Semantic Web (ITA6012)

JCOMPONENT
PROJECT REPORT

SUMMER SEMESTER-2

Ontology on States of India

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ABSTRACT:

Ontologies capture the structure of the domain, i.e. conceptualization. This includes the model of the domain with possible restrictions. India is a federation of 29 states plus 7 union territories, as in territories controlled directly by the federal government. These states are all very diverse and unique culturally, politically, and demographically.

The present project has been undertaken to study various relations between the entities and classes on states of India. The Ontology on States of India includes subclasses as states and Union territories. Each subclass has its own characteristics which contains information related to it.

Ontology describes a domain and characteristics which are defined based on different IT Companies and various languages. This project will help us to showcase th e relationship between the classes with their subclasses and characteristics.

INTRODUCTION:

The term "ontology" can be defined as an explicit specification of conceptualization. Ontologies capture the structure of the domain, i.e. conceptualization. This includes the model of the domain with possible restrictions. The conceptualization describes knowledge about the domain, not about the particular state of affairs in the domain. In other words, the conceptualization is not changing, or is changing very rarely. Ontology is then specification of this conceptualization - the conceptualization is specified by using particular modeling language and particular terms. Formal specification is required in order to be able to process ontologies and operate on ontologies automatically.

Ontology describes a domain, while a knowledge base (based on an ontology) describes particular state of affairs. Each knowledge based system or agent has its own knowledge base, and only what can be expressed using an ontology can be stored and used in the knowledge base. When an agent wants to communicate to another agent, he uses the constructs from some ontology. In order to understand in communication, ontologies must be shared between agents.

India is a federation of 29 states plus 7 union territories, as in territories controlled directly by the federal government. These states are all very diverse and unique culturally, politically, and demographically. India has 22 official languages (part of the Scheduled Languages of India; languages subject to development and use), and that's not counting hundreds of minority languages or thousands of dialects whose speakers number in the millions considering India's humongous population size... actually, if seen from the viewpoint of cultural diversity, India is comparable to Europe - had it not fractured into the multitude of countries it currently has, of course.

Ontology on states of India has been undertaken to study various relations between the entities and classes on states of India. The Ontology on States of India includes subclasses as states and Union territories. Each subclass has its own characteristics which contains information related to it. Ontology describes a domain and characteristics which are defined based on different IT Companies and various languages. This project will help us to showcase the relationship between the classes with their subclasses and characteristics.

RESULTS & DISCUSSION:

I. Onto Graph:

One of the standard reasoning tasks in OWL ontologies is the generation of the backbone taxonomy underlying an ontology based on the axioms provided. This classification task is used to generate graphs in which subsumption (i.e., is-a) relations are expressed, but cannot easily be used to generate different types of edges, such as those labeled part-of, which represent axioms involving complex class descriptions. In general, these edges can also not be created syntactically; an obvious example is a general concept inclusion axiom (i.e., an axiom in which a complex class description instead of a named class appears on both sides of a subclass axiom), in which axioms involving object properties cannot clearly be associated with a single class, or the inferences resulting from the use of inverse object properties or property hierarchies. While axioms in OWL may be arbitrarily complex and may not easily be representable in a graph-based form, they may imply axioms that can naturally be expressed in the form of a graph.

