Map-Me-Mate

Karthikeya Sai Boggarapu, Paul Nischal Samuel Bhushanam,
Rohith Gottipati, Shyam Prasad Yanamaddi and
Vinaykumar Chalamalla

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1st Karthikeya Sai Boggarapu
dept. of Software Engineering
Arizona State University
Tempe, Arizona
kboggara@asu.edu

2nd Paul Nischal Samuel Bhushanam
dept. of Software Engineering
Arizona State University
Tempe, Arizona
pbhusha1@asu.edu

3rd Rohith Gottipati
dept. of Software Engineering
Arizona State University
Tempe, Arizona
rgottipa@asu.edu

4thShyam Prasad Yanamaddi
dept. of Software Engineering
Arizona State University
Tempe, Arizona
syanamad@asu.edu

5th Vinaykumar Chalamalla
dept. of Software Engineering
Arizona State University
Tempe, Arizona
vchalama@asu.edu

***Abstract*—Generally, most of the international students face difficulties while searching for accommodation in the vicinity of university. They try different ways, such as contacting the leasing officer, brokerage sites which consume lot of money and wastage of time with meagre output. Furthermore, students even face difficulties while searching for roommates as certain people have different food habits and culture. To make this process easier and hassle-free, a web application is developed which optimizes the accommodation booking process and finding roommate. We have come across many applications with different filters and information fetching sites. The purpose of this study is to develop a web app which works to give the Semantics with certain unique features like budget, transportation facilities, communal harmony, security, grocery stores and many more.This web app is useful to provide boarding house information and communication with leasing managers, owners and tenants.**

***Index Terms*—Web semantics, Ontology, Shopbot, Boarding house-information, Notifications, Geo-locator.**

I. Introduction

The basic vital necessities of human are food and shelter. In the student phase of life most of them prefer quality education to gain niche skills and prefer to migrate to different countries for studies. They travel to an entirely different geographical location which has different climatic conditions. So,when the students step into the countries like United States of America they need to have shelter primarily. Most of the students are ambiguous to which university they do travel as they have to get admit. After that they do literally have a short time to get an accommodation and are prone to make errors while choosing shelter.

The accommodation booking is a rigorous process. It involves lot of human effort and precious time. As majority of students are new to the locality they need to contact travel advisors, multiple leasing managers, family persons, mutual friends. Despite, the presence of many housing arenas in the vicinity of university area, finding the right and legitimate place is an Herculean task, especially for international students.

In this modern era, with the advancement of technology and internet has created wide access of information. Technology plays a greater role in fetching the information and it reduces human effort. Technology is rapidly growing and updating. The use of technology in the rental applications has existed even before this study with partial success. There are many more applications such as booking a banquet hall, hotel or boarding houses. However, there is lot of inconsistent data and even sometimes irrelevant data is present. If someone wants to find a room according to his preferences, the information may not be fetched accordingly even after applying several filters. This is mainly due to the loss of relationship between the data while translating the web information to machine processable data. In order to overcome this relying on unreasonable effectiveness of data, we need to implement semantics. It is basically a vision about an extension on the existing technology of World Wide Web. It provides machine-interpretable metadata of the published data. It will add further data descriptors to otherwise existing content and data on the web.

The purpose of this study is to develop an web application incorporating the Semantics, Web Services and Application Program Interfaces to provide information about boarding houses and then evaluate it. This application can be accessed by room-seekers, existing tenants and building managers.

II. Problem Statement

As we geared up to enter a new country post our visa interview, the most essential part was to find an accommodation for ourselves, we used a manual approach to find out about the best place to live and this was a long and tedious process. Thinking about this we found a need for an application which would offer us places to live in an unknown country; like a guide who knew us personally; in a custom made manner.

