Solution to Homework Problem 18

**Homework Problem 18.** Use the general algorithm to transform a finite automaton from Problem 3 into a Turing machine. Show step-by-step, on an example of a word 101, how this word will be recognized by your Turing machine.

**Automaton from Problem 3: reminder.** This automaton has two states: 
\( x \) and \( y \), \( x \) is the starting state and \( y \) is the final state. The only two symbols are 0 and 1. From \( x \), 0 leads back to \( x \), and 1 leads to \( y \). From \( y \), 1 leads to \( y \), and 0 leads to \( x \).

**Solution.** Here are the rules for the Turing machine:

- start, \(-\) \(\rightarrow\) R, \(x\)
- \(x\), 1 \(\rightarrow\) R, \(y\)
- \(x\), 0 \(\rightarrow\) R, \(x\)
- \(y\), 1 \(\rightarrow\) R, \(y\)
- \(y\), 0 \(\rightarrow\) R, \(x\)
- \(y\), \(-\) \(\rightarrow\) accept
- \(x\), \(-\) \(\rightarrow\) reject

**Tracing.**

\[
\begin{array}{cccccc}
\_ & 1 & 0 & 1 & \ldots \\
\_ & 1 & 0 & 1 & \ldots \\
\_ & 1 & 0 & 1 & \ldots \\
\_ & 1 & 0 & 1 & \ldots \\
\_ & 1 & 0 & 1 & \ldots \\
\_ & 1 & 0 & 1 & \ldots \\
\end{array}
\]

- start
- \(x\)
- \(y\)
- \(x\)
- \(y\)
- accept