Assignment 1

1 Rules of the Game

- You work on this assignment alone, no groups of students are allowed.
- Your solution will be evaluated with points ranging from 0 to 15.
- You have to upload your solution to this assignment by 30.10.2016. After this date, **you lose 3 points for each started week of delay**. In exceptional and justified cases (e.g. long-term disease) we decide how to proceed on individual basis. In that case, write me an email at petr.kremen@fel.cvut.cz.
- The solution of the assignment has to be uploaded through the **web application** `http://cw.felk.cvut.cz/upload`. Please, upload the ZIP archive containing:
  - one file `report.pdf` – answers to all questions
  - one file `assignment-<YOUR_FEL_USERNAME>.rdf` – final ontology developed in Section 2.2.

2 Assignment

2.1 Analysis

Consider a description logic theory $\mathcal{K} = (\mathcal{T}, \mathcal{A})$ with a TBox containing three axioms:

$$\begin{aligned} \mathcal{T} \quad = \quad & \{\mathit{Man} \sqcup \mathit{Woman} \sqsubseteq \mathit{Person}, \\ & \mathit{Man} \sqsubseteq \neg \mathit{Woman} \sqcap \exists \mathit{hasFather} \cdot \mathit{Man}\}, \end{aligned}$$

and $\mathcal{A} = \emptyset$. For each question, you can use Protégé to verify your findings.

1. Construct any model $\mathcal{I} = (\Delta^{\mathcal{I}}, \bullet^{\mathcal{I}})$ of $\mathcal{K}$ for which $|\Delta^{\mathcal{I}}| < 4$, $|\mathit{Woman}^{\mathcal{I}}| > 1$ and $|\mathit{Man}^{\mathcal{I}}| > 0$. If no such model exists, explain why.
2. Using a tableau algorithm, check, whether the concept $\mathit{Man} \sqcap \neg \mathit{Woman}$ is satisfiable with respect to $\mathcal{K}$. Describe and depict the algorithm run in detail, including algorithm states, state transitions, and inference rule applications.

3. For each of the three theories:

$$\begin{aligned}\mathcal{K}&\\ \mathcal{K}_1 &= \mathcal{K} \cup \{\mathit{Woman} \sqsubseteq (\leq 1\ \mathit{hasFather}^-)\}\\ \mathcal{K}_2 &= \mathcal{K}_1 \cup \{\mathit{hasFather} \sqsubseteq \mathit{hasParent}\}\end{aligned}$$

   decide, whether it employs the *tree model property* and whether it employs the *finite model property*. You can use the Description Logic Complexity Navigator at `http://www.cs.man.ac.uk/~ezolin/dl` when solving this task.

2.2 Data Integration Task

We will abuse the terminology and use description logic terms and OWL terms interchangably (see `https://cw.felk.cvut.cz/wiki/_media/courses/ae4m33rzn/protege-crash-course.pdf` for more details).

Download the OWL document at the URL `http://onto.fel.cvut.cz/ontologies/rzn/2016/assignment.rdf`. Change the file name to `assignment-<YOUR_FEL_USERNAME>.rdf` and the ontology URI (in Protege) to `http://onto.fel.cvut.cz/ontologies/rzn/2015/assignment-<YOUR_FEL_USERNAME>` The document contains a simple *family ontology* axiomatizing a few classes and properties about family relationships.

1. The ontology is inconsistent. The inconsistency is caused by a modeling error in a single TBOX axiom. Find and repair the error by editing the axiom. What is the size of the minimal set of axioms causing the inconsistency ? You can benefit from the Protege explanation feature during this task.

2. Specify suitable characteristics (reflexivity, asymmetry, etc.) of the object property *hasChild*.

3. Formalize the object properties *hasParent* and *hasAncestor* that will be used for inferring grand-parents, grand-grand parents, etc. into arbitrary depth.

> Now use the *Imported ontologies* view in Protege and import the ontology at URL `http://onto.fel.cvut.cz/ontologies/rzn/2016/premyslovci.rdf`. The imported file contains a fragment of DBPedia about the famous czech monarch dynasty. **Make sure that all changes you will do as a part of this task will be implemented in the** `assignment-<YOUR_FEL_USERNAME>.rdf` and not in the `premyslovci.rdf` file.

4. The properties *dbp* : *before*, *dbp* : *after*, *dbp* : *successor* and , *dbp* : *predecessor* relate monarchs with their followers in reign. Define *RulerFollowedByHisHerChild* as a concept defining all rulers (monarchs) that are succeeded in their reign by one of their children. You might need to introduce new concepts, roles, as well as SWRL rules to achieve this.

5. Define a DL Query (concept description) that selects only those rulers from the concept *RulerFollowedByHisHerChild* that died in Prague.

6. Based on the well-known story about the tragic fate of Wenceslaus I[1], complete the information about him – his relatives and place/date of his birth/death. As a reference, use e.g. the wikipedia article[2].

7. Explain, why `http://dbpedia.org/resource/Ottokar_II_of_Bohemia` does not belong to the OWL class ($dbp : spouse$ min 2), i.e. concept ($\geq$ *spouse* 2), although it is connected by two $dbp : spouse$ links to *Margaret of Austria* and *Kunigunda of Halych* ?

[1] `http://dbpedia.org/resource/Wenceslaus_I,_Duke_of_Bohemia`
[2] `https://en.wikipedia.org/wiki/Wenceslaus_I,_Duke_of_Bohemia`