Semantic Web

(KEN3140)

Assignment 3:

Web Ontology Language (OWL)

01-10-2020

Assignment task overview

This assignment will assess your ability to construct an OWL 2 DL ontology that captures knowledge about a domain of interest - **universities (or academic institutions).** You will build your ontology using a similar Jupyter notebook to the one you used for Lab 9.

Learning objectives

1. How to construct an OWL 2 DL ontology programmatically (and to transfer what you have learned in this process within the “family relations” domain to another domain).
2. To assess which OWL features are suited to capture certain kinds of knowledge about a domain. I.e., to **accurately** capture knowledge about the domain using OWL semantics
3. To be able to judge whether two syntactically different axioms or class expressions represent the same knowledge (i.e., are semantically equivalent)
4. How to apply an ontology design pattern in the construction of ontologies
5. To be able to distinguish between classes, instances and object properties

Task description

You will develop an ontology about the topic of **universities.** It should describe the terminology and relationships occurring in a **typical** university setting. You have the freedom to choose the names for your classes, relations and individuals. You are also permitted to reuse some of your class and relation names from other ontologies on the Web (**but not from those whose central topic is about universities**). The most important requirement for the ontology is that it accurately captures a typical university setting. E.g. Course subClassOf Student is inaccurately capturing knowledge about this domain (courses are not students).

Requirements of the ontology:

1. The ontology should have between 15-20 unique atomic classes, 7-10 unique atomic roles, and 10 unique individuals.
2. At least 3 of the atomic classes should have both necessary & sufficient conditions (i.e, they should be defined). The necessary and sufficient conditions should contain role names. At least one of the class definitions should make use of universal role restrictions.
3. At least three of the atomic classes should have **only** necessary conditions with no sufficient ones. At least two of these necessary conditions should make use of **nested** class expressions (of arbitrary depth) with role restrictions.
4. Your ontology should make use of the exception ontology design pattern (ODP) to model "abnormality" or "atypical". E.g., in the case where Penguin subClassOf Bird, Bird subClassOf FlyingOrganism, Penguin subClassOf not FlyingOrganism, we find that Penguin is unsatisfiable. You can use the exception ODP to avoid this unsatisfiability by expressing knowledge about birds and penguins in a different way. You can differentiate between "Typical" birds which can fly and "Atypical" birds, like penguins, which cannot.
5. You must make use of all the main features in the full SROIQ (OWL 2 DL) language in the ontology.
    a. There should be at least one role specified as the inverse of another role.
    b. There should be at least three unique role chain axioms in your ontology that provide **new** inferences (i.e. new implicit role assertions should be inferred after applying reasoning)
    c. There should be at least two unique roles which have super roles in the role hierarchy
    d. You should have at least one transitive and one symmetric role in the ontology
    e. Negation should be used in at least 3 unique axioms
    f. At least three unique qualified cardinality restrictions should be used in the ontology
    g. Make at least three classes or class expressions disjoint in the ontology
    h. Valid Domain and Range restrictions should be provided for **all** roles specified
    i. Make use of **at least one** closure axiom in the ontology
6. "Orphaned" roles, classes and individuals will be **ignored** in the assessment of your ontology. Orphaned entities are those that do not appear in any axioms i.e. they are isolated by themselves and do not contribute any additional meaning to the ontology other than serving as an isolated term.
7. Your ontology must be consistent (otherwise, we cannot derive any meaningful inferences from it)

Material to Hand in

Your assignment is due on **Sunday, 11 October 2020 at 23:59**. Upload **only** the following two files to Canvas under Assignments>Assignment 3:

1. A single .ipynb Jupyter Notebook for assignment 3. Please name your file as: **“your-student-id.ipynb”** (**NB:** this is different from previous assignments where you additionally added your name and other information). **Please just use your student ID as the file name with the .ipynb extension.**
2. A single .owl file which is your ontology saved from your notebook. The .owl file has to be in valid Manchester OWL Syntax and again named with **your student ID only “your-student-id.owl”**

Grading criteria

We will assess the design of your ontology on a number of criteria directly related to the learning objectives of the assignment. I.e., we will assess to what extent you have demonstrated that you have achieved or mastered the learning objectives in the formulation of your OWL axioms, class expressions and constraints. **Please make sure to follow the assignment instructions carefully and meet all the requirements!** You will receive a grade out of 10 points for this assignment.

Helpful resources

1. KEN3140 Lectures 6 - 9 slides (Canvas)
2. KEN3140 Labs 6 - 9 slides and materials (Canvas)
3. Reading material: Semantic Web for the Working Ontologist (Chapters 1 - 7)
4. OWL W3C specification pages

Contact

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Notes

1. **Warning:** the assignment may look easy but it is not. If you start with the development of the ontology only the day or so before the deadline, there is a high probability that you will fail this assignment.
2. Your ontology will be of a higher quality if you start thinking about it at least a week before the deadline and you develop it over an extended period before the deadline
3. Think about what knowledge you want to capture first. Write out your axioms in plain English (or whatever your mother tongue is) and think about the semantics of OWL expressions and be careful about selecting the correct expressions to most accurately capture the meaning of the statements you want to