

Assignment 1

Models and Properties of Sequential and Parallel Systems

1. Below is a simple concurrent program, comprising two independent parallel processes accessing a shared integer variable x , which is initially set to 0.

<pre style="margin: 0;"> while (true) { l₀ : x := 1; l₁ : x := 2; }</pre>	<pre style="margin: 0;"> while (true) { l₀ : x := 1; }</pre>
---	--

For convenience, lines of the program are labelled with program locations (of the form l_i).

- (a) Draw a labelled transition system (LTS) representing the system described above, where, apart from the mutual dependency on the variable x , the two processes operate asynchronously.
- (b) Here are some properties that could be verified on the program above. For each one, state which classes of properties it belongs to (invariant, safety, liveness) and justify your answer.
 - (i) x is always greater than 0;
 - (ii) x is equal to 2 infinitely often;
 - (iii) x is never equal to 2 in two successive states;
 - (iv) on any execution where x eventually exceeds 1, x will only equal 1 finitely often;
 - (v) x is eventually equal to 2 and is never negative before that point.

[18 marks]

2. (a) Draw an LTS \mathcal{M}_{stack} to model the behaviour of a stack with capacity 3, which has the operations *push*, *pop* and *peek* (where these have their usual meanings) and is initially empty. You do not need to represent the actual values stored on the stack. You also do not need to model errors – just only allow operations to occur if they are possible.
- (b) Draw an LTS \mathcal{M}_{user1} which, when composed in parallel with \mathcal{M}_{stack} pushes either 1 or 2 items to the stack and then removes them. The LTSs should synchronise using handshaking, i.e., $\mathcal{M}_{stack} \parallel_H \mathcal{M}_{user1}$. Specify also what the set H of handshake actions is.

[12 marks]