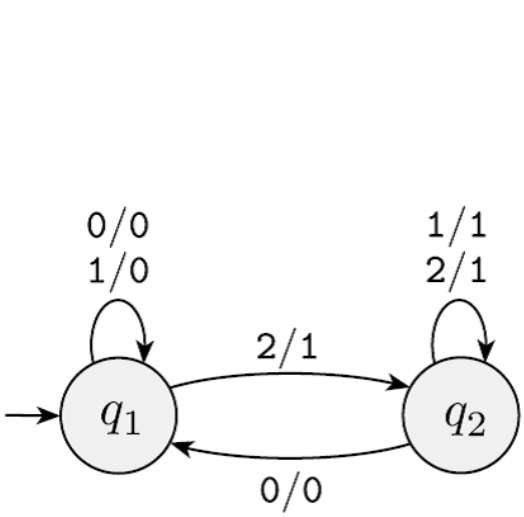
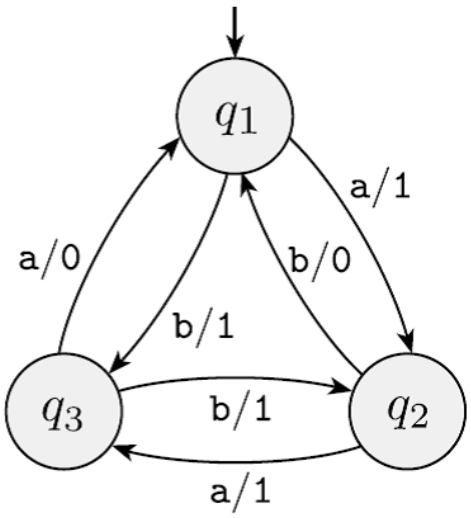
Problem

A ***finite state transducer*** (FST) is a type of deterministic finite automaton whose output is a string and not just accept or reject . The following are state diagrams of finite state transducers T_1 and T_2.



T_1



T_2

Each transition of an FST is labeled with two symbols, one designating the input symbol for that transition and the other designating the output symbol. The two symbols are written with a slash, /, separating them. In T_1, the transition from q_1 to q_2 has input symbol 2 and output symbol 1. Some transitions may have multiple input–output pairs, such as the transition in T_1 from q_1 to itself. When an FST computes on an input string w, it takes the input symbols $w_1 \cdots w_n$ one by one and, starting at the start state, follows the transitions by matching the input labels with the sequence of symbols $w_1 \cdots w_n = w$. Every time it goes along a transition, it outputs the corresponding output symbol. For example, on input 2212011, machine T_1 enters the sequence of states $q_1, q_2, q_2, q_2, q_2, q_1, q_1, q_1$ and produces output 1111000. On input abbb, T_2 outputs 1011. Give the sequence of states entered and the output produced in each of the following parts.

a. T_1 on input 011

b. T_1 on input 211

c. T_1 on input 121

d. T_1 on input 0202

e. T_2 on input b

f. T_2 on input bbab

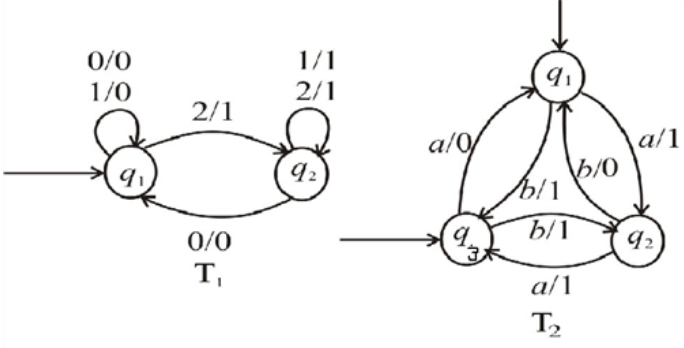
g. T_2 on input bbbbbb

h. T_2 on input ε

Step-by-step solution

Step 1 of 9

Given state diagram of finite state transducers (FST) T_1 and T_2 are as follows



Comment

Step 2 of 9

(a) Input 011

FST T_1 will enter the following sequence of states on input 011: q_1, q_1, q_1, q_1 and produces the output: 000

Comment

Step 3 of 9

(b) Input 211

FST T_1 will enter the following sequence of state on input 211: q_1, q_2, q_2, q_2 and produces the output: 111

Comment

Step 4 of 9

(c) Input 121

FST T_1 will enter the following sequence of states on input 121: q_1, q_1, q_2, q_2 and produces the output 011

Comment

Step 5 of 9

(d) Input 0202

FST T_1 will enter the following sequence of states on input 0202: q_1, q_1, q_2, q_1, q_2

and produces the output: 0101

Comment

Step 6 of 9

(e) Input *b*

FST T_2 will enter the following sequence of states on input *b*: q_1, q_3 and produces the output: 1

Comment

Step 7 of 9

(f) Input $bbab$

FST T_2 will enter the following sequence of states on input $bbab$: q_1, q_3, q_2, q_3, q_2

and produces the output 1111

Comment

Step 8 of 9

(g) Input $bbbbbb$

FST T_2 will enter the following sequene of states on input $bbbbbb$:

$q_1, q_3, q_2, q_1, q_3, q_2, q_1$ and produces the output: 110110

Comment

Step 9 of 9

(h) Input $\in$

FST T_2 will enter the following sequence of states on input $\in$: q_1

and produces the following output $\in$

Comment