Chapter 5

Scope of Research Work

Section – I SWBEF Architectural Aspect

5.1 A Semantic Web-based Examination Framework: Scope of Research Work

The Web is moving from a collection of pages towards an accumulation of services that interoperate through the Internet. Consequently, people Worldwide are carrying out more and more commercial activities rather than simple information readings on the Web. However, current online examination is experiencing many restrictions. On the one hand, online examination is asked to perform more intelligently and autonomously for fitting the changing situation. On the other hand, due to lack of a meaningful (semantic) description, machines are unable to handle the online examination tasks sophisticatedly in the current Web context. To this end, traditional online examination needs a new Web communications that provides users with well-defined in sequence and supports the semantic level interoperability. It can expect that the online examination will benefit from the advances of actual research on the Semantic Web. Indeed, the Semantic Web may improves the current online assessment on resource building like assignment with machine-process information using semantic description and semantic reasoning. Thus Connecting and helping the semantics become a basis of the online examination interoperability.

In this chapter, we introduce the online examination architecture and discuss its problems as well as its limitations. Then, we illustrate how the Semantic Web may enhance the traditional online examination. Finally, we present our Semantic Web-based Online examination framework is presented.
5.2 Current status of Online Examination

Internet has greatly changed people’s lifestyle so far. Online services have enabled people from all walks of life to bring entire libraries, entertainment venues, post offices and financial centers to a workplace, to a desktop or to a shirt pocket. The Internet’s largest and most meaningful impact may very well be on the way consumers shop for everything from gifts, gadgets and groceries to clothing, cars, and cruises [PayPal, 2003]. All of these commercial activities, including online shopping and online banking, compose the concept of online examination.

The ease and selection that online examination provided to Universities would change the face of education. The reason for all these is most of the online services are available 24 hours a day, seven days a week, and their inventories are often more complete than those of their brick-and-mortar counterparts. Furthermore, online examination makes it easy for universities to compare products within or between colleges/students, any information. A recent marketplace study made by Nielsen and Net Ratings mentioned that more than 200 million Americans (or 75%) are using online examination services. Online examination boomed in 2000s - led by explosive growth in the use of Internet. The infrastructure for online examination is a networked Computing environment in business, home, and government.

5.3 System Architecture

The system is broadly classified into three main modules of pre examination, the real time main module & the post examination module.

Fig 5.3 : System Architecture
(i) Pre-examination

The question database is composed of the questions, a set of possible answers, the question types and other metadata, which are indexed by several factors, such as topics, keywords, complexity and difficulty, etc. The prior set of journey of examination to cover up in an organized manner is the following: Registration & creation of login through student Id, teachers Q bank which are questions distributed to the formative assessment on the course of syllabi. Integrated keys based on semantic technique which is bounded with auto grading. All questions are divided into topic. Schedule of exams

(ii) Real Time Screen Examination

Requires students not to leave the computer during the test by user id, password authenticated tracking technology. The data transmission encryption system transmits the examination question and result in secret form through the network to the server. It has following job to control a) Real time attempt b) time control and management

(iii) Post Exam

a) Auto grading (phpmysql) b) submission system .The system is divided into four arenas, to work on the various aspects of Academics. Exam management systems are very important for all whom are involved in the education process like (Faculty, students and administration staff). For the faculty: The faculty section is responsible for the assignments and test uploading. For this prior to the test faculties are creating question banks and answer solutions to them .The questions provided in conjunction with the syllabus are assessed and then uploaded using intelligent tailor made integrated evaluation system. Marking the test is done automatically and instantaneously; the faculty is relieved from these, time consuming duties. Questions can be easily cast-off from the question bank, easily edited and changed, different versions of the same question can be generated for different students. Moreover the faculties have acumen to evaluate on the IQ skills of the students to help them select the proper stream of their career.

For the students:

Tests can be taken in a prior scheduling according to the academic calendar conceptualized in a planned order & can be taken anywhere. Questions can be attempted in a peaceful environment, it can be taken using an undemanding personal computer and the minimal requirement is just a Web browser, Questions can be visualized with unique visual effects such as 3D, and objects in motion can be viewed.

