University Ontology for Choice Based Credit System

Jasmin Sirja Mital Kapadia Jyoti Pareek Maitri Jhaveri

Abstract

The classical web is based on HTML which cannot be exploited by information retrieval techniques. Processing of information on web is mostly restricted to manual keyword searches which results in irrelevant information retrieval. This limitation can be overcome by a web architecture known as semantic web which is an intelligent and meaningful web proposed by Sir Tim Berner's Lee. In his roadmap for semantic web, Ontology plays a pivotal role in information exchange, use and re-use of knowledge, shared and common understanding of a domain that can be communicated between people and across application systems. Ontology can be used to capture knowledge about any domain of interest with the objective of incorporating the machine-understandable data on the current human-readable web. In this document, we consider the education domain and demonstrate the development of a University Ontology using Protégé 4.2 Editor. Mysore University, Mysore, India has been taken as a case for the Ontology Development. This university has implemented Choice Based Credit System (CBCS).Various aspects like super class and sub class hierarchy and relations among them have been demonstrated. Sample execution of DL query and SPARQL query has been shown as a proof of concept.

Keywords: Semantic Web, Ontology, Protege, Intelligent Web, CBCS, DL Query, SPARQL

1. Introduction

1.1 Semantic Web

The vision of semantic web is-"the idea of having data on the Web defined and linked in a way that it can be used by machines not just for display purposes, but for automation, integration and reuse of data across various applications"[9]. Semantic Web is an extension to the current World Wide Web, not a complete replacement of the current standards. It brings a number of new tools and technologies to model, annotate, search and integrate data. Currently, the World Wide Web consists of documents written in HTML. This makes the web readable for humans, but since HTML has limited ability to classify the blocks of text apart from the roles they play, the Web in its current form is very hard to understand. The purpose of the Semantic Web is to add a layer of descriptive technologies to web pages so they become readable. This layer includes various technologies like Unicode and URI, XML, Resource Description Framework, RDF Schema, Ontology, etc.

1. 2 Ontology as a Part of Semantic Web

Ontology is formal and explicit specification of a shared conceptualization. 'Conceptualization' refers to an abstract model of phenomena in the world by having identified the relevant concepts of those phenomena.

'Explicit' means that the type of concepts used, and the constraints on their use are explicitly defined. 'Formal' refers to the fact that the ontology should be machine readable. 'Shared' reflects that ontology should capture consensual knowledge accepted by the communities. Ontology is a key factor for enabling interoperability in the semantic web. Ontology has been set out to overcome the problem of implicit and hidden knowledge by making the conceptualization of a domain explicit.Figure-1 shows how ontology fits into semantic web.

