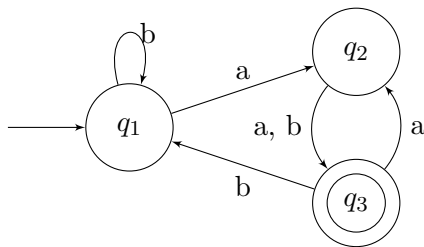# Assignment 1 Solution

1. Consider the finite automaton M_1 and answer the following questions.

   (a) What is the start state?

   q_1

   (b) What is the set of accept states?

   $\{q_3\}$

   (c) What sequence of states does M_1 go through on input $abab$?

   $q_1 q_2 q_3 q_2 q_3$

   (d) Does M_1 accept the string $abab$?

   Yes

   (e) Does M_1 accept the empty string, i.e., ϵ?

   No

   (f) Define M_1 formally.

   $M_1 = (\{q_1, q_2, q_3\}, \{a, b\}, \delta, q_1, \{q_3\})$
   $\delta(q_1, a) = q_2$
   $\delta(q_1, b) = q_1$
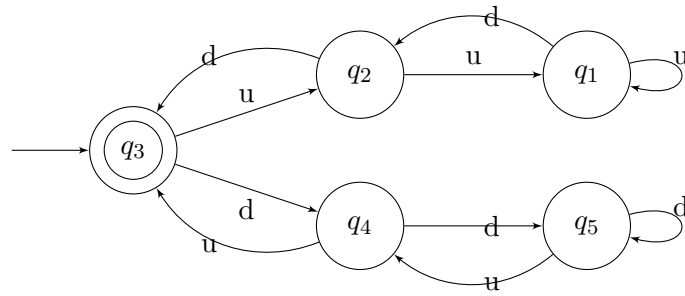 $\delta(q_2, a) = q_3$
   $\delta(q_2, b) = q_3$
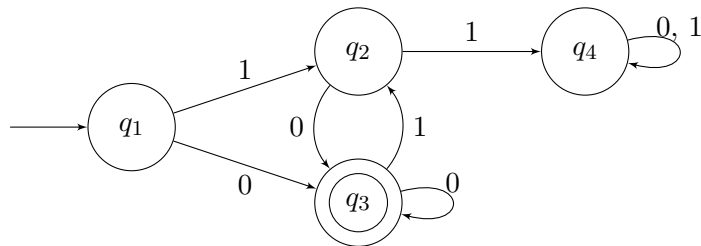 $\delta(q_3, a) = q_2$
   $\delta(q_3, b) = q_1$

2. The formal description of a DFA M_2 is $(\{q_1, q_2, q_3, q_4, q_5\}, \{u, d\}, \delta, q_3, \{q_3\})$, where δ is given by the following table.

	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

(a) Draw the state diagram of M_2.

3. Consider the finite automaton M_3 and answer the related questions

(a) For each of the following strings specify whether or not it is accepted/recognized by M_3.

  i. 0100
    Accepted

  ii. 1001
    Not accepted

  iii. 0101
    Not accepted

  iv. 1
    Not accepted

  v. 11111
    Not accepted

  vi. 0101011
    Not accepted

(b) Describe in English the language that M_3 accepts/recognizes.

All strings that end with a 0 and don't contain the substring 11

Observe that M_3 is a deterministic finite automaton because (i) every state has exactly one transition for each symbol in the alphabet (assuming the alphabet is $\{0, 1\}$), (ii) there is no transition that is labeled by ϵ.

4. Consider alphabet $\Sigma = \{0, 1\}$.

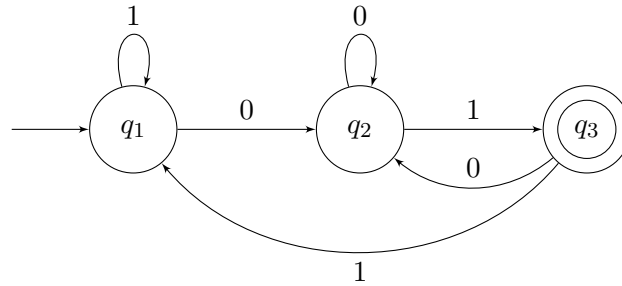(a) Design a finite automaton that accepts all strings that end with 01.

Figure 1: A deterministic finite automaton

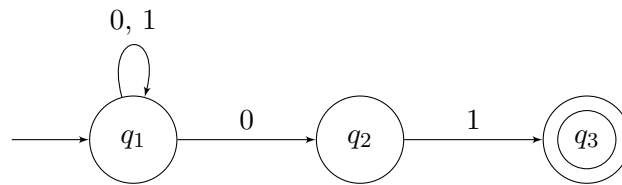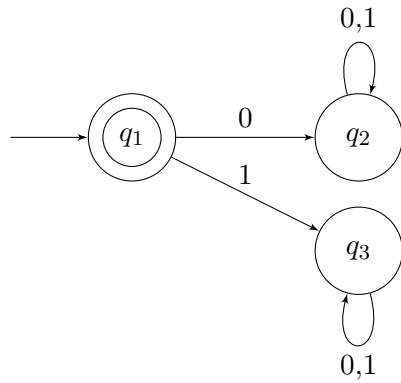
Figure 2: An equivalent non-deterministic finite automaton

(b) Design a finite automaton that accepts *only* the empty string.

There are many finite automata that accept *only* the empty string. Here is an example of a deterministic finite automaton:

Here is an example of a non-deterministic finite automaton:

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