German University in Cairo
Department of Computer Science
Assoc. Prof. Haythem O. Ismail

CSEN 1003 Compiler, Spring Term 2020
Practice Assignment1
Discussion: 02.02.20 - 05.02.20

Exercise 1-1

Answer the following general questions:

a) What are the advantages of an interpreter over a compiler?

Solution:

An Interpreter does not produce a target program as a translation. It appears to directly execute the operations specified in the source program on inputs supplied by the user. For this reason, it is machine independent. An interpreter would also give better error-diagnostics than a compiler because it executes the source program statement by statement.

b) What are the advantages of a compiler over an interpreter?

Solution:

The machine-language target program produced by a compiler is usually much faster than an interpreter as it is more suitable for code optimization.
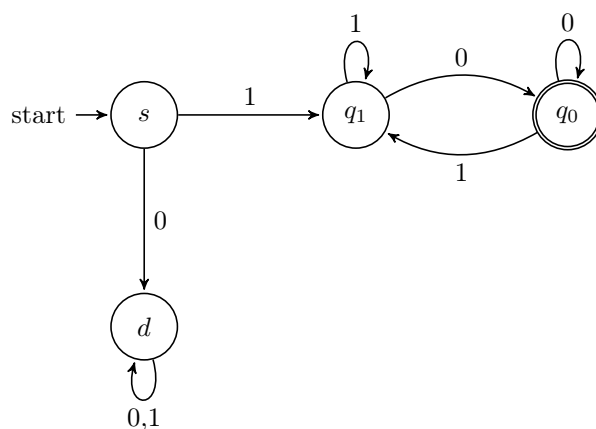
Exercise 1-2

DFA Design

Give state diagrams of DFAs recognizing the following languages. The alphabet is $\{0, 1\}$

a) $\{w|\ w$ begins with a 1 and ends with a $0\}$

Solution:
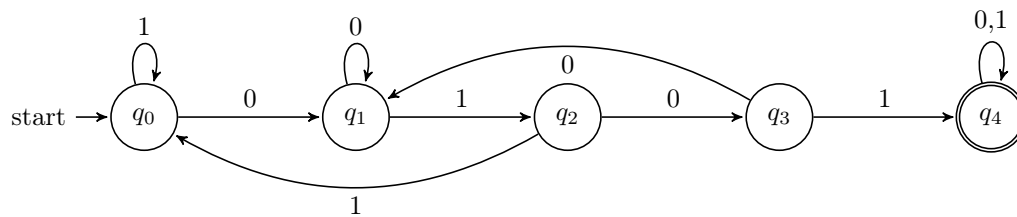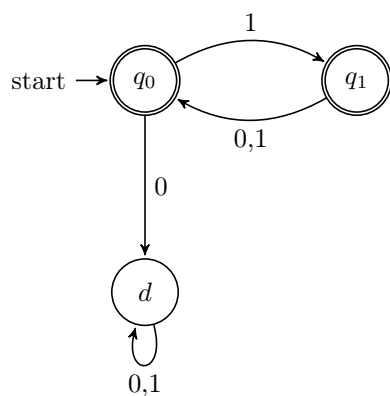

b) $\{w|\ w$ contains the substring $0101\}$

Solution:

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c) $\{w|$ every odd position of w is a 1 $\}$

Solution:

d) $\{w|$ w contains at least two 0s and at most one $1\}$

Solution:
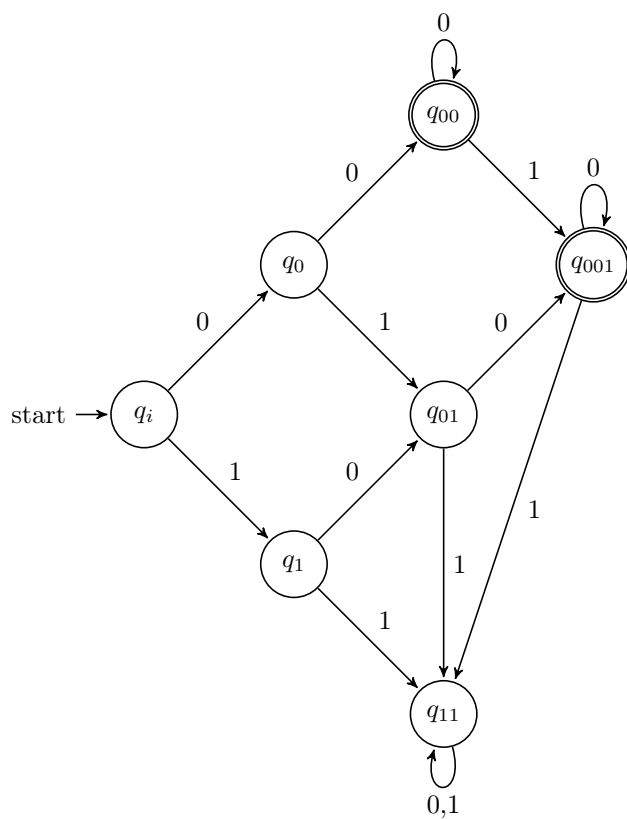
Exercise 1-3

Regular expressions

Give regular expressions generating the languages of Exercise 1-2

Solution:

a) $1(0 \cup 1)^*0 = 1\Sigma^*0$

b) $\Sigma^*0101\Sigma^*$

c) $(1\Sigma)^* \cup (1\Sigma)^*1 \equiv (1\Sigma)^*(\varepsilon \cup 1)$

d) $00^+ \cup 00^+10^* \cup 0^*100^+ \cup 0^+10^+$

Exercise 1-4

Regular expressions

Describe the set of patterns (ie. The language) denoted by the following regular expressions:

a) $(a|b)^*(a|b)$

   Solution:

   equivalent to $(a|b)^+$. This is the language of all strings drawn from the alphabet $\Sigma = \{a, b\}$ containing atleast one character.

b) $a(a|b)^*a$

   Solution:

   language of strings drawn from the alphabet $\Sigma = \{a, b\}$ that start and end with a, and contain at least 2 characters.

c) $((\varepsilon|a)b^*)^*$

   Solution:

   This denotes the language of all strings drawn from the alphabet $\Sigma = \{a, b\}$ including the empty string ε.

   The fact that the whole formula contains a union of a two characters alphabet within $()^*$ implies that this expression has no fixed prefix or suffix, and can contain a or b in any order. It can be reformulated as: $(b^*|ab^*)^*$ which includes the language $(b^*|a)^*$, itself including the language $(b|a)^*$.

Exercise 1-5

Consider the following NFA:
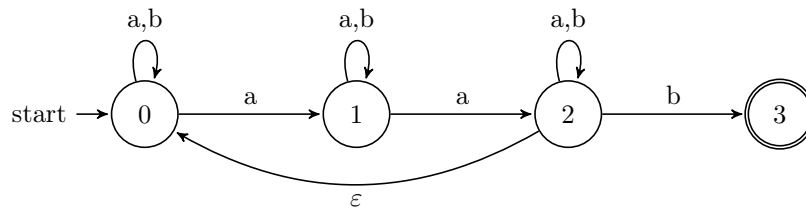
a) Indicate all the paths labeled: `aabb`

   Solution:

   $0000, 0111, 1111, 1222, 12220, 1223, 12200, 12000$

b) Indicate all the accepting paths labeled: `aabb`

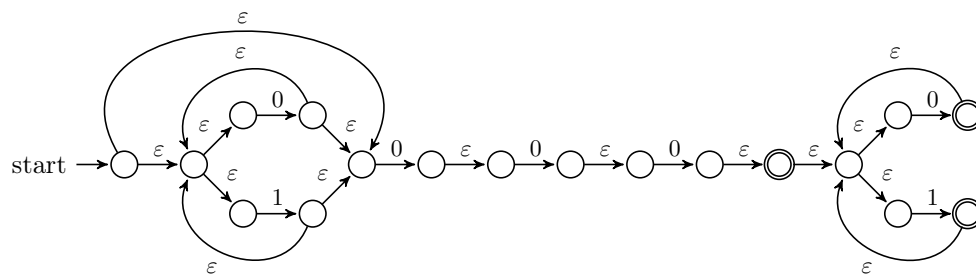   **Solution:**

   1223

Exercise 1-6

Convert the following regular expression to NFA.
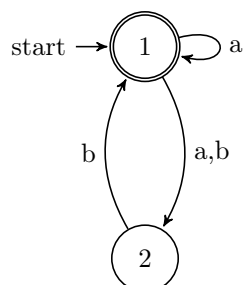
$$(0 \cup 1)^*000(0 \cup 1)*$$

Solution:

Exercise 1-7
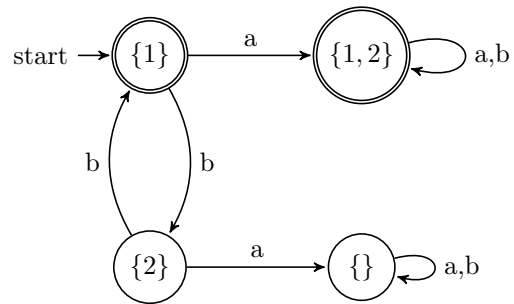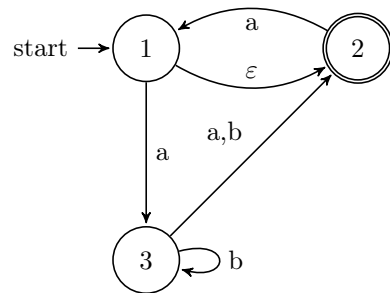
Convert the following NFAs to equivalent DFAs

a)

Solution:

b)

Solution: