

**CSEN 1003 Compiler, Spring Term 2017**  
**Practice Assignment 1**

Discussion: 04.02.17 - 09.02.17

**Exercise 1-1**

Answer the following general questions:

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

**Solution:**

An interpreter would give better error-diagnostics than a compiler, because it executes the source program statement by statement. It is also machine independent.

Interpreter does not produce target program as a translation, directly execute the operations specified in the source program, on inputs supplied by the user.

- 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 when mapping inputs to outputs, more suitable for code optimization.

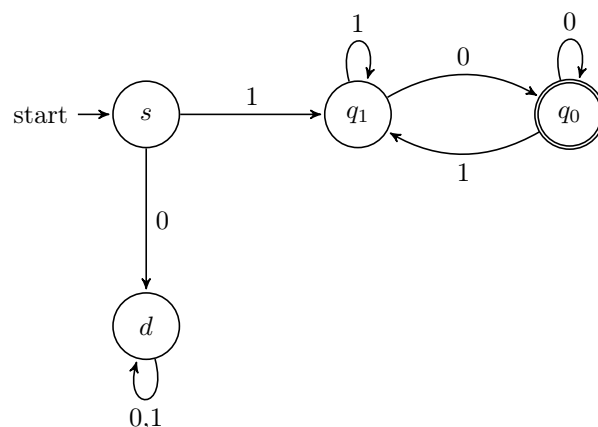
**Exercise 1-2**

**DFA Design**

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

- a)  $\{w \mid w \text{ begins with a } 1 \text{ and ends with a } 0\}$

**Solution:**

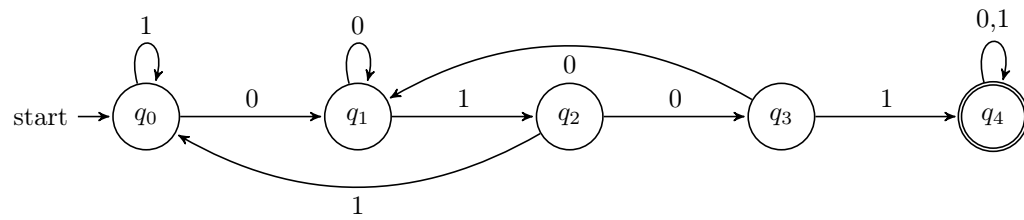


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<sup>0</sup>The exercises are due to Dr. Carmen Gervet and Sipser textbook

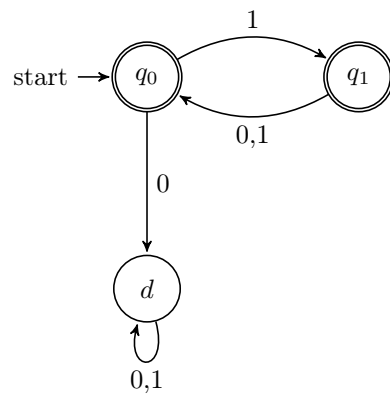
b)  $\{w \mid w \text{ contains the substring } 0101\}$

**Solution:**



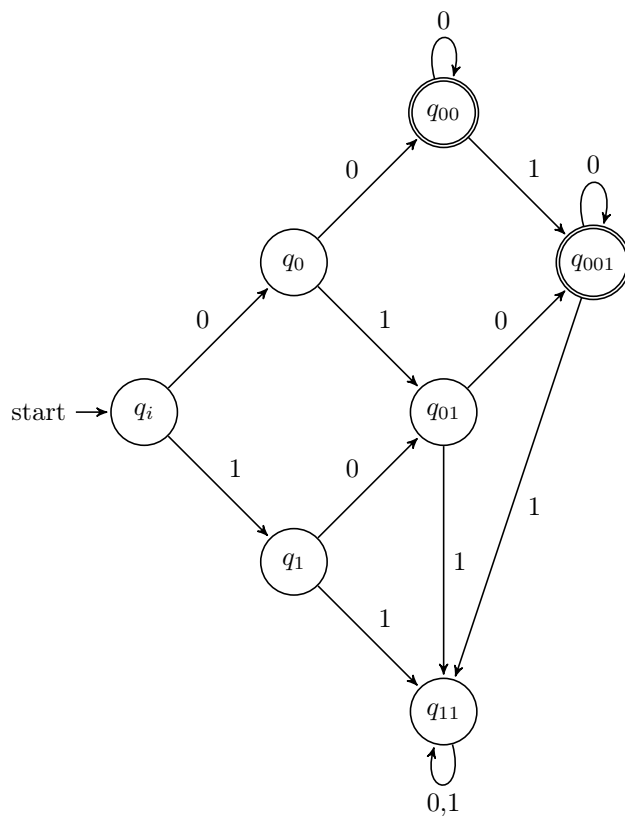
c)  $\{w \mid \text{every odd position of } w \text{ is a } 1\}$

**Solution:**



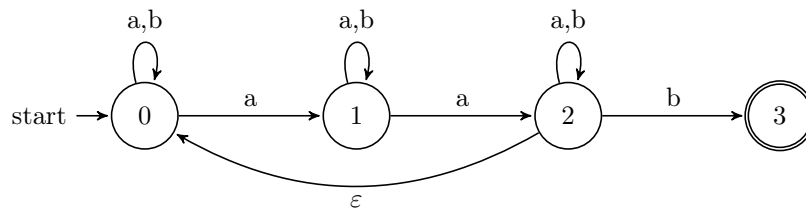
d)  $\{w \mid w \text{ contains at least two 0s and at most one 1}\}$

**Solution:**



### Exercise 1-3

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:**

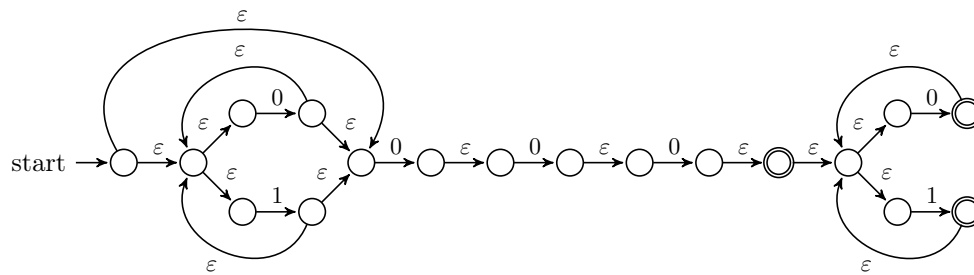
1223

### Exercise 1-4

Convert the following regular expression to NFA

- a)  $(0 \cup 1)^*000(0 \cup 1)^*$

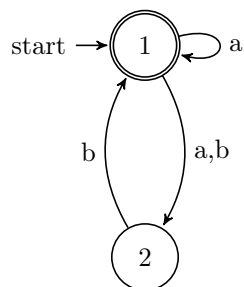
**Solution:**



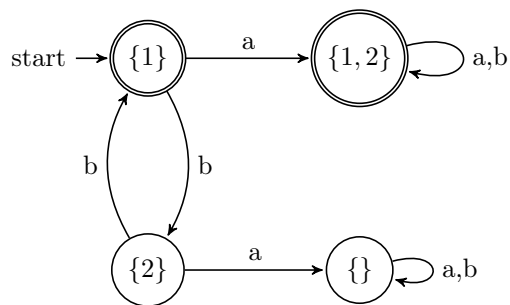
### Exercise 1-5

Convert the following NFAs to equivalent DFAs

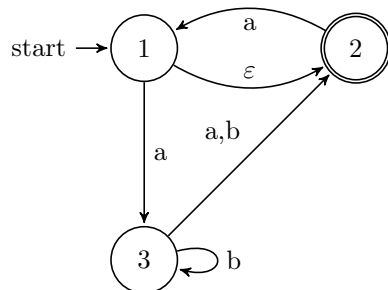
a)



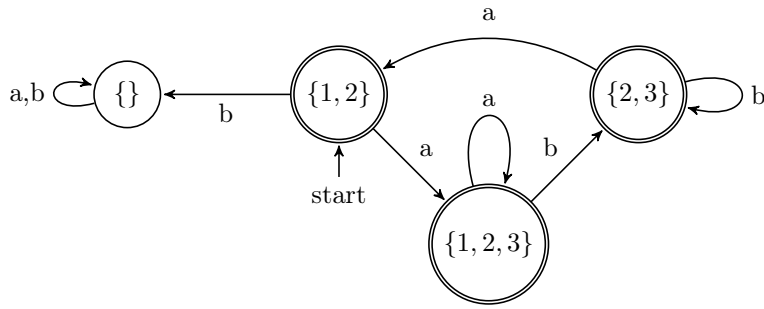
**Solution:**



b)



**Solution:**



### Exercise 1-6

#### 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 1-7

#### 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  $\varepsilon$ .

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  $(b|a)^*$ .