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Tribalization, E-learning and the Semantic Web

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Introduction

We are at the beginning of a three year project which will provide a Semantic Portal for E-Learning — SPEL. SPEL's main role will be to deliver the materials which make up e-learning courses. More significantly, it will also be able to overcome any inadequacies in a course's learning materials by providing semantic searches for alternative resources as well as facilities for communication and collaboration where needed.

We start with the following assumptions: firstly, that the semantic web will become a reality and, secondly, that it will include an increasingly large number of learning objects resulting from the growing interest in e-learning. When the semantic web is fully realized, learning objects (or self-contained educational resources fully described in meta-data) will be one class of entity with which agents can interact to provide services for learners. Given the second assumption it follows that learners (and institutions) will need these services to ensure that relevant resources are retrieved when the range of available candidates may be otherwise unmanageable. Even if the semantic web does not succeed, our design for SPEL ensures that it will still be able to search for learning objects using more conventional means.

Apart from its function as a broker which matches material to learners using semantic (or ontology-driven) searches of the nascent semantic web, SPEL will provide a range of guides which the learner can use to customize how learning materials are presented. These will include a guide able to summarize learning materials and others which can aid in learning tasks (such as essay-writing).

The ontology-driven reasoning used in performing semantic searches and in supporting guide-based customization, will be combined with techniques borrowed from personalization on e-commerce web sites. Clustering and other statistical techniques derived from the two main forms of personalization, content-based filtering and collaborative filtering, along with machine learning, will be used to dynamically update SPEL's knowledge bases. In addition, SPEL will go beyond the usual personalization schemes to incorporate ideas on virtual communities of consumption or e-tribes as the basis for tailoring and selection of material. This will ensure that inferences about mappings between learners and resources are both less intrusive and more appropriate to a collaborative learning context.

As a means of fostering learning e-tribes, SPEL will provide guide-based tools to facilitate task-oriented communication and collaboration among their members. It will therefore identify individuals as members of particular groups both as a means of retrieving suitable material and in order to form the basis for communication and collaboration.

The provision of access to learning materials

The portal will provide access to the learning materials appropriate to a particular course. In later versions of the portal the learner will be assisted in choosing a course using the community-based tailoring process described below. The primary course components will be created or selected by the course providers. Where there are optional course components the system will help the learner to make choices. This process will be informed by knowledge about learners, their goals, course requirements, institutional requirements and so on. In addition the system will identify which group or groups learners belong to and, using its knowledge of the standards, culture and so on of these groups, items will be rated as more or less suitable. However, the final choice of material is left to the student and, indeed, the system component (or guide) which provides choices can be switched off at any point.

For example a course on Roman Britain could have optional modules on Military Architecture, Excavation Techniques and Mosaics. Depending on information about the learner (for example that she

is a keen amateur archaeological excavator) components can be rated. In this case the system might highlight the Excavation Techniques component.

How material is presented - guide-based interaction

Guides are software agents which enhance the interaction between machines and learners. Guides will be used to mediate student access to online resources using the types of knowledge mentioned above. Laurel, Oren and Don (1990) emphasize the importance of reducing the cognitive load for computer users through a guides metaphor. For example, in a hypermedia database depicting early American history from the late 1980s, the guides were characters drawn from the period and were used to deliver stories from specific viewpoints.

In SPEL guides have three roles:

i) Learners will indicate their preferences to the system by selecting particular guides. For example, a guide could be selected which searches for theoretical material rather than practical exercises.

ii) Guides will act as a means of presenting material in a manner which is further customized to learner preferences. For example, a guide could be deployed to summarize alternative educational resources.

iii) Guides will also act as facilitators of communication and collaboration among members of learning communities.

Our learner, for example, could select the summarizer guide to provide summaries of some of the alternative material. As we will see below she could also invoke guides dedicated to specific learning tasks such as the essay-writing guide in combination with the communication guide to initiate task-oriented conversations with other learners.

