**Lehrstuhl für Automatentheorie**
Institut für Theoretische Informatik, TU Dresden
Prof. Dr. F. Baader

Nöthnitzer Str. 46
01187 Dresden
Tel.: 0351/463–38237
Tel.: 0351/463–39171

# 2. Exercises for the Course „Description Logics“

**Exercise 6:**

Let $G = (V, E)$ be a directed graph represented as a set of PROLOG facts

$$\{\mathsf{directly\text{-}connected}(x, y).\mid (x, y) \in E\}.$$

Consider three PROLOG programs that compute whether two nodes of a graph are connected:

(a) $\mathsf{connected}(x, y)$ :− $\mathsf{directly\text{-}connected}(x, y)$
$\mathsf{connected}(x, y)$ :− $\mathsf{directly\text{-}connected}(x, z)$, $\mathsf{connected}(z, y)$

(b) $\mathsf{connected}(x, y)$ :− $\mathsf{directly\text{-}connected}(x, y)$
$\mathsf{connected}(x, y)$ :− $\mathsf{connected}(z, y)$, $\mathsf{directly\text{-}connected}(x, z)$

(c) $\mathsf{connected}(x, y)$ :− $\mathsf{directly\text{-}connected}(x, z)$, $\mathsf{connected}(z, y)$
$\mathsf{connected}(x, y)$ :− $\mathsf{directly\text{-}connected}(x, y)$

Do the following:

- For each of the three programs, determine whether it is sound, complete, and terminating.
- Rewrite each program as a set of implication in first-order logic. Are the three sets logically equivalent?
- A KR formalism is *declarative* if the meaning of its terms is defined independently of a concrete interpreter or reasoning algorithm. Is KR in PROLOG declarative?

**Exercise 7:**

Let $\alpha$ and $\beta$ be propositional formulae. Prove or disprove the following propositions:

(a) If $\varphi \to \psi$ and $\varphi$ are valid, then $\psi$ is valid.

(b) If $\varphi \to \psi$ and $\varphi$ are satisfiable, then $\psi$ is satisfiable.

(c) If $\varphi \to \psi$ is valid and $\varphi$ is satisfiable, then $\psi$ is satisfiable.

**Exercise 8:**

A propositional formula using only the constructors $\wedge$, $\vee$, and $\neg$ is in *negation normal form* (NNF) if negation occurs only in front of propositional variables.

Prove that each propositional formula can be transformed into an equivalent one in NNF.

**Exercise 9:**

Define a generic frame that describes the prototypical object “computer science course”. Use slots

- *Title*,
- *Lecturer*,
- *Type of course*, and
- *Hours per week*.

Find other meaningful slots. Then construct an instance frame for the generic frame.