Formal Models SS 2018: Assignment 8

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Due 24.05.2018

To indicate that you solved an exercise and that you can present it in the exercise group, tick it off in our MOODLE course until **8am on the day of the exercise**. Unmarking and marking exercises at the begin of the exercise class is **not** possible.

Exercise 29

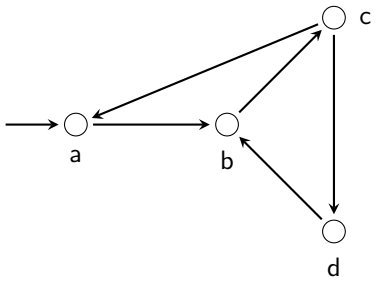
a) Reformulate $\forall x.\ (\phi \leftrightarrow \psi)$ using only $\exists$ and operators $\neg$ and $\wedge$. Specify all intermediate steps.

b) Referring to the semantical rules of Simplified HML on slide 53, explain in detail why formula $[a]\,1$ is always true in a state s and why formula $\langle a \rangle\, 0$ is always false.

c) Explain the relation between $\neg\,[a]\,1$ and $\langle a \rangle\, 0$.

Exercise 30

Given LTS L as shown on the right.

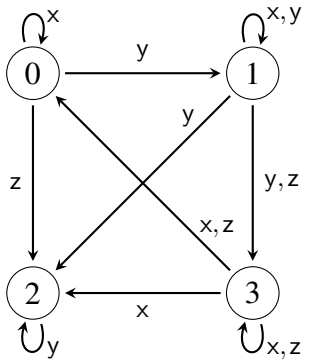


a) List at least 10 different infinite traces in L, using ω-notation, e.g. $abababab\cdots = (ab)^{\omega}$.

b) Find 6 equivalences between traces from part a), using notation π^i, e.g. $\pi_2 = \pi_1^1$ for $\pi_1 = xyz$ and $\pi_2 = yz$.

Exercise 31

Given the LTS L shown in the figure below.



Decide for which states of L the following HML expressions hold.

- $\langle x \rangle 1$
- $\langle x \rangle ([y] 0 \vee \langle z \rangle 1)$
- $([y] [x] 1) \vee (\langle x \rangle \langle y \rangle 0)$
- $\langle z \rangle 1 \wedge \langle z \rangle [y] 0$
- $([y] \langle x \rangle 1) \vee ([x] \langle y \rangle 1)$

Exercise 32

Given LTS L and CTL/HML formulae 1 to 6 as shown below. For each state s of L, determine which of formulae 1 to 6 hold in s.

1. $\mathbf{EX}(\langle x \rangle 1)$
2. $\mathbf{AX}([y] 0)$
3. $\mathbf{AF}(\langle z \rangle 1 \rightarrow \langle y \rangle 1)$
4. $\mathbf{E}[\langle x \rangle 1 \, \mathbf{U} \, \langle z \rangle 1]$
5. $\mathbf{EG}(\langle y \rangle 1)$
6. $\mathbf{E}[\langle y \rangle 1 \, \mathbf{U} \, \langle z \rangle 1]$