MOD004979

Ancient Mythology search

Semantic Data Technologies

SSID:2021497

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1.Purpose

The objective of this study is to achieve the level of understanding for the people at large regarding the Hindu mythology. There is existence of variety of ontologies having that level of insights and understanding for the same. But it is also the fact that the ontologies related to mythologies and epics are few. This paper seeks to develop deeper and provide an insightful understanding of Ancient Hindu Mythology.

Though there is availability of the web-based information through the medium of various channels and websites that are there to provide information, but the authenticity factor is missing and this needs to be sorted out. There is existence of many of the problems when it comes to search engines too. The information retrieved is inaccurate and fallacious. This is part of the problem because the search engines such as Yahoo! Use statistical analysis that only keeps into consideration the occurrence and the frequency of occurrence of words. Though there is employment of manual data entries also but the same don't give the required information that have the accuracy. This needs to be changed with the attuning of the system in which these search engines work. The manner of the retrieval of information should have the required accuracy to be more effective. Here, Semantics web can be employed.

2.Introduction

2.1 Hindu Mythology

Hindu mythology is assortment and anthology of collected stories that are there because of the deep-earned wisdom of the ancient Hindus. These are the stories of joy, triumph, pain, and struggles between persons that make them truly alive. One of the factors of notice is the gaining of the knowledge regarding the quality of vice and virtue. Literary Sage, **Rishi Vyasa** who lived in the 4th Century BC is the one that narrated Mahabharata and also has a character in the epic named after him. The narrative component in the epic is the struggle between two group of cousins of the dynasty, Kauravas and Pandavas in the war of succession to the throne. They offer saying that can be employed in the variety of situation in our daily lives. Some of the important lessons from the book includes- "*Greed Is the Start of One's Downfall, Standing Against Wrongdoers Is Necessary, Good Family and Friends are a Blessing, Extreme Devotion, Respecting Women, and Never Support Your Children in Their Wrong Desires" (Adrija Saha,2020).* The influence of the people has had a great impact on today's life. For example, in 2007, when American astronaut Sunita Williams took off for the International Space Station, took copies of the Bhagvad Gita. She said, "she took it to keep her stay rooted" and she also mentioned that to have a life abided by a perspective to view the world through a lens, the sayings of Arjuna are to be employed (Shabdita Pareek, 2016).

2.2 Objectives of the study

The main objective of the paper is to seek and develop an understanding related to the ancient Hindu mythologies involving great characters and provide an insight in an in-depth manner. There is an endeavour to trace the complexities in the relationships of the characters that are involved such epics and mythologies. The stages of development, and evaluation are diagrammatically represented in this report. Each section is detailed below.

The primary use of this application is to assist users with browsing set of persons from the book by performing complex SPARQL queries to retrieve relevant data.

2.3 Aim

Through the development stages, this paper seeks to describe the web-semantics in clarity through various processual system of it by the communication through user interface aimed at the end-user results. It aims to describe in sufficient details the various processual stages in web-semantics and the challenges faced by the same and what could be the possible solutions that can be employed to avert such issues.

2.4 Why ontology?

The growth of the internet has been humongous and at the pace that is exponential in nature. The designing of the availability of tools for creating the web pages for the users are also being sone here. Through the usage of Hyper Text Mark-up Language (HTML.), the web pages are created in large numbers. This is desirable because of the difficulty in reading, emulating and eventual morphing of the coding of pages that are done in HTML. This is not the case when the same is being done using XML. This is because the usage of text variabilities that are done through XML don't have any predefined existence of meaning. This is true because of the accessibility of the content that is meant for the readers that are human and not machines. The problem persists if a machine answers a query through statistical analysis of the data that are done via spell check and other methods, and this is mechanical in nature. The problem further gets convoluted through the increase in the number of web pages where the accuracy of the data retrieval becomes very tiring for a reader. This leads to the users spending long duration of time in accessing the correct and accurate information through the flood of keywords via which the web pages get to be there. This is because the search engines work through key-word methodology and not using semantics search mechanism that leads to manual extracting of information for the users. The solution is the usage of ontologies for the same that ameliorates the situation to an extent.

3.Semantic data terminologies

Semantic Web

Tim Berners-Lee (1998) introduced the idea of semantic web system. This was intended to make meaningful information extraction that is done by the user. That's why instead of using syntactics, semantics can be employed for the search results to be accurate. The steps that

were taken are the development and designing of the web-based system where semantics of a documents can be read using the tools of language, standards, and protocols. Some of the examples are Uniform resource identifier (URIs), extensible mark-up language (XML), framework of resource description, schema of RDF and of course, ontology. The web semantics is aimed at converting the unstructured data of the search engines into a classified, accurate and easily retrieval web of pages. It is based on W3C Resource Description Framework (RDF). Semantic web architecture is shown in figure 1.

