A3-D2

Thread on Testbeds

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Abstract
This deliverable presents a set of possible scenarios in which personalization plays a fundamental role in the Semantic Web. These scenarios have been collected with the contribution of many partners of the working group A3, and have then been analysed with two aims. First of all, we have identified the key concepts of personalization scenarios, and subsequently we have analysed the currently available tools and languages supplied by the (Semantic) Web in order to define a set of requirements to be passed to the other working groups of the network.

Keyword List
semantic web, reasoning, personalization, adaptation, scenarios, applications, testbeds

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Thread on Testbeds

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Contents

1 Introduction

The purpose of the work carried on in the last months was to collect a set of scenarios that expressed, by means of examples, mechanisms and characteristics that are typical of personalization systems over the Web. The idea was to use these exemplifications in order to understand the view on personalization that the various partners, each with its own background and expertise, have and, then, merge these views for sketching a model of personalization scenarios. So, starting from these examples and by induction, we have identified some concepts and processes that are at the basis of personalization systems. Such concepts and processes have been compared with the languages and tools that are currently available in the Web, semantic or not, highlightening, as a result, the main needs of the personalization in the Semantic Web. The colleciton gathers future scenarios and scenarios that have already met early implementations. The former mainly outline mechanisms that one would like to see implemented, without getting into the technical details of implementations themselves. The latter give hints about the tools that are being tried and give requirements about the tools that developers would like to have.

Section 2 reports the collected scenarios, that are given in terms of answers to a same questionnaire. The choice of defining a questionnaire was motivated by the need of making the descriptions comparable, need that emerged from a preliminary collection of freely described scenarios, and to analyse the state of the scenarios, developement, and, most important, possible connections to other working groups of the REWERSE project. A synopsis of the scenarios is given in Section 3.

The remainder of this section is already derived from the analysis of the proposed scenarios; it has been positioned at the beginning of the deliverable because it abstracts from the specific descriptions a set of key concepts and processes that resulted as typical of personalization systems and that are, for this reason, useful for a better understanding of the single proposals. A more technical analysis leading to a set of requirements is, instead, contained in Section 4.

1.1 Key concepts of the proposed scenarios

The first observation that results from the analysis of the proposals in Section 2, is that they can all be seen as extensions of researches already carried on in the Semantic Web or in areas connected with the Semantic Web, such as Adaptive Hypermedia or Intelligent Web-based Systems. This is due to the expertise of the proposers and it is very reasonable because the extensions that have been proposed are likely to be implemented in a quite near future.

Almost all the scenarios rely on a *user model*. The user model, however, may contain different kinds of information; depending on what the user model contains, different reasoning techniques might be necessary. Often the user model contains general information about the user, e.g. age, education, etc. (for instance in the health care systems, see Section 2.5). In this case, in the tradition of works on personalization, the adaptation occurs at the level of information selection and, especially, presentation. Different kinds of users better understand different ways of explaining things. Choosing the best possible communication pattern is fundamental in application systems that supply a kind of information, which, because of its nature, might be difficult to follow but that it is important for the user to understand. In order for this kind of task to be executed, it is necessary to enrich the data sources and the data itself with semantic information. One of the greatest difficulties is to define adequate ontologies.

In most of the proposals, however, the Semantic Web is not seen as an information provider but as a *service provider*. This is actually in the line with the most recent view of the World

Wide Web as a platform for sharing resources and services. Services can be divided in two families: world services and Web services. A world service is, for instance, a shop, a museum, a restaurant, whose address, type and description is accessible over the Web. A Web service, instead, is a resource, typically a software device, that can be automatically retrieved and invoked over the Web, possibly by another service.

To begin with, let us consider services of the former kind, world services. The scenarios in which these services are considered (see Sections 2.1 and 2.2) adopt a user model approach in which a different kind of information is considered: the location of the user, which is supposed to vary along time. In the simplest case, the user (a tourist or a person who is abroad for work) describes in a qualitative way a service of interest, as done with the regular Web browsers. The answer, however, contains only information about world services that are located nearby. The scenario can be made more complex if one adds the time dimension. In this case the user is not necessarily interested in a service that is available now, the system is requested to store the user's desire and alert the user whenever a matching event occurs, that refers to a service that is nearby. As an example, consider a user who loves classical ballet. He is traveling, and has just arrived at Moscow. After a couple of days he receives an SMS informing him that in the weekend Romeo and Juliet is going to be held at the Boljsoi Theatre and that tickets are available. Notice that besides a different kind of information contained in the user model, also the mechanism by which personalization is obtained is very different from the previous case: here the answer changes according to the *context*, in this case given by the position of the user in space and time, and the answer is not always immediately subsequent the query. As we have seen, in fact, a *triggering mechanism* is envisioned that alerts the user whenever an event that satisfies the description occurs. The word "triggering mechanism" makes one think of a sort of reactive system, nevertheless, many alternatives might be explored and, in particular, inference mechanisms. Moreover, this approach is suitable also to a very different application domain: ambient intelligence (see Section 2.10), where appliances are the world services to be handled.

As a last observation, when the answer is time-delayed, as described, the descriptions of the services (or more in general, of the events) of interest are sometimes considered as part of the user model. In this case the user model does not contain general information about the user but a more specific kind of information. Alternatively, this can be seen as a configuration problem: I configure a personalized assistant that will warn me when necessary. It is interesting to observe that no-one considers these as queries. A last kind of systems which might be included in this category is the one proposed in Section 2.8, for building personalized agendas. The proposal suggests the use of automatic configuration systems for filling the agenda of a tourist, taking into account his/her preferences. It would be very interesting to find ways for integrating this task with the other two. Indeed, filling the agenda could be considered as the topmost level of a system that also retrieves services triggered by events and biased by the user's location. Observe that this kind of systems should perform also personalization w.r.t. the device by which the user interacts with the system (mobile, laptop, ...).

No proposal explicitly refers to Web services (the closest is the one in Section 2.10 if appliances controllers are considered as automatically invokable services, that are accessible through the Web), although many scenarios that refer to world services could naturally be extended so as to include Web services. In this case, the meaning of localization should be revised, if at all applicable, while the idea of combining services, as proposed in the case of the tourist agenda, should be explored with greater attention; Web service automatic composition is, actually, quite a hot topic as research in the field proves [Bryson et al., 2002, Baldoni et al., 2004a].

A third category gathers goal-driven scenarios and applications (see Sections 2.3, 2.4, 2.7).

The main characteristic of these systems is that the user model contains (or is accompanied by) the description of what the user would like to achieve. This description cannot be referred to single resources or single services to be returned as the result of a query, after a more or less sophisticated selection/construction process. In this case a planning process is to be enacted. Sometimes besides the planning process other reasoning techniques are envisioned in order to supply a more complete support to the user. An application domain in which the goal-driven approach seems particularly promising is *e-learning*. In this case the goal is the learning goal of the user, and the plan contains the learning resources that the user should use for acquiring the desired expertise. The whole interaction with the user is supposed to be carried on through a browser. It is important to remark that students are not the only kind of users of this sort of systems. Also teachers should access them but with a different aim. For instance, a teacher might look for learning resources for a new course that s/he will teach. A new notion is, then, introduced, that of *role*. Not only user models contain general or specific information about the users' interests but they also contain the role that the user plays. Depending on the role, different views might be supplied by the system (personalization at the level of presentation) and different actions might be allowed. Rather than being just one of the many features from a user model, the role could, actually, be considered as orthogonal to it (the role is independent from the specific user). Beyond e-learning, the concept of role is useful in many application domains. In health care, there are patients and there are doctors and nurses. In tourism, there are tourists and there are travel agencies. It is also explicitly envisioned by the scenario described in Section 2.6 where publication corpora are supposed to be used in different ways depending on the role of the person that queries the system (see also Section 2.9).

A characteristic, that emerges in e-learning applications that, instead, has not been clearly proposed for other application domains, is the need of supplying the system with a domain knowledge that not only contains the semantic description of the single learning resources (for instance, by giving preconditions and effects on the knowledge of the user, analogously to atomic actions), but it also contains definitions of more abstract concepts, not directly related to the courses and defined on the basis of other concepts. This knowledge is used to bias the planning process and build solutions that make sense from a pedagogical point of view. The use of a knowledge of this kind might be exported also to other application domains, whenever similar reasoning techniques are adopted.

2 A collection of scenarios and of possible applications

This section reports a collection of scenarios and applications in the Semantic Web, that involve forms of personalization. All the proposals have been described according to a common schema, a same questionnaire, that was aimed at simplifying the analysis phase.

2.1 Alert Services – Scenario

Keywords: alarms, SMS, e-mail
This scenario is about a system that alerts users about situations that the user would like to know via short messages or e-mail (depending on the terminal). Its main use is intended to be the booking of the tickets for cultural/leisure/sports events. For example, if the user wants to go to a certain concert, but he does not know when it is going to be held, the user may program the service to inform him when tickets become available. Another use could be to program

the service so as to inform the user about any football match in the next two days in any city closer than 100 miles around his location, or similar events. When such a situation happens, the system will send a message for informing the user.

This is a scenario; it is based on old similar applications. For this reason it is difficult to answer some questions; some features has not been considered yet.

Knowledge representation and reasoning techniques:

1. *Which techniques do you use now?* So far, a user can define a profile of a specific alert and the system would decide to send him the alert if it matches user profile.

2. *Why did you decide to use this/these specific technique(s)?* No specific technique has been chosen yet.

3. *How does it influence the reasoning and vice versa?* N/A

4. *Which solutions do you use for managing - organizing - storing knowledge?* User can define about he wants to be warned. This information is represented by a profile that is stored into a database.

5. *Do you have plans to extend/change your knowledge representation techniques in the near future?* Yes, in order to improve the system, but we do not know yet in which manner.

6. *What would be the ideal knowledge representation for your needs?* The idea is to understand user's willingness in order to warn him about the events he wants. Thus, the system could filter some seemingly appropriate but unwanted results and add some seemingly different but actually same results. This would help to warn about what user really wants, increasing user satisfaction.

7. *Which reasoning techniques, if any, do you currently use? Please give examples (e.g. used rules, constraints). If you use more than one technique, please describe each shortly, and with examples.* It is thought that the system would be based on rules. The system will use a set of rules to decide if it is necessary to alert the user about an event.

8. *Which techniques, if any, do you plan to use in the near future?* So far, it is not planned to use other techniques in the future.

9. *Which techniques would you like to have, which expressibility would you like to use?* This is not considered yet

User interaction:

1. *How can the user interact with the current system (or in your current plans)? Do you have examples of user interactions?* The user can just modify its profiles and priorities via Web and WAP.

2. *Which extensions do you plan for the near future? Examples?* The user would be able to change the way the system applies the rules.

3. *How should the user ideally interact with your application? Examples?* Perhaps the best way of interacting could be no interaction. In this case, the system would guess what the user wants to be warned about. Now, user could add its alarms through filling a profile, but it could be improved allowing the user to express its alerts in a more natural way understandable by the system.

Adaptation and personalization:

1. *Which adaptation techniques do you currently use? Do you have examples?* For instance, from user's profile, system changes the language in which the messages are sent or the portal is shown (Web and WAP portals).

2. *What is the goal of the adaptation?* The goal of the adaptation is to make the service as user friendly as possible.

3. *Can you categorize adaptation according to existing adaptation functionalities? (e.g. P. Brusilovsky's ontologies). If you can not categorize it according to existing adaptation functionalities, please give a short summary of the adaptation you use, and provide comments for possible categorizations.* N/A

4. *Which actors are involved in the adaptation? Please name them, e.g. user, tutor, expert, etc.* The user expresses could choose some features of the system, like interface language.

5. *Which input data (knowledge, real-time data, data about user, etc.) does your application/scenario need?* Data about the user, its needs and preferences. We need also information about events, but this can be obtained from content providers.

6. *What are your plans for adaptation in the near future?* No future plan has been thought yet.

7. *What would be the ideal manner of personalization for your application?* User should easily modify the way he wants to be warned, not only his preferences but also the rules and the logic that system employs.

Data:

1. *Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations?)* Data is classified and stored in a database.

2. *What is the amount of data that you use? Is it derived from real data? (e.g. demonstrator data, real-world data, etc.)* The amount of data depends on the number of users and events.

3. *Can you share the data (or part of it) with other partners in REWERSE? Can you make the data public or is it only available for REWERSE-internal demonstrators?* Data is not available.

4. *Is your data distributed?* Not distributed

5. *Dynamics of your data:*

   - are there updates? If yes, how often? Which kind of updates?

   - are there changes of the data? If yes, how often, and of which kind?

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

   N/A

6. *Do you expect development of your data in the next future?* It is not considered yet

7. *How do you estimate the development of your data?* It is not considered yet

requirements to the I-groups:
Mainly reasoning techniques but also knowledge representation
Indicate which I-groups might be most promising to help establishing personalization in your application:
I2, I5

2.2 Customised positioning and location services - Scenario

Keywords: positioning, location.
Positioning and location services are related to each other. Position techniques allow to localization of the user in order to serve him customised services, depending on the place the user is. These offered services could be the usual tourist services, such as booking, guiding, etc. but customised using the user position as reference.

This is a scenario. For this reason it is difficult to answer some questions because some features has not been considered yet.

