Discrete Event Systems
Exercise Sheet 1

1 Finite Automata

In this exercise you are asked to design your first finite automata. Try to minimize the number of states of your machines.

a) Consider the alphabet {0,1}. Implement an automaton which accepts the following strings:

At first there are zero or more '1's, followed by zero ore more '0's. This in turn is followed by an arbitrary (non-zero) number of '1's.

b) Design an automaton which decides whether a number is divisible by three. Assume that the digits of the number are inserted sequentially, that is, the number '135' is inserted as '1', '3' and finally '5'. How many states do you need? (Hint: Cross sum!)

2 Vending Machine Revisited

Consider the vending machine shown at the beginning of the course. Do you see any problems with this machine? How can the machine be made more user-friendly?

3 Build Finite Automata with the Construction Rules

Consider the alphabet {a,b}. For each of the following languages, implement an automaton that accepts it using the constructions seen in the lecture (*e.g.,* the cartesian product construction).

a) $\{w \mid w$ has exactly two **a**'s and at least two **b**'s$\}$

b) $\{w \mid w$ does not contain the substring **baba**$\}$

4 "Mais im Bundeshuus"

It is Wednesday morning and the seven members of the Swiss Federal Council meet to decide about an important topic: In order to decrease the expenses of education, should only women be allowed to study at ETH?

a) Assume that the seven members vote one after another. Further, assume that there is no abstention of voting. Design an automaton which accepts the ballot if and only if the majority of the members voted in favor of the proposition.

b) Extend your automaton for the case of abstentions of voting. The automaton should accept if and only if more members voted in favor of the proposition than against it.

Turn page for general information on the course and the exercises!

General Information

Please find below the most important information about the course and the exercises.

Time and Place

- Lecture by Prof. L. Vanbever, Prof. R. Wattenhofer and Prof. L. Thiele, Thursday, 13:15–15:00, ETZ E6.

- Exercises after the course, *i.e.* Thursday, 15:15–16:45, ETZ E6.

Exam Requirements

There are *no requirements* for attending the final exam from our side. However, if you need a Testat due to special circumstances, you need to hand in solutions to at least 80% of the exercises.

Exercise Proceedings

At the beginning of every lecture week, we will publish a new exercise sheet on the course website[1]. This exercise sheet is intended to be solved *during the exercise session* on Thursday where tutor(s) will be available to assist you and to answer potential questions. After every exercise session we will provide a detailed sample solution for the respective exercise sheet on the course website.

You can hand in your solutions for correction after the exercise session on a *voluntary basis*. This is not mandatory since a *Testat is not required* to be admitted to the final exam.

Lecture Material

The lecture slides will also be made available on the course website in due time.

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[1] http://disco.ethz.ch/lectures/des/