**Competency Questions**

We implemented six different competency questions which were further divided into multiple sub-questions. All of the details related to these questions can be found below:

**Question 1**: How can I get to know my university? (Click here to visit the link provided to solve all your queries related to health insurance.)

* Where can I park my bike or car on campus? (You can buy an hourly or daily passes. Click here to get more information on rates, locations, etc.)
* Where can I eat on campus? (Look out for the smaller food outlets, coffee shops and quick-stop shops, such as Pivik, Bento Sushi and Tim Hortons.)
* How can I avoid the lines to get my uOttawa Card? (You can order the uOttawa card online.)
* How can I add money to uOttawa card? Has same answer as the previous one
* How do I get around campus? (Click here to use an interactive map to get your bearings. Please note that classes finish 10 minutes before their scheduled end to allow travel time between back-to-back classes.)
* How can I find accommodation on campus? (We have multiple options for you. Please click here to go the university page for all your queries about accommodation)

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| Verbs | Eat, drink, park, add, deposit, add, live, rent, get, purchase, provide, issue, order, apply. |
| Nouns | Restaurants, coffee, money, apartment, accommodation, campus, registration office, ID card, Parking office, Parking permit, Monthly/daily/hourly permit prices, card, online, Virtual Maps University of Ottawa, Housing Service. |

**Question 2**: Where can I find solutions for academic issues? (Each faculty has academic advisers ready to answer your questions. Check your faculty website and make an appointment.)

* How can I access the study material? (The material required for the course will be posted on Brightspace Portal)
* How to prepare for the exams? (All the information on the exam preparation should be found at the student success services portal by clicking here.) (SASS - Student Academic Success Service)
* How can I find study partners? (Click here to visit SASS portal where you can find information related to Study Groups.)
* How to access the class schedule and timings? (Click here to visit uoZone portal and goto the My Class Schedule under the applications tab to find about your class.)
* With whom and how can I share my academic plans? (Each faculty has academic advisers ready to answer your questions. Check your faculty website and make an appointment.)
* How can I keep track of my academic matters? (grades ) (Click here to visit uoZone portal. All the information regarding fees and student can be accessed via the portal.
* How can I enrol or drop my courses? (You can easily enroll or drop from courses by visiting the uoZone portal then go to enrol option under the applications tab.)
* How can I get a mentor? (Please visit this link for help regarding mentoring .)
* Where can I find material to read and books for the course? (You can access our wide range of books on every possible topic. Tap here to directly go to the online library service provided to the uOttawa students for free.)

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| Verbs | Access, prepare, find, share, keep, track, enrol, drop, get |
| Nouns | Material, courses, Brightspace, exams, study, partners, class, schedule, time, academic plan/matters, mentor, read, books, SASS - Student Academic Success Service, Study Groups, uoZone portal, academic advisers, Mentoring Centres, online library service |

**Question 3**: How to get information related to jobs and job searches? (All information regarding job search can be obtain at Career Development Centre. Tap tp find out more details.)

* Can I earn money while studying? (As an international student you are allowed to work 20 hours per week. Tap here to find out more related information on the Canadian government website.)
* How to apply for jobs, internships? (All information regarding job search can be obtain at Career Development Centre. Tap tp find out more details.)
* How to apply for co-op positions? (Click here and visit the link to find answers to all your co-op related queries.)

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| Verbs | Obtain, earn, apply |
| Nouns | Career Development Centre, job, co-op, internship, Work off/on campus as an international student, Co-operative Education Programs |

**Question 4**: How to get information regarding scholarships and fees? (We do offer scholorships and brusary in special cases. Click here get more information.)

* Where can I apply for scholarships? (We do offer scholorships and brusary in special cases. Click here get more information.)
* How to pay my fees and keep track of my student account? (Click here to visit uoZone portal. All the information regarding fees and student can be accessed via the portal.)
* What is the scheme regarding bursary? (Click here to visit the scholarship and bursary webpage for more information on your query .)

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| Verbs | Get, offer, apply for, pay, keep track |
| Nouns | Service, Study Groups, uoZone portal, academic advisers, Mentoring Centres, online library service, Financial aid and awards, Scholarships and bursaries, uoZone portal, fees, scholarships, bursary, student account, information. |

**Question 5**: How do I secure my rights and safety at the university? (Click here to visit Uottawa's Security website and you can download secure Uoapp from play store.)