Knowledge representation and reasoning techniques:

1. *Which techniques do you use now?* Ontologies for geotemporal and geospatial would be required.

2. *Why did you decide to use this/these specific technique(s)?* No specific technique has been chosen yet.

3. *How does it influence the reasoning and vice versa?* It has not been considered yet.

4. *Which solutions do you use for managing - organizing - storing knowledge?* It has not been considered yet.

5. *Do you have plans to extend/change your knowledge representation techniques in the near future?* It has not been implemented yet, so no change or extension has been considered.

6. *What would be the ideal knowledge representation for your needs?* It has not been considered yet.

7. *Which reasoning techniques, if any, do you currently use? Please give examples (e.g. used rules, constraints). If you use more than one technique, please describe each shortly, and with examples.* No current reasoning technique is used because the system is not implemented.

8. *Which techniques, if any, do you plan to use in the near future?* There would be necessary some techniques to process user's data and positioning-location data in order to provide user-demanded service. Constraint and chaining reasoning would be needed.

9. *Which techniques would you like to have, which expressibility would you like to use?* It is not considered yet.

User interaction:

1. *How can the user interact with the current system (or in your current plans)? Do you have examples of user interactions?* The user must be able to interact with the reasoner through mobile devices such as PDAs, laptops, etc.

2. *Which extensions do you plan for the near future? Examples?* No extension is planned yet.

3. *How should the user ideally interact with your application? Examples?* As said before, these kinds of services are thought of as to be used by people who are not in a fixed place. So the devices should be portable in order to give access to these services. They should be highly interactive, too. Perhaps, the user is driving a car and he wants to know some information. He uses his voice to give the necessary orders and the system tells him the answer.

Adaptation and personalization:

1. *Which adaptation techniques do you currently use? Do you have examples?* Some features of the user (like his preferred language, hobbies, etc.) and its position are needed. If a French tourist is in Spain and he looks for a chemist's shop the system would look for a "famarcia" (Spanish word for chemist's shop) and the answer would be in French because he is French.

2. *What is the goal of the adaptation?* The goal of the adaptation is to provide the exact service that the user is demanding.

3. *Can you categorize adaptation according to existing adaptation functionalities? (e.g. P. Brusilovsky's ontologies). If you can not categorize it according to existing adaptation functionalities, please give a short summary of the adaptation you use, and provide comments for possible categorizations.* It has not been implemented yet, so no information about it can be summarized.

4. *Which actors are involved in the adaptation? Please name them, e.g. user, tutor, expert, etc.* The user, its position and the location of the service required.

5. *Which input data (knowledge, real-time data, data about user, etc.) does your application/scenario need?* The service demanded by the user and its position are the main input data.

6. *What are your plans for adaptation in the near future?* No future plan has been thought yet.

7. *What would be the ideal manner of personalization for your application?* Through the position of the user, the location of the service demanded and the data about the user.

Data:

1. *Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations?)* No data format is currently used because the system is not implemented yet.

2. *What is the amount of data that you use? Is it derived from real data? (e.g. demonstrator data, real-world data, etc.)* Data would be real-world data.

3. *Can you share the data (or part of it) with other partners in REWERSE? Can you make the data public or is it only available for REWERSE-internal demonstrators?* Data is not available because the system is not implemented yet.

4. *Is your data distributed?* It has not been considered yet, although it is likely to be distributed.

5. *Dynamics of your data:*

   - are there updates? If yes, how often? Which kind of updates?

   For instance, as the user travels, its position changes.

   - are there changes of the data? If yes, how often, and of which kind?

   For instance, if a new motorway is built, the route map would be modified.

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

   If the user crosses the border, then the route map should be another one.

6. *Do you expect development of your data in the next future?* It is not considered yet

7. *How do you estimate the development of your data?* It is not considered yet

Specific requirements to the I-groups: Geospatial and geotemporal reasoning would be the most important requirements.

Indicate which I-groups might be most promising to help establishing personalization in your application: I4

2.3 WLog - Application

Keywords: e-learning, curriculum sequencing, reasoning about actions
The WLog system [Baldoni et al., 2004b] tackles the problem of supporting students in the construction of personalized "study plans", e.g. sequences of courses that they will attend during the first three years of University. The system can be seen as a "virtual tutor" which, on the basis of knowledge about the user, the available courses, the learning goal (that is, a description of the competence that the student would like to acquire) can basically perform three different tasks: (1) to build personalized study plans, (2) to verify the correctness of a student-given study plan, (3) to explain, if necessary, why a plan is not correct. WLog is a multi-agent system, that is accessible over the Web; its core is a rational agent that can reason about actions. However, WLog cannot be strictly considered as a Semantic Web application.

Knowledge representation and reasoning techniques:

1. *Which techniques do you use now?* We exploit the so called "action metaphor": 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". So, for instance, a student can attend the Operating Systems course only if he/she knows the C language, independently from which course he/she actually attended for gaining such knowledge. As an outcome of attending the Operating Systems course, for instance, we expect the student to acquire knowledge about Unix.

   Prerequisites and effects are expressed by means of "knowledge entities", i.e. ontology terms. In the WLog system such terms are called competences.

   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.

   The WLog knowledge base is written in DyLOG.

2. *Why did you decide to use this/these specific technique(s)?* We do not use an XML-based language for representing knowledge but the DyLOG language itself. Actually the project did not begin as a Semantic Web project but as a multi-agent system project, so we chose the representation that was the most compatible with the rational agents involved. Consider that the DyLOG interpreter is written in Sicstus Prolog, and only recently we began a Java implementation.

3. *How does it influence the reasoning and vice versa?* As mentioned in the answer to question (1a) the choice of the reasoning techniques that have been used is related to the agent programming language that has been chosen for implementing the virtual tutor, DyLOG. In the beginning this language was chosen because it allowed procedural planning (very useful for the kind of task that we had in mind), then we exploited it more thoroughly, taking advantage also of the other reasoning techniques that it allowed. So the choice of the agent programming language came first.

4. *Which solutions do you use for managing - organizing - storing knowledge?* The knowledge base is a logic theory, stored in a file.

5. *Do you have plans to extend/change your knowledge representation techniques in the near future?* In a future implementation we would like to develop an ontology, probably in OWL, for representing the domain knowledge in a way that is compatible with the Semantic Web.

6. *What would be the ideal knowledge representation for your needs?* We are working at an OWL ontology for representing DyLOG programs. By means of it, we will represent the semantic knowledge related to learning resources over the Web.

7. *Which reasoning techniques, if any, do you currently use? Please give examples (e.g. used rules, constraints). If you use more than one technique, please describe each shortly,*

and with examples. The reasoning techniques that have been used are the following. Procedural planning is used for building personalized study plans, temporal projection for verifying the correctness of a linear plan, and temporal explanation for explaining the reasons of the possible incorrectness.

WLog exploits goal-driven techniques for reasoning about actions and change in a modal logic framework. In particular, the WLog virtual tutor has been implemented in the DyLOG language. 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.

8. *Which techniques, if any, do you plan to use in the near future?* no new technique

9. *Which techniques would you like to have, which expressibility would you like to use?* The system was developed to study the usefulness of the "action metaphor" in educational domains. Results are positive, we will further explore this topic. In particular, it would be nice to exploit mechanisms for handling failure and for replanning.

User interaction:

1. *How can the user interact with the current system (or in your current plans)? Do you have examples of user interactions?* The user interaction with the reasoner is mediated by a reactive agent, called executor. The Web interface is very simple: in the case of study plan suggestion, the user is asked his/her learning goals, which exams (s)he has passed, what competence (s)he would like to acquire. At this point, the virtual tutor produces a conditional plan that allows reaching the user's goals. The plan is then executed. This means that courses are presented one after the other, in the order in which they should be attended. Each branching point corresponds to a question to the user: since the branches correspond to alternative courses that supply a same competence, the user is asked to choose a preferred one. The whole interaction is carried on by constructing in a dynamic way the HTML pages to show to the user, one after the other.

2. *Which extensions do you plan for the near future? Examples?* In the near future we plan to turn the current architecture in a "Web service" architecture. Each Web service should supply a different functionality. We do not plan to work on courses, anyway, but on smaller units of information, called learning resources. One of the main problems to study will be knowledge representation. Actually, different reasoning techniques might require different descriptions of the learning resources. The study of their representation is being carried on.

3. *How should the user ideally interact with your application? Examples?* In the most free and natural possible way.

Adaptation and personalization:

1. *Which adaptation techniques do you currently use? Do you have examples?* We use curriculum sequencing, although differently than what often found in the literature of educational adaptive hypermedia, it is a multi-step sequencing (and not a suggestion of the next step only). Moreover, we produce conditional plans and not only linear plans.

2. *What is the goal of the adaptation?* The goal of adaptation is to produce sequences of courses that fit: <1> the specific user characteristics (users with different initial knowledge will be suggested different solutions), <2> the user's learning goal (a user could desire to become not only an expert of "Web design", high-level competence that identifies a whole set of curricula, but at the same time to acquire expertise in "3D graphics").

3. *Can you categorize adaptation according to existing adaptation functionalities? (e.g. P. Brusilovsky's ontologies). If you can not categorize it according to existing adaptation functionalities, please give a short summary of the adaptation you use, and provide comments for possible categorizations.* 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 user's goal rather than w.r.t. a user model. We do not use techniques of link hiding nor a semaphore annotation.

4. *Which actors are involved in the adaptation? Please name them, e.g. user, tutor, expert, etc.* Three actors are involved: a user, a rational agent (the virtual tutor), and a reactive agent (the executor)

5. *Which input data (knowledge, real-time data, data about user, etc.) does your application/scenario need?* The application requires: knowledge about the user's learning goal, knowledge about the user's expertise, knowledge about the single courses, and a set of curriculum schemas.

6. *What are your plans for adaptation in the near future?* It would be interesting to use user modeling techniques in order to help the refinement process of the extracted conditional plan.

7. *What would be the ideal manner of personalization for your application?* The system should also deal with failure and replanning: so far, in fact, the idea is that the user will necessarily choose one of the proposals of the system and that (s)he will not wish to rollback any of the choices. What if, at a certain point of the interaction, the user discovers that (s)he does not like the solution that (s)he is currently focusing on? (S)he should interrupt the current interaction or in some way step back to some previous point. The system should take into account the information given by this behavior, roll back part of the information and, possibly, produce a different (partial) plan.

Data:

1. *Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations?)* It is a knowledge base, written in Prolog.

2. *What is the amount of data that you use? Is it derived from real data? (e.g. demonstrator data, real-world data, etc.)* It is a demonstrator that derives from real data: we have analyzed the courses that are offered by the Department of Computer Science of the University of Turin for building this knowledge base.

3. *Can you share the data (or part of it) with other partners in REWERSE? Can you make the data public or is it only available for REWERSE-internal demonstrators?* Yes, we can make this data public.

4. *Is your data distributed?* No, the knowledge base is in a single file.

5. *Dynamics of your data:*

   - are there updates? If yes, how often? Which kind of updates? The mental state of the user is supposed to change as an effect of the attend-course actions.

   - are there changes of the data? If yes, how often, and of which kind? Ideally the course repository might be updated, when the course offer changes. This, however, does not happen often.

   - do these changes trigger automatically reactions? If yes, how, and what kind of reactions? no

6. *Do you expect development of your data in the next future?* No.

7. *How do you estimate the development of your data?* No idea yet.

Specific requirements to the I-groups: In order to make the system more reactive/interactive w.r.t. the user's feedbacks, it would be interesting to integrate mechanisms that can handle failure, in particular techniques for user constraint relaxation or replanning.

Indicate which I-groups might be most promising to help establishing personalization in your application: I2, I5.

2.4 Construction of reading sequences of learning objects - Scenario

Keywords: e-learning, building reading sequences, reuse of learning resources

hereby we describe a scenario in which a system, accessible over the Semantic Web, manages a repository of learning resources, helping users not only to retrieve the learning materials that they need for achieving a desired learning goal, but also to arrange such materials in a reasonable way. By reasonable way we mean that a set of learning dependencies are respected, that is, information that is supposed to be a prerequisite for understanding the contents of a specific resource, is supplied before that resource is actually presented to the user. Generally speaking, the system will return a reading sequence through a (sub)set of the available resources, that will allow the user to reach his/her learning goal. Notice that resources may be of different kind, e.g. text, examples, tests, programming patterns, references to books, and so forth. We suppose the learning resources as being semantically annotated according to a reference ontology, and the construction of the reading sequence to be carried on by means of reasoning techniques. A preliminary discussion can be found in [Baldoni et al., 2004c].

Though drawing from the experience reported in Section 2.3, this is a "perspective scenario", this means that it does not correspond to any already existing prototype demonstrators or more advanced implementations. For this reason it is difficult to answer to some of the questions. The proposal is done because we believe that e-learning is one of the application domains that could greatly profit from Adaptation in the Semantic Web, and we plan to study the kind of interaction that has been outlined in this form. In the case of presented scenario, one of the greatest advantages of passing to semantic-based representations of the learning resources (besides the obvious effect of helping the user in the most appropriate way) stands in a greater reuse of the learning resources, which could be automatically composed in different ways, according to learning goals and requirements.

Knowledge representation and reasoning techniques:

1. *Which techniques do you use now?* So far, there is no implementation but the idea is to refer to the action metaphor because the act of reading a learning resource has an effect on the mind of the reader; moreover, the contents of a learning resource can be understood by the reader only if (s)he has already acquired other knowledge, that we can consider as the prerequisites of the action.

   Let us call "knowledge entities" the ontology terms that are used for defining course prerequisites (if any) and effects: we would also like to state relations between them so to be able of representing higher-level (more complex and more abstract) knowledge entities.

2. *Why did you decide to use this/these specific technique(s)?* In the line of what has been done in the Semantic Web, we plan to use the OWL language, which is becoming the standard for ontology description in the Semantic Web.

   This is not the only path to explore, however. For instance, as suggested by some authors, there is a connection between learning resources and Semantic Web Services. In this perspective another language that may be used for describing learning resources is OWL-S. OWL-S is, in a way, connected to the action metaphor in a very similar way to what happens in the case of learning resources. Another similarity is that learning resources could be atomic or structured (in this case composed of other learning resources) in the very same way in which Web services can be atomic or structured (i.e. composed of other Web services).

3. *How does it influence the reasoning and vice versa?* We do not think that the choice of a given specification language will affect the choice of the reasoning techniques very much, because we would like to use this representation more as a semantic-based interchange format, exploiting non-ontological reasoning techniques for working on it. The real problem is how to implement, by means of OWL (or OWL-S, RDF, ...), the chosen approach to knowledge representation.

4. *Which solutions do you use for managing - organizing - storing knowledge?* Actually, so far we do not have a knowledge-base stored in some way, we plan to use a Java tutorial that is already tagged, although not yet in the right way for performing reasoning about actions. The current tagging is in RDF but we will change it.

5. *Do you have plans to extend/change your knowledge representation techniques in the near future?* It would also be important to have means for representing strategies for organizing learning materials in some way, for instance something similar to the so called "learning design" patterns proposed by pedagogy, and partly supported by learning management systems (some references: EML language, IMS learning design). Maybe a rule-based language that allows to represent policies would help in this case.

6. *What would be the ideal knowledge representation for your needs?* In the "ideal world", in the case in which the tutoring system actually allows the execution of different reasoning tasks, each by exploiting a (possibly) different reasoning technique, it would be nice to find a knowledge representation that is as much as possible independent from the specific reasoning mechanism that is applied. The idea of basing knowledge representation on the action metaphor is a step in this direction because we know that it ideally allows a

certain number of different tasks to be executed based on the same representation (e.g. planning, replanning, strategy refinement, validation, etc.).

7. *Which reasoning techniques, if any, do you currently use? Please give examples (e.g. used rules, constraints). If you use more than one technique, please describe each shortly, and with examples.* The current idea is to use techniques for reasoning about actions, based on the experience gained in previous work. In fact, we can consider a learning resource as an action that has effects on the knowledge of the reader. For instance, if I read some documentation about how to declare variables in Java, afterwards, I will (supposedly) be able of writing or recognizing a variable declaration. This choice is quite straightforward and it is also supported by research in pedagogy that shows that human learning is goal-driven, and the notions of prerequisite and effect (in our case, knowledge gain) play a fundamental role.

8. *Which techniques, if any, do you plan to use in the near future?* As mentioned, there is no implementation yet, so the first step could be to apply the above mentioned techniques for reasoning about actions and change.

9. *Which techniques would you like to have, which expressibility would you like to use?* Actually, a real tutoring system should allow not only the construction of reading sequences but also many other tasks, each of which could better be performed by exploiting different reasoning techniques. Besides the fact that different reasoning techniques may require different knowledge representations, one research question is to identify those reasoning techniques that are the most suitable to accomplish a given task.

   To begin with, supposing to represent learning resources as actions, we basically need planning techniques for building the reading sequences, and possibly also explanation techniques because in order to motivate the user to follow a given path (maybe by reading documents that apparently have no direct relation to the learning goal) it is useful to explain in some way the "structure" of the proposed solution. It would also be interesting to introduce replanning capabilities, in case a user is not satisfied of the proposed solution on the whole or of part of it. Maybe non-monotonic reasoning techniques could help in this case.

User interaction:

1. *How can the user interact with the current system (or in your current plans)? Do you have examples of user interactions?* So far there is no implementation, so there is no real interaction.

2. *Which extensions do you plan for the near future? Examples?* As an example of the interaction that we would like to have, consider the following example: Johnny is a client of an e-learning system that can be seen as a virtual tutor, with access to a huge library of learning resources. Given a learning goal, the tutor selects those learning resources that better fit the requirements and the characteristics of the user, organizes a reading sequence through the selected material, and proposes it to the user. Recently, Johnny has bought a digital camera and he would like to learn how to process photographs by means of a software application. He already knows "color models" because he read some introductory material about graphics, finding it by means of the tutoring system. The

system has stored this information about Johnny's knowledge and can use it in the current interaction. At the beginning of the interaction, Johnny states his learning goal: learning to use a digital image processing software. The learning goal is, actually, expressed in the terms of some reference ontology; here, we do not focus on the details of how such a description is obtained. By exploiting its knowledge base, the system knows that for learning how to use a software it is necessary: to learn some theory (the concepts and the model of reference, in the present case notions about image representation, vector and raster images, color models, the alpha channel, etc.) and to learn the specific commands of a specific application (brush, gradient, selection, filters, etc.). The two parts are, of course, related. Suppose that the library contains some material about how to use just one application software for creating/editing images: the Gimp (Gimp is a tool for creating/modifying raster images) and that it has plenty of learning resources about theoretical aspects of image processing, at various levels of details. The system is supposed to return a reading sequence through a selection of learning resources that explain the main notions of raster image processing (at a quite shallow level of detail: Johnny's wish is not to become an expert of the theory behind computer graphics but just to learn how to retouch his photos). Of course, since the system knows that he already knows color models, he will not be proposed to read anything about it.

3. *How should the user ideally interact with your application? Examples?* Interaction should be very natural.

Adaptation and personalization:

1. *Which adaptation techniques do you currently use? Do you have examples?* The technique proposed by the scenario is curriculum sequencing, joined with the construction of evolving user models; the first is taken from the area of adaptive hypermedia, while user modeling is a research area itself.

2. *What is the goal of the adaptation?* To produce a reading sequence of learning resources that fits the user's learning goals and characteristics. The user's profile is updated according to the user's behavior, which is somehow monitored by the system.

3. *Can you categorize adaptation according to existing adaptation functionalities? (e.g. P. Brusilovsky's ontologies). If you can not categorize it according to existing adaptation functionalities, please give a short summary of the adaptation you use, and provide comments for possible categorizations.* The solution built by the system is personalized w.r.t. the user's needs. The construction of the solution should take into account also the user model. Ideally, the user model should evolve along time, according to the interaction.

4. *Which actors are involved in the adaptation? Please name them, e.g. user, tutor, expert, etc.* The user, the system. No other human intervention should occur.

5. *Which input data (knowledge, real-time data, data about user, etc.) does your application/scenario need?* Knowledge about the available learning resources, knowledge about the user and about his/her learning goals, the knowledge entities might be arranged so to express a set of learning dependencies among them.

6. *What are your plans for adaptation in the near future?* This is the first proposal of the scenario.

7. *What would be the ideal manner of personalization for your application?* So far, no more than what has already been said.

Data:

1. *Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations?)* No data is available yet. In the short term, we will likely have some semi-structured data (basically LOM-annotations of a set of learning resources).

2. *What is the amount of data that you use? Is it derived from real data? (e.g. demonstrator data, real-world data, etc.)* In the short period it could be a demonstrator.

3. *Can you share the data (or part of it) with other partners in REWERSE? Can you make the data public or is it only available for REWERSE-internal demonstrators?* Yes.

4. *Is your data distributed?* Not yet but, in principle, the system might interact with a set of repositories of learning resources, that are distributed over the Web.

5. *Dynamics of your data:*

   - are there updates? If yes, how often? Which kind of updates? The user model should be updated according to the interactions between the user and the system. About how often, this depends on the user mostly.

   - are there changes of the data? If yes, how often, and of which kind? Yes, there are. Both of the user model and of the library of learning resources. Difficult to say how often, it depends on many factors.

   - do these changes trigger automatically reactions? If yes, how, and what kind of reactions? They will probably do it when more sophisticate forms of interaction will occur, so far they are not supposed to.

6. *Do you expect development of your data in the next future?* In principle the repositories will evolve because new learning objects can be created or removed along time.

7. *How do you estimate the development of your data?* Early to say.

Specific requirements to the I-groups: We are interested in reasoning techniques for: planning, replanning, explanation. It would also be important to have techniques that apply reasoning to policies, which in our case would represent strategies for organizing learning materials in some way, for instance something similar to the so called "learning design" patterns proposed by pedagogy, and partly supported by learning management systems (some references: EML language, IMS learning design)

Indicate which I-groups might be most promising to help establishing personalization in your application: I2, I5.

2.5 Personalized presentation of health care information - Scenario/Application

Keywords: health care, public health, personalized health care presentation

Those responsible for providing healthcare information to patients or the general public are faced with a considerable challenge these days. Generally the messages they have to convey

may not be what the user wants to hear. For example, issues of lifestyle are fairly central to healthcare advice these days but those to whom they most apply are least likely to want to hear them. Messages about smoking being bad for one's health, exercise being an important component of a healthy lifestyle, dietary considerations, the effect of drugs and so on are all messages that are not easily put across to the people to whom they most apply, and a single one-size-fits-all approach is definitely not effective.

Even aside from lifestyle issues, the task of presenting information effectively needs to take account of the recipient. For example, the way in which maternity information is presented to a young school girl who has accidentally become pregnant at the age of fifteen should be handled differently to presentation of the same advice to a mature lady having her second or third child at the age of thirty.

As a result personalization is being used to provide health care information in different ways to suit the preferences of the end-user. This may take account of a range of different attributes, from those pertaining to the user's medical condition (e.g. stage of pregnancy, asthma, diabetes, etc) to non-medical attributes such as age, gender, ethnic origin, etc.

These issues are discussed in [Bental et al., 2001, Pacey et al., 2003].

Knowledge representation and reasoning techniques:

1. *Which techniques do you use now?* XML is used as the basic formalism for representing both content and rules. XML schema are used to check consistency of content. Ontologies are catered for and these are again expressed in XML. These are manipulated by modules developed in Java.

2. *Why did you decide to use this/these specific technique(s)?* This work was started five years ago and at that stage we were collaborating with a health care information provider who was interested in XML.

3. *How does it influence the reasoning and vice versa?* More general reasoning would have been more easily handled if a general purpose rule engine had been used.

4. *Which solutions do you use for managing - organizing - storing knowledge?* XML is used to represent knowledge and information in the system. XSLT is used to transform knowledge and information, and to display it.

5. *Do you have plans to extend/change your knowledge representation techniques in the near future?* No.

6. *What would be the ideal knowledge representation for your needs?* N/A.

7. *Which reasoning techniques, if any, do you currently use? Please give examples (e.g. used rules, constraints). If you use more than one technique, please describe each shortly, and with examples.* The system developed uses simple if-then rules, which may either be embedded in the content or kept in a separate repository. These rules may either be interpreted within XSLT or by a separate inference engine which has been built as part of our toolkit for this type of application.

8. *Which techniques, if any, do you plan to use in the near future?* No further additions are envisaged at this stage.

9. *Which techniques would you like to have, which expressibility would you like to use?* N/A.

User interaction:

1. *How can the user interact with the current system (or in your current plans)? Do you have examples of user interactions?* When the end user accesses one of these personalized information sources via a browser the first thing that is generally required is that he/she must answer a set of questions to provide the necessary information required for personalization. Here different strategies may be adopted by different information providers. Some may store a profile so that the user does not need to re-enter information each time he/she returns to the site, others do not. Generally most providers will allow for missing fields so that if the user does not wish to provide items of information a default value is assumed.

   Once the user's preferences are stored these may be used in different ways. Firstly they may be used to select the information presented. For example, in the case of a medical news provider which draws information from a number of different sites and presents it to the user, the user's preferences can be used to filter the information provided so that only relevant news items are included which match the user's interests. Secondly, they may be used to order the information presented. A simple example of this is the news provider.

   Another example of this is in providing advice on breastfeeding to mothers or mothers-to-be. Once again different items of text and different images are selected, depending on the values of attributes in the user's profile.

2. *Which extensions do you plan for the near future? Examples?* No plans for further work at this stage.

3. *How should the user ideally interact with your application? Examples?* The normal way that the end-user interacts with the personalized information is through a standard browser. On the other hand the information provider can use a toolkit to create presentations aimed at different types of users.

Adaptation and personalization:

1. *Which adaptation techniques do you currently use? Do you have examples?* Selection of different information sources. Selection of different items of text and/or images and compilation of these into relevant presentations. Ordering of information presented. Customization of the result to fit user preferences such as font, colours, etc.

2. *What is the goal of the adaptation?* To increase the effectiveness of presentations of health care information.

3. *Can you categorize adaptation according to existing adaptation functionalities? (e.g. P. Brusilovsky's ontologies). If you can not categorize it according to existing adaptation functionalities, please give a short summary of the adaptation you use, and provide comments for possible categorizations.* N/A.

4. *Which actors are involved in the adaptation? Please name them, e.g. user, tutor, expert, etc.* User, health care information provider.