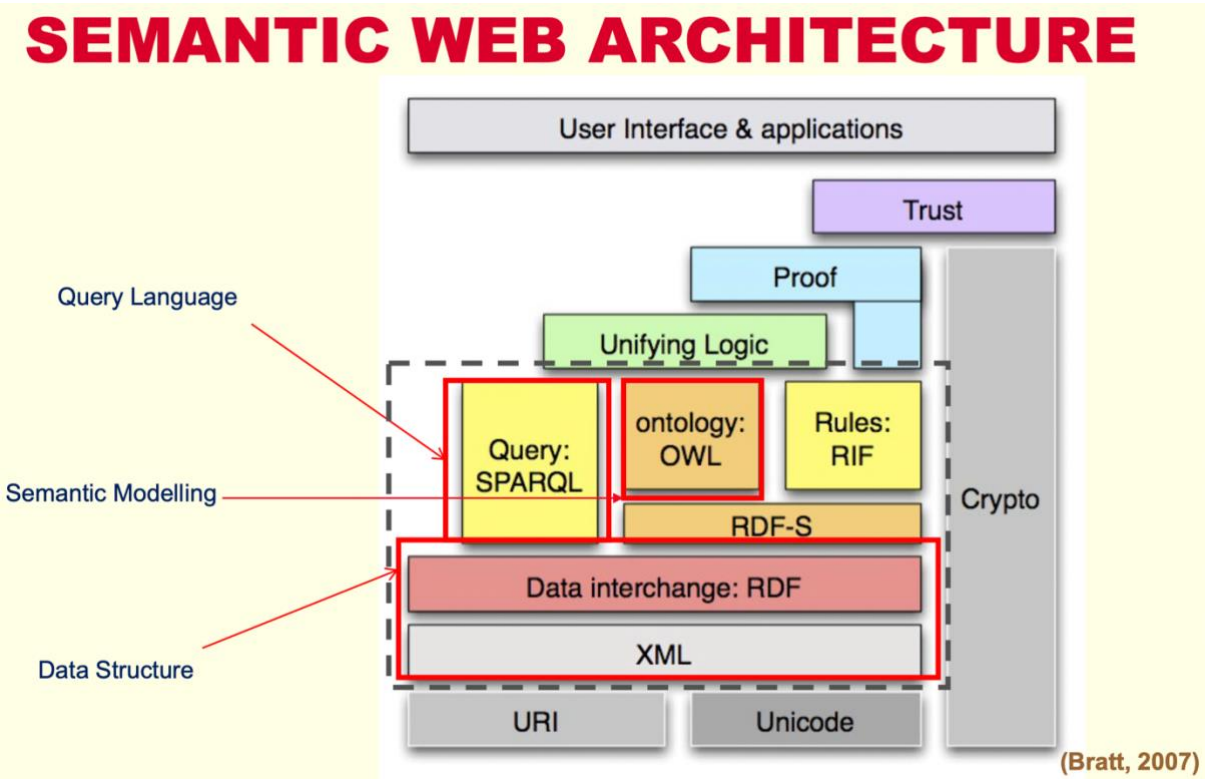

Fig.1 Semantic web architechture. (Bratt,2007)

Ontology:

Ontology is an important factor in the Web Semantics based framework mechanism. Ontology can also be helpful for providing the correct information through the analysis of data to the next generation of users. Ontology has started to gain its reputation in the fields of computer science and the Informatics Systems. In clear-cut terms it can be defined as a set of data system that have concepts bounded up together and a mechanism to have the interrelationship between those concepts. It can also be defined in the overall broad frame as to having formalism and a set of data system.

Content Ontology gets to be defined in the traditional ontology mechanism such as interoperability between data structure, fencing of the interface, reasoning and concept modelling and the capturing of the required knowledge insights in the data domain. Inference basically defined as the knowledge factors in the logic domain where it derives information through the set of premises and reaches to a conclusion. The logic within the factors of ontology is assuming several premises and reaching a set of conclusions within

them. This is done using various software that delivers inference and reaches to a conclusion.

Web Ontology Language (OWL) is the designing of formal ontologies. An OWL ontology gets to be included within its domain relatable properties and characteristics. This becomes the variety of OWL dialects.

Resource Description Framework (RDF) is a collection of descriptive World Wide Web Consortium (W3C) standards that are in the process of being established as a model of metadata,employing syntactic format where it specifies the usage of the data. The RDF metadata model is based on the subject-predicate-object format, which specifies a specific piece of information, and the predicate denotes aspects or characteristics and defines the interrelationship between the subject and the object. This is referenced using the URL.

RDFS or RDF Schema is known as RDF vocabularies where the subject-predicate modelling is used to predicate the accessibility of the data.

Axiom - An axiom is a premise or can be said to be starting point of Ontology where each premise having a distinct stage of its own.

A **class** is a collection of set instances where each set is interrelated helping in the accessibility of the data modelling system. In my ontology, kingdoms, dynasty, person, places, rivers are class names. Class with child are known as subclasses. For example, two dynasty names are subclasses of dynasty class.

Property/predicate – This gives out the interrelationship between the classes and instances. These are known as predicates. Properties are defined as making to the fore the attributable relationship between the instances.

Entity- Can be called as **named entity** where the set of classes are defined.

Instance/individual – Instance are ground level of entities where the interrelationships between the classes are predefined. Individuals are data added to each class and subclass. For example, names of person are instances to Person class.

Reasoner – It is a software technique capable of deducing logical conclusions from a collection of axioms. All relationships with inferences are loaded once the reasoner is run. It can also determine if the data has any inconsistencies.

4.Design

4.1: Following Procedure

- Determine domain and scope – This is the basic tool in determining the ontology. First of all, what is the field of study where ontology is used? In what situation?
  This mythology is having wide variety of characteristics having variegated interrelationships between the characters. There can be demonstration of this using the factors of ontology.
  This helps as a guide tool to the historians and researchers having interest in Hindu mythology. All these questions should help in developing the ontology to be used as a guide.

- Consideration of the utilisation of ontologies that are already existing - It is important to develop ontology within the same domain where researchers and engaged in. This helps in various ways. Firstly, it helps in providing in-depth knowledge that is required in the clarity before developing ontology. It ensures interoperability. A well-founded literature research could be done through this which is deployed in dealing with various mythology related research. It has been found that only few ontologies are there for mythologies. The facets of Greek Ontology are among them. (C. Syamili, R.V. Rekha, 2018)

- Acquisition of Knowledge Domain- It is the acquisition and accumulation of knowledge through using various literature that are there in the forms of books and journal including any source having the selected domain data. During this framework development I have come to understanding of various literature in the form of books and journals that are there for Hindu mythology. It includes, novels, other forms of literature and historical evidence-based research papers.

- Defining of the classes and the class hierarchy - The ideas that are there to be connected using the order of history-based evidence. The domains having similar terms are there to be placed together. Through the factors of this ontology, there is the division in the classification of characters in a distinct manner into gods, demons and humans. Grouping of such characters are done based on the dynasty they belong and their characteristics. There is classification in 3 ways when it comes to class structures of classification. The relationships of methodology and classification given below are discussed in details in the sections below.
- Property Generation between classes
- Data addition
- SPARQL Query Evaluation
- Through the Implementation of User Interface

The tools that can be employed are Protégé-OWL 3.4.2, HTML, Hypertext Pre-processor (PHP), Apache Jena Fuseki, Xampp that help in development of a website.

4.2 Ontology Design

4.2.1 Class and subclasses

Classes of ontology are resources which gets to predefined by IRIs and explained through the usage of RDF properties. This defines where the resources are classifies through the instance of classes.

