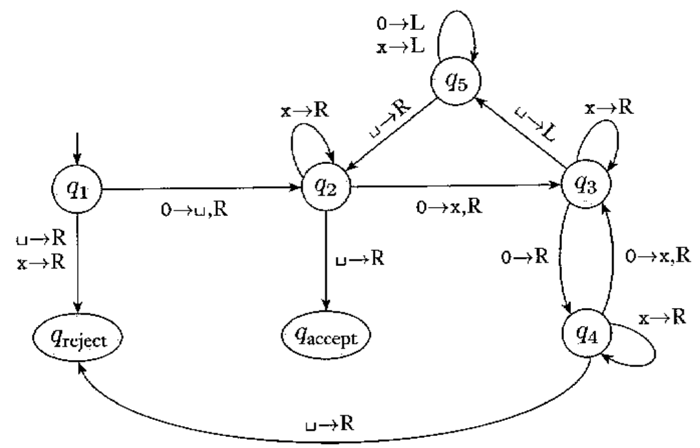

RE 3.8
diagram for Turing machine M_2

this state diagram, the label 0→⊔,R appears on the transition from q_1 to q_2. label signifies that, when in state q_1 with the head reading 0, the machine to state q_2, writes ⊔, and moves the head to the right. In other words, 0) = (q_2,⊔,R). For clarity we use the shorthand 0→R in the transition from q_4, to mean that the machine moves to the right when reading 0 in state q_3 oesn't alter the tape, so $\delta(q_3,0) = (q_4,0,R)$.

his machine begins by writing a blank symbol over the leftmost 0 on the so that it can find the left-hand end of the tape in stage 4. Whereas we d normally use a more suggestive symbol such as # for the left-hand end niter, we use a blank here to keep the tape alphabet, and hence the state ram, small. Example 3.11 gives another method of finding the left-hand end e tape.

ext we give a sample run of this machine on input 0000. The starting conation is $q_1$0000. The sequence of configurations the machine enters appears llows; read down the columns and left to right.

$q_1$0000	⊔q_5x0x⊔	⊔x$q_5$xx⊔
⊔$q_2$000	q_5⊔x0x⊔	⊔$q_5$xxx⊔
⊔x$q_3$00	⊔q_2x0x⊔	q_5⊔xxx⊔
⊔x0$q_4$0	⊔x$q_2$0x⊔	⊔$q_2$xxx⊔
⊔x0xq_3⊔	⊔xxq_3x⊔	⊔x$q_2$xx⊔
⊔x0q_5x⊔	⊔xxxq_3⊔	⊔xxq_2x⊔
⊔x$q_5$0x⊔	⊔xxq_5x⊔	⊔xxxq_2⊔
		⊔xxx⊔q_{accept}

EXAMPLE 3.9

The following is a formal description of $M_1 = (Q, \Sigma, \Gamma, \delta, q_1, q_{accept}, q_{reject})$, the Turing machine that we informally described (page 139) for deciding the language $B = \{w\#w \mid w \in \{0,1\}^*\}$.

- $Q = \{q_1, \ldots, q_{14}, q_{accept}, q_{reject}\}$,
- $\Sigma = \{0,1,\#\}$, and $\Gamma = \{0,1,\#,x,⊔\}$.
- We describe δ with a state diagram (see the following figure).
- The start, accept, and reject states are q_1, q_{accept}, and q_{reject}.

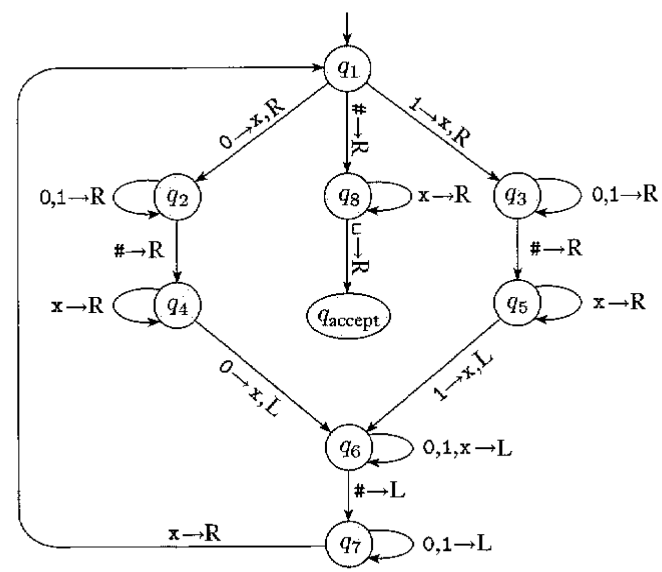

FIGURE 3.10
State diagram for Turing machine M_1

In Figure 3.10, which depicts the state diagram of TM M_1, you will find the label 0,1→R on the transition going from q_3 to itself. That label means that the machine stays in q_3 and moves to the right when it reads a 0 or a 1 in state q_3. It doesn't change the symbol on the tape.

Stage 1 is implemented by states q_1 through q_6, and stage 2 by the remaining states. To simplify the figure, we don't show the reject state or the transitions going to the reject state. Those transitions occur implicitly whenever a state lacks an outgoing transition for a particular symbol. Thus, because in state q_5 no outgoing arrow with a # is present, if a # occurs under the head when the machine is in state q_5, it goes to state q_{reject}. For completeness, we say that the head moves right in each of these transitions to the reject state. □