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Using Apache Jena Fuseki Server for Execution of SPARQL Queries in Job Search Ontology Using Semantic Technology

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ABSTRACT: The "SPARQL Protocols as well as RDF Query Language" allows users to query information from a database or any other data source that can be mapped to RDF. The SPARQL standard, created and supported by the W3C, allows developers and users to concentrate on whatever they wants to know instead of how a database is organized. The proposed paper presents a Job Search Ontology to help the employers, by recommending the most eligible candidates for a particular job in IT domain and, on the other hand, to propose jobs to the aspiring candidates, matching their profiles with the existing job offers. This paper also discussed the continuous demand for qualified candidates in the Information Technology (IT) domain has empowered the use of e-Recruitment tools, which are becoming more and more exploited at the expense of the traditional methods in this paper. The major purpose of this research is to create an ontologies using the Protégé ontology construction tool, which is then used to run Simple Protocols as well as RDF (Resource Description Framework) Query Language (SPARQL) queries on it. This proposed system utilized Apache Jena Fuseki Server for execution of SPARQL queries for Job Search Ontology and it is very useful in upcoming days.

KEYWORDS: Apache Jena Fuseki, Job Search, Ontology, Semantic Web, SPARQL.

I. INTRODUCTION

The most important challenge faced by the people using the various technological tools is “Getting the Right Information at the Right Time and in the Right Context”. The proposed paper focuses on the importance of Semantic Web in Job Search Ontology development [1]. Using the Job Search Ontology helps to connect people with job opportunities [2]. For example, It includes all of the information needed to do a thorough study of the IT market, such as what capabilities most businesses are looking for, what degree of training and competence candidates have, and what wage expectations applicants have, among other things[3]. The Ontology is created utilizing the most well known Ontology advancement manager "Protégé". For executing the triple straightforwardly Apache Jena Fuseki Server is utilized for beating the limit of Protégé. Apache Jena Fuseki server is utilized for controlling triple straightforwardly, which is unimaginable utilizing the Protégé apparatus. Apache Jena Fuseki is a SPARQL server. It can run as a functioning structure organization, as a Java web application (WAR record), and as an autonomous server. It is utilized for building Semantic web and connected information applications. The field of Web as well as Semantic Web is explored to energize the execution of semantic electronic applications by giving developing information over the web to take benefit in extricating semantic related information, as it empowers the execution of semantic based web applications by giving organizing information over the web to take advantage in removing semantic based data[4]. The World Wide Web (WWW) is a worldwide data sharing and correspondence framework made by Tim Berners-Lee and comprising of three principles: Uniform Resource Identifier (URL), Hypertext Transfer Protocol (HTTP), and Hypertext Mark-up Language (HTML) to actually store, impart, and share different kinds of data [5]. The World Wide Web (WWWW), which is made up of three standards, is the most widely used worldwide information exchange and communication technology. HTML, which is regarded unorthodox in defining and formalizing the meaning of the context, is used to convey information in text, picture, audio, and video forms via the web [6] [7]. The majority of the information supplied is unstructured, making it very difficult to extract concrete data [8]. Although various search engines and screen scrapers have been created, they are inefficient and need a lot of human preprocessing, like characterizing a blueprint, cleaning crude information, physically arranging texts into scientific categorizations, and manual post handling [9]. The notion of "Online Service" was established to promote web interaction and interoperability [10]. Because of its dynamic nature, Web Services have been highly popular in the business in a short period of time. Nonetheless, as the quantity of administrations has developed, troubles with start to finish administration confirmation, approval, information trustworthiness, and classification have arisen[11]. To manage the current online issues. The creators introduced the "Semantic Web," a semantic-based answer for data filtration, security, mystery, and expansion of significant substance in increase show by means of the web[12]. The Semantic Web is a canny epitome and movement of the World Wide Web that gathers, controls, and comments on information by ordering it, permitting steady admittance to assets, and organizing it in a machine-process able way. The possibility of "philosophy" was

created by the Semantic Web to organize data into machine-process able semantic models.

II. LITERATURE REVIEW

R. Valencia-García et al. states that People's social lives, information gathering, staying informed, and problem-solving are all being influenced by social networks. Authors can assume, this tendency is impacting software engineering at several levels. With conventional methodologies, the quantity of data accessible in software development is becoming excessively overwhelming for analytical purposes. This study states semantic technologies advance, they will offer a consistent and dependable foundation for dealing with vast volumes of data. Besides, they offer critical benefit by permitting thinking based usefulness to consequently recover such information in his paper. As indicated by observing this framework which are joins the upsides of semantics and informal communities to work with the structure of gatherings for programming advancement projects. They present a total arrangement that is upheld by a proof-of-idea execution that has been tried with regards to small and medium Enterprises (SME)[13].

