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# Learning System Development Using Ontology and Learning Objects

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***Abstract*— As learning systems are increasing day by day, it becomes necessary to manage them and the educational materials they contain. Various methods are proposed to manage the course contents, but we feel that the use of ontologies presents the most effective approach. This work aims to retrieve the learning objects of a course with the help of Domain Ontology and Learning Object Database. The Domain Ontology maps the concepts of the course and the learning object database stores the learning objects.**

***Keywords*— Ontology, Learning Objects, Learning System.**

## I. INTRODUCTION

The development of an e-learning system requires the development of various features. This work aims to implement the managing of the course materials in an e-learning course. Thus the developed system to retrieve learning objects using ontologies can be integrated into the e-learning systems to manage the materials and to enable to users to effectively retrieve the course contents. The concepts of the courses domain are extracted with the help of the keyword which is obtained from user input. The learning objects which match the user keyword from the Learning Object Database are returned as output. The learning objects which are conceptually related in the domain ontology with the keyword are also included in the final output. Our particular aim is to help learners by giving them the opportunity to interact with the core concepts in the course domain and thus becoming able to better understand and perceive knowledge regarding the field of computer science [1].

## II. DOMAIN REVIEW

### *A. Ontology:*

Ontology defines the terms used to describe and represent an area of knowledge [2]. Normally an ontology can be described as a 3-tuple:
O = (C, I, R) where,
C is a set of Classes,
I is a set of Instances,
R is a set in relations on the set of classes.

### *B. Learning Objects:*

The main idea here is to decompose the educational content into smaller chunks and construct self-contained learning units

### *C. Domain Ontology:*

Domain ontology refers to the course domain.
For the purpose of our project we have taken the domain of data structures as our course domain [3].

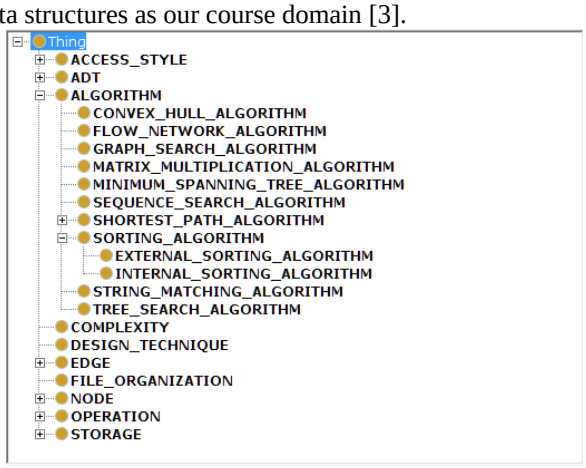


Fig 1. Example of Domain Ontology

### *D. Learning Object Database:*

The Learning Object Database stores the links of the learning objects along with the keywords associated with each link.

## III. ARCHITECTURE

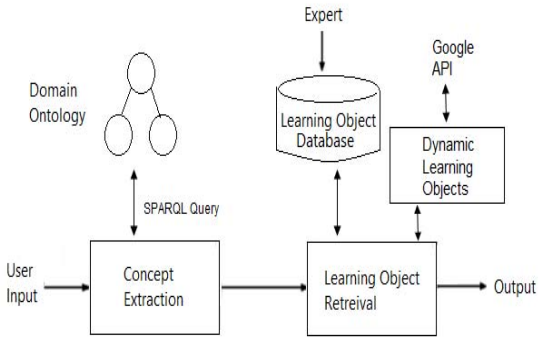


Fig 3. Proposed Architecture

The architecture has been divided into various modules and the implementation is carried out in two phases. The creation of ontology and the retrieval of domain concepts constitute the first phase. The matching of the domain concepts with the learning objects in the database constitute the next phase of the system.

### Phase I – Concept Extraction

Phase I is Concept Extraction process. It consists of Domain Ontology, User Input and Similarity algorithm. Domain Ontology consists of concepts or topics of the course. Domain Ontology is a hierarchy structure. Classes are at the top of the hierarchy. Followed by Subclasses. Instances of the class which are even called as Individuals actually contains the concepts of the course. Using the SPARQL query, individuals are retrieved. Initially User selects the keyword using dropdown list. Now the selected keyword is compared with each individual using similarity algorithms. Here similarity algorithms used are edit distance and cosine similarity. The result of similarity algorithms are numeric values. Average is taken of this numeric values. If the average is above a preset threshold then that corresponding individual is passed in next phase, else the corresponding individual is discarded.

**Example for Edit Distance algorithm is as follows:**

User Input: mergeSort
One of the Individual in Ontology: quickSort
Similar characters present in both the strings: Sort
Size of Similar characters = 4
Size of Longest String among both the strings = 9

Similarity (mergeSort, quickSort) = Size of Similar characters / Size of Longest String present among both the strings
= 4 / 9
= 0.44

**Example for Cosine Similarity algorithm is as follows:**

User Input: mergeSort
One of the Individual in Ontology: quickSort

| | m | e | r | g | s | o | t | q | u | i | c | k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| V2 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

V1.V2=1.0+2.0+2.1+1.0+1.1+1.1+1.1+0.1+0.1+0.1+ 0.1+ 0.1
= 2 + 1 + 1 + 1
V1.V2 =5
|V1| = sqrt (sq(1) + sq(2) + sq(2) + sq(1) + sq(1) + sq(1) + sq(1))
= sqrt (1 + 4 + 4 + 1 + 1 + 1 + 1)
= sqrt (13)
|V1| = 3.61
|V2|=sqrt(sq(1)+sq(1)+sq(1)+sq(1)+sq(1)+sq(1)+sq(1)+ sq(1)+ sq(1))
= sqrt (1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1)
= sqrt (9)
|V2| = 3
Similarity(mergeSort,quickSort)=V1.V2 / |V1||V2|
= 5 / 3.61 * 3
= 5 / 10.83
Similarity (mergeSort,quickSort)= 0.46

Average of Both Similarities = (0.44 + 0.46) / 2
= 0.45

Preset Threshold = 0.9
Here, Average < Preset Threshold
Therefore, The Considered Individual is discarded.

### Phase II – Learning Object Retrieval

Phase II is Learning Object Retrieval phase. This phase consists of Learning Object Database, Dynamic learning object retrieval process using Google API. The individual obtained from phase I is used to retrieve learning objects from database using sql query. If the user wants some additional learning objects then the respective individual is sent as a query to Google API using gson. The learning object retrieved from Google API are ranked according to their respective domain. And then these ranked learning objects are displayed to the user along with learning objects retrieved from database.

## IV. CONCLUSION

The purpose of this work was to propose a novel approach using ontology and learning objects that could enhance the task of designing the structure and organization of an e-learning course which could probably lead to more effective learning paths.

Here ontologies are used to represent the network of concepts and relationships between them and Lo's are used as a mean to organize the educational material into self-contained learning units, which are directly related to ontology concepts.

The above approach which uses the knowledge domain of data structures provides tutors with a clearer picture about the domain concepts and their relationships. Such organization also helps tutors to more easily discover useful and relevant educational material.

## REFERENCES

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