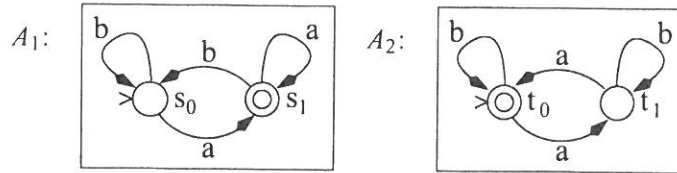


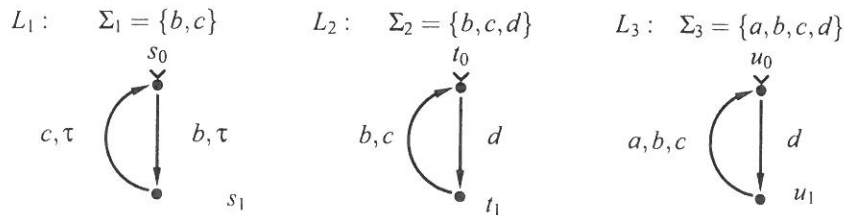
Please note the following: To pass the course you need at least 50% of the home assignment points. Please contact the Lecturer after the exam if you have not completed the home assignments successfully.

Assignment 1 Consider the following finite state automata A_1 and A_2 , where $\Sigma_1 = \Sigma_2 = \{a, b\}$.



- Construct the finite state automaton $A_a = A_1 \cap A_2$. (3p)
- Construct the finite state automaton A_b that accepts the complement of the language accepted by the automaton A_a . (1p)

Assignment 2 Consider the following three labelled transition systems (LTSs) L_1 , L_2 , and L_3 :



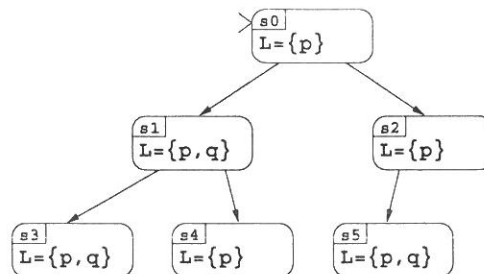
- Compute the parallel composition $L = L_1 || L_2 || L_3$. (3p)
- Does L contain any conflicts? If it does, please give a list consisting of all the triples (v, t, t') , where: v is a global state of L where a conflict occurs and t, t' are a pair of global transitions of L which are in conflict in v . (1p)
- Does L contain any deadlocks? If it does, please give a list of global states of L which are deadlocks. (1p)
- Does L contain any livelocks? If it does, please give a list of global states of L in which a livelock exists. (1p)
- Does L contain a pair of independent transitions? If it does, give one example of two global transitions which are independent. (1p)
- Give a deterministic finite automaton A_f accepting the language $\Sigma^* \setminus traces(L)$, where Σ is the alphabet of L . (1p)
- Answer the question: Is $traces(L_3) \subseteq traces(L)$? Please use the automaton A_f constructed in the previous step. If the answer is no, give a word in $traces(L_3) \setminus traces(L)$. (1p)

Note! More assignments on the other side of the paper.

- Assignment 3**
- (a) Is the following claim true: If L_a and L'_a are bisimilar then $traces(L_a) \subseteq traces(L'_a)$. Please justify your answer using a sentence or two. (1p)
 - (b) Give two LTSs L_b and L'_b such that $L_b \leq_{ir} L'_b$ holds but $L_b \leq_{sim} L'_b$ does not hold. (1p)
 - (c) Is the following claim true: If L_c and L'_c are bisimilar then both $L_c \leq_{sim} L'_c$ and $L'_c \leq_{sim} L_c$ hold. Please justify your answer using a sentence or two. (1p)
 - (d) Define formally the notion from theory of LTSs: “independence”. (1p)
 - (e) Define formally the notion: “safety property”. (1p)

Assignment 4 Consider the Kripke structure M below. For each of the formulas below check whether the formula holds in M or not. If the formula holds, give a short explanation (max 5 lines of text) why the formula holds. If the formula does not hold, give a counterexample path through the Kripke structure. (A simple yes/no answer is **not** sufficient to obtain full points in this assignment.)

- (a) Does $M \models \mathbf{G} p$ hold? (1p)
- (b) Does $M \models \mathbf{G} (\mathbf{Y} p)$ hold? (1p)
- (c) Does $M \models \mathbf{G} (q \Rightarrow (\mathbf{Y} \neg q))$ hold? (1p)



Assignment 5 Describe bierly (using half a page maximum) how constructions from the automata theory can be used to check whether $L \leq_{ir} L'$ holds. (3p)