Assignment 1 - Solutions

Models and Properties of Sequential and Parallel Systems

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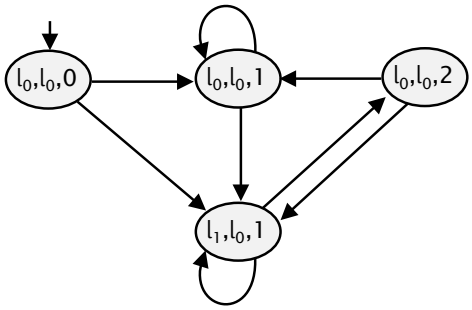
1. (a) A suitable labelled transition system is shown below, where states of the model are of the form (l_i, l_j, x), denoting the line of processes 1 and 2, and the value of x, respectively.



(b) (i) This is an invariant (and therefore also a safety property). This is is because it requires a property of states (that the value of variable x is greater than 0) to be true in every reachable state.

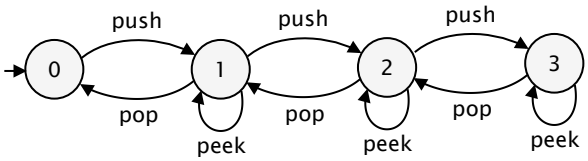
(ii) This is a liveness property. This is because any finite trace can always be extended to an infinite trace that satisfies the property by adding a suffix in which infinitely many states satisfy $x = 2$.

(iii) This is a safety property. This is because any trace in which the property is false must have a finite bad prefix in which the last two states both satisfy $x = 2$.

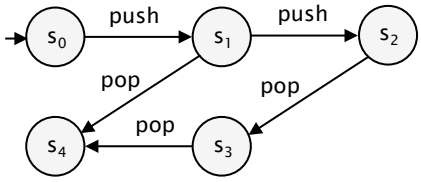
(iv) This is a liveness property. This is because any finite trace can always be extended to an infinite trace that satisfies the property by adding a suffix on which all states do *not* satisfy $x = 1$.

(v) This is neither a safety nor a liveness property. It cannot be a safety property because there are some paths (for example where x is never equal to 2 but also never negative) which have no finite bad prefix. It cannot be a liveness property because there are some finite prefixes (those containing a state where x is negative) which cannot possibly be extended to a path that satisfies the property.

2. (a) Letting i denote the state where the stack contains i items, an LTS $\mathcal{M}_{stack}$ is:



(b) An LTS $\mathcal{M}_{user1}$ is:



and the set H is $\{push, pop, peek\}$.