Exercises for "Non-Classical Logics"
Exercise sheet 11

Exercise 11.1: *(4 P)*
Snomed CT is a comprehensive clinical healthcare terminology that comprises more than 400 000 vocabulary items and almost the same number of logical axioms. An example of concept which is defined in Snomed CT is apendicitis.

Assume that we have:
– the concept names: Disease, Appendicitis, Inflammation, Appendix and
– the role names: AssociatedMorphology, FindingSite.

(1) An example of a typical Snomed CT axiom mentions that appendicits is a disease which is morphologically an (= some) inflammation. In ALC this can be expressed as follows:

$$\text{Appendicitis} \sqsubseteq \text{Disease} \sqcap \exists \text{AssociatedMorphology.Inflammation}$$

How can this be expressed in first-order logic?

(2) How can one express in ALC the fact that appendicitis is a disease which is located in the (= some) appendix?

Exercise 11.2: *(6 P)*
We suppose that in the set of all possible objects there is a set of objects that are trees and a binary relation direct-subtree between objects that leads from a tree to its direct subtrees.

Then the binary trees are the trees with at most two direct subtrees and such that all these direct subtrees are themselves binary trees.

(1) Write a formal description of the concept of binary tree in SHIQ. Indicate the set of concepts and roles which you used for this.

(2) Assume that we additionally consider the proper-subtree relation, with the following properties:

- Every direct subtree of a tree T is a proper subtree of T.
- If T_1 is a proper subtree of T_2 and T_2 is a proper subtree of T_3 then T_1 is a proper subtree of T_3 (transitivity).

Present a SHIQ formalism in which you can also consider this relation, by specifying:

- a set N_C of concept names;
- a set N_R^0 of atomic role symbols which you need for the specification;
- a subset $N_t^0 \subseteq N_R^0$ of transitive role symbols needed for the specification;
- a hierarchy on roles.

Is the description of the concept of a binary tree you gave in (1) a correct SHIQ concept description over this extended language? Justify your answer.

Please submit your solution until Wednesday, February 1, 2012. Please do not forget to write your name on your solution.