For the administrator:

This module is the building block of the entire module, bridging an interface with the faculty & students. It primarily focuses on the authentication of the other two modules which comprises the probability of unauthorized accession. The scheduling of the topic of test is also the foremost job of the administrator to ensure smooth functioning of formative assessment. The extensive use of programmed testing in grading reduces ranking time and allows evaluators to focus on issues such as code style. In this paper the focus is on
the conjunction of computerized testing systems with the ever expanded World Wide Web to produce web-based assessment and testing systems. This paper focuses on wide-ranging systems in which exams are delivered and graded by a vital server. The objective of this work is to build exam management tool for students and instructors to monitor and enhance learning and teaching procedure.

**Online Intelligent Semantic Performance based Solution**

The system based tailored software is made to present an evaluation system which requires minimal overhead by the teachers with respect to the performance system. By integrating and placing student’s database from different branches of examination at centralized and data can be made available anywhere – anytime through internet.

**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.

### 5.3.1 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 ClientIEWorkstation OISP ClientIEWorkstation& OISPS ManagerIERouter.

The kernel of OISPS is the OISPS Server and the OISPS client module, which is designed according to the apache administrator’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.
Contributions of the semantic Web to Online examination

The Semantic Web, as the future Web, is an infrastructure that makes Web resources more accessible both for human and computers. Due to adding the semantics in a machine-process able fashion, and running the intelligence for services, the Semantic Web will give a more valuable benefit to online examination. The contribution of the Semantic Web to online examination is related to the semantic description, semantic querying, and semantic reasoning (Peng, 2002).

Semantic description

Currently Online examination is in the state of emerging for a low level description. This description could be enriched with meaningful information using Semantic Web ontologies that act for the online examination property and capability description. A Web ontology supports a service description of given application, and specifies what the service can do rather than how this service is carried out.

Semantic reasoning

The semantic reasoning is an important aspect of online examination. Currently, the online examination transactions are complicated. In order to make these transitions easier for everybody, online examination must be automated including the maximal intelligence, and the minimal human intervention. The Semantic Web provides a substantial support of reasoning, such as, Description Logic, RDF & RDFS and OWL. Moreover, reasoning and consistency checking can be useful at many stages during the design, maintenance, and
deployment of Semantic Web ontology [Song dong, 2000]. A significant example is the recommendation support in online examination. Nowadays, people spend a lot of time in navigating the Web to see documents. However, the Semantic Web-based online examination can give the appropriate recommendation according to the users' profile and preference information. This recommendation assistance makes online examination more convenient and easier for customers Worldwide.

The contribution of the Semantic Web to online examination is related to the semantic description, semantic querying, and semantic reasoning (Peng, 2002)\

A Semantic Web-based online examination framework

Undoubtedly, the Semantic Web brings a valuable advance to online examination. The limitations of current online examination infrastructures could be overcome by providing a semantic markup about the service description. On the one hand, the Semantic Web provides ontologies that act like shared knowledge bases across the Web. On the other hand, it also offers a logic to infer how such terms (ontologies) are combined to form complex concepts and how do they interact with the knowledge already accumulated (Paolucci, 2001). In this section, we propose a Semantic Web-based online examination framework. In this framework, the semantic information improves the growing online examination infrastructure by adding meaningful capabilities and a high degree of autonomy. This solution enables online examination fit situation changes.

5.3.2 Design object

Online examination extends the Web from a distributed source of information to a distributed

Source of services. Meanwhile, the Semantic Web added a machine-interpretable access to the heterogeneous and distributed information. Thus, our design goal is to integrate the Semantic Web into the online examination architecture in order to give a rich and flexible metadata and further support an intelligent and autonomous process. First of all, our design aims at doing a richer service description, which depends upon the use of ontologies and relevant Semantic Web languages. In detail, the design should meet the following requirements:

• High degree of flexibility and expressiveness, this requirement concerns the potential complexity of the service description. Although some description can be expressed with a simple pair attribute-value, others must have more complex structures.

• Ability to express semi-structured data Semi-structured data often appeared in the online examination software.

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• Supporting capability description the capability description gives the specification of some online examination issues. For example: How is
the execution carried out? What are the services provided? What are the student's requirements? Etc.

- Ability to express constraints on the one hand, the Semantic Web provides ontologies that act like shared knowledge bases across the Web. On the other hand, it also offers a logic to infer how such terms (ontologies) are combined to form complex concepts and how do they interact with the knowledge already accumulated [Paolucci, 2001].

