (c) If yes, how deduction rules are used for performing personalization?

   *Yes, several so-called personalization rules infer relations between resources with user-specific constraints.*

   (d) Is there any exchange of rule sets in your application?

   *No*

   (e) Does your application offer some explanation of the reasoning behind your personalization features?

   *No*

2. Knowledge representation:
   (a) Which techniques/languages do you use?

   *RDF (as the goal format of data on publications extracted from the Web), and OWL for describing Persons.*

3. Adaptation / Personalization:
   (a) Which kind of adaptation do you currently use?

   (b) Which techniques do you use?

   *Adaptive navigation support*

   (c) What is the goal of the adaptation?

   (d) In which phase the information is filtered according to the user's particulars (context, preferences, goal,...)? During the information request phase? During the information retrieval phase? During the information selection phase? Or, finally, during the information shipping phase?

*At request time: by determining which query to send*

4. User Model:

   (a) Dynamics of the user model:

      i. are there updates? If yes, which kind of updates?

         *No updates. In each session, the user specify their interests, this is not updated during a session*

      ii. are there changes of the user model? If yes, of which kind?

         *No*

      iii. do these changes trigger automatically reactions? If yes, how, and what kind of reactions?

5. Data:

   (a) Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations? ). Is your data distributed?

      *Only metadata annotations in RDF, OWL, aggregated from various sources.*

      **source data:** *at distributed web sites in changing formats,*

      **ontologies:** *distributed and maintained by different authorities.*

6. Architectures:

   (a) Which kind of architecture and technological solutions did you choose for implementing your appplication (Web services architecture, agent tecnology, other solutions...)?

      *Service-oriented architecture, using UDDI and WSDL, currently moving to Semantic Web Services.*

7. Comments, important aspects that you would like to highlight?

   - *need for reasoning techniques that can deal with increasing data / knowledge bases, e.g. non-monotonic reasoning*
   - *need for constructing knowledge bases on the fly which can be handeled by reasoners in real-time: We are constructing data which is more like data in databases, and we have no heuristics to limit the data beforehand. This causes a serious performance problem.*
   - *real-time reasoners*
   - *for the extensions of the PPR to be a starting point of a portal: reasoning techniques that allow to reason on highly-annotated data (on the REWERSE portal side), and less annotated data (outside of the REWERSE portal side)*

### 1.4 BEATCA (Institute of Computer Science, Polish Academy of Sciences)

**Keywords:** Conceptual maps, intelligent navigation, WWW, Bayesian networks, artificial immune systems, growing neural gas


Figure 5: DOAP: BEATCA Framework

**Main publications:**

(BEATCA:IIPWM2005) Krzysztof Ciesielski, Michal Draminski, Mieczyslaw Klopotek, Mariusz Kujawiak, Slawomir Wierzchon: On Some Clustering Algorithms for Document Maps Creation. Intelligent Information Processing and Web Mining. Advances in Soft Computing. Springer Verlag, Heidelberg New York 2005. ISBN-3-540-25056-5.pp.259-268 pdf

(BEATCA:ICAINN2005) M.Klopotek, s.Wierzchon, K.Ciesielski, M.Draminski, D.czerski: Coexistence of Crisp and Fuzzy Concepts in Document Maps. Konf. ICAINN LNCS vol. 3697/2005, Springer Verlag, , W. Duch,J. Kacprzyk, eds, part II pp. 859. pdf

(BEATCA:AI2005) Mieczys?aw A. K?opotek, S?awomir T. Wierzcho?, Krzysztof Ciesielski, Micha? Drami?ski, Dariusz Czerski, Mariusz Kujawiak: Understanding Nature of Map Representation of Document Collections ? Map Quality Measurements in: Proceedings of Artificial Intelligence Studies. Proc. 7th Int.Conf. on Artificial Intelligence, Publishing House of University of Podlasie, Siedlce, September 2005. , pp. 85-92 pdf

(BEATCA:AI2005CBN) Mieczys?aw A. K?opotek: Cyclic Bayesian Networks - Markov Process Approach. in: Proceedings of Artificial Intelligence Studies. Proc. 7th Int.Conf. on Artificial Intelligence, Publishing House of University of Podlasie, Siedlce, September 2005.pp. 33-38. pdf

1. Reasoning and Rules:

   (a) Which reasoning techniques do you currently use?

   *Reasoning based on a mixture of Bayesian networks, and artificial immune systems. Personalization is a feature to be added in the near future*

2. Knowledge representation:

   (a) Which techniques/languages do you use?

   *The internal knowledge is represented in terms of Bayesian networks (our own representation structures) and cluster hierarchies*

3. Adaptation / Personalization:

   (a) Which kind of adaptation do you currently use?

   *A through framework of adaptation to the incoming new document collections is developed, rooting basically in adaptive features of growing neural gas, large Bayesian network trees, and WebSOM?; special additional tools were needed to achieve intrinsic adaptability (mainly detection of main thematic groups in document collections). The goal of adaptation is to enable continuous growth of document map (without abrupt changes unpon re-indexing).*

4. User Model:

   *Currently, the system is not user-specific. It can, however, adapt to user query (selecting appropriate document map)*

5. Data:

   (a) Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations? ). Is your data distributed?

