Chapter 6

Methodology

6.1 Semantic Web Layered Architecture

Semantic Web is the new generation Web that tries to represent information such that it can be used by machines, not just for display purposes, but for automation, integration, and reuse across applications (Berners-Lee 2000). Furthermore, semantic Web is about explicitly declaring the knowledge embedded in many Web based applications, integrating information in an intelligent way, providing semantic based access to the Internet, and extracting information from texts. Traditionally, HTML provides the standard of structured document published on the Internet. Though the simplicity of HTML promotes the growth of the Web, it seriously hampered advanced applications such as processing, understanding and semantic interoperability of information contained in several documents. Semantic Web is the new generation Web which makes possible to express information in precise, machine-interpretable form. It enables intelligent services such as information brokers, search agents and information filters, and also offers greater functionality and interoperability. Semantic Web promotes Web based applications with both semantic and syntactic interoperability. The explicit representation of median formation, accompanied by domain theories (i.e. ontologies), will enable a Web to provide a qualitatively new level of service. This process may ultimately create extremely knowledgeable systems with various specialized reasoning services. The architecture of semantic Web (W3C) is shown in Figure. The semantic Web technologies offer a new approach to managing information and processes, the fundamental principle of which is the creation and use of semantic metadata.

6.1.1 URI

A universal resource identifier (URI) is a formatted string that serves as a means of identifying abstract or physical resource. A URI can be further classified as a locator, a name, or both. Uniform resource locator (URL) refers to the subset of URI that identifies resources via a representation of their primary access mechanism. A uniform resource name (URN) refers to the subset of URI that is required to remain globally unique and persistent even when the resource ceases to exist or becomes unavailable.

For example: The URL http://dme.uma.pt/jcardoso/index.htm identifies the location from where a Web page can be retrieved The URN urn:isbn:3-540-24328-3 identifies a book using its ISBN.

Unicode

Unicode provides a unique number for every character, independently of the underlying platform, program, or language. Before the creation of Unicode, there were various different encoding systems. The diverse encoding made the manipulation of data complex. Any given computer needed to support many different
encodings. There was always the risk of encoding conflict, since two encodings could use the same number for two different characters, or use different numbers for the same character. Examples of older and well known encoding systems include ASCII and EBCDIC.

Logic, Proof, Trust and Digital Signature

The logic layer is used to enhance the ontology language further and to allow the writing of application-specific declarative knowledge. The proof layer involves the actual deductive process as well as the representation of proofs in Web languages and proof validation. Finally, the Trust layer will emerge through the use of digital signatures and other kinds of knowledge, based on recommendations by trusted agents or on rating and certification agencies and consumer bodies. For the semantic Web to become more expressive enough to help in a wide range of situations, it will become necessary to construct a powerful logic language for making inferences. The next step in the architecture is _Trust ‘and _Proof_. Very little is written about these layers though they will become important in future.

6.1.2 The aim of the performance based system

As a universal examination system for the education of basic computer operation, it must meet the following requirements: realistic question storage, which must be conventional to the general outline of the exam. There are two types of exam edge. One is the simulation; the other is the actual environment. The second scheme will give the student more leniencies because of the practical nature of computer skills. An array of question types, such as objective questions, conceptualized questions, and design questions, group testing, etc. leads to a safety and consistent examination system.

Components of OISPS:
The Web based Online Examination System (OISPS) is a multi-layer system which is composed of the Web Server (Apache Server), Database Server, OISPS middleware Server, OISPS client module and Browser, such as Internet Explorer. In this system, we use the Apache Web Server as the Web Server; the Database Server is MySQL Internet/Intranet OISPS DB Workstation OISPS ClientIE Workstation OISP ClientIE Workstation & OISPS ManagerIERouter

The kernel of OISPS is the OISPS Server and the OISPS client module, which is designed according to the apacheadministrator’s server object’s extension joining LAN, database, front end and Internet, which can instance and bind objects over different network. It is an advanced network protocol used to cooperate with COM based components of two processes in different locations.

