Exercise Class Solutions 3

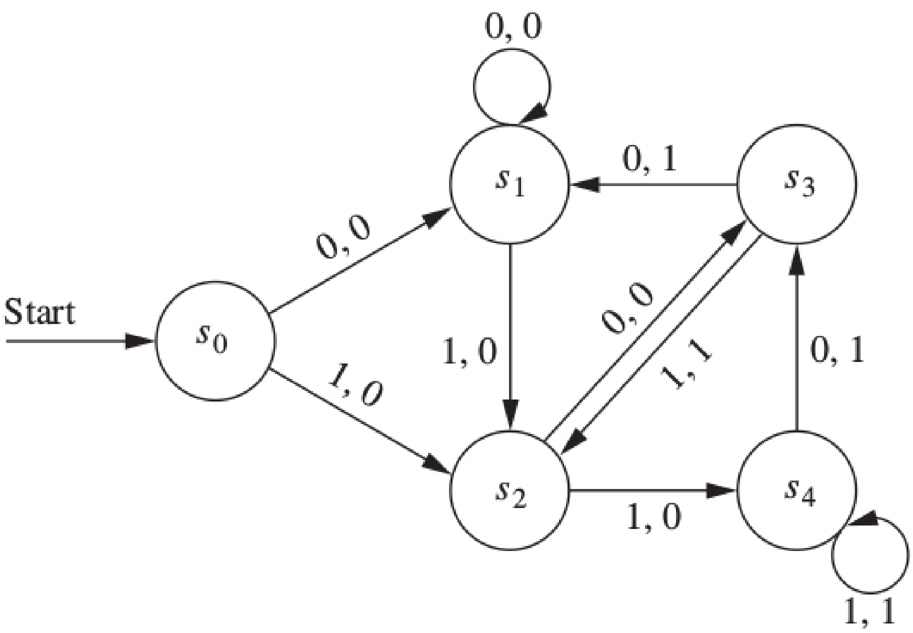
13 Modeling Computation

13.2 Finite-State Machines with Output

13.2.9

Construct a finite-state machine that delays an input string two bits, giving 00 as the first two bits of output.

Solution



13.3 Finite-State Machines with no Output

13.3.1

Let $A = \{0, 11\}$ and $B = \{00, 01\}$. Find each of these sets.

a) AB

b) BA

c) A^2

d) B^3

Solution

a) $\{000, 001, 1100, 1101\}$

b) $\{000, 0011, 010, 0111\}$

c) $\{00, 011, 110, 1111\}$

d) $\{000000, 000001, 000100, 010000, 000101, 010001, 010100, 010101\}$

13.3.5

Describe the elements of the set A^* for these values of A.

a) $\{10\}$

b) $\{111\}$

c) $\{0, 01\}$

d) $\{1, 101\}$

Solution

a) The set of all bit strings consisting of zero or more repetitions of 10.

b) The set of all bit strings consisting of zero or more repetitions of 111; or equivalently, the set of all bit strings containing only 1s and having length divisible by 3.

c) The set of all bit strings where a 1 is always preceded by a 0.

d) The set of all bit strings that start and end with 1s and have at least two 1s between each pair of 0s.

13.3.9

Determine whether the string 11101 is in each of these

c) $\{11\}\{0\}^*\{01\}$

d) $\{11\}^*\{01\}^*$

e) $\{111\}^*\{0\}^*\{1\}$

Solution

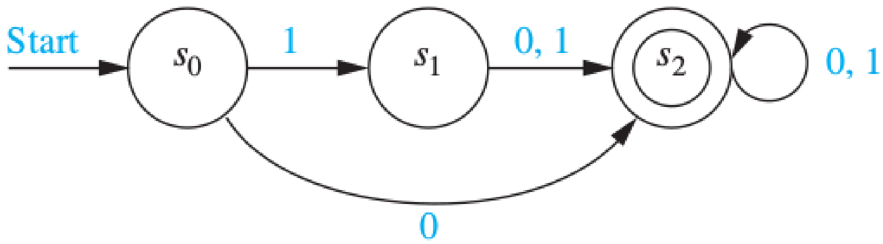
c) No

d) No

e) Yes

13.3.17

Find the language recognized by the given deterministic finite-state automaton.

