Faculty of Computer and Artificial Intelligence
Cairo University
Computer Science Department
Year 2022 – 2023
First Term

Semantic Web Project

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1. Definition of the problem

This project introduce an expert university system and the different relations between its parts represented as facts and rules in clips and hierarchy ontology in protégé. It also discusses how to infer on it using rule based system “clips” and SparQl query language.

2. Design of the proposed solution

Part1 (ontology):

a) Define the different classes and subclasses in the system using ontology.
b) Define the relations between classes using object property.
c) Define the attributes of each class using data property.
d) Define the individuals (instance) of each class.
e) Reason on the whole ontology system to infers new data.
f) Use SparQl query language to extract new knowledge.

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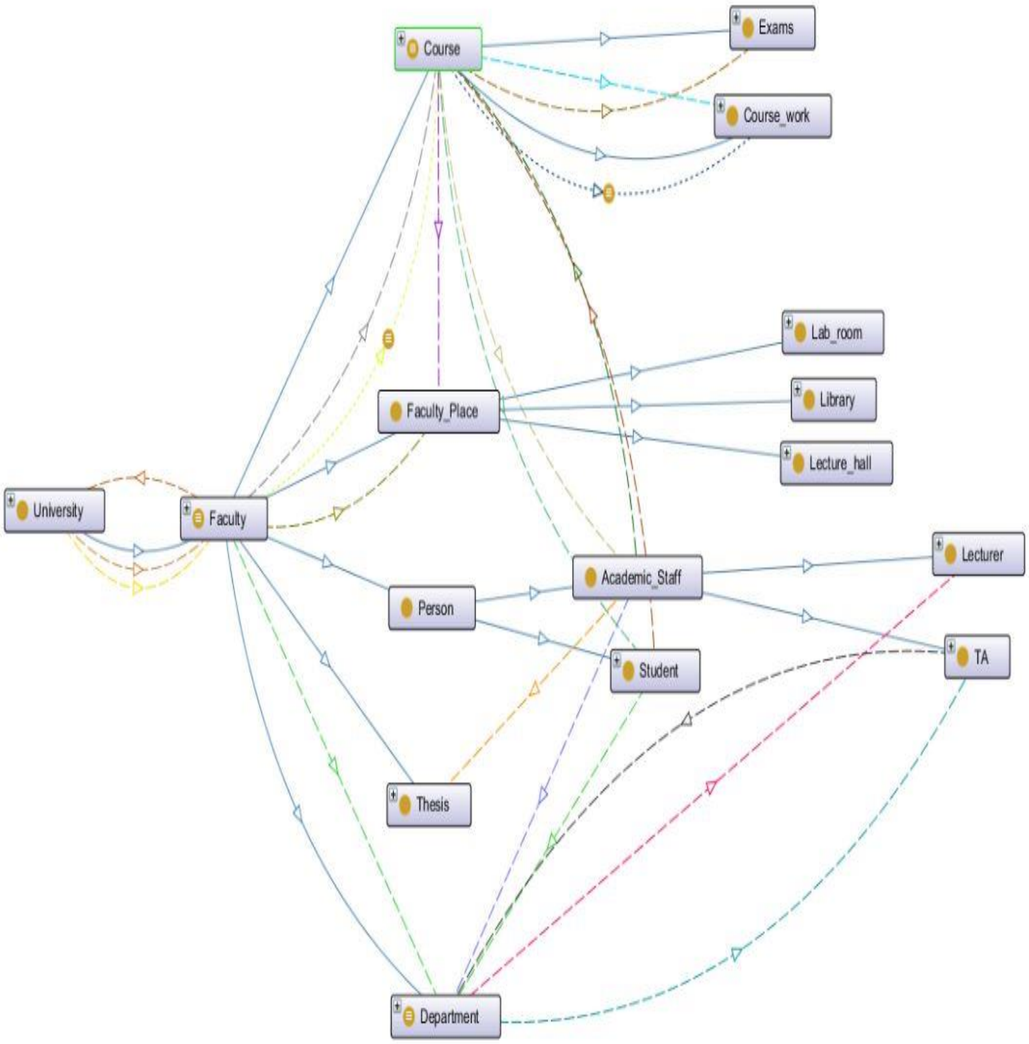
1. Ontology Diagram:

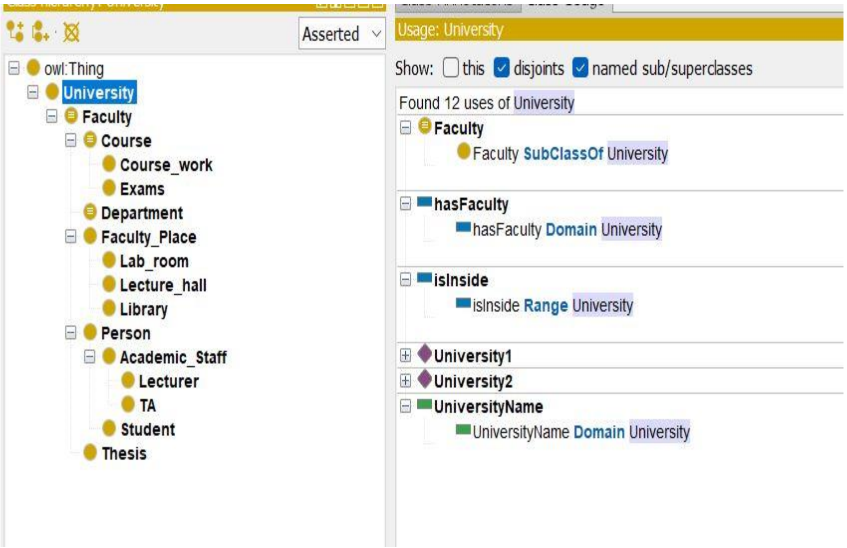


2. Object Properties(Relationships), Data Property and Classes:

2.1. Class University

Data properties: UniversityName.

Object properties: hasFaculty.



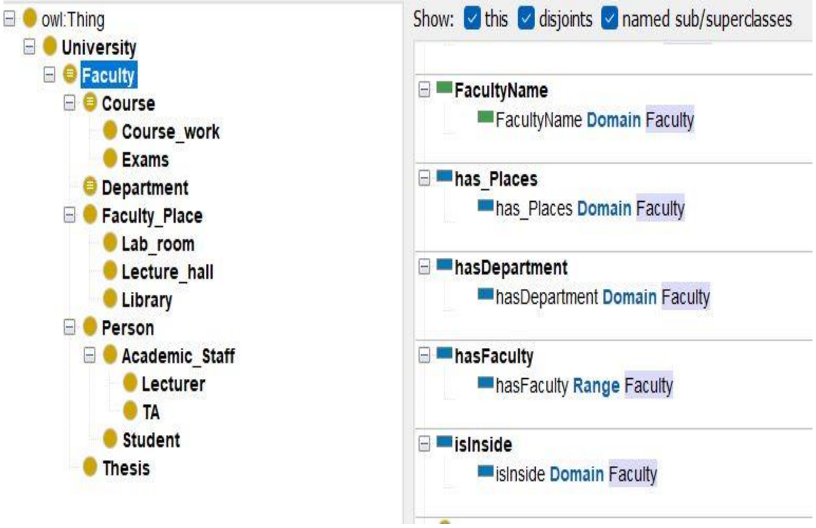
```
Asserted

owl:Thing
  University
    Faculty
      Course
        Course_work
        Exams
      Department
      Faculty_Place
        Lab_room
        Lecture_hall
        Library
      Person
        Academic_Staff
          Lecturer
          TA
        Student
      Thesis
```

```
Usage: University
Show: □ this ☑ disjoints ☑ named sub/superclasses
Found 12 uses of University
Faculty
    Faculty SubClassOf University
hasFaculty
    hasFaculty Domain University
isInside
    isInside Range University
University1
University2
UniversityName
    UniversityName Domain University
```

2.2. Class Faculty

Data properties: FacultyName.

Object properties: hasPlaces ,hasDepartment and isInside.