5. *Which input data (knowledge, real-time data, data about user, etc.) does your application/scenario need?* Data about the user as mentioned in a previous answer.

6. *What are your plans for adaptation in the near future?* No plans for further work in this area at this stage.

7. *What would be the ideal manner of personalization for your application?* N/A.

Data:

1. *Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations?)* User profiles are represented in XML and may be stored in a database if the information provider so chooses. The information sources themselves are represented in XML with accompanying XSLT.

2. *What is the amount of data that you use? Is it derived from real data? (e.g. demonstrator data, real-world data, etc.)* The sizes of our examples are relatively small at this stage.

3. *Can you share the data (or part of it) with other partners in REWERSE? Can you make the data public or is it only available for REWERSE-internal demonstrators?* It can be made available for REWERSE internal demos. Beyond this would depend on what is to be done as this work was developed in conjunction with our collaborating partner.

4. *Is your data distributed?* No.

5. *Dynamics of your data:*

   - are there updates? If yes, how often? Which kind of updates?

   - are there changes of the data? If yes, how often, and of which kind?

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

   At this stage we are dealing with static user profiles and relatively static information sources (i.e. static from the point of view of a user's session). For this type of application a relatively small degree of dynamicity could be catered for if this is needed.

6. *Do you expect development of your data in the next future?* There are no plans for further work at this stage.

7. *How do you estimate the development of your data?* N/A.

Specific requirements to the I-groups: none.
Indicate which I-groups might be most promising to help establishing personalization in your application: none.

2.6 PPR - the Personal Publication Browser: A Personal Reader Application - Application

Keywords: Personal Context Provision, Personalization Service, Personal Reader
The Personal Publication Reader is developed for the Network of Excellence REWERSE (www.rewerse.net) and provides a personal interface to the publications developed by partners in REWERSE: All Web-pages containing information about publications of the REWERSE network are periodically crawled and new information is automatically detected, extracted and indexed in the repository of semantic descriptions of the REWERSE network. This information, together with extracted information on the project REWERSE, on people involved in the project, their

research interests, etc., is used to provide more information on each publication: who has authored it, which research groups are related to this kind of research, which other publications are published by the research group, which other publications of the author are available, which other publications are on similar research, etc.

Knowledge representation and reasoning techniques:

1. *Which techniques do you use now?* Currently, we use RDF (as the target format of data on publications extracted from the Web), and OWL (describing the REWERSE project).

2. *Why did you decide to use this/these specific technique(s)?* Expressibility of RDF is enough for describing publications, for persons and relations in the project REWERSE, some expressibility of OWL was needed.

3. *How does it influence the reasoning and vice versa?* Only on the practical side: we only use reasoners which have an interface for RDF/OWL data.

4. *Which solutions do you use for managing - organizing - storing knowledge?* So far, all knowledge was stored in RDF/OWL descriptions without any database or other storage layer in between.

5. *Do you have plans to extend/change your knowledge representation techniques in the near future?* For using RDQL / Jena, we currently check whether to use a mySQL database with Jena.

6. *What would be the ideal knowledge representation for your needs?* No answer yet; Preference is on knowledge which is constructed at real time according to a user's request, and makes use of distributed metadata-annotations of Web resources.

7. *Which reasoning techniques, if any, do you currently use? Please give examples (e.g. used rules, constraints). If you use more than one technique, please describe each shortly, and with examples.* Currently, we are using the TRIPLE language (http://triple.semanticweb.org/) developed by Stefan Decker and Michael Sintek [Sintek and Decker, 2002]. Rules defined in TRIPLE can reason about RDF-annotated information resources (required translation tools from RDF to triple and vice versa are provided). An RDF statement (which is a triple) is written as `subject[predicate -> object]`

   RDF *models* are explicitly available in TRIPLE: Statements that are true in a specific model are written as "@model". This is particularly important for constructing the *temporal knowledge bases* as required in the Personal Reader. Connectives and quantifiers for building logical formulae from statements are allowed as usual: `AND`, `OR`, `NOT`, `FORALL`, `EXISTS`, `<-`, `->`, etc. are used.

8. *Which techniques, if any, do you plan to use in the near future?* Due to performance problems, we have investigated the use of RDQL. Currently we have the PPR running with both TRIPLE and an RDQL-based reasoner.

9. *Which techniques would you like to have, which expressibility would you like to use?* Techniques that we need to overcome performance problems are reasoners, which can incrementally build knowledge bases, which allow for non-monotonic reasoning (as our databases increase over time, we have to integrate new facts efficiently), and reasoners that can deal with masses of data.

User interaction:

1. *How can the user interact with the current system (or in your current plans)? Do you have examples of user interactions?* Current state: Example of an interaction: The user requests a publication. The answer to this request is the publication (the *Reader* part of the PPR) together with information about the authors, the working group in which the publication was published, other, related publications in the same research area, other publications of the authors, etc. (the *Personal* part of the PPR).

2. *Which extensions do you plan for the near future? Examples?* Future: Example of an interaction: The user can specify her/his research interests. According to her/his profile (being a member of REWERSE, being a scientist, being a PhD student), some of the presented information will additionally be highlighted to improve guidance.

3. *How should the user ideally interact with your application? Examples?* Ideally, the user should get an interface in which s/he clearly sees:

   - in which role s/he is currently regarding the information,
   - has a clear and easy paradigm to switch roles,
   - can explore information in REWERSE, and, in the same manner, can explore

   information on the same topics in the Web, thus using the REWERSE portal as the starting point for checking out topics on Reasoning on the Web.

Adaptation and personalization:

1. *Which adaptation techniques do you currently use? Do you have examples?* Adaptation so far is triggered by simple adaptation rules.

   Some examples of Triple rules:

```
/* information on an author */
FORALL ID, NS_CP,CP, A, A_name,A_id,P,E,W,PI,EA,EAC,P_id
   authorinfo(CP,A_name,A_id,P,E,W,PI,EA, EAC) <-
     querydetails(ID, NS_CP:CP,  'http://hoersaal.kbs.uni-hannover.de/
                                        rdf/rewerse.rdf#':author_details)
     AND requested_publication_id(CP,P_id)
     AND authors(P_id, A)
     AND match_author(A, A_name)
     AND isauthor(A,A_id)@'http://mydomain#':mysearch
     AND phone(A_name,P)@'http://mydomain#':mysearch
     AND email(A_name,E)@'http://mydomain#':mysearch
     AND website(A_name,W)@'http://mydomain#':mysearch
     AND picture(A_name, PI)@'http://mydomain#':mysearch
     AND employedat(A_name, EA)@'http://mydomain#':mysearch
     AND employedat_city_or_company(A_name,EAC)@'http://mydomain#':mysearch.

/* related publications for the author */
FORALL ID, NS_CP,CP,A_name, A_id,T,A_String,P_other
  other_publications_from_same_author(CP, A_name,T) <-
    EXISTS A, P_id(
```

```
     querydetails(ID, NS_CP:CP, 'http://hoersaal.kbs.uni-hannover.de/rdf/
                           rewerse.rdf#':other_publications_same_rewerse_author)
     AND requested_publication_id(CP,P_id)
     AND authors(P_id, A)
     AND isauthor(A,A_id)@'http://mydomain#':mysearch
     AND isauthor(A_String,A_id)@'http://mydomain#':mysearch
     AND rewerse_author(A_String, P_other)@'http://mydomain#':mysearch
     AND NOT unify(P_other, P_id)@'http://mydomain#':mysearch
     AND match_author(A_String, A_name)
     AND title(T,P_other)@'http://mydomain#':mysearch).

/* related publications from the same working group */
FORALL P_other, P, WG relevant_publications(P, P_other,WG) <-
       EXISTS A,A_id,A_name (
       working_group(P,WG)
       AND rewerse_author(A,P_other)@'http://mydomain#':mysearch
       AND match_author(A,A_name)
       AND works_at(A_name,WG)@'http://mydomain#':mysearch).

/* determine working group of a person */
FORALL WG, P working_group(P,WG) <-
       EXISTS A,A_id,A_name (
       authors(P,A)
       AND match_author(A,A_name)
       AND involved_in_workingroup(A_name,WG)@'http://mydomain#':mysearch).
```

Some Examples of RDQL rules:

```
/* information on an author */
/* Input: author_id, e.g. http://www.example.org/rewerse#nejdlWolfgang */

SELECT ?name ?phone ?email ?website ?picture ?employedat
WHERE  (<http://www.example.org/rewerse#nejdlWolfgang>,
                  <http://www.example.org/rewerse#phoneNumber> ?phone),
       (<http://www.example.org/rewerse#nejdlWolfgang>,
                  <http://www.example.org/rewerse#eMail> ?email),
       (<http://www.example.org/rewerse#nejdlWolfgang>,
                  <http://www.example.org/rewerse#website> ?website),
       (<http://www.example.org/rewerse#nejdlWolfgang>,
                  <http://www.example.org/rewerse#picture> ?picture),
       (<http://www.example.org/rewerse#nejdlWolfgang>,
                  <http://www.example.org/rewerse#name> ?name),
       (<http://www.example.org/rewerse#nejdlWolfgang>,
       <http://www.example.org/rewerse#employedAt> ?employedat_id),
       (?employedat_id, <http://www.example.org/rewerse#name> ?employedat)

/* related publications for the author */
/* Input: author_id, e.g. http://www.example.org/rewerse#nejdlWolfgang */

SELECT ?pub_title ?a_name
```

```
WHERE (?p_id, <http://www.example.org/rewerse#title>, ?pub_title),
      (?p_id, <http://www.example.org/rewerse#author>, ?seq),
      (?seq, ?r, ?a_name),
      (<http://www.example.org/rewerse#nejdlWolfgang>,
                  <http://www.example.org/rewerse#alternativeNames>, ?a_name)

/* determine working group members */
/* Input: wg_id, e.g. http://www.example.org/rewerse#a3 */

SELECT ?member
WHERE  (<http://www.example.org/rewerse#a3>, ?x, ?member),
       (?member, <http://www.example.org/rewerse#involvedIn>,
                  <http://www.example.org/rewerse#a3>)
```

2. *What is the goal of the adaptation?* The goal of adaptation is to provide personalized content syndication: Searching for information on different Web-sites / in different information resources, and providing a syndicated view on the information in one interface.

3. *Can you categorize adaptation according to existing adaptation functionalities? (e.g. P. Brusilovsky's ontologies). If you can not categorize it according to existing adaptation functionalities, please give a short summary of the adaptation you use, and provide comments for possible categorizations.* Adaptive navigation support: adaptive link generation (current state).

4. *Which actors are involved in the adaptation? Please name them, e.g. user, tutor, expert, etc.* The user.

5. *Which input data (knowledge, real-time data, data about user, etc.) does your application/scenario need?* User profile, user's current request (click), user's browsing history.

6. *What are your plans for adaptation in the near future?* Adaptive link annotation.

7. *What would be the ideal manner of personalization for your application?* As this is a "Reader" application, the object the user is currently reading should be embedded in a context with further, helpful information to the user: Thus link generation (for creating the context) and link annotation (for recommending special pointers in the context) are in the center for future adaptation.

   We would like to use recommendation strategies based on user navigation patterns, especially when using the REWERSE Portal only as a starting point for checking Web resources.

Data:

1. *Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations?)* Only metadata annotations in RDF, OWL.

2. *What is the amount of data that you use? Is it derived from real data? (e.g. demonstrator data, real-world data, etc.)* This is a real application: we use both data on all REWERSE

researchers and on the REWERSE project organization in working groups, etc. and data on all publications of (currently) 7 REWERSE members (it will be extended to get the publications of all the 27 members).

3. *Can you share the data (or part of it) with other partners in REWERSE? Can you make the data public or is it only available for REWERSE-internal demonstrators?* Available for all REWERSE members (for internal and external use), for non-REWERSE members: only on request.

4. *Is your data distributed?* Yes.

5. *Dynamics of your data:*

   - Are there updates? If yes, how often? Which kind of updates? Whenever a publication is published in REWERSE, we have an update. In addition, whenever a entry on the Web page is updated (e.g., for a journla paper form "accepted/to be published" to "3(4), 2004", there is an update.

   - Are there changes of the data? If yes, how often, and of which kind? The Lixto Web information extractor recognizes the event, and the RDF-descriptions of the publication data changes.

   - Do these changes trigger automatically reactions? If yes, how, and what kind of reactions? Yes, by the Lixto suite. No, the rules we currently have work on on-the-fly constructed knowledge bases, thus if the RDF descriptions have changed, the rules working on these description might lead to other results.

6. *Do you expect development of your data in the next future?* Even more data.

7. *How do you estimate the development of your data?* N/A.

Specific requirements to the I-groups:

- 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 handled 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).

Indicate which I-groups might be most promising to help establishing personalization in your application: I1, I4, I5.

2.7 PR-el: the Personal Reader for e-Learning - Application

Keywords: e-Learning, adaptive annotation support, standards for describing e-Learning resources, personalization services.
The Personal reader for e-Learning provides a learner with a personal interface for regarding learning resources: the Personal Annotation Service recommends 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 information from the actually regarded learning resource and checks for related information in other e-Learning corpora, and recommends retrieved results. If you want to set up your own Personal Reader instance for a course you are running, you 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!

For further details about the Personal Reader see [Henze and Nejdl, 2004, Henze and Herrlich, 2004, Dolog et al., 2004a, Henze and Kriesell, 2004, Dolog et al., 2004b, Henze et al., 2004].

Knowledge representation and reasoning techniques:

1. *Which techniques do you use now?* Currently, we use RDF descriptions of e-learning materials, user profiles, and for expressing requests to the Personalization Services / the Web Services.

2. *Why did you decide to use this/these specific technique(s)?* e-learning materials are described according to standards for e-learning materials: LOM.

3. *How does it influence the reasoning and vice versa?* RDF is sufficient for our current implementation.

4. *Which solutions do you use for managing - organizing - storing knowledge?* Only on the practical side: we only use reasoners which have an interface for RDF/OWL data.

5. *Do you have plans to extend/change your knowledge representation techniques in the near future?* So far, all knowledge was stored in RDF descriptions. User profile information is permanently stored in a mySQL database.

6. *What would be the ideal knowledge representation for your needs?* Further exploring the use of the mySQL database.

7. *Which reasoning techniques, if any, do you currently use? Please give examples (e.g. used rules, constraints). If you use more than one technique, please describe each shortly, and with examples.* Currently, we are using the TRIPLE language (http://triple.semanticweb.org/) developed by Stefan Decker and Michael Sintek [Sintek and Decker, 2002] (see description in section 2.6).

8. *Which techniques, if any, do you plan to use in the near future?* No precise plans yet.

9. *Which techniques would you like to have, which expressibility would you like to use?* For user modeling, we need reasoners capable of reflecting time and, (eventually contradicting) user observations. In addition, we need reasoners capable of handling possibly conflicting personalization rules.

User interaction:

1. *How can the user interact with the current system (or in your current plans)? Do you have examples of user interactions?* The user can browse learning materials, or follow the structure, or explore the context of a learning resource provided by the PR-eL.
2. *Which extensions do you plan for the near future? Examples?* N/A.
3. *How should the user ideally interact with your application? Examples?* give the user the possibility to subscribe for personalization service via a supportive, personalized interface.

Adaptation and personalization:

1. *Which adaptation techniques do you currently use? Do you have examples?*

```
/* Extract statements of the query */

 FORALL O, P, V O[P->V] <-
    O[P->V]@'http://www.examples.org/test#':query.


/* Extract ID, user name, current page out of the query */

 FORALL NS_ID, ID, NS_U, U, NS_LO, LO, NS_R, R querydetails(NS_ID:ID, NS_LO:LO,
     NS_U:U, NS_R:R) <-
     NS_ID:ID['http://www.w3.org/1999/02/22-rdf-syntax-ns#':type ->
     'http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':'Query'] AND
     NS_ID:ID['http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':aboutUser
-> NS_U:U] AND
     NS_ID:ID['http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':currentPage
          -> NS_LO:LO] AND
     NS_ID:ID['http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':queryFor
     -> NS_R:R].


/* Compiling the answer for the query */

/*** all recommendations of all learning resources ***/
 FORALL ID, LO, LO2, U, S learning_state(ID, LO, U, S) <-
     querydetails(ID, LO2, U,
         'http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':learningState)
     AND learning_state(LO, U, S)@'http://www.examples.org/test#':personalization.

/*** all recommendations of a specific learning resources ***/
 FORALL ID, LO, U, S learning_state_for(ID, LO, U, S) <-
     querydetails(ID, LO, U,
         'http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':thislearningState)
     AND learning_state(LO, U, S)@'http://www.examples.org/test#':personalization.

/*** specific recommendations for a learning resource ***/
 FORALL ID, LO, LO2, U, S learning_state_specific(ID, LO, U, S) <-
```

```
     querydetails(ID, LO2, U, 'http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':S)
     AND learning_state(LO, U, S)@'http://www.examples.org/test#':personalization.


/*** details ***/
 FORALL ID, LO, U, LO_DETAIL detail_learningobject(ID, LO, U, LO_DETAIL) <-
     querydetails(ID, LO, U, 'http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':details) AND
     detail_learningobject(LO, LO_DETAIL)@'http://www.examples.org/test#':personalization.

/*** general ***/
 FORALL ID, LO, U, LO_GENERAL general_learningobject(ID, LO, U, LO_GENERAL) <-
     querydetails(ID, LO, U, 'http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':general) AND
     general_learningobject(LO, LO_GENERAL)@'http://www.examples.org/test#':personalization.

/*** context-summary ***/
 FORALL ID, LO, U, S context_summary(ID, LO, U, S) <-
     querydetails(ID, LO, U, 'http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':summary) AND
     context_summary(LO, S)@'http://www.examples.org/test#':personalization.

/*** quiz ***/
 FORALL ID, LO, U, Q quiz(ID, LO, U, Q) <-
    quiz(LO, Q)@'http://www.examples.org/test#':personalization AND
   querydetails(ID, LO, U, 'http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':quiz).

/*** all learned LOs (*done*), marked by user ***/

 FORALL ID, LO, U done(ID, LO, U) <-
    U['http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':done -> LO]
                                          @'http://www.examples.org/test#':user
    AND EXISTS Z, LO2 (querydetails(ID, LO2, U, Z)).


/*** all LOs that should be learned again (*needAgain*), marked by user ***/

FORALL ID, LO, U needAgain(ID, LO, U) <-
   U['http://hoersaal.kbs.uni-hannover.de/rdf/l3s.rdf#':needAgain -> LO]
                                          @'http://www.examples.org/test#':user
   AND EXISTS Z, LO2 (querydetails(ID, LO2, U, Z)).
```

2. *What is the goal of the adaptation?* To 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.

3. *Can you categorize adaptation according to existing adaptation functionalities? (e.g. P. Brusilovsky's ontologies). If you can not categorize it according to existing adaptation functionalities, please give a short summary of the adaptation you use, and provide comments for possible categorizations.* Adaptive navigation support: adaptive link generation, adaptive link annotation.

4. *Which actors are involved in the adaptation? Please name them, e.g. user, tutor, expert, etc.* User.

5. *Which input data (knowledge, real-time data, data about user, etc.) does your application/scenario need?* Input data at run-time: user identifier, the user interface event; input data for the reasoner: run-time input data, plus meta-information on the course, the domain, and the user.

6. *What are your plans for adaptation in the near future?* Adaptive interface which the user can use to control the appearance of the PR-eL.

7. *What would be the ideal manner of personalization for your application?* Smart e-Learning is difficult to describe. Ideally, one interface to manage the different courses / activities the user is currently interested in, which also manages the things the user has already learnt (offering e.g. a portfolio dimension where previously visited courses, knowledge, discussion threads can be found, too).

Data:

1. *Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations?)* Metadata annotations in RDF, no further data, no database.

2. *What is the amount of data that you use? Is it derived from real data? (e.g. demonstrator data, real-world data, etc.)* Real-world data for two different courses: A course on Java Programming, and a course on Semantic Web.

3. *Can you share the data (or part of it) with other partners in REWERSE? Can you make the data public or is it only available for REWERSE-internal demonstrators?* REWERSE: both courses: public to all members of REWERSE, world: Java course public to the world, Semantic Web course only on request.

4. *Is your data distributed?* The RDF descriptions of the courses, e-learning resources, and the users are distributed.

5. *Dynamics of your data:*

   - are there updates? If yes, how often? Which kind of updates?

   - are there changes of the data? If yes, how often, and of which kind?

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

   Currently: only new facts about user interactions are monitored and saved in the user profiles.

6. *Do you expect development of your data in the next future?* No significant change in the amount of data.

7. *How do you estimate the development of your data?* No significant change in the amount of data.

Specific requirements to the I-groups: - modeling and reasoning about updates and events for improved user modeling

- all I-groups which need a testbed with real data on the Semantic Web can use the Personal Reader framework: We offer a Web service based infrastructure for experimenting with rules and reasoning techniques.

Indicate which I-groups might be most promising to help establishing personalization in your application: I4, I5.

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 and powered by different reasoning techniques.

2.8 STAR, a Smart Tourist Agenda Recommender - Scenario/Application

Keywords: e-tourism, configuration, reasoning, adaptive web systems.
Brief usage scenario. Susan wants to organize a one day trip to Torino (Italy). She is interested in an exhibition about African art she heard of and she would like to spend the rest of the day in sightseeing, buying some gifts and eating good Italian food. Her favorite tour operator can support her with travel and hotel reservations and with information about tourist attractions and events in the area, but the organization of the tour is left to Susan's initiative. Scheduling the agenda for a tour is a quite complex task, which requires a detailed knowledge: the most interesting tourist attractions, their opening hours, the cultural events going on at that time, the places where you can find good food, or buy typical products. Susan connects to a tourist Web portal which offers many services, among which STAR. As a first step, STAR asks Susan some questions (e.g., the date of the trip, and so on) and, on the basis of Susan's answers provides her with a one-day agenda.

Information about STAR can be found in [Goy and Magro, 2004a, Goy and Magro, 2004b].

Knowledge representation and reasoning techniques:

1. *Which techniques do you use now?* A conceptual language close to description logics, in which only tree-structured models are allowed.

2. *Why did you decide to use this/these specific technique(s)?* Because we exploit a configuration engine based on such a representation.

3. *How does it influence the reasoning and vice versa?* Knowledge representation and reasoning are strictly connected.

4. *Which solutions do you use for managing - organizing - storing knowledge?* We exploit a previously implemented tool for knowledge acquisition, which produces a declarative representation, in a proprietary format, stored in text files.

5. *Do you have plans to extend/change your knowledge representation techniques in the near future?* We would like to exploit an XML-based language, instead of the current proprietary format, for storing knowledge.

6. *What would be the ideal knowledge representation for your needs?* N/A.

7. *Which reasoning techniques, if any, do you currently use? Please give examples (e.g. used rules, constraints). If you use more than one technique, please describe each shortly, and with examples.* Taxonomic/partonomic inferences and constraint satisfaction. The partonomy represents the compositional structure of the agenda, whereas the tourist activities are organized in a taxonomy. The complex relations among the tourist activities are expressed by means of constraints.

8. *Which techniques, if any, do you plan to use in the near future?* Simple production rules for User Modeling.

9. *Which techniques would you like to have, which expressibility would you like to use?* N/A.

User interaction:

1. *How can the user interact with the current system (or in your current plans)? Do you have examples of user interactions?* When Susan connects to STAR (on-line configurator for a tourist agenda), the system asks her some questions (e.g., the date of the trip; if she would like to try the famous "aperitivo"; if she is interested in a particular artistic style, ...). Moreover, Susan can specify (a) a set of tourist attractions, events, restaurants, etc. she is interested in, by browsing the available categories; (b) the starting point of the tour, by providing the name of her hotel, or choosing a specific tourist attraction, or selecting an area in the city by means of an interactive map. STAR gathers the information provided by Susan and tries to suggest her a one-day agenda. If the proposed solution is partial, i.e. not all the time slots are filled in, Susan can select new items in order to fill them in. Moreover, Susan can "criticize" STAR's choices and modify them. For instance, if STAR proposed a visit to the Egyptian Museum in the morning, and Susan is not very happy with it, she can click on the corresponding button: a pop-up window will appear, where Susan can select a new item (e.g. the Museum of Cinema) that will replace the Egyptian Museum. The system takes into account this new requirement and displays the modified agenda.

2. *Which extensions do you plan for the near future? Examples?* We would like to introduce explanations for system failures. Moreover, we think of introducing a User Model, which could provide input to the system on behalf of the user.

3. *How should the user ideally interact with your application? Examples?* N/A.

Adaptation and personalization:

1. *Which adaptation techniques do you currently use? Do you have examples?* The system provides an interactive way to build a personalized agenda. Currently, the requirements are elicited by means of a dialog with the user.

2. *What is the goal of the adaptation?* The definition of a tourist agenda is an actual problem solving task and manually solving it can be annoying and time consuming: it requires to access different information sources (tourist guides, the Internet, local newspapers, etc.) and to mentally backtrack many times (e.g. when discovering that an interesting museum is closed, that two historical buildings are too far from each other to be visited in the same morning, and so on). Our claim is that the task of building a personalized agenda can be automated by defining it as a configuration problem.

3. *Can you categorize adaptation according to existing adaptation functionalities? (e.g. P. Brusilovsky's ontologies). If you can not categorize it according to existing adaptation functionalities, please give a short summary of the adaptation you use, and provide comments for possible categorizations.* We think that our current proposal can be considered an adaptive system only in the sense that it provides a flexible tool that helps the user in organizing a personalized trip. This proposal clearly differs from the current offers on the Web, that apply a "one-fits-all" approach (e.g. pre-packed travel solutions provided by on-line tour operators) which do not fulfill the requirements of heterogeneous users having different goals.

4. *Which actors are involved in the adaptation? Please name them, e.g. user, tutor, expert, etc.* Tourists (possibly, non web expert).

5. *Which input data (knowledge, real-time data, data about user, etc.) does your application/scenario need?* The configuration engine takes as input the knowledge base (partonomy, taxonomy, and constraints) and the user's requirements about the agenda.

6. *What are your plans for adaptation in the near future?* An interesting enhancement of the system would be to include a User Model, which could provide input on behalf of the user. The idea is that the set of requirements currently directly elicited by asking the user could be partially determined by asking the User Model, which could contain information about the user's interests, needs, and so on, thus significantly reducing the input needed from the user.

7. *What would be the ideal manner of personalization for your application?* N/A.

Data:

1. *Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations?)* Mainly databases.

2. *What is the amount of data that you use? Is it derived from real data? (e.g. demonstrator data, real-world data, etc.)* We only use demonstrator data, i.e. a very small amount, manually coded.

3. *Can you share the data (or part of it) with other partners in REWERSE? Can you make the data public or is it only available for REWERSE-internal demonstrators?* Our data are exploited only to the purpose of demonstration.

4. *Is your data distributed?* No.

5. *Dynamics of your data:*

   - are there updates? If yes, how often? Which kind of updates?

   - are there changes of the data? If yes, how often, and of which kind?

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

   No dynamicity is currently supported. Knowledge base maintenance is out of the scope of the current work.

6. *Do you expect development of your data in the next future?* It would be nice to find a provider of real data.

7. *How do you estimate the development of your data?* N/A.

Specific requirements to the I-groups: we are particularly interested in mechanisms that are able to give explanations even when no (good) solution exists.

Indicate which I-groups might be most promising to help establishing personalization in your application: I2, I5.

2.9 Personalized System for REWERSE Web-sites - Scenario

Keywords: Technology Transfer, rules, REWERSE Web-sites.
The user wants to search the REWERSE Web-sites for information relevant for companies. The system supports the user in the process of asking the questions and presents the search results grouped into categories to the user. Also information from the general Web is included for answering the questions. Other profiles (that is journalist, professional, etc.) for users searching the REWERSE Web-sites are also conceivable.

Knowledge representation and reasoning techniques:

1. *Which techniques do you use now?* N/A.
2. *Why did you decide to use this/these specific technique(s)?* N/A.
3. *How does it influence the reasoning and vice versa?* N/A.
4. *Which solutions do you use for managing - organizing - storing knowledge?* N/A.
5. *Do you have plans to extend/change your knowledge representation techniques in the near future?* N/A.
6. *What would be the ideal knowledge representation for your needs?* N/A.
7. *Which reasoning techniques, if any, do you currently use? Please give examples (e.g. used rules, constraints). If you use more than one technique, please describe each shortly, and with examples.* N/A.
8. *Which techniques, if any, do you plan to use in the near future?* N/A.
9. *Which techniques would you like to have, which expressibility would you like to use?* N/A.

User interaction:

1. *How can the user interact with the current system (or in your current plans)? Do you have examples of user interactions?* The user poses a question. Similar questions already posed by members of the same user group (e.g. TTA affiliated person) are presented to the user by the system. The system scans Web-sites according to rules which are associated with the particular question chosen. Related words (imported from a remote knowledge server) are also used for the search by the system.
2. *Which extensions do you plan for the near future? Examples?* N/A.

3. *How should the user ideally interact with your application? Examples?* Ideally, the user can put natural language text in a mask and is then presented with a list of possible questions. By clicking on the applicable question the rules associated with the question are "loaded" as well. The user should be able to redefine the rules. One idea also would be if the systems learns from which answers, categories the user selects from what is offered by the system. General interaction loop: user input; system feedback; user can refine or choose; system searches, does inferencing; feedback to the user; goto beginning.

Adaptation and personalization:

1. *Which adaptation techniques do you currently use? Do you have examples?* N/A.

2. *What is the goal of the adaptation?* To allow different users to have quicker access to the information they need and to help users profit from the information stored from other users belonging to the same user group. Different user groups are TTA affiliated person, journalist, professional from a specific company.

3. *Can you categorize adaptation according to existing adaptation functionalities? (e.g. P. Brusilovsky's ontologies). If you can not categorize it according to existing adaptation functionalities, please give a short summary of the adaptation you use, and provide comments for possible categorizations.* N/A.

4. *Which actors are involved in the adaptation? Please name them, e.g. user, tutor, expert, etc.* user, maybe also an administrator who needs to validate the rules etc.

5. *Which input data (knowledge, real-time data, data about user, etc.) does your application/scenario need?* knowledge, real-time data, data about the user, the user can also define rules

6. *What are your plans for adaptation in the near future?* N/A.

7. *What would be the ideal manner of personalization for your application?* N/A.

Data:

1. *Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations?)* N/A.

2. *What is the amount of data that you use? Is it derived from real data? (e.g. demonstrator data, real-world data, etc.)* N/A.

3. *Can you share the data (or part of it) with other partners in REWERSE? Can you make the data public or is it only available for REWERSE-internal demonstrators?* N/A.

4. *Is your data distributed?* N/A.

5. *Dynamics of your data:* N/A.

6. *Do you expect development of your data in the next future?* N/A.

7. *How do you estimate the development of your data?* N/A.

2.10 Ambient Intelligence - Scenario/Application

Keywords: automation, ambient intelligence, integrated devices
This is the description of a scenario and of a prototype implementation whose is to improve and enhance a person's lifestyle through the use of a number of devices creating an automated intelligent environment [Micallef, 2004].

Knowledge representation and reasoning techniques:

1. *Which techniques do you use now?* The initial system does not require any knowledge representation features but only a single storage mechanism. Additionally DAML+OIL and OWL were employed within the ontologies purposely developed for this application.

2. *Why did you decide to use this/these specific technique(s)?* Because of the idea of implementing the lowest complexities to use and setup.

3. *How does it influence the reasoning and vice versa?* It doesn't and theoretically shouldn't influence the reasoning. If it turns out to do so from the test being performed then a decision has to be made.

4. *Which solutions do you use for managing - organizing - storing knowledge?* A simple off-the-shelf solution that minimizes setup and delivery.

5. *Do you have plans to extend/change your knowledge representation techniques in the near future?* Yes surely, in order to produce better quality ambient agents, truly and realistically enhancing the environment.

6. *What would be the ideal knowledge representation for your needs?* Any kind of representation that is semantically interoperable with all components and devices in an optimized scenario.

7. *Which reasoning techniques, if any, do you currently use? Please give examples (e.g. used rules, constraints). If you use more than one technique, please describe each shortly, and with examples.* Simple rules were implemented in the prototype that was modeled on only one room in the house: the kitchen. In this case agents in different states interacted with the environment and utensils encountering conditions which they had to satisfy in order to trigger some action.

8. *Which techniques, if any, do you plan to use in the near future?* This is only a prototype implementation and eventually a decision will be taken to further enhance the decision making of the individual agents.

9. *Which techniques would you like to have, which expressibility would you like to use?* Ideally the software will be able to get input from the different devices and integrated devices to further help the agents to realistically interact with the environment to accommodate the user and his/her needs.

User interaction:

1. *How can the user interact with the current system (or in your current plans)? Do you have examples of user interactions?* The user currently does not directly interact with the reasoner but only with the front interface of the prototype giving some input, constraints and requirements.

2. *Which extensions do you plan for the near future? Examples?* In the future the plan is to extend all aspects of the prototype as well as the environment of application. A typical example would be using a Natural Language interface to interact with the various devices.

3. *How should the user ideally interact with your application? Examples?* As mentioned before the ideal interaction would be Natural Language.

Adaptation and personalization:

1. *Which adaptation techniques do you currently use? Do you have examples?* Not much personalization was implemented in this initial prototype but eventually in the future the idea of personal ambient agents is very interesting, obviously tailored to the individual needs of the habitants.

2. *What is the goal of the adaptation?* The goal of the adaptation is to simulate a realistic scenario where every person within a household has different needs and requirements, thereby extending the idea of ambient intelligence to its limits.

3. *Can you categorize adaptation according to existing adaptation functionalities? (e.g. P. Brusilovsky's ontologies). If you can not categorize it according to existing adaptation functionalities, please give a short summary of the adaptation you use, and provide comments for possible categorizations.* As mentioned before no adaptation was implemented yet.

4. *Which actors are involved in the adaptation? Please name them, e.g. user, tutor, expert, etc.* In the case of a future system only a user will be involved in the adaptation. Having said this, the agents will have to cater for different users, maybe also to a power user with special high-level access control, like those exerted by mature and adult guardians within a family household.

5. *Which input data (knowledge, real-time data, data about user, etc.) does your application/scenario need?* At this stage the only data input by the user are the requirements with the kitchen setup as well as constraints and other needs. To give an example a number of agent categories interact with each other with the goal of satisfying these needs, namely:

    - environment related agents like air-conditioning agent and the user's favorite settings, audio manager, light agent, telephone agent;
    - kitchen appliances like microwave agent, fridge freezer agent, cooker agent, dishwasher agent;
    - others like delivery box, recipes manager and stock manager.

6. *What are your plans for adaptation in the near future?* In the near future, multi-user scenarios together with multi-agent interaction and communication are envisaged as a first stage towards basic adaptation.

7. *What would be the ideal manner of personalization for your application?* The ideal manner would be a parallel incrementation as the user manually controls the personalized ambient agent reinforcing the personalization suggested, a sort of training mode.

Data:

1. *Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations?)* A simple MySQL database is being used at the moment: it is not complex, easy to set up and enough for the system requirements.

2. *What is the amount of data that you use? Is it derived from real data? (e.g. demonstrator data, real-world data, etc.)* At the moment its only test data (ficticious).

3. *Can you share the data (or part of it) with other partners in REWERSE? Can you make the data public or is it only available for REWERSE-internal demonstrators?* No problem with sharing publicly this data.

4. *Is your data distributed?* No, in future implementations with multi-agents and multi-users over multiple locations in the house there might be the possibility of having data distribution.

5. *Dynamics of your data:*

   - are there updates? If yes, how often? Which kind of updates?

   - are there changes of the data? If yes, how often, and of which kind?

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

   No updates, changes or reactions expected on the data.

6. *Do you expect development of your data in the next future?* One bachelors degree student and a potential masters student might be working on extending this prototype to the levels described above.

7. *How do you estimate the development of your data?* It is not easy to really predict this but it will relative to both the development being made and the number of user, agents and locations with the test environment.

Indicate which I-groups might be most promising to help establishing personalization in your application: surely those workgroups focusing on evolving environments where software is required to adapt and evolve in networked environments. Definitely I5 might be the most promising that encompasses the system under consideration.

3 Synopsis

3.1 Knowledge Representation and Reasoning Techniques

Question	2.1 Alert Services	2.2 Position & Location	2.3 WLog
Status	**Scenario**	**Scenario**	**Application**
1.) Techniques used	user defines profile of a specific alert (user teaches system)	ontologies for geotemporal and geospatial data	*action metaphor*: actions are carried out based on prerequisites (simple or complex competencies) and their effects. Implementation: *DyLog*
2.) Reasons for 1.)	-	-	originally: a mulit-agent system: DyLog interpreter fulfills the required functionality for such a multi-agent system
3.) Implications of 1.)	-	-	Realization of procedural planning
4.) Storing knowledge - *currently*	user profile in database, user changes his profile	-	knowledge-base is a logic theory, stored in some file
5.) Storing knowledge - *planned*	-	-	use OWL for representing domain knowledge
6.) Storing knowledge - *ideally*	improved "understanding" of the needs of the user	-	OWL ontology for representing DyLog programs
7.) Reasoning techniques - *currently*	set of rules	-	procedural planning (constructing study plan), temporal projection (verifying the plan), temporal explanation (explaining plan)
8.) Reasoning techniques - *planned*	-	-	-
9.) Reasoning techniques - *ideally*	-	constraint reasoning, chaining reasoning	exploit mechanisms for handling failure and replanning

	2.4 Reading Sequences	2.5 Health Care	2.6 Personal Publication Reader
	Scenario	**Scenario / Application**	**Application**
1.)	action metaphor to construct reading sequences, ontology for defining "knowledge entities" and relations between them	XML for representing content and rules, XML Schema, and Ontologies (manipulated by Java modules)	RDF (describing publication information) OWL (describing REWERSE project)
2.)	plan: OWL, OWL-S	work started 5 years ago, health care information provider was interested in XML	Expressibility of RDF is enough for describing publications, for modeling the project REWERSE, OWL was needed.
3.)	Technique is seen as a semantic-based interchange format; exploit also non-ontological reasoning techniques	more general reasoning would have been more easily handled if a general purpose Rule engine had been used	Only on the practical side: we only use reasoners which have an interface for RDF/OWL data.
4.)	metadata	XML for representing knowledge & information; XSLT for transformation & display	So far, all knowledge was stored in RDF/OWL descriptions without any database or other storage layer in between.
5.)	exploit e.g. "learning design" approach	No.	For using RDQL / Jena, we currently check whether to use a mySQL database with Jena.
6.)	a knowledge representation in such a way that different reasoning tasks, exploiting (possibly) different reasoning techniques can use it.	-	Preference is on knowledge which is constructed at real time according to a user's request, and makes use of distributed metadata-annotations of Web resources.
7.)	actions, with prerequisites and effects	if-then rules, embedded either in the content or kept in a separate repository. These rules may either be interpreted within XSLT or by a separate inference engine (one has been built as part of our toolkit)	TRIPLE [Sintek and Decker, 2002]. Due to performance problems with TRIPLE, we have investigated to use RDQL:. Currently we have the PPR running with both TRIPLE and an RDQL-based reasoner.
8.)	-	No.	-
9.)	more learner support besides reading sequences, making use of 6.)	-	Techniques that we need to overcome performance problems are reasoners, which can incrementally build knowledge bases, which allow for non-monotonic reasoning (as our data bases increase over time, we have to integrate new facts efficiently), and reasoners that can deal with masses of data.

