COMP 6741

Intelligent Systems

Project Report

Submitted to: Prof. Dr. Rene Witte

Team id – FL_G_5

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1. Introduction

This assignment is part of the COMP 6741(Intelligent System) project work. In this first and second part of the project, we focus on developing University chatbot as efficient as possible. Unibot is an intelligent agent that answers university, their course and student related questions. We present competency questions, schema definition, knowledge base and queries designed as a part of intelligent system. Also, we have added RASA model and DBpedia links in the knowledgebase.

2. Competency Questions

We create the following competency questions to design our agent.

1. What is course [course] about?
2. Which [topics] [student] competent in?
3. Which [courses] at [university] teach [lecture]?
4. Which [topics] are covered in [course]?
5. What is the name of [course] [lecture]?
6. How many courses does the [university] offer?
7. How many [topics] are covered in [course]?
8. Does [course] have labs?
9. What is the course Credit of [course]?
10. Which [course] [student] will take again?

3. Vocabulary

Our schema has multiple classes and properties, which are defined using both existing vocabularies and newly created vocabularies. Whenever it's possible to reuse existing vocabulary, we try to use it keeping in mind whether it is logically correct or not.

We have used following existing Vocabularies for defining schema:

rdfs: <http://www.w3.org/2000/01/rdf-schema#> .

rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

xsd: <http://www.w3.org/2001/XMLSchema#> .

foaf: <http://xmlns.com/foaf/0.1/> .

vivo: <http://vivoweb.org/ontology/core#> .

RDF is useful for defining the overall structure of the vocabulary. RDF schema is the key tool for defining schema as it provides facility for creating classes, properties, label, comment and many more. FOAF is most famous ontology for defining person, activities and their relations. VIVO ontology is useful for defining different Courses. These ontologies provide flexibility as well as connections with the mainstream vocabularies.

Other than this we developed following vocabulary extension for fulfill the project data requirement:

uni: <http://uni.io/schema#> .

unidata: <http://unidata.io/data#> .

UNI is defined for managing the whole university schema. We can treat it as a base library of Unibot. It is useful for defining many classes and their respective properties. UNIDATA is the data part of the UNI schema. By using this we are able to store whole university data in the knowledge base.

There are main 5 classes in the vocabulary:

(1) University

(2) Course

(3) Lecture

(4) Topic

(5) Student

Other than this we defined 5 subclasses of the Lecture class for fulfilling the requirement of storing detailed data.

Lab, Slide, Worksheet, Tutorial, Readings.

We have tried to use as many existing properties but still need to define some new properties. As described in below table, all the properties are defined with their domain and range to make it sensible and understandable.

Property	Domain	Range
offers	University	Course
courseName	Course	Literal
courseSubject	Course	Literal

courseNumber	Course	Literal
courseCredit	Course	Literal
courseDescription	Course	Literal
lectureNumber	Lecture	Literal
lectureName	Lecture	Literal
hasLectureContent	Lecture	Literal
in_a	Lecture	Course
Covered_by	Topics	Course
id	Student	Literal
hasTaken	Student	Course
hasGrade	Student	Literal
willRetake	Student	Course
cTopic	Student	Literal

4. Knowledge Base Construction

Dataset description

Our dataset contains mainly three things. Two csv files for the course information and student information and Course directory containing all the material of the two special courses.

For filling out the most required fields in our knowledge Base, we found CATALOG.csv as most compatible for our project from the https://opendata.concordia.ca/datasets/.

As per the project description we gathered two subject information form the Moodle website. First course is the current course (COMP474/6741) and second one is COMP6721 taken in the past.

Lastly, there is no student data available as per the project requirement, so we created it form the scratch and use it as a student dataset.

Process and developed tools for populating the knowledge base

Firstly, for working with the csv file we have used in-built python module namely CSV module. It provides classes for reading and writing tabular information in the csv file format. We have used the open() method for opening csv file and then used the DictReader class for mapping csv file data into the dictionary format.

For populating knowledge graph using python we have used RDFLib, which is pure python package useful for working with RDF. It provides different facilities like parser, serializers and graph interface. It is open source and maintained in a GitHub repository.

After adding the University details manually, first thing we need to add is Lecture and Course information. We have two special subjects COMP474/6741 and COMP6721, for that as mentioned we have all the information collected in the dataset. Using RDFLib and functionality graph, we are able to parse the data in the knowledge base. RDFLib also provide facility to define namespace and allow to use existing namespace, which is useful for providing useful URIs of the DBpedia and reuse the existing vocabulary.

After extracting course and lecture details, next task was mapping the documents of the lectures. We used local URIs to map lecture materials available in the dataset. As mentioned in dataset some information like Topics covered in course and their DBpedia sources were not available in the dataset, so we manually add it as a list and used it in the knowledge base construction.

Lastly, we serialized everything using graph method and store in sample.ttl file as our Knowledge base.

For create the knowledge base again, you need to follow the following steps:

(1) As we submitted everything as a ZIP, first thing need to perform is unzip it.
(2) Resolve the local URI path provided to the dataset in the KnowledgeBase.py file.
(3) Run the KnowledgeBase.py file to regenerate the Knowledge base. (Python 3.6 is mandatory)
(you can change output filename and format in serialization code as required.)

