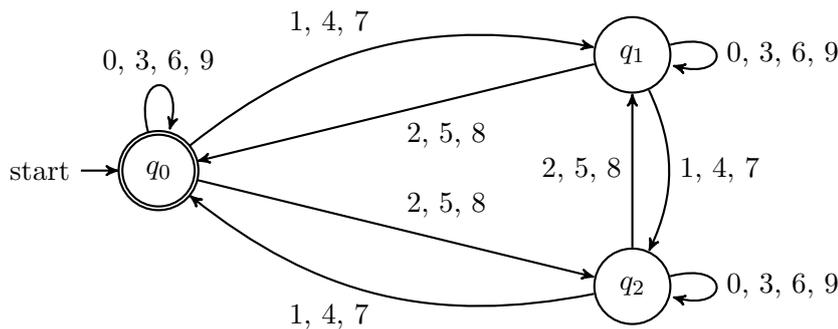


Mathematical Methods for Computer Science I

Fall 2016

Series 7 – Hand in before Monday, 14.11.2016 - 12.00

- For each of the following languages defined over the alphabet $\Sigma = \{a, b\}$, construct a deterministic finite automaton which accepts it.
 - $L_1 = \{\text{words of even length}\}$.
 - $L_2 = \{\text{words ending in } aa\}$.
 - $L_3 = \{\text{words which begin and end with the same letter}\}$.
 - $L_4 = \{\text{words with three consecutive } b\text{'s (not necessarily at the end)}\}$.
 - $L_5 = \{\text{words with } bba \text{ as a substring}\}$.
 - $L_6 = \{\text{words whose third last character is the character } b\}$.
 - Implement each automaton in your preferred programming language and test it on a few words that are in the language and on a few words that are not in the language.
- Describe the functioning of the DFA displayed below, as well as the language it accepts.



- Consider the deterministic finite automaton $(Q, \Sigma, \delta, q_0, F)$ where:

$$Q = \{A, B, C\} \quad \Sigma = \{0, 1\} \quad q_0 = A \quad F = \{B, C\}$$

$$\delta(X, z) = \begin{cases} A & \text{if } (X, z) = (B, 0) \\ B & \text{if } X = C \text{ or } (X, z) = (A, 0) \\ C & \text{otherwise.} \end{cases}$$

- Draw the transition graph and write down the transition table.
 - Explain which language is recognised by this automaton.
- In data transmission, parity bits play an important role in error detection schemes, which help checking whether data has been altered during transmission. The underlying idea is to exclusively transmit data sets with an even number of ones. Before data sets are transmitted, they are added a parity bit, which guarantees that each data set has an even number of ones. This means that a data set with an even number of ones gets an additional zero, while a data set with an odd number of ones gets an additional one. For this exercise, we only consider data sets with 4 bits and one additional parity bit.
 - Construct a DFA, which checks the transmitted data for their correctness and only accepts correct data sets.
 - How does the DFA react if two bits have been altered during transmission?