* How can I ensure my rights are protected? (Manages complaints of harassment and discrimination, among other things. Click here to visit the human rights office to resolve your issue.)
* What if I have other safety concerns? (Click here to visit Uottawa's Security website and you can download secure Uoapp from play store.)
* How can I file a complaint against someone? (Manages complaints of harassment and discrimination, among other things. Click here to visit the human rights office to resolve your issue.)

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| Verbs | Secure, ensure, manage, complaint, file |
| Nouns | Protection Services, Human Rights Office, rights, safety, university, secure Uoapp, playstore, complaint, harassment, discrimination |

**Question 6**: How does the university's health insurance scheme work? (Click here to visit the link provided to solve all your queries related to health insuance.)

* What is the medical insurance offered by the university? (Click here to visit the link provided to solve all your queries related to health insuance.)
* Can we opt out of medical insurance? (Click here to visit the webpage to find out more information on health insurance.)
* Is COVID-19 treatment/vaccination included in the insurance plan? (Click here to visit the webpage that provides all the information regarding the covid19 virus.)
* From where can I get the UHIP card? (Click here to visit the webpage to find out more information on health insurance.)
* Whom to contact in case of a health emergency? (Click here to visit the health emergency advise.)

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| Verbs | work , offer, cover, opt out, include, get, contact |
| Nouns | Student Accounts, Health and dental insurance, International Office, University Health Insurance Plan (UHIP), Coronavirus (COVID-19), Health, Safety and Risk Management, Protection Services, health insurance, university, medical insurance, treatment, UHIP card, emergency |

Knowledge structure

**UOTTAWA**

* **Students**
  + New student
  + Old student
* **Campus Services**
  + Housing Service
  + Parking Office
  + Registration Office
  + Restaurants and Coffee
  + Virtual Maps
  + Brightspace
  + Student Academic Success Service
  + Study Groups
  + uoZone Portal
  + Academic Advisers
  + Mentoring Centres
  + Online Library Service
  + Financial Aid and Awards
  + Career Development Centre
  + Co-operative Education Programs
  + International Office
  + Health and dental insurance
  + University Health Insurance Plan (UHIP)
  + Coronavirus (COVID-19)
  + Health, Safety and Risk Management
  + Protection Services
  + Human Rights Office
  + Secure Uoapp
* **Inquiries**
  + Get to Know the University
    - Getting around
    - Parking
    - Accommodation
    - Food options
    - uOttawa card

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| Verbs | Eat, drink, park, add, deposit, add, live, rent, get, purchase, provide, issue, order, apply. |
| Nouns | Restaurants, coffee, money, apartment, accommodation, campus, registration office, ID card, Parking office, Parking permit, Monthly/daily/hourly permit prices, card, online, Virtual Maps University of Ottawa, Housing Service. |
| Relation | The student can use Virtual Maps to get around the university  The Parking Office provides permission to students  The students can use Virtual Maps to locate the parking sites  Registration Office issues the uOttawa ID for new students by online application.  Housing Service at uOttawa provides accommodation to students  Students eat at Restaurants on-campus |

* + Academic Guidance
    - Mentor
    - Exam preparation
    - Class schedule
    - Course material
    - Study partners
    - Drop/add course
    - Tracking academic progress
    - Academic advisor

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| Verbs | Access, prepare, find, share, keep, track, enrol, drop, get |
| Nouns | Material, courses, Brightspace, exams, study, partners, class, schedule, time, academic plan/matters, mentor, read, books, SASS - Student Academic Success Service, Study Groups, uoZone portal, academic advisers, Mentoring Centres, online library service |
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* + Scholarship and Fees
    - Applying for scholarship and bursary
    - How to pay fees
    - Track of student account

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| --- | --- |
| Verbs | Get, offer, apply for, pay, keep track |
| Nouns | Service, Study Groups, uoZone portal, academic advisers, Mentoring Centres, online library service, Financial aid and awards, Scholarships and bursaries, uoZone portal, fees, scholarships, bursary, student account, information. |

* + Job and CO-OPS
    - Working while studying

Yes,new students can work while studying, they can do it either by doing a co-op or finding an internship and the information regarding the same can be obtain from Career Development Centre or at Co-operative Education Office/centre

* + - CO-OP

University provides CO\_OP opportunities to the students enrolled in the co-op courses. More Information can be obtained at The CO-Operative Office/Centre

* + - Job

Students can search/apply for jobs and can work both on/off campus, Student can get more information regarding the same at the Career Development Centre