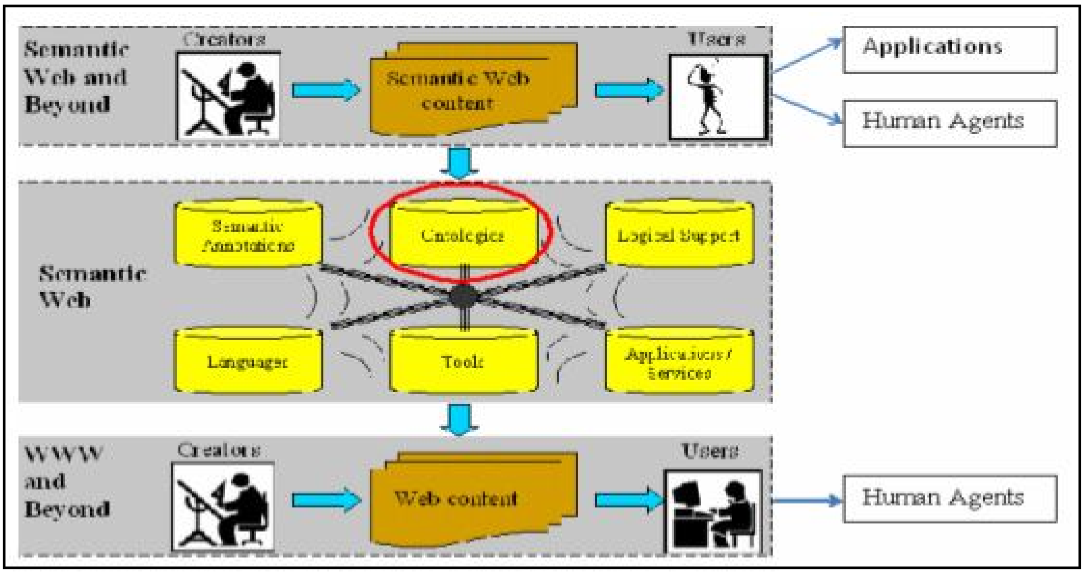

Figure 1: Semantic Web and use of Ontologies [9].

1.3 Protégé as Ontology Development Tool

A number of ontology editors are available for developing an ontology, e.g. Protégé, SWOOP, OntoEdit, Altova Semantic Works, OntoStudio, and hence forth. Figure-2 shows that according to survey conducted by Jorge Cardoso [5] Protégé is most widely used tool by researchers, professionals, programmers and others alike. Protégé is a free, open-source platform that provides a growing user community with a suite of tools to construct domain models and knowledge-based applications with ontologies. At its core, Protégé implements a rich set of knowledge-modeling structures and actions that support the creation, visualization, and manipulation of ontologies in various representation formats. Protégé can be customized to provide domain-friendly support for creating knowledge models and entering data. Further, Protégé can be extended by way of a plug-in architecture and Application Programming Interface (API) for building knowledge-based tools and applications [10].

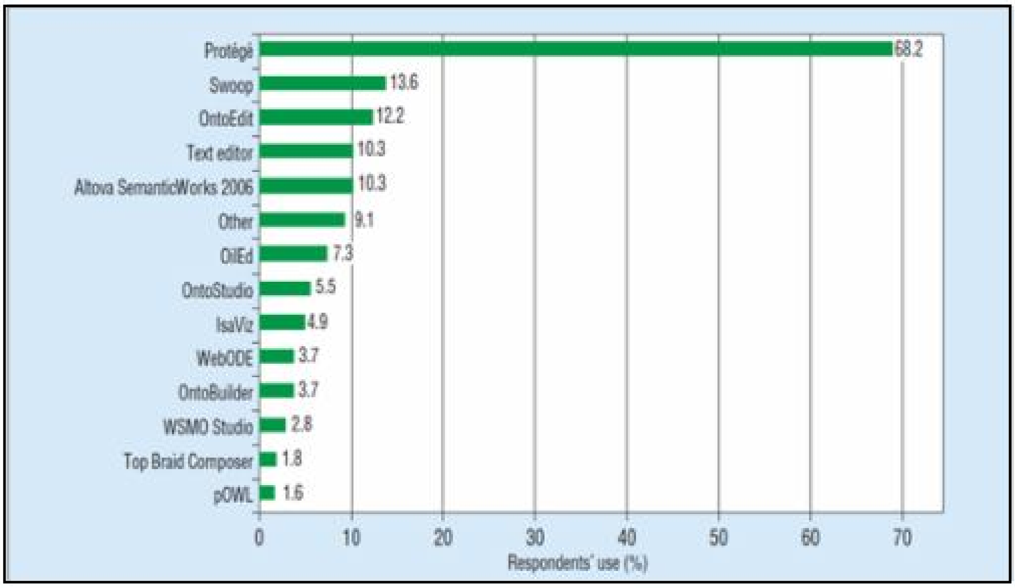

Figure 2: Ontology Editors used by Respondents (Researcher, Professional, Programmer, etc.) Domains 10].

