Exercise Sheet 1

RDF, RDFS and Linked Data

*Submit your solutions until **Friday, 12.5.2017, 23h00** by uploading them to ILIAS. Later submissions won't be considered. Every solution should contain the **name(s)**, **email adress(es)** and **registration number(s)** of its (co-)editor(s). Read the slides for more submission guidelines.*

1 Knowledge Representation (4pts)

1.1 Knowledge Representation

Humans usually express their knowledge in natural language. Why aren't we using, e.g., English for knowledge representation and the semantic web?

1.2 Terminological vs Concrete Knowledge

What is the role of terminological knowledge (e.g. *Every company is an organization.*), and what is the role of facts (e.g. *Microsoft is an organization. Microsoft is headquartered in Redmond.*) in a semantic web system?

Hint: Imagine an RDF ontology that contains either only facts (describing factual knowledge: states of affairs) or constraints (describing terminological knowledge: relations between concepts). What could a semantic web system do with it?

2 RDF (10pts)

RDF graphs consist of **triples** having a **subject**, a **predicate** and an **object**. Different syntactic notations can be used in order to *serialize* RDF graphs. By now you have seen the **XML** and the **Turtle** syntax of RDF. In this task we will use the **Notation3** (N3) format described at http://www.w3.org/2000/10/swap/Primer. Look at the following N3 file:

```
@prefix model: <http://example.com/model1/> .
@prefix cdk: <http://example.com/chemistrydevelopmentkit/> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix owl:  <http://www.w3.org/2002/07/owl#> .


model:atom1
        a       cdk:Atom ;
        cdk:hasFormalCharge "1" ;
        cdk:symbol "O" .


model:atom2
        a       cdk:Atom ;
        cdk:symbol "C" .


model:mol1
        a       cdk:Molecule ;
        rdfs:label "Methanol" ;
        owl:sameAs <http://rdf.openmolecules.net/?InChI=1/CH4O/c1-2/h2H,1H3> ;
        cdk:hasAtom model:atom2 ,
                    model:atom1 ;
        cdk:hasBond model:bond1 .


model:bond1
        a       cdk:Bond ;
        cdk:bindsAtom model:atom1 ,
                      model:atom2 ;
        cdk:hasOrder cdk:SingleBond .
```

2.1 RDF Graph

Draw the RDF graph resulting from this file. An example for an RDF graph can be seen at http://www.w3.org/2000/10/swap/Examples.html.

2.2 What You See Is What You Get

Describe the information you have about `model:mol1` in your own words.

3 Modeling (15pts)

In this exercise we will look into an RDF vocabulary and use it to create a model. The information will be taken from the following text about the band Metallica:

> "Metallica is an American heavy metal band from Los Angeles, California. The band's fast tempos, instrumentals, and aggressive musicianship placed them as one of the founding "big four" of thrash metal alongside Slayer, Megadeth, and Anthrax. Metallica formed in 1981 when James Hetfield responded to an advertisement that drummer Lars Ulrich had posted in a local newspaper. As of 2003, the line-up features long-time lead guitarist Kirk Hammett (who joined the band in 1983) and bassist Robert Trujillo (a member since 2003) alongside Hetfield and Ulrich. Previous members of the band are lead guitarist Dave Mustaine (who went on to found the band Megadeth), and bassists Ron McGovney, Cliff Burton and Jason Newsted. The band also had a long collaboration with producer Bob Rock, who produced all of its albums from 1990 to 2003 and served as a temporary bassist between the departure of Newsted and the hiring of Trujillo. The band earned a growing fan-base in the underground music community and critical acclaim with its first four albums, with their third, Master of Puppets (1986), described as one of the most influential and "heavy" thrash metal albums. Metallica achieved substantial commercial success with their eponymous fifth album (also known as The Black Album), which debuted at number one on the Billboard 200."

Source: https://en.wikipedia.org/wiki/Metallica

3.1 FOAF

One widely known RDF vocabulary is FOAF ("Friend of a Friend") which is useful for expressing metadata about people, and their interests, relationships and activities. You can find an introduction here http://www.xml.com/pub/a/2004/02/04/foaf.html and the complete specification here http://xmlns.com/foaf/spec .

Look at the definitions of the following classes: `foaf:Group`, `foaf:Person`, `foaf:Organization`

Mark (e.g. underline) all relevant entities in the given text with regard to the foaf-classes mentioned above.

3.2 Creating a model

Create an RDF model for the text above. Only use the classes in the FOAF vocabulary that were mentioned before and the following properties: `foaf:birthday`, `foaf:member`, `foaf:knows`. **Store your model in both a validated XML file and Turtle**. To do so you can:

1. use the service at http://www.rdfabout.com/demo/validator/ that can translate between formats and validate the input; or

2. use http://turtled.net/[1].

---

[1] If you want to run *turtled* locally, the code is available at https://github.com/mhausenblas/turtled.

Remember that each entity should be represented by an URI, e.g. http://dbpedia.org/page/Metallica or if no DBpedia entity exits you can introduce your own URI http://example.org/CustomEntity.

3.3 Problems

What were problems you encountered when modeling the information in the text? Which information could not be modeled, e.g. because of missing classes and properties?

4 Practical RDFS (8pts)

We have seen in the course that RDFS can be used to specify terminological knowledge that further specify –i.e., *constrain*– the semantics of RDF resources.

1. Define a few classes and a small hierarchy of classes for rock band types in Turtle notation

2. Define the relationships between the individuals from the previous exercise and the classes from part 1. of this exercise using Turtle notation.

3. Define a domain and a range for each of the properties (e.g., `foaf:knows`) of your RDF model.

4. Which RDF statements satisfy these constraints, which violate them? Give examples.

Hint: Cheat sheet for RDFS:

instance relation	`rdf:type`
subclass relation	`rdfs:subClassOf`
domain of a property	`rdfs:domain`
range of a property	`rdfs:range`
subproperty	`rdfs:subPropertyOf`

5 Looking deeper into RDFS (8pts)

In this section we look at some advanced features of RDFS.

5.1 Domain and Range

What is the semantics if you specify more than one domain for a property? Example:

```
ex:containedInBox rdfs:domain ex:Banana .
ex:containedInBox rdfs:domain ex:Apple .
ex:containedInBox rdfs:range ex:FruitBox .
```

5.2 Cycles

What happens if you define cyclic subclass relations? Is there a situation where this is desired?

```
ex:A rdfs:subClassOf ex:B .
ex:B rdfs:subClassOf ex:C .
ex:C rdfs:subClassOf ex:A .
```

5.3 RDFS and Turtle

Decide if the following statements can be modeled with RDF/S. If yes, write down the statement in Turtle notaion. If not, write down what is missing from RDF/S.

- Every pear is a fruit.

- If customer X ordered box Y, then box Y is ordered by customer X.

- Every fruit box contains fruit flies.

- A customer is never a fruit.

- A fruit box can have only one order number.

- Everything that is in a fruit box is a fruit.

- If something contains fruit, it is a fruit box.

- No fruit box contains meat.