INTRODUCTION

This thesis is on “Towards E-Learning Management System using Semantic Web and a unique University namespace “univ””. Here this introduction contains an overview of our thesis and background information about the Semantic Web and E-learning using Semantic web. It also shortly discusses some intended Semantic Web applications and about creating a namespace of universities that identify any universities that could be used to build for E-learning Content Management System using Semantic web.

1.1 Background

E-learning is not just concerned with providing easy access to learning resources, anytime, anywhere, via a repository of learning resources, but is also concerned with supporting such features as the personal definition of learning goals, and the synchronous and asynchronous communication, and collaboration, between learners and between learners and instructors. One of the hottest topics in recent years in the AI community, as well as in the Internet community, is the “Semantic Web”. It is an evolving extension of the World Wide Web in which the semantics of information and services on the web is defined, making it possible for the web to understand and satisfy the requests of people and machines to use the web content.” It is about making the Web more understandable by machines. It is also about building an appropriate infrastructure for intelligent agents to run around the Web performing complex actions for their users. 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. Ultimately, Semantic Web is about how to implement reliable, large-scale interoperation of Web services, to make such services computer interpretable, i.e., to create a Web of machine-understandable and interoperable services that intelligent agents can discover, execute, and compose automatically. Unfortunately, the Web was built for human consumption, not for machine consumption, although everything on the Web is machine-readable, it is not machine-understandable. We need the Semantic Web to express information in a precise, machine interpretable form, ready for software agents to process, share, and reuse it, as well as to understand what the terms describing the data mean. That would enable web-based applications to interoperate both on the syntactic and semantic level. Note that it is Tim Berners-Lee (inventor of the WWW, URIs, HTTP, and HTML) himself that pushes the idea of the Semantic Web forward. The father of the Web first envisioned a Semantic Web that provides automated information access based on machine-processable semantics.
of data and heuristics that use these metadata. The explicit representation of the semantics of data, accompanied with domain theories (ontologies), will enable a Web that provides a qualitatively new level of service, such as: intelligent search engines, information brokers, and information filters. Researchers from the World Wide Web Consortium (W3C) already developed new technologies for web-friendly data description. Moreover, AI researchers have already developed some useful applications and tools for the Semantic Web. We will introduce the implementation of Semantic Web concept on the e-Learning environment offered by our web-based e-learning. The facilities that the application will provide include allowing e-learning content to be created, annotated, shared and discussed, together with supplying resources such as lecture notes, course description, documents, announcements, student papers, useful URL links, exercises and quizzes for evaluation of the student knowledge. [16]

1.2 Outline

This thesis is mainly divided in two parts:

- a theoretical and
- a practical part.

The practical part answers - and gives solutions to - the thesis goals whereas the theoretical part describes the theoretical foundation for our choices. The structure of the thesis is as follows:

**Theoretical part**

1.2.1 Chapter 2

This chapter includes the main goals and definition of our thesis. Here we include various research questions that we are faced during research and a research plan model of our thesis.

1.2.2 Chapter 3

This chapter is committed to an overview of the Learning Management system and E-learning.

1.2.3 Chapter 4

This chapter is committed to an overview of the Semantic web. In this chapter we represent the limitations of current web (WWW) and benefits using Semantic web technologies. Here we include various elements of semantic web, structure of the Semantic web and details descriptions about those elements of semantic web part by part. In this chapter we include various applications and challenges of Semantic web technologies.

1.2.4 Chapter 5

This chapter includes some related works of various researchers in different countries that help us to propose our thesis model and create namespace.

1.2.5 Chapter 6
This chapter includes why we use semantic web technologies in E-learning management system and the proposed model that we are created by researching.

1.2.6 Chapter 7
This chapter includes the basic definitions and information of Domains and Namespaces that we want to create into implementation part in our thesis.

Implementation part

1.2.6 Chapter 8
Chapter 8 includes the description of proposed “univ” namespace ontology and the snapshot of the proposed ontology for univ namespace using Protégé(ontology editor) that we create in the implementation part of the thesis.

1.2.6 Chapter 9
This chapter includes the testing of univ namespace using the W3C RDF Validation Service.

1.2.6 Chapter 10
Chapter 10 includes the Result and Discussion after validating rdf file and the resulted triples.

1.2.6 Chapter 11
This chapter includes the future works of our thesis.

1.2.6 Chapter 12
Chapter 12 concludes the thesis with a summary of the main contributions of this thesis.

1.3 Summary

In this chapter we introduce about our thesis and its overall outline of our thesis paper. All chapters that are included in theoretical part introduce the basic of Learning management system, Semantic web, its technologies, our proposed model, and the univ namespace. Those chapters that are included in practical part include implementation of our thesis. During our research, it became clear that for a semantic search engine to create Learning management system, all elements including semantic web and Learning management system are needed to know. Those elements help us to implement the univ namespace in our thesis.
Chapter 2

Problems Definitions & Goals

Semantic web is going to change the way we use web, design and develop the web technologies today. Many technologies have been developed for constructing and developing the semantic web. During the last few years semantic web has achieved long milestones and also during this period it brought up new ideas to set up a new form of web. In this thesis, First, we try to analyze the Semantic web development in detail, limitations of today’s web and study the reasons that caused to come out the concept of semantic web vision. We will discuss the impact of this semantic web development on current research in academic environment. Second, main objective of our thesis is to present an E-learning management system using our proposed model and vocabulary semantic web technologies for Bangladeshi environment that provide a general platform for the Bangladeshi learning institutions. At the end we will test the proposed E-learning management system model that we create by researching our thesis.

2.1 Aims
Followings objectives are set to achieve the aims.

- To identify the main reasons that brought up the semantic web development,
- To identify the problems for individual and a learner to adopt the semantic web
- To propose a ontology based Learning management system model
- To create universal namespace that defines a University in Semantic web.

2.2 Objectives
The goal of our research is to design an e-learning management system that provide as a general pattern for Bangladeshi learner. This system consists on ontology for different process in e-learning, such as learning activities, learning style, teaching methods, and course syllabus. Following objectives are set to achieve the goal.

- Literature study to explore the topics of Semantic web, Ontology.
- Identification of the problems related to Semantic web development.
- Advantages of the Semantic web over our world wide web.
- Design and conduct the experiment.
- Analyze the experiment result.
The purpose of the study is to gather academia requirements for the implementation of e-learning management system from different perspectives. Researchers focused on training material, related to search results in industry and online courses searching material in academia. However, after implementation, researchers will verify its results in academia and industry.

2.3 Research Plan:

In our thesis previously we include that there are two parts in our thesis.

21.1 Theoretical or literature review and
22.1 Practical or Experimental part.

During our research what topics we will discuss in theoretical and experimental part that are given in following our research plan model.

2.4 Summary

In this chapter we include our goal, aim and research plan of our thesis. We implement and develop our thesis by following this research plan model that includes literature view and experimental view.
3.1 Learning Management System

A learning management system (commonly abbreviated as LMS) is a software application for the administration, documentation, tracking, and reporting of training programs, classroom and online events, e-learning programs, and training content [19]. Generally, A Learning Management System, is an implemented computer system on Internet/Intranet servers that takes care of the following basic activities:

- **Users’ management.** The system must allow the entrance to users with different profiles, for instance: the teacher, the student and the system administrator.

- **Administrative management of the virtual courses.** It is made a tracking of the student, storing all and each one of the activities the student develops with the tool. For example, the evaluations carried out by the students to fix the assimilation degree of the contents of the courses are one of the most important administrative tasks.

- **Management of the communication tools.** This component of the LMS, is under our point of view, basic. Since we are able to establish, from different possibilities, communication among the different system actors. These communication tools can be forums, e-mail, videoconference, chat, etc.[7]

LMSs range from systems for managing training and educational records, to software for distributing courses over the Internet with features for online collaboration. Corporate training use LMSs to automate record-keeping and employee registration. Student self-service (e.g., self-registration on instructor-led training), training workflow (e.g., user notification, manager approval, wait-list management), the provision of on-line learning (e.g., Computer-Based Training, read & understand), on-line assessment, management of continuous professional education (CPE), collaborative learning (e.g., application sharing, discussion threads), and training resource management (e.g., instructors, facilities, equipment), are dimensions to Learning Management Systems[19].

3.2 Characteristics

LMSs cater to educational, administrative, and deployment requirements. While an LMS for corporate learning, for example, may share many characteristics with a VLE, or virtual learning environment,
used by educational institutions, they each meet unique needs. The virtual learning environment used by universities and colleges allow instructors to manage their courses and exchange information with students for a course that in most cases will last several weeks and will meet several times during those weeks. In the corporate setting a course may be much shorter in length, completed in a single instructor-led event or online session.

