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Wintersemester 2013/14

Software Design, Modeling, and Analysis in UML

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

Exercise Sheet 2

Early submission: Monday, 2013-11-11, 10:00 Regular submission: Wednesday, 2013-11-13, 10:00

Exercise 1 – OCL Abbreviations (5/20 Points)

Consider the basic object signature and structure for WSN from Exercise 2 of the first exercise sheet.[1]

(i) Un-abbreviate self.*slaves*. (1)

(ii) Un-abbreviate self.*slaves* -> size. (1)

(iii) Un-abbreviate the OCL expression

$$\text{context } Node \text{ inv} : rssi \leq master.rssi$$

and bring it to prefix-normal form (i.e. $\omega(expr_1, \ldots, expr_1)$

Exercise 2 – OCL Iterate (5/20 Points)

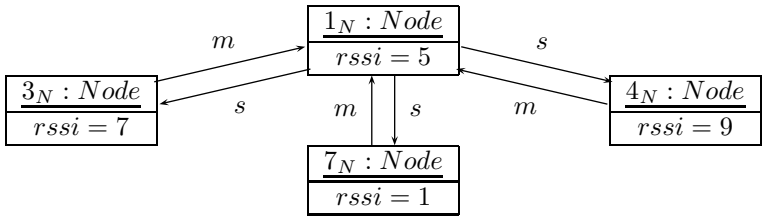

Figure 1: Object Diagram for Exercise 2.

Consider the system state σ described by the object diagram in Figure 1 and the following OCL expression.

$$expr = \mathsf{AllInstances}_{Node} \text{ -> } \mathsf{iterate}(i; r : Int = 0 \mid r + i.rssi)$$

(i) To which value does *expr* evaluation in σ? (4)

Hint: convince the tutor somehow *of the correctness of your proposal; the most convincing (and most tedious) way to do so is of course to mechanically apply the definition of the interpretation of* iterate.

(ii) What does *expr* mean informally? (1)

[1] You may choose your own or the one from the tutorial without explicit address class. Just please state your choice and repeat the signature.

Exercise 3 – OCL (10/20 Points)

Consider the basic object signature and structure for WSN from Exercise 2 of the first exercise sheet.
Consider the following requirements on system states. Formalise each requirement in the OCL fragment from the lecture and provide two system states σ_1, σ_2 such that $I[\![\phi]\!](\sigma_1, \emptyset) = \mathit{true}$ and $I[\![\phi]\!](\sigma_2, \emptyset) = \mathit{false}$, where ϕ is your formalisation of the requirement and (of course) prove that your σ_1, σ_2 are correct solutions.

(i) The RSSI value ranges from 0 to 10. (2)

(ii) Node n_1 is master of node n_2 if and only if n_2 is slave of n_1 (2)

(iii) The RSSI values of all slaves of one master do not differ by more than 3. (2)

(iv) Assume an OCL requirement of the form

$$\text{context } \mathit{Node} \text{ inv} : \mathit{rssi} \leq \mathit{master.rssi}$$

is supposed to formalise the requirement, that the RSSI value of a slave is lower than the RSSI value of its master (please adjust the class and attribute names according to the signature you use).

Provide σ_1 and σ_2 as before and in addition a third system state σ_3 such that $I[\![\phi]\!](\sigma_3, \emptyset) = \bot$. (Prove that your σ_3 is also correct.)

Can you fix the OCL expression such that it never evaluates to "undefined"? (3)

(v) Is it possible to formalise the requirement that there exists at least one node in OCL? If yes, tell how, if no, explain why not. (1)

Hint: you may use object diagrams to represent system states.

Exercise 4 (0/20 Points + 5 Bonus)

Is I (as defined in Annex A of the OCL standard document [OMG, 2006]) a function or not?
Hint: First recall the definition of "function" and then prove or disprove I to be one.

References

[OMG, 2006] OMG (2006). Object Constraint Language, version 2.0. Technical Report formal/06-05-01.