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Real-Time Systems

`http://swt.informatik.uni-freiburg.de/teaching/WS2017-18/rtsys`

Exercise Sheet 1

Early submission: Monday, 2017-10-23, 14:00 Regular submission: Tuesday, 2017-10-24, 14:00

Exercise 1 (14/20 Points + 5 Bonus)

A *real-time system* has performance deadlines on its computations and actions, thus a requirements specification for a real-time system typically explicitly mentions *timing constraints*.

(i) Give an own[1] example of a real-time system in this sense.

Describe the purpose of the system and some relevant timing constraints in sufficient detail. (3)

Originality Challenge: You will be awarded bonus points for your answer following the rules of originality challenges (see next page). (5 Bonus)

(ii) Define a set of useful *observables* to describe the timing constraints for the example from Task (i) more precisely. Explain how they relate to the system behaviour, i.e. which domain value models which situation of the real system. (3)

(iii) Demonstrate the usefulness of your observables by giving one typical evolution (or behaviour) of your example from Task (i). (2)

(iv) Formalise at least one of your relevant timing constraints from Task (i) using predicate logic and the observables from Task (ii). (2)

(v) Give (and explain) one evolution for each of the following cases (or argue, why your example from Task (i) does not have timing constraints of that case): (4)

a) The timing constraint(s) from Task (iv) are satisfied.

b) The timing constraints are not satisfied since some computation or action happens *too early*.

c) The timing constraints are not satisfied since some computation or action happens *too late*.

d) The timing constraints are not satisfied since some phase, i.e. some valuation of observables has an undesired *duration*.

Exercise 2 (3/20 Points)

Give an own example of a system which is not a real-time system in the sense of the lecture, i.e. where timing constraints would typically not be part of a requirements specification for that system, but for which computations or actions happening *much* too early or *much* too late would cause people to consider systems with the much too early/late behaviour not to satisfy the requirements.

Describe the purpose of the example system, give at least one such problematic evolution, and explain using that evolution why people may argue that systems exhibiting that evolution do not satisfy their requirements. (3)

Exercise 3 (3/20 Points)

Give an own example of a system whose timing behaviour does not at all influence the perception of it satisfying its requirements. (3)

[1] not discussed in the lecture

Originality Challenge: For this type of exercise, the points attained depend on how original the answer you provide is. Every different answer is given a total number of points (5 points in this case). These points will be divided among the teams that provide the same answer (what is "the same answer" is at your tutor's discretion). Concretely, the number of points you will obtain for a certain answer is $\lceil p/n \rceil$, where p is the number of points for the originality challenge exercise and n is the number of teams that provided the same answer (so in this case, more than 5 groups giving the same example yields no bonus points for any of these groups).