The characteristics shared by both types of LMSs include:

- Manage users, roles, courses, instructors, facilities, and generate reports
- Course calendar
- Learning Path
- Student messaging and notifications
- Assessment and testing handling before and after testing
- Display scores and transcripts
- Grading of coursework and roster processing, including wait listing
- Web-based or blended course delivery

A LMS allows for teachers and administrators to track attendance, time on task, and student progress. LMS also allows for not only teachers and administrators to track these variables but parents and students as well. Parents can log on to the LMS to track grades. Students log on to the LMS to submit homework and to access the course syllabus and lessons.

3.3 E-learning

Electronic base training is known as E-learning. A learner learns the instructional contents through the electronic technology. E-learning has a wide range of learning strategies and technologies; from CD-ROMS, videoconferencing, TV lectures, and virtual educational work, corporate universities and many more but our main focus is on virtual education, based on semantic web. E-learning has the potential of higher quality of education, more competitive workforce, increases the level of literacy and also is beneficial to reduce the costs of education training in institutions [5]. E-learning has different benefits over traditional classroom study: it is much faster, less expensive, create more interest to busy in study, get required information any time any place, keeps update easily, easy to manage large groups of students and many more [6]. There are also some disadvantages of E-learning as you feel loneliness and also it is boring text based courses.

3.3.1 Level of E-learning

There are four levels of E-learning, from the very basic to advance level. These levels are:
3.3.1.1 Knowledge database

It is most basic level of E-learning probably we have seen in software sites offering indexed explanation and guidance for software questions also gives the step by step instructions to perform specific task. We can find out the database by typing a keyword or phrase [6].

3.3.1.2 Online support

Online support is the second level of E-learning. Function of online support is almost similar to knowledge database. It comes in the form of online bulletin boards, chat rooms, email, or live instant messaging supports. Mostly targeted questions are asked in it which has the more immediate answers [6].

3.3.1.3 Asynchronous training

Third level of E-learning is asynchronous training. Self learning is essential in this level; either it is CD ROM based, network based, internet based or intranet based. It is known as most traditional way of E-learning. You may contact instructor through online discussion board and email or it may be totally self study with links to reference materials in place of live instructor [6].

2.3.1.4 Synchronous training

Most advance level of E-learning, live instructor is available for everyone to negotiate their problems in a predefine time. Everyone can communicate with each other. This type of training takes place through internet web sites, audio or video conferences, internet telephone [6].

3.4 Summary

In this chapter we include a brief overview about Learning Management System, E-learning and various levels of E-learning. Since our thesis topic is “E-Learning Management system using Semantic web” so Learning Management System and E-learning are major parts. From this chapter we can learn brief information about those topics that will help us to implement our thesis. Without knowing about those major parts it will not easy to implement this thesis.
Chapter 4

The Semantic Web Vision

4.1 Today’s web (World Wide Web)

Current web (Web 2.0) named as www has over than 11 billion pages and majority of them are only human readable format e.g. HTML [1, 2]. Tim Berners-Lee developed the WWW, defined it as "distributed heterogeneous collaborative multimedia information system". WWW is primarily document for centric communication services which focuses on the need of users using browsers. The basic and powerful characteristics of WWW are [2, 3]:

- Revolutionizing the way people access the information. Current web pages act as a digital library for documents and are interconnected through hypermedia link.
- It opens new ways and opportunities in different area such as scientific information, virtual learning, commerce, health care, business.
- It is an attractive platform for multimedia and news. WWW provides news, sports and entertainment programs from all over the world.
- WWW has the ability to put together all type of media objects (videos, audio, text, images etc.) into a single document.
- WWW is a platform for businesses like Amazon, eBay, Stock market, Forex etc.
- This platform support almost all type of protocol i.e. FTP, E-MAIL, and TELNET etc.

Now doubt WWW has been changing our world by providing unbelievable features and benefits. However these web technologies have some limitations to support today’s dynamic, fast and robust computational requirements. New web technologies are required to improve the current search mechanism. Following are the major problems in web technologies which enforce us to bring a new version and infrastructure for the web[3,4]:

- Some time we do not get the result of our specify keywords. Although the required information is available in search document but this document use different terminology and vocabulary.
- Many times we get the information from a single web page and a single document, and it is extremely difficult to collectively get the information which is spread over several web pages and documents.
Most information is HTML based format which is suitable for human but not suitable for machine. Many parts of the information are not well structured.

Usually we get an excessive amount of information which is irrelevant to our required information. It is very difficult to separate so it is time consuming task.

Therefore, the term *information retrieval*, used in association with search engines, is somewhat misleading; *location finder* might be a more appropriate term. Also, results of Web searches are not readily accessible by other software tools; search engines are often isolated applications. The main obstacle to providing better support to Web users is that, at present, the meaning of Web content is not *machine-accessible*.

Of course, there are tools that can retrieve texts, split them into parts, check the spelling, count their words. But when it comes to *interpreting* sentences and extracting useful information for users, the capabilities of current software are still very limited.

An alternative approach is to represent Web content in a form that is more easily machine-processable and to use intelligent techniques to take advantage of these representations. We refer to this plan of revolutionizing the Web as the *Semantic Web* initiative. It is important to understand that the Semantic Web will not be a new global information highway parallel to the existing World Wide Web; instead it will gradually evolve out of the existing Web.

### 4.2 Semantic Web Overview

As a huge information space, the Web should be useful not only for human-human communication, but also allows machines to participate and help. However, nowadays most information on the Web is designed for human consumption and the structure of the data is not evident for a robot browsing the Web. There are two distinct approaches to enable the machine to automatically manipulate the information in the Web. One approach which comes from artificial intelligence is machine learning. The machine is trained to behave like a person. However this approach is domain-dependent and requires a huge training process. The Semantic Web [25] is an
extension of the World Wide Web. The major philosophical difference between the Semantic Web and the World Wide Web is that the Semantic Web is supposed to provide machine accessible meaning for its constructs whereas in the World Wide Web this meaning is provided by external mechanisms. The Semantic Web approach instead develops language for expressing information in a machine process able form[26].

The W3C gives the following definition for the Semantic Web:

The word semantic stands for “the meaning of”. The semantic of something is the meaning of something.

“The Semantic Web = a Web with a meaning.”[8]

Semantic Web is a group of methods and technologies to allow machines to understand the meaning - or "semantics" - of information on the World Wide Web.

Semantic Web was “invented” by Tim Berners-Lee (amongst others), a physicist working at CERN in 1980s. TBL’s original vision of the Web was much more ambitious than the reality of the existing (syntactic) Web:

TBL (and others) have since been working towards realising this vision, which has become known as the Semantic Web.

Semantic web is a collaborative effort led by W3C with participation from a large number of researchers and industrial partners. With the SW, the machine can do many complicate tasks which currently can only be performed manually. For example, user can directly send the following request to web agent “Book me a holiday next weekend somewhere warm, not too far away, and where they speak Chinese or English.”. The Web agent will be able to `understand' the request and perform it for the users.

In Semantic web, the machine understands, collects and integrates data by the following way:

1. Map the various data onto an abstract data representation
2. Merge the resulting representations
3. Start making queries on the whole![9]
The Semantic Web is best understood in comparison to the World Wide Web (WWW). Table 3-1 compares the two. Rather than being a substitute for the WWW, the Semantic Web extends it through useable, standardized semantics that draw deeply on academic research in knowledge representation and logic to approach the goal of ubiquitous automated information sharing.

Table 4-1 Comparison of World Wide Web (WWW) and Semantic web (SW) [14]

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>World Wide Web(WWW)</th>
<th>SEMANTIC WEB(SW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamental component</td>
<td>Unstructured content</td>
<td>Formal statements</td>
</tr>
<tr>
<td>Primary audience</td>
<td>Humans</td>
<td>Applications</td>
</tr>
<tr>
<td>Links</td>
<td>Indicate location</td>
<td>Indicate location &amp; meaning</td>
</tr>
<tr>
<td>Primary vocabulary</td>
<td>Formatting instructions</td>
<td>Semantics and logics</td>
</tr>
<tr>
<td>Logic</td>
<td>Informal/nonstandard</td>
<td>Description logic</td>
</tr>
</tbody>
</table>

4.3 From Today’s Web to the Semantic Web: Examples

There are a lot of limitations of Today’s Web. Suppose we see the following example,

*Let’s organize a trip to Budapest using the Web!* [9]. We may want to know something about Budapest; look for some photographs. So we search….

… on flickr …
Here, following things are happened,

- We had to mentally integrate all those information to achieve our goals,
- We had to consult a large number of sites, all different in style, purpose, possibly language…
We all know that, sometimes, this is a long and tedious process![9]

We can see another example, If we want to search details information about any topics, suppose we want to search about “World Wide Web” in google then we see this page-

Here we see that there show a lot of document links from different websites. So we can access each links to know about WWW, collect and integrate data about WWW from those different document links. It is very tedious and time consuming process. These are great limitations of World Wide Web (WWW).