III. Literature Review

The literature review is carried out to study and analyze the similar studies carried out on the specific topic. We got the problems and difficulties faced by an individual while booking an accommodation in an unknown area[1]. We have gained the transition of knowledge about the skeleton framework which is generally followed in the implementation of the web application. The back-end process followed in the development of the application such as the Application Program Interfaces used and many more technologies[2]. The similar kind of ideology is implemented in other application such as venue booking[3], where they are using PACT framework. Furthermore, we have gone through various other publication which involve advanced features such as dynamic implementation based on real time occupancy for meeting room scheduling[4]. Also there are instances where the individual is ambiguous and may not take proper decisions[5] where they used Flutter and open access. We have also gone through advance reservation system which most of the people prefer such as in Hotel booking segmentation[6] and there are even chances that the individual may even dislike the accommodation after experiencing lively.

Yes, there are many sites that give you locations based on you preferences, but what sets our application aside from these is that we are going to also have a feature of temporary accommodation provision availability which will map people who will enter a new country before their lease date to people looking forward to offer temporary accommodation, all this still under the preference of stay of the student. In such a way we have a win win situation. The injection of ontology and metadata strengthens our application and makes is easy accessible for inter-operability by the machine as it can understand the context without hassle. This application consists of the unique feature of temporary accommodation. As the international students have to spend prices for accommodation which are exorbitant, it will be beneficial for them to book a temporary stay with economical budget. So, here the role of existing tenants is vital. As, they will provide us the data of vacancies available in their apartment. This ideology has been grabbed from SRide application where the existing vehicle owner posts the information about the ride availability and the prices charged are less compared to commercial sites.

Moreover, we have referred the organization and visualization of the data representation through online sites for availability of apartment[8]. Furthermore,the differentiation in the interfaces has been figured out through other sites as well[9]. The development of this application needs many other technological implementations. Moreover, we have referred the organization and visualization of the data representation through online sites for availability of apartment[8]. Furthermore, the differentiation in the interfaces has been figured out through other sites as well[9]. Even there are few applications[10] which exclusively run on mobile. The development of this application needs many other technological implementations.

IV. APPROACH AND HIGH-LEVEL SYSTEM DESIGN

A. HIGH LEVEL DESIGN

Client will have a search option to search for an accommodation nearby university. Once the search request is submitted it will be processed to the corresponding REST API controller along with the input data (search query). Now the Controller API processes the request using query execution engine. In the application we have three different ontologies and datasets have been deployed on three different cloud environments. Created an endpoint using the fuseki server. Now the API server will execute the federated query on all over the three datasets using the query execution engine on the provided endpoints. This query engine will produce the corresponding query result as response back to the API Controller. API Controller will structure the data as per the client request and the same data will be served back as http response to client. This response will be visualized on the client machine. Now user can apply the various filters like rating, review, rent to get the better query output.The high level design of the application is depicted in the form of Fig 1 below.