Ji Xiang et al. proposed in their review for a patient to address her medical problems, there is an abundance of free wellbeing data open. The scientists exhibit that there are likewise understanding created data sets on the ailments, treatments, and secondary effects that specific patients experience, which are accessible through online entertainment. Clinicians and medical care experts might profit from incorporated data and information intrinsic in open medical services datasets, for example, public wellbeing patterns as well as friendly wellbeing patterns got from patient-produced medical care encounters, while really focusing on patients. The chief goal of this paper is open health datasets, on the other hand, are dispersed and range from organized to very unstructured. An information seeker which must spend time viewing a variety of websites, some of which may be useless, and selecting pertinent material from each to integrate into a cohesive mental picture. Creators are depict a Linked Data system to interfacing different wellbeing information sources and showing logically significant data to patients and medical services suppliers through Social Info Buttons in this review [14].

P. Singto and A. Mingkhwanordered in their examination that Nowadays, there are numerous IT Careers (ITC) that are not kept in a various leveled construction of ITC standard, and watchword based matching ventures are widely utilized yet neglect to give great outcomes. The main problem is that typical ITC search is semantically deficient. They recommend looking through ITC thoughts utilizing philosophy, which is a related determination with semantic comment, in their review. IT Careers Ontology (ITCO) expressed structure comprises of three key parts: IT Career Category, IT Skill, and IT Education, which are point by point with promoting the selecting on internet based work commercials that are models[15].

M. Mochol et al. the authors presents a prototype employment site that leverages semantically annotated job offers as well as candidates in this study. Utilizing Semantic Web innovation, in our view, essentially further develops market straightforwardness, brings down exchange expenses, and rates up the acquirement interaction. Adding semantics, then again, isn't a remedy for all issues. They talk about how the methodology of question estimate might be the establishment for an answer for a few squeezing difficulties in quest for new employment using the framework. They are expanding the prototype using these semantic tools as part of an industry-research collaboration to show a more accurate job search [16].

III. METHODOLOGY

A. Design

Apache Jena Fuseki is a SPARQL server and It can run as a functioning system organization, as a Java web application (WAR archive), and as a free server. Fuseki comes in two structures, a solitary framework "webapp", joined with a UI for administrator and query, and as "main", and a server appropriate to run as a larger deployment. Fuseki gives the SPARQL 1.1 conventions to inquiry and update just as the SPARQL Graph Store convention. It is user-friendly and enables the SPARQL queries to get executed. With the installation of JAVA, it runs as a JAVA web application as an independent server as shown in Figure 1.

B. Apache Jena Architecture

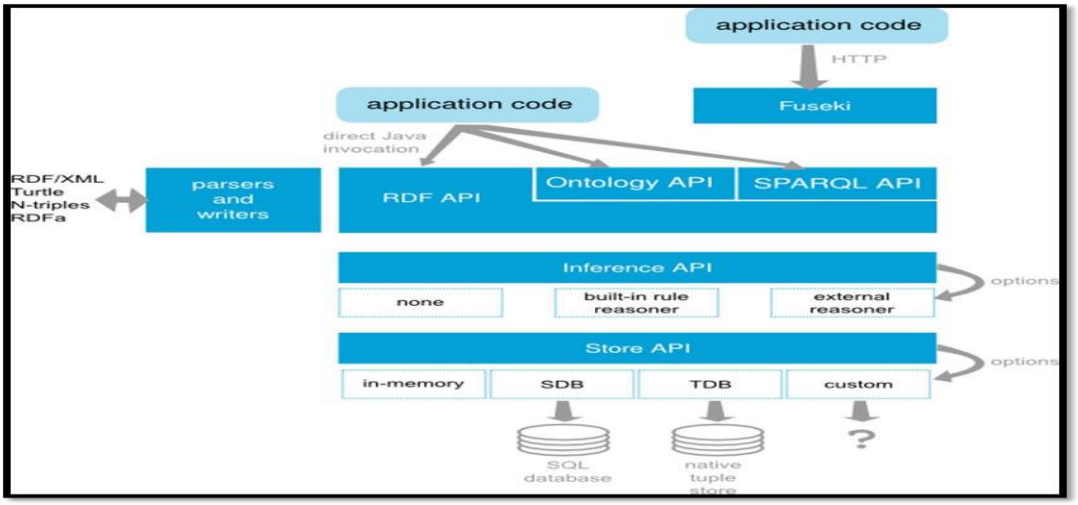

Figure 1: Shows the Apache Jena Architecture (jena.apache.org)