The semantic web collects data about any topics from various websites that are machine understandable and there is no need to access documents from various websites. Machine collect and integrate those data in one page and show links from where it collects data. We can also see following areas:

**Knowledge Management**

Knowledge management concerns itself with acquiring, accessing, and maintaining knowledge within an organization. It has emerged as a key activity of large businesses because they view internal knowledge as an intellectual asset from which they can draw greater productivity, create new value, and increase their competitiveness. Knowledge management is particularly important for international organizations with geographically dispersed departments.
Most information is currently available in a weakly structured form, for example, text, audio, and video. From the knowledge management perspective, the current technology suffers from limitations in the following areas:

- **Searching information.** Companies usually depend on keyword-based search engines, the limitations of which we have outlined.
- **Extracting information.** Human time and effort are required to browse the retrieved documents for relevant information. Current intelligent agents are unable to carry out this task in a satisfactory fashion.
- **Maintaining information.** Currently there are problems, such as inconsistencies in terminology and failure to remove outdated information.
- **Uncovering information.** New knowledge implicitly existing in corporate databases is extracted using data mining. However, this task is still difficult for distributed, weakly structured collections of documents.
- **Viewing information.** Often it is desirable to restrict access to certain information to certain groups of employees. “Views,” which hide certain information, are known from the area of databases but are hard to realize over an intranet (or the Web).

The aim of the Semantic Web is to allow much more advanced knowledge management systems:

- Knowledge will be organized in conceptual spaces according to its meaning.
- Automated tools will support maintenance by checking for inconsistencies and extracting new knowledge.
- Keyword-based search will be replaced by query answering: requested knowledge will be retrieved, extracted, and presented in a human friendly way.
- Query answering over several documents will be supported.
- Defining who may view certain parts of information (even parts of documents) will be possible.[10]

**Business-to-Consumer Electronic Commerce**

Business-to-consumer (B2C) electronic commerce is the predominant commercial experience of Web users. A typical scenario involves a user’s visiting one or several online shops, browsing their offers, selecting and ordering products. Ideally, a user would collect information about prices, terms, and conditions (such as availability) of all, or at least all major, online shops and then proceed to select the best offer. But manual browsing is too time-consuming to be conducted on this scale. Typically a user will visit one or a very few online stores before making a decision.

To alleviate this situation, tools for shopping around on the Web are available in the form of shop bots, software agents that visit several shops, extract product and price information, and compile a market overview. Their functionality is provided by wrappers, programs that extract information from
an online store. One wrapper per store must be developed. This approach suffers from several drawbacks. The information is extracted from the online store site through keyword search and other means of textual analysis. This process makes use of assumptions about the proximity of certain pieces of information (for example, the price is indicated by the word *price* followed by the symbol $ followed by a positive number). This heuristic approach is error-prone; it is not always guaranteed to work. Because of these difficulties only limited information is extracted. For example, shipping expenses, delivery times, restrictions on the destination country, level of security, and privacy policies are typically not extracted. But all these factors may be significant for the user’s decision making. In addition, programming wrappers is time-consuming, and changes in the online store outfit require costly reprogramming.

The Semantic Web will allow the development of software agents that can *interpret* the product information and the terms of service:

- Pricing and product information will be extracted correctly, and delivery and privacy policies will be interpreted and compared to the user requirements.
- Additional information about the reputation of online shops will be retrieved from other sources, for example, independent rating agencies or consumer bodies.
- The low-level programming of wrappers will become obsolete.
- More sophisticated shopping agents will be able to conduct automated negotiations, on the buyer’s behalf, with shop agents.[10]

**Wikis**

Currently, the use of the WWW is expanded by tools that enable the active participation of Web users. Some consider this development revolutionary and have given it a name: Web 2.0. Part of this direction involves *wikis*, collections of Web pages that allow users to add content (usually structured text and hypertext links) via a browser interface. Wiki systems allow for collaborative knowledge creation because they give users almost complete freedom to add and change information without ownership of content, access restrictions, or rigid workflows.

Wiki systems are used for a variety of purposes, including the following:

- Development of bodies of knowledge in a community effort, with contributions from a wide range of users. The best-known result is the general purpose Wikipedia.
- Knowledge management of an activity or a project. Examples are brainstorming and exchanging ideas, coordinating activities, and exchanging records of meetings.

While it is still early to talk about drawbacks and limitations of this technology, wiki systems can definitely benefit from the use of semantic technologies. The main idea is to make the inherent structure of a wiki, given by the linking between pages, accessible to machines beyond mere
navigation. This can be done by enriching structured text and untyped hyperlinks with semantic annotations referring to an underlying model of the knowledge captured by the wiki. [10].

4.4 Semantic Web Technologies

"Semantic Web" is mainly used to describe the model and technologies proposed by the W3C. These technologies are greatly used in creating E-learning CMS by semantic web. These include-

- Resource Description Framework (RDF),
- RDF Schema (RDFS),
- Web Ontology Language (OWL),
- Uniform Resource Identifier (URI),
- XML, and SPARQL

The structure of those technologies is given below

![Semantic Web Technologies Diagram](image)

Figure 4.2: Semantic Web Technologies

Figure 4.2 shows the “layer cake” of the Semantic Web (due to Tim Berners-Lee), which describes the main layers of the Semantic Web design and vision which describes the main layers of the Semantic Web design and vision.

4.4.1 URI and Unicode

**Uniform resource identifier (URI)** is the main component of the basic layer and it is used to identify a resource e.g. web page, country etc. URL and URN are the subset of URI. Uniform Resource
Locator (URL) identifies resources through the representation of primary access mechanism. Universal resource name (URN) has to be globally unique.[15]

![Fig 4.3: URI schema](image)

Here this diagram of URI scheme categories. Schemes in the URL (locator) and URN (name) categories form subsets of URI, and also (generally) disjoint sets. Technically URL and URN function as resource IDs; however, one cannot exactly categorize many schemes as one or the other: we can treat all URIs as names, and some schemes embody aspects of both categories.[13]

**Unicode** provides a unique number for every character,
- no matter what the platform,
- no matter what the program,
- no matter what the language.

Unicode provides an international standard to encode the text. XML, Java and some operating systems have used Unicode as fundamental scheme to represent text.[12]

### 4.4.2 XML

At the bottom we find Extensible Markup Language (XML), a language that lets one write structured Web documents with a user-defined vocabulary. XML is particularly suitable for sending documents across the Web. It is a set of rules for encoding documents in machine-readable form. It is defined in the XML 1.0. Specification produced by the W3C, and several other related specifications, all gratis open standards. XML’s design goals emphasize simplicity, generality, and usability over the Internet. It is a textual data format with strong support via Unicode for the languages of the world. Although the design of XML focuses on documents, it is widely used for the representation of arbitrary data structures, for example in web services.

An XML document consists of three parts: an XML declaration, a DTD or XML Schema, and an XML instance (XML document data). An XML declaration and schemas are not mandatory for an XML document. An XML declaration specifies the version and the encoding of XML being used. A DTD or XML Schema is a schema that constrains the structure of XML instances, and corresponds to an extended context-free grammar. An XML instance is a tagged document. An XML instance is a hierarchy of elements, the boundaries of which are either delimited by start-tags and end-tags, or, for
empty elements, by empty element tags. Character data between start-tags and end-tags are the content of the element. Figure 4.5 shows an example of an XML instance. A start-tag is the token that encloses an element type with < and >, and an end-tag is the token that encloses an element type with </ and >. Elements can nest properly within each other, and the nesting represents logical structure. Within start-tags, attribute names and attribute values can be specified. [16]

**Example of HTML:**

```html
<H1> Knowledge Management</H1>
<UL>
  <LI>Manager: Md.Nabil
  <LI> Project: E-learning CMS </UL>
```

Fig 4.4: Example of HTML

**Example of XML:**

```xml
<research-topic>
    <title>Semantic Web</title>
    <manager>Md.Nabil</manager>
    <project>E-learning CMS</project>
</research-topic>
```

Fig 4.5: Example of XML

### 4.4.2 RDF

**RDF** is a basic data model, like the entity-relationship model, for writing simple statements about Web objects (resources). The RDF data model does not rely on XML, but RDF has an XML-based syntax. Therefore, in figure 4.2 it is located on top of the XML layer.

The RDF (Resource Description Framework) is a language for describing information and resources on the web. It creates relationships between documents. Putting information into RDF files, makes it possible for computer programs to search, discover, pick up, collect, analyze and process information from the web. It is a framework to represent data about data (metadata), and a model for representing data about "things on the Web" (resources). It comprises a set of triples (O, A, V) that may be used to describe any possible relationship existing between the data –

- Subject,
- Predicate and
- Object
RDF “Statements” consist of
Resources(=nodes) = subject
Which have properties = predicate
Which have values(= nodes, strings) = object

Fig 4.6: RDF elements

Regardless of the representation syntax, RDF models use traditional knowledge representation techniques order to provide better semantic interoperability (traditionally, O-A-V triplets are natural semantic units for representing a domain). Still, an RDF model just provides a domain-neutral mechanism to describe metadata, but does not define the semantics of any application domain. Figure 4.6 shows that each statement is essentially a relation between an object (a resource), an attribute (a property), and a value (a resource or free text).