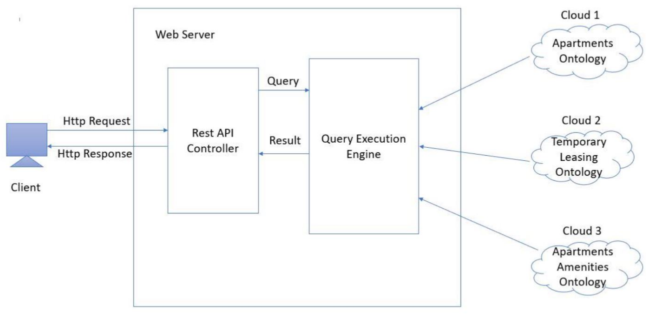


Fig. 1. Map Me Mate High Level Design

B. ONTOLOGY DESIGN AND VISUALIZATION

In Map-Me-Mate project we are including 3 ontologies deployed on three different clouds.Once the user ,mainly student ,who is in need of an accommodation visits Map-Me-Mate and he/she will select the university from the drop down , select his preferred ratings, apartment size and rent range, then a federated query will run at the back end and he will be offered with the apartment list and details about the apartment from which he can make the choice. Next he will be given an temporary accommodation option from which he/she will be given the names of those offering temporary accommodation and their rental demands.The user can user the filters to meet his/her required amenities. The Ontologies are 1)Apartment Ontology: Having the list of Apartments and their details like Apartment name, apartment website URL, apartment address, phone number, the reviews about the apartment, the area of the apartments, the rent range and the apartment descriptions. Every Apartment, University, Person offering temporary accommodation and locations have a unique ID.This the prime ontology which we have created.. The below figure Fig 2 depicts the Apartment Ontology.

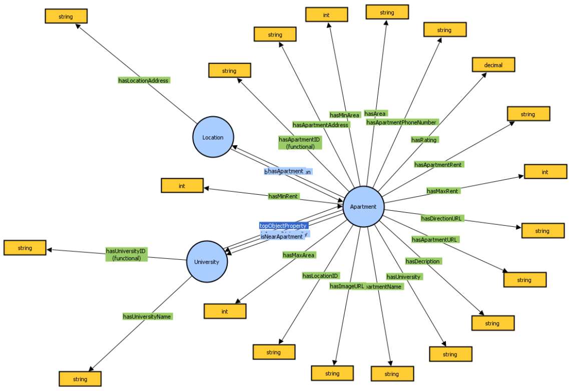


Fig. 2. Apartment Ontology

2)Temporary Leasing Person Ontology : Having the list of all those people offering Temporary accommodation along with the details like their, gender, course, nationality and semester which they belong to will be helpful while choosing accommodation as few students prefer to stay with roommates who are pursuing the similar course in the college which will be helpful in their career perspective. All these fields have unique Ids. We have also included the id numbers for the countries and the courses as well which make the search easier as you will be provided with an additional filter which is feasible. Below figure Fig. 3 that depicts the Temporary Leasing Person Ontology.

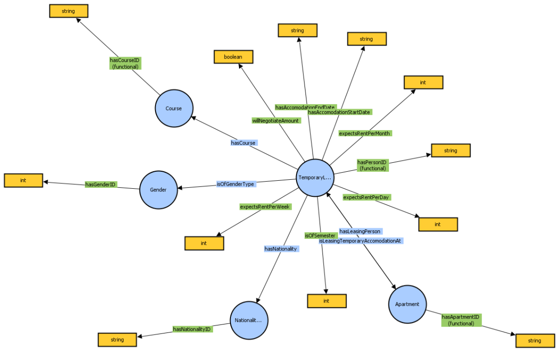


Fig. 3. Temporary Leasing Person Ontology

3)Apartment Amenities : Having the list of all the Apartments in our cloud with the banks ,bus stops ,ATM's ,hospitals ,grocery stores, food outlets and their distance from apartment. So, basically the different resources which are useful on a regular basis in the vicinity of the apartment are considered. Below figure Fig 4 depicts the Apartment Amenities Ontology Visualization.

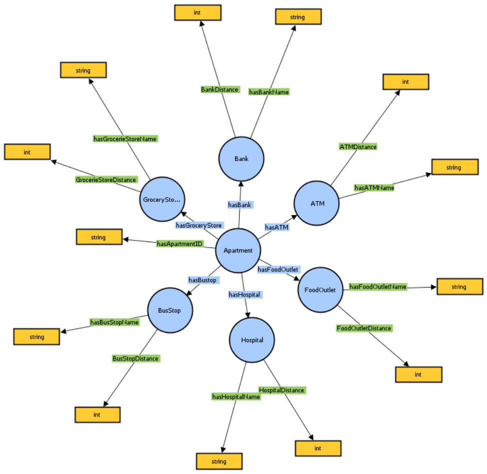


Fig. 4. Apartment Amenities Ontology Visualization

C. DATA COLLECTION AND PROCESSING

We have taken a wide range of resources into consideration while collecting our data. The main resource we have referred to is the website called Apartments.com[8] for our application. This application provides us with accommodation details for the students which are primarily focusing on. The various data sets which we are using are as follows: Apartment details, Amenities and Temporary Leasing details data sets.