Figure below charts out the ontology classes and the defined sub-classed and the sub-classes of these sub-classes:

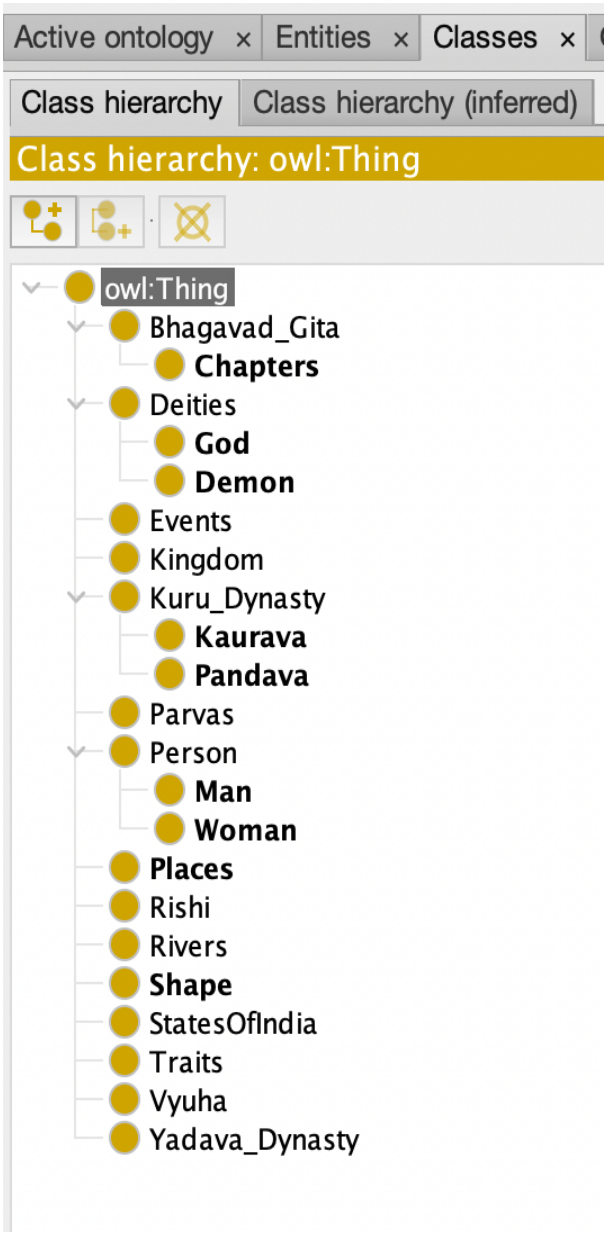

Fig 2. Classes and Subclasses

Bhagavad Gita has many about 18 chapters, so I have included chapters as subclass. There are many kingdoms like *Anga*. Person class which has Man and Woman as subclasses in my ontology are the characters in this book. *God* and *Demon* are sub classes for Deities class. I have included two main dynasties from Mahabharata – *Kuru and Yadava dynasty*. The Subclasses *Kaurava* and *Pandava* are two clans that fought in this book.

On the other hand, the person skills are defined as *traits*. *Rishi* also called as teacher is one of class in ontology. *Places* and *StatesOfIndia* are two classes for connecting past and present location.

In an ontology, the object and data properties define the class hierarchy having relationships, called object and data properties.

4.2.2 Object Properties

Object properties have the interconnection between two individuals being subject and the object that gets bounded with a predicate, while usage of the data properties the subject with some form of attributable data. To get maximum out of classes, I have included all these relationships and use this to add some restriction onto classes. There are about 33 Object properties in my ontology.

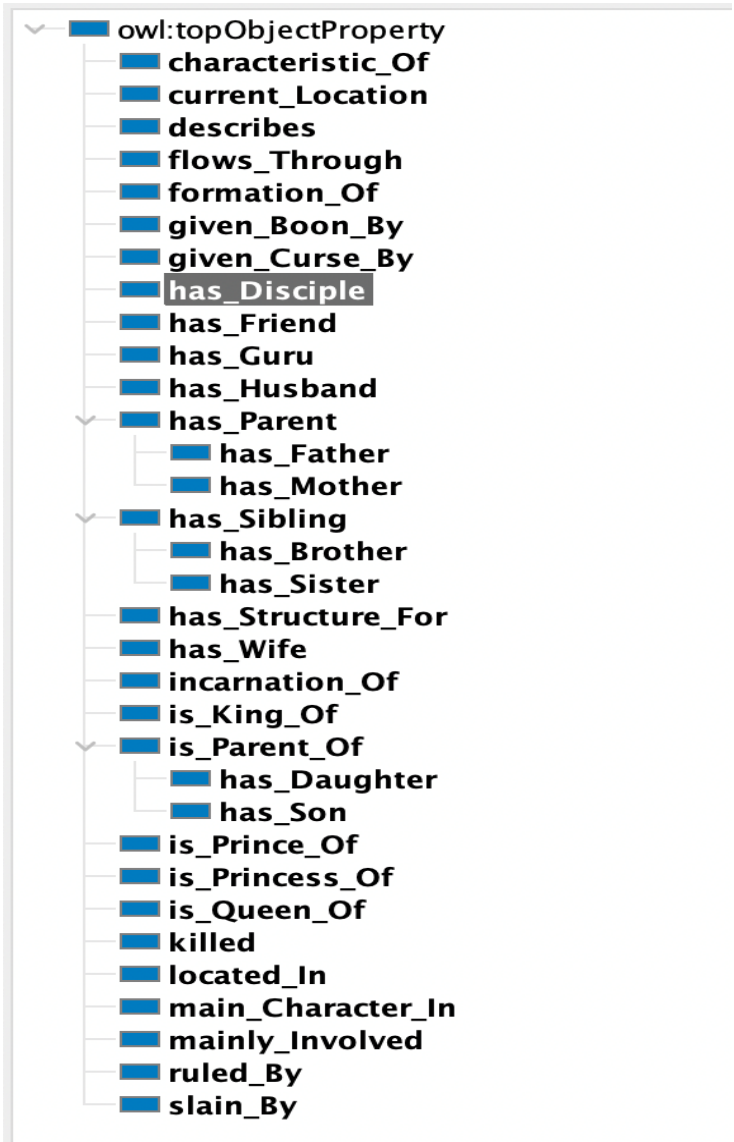

Fig 3. Object Properties

Explanation:

- *is_King_Of* is a property between Man and Kingdom. For example, *Karna* is a king of *Anga* Kingdom. This is works with *is_Queen_Of* between Woman and Kingdom.
- *main_Character_In* is a property between Person and chapter.
- *Current_Location* defines relation between past location Places class and present *StatesOfIndia* class.
- There are 6 Sub object property- 2 for each of these properties *has_parent*, *has_sibling*, and *is_parent_of*.
- There are 4 inverse object properties - *Killed* and *slain_by* are inverse for each other. In the same with *has_Disciple* and *has_Guru*.
- There are 2 disjoint classes- *rivers* are disjoint with with *parvas*. None of the individuals are connected to one of each of disjoint classes.
- Adding Characteristics of object properties is important in this step.
    1. Functional – the property can have at most one value (outgoing relationship). Example - *Current_Location, Located_in*.
    2. Inverse - at most one incoming relationship for that individual.
    3. Symmetric – means that the property has itself as an inverse.
    4. Reflexive – means that every single individual is related to itself. Example – *has_Friend*.
    5. Irreflexive – means that every single individual is not related to itself via that property

4.2.3 Data Properties

The data property hierarchy that is shown in the below figure is foremost navigation devices used in Protégé. These are basically end-notes that provide the hierarchical information about a class in a specified manner. It is presented as tree nodes where the nodes specify the data properties. A data property comes under another data property when it is shown as the sub-property of another data property. Data properties connects a single subject with some form of attribute data.

