Introduction to Turing Machines
Supplement for Preparatory Viewing

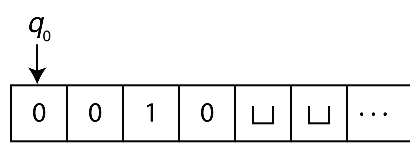
Representing and Working with Configurations

Consider a Turing machine with input alphabet $\Sigma = \{\mathtt{0}, \mathtt{1}\}$ and start state q_0. Suppose that the set of this Turing machines also includes states q_1 and q_2, and that its tape alphabet is

$$\Gamma = \Sigma \cup \{\sqcup, \$\}.$$

Let this Turing machine's transition be a partial function $\delta : Q \times \Gamma \to Q \times \Gamma \times \{\mathtt{L}, \mathtt{R}\}$.

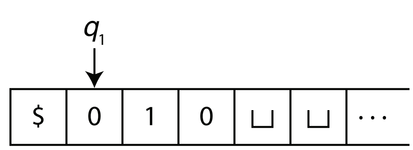
- The ***initial configuration*** on an input string $\omega = \mathtt{0010} \in \Sigma^\star$ looks like



  and is represented by the string

$$q_0\mathtt{0010}$$

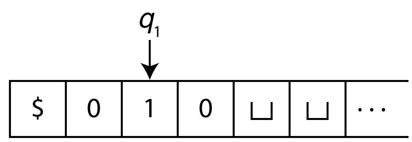
- Suppose that $\delta(q_0, \mathtt{0}) = (q_1, \$, \mathtt{R})$. Then, after the first step of the Turing machine's execution on the input string $\omega = \mathtt{0010}$, the configuration looks like



  and is represented by the string

$$\$q_1\mathtt{010}$$

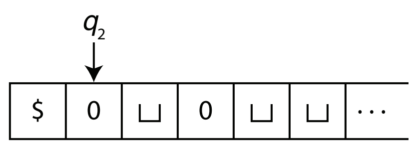
- Suppose, as well, that $\delta(q_1, \texttt{0}) = (q_1, \texttt{0}, \texttt{R})$. Then, after the second step of the Turing machine's execution on the input string $\omega = \texttt{0010}$, the configuration looks like



and is represented by the string

$$\$0q_110$$

- Suppose that $\delta(q_1, \texttt{1}) = (q_2, \sqcup, \texttt{L})$. Then, after the third step of the Turing machine's execution on the input string $\omega = \texttt{0010}$, the configuration looks like



and is represented by the string

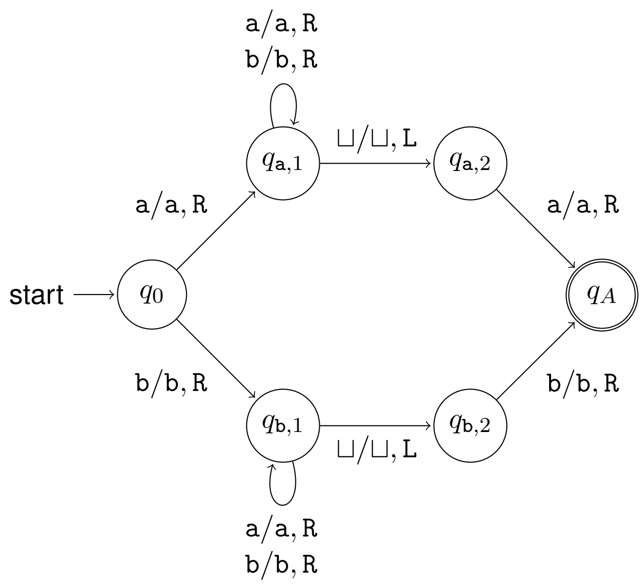
$$\$q_20 \sqcup 0$$

An Example of Turing Machines

The first complete example of a Turing machine is a Turing machine

$$M_1 = (Q_1, \Sigma_1, \Gamma_1, \delta_1, q_0, q_{\text{accept}}, q_{\text{reject}})$$

with the following transition diagram.



To keep the picture simple, the accept state is shown as "q_A" instead of q_{accept}, and transitions to the reject state, and this state, are left out — but

$$\delta(q, \sigma) = (q_{\text{reject}}, \sigma, \mathtt{R})$$

for $q = q_0$ and $\sigma = \sqcup$, for $q = \mathtt{a}, 2$ and either $\sigma = \mathtt{b}$ or $\sigma = \sqcup$, and for $q_{\mathtt{b},2}$ and either $\sigma = \mathtt{a}$ or $\sigma = \sqcup$.