Assignment 3

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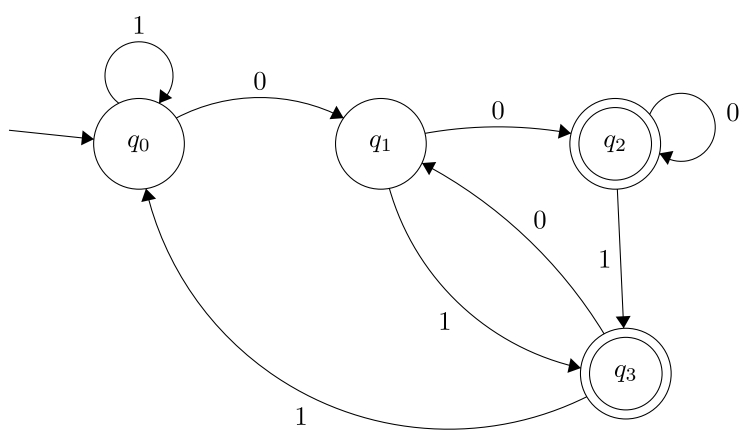
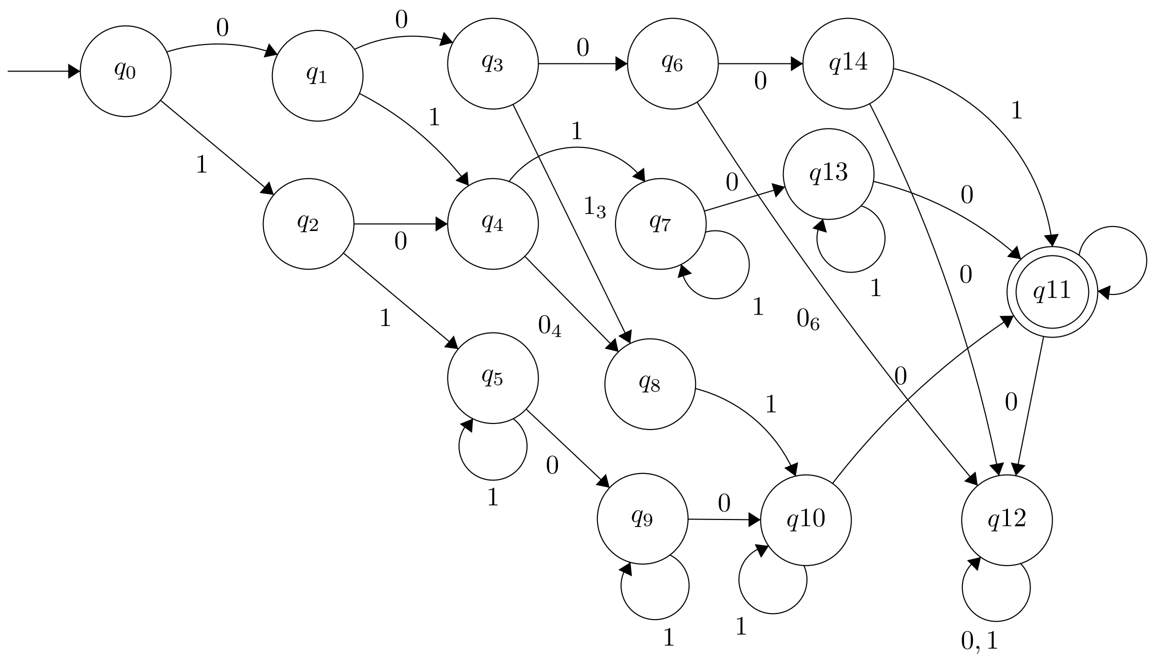
Chapter 1

Tasks 4 (e-g-h-i)

1.1 e)

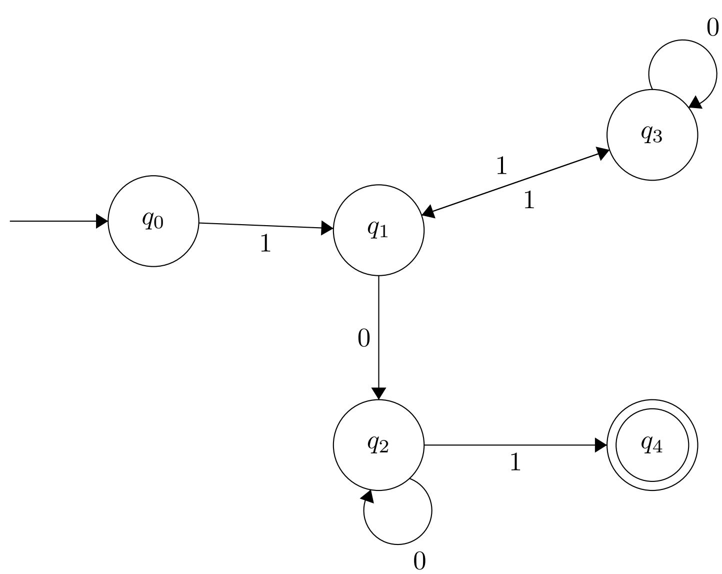


1.2 g)



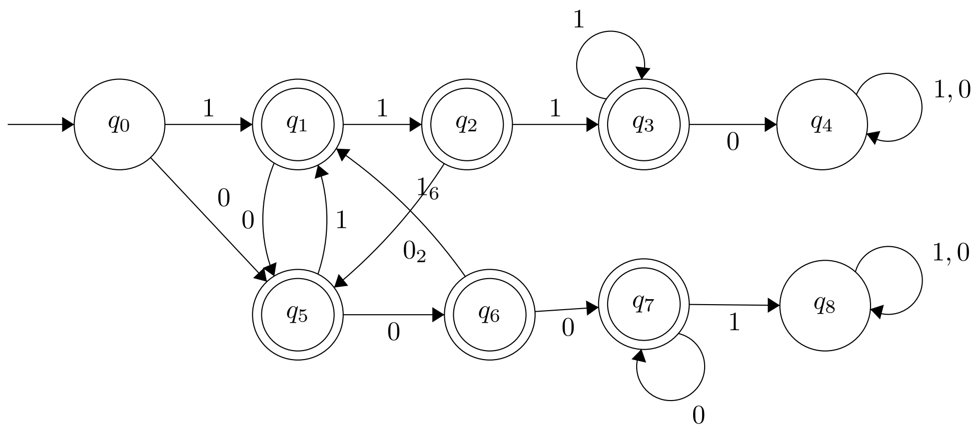
q_0
q_1
q_2
q_3
q_4
q_5
q_6
q_7
q_8
q_9
$q10$
$q11$
$q12$
$q13$
$q14$
1_3
0_4
0_6
$0, 1$

1.3 h)



q_0
q_1
q_2
q_3
q_4

1.4 i)



Chapter 2

Tasks 5 (c-d)

- Let's first prove the closure under concatenation of regular languages.
  Let L_1 and L_2 be arbitrary regular languages. Because they are regular languages, we know there are minimal DFAs for L_1 and L_2; let's call these M1 and M2, respectively.

  To see that the concatenation of these languages must be regular, construct a machine M* as follows:

  – the states of M* are the states of M1 and M2 put together
  – the alphabet of M* is the union of the alphabets of M1 and M2
  – initial state of M* is the initial state of M1
  – accepting states of M* are the accepting states of M2
  – M* has all the same transitions as M1 and M2 put together, plus empty/epsilon/lambda transitions from all the accepting states in M1 to the initial state of M2

  This defines an NFA-lambda (NFA with empty/lambda/epsilon transitions). We know those are equivalent to DFAs and all DFAs can be minimized; let us call the equivalent minimal DFA M**.

  Because there is a minimal DFA for the concatenation of L1 and L2, the concatenation must be regular.
  Having proved that, we could see doubling each letter in each word of the language L_1, to form the language L_2 as the concatenation of L_1 on itself; thus proving that L_2 is also a regular language.

- we have already proved the closeness of concatenation in the previous point.[1]

Chapter 3

Task 6

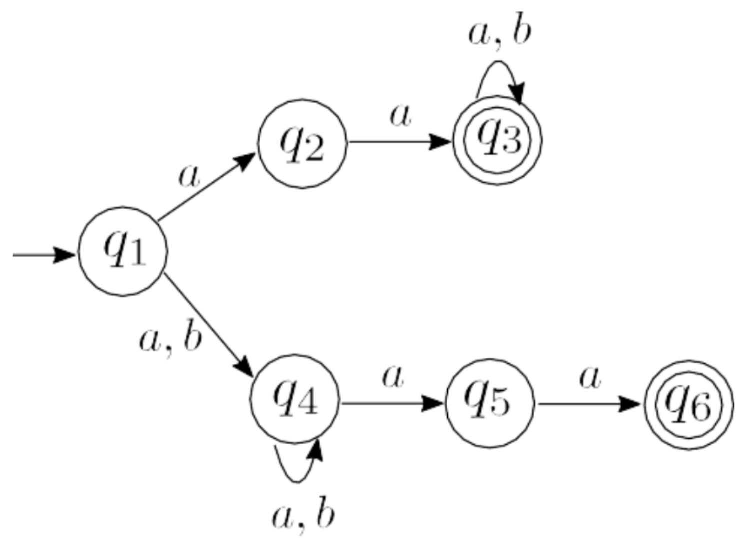


Figure 3.1: Task6

The Figure shown above, represent a NFA that accepts the language composed by the alphabet a, b, ϵ where all strings accepted are the ones that contain the substring: "aa".

The reason being the fact that NFA when given an input that would be processed by multiple state, like in this case the input a would be accepted simultaneously by state q_2 and q_4; the machine would be split up in two different machine and if even one of the multiple machine in which an NFA would split accept the given input then, the input is accepted.

Chapter 4

Task 8 (c)

If the positive integers and decimal would be represented by the formal alphabet of $\Sigma = 0, 1$ with 1 being the positive integers and 0 being the decimals, then the sum would be described by:

$$1^*0^* \cup 1^*0^*$$

Bibliography

Sipser, Michael. *Introduction to the theory of computation*. 2nd ed. Boston: Thomson Course Technology, 2006. ISBN: 0534950973. URL: `http://www.loc.gov/catdir/enhancements/fy1103/2006271030-b.html`.