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C. Schätzle Wintersemester 2016/17

Software Design, Modeling, and Analysis in UML

http://swt.informatik.uni-freiburg.de/teaching/WS2016-17/sdmauml

Exercise Sheet 1

Early submission: Monday, 2016-10-24, 12:00 Regular submission: Tuesday, 2016-10-25, 8:00

Regarding the form of submission, we have the following preferences:

- *perfect*: a PDF via ILIAS
- *fine*: any other common document format (such as ODF) via ILIAS
- *kind*: a scanned version of the handwritten proposal via ILIAS — there is a magic print-copy-scan-machine in the pool room which can send the scan to you by mail
- *tolerated*: paper submission

Exercise 1 – Model (3/20 Points)

Discuss whether the following items are models in the sense of the course:

(i) The natural language description of the UML course on the homepage. (1)

(ii) A Gantt diagram in a project plan. (1)

(iii) The sentence: "The number of achievable admission points of this exercise sheet is 25." (1)

Hint: To strongly convince your readers of your claims, explicitly discuss each and every aspect of the two definitions from the lecture, like the 'image attribute'. If something is not *a model, it is (of course) sufficient to point out the aspect which is not satisfied.*

Exercise 2 – Signature, System State (6/20 Points)

Consider the basic object system signature

$$\mathscr{S} = (\{Int\}, \{\text{ExerciseSheet}, \text{Exercise}\}, \{n : Int, p : Int, t : \text{Exercise}_*\},$$
$$\{\text{ExerciseSheet} \mapsto \{t\}, \text{Exercise} \mapsto \{n, p\}\}).$$

(i) Give a basic object system structure $\mathscr{D}$ of $\mathscr{S}$. (2)

(ii) Give a non-trivial example of a system state of $\mathscr{S}$ wrt. your $\mathscr{D}$ from Task (i). (2)

(iii) Give a partial function

$$\sigma : \mathscr{D}(\mathscr{C}) \nrightarrow (V \nrightarrow (\mathscr{D}(\mathscr{T}) \cup \mathscr{D}(\mathscr{C}_*)))$$

which *is not* a system state wrt. your $\mathscr{D}$ from Task (i). (2)

Hint: Explain why your submission is a correct solution.

Exercise 3 – Modelling (3/20 Points)

Assume we want to model a *wireless sensor network* (WSN) and its tree topology.
Each *device* (or *node*) in the considered network

- knows zero or one other node as *master*,
- knows a number of other nodes as *slaves*,
- has a sensor reading value of float type.

Provide a basic object system signature and structure suitable to model WSN.
Convince your readers that your proposal is a good model by giving sufficient explanations.

Hint: Exemplary system states can convince readers of the fact that a basic object system signature model is "not completely broken". Please stick carefully to the syntax introduced in the lecture to make your tutor's life easier.

Exercise 4 – Requirements (8/20 Points)

Consider the basic object system signature and structure for WSN from Exercise 3.
Consider the following (natural language) requirements on system states. For each (i)–(iii), provide two system states σ_1, σ_2 wrt. your signature and structure from Exercise 3 such that σ_1 is a positive example, i.e. a system state which satisfies the requirement, and σ_2 is a negative example, i.e. a system state which does not satisfy the requirement.

(i) "The sensor reading value of nodes ranges from 0.0 to 10.0." (2)

(ii) "A node n_1 is master of a node n_2 if and only if n_2 is slave of n_1." (2)

(iii) "The sensor readings of all slaves of one master do not differ by more than 3." (2)

(iv) "There is exactly one node with no master or slave, and sensor reading value 7."
Please provide one positive example. Is this positive example unique? (2)

Explain your solution, i.e., explain *why* your respective system states σ_1 and σ_2 are actually positive and negative examples for (your (!) reasonable interpretation of) the considered requirement.

Hint: You may want to work on the Bonus Exercises first.

Bonus Exercise – Formalising Requirements (5 Bonus)

Natural language requirements are notoriously imprecise and prone to misunderstandings. As the requirements in Exercise 4 are requirements on the purely mathematical entities basic object system signature and structure, and system states, it should be possible to *formalise* (your understanding of) these requirements using plain mathematics from the undergraduate courses, i.e. to provide a formula such that the formula is satisfied by a system state if and only if the requirement is satisfied.
Provide (and, of course, explain) a formalisation of the requirements in Exercise 4. Test your formalisation by checking that your formulae evaluate to the expected value for your system states from Exercise 4.