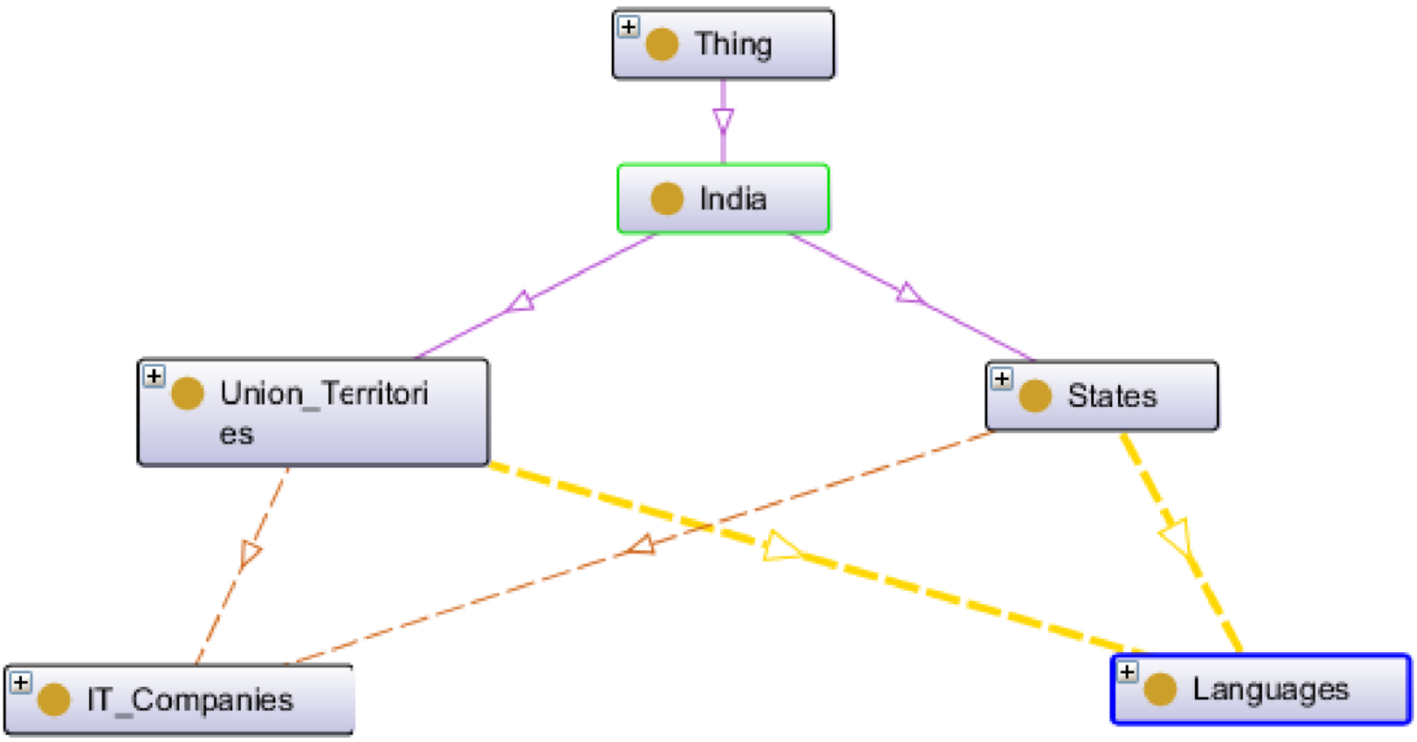
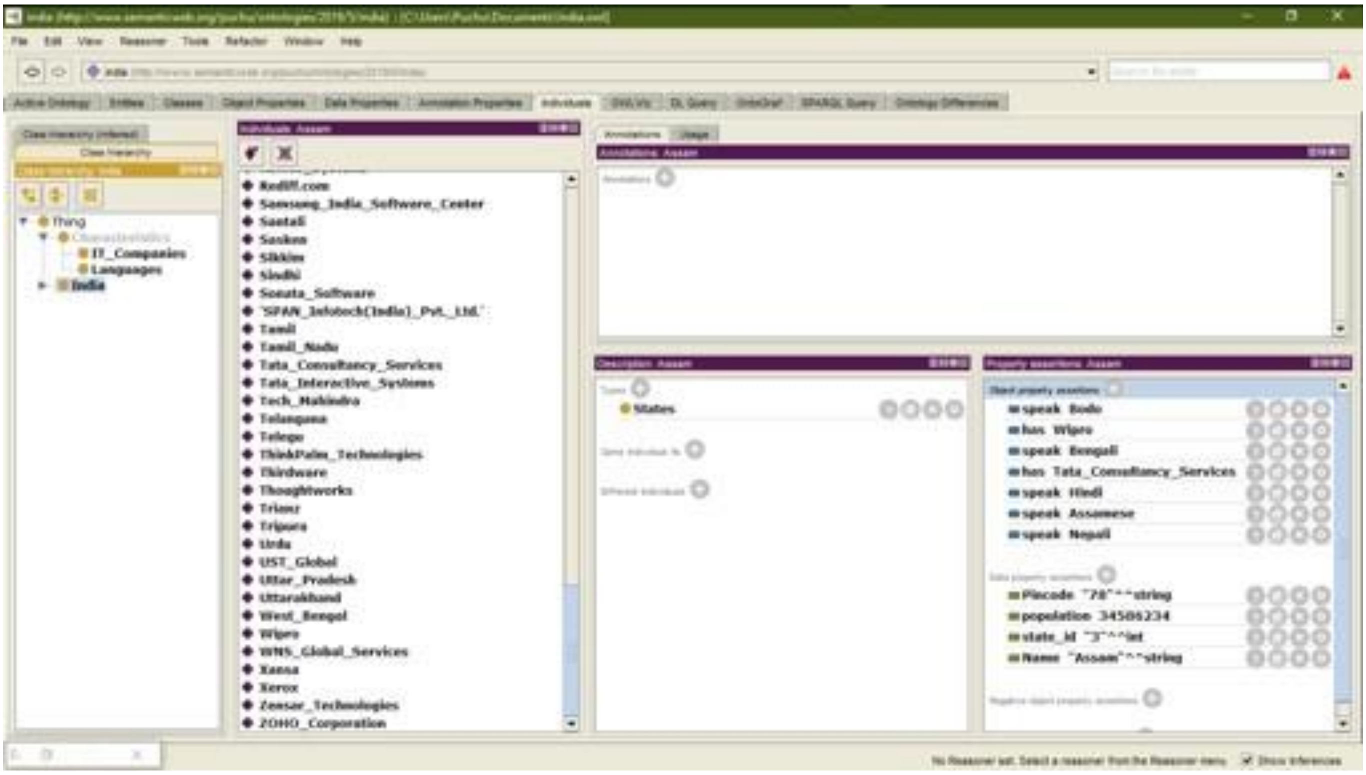