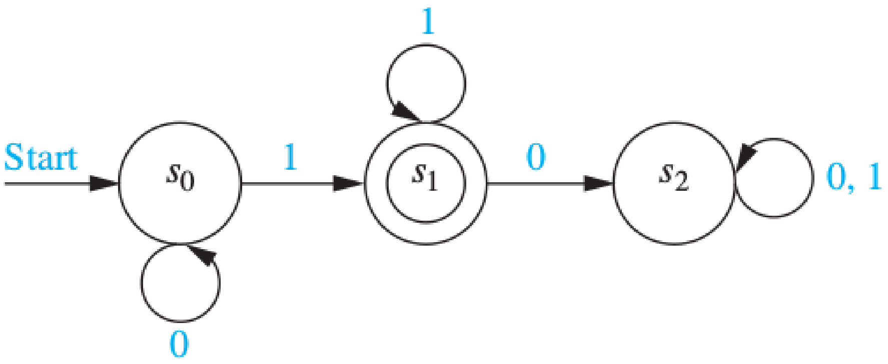


Solution

The set of bit strings that start with 0, 10, or 11; i.e., $\{0, 10, 11\}\{0, 1\}^*$

13.3.19

Find the language recognized by the given deterministic finite-state automaton.



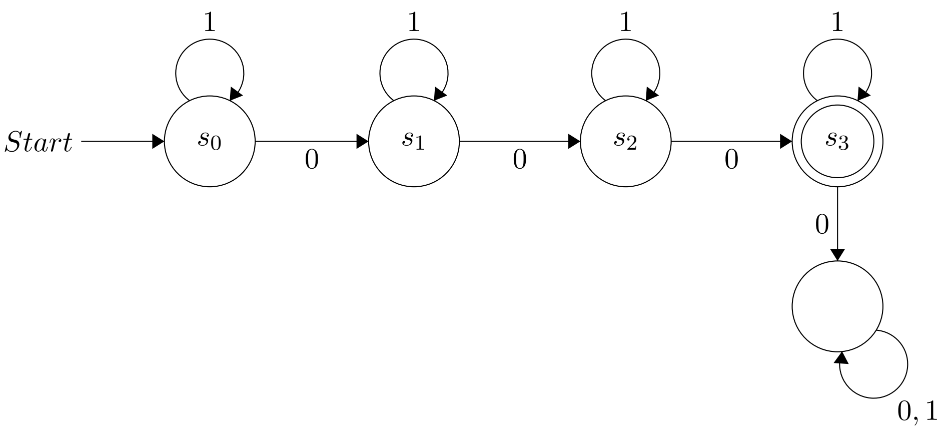
Solution

The set of bit strings starting with zero or more 0s and followed by one or more 1s; i.e., $\{0^m 1^n | m \geq 0, n \geq 1\}$.

13.3.27

Construct a deterministic finite-state automaton that recognizes the set of all bit strings that contain exactly three 0s.

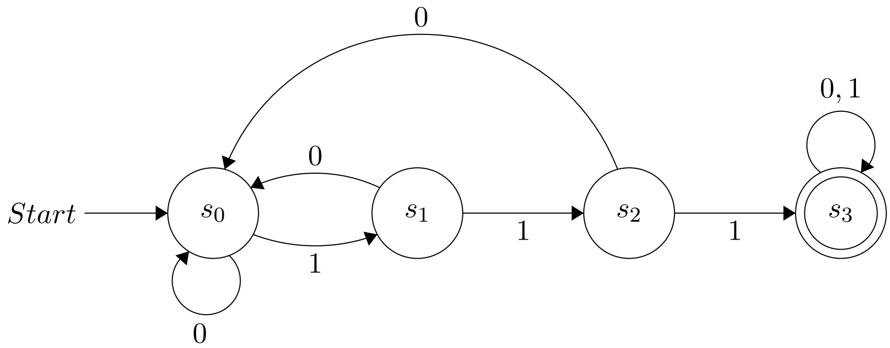
Solution



13.3.29

Construct a deterministic finite-state automaton that recognizes the set of all bit strings that contain three consecutive 1s.