   *Data is not distributed. The system accepts HTML, free text and PDF documents as input, transforms them to inverse lists (vector space representation) for document retrieval and to document maps for presentation. All structures are mapped to a relational database*

6. Architectures:

   (a) Which kind of architecture and technological solutions did you choose for implementing your appplication (Web services architecture, agent tecnology, other solutions...)?

*We implemented the system "from scratch", creating a pure-Java solution, with cooperation with a relational (SQL) database.*

7. Comments, important aspects that you would like to highlight?

## 1.5 ECA Framework, University of Göttingen, Germany

**DOAP document of the Project** Figure 6 is a representation of the DOAP description for the ECA Framework.

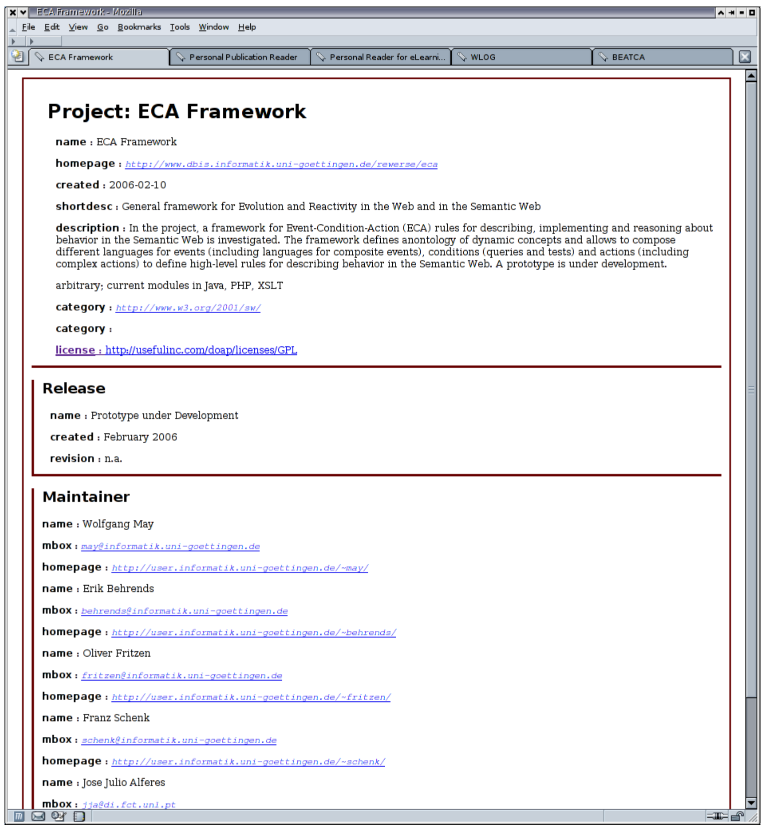


Figure 6: DOAP: ECA Framework

## 1.6 Synposis

### 1.6.1 Knowledge Representation and Reasoning Techniques

| | WLOG | PR | PPR | BEATCA |
|---|---|---|---|---|
| | WLog | Personal Reader for Elearning | Personal Publication Reader | BEATCA |
| Reasoning techniques *current*: | **DyLOG**: is a logic programming language based on a modal action logic. | **Triple** | **Triple, Jena RDQL** | Bayesian networks, and artificial immune systems |
| Using Rules: | **Yes** | **Yes** | **Yes** | n.n. |
| How Rules are used: | sequent-like derivation rules, procedural planning | personalization rules infer relations between resources with user-specific constraints | personalization rules infer relations between resources with user-specific constraints | |
| Exchanging Rules: | No | No | No | |
| User Feedback: | temporal explanation for explaining to the user the reasons of the possible incorrectness of a user-built plan | No | No | |
| Knowledge representation (technical) | **DyLOG** Knowledge Base | **RDF** Repository, LOM | **RDF**, OWL | Bayesian networks, cluster hierarchies |
| Knowledge representation (conceptual) | users expertise, knowledge about the single courses, and a set of curriculum schemas | e-learning materials, user profiles, and requests to the Personalization Services / the Web Services | publications and persons | Document collections |

### 1.6.2 Adaptation, Personalization and User Models

| | WLOG | PR | PPR | Beatca |
|---|---|---|---|---|
| Type of Adaptation | curriculum sequencing and validation | Adaptive navigation support, adaptive context provision. | Adaptive navigation support | adaptation is rooting in adaptive features of growing neural gas, large Bayesian network trees, and WebSOM |
| Goal | produce sequences of courses that fit the specific user characteristics and the users learning goal | Embed a learning resource into a context | | detection of main thematic groups in document collections, enable continuous growth of document map, without abrupt changes upon re-indexing |
| User Model | log of a user's history | | | not user specific |
| User Model Updates | | page access triggers the update of the user model | no updates | |

