Data and Knowledge Representation Languages: July 22, 2016

NAME ………………….. SURNAME ………………….. STUDENT ID…………………..

1. [6 PT] Say (mark with an X) whether the following statements are true (T) or false (F).

a) Venn diagrams in general cannot be used to prove the satisfiability of a DL ALC formula w.r.t. a TBox	□ **T**	□ **F**
b) The definition by Gruber says that an ontology is "an explicit representation of a conceptualization"	□ **T**	□ **F**
c) In a lightweight ontology there are is-a and part-of relations	□ **T**	□ **F**
d) The main idea of the semantic web is to link entities via URIs	□ **T**	□ **F**
e) RDF is a relational data model like databases	□ **T**	□ **F**
f) Meronymy lexical relations include part, substance and membership	□ **T**	□ **F**

2. [6 PT] Explain (a) the notion of formal theory, (b) the notion of model of a formal theory and the relation which exists between a model and an interpretation function, and (c) the notion of unsatisfiable theory.

(a) A formal theory is a set of facts about the world, written in a formal language, which are considered to be always true by the modeler.

(b) A formal theory can be seen as a set of constraints on possible models to filter out all undesired ones. A model of a theory is a set of true facts consistent with those constraints, i.e. an interpretation function which satisfies all the facts in the theory.

(c) It is a theory with no models.

3. **[2 PT] Explain the two purposes of logic languages, i.e. specification and automation, in relation to the tension between expressiveness and computational efficiency.**

Specification is to represent a problem. Automation is to draw consequences from known facts. The more expressive is a language the more computationally expensive is the reasoning.

4. **[3 PT] Define a TBox for the following problem:** ***A doctor has two types of events stored in his agenda: Familiar Events and Work Events. The Family Members of the doctor can Read only Familiar Events, while the Co-workers of the doctor can only Read Work Events. Finally, the Doctor's Assistant can Read and Write all Events*****.**

WorkEvent ⊑ Event

FamiliarEvent ⊑ Event

FamilyMember ⊑ ∀Read.FamiliarEvent

Co-worker ⊑ ∀Read.WorkEvent

Assistant ⊑ ∃Read.Event ⊓ ∃Write.Event

5. **[4 PT] For each DL sentence below, say which DL language with lowest expressiveness possible (e.g. AL, ALC, FL0…) has been used and translate to natural language.**

DL sentence	DL lang.	Natural language sentence
Spider ⊑ Beast ⊓ ≥8 Leg ⊓ ≤8 Leg	ALN	A spider is a beast with 8 legs
Male ⊑ ¬ Female	AL	Male and female are disjoint
Shark ⊑ ¬ (Mammal ⊔ Fish)	ALUC	A shark it is neither a mammal nor a fish
Stakhanovite ⊑ Person ⊓ employed ⊓ ¬ ∃hasHobby.⊤ ⊓ ≥2 hasJob	ALNCE	A stakhanovite is an employed person that does not have any hobby and with at least two jobs.

6. [2 PT] Explain, using an example, the purpose of the instance retrieval ABox service.

Instance retrieval: given a concept C, retrieve all the instances *a* which satisfy C.

Given ABox A = {C(a), C(b), D(a) }
IR(C) = {a, b}

7. [4 PT] Using the tableau calculus, say whether the DL formula below is satisfiable:

$$\textit{person} \sqcap (\neg \textit{person} \sqcup \exists \textit{eats}. \neg \textit{plant}) \sqcap \forall \textit{eats}.(\textit{plant} \sqcup \textit{dairy})$$

Motivate your answer with a proof. If satisfiable, provide a possible ABox.

By $\sqcap$-rule we put into the ABox:

$person(z)$, $(\neg person \sqcup \exists eats. \neg plant)(z)$, $\forall eats.(plant \sqcup dairy)(z)$,

(1) $person(z)$ is already an ABox assertion.

(2) $(\neg person \sqcup \exists eats. \neg plant)(z)$ by $\sqcup$-rule has to be split into:

(2.1) $\neg person(z)$ that is clearly in contradiction with (1), therefore we backtrack;

(2.2) $\exists eats. \neg plant(z)$ by $\exists$-rule we add into the ABox: $eats(z, y)$, $\neg plant(y)$

(3) $\forall eats.(plant \sqcup dairy)(z)$ by $\forall$-rule we add into the ABox:

$eats(z,\ plant(x) \sqcup dairy(x))$ (in fact $person(z)$ is already in the ABox), that by $\sqcup$-rule has to be split into:

(3.1) $plant(y)$ given that $eats(z, y)$ is in the ABox because of (2.2), that is clearly in contradiction with $\neg plant(y)$ (2.2)

(3.2) $dairy(x)$

Thus, there is at least a path which proves the satisfiability of the formula, for instance:

(1) (2) (2.1) (3) (3.2)

This path generates the ABox A = { $person(z)$, $eats(z, y)$, $\neg plant(y)$, $dairy(x)$ }

8. [4 PT] Represent the database table below in RDF turtle using standard vocabularies

Title	Author	Medium	Year
Hamlet	Shakespeare	Play	1599

```
@prefix dc:   <http://purl.org/dc/elements/1.1/> .

_a:      dc:title          Hamplet
_a:      dc:creator       Shakespeare
_a:      dc:format        Play
_a:      dc:date           1599
```

9. [2 PT] Explain what DBPedia, YAGO and Freebase are and spot their main similarities and differences.

- **They are all knowledge resources which are built semi-automatically**
- **In YAGO and Freebase text is semantically analyzed, while in DBPedia it is not.**
- **YAGO and DBPedia are built from Wikipedia, while Freebase includes a broader set of sources.**