The provision of alternatives using semantic search

While knowledge engineers have been building knowledge models, or semi-formal representations of problem-solving knowledge for over a decade, it is only with the increased interest in the semantic web that one aspect of this modeling activity, the production of ontologies, has come to fore. An ontology can be seen as a formal specification of the classes which make up some domain, their properties and relations among them (see Gruber, 1993). For instance, we could have an ontology for the medical domain which specifies classes such as symptom and disease and relations such as 'indicates(symptom, disease)'.

With the publication of the landmark article in Scientific American in 2001 by Tim Berners-Lee, the founding father of the World Wide Web, interest in its successor, the Semantic Web, took off (Berners-Lee et al., 2001). According to Berners-Lee, the semantic web can be seen as a new web infrastructure which will rely on agents able to interact with suitably annotated entities and with one another to perform useful functions. In their example, Berners-Lee and colleagues describe an agent which can arrange appointments for medical treatment by interacting with the agents of the prescribing doctor, the treatment providers, and services which rate the treatment providers. Central to these interactions is a shared ontology (or ontologies) which ensure that the agents are interacting about the same thing. It is this shared ontology which provides the semantics of the agent exchanges.

SPEL will incorporate a range of semantic information about learners, communities, courses, course components, subject areas, institutional requirements and so on. These will be specified as formal ontologies. Using these, SPEL will include a series of populated ontologies (or knowledge models) covering the various sub-domains it is to deal with. As the semantic web becomes an actuality rather than an intention, and as more and more self-contained learning materials (or learning objects) are marked up using metadata derived from the various competing metadata schemes (Anido et al., 2002), it becomes more feasible to design systems which can use their knowledge of learners and of learning objects to search the web for materials which are suitable for particular learners or learning communities. Ultimately this will only be successful if the metadata schemes required to annotate the components mentioned above are widely used by course component providers. This in turn depends on the availability of standardized metadata schemes and tools to facilitate the required annotations. Both of these are in development.

To extend our example above the system could search the web for various pieces of reference material relevant to the excavation of Romano-British sites – for example, databases of standard Samian ceramic ware shapes. In addition the system could find alternative course modules which fulfill one or more of the criteria set by the learner, the learner's group or the course he or she is pursuing. These

could come from alternative course providers (i.e., other online institutions) or from other e-learning brokers. SPEL thus anticipates and forms part of the initial phase of the semantic web.

SPEL and personalization

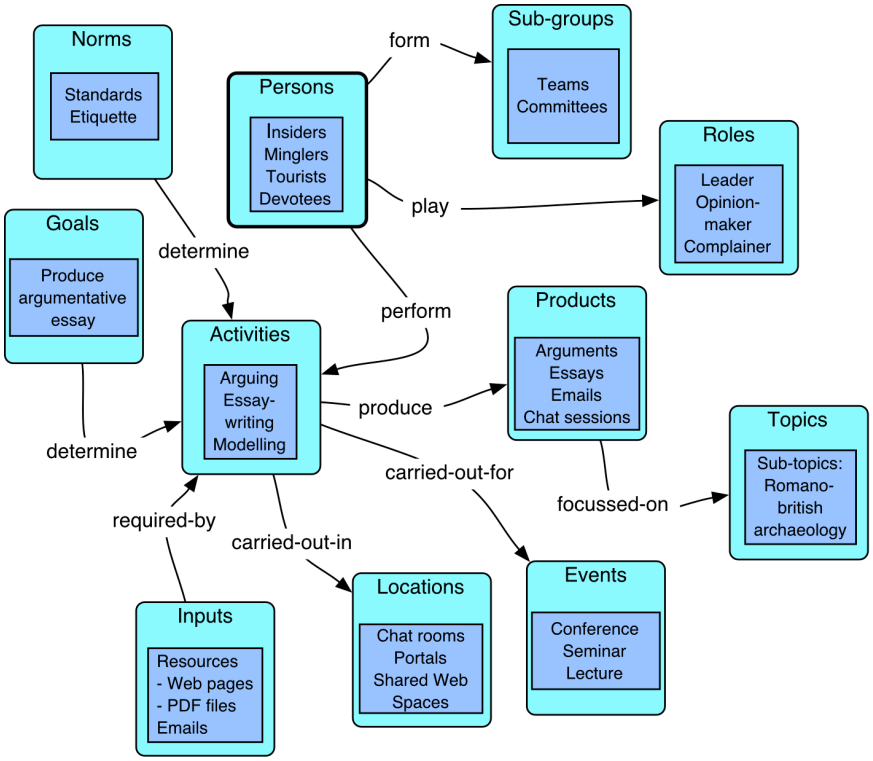
Most of the proliferating e-commerce web sites which sell to customers rather than other businesses make use of some personalization scheme. There are two main types of personalization: contented-based filtering and collaborative filtering (Cotter and Smyth, 2000). The former uses information technology to track and make inferences about what consumers have purchased in the past and to find new products which might interest them. The latter tries to make inferences about what is relevant for a particular consumer based on some measure of similarity with other consumers and the products they have bought. The main problem with these approaches is that they are geared to individuals (even though the collaborative approach makes an implicit appeal to group membership). It is hard to get sufficient information about individuals (since users are reluctant to spend time filling in questionnaires) and harder still to match individuals to products. While we make use of these personalization techniques, for example, to match the amateur excavator with appropriate online databases, another approach is possible and more relevant to learning communities.