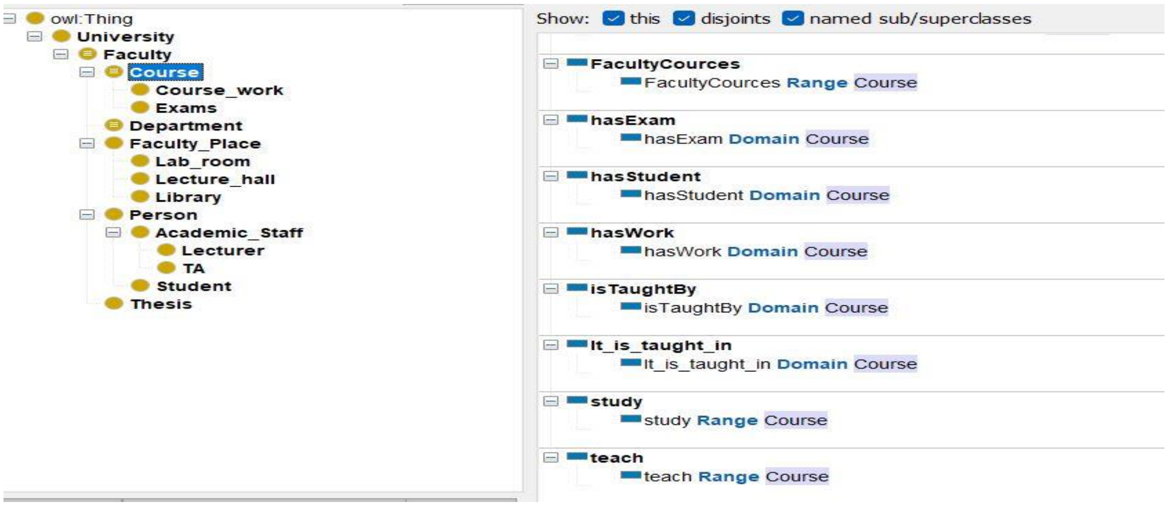
```
owl:Thing
  University
    Faculty
      Course
        Course_work
        Exams
      Department
      Faculty_Place
        Lab_room
        Lecture_hall
        Library
      Person
        Academic_Staff
          Lecturer
          TA
        Student
      Thesis
```

```
Show: ☑ this ☑ disjoints ☑ named sub/superclasses
FacultyName
    FacultyName Domain Faculty
has_Places
    has_Places Domain Faculty
hasDepartment
    hasDepartment Domain Faculty
hasFaculty
    hasFaculty Range Faculty
isInside
    isInside Domain Faculty
```

2.3. Class Course

Data properties: CourseName.

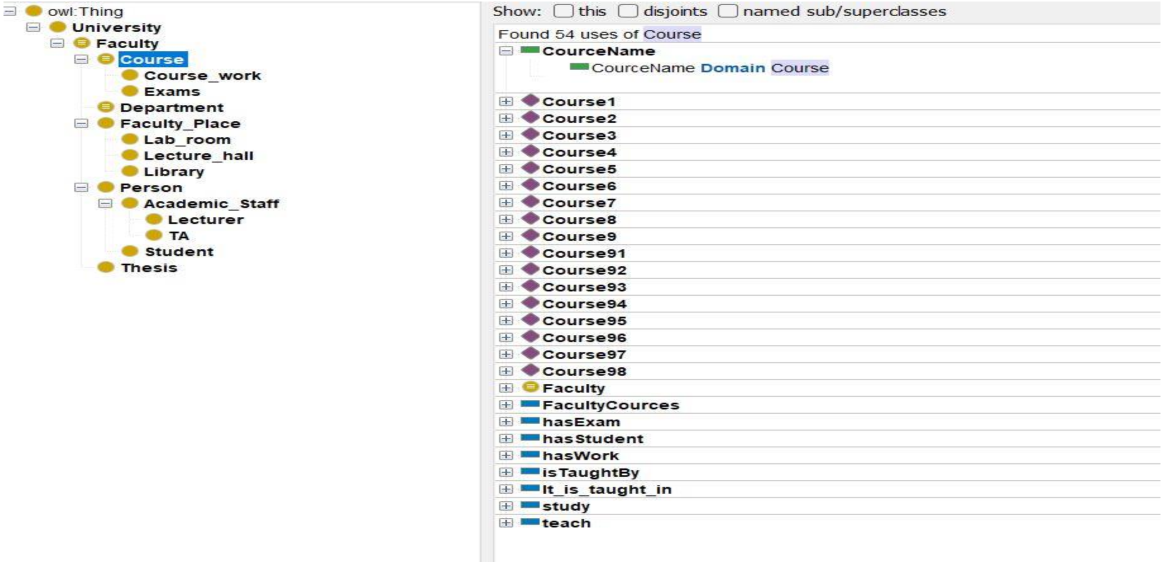
Object properties: hasExam , hasStudent, hasWork, isToughtBy and is_taught_in .



```
owl:Thing
  University
    Faculty
      Course
        Course_work
        Exams
      Department
      Faculty_Place
        Lab_room
        Lecture_hall
        Library
      Person
        Academic_Staff
          Lecturer
          TA
        Student
      Thesis
```

Show: ☑ this ☑ disjoints ☑ named sub/superclasses

```
FacultyCources
    FacultyCources Range Course
hasExam
    hasExam Domain Course
hasStudent
    hasStudent Domain Course
hasWork
    hasWork Domain Course
isTaughtBy
    isTaughtBy Domain Course
It_is_taught_in
    It_is_taught_in Domain Course
study
    study Range Course
teach
    teach Range Course
```



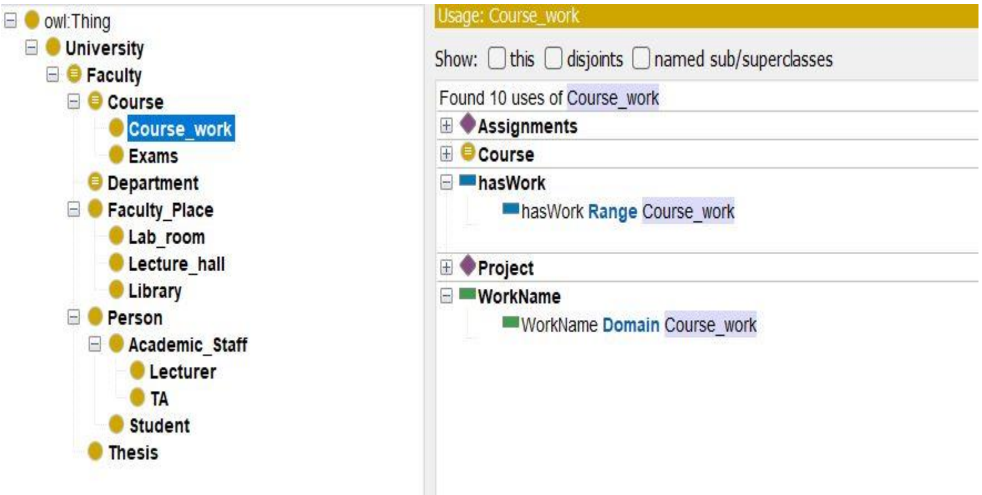
```
owl:Thing
  University
    Faculty
      Course
        Course_work
        Exams
      Department
      Faculty_Place
        Lab_room
        Lecture_hall
        Library
      Person
        Academic_Staff
          Lecturer
          TA
        Student
      Thesis
```

Show: □ this □ disjoints □ named sub/superclasses

```
Found 54 uses of Course
CourceName
    CourceName Domain Course
Course1
Course2
Course3
Course4
Course5
Course6
Course7
Course8
Course9
Course91
Course92
Course93
Course94
Course95
Course96
Course97
Course98
Faculty
FacultyCources
hasExam
hasStudent
hasWork
isTaughtBy
It_is_taught_in
study
teach
```

2.4. Class Course Work

Data properties: workName.



```
owl:Thing
  University
    Faculty
      Course
        Course_work
        Exams
      Department
      Faculty_Place
        Lab_room
        Lecture_hall
        Library
      Person
        Academic_Staff
          Lecturer
          TA
        Student
      Thesis
```