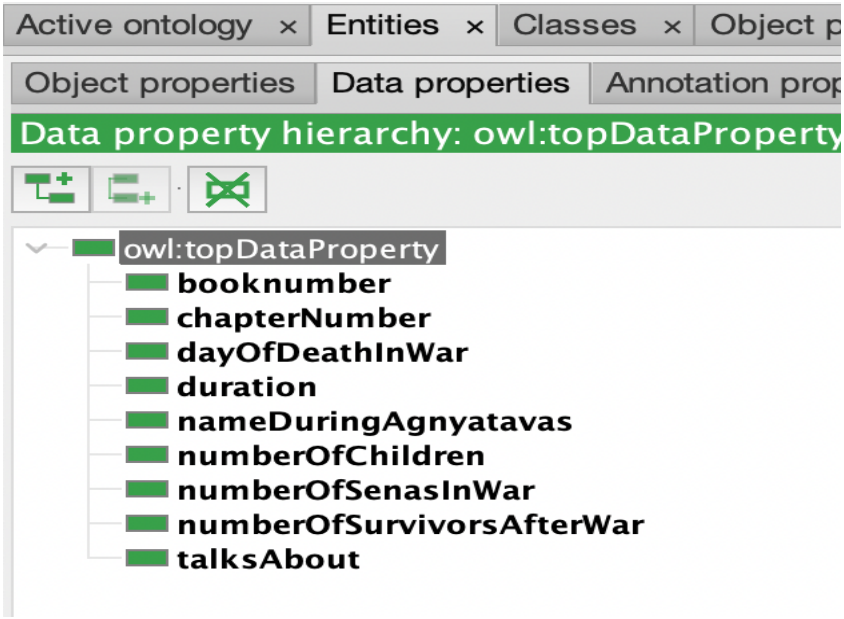

Fig 4. Data Properties

Explaination

- Integer type - *booknumber, chapterNumber, duration* of events, *numberofChildren* for Person, *numberOfSenasInWar*, and *numberOfSurvivorsAfterWar* (count of survivors)
- String type – *nameDuringAgnyatavas* describes about name of person during specific event *Agnyatavas*, and *talksAbout* is description of chapters.
- Date type – *dayOfDeathInWar* is a date that person died in book.

4.2.4 Including Annotations

One of the purposes of this paper is to provide the knowledge of the development of ontology in the modality that can be understood even by laymen; this is sought to be achieved by inclusion of annotated properties in the data of the ontology.

4.2.5 Onto graf

In order to create the OWL File, foremost thing to do is the installation of Protégé-OWL with all the characters built into the system and plugins into the system. OntoGraf is one of the plugins of Protege-OWL. It enables the users to view the graphical representation or the hierarchical tree model of the ontology. The representative model of this ontology tree is presented below.

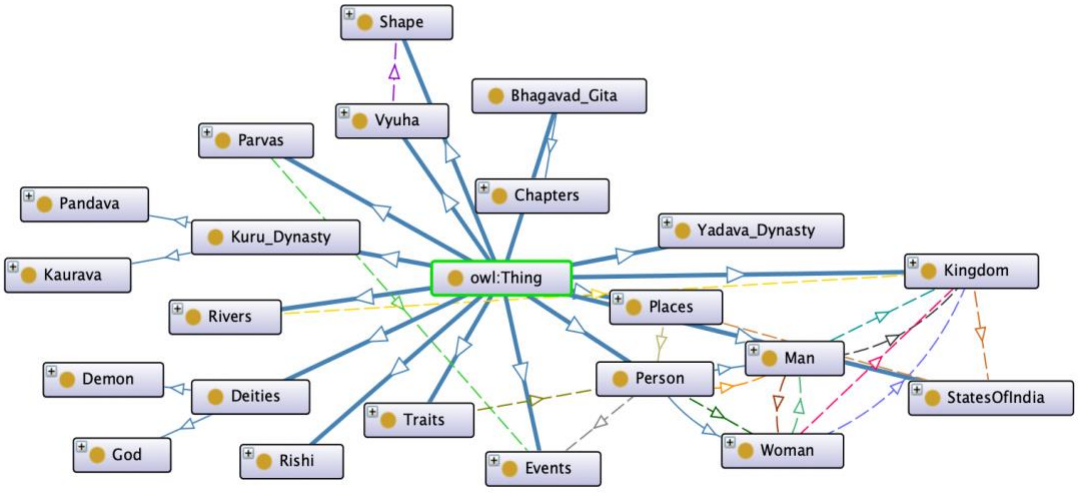

Fig 5. Onto_graf

4.2.6 Data/Individuals

The next step after creating properties is to add data into our ontology. I have used two ways to add individuals into my ontology:

1. By manual – Add individual and connect Object and data properties for every individual.
2. Using Excel – In Protégé, it is easy to import excel file with and connect it with ontology with simple code. First, I have created an Excel file with all the data I require and import into protégé then connect each column with class properly. Finally, Execute the Hermit reasoner to make sure that there are no errors in ontology.

My final ontology has 249 individuals. One of them includes *arjuna* is shown in the figure below. *Arjuna* is a Man belong to *Pandava* clan, below figure shows all the object properties related to *arjuna.* One of data property linked to him describes that there are 4 children for him.