A Key feature of semantic web applications is that the semantic principles of RDF, RDFS and OWL can be utilized to infer information that isn't explicitly mentioned in the graph. Jena's induction API provides a way through which the triples can be shown up in the store though they had been added explicitly. The collection of standards that define semantic web technology includes SPARQL which is a query language for RDF. It is the responsibility of SPARQL API to handle SPARQL for query as well as for update. OWL and RDFS, both the ontology languages are supported in Jena by SPARQL API illustrated in Figure 2. Taking all things together, Fuseki is an information distributing server, which can present and refresh Resource Description Framework (RDF) models over the web utilizing HTTP and SPARQL.

C. Ease Of Use

Working with Apache Jena Fuseki Server to execute the SPARQL Queries on Apache Jena Fuseki Server follow the accompanying advances.

Do the installation of Apache Jena Fuseki Server on C Drive.

Install Apache Jena Fuseki server using Internet and install it in C Drive. Make required folder named “Fuseki” in C drive and save the entire installation files in it. Then run the sever batch file.

Run Apache Jena Fuseki on the Web Browser.

To run Apache Jena Fuseki on the Web Browser, one needs to work on localhost and port 3030. i.e. on the web browser type “//localhost:3030”.

Figure 2: Illustrating the Loading Apache Jena Fuseki on Web Browser.

D. Instruments

a. SPARQL

Users might inquiry data from data sets or any information source that can be planned to RDF utilizing SPARQL, which means "SPARQL Protocol and RDF Query Language." The W3C laid out and took on the SPARQL standard, which permits clients and engineers to focus on what they need to know instead of how a data set is organized.

b. RDF

The Resource Description Framework (RDF) is a norm for communicating arranged information on the web. RDF statements are used to describe and communicate metadata, allowing for the standardization of data sharing based on relationships. RDF is a format for combining data from many sources.

c. WAR Document

Servlets, JSPs, a deployment descriptor, and relevant resource files are all included in each WAR file. The top level of the WAR directory contains static HTML files and JSP. The WEB-INF subfolder of the top-level directory includes tag library descriptor files as well as the following: Classes that run on the server.

d. Ontology

Ontologies are structures for portraying shareable and reusable information across spaces, more or less. They are the establishment for demonstrating top caliber, connected, and lucid information in light of their ability to address associations and high interconnectivity[17].

e. HTML

Website pages are created using HTML, or Hypertext Markup Language. HTML is used by website designers to create text headers and headings, arrange graphics on a site page, link to other pages within a site, and connect too many places. HTML is used for things like web archives and web routing.

E. Data collection

Uploading the Job Search dataset in it.

For uploading the dataset in Jena Fuseki Server we need to click on the manage dataset option. Select the Job search dataset and click on the upload button as shown in the below figure. For adding and uploading more data sets, you need to click on add new datasets option and select the required dataset in it and upload it. After uploading the screen shall look as shown below in Figure 3.