### 1.6.3 Data Structures and System Architecture

| | WLOG | PR | PPR | BEATCA |
|---|---|---|---|---|
| Data Repository | Knowledge Base: Prolog | Annotations in RDF | Aggregated Annotations in RDF and OWL | HTML, free text and PDF as vector space representation |
| Location of Data | **not distributed** | no database, RDF documents are **distributed** | sources are distributed and maintained by different authorities | structures are mapped to a relational database |

| | | | | |
|---|---|---|---|---|
| Architecture (current) | multi-agent architecture, Reasoners in DyLOG and Executors as Interface between user and agents. | SOA | SOA | RDBMS, SQL and pure-Java |
| Web Services | Java Servlets, Tomcat | Web Services with UDDI and WSDL | Service-oriented architecture (SOA) using UDDI and WSDL | |
| Architecture (planned) | providing reasoning services to other testbeds/applications | moving to Semantic Web Services, utilizing different reasoning | moving to Semantic Web Services | |

## 2 Guidelines for Testbeds

The following information and notes are meant as a guideline on how to effectively create and use testbeds, and how to identify important issues when designing prototypes, for the project in general, and also more specific for developing adaptive and personalized software.

For increasing visibility and as a central point of documentation, it is reasonable to create a standardized description of the project, like e.g. DOAP. In such a DOAP document, a short description, versioning information, contact information, etc. is provided. The DOAP description in this special format is readable by machines, and can thus be included in software repositories.

The questionnaire we used to collect the information for the catalogue of testbeds, and the questionnaire presented in A3-D2, can be seen as a tool to help identifying problems in the design phase of a new testbed or prototype, but also for already established use-cases as a synoptical description on main characteristics.

The following list of topics shortly describes the aspects covered by the questionnaire:

**Reasoning and Rules** This aspect covers reasoning mechanisms and rules used in the (personalized) system. It provides a quick reference, e.g. for finding a suitable prototype / testbed to test a technology or verify an assumption.

**Knowledge Representation** Knowledge- and representation languages, dynamical and evolutionary aspects are summarized here.

**Adaptation/Personalization** Adaptive procedures and functionality are described here.

**User Model** Core of each personalized system is the user model which provides the personalization algorithms and - strategies with up-to-date information about the user's needs, requirements, goals, knowledge, and many more information about the user.

**Data** Which data formats are used, characteristics of the data.

**Architecture** Personalized systems range from client-server applications, pure client technology or mediated proxy-based architecture, to service-oriented architectures. Architectural design decisions have impact on the whole personalized systems, and must be therefor contained in the synoptical system descriptions.

# 3 Lessons Learnt

In the following, we will discuss observations about Re-usability and Interoperability in the discipline of adaptive hypermedia, which is one of the major research areas dealing with personalization in Web-based systems.

> In various meetings and correspondences via email, it became more and more clear that a very promising approach to tackle the re-usability and interoperability problems is to rely on service-oriented approaches and architectures. We finally agreed to follow the *service concept*: Regarding a personalization task as some "service", which a user can `choose / register / use` to get individual, task-, goal, and/or domain-dependent support.

Thus, after the short review on re-usability and interoperability aspects, we briefly summarize service-oriented approaches in the Semantic Web, in particular Web Services, and Semantic Web Services.

## 3.1 Re-usability

Traditional adaptive hypermedia systems operate on some fixed document space [Brusilovsky, 2001, Henze and Nejdl, 2000], where documents and relations between them, eventually coded as metadata, are known at the design time of the system, and adaptation strategies are developed with respect to this specific set of documents. Especially the often used document-to-document relations (see e.g. the analysis given in [Henze and Nejdl, 2004]) can only be validly assigned if knowledge on the complete document space is available. Adaptation algorithms deliver faulty results if the document space is altered (e.g. if documents are modified, deleted, or new documents are introduced) as the document-to-document relations used in the algorithms become invalid. Only sophisticated re-engineering of the metadata (again on the complete document space) can recover the situation. One implication of the closed corpus in traditional adaptive hypermedia is that adaptive applications consequently fail in exchanging content with other (adaptive or non-adaptive) applications. The *re-use of content* – a very important aspect especially when it comes to the Web – is not foreseen. To achieve re-usability, substantial re-engineering of particular systems is required, which cannot be realized on an on-demand basis.

## 3.2 Interoperability

Apart from the re-use of content which might be the most obvious implication of the open corpus problem, the *re-use of adaptive functionality* itself can be seen as at least is equally important. Currently, most adaptive hypermedia systems are built frrom scratch, re-implementing adaptive functionality instead of re-using appropriate software modules. A first step to come to re-usable adaptive functionality is to analyze and describe adaptive functionality in a system-independent manner, which formally describes the adaptation algorithms together with the required processing data. This processing data pertains all aspects of the adaption process: the adaptation-specific information in the adaptive hypermedia system, the user characteristics and models, as well as data which is only available at runtime.