SPEL and virtual communities of consumption – from personalization to tribalization

In SPEL we extend the notion of personalization beyond the individual consumer and whole-heartedly embrace the ideas advocated by Kozinets (1999) when he puts forward the notion of virtual communities of consumption or *e-tribes*. For Kozinets these communities are organized around the consumption of a particular commodity. In our case the commodity would be knowledge of a particular subject area, the learning experience itself or the course certificate. While members of e-tribes are interested in the consumption of the product they are also keen to acquire knowledge about the product (in our case, knowledge of how the subject matter can be used in practice, knowledge of how to learn, of how the particular subject area fits with other areas, and so on), and in being acculturated into the language, world-views and social norms of the community based around the product. It is Kozinets' contention that as opposed to individualistic consumers, e-tribe members are: (i) active rather than passive consumers and (ii) heavily influenced by the *mores* of their community. Any system such as SPEL which aims to cater for learning communities has to take account of these points. In our case we will do this by incorporating knowledge about communities in general, their standards, norms, specialized languages, and so on, as well as about particular communities.

Kozinets identifies four types of community member: devotees, insiders, minglers and tourists. An individual's classification as one of these depends on the extent to which they are (a) committed to a product or consumption activity and (b) to the community based around this. For example, the mingler has strong ties to the community but is less committed to the product, while the devotee is strongly committed to the product but less so to the community. He also outlines the main types of interaction an individual can have with a community. These depend on the extent to which an individual's communication is socially oriented as well as on whether the interaction is a goal in itself or for some other end (for example, passing a course component as opposed to recreational chat). However, a community is not something static. Work by Hagel and Armstrong (1997) shows how virtual communities evolve. They recognize four stages — virtual villages, concentrated constellations, cosmic coalitions, integrated infomediaries — as communities move from isolated small scale entities to fully functioning proactive large-scale entities. Apart from these macro-level changes, a variety of transformations can take place in a community. For instance there can be: changes in members' roles; new sub-groups; new topics of interest; new goals; new standards; breakaway groups and so on. If SPEL is to track communities it needs a dynamic ontology which can recognize these changes. One means of updating the ontology will be to use the clustering techniques which will form part of the personalization sub-system as a means of recognizing new or changed groups of individuals.

While we cannot hope to create a knowledge model which can capture all these features, we can produce a model which is sufficiently detailed to allow us to represent and track communities over time. A preliminary model of a learner e-tribe is given in Figure 1.



