Theoretical Computer Science – Exercise 1

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Exercise 1

Given: The finite automaton over the alphabet $\Sigma = \{a, b, c\}$ with states $Q = \{q_s, q_1, q_2, q_e\}$, defined by its transition table as shown on the right, with:

	q_s	q_1	q_2	q_e
a	q_1	q_s	q_1	q_e
b	q_e	q_1	q_1	q_s
c	q_2	q_s	q_e	q_2

q_s = start state, q_e = end state

a) Draw the state diagram for this automaton.

b) The recognized language of an automaton is defined as the set of all words that can be built from the symbols of the alphabet, where the automaton is in an end state after processing the word from left to right.
Which of the following words belong to the recognized language of this automaton? abc, a^3bc^3, $a^2b^2c^2$, $a^3b^2c^2$, b, cba, $b^{111}a^{111}c^{111}$

Exercise 2

Specify the state diagram and transition table of a finite automaton with $\Sigma = \{a, b\}$, whose recognized language L consists of the set of all words from Σ^* that start with a and do not contain bb as a substring.

Exercise 3

Construct a Mealy machine that translates an arbitrary sequence of binary input digits into a sequence of decimal digits, where two binary digits are combined into one decimal digit:

Input digits	Output
00	0
01	1
10	2
11	3

Specify the machine as a transition table and as a state diagram.

Exercise 4

Specify a finite automaton as a transition table and as a state diagram that accepts simple polynomial expressions like: r + r*x + x*x*x – r*x*x

The expression consists of operators + und – that combine terms. Each term consists of a single, optional real number r, optionally multiplied by an arbitrary number of variables (x). Mixtures of r and x (e.g., r*x*r) are not allowed, i.e., if there is an r and x, the r must always come first.

The alphabet is $\Sigma = \{r, x, *, +, –\}$.