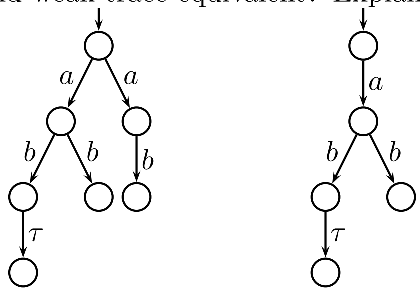
# Exam Software system engineering
# 2IW60, January 25, 2011, 14:00-17:00

It is neither allowed to use the study material nor a computer. The answers to the questions can be formulated in either English or Dutch. This exam consists of 6 questions. Good luck!

1. Automotive Software Engineering in general
   (a) Software does not wear out, but why do we need updates and new releases all the time?
   (b) One of the definitions of software engineering is "The process of solving customers problems by the the systematic development and evolution of large systematic development and evolution of large, high-quality software systems within cost, time and other constraints". Does automotive software engineering solves a customers problem? If so, give an example, if not, why do we bother about automotive software engineering?
   (c) Is the V-model product or process oriented? Give a good motivation or example.
   (d) Describe at least 2 consequences categories of IEC 61508 (Functional Safety standard).
   (e) Which non-functional requirement do standards, like ISO 26262, IEC 61508, and Misra-C, implement? Give a proper motivation.
2. Software Design and Automotive
   (a) What is the difference between UML and SysML?
   (b) What is the purpose of the behavior diagrams in both SysML and UML?
   (c) What does SysML offer with respect to requirements modeling?
   (d) Is there a conflict between the design principle "Design and conquer" and "Increase cohesion where possible"? Motivate your answer by explaining these design principles.
   (e) Given one of the definitions of software architecture: "The software architecture of a program or computing system is the structure or structures of the system, which compromise software elements, the externally visible properties of those elements, and relationships among them". Does AUTOSAR fit this definition? Motivate your answer.
3. In this exercise we design the behaviour of a simple calculator.
   (a) Declare a sort *Instruction* with three values, *plus*, *minus* and *result*.
   (b) Describe a process that must read two integers (using an action *read*), and an instruction (also using the action *read*) and then displays the outcome (using an action *display*). If the instruction is *result*, the last value read is displayed.
   (c) Make the calculator process more 'natural'. The precise behaviour is up to you, but at least the calculator must be usable for an infinite sequence of calculations. The result of the last calculation must be usable in the next calculation. Finally, the behaviour must be a reasonable behaviour for a (n extremely simple) calculator.

4. Determine for the following pair of transition systems whether they are strongly bisimilar, branching bisimilar and weak trace equivalent? Explain your answers.




5. Explain clearly and compactly in your own words what the following formulas express:

   (a) $[a]\langle b\rangle \mathit{true}$.

   (b) $\langle \mathit{true}\rangle \mathit{true}$.

   (c) $[\mathit{true}^{\star}{\cdot}a{\cdot}\overline{b}^{*}{\cdot}c]\mathit{false}$.

6. Consider the two modal formulas

$$\begin{aligned}\phi_1 &= \langle a\rangle([b]\mathit{false} \vee [c]\mathit{false})\\ \phi_2 &= \langle a\rangle(\langle b\rangle \mathit{true} \vee \langle c\rangle \mathit{true})\end{aligned}$$

   Draw two transition systems, one for which $\phi_1$ is valid and $\phi_2$ is not valid for the initial state, and one for which $\phi_2$ is valid and $\phi_1$ is not valid.

Score: $(10 + n)/10$ where $n$ is the cumulative judgement given by the following table:

| question | (a) | (b) | (c) | (d) | (e) |
|---|---|---|---|---|---|
| 1 | 4 | 4 | 4 | 5 | 5 |
| 2 | 4 | 4 | 5 | 5 | 5 |
| 3 | 5 | 5 | 5 | | |
| 4 | 10 | | | | |
| 5 | 3 | 4 | 3 | | |
| 6 | 10 | | | | |