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Software Design, Modeling, and Analysis in UML

<http://swt.informatik.uni-freiburg.de/teaching/WS2013-14/sdmauml>

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Exercise Sheet 3

Early submission: Monday, 2013-11-25, 10:00    Regular submission: Wednesday, 2013-11-27, 10:00

**Exercise 1** **(5/20 Points)**

Consider the Rhapsody example model of the automated rail cars system. The (composite) class `AutomatedRailCarsSystem` includes classes `Terminal` and `Car`.

Provide a signature which corresponds to the following part of the system:

- classes `Terminal` and `Car`,
  - the associations between the two classes,
  - and for each of the two classes, about three interesting basic type attributes of your choice.
- (5)

*Hints:*

- To use Rhapsody, connect to `archithor.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)**

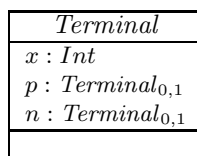


Figure 1: Class diagram for Exercise 2.

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)

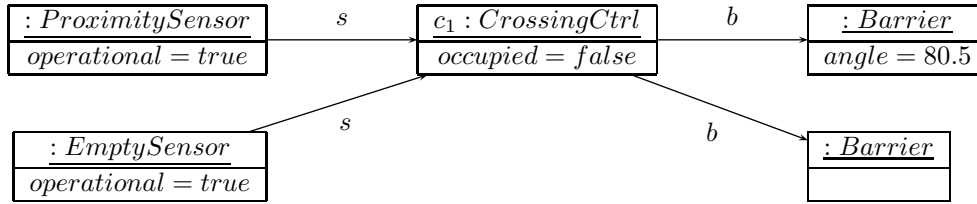


Figure 2: Object Diagram for Exercise 3.

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

- (i) Provide a Rhapsody class diagram and a structure  $\mathcal{D}$  such that  $G$  becomes an object diagram wrt.  $\mathcal{S}$  (as defined by the class diagram) and  $\mathcal{D}$ .

Explain your proposal.

(3)

- (ii) Consider the following OCL expression  $expr$ :

context *CrossingCtrl* inv : *occupied* = false implies  $n \rightarrow \text{forAll}(it \mid it.angle > 80.0)$

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

(2)

**Exercise 4**

(5/20 Points)

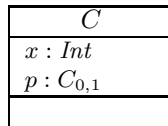


Figure 3: Class diagram for Exercise 4.

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

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

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

with  $A = self : \tau_C$  in the type-system from the lecture.

(3)

- (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)