Semantic Web: Lab 2

OWL Ontology Building

This lab is to help to get you familiar with the process of defining an ontology for a domain. Ontology is an important concept for Semantic Web, for which W3C has published OWL and OWL 2 as the standard languages. An ontology is to encode pieces of background knowledge for a domain, and they are saved in the format .owl, guaranteeing a great information sharing among different applications. The description logics based semantics equips OWL and OWL2 with a sound unambiguous meaning to prevent mis-interpretations among different users of these data. Note that, we use the terminologies "property", "role", and "attribute" interchangeable to mean a binary relation.

You are asked first to write down several elements of an ontology in paper. You are then assigned to build an ontology with the tool Protégé (or OWL API) and check the inconsistency of your ontology with the plugin reasoner of Protégé (or in OWL API).

Excise 1. This exercise is to recall that description logics is not a single logic, but a family of language, among which is $\mathcal{ALC}$ as we discussed in the lecture. Indeed, OWL and OWL 2 standards contains 7 different description logic languages that differ in syntax and expressivity.

Consider the university study scenario, in particular the D2K Examination Regulation (attached), and answer the following questions.

- List the atomic concept names, role names, and individual names for this scenario. (For example, Students is an atomic name, and hasStudentId is a role, and Pierre can be an individual)

- Construct at least 10 complex concepts using different Description Logic constructors given below:

  $$\sqcup, \sqcap, \neg, \exists\ R.C, \forall\ R.C, \geq n\ R.C, \leq n\ R.C$$

  For each of these complex concepts, give its explanation in natural language.
  For example, $Student \sqcap \exists hasDiploma.Engineering$ means "all students who have obtained Engineering diploma".

- Construct a TBox and a ABox for this domain. In Description Logic, an element from TBox or Abox is called an axiom.
  For example, $Apprentice = Student \sqcap \exists\ WorkIn.Enterprise$ can be an element from TBox (so it is call an axiom), and $WorksIn(John, Thales)$ can be an ABox element.
  You are required to build a TBox having at least 7 TBox axioms and an ABox having at least 5 axioms.

- Can you infer some implicite information from the ontology $\mathcal{O}$ =(TBox, ABox) from the TBox and ABox you built above?
  For example, I can deduce $Apprentice(John)$ based on the TBox

$$\mathcal{T} = \{Apprentice = Student \sqcap \exists\, WorkIn.Enterprise\}$$

  and ABox

$$\mathcal{A} = \{WorksIn(John, Thales), Student(John), Enterprise(Thales)\}.$$

Excise 2. This exercice is to understand a typical ontology browser for the biomedical ontology Snomed CT.
Go to the webpage `http://browser.ihtsdotools.org`, and click "Go browsing International edition" to enter the latest version of Snomed CT browser page. On the left, you can see the list of concepts defined in this ontology, by clicking on a concept, you will get information about it on the right column. You can search a concept by its id, and you can click on "Summary" and "Diagram" to figure out its information. Can you write down the description logic formats for the following concepts?

- 131148009(Bleeding),
- 284666000(Trophic life form),
- 844005(Behavior finding),
- 420395004

For example, $262832002 = 30171000 \sqcap \exists\, 363698007.23451007 \sqcap \exists\, 116676008.35566002$.

Excise 3. Creation of the ontology (with Protégé and/or OWL API)

1. Download Protégé from `http://protege.stanford.edu/`.
2. Run Protégé from terminal: path-protege/run.sh
3. Import an existing ontology into Protégé (e.g. the pizza ontology `protege.stanford.edu/ontologies/pizza/pizza.owl`
4. Verify the ontological elements (concepts, properties, instances, axioms) in the ontology
5. Create a new OWL ontology that encodes the answers you have for Excise 1. And enrich it as much as possible to model the knowledge conveyed by the exam regulation.
6. Using OWL API for the creation of ontology will be in the next Lab.

Excise 4. Reasoning with your ontology by a reasoner With Protégé, choose a reasoner by clicking on the button "reasoner", and then "start reasoning".

- Is your ontology consistent?
- What do the buttons "Stated" and "Inferred" mean?
- Using OWL API for reasoning with an ontology will be in the next Lab.