To enable the *re-use of adaptive functionality* across applications requires interoperability solutions for adaptive systems. Interoperability is a very important aspect of todays systems, not only adaptive systems, and still many issues for enabling true interoperability have to be solved.

We claim that solutions to the open corpus problem in adaptive hypermedia contribute to solve interoperability issues, and on the other hand, interoperable adaptive hypermedia systems have – in one way or the other – to tackle and to contribute to solutions to the open corpus problem. Furthermore, continuous efforts are required to solve re-usability of adaptive functionality and adaptive systems, and interoperability between adaptive components or systems. As of today, adaptive hypermedia systems are mainly developed at universities, with limited commercial use. While evaluations of adaptive hypermedia systems have proven their benefit, the wide use of these methods and techniques in real systems is still pending. One of the reasons can be seen in missing / limited re-usability. Development costs are high as in the majority of cases the realization of a new adaptive hypermedia system starts from scratch instead of extending / re-using existing systems. Re-use can help in limiting development costs, and less development costs will make it more attractive for developers and project managers to decide for adaptive, personalized solutions.

## 3.3 Service-oriented Architectures and Web Services

Starting a few years ago with the emerging Web Services, a new architectural style was defined, whose goal is to archive a loosely coupling among interacting software agents. This so-called **Service-oriented architecture (SOA)** is defining concepts like *Service*, *Provider*, *Consumer* and *Discovery* (among more). One of the driving forces behind the development of SOA is the IT business industry, trying to support the real world business models with a communication infrastructure, an effort mostly led by the OASIS Standards Group[3] Important for the success of web-services and the architectures that are based on them is the rather *loose coupling* and *high interoperability* between the services. An effort supported by the set of established W3C standards, because of this, services in SOA are reusable and independent of implementation and development technology. The current web-services are covered by the technologies of SOAP, WSDL and UDDI, which all rely on XML as a device-independ transport medium.

**SOAP** Based on XML, SOAP provides a definition for exchanging structured and typed information between nodes in a distributed, decentralized environment [w3c, b]. Basically, SOAP defines a way of exchanging messages in a stateless, one-way protocol. Thereby being agnostic to the semantics of the application, and not paying attention to the routing of messages, reliability of the transfer or other obstacles, like firewalls in the path. On a more technical level, SOAP enables the use of remote procedure calls (RPC), by using XML to encapsulate the names, identities and values of a procedure.

[3] Organization for the Advancement of Structured Information Standards `http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=soa-rm`

**WSDL** The Web Services Description Language (WSDL) provides a model and an XML format for describing Web services [w3c, d]. The WSDL document describes how a potential client is intended to interact with the described service, a potential interaction, not a required one.

**UDDI** The Universial Description, Discovery and Integration (UDDI) specification [oas, ] describes a way of discovering web-services on the net using a group of web-based registries. Operator Sites provide basic services free of charge for anyone, to announce their web-services or to search for information.

These first generation of Web Service, especially the description language and discovery ignored the "Semantic Web" completely, and are only used to describe the services w.r.t technical implementation, in case of UDDI with the possibility to refer to a Category or Taxonomy for classifying the provided services and protocols.

Currently four new frameworks are proposed, discussed and evaluated by W3C to fill this gap: OWL-S, WSMO, SWSF and WSDL-S.

**OWL-S** OWL-S is an ontology for describing services, using a basic set of classes and properties defined in OWL. [Burstein et al., 2005]. Top-level elements of the Ontology are *Profile, Grounding and Model*, providing information on what a service does, how it can be accessed, and how it works.

**WSMO** The Web Service Modeling Ontology (WSMO) is build around four central elements, *Ontologies*, which provide the terminology used by other elements, *Web Service Descriptions*, which describe the functional and behavioral aspects of a service, *Goals* that represent user desires, and *Mediators*, which aim at automatically handling interoperability problems between different elements. [w3c, c] *Used by IRS-III [Domingue et al., 2004]*

**SWSF** This submission presents the Semantic Web Services Framework (SWSF), which includes the Semantic Web Services Language (SWSL) and the Semantic Web Services Ontology (SWSO). This is the work of the Semantic Web Services Language Committee of the Semantic Web Services Initiative. [w3c, a]

**WSDL-S** Web Service Semantics (WSDL-S) [Akkiraju et al., ] is extending the WSDL standard with semantic expressivity needed to represent the requirements and capabilities of Web Services. Assuming, that formal semantic models for the services already exists, maintained outside of WSDL documents, which are then referenced using WSDL elements. Semantic information includes definitions of *preconditions, input, output and effects* of a web service call, with proclaimed advantages over OWL-S, namely the use of the WSDL language, and the independance of a special ontology representation language because the model is externalized.