1.4 Choice Based Credit System for University

Choice Based Credit System is a proven, advanced mode of learning in higher education which facilitates a student to have some freedom in selecting his/her own choices in the curriculum for completing any Degree program. It is more focused towards a student's choice in providing a wide range of modules available in a single campus across various disciplines offered by experts in the subjects. It leads to quality education and with active teacher-student participation. In this system, three types of courses like hardcore, soft-core and elective courses are included [8]. Hard core papers are compulsory and fundamental in requirement for a subject of study. These papers cannot be substituted by any other papers. Soft-core papers are slightly advanced papers. Every department of the University will furnish a detailed list of need-based soft core papers and students can choose one/two or many of them depending upon the course structure [8]. The soft core paper provides enough scope for advanced learning in a subject within or outside the department. Elective papers are the concept papers and offered by each department. These papers are general in nature and students have the freedom to choose any of them [8].

2. Related Work

Sanjay Malik, et al. [1] has developed ontology which included university employee details like name, address, date of joining, designation, etc. in his ontology; but student relation with the year, teacher and subject has not been included. Ling Zeng, et al. [13] represents course-based design for the purpose of teaching but does not contain other administrative details of a university. Naveen Malviya, et al. [2] has included detailed course mapping but does not cover all the aspects of a Choice Based Credit System (CBCS).

Ontology based on Choice Based Credit System (CBCS) covers administrative part of university and courses details like which specialization it belongs to and how many degrees associated to it and names of such degrees. It helps to facilitate students in the selection of suitable course considering their area of interest, past performance and time availability.

3. Ontology for Choice Based Credit System

We have developed ontology for a university which fulfills very specific details and aspects of any Choice Based Credit System (CBCS). Our ontology includes - University information like - affiliated institutes, departments; Course details like - Degree names, Degree specializations, Degree types, Degree duration, Pre-requisites, Completion requirements, Credit details, subjects; Student details like - Personal Information, Area of Interest, Result record, Attendance record, Preferences, Time availability, Fees affordability, Goals of study, Personal qualities, Academic record; Staff Details like - Personal details, Academic record, Research.

3.1 Obtain Domain Knowledge

We identified number of competency questions that we use to decide the scope of the ontology. Examples of such questions are-

a) Which course should I opt for?

b) How much time it requires?

c) How much financial support it requires?

d) Is it related to my area of interest?

e) Does it have good employability?

f) Can I do it part-time?

g) Can I do from distance learning?

h) What are the degrees offered in this area?

i) What are the specializations offered in this area?

j) What all documents are required to present at the time of registration?

k) What are the prerequisites for this course?

l) What are the completion requirements for this course?

m) Which subjects should I choose?

n) Subjects should be chosen in which sequence?

o) What is the level of difficulty?

p) And many more such questions might occur.

These questions should be answered according to students' age, time availability, financial status, area of interest, past performance, required number of credits to be achieved, career preferences.

We conducted a survey both online[11] and offline so that we can have preliminary data to start with. As and when required there can be additions or modifications. This makes our ontology flexible enough to adapt to another university which follows Choice Based Credit System. Participants were requested to answer 15 multiple-choice questions which we identified to decide the scope of our ontology. Out of 15 questions 11 contained an option of "Other" to be specified. The electronic survey was carried out by sending survey link to participants of various age groups and from various domains and industries. Our offline survey was conducted in an educational campus of L. J. Group of Institutes and targeted students were of various courses like Management, Pharmacy, Engineering, Commerce, etc.

3.2 Identification of Key Concepts

After analyzing the data we received from our survey we could derive basic classes and properties which we needed to incorporate in our ontology. These concepts have been used in step3 of our ontology building process which is "Build the Taxonomy".

3.3 Build the Taxonomy

As per the key concepts which we have derived after obtaining the domain knowledge from the survey we have built the class hierarchy by creating the classes and their respective subclasses in protégé. Figure 3 shows the basic class hierarchy in protégé.

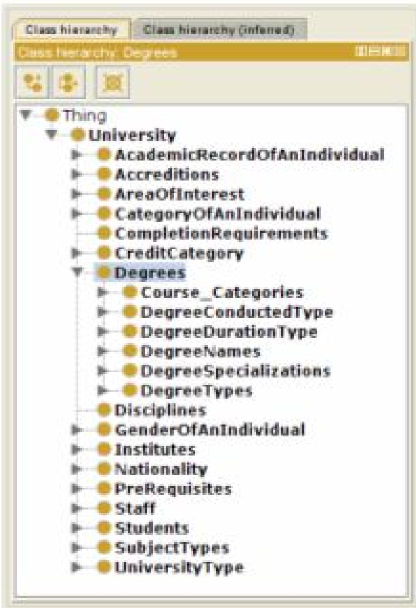

Figure 3: Class hierarchy created in protégé using domain knowledge gained from our online survey.

3.4 Identify Relationships between Classes

Figure 4: Displays the relationship between Course Categories, Degree Names and Degree Specializations.

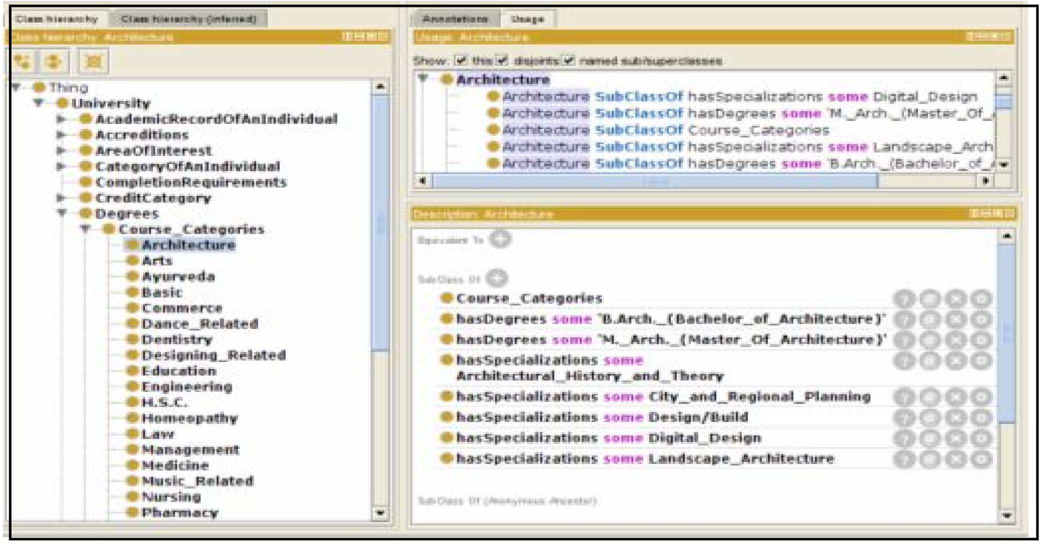

Figure 4: Sample relationships between various classes of ontology in protégé.

4. Experiments Conducted

4. 1 Querying the Ontology Using DL Query

Figure-5 shows sample DL Query executed to list all the degree names which belong to Course category- "Architecture" and the output matches the relations shown in Figure-4. We used the plug-in for DL Query which comes along with protégé for the demonstration purpose.