* + - Work hours

IRCC has specified working hours guidelines, student can work 20 /week during full time studies and 40hours/week during Breaks

More information can be obtained at the Career development Centre and International Office

* + - Internships

Students can apply for internships while studying and during the break. More information regarding can be found at the Career Development Centre and University Job Serach Webpage

* + - Job search portals

University has a dedicated Job search Webpage where it has all important links for the job search portals

More information can be found at Career Development Centre and co-op Centre

* + Job and CO-OPS
    - Working while studying
    - CO-OP
    - Job
    - Work hours
    - Internships
    - Job search portals

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| --- | --- |
| Verbs | Obtain, earn, apply |
| Nouns | Career Development Centre, job, co-op, internship, Work off/on campus as an international student, Co-operative Education Programs |

* + Health and Medical
    - Health insurance

Health and dental insurance for all new and old university students is covered. University helath insurance plan (UHIP) is currently offered by the university.

Univerity offers

* + - Medical emergency contact

Medical emergency contact is provided to students to deal with emergencies. Health, Safety and Risk Management makes sure that student’s UHIP covers all emergencies.

* + - University health plan

The university offers a mandatory Health and dental insurance plan called University health insurance plan (UHIP) to all students to deal with all treatment and emergencies.

* + - Diseases covered in health plan

The UHIP card covers various diseases including the Coronavirus(COVID-19) test and treatment plan as well.

* + Health and Medical
    - Health insurance
    - Medical emergency contact
    - University health plan
    - Diseases covered in health plan

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| Verbs | work , offer, cover, opt out, include, get, contact |
| Nouns | Student Accounts, Health and dental insurance, International Office, University Health Insurance Plan (UHIP), Coronavirus (COVID-19), Health, Safety and Risk Management, Protection Services, health insurance, university, medical insurance, treatment, UHIP card, emergency |

* + Rights and Safety
    - Ensure my rights

Students can ensure that their rights are secure and can file a complaint if there is any voilation of the rights. Student can visit Human Rights Office or use the protection service like the Uoapp from Playstore to secure their rights

* + - File a complaint

University strongly condemns harassment and discrimination against any student

Student can file a complaint either at the Human rights Office or they can use protection Service like the Uoapp from Playstore

* + - Other safety concerns

University wants to ensure the security of all its students so to ensure their safety. University has Human Rights Office and various Protection Services to address that issues.

* + Rights and Safety
    - Rights Ensuring
    - Other safety concerns
    - Complaint Filing

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| --- | --- |
| Verbs | Secure, ensure, manage, complaint, file |
| Nouns | Protection Services, Human Rights Office, rights, safety, university, secure Uoapp, playstore, complaint, harassment, discrimination |

**Ontology**

Defines the concepts and relationships used to describe and represent an area of knowledge.

* The branch of metaphysics dealing with the nature of being.
* A set of concepts and categories in a subject area or domain that shows their properties and the relations between them.
* An ontology defines a common vocabulary for researchers who need to share information in a domain. It includes machine-interpretable definitions of basic concepts in the domain and relations among them.

Why would someone want to develop an ontology? Some of the reasons are:

* To share common understanding of the structure of information among people or software agents.
* To enable reuse of domain knowledge.
* To make domain assumptions explicit.
* to separate domain knowledge from the operational knowledge.
* To analyse domain knowledge.

In this assignment, we used Protégé 5.5.0 for our topic.

Classes are the focus of most ontologies. Classes describe concepts in the domain. For example, a class of students represents all students. Specific students are instances of this class. The new admitted student is an instance of the class of students. A class can have subclasses that represent concepts that are more specific than the superclass. For example, we can divide the class of students into new students and old students.

Slots describe properties of classes and instances:

Registration Office can issue the uOttawa ID for new students by online application, so the ID card has slots such as body, way of application, the issuer, and receiver.

In our situation, all instances of the class **Inquiries** and itssubclasses have slot produces that from **Campus Services** class to **Students** class.

In practical terms, developing an ontology includes:

* Defining classes in the ontology.
* Arranging the classes in a taxonomic (subclass–superclass) hierarchy.
* Defining slots and describing allowed values for these slots.
* Filling in the values for slots for instances.

We can then create a knowledge base by defining individual instances of these classes filling in specific slot value information and additional slot restrictions.

First, we would like to emphasize some fundamental rules in ontology design to which we will refer many times. These rules may seem rather dogmatic. They can help, however, to make design decisions in many cases.