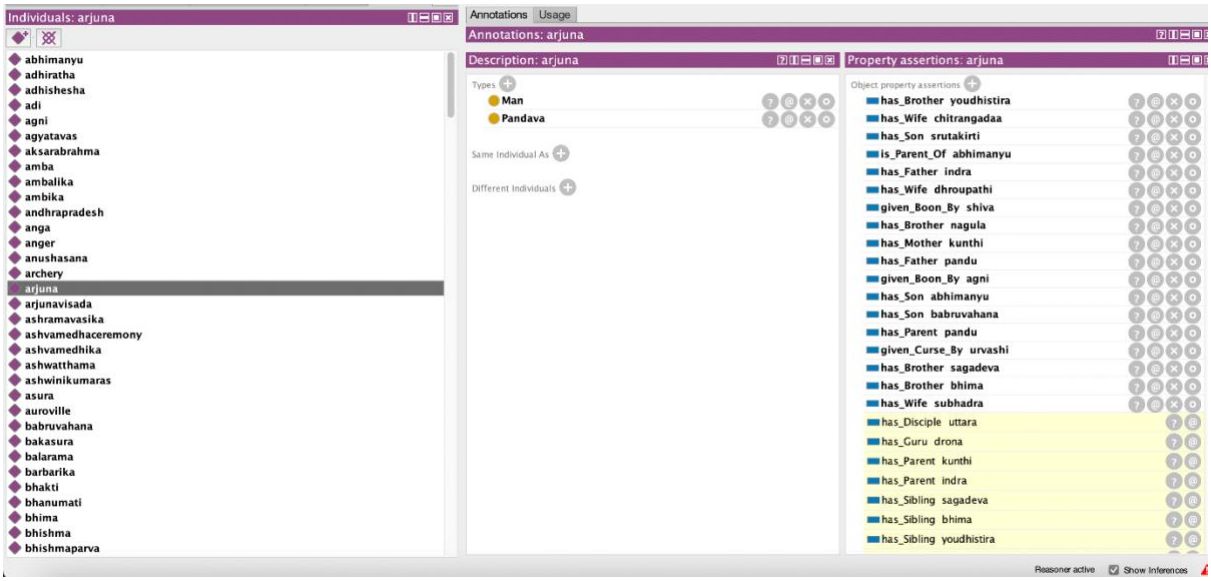

Fig 6. Example for individual

5.Implementation

PHP is used for the development of the ontology model for Hindu mythology in combination with Fuseki server and SPARQL queries in acquisition of the data from the ontology.

5.1 Connecting Fuseki

Apache Jena Fuseki is an open-source SPARQL server with an HTTP interface that provides an API for querying, writing, and updating data from various RDF models using the SPARQL protocols.

Steps for connecting Fuseki and ontology:

1. Install Fuseki on local machine.
2. Surf the internet and fire-up the web browser navigating to *http://localhost:3030*.
3. Add a new dataset to upload Ontology file.
4. If the ontology is uploaded without any errors, then evaluate the ontology with SPARQL queries.

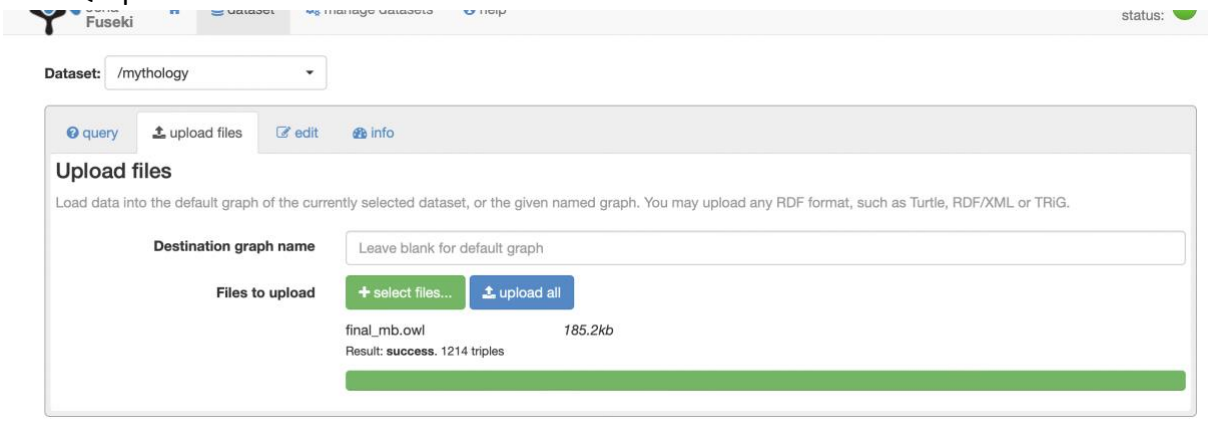

Fig 7. showing that ontology is uploaded into Fuseki Server.

5.2 Programming Language PHP

It stands for Hypertext pre-processor and is a powerful object-oriented scripting language that is especially suited to web programming and web development. It has become one of the most popular languages for powering online-based websites, and it was chosen as the programming language for the ancient mythology search web application of people, characteristics, and places.

5.2.1 Sparqllibrary.php

It is RDF library using SPARQL queries from PHP. It connects the link between PHP and the dataset that has been created on Fuseki server. The below used to diagrammatically represent this interconnection.

```
7   public function __construct(){
8   $db = sparql_connect( "http://localhost:3030/dataset.html?tab=upload&ds=/mythology" );
9   if( !$db ) { print sparql_errno() . ": ---" . sparql_error(). "\n"; exit; }
10  sparql_ns( "table","http://www.semanticweb.org/mb/srinivas/ontologies/2021/3/book-ontology-64#" );
11  }
```

Fig 8. Connecting Fuseki and PHP

To use the *sparqIlibrary.php()* library functions, download and place the files in our PHP project folder, then use the *requireonce()* PHP method to access to the fold of the *sparqIlibrary.php()* library. The *sparqI_connect()* method takes the parameters of the URL where the dataset sends SPARQL queries and receives data, as well as the *sparqI_ns()* function defined in our Ontology's namespace.

The *sparqllibrary.php()* is a library that has the containment functions in order to help in obtaining the data from Fuseki server through the usage of SPARQL queries that makes it easy to display on the web.

1. The *sparql_query()* takes SPARQL query as a parameter input and returns ontology data in the form of array with query headers and instances.

2. The *sparqI_fetch_array() is* used to display the data on the interface which modifies the data obtained from the results of sparqI_query() function into a array of servers containing only the data for query submitted.

3. The *sparqI_ field_array()* function will only provide the names of the variables sent during the SPARQL query, not the individual's actual information.

4. In the event of an issue, the *sparqI_error()* feature will display the exceptions thrown by the Fuseki server.

All these functions are used to manipulate data queries and results to the queries having consideration to PHP for interface development.