4.4.3 RDF Schema

RDF Schema provides modeling primitives for organizing Web objects into hierarchies. Key primitives are classes and properties, subclass and sub property relationships, and domain and range restrictions. RDF Schema is based on RDF.

RDF Schema (RDFS) defines the vocabulary of an RDF model. It provides a mechanism to define 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). An RDFS can be specified using RDF encoding [16]. The example of RDF schema is given below:

```
http://qu.edu.qp/ #anonymous_resource1
#anonymous_resource1

created byname
Phone

#anonymous_resource1
"QU Web dev."
"4851238"

<rdf:Class rdf:ID="book"><rdfs:subClassOf rdf:resource="#publication"/></rdf:Class>
</rdfs:subClassOf>
</rdfs:subClassOf>
</rdfs:Class>

A SIMPLE RDF MODEL

Fig 4.7: a) A simple RDF model , b)An example of RDF schema code[17]
4.4.4 Ontology

RDF Schema can be viewed as a primitive language for writing ontologies. But there is a need for more powerful ontology languages that expand RDF Schema and allow the representations of more complex relationships between Web objects.

**OWL = Web Ontology Language**

OWL is based on Description Logics knowledge representation formalism. OWL adds more vocabulary for describing properties and classes among others and relations between classes. [18]

It describes the function and relationship of each of these components of the semantic web:

- XML
- XML schema
- RDF
- RDF Schema
- OWL
- SPARQL

An ontology comprises a set of knowledge terms, including the vocabulary, the semantic interconnections, and some simple rules of inference and logic for some particular topic [20]. Ontologies applied to the Web are creating the Semantic Web [21]. Ontologies provide the necessary armature around which knowledge bases should be built [22], and set grounds for developing reusable Web-contents, Web services, and applications [23]. Ontologies facilitate knowledge sharing and reuse, i.e. a common understanding of various contents that reaches across people and applications.

Technically, an ontology is a text-based piece of reference-knowledge, put somewhere on the Web for agents to consult it when necessary, and represented using the syntax of an ontology representation language. There are several such languages around for representing ontologies. It is important to understand that most of them are built on top of XML and RDF. Figure 4.8 shows a piece of a simple ontology developed using the OWL language.

In practice, ontologies are often developed using integrated, graphical, ontology-authoring tools, such as Protégé-2000, OILed, and OntoEdit [24]. They are used to develop new ontologies and modify existing ones. They let the author edit and develop ontologies concentrating on the domain's concepts and relationships, without worrying much about ontology-representation languages. The author can choose ontologies from a list, choose attributes and relations from another list, edit, add, remove, and merge ontologies. The output is usually produced in a specific high-level ontology-representation language such as OWL, RDF/RDFS, HTML, or in plain text.[16].
4.4.5 Logic Layer

The *Logic* layer is used to enhance the ontology language further and to allow the writing of application-specific declarative knowledge. It is part of the Semantic Web is not fully developed yet. Its implementation will allow the user to state any logical principles and permit the computer to infer new knowledge by applying these principles to the existing data. Since there are many different inference systems on the Web that are not completely interoperable, the vision is to develop a universal logic language for representing proofs – systems will then be able to export these proofs into the Semantic Web.[10]

4.4.6 Proof Layer

The *Proof layer* involves the actual deductive process as well as the representation of proofs in Web languages (from lower levels) and proof validation.[10]

4.4.7 Trust Layer

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. Sometimes “Web of Trust” is used to indicate that trust will be organized in the same distributed and chaotic way as the WWW itself. Being located at the top of the pyramid, trust is a high-level and crucial concept: the Web will only achieve its full potential when users have trust in its operations (security) and in the quality of information provided[10]. The figure of proof and trust layer with example is given in figure 4.9:
This classical layer stack is currently being debated. Figure 4.10 shows an alternative layer stack that takes recent developments into account. The main differences, compared to the stack in figure 4.9, are the following:

- The ontology layer is instantiated with two alternatives: the current standard Web ontology language, OWL, and a rule-based language. Thus an alternative stream in the development of the Semantic Web appears.
- DLP is the intersection of OWL and Horn logic, and serves as a common foundation.[10]
The Semantic Web architecture is currently being debated and may be subject to refinements and modifications in the future.

4.5 Summary

In this chapter we include about the basic concept of semantic web, its technologies and differences between World Wide Web and Semantic Web with different examples. These technologies of Semantic web help and use to implement this thesis. Without those technologies it is not possible to implement E-learning Content Management system using Semantic web.
5.1 Related works

F. P. Rokou *et al.* distinguished three basic levels in every Web-based application: the Web character of the program, the pedagogical background, and the personalized management of the learning material [31]. They defined a Web-based program as an information system that contains a Web server, a network, HTTP, and a browser in which data supplied by users act on the system’s status and cause changes. The pedagogical background means the educational model that is used in combination with pedagogical goals set by the instructor. The personalized management of the learning materials means the set of rules and mechanisms that are used to select learning materials based on the student’s characteristics, the educational objectives, the teaching model, and the available media.

Many works have combined and integrated these three factors in e-learning systems, leading to several standardization projects. Some projects have focused on determining the standard architecture and format for learning environments, such as IEEE Learning Technology Systems Architecture (LTSC), Instructional Management Systems (IMS), and Sharable Content Object Reference Model (SCORM). IMS and SCORM define and deliver XML-based interoperable specifications for exchanging and sequencing learning contents, i.e., learning objects, among many heterogeneous e-learning systems. They mainly focus on the standardization of learning and teaching methods as well as on the modeling of how the systems manage interoperating educational data relevant to the educational process [32].

IMS and SCORM have announced their content packaging model and sequencing model, respectively. The key technologies behind these models are the content package, activity tree, learning activities, sequencing rules, and navigation model. Their sequencing models define a method for representing the intended behavior of an authored learning experience, and their navigation models describe how the learner- and system-initiated navigation events can be triggered and processed. Juan Quemada and Bernd Simon have also presented a model for educational activities and educational materials [33]. Their model for educational activities denotes educational events that identify the instructor(s) involved and take place in a virtual meeting according to a specific schedule. F. P. Rokou *et al.* described the introduction of stereotypes to the pedagogical design of educational systems and
appropriate modifications of the existing package diagrams of UML (Unified Modeling Language) [33].

The IMS and SCORM models describe well the educational activities and system implementation, but not the educational contents knowledge in educational activities.

Juan Quemada’s and F. P. Rokou’s models add more pedagogical background by emphasizing educational contents and sequences using the taxonomy of learning resources and stereotypes of teaching models. But the educational contents and their sequencing in these models are dependent on the system and lack standardization and reusability. Thus, we believe that if an educational contents frame of learning resources can be introduced into an e-learning system, including ontology-based properties and hierarchical semantic associations, then this e-learning system will have the capabilities of providing adaptable and intelligent learning to learners.

The hierarchical contents structure is able to show the entire educational contents, the available sequence of learning, and the structure of the educational concepts, such as the related super- or sub-concepts in the learning contents. Furthermore, some of semantic relationships among the educational contents, such as ‘equivalent’, ‘inverse’, ‘similar’, ‘aggregate’ and ‘classified’, can provide important and useful information for the intelligent e-learning system.

Stojanovic et al. [37] describe an e-learning scenario based on the Semantic Web, in particular concentrating on ontologies for e-learning objects. This group is associated with the Learning Lab Lower Saxony, which itself is a partner in the Wallenberg Learning Network.

Naeve et al. [36] describe an e-learning framework, again based on the Semantic Web, that discusses Semantic Web techniques and peer-to-peer services for the search, retrieval, publication, replication and mapping of metadata. This group is part of a consortium comprising Swedish and German universities developing a P2P network for the exchange of educational resources.

Fayed Ghaleb, Sameh Daoud, Ahmad Hasna, Jihad M. ALJa’am, Samir A. El-Seoud, and Hosam El-Sofany[16] proposed Semantic Web-Based model for our e-learning system. They presented an approach for developing a Semantic Web-based e-learning system, which focus on the RDF data model and OWL ontology language. They had demonstrated the effectiveness of this approach through several experiments using different type of courses taught in Qatar University. The facilities that the application will provide include allowing e-learning content to be created, annotated, shared and discussed, together with supplying resources such as lecture notes, course description, documents,
announcements, student papers, useful URL links, exercises and quizzes for evaluation of the student knowledge. Their proposed model and Ontology’s snapshot are-

In their model, they did not specify any conceptualization of a specific domain in terms of concepts, attributes, and relationships. They did not create any vocabulary or namespace for university using ontology that is very necessary to identify any university semantically. They created this ontology based model only for Qatar University.

For this purpose, ontology is introduced in our model. We also create a namespace “univ” to identify any university from around the world that is based on our proposed model. It can play a crucial role in enabling the representation, processing, sharing and reuse of knowledge among applications in modern Web-based e-learning systems because it specifies the conceptualization of a specific domain in terms of concepts, attributes, and relationships.

Moreover, the number of ontology-centered researches has increased dramatically because popular ontological languages are based on Web technology standards, such as XML and RDF(S), so as to
share and reuse it in any Web-based knowledge system [34, 35]. Thus, we have devised a model that provides the contents structure using an ontology for a adaptive and intelligent e-learning system.

5.2 Summary

In this chapter we include some related works that were done by different researchers and they presented various proposed model for their country’s university’s perspective. By finding their limitations in their work, those works help us to create our model of E-learning management system using Semantic web and the namespace to implement our thesis.
6.1 General concept

The E-Learning Management Systems (E-LMSs) are much more successful in Web-enhanced education (related to a number of users). E-LMSs are integrated systems that support a number of teachers’ and students’ needs. LMSs provide a teacher to compose their courses from newly created and existed learning contents. These objects are modeled and described by standard structure and metadata. This means that learning contents would be reused in many courses and for different purposes. The standardization means that learning contents could be found on the different locations on the Web, and semantically can be connected in the number educational structures in the same time [28].

The LMS general architecture shown in figure-6.1 consists of three basic parts:

i) Administration,
ii) Instructor/teacher and
iii) Learner/student.

*The administrative tools* support the realization of different management tasks. For example: maintenance of student and teacher records, administration of the domain knowledge and the system security protection.

*The Instructor tools* of the system help teachers to create learning contents, combine them with existing learning contents and compose the courses. A teacher is responsible for entering students’ data and giving the system students’ profiles (by creating a specific student model). The *Instructor* package provides the monitoring of student results that *Instructors* can use to track student sessions with an ILMS.

*The student tools* generally help students to master the knowledge. The system enables a student to declare his interests, favorites, predisposition and real skills. These data help the system to initiate a student model and determine a student stereotype. While the student uses the system, different tools provide her/him navigation through the learning space, marks for important things, contextual help and skills measurement.
The student can also collaborate with other students, teachers and experts. This is a way that an ILMS provides high cohesion and synergy of efforts from all the subjects in the learning process [27].

6.2 Why choose Semantic web for our proposed E-LMS?

A new web generation, the Semantic web have a promising technique for improving the semantics interoperability for e-learning components. Most of the Semantic web domain ontology is to receive a formal conceptualization of a single domain. The new-generation web, the Semantic web has the best
capabilities for composition and reuse of materials and contexts of e-learning. The Semantic web provides an opportunity to improve the metadata connected with e-learning materials and also expansion of the existing opportunities for e-learning stipulations[30]. Again it becomes possible to use concepts of the Semantic Web integration process in the adaptive composing of learning materials. Different specialized pedagogical knowledge becomes accessible for all interested systems over the Semantic Web. Note also that current LMSs like Blackboard CourseInfo or WebCT cannot be easily made intelligent educational systems not only because they lack ontological support [29]. They also lack intelligent learner modeling, reasoning and adaptivity, although they do provide presentation and management of learning material and scenarios, as well as database management and administration of learners.

6.3 Proposed Model

In this paper we proposed an Ontology based E Learning Management System where basic tools administration, Instructor, Learner are interrelated through Learning Resource (RDF) and Ontology-based Contextual Knowledge (OWL). Where each tools contains several elements that are given in the figure-6.2. This model is designed with six subsection that are marked(1,2,3,.6) in our Proposed ontology based E-LMS model in fig-6.3.