* There is no one correct way to model a domain— there are always viable alternatives. The best solution almost always depends on the application that you have in mind and the extensions that you anticipate.
* Ontology development is necessarily an iterative process.
* Concepts in the ontology should be close to objects (physical or logical) and relationships in your domain of interest. These are most likely to be nouns (objects) or verbs (relationships) in sentences that describe your domain.

**Competency Questions**

Q1: How can I get to know my university?

Q2: Where can I find solutions for academic issues?

Q3: How to get information related to jobs and job searches?

Q4: How to get information regarding scholarships and fees?

Q5: How do I secure my rights and safety at the university?

Q6: How does the university's health insurance scheme work?

1. **Determine the domain and scope of the ontology**

Based on our competency questions, we plan to use this ontology for first year newly admitted students at a university to provide them answers for their most frequent questions.

1. **Define the classes and the class hierarchy**

A top-down development process has been used to define the most general concepts in the domain and subsequent specialization of the concepts.

1. **Define the properties of classes—slots**

The classes alone will not provide enough information to answer the competency questions. Once we have defined some of the classes, we must describe the internal structure of concepts.

We have already selected classes from the list of terms. Most of the remaining terms are likely to be properties of these classes. These terms include, for example,

For each property in the list, we must determine which class it describes. These properties become slots attached to classes.

In general, there are several types of object properties that can become slots in an ontology:

* intrinsic properties such as the flavor
* extrinsic properties such as a name and area.
* parts, if the object is structured; these can be both physical and abstract “parts”
* relationships to other individuals; these are the relationships between individual members of the class and other items (e.g., the issuer of a ID card, representing a relationship between a student and the ID card)

1. **Define the facets of the slots**

Slots can have different facets describing the value type, allowed values, the number of the values (cardinality), and other features of the values the slot can take. For example, the value of a name slot is one string. That is, name is a slot with value type String. A slot produces can have multiple values and the values are instances of the a class. That is, produces is a slot with value type Instance.

1. **Domain and range of a slot**

Allowed classes for slots of type Instance are often called a range of a slot. The classes to which a slot is attached or a classes which property a slot describes, are called the domain of the slot. In the systems where we attach slots to classes, the classes to which the slot is attached usually constitute the domain of that slot.

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| Figure 1:Classes hierarchy for uOttawa, showing the campus services, students, and inquiries. |

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| Figure 2:Classes hierarchy for campus services. |

When defining a domain or a range for a slot, find the most general classes or class that can be respectively the domain or the range for the slots .

On the other hand, do not define a domain and range that is overly general: all the classes in the domain of a slot should be described by the slot and instances of all the classes in the range of a slot should be potential fillers for the slot. an overly general class for range (i.e., one would not want to make the range THING) but one would want to choose a class that will cover all fillers.

In more specific terms:

* If a list of classes defining a range or a domain of a slot includes a class and its subclass, remove the subclass.
* If a list of classes defining a range or a domain of a slot contains all subclasses of a class A, but not the class A itself, the range should contain only the class A and not the subclasses.
* If a list of classes defining a range or a domain of a slot contains all but a few subclasses of a class A, consider if the class A would make a more appropriate range definition.

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| Figure 3:Classes hierarchy for campus services, showing the main topics for competency questions and their possible branches. |

**Create instances**

The last step is creating individual instances of classes in the hierarchy. Defining an individual instance of a class requires (1) choosing a class, (2) creating an individual instance of that class, and (3) filling in the slot values.

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| Figure 4: Define the properties of classes-slots, showing the domain and range of a slot. |
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| Figure 5: Create instances |
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| Figure 6: Create instances |

After building the ontology structure and its Classes hierarchy, we tried to find a priorities and relations for the classes and subclasses as shown below. So, we got a general knowledge about how to create sub questions for chatbot.