To continue our example, while it is difficult (but not impossible) to reason from a particular learner's attributes to particular web resources, if we know that she is an amateur archaeologist interested in excavating Romano-British sites, we can make inferences about what will be relevant to her as a member of that community. In addition, we can make use of knowledge about the standards, norms and language of this community to determine, for example, that this learner uses "Samian" to refer to a particular ceramic tradition rather than a Greek island or more significantly that our archaeologist might have as an important goal the need to preserve her local cultural and historical heritage - a goal which will influence what alternative resources she will be interested in.

Tools for intra and inter community communication and collaboration

Kozinets suggests that marketers "must provide community members with the raw materials they need to construct a meaningful community" (p. 264). If we substitute marketer for e-learning portal we can see why SPEL goes beyond its use of machine learning and statistics to group individuals as members of existing communities and use this to make inferences about their needs. As well as supporting existing communities, SPEL can foster its newly discovered communities. It will derive these using its analyses of individual interactions with the system and similarities between groups of learners so interacting. To facilitate communication between communities, SPEL will include a guide which will provide a graphical interface showing which communities a learner belongs to, which other users of the portal belong to these and which other communities (or sub-communities) have similar interests. By selecting the graphical representation of one or more other learners the user of SPEL can set up a synchronous or asynchronous chat or email or chat session with these other users. From the user's perspective this provides the means for cementing community ties, acquiring community norms and getting answers to particular questions. From SPEL's point of view other users are resources which it can deploy to enhance the users' acquisition of knowledge. In future versions of the portal we hope to include some capacity for learning from these interactions (given that the participants permit their interactions to be monitored). This would be especially valuable when another learner satisfies some requirement which SPEL is unable to satisfy with an unambiguous answer (e.g., by providing an URL which points to a resource the first learner needs).

The argument construction guide can act as an example of a collaborative guide. This guide can be used by a single individual. However it is best used collaboratively by a group of learners to create and manipulate a representation of an argument. In order to initiate collaboration, the communication guide is used to indicate possible collaborators and facilitate exchanges among them. The system also provides a public area for drawing and amending the argumentation structure. Tools will be available

for inserting nodes representing claims and for relating them with links for relations such as 'contradicts', 'supports', 'restates' and so on. Learners proceeds by adding text to the nodes or by searching for appropriate material on the semantic web and storing suitable URLs in the nodes. The structure which results can be stored by the system,and published as part of the semantic web or the semantic neighbourhood (e.g., of a university).

To complete our example, our archaeology student, having to complete an essay on the possible causes of the Roman withdrawal from Britain, invokes the essay-writing and argumentation guides. Finding that she is unable to clarify some points in her argument about the topic she invokes the communication guide to aid her in completing her task. Together with other learners (e.g., those with similar tasks, previous students, or insiders/'experts') she adds several new nodes to her argumentation structure. When she is satisfied she incorporates both the graphical and textual version of the argument into her essay. After completing this she decides to publish her argument as an annotated semantic web object for the use of future students.

Conclusion

To summarise, SPEL will:

• provide a friendly and consistent e-learning environment

• help to deal with inadequacies in material with semantic searches

• tailor resources to student and community interests

• facilitate communication among students with the emphasis on learning activities rather than on unfocussed chat

• encourage students to work on learning tasks as a part of a group rather than on their own

SPEL will be well-placed to take full advantage of the semantic web when it is fully realized since it can deploy its knowledge of learners and courses to track down and retrieve suitable learning objects. More than that, it can make use of its knowledge of, and tools for the facilitation of, learning communities to make sure that the learning experience is contextualized to communities to which the learner owes allegiance and within which he or she constructs their sense of self. Learning will be facilitated by the support of community members and by the access the community provides to conceptual frameworks, specialized terminology and standards (for example, of evidence and accuracy). SPEL will therefore act to overcome inadequacies in learning resources and as a means of adding a community dimension to otherwise non community-based resources.

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