Usage: Course_work

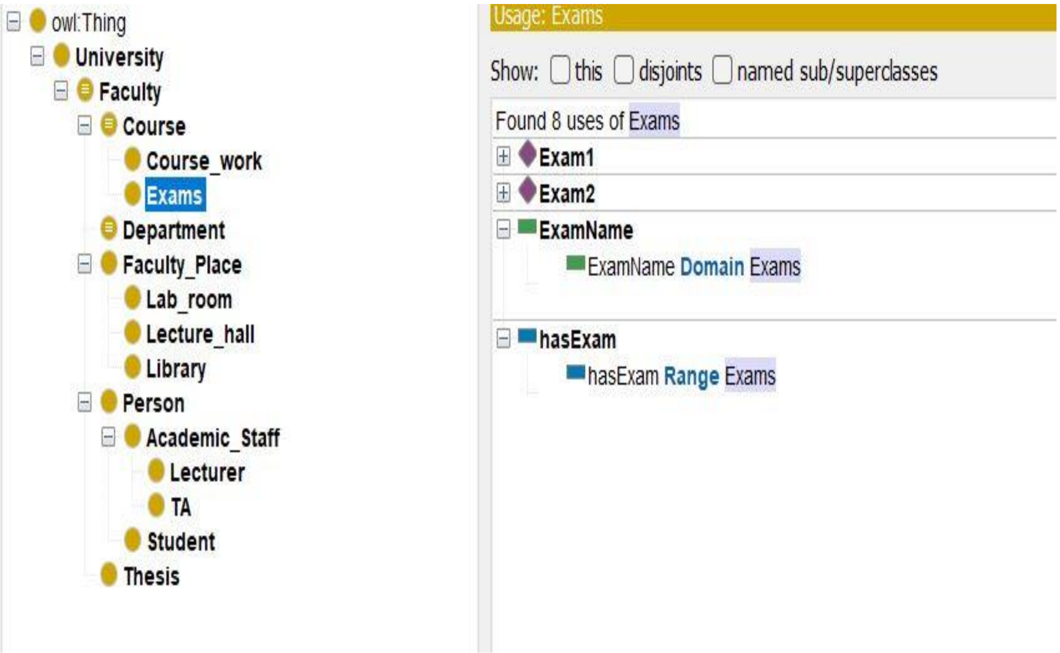
Show: □ this □ disjoints □ named sub/superclasses

Found 10 uses of Course_work

```
⊞ Assignments
⊞ Course
⊟ hasWork
      hasWork Range Course_work
⊞ Project
⊟ WorkName
      WorkName Domain Course_work
```

2.5. Class Exams

Data properties: ExamName.



```
owl:Thing
  University
    Faculty
      Course
        Course_work
        Exams
      Department
      Faculty_Place
        Lab_room
        Lecture_hall
        Library
      Person
        Academic_Staff
          Lecturer
          TA
        Student
      Thesis
```

Usage: Exams

Show: □ this □ disjoints □ named sub/superclasses

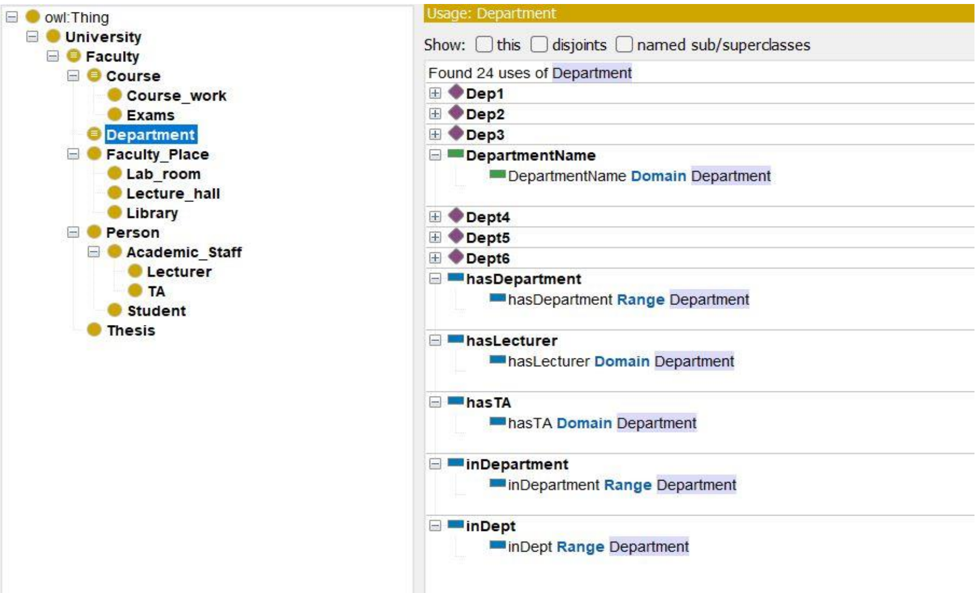
Found 8 uses of Exams

```
⊞ Exam1
⊞ Exam2
⊟ ExamName
      ExamName Domain Exams
⊟ hasExam
      hasExam Range Exams
```

2.6. Class Department:

Data properties: DepartmentName.

Object properties: hasLecturer and hasTA.



```
owl:Thing
  University
    Faculty
      Course
        Course_work
        Exams
      Department
      Faculty_Place
        Lab_room
        Lecture_hall
        Library
      Person
        Academic_Staff
          Lecturer
          TA
        Student
      Thesis
```

Usage: Department

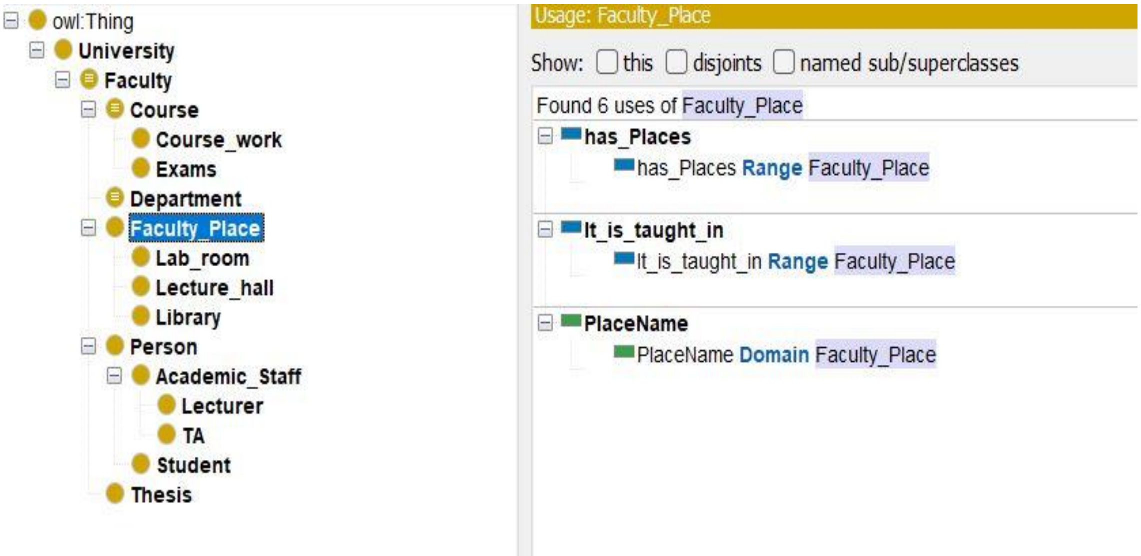
Show: □ this □ disjoints □ named sub/superclasses

Found 24 uses of Department

```
⊞ Dep1
⊞ Dep2
⊞ Dep3
⊟ DepartmentName
    DepartmentName Domain Department
⊞ Dept4
⊞ Dept5
⊞ Dept6
⊟ hasDepartment
    hasDepartment Range Department
⊟ hasLecturer
    hasLecturer Domain Department
⊟ hasTA
    hasTA Domain Department
⊟ inDepartment
    inDepartment Range Department
⊟ inDept
    inDept Range Department
```

2.7. Class Faculty_Place

Data properties: PlaceName.



```
owl:Thing
  University
    Faculty
      Course
        Course_work
        Exams
      Department
      Faculty_Place
        Lab_room
        Lecture_hall
        Library
      Person
        Academic_Staff
          Lecturer
          TA
        Student
      Thesis
```

