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Software Design, Modeling, and Analysis in UML

http://swt.informatik.uni-freiburg.de/teaching/WS2015-16/sdmauml

Exercise Sheet 1

Early submission: Monday, 2015-10-26, 12:00 Regular submission: Tuesday, 2015-10-27, 10:00

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 (5/20 Points)

Consider Slide 7 of Lecture 1. Assume that the sequence diagram on the left bottom is a proper formalisation of user requirements, that the class diagram on the middle bottom is a proper description of the software structure, and that the state machines on the right bottom are a proper description of the software's behaviour.

(i) Does Slide 7 show a model in the sense of the definitions of *model* on Slide 5? Discuss.

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

- The natural language description of the UML course on the homepage.
- A wiring diagram for an electronic component.
- The sentence

  "program statements must be followed by a semicolon".

Hint: To strongly convince your readers, explicitly discuss each and every aspect of the two definitions, 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 (7/20 Points)

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

- knows the address of zero or one *master*,
- knows the addresses of a number *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 model is "not completely broken". Please stick carefully to the syntax introduced in the lecture to make your tutor's life easier.

Exercise 3 – System States (8/20 Points)

Consider the basic object system signature and structure for WSN from Exercise 2.
Consider the following (natural language) requirements on system states. For (i)–(iii), provide two system states σ_1, σ_2 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 ranges from 0.0 to 10.0." (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 sensor readings of all slaves of one master do not differ by more than 3." (2)

(iv) "There is exactly one object with no master and no 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 the considered requirement.

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

Bonus Exercise – Representing System States (5 Bonus)

Writing down system states as functions, i.e. as sets of $\mapsto$-pairs is tedious. Propose a convenient alternative representation: describe the syntax of your representation and explain how one can derive a unique system state as such (i.e. in the function notation) from your representation of a system state.