We have used different tools like parse hub executable, web scrapers such as python scraper and scripting codes for fetching the data. The data fetched by us includes quantitative and qualitative data and some of the raw data has problems such as redundancy, different format, missing data. For our ease of cleaning, we have used numpy stack and IDE Spyder. In the processing of raw data, we have removed unwanted data, duplicates and outliers as well. We have fixed the data format and filled the major gaps. The final processed data is stored in the form of excel with three different data sets named previously.

D. IMPLEMENTATION PLAN AND TASKS

1)Usage of Cellfie plugin for creating instances in protégé using the datasets. 2)Selection of the type of cloud to deploy three different ontologies. 3)Fuseki server implementation and building end point. 4)Implementation of Federated query on all the datasets. 5)Configuring and running the query execution engine. 6)Implementation of REST API controllers. 7)Implementation of Front End using JSP. Implementation of back end using spring boot and java.

E. ROLES AND RESPONSIBILITIES

(1)VinayKumar Challamala :
Backend Developer, Cloud Infrastructure.

(2)Paul Nischal Samuel Bhushanam :
Creating Ontologies, Data Collection,
Fuseki Server Configuration, Ontology Visualization.

(3)Rohith Gottipati :
Front End Developer and Documentation.

(4)Karthikeya Sai Boggarapu :
Backend Developer and Documentation.

(5)Y.Shyam Prasad :
Front End Developer and Writing Queries.

F. FUTURE SCOPE

We are planning to implement the recommendation system using liked data and other similar concepts. As we are aware that the recommendation system is in boom now-a-days and is successful in winning the hearts of the users. As every recommendation system requires the background data, inputs and various algorithms such as collaborative filtering, content based and knowledge based recommendation.

Our recommendation system will work on the following factors: It shows nearby apartment which are reviewed by students have similar preferences. It is mostly based on the high ratings and good reviews. The recommendation system also includes other factors such as reasonable rate, amenities, the distance between the various stores and other criteria.

Furthermore, we would be dwelling further in data analytics and we will create a visualization of our data and include statistical graphs and various mathematical implementations. This will create a visual treat for the user as the data would be well organized and easy to understand as it is lucid.

G. TOOLS AND TECHNOLOGIES USED

Front End: HTML5, CSS3 and Material Bootstrap,JSP
Back End: Spring Boot Framework, Java Programming.
Tools: Protégé, VOWL, cellfie plugin, SPARQL, Apache Jena fuseki server, parse hub and beautiful soap(web scraping)

V. IMPLEMENTATION

In our project Map-Me-Mate we are including different features in order to book an apartment by the student. They are provided with wide range of options to book according to their choice. This section includes various details involved in the implementation of our project.

A. DATA GENERATION AND MAPPING

Data generation and Mapping: We have referred several external resources and live websites for fetching the data. In the phase of gathering and collection of the data we used different tools like ParseHub. This is a powerful tool used for web scraping and assists the user to extract the desired data without redundancy. Also, we have combined the data from different sources into one sheet using numpy stack in Jupyter notebook and randomized generator with shuffling functions for trivial fields in the data. We have also used multiple scripts containing user defined functionalities for easy collection and organization of data.After referring to many websites we have created approximately more than 120 thousands of axioms.

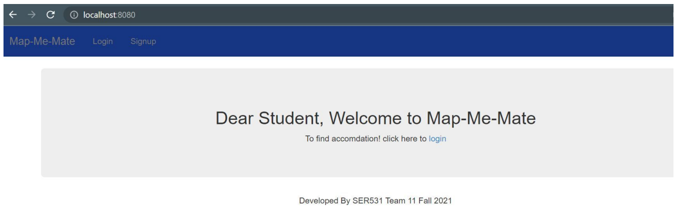
We have used cellfie plugin for mapping our data with the entities which are present in the ontologies. These ontologies are created in Protege tool and the plugin is installed to this tool. It's functionality is beneficial as it directly links the data present in the excel sheets which was previously generated during the data generation phase with the entities present in the ontologies.

