

CS 720, Fall 2016
Homework 3

Due Date: October 5

1. Let $AP = \{a, b\}$.
 - (a) Classify each of the following properties as being i) invariant, ii) a safety property but not an invariant, iii) a liveness property, or iv) neither a safety nor a liveness property. Explain your answers.
 - i. $\{A_0A_1 \cdots \in (2^{AP})^\omega \mid \text{there is no } i \text{ with both } a \text{ and } b \text{ in } A_i\}$
 - ii. $\{A_0A_1 \cdots \in (2^{AP})^\omega \mid \text{there is more than one value of } i \text{ with } a \in A_i\}$
 - iii. $\{A_0A_1 \cdots \in (2^{AP})^\omega \mid \text{there is exactly one value of } i \text{ with } a \in A_i\}$
 - iv. $\{A_0A_1 \cdots \in (2^{AP})^\omega \mid \text{there is at most one value of } i \text{ with } a \in A_i\}$.
 - (b) For each property that you classified as being either (i) or (ii), describe the set of bad prefixes and the set of minimal bad prefixes for the property.
2. Give an example of two transition systems T and T' with no terminal states such that $Traces_{fin}(T) = Traces_{fin}(T')$, but $Traces(T) \neq Traces(T')$.
(Slide 93 of the slides for September 26 gives an example of two transition systems \mathcal{T} and \mathcal{T}' with $Traces_{fin}(\mathcal{T}) \subseteq Traces_{fin}(\mathcal{T}')$ but $Traces(\mathcal{T}) \not\subseteq Traces(\mathcal{T}')$. You can change this example to make the finite traces the same in both transition systems.)
3. The pseudocode for Algorithm 4 on page 110 of the textbook has a small mistake. What is the mistake, and how can you fix it (with a small change)?
4. Let $AP = \{a, b\}$ and let E be the LT property over AP given by

$$E = \{A_0A_1 \dots \in (2^{AP})^\omega \mid \text{for some } i \geq 0, b \in A_i \\ \text{and for all } j, 0 \leq j \leq i, a \in A_j\}$$

(so for instance $\{a\}\{a\}\{a, b\}\emptyset^\omega$ and $\{a\}\{a, b\}\{a\}^\omega$ are in E , while $\{a\}\emptyset\{b\}^\omega$ is not in E). Express E as $P_{safe} \cap P_{live}$ where P_{safe} is a safety property and P_{live} is a liveness property. Give explicit descriptions of P_{safe} and P_{live} rather than using the formulas in Theorem 3.37.