The condition of online examination service should be represented. Examples of conditions are: pre-conditions (inputs to the service together with conditions over these inputs) and post-conditions (results of the service execution together with conditions over these results) [Lara, 2001]. In addition to the service description, the intelligence and automation of online examination must be implemented. In this case, existing human online examination interactive operations would be replaced by an automatic machine act, which will enhance services' quality and users' satisfaction. Concretely, our objectives include:

- Supporting semantic reasoning the framework must support reasoning using logic or rules, which are used for sophisticated task achievement.
- Professional domain oriented domain ontologies are adopted for the general domain knowledge, which can assist the regular user to carry out domain-professional transactions
- Friendly interface the human-computer interaction is provided. Users can communicate with online examination services using a native language that is convenient for an ordinary user to process professional and complicated online commercial activities.

5.3.3 The framework
Our framework is based upon the traditional online examination structure (Figure 3-2). We propose to enrich this structure with a layer between the online examination infrastructure and online examination application (Figure 5.3.3). We call this layer the Semantic Virtual Machine (SVM). The condition of online examination service should be represented. Examples of conditions are: pre-conditions (inputs to the service together with conditions over these inputs) and post-conditions (results of the service execution together with conditions over these results) [Lara, 2001].
In our framework, on the right hand side is the **online examination, Application** layer. It represents the main body of online examination services. Applications may range from Kindergarten exams to PhD entrance tests. Crucially the application layer is the interface between the SVM and Online examination participants. The left hand side layer is the **online examination Infrastructure**. It consists of Web resources for online examination (such as, Web documents and Web database) and some online examination fundamental modules (such as, messaging, communication, management, security and etc.). Ideally, SVM does neither make any assumption on the infrastructure layer, nor on its internal structure. Therefore, as our point of view, the online examination Infrastructure is just a black box. Obviously, the core part of the framework is the middle layer - **Semantic Virtual Machine (SVM)**. The SVM consists of two modules that are activated in sequence. The first module is the **Services Description**. It provides Online examination with a machine-accessible semantics. The second module, called the **Services Processor**, enables Web services to interoperate and to run autonomously. As our design idea, the **Services Description** is the process of Web semantics adding using Web ontologies. The specification of Web ontologies is achieved by the Semantic Web language and relevant logic framework (such as OWL).

The Services Processor is the module for reasoning which is supported by the Jena parser. Jena is a Java framework for the transformation of information between domain ontology and inference engine. As a key component, the inference engine plays an important role in our semantic reasoning. It infers the information passed by Jena parser. The inference engine may be built using the logic (such as, Description Logic) as well as the Specialized Algorithms (Problem Solving Methods). In summary, building a Semantic Web-based Online examination is a process of adding and running semantics. Certainly, this process has its own workflow composed of several steps. In the next section, we investigate the SVM layer and find out its workflow.

### 5.3.4 Work flow

According to our framework, the SVM layer is divided into two different parts: **Services Description** and **Services Processor**. The **Services Description** is the interface of the online examination infrastructure. This infrastructure is responsible for presenting Web resource semantics (such as Web documents and Web database). The **Services Processor** irresponsible for semantics running. It communicates with online examination applications. The Semantic Web-based online examination framework could be built according to figure 5.3.4:
5.3 (a) Metadata base.

The metadata base allows us to explicitly define the nature of attributes and their relationships in terms of the metadata language itself. Therefore it is possible to add semantics to Online examination and its domain.

In Semantic Web, RDF and RDFSchema are used to build a common metadata base. As specified in chapter 2, RDF is a W3C recommendation to express metadata according to any kind of object, from real life objects to abstract entities. However it is particularly useful to present Web resources such as documents or server-side processes [Ciancarini, 2003].

Based on a mathematical model, RDF provides a "triple" mechanism to group sets of very simple metadata statements. This triple mechanism consists of the "resource", "property", and "value".

• Ontology construction.

The stored resource metadata forms a group of vocabularies about an interesting domain. These vocabularies can be structured into an ontology using human standards. The domain ontology can formalize the expression of the service semantics. Therefore, all the applications in our Semantic Web-based Online examination framework will be manipulated, understood and reasoned through the ontologies. Thus, the construction of the domain ontology can be considered as one of the most important tasks in the workflow.

• OWL specification.

After the construction of the ontology, we need a formal ontology specification. And this can be done using an ontology representation language. Ontology languages allow users to write an explicit, formal conceptualization of the domain models. Nevertheless, these languages should meet some requirements [Antoniou, 2003], such as:

a) a well-defined syntax,

b) a well-defined semantics,

c) efficient reasoning support,

d) sufficient expressive power,

e) convenience of expression.

The Ontology Web Language (OWL) is a language defined by W3C Web Ontology Working Group. This group aims to standardize ontology languages for the Semantic Web. OWL has the features from several families of the representation languages which include RDF. The OWL ontology specification is the final representation of the Services Description.
• Semantic annotation.

To achieve semantics annotation for Online examination is the important work of the Services Description in our framework. Semantic annotation is the integration result of the above workflows. The "Annotation" has two meanings in contemporary English (according to WordNet and Merriam-Webster) • "

> note, annotation, notation: a comment (usually added to a text);

> annotation, annotating ~ the act of adding notes.

5.3 (b) Metadata collection

Metadata is a structure that describes, explains, and locates information. It makes easier to retrieve, use, and manage an information resource. Metadata is often defined as data about data or information about information (Guenther)83. Here, metadata refers to the Web metadata which is machine-understandable information for the Web [W3C Technology, 2001]. Metadata collection is used in order to distill the "keywords" and "description" embedded in the HTML tags of Web resources. Moreover, through metadata we can select the Online examination service and associate it with other information, such as a description, classification data, or any other attributes. For example, in an online credit card application service, metadata indicates the credit card name and feature, and specifies the admission qualification. Using metadata, we can establish the explicit relationships among the online examination resources we are interested in.
In linguistics (and particularly in computational linguistics), an annotation is considered as a formal note specified part of the text. The annotation referred to [KIM, 2006].

Figure 5.3 (a) Flow chart of the semantic Web Based Exam
>a sort of meta-data and
>the process of generation of such meta-data.

In our framework, the semantic annotation step is a metadata collection and organization process. Generally, semantic annotation is based upon a manual human intervention. Nevertheless, for the semantic annotation process, many technologies have been investigated so far. These technologies will be discussed in Chapter 4.

• Logic / rule.

As Berners-Lee's Semantic Web Cake (Figure 2-2), the logic is an important layer on the top of the ontology vocabulary. The Logic layer enables us to write the necessary rules. The Proof layer executes these rules and evaluates the results with the Trust layer mechanism in order to determine whether to trust the given proof or not. Furthermore, OWL, as a Semantic Web representation language, is also a Description Logic language. It can express logics and construct the relevant rules used for reasoning.

• Inference engine.

The inference engine is used to process the knowledge available in the Semantic Web. It deduces new knowledge from the already specified knowledge [Semantic Web org, 2001]. Two approaches are available: using general logic based inference engines and specialized algorithms (Problem Solving Methods). The inference engine as well as the logic / rule are the essential promises for the semantic reasoning.

• Semantic based reasoning.

The Semantic Web-based Online examination framework enriches the traditional Online examination with advanced (so-called "intelligent") capabilities (such as, recommendation support). Certainly, these capabilities primarily require reasoning. Currently, reasoning capabilities are supported by Semantic Web languages, such as OWL. In addition, the semantic reasoning can be deployed using the logic based inference or specialized algorithms. As an important point, it will be discussed deeply in Chapter 6.
5.1 A Semantic Web-based online examination framework: Scope of Research Work

The Web is moving from a collection of pages towards an accumulation of services that interoperate through the Internet. Consequently, people Worldwide are carrying out more and more commercial activities rather than simple information readings on the Web. However, current online examination is experiencing many restrictions. On the one hand, online examination is asked to perform more intelligently and autonomously for fitting the changing situation. On the other hand, due to lack of a meaningful (semantic) description, machines are unable to handle the online examination tasks sophisticatedly in the current Web context. To this end, traditional online examination needs a new Web communications that provides users with well-defined in sequence and supports the semantic level interoperability. It can expect that the online examination will benefit from the advances of actual research on the Semantic Web. Indeed, the Semantic Web may improves the current online assessment on resource building like assignment with machine-process information using semantic description and semantic reasoning. Thus Connecting and helping the semantics become a basis of the online examination interoperability.

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![Fig5.1.2: OISPS Components](image)

5.2 Current status of Online Examination

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The system is broadly classified into three main modules of pre examination, the real time main module & the post examination module.

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Table 5.3:- Semantic Web Representation Languages

Supporting capability description the capability description gives the specification of some online examination issues. For example: How is the execution carried out? What are the services provided? What are the student's requirements? Etc.

• Ability to express constraints on the one hand, the Semantic Web provides ontologies that act like shared knowledge bases across the Web. On the other hand, it also offers a logic to infer how such terms (ontologies) are combined to form complex concepts and how do they interact with the knowledge already accumulated (Paolucci)52.

