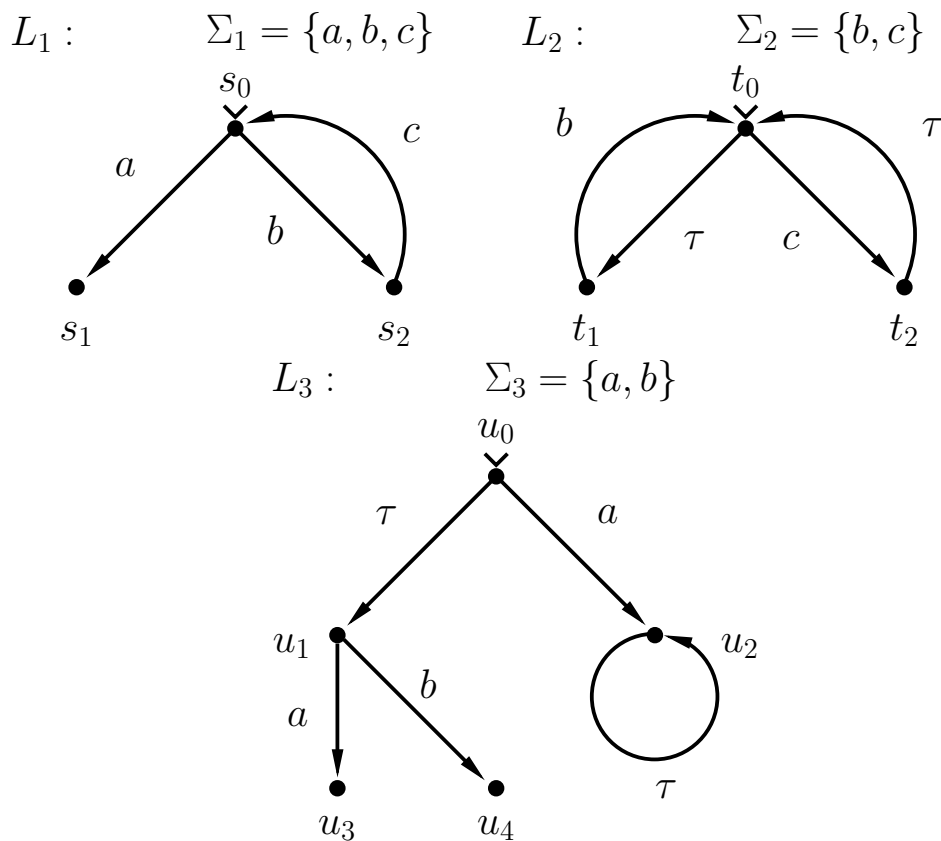


1. Consider the following three LTSs  $L_1$ ,  $L_2$ , and  $L_3$ :



- Compute the parallel composition  $L = L_1 \parallel L_3$ .
- Does  $L = L_1 \parallel L_3$  contain any conflicts? If it does, please give a list consisting of triples  $(v, t, t')$ , where:  $v$  is a global states of  $L$  where a conflict occurs and  $t, t'$  are a pair of global transitions of  $L_1 \parallel L_3$  which are in conflict in  $v$ .
- Does  $L = L_1 \parallel L_3$  contain any deadlocks? If it does, please give a list of global states of  $L$  which are deadlocks.
- Does  $L = L_1 \parallel L_3$  contain any livelocks? If it does, please give a lists global state of  $L$  in which a livelock exists.

- e) Does  $L = L_1 \parallel L_3$  contain a pair of independent transitions? If it does, give two global transitions which are independent.
- f) Give  $traces(L_3)$  as a list of sequences over  $\Sigma_3$ .
- g) Give  $traces(L_1)$  as a regular expression.
- h) Give a deterministic finite automaton accepting  $\Sigma_1^* \setminus traces(L_2)$ .
- i) Check whether  $traces(L_1) \subseteq traces(L_2)$  using the automaton constructed in the previous step. If not, give a word in  $traces(L_1) \setminus traces(L_2)$ .