Fig. 1: Onto Graph representation on States of India

In the above mentioned graph, representation of Ontology on States of India includes subclasses as states and Union territories. Each subclass has its own characteristics which contains information related to it. ontology describes a domain and characteristics which are defined based on different IT Companies and various languages. This onto graph will help us to showcase the relationship between the classes with their subclasses and characteristics.

II. Representation of Individual:

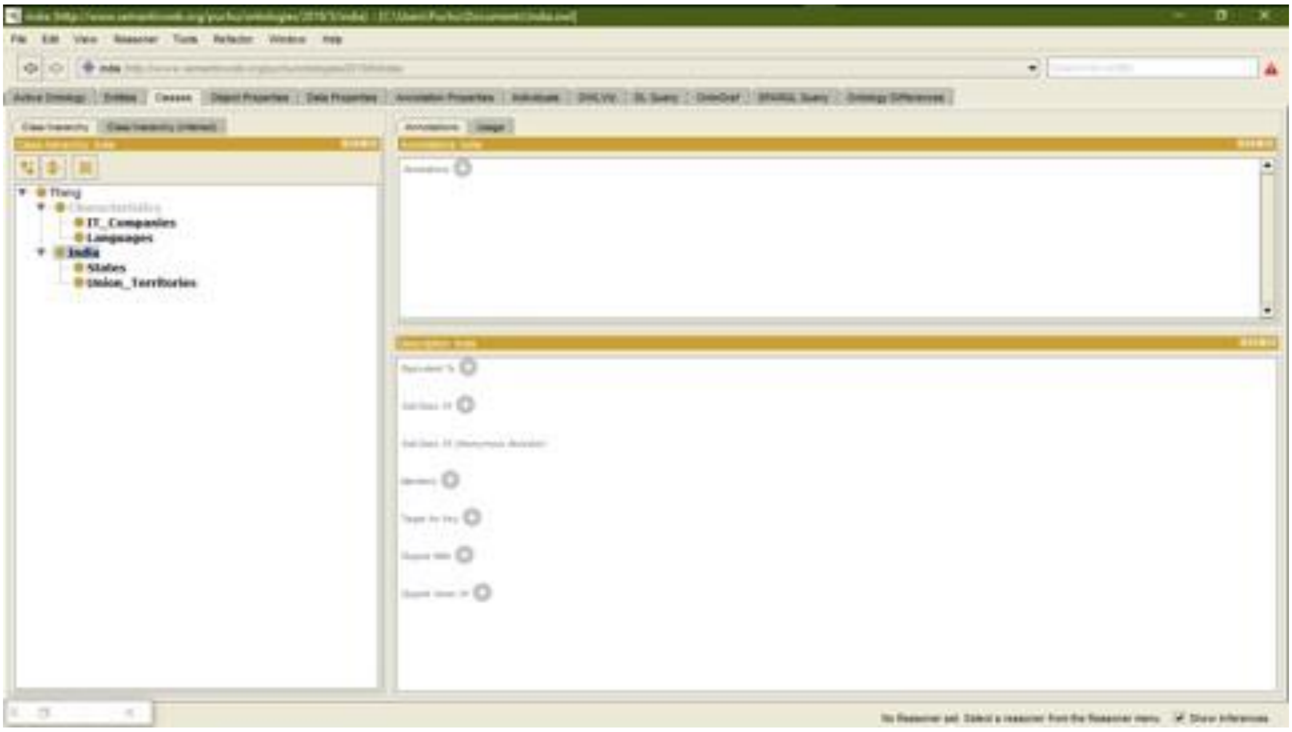
Individuals (instances) are the basic, "ground level" components of an ontology. The individuals in an ontology may include concrete objects as well as abstract individuals (although there are differences of opinion as to whether numbers and words are classes or individuals). An ontology need not include any individuals, but one of the general purposes of an ontology is to provide a means of classifying individuals, even if those individuals are not explicitly part of the ontology.



