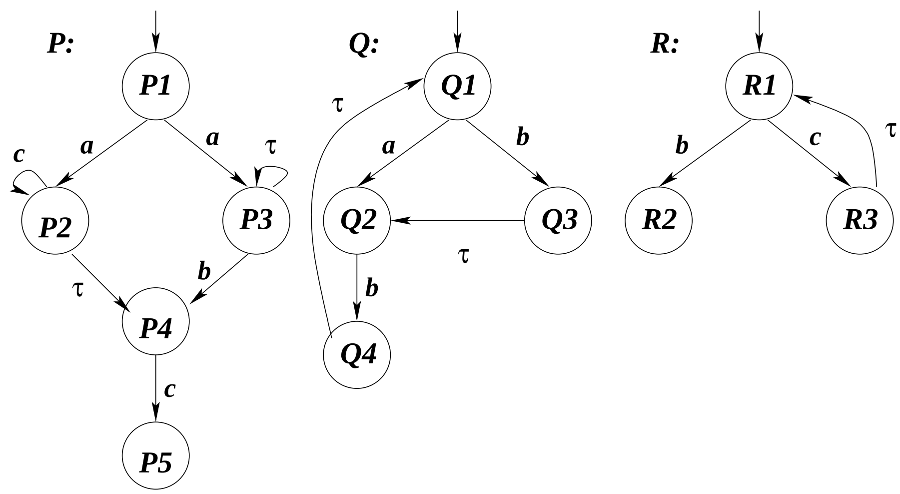
An Introduction to Specification and Verification

Exercise 3, Feb. 1st 2008

1. We look at the labelled transition systems:



   - Draw the global state graph of the $P|[b,c]|Q$.
   - Draw the global state graph of the $R||Q$.

2. Draw the global state graph of the $Q|||R$ and $P|[b]|R$. Labelled transition systems of P, Q, and R are in exercise 1.

3. Is it true for the labelled transition systems given in exercise 1, that

$$P\,|[a,b]|\,(Q\,|[a,b]|\,R) \equiv (P\,|[a,b]|\,Q)\,|[a,b]|\,R,$$

   where $\equiv$ means isomorphism, i.e. the states in the transition systems $P|[a,b]|(Q|[a,b]|R)$ and $P|[a,b]|Q)|[a,b]|R$ correspond bijectively each other and the transitions between corresponding states are labeled with same actions.

4. Give an example where synchronous, blocking parallel composition is not associative. ($P\,|A_1|\,(Q\,|A_2|\,R) \equiv (P\,|A_1|\,Q)\,|A_2|\,R$ is not true.)

5. Let P, Q, and R be processes and A_P, A_Q, and A_R are action set of these processes. Prove that

$$P\,|A_P \cap (A_Q \cup A_R)|\,(Q\,|A_Q \cap A_R|\,R) \equiv (P\,|A_P \cap A_Q|\,Q)\,|(A_P \cup A_Q) \cap A_R|\,R,$$

   where $\equiv$ means isomorphism, i.e. the states in the transition systems correspond bijectively each other and the transitions between corresponding states are labeled with same actions.

Prove at least the situation where
$a \notin A_P \cap (A_Q \cup A_R)$, $a \notin A_Q \cap A_R$ and

$$P \left| A_P \cap (A_Q \cup A_R) \right| (Q \left| A_Q \cap A_R \right| R) \xrightarrow{a} P \left| A_P \cap (A_Q \cup A_R) \right| (Q' \left| A_Q \cap A_R \right| R).$$

6. Prove that using arbitrary set B

$$P \left| B \right| (Q \left| B \right| R) \equiv (P \left| B \right| Q) \left| B \right| R.$$