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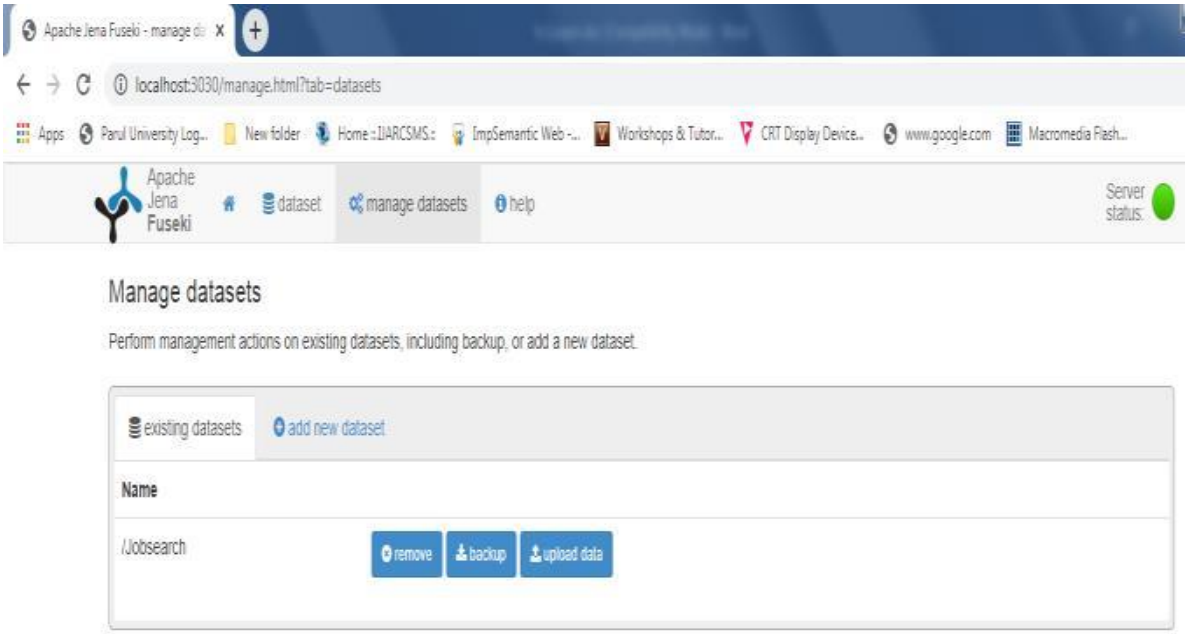

Figure 3: Shows the Uploading the Job Search dataset in Jena Fuseki Server.]

Selecting and uploading the required .owl file.

For the Job Search Ontology, after selecting the data set, we need to select the corresponding RDF supported file formats like .owl, .rdf etc. We are selecting the job search. owl file i.e. the ontology file consisting of its various classes, object properties, data properties and instances as shown below in Figure 4.

Figure 4: Illustrates the Uploading owl file For the Job Search Ontology.

Uploading the system processes.

Finally the system processes the uploaded and Owl file on the Fuseki server and displays the total number of extracted triples as given in Figure 5.

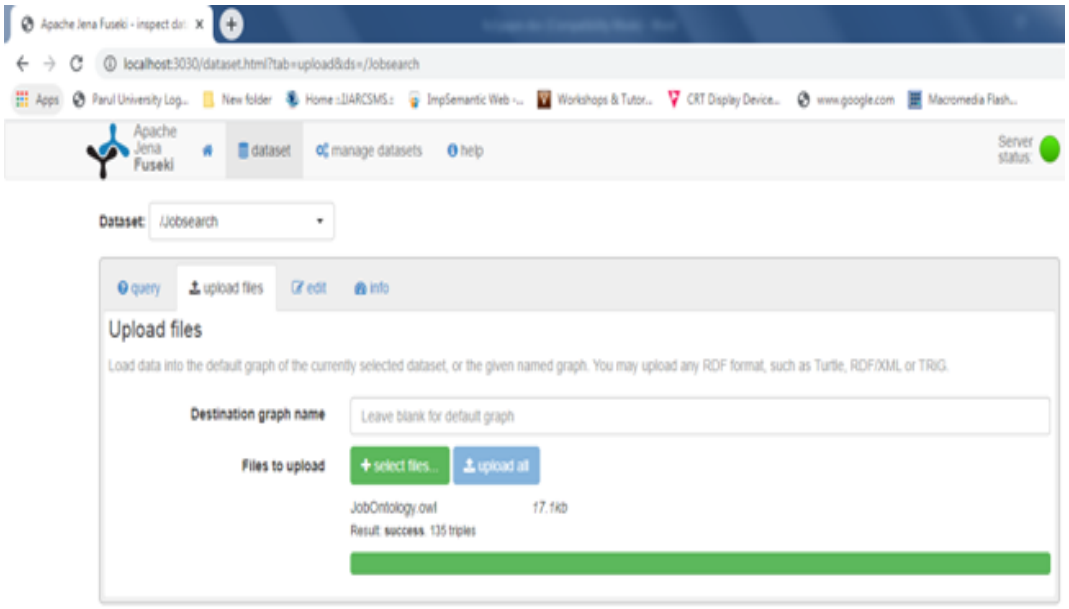

Figure 5: Demonstrate the Uploading of Database of Owl file on the Fuseki Server.

F. Data Analysis

Using Apache Jena Fuseki Server and Executing SPARQL Queries on it.