B. FRONT END

The presentation layer which acts as the mediator between the user and the application layer for visualization i.e Front end part is implemented using HTML5, CSS3 and Bootstrap, JSP for styling and attractive appearance of buttons, navigation bars, drop down

C. USER INTERFACE

The student aka user is provided with a home page when they navigate to Map-Me-Mate site, where they generally login if they are an existing user or else they have to register in order to enjoy few privileges which are provided for registered users. After they login they can view an interface page with drop down provided for selection of the particular college which the student wants to select and then gets navigated to other page. They can view the various apartment in the vicinity of the university. The student is also provided with an option to filter certain fields and fetch the apartment list according to user requirements such as the minimum budget and maximum budget which they are capable of affording and also they can choose rating of the apartments on a scale of 1 to 5. This rating helps in the selection of apartment which is mostly preferred by students. This rating has been given to a particular apartment by the residents and guests who have visited this apartment previously. In the next step i.e. after entering all the fields required and setting the filter criteria the user can view the list of apartments with description and images if generally available. If we select the particular apartment it will be viewed along with the amenities provided in the apartment and rent for it. They can also view the availability of temporary accommodation available in that particular apartment during a certain time duration. Furthermore, there would be other apartments recommended to the user which other users has searched with similar preferences.

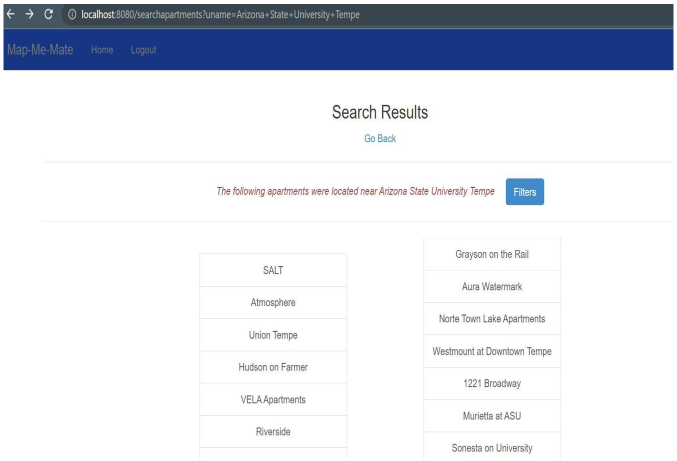


Dear Student, Welcome to Map-Me-Mate

To find accomdation! click here to login

Developed By SER531 Team 11 Fall 2021

Fig. 5. Home Page of the website


localhost:8080/searchapartments?uname=Arizona+State+University+Tempe
Map-Me-Mate
Home
Logout
Go Back
Filters

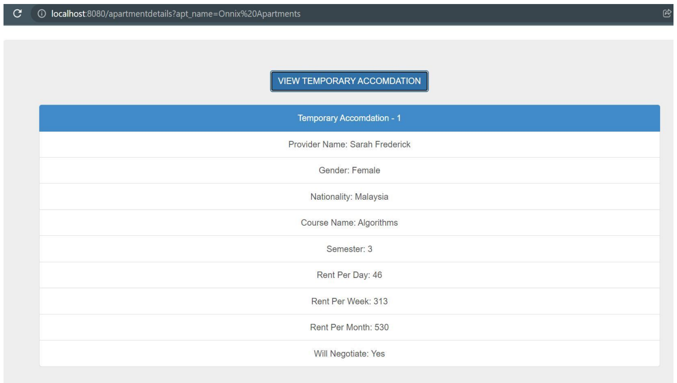
Search Results

The following apartments were located near Arizona State University Tempe

SALT
Atmosphere
Union Tempe
Hudson on Farmer
VELA Apartments
Riverside

Grayson on the Rail
Aura Watermark
Norte Town Lake Apartments
Westmount at Downtown Tempe
1221 Broadway
Murietta at ASU
Sonesta on University

