Theoretical Computer Science II

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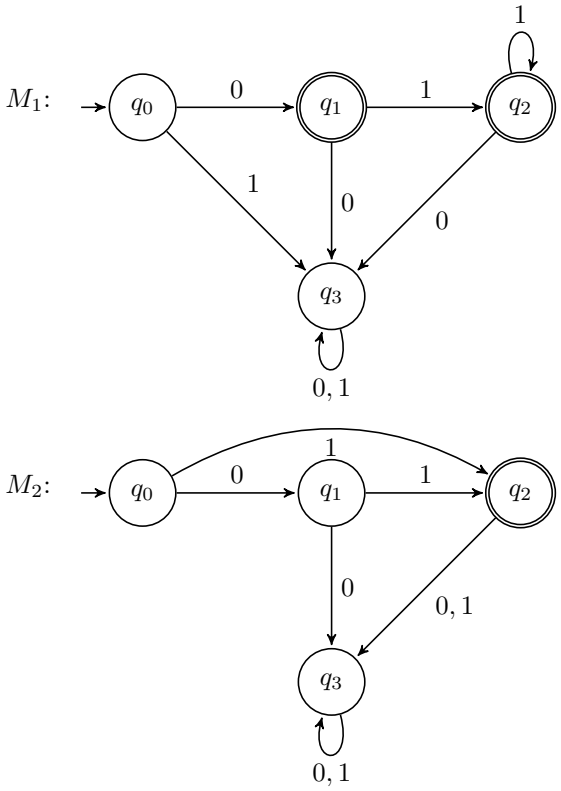
Exercise Sheet 6

Due: December 5, 2011

Exercise 6.1 (DFA, 1+1+2 marks)

Consider the following two DFAs (deterministic finite automata) with $\Sigma = \{0, 1\}$:



(a) What languages (L_1 and L_2) do these two automata individually recognize?

(b) Give the formal definition for M_1.

(c) Show that $L_1 \cup L_2$ is also a regular language, by constructing **one** DFA. Please hand in a **high quality** diagram.

Exercise 6.2 (DFA, 1+1 marks)

(a) Construct a DFA that recognizes the language L with an alphabet $\Sigma = \{0, 1\}$, where $L = \{w \mid w$ has both an even number of 0's and an even number of 1's$\}$

(b) Give the state diagram for a DFA accepting the language
$L = \{w \mid w$ starts with 1 and contains 10 or starts with 0 and contains the 01$\}$
The alphabet is $\Sigma = \{0, 1\}$.

Exercise 6.3 (Regular Languages, 2.5 + 1.5 marks)

In this exercise we want to prove that regular languages are closed under intersection and under complement. The intersection of two languages is defined as $L_1 \cap L_2$. The complement of a language is defined as the set of all words in Σ^* which are not in L, i.e. $\bar{L} = \Sigma^* \setminus L$ (Σ^* is the set of all words/strings over Σ).
Let L and L' be regular languages that are recognized by DFAs $M = (Q, \Sigma, \delta, q_0, F)$ and $M' = (Q', \Sigma', \delta', q_0', F')$, respectively.

(a) Show that the regular languages are closed under *intersection*, i.e. give a finite automaton that recognizes $L \cap L'$.

(b) Show that the regular languages are closed under *complement*, i.e. give a finite automaton that recognizes $\bar{L}$.