Formal Models SS 2016: Assignment 6

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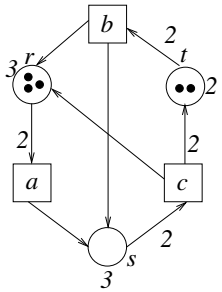
Due 28.04.2016

Exercise 21

Let N be the PTN shown below.



- Specify N formally as a 5-tuple $N = (P, I, T, G, C)$. How many markings for N are possible *theoretically*?
- Now let M and M' be two markings of N, with $M(r) = 0$, $M(s) = 2$, $M(t) = 0$ and $M'(r) = 1$, $M'(s) = 3$, $M'(t) = 1$, respectively. Which are the transitions that can fire in M and M', respectively? What are the possible new markings obtained from this?
- Draw the LTS corresponding to N.

Exercise 22

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

b) Explain in your own words the effects of reordering quantifiers. More precisely, explain the semantical difference between $\forall x \exists y.\ \phi$ and $\exists y \forall x.\ \phi$ in general.

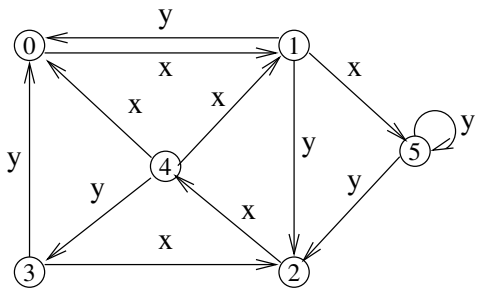
c) Define the semantics of the boolean operators $\neg$, $\wedge$, $\vee$, $\rightarrow$, and $\leftrightarrow$ in Simplified HML analogously to the definitions of the modal operators and boolean constants (see slide 53).

d) 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.

Exercise 22

Given LTS L and Simplified HML formulae 1 to 5 as shown below.

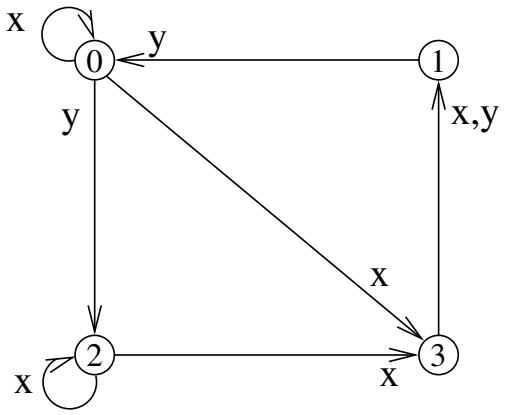
1. $\langle x\rangle\,1$
2. $[y]\,0$
3. $[x]\,[y]\,0$
4. $[y]\,\langle x\rangle\,1$
5. $\langle x\rangle([y]\,0 \vee \langle x\rangle\,1)$



a) For each state s of L, determine which of formulae 1 to 5 hold in s.

b) Given formula $f := [y]\,[y]\,0$. Explain in detail how f is evaluated recursively in states 1 and 5 of LTS L. That is, check if $1 \models f$ and if $5 \models f$, and show recursive applications of $\models$.

Exercise 24



Given an LTS L as above with $\Sigma = \{x, y, z\}$. Calculate $\langle y\rangle 1 \rightarrow ([x]1 \wedge [x][y]1)$, i.e., the set of all states in which the formula holds.