PhD course on Knowledge Graphs in the era of Large Language Models

Creating a small KG and ontology

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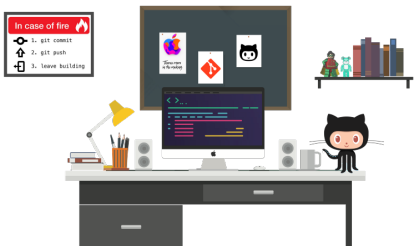
1 Git Repository

Support codes for the laboratory sessions are available in *github*.

`https://github.com/city-knowledge-graphs/phd-course-uji`



2 Creating RDF triples

RDFlib provide methods to populate an empty graph or add triples to an existing one.

RDFLib documentation:

- `https://rdflib.readthedocs.io/en/stable/intro_to_creating_rdf.html`
- `https://rdflib.readthedocs.io/en/stable/rdf_terms.html`

Task 1: Transform Table 1 into triples.

- Try to first create them with a text editor.
- Create the triples using RDFLib (programatically). Tip: *An example script to create triples is given in GitHub.*
- Try to create triples by automatically processing the CSV file representing Table 1. Tip: *An example script to load a csv file is given in GitHub.*

Table 1: Table about companies

Company	Founding year	Headquarters
OST	2017	Oxford
DeepReason.ai	2018	Oxford
Oxstem	2011	Oxford
Oxbotica	2014	Oxford
DeepMind	2010	London

3 First steps with ontology modelling

Task 2: Create an axiom (or axioms) for each of the following modelling tasks. Use DL or Manchester syntax to define the axioms (on paper). If you do not know how to proceed, it may be useful to start with the Section 4 Task. Feel free to ask ChatGPT or similar language models.

1. All Mexican restaurants are restaurants.
2. Cities and countries are locations.
3. United Kingdom is a country.
4. An instance cannot be a pizza and a location at the same time.
5. Restaurants are located in cities.
6. Ernesto works for City, University of London
7. If a person teaches a module and that module belongs to a university then that person works for the university.
8. A vegan pizza contains only vegan ingredients.
9. A pizza with meat as ingredient is a meaty pizza.
10. A super veggie pizza contains at least 5 vegetarian ingredients.

Task 3: Enrich the created triples in Task 1 with additional ontological triples or OWL axioms to better describe the domain of the table.

4 The Pizza ontology

The pizza ontology and its tutorial are well-known resources in the Semantic Web community. They were developed for educational purposes by the University of Manchester. The tutorial have been recently updated by Michael DeBellis.

The pizza ontology and the tutorial are found at:

- `https://tinyurl.com/NewPizzaTutorialV3-2`
- `http://protege.stanford.edu/ontologies/pizza/pizza.owl`

In the following exercises we are going to explore the Pizza ontology and the ontology editor Protégé.[1]

Task 4: Open the pizza ontology in Protégé (*File menu and open from URL*). Take some time to browse the class hierarchy, the property hierarchies and the individuals and note how the ontology describes the domain of pizzas.

[1] Some additional documentation can be found here: `http://protegeproject.github.io/protege/`. The `Protégé` demo video from Lab 2 may also be helpful.

Task 5: Find `Margherita` and see how it is defined as a pizza with only cheese and tomato topping. Look at the definition of `VegetarianPizza`. Is a `MargheritaPizza` a vegetarian pizza? Why / why not?

Task 6: Find `hasIngredient`. What is the domain and range of this property? What are the subproperties of `hasIngredient`? What is the inverse property of `hasIngredient`? What property characteristics does `hasIngredient` have?

Task 7: Classify the ontology by choosing a reasoner (*e.g.*, HermiT) and then "classify/start reasoner" in the reasoner menu. In the entities/classes tab we can chose between the asserted classification and inferred classification (as a results of reasoning).

- In the "Inferred class hierarchy" two classes show up as subclasses of `owl:Nothing`. What does it mean for a class to be a subclass of `owl:Nothing`? Why these two classes appear as subclasses of `owl:Nothing`?
- Find Margherita in the inferred class hierarchy and see which classes are inferred as superclasses of Margherita.

Task 8: Add a new class `RomanoPizza` as a subclass of `NamedPizza`. Define `RomanoPizza` as a pizza with:

- `hasTopping some AnchoviesTopping`,
- `hasTopping some TomatoTopping` and
- `hasTopping some MozzarellaTopping`.

Classify the ontology. What superclasses are inferred as superclass of `RomanoPizza`? Why?

Task 9 (optional): Use the tutorial `https://tinyurl.com/NewPizzaTutorialV3-2` (also available in moodle). Chapters 1-3 give an overview of what we saw in the slides. Chapters 4-8 give step by step instruction to create a version of the Pizza ontology.