6.2 Techniques

6.2.1 XML and XML Architecture

XML (eXtensible markup language) with XML namespace and XML schema definitions makes sure that there is a common syntax used in the semantic Web. XML namespaces allow specifying different markup
vocabularies in one XML document. XML schema serves for expressing schema definition of a particular XML document. When it comes to semantic interoperability, however, XML has disadvantages.

a) Expression of Meaning - Content authoring

The obvious direct relation of Semantic Web and Enhanced learning combines the traditional content authoring process with the critical objective of expression of meaning. Issues like semantic mark-up, semantic retrieval, personalized, (semi)-structured annotation and content conversion are leading a big research stream, in which the main concern is the development of semantic enhanced learning content.

b) Information flow and collaborative Life / Learning Context:

As mentioned above, the instrumenting of knowledge flows has been set as one of the priorities of the SW W3C activity. According to Eric Miller “One of the challenges we will meet is to strike a balance between requiring authors to do more at the outset to make information machine processable, insisting that everything the machine could use to answer a question be recognized and identified by the (human) questioner, and leaving large quantities of information inaccessible to the machine”. In this area Semantic Services, (Semi) Automated Reasoning and Argumentation are critical themes on the semantic enhanced learning agenda.

Semantic markup of a Web page, document, or service might state that a particular entity is a member of a class, an entity has a particular property, two entities have some relationship between them, and that descriptions from different people refer to the same entity. Typically, semantic markup is published using an XML encoding for a high-level Ontology representation language syntax.

6.2.2 RDF and RDF Schema

On top of XML is the Resource Description Framework (RDF), for representing information about resources in a graph form. RDF is based on triples O-A-V that form a graph data with a relation among object (a resource), an attribute (a property), and a value (a resource). RDF Schema (RDFS) defines the vocabulary of RDF model. It provides a mechanism to describe domain-specific properties and classes of resources to which those properties can be applied, using a set of basic modeling primitives (class, subclass-of, property, sub property-of, domain, range, type). However, RDFS is rather simple and it still does not provide exact semantics of a domain.
Table 6.2.2: Parameterized Weightage on Question Distributions.

<table>
<thead>
<tr>
<th>Arguments</th>
<th>Weight(range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of IQ (semantic concepts)</td>
<td>5-20</td>
</tr>
<tr>
<td>Length of question</td>
<td>8-25</td>
</tr>
<tr>
<td>Pattern</td>
<td></td>
</tr>
<tr>
<td>a. Reappearance of keyword</td>
<td>2-10</td>
</tr>
<tr>
<td>b. image</td>
<td>0-5</td>
</tr>
<tr>
<td>Type of question</td>
<td></td>
</tr>
<tr>
<td>a. true/false type</td>
<td>2</td>
</tr>
<tr>
<td>b. Objective type questions</td>
<td>4</td>
</tr>
<tr>
<td>c. calculatedMCQ</td>
<td>6</td>
</tr>
<tr>
<td>d. radio button/checkbox (multiple correct answers)</td>
<td>8</td>
</tr>
<tr>
<td>e. textbox</td>
<td>10</td>
</tr>
</tbody>
</table>

RDF Representation

At the top of XML, the World Wide Web Consortium (W3C) has developed the Resource Description Framework (RDF) language to standardize the definition and use of metadata. RDF is a simple general-purpose metadata language for representing information in the Web and provides a model for describing and creating relationships between resources. With RDF it is possible to add predefined modeling primitives for expressing semantics of data to a document without making any assumptions about the structure of the document. The fundamental concepts of RDF are resources, properties and statements. Resources: A resource as an object, can be a thing such as person, a song, or a Web page. Every resource has URI to identify itself. Properties: They are a special kind of resources; they describe relations between resources, for example written by, age, and title and so on. Statements: Statements assert the properties of resources. A statement is object attribute-value (O-A-V) tripe, consisting of a resource, a property and a value. Value can be either being resources or literals. It may also be represented as (Subject-Predicate Object).

The basic structure of RDF is in the form of triples

Object/Resource/Thing  \(\leftrightarrow\)  Property/Attribute  \(\leftrightarrow\)  Value (is also a resource / literal)

An example of a statement is David Billington is the owner of the Web page http://www.cit.gu.edu.au/~db.

The simplest way of interpreting this statement is to use the definition and consider the triple (“David Billington”, http://www.mydomain.org/site-owner, http://www.cit.gu.edu.au/~db). The graphical RDF representation. We can think of this triple \((x,P,y)\) as a logical formula \(P(x,y)\), where the binary predicate \(P\) relates the object \(x\) to the object \(y\). In fact, RDF offers only binary predicate (properties).

