

# Logics, Categories, and Colimits for Artificial Intelligence

T. Mossakowski  
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University of Freiburg  
Department of Computer Science

## Exercise Sheet 13

**Due: February 6, 2009**

**Exercise 13.1** (Satisfaction condition of institution comorphisms)

For the institution comorphism  $\text{FOL} \rightarrow \text{Propositional}$  from the lecture, show the satisfaction condition.

**Exercise 13.2** (Semi-exactness of institution comorphisms)

Show that if the model translation of an institution comorphism consists of isomorphisms, then the comorphism is semi-exact.

**Exercise 13.3** (Borrowing for structured specifications)

Complete the proof of the following fact:

For a comorphism  $\rho = (\Phi, \alpha, \beta) : I \rightarrow I'$ , a signature  $\Sigma \in |\mathbf{Sign}|$ , a  $\Sigma$  specification  $\text{SP}$ , and a model  $M' \in \text{Mod}'(\Sigma)$ ,

$$M' \in \text{Mod}'(\hat{\rho}(\text{SP})) \text{ implies } \beta_{\Sigma}(M') \in \text{Mod}(\text{SP}).$$

The case of hiding was missing.

**The following exercise is a bonus problem and can be omitted.**

**Exercise 13.4** (Preservation of pushouts and normal forms)

Consider the following theorem from the lecture:

If the signature translation of an institution comorphism  $\rho$  preserves pushouts, then  $\hat{\rho}$  preserves normal forms.

Experiment with HETS (computation of normal forms and translation of development graphs along comorphisms).

Do all the comorphisms in HETS preserve pushouts?

Show that those coding out subsorting do not.

The exercise sheets may and should be worked on in groups of two (2) students. Please write both names on your solution.