Tutorial 12

1. Prove that strong bisimulation equivalence allows for NFA (nondeterministic finite automata) minimization.
2. Suppose that P simulates Q and vice versa. Does it already mean that P is bisimilar to Q?
3. Prove that $P \sim Q$ iff Duplicator has a winning strategy from (P, Q).
4. Can a modification of the bisimulation game be used to define the following relations: $\approx$, $\sim_n$, $\approx_n$, $\sim_\omega$, $\sim_{\omega+1}$, $\precsim$ (simulation).
5. Prove that if S is a bisimulation up to $\sim$, then $S \subseteq \sim$.
6. Let X, Y be defined as follows:

$$P_1 \stackrel{\text{def}}{=} a_1.b_1.P_1 \qquad Q_1 \stackrel{\text{def}}{=} a_1.\bar{p}.b_1.\bar{v}.Q_1$$
$$P_2 \stackrel{\text{def}}{=} a_2.b_2.P_2 \qquad Q_2 \stackrel{\text{def}}{=} a_2.\bar{p}.b_2.\bar{v}.Q_2$$
$$S \stackrel{\text{def}}{=} p.v.S$$
$$X \stackrel{\text{def}}{=} P_1|P_2 \qquad Y \stackrel{\text{def}}{=} (Q_1|Q_2|S)\backslash\{p, v\}$$

   Does it hold that $X \sim Y$? Can X simulate Y and vice versa?

Homework (not mandatory)

1. Point the pairs of processes that are in the bisimulation equivalence relation for any P, Q, R? If you claim that the processes are not bisimilar, present a counterexample (define P, Q and R for which the relation does not hold):

$$\begin{aligned}
(P + Q) + R &\sim P + (Q + R)\ ? \\
a.(P + Q) &\sim a.P + a.Q\ ? \\
a.\tau.P &\sim a.P\ ? \\
P + \tau.Q &\sim P + Q\ ? \\
P + \tau.\tau.P &\sim P\ ?
\end{aligned}$$