Semantic Web

Exam (Session 1, Documents Authorized)
14h00 – 16h30, 07/11/2016

Exercise n^o 1

Given the following Horn rules RB :
R1 : if A then B.
R2 : if C and D then E.
R3 : if F and G then H.
R4 : if B and I and H then K.
R5 : if L and G then K.
R6 : if C then G.

Question 1. What can we deduce from the facts FB={C, A, F, L} ? Justify your answer with the forward chaining algorithm **and** the forward chaining with optimization.

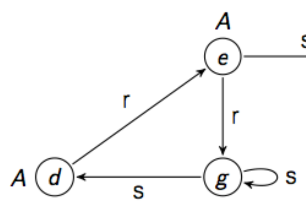
Question 2. Is $RB \cup FB \vdash K$? Justify your answer with the backward chaining algorithm.

Exercise n^o 2

Is the following propositional formula α a logical consequence of the formula β ?
$\alpha = p \vee q \vee r$
$\beta = (p \wedge q) \vee (\neg p \wedge r)$

Exercise n^o 3

Consider the following description logic interpretation I represented in the form of a graph :



Question 1. Write down the definition of $I = (\Delta^I, \cdot^I)$ corresponding to the graph.

Question 2. For each of the following $\mathcal{ALC}$ concepts C, list all the elements x of Δ^I such that $x \in C^I$:

1. $A \sqcup B$
2. $\neg A$
3. $\neg \exists r.(A \sqcap B)$

Question 3. For each of the following set S, give three concepts C each of which has **exactly** the elements in S as its instances under the interpretation of I (that is, $C^I = S$) :

1. $S = \{d, e\}$
2. $S = \{e, f, g\}$

Exercise n^o 4

Using Tableau algorithm, check the satisfiability of the following concepts C with respect to the given TBoxes. If C is satisfiable, give the interpretation corresponding to your tableau construction.

1. TBox is $\emptyset$ and C is $(A \sqcup B \sqcup \exists R.B) \sqcap (\neg A \sqcap \neg B \sqcap \forall R.\neg B)$.
2. TBox is $\emptyset$ and C is $(\exists R.\exists S.\exists R.A) \sqcap (\forall R.\forall S.\forall R.\neg A)$.
3. TBox is $\{D = A \sqcup \neg G, E = \neg A \sqcup \forall S.\neg B, G = \exists S.B\}$ and C is $\exists R.\neg E \sqcap \forall R.\neg A \sqcap \forall R.D$. (Hints : when TBox is not empty, it requires three steps : unfolding, NNF (Negative Normal Form), and then the tableau algorithm CSat).

Exercise n^o 5

1. Is the ontology $O = (TBox, ABox)$ consistent, where $TBox = \{A \sqsubseteq B \sqcap \forall r.C\}$ and $ABox = \{A(a)\}$? If yes, please give a model of O ; Otherwise, justify your answer.
2. The same question as the previous one for $O' = O \cup \{r(a, b), \neg C(b)\}$.
3. Which of the following subsumptions are always true ? Justify your answer by the semantics of $\mathcal{ALC}$.
   - $\exists s.(A \sqcap B) \sqsubseteq \exists s.A \sqcap \exists s.B$
   - $\forall s.(A \sqcap B) \sqsubseteq \forall s.A \sqcap \forall s.B$
   - $\exists s.A \sqcap \exists s.B \sqsubseteq \exists s.(A \sqcap B)$
   - $\forall s.A \sqcap \forall s.B \sqsubseteq \forall s.(A \sqcap B)$

Exercise n^o 6

Suppose that a domain expert is looking for help in using ontology for sharing their data over the web. What suggestions can you provide him/her ? You can discuss the problem from, but not limited to, the following perspectives : the benefits of using ontology, the chosen ontology representation language, supported reasoning tasks, and available tools for working with ontologies.