Introduction to Software Verification – HW No. 6

Winter 2022-2023

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Please note that answers without an explanation will not be checked.

Question 1

Reminder: Let $M_1 = (S_1, I_1, R_1, L_1)$ and $M_2 = (S_2, I_2, R_2, L_2)$ be two Kripke structures over the same set of atomic propositions AP. We denote $M_1 \preccurlyeq M_2$ (and say that M_2 simulates M_1) if there exists a simulation relation $H \subseteq S_1 \times S_2$ such that for every initial state $s_1 \in I_1$ there is an initial state $s_2 \in I_2$ for which $(s_1, s_2) \in H$.

a. Prove/disprove: the relation $\preccurlyeq$ is reflexive.
b. Prove/disprove: the relation $\preccurlyeq$ is symmetric.
c. Prove/disprove: the relation $\preccurlyeq$ is anti-symmetric.
d. Prove/disprove: the relation $\preccurlyeq$ is transitive.

Question 2 (optional)

Let $M_1 = (S_1, I_1, R_1, L_1)$ and $M_2 = (S_2, I_2, R_2, L_2)$ be two Kripke structures over the same set of atomic propositions AP, with $S_1 = \{s_1\}$ and $S_2 = \{s_2\}$ (both structures have a single initial state).

Prove: if for every CTL formula φ, $M_1 \vDash \varphi \Leftrightarrow M_2 \vDash \varphi$, then $M_1 \equiv M_2$.

Guidance: show that the following relation $B \subseteq S_1 \times S_2$ is a bisimulation between M_1 and M_2: $(t_1, t_2) \in B$ iff for every CTL formula φ, $t_1 \vDash \varphi \Leftrightarrow t_2 \vDash \varphi$.

Remark: This is the opposite direction of a theorem from lecture 12.

Good luck!