The Job Search ontology developed using the Protégé tool also enables us to execute SPARQL queries on it. After installing the Jena Fuseki Server and uploading the JobSearch data set and the .owl file, the SPARQL queries can be directly executed on the Fuseki server without using the Protégé tool. The following steps shall be followed for executing the SPARQL queries as shown in Figure 6.

Setup the SPARQL Endpoint. On the browser type "http://localhost:3030/JobSearch/JobOnto. The below figure depicts the setup of the SPARQL Endpoint for the jobsearch ontology.

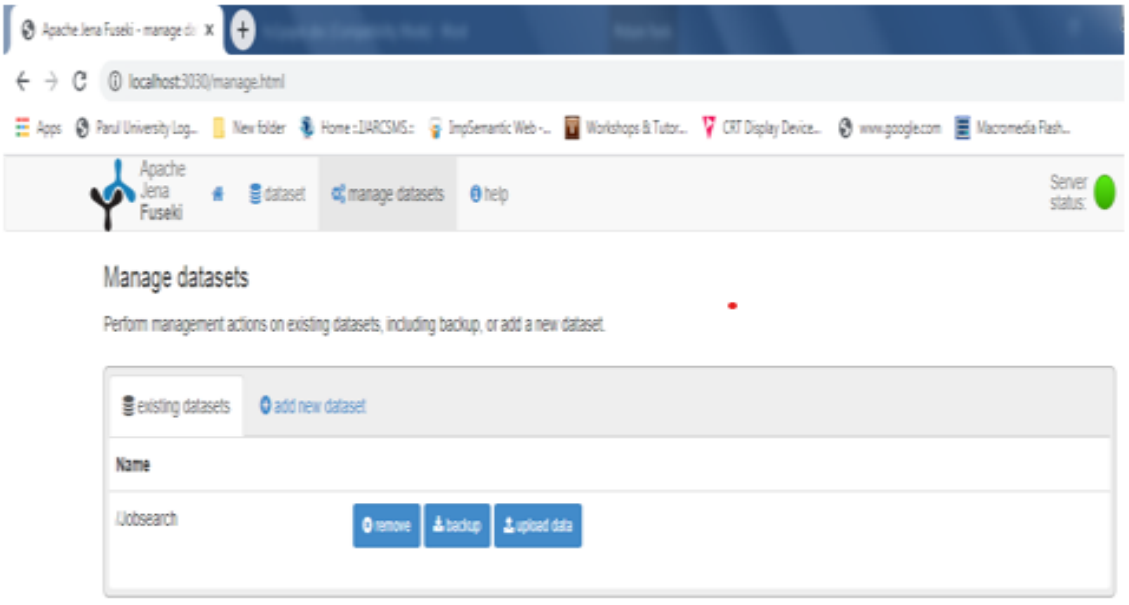

Figure 6: Demonstrate the six SPARQL Endpoint Setup.

Writing and executing a basic SPARQL query for displaying the subject, object and predicate for the given JobSearch ontology. For executing the SPARQL query we need to click on the Run (Play) button, which then displays the result of the query as shown in Figure 7.

