

Logics and categories for software engineering and artificial intelligence

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Exercise Sheet 8

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Exercise 8.1 (Theory morphisms)

- (a) Briefly: Specify the mother-in-law riddle in Manchester syntax and prove it with HETS. Explicitly: recall that the riddle asked whether you are allowed to marry the mother-in-law of your brother's wife, the answer being 'no' because that person is your own mother. Write two specifications in DL using Manchester syntax, one specifying two persons one of which is the mother of the second, and another specifying the situation described in the riddle. Write a view from the first to the second specification and prove it correct. As theory morphisms in DL are not yet fully implemented in HETS, you need to transform the correctness claim for the view manually into a single specification with some formulas marked as implied, and then discharge these explicit proof obligations using HETS.
- (b) Specify another theory morphism of your choice and prove it with HETS.

Exercise 8.2 (Functors)

Given a category \mathbf{C} , what are the functors

(a) from $\mathbf{1} = \begin{array}{c} \text{id}_A \\ \curvearrowright \\ A \end{array}$ to \mathbf{C} ?

(b) from $\mathbf{2} = \begin{array}{c} \text{id}_A \quad \text{id}_B \\ \curvearrowright \quad \curvearrowright \\ A \xrightarrow{f} B \end{array}$ to \mathbf{C} ?

(c) from $\mathbf{3} = \begin{array}{c} \text{id}_B \\ \curvearrowright \\ B \\ \swarrow f \quad \searrow g \\ \text{id}_A \curvearrowright A \xrightarrow{h} C \curvearrowright \text{id}_C \end{array}$ to \mathbf{C} ?

Exercise 8.3 (Structured specifications)

- (a) Show that, given a structured specification SP and a signature morphism $\sigma : \Sigma \rightarrow \text{Sig}(\text{SP})$,
 - (i) σ is a specification morphism $\sigma : \text{SP} \text{ hide } \sigma \rightarrow \text{SP}$
 - (ii) the specification morphism is model-theoretically conservative

- (b) Structure some of the specifications that you have written so far and/or that have been used in the lecture using the new structuring mechanisms.

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