Question	2.7 PR-eL	2.8 STAR
Status	**Application**	**Scenario / Application**
1.) Techniques used	RDF descriptions of e-learning materials, user profiles, and for expressing requests to the Personalization Services / the Web Services.	A conceptual language close to description logics, in which only tree-structured models are allowed.
2.) Reasons for 1.)	e-learning materials are described according to Standards for e-learning materials: LOM.	Because we exploit a configuration engine based on such a representation.
3.) Implications of 1.)	RDF is sufficient for our current implementation.	Knowledge representation and reasoning are strictly connected.
4.) Storing knowledge - *currently*	Only on the practical side: we only use reasoners which have an interface for RDF/OWL data.	We exploit a previously implemented tool for knowledge acquisition, which produce a declarative representation, in a proprietary format, stored in text files.
5.) Storing knowledge - *planned*	So far, all knowledge was stored in RDF descriptions. User profile information is permanently stored in a mySQL database.	We would like to exploit an XML-based language, instead of the current proprietary format, for storing knowledge.
6.) Storing knowledge - *ideally*	Further exploring the use of the mySQL database.	-
7.) Reasoning techniques - *currently*	TRIPLE [Sintek and Decker, 2002]	Taxonomic/partonomic inferences and constraint satisfaction. The Partonomy represents the compositional structure of the agenda, whereas the tourist activities are organized in a taxonomy. The complex relations among the tourist activities are expressed by means of constraints.
8.) Reasoning techniques - *planned*	No precise plans yet	Simple production rules for User Modeling.
9.) Reasoning techniques -*ideally*	For user modeling, we need reasoners capable of reflecting time and, (eventually contradicting) user observations. In addition, we need reasoners capable of handling possibly conflicting personalization rules.	-

Question	2.9 Info. Portal	2.10 Ambient Intelligence
Status	**Scenario**	**Scenario / Application**
1.) Techniques used	-	The initial system does not require any knowledge representation features but only a single storage mechanism. Additionally DAML+OIL and OWL were employed within the Ontologies purposely developed for this application.
2.) Reasons for 1.)	-	Because of the idea of implementing the lowest complexities to use and setup.
3.) Implications of 1.)	-	It doesn't and theoretically shouldn't influence the reasoning.
4.) Storing knowledge - *currently*	-	A simple off-the-shelf solution that minimizes setup and delivery.
5.) Storing knowledge - *planned*	-	Yes surely, in order to produce better quality ambient agents, truly and realistically enhancing the environment.
6.) Storing knowledge - *ideally*	-	Any kind of representation that is semantically interoperable with all components and devices in an optimized scenario.
7.) Reasoning techniques - *currently*	-	Simple rules were implemented in the prototype that was modeled on only one room in the house.
8.) Reasoning techniques - *planned*	-	This is only a prototype implementation and eventually a decision will be taken to further enhance the decision making of the individual agents.
9.) Reasoning techniques -*ideally*	-	Ideally the software will be able to get input from the different devices and integrated devices to further help the agents to realistically interact with the environment to accommodate the user and his/her needs.

3.2 User Interaction

Question	2.1 Alert Services	2.2 Position & Location	2.3 WLog
Status	**Scenario**	**Scenario**	**Application**
1.) User interaction - *currently*	modify user profile via Web and WAP	interact using mobile devices such as PDAs, Laptops, etc.	interaction with a reactive agent, the executor; dialogue-like situations during construction of study plan
2.) User interaction - *planned*	change the way the system applies the rules	No plans.	Realization of executor in a "Web service" architecture.
3.) User interaction - *ideally*	No interaction, but system guesses correct. Or: allow user to express needs in a natural way.	Due to mobility: voice interaction, etc.	the most free and natural possible way

Question	2.4 Reading Sequences	2.5 Health Care	2.6 Personal Publication Reader
Status	**Scenario**	**Scenario / Application**	**Application**
1.) User interaction - *currently*	-	via browser; questionnaire to capture user preferences	user requests a publication by it's title
2.) User interaction - *planned*	user specifies a learning goal / learning interest, system analyses the learning goal, and constructs a complete study plan according to users goal, previously achieved knowledge, preferences, etc.	No plans.	user can specify her/his interests
3.) User interaction - *ideally*	as natural as possible	create presentations according to types of users	an interface where s/he clearly sees: in which role s/he is currently regarding the information, has a clear and easy paradigm to switch between roles. Further: user can use REWERSE portal as starting point for checking out further resources found on the Web which are related to this topic

Question	2.7 PR-eL	2.8 STAR
Status	**Application**	**Scenario / Application**
1.) User interaction - *currently*	browse learning material, explore context	questionnaire; user can specify set of tourist attractions, events, restaurants etc. s/he is interested in; user can specify starting point of the tour; user can select items out of a presented tour, can "criticize" choices and modify them
2.) User interaction - *planned*	-	explanations for system failures; a user model which could provide input on behalf of the user.
3.) User interaction - *ideally*	use subscribes for personalization services via a supportive, personalized interface	-

Question	2.9 Info. Portal	2.10 Ambient Intelligence
Status	**Scenario**	**Scenario / Application**
1.) User interaction - *currently*	user asks questions	user interacts with the front interface, giving some input, constraints, and requirements
2.) User interaction - *planned*	-	extensions of current interactions
3.) User interaction - *ideally*	natural language interface; system tries to guess related "questions"; system learns from the interactions; user should be able to redefine rules associated with the questions	Natural language interface to interact with the various devices

3.3 Adaptation and Personalization

Question	2.1 Alert Services	2.2 Position & Location	2.3 WLog
Status	**Scenario**	**Scenario**	**Application**
1.) Functionality	change of appearance, e.g. change of language in which messages are sent	based on user profile and location: change of appearance, language	curriculum sequencing (multi-step sequencing), conditional plans
2.) Goal	user friendly service	provide the exact service that this particular user is demanding	produce individual sequences through course material
3.) Category	adaptive presentation	adaptive retrieval and presentation	adaptive navigation, reading sequences
4.) Actors	user	user, position, and location of service	user, rational agent (the virtual tutor), and a reactive agent (the executor)
5.) Input Data	Data about user, his needs, and preferences. Data from content providers about events.	the service demanded by the user, and its position	knowledge about the user's learning goal, expertise. Knowledge about single courses, and a set of curriculum schemas.
6.) Plans	-	-	user modeling techniques to support the refinement process
7.) Ideal	User should easily modify the way he wants to be warned; not only preferences but also rules and logic	through the position of the user, the location of the service demanded and the data about the user	deal with failure and replanning; roll back, produce partial plans

Question	2.4 Reading Sequences	2.5 Health Care	2.6 Personal Publication Reader
Status	**Scenario**	**Scenario / Application**	**Application**
1.) Functionality	curriculum sequencing, construction of evolving user models	selection of appropriate information, text items, images, etc. Ordering of information presented; Customization of the result (font, colours, ..)	Adaptation rules
2.) Goal	produce a reading sequence of learning resources; user profile is updated according to user's behavior	increase the effectiveness of presentations of health care information	personalized content syndication
3.) Category	curriculum sequencing	adaptive retrieval and presentation	adaptive navigation support: adaptive link generation
4.) Actors	user and system	user, health care information provider	user
5.) Input Data	Data about available learning resources, knowledge about the user, the learning goal, dependencies among knowledge entities.	Data about user	user profile, user's current request (click), user's browsing history
6.) Plans	-	-	Adaptive link annotation
7.) Ideal	-	-	Provide a individually optimized embedding context for a Web resource

Question	2.7 PR-eL	2.8 STAR
Status	**Application**	**Scenario / Application**
1.) Functionality	Personalization Rules	personalized agenda, dialogue with user
2.) Goal	Embed a learning resource in a context: details, general topics, quizzes, summaries, examples, etc.	create a personal agenda, solving a configuration problem
3.) Category	adaptive link generation, adaptive link annotation	adaptive retrieval and planning
4.) Actors	user	tourists as users
5.) Input Data	At run-time: user identifier, user interface event. Input for reasoner: run-time input data, plus meta-information on the course, the domain, and the user.	knowledge base (partonomy, taxonomy, and constraints), and the user's requirements about the agenda
6.) Plans	adaptive interface which the user can use to control the appearance of the PR-eL	employ persistent user model
7.) Ideal	"Smart e-Learning"? User can manage his learning experiences, creates portfolios, ...	-

Question	2.9 Info. Portal	2.10 Ambient Intelligence
Status	**Scenario**	**Scenario / Application**
1.) Functionality	-	plan: personal ambient agent
2.) Goal	quicker access to information they need; help users to profit from the information accessed by users with similar interests. User Groups: TTA affiliated persons, journalists, professionals from industry, etc.	support every person within a household
3.) Category	-	-
4.) Actors	user	user (different roles of same user possible, e.g. power-user)
5.) Input Data	knowledge, real-time data, user profile, user should be able to define rules	for the example of a kitchen setup: environment related agents (air-conditioning, audio, light, telephone, ...); kitchen appliances (microwave agent, fridge freezer agent, cooker agent, dishwasher agent
6.) Plans	-	multi-user scenarios, multi-agent interaction and communication
7.) Ideal	-	parallel incrementation as the user manually controls the personalized ambient agent reinforcing the personalization suggested, a sort of training mode

3.4 Data & Collaboration

Question	2.1 Alert Services	2.2 Position & Location	2.3 WLog
Status	**Scenario**	**Scenario**	**Application**
1.) Format	classified and stored in a DB	-	Knowledge base, written in Prolog
2.) Amount	depends on users and events	would be real-world data	demonstrator
3.) Availability	no	-	yes
4.) Distributed	no	likely to be distributed	no
5.) Updates Changes Triggers	- - -	e.g if a user travels, the position changes e.g. a new motorway is build, the route map will be modified e.g. if a user crosses the border, a new route map is required	mental state of the user changes to course repository when the course offer changes (not often) no
6.) Near future	-	-	-
7.) Developments	-	-	-
8.) requirements to I-groups	reasoning techniques, knowledge representation	geospatial and geotemporal reasoning	mechanisms for handling failure, in particular techniques for user constraint relaxation or replanning
9.) Indicate I-groups	I2, I5	I4	I2, I5

Question	2.4 Reading Sequences	2.5 Health Care	2.6 Personal Publication Reader
Status	**Scenario**	**Scenario / Application**	**Application**
1.) Format	No data yet, demonstrator expected soon	user profiles in XML; information sources in XML with accompanying XSLT	metadata annotations in RDF, OWL
2.) Amount	demonstrator	relatively small	real-world data; large amount
3.) Availability	yes	internal REWERSE demos; negotiation	for all REWERSE members yes; others: negotiation
4.) Distributed	likely	no	Yes
5.) Updates Changes Triggers	update of user model library of learning resources maybe	currently static currently static currently static	whenever a new publication is published currently: weekly crawls Lixto: yes, Personalization Rules: no.
6.) Near future	repositories will evolve	no plans	extend for all partners of REWERSE
7.) Developments	-	-	-
8.) requirements to I-groups	reasoning techniques for: planning, replanning, explanation. Reasoning to policies	-	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 handled 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)
9.) Indicate I-groups	I2, I5	-	I1, I5

Question	2.7 PR-eL	2.8 STAR
Status	**Application**	**Scenario / Application**
1.) Format	Metadata in RDF	mainly databases
2.) Amount	Real-world data for two courses: Java programming, and a course on Semantic Web	demonstrator data, small amount,
3.) Availability	REWERSE partners: Yes.	data exploited only for demonstration
4.) Distributed	Yes.	No.
5.) Dynamics:	only new facts about user interactions are monitored and saved in the user profiles	no dynamics
6.) Near future	-	nice to have: real data
7.) Developments	-	-
8.) requirements to I-groups	modeling and reasoning about updates and events for improved user modeling; all I-groups which need a testbed with real data on the Semantic Web can use the Personal Reader framework: We offer a Web service based infrastructure for experimenting with rules and reasoning techniques. 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 and powered by different reasoning techniques.	we are particularly interested in mechanisms that are able to give explanations even when no (good) solution exists.
9.) Indicate I-groups	I4, I5	I2, I5

Question	2.9 Info. Portal	2.10 Ambient Intelligence
Status	**Scenario**	**Scenario / Application**
1.) Format	-	MySQL database
2.) Amount	-	test data (ficticious)
3.) Availability	-	yes
4.) Distributed	-	no
5.) Dynamics:	-	no updates, changes, ore reactions expected on data
6.) Near future	-	extension of prototype
7.) Developments	-	-
8.) requirements to I-groups	-	surely those workgroups focusing on evolving environments where software is required to adapt and evolve in networked environments.
9.) Indicate I-groups	-	I5

4 Analysis

Let us now analyze the proposed scenarios and applications in order to derive a set of needs and of proposals to pass on to the I-groups and to further discuss within the working group A3.

4.1 Considerations about knowledge in personalization systems

Given the overview of the proposed scenarios and applications, reported in Section 1.1, in which the main characteristics of personalization systems have been outlined, w.r.t. user modeling, querying, and desired adaptation mechanisms, let us now draw some considerations about the different kinds of knowledge that are involved by personalization systems before passing to an overview of the languages and tools that are currently available. Particularly interesting, in this perspective, those descriptions of Section 2 that refer to an existing application system, normally prototypes, in which the implementation issue has been faced to some extent.