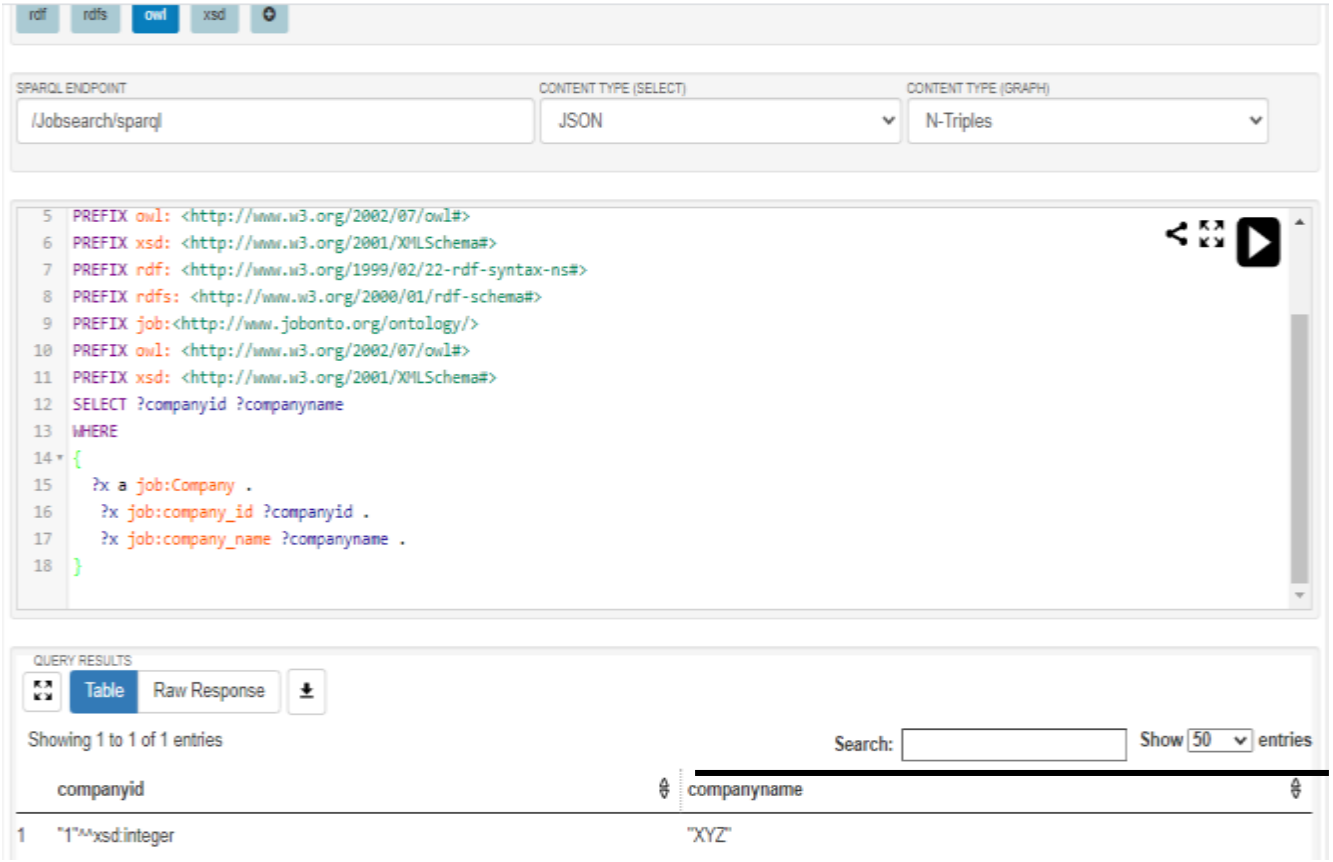

Figure 7: Illustrates the Query Execution for displaying the subject, object and predicate.

IV. RESULT AND DISCUSSION

Using Semantic Web advancements in the areas of internet enlisting and ability the executives, we accept, may resolve these issues while likewise fundamentally expanding market straightforwardness, bringing down exchange costs for businesses, and accelerating the acquirement interaction. Each situation contains an innovation part that takes utilization of the normal accessibility of semantic advances before long, as well as an arrangement part that expects the fundamental data is accessible in machine-lucid structure. The mix of these two expectations empowers us to make e-business situations for investigation and trial and error from one perspective, and to offer remarks about the impacts of new innovation on situation players at the present beginning phase of advancement on the others. The information exchange between organizations, up-and-comers, and occupation entrances in a Semantic Web-put together enlisting situation is worked with respect to a bunch of vocabularies that give normal phrasing to portray employments, modern areas, and occupation capacities. In this specific circumstance, the foundation of a HR metaphysics was the initial move toward understanding the Semantic Web e-Recruitment situation (HR-cosmology). The metaphysics was intended to be utilized in a place of work to work with semantic coordinating (a technique that consolidates explanations utilizing limited vocabularies with earlier data about a particular application area) in work looking and acquisition processes. One more critical need was to incorporate client requests into the Semantic Web-based business webpage, which is presently standard practice in the business. We zeroed in on how vocabularies might be created from norms at present being used in the selecting area and how the information combination framework can be coordinated with existing non-RDF human-asset frameworks as per this detail.

A. Output of Executed Query

Execute Query is a database tool built completely in Java that is independent of the operating system as shown in Figure 8. Execute Query makes it easy to interface with nearly any database, from basic queries to table creation and the import/export of a whole schema's data, thanks to the flexibility given by Java Database Connectivity (JDBC).