III. Representation of Class:

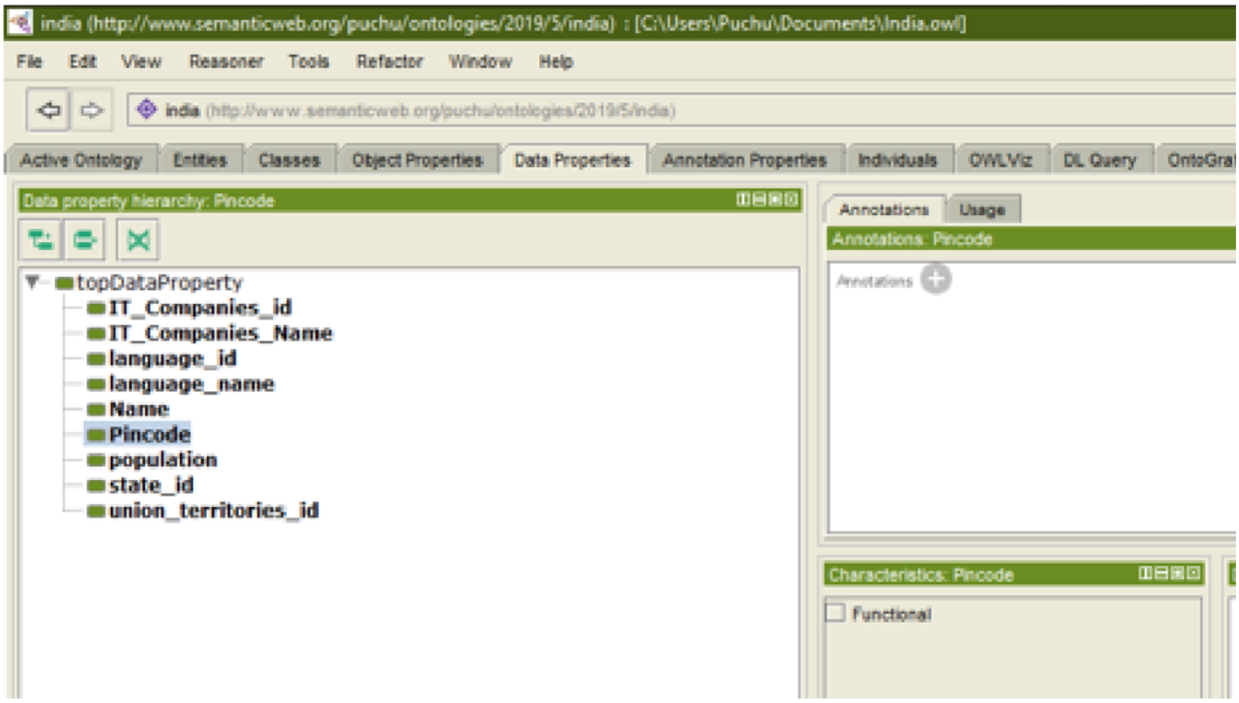
Classes – concepts that are also called type, sort, category, and kind – can be defined as an extension or an intension. According to an extensional definition, they are abstract groups, sets, or collections of objects. According to an intensional definition, they are abstract objects that are defined by values of aspects that are constraints for being member of the class. The first definition of class results in ontologies in which a class is a subclass of collection. The second definition of class results in ontologies in which collections and classes are more fundamentally different. Classes may classify individuals, other classes, or a combination of both.

