Exercises from Section 13.1: (4), (5)

4. Let $G = (V, T, S, P)$ be the phrase-structure grammar with $V = \{0, 1, A, S\}$, $T = \{0, 1\}$, and set of productions P consisting of $S \rightarrow 1S$, $S \rightarrow 00A$, $A \rightarrow 0A$, and $A \rightarrow 0$.

a) Show that 111000 belongs to the language generated by G.

b) Show that 11001 does not belong to the language generated by G.

c) What is the language generated by G?

5. Let $G = (V, T, S, P)$ be the phrase-structure grammar with $V = \{0, 1, A, B, S\}$, $T = \{0, 1\}$, and set of productions P consisting of $S \rightarrow 0A$, $S \rightarrow 1A$, $A \rightarrow 0B$, $B \rightarrow 1A$, $B \rightarrow 1$.

a) Show that 10101 belongs to the language generated by G.

b) Show that 10110 does not belong to the language generated by G.

c) What is the language generated by G?

Exercises from Section 13.3: (11), (17), (19)

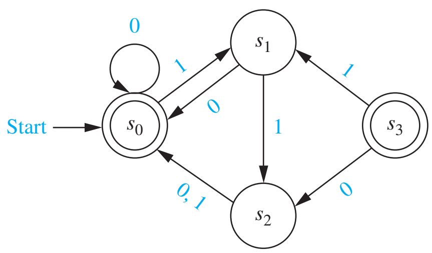


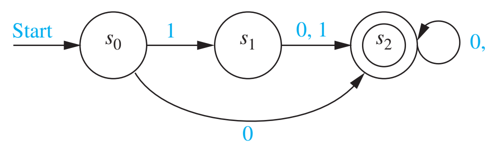
FIGURE 1 **The state diagram for a finite-state automaton.**

11. Determine whether each of these strings is recognized by the deterministic finite-state automaton in Figure 1.

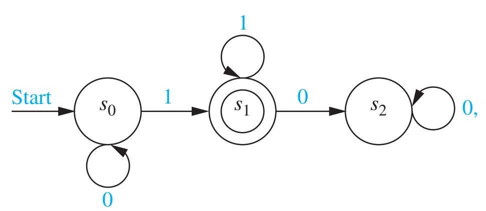
a) 111 **b)** 0011 **c)** 1010111 **d)** 011011011

In Exercises 16–22 find the language recognized by the given deterministic finite-state automaton.

17.



19.



Solution for Section 13.1: (4)

4. a) It suffices to give a derivation of this string. We write the derivation in the obvious way. $S \Rightarrow 1S \Rightarrow 11S \Rightarrow 111S \Rightarrow 11100A \Rightarrow 111000$.

b) Every production results in a string that ends in S, A, or 0. Therefore this string, which ends with a 1, cannot be generated.

c) Notice that we can have any number of 1's at the beginning of the string (including none) by iterating the production $S \to 1S$. Eventually the S must turn into $00A$, so at least two 0's must come next. We can then have as many 0's as we like by using the production $A \to 0A$ repeatedly. We must end up with at least one more 0 (and therefore a total of at least three 0's) at the right end of the string, because the A disappears only upon using $A \to 0$. So the language generated by G is the set of all strings consisting of zero or more 1's followed by three or more 0's. We can write this as $\{\, 0^n 1^m \mid n \geq 0 \text{ and } m \geq 3 \,\}$.