The resultant knowledge base has been stored in the Knowledge Base dictionary in two different turtle and N-triple format.

total number of triples	SELECT (COUNT(*) as ?triples)	12733

	WHERE{ ?s ?p ?o}	

number of distinct topics	SELECT DISTINCT (COUNT(?topic) as ?count)
	WHERE{ ?topic a uni:Topics .}
		675

number of topic instances/course	SELECT (COUNT(?course) as ?courses)
	WHERE{ ?course a vivo:Course .}
		1224

In the second part of the project, first, we need to convert all pdf files into text files so that they can be parsed to the DBpedia Spotlight for the links. We used Python open() function, which is an inbuilt function for working with files. Using that files are converted into text and stored at corresponding repositories. We settled DBpedia server on localhost for avoiding bad HTTP requests and get all the links required.

In the Knowledge base, we filtered dbpedia links using naming entity, If the entity has a label as well as dbpedia link then it will be added to the knowledge base. Another thing is POS tags. For making the dataset efficient, we considered POS tags “NOUN” and “PROPN”. These tags provide a sufficient amount of data. Similarity score also helped us to filter unwanted topic URIs. SpaCy is the most useful library for all pipeline setup and filtering, the pattern matcher is also provided by SpaCy. By mapping entities and tokens with dbpedia links, we able to generate our Knowledge Base. Some statistical information is mentioned in the above table as well.

After getting data, our next task was adding data in a triple format to the graph. As suggested, we store data triples in a different file than the schema file. We implemented pattern flow in Course→ Lecture→LectureMaterial(Slide,Lab)→Topic sequence. Finally using serialization, we generated a knowledge base in turtle and n-triple format.

5. Queries

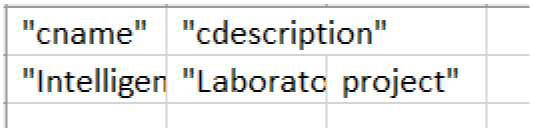
The following queries are built to express the competency questions in the section 1.

1. What is course COMP474 about?

This query finds the course name and description through course label.

```
SELECT ?cname ?cdescription
WHERE{
  ?course a vivo:Course.
  ?course rdfs:label "COMP474".
  ?course uni:courseName ?cname.
  ?course uni:courseDescription ?cdescription.
}
```

Result:



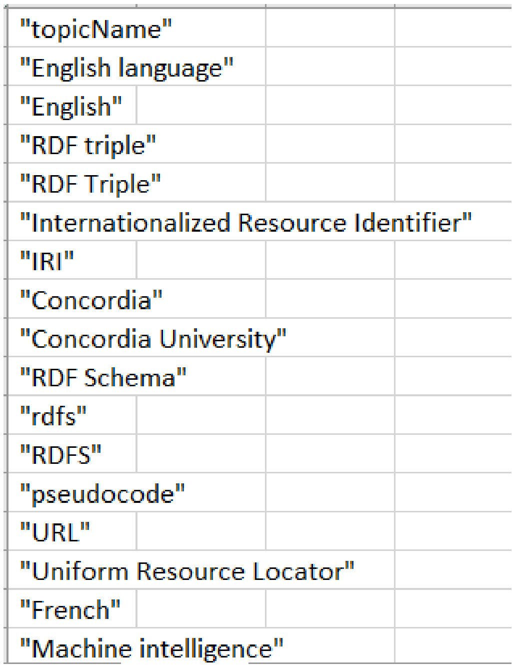
"cname"	"cdescription"
"Intelligen	"Laborato project"

2. Which topics Sarah competent in?

This query first finds the student, then find the topic he/she competent in through courses he/she passes.

```
SELECT ?topicName
WHERE{
 ?student foaf:name "Sarah".
 ?student uni:hasTranscript ?t.
 ?t uni:forCourse ?course.
 ?courseId rdfs:label ?course.
 ?t uni:hasGrade ?grade.
 ?lec uni:in_a ?courseId.
 ?lec uni:hasLectureContent ?lecmat.
 ?topic uni:covered_by ?lecmat.
 ?topic rdfs:label ?topicName.
 FILTER (?grade >= "1.5")
}
```

Result:



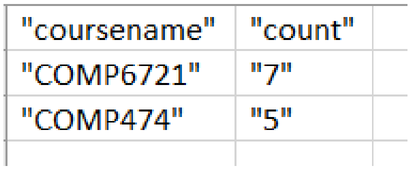
"topicName"
"English language"
"English"
"RDF triple"
"RDF Triple"
"Internationalized Resource Identifier"
"IRI"
"Concordia"
"Concordia University"
"RDF Schema"
"rdfs"
"RDFS"
"pseudocode"
"URL"
"Uniform Resource Locator"
"French"
"Machine intelligence"

3. Which courses include Machine Learning?

This query finds the lecture name via cover_by property, and then finds the course through in_a property, and order them by the times they appeared.

```
SELECT ?coursename  (count (?coursename) as ?count)
WHERE {
  ?topic uni:covered_by ?lcURI.
  ?topic rdfs:label Machine Learning.
  ?lecId uni:hasLectureContent ?lcURI.
  ?lecId rdfs:label ?lecture.
  ?lcURI rdf:type ?t.
  ?lcURI rdfs:label ?type.
  ?lecId uni:in_a ?course.
  ?course rdfs:label ?coursename.
  }GROUP BY ?coursename ORDER BY DESC(?count)
```

Result:



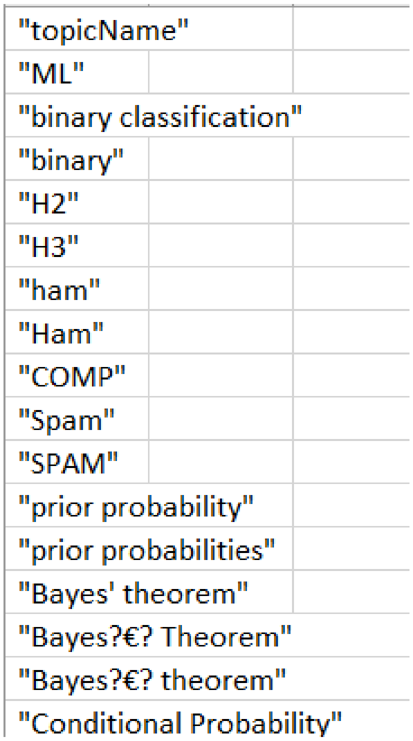
"coursename"	"count"
"COMP6721"	"7"
"COMP474"	"5"

4. Which topics are covered in COMP6721?

This query finds the topic through covered_by property

```
SELECT DISTINCT ?topicName
WHERE{
 ?courseId rdfs:label "COMP6721".
 ?lec uni:in_a ?courseId.
 ?lec uni:hasLectureContent ?lecmat.
 ?topic uni:covered_by ?lecmat.
 ?topic rdfs:label ?topicName.
}
```

Result:



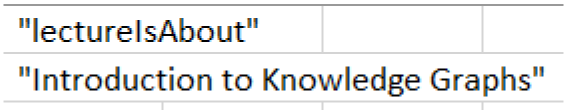
"topicName"
"ML"
"binary classification"
"binary"
"H2"
"H3"
"ham"
"Ham"
"COMP"
"Spam"
"SPAM"
"prior probability"
"prior probabilities"
"Bayes' theorem"
"Bayes?€? Theorem"
"Bayes?€? theorem"
"Conditional Probability"

5. What is the name of COMP474 lecture 2?

This query finds the course through course label, and then finds the lecture name by in_a property.

```
SELECT ?lectureIsAbout
WHERE{
 ?lec a uni:Lecture .
 ?lec uni:lectureNumber 2 .
 ?lec uni:in_a ?course .
 ?course rdfs:label "COMP474".
 ?lec uni:lectureName ?lectureIsAbout .
}
```

Result:



"lectureIsAbout"
"Introduction to Knowledge Graphs"

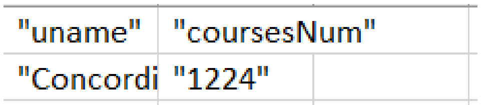
6. How many courses does the University offer?

This query counts all the courses the university offers.

```
SELECT  ?uname (COUNT(?course) AS ?coursesNum)
```

```
WHERE{
 ?university a uni:University.
 ?university foaf:name ?uname.
 ?university uni:offers ?course.
} GROUP BY ?university ?uname
```

Result:



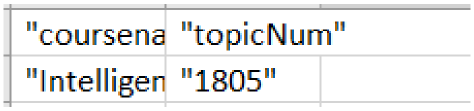
"uname"	"coursesNum"
"Concordi	"1224"

7. How many topics are covered in COMP474?

This query finds the course through course subject and number, and then counts all the topics through covered_by property.

```
SELECT ?coursename (COUNT(?topic) AS ?topicNum)
WHERE {
 ?course a vivo:Course.
 ?course rdfs:label "COMP474".
 ?course uni:courseName ?coursename.
 ?lec uni:in_a ?courseId.
 ?lec uni:hasLectureContent ?lecmat.
 ?topic uni:covered_by ?lecmat.
} GROUP BY ?coursename
```

Result:



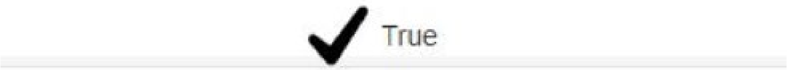
"coursena	"topicNum"
"Intelligen	"1805"

8. Does COMP6741 have labs?

This query finds the course through course subject and number, and then finds out whether it has lab through in_a property.

```
ASK{
 ?course a vivo:Course.
 ?course rdfs:label "COMP6721".
 ?lab uni:in_a ?course.
}
```

Result:

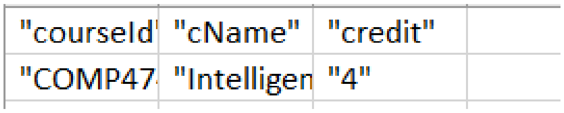

True

9. What is the course Credit of comp474?

This query finds the course through course subject and number, and then get the course name course label and credit.

```
SELECT ?courseId ?cName ?credit
WHERE {
 ?course a vivo:Course.
 ?course uni:courseSubject "COMP".
 ?course uni:courseNumber "474".
 ?course rdfs:label ?courseId.
 ?course uni:courseName ?cName.
 ?course uni:courseCredit ?credit .
}
```

Result:



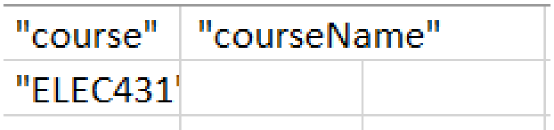
"courseId	"cName"	"credit"	
"COMP47	"Intelligen	"4"	

10. Which course Sarah will take again?

This query finds the student, and then finds the course he/she will take again using filter, finally get the course name, subject and number.

```
SELECT ?course ?courseName
WHERE {
 ?student foaf:name "Sarah".
 ?student uni:hasTranscript ?t.
 ?t uni:forCourse ?course.
 ?t uni:hasGrade ?grade.
 FILTER (?grade <= "2")
}
```

Result:

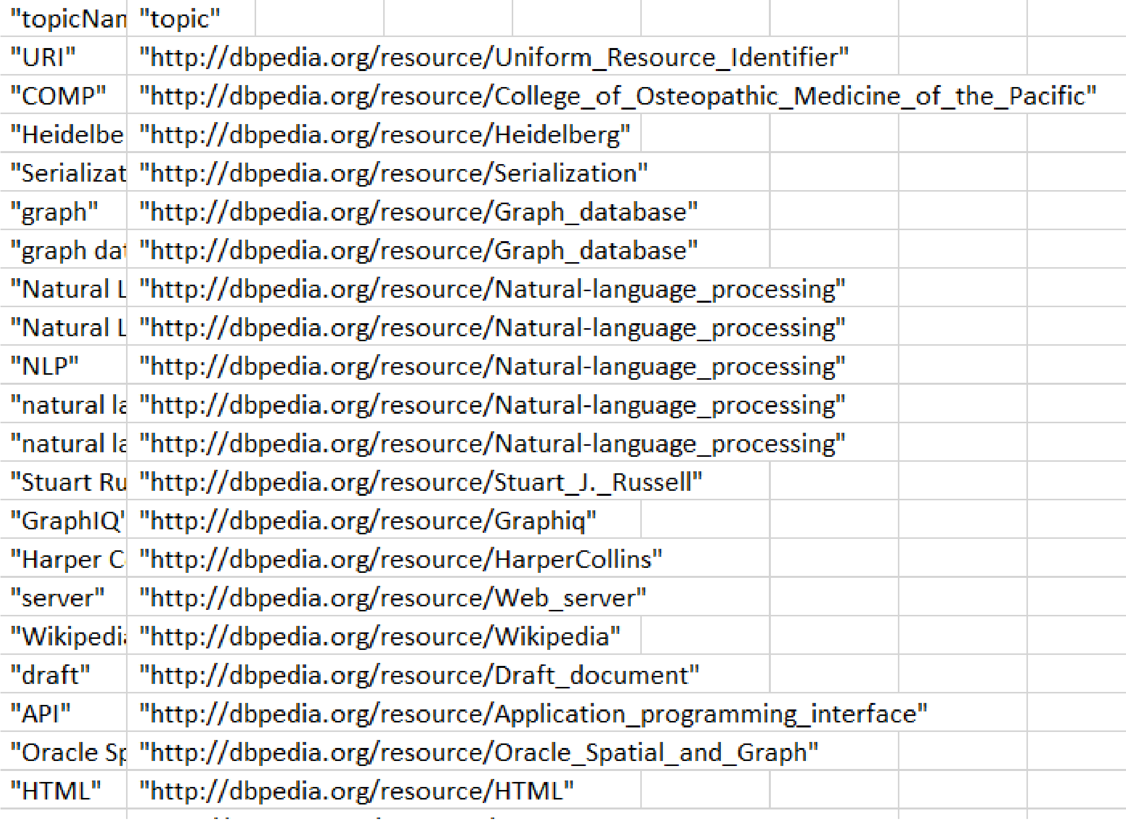


"course"	"courseName"
"ELEC431	

11. Which topics are covered in slide 2 of COMP 474?

This query first find the lecture through course and slide, and then find the topic covered by the lecture.

```
SELECT ?topicName ?topic
 WHERE {
  ?lecid uni:in_a ?course.
  ?course rdfs:label "COMP474".
  ?lecid uni:hasLectureContent ?lc.
  ?lc rdfs:label "slide2".
  ?topic uni:covered_by ?lc.
  ?topic rdfs:label ?topicName.
 }
```

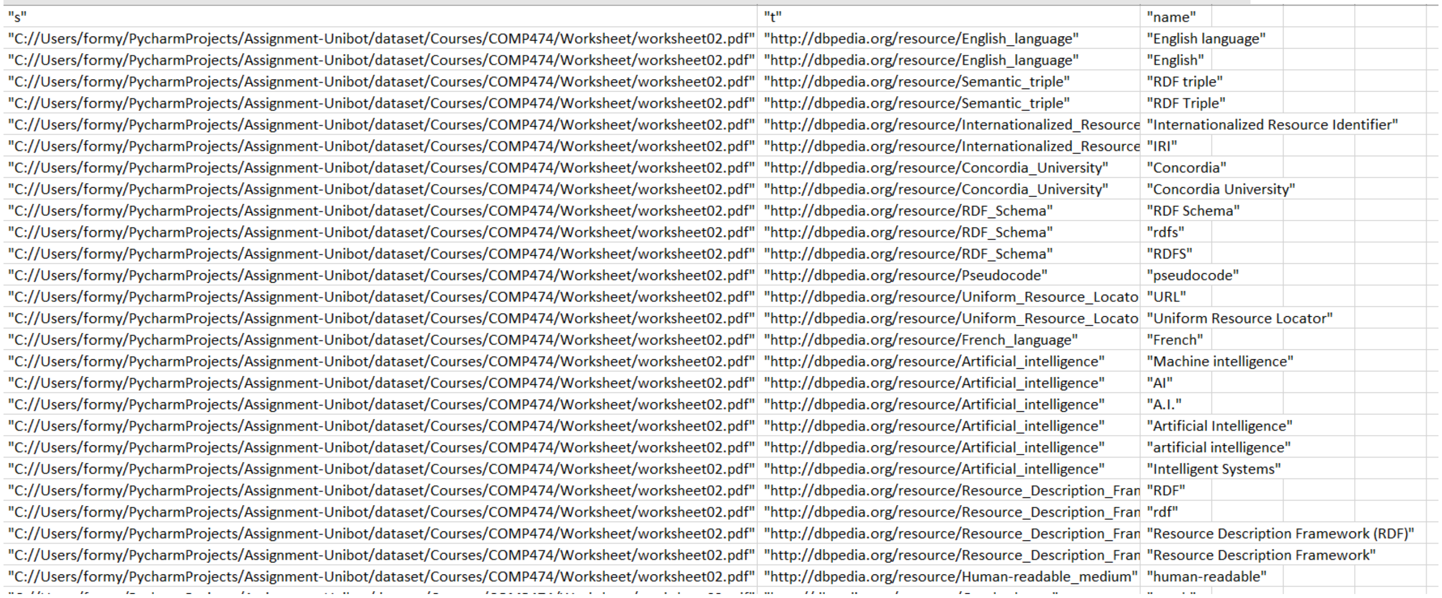


"topicNan	"topic"
"URI"	"http://dbpedia.org/resource/Uniform_Resource_Identifier"
"COMP"	"http://dbpedia.org/resource/College_of_Osteopathic_Medicine_of_the_Pacific"
"Heidelbe	"http://dbpedia.org/resource/Heidelberg"
"Serializat	"http://dbpedia.org/resource/Serialization"
"graph"	"http://dbpedia.org/resource/Graph_database"
"graph da	"http://dbpedia.org/resource/Graph_database"
"Natural L	"http://dbpedia.org/resource/Natural-language_processing"
"Natural L	"http://dbpedia.org/resource/Natural-language_processing"
"NLP"	"http://dbpedia.org/resource/Natural-language_processing"
"natural la	"http://dbpedia.org/resource/Natural-language_processing"
"natural la	"http://dbpedia.org/resource/Natural-language_processing"
"Stuart Ru	"http://dbpedia.org/resource/Stuart_J._Russell"
"GraphIQ'	"http://dbpedia.org/resource/Graphiq"
"Harper C	"http://dbpedia.org/resource/HarperCollins"
"server"	"http://dbpedia.org/resource/Web_server"
"Wikipedi	"http://dbpedia.org/resource/Wikipedia"
"draft"	"http://dbpedia.org/resource/Draft_document"
"API"	"http://dbpedia.org/resource/Application_programming_interface"
"Oracle Sp	"http://dbpedia.org/resource/Oracle_Spatial_and_Graph"
"HTML"	"http://dbpedia.org/resource/HTML"

Special SPARQL queries:-

1. For a course c(COMP474), list all covered topics t, printing out their English labels and their DBpedia URI, together with the course event URI (e.g., ’lab3’) and resource URI (e.g., ’slides10’) where they appeared.

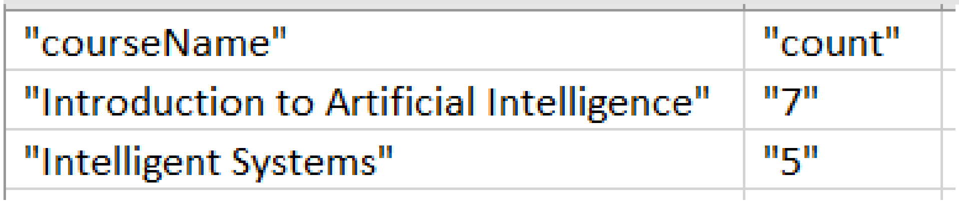
```
SELECT ?s ?t ?name
WHERE{
 ?c rdfs:label "COMP474".
 ?l uni:in_a ?c.
 ?l uni:hasLectureContent ?s.
 ?t uni:covered_by ?s.
 ?t rdfs:label ?name.
}
```



"s"	"t"	"name"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/English_language"	"English language"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/English_language"	"English"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Semantic_triple"	"RDF triple"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Semantic_triple"	"RDF Triple"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Internationalized_Resource	"Internationalized Resource Identifier"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Internationalized_Resource	"IRI"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Concordia_University"	"Concordia"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Concordia_University"	"Concordia University"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/RDF_Schema"	"RDF Schema"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/RDF_Schema"	"rdfs"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/RDF_Schema"	"RDFS"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Pseudocode"	"pseudocode"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Uniform_Resource_Locato	"URL"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Uniform_Resource_Locato	"Uniform Resource Locator"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/French_language"	"French"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Artificial_intelligence"	"Machine intelligence"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Artificial_intelligence"	"AI"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Artificial_intelligence"	"A.I."
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Artificial_intelligence"	"Artificial Intelligence"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Artificial_intelligence"	"artificial intelligence"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Artificial_intelligence"	"Intelligent Systems"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Resource_Description_Fran	"RDF"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Resource_Description_Fran	"rdf"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Resource_Description_Fran	"Resource Description Framework (RDF)"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Resource_Description_Fran	"Resource Description Framework"
"C://Users/formy/PycharmProjects/Assignment-Unibot/dataset/Courses/COMP474/Worksheet/worksheet02.pdf"	"http://dbpedia.org/resource/Human-readable_medium"	"human-readable"

2. For a given topic t (DBpedia URI), list all courses where they appear, together with a count, sorted by frequency.

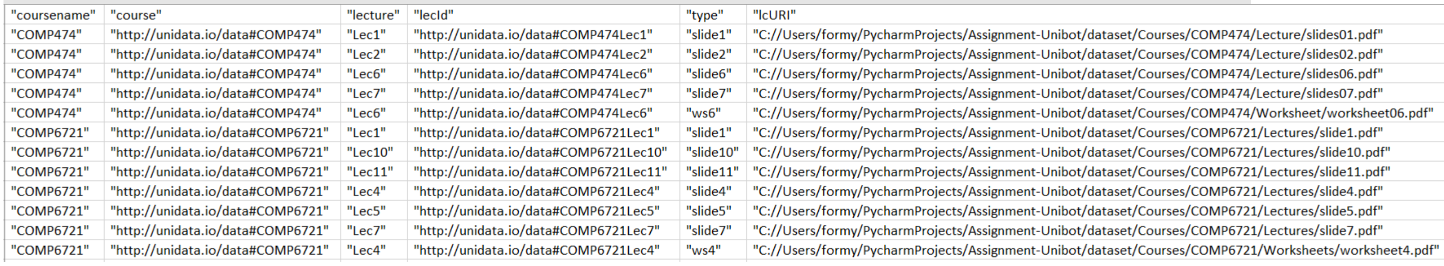
```
SELECT ?courseName (count (?courseName) as ?count)
WHERE{
?topic rdfs:label "Machine Learning".
?topic uni:covered_by ?lecmat.
?lecture uni:hasLectureContent ?lecmat.
?lecture uni:in_a ?course.
?course rdfs:label ?courseLabel.
?course uni:courseName ?courseName.

unidata:Concordia uni:offers ?course.

}GROUP BY ?courseName ORDER BY DESC(?count)
```



"courseName"	"count"
"Introduction to Artificial Intelligence"	"7"
"Intelligent Systems"	"5"

3. For a given topic t, list the precise course URI, course event URI and corresponding resource URI where the topic is covered (e.g., “NLP” is covered in COMP474 → Lecture 10→ Lab 10 → Lab Notes)

```
SELECT ?coursename ?course ?lecture ?lecId ?type ?lcURI

WHERE {

 ?topic uni:covered_by ?lcURI.

 ?topic rdfs:label "Machine Learning".

 ?lecId uni:hasLectureContent ?lcURI.

 ?lecId rdfs:label ?lecture.

 ?lcURI rdf:type ?t.

 ?lcURI rdfs:label ?type.

 ?lecId uni:in_a ?course.

 ?course rdfs:label ?coursename.

}ORDER BY(?coursename)
```



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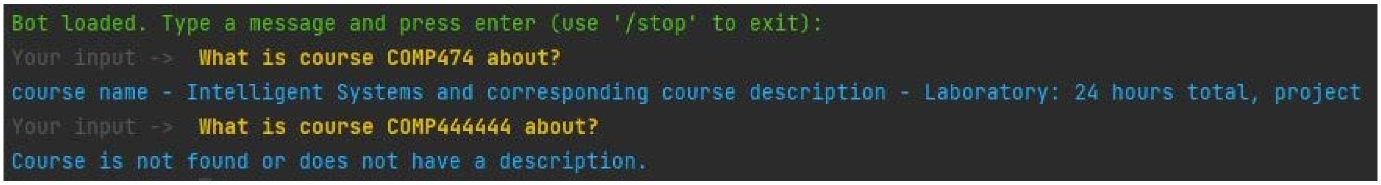
6. Chatbot design using RASA

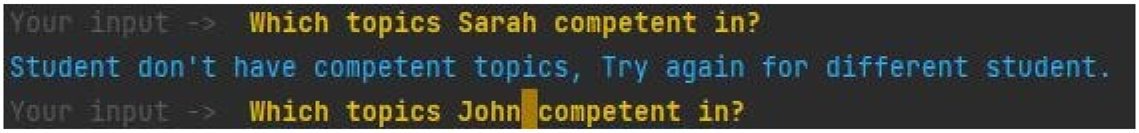
RASA is the most interesting and challenging part of the project as we need to work with Natural Language. First, we implemented our 10 competency question in rasa in which 2 special cases mentioned by professor are covered. We already have queries defined, as per updation in knowledgebase we did a few changes. One special question is handled separately. We used the request and response module to interact with Fuseki. Using tracker, json() object and binding, we were able to manage the input and output of the chatbot. As per requirement, we trained our model with default answers for getting proper reponses. Following are the sample queries and output performed using RASA.

1) What is course COMP474 about?

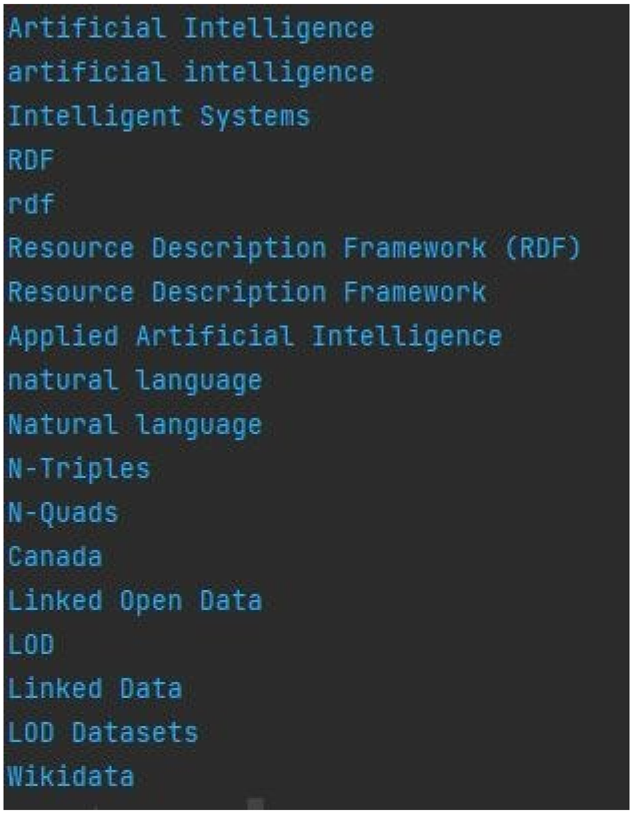


```
Bot loaded. Type a message and press enter (use '/stop' to exit):
Your input ->  What is course COMP474 about?
course name - Intelligent Systems and corresponding course description - Laboratory: 24 hours total, project
Your input ->  What is course COMP444444 about?
Course is not found or does not have a description.
```

2) Which topics Sarah competent in?

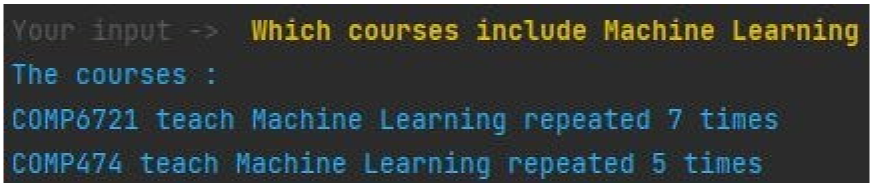


```
Your input ->  Which topics Sarah competent in?
Student don't have competent topics, Try again for different student.
Your input ->  Which topics John competent in?
```



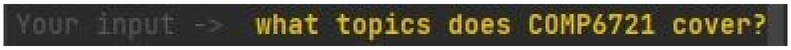
```
Artificial Intelligence
artificial intelligence
Intelligent Systems
RDF
rdf
Resource Description Framework (RDF)
Resource Description Framework
Applied Artificial Intelligence
natural language
Natural language
N-Triples
N-Quads
Canada
Linked Open Data
LOD
Linked Data
LOD Datasets
Wikidata
```

3) Which courses include Machine Learning?

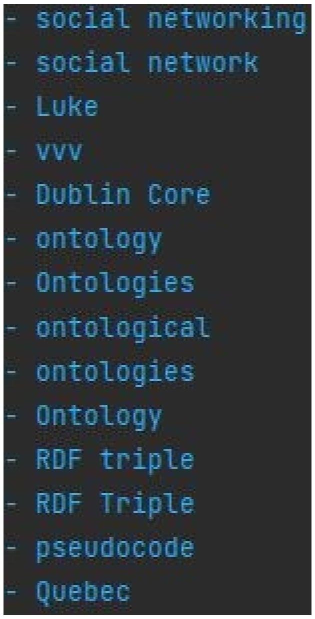


```
Your input ->  Which courses include Machine Learning
The courses :
COMP6721 teach Machine Learning repeated 7 times
COMP474 teach Machine Learning repeated 5 times
```

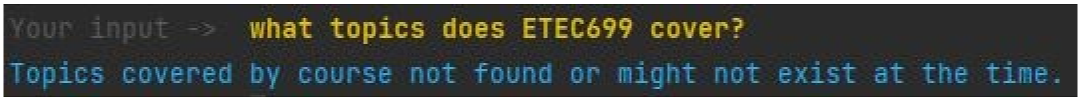
4) what topics does COMP6721 cover?



```
Your input ->  what topics does COMP6721 cover?
```

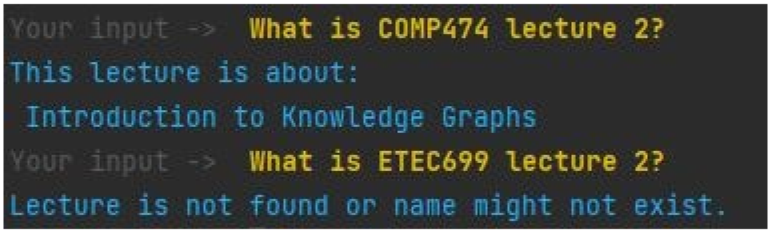


```
- social networking
- social network
- Luke
- vvv
- Dublin Core
- ontology
- Ontologies
- ontological
- ontologies
- Ontology
- RDF triple
- RDF Triple
- pseudocode
- Quebec
```



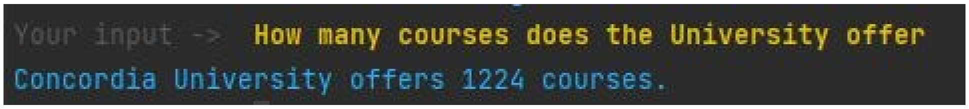
```
Your input ->  what topics does ETEC699 cover?
Topics covered by course not found or might not exist at the time.
```

5) What is COMP474 lecture 2?



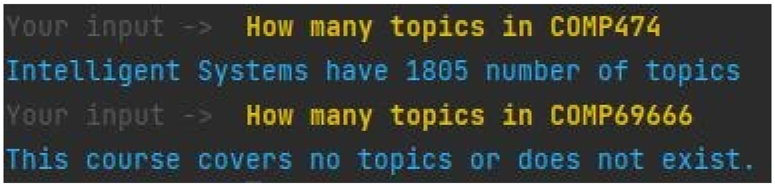
```
Your input ->  What is COMP474 lecture 2?
This lecture is about:
 Introduction to Knowledge Graphs
Your input ->  What is ETEC699 lecture 2?
Lecture is not found or name might not exist.
```

6) How many courses does the University offer?



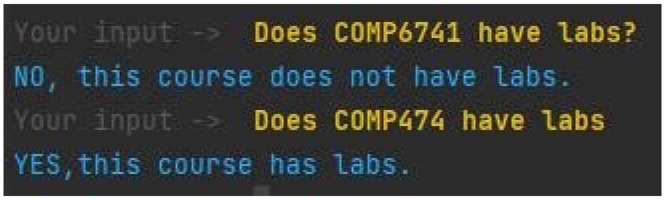
```
Your input ->  How many courses does the University offer
Concordia University offers 1224 courses.
```

7) How many topics in COMP474?



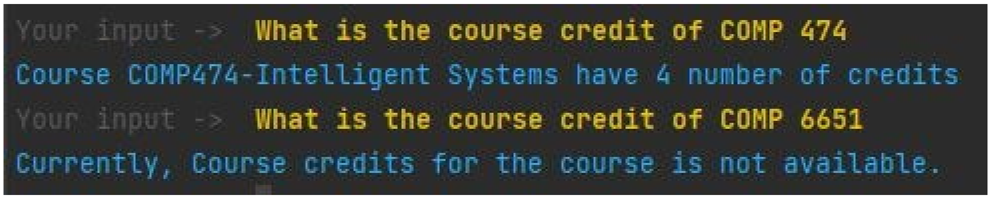
```
Your input ->  How many topics in COMP474
Intelligent Systems have 1805 number of topics
Your input ->  How many topics in COMP69666
This course covers no topics or does not exist.
```

8) Does COMP6741 have labs?



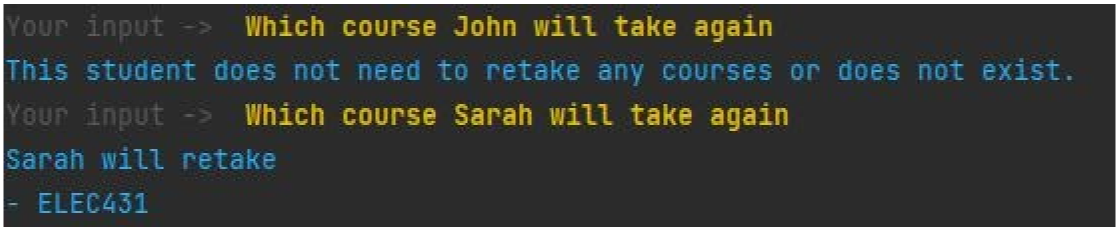
```
Your input ->  Does COMP6741 have labs?
NO, this course does not have labs.
Your input ->  Does COMP474 have labs
YES,this course has labs.
```

9) What is the course credit of COMP 474?



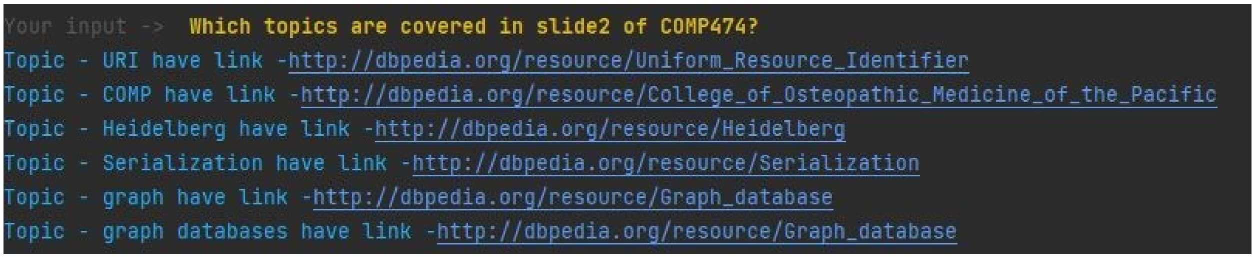
```
Your input ->  What is the course credit of COMP 474
Course COMP474-Intelligent Systems have 4 number of credits
Your input ->  What is the course credit of COMP 6651
Currently, Course credits for the course is not available.
```

10) Which course Sarah will take again?

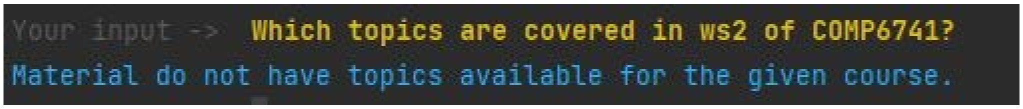


```
Your input ->  Which course John will take again
This student does not need to retake any courses or does not exist.
Your input ->  Which course Sarah will take again
Sarah will retake
- ELEC431
```

11) Which topics are covered in slide2 of COMP474?



```
Your input ->  Which topics are covered in slide2 of COMP474?
Topic - URI have link -http://dbpedia.org/resource/Uniform_Resource_Identifier
Topic - COMP have link -http://dbpedia.org/resource/College_of_Osteopathic_Medicine_of_the_Pacific
Topic - Heidelberg have link -http://dbpedia.org/resource/Heidelberg
Topic - Serialization have link -http://dbpedia.org/resource/Serialization
Topic - graph have link -http://dbpedia.org/resource/Graph_database
Topic - graph databases have link -http://dbpedia.org/resource/Graph_database
```



```
Your input ->  Which topics are covered in ws2 of COMP6741?
Material do not have topics available for the given course.
```