5.3 User interface development

5.3.1Person-search

```
public function get_persons(){
    $sparql = "SELECT *
        WHERE {
        OPTIONAL { ?Man table:has_Son ?son.
        OPTIONAL { ?Man table:has_Father ?father.
        OPTIONAL { ?Man table:has_Wife ?wife.
        OPTIONAL { ?Man table:has_Mother ?mother.
        FILTER(regex(str(?Man),'arjuna'))
        }
    }";
    $result = sparql_query( $sparql );
    return $result;
}
```

Fig 9. Function for person search

The Person, Characteristics, and Chapters search in user interface was developed to display details of in the web application. The application interface presents an input related field where the required and user can have the viability to enter the name of the person from book as the required terms helping in searches. In the above figure, get_persons() method is used to search persons.

In order to get all the information that corresponds to the typing of the name in the input of the searches, there is the utilisation of the *sparql_ fetch_ array()* functionality. This gets to fetch the data that has been obtained from Fuseki server. The while() function, which is used to display the person's name, aids in iterating through the array to get the required corresponding list of people.

5.3.2 Chapter search

The interface of the chapter search has the properties of an input box where typing takes place and the chapter number as a search phrase to search all of the information linked to the chapters using get_chapters() methos (Fig). The result is a list of people who match the search keyword and have all of the required and associated information from the Ontology. A brief summary of the chapter and the person looked for are included in the associated result.

```
public function get_chapters() {
    $sparql = "SELECT ?n
        WHERE {
        ?n a table:Chapters;
        table:chapterNumber "8"^^xsd:int;
        }";
    $result = sparql_query( $sparql );
    if( !$result ) { print sparql_errno() . ": " . sparql_error(). "\n"; exit; }
    return $result;
}
```

Fig 10. Function used for Chapter search

5.3.3 Characteristic Search

This search is to display traits of each person which person have used in the book using get_characteristics() method (Fig). This interface features an input field where input is name of the person and result is skills possessed by the person. For example, result for *arjuna* is archery and dance as per the data added for this person on the ontology.

```
35
36      public function get_characteristics($language) {
37          $sparql = " SELECT ?Person (str(count(?Traits)) as ?count)
38              WHERE {
39                  ?Traits table:characteristic_Of ?Person.
40              }
41              group by ?Person
42              ORDER BY(?Traits)";
43          $result = sparql_query( $sparql );
44          if( !$result ) { print sparql_errno() . ": " . sparql_error(). "\n"; exit; }
45          return $result;
46      }
```

Fig 11. Function used for Characteristics search

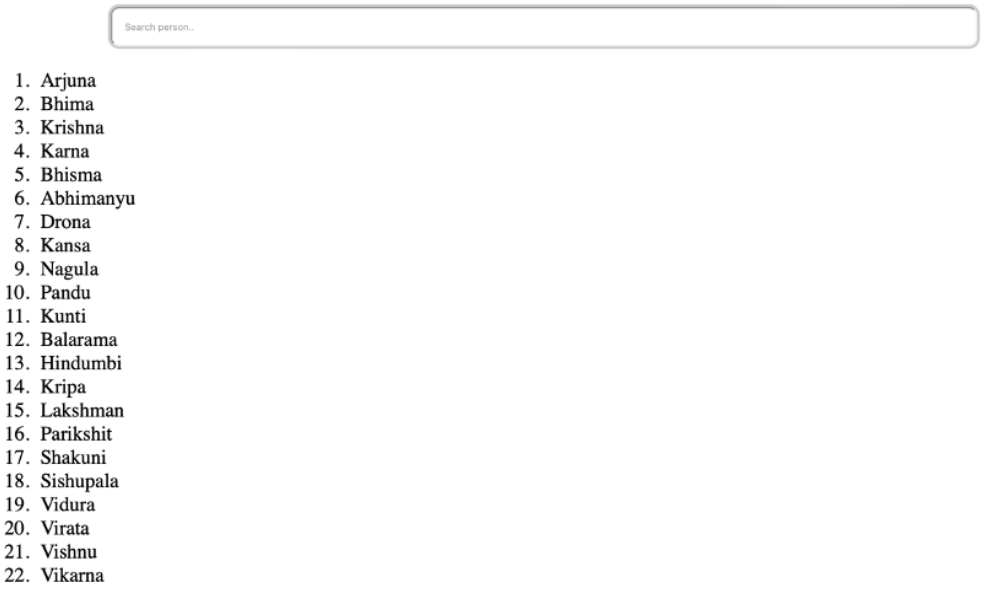

Fig 12. User Interface

This is the basic User interface created for person search. Though all the queries are executed on fuseki server, and connected fuseki server and php successfully, I was not able to retrieve the results of SPARQL queries In the web application.

6.Evaluation and Use

In terms of evaluating and the utilisation what is to be kept in mind is the fact that the SPARQL queries utilised and draws data from the Fuseki server to show the same on the application related to searches. For deeper understanding, foremost explanation is required where the Fuseki server gets utilised to test the right modelling and implementation of the queries before adding them to the backend of the application. There is wider detailing of the finer version of the queries that is presented below.

Including PREFIX for writing the queries: PREFIX, is the SPARQL instruction for a declaration of a prefixes related to names of the places., allowing the same to write prefixed names in the modelling of the queries while getting rid of the usage to have URIs in all the places. In my Queries I have named my PREFIX as table and included my ontology URI from Active Ontology tab in Protégé.

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
prefix owl: <http://www.w3.org/2002/07/owl#>
prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX mb:<http://www.semanticweb.org/mb/ontologies/2021/Mythology-ontology-64#>
```

Fig 13. PREFIX names used to query

Prefix ‘mb’ is used for active ontology. And the remaining prefixes are default provided by protégé.

6.1 Query for displaying description

This query is to display every relationship linked to person; this query is used when a name of person is entered into search box to describe about all the relationships.

SPARQL query:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX mb:<http://www.semanticweb.org/srinivas/ontologies/2021/3/mb-ontology#>
DESCRIBE *
WHERE
{
        ?Man a mb:Pandava
        FILTER(regex(str(?Man) , 'bhima'))
}
```

Fig 14. Query for displaying description

This query displays the details of Person ‘bhima’

bhima	has_Parent	pandu
bhima	rdf:type	owl:NamedIndividual
bhima	has_Brother	sagadeva
bhima	rdf:type	owl:NamedIndividual
bhima	rdf:type	owl:NamedIndividual
bhima	has_Brother	nagula
bhima	rdf:type	owl:NamedIndividual
bhima	has_Mother	kunthi
bhima	rdf:type	owl:NamedIndividual
bakasura	slain_By	bhima
duryodhana	slain_By	bhima
varnavatandexile	mainly_Involved	bhima
exile	mainly_Involved	bhima
hidumbi	has_Husband	bhima
dhroupathi	has_Husband	bhima
pandu	is_Parent_Of	bhima
arjuna	has_Brother	bhima

Fig 15. Description of 'bhima'

Some of the relations linked to 'bhima' includes has_brother, has_Mother, has_Parent,

Is_Parent_Of, slain_By.