Fig. 6. Apartment Search Results


localhost:8080/apartmentdetails?apt_name=Onnix%20Apartments
VIEW TEMPORARY ACCOMDATION

Temporary Accomdation - 1

Provider Name: Sarah Frederick

Gender: Female

Nationality: Malaysia

Course Name: Algorithms

Semester: 3

Rent Per Day: 46

Rent Per Week: 313

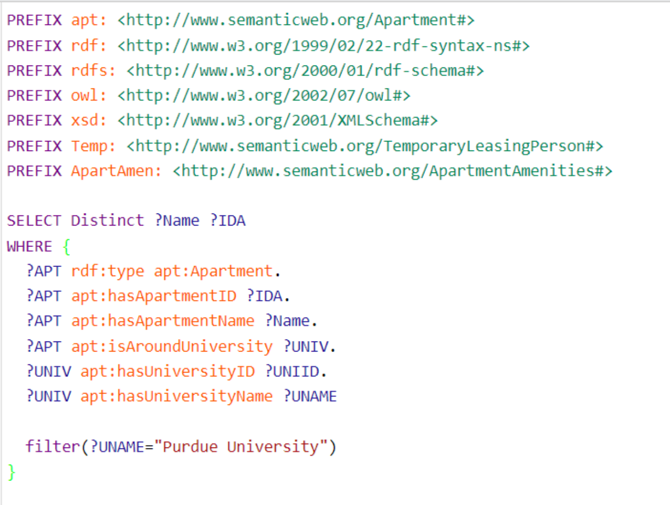
Rent Per Month: 530

Will Negotiate: Yes

Fig. 7. Temporary Accommodation

D. SPARQL QUERYING

We have implemented various SPARQL queries for our application. Among them one of the query returns the results based on the university ID which is unique number for a certain university. Initially, when a user logs in to the website he is provided with a vast range of universities in the drop down and the user selects a university and click on the search button to find the apartments nearby.

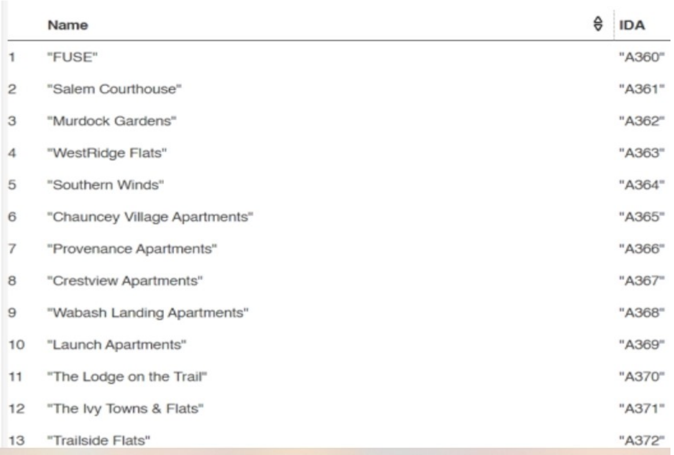


```
PREFIX apt: <http://www.semanticweb.org/Apartment#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX Temp: <http://www.semanticweb.org/TemporaryLeasingPerson#>
PREFIX ApartAmen: <http://www.semanticweb.org/ApartmentAmenities#>

SELECT Distinct ?Name ?IDA
WHERE {
  ?APT rdf:type apt:Apartment.
  ?APT apt:hasApartmentID ?IDA.
  ?APT apt:hasApartmentName ?Name.
  ?APT apt:isAroundUniversity ?UNIV.
  ?UNIV apt:hasUniversityID ?UNIID.
  ?UNIV apt:hasUniversityName ?UNAME

  filter(?UNAME="Purdue University")
}
```

