Software Design, Modeling, and Analysis in UML

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

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)

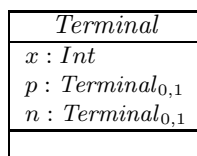| $Terminal$ |
| --- |
| $x : Int$ |
| $p : Terminal_{0,1}$ |
| $n : Terminal_{0,1}$ |
| |

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)
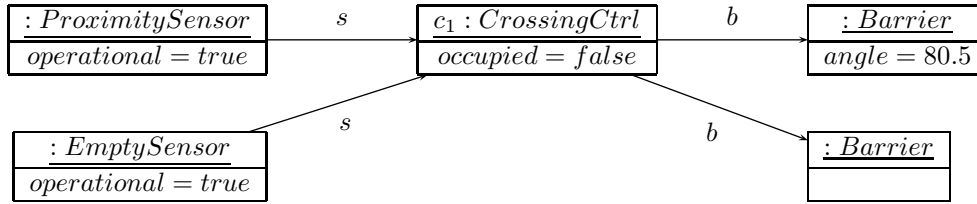
Exercise 3 (5/20 Points)

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. $\mathscr{S}$ (as defined by the class diagram) and $\mathscr{D}$.

Explain your proposal. (3)

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

$$\text{context } CrossingCtrl \; \text{inv}: occupied = \text{false} \; \text{implies} \; n \mathrel{-\!\!>} \text{forAll}(it \mid it.angle > 80.0)$$

Does G satisfy $expr$? If yes, explain the reason; otherwise, provide a counterexample in form of a system state. (2)
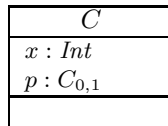
Exercise 4 (5/20 Points)

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)