6.2 Query for the Person search

The query on the below figure is used to acquire data of Persons who engage in this book as individuals. I used SELECT to select certain information; in this case, it retrieves all of the data, and WHERE makes extensive use of the filters, the specified restrictions, and the filters. The query includes a FILTER clause that filters the results, as well as a REGEX condition that only returns data matching the name arjuna.

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX mb:<http://www.semanticweb.org/mb/ontologies/2021/Mythology-ontology-64#>
SELECT *
WHERE
{
OPTIONAL { ?Man mb:has_Son ?son. }
OPTIONAL { ?Man mb:has_Father ?father }
OPTIONAL { ?Man mb:has_Wife ?wife. }
OPTIONAL { ?Man mb:has_Mother ?mother.}
FILTER(regex(str(?Man) , 'arjuna' ))
}
```

Fig 16. Query for person search

Man	son	father	wife	mother
arjuna	abhimanyu	indra	dhroupathi	kunthi
arjuna	abhimanyu	indra	chitrangadaa	kunthi
arjuna	abhimanyu	indra	subhadra	kunthi
arjuna	abhimanyu	pandu	dhroupathi	kunthi
arjuna	abhimanyu	pandu	chitrangadaa	kunthi
arjuna	abhimanyu	pandu	subhadra	kunthi
arjuna	babruvahana	indra	dhroupathi	kunthi
arjuna	babruvahana	indra	chitrangadaa	kunthi
arjuna	babruvahana	indra	subhadra	kunthi
arjuna	babruvahana	pandu	dhroupathi	kunthi
arjuna	babruvahana	pandu	chitrangadaa	kunthi
arjuna	babruvahana	pandu	subhadra	kunthi
arjuna	srutakirti	indra	dhroupathi	kunthi
arjuna	srutakirti	indra	chitrangadaa	kunthi
arjuna	srutakirti	indra	subhadra	kunthi
arjuna	srutakirti	pandu	dhroupathi	kunthi

Fig 17. Query with results for the Person search

The data resulting from this query will give the details of the person which includes son, daughter, father, mother of arjuna.

6.3 Query for the chapter search interface

This Query is to retrieve selected chapter from the book. The SPARQL keyword is meant to develop in a way where there are shortcuts for the foremost predication of the common rdf:type, giving the class in terms of the resource. *Chapters* class has data property *chapterNumber.* In this Query, chapter number 8 is *aksarabrahma* as shown in figure.

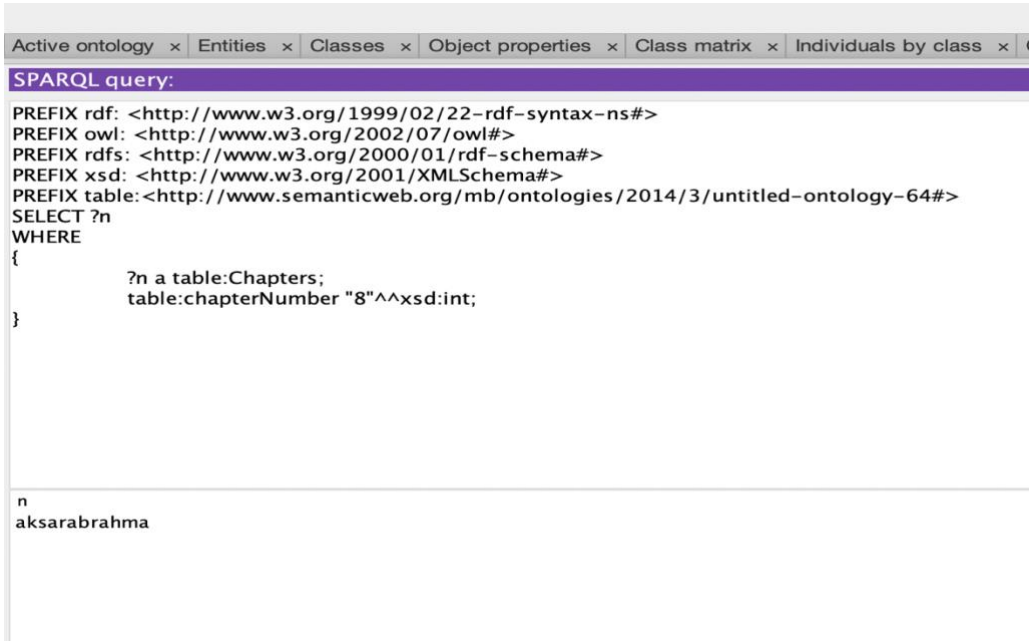

Fig 18. Query with results for the chapter search

Results shows that chapter name in the book with 8th chapter is *aksarabrahma* in Fuseki Server.

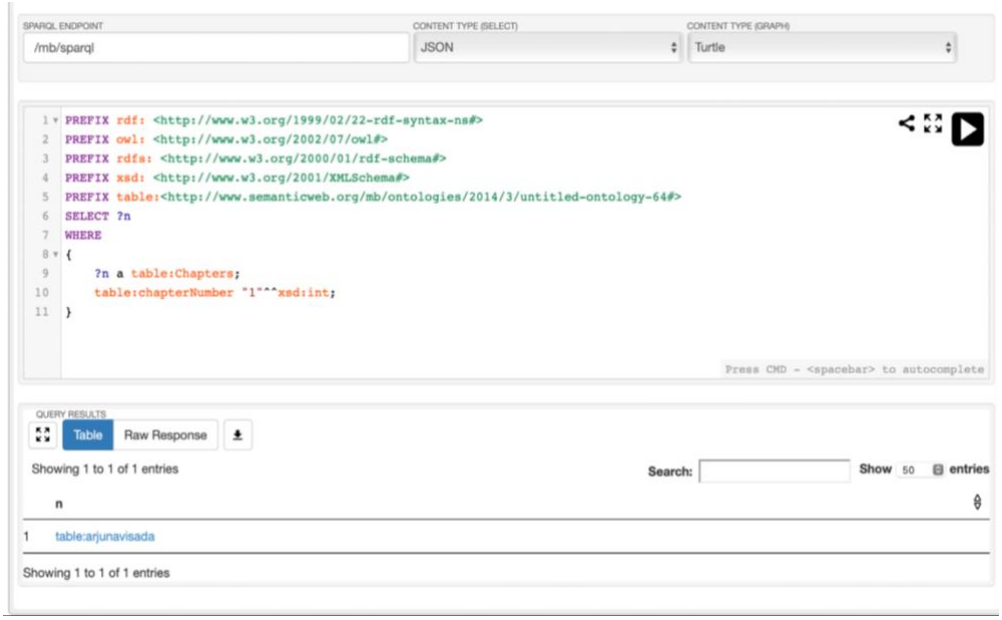

Fig 19. Query with results for the chapter search

This is another example of retrieving chapter name with 1st first chapter in the book.

6.4 Query for the Characteristics search

The following query shows number of skills each person as per my ontology. I have used WHERE Clause with object property *characteristic_of* object property to like between *Traits* and *Person* class. To retrieve the number in SELECT Clause, I have used COUNT clause and renamed with the help of *as* to count. All these persons displayed in results are displayed in Ascending order. For example, '*arjuna'* has 2 skills – archery and dance, 'karna' has 2 skills.

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX mb:<http://www.semanticweb.org/mb/ontologies/2021/Mythology-ontology-64#>
SELECT ?Person (str(count(?Traits)) as ?count)
WHERE
{
        ?Traits mb:characteristic_Of ?Person.
}
group by ?Person
ORDER BY(?Traits)
```