## 3.4 Service Oriented Personalization

The next Web generation promises to deliver Semantic Web Services, that can be retrieved and combined in a way that satisfies the user. It opens the way to many forms of *service oriented personalization*. Indeed web services provide a suitable infrastructure for constructing Plug&Play-like environments, where the user can select and combine the kinds of services he or she prefers. Personalization can be obtained by taking different approaches, e.g. by developing services that offer personalization functionalities as well as by personalizing the way in which services are discovered, selected, invoked and composed in order to meet specific user's requirements or by customizing the composition of different services offering personalization.

A prerequisite to this is the emergency of an infrastructure for *semantic interoperability* of web services provided by the evolution of the Semantic Web initiatives. Indeed functionalities for performing personalization require a machine-processable knowledge layer that is not supplied by the current web. Web services should be augmented with public machine-interpretable semantic descriptions of their capabilities, such that a rational inspection of their behavior is enabled and new applications encapsulating personalization functionalities can be developed on this basis. Just as the current Web is inherently heterogeneous in data formats and data semantics, the Semantic Web will be heterogeneous in its reasoning forms and the same will hold for service oriented personalization systems developed in the Semantic Web. In fact, the introduction of machine-processable semantics makes the use of a wide variety of reasoning techniques possible, thus widening the range of the forms that personalization can assume.

So far, reasoning in the Semantic Web is mostly reasoning about knowledge expressed in some ontology; the ontology layer is the highest layer of the Semantic Web tower that can be considered as quite well assessed. However personalization may involve also other kinds of reasoning and knowledge representation, that conceptually lie at the logic and proof layers of the Semantic Web tower and rely on some kind of rule language. What kinds of rules and what kind of reasoning are necessary for performing personalization? This is still an open research question. Independently from the answers that can be given to this question rule-based personalization would give the further advantage of bringing transparency and user awareness into the picture, by enabling an explanation of why the personalization functionality derived a result.

So far, most of the current standard technologies for web services (e.g WSDL [WSDL, 2004], BPEL4WS [BPEL4WS, 2003], WS-CDL [WS-CDL, 2004]) provide descriptions of the service capabilities, business process orchestration and choreography at the syntactic level. Such descriptions do not rely on *well-founded models* that make possible to define access and usage mechanisms without necessitating human intervention and to perform the analysis of the described process. But the capability of performing this analysis is fundamental to the real implementation of those sophisticate forms of flexibility and composition that one expects in the context of the personalization on web. For achieving such a flexibility and enable automatic devices to use a web resource, the latter must bear some public information about itself, its structure, the way in which it is supposed to be used, and so forth. This information should be represented according to some conventional formalism which relies on *well-founded semantics*, upon which it is possible to define access and usage mechanisms. To meet these requirements, one possibility is to focus on giving to the standard languages a formal semantics, by translation into formal models supporting the rational inspection necessary for personalization. Part of the formal methods community focussed the attention on capturing the behavior of BPEL and WS-CDL in a formal way, and many translations of such languages into models supporting analysis and verification (process algebras, petri nets, finite state machines) are currently under investigation [Bravetti and Zavattaro, 2004, Bravetti et al., 2005].

In parallel to the industrial standards, in the last years some proposals of standards for describing *Semantic Web Services* have been developed within the Semantic Web Initiative [Cabral et al., 2004]. In this area we can distinguish two main approaches: IRS III [III, 2004], which is based on a knowledge oriented approach and relies on WSMO ontology [WSMO, 2005] and OWL-S [owls, 2004], which is based on an agent-oriented approach. The common goal of such proposals is augmenting web services with semantic descriptions that enable some kind of automatic service discovery and composition. Such semantic descriptions may concern services goal and capabilities as well as the possible compositions or choreographies. They aim at allowing applications to discover and compose services based on its goals and capability and can provide a basis for enabling service discovery/composition personalized w.r.t. the user's goal or for developing semantic personalization service that can be combined or customized w.r.t to the user's requirements. For instance in the OWL-S proposal the introduction of the so called *process model* allows to describe orchestrations of services in terms of constituent processes. Such description can be used for reasoning about possible compositions and customizing composition w.r.t. the user goal, in a way inspired by the language GOLOG and its extension. Also the approach taken in [Baldoni et al., 2006] can be classified as an agent oriented- approach. Services are augmented with a high-level description of their *interaction protocols*, and agent applications can reason about such description in order to personalize the selection and the composition of services to meet some specific user's requirements.

# 4 Conclusion and Road-Map for Future Work in A3

In this report we have described the achievements of the working group A3 about the development of applications and use-cases that enable personalized access to Semantic Web information.

We have provided a synopsis of the current state of prototypes and use-cases available in the REWERSE project in a concise and standardized format. For each of them a *DOAP machine-readable description* has been given, according to the indications of the W3C Semantic Web Best Practices and Deployment Working Group. We also provided a human-readable description of the testbeds which is meant to highlight specific *REWERSE requirements* and is especially focused on reasoning methods. Such a description is based on an updated version of the questionnaire developed in the previous deliverable A3-D2 on testbeds. In addition we have set up a list of guidelines to be followed in developing future testbeds and use-cases for personalization.