Consider the RDF statement:
Discrete Mathematics is taught by David Billington. The schema for this statement may contain classes such as lecturers, academic staff members, staff members, first-year courses, and properties such as is-taught by, involves, phone, employee id. In the given figure blocks are properties, ellipses above the dashed line are classes, and ellipses below the dashed line are instances.

Fig6.2: RDF Example
Example Stating that all lectures are staff members
<rdfs:Class rdf:about="lecturer"/>
<rdfs:subClassof rdf:resource="staffMember"/>
</rdfs:Class>

Example stating that phone applies to staff members only and that is value is a always a literal
<rdfs:Property rdf:ID="Phone"/>
<rdfs:domain rdf:resource="#staffMember"/>
<rdfs:range rdf:resource="&rdf;Literal"/>
</rdfs:Class>

6.3 Ontology

Ontology comprises a set of knowledge terms, including the vocabulary, the semantic interconnections, simple rules of inference and logic for some particular topic. Ontologies applied to the Web are creating the
semantic Web. Ontologies facilitate knowledge sharing and provide reusable Web contents, Web services, and applications. Few of the ontology languages are DAML (DARPA Agent Markup Language), OIL (Ontology Interference Layer) and OWL (Web Ontology Language). OWL is developed starting from description logic and DAML+OIL. OWL is a set of XML elements and attributes, with well-defined meaning, that are used to define terms and their relationships (e.g. Class, equivalent Property, intersection OF, union OF, etc.). OWL elements extend the set of RDF and RDFS elements, and the OWL namespace is used to denote OWL encoding. OWL comes in three species – OWL Lite for taxonomies and simple constraints, OWL DL for full description logic support and OWL full for maximum expressiveness and syntactic freedom of RDF. OWL DL is widely used for ontology representation. In practice, ontologies are often developed using integrated, graphical, ontology authoring tools, such as Protégé, Oiled and Onto Edit. Protégé facilitates extensible infrastructure and allows an easy construction of knowledge rich domain ontologies.

6.4 Semantic Model and Ontology

The semantic model forms the core of our protoSoftware Recommendation environment. The semantic model integrates together design information from various activities. Very importantly, it provides us a standardized mechanism for not only creating machine readable representations of design data inside the design domains, but also to connect these domains together. We strive at creating a comprehensive semantic model that could be used to generate any aspects of a VML as well as provide basis of integrating design data from many of the disciplines participant machine design. With a schema, we can also provide validation and integrity checks to the data.

Initially, the semantic model was created as an ad hoc aggregation of various RDF files from design data adapters. A semi-formal schema was written with SKOS (Simple Knowledge Organization System). This approach was sufficient for environment bootstrapping as well as for some rudimentary use cases such as using SKOS broader concept to interconnect design domains. In order to effectively manage instance data, features of RDF Schema were used. We added rdfs :Class, rdfs:subClassOf, rdf:Property, rdfs:domain and rdfs:range assertions to create classes and their hierarchies as well as properties associated to classes. Adding these assertions was important to provide the semantic model with rudimentary schema-based validation capabilities, including checking for valid properties and valid property values.

Here desire was to provide engineers with a graphical user interface for schema development. While modeling-wise RDFS would have provided us with most of the features required for schema writing, we could not find suitable tools for easily managing an RDFS-based schema. The most suitable software for this purpose was OWL ontology editor (http://protege.stanford.edu/). Thus for mostly practical reasons, the original schema file was maintained in Web Ontology Language (OWL) format.

6.5 Web Ontology Tool

The Web Ontology Tool (OWT) is a semantic markup language for publishing and sharing ontology on the World Wide Web. OWL is based on RDF and is used to specify the meaning of the resources described in the internet. For example there is a possibility to describe a human by stating that the human is an animal, has two legs and a name. If one of these conditions is not met, then the object is not an instance of human class.

Another example describes the information of the book and its author John. This ontology spans two variables- data type name, author- a variable of object data type, and two classes - a Book and a Person.
Further these are instructions, which describe how an instance of a book and author are connected between with relationships: a book has author’s variable with a particular object – a Person, which name John.

Method for ontology supported learning

Knowledge and competencies development and students’ abilities to successfully adapt professional skills in real life situations are what students strive when learning at university. One of the ways to assure, that these objectives are obtained and knowledge with new skills are competitive when compared with other specialist is knowledge and competencies constant inspection. In this article we try to describe the possibilities to automatic adequate knowledge testing by using semantic web technologies in enhanced learning environments.

Testing student knowledge understanding by using ontologies

There are a lot of ways that can be used to test knowledge. This can be done orally or in written form, but then the knowledge checking has a requirement to be done automatically – frequently it is done using testing forms. Knowledge inspection by using test forms can’t clearly show true state of the knowledge, because there is a lot of space for merely luck by doing blind guessing. We propose a different way to test knowledge by requesting to describe it in concepts and relationships between them. Concept is an idea, especially an abstract on. The definition of conceptualization provided by Thomas R. Gruber the objects, concepts, and other entities that are assumed to exist in some area of interest and the relationships which hold among them. Ontology is as “an explicit specification of a conceptualization”. Conceptualization is a simplified view of the object we wish to represent. Anatoly Gladun& Julia Rogushina suggests another way of knowledge testing. They let students create domain ontology and later the created ontology and the etalon ontology, created by the tutor, is compared by the automatic algorithm. The algorithm automatically detects errors made by the students. The method suggests offering a lot of concepts for a student, and limiting the possibilities to relate these concepts into ontology by such relations:
• Does an instance of a class A is a child of an instance of the class B
• Does an instance of a class A is a part of an instance of the class B
• Does an instance of a class A is a synonym to an instance of a class B.

These limits block the possibilities to have a deeper understanding of the knowledge domain inspection. We propose to use a big set of relations, so that testing could go into details. Because it would make the creation of the whole ontology a very complicated task for the students, we propose to use give to students only a small part of ontology and to request them to insert a missing concept into it. This way student will be tested: - 109 do they understand the domain, and which part of the whole ontology is the one, that is given to them; do they understand where the missing concept should be inserted and what relations should be used when inserting the concept. This way students testing of the knowledge can be divided into two levels. Trying to understand how a part of ontology fits into the whole ontology is one level of testing the understanding of knowledge domain. The request to insert a missing concept into ontology is a second level. The relationships that student suggests to use then inserting concept into ontology can be compared with the etalon one, made by the tutor. The concept can be chosen differently by the system each time the student is taking an assignment. This way the student would have a possibility to look at the knowledge domain each time from
the different perspective. This would deepen student’s understanding and would encourage critical thinking. In this way the tutor would avoid a possibility for a student to get the same assignment to insert the same concept in to the part of the ontology. This specification of relationships between concepts can be done by using semantic web technologies and tools to build ontologies.

6.5.1 Enhanced learning Model based on semantic web

Intelligent web based education system have been doing its round for several years. However Intelligence of a Web-based educational system means the capability of demonstrating some form of knowledge-based reasoning in various activities related to curriculum sequencing, in analysis of the student's solutions, and in providing interactive problem-solving support (possibly example-based) to the student, all adapted to the Web technology.

![Reference Models for SWEBS](image)

Teacher’s role, also called as content providers, help provide learning content and design learning activities. Its job is also to monitor learners” interactions (problem solving, assessment, etc.) and to configure learners” strategies, to support students” evaluation etc.

Learner’s Role: The main interest of learners is to interact with the system in order to receive personalized educational content in order to improve their knowledge and fulfill their learning goals;

Author’s Role: Authors are responsible for structuring the educational content. Authoring activities are concerned with (i) educational content, (ii) instructional process, and (iii) adaptation and personalization.

The pedagogical agent job is to access the educational contenton the server placed at different locations by using high-level educational services. The educational server possesses enough intelligence to arrange for personalization of the learning tasks it supports. The server appears to act as an intelligent tutor with both domain and pedagogical knowledge to conduct a learning session from the learner’s point of view. It uses a presentation planner to select, prepare, and adapt the domain material to show to the student. During interaction, the SWEBS gradually builds the student model during the session, in order to keep track of the student's actions, learning progress, detect and correct his/her errors and misconceptions. This helps redirect the session accordingly if required. The end result of the architecture is that the student need not perform the discovery of the relevant material manually.
Using Semantic Web tools in higher education and learning:

The widespread use of web-based technology in education offers new opportunities for teachers and students. In particular, the availability of large datasets and real-life cases has the potential to enhance higher education teaching.