Usage: Faculty_Place

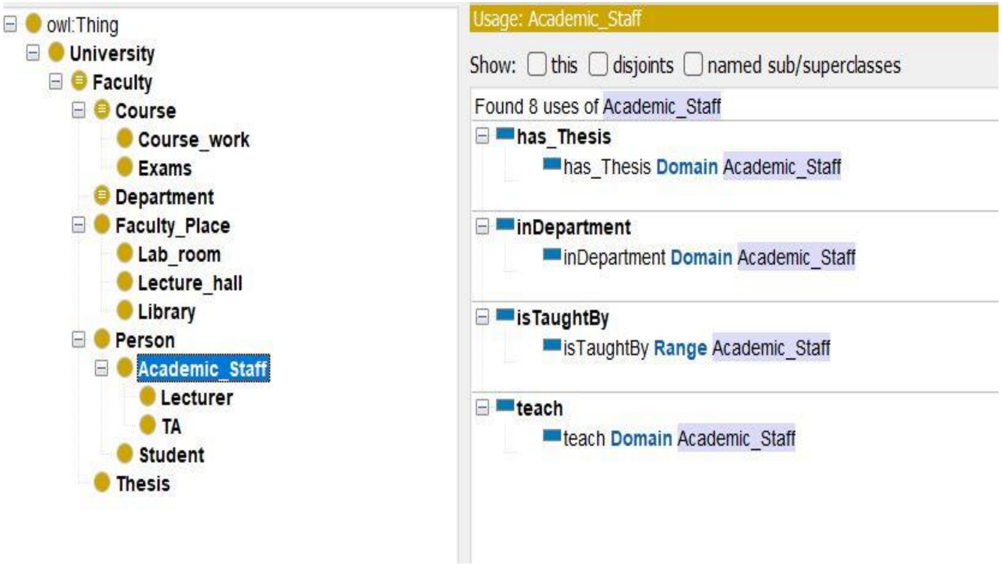
Show: □ this □ disjoints □ named sub/superclasses

Found 6 uses of Faculty_Place

```
⊟ has_Places
    has_Places Range Faculty_Place
⊟ It_is_taught_in
    It_is_taught_in Range Faculty_Place
⊟ PlaceName
    PlaceName Domain Faculty_Place
```

2.8. Class Academic_Staff

Object properties: hasThesis ,inDepartment and teach.



```
⊟ owl:Thing
  ⊟ University
    ⊟ Faculty
      ⊟ Course
          Course_work
          Exams
        Department
      ⊟ Faculty_Place
          Lab_room
          Lecture_hall
          Library
      ⊟ Person
        ⊟ Academic_Staff
            Lecturer
            TA
          Student
        Thesis
```

Usage: Academic_Staff

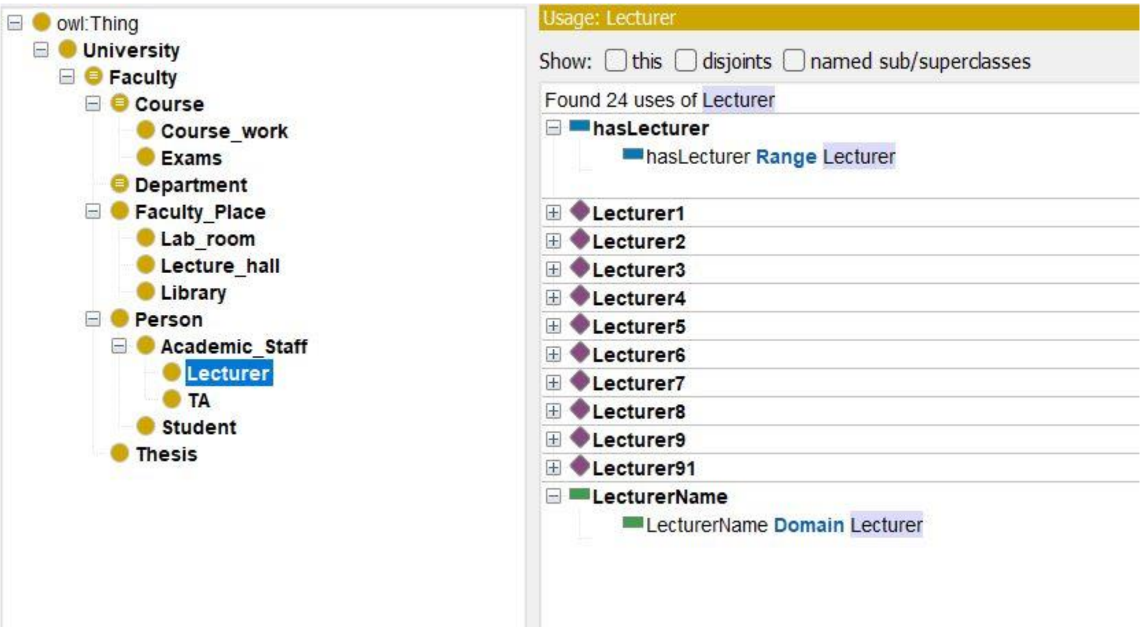
Show: □ this □ disjoints □ named sub/superclasses

Found 8 uses of Academic_Staff

```
⊟ has_Thesis
    has_Thesis Domain Academic_Staff
⊟ inDepartment
    inDepartment Domain Academic_Staff
⊟ isTaughtBy
    isTaughtBy Range Academic_Staff
⊟ teach
    teach Domain Academic_Staff
```

2.9. Class Lecturer

Data properties: LecturerName.



```
⊟ owl:Thing
  ⊟ University
    ⊟ Faculty
      ⊟ Course
          Course_work
          Exams
        Department
      ⊟ Faculty_Place
          Lab_room
          Lecture_hall
          Library
      ⊟ Person
        ⊟ Academic_Staff
            Lecturer
            TA
          Student
        Thesis
```

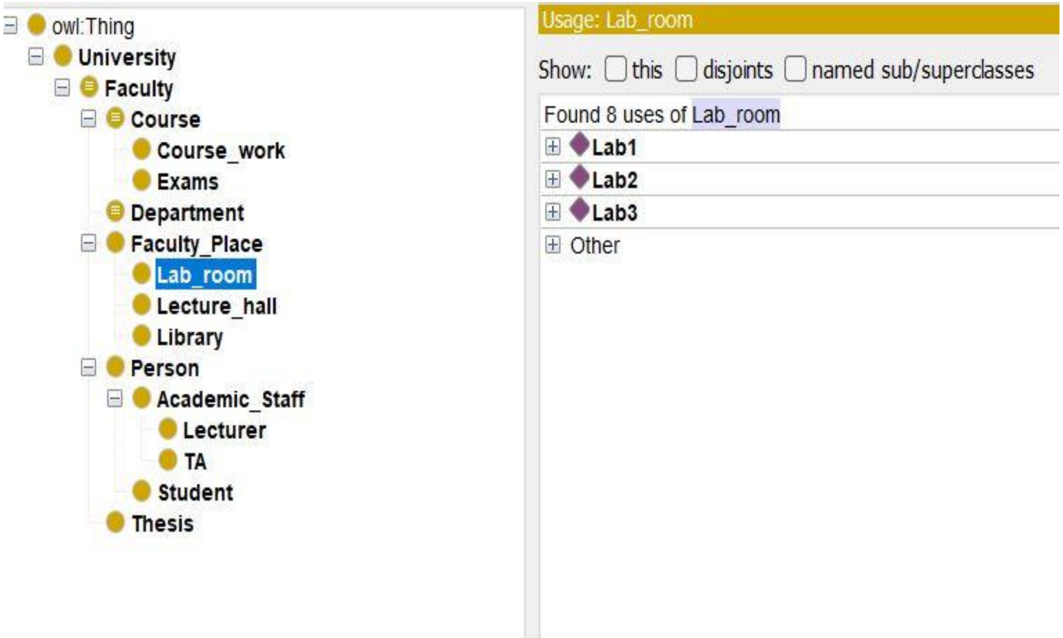
Usage: Lecturer

Show: □ this □ disjoints □ named sub/superclasses

Found 24 uses of Lecturer

```
⊟ hasLecturer
    hasLecturer Range Lecturer
⊞ Lecturer1
⊞ Lecturer2
⊞ Lecturer3
⊞ Lecturer4
⊞ Lecturer5
⊞ Lecturer6
⊞ Lecturer7
⊞ Lecturer8
⊞ Lecturer9
⊞ Lecturer91
⊟ LecturerName
    LecturerName Domain Lecturer
```