Importantly, a class can subsume or be subsumed by other classes; a class subsumed by another is called a subclass (or subtype) of the subsuming class (or supertype). A partition is a set of related classes and associated rules that allow objects to be classified by the appropriate subclass. The rules correspond with the aspect values that distinguish the subclasses from the superclasses.



IV. Representation of Attributes:

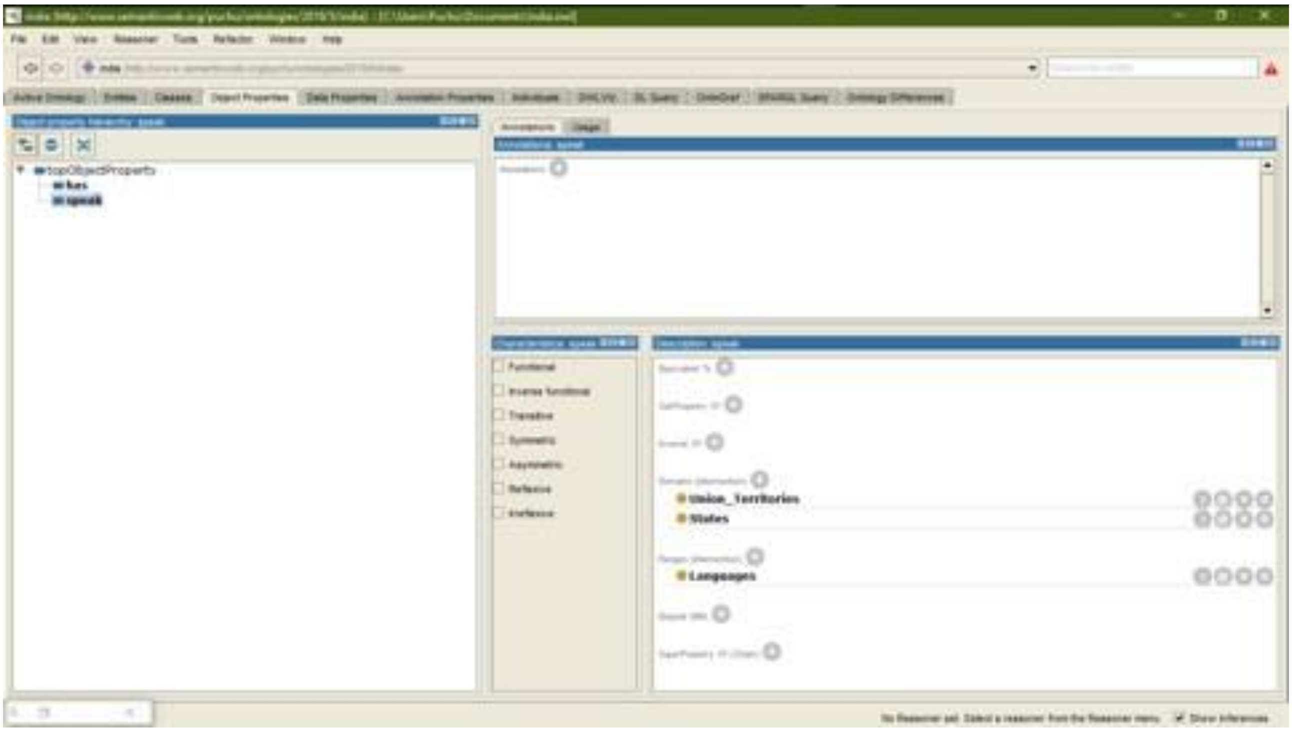
Objects in an ontology can be described by relating them to other things, typically aspects or parts. These related things are often called attributes, although they may be independent things. Each attribute can be a class or an individual. The kind of object and the kind of attribute determine the kind of relation between them. A relation between an object and an attribute express a fact that is specific to the object to which it is related.



