





abbb 1111

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$$\xi(x, y) = x - y \quad \begin{cases} x > y \\ = 0 & x \leq y \end{cases}$$

input: 0 1 1 1 0 1 0 1 0  
output: 0 1 1 1 0 1 0 1 0

$\pi$   $\gamma$

$\pi + \gamma$   
0 ✓

Diagