Problem Set 10

1. Let TS and TS' be two transition systems without terminal states on the same set of atomic propositions AP. Then show that $Traces(TS) = Traces(TS')$ iff TS and TS' satisfy the same set of LT properties.

2. Consider a set of atomic propositions AP. Consider the following logic $\mathcal{X}$ defined as follows:

$$\varphi ::== (a \in AP) | \varphi \wedge \varphi | \neg \varphi | \varphi \Delta \varphi$$

   with semantics as follows:
   Given a word $w = A_0 A_1 \ldots$ over 2^{AP} and a position $i \in \mathbb{N}$, we define
   (a) $w, i \models a$ iff $a \in A_i$ for $a \in AP$
   (b) $w, i \models \varphi_1 \wedge \varphi_2$ iff $w, i \models \varphi_1$ and $w, i \models \varphi_2$
   (c) $w, i \models \neg \varphi$ iff $w, i \not\models \varphi$
   (d) $w, i \models \varphi \Delta \psi$ iff $\exists j > i$, $w, j \models \psi$ and $\forall i < k < j$, $w, k \models \varphi$.
   Comment on the equivalence of LTL and $\mathcal{X}$.

3. Exercises 5.1, 5.2, 5.5, 5.6 and 5.7 from Baier-Katoen.

4. Consider a ω-automaton $(Q, \Sigma, \delta, q_0, Acc)$, and let $\mathcal{G} \subseteq 2^Q$ be a set of good states. An ω-word α is said to be accepted iff there is a run ρ of α such that $Inf(\rho) \in \mathcal{G}$. $\delta : Q \times \Sigma \to 2^Q$ is the transition function.
   - Construct a deterministic ω-automata with this acceptance condition that captures the language "Finitely many b's".
   - Show that ω-automata with this acceptance condition captures ω-regular languages.
   - How do you complement a deterministic ω-automata with this acceptance condition?