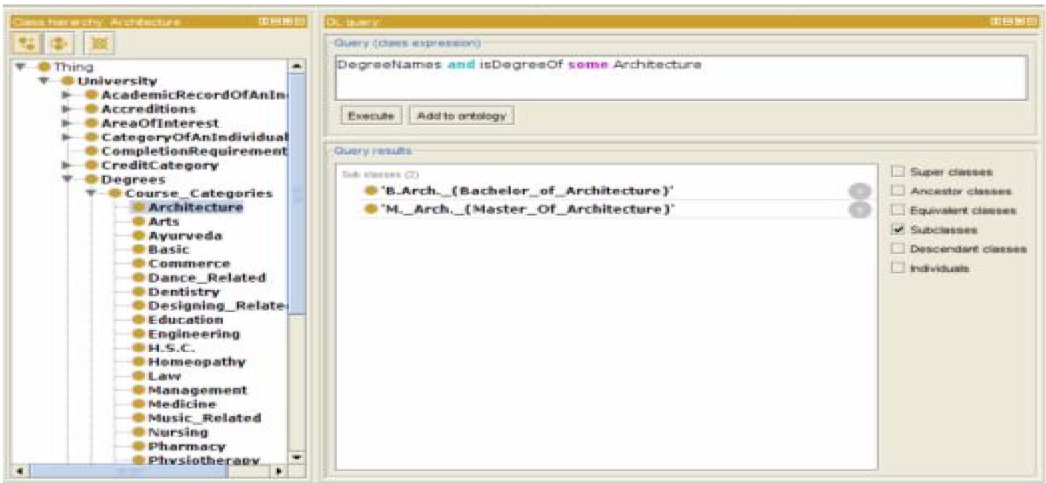

Figure-5.Execution of sample DL Query on CBCS Ontology in Protégé.

4.2 Sample Usage Using .Net Framework and SPARQL Query

We have demonstrated queries on individuals (objects of an ontology) using .Net as a frontend and our ontology acting as a back-end. We used SemWeb API [12] for integrating .Net with our ontology. C#.Net language has been used for this purpose.

The SPARQL query which we have used for demonstration is shown in Table-1. The output is shown in Figure-6.

```
SELECT ?Institute ?University WHERE { ?Institute cbcs:isInstituteOf ?University . }
```

Table1: Sample SPARQL query to list institutes of all the universities

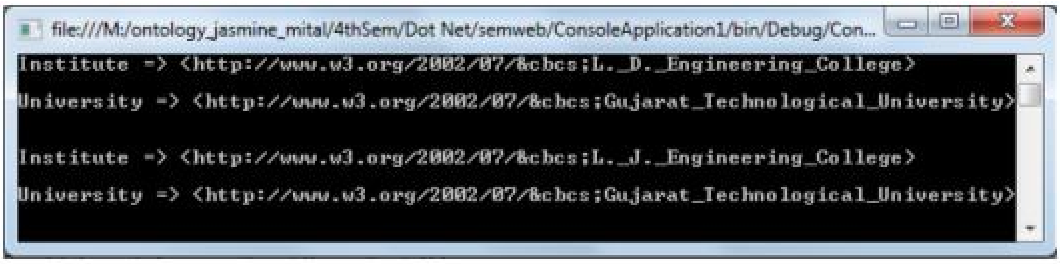

Figure 6: Execution of SPARQL Query using SemWeb API using .Net Framework

5. Conclusion and Future Work

This paper describes University ontology for the Choice Based Credit System (CBCS). We described the ontology development process and sample relationship between various classes of ontology. We demonstrated the sample usage with the help of DL Query and its implementation in .NET framework along with SPARQL. Our future work will be to use this ontology to model knowledge base for a course recommendation system for any university which is based on Choice Based Credit System (CBCS) pattern.

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About Authors

Ms. Jasmin Sirja, PG Research Scholar, Dept. of Computer Science, Rollwala Computer Centre, Gujarat University, Ahmedabad.
E-mail: jhajasmine@gmail.com

Ms. Mital Kapadia, PG Research Scholar, Dept. of Computer Science, Rollwala Computer Centre, Gujarat University, Ahmedabad.
E-mail: kapadiamital@gmail.com

Dr. Jyoti Pareek, Associate Professor, Dept. of Computer Science, Rollwala Computer Centre, Gujarat University, Ahmedabad.
E-mail: drjyotipareek@yahoo.com

Ms. Maitri Jhaveri, Assistant Professor- G. L. S. Institute of Computer Technology (M.C.A.), Ahmedabad.
E-mail: jmaitri@gls.ict.org