

Development of Safety-Critical Embedded Systems WS 2012/2013

Exercise Sheet 2

Please hand in the solutions to the theoretical exercises until the beginning of the next lecture, Fri. 2012-11-16, 10:00. Please write your name as well as the number of your tutorial group and/or the date/time slot on the first sheet of your solution.

Exercise 2.1: Finite Automata And Regular Expressions (Points: 2+2+2+8)

1. Construct *deterministic* finite automata over $\{0, 1\}$ which accept the following languages:
 - words containing n zeros with n divisible by 3,
 - words with exactly one occurrence of the substring 010,
 - words not containing the substring 101.
2. Furthermore, let the regular expression $(a|b)^*ac(a|ab)^*$ over $\Sigma = \{a, b, c\}$ be given. Construct an equivalent minimal deterministic finite automaton for this regular expression. (Use the algorithms presented in the lecture for this exercise.)

Exercise 2.2: Moore vs Mealy Automata (Points: 3+3)

Provide (a) a Mealy automaton as well as (b) a Moore automaton that reads a sequence of symbols from the set $\{0, 1\}$ and outputs '1', if the last 3 symbols match the pattern "101". Otherwise, its output is '0'.

Example:

Input	0	1	1	0	1	0	0	1	0	1	0	1	0	1	...
Output	0	0	0	0	1	0	0	0	0	1	0	1	0	1	...

Exercise 2.3: More on Mealy Automata (Points: 6)

For some numbers there exist roman symbols representing them:

Roman Symbol	Represented Value
I	1
V	5
X	10
L	50
C	100
D	500
M	1000

Each decimal number can be represented as a combination of these roman symbols with the following rules to be respected:

- Normally values of symbols are added up.

- The symbols V, L and D can occur only once in each string; other symbols must never occur more than three times directly one after another in a string and must never occur more than four times.
- Normally symbols are listed in the order of decreasing values with the following exceptions:

Roman Number	Value
IV	4
IX	9
XL	40
XC	90
CD	400
CM	900

If these rules are respected you can understand the following table:

Roman Number	Value
VI	6
XC	90
CDXCVI	496
MXXIV	1024

Construct a Mealy automaton which accepts roman numbers assuming that only correct roman numbers are given as inputs and produces the following output: Let the value of the number so far determined be x . If the value changes by k upon taking this transition, emit the string $+k$ (or $-k$).

Example: A potential transition from a node labeled X to I should be associated with the output +1.