V. Representation of Relationship:

Relationships (also known as relations) between objects in an ontology specify how objects are related to other objects. Typically a relation is of a particular type (or class) that specifies in what sense the object is related to the other object in the ontology.

An important type of relation is the subsumption relation (is-a-superclass-of, the converse of is-a, is-a-subtype-of or is-a-subclass-of).The addition of the is-a-subclass-of relationships creates a taxonomy; a tree-like structure (or, more generally, a partially ordered set) that clearly depicts how objects relate to one another. In such a structure, each object is the 'child' of a 'parent class' (Some languages restrict the is-a-subclass-of relationship to one parent for all nodes, but many do not). Relation types are sometimes domain-specific and are then used to store specific kinds of facts or to answer particular types of questions. If the definitions of the relation types are included in an ontology, then the ontology defines its own ontology definition language. An example of an ontology that defines its own relation types and distinguishes between various categories of relation types is the Gellish ontology.



VI. Query to fetch data from the ontology:

Below mentioned the query which will result the names of states which speak “Hindi” language. The query is being performed to showcase the output for the name of the states appropriately.

```
PREFIX UNI: <http://www.semanticweb.org/puchu/ontologies/2019/5/india#>
SELECT * {?States UNI:speak UNI:Hindi}
```

Result of above mentioned query:

	States
1	UNI:Nagaland
2	UNI:Haryana
3	UNI:Odisha
4	UNI:Madhya_Pradesh
5	UNI:Mizoram
6	UNI:Daman_&_Diu
7	UNI:Rajasthan
8	UNI:Uttar_Pradesh
9	UNI:Delhi
10	UNI:Arunachal_Pradesh
11	UNI:Uttarakhand
12	UNI:Jharkhand
13	UNI:Chhattisgarh
14	UNI:Andhra_Pradesh
	UNI:Dadra_&_Nagar_Haveli

SOFTWARE USED:

1. **Protégé:**

Protégé provides a graphic user interface to define ontologies. It also includes deductive classifiers to validate that models are consistent and to infer new information based on the analysis of an ontology. Like Eclipse, Protégé is a framework for which various other projects suggest plugins. This application is written in Java and heavily uses Swing to create the user interface.

This application is written in Java and heavily uses Swing to create the user interface. Protégé recently has over 300,000 registered users. According to a 2009 book it is "the leading ontological engineering tool".

2. **Apache Jena:**

Apache Jena is an open source Semantic Web framework for Java. It provides an API to extract data from and write to RDF graphs. The graphs are represented as an abstract "model". A model can be sourced with data from files, databases, URLs or a combination of these. A Model can also be queried through SPARQL 1.1.

Jena is similar to RDF4J (formerly OpenRDF Sesame); though, unlike RDF4J, Jena provides support for OWL (Web Ontology Language). The framework has various internal reasoners and the Pellet reasoner (an open source Java OWL-DL reasoner) can be set up to work in Jena.

Jena supports serialisation of RDF graphs to:

- a relational database
- RDF/XML
- Turtle
- Notation 3

CONCLUSION:

We developed the Onto2Graph and major class with their subclasses that is converted ontologies into graphs efficiently. The tool integrates two different ways to perform this conversion, by using OWL reasoning and by syntactically analyzing the ontology axioms. The Onto2Graph can output graphs generated from OWL ontologies and Indian states information can easily be extracted.

We demonstrated that the graphs generated by Onto2Graph can outperform graph structures generated syntactically. While the observed differences are small, our results nevertheless demonstrate how inclusion of more information that is already present within ontologies can contribute to States of India.