Knowledge structure

**UOTTAWA**

* **Students**
  + New student
  + Old student
* **Campus Services**
  + Housing Service
  + Parking Office
  + Registration Office
  + Restaurants and Coffee
  + Virtual Maps
  + Brightspace
  + Student Academic Success Service
  + Study Groups
  + uoZone Portal
  + Academic Advisers
  + Mentoring Centres
  + Online Library Service
  + Financial Aid and Awards
  + Career Development Centre
  + Co-operative Education Programs
  + International Office
  + Health and dental insurance
  + University Health Insurance Plan (UHIP)
  + Coronavirus (COVID-19)
  + Health, Safety and Risk Management
  + Protection Services
  + Human Rights Office
  + Secure Uoapp
* **Inquiries**
  + **Get to Know the University**
    - Getting around
    - Parking
    - Accommodation
    - Food options
    - uOttawa card

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| Verbs | Eat, drink, park, add, deposit, add, live, rent, get, purchase, provide, issue, order, apply. |
| Nouns | Restaurants, coffee, money, apartment, accommodation, campus, registration office, ID card, Parking office, Parking permit, Monthly/daily/hourly permit prices, card, online, Virtual Maps University of Ottawa, Housing Service. |
| Relations examples | The student can use Virtual Maps to get around the university  The Parking Office provides permission to students  The students can use Virtual Maps to locate the parking sites.  Registration Office issues the uOttawa ID for new students by online application.  Housing Service at uOttawa provides accommodation to students.  Students eat at Restaurants on-campus |

* + **Academic Guidance**
    - Mentor
    - Exam preparation
    - Class schedule
    - Course material
    - Study partners
    - Drop/add course
    - Tracking academic progress
    - Academic advisor

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| --- | --- |
| Verbs | Access, prepare, find, share, keep, track, enrol, drop, get |
| Nouns | Material, courses, Brightspace, exams, study, partners, class, schedule, time, academic plan/matters, mentor, read, books, SASS - Student Academic Success Service, Study Groups, uoZone portal, academic advisers, Mentoring Centres, online library service |

* + **Scholarship and Fees**
    - Applying for scholarship and bursary
    - How to pay fees
    - Track of student account

|  |  |
| --- | --- |
| Verbs | Get, offer, apply for, pay, keep track |
| Nouns | Service, Study Groups, uoZone portal, academic advisers, Mentoring Centres, online library service, Financial aid and awards, Scholarships and bursaries, uoZone portal, fees, scholarships, bursary, student account, information. |

* + **Job and CO-OPS**
    - Working while studying
    - CO-OP
    - Job
    - Work hours
    - Internships
    - Job search portals

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| --- | --- |
| Verbs | Obtain, earn, apply |
| Nouns | Career Development Centre, job, co-op, internship, Work off/on campus as an international student, Co-operative Education Programs |

* + **Health and Medical**
    - Health insurance
    - Medical emergency contact
    - University health plan
    - Diseases covered in health plan

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| --- | --- |
| Verbs | work , offer, cover, opt out, include, get, contact |
| Nouns | Student Accounts, Health and dental insurance, International Office, University Health Insurance Plan (UHIP), Coronavirus (COVID-19), Health, Safety and Risk Management, Protection Services, health insurance, university, medical insurance, treatment, UHIP card, emergency |

* + Rights and Safety
    - Rights Ensuring
    - Other safety concerns
    - Complaint Filing

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| --- | --- |
| Verbs | Secure, ensure, manage, complaint, file |
| Nouns | Protection Services, Human Rights Office, rights, safety, university, secure Uoapp, playstore, complaint, harassment, discrimination |

The final competency questions and their sub questions are listed below:

**Question 1**: **How can I get to know my university?**

* Where can I park my bike or car on campus?
* Where can I eat on campus?
* How can I avoid the lines to get my uOttawa Card
* How can I add money to uottawa card?
* How do I get around campus?
* How can I find accommodation on campus?

**Question 2**: **Where can I find solutions for academic issues?**

* How can I access the study material?
* How to prepare for the exams?
* How can I find study partners?
* How to access the class schedule and timings?
* With whom and how can I share my academic plans?
* How can I keep track of my academic matters? (grades )
* How can I enrol or drop my courses?
* How can I get a mentor?
* Where can I find material to read and books for the course?

**Question 3**: **How to get information related to jobs and job searches?**

* Can I earn money while studying?
* How to apply for jobs, internships?
* How to apply for co-op positions?

**Question 4**: **How to get information regarding scholarships and fees?**

* Where can I apply for scholarships?
* How to pay my fees and keep track of my student account?
* What is the scheme regarding bursary?

**Question 5**: **How do I secure my rights and safety at the university?**

* How can I ensure my rights are protected?
* What if I have other safety concerns?
* How can I file a complaint against someone?

**Question 6**: **How does the university's health insurance scheme work?**

* What is the medical insurance offered by the university?
* Can we opt out of medical insurance?
* Is COVID-19 treatment/vaccination included in the insurance plan?
* From where can I get the UHIP card?
* Whom to contact in case of a health emergency?