Languages and Automata

Assignment 2, Tue 11th Feb, 2020

Handing in your answers: There are two options:

1. Brightspace. Before submitting, make sure:
   - the file is a PDF document
   - your name and student number are included in the document (they might be printed).
2. Post box, located in the Mercator building on the ground floor. There will be boxes labelled with *LnA* and the corresponding group teacher's name. Put your work in the post box corresponding to your group. Before putting your solutions in the post box make sure:
   - your name and student number are written clearly on the document.

   There will be 1 box, the *Uitleverbak*, for work that hasn't been picked up at the exercise hours.

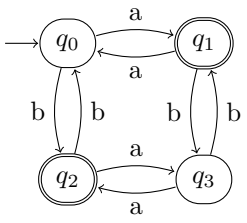
Deadline: Fri 14th Feb, 2020, 17:00 (in Nijmegen!). This deadline is strict: submission in brightspace will close at that time.

Goals: After completing these exercises successfully you should be able to construct an automaton from a description of a language, describe the language of a basic automaton, perform the complement and product constructions, and compute a regular expression from an automaton.

There are 2 exercises, worth **10 points** in total.

1 DFAs and Their Languages

a) Consider the following DFA over the alphabet $A = \{a, b\}$.



Describe explicitly the language accepted by this automaton. **(1pt)**

b) Let L be the following language over $A = \{a, b\}$. **(3pt)**

$$L = \{w \in A^* \mid |w|_a \text{ is } \textit{not} \text{ divisible by 3 and } w \text{ ends with } a\}$$

Use the constructions for product and complement automata, given in the lecture, to construct an automaton M with $\mathcal{L}(M) = L$.

c) Which of the words *abaa*, *ba* are accepted by your automaton from the previous answer (1b)? Justify your answer with accepting or rejecting computations. **(1pt)**

d) Let $A = \{a, b\}$ and $w \in A^*$. We say that w contains a word v as subword, if there are $x, y \in A^*$, such that $w = xvy$. This means, if we count occurrences of subwords, then letters can be counted twice in an overlap. For example, the word *ababa* contains the word *aba* twice as subword.

Construct a deterministic automaton M that accepts the language **(2pt)**

$$L = \{w \in A^* \mid w \text{ contains } aba \text{ exactly once as subword}\},$$

2 DFAs and Regular Expressions

Let M be the DFA given by:

- set of states $Q = \{q_0, q_1, q_2\}$
- initial state q_0
- set of final states $F = \{q_0, q_2\}$
- transition function δ given by

δ	a	b
q_0	q_1	q_0
q_1	q_1	q_2
q_2	q_0	q_1

a) Draw a state/transition diagram for the automaton M. **(1pt)**

b) Construct a regular expression e such that $\mathcal{L}(M) = \mathcal{L}(e)$. **(2pt)**