SEMANTICS AND CONTEXT

Preliminary Analysis of Users and Tasks for the Semantic Web

Lisa Battle

It is important to understand the users of the Semantic Web and the tasks that will bring them to the Semantic Web in order to ensure ease of use for semantic applications. This paper proposes a high-level framework for categorizing those users and tasks, and provides preliminary implications to be considered in end-user interaction design.

Introduction

Researchers and practitioners are increasingly looking beyond the view of the Semantic Web as "computers talking to computers" to consider the impact on users. While the Semantic Web may adopt some interaction design models from existing Web applications and informational sites (especially from Web 2.0), it may also introduce new styles of user interaction. It is not too early for us to begin asking ourselves how to ensure a positive user experience for the Semantic Web.

In three previous Semantic Web workshops, I have observed a lack of clarity about the users of the Semantic Web and their tasks. This is understandable because the technologies are so new; however, it is an important omission to address if our goal is to ensure ease of use.

This paper provides starting points for describing Semantic Web users and their tasks. Specifically, it presents:

- Three high-level categories of Semantic Web users.
- Preliminary categories of tasks that would reasonably be performed by each user group.
- Some specific examples of these tasks, drawn from recent published papers and conference presentations by researchers and practitioners who are building Semantic Web applications.
- Some basic principles to consider when designing user interfaces to support these users and tasks, based on best practices in the interaction design community.

These categories of users and tasks are provided as input to discussion at the Semantic Web User Interaction workshop. Any Semantic Web application that is discussed in the workshop can be considered in light of this framework of tasks and design considerations. The discussion can then be used to refine and extend the framework for future use.

Background: Understanding Users, Tasks, and Context

User-centered design (UCD) is an industry-standard best practice for creating usable software applications and technology products. It involves iterative design based on a deep understanding of the users, their tasks, and the context in which they work [1]. UCD always begins with asking "Who are the users?" and "What tasks do they need to perform?" [2,3] Even when there is a temptation to say that the users are "everyone," user-centered design recommends dividing the target audience into groups [4]. This is reflected in the ISO standard, which defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [5]. There is no such thing as generic usability; usability can only be defined for a specific group of users and context.

In my professional experience as a usability and user-centered design consultant, I have worked extensively to align user goals and tasks with different types of interactive and informational applications. Users interact with computers for specific reasons, where task completion for their situation and goals is paramount to a satisfying user experience. Users' personal characteristics,

including their knowledge of the subject matter and of the technology, their motivations, their prior experiences, and their expectations, play an important role in determining what is usable.

A Preliminary Framework for Users and Tasks

As a starting point for discussion, I propose three broad user groups, each having a few categories of tasks for which they would use the Semantic Web (see Table 1). Considering these user groups can help us ask more relevant questions about user experience.

User Group	Task Types
1. End users	Information seeking tasks Information synthesis tasks Action-oriented tasks Information sharing tasks
2. Content curators	Content update tasks Content distribution tasks
3. Ontologists	Ontology update tasks Ontology creation & mapping

Table 1: Some proposed user groups and task types for the Semantic Web

Each user group is described in more detail below. The examples given for each user group are based on papers from previous workshops as well as published articles on the Semantic Web.

End Users

Profile: Ordinary people who are either seeking information or trying to accomplish something in the course of their everyday life or work. They do not know what the Semantic Web is, and they don't care, as long as they can get what they need quickly.

Knowledge:

- Knowledge of subject matter: Ranges from very high to very low
- Knowledge of ontologies: Little or none
- Knowledge of semantic web technologies: Little or none

Examples:

Users	Information-Seeking Tasks
Faculty and graduate students	Find people to collaborate with on grant applications and research projects [6]
News seekers	Read news of interest to me from various on-line newspapers (filtered by timeline, geographical area, subject, and other attributes) [7]
Entertainment seekers	Find a restaurant near the movie theater that will still be open when the movie is over [8]
Museum visitors	Learn more about cultural heritage topics related to the museum artifacts they particularly liked [9]
Music fans	Find new music similar to other music I like [10]

Table 2: Examples of end users with information-seeking tasks

Users	Information-Synthesis Tasks
Medical researchers	Draw conclusions about appropriate medical treatment based on synthesis of information on specific drugs and diseases from a wide range of published medical sources [11]
Terrorism experts	Identify connections between suspected terrorist groups, based on pieces of information, some of it unreliable, from very disparate sources [12]
Conference attendees	Download all conference information into mobile device--maps, itinerary, information about the participants, agenda. Find out about people—what have they written? Who should you meet? [13]
Biologists	Predict the effect of introducing a new beetle into the ecosystem [14]
Biochemists	Determine whether an enzyme can be used to degrade a particular type of industrial waste product [15]
Marketing specialist	Learn more about a targeted consumer group by integrating statistical data from multiple sources such as surveys, opinion polls, and censuses [16]

Table 3: Examples of end users with information-synthesis tasks

Users	Action-Oriented Tasks
Emergency responders	Coordinate the efforts of multiple emergency response teams during an incident [17]
Disability claim reviewers	Approve or deny a disability claim based on whether medical criteria are met (compare patient record with standard medical listings) [18]
Patients	Schedule an appointment with a medical specialist covered by insurance in a certain geographic area with high approval ratings and who has available appointments [19]
Scientific researchers	Building a personalized portal to manage research tasks, including quick access to lab data, published papers, and emails from collaborators [20]
Car buyers	Buy a used car from someone who is selling the type of car I want within 30 miles of my home [21]

Table 4: Examples of end users with action-oriented tasks

Users	Information-Sharing Tasks
Amateur photographers	Share pictures with friends and family [22]
Friends with similar interests	Share bookmarks within my personal network [23]
Entertainment seekers	Write a review of a restaurant, movie, etc. [24]

Table 5: Examples of end users with information-sharing tasks

Preliminary implications for design:

- Ensure that information is as relevant as possible to the user's interests, through:
- Customization and personalization
- Context sensitivity
- Provide information displays that are easy to understand:
- Progressive disclosure and "layering" of information
- Displays that reduce information overload through clean, minimalist design
- Communicating complex information, not just as display data, but interpreted and made relevant for a specific situation
- Plain language
- Provide easy ways for the user to control, refine, and filter information:
- Faceted browse/search
- Refining search
- Manage data sources and levels of detail
- Make action-oriented tasks simple and appealing:
- Eliminating redundant data entry
- Using appropriate default values
- Ensuing authentication and privacy
- Show provenance (E.g. Hover over a link or a data element to see where it came from. Possibilities may include inferred from _____; asserted by _____)
- Hide the complexity from people who don't want to know how it works

Content Curators

Profile: Subject matter experts, who as part of their jobs are responsible for providing or updating information that is used by others.

Knowledge:

- Knowledge of subject matter: Very high
- Knowledge of ontologies: Moderate
- Knowledge of semantic web technologies: Little or none

Examples:

Users	Content Update Tasks
Biologists	Adding new findings about bird migrations to existing repositories [25]
Book publisher	Adding new books to the catalog of published books
Photo editor	Annotating photos to make them searchable [26]
Policy expert	Writing or editing policy and procedures to be added to a policy repository [27]

Table 6: Examples of content curators with content update tasks

Users	Content Distribution Tasks
National Library of Medicine (NLM)	Providing all known medical ontologies for others to download and use [28]
Museum/historic site curators	Providing information and interactive learning opportunities to visitors via a pervasive computing system and PDAs [29]

Table 7: Examples of content curators with content distribution tasks

Preliminary implications for design:

- Allow editorial changes and additions of new content without needing to view and traverse the ontology.
- Minimize the burden of data entry, annotation, and content tagging, which is time consuming and tedious.
- Support collaborative work.
- Support versioning of content and ontologies.
- Will this user group should responsibility for editing ontologies? It may depend in part on whether or not the tools are usable enough for domain/subject experts to use, and whether error prevention and troubleshooting can be supported.

Ontologists

Profile: Specialists in content categorization/classification systems who participate in the development and maintenance of ontologies and interactive systems that use them.

Knowledge:

- Knowledge of subject matter: Moderate to very high
- Knowledge of ontologies: High
- Knowledge of semantic web technologies: Moderate?

Examples:

Users	Ontology Update Tasks
Biologists	Adding a new insect to an existing hierarchy
Book publisher	Re-organizing the categorization scheme for types of books published
Policy expert	Adding new terms for tagging content within the public policy repository

Table 8: Examples of ontologists with ontology update tasks

Users	Ontology Creation and Mapping Tasks
Member of project team creating a semantic application	Finding and selecting an existing ontology to use in a new semantic web application [30]
Intelligence analyst	Reviewing the results of terms automatically extracted from text; Populating an ontology through automated pattern recognition and information extraction [31]
"Owner" of an ontology	Cleaning up ontologies [32]
Member of project team creating health informatics systems	Mapping between different medical ontologies [33]

Table 9: Examples of ontologists with ontology creation and mapping tasks

Preliminary implications for design:

- Provide ability to easily visualize and traverse the ontology, which may include:
- Indicators of how much content is under a tree node: e.g. SpaceTree uses different sized triangles next to each tree node to indicate how much is under that tree node. When you expand one node, it closes the previous node. You don't lose track of where you are, because the branches always open up in the same place.
- Calculate how much space is available on the screen to determine how many nodes can reasonably displayed at once.
- Smooth animation to help users see how they have moved from one part of the ontology to another.
- Signpost "parents," "children," "siblings," and indicate "you are here"
- Provide error prevention and error recovery mechanisms, including:
- Support for troubleshooting inconsistencies in the ontology. Sometimes problems are not clearly traceable. For example, if a user imported someone else's ontology, and there were clashes or inconsistencies, they would need to be able to find and address the problems.
- Predict consequences of changes?
- Avoid re-adding terms that are already in the ontology (but how can you be sure it's the same term?)
- Ability to back out changes easily.
- Support activities that span multiple ontologies, including:
- Support comparison of different ontologies, allowing users to evaluate two or more similar ontologies and pick the one that is the best choice for the purpose.
- Integrating knowledge across domains – what if you don't have the mental model of the other domain?
- Ontology update may be an infrequent task; if so, additional user support may be required to help people make the correct decisions.
- Ontology update should not be undertaken casually because of the potentially far-reaching consequences of changes to the ontology. It is probably best done by a person who understands the ontology well enough to recognize potential consequences of changes.

Conclusion

This inventory of users and tasks for the Semantic Web is just a starting point. It should be refined as more examples of Semantic Web applications become available. The preliminary design implications can be refined through a combination of usability testing, heuristic evaluation, and feedback from users interacting with current Semantic Web applications.

Returning to the idea of the generic Semantic Web browser, it seems that it may be more practical to first address whether a generic browser could be created that addresses all known examples of tasks in any one of the task categories described. For example, can one generic browser support all known "information seeking" tasks or all known "ontology update" tasks for the Semantic Web? If so, can it be extended to support all of the other task categories for that user group? Only then is it reasonable to ask whether it can support all usage of the Semantic Web.

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