Person	count
vikarna	"1"
bhishma	"1"
bhima	"2"
dhritarashtra	"1"
arjuna	"2"
vidura	"1"
abhimanyu	"1"
sagadeva	"1"
durvasa	"1"
gandhari	"1"
shakuni	"1"
youdhistira	"2"
karna	"2"
ekalavya	"1"

Fig 20. Query with results for the Characteristics search.

6.5 Query to compare places in book with current location

This query is to connect the past places in book with present locations for more clear understanding of story. Keeping this point in mind, this query is designed. These two classes' places and StatesOfIndia relates to current_Location Object property.

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX mb:<http://www.semanticweb.org/mb/ontologies/2021/Mythology-ontology-64#>
SELECT (?Man as ?King) ?Kingdom (?StatesOfIndia as ?Current_Location)
WHERE
{
        ?Man mb:is_King_Of ?Kingdom.
        ?Kingdom mb:current_Location ?StatesOfIndia.
}
ORDERBY(?Man)
```

Fig 21. Query relating places in the book with current location

King	Kingdom	Current_Location
balarama	dwarka	gujarat
dhritarashtra	hastinapur	uttarpradesh
shurasena	mathura	uttarpradesh
sishupala	chedi	madhyapradesh
youdhistira	indraprastha	delhi

Fig 22. Figure showing relation between places in the book with current location

Result displayed has three columns – King, Kingdom and present location of that kingdom. One of the result is 'balarama' who is king of 'dwarka' kingdom is now located in 'gujarat' in India.

SPARQL Queries Execution Error- There is an issue with executing my ontology and running it on fuseki Server. One of the most common issues encountered when running queries is that one query does not always provide results in either the protégé or fuseki servers. To fix this, I reinstalled protégé and Apache Jena fuseki to fix the problem. Another problem I noticed while performing was several rows of the same data in the results. This is due to the object properties' cardinality. Even a minor misunderstanding of object characteristics can result in a different answer. I'll have to double-check, confirm, and adjust a number of the attributes to do this.

7.Critical Reflection

One of the inspirations to this topic includes Greek mythology ontology published by (C. Syamili, R.V. Rekha, 2018). They have presented and evaluated nearly 130 queries answering 62 percent of the questions on this topic; that is, 76 out of the 123 questions proposed. There are few questions either partially answered or unanswered. They have clearly visualised the scope of answering the questions and presented list of questions answered, partially answered and unanswered.

Complexity of book

Though this book is quite so popular and known to nearly 2 billion people via Television series according to google search. It is quite difficult to express the same relations via semantic web unlike book. There are too complex relations that can't be handled/entered manually into ontology which needs deep understanding of the past events and interpret. I have limited my ontology to not complicate to certain level for example, my ontology can answer wife, siblings, parents of arjuna but cannot answer -

Ontology can be improved by adding certain classes like time of event or at what time certain event happened which is quite important of clear understanding and connecting points for user. I could not be able to add this in short span of time for all the individuals. According to mythology, there are total of 2736 characters in this book. Adding all these Individuals and relations can build a complex system that can answer most of the unanswered question related to this mythology with more accuracy.

8. Conclusion

There is a utilisation of various techniques and technicalities that were into the construct of the Hindu Ontology. The utilisation of the Protégé-OWL in order to get the domain of maximum expressive content while the same time maintaining the required and needed consistency in the concepts. I have utilised the Protégé in order to capture the conceptual understanding and relational domain modelling of knowledge of the ontologies. The interrelationship of the Taxonomical hierarchy and the required and sought historical data interrelationship were being formulated through this work where the implementation of the ontology is designed and created. A brief description about use of semantic data technologies for implementation of this ontology is discussed. I have designed classes, added relationships, data properties, and defined individuals in the design section.

This is partial implementation of the comprehensive database in order to have the provision of the utilisable structure of information for the required user using the application. The section where the implementation is being done can be describes as having all the features that are being implemented, where the explanation of how the programming language related to PHP will work can have the connection to the Fuseki server through the utilisation of the sparqllibrary() library. This application is not completed as data from Ontology is not rendered with the interfaces. Only the home page where it consists of existing names in the book is presented.

In the section of Evaluation and Use, the SPARQL queries that are utilised through the interfaces of the application get to be described in an in-depth detailing having all the meticulous components. The same has been tested over and over on the Fuseki server to harness the correctness and the accuracy of the delivery. User-friendliness is one of the qualities that we seek and the inbuilt ontology system shows that the same has that quality of user friendliness through the usage of the interface, has the precise information in the crisp and concise manner having short detailing, and gets to be recommended to be utilised as providing reference for any of the in-depth and insightful research that gets done by the user in the future date sometimes.

Lastly, coming to the part of the section of critical reflection, I have explained the similarity in the applications that are available through the web-based medium, having the base for it in order to have the comparison where we can very well conclude that there is needed requirement for improvement of the application where in the versions of the app meant for some future date , a meticulous detailing and charting out of the information could be included on the factors of Ontology where some of the instances could be including short biographies and the chronology of the various events that has taken place at some past date. This will lead first and foremost and the most important way lead to the development of a set of complex queries which would help the researchers come up with accurate and factually correct information as far as possible.

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