2.10. Class Lab_room



- owl:Thing
  - University
    - Faculty
      - Course
        - Course_work
        - Exams
      - Department
      - Faculty_Place
        - Lab_room
        - Lecture_hall
        - Library
      - Person
        - Academic_Staff
          - Lecturer
          - TA
        - Student
      - Thesis

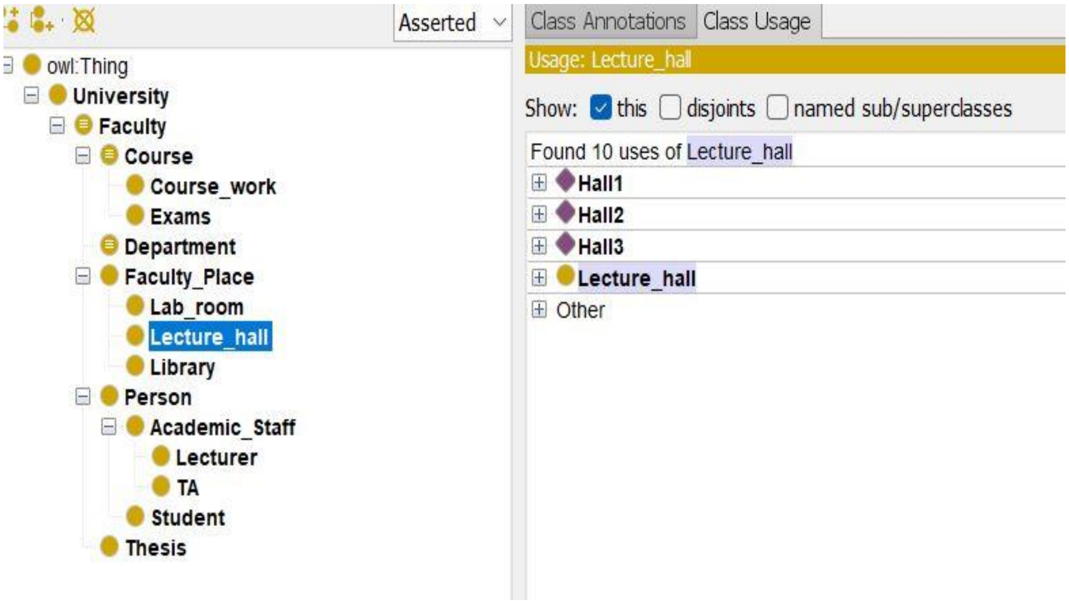
Usage: Lab_room

Show: ☐ this ☐ disjoints ☐ named sub/superclasses

Found 8 uses of Lab_room

- ⊞ Lab1
- ⊞ Lab2
- ⊞ Lab3
- ⊞ Other

2.11. Class Lecture_hall



Asserted

- owl:Thing
  - University
    - Faculty
      - Course
        - Course_work
        - Exams
      - Department
      - Faculty_Place
        - Lab_room
        - Lecture_hall
        - Library
      - Person
        - Academic_Staff
          - Lecturer
          - TA
        - Student
      - Thesis

Class Annotations | Class Usage

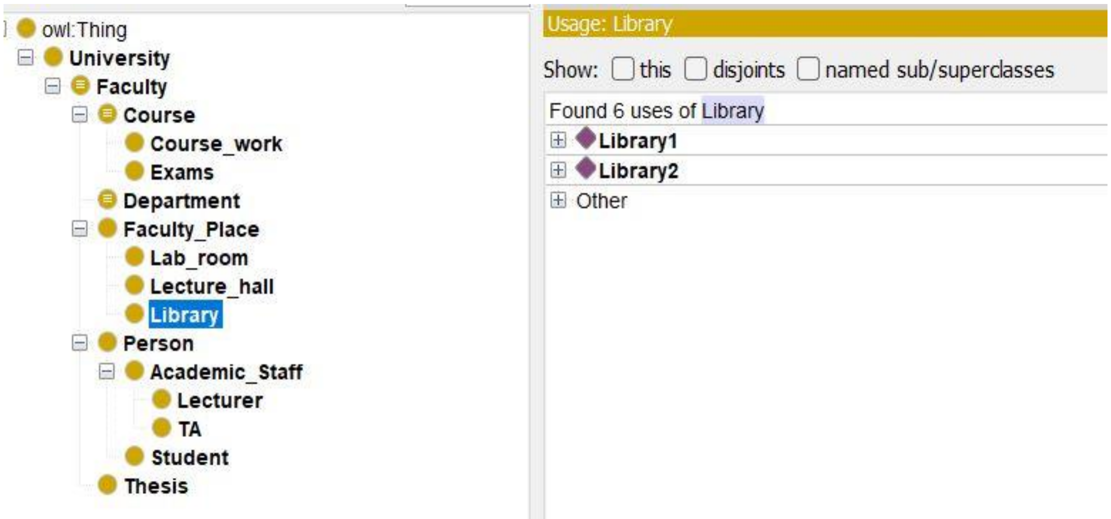
Usage: Lecture_hall

Show: ☑ this ☐ disjoints ☐ named sub/superclasses

Found 10 uses of Lecture_hall

- ⊞ Hall1
- ⊞ Hall2
- ⊞ Hall3
- ⊞ Lecture_hall
- ⊞ Other

2.12. Class Library



```
owl:Thing
  University
    Faculty
      Course
        Course_work
        Exams
      Department
      Faculty_Place
        Lab_room
        Lecture_hall
        Library
      Person
        Academic_Staff
          Lecturer
          TA
        Student
      Thesis
```

Usage: Library

Show: □ this □ disjoints □ named sub/superclasses

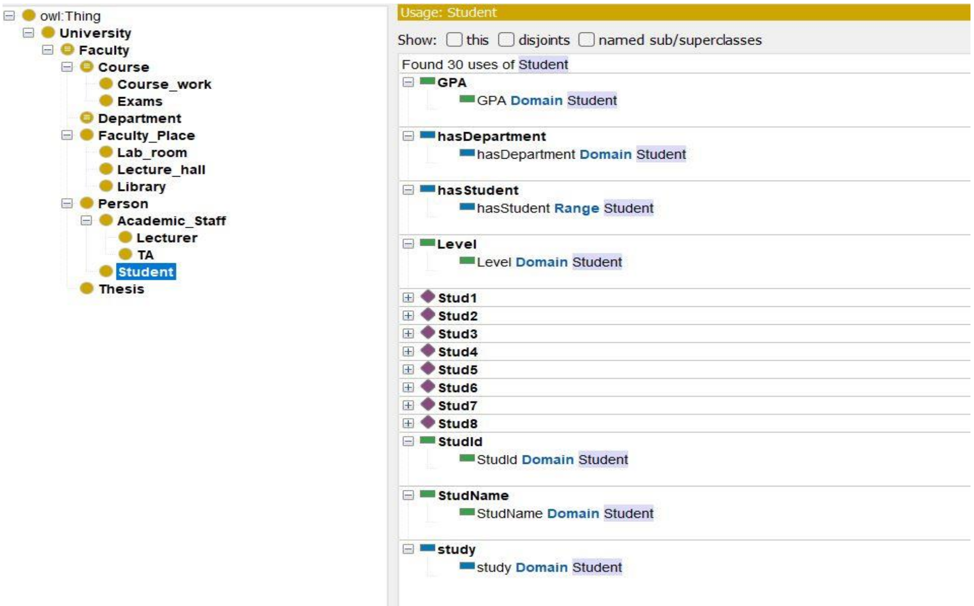
Found 6 uses of Library

- Library1
- Library2
- Other

2.13. Class Student

Data properties: GPA, level, studId and StudName.