Generally speaking, a system that performs some kind of personalization needs to represent different kinds of knowledge: knowledge about the user, knowledge about the user's purpose (sometimes considered as included in the user's description), knowledge about the context, knowledge about the resources that can be queried, retrieved or composed, domain knowledge that is used by the inferencing mechanism for obtaining personalization.

Knowledge about the user can roughly be viewed as partitioned in generic knowledge about the user's characteristics and preferences and in "state" knowledge. By the word "state knowledge" we hereby mean information that can change and that is relevant w.r.t. a specific application system, such as which exams have been passed in the case of an e-learning system.

A user's *goal* most of the times is considered as being coincident with a query but, as the scenarios underline, there is a variety to take into account. First of all, queries suppose an answer, that is a selection process, performed by means of the most various techniques. The answer is supposed to be returned within a few seconds. Nevertheless, in the case of events and triggers the goals are conditions that can be imagined as embedded in rules: when some event satisfies a rule condition, the rule is triggered and, typically, the user is warned in a way that can be subject to further personalization (e.g. w.r.t. the physical device that is used –laptop, mobile, hand-held–). In this case, an answer, that depends on location and time, might be returned days or weeks after the rule has been set. Moreover, the same rule might be activated many times by many different events. A third kind of goal, that we have seen, is not directly related to queries. It is the case of the learning goal: a learning goal is a description of the expertise that a user would like to acquire. The system uses this information to build a solution that contains many Web resources. None of them is (possibly) directly tied with the learning goal; the goal will be reached by the user if s/he will follow the proposed reading path.

In performing resource selection, also knowledge about the *context* plays a very important part. We have identified three kinds of contextual information: location in time and space, and role. Location in time and space are used for refining resource selection, that is only those resources that fit the context description, are shown. The context description is not necessarily expressed by the user, since it might as well be obtained in other ways. Roles are predefined views (possibly with a limitation of the actions, that the role players can execute). They are used to personalize information source selection, information selection and presentation.

For performing semantic-based processing on the Web it is necessary that the *Web resources* are semantically annotated. This is normally done by means of ontologies. Even though semantic annotation is not so much diffused, the languages for writing such annotations are pretty

well assessed. For this reason ontological annotation is not considered (in the proposed scenarios) as a research topic to be further investigated. Despite these considerations, the question about the existence of appropriate ontologies, for instance for geospatial and temporal tagging, is quite urgent. One of the major difficulties is, actually, to retrieve –if any– an ontology that can be suitable for the application at hand without writing a new one, unless really necessary.

The last kind of knowledge that is often felt as necessary, that we called *domain knowledge*, is aimed at giving a structure to the knowledge, a structure that relates the ontological terms in a way that can be exploited by inferencing mechanisms (and not necessarily with the aim of performing ontological reasoning only). For instance, we have seen that planning is considered as a useful reasoning technique for obtaining personalization and that, for biasing planning some schemas are introduced (see Section 2.3) that roughly correspond to learning design, i.e. abstract descriptions of solutions that make sense, pedagogically speaking. Moreover, many scenarios have underlined the usefulness of expressing some event-driven behavior (see Sections 2.6, 2.1, etc.). It is especially at this level that rules can play a fundamental role in the construction of personalization systems in the Semantic Web.

4.2 Knowledge representation languages

After this overview, we are now ready to consider the languages for representing knowledge and for querying the Semantic Web. We will both examine which languages have been used in the prototype systems mentioned in the scenarios and those that are suggested by the proposers as potentially useful for achieving personalization in the Semantic Web. The aim is to highlight what is actually missing, i.e. the limits of the available tools, in order to define some requirements to pass on to the I-groups.

Data is alternatively described in plain XML or in RDF; seldom OWL is used. There is also a proposal in which a logic language has been used. In the case of XML no semantic information is properly available, although when the domain is very closed and controlled, in some scenario the tags are supposed as being associated with a meaning. The solution is risky and the application as such cannot be safely extended with further reasoning capabilities but, for personalization of presentations, this is sometimes sufficient. Semantic annotation is done by means of RDF; in a case RDF was used to implement the standard for learning objects metadata, also known as LOM. So far, OWL has been used in a very limited number of situations. The logic language was used by a closed system, that did not have to retrieve information on the Web but only from a local repository.

Almost all the proposers recognize as a basic need the representation of a consistent amount of data in RDF or OWL. For some application domains, more peculiar suggestions have been presented. For instance, for e-learning it would be possible to rely also on ad hoc standard languages for learning object description, which account also for semantic annotation. In particular, SCORM seems an interesting candidate. The reason is that a SCORM learning object has a composite nature, that aggregates, according to specific rules, other learning objects. This is due to the fact that, since the production of learning objects is expensive (and time-consuming), it is desirable to support their reuse. Hence, the recursive definition of SCORM learning object. Maybe that analogous standards exist also for data belonging to other application domains, e.g. geospatial information.

So far we have considered as data only the Web resources, that are to be properly annotated as described. It is relevant to remark, however, that the ontologies used for doing these annotations are resources as well, hence they are data. This is very important to the functioning

of the Semantic Web itself, where the basic inferencing mechanisms must work on semantically annotated resources, in a way that is parametric w.r.t. the specific ontology.

Let us, now, consider another kind of knowledge that has a crucial role in personalization: knowledge about the user's goal. Goal information is expressed in different ways depending on the system. In plain (personalized) retrieval systems, it is a keyword-based description of what is desired, as queries in normal browsers. In the case of event-driven retrieval, it is expressed as a set of if-then rules that, as suggested by some of the scenarios, is currently represented as a part of the user model. In planning-based systems it is derived by the system by the interaction with the user and represented according to the system's internal format specifications. Goal representation and inferencing mechanisms are very tightly related. A standardized, general representation of goals would allow the definition of standardized inferencing mechanisms for personalization. In many systems the goal of the user is to retrieve some information. The earliest personalization services personalized the presentation of the retrieved material in a way that depended on the user's general preferences. Provocatively, we might say that the user model can, then, be considered as a part of the user's goal. This view is opposed to the approach of the proposed scenarios, where the user's goals are considered as a part of the user model. The query-as-a-goal perspective is clearer if we consider those rules that encode event-driven queries. In this case the rules encode the desires of the user as an action, that should fire when a given event occurs. Even clearer the case in which the goal can be accomplished only by solving a task. Notice that, in this perspective, also knowledge about the context can be considered as a part of the goal description, because it is analogous to the user model, the only difference being that it has not been supplied by the user him/herself but it has been retrieved by the system, by other sources of information. Actually, there is a subtle borderline between the user's goal and the system's goal (or task) and both should be studied more deeply. In particular, the current lack, in the Semantic Web, of standardized ways for representing the goals, should be overcome in order to support the development and the diffusion of personalization services. The main query languages currently available in the Semantic Web are described and commented in Section 4.3.

Domain knowledge belongs to the personalization system, and it is used by it for performing its tasks. So far we can only say that rule-based declarative languages would allow the representation of this kind of knowledge.

4.3 Query languages used by the applications / scenarios

In the following, we provide short descriptions about the query languages that have been used by the applications & scenarios described in this report (a longer report can be found in deliverabe I4-D1).

4.3.1 TRIPLE

TRIPLE [Sintek and Decker, 2002] is a rule language for the Semantic Web which is based on Horn logic and borrows many basic features from F-Logic but is especially designed for querying and transforming RDF models.

In contrast to procedural programming languages such as C or Java, TRIPLE is a declarative language which shares some similarities with SQL or Prolog. TRIPLE lets you work with programs that consist of facts and rules from which TRIPLE can draw conclusions for answering queries.

Rules defined in TRIPLE can reason about RDF-annotated information resources (required translation tools from RDF to triple and vice versa are provided). An RDF statement (which is a triple) is written as `subject[predicate -> object]`. RDF *models* are explicitly available in TRIPLE: Statements that are true in a specific model are written as "@model". This is particularly important for constructing the *temporal knowledge bases*. Connectives and quantifiers for building logical formulae from statements are allowed as usual: `AND`, `OR`, `NOT`, `FORALL`, `EXISTS`, `<-`, `->`, etc. are used.

TRIPLE is available as a stand-alone shell-based tool, and alpha-versions of a TRIPLE-Server are available via the authors.

4.3.2 RDQL

RDQL[RDQL, 2005] is a query language for RDF and is provided as part of the Jena Semantic Web Framework [Jena, 2004] from HP labs. The Jena Framework includes:

- A RDF API
- Reading and writing RDF in RDF/XML, N3 and N-Triples
- An OWL API
- In-memory and persistent storage
- RDQL - a query language for RDF

RDQL provides a data-oriented query model so that there is a more declarative approach to complement the fine-grained, procedural Jena API. It is "data-oriented" in that it only queries the information held in the models; there is no inference being done. Of course, the Jena model may be 'smart' in that it provides the impression that certain triples exist by creating them on-demand. However, the RDQL system does not do anything other than take the description of what the application wants, in the form of a query, and returns that information, in the form of a set of bindings.

4.4 Requirements for REWERSE

In this chapter, we summarize the requirements that the scenarios / applications for A3 have to the I-groups of the project by keywords:

planning & explanations Mentioned techniques:

- for planning, replanning, explanation (testbed status: scenario / application)

Reasoning about policies (testbed status: scenario)

geospatial and geotemporal reasoning (testbed status: scenario)

reasoning for dynamic data & knowledge bases, non-monotonic reasoning (testbed status: application)

mechanisms for handling failure in particular:

- techniques for user constraint relaxation or replanning (testbed status: application)

updates and events in particular:

- modeling and reasoning about updates and events for improved user modeling (testbed status: application)

real-time reasoning

- performance problems with large RDF repositories;
- combination of atabase-like queries with reasoning languages?

5 Conclusion

This report gives an overview about the current state of testbeds (both scenarios and applications) available in the REWERSE project for the area of Personalized Information Systems. The investigation carried out for creating this work started in getting informal descriptions about scenarios and applications that partners in REWERSE are interested in or can offer for the project.

We developed a questionnaire (see Appendix A) for formally describing scenarios and testbeds. Section 2 provides detailed descriptions of the testbeds, based on this questionnaire. We summarize the main characteristics of the scenarios in a synoptical overview (see Section 3).

Section 4 provides an analysis of the scenarios & applications for personalized information systems with respect to *knowledge*, *knowledge representation languages*, and *query languages*. This section concludes with a list of requirements that these scenarios & applications of personalized information systems have on reasoning- and query languages for the Semantic Web.

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A Questionnaire on Testbeds

```
-------------------------------------------------------------------------
Questionnaire
-------------------------------------------------------------------------
```

Title:

[ ] Scenario [ ] Application [ ] Testbed

Keywords:

Brief description:

Main publications (if any):

QUESTIONNAIRE:

1.) Reasoning techniques:

1a) Which reasoning techniques, if any, do you currently use? Please give examples (e.g. used rules, constraints, etc. If you use different techniques, please describe each shortly, and with examples)

1b) Which techniques, if any, do you plan to use in the near future?

1c) Which techniques would you like to have, which expressibility would you like to use?

2.) Knowledge representation:

2a) Which techniques do you use now?

2b) Why did you decide to use this / these specific technique(s)? Reasons? (Example: RDF / OWL, why, needed?)

2c) How does it influence the reasoning and vice versa?

2d) Which techniques / solutions do you use for managing / organizing /storing knowledge?

2e) Do you have plans to extend / change your knowledge representation techniques in the near future?

2f) What would be the ideal knowledge representation for your needs?

3.) User interactions:

3a) How can the user interact with the reasoner currently? Do you have examples of user interactions?

3b) What do you plan to extend in the near future? Examples?

3c) How should the user ideally interact with your application? Examples?

4) Adaptation / Personalization

4a) Which kind of adaptation do you currently use (techniques)? Do you have examples?

4b) What is the goal of the adaptation?

4c) Can you categorize it according to existing adaptation functionalities? (e.g. P. Brusilovsky's ontologies). If you can not categorize it according to existing adaptation functionalities, please give a short summary of the adaptation you use, and provide comments for possible categorizations

4d) Which actors are involved in the adaptation? Please name them, e.g. user, tutor, expert, etc.

4e) Which input data (knowledge, real-time data, data about user, etc.) does your application need?

4f) What are your plans for adaptation in the near future?

4g) What would be the ideal manner of personalization for your application?

5) Data:

5a) Which data format (technical specification) do you currently use? (do you use a database, semi-structured data, metadata annotations?)

5b) What's the amount of data that you use? Is it derived from real data? (e.g. demonstrator data, real-world data, etc.)

5c) Can you share the data (or part of it) with other partners in REWERSE? Can you make the data public or is it only available for REWERSE-internal demonstrators?

5d) Is your data distributed?

5e) Dynamics of your data:
- are there updates? If yes, how often? Which kind of updates?
- are there changes of the data? If yes, how often, and of which kind?
- do these changes trigger automatically reactions? If yes, how, and what

kind of reactions?

5f) do you expect development of your data in the next future?

5g) How do you estimate the development of your data?

6) Miscellaneous

6a) Which specific requirements to the I-groups do you have?

6b) Indicate which I-groups might be most promising to help establishing personalization in your application?

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