The Lesson Learnt section gives a summary of observations about key issues for achieving the goal of implementing applications enabling open, re-usable and interoperable personalization functionalities. Based on this observation we have discussed the advantages of taking a *service oriented approach* to personalization in the Semantic Web, by investigating how (semantic) web service technologies can provide a suitable infrastructure for implementing Personalization Systems showing re-usable and interoperable personalization functionalities.

Work in A3 will continue exploring the vision of *Personalization as Services*. While the (Semantic) Web Services paradigm provides technologies and frameworks for realizing service-oriented architectures, the personalization task still settles further requirements, e.g.

- Service discovery: The Personalization Service which - among other criteria - fits the needs of the individual user must be discovered
- Service selection: the *best fitting* service must be selected; here, usability constraints have to be considered, as not in all cases this can be done on behalf of the users; however, bothering the users with too many questions / interactions can considered to be bad design as well
- Service execution: Personalization Services must be scrutable, in case user models are used, these must be transparent to users; users must have the possibility to inspect, modify

or delete their user models at any time (which, especially with respect to composed Web Services, is important but challenging); The personalization process must be transparent for the user, and Users need to be aware of the personalization process.

The next steps of research in working group A3 include to plug together personalization services, which have been developed by different group members for various applications, together in one application. Therefor, we will use the Web-Service-enabled Personal Reader framework. In addition, the further refinement of the personalization services, e.g. with respect to rational inspection of services to support service discovery & selection activities, and the adjustment of Personalization Services, e.g. to personalize off-the-shelf services to the individual needs of the users, will be explored.

## Acknowledgement

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## References

[w3c, a] Semantic web services framework (swsf).

[w3c, b] Soap version 1.2.

[oas, ] Uddi version 2.04 api specification.

[w3c, c] Web service modeling ontology (wsmo).

[w3c, d] Web services description language (wsdl) 2.0.

[Akkiraju et al., ] Akkiraju, R., Farrell, J., Miller, J., Nagarajan, M., Schmidt, M.-T., Sheth, A., and Verma, K. Web service semantics - wsdl-s.

[Baldoni et al., 2006] Baldoni, M., Baroglio, C., Martelli, A., and Patti, V. (2006). Reasoning about interaction protocols for customizing web service selection and composition. *Journal of Logic and Algebraic Programming, special issue on Web Services and Formal Methods*. To appear.

[BPEL4WS, 2003] BPEL4WS (2003). http://www-106.ibm.com/developerworks/library/ws-bpel.

[Bravetti et al., 2005] Bravetti, M., Kloul, L., and Zavattaro, G., editors (2005). *Proc. of the 2nd International Workshop on Web Services and Formal Methods (WS-FM 2005)*, number 3670 in LNCS. Springer.

[Bravetti and Zavattaro, 2004] Bravetti, M. and Zavattaro, G., editors (2004). *Proc. of the 1st Int. Workshop on Web Services and Formal Methods (WS-FM 2004)*. Elsevier Science Direct. vol. 105 of Electronic Notes in Theoretical Computer Science.

[Brusilovsky, 2001] Brusilovsky, P. (2001). Adaptive Hypermedia. *User Modeling and User-Adapted Interaction*, 11:87–110.

[Burstein et al., 2005] Burstein, M. H., Bussler, C., Zaremba, M., Finin, T. W., Huhns, M. N., Paolucci, M., Sheth, A. P., and Williams, S. K. (2005). A semantic web services architecture. *IEEE Internet Computing*, 9(5):72–81.

[Cabral et al., 2004] Cabral, L., Domingue, J., Motta, E., Payne, T., and Hakimpour, F. (2004). Approaches to semantic web services: An overview andcomparisons. In *proceedings of the First European Semantic Web Symposium (ESWS2004)*, Heraklion, Crete, Greece.

[Domingue et al., 2004] Domingue, J., Cabral, L., Hakimpour, F., Sell, D., and Motta, E. (2004). Irs-iii: A platform and infrastructure for creating wsmo-based semantic web services. In *Proceedings of the Workshop on WSMO Implementations (WIW 2004) Frankfurt, Germany, September 29-30, 2004, CEUR Workshop Proceedings, ISSN 1613-0073*.

[Henze and Nejdl, 2000] Henze, N. and Nejdl, W. (2000). Extendible Adaptive Hypermedia Courseware: Integrating Different Courses and Web Material. In *Proccedings of the International Conference on Adaptive Hypermedia and Adaptive Web-Based Systems (AH 2000)*, Trento, Italy.

[Henze and Nejdl, 2004] Henze, N. and Nejdl, W. (2004). A Logical Characterization of Adaptive Educational Hypermedia. *New Review of Hypermedia*, 10(1).

[III, 2004] III, I. (2004). http://kmi.open.ac.uk/projects/irs/.

[owls, 2004] owls (2004). OWL-S: Web Ontology Language for Services, W3C Submission. http://www.org/Submission/2004/07/.