Object properties: hasDepartment and study**.**



```
owl:Thing
  University
    Faculty
      Course
        Course_work
        Exams
      Department
      Faculty_Place
        Lab_room
        Lecture_hall
        Library
      Person
        Academic_Staff
          Lecturer
          TA
        Student
      Thesis
```

Usage: Student

Show: □ this □ disjoints □ named sub/superclasses

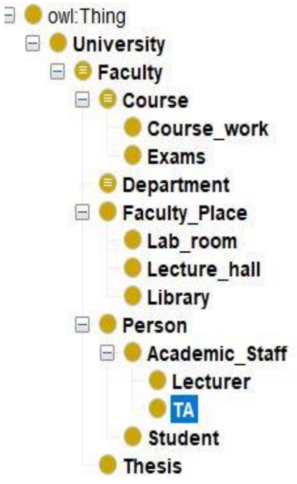
Found 30 uses of Student

- GPA
  - GPA Domain Student
- hasDepartment
  - hasDepartment Domain Student
- hasStudent
  - hasStudent Range Student
- Level
  - Level Domain Student
- Stud1
- Stud2
- Stud3
- Stud4
- Stud5
- Stud6
- Stud7
- Stud8
- StudId
  - StudId Domain Student
- StudName
  - StudName Domain Student
- study
  - study Domain Student

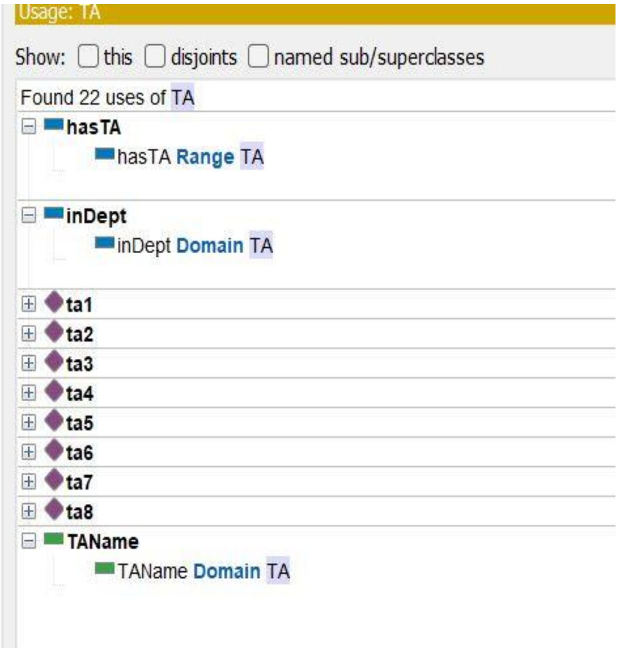
2.14. Class TA

Data properties: TAName.

Object properties: inDept .



- owl:Thing
  - University
    - Faculty
      - Course
        - Course_work
        - Exams
      - Department
      - Faculty_Place
        - Lab_room
        - Lecture_hall
        - Library
      - Person
        - Academic_Staff
          - Lecturer
          - TA
        - Student
      - Thesis



Usage: TA

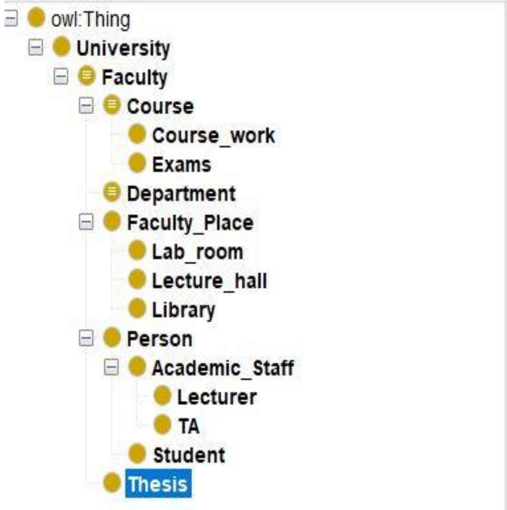
Show: □ this □ disjoints □ named sub/superclasses

Found 22 uses of TA

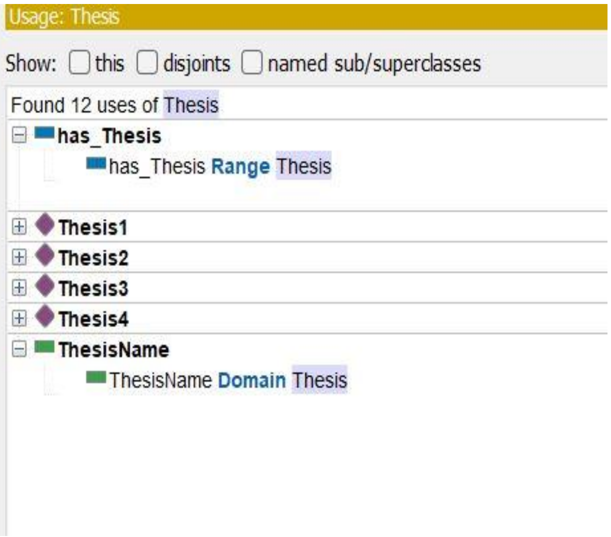
- hasTA
  - hasTA Range TA
- inDept
  - inDept Domain TA
- ta1
- ta2
- ta3
- ta4
- ta5
- ta6
- ta7
- ta8
- TAName
  - TAName Domain TA

2.15. Class Thesis

Data properties: TAName.



- owl:Thing
  - University
    - Faculty
      - Course
        - Course_work
        - Exams
      - Department
      - Faculty_Place
        - Lab_room
        - Lecture_hall
        - Library
      - Person
        - Academic_Staff
          - Lecturer
          - TA
        - Student
      - Thesis



Usage: Thesis

Show: □ this □ disjoints □ named sub/superclasses

Found 12 uses of Thesis

- has_Thesis
  - has_Thesis Range Thesis
- Thesis1
- Thesis2
- Thesis3
- Thesis4
- ThesisName
  - ThesisName Domain Thesis

Part2 (clips):

a) Define the different classes and subclasses in the system using clips.

b) Define the relations between classes using rules.

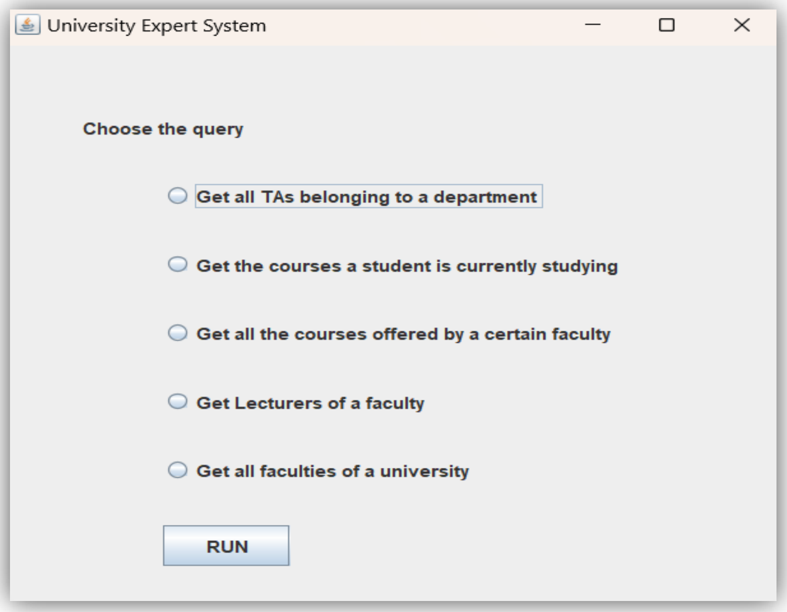
c) Define the individuals (instance) of each class.

d) Create functions to be able to infer on data.

e) Use clips rule based system to extract new knowledge.