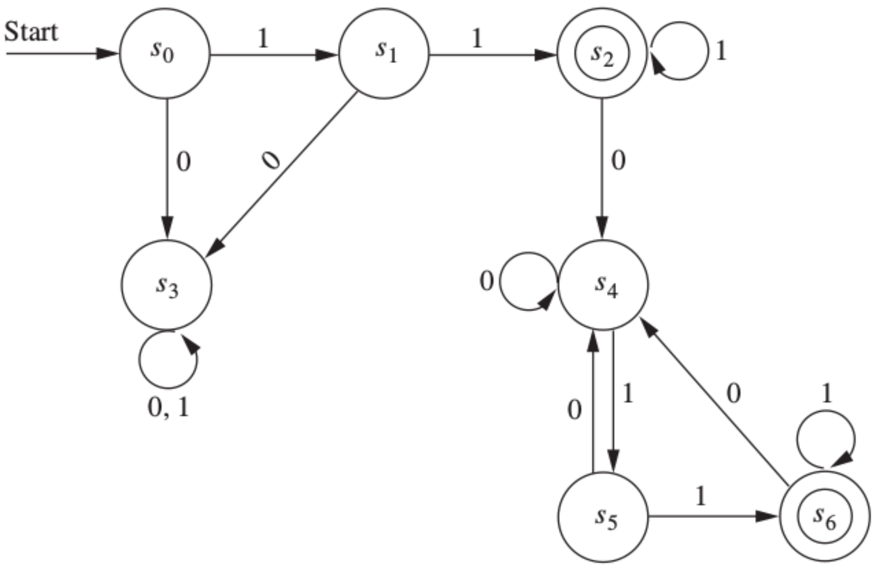
Solution



13.3.31

Construct a deterministic finite-state automaton that recognizes the set of all bit strings that begin and end with 11.

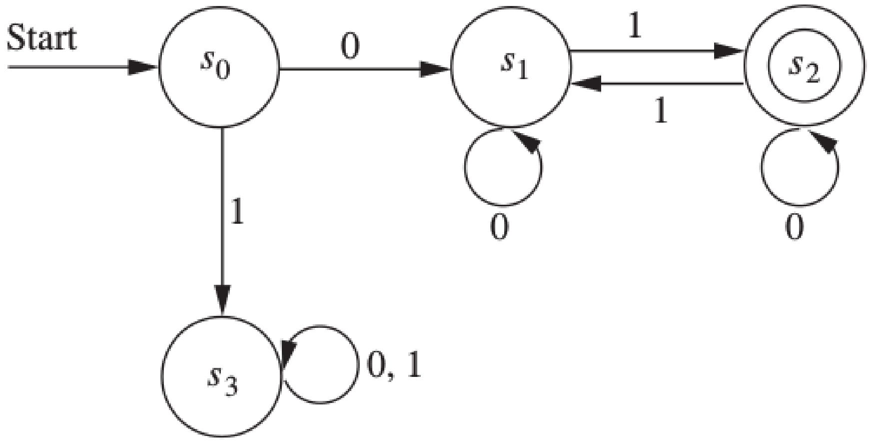
Solution



13.3.35

Construct a deterministic finite-state automaton that recognizes the set of bit strings consisting of a 0 followed by a string with an odd number of 1s.

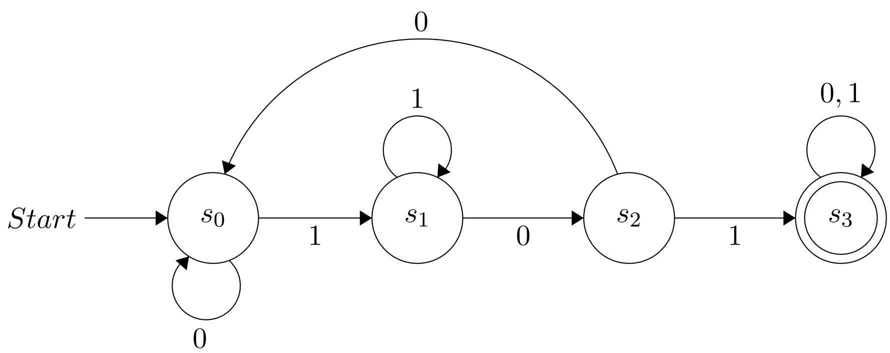
Solution



13.3.25

Construct a deterministic finite-state automaton that recognizes the set of all bit strings that contain the string 101.

Solution



13.3.39

Explain how you can change the deterministic finite-state automaton M so that the changed automaton recognizes the set $I^* - L(M)$.

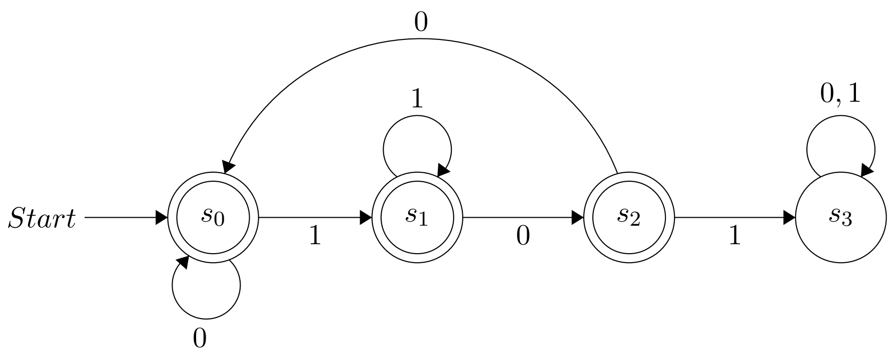
Solution

Make all of the final states non-final, and vice versa.

13.3.41

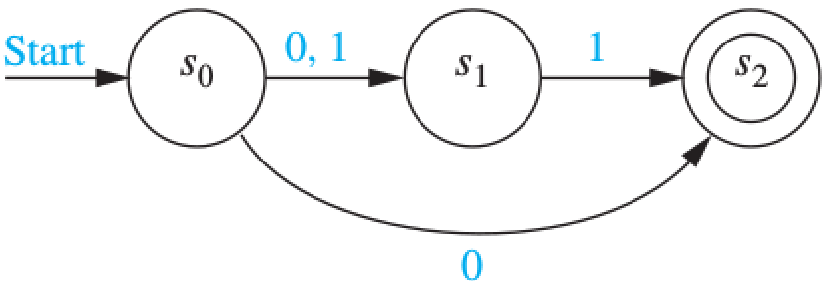
Use the procedure you described in Exercise 39 and the finite-state automata you constructed in Exercise 25 to find a deterministic finite-state automaton that recognizes the set of all bit strings that do not contain the string 101.

Solution



13.3.43

Find the language recognized by the given nondeterministic finite-state automaton.

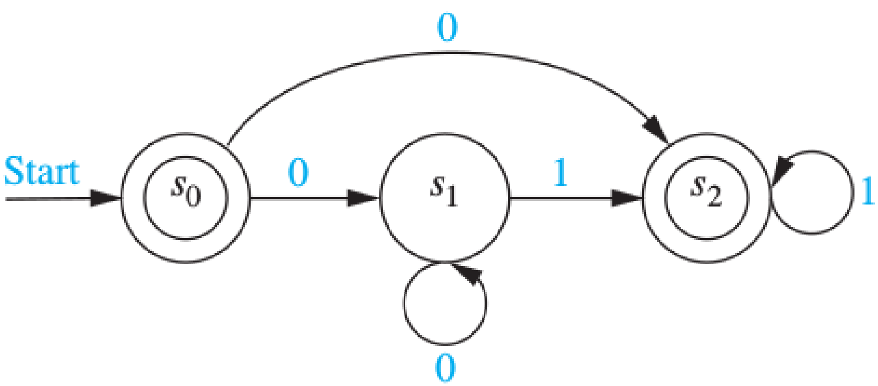


Solution

$\{0, 01, 11\}$

13.3.45

Find the language recognized by the given nondeterministic finite-state automaton.



Solution

$\{\lambda, 0\} \cup \{0^m 1^n | m \geq 1, n \geq 1\}$