[WS-CDL, 2004] WS-CDL (2004). http://www.w3.org/tr/2004/wd-ws-cdl-10-20041217/.

[WSDL, 2004] WSDL (2004). WSDL: Web Services Description Language, version 2.0. http://www.w3.org/TR/2004/WD-wsdl20-20040803/.

[WSMO, 2005] WSMO (2005). http://www.wsmo.org/.

# Appendix

```
<?xml version="1.0" encoding="utf-8"?>

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  <!ENTITY rro 'http://personal-reader.de/rdf/ResearcherOntology.owl#'>
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         xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
         xmlns:doap="http://usefulinc.com/ns/doap#"
         xmlns:foaf="http://xmlns.com/foaf/0.1/"
         xmlns:rro="&rro;"
         xml:lang="en">

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        <doap:shortdesc xml:lang="en">Web-based adaptive tutoring: curriculum se
quencing by reasoning about actions</doap:shortdesc>

        <doap:description xml:lang="it">
          WLOG Ã¨ un sistema multi-agente accessibile via web e adattativo,
          sviluppato per aiutare gli studenti nel processo di costruzione e vali
dazione di piani
          di studio. Lo scopo del sistema Ã¨ produrre sequenze di lettura che si
 adattano
          alle caratteristiche specifiche dell'utente (quindi utenti con conosce
nza iniziale
          differente si vedranno consigliare soluzioni differenti) e al suo lear
ning goal.
          L'adattivitÃ  Ã¨ ottenuta sfruttando tecniche di ragionamento su azi
oni.
        </doap:description>

        <doap:description xml:lang="en">
          WLOG is an adaptive web-based multi-agent system developed for support
ing
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ystem is to
      produce reading sequences that fit the specific user's characteristics (i.
e. users
          with different initial knowledge will be suggested different solutions
) and the
      user's learning goal. Adaptation is enabled by reasoning about actions tec
hniques.
        </doap:description>

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                        <foaf:mbox rdf:resource="mailto:baldoni@di.unito.it" />
                        <foaf:homepage rdf:resource="http://www.di.unito.it/%7Eb
aldoni/" />
                </foaf:Person>
        </doap:maintainer>

        <doap:maintainer>
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o.it" />
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                        </foaf:Person>
        </doap:maintainer>

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         xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
         xmlns:doap="http://usefulinc.com/ns/doap#"
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         xml:lang="en">

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quencing by reasoning about actions</doap:shortdesc>

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        The Personal reader for e-Learning provides a learner with a personal in
terface for regarding learning resources: the Personal Annotation Service recomm
ends the learner next learning steps to take, points to examples, summary pages,
 more detailed information, etc., and always recommends the most appropriate of
these information according to the learner's current knowledge, his/her learning
 style, learning goal, background, etc. The Personal search service extracts inf
ormation from the actually regarded learning resource and checks for related inf
ormation in other e-Learning corpora, and recommends retrieved results. If you w
ant to set up your own Personal Reader instance for a course you are running, yo
u need to provide RDF descriptions on the learning resources of this course, and
 a link to some domain ontology describing the application domain of your course
, which you also use to annotate your resources. That's it!
        </doap:description>

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@gmx.de" />
                        </foaf:Person>
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 personalized, syndicated views on distributed Web data using Semantic Web
 technologies. The application comprises three steps: The information
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 in which rules reason about the created semantic descriptions and additional
 knowledge-bases like ontologies and user profile information, and the user
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<doap:Project>
 <doap:name>ECA Framework</doap:name>
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se/eca"/>
 <doap:created> 2006-02-10 </doap:created>
 <doap:shortdesc xml:lang="en">
   General framework for Evolution and Reactivity in the Web and in the
   Semantic Web
 </doap:shortdesc>
 <doap:description xml:lang="en">
   In the project, a framework for Event-Condition-Action (ECA) rules
   for describing, implementing and reasoning about behavior in the Semantic Web

   is investigated. The framework defines anontology of dynamic concepts and
   allows to compose different languages for events (including languages for
   composite events), conditions (queries and tests) and actions (including
   complex actions) to define high-level rules for describing behavior in
   the  Semantic Web. A prototype is under development.
 </doap:description>
 <doap:programming-language>arbitrary; current modules in Java, PHP,
       XSLT</doap:programming-language>
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 <doap:category> infrastructure </doap:category>
 <doap:maintainer>
  <foaf:Person>
   <foaf:name>Wolfgang May</foaf:name>
   <foaf:mbox rdf:resource="may@informatik.uni-goettingen.de"/>
   <foaf:homepage rdf:resource="http://user.informatik.uni-goettingen.de/~may/"/