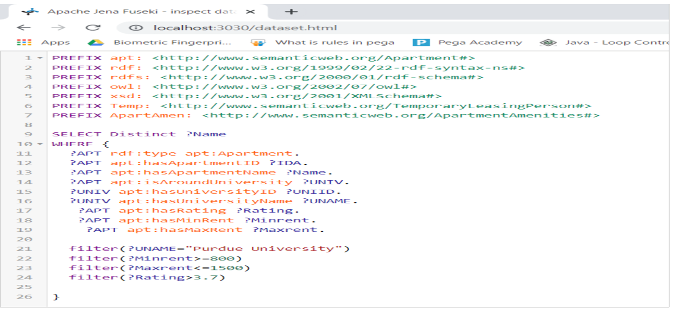
Fig. 8. To Query the apartments



	Name	IDA
1	"FUSE"	"A360"
2	"Salem Courthouse"	"A361"
3	"Murdock Gardens"	"A362"
4	"WestRidge Flats"	"A363"
5	"Southern Winds"	"A364"
6	"Chauncey Village Apartments"	"A365"
7	"Provenance Apartments"	"A366"
8	"Crestview Apartments"	"A367"
9	"Wabash Landing Apartments"	"A368"
10	"Launch Apartments"	"A369"
11	"The Lodge on the Trail"	"A370"
12	"The Ivy Towns & Flats"	"A371"
13	"Trailside Flats"	"A372"

Fig. 9. Output of the above Query

In the next query, the user enters the filter criteria such as the minimum and maximum budget range that they can afford for the apartment and also the rating for the apartment. Here, we should give the integer values as the input for the budget and it does not accept any other format such as string.After entering all these details the resultant apartment list is displayed on the basis of the SPARQL query written.The query and the result are shown in the images.



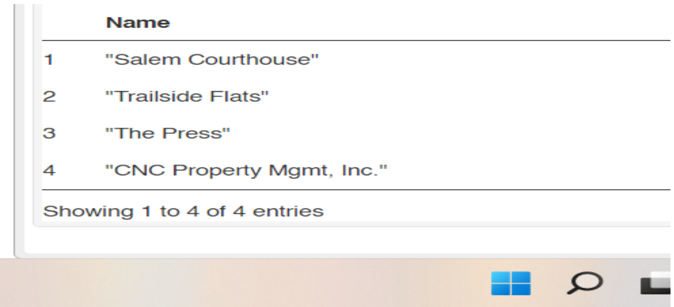
```
PREFIX apt: <http://www.semanticweb.org/Apartment#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX Temp: <http://www.semanticweb.org/TemporaryLeasingPerson#>
PREFIX ApartAmen: <http://www.semanticweb.org/ApartmentAmenities#>

SELECT Distinct ?Name
WHERE {
  ?APT rdf:type apt:Apartment.
  ?APT apt:hasApartmentID ?IDA.
  ?APT apt:hasApartmentName ?Name.
  ?APT apt:isAroundUniversity ?UNIV.
  ?UNIV apt:hasUniversityID ?UNIID.
  ?UNIV apt:hasUniversityName ?UNAME.
   ?APT apt:hasRating ?Rating.
   ?APT apt:hasMinRent ?Minrent.
    ?APT apt:hasMaxRent ?Maxrent.

  filter(?UNAME="Purdue University")
  filter(?Minrent>=800)
  filter(?Maxrent<=1500)
  filter(?Rating>3.7)

}
```