The ability of teachers and students to draw on authentic and even ‘real time’ data from across the world offers significant opportunities for learning - not just in working with ‘big data’, but in supporting problem-based learning environments, encouraging case-based learning, and allowing new forms of collaboration at individual, institutional and global levels.

However this requires a new range of digital skills for teachers, and space for new teaching practice to be developed. Teachers who have previously taught using ‘textbook examples’ need to be supported to develop expertise for engaging with rapidly changing, contested and ‘messy’ data from multiple sources.

Engaging students themselves as researchers and designers allows the development of technologies where the curriculum becomes a ‘first-hand experience’, rather than mediated solely by teachers.

The effective use of semantic web technologies is dependent on easy-to-use software for authoring, archiving and publishing. Tools developed through the Ensemble project improved the ability to store, combine and share digital resources.

These tools also enabled students and teachers to acquire a more sophisticated understanding of key issues in their subjects, of how problems could be answered in different ways – in turn suggesting further directions for enquiry.

6.6 Technologies/ Platforms Used

XAMPP is the most popular PHP development environment. XAMPP is a free and open source cross-platform web server solution stack package, consisting mainly of the Apache HTTP Server, MySQL database, and interpreters for scripts written in the PHP and Perl programming languages.

6.6.1 XAMP Control Panel

To run php code, we are required three important things i.e. Php, mysql and a server (Apache/IIS). To create such environment, we may install all of them individually. But installing and managing them separately can be typical task. Here XAMPP Control panel comes up with a solution. It is a free and open source cross-platform web server solution stack package, consisting mainly of the Apache HTTP Server, MySQL database, and interpreters for scripts written in the PHP. It is known as XAMPP because of following X – Windows/Linux, A- Apache, M- Mysql,P – PHP.

Combinations of advantages of using XAMPP for development are as follow:

You can start and stop the whole webserver+database stack with one command.

Good user interface.

XAMPP is portable so you can carry it around on a thumb drive.

The security settings are strict by default, nobody but you will be able to access the web server.

Runs on both windows and linux.

Php error reporting is enabled by default, which helps when debugging scripts.
6.6.2 Database Design (DB2)

DB2 is a family of relational database management system (RDBMS) products from IBM that serve a number of different operating system platforms. DB2 provides an open database environment that runs on a wide variety of computing platforms. A DB2 database can grow from a small single-user application to a large user system. Using SQL, users can obtain data simultaneously from DB2 and other databases. DB2 includes a range of application development and management tools. It provides continuous availability of data to keep transactional workflows and analytics operating at maximum efficiency. And, it delivers breakthrough in-memory performance enabling speed of thought analytics without the constraints of other in-memory solutions with the simplicity of “load and go” setup. DB2 is optimized to deliver industry-leading performance while lowering costs and improving IT productivity.

Benefits:

SQL Compatibility: Minimize the cost and risk of moving legacy applications built for the Oracle Database to DB2. Best of all, your staff can leverage existing skills and hit the ground running.

Security: Include a comprehensive suite of security features that effectively and decisively minimize threats: authentication, authorization, trusted context, auditing, encryption, and fine-grain controls.

Performance Optimization: Save money, lower risks and improve IT productivity by easily optimizing performance and increase DBA productivity.

Storage Optimization: Reduce storage costs and increase performance with industry leading technologies that compress tables, indexes, archive logs, temporary space, LOBs, XML, and back-up data

High Availability: Help ensure your database remains operational during planned or unplanned outages. Reduce downtime to help meet strict Service Level Agreements (SLAs) with no loss of data during infrastructure failures.

6.7 System evaluation

The tool/system that is proposed is around the Semantic Web applied to Online Exams. Towards the automation and intelligence of meaningful Web information, this tool provides the appropriate assistance to students' Online Exams activities.
Intelligent assistance is the key function of our application. Compared with current online exam solution, our tool realizes the recommendation based on reasoning instead of simple questions asking. Obviously our tool neither requires In addition, we made a comparison test between our tools and current examination software On the other hand, customers will feel comfortable in making a choice through features identification in case of multiple recommendations.

The Online exam ontology can be extended or integrated into an upper level ontology when the System is asked to perform financial products recommendations in a higher degree. In addition, different subjects of Web ontologies could be discovered and used easily. In the meantime, ontology integration, extension and evolution is becoming the main focus of research in the Semantic Web technologies.