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Semantic Web in Program Management

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Abstract
In an academic setting, information administration systems are typically fragmented, distributed among multiple departments, and designed to accommodate autonomous searches. This initiative aims to investigate the integration of these separate systems in order to support
The integrated platform is used to conduct intelligent queries. In order to provide a value-added semantic layer where annotation, querying, and reasoning may be done to satisfy management requirements, a framework is proposed that enriches data in the legacy systems. The creation of this framework is explored along with a case study of a typical engineering program to demonstrate how program stack holders might leverage semantic web technologies for improved academic program management. The comparative work presents applications that have been investigated in relation to the semanticweb.

Keywords
Semantic Web, Web Technology, Integrated Academic Systems

I. INTRODUCTION

Unlike Content Management Systems (CMS) that provide educational services, such as Virtual Learning Environments (VLEs), course repositories, library archives, online examinations, online coursework submission, etc., the learning process management systems use Web-based technology to plan, implement, and assess a specific learning process. This technology allows the employee/student to take learning into their own hands while either staying current in their specific field or branch out and learning new skills. On the other hand, Academic Information and Management Systems (AIMS)are mostly used in academic environment to support information, finance, logistics, human resource and student services. Both types of systems create huge databases containing interrelated data. Generally, the academic and content management systems work in isolation (mostly maintained by different departments) and in many cases, not even designed to interact with each other at later stages. The growth of an academic system is measured through its evolution. Typically, the stake holders include students, faculty, administration, local industry and professional bodies etc. In absence of collaborative subsystems, the decision making in a distributed system would require tiring analysis of extensive data resulting in evolving rate that may not keep up to local industry needs. The yield from an academic system relies heavily on timely collection of data from stake holders and decision making based on faculty-administration nexus. With reference to engineering education, this slows down the local and international accreditation efforts. Ontology is a formal representation of a set of concepts within a domain and the relationships between those concepts. It is used to reason about the properties of that domain, and may be used to define the domain. In order to coordinate different semantic web activities, an educational ontology may be explicitly defined to share a contextual conceptualization of the educational domain, which can be then used to annotate lecture resources, program specifications, modules, assessments, etc. This allows the users to make their resources more machine processable by collaboratively constructing an enriched layer of the semantic web that links educational artefacts with formal semantics to support other semantic activities such as semantic query, aggregation and reasoning [9]. As semantic web opens up the data for reuse of learning resources within a domain (for example in an engineering college), the relations amongst data related to various college departments become clearer and thus rationale may easily be developed to initiate possible joint/multidisciplinary programs or identify common weaknesses within college departments.

II. RELATED WORK

In an academic environment, the main outcomes of semantic web technologies are considered as information gathering, collaborative teaching and learning activities, such as team building, content creation and formation of well-formed metadata for content. One of the implementation examples discussed in enables students to access and search over a number of pre-selected and semantically matched to curriculum online resources that include books, multimedia and resources from encyclopaedias. These resources may be clustered as per students' age group and automatically 'pushed' to students whilst they work. Another example is a scheduling tool to help students at Massachusetts Institute of Technology (MIT) to plan their course subjects using a semantic data source.

This system uses well-formed metadata of the university's official course catalogue, generating time tables, course loads, and folksonomy of students rating for a particular course. The objective of the work in is to develop a prototype of a distributed network of semantically aware shared annotated services, in the form of RDF stores, resulting in a semantic layer to support a cluster of applications which will either directly support users in finding and recovering useful resources in a particular academic domain, or indirectly support students by supporting user-facing applications. The implementation example in is a web based assessment engine in addition to computing statistics that are tied directly to program outcomes for accreditation process implementation. In another effort, Ed-Scene is an effort to combine all the information and data available in an academic system in order to develop scenarios using semantic web to support different roles (such as teachers, students, quality assurance people, management, perspective employers, etc.) in an academic system

III. ACADEMIC PROGRAMME ADMINISTRATION MANAGEMENT

Generally, the integration of academic environment sub-systems is also meant for providing support to all stakeholders of an academic system for solving intelligent queries. Intelligent query is defined as searching and mining large knowledge bases which are collections of atomic facts and general rules (horn clauses), the rules should be allowed to occur in the answer for a query. The following are some of the example engineering education scenarios that are being addressed in this research:

a) The department wishes to allocate a course, for which no straight matching to any lecturer is available. A layer can be developed to identify near matching of skills of lecturers to teach a course. Similarly, database of teaching load can be attached to check the loading of the teachers.

b) A group of students have completed core courses and are in final year for elective/specialization courses. The department wishes to know the size of students per each elective course with a requirement of grading point average (GPA) of 3.0 and above in design and simulations

c) The department is interested in comparing two groups for strengths and skills in engineering design. Each group graduated recently from a different engineering program.

d) The college is interested in comparing performance of its students in science and mathematics in order to select a group of students to send it to a science exhibition. The students belong to various departments of the college.