Fig. 10. Displaying Apartments

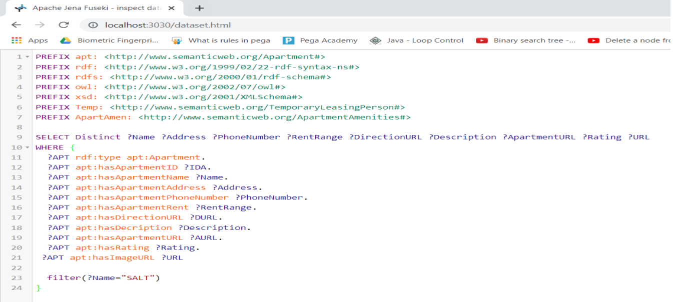


	Name
1	"Salem Courthouse"
2	"Trailside Flats"
3	"The Press"
4	"CNC Property Mgmt, Inc."

Showing 1 to 4 of 4 entries

Fig. 11. Output of the above second Query

The following SPARQL query, displays the apartment with the description about it and details like rating, rent and so on after the selection of the apartment in the previous step.

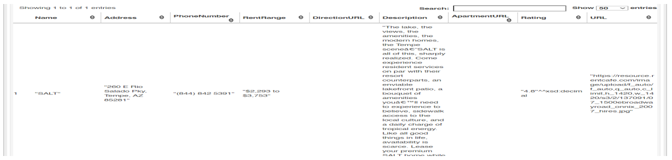


```
PREFIX apt: <http://www.semanticweb.org/Apartment#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX Temp: <http://www.semanticweb.org/TemporaryLeasingPerson#>
PREFIX ApartAmen: <http://www.semanticweb.org/ApartmentAmenities#>

SELECT Distinct ?Name ?Address ?PhoneNumber ?RentRange ?DirectionURL ?Description ?ApartmentURL ?Rating ?URL
WHERE {
  ?APT rdf:type apt:Apartment.
  ?APT apt:hasApartmentID ?IDA.
  ?APT apt:hasApartmentName ?Name.
  ?APT apt:hasApartmentAddress ?Address.
  ?APT apt:hasApartmentPhoneNumber ?PhoneNumber.
  ?APT apt:hasApartmentRent ?RentRange.
  ?APT apt:hasDirectionURL ?DURL.
  ?APT apt:hasDecription ?Description.
  ?APT apt:hasApartmentURL ?AURL.
  ?APT apt:hasRating ?Rating.
 ?APT apt:hasImageURL ?URL

  filter(?Name="SALT")
}
```

Fig. 12. Filtered Apartments



Showing 1 to 1 of 1 entries

Search: Show 50 entries

	Name	Address	PhoneNumber	RentRange	DirectionURL	Description	ApartmentURL	Rating	URL
1	"SALT"	"260 E Rio Salado Pky, Tempe, AZ 85281"	"(844) 842 5391"	"$2,293 to $3,753"		"The lake, the views, the amenities, the modern homes, the Tempe sceneâ€"SALT is all of this, sharply realized. Come experience resident services on par with their resort counterparts, an enviable lakefront patio, a bouquet of amenities youâ€™ll need to experience to believe, sidewalk access to the local culture, and a daily charge of tropical energy. Like all good things in life, availability is scarce. Lease your premium SALT home while		"4.8"^^xsd:decimal	"https://resource.rentcafe.com/image/upload/f_auto/f_auto,q_auto,c_limit,h_1420,w_1420/s3/2/137091/07_1500ebroadwayroad_onnix_2007_hires.jpg"

Fig. 13. Output of the above third Query

In the last query the temporary accommodation details are displayed based on the availability of it in the apartments posted by the resident on the site who are already existing users of the site. The details and tentative move-in date are also displayed as resultant output of this query.Using this query as main query the apartments recommended are also fetched and displayed below the apartment.

E. APPLICATION EVALUATION

We had a real time problem as the case study and we used that to implement the project. This application will be mainly useful for those who are looking for temporary accommodation with the required amenities.

F. CHALLENGES FACED

Large sets of data needed to be collected for creating instances to the entities present in the ontologies. This data needed a lot of collective effort as it was diverse and distinct.

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