3. <u>Graphical user Interface</u>

1) Choose the query to run from the following:



University Expert System

Choose the query

○ Get all TAs belonging to a department

○ Get the courses a student is currently studying

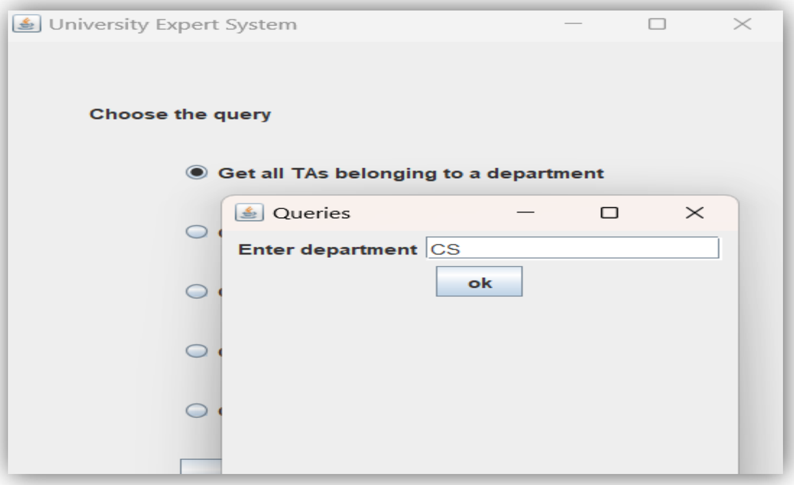
○ Get all the courses offered by a certain faculty

○ Get Lecturers of a faculty

○ Get all faculties of a university

1. Get all TAs belonging to a department.

- Enter the name of the department

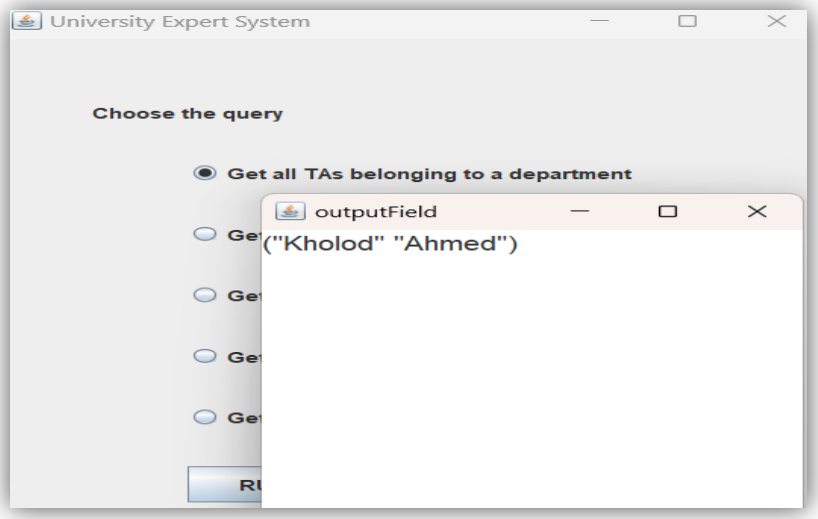


Choose the query

● Get all TAs belonging to a department

Enter department CS

- The system would infer and get the TAs in this department.



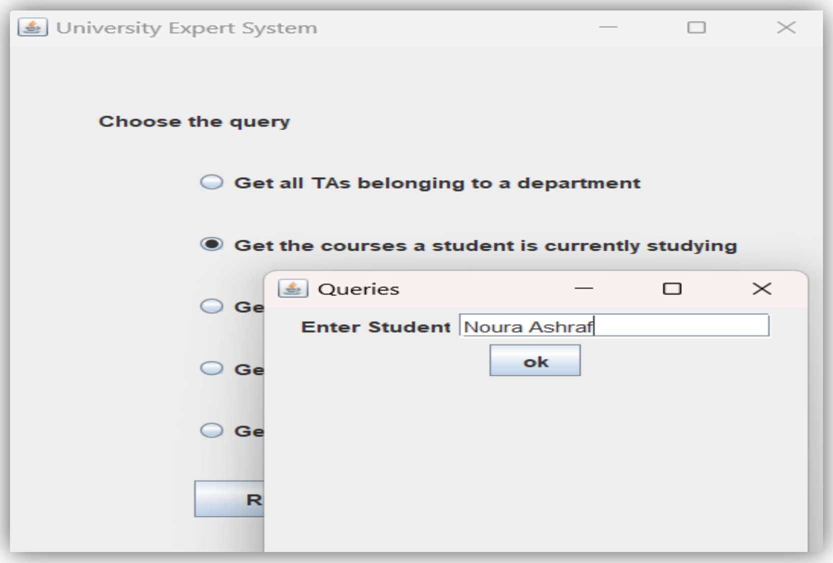
Choose the query

● Get all TAs belonging to a department

```
("Kholod" "Ahmed")
```

2. Get the courses a student is currently studying.

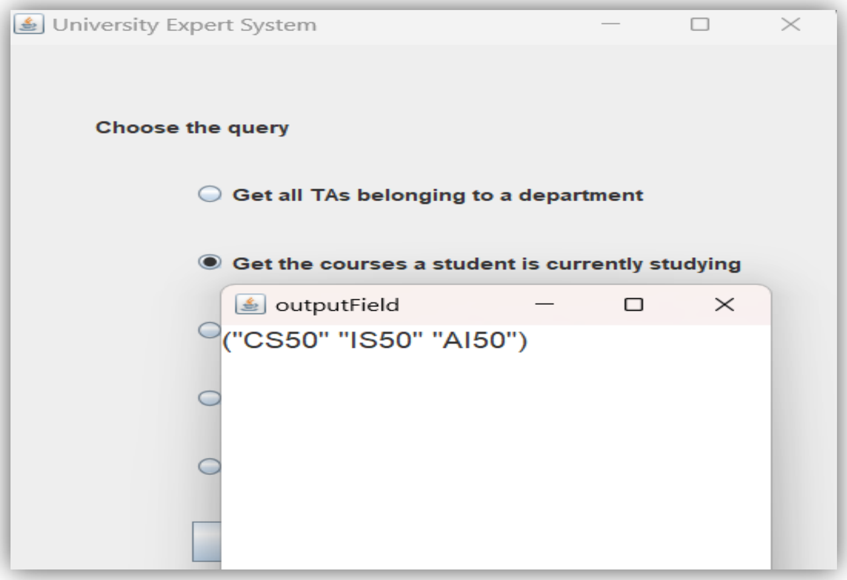
- Enter the name of the student



● Get the courses a student is currently studying

Enter Student: Noura Ashraf

-The system would infer and get the Courses the student is studying

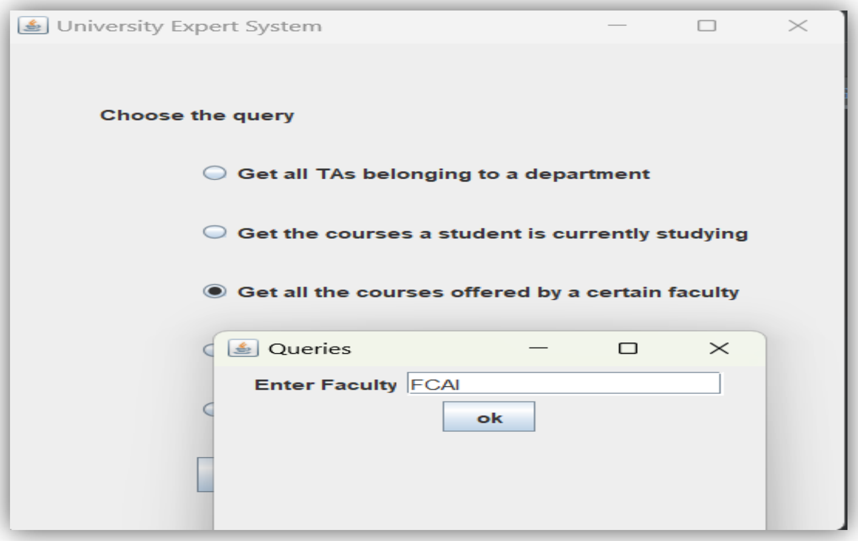


● Get the courses a student is currently studying

```
("CS50" "IS50" "AI50")
```

