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Wintersemester 2011/12

Software Design, Modeling, and Analysis in UML

`http://swt.informatik.uni-freiburg.de/teaching/winter-term-2011-2012/sdmauml/sdmauml`

Exercise Sheet 2

Early submission: Monday, 2011-11-21, 9:00 Regular submission: Tuesday, 2011-11-22, 12:00

Exercise 1 (4/20 Points)

Consider a Rhapsody model of the automated rail cars system. Provide the signature which corresponds to the following part of the system: classes `Terminal` and `Car`, and the associations between the two classes, as shown in the (composite) class `AutomatedRailCarsSystem`. (2)

Hints:

- *To use Rhapsody, you want to connect to* `architor.informatik.uni-freiburg.de` *with some RDP client.*
- *The model of the automated rail cars system is located in* `C:/Program Files/Telelogic/Rhapsody 7.4/Samples/CppSamples/Cars`
- *The host can (for limited number of licences) only run a limited number of parallel instances of Rhapsody. If you don't get a license, please try again later. If the problem persists, tell me.*
- *In a Rhapsody model, classes and their structural relationships are specified by object model diagrams. For the purpose of the task, please disregard irrelevant "instance-related" information, i.e., the number and the object name in the first compartment in the boxes.*

Exercise 2 (5+5/20 Points)

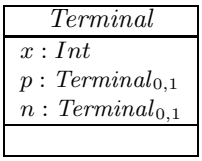

Figure 1: Class diagram for Exercise 2.

Consider the class diagram $\mathcal{CD}$ in Figure 1.

(i) Assume that the intention of the class diagram is to model lists of terminals that are doubly linked and located on a two-way circular path.

Provide a brief but adequate (textual) explanation of this intention and use object diagrams of system states of $\mathcal{CD}$ to reasonably illustrate the text. (3)

Hint: you decide, what a "reasonable illustration" is, e.g. whether you use one or more object diagrams, whether you announce that they're partial or complete, etc.

(ii) Give an object diagram of $\mathcal{CD}$ which illustrates a case that is not intended. (2)

(iii) Can you *formalise* this intention?
(By any means provided by the lecture? By any means?) (+5)

Exercise 3 (5/20 Points)

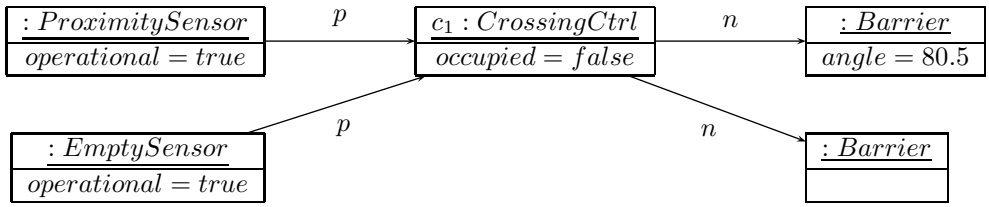

Figure 2: Object Diagram for Exercise 3.

Figure 2 shows an object diagram G for a railway crossing system.

(i) Provide a Rhapsody class diagram and a structure $\mathscr{D}$ such that G becomes an object diagram wrt. a system state σ from $\Sigma^{\mathscr{D}}_{\mathscr{S}}$ as induced by $\mathscr{S}$ (defined by the class diagram) and $\mathscr{D}$.
Explain your proposal. (3)

(ii) Consider the following OCL expression *expr*:

$$\mathsf{context}\ \ \mathit{CrossingCtrl}\ \ \mathsf{inv}: \mathit{occupied} = \mathsf{false}\ \ \mathsf{implies}\ \ n\ \mathsf{->}\ \mathsf{forAll}(\mathit{it} \mid \mathit{it}.\mathit{angle} > 80.0)$$

Does G satisfy *expr*? If yes, explain the reason; otherwise, provide a counterexample in form of a system state. (2)

Exercise 4 (6/20 Points)

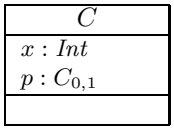

Figure 3: Class diagram for Exercise 4.

Consider the class diagram $\mathcal{CD}$ in Figure 3.

(i) Show that $\mathit{expr} := \mathit{self}.p.x$ is well-typed, i.e. derive

$$A, C \vdash \mathit{self}.p.x > 0 : \tau$$

with $A = \mathit{self} : \tau_C$ in the type-system from the lecture. (5)

(ii) By the lecture's convention, x is public in C. Now assume x is changed to be private in C, is *expr* still well-typed after the change? (Briefly explain your answer.) (2)