>
     <foaf:page rdf:resource="&rro;mayWolfgang" />

  </foaf:Person>
  <foaf:Person>
   <foaf:name>Erik Behrends</foaf:name>
   <foaf:mbox rdf:resource="behrends@informatik.uni-goettingen.de"/>
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ds/"/>
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  </foaf:Person>

  <foaf:Person>
   <foaf:name>Oliver Fritzen</foaf:name>
   <foaf:mbox rdf:resource="fritzen@informatik.uni-goettingen.de"/>
   <foaf:homepage rdf:resource="http://user.informatik.uni-goettingen.de/~fritze
n/"/>
  </foaf:Person>
  <foaf:Person>

   <foaf:name>Franz Schenk</foaf:name>
   <foaf:mbox rdf:resource="schenk@informatik.uni-goettingen.de"/>
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/"/>
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  <foaf:Person>
   <foaf:name>Jose Julio Alferes</foaf:name>
   <foaf:mbox rdf:resource="jja@di.fct.unl.pt"/>
   <foaf:homepage rdf:resource="http://centria.di.fct.unl.pt/~jja/"/>
     <foaf:page rdf:resource="&rro;alferesAlferes" />
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  <foaf:Person>
   <foaf:name>Ricardo Amador</foaf:name>
   <foaf:mbox rdf:resource="jja@di.fct.unl.pt"/>
   <foaf:homepage rdf:resource="http://www.ricardoamador.com/index.aspx"/>
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<!-- currently supported versions-->
 <doap:release>
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   <doap:name>Prototype under Development</doap:name>
   <doap:created>February 2006</doap:created>
   <doap:revision>n.a.</doap:revision>
  </doap:Version>
 </doap:release>
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</doap:Project>
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  <!ENTITY rro 'http://personal-reader.de/rdf/ResearcherOntology.owl#'>
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         xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
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<doap:Project>

<!--  <name>Conceptual maps and intelligent navigation in WWW using -->
<!--  Bayesian networks and artificial immune systems</name> -->

<doap:name>BEATCA</doap:name>

  <doap:shortdesc>Internet search engine, document map paradigm, Data Mining,
  processing of uncertain and incomplete information,
  text document classifiers based on Bayesian multinets
  with vocabularies of 100,000 words</doap:shortdesc>

  <doap:description>The main result of the project
  is a search engine BEATCA for full text document bases with map interface,
  associating closeness on the map with conceptual closeness.

  * soft classification of documents and construction of conceptual closeness
    graph is based on large-scale Bayesian networks
  * optimal document map search and document clustering is based on
    SOM (self-organizing maps), AIS (artificial immune systems),
    and GNG (growing neural gas)

  # New general and particular solutions have been proposed for this class of se
arch engines:

  * New concepts of search engine
    o one million documents processed within 72 hours
      (crawling + indexing + map generation)
    o co-existence of multiple document map concepts (SOM, GNG, AIS)
        o co-existence of multiple document map representation concepts
        o co-existence of multiple maps of the same document collection
        o possibility of incremental map formation
        o test-bed for map generation research
  * new concepts for spider design
        o spider  navigation driven by partial Bayesian networks - proved to be
focus-keeping
  * new concepts for indexer
        o a new dynamic block inversion list method designed
        o new methods of dynamic dictionary reduction
        o a new method of phrase identification, based on association rules
  * New concepts for analyser - mapper
        o mixed  local/global methods for winner search in GNG and SOM
          - keep quality, but accelerate considerably
        o new methods of thematic initialization of SOM maps
          (medoidal SVD/LSI, defuzzified PLSA  with
          large scale ETC Bayesian network, adopted HAL method)
    o new methods of map area clustering (fuzzy equivalence based,
      pruned minimal spanning tree for neighbourhoods,
      Fuzzy-C-means/ISODATA and mixed methods)
        o modified aiNet algorithm
  * New informator (map visualizer) concepts
        o GNG representation on a document map
        o automatic selection of best map from a set of possible ones
        o multilayer (contextual) maps
        o identification of compact fuzzy thematic areas
  * An embedded test environment for
    comparison of various methods of map construction
  </doap:description>

  <doap:homepage rdf:resource="www.ipipan.waw.pl/~klopotek/BEATCA"/>

  <doap:download-page rdf:resource="www.ipipan.waw.pl/~klopotek/BEATCA"/>

  <doap:os>tested for Windows XP</doap:os>

  <doap:programming-language>Java 1.5</doap:programming-language>

  <doap:maintainer>
    <foaf:Person>
          <foaf:name>Krzysztof Ciesielski</foaf:name>
      <foaf:homepage rdf:resource="http://www.ipipan.waw.pl/~kciesiel"/>
      <foaf:mbox_sha1sum>70be0f0771414aa8c7fccdcfebdd583fac498038</foaf:mbox_sha
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  </doap:maintainer>

  <doap:developer>
    <foaf:Person>
      <foaf:name>Krzysztof Ciesielski</foaf:name>
      <foaf:homepage rdf:resource="http://www.ipipan.waw.pl/~kciesiel"/>
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    </foaf:Person>
  </doap:developer>

  <doap:helper>
    <foaf:Person>
      <foaf:name>MichaÂ³ DramiÃ±ski</foaf:name>
      <foaf:homepage rdf:resource="http://www.ipipan.waw.pl/~mdramin"/>
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