The condition of online examination service should be represented. Examples of conditions are: pre-conditions (inputs to the service together with conditions over these inputs) and post-conditions (results of the service execution together with conditions over these results) [Lara, 2001]. In addition to the service description, the intelligence and automation of online examination must be implemented. In this case, existing human online examination interactive operations would be replaced by an automatic machine act, which will enhance services' quality and users' satisfaction. Concretely, our objectives include:

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Our framework is based upon the traditional online examination structure (Figure 5.3.1). We
propose to enrich this structure with a layer between the online examination infrastructure and online examination application (Figure 5.3.3). We call this layer the Semantic Virtual Machine (SVM).

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Figure 5.3.3 The Semantic Web-based e-examination Framework.

In our framework, on the right hand side is the online examination, Application layer. It represents the main body of online examination services. Applications may range from Kindergarten exams to PhD entrance tests. Crucially the application layer is the interface between the SVM and Online examination participants. The left hand side layer is the online examination Infrastructure. It consists of Web resources for online examination (such as, Web documents and Web database) and some online examination fundamental modules (such as, messaging, communication, management, security and etc.). Ideally, SVM does neither make any assumption on the infrastructure layer, nor on its internal structure. Therefore, as our point of view, the online examination Infrastructure is just a black box. Obviously, the core part of the framework is the middle layer - Semantic Virtual Machine (SVM). The SVM consists of two modules that are activated in sequence. The first module is the Services Description. It provides Online examination with a machine-accessible semantics. The second module, called the Services Processor, enables Web services to interoperate and to run autonomously. As our design idea, the Services Description is the process of Web semantics adding using Web ontologies. The specification of Web ontologies is achieved by the Semantic Web language and relevant logic framework (such as OWL).
The Services Processor is the module for reasoning which is supported by the Jena parser. Jena is a Java framework for the transformation of information between domain ontology and inference engine. As a key component, the inference engine plays an important role in our semantic reasoning. It inferences the information passed by Jena parser. The inference engine may be built using the logic (such as, Description Logic) as well as the Specialized Algorithms (Problem Solving Methods). In summary, building a Semantic Web-based Online examination is a process of adding and running semantics. Certainly, this process has its own workflow composed of several steps. In the next section, we investigate the SVM layer and find out its workflow.
5.3.4 Work flow

According to our framework, the SVM layer is divided into two different parts: *Services Description* and *Services Processor*. The *Services Description* is the interface of the online examination infrastructure. This infrastructure is responsible for presenting Web resource semantics (such as Web documents and Web database). The *Services Processor* irresponsible for semantics running. It communicates with online examination applications. The Semantic Web-based online examination framework could be built according to figure 5.3.4:

In linguistics (and particularly in computational linguistics) an annotation is considered as a formal note added to a specified part of the text. The semantic annotation referred to [KIM, 2006]18:

> a sort of meta-data and

> the process of generation of such meta-data.

In our framework, the semantic annotation step is a metadata collection and organization process. Generally, semantic annotation is based upon a manual human intervention. Nevertheless, for the semantic annotation process, many technologies have been investigated so far. These technologies will be discussed in Chapter 4.

• Logic / rule.

As Berners-Lee's Semantic Web Cake (Figure 2-2), the logic is an important layer on the top of the ontology vocabulary. The Logic layer enables us to write the necessary rules. The Proof layer executes these rules and evaluates the results with the Trust layer mechanism in order to determine whether to trust the given proof or not. Furthermore, OWL, as a Semantic Web representation language, is also a Description Logic language. It can express logics and construct the relevant rules used for reasoning.

• Inference engine.

The inference engine is used to process the knowledge available in the Semantic Web. It deduces new knowledge from the already specified knowledge [Semantic Web org, 2001]. Two approaches are available: using general logic based inference engines and specialized algorithms (Problem Solving Methods). The inference engine as well as the logic / rule are the essential promises for the semantic reasoning.

• Semantic based reasoning.

The Semantic Web-based Online examination framework enriches the traditional Online examination with advanced (so-called "intelligent") capabilities (such as, recommendation support). Certainly, these capabilities primarily require reasoning. Currently, reasoning capabilities are supported by Semantic Web languages, such as OWL. In addition, the semantic reasoning can be deployed using the logic based inference or specialized algorithms. As an important point, it will be discussed deeply in Chapter 6.