3. Get all the courses offered by a certain faculty.

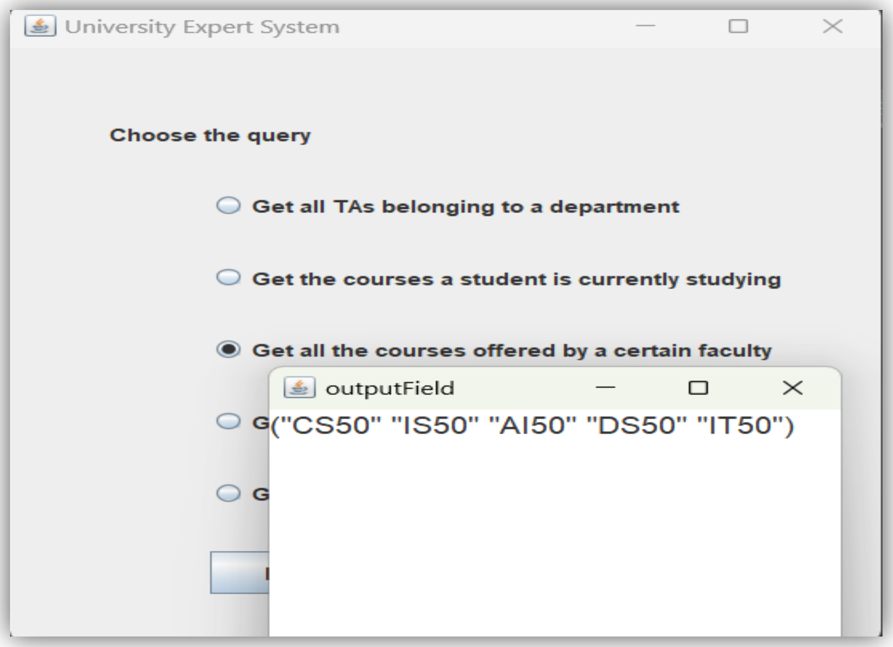
- Enter the name of the faculty


University Expert System
Choose the query
○ Get all TAs belonging to a department
○ Get the courses a student is currently studying
Queries
ok

● Get all the courses offered by a certain faculty

Enter Faculty FCAI

- The system would infer and get the Courses the student is studying

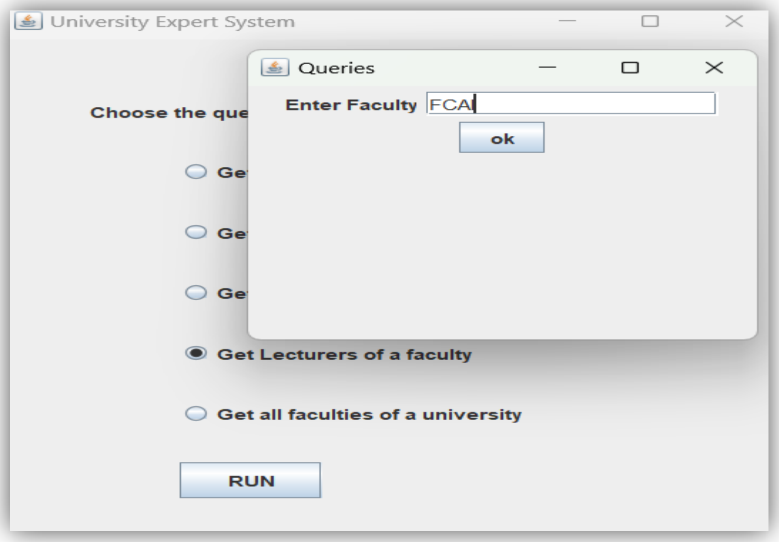

University Expert System
Choose the query
○ Get all TAs belonging to a department
○ Get the courses a student is currently studying
outputField

● Get all the courses offered by a certain faculty

```
("CS50" "IS50" "AI50" "DS50" "IT50")
```

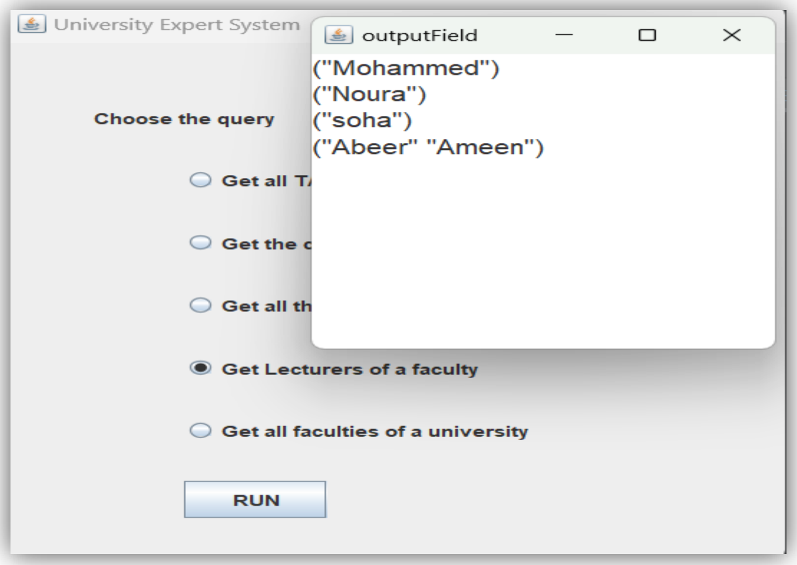
4. Get Lecturers of a faculty.

- Enter the name of the faculty


University Expert System
Queries
Choose the que
○ Ge
○ Ge
○ Ge
● Get Lecturers of a faculty
○ Get all faculties of a university
RUN
ok

Enter Faculty FCAI

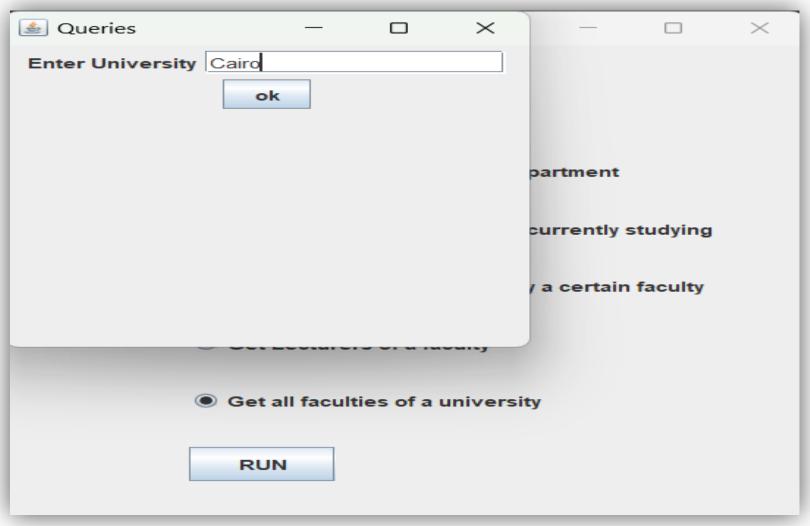
- The system would infer and get the Courses the student is studying.



```
("Mohammed")
("Noura")
("soha")
("Abeer" "Ameen")
```

5. Get all faculties of a university.

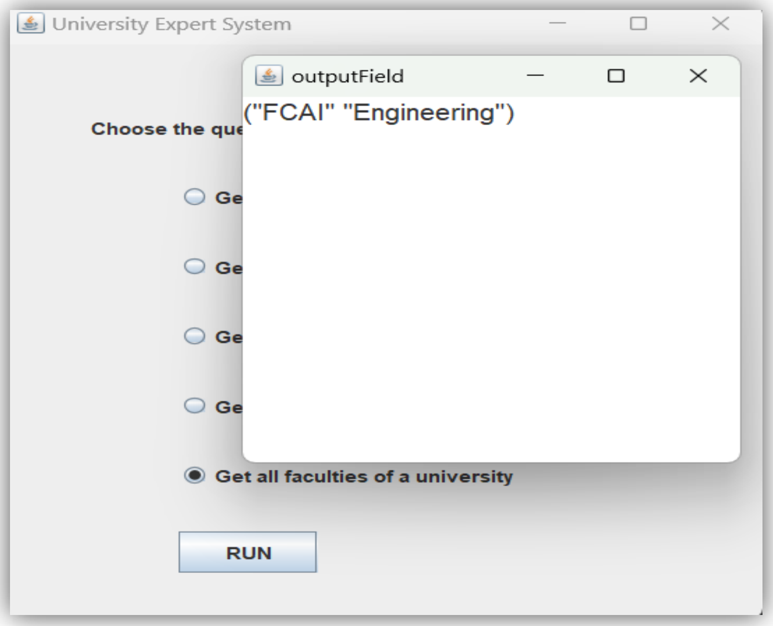
- Enter the name of the university.



Enter University: Cairo

● Get all faculties of a university

- The system would infer and get the Courses the student is studying.



```
("FCAI" "Engineering")
```

● Get all faculties of a university