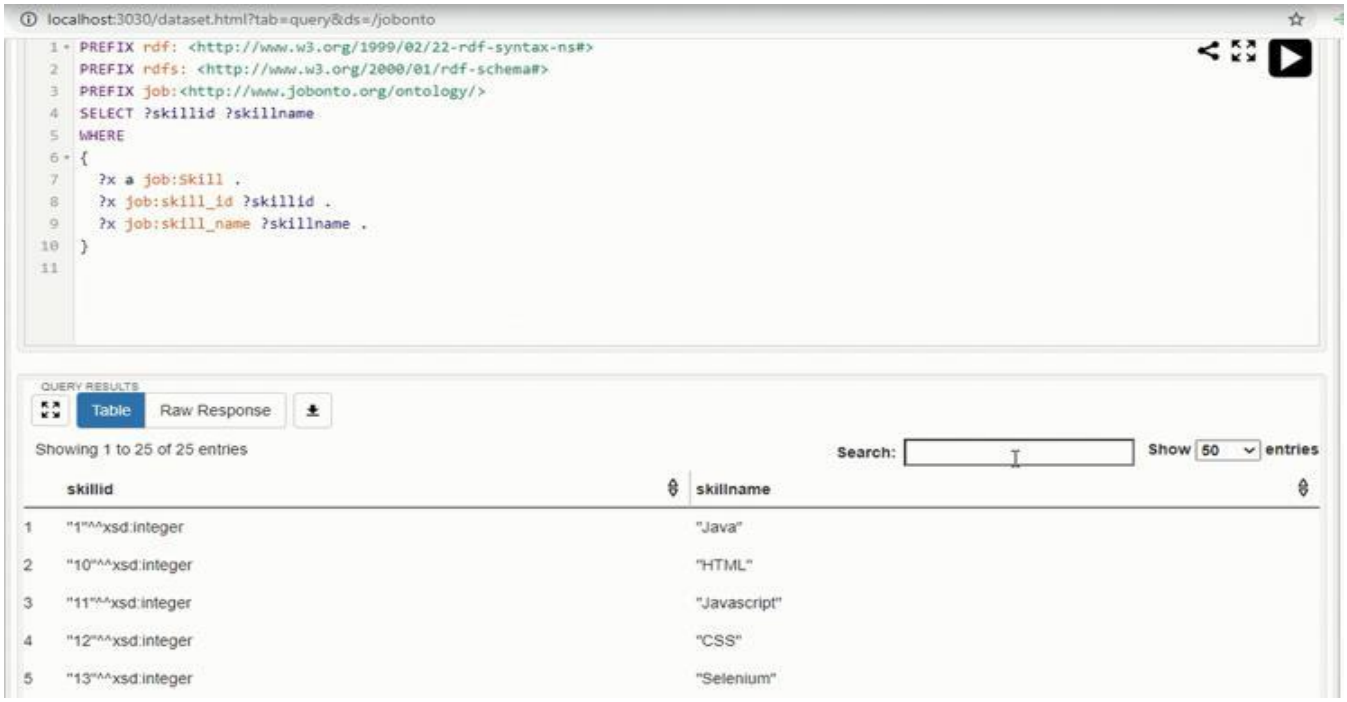

Figure 8: Illustrates the Output of Executed Query.

A. Select Query

Query to display the execution of SPARQL query on a single dataset.

Displaying the skill details like skill id and skill name.

To display all the company names

PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd:
<http://www.jobontologyportal.com/ontology#>
SELECT?cid ?cname
WHERE
{
?x a test:Company .
?x test:company_id ?cid .
?x test:company_name ?cname .
}

On execution of the above query following output is received

Query to find the total number of employers belonging to different companies.

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> PREFIX owl:
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd:
PREFIX job:
<http://www.jobontologyportal.com/ontology#>

On execution of the above query following output is received.

V. CONCLUSION

The proposed research paper has presented the concepts of ontology for Job Search using the semantic technology and also how Jena Fuseki Server can be integrated with Protégé for execution of SPARQL queries for the proposed job search ontology dataset. The entire process starting from installation, setting up the dataset, the supported file types and querying the data set is depicted. Various types of SPARQL queries including Select, Insert, Update and Delete are implemented on the ontology through Jena Fuseki Server are also presented, which shall ease out the process of integrating any interface developed in any language eg. PHP with the Jean Fuseki Server. The proposed research shall benefit any researcher as Apache Jena fuseki can easily get integrated with PhP platform to show the working interface of any ontology. The researcher shall further develop a PhP interface using which the proposed JobSearch portal can be accessed the way we access through any WWW supported interface.

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