CSc 30400 Introduction to Theory of Computer Science
2nd Homework Set

1. Figure 1 presents the state diagrams of two DFAs, M_1 and M_2. Answer the following questions about each of these machines.

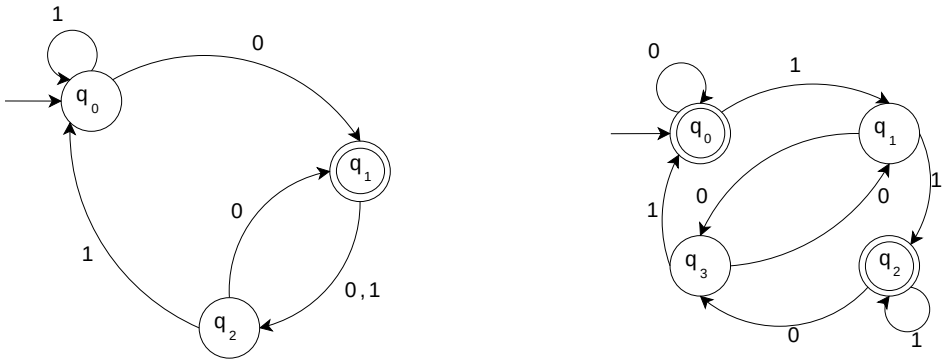

Figure 1: M_1 and M_2 of exercise 1.

   (a) What is the start state?

   (b) What is the set of accepting states?

   (c) What sequence of states does the machine go through on input 0011?

   (d) Does the machine accept the string 0011?

   (e) Does the machine accept the string ε?

2. The formal definition of a DFA M is $(\{q_1, q_2, q_3, q_4, q_5\}$, {u,d}, δ, q_3, $\{q_3\})$, where δ is given by table 1. Give the state diagram of this machine.

	u	d
q_1	q_1	q_2
q_2	q_1	q_3
q_3	q_2	q_4
q_4	q_3	q_5
q_5	q_4	q_5

Table 1: The transition function δ of exercise 2.

3. Design an automaton on the alphabet $\Sigma = \{0, 1\}$ that recognizes the language:

   (a) $L_1 = \{w | w$ contains exactly two 1s$\}$

   (b) $L_2 = \{w | w$ contains at least two 1s$\}$

   (c) $L_3 = \{w | w$ contains two consecutive 1s$\}$

   (d) $L_4 = \{w | w$ contains exactly two 1s and three 0s$\}$

   (e) $L_5 = \{w | w$ contains an even number of 1s$\}$

   (f) $L_6 = \{w | w$ contains a number of 1s that is a multiple of 3$\}$

4. Imagine a home alarm. This alarm has a numpad with 5 digits (from 1 to 5). The password to deactivate the alarm is set to 3143. Every time that you press a wrong digit you lose a try. Then you should retype the whole password. You have only 3 tries to deactivate the alarm.

   (a) Design an automaton *Alarm* that describes this alarm. Draw the state diagram. Explain the figure.

   (b) Determine Q (*the set of states*), Σ (*the alphabet*), δ (*the transition function*), q_0 (*the start state*) and F (*the set of accepting states*) in your automaton. What each of the above symbols represent in the alarm? Describe in English.

   (c) Which is the Language $L(Alarm)$ that this automaton recognizes?

   (d) How many states does your automaton have? Can you find a minimum equivalent automaton (an automaton with minimum number of states that recognizes the same language)?