IV. THE SEMANTIC WEB FRAMEWORK

In order to enrich underlying data layer with well-defined meaning, a machine processable semantics layer can be provided using semantic web technology. In this section, techniques used in Protégé [16] are used to simulate various semantic web management activities such as ontology management, semantic annotation and semantic query of annotation triples. The ontology management, semantic annotation and semantic query of annotation triples are designed and exemplified to demonstrate the potential usefulness of semantic web technologies in supporting academic administration environment

It can be argued that such queries can be handled by simple database searches, if well-defined schemas are used. However, such queries will become extremely complex due to the main reason that such databases of different management systems are not designed at the planning level to define relationships between their data, hence data traversing gets complicated. Due to this fact, a set of ontologies is developed to contextualize the related data to generate semantic web framework.

A. Ontology Map and Specification

Ontologies have emerged as explicit formal specifications of the terms in the domain and relations between them. They have become common on World Wide Web and range from large taxonomies categorizing web sites to categorizations of type of relations between different objects on a same server. Many disciplines now develop standardized ontologies that domain experts can use to share and annotate information in their fields such as medicine, chemistry, biotechnology, social sciences, etc. Ontology defines a common vocabulary for web users who need to share information in a domain. It includes machine-interpretable definitions of basic concepts in the domain and relations among them. Some of the general uses of ontologies are to share common understanding of the structure of information among people or software agents, to enable reuse of domain knowledge, to make domain assumptions explicit, to separate domain knowledge from the operational knowledge and to analyse domain knowledge.

B. Semantic Annotation

The semantic annotations are defined as metadata for a particular entity and its relations. They are also used to define the process generation of such metadata. After ontologies are developed for an environment, the end users are envisaged as using the ontologies to annotate resources in the scenarios. The idea is to filter and mould the data at the input level as per our designed ontology. Annotation of resources may also be carried out using RDF, based on certain ontologies. Additional semantics could improve the search power. Adding semantics to end results (in our case generated web pages) means that it is possible to make these distinctions explicit in the content itself and search systems can ignore homonyms but find synonyms

C. Generating Semantic Annotations

University programs and corresponding courses are always tailored to a common goal. Courses that are taught in a particular program are designed in a way that their outcomes are cumulated for the academic program's common goal. This forms a natural hierarchy between program objectives and course outcomes. Similarly, the co-curricular and extra-curricular activities carried out by students also comply with the main goals of the program that the student is progressing through. The idea is to map that hierarchy and create a conceptual map that can be specified using semantic technologies. The program objectives form the key basis to develop ontologies. The program objectives and outcomes form the basis of rules that are to be matched through our defined ontologies. Similarly, these objectives and outcomes benchmark the criteria that are to be achieved by querying student records. In other words, the main context of this work is to map student achievements and scores as per University's defined objectives and outcomes set for a particular academic program

D. Reuse of the Semantic Annotations

The semantic query of annotated triples is exemplified in this section to understand use of semantic web framework. The Simple Protocol and RDF Query Language (SPARQL) [19] is now considered as the main RDF querying language for semantic web. The specification defines the syntax and semantics of the SPARQL query language for RDF. SPARQL can be used to express queries across diverse data sources, whether the data is stored natively as RDF or viewed as RDF via middleware. SPARQL contains capabilities for querying required and optional graph patterns along with their conjunctions and disjunctions. The results of SPARQL queries can be results sets or RDF graphs. SPARQL is a query language designed for querying semantic web triples. For this purpose, a part implementation of the scenario is used where an employer wishes to search profiles of graduating students for specific skills and abilities. For example, assume that the employer is looking for students with good skills in signal processing, adaptive filters, image acquisition, sampling, quantization, along with some communication and presentation skills

V. DISCUSSIONS

Like any semantic web application, challenges include manageable set of concepts and assertions, vastness, vagueness and inconsistency. Automated reasoning system will have to deal with these issues in order to deliver onto the promise of semantic web. Cost of adding new concepts and assertions is another challenge that we have to deal with. It will become tediously difficult to map new concepts and assertions along with the old one. Uncertainty is another challenge that Semantic Web applications face. For example, a student portfolio might present a set of outcomes which correspond to a number of different distinct areas of expertise, each with a different probability. Probabilistic reasoning techniques are generally employed to address uncertainty in such circumstances, which the authors feel are beyond the scope of this paper. Semantic technologies also claim of enhancing intelligence and provide meaningful information for searching and browsing. Ontology consensus has appeared to be a major issue in implementing semantic technologies. This is mostly due to different implementation procedures cross departments or cross organizations. Ontologies typically describe more structure than dictionaries e.g., in their arrangement of concepts into an is-a hierarchy (that is, into a taxonomy). They may have more precise semantics than taxonomies, e.g., by identifying attributes associated with a given concept, and possibly rules governing the values that the attributes assume. The semantic web can be compared with semi-structured data model. In semi-structured model, there is no separation between the data and the schema, and the amount of structure used depends on the purpose. Some of the advantages of this model include flexible format for data exchange between different databases, viewing structured data as semi-structured (for browsing purposes); that the schema can easily be changed; and portable data transfer format. The primary trade-off in using a semi-structured database model is that queries cannot be made as efficiently as in a more constrained structure, such as in the relational model. For unstructured or semi-structured data, a relational database management system (RDBMS) has greater difficulty, and query performance is usually unacceptable for relatively large amount of data. Typically, the records in a semi-structured database are stored with unique IDs that are referenced with pointers to their location on disk. So for doing searches over many records, it is not as efficient because it has to seek around the disk following pointers. For semi-structured databases, despite the simple syntax of the constraints, their associated implication problem is R.E. complete and finite implication problem is co-R. E complete. The view of this layer can be generalized to stake holders (say college industrial advisory board or any stake holder) of the program through Internet, assuming university is willing to provide due access of the system. This concept may also be very useful to the university, i.e., instead of acting on the query of employer, the university should catalogue its students telling the employers that they are 'fit' for x or y type of industries. But for this, a proper categorization within a country-specific industrial sector may be needed, to be mapped against the skills of the students

VI. CONCLUSIONS

The effort exercised in this work demonstrates the effective use of semantic web in a typical environment like an engineering college of a university. The implementation was exemplified by developing student profiles as student profiling has become an important aspect of any growing academic system. The demonstrated benefits in this work are reduced cyclic and tiring work, quicker decision making at needed time, etc. The implementation of semantic web approach towards academic program administration helps in program accreditation process, as queries may be set to the system to dig out useful and needed information about student achievements. It was also demonstrated that semantic web approach may be applied to any academic program administration. However, the complexity of semantic web increases once additional criteria or sub-systems are added to the integrated platform. It was discussed that top-down approach seems more natural to integrate existing data through semantic web, though it depends on academic institutions how strategy is defined. In order to improve capacity on this development, web services or web portals can be examined to include more complex functions at service level or for end users.

REFERENCES

[1]. Botev C, Chao H, et. al., Supporting Workflow in a Course Management System, Proceedings of ACM Technical Symposium on Computer Science Education, February 23–27, St. Louis, Missouri, USA, 262 - 266 (2005).

[2]. Moule P., Developing the Communities of Practice, Framework for E-learning, Electronic Journal of E-Learning, 4(2), (2006)

[3]. Mair R., Knowledge Management Systems: Information and Communication Tech for Knowledge Management, 3rd Edition, Springer Verlog, (2007).

[4]. Feng (Barry) Tao, Shakeel A. Khoja, Hugh Davis, Andy Gravell, Academic Administration and Management Scenarios on the Semantic Web, Proceedings of the 2008 Eighth IEEE International Conference on Advanced Learning Technologies, Santander, Cantabria, Spain, 149-151 (2008)

[5]. Lopez G., Technological Capabilities Indicators of the State University, New Organizational Tools for its Management Guiding and Strengthening, and Knowledge Building and Transfer, Proceedings of IEEE Engineering Management Conference, Managing Technologically Driven Organizations: The Human Side of Innovation and Change, Albany New York USA, 2-4 Nov. (2003).

[6]. Aurona Gerber, Alta van der Merwe, Andries Barnard, A Functional Semantic Web Architecture, European Semantic Web Conference, 273-287 (2008)

[7]. Bailin, SC, Berg-Cross, G, Finin, T, Panel Discussion on Ontologies, Lecture Notes on Computer Science, 2564, DOI 10.1007/b83557, Springer Berlin / Heidelberg (2003)

[8]. Peter B., Wenfei F., Scott W., Path Constraints on Semistructured and Structured Data, Proceedings of the seventeenth ACM SIGACT-SIGMOD-SIGART symposium on Principles of database systems, Seattle, 129–138 (1998)

[9]. Wikipedia, http://en.wikipedia.org/wiki/Semantic_Web