T-79.186 **Spring 2004**
Reactive Systems
Home Exercise 4
Deadline 17.3 16.15

Return your answers by email (Postscript or PDF) to Timo.Latvala@hut.fi, or on paper to the lecture. Remember to include your name *and* student number.

For this home exercise round use the automata definition used in the lecture slides.

1.) For each LTL formula f_i below construct a Büchi automaton $\mathcal{A}_i$ that accepts the language $\{w \in (2^{AP_i})^\omega \mid w \models f_i\}$. In other words, the language contains exactly the infinite words which are models of the formula.

   (a) $AP_a = \{p\}$, $f_a = \Box\Diamond p$.
   (b) $AP_b = \{p\}$, $f_b = \Diamond\Box\neg p$.
   (c) $AP_c = \{p, q\}$, $f_c = p\mathbf{U}q$.
   (d) $AP_d = \{p, q\}$, $f_d = (\Diamond\Box p) \Rightarrow (\Diamond\Box q)$.
   (e) $AP_e = \{p\}$, $f_e = XXp$.
   (f) $AP_f = \{p, q\}$, $f_g = p\mathbf{R}q$.

2) Given $\Sigma = \{a, b\}$, consider the following two Büchi automata.

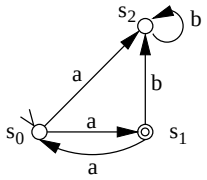

Figure 1: $\mathcal{A}_1$

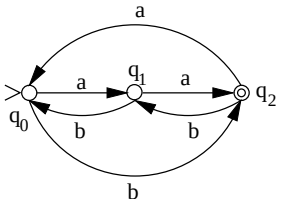

Figure 2: $\mathcal{A}_2$

   (a) Is it true that $\mathcal{L}(\mathcal{A}_1) = \emptyset$?
   (b) Does automaton $\mathcal{A}_1$ accept the infinite string $(a)^\omega$?
   (c) Does automaton $\mathcal{A}_1$ accept the infinite string $a(b)^\omega$?
   (d) Does automaton $\mathcal{A}_2$ accept the infinite string $(abb)^\omega$?
   (e) Construct the product automaton $\mathcal{A}_e = \mathcal{A}_1 \times \mathcal{A}_2$.
   (d) Is it true that $\mathcal{L}(\mathcal{A}_e) = \emptyset$?

   Remember to justify your answer. Answering only yes/no or true/false will get you no points!