Elements of Proposed ontology based E Learning Management System

Learner/Student
- Registration
- Notification
- Student Profile
- Course Document
- Announcement
- Initial Tutorial
- Exercise/Quizzes
- Useful Links
- Student Paper
- Collaboration Tools
- Help & Discussion
- Course Navigation
- Semantic Search

Instructor/Teacher
- Confirmation tools
- Monitor Student Performance
- Publish Document
- Student Model Designer
- Course Designer
- Learning Content Designer
- Make Announcement
- Control Submit Paper
- Compose Question
- Assessment
- Manage Links
- Annotation Tools

Administrator
- Student Management Tool
- Teacher Management Tool
- Security Management
- Course Management
- Ontology Management

Elements of Proposed ontology based E Learning
In the following subsections, based on the Semantic Web technology we describe our **Proposed ontology based LMS model** illustrated in Figure-6.3.
6.4 Registration and Confirmation

To illustrate the overall procedure, we will go through an e-learning scenario. A student first search for an online course: the broker handles the request and returns a set of choices satisfying the query. If no course is found, the user can register with a notification service. Otherwise, the user may find a suitable course among the offerings and then makes a final decision about registering for the course. Processing the registration can be seen as a complex service involving registering with the system, creating a confirmation notification, creating a student account (authentication/authorization), and providing learning materials. Here the figure 6.4 shows a model.

Fig 6.4: Registration Model

that represents how to register with our proposed LMS. Firstly a registration request is sent to the Instructor and instructor forward the request to the confirmation tools to check the validity of the learner. Then accept or reject message according to the result of confirmation tools is sent to the notification tools. If confirmation tool accept the learner request then student management tools under the Administrator parts doing the following things:

i) Create a student profile, that is the learner get his/her learning resources after log in.
ii) Save the Records to the database for further use.

6.5 Course document distribution

LMSs are high-distributed systems over the Web. One course presents an integrated structure of many learning resources that can be hosted on different Web locations. The same resources can be combined with others in different courses. Also, more student groups can learn many courses at the
same time. When Instructor finds new student under his specific course, he sends queries to the learning resources to search for learning content that is appropriate for the learner entity component. The ontological knowledge is added to the learning resources as a resource for contextual learning, and it may be searched by means of queries.

![Fig 6.5 Course Document Model](image)

Here in figure-6.5 shows a course document model where publish document sequencing the query related course document by using a knowledge base of learning resources. To implement the knowledge base, first of all, the leaning resources have to be described by means of metadata. The metadata consists of the contextual knowledge of the learning resources. Then after completing all this procedure learning contents are delivered to the course document section of Learner entity.

### 6.6 Annotation

In our proposed LMS model, annotations might include the context in which the document is placed, links toward other similar objects, the relationship to other documents (some learning contents might be prerequisites for access to others), rating (which will be updated with other users’ ratings), etc. Importantly, however, the Learner will also be able to add his own, further annotations to personalize and enrich the learning material and Instructor may also include some annotation on that particular contents.
Fig 6.6: Annotation Model

Moreover, these annotations are not necessarily collected in one document – they may be dispersed throughout the Web. Here in the figure-6.6 when further annotation is added with the learning content it also automatically converted this additional information to the RDF statements and add this new statements to the existing RDF statements repository for further use. RDF specifications provide XML syntax for writing down and exchanging RDF statements (called RDF/XML), the repository is implemented as a set of RDF/XML files. However, the RDF/XML syntax is quite complex and developing an RDF parser is not a trivial task. Motivated by the need for an RDF parser and automatic conversion is done by using the Jena API, rap API, etc and among this API which one is chosen is described in implementation chapter.

6.7 Assessment:

Main purpose of Assessment tools is to evaluate the performance of learners. Instructor provides exercises, quizzes or exam question towards learner for evaluation. Learner submits answer script to the assessment tools. Student may also submit papers on various topics to the control submit paper tools. Here in the figure 6.7 after evaluating the script and paper the assessment tools sends result the Monitor student performance tools. Then finally the result is stored on the database and one copy is
sent to the announcement tools for learner. In LMS, every moment the teacher can monitor his students’ result.

**Fig 6.7: Assessment Model**

6.8 Useful Links and Tutorials:

As our system is web based thus instructor may update information like useful links (displays a list of useful URL links that have been identified by the course instructors), interactive tutorial (about any course topics). All this job is performed by the manage Link & and other document tool. He can modify the learning contents during the students learning. Here in the figure 6.8 shows one of the most important tools of our model is update information. As most of the contents will initially be provided by the instructor in the form of links to small learning objects. All of these links will be annotated with RDF statements that will provide a description about the document/URL linked.
In case new links or documents the *update information* tools does the followings:

1) When new link are added by the instructor then all related course document will be updated according to the link document.

2) Especially when learners read some contents and instructor add or update link or information related to that contents then the lesson will update automatically without the request of learner.

This *update information* is not a part of Learner or Instructor, it is autonomous tools and how these tools execute its functions are described in implementation chapter.

### 6.9 Help and Discussion

This tools mainly deals with learners help by means of search, navigate or discussion. Here in figure-6.9 *semantic search* is used for finding contents with learner interest about any topics. *Course navigator* is used mainly for navigate through the all courses with its contents and related information. Both *semantic search* and *Course navigator* retrieve result to the learner by applying query on learning resources (RDF) and Ontology Based knowledge (OWL).
In the given figure through collaboration tools the learners can also collaborate with other learners and teachers. This communication is mainly Synchronous or Asynchronous. When two or more learners or instructors are logged on, they can directly communicate with each other is Synchronous communication. But communication like e-mail to instructor is Asynchronous communication. There is also a predefined given time when Instructors are in online for synchronous communication with their respective Learners.

6.10 Summary

In this chapter we include our proposed model of E-learning management system using Semantic web technologies. There are five subdivide parts that are used in E-learning management system. To implement this thesis semantic web is the main platform. We hope that this proposed model will help us to implement our thesis easily and this model will also help for E-learning in any learning institutions.
Chapter 7

About domain and name space

7.1 Domains:

An ontology is a formal representation of knowledge as a set of concepts within a domain, and the relationships between those concepts. [38]

Now this leads to the concept of domains. The domain of discourse, also called the universe of discourse (or simply universe), is the set of entities over which certain variables of interest in some formal treatment may range. The domain of discourse is usually identified in the preliminaries, so that there is no need in the further treatment to specify each time the range of the relevant variables. [39]

Another good definition is "A class containing all the entities referred to in a discourse or an argument. Also called universe." [42]

For example, in an interpretation of first-order logic, the domain of discourse is the set of individuals that the quantifiers range over. In one interpretation, the domain of discourse could be the set of real numbers; in another interpretation, it could be the set of natural numbers. If no domain of discourse has been identified, a proposition such as \( \forall x \ (x^2 \neq 2) \) is ambiguous. If the domain of discourse is the set of real numbers, the proposition is false, with \( x = \sqrt{2} \) as counterexample; if the domain is the set of naturals, the proposition is true, since 2 is not the square of any natural number. [39]

In the concept of ontology, A domain ontology (or domain-specific ontology) models a specific domain, which represents part of the world. Particular meanings of terms applied to that domain are provided by domain ontology. For example the word card has many different meanings. An ontology about the domain of poker would model the "playing card" meaning of the word, while an ontology about the domain of computer hardware would model the "punched card" and "video card" meanings.

Another concept is the upper ontology. An upper ontology (or foundation ontology) is a model of the common objects that are generally applicable across a wide range of domain ontologies. It employs a core glossary that contains, the terms, and associated object descriptions, as they are used in various,
relevant domain sets. There are several standardized upper ontologies available for use, including Dublin Core, GFO, OpenCyc/ResearchCyc, SUMO, and DOLCE. WordNet, while considered an upper ontology by some, is not strictly an ontology. However, it has been employed as a linguistic tool for learning domain ontologies. [38]

7.2 Namespace:

The attribute namespace provides the namespace of an ontology or similar vocabulary. It is encoded as a simple URL. As an additional service, [40]

Essentially, a namespace is a collection of terms that multiple people agree to share, and furthermore, they agree on specific meanings for those terms. The Web, as it turns out, provides a powerful way of sharing namespaces: we can plant them on websites and anyone who wants to use those terms knows where to find them, along with their meanings.

The Web, as it turns out, provides a powerful way of sharing namespaces: we can plant them on websites and anyone who wants to use those terms knows where to find them, along with their meanings.

One of the first namespaces to explode on the Web is called the Dublin Core. (Sorry, but the name refers not to the Dublin in Ireland, but to the Dublin in Ohio, where a group of people met to establish this namespace.) It is a collection of terms that can be used to describe resources that can be found on the Web, or in paper libraries, or in any other place where we store information. These terms include Contributor, Date, Publisher, Subject, and many more.[43]

A vary popular namespace is FOAF. FOAF (from “friend of a friend”) is an RDF based schema to describe persons and their social network in a semantic way. FOAF could get used within many wikis for annotating user pages, or describing articles about people. In Semantic MediaWiki, FOAF annotations can be used as imported vocabulary. [41]
The "univ" Namespace

With the concept of name space we have gathered in previous chapters, and towards the goal of making an e-learning management system in semantic web, we now will create a name space called the univ name space.

The semantic web is a web of data. A person or a program can be represented by either FOAF or BBC ontology. So we thought to make a name space that will able to provide the information about university in semantic web.

We defines the univ name space as-

"The name space and supported ontologies to visualize and supports the information of an university in semantic web"

Throughout the next chapters, we will develop the name space, test and validate it, and will discuss what we can do next with it.

Proposed Ontology for Univ namespace:

The following ontology is used for our proposed univ namespace. Here University is base class and it contains eight sub class are shown in figure.
8.1 Description Of proposed Univ Ontology:

Here relationship among several classes and objects are shown in figure. Figure-8.2 shows that a people may be student ,teacher or stuff by indicating arrows from people to those class. Inversely every student ,teacher or stuff must be a people are indicated by arrow towards People. The Research class also directed to people as researcher is a people.
Figure 8.2 Relationship among Student, Teacher, Stuff and People Classes

Figure 8.3 Relationship among Research, Courses, Program and School Classes

Figure 8.3 shows that the Research, course, Program classes belong to the school class and inversely related to each other. In figure-8.4 objects of People and Student class are shown. Here assume that people1 is student1 and researcher1 is people1 that’s why they belongs to a same people. In figure-8.5 the basic relationship among student, teacher, stuff and people objects are shown. Here assume that people1 is student1, people2 is student2, people3 is student3, people4 is teacher1, people5 is stuff1.
Figure 8.4 Relationship among People, Research and Student objects.

Figure 8.5: Relationship among Student, Teacher, Stuff and People Objects
Univ namespace specification

To Relationship among Student, Teacher, Stuff and People Objects implement the Univ namespace by using the above ontology we use the following classes and properties.

Classes:

University, Courses, People, Programs, Research, School, Student, Stuff, Teacher

Properties:

i) Object Properties:

courseProgram, hasElement, isElementOf, schoolHaselement, isElementOfSchool, researchAuthor.

ii) Data Properties:

programDetails, schoolDetails, researchDetails, peopleDetails, courseDetails, name, address, city, country, about.

Description of Classes:

Class: Univ#University

University - A university
Status: Stable.
Has Subclass: Courses, People, Programs, Research, School, Student, Stuff, Teacher
Properties Include: name, address, city, country, about.

The University Class contains a collection of subclasses that represents a university system in ontological structure. For simplification only name properties are shown. For example, here is a fragment of a University class:

<owl:Class rdf:about="http://www.pstu.ac.bd/ontology/univ#University">
  <rdfs:subClassOf>
    <owl:Restriction>
      <owl:onProperty rdf:resource="http://www.pstu.ac.bd/ontology/univ#name"/>
      <owl:someValuesFrom rdf:resource="&xsd;string"/>
    </owl:Restriction>
  </rdfs:subClassOf>
</owl:Class>

Class: Univ#Programs

Courses – A collection of program (Like B. Sc. Engg (CSE, ECE)).
Status: partially stable
Has Subclasses: Program 1
Properties Include: hasprogram, programMustHave, courseProgram, programDetails.
Subclasses of: University

The Programs class contains a collection of degree that a university provide.
For example, here is a fragment of the Programs class:

```xml
<owl:Class rdf:about="http://www.pstu.ac.bd/ontology/univ#Programs">
  <rdfs:subClassOf rdf:resource="http://www.pstu.ac.bd/ontology/univ#University"/>
  <owl:Restriction>
    <owl:onProperty rdf:resource="http://www.pstu.ac.bd/ontology/univ#prName"/>
    <owl:someValuesFrom rdf:resource="&xsd;string"/>
  </owl:Restriction>
</owl:Class>
```

Class: Univ#Courses

Courses – A collection of courses.
Status: partially stable
Has Subclasses: Course1
Properties Include: hasCourses, coursesMustHave, courseProgram, courseDetails.
Subclasses of: University

The Courses class contains a collection of courses under each Program of a university.

Class: Univ#School

School – A collection of faculties.
Status: stable
Has Subclasses: school1
Properties Include: schoolHasElement, isElementOfSchool, schoolDetails.
Subclasses of: University

The Courses class basically deals with the Courses, Research, Program class. For example, here is a fragment of the School class:

```xml
<owl:Class rdf:about="http://www.pstu.ac.bd/ontology/univ#School">
  <rdfs:subClassOf rdf:resource="http://www.pstu.ac.bd/ontology/univ#University"/>
  <owl:Restriction>
    <owl:onProperty rdf:resource="http://www.pstu.ac.bd/ontology/univ#sName"/>
    <owl:someValuesFrom rdf:resource="&xsd;string"/>
  </owl:Restriction>
</owl:Class>
```

Class: Univ#Research

Research – research document.
Status: stable
Has Subclasses: research1
Properties Include: hasResearch, researchMustHave, researchDetails, researchAuthor
Subclasses of: University
The **Research** class basically deals with the various researches under several schools and also connected with the People class via researchAuthor property.

**Class: Univ# People**

People – overwall peoples of university.
- **Status:** stable
- **Has Subclasses:** people1, people2, people3, people4, people5
- **Properties Include:** hasElement, peopleDetails.
- **Subclasses of:** University

The **People** class basically deals with Student, Teacher, Stuff classes. It mainly contains all of the peoples those are connected with the University. For example, here is a fragment of the **People** class:

```xml
<owl:Class rdf:about="http://www.pstu.ac.bd/ontology/univ#People">
  <rdfs:subClassOf rdf:resource="http://www.pstu.ac.bd/ontology/univ#University"/>
  <rdfs:subClassOf>
    <owl:Restriction>
      <owl:onProperty rdf:resource="http://www.pstu.ac.bd/ontology/univ#pName"/>
      <owl:someValuesFrom rdf:resource="&xsd;string"/>
    </owl:Restriction>
    <rdfs:subClassOf>
      <owl:Restriction>
        <owl:onProperty rdf:resource="http://www.pstu.ac.bd/ontology/univ#pAddress"/>
        <owl:someValuesFrom rdf:resource="&xsd;string"/>
      </owl:Restriction>
      </owl:Restriction>
    </rdfs:subClassOf>
  </owl:Restriction>
</owl:Class>
```

**Class: Univ# Student**

Student – student entity.
- **Status:** stable
- **Has Subclasses:** student1, student2, student3.
- **Properties Include:** isElementOf,
- **Subclasses of:** University

The **Student** class is mainly connected with the People class.

**Class: Univ# Teacher**

Teacher – teacher entity.
- **Status:** stable
- **Has Subclasses:** teacher1,
- **Properties Include:** isElementOf,
- **Subclasses of:** University

The **Teacher** class is mainly connected with the People class.

**Class: Univ# Stuff**

Stuff – stuff entity.
- **Status:** stable
The Stuff class is mainly connected with the People class.

**Description of Properties:**

**Property: univ# coursesMustHave**

- **Status:** stable
- **Domain:** Courses
- **Range:** School
- **Inverse Of:** hasCourses
- **SubProperty Of:** isElementOfSchool

The property coursesMustHave refers that each course is under a specific school class. For example, here is a fragment of the coursesMustHave property:

```
<owl:ObjectProperty
rdf:about="http://www.pstu.ac.bd/ontology/univ#coursesMustHave">
<rdfs:domain rdf:resource="http://www.pstu.ac.bd/ontology/univ#Courses"/>
<rdfs:range rdf:resource="http://www.pstu.ac.bd/ontology/univ#School"/>
<owl:inverseOf rdf:resource="http://www.pstu.ac.bd/ontology/univ#hasCourses"/>
<owl:subPropertyOf
rdf:resource="http://www.pstu.ac.bd/ontology/univ#isElementOfSchool"/>
</owl:ObjectProperty>
```

**Property: univ# hasCourses**

- **Status:** stable
- **Domain:** School
- **Range:** Courses
- **Inverse Of:** coursesMustHave
- **SubProperty Of:** schoolHasElement

The property hasCourses refers that every school must have some specific courses. For example, here is a fragment of the hasCourses property:

```
<owl:ObjectProperty rdf:about="http://www.pstu.ac.bd/ontology/univ#hasCourses">
<rdfs:range rdf:resource="http://www.pstu.ac.bd/ontology/univ#Courses"/>
<rdfs:domain rdf:resource="http://www.pstu.ac.bd/ontology/univ#School"/>
<owl:inverseOf rdf:resource="http://www.pstu.ac.bd/ontology/univ#coursesMustHave"/>
<owl:subPropertyOf
rdf:resource="http://www.pstu.ac.bd/ontology/univ#schoolHasElement"/>
</owl:ObjectProperty>
```
The rest of the properties that are given above are also specified like the similar procedure. To implement the relation among several classes through the properties we also used the following Individuals.

**Individuals:**
About_course1, About_people1, About_People2, About_people3, About_people4, 
About_people5, About_program1, About_research1, About_school1, About_student1, About_student2, 
About_student3, About_stuff1, About_teacher1.
Testing the univ Namespace

As we already discuss the namespace in semantic web and define the univ namespace, the namespace for defining an university , next we are going to testing the namespace.

For testing , we will use the W3C RDF Validation Service [44] This RDF validation service is based on Another RDF Parser (ARP). It currently uses version 2-alpha-1. ARP was created and is maintained by Jeremy Carroll at HP-Labs in Bristol.

This means that the service now supports the Last Call Working Draft specifications issued by the RDF Core Working Group, including datatypes. It no longer supports deprecated elements and attributes of the standard RDF Model and Syntax Specification and will issue warnings or errors when encountering them. See RDF Issue Tracking for more information. The service does not do any RDF Schema Specification validation.

This W3C service was created by Nokia's Art Barstow (a former W3C Team member). The internationalization was done by Martin Dürst. It was previously maintained by Emmanuel Pietriga (another former W3C Team member), who also implemented the IsaViz plug-in. It is currently maintained jointly by Eric Prud'hommeaux (eric@w3.org), Ryan Lee (ryanlee@w3.org) and Ted Guild (ted@w3.org). [45]

First, we have to develop an rdf file. That must include our univ namespace. We test the namespace in localhost. The following link we gave-

\[<\text{xmlns:univ="http://localhost/ontology/univ.owl"}\\>

However, the true link will be,

\[<\text{xmlns:univ="http://www.pstu.ac.bd/ontology/univ.owl"}\\>

We will consider our university (Patuakhali Science and Technology University) should be represented in web 3.0 by the namespace. However, we are not going to visualize the full university but some portion of it. Here is the detail we are going to use:-
resource=http://www.pstu.ac.bd
name= Patuakhali Science and Technology University
address= Dumki, Patuakhali
city= Patuakhali
country=Bangladesh
about= The host University for univ namespace

**Programs:**
resource=http://www.pstu.ac.bd/faculties/cse.html
prName=Bsc in CSE
prClass=undergraduate

**Research:**
resource=http://www.pstu.ac.bd/ontology/univ
Publisher= resource:http://www.pstu.ac.bd
rTitle=The univ Namespace
rYear=2011
people=resource:http://faysalahmed.wordpress.org

**School:**
resource=http://www.pstu.ac.bd/faculties/cse.html
sName=Faculty of CSE
sLocation="http://www.pstu.ac.bd"

**Course:**
resource=http://www.pstu.ac.bd/faculties/cse.html
cName=Computer Fundamentals
cCode=CSE101
cSemester=1st
resource=http://www.pstu.ac.bd/faculties/cse.html
cName=Programming
cCode=CSE102
cSemester=1st

**People:**
resource=http://faysalahmed.wordpress.com
pName=Faysal Ahmed
pAddress= 180/6/23/B East Rampura
pCountry=Bangladesh
pDesignation=student
pCity=Dhaka
We write the following rdf file for testing purpose which have the above definitions.

```xml
<?xml version="1.0"?>
<!--

Demo file for univ namespace -->
<!-- Faysal Ahmed-->
<!--the header -->
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:univ="http://localhost/ontology/univ.owl#">
<!-- the university--> 
<rdf:Description
rdf:about="http://www.pstu.ac.bd">
 <univ:name>Patuakhali Science and Technology University </univ:name>
 <univ:address>Dumki, Patuakhali</univ:address>
 <univ:city>Patuakhali</univ:city>
 <univ:country>Bangladesh</univ:country>
 <univ:about>The host university for "univ" namespace</univ:about>
</rdf:Description>
<!-- Courses--> 
<rdf:Description
rdf:about="http://www.pstu.ac.bd/faculties/cse.html">
 <univ:cName>Computer Fundamentals</univ:cName>
 <univ:cCode>CSE101</univ:cCode>
 <univ:cSemester>1st</univ:cSemester>
 <univ:university rdf:resource="http://www.pstu.ac.bd"/>
</rdf:Description>
<rdf:Description
rdf:about="http://www.pstu.ac.bd/faculties/cse.html">
 <univ:cName>Programming</univ:cName>
 <univ:cCode>CSE102</univ:cCode>
 <univ:cSemester>1st</univ:cSemester>
 <univ:university rdf:resource="http://www.pstu.ac.bd"/>
</rdf:Description>
<!-- People--> 
```

<rdf:Description rdf:about="http://faysalahmed.wordpress.com">
  <univ:pName>Faysal Ahmed</univ:pName>
  <univ:pAddress>180/6/23/B East Rampura</univ:pAddress>
  <univ:pCountry>Bangladesh</univ:pCountry>
  <univ:pDesignation>Student</univ:pDesignation>
  <univ:pCity>Dhaka</univ:pCity>
  <univ:university rdf:resource="http://www.pstu.ac.bd"/>
</rdf:Description>

<!-- programs -->

<rdf:Description rdf:about="http://www.pstu.ac.bd/faculties/cse.html">
  <univ:university rdf:resource="http://www.pstu.ac.bd"/>
  <univ:prName>BSc in Engg. (CSE)</univ:prName>
  <univ:prClass>Undergraduate</univ:prClass>
</rdf:Description>

<rdf:Description rdf:about="http://www.pstu.ac.bd/ontology/univ">
  <univ:Publisher rdf:resource="http://www.pstu.ac.bd"/>
  <univ:rTitle>The univ Namespace</univ:rTitle>
  <univ:rYear>2011</univ:rYear>
  <univ:people rdf:resource="http://faysalahmed.wordpress.com"/>
</rdf:Description>

<rdf:Description rdf:about="http://www.pstu.ac.bd/faculties/cse.html">
  <univ:university rdf:resource="http://www.pstu.ac.bd"/>
  <univ:sName>Faculty of CSE</univ:sName>
  <univ:sLocation rdf:resource="http://www.pstu.ac bd"/>
</rdf:Description>

</rdf:RDF>

We, as stated before, tested the rdf in the validator and find accurate result. The results are given in the Result and Discussion chapter.
After validating the rdf file discussed in previous chapter, we found the following triples:

<table>
<thead>
<tr>
<th>Number</th>
<th>Subject</th>
<th>Predicate</th>
<th>Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><a href="http://www.pstu.ac.bd">http://www.pstu.ac.bd</a></td>
<td><a href="http://localhost/ontology/univ.ow">http://localhost/ontology/univ.ow</a></td>
<td>&quot;Patuakhali Science and Technology University&quot;</td>
</tr>
<tr>
<td>2</td>
<td><a href="http://www.pstu.ac.bd">http://www.pstu.ac.bd</a></td>
<td><a href="http://localhost/ontology/univ.ow">http://localhost/ontology/univ.ow</a></td>
<td>&quot;Dumki, Patuakhali&quot;</td>
</tr>
<tr>
<td>3</td>
<td><a href="http://www.pstu.ac.bd">http://www.pstu.ac.bd</a></td>
<td><a href="http://localhost/ontology/univ.ow">http://localhost/ontology/univ.ow</a></td>
<td>&quot;Patuakhali&quot;</td>
</tr>
<tr>
<td>4</td>
<td><a href="http://www.pstu.ac.bd">http://www.pstu.ac.bd</a></td>
<td><a href="http://localhost/ontology/univ.ow">http://localhost/ontology/univ.ow</a></td>
<td>&quot;Bangladesh&quot;</td>
</tr>
<tr>
<td>5</td>
<td><a href="http://www.pstu.ac.bd">http://www.pstu.ac.bd</a></td>
<td><a href="http://localhost/ontology/univ.ow">http://localhost/ontology/univ.ow</a></td>
<td>&quot;The host university for &quot;univ&quot; namespace&quot;</td>
</tr>
<tr>
<td>7</td>
<td><a href="http://www.pstu.ac.bd/faculties/cse.html">http://www.pstu.ac.bd/faculties/cse.html</a></td>
<td><a href="http://localhost/ontology/univ.ow">http://localhost/ontology/univ.ow</a></td>
<td>&quot;CSE101&quot;</td>
</tr>
<tr>
<td>8</td>
<td><a href="http://www.pstu.ac.bd/faculties/cse.html">http://www.pstu.ac.bd/faculties/cse.html</a></td>
<td><a href="http://localhost/ontology/univ.ow">http://localhost/ontology/univ.ow</a></td>
<td>&quot;1st&quot;</td>
</tr>
<tr>
<td>11</td>
<td><a href="http://www.pstu.ac.bd/faculties/cse.html">http://www.pstu.ac.bd/faculties/cse.html</a></td>
<td><a href="http://localhost/ontology/univ.ow">http://localhost/ontology/univ.ow</a></td>
<td>&quot;CSE102&quot;</td>
</tr>
<tr>
<td>12</td>
<td><a href="http://www.pstu.ac.bd/faculties/cse.html">http://www.pstu.ac.bd/faculties/cse.html</a></td>
<td><a href="http://localhost/ontology/univ.ow">http://localhost/ontology/univ.ow</a></td>
<td>&quot;1st&quot;</td>
</tr>
<tr>
<td></td>
<td>ress.com</td>
<td>l#pName</td>
<td>&quot;180/6/23/B East Rampura&quot;</td>
</tr>
<tr>
<td>---</td>
<td>-------------------</td>
<td>-----------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>15</td>
<td><a href="http://faysalahmed.wordpress.com">http://faysalahmed.wordpress.com</a></td>
<td><a href="http://localhost/ontology/univ.owl">http://localhost/ontology/univ.owl</a> l#pAddress</td>
<td>&quot;Bangladesh&quot;</td>
</tr>
<tr>
<td>17</td>
<td><a href="http://faysalahmed.wordpress.com">http://faysalahmed.wordpress.com</a></td>
<td><a href="http://localhost/ontology/univ.owl">http://localhost/ontology/univ.owl</a> l#pDesignation</td>
<td>&quot;Dhaka&quot;</td>
</tr>
<tr>
<td>18</td>
<td><a href="http://faysalahmed.wordpress.com">http://faysalahmed.wordpress.com</a></td>
<td><a href="http://localhost/ontology/univ.owl">http://localhost/ontology/univ.owl</a> l#pCity</td>
<td>&quot;Student&quot;</td>
</tr>
<tr>
<td>21</td>
<td><a href="http://www.pstu.ac.bd/faculties/cse.html">http://www.pstu.ac.bd/faculties/cse.html</a></td>
<td><a href="http://localhost/ontology/univ.owl">http://localhost/ontology/univ.owl</a> l#prName</td>
<td>&quot;BSc in Engg. (CSE)&quot;</td>
</tr>
<tr>
<td>22</td>
<td><a href="http://www.pstu.ac.bd/faculties/cse.html">http://www.pstu.ac.bd/faculties/cse.html</a></td>
<td><a href="http://localhost/ontology/univ.owl">http://localhost/ontology/univ.owl</a> l#prClass</td>
<td>&quot;Undergraduate&quot;</td>
</tr>
<tr>
<td>24</td>
<td><a href="http://www.pstu.ac.bd/ontology/univ">http://www.pstu.ac.bd/ontology/univ</a></td>
<td><a href="http://localhost/ontology/univ.owl">http://localhost/ontology/univ.owl</a> l#rTitle</td>
<td>&quot;The univ Namespace&quot;</td>
</tr>
<tr>
<td>25</td>
<td><a href="http://www.pstu.ac.bd/ontology/univ">http://www.pstu.ac.bd/ontology/univ</a></td>
<td><a href="http://localhost/ontology/univ.owl">http://localhost/ontology/univ.owl</a> l#rYear</td>
<td>&quot;2011&quot;</td>
</tr>
<tr>
<td>28</td>
<td><a href="http://www.pstu.ac.bd/faculties/cse.html">http://www.pstu.ac.bd/faculties/cse.html</a></td>
<td><a href="http://localhost/ontology/univ.owl">http://localhost/ontology/univ.owl</a> l#sName</td>
<td>&quot;Faculty of CSE&quot;</td>
</tr>
</tbody>
</table>
Fig 10.1: The graph of the tested rdf file by rdf validator
Here, we are actually representing a very small representation of the Patuakhali Science and Technology University, a very fictional one. However it shows the possibility of the full visualization of this university as well as any university by the constraints of the given univ namespace.

But it is also true that we are seeing a possibility of merging this rdf to the linked data by proper statements.
**Future Works**

We have developed the univ name space, which is able to visualize an university to the web of the future, known as web 3.0, or the semantic web. However it is unstable one. Stability of this name space will be the next task.

This name space can be used to develop any web 3.0 application. However, it is not tested yet. We have also to test it for a custom application.

The stability is a future task, as well as we have to make a standard name space that can be used by most of the universities around the world. For this, we have to convert it an universal framework, we may say it an universal university name space.

Many more possibility this framework has, and it can produce a lot of opportunity.
Conclusions

The main contribution of this thesis is proposing a new model and creating a universal namespace “univ” for E-learning Management system using Semantic web, using the Semantic Web technology in any universities. This model including various services and tools in the context of a semantic portal, such as: course registration, uploading course documents and student assignments, interactive tutorial, announcements, useful links, assessment, simple semantic search and the namespace is used to visualize and supports the information of a university in semantic web.

In our thesis there are two primary advantages; one is that the proposed model, which contains a hierarchical contents structure and semantic relationships between concepts, can provide related useful information for searching and sequencing learning resources in web-based e-learning systems and Second is creating namespace to represent an university on semantic web. We hope that this proposed model and this namespace will be very beneficial than other proposed model that we got from other research papers. It can help a developer or an instructor to develop a learning sequence plan by helping the instructor understand the why and how of the learning process. This proposed model and this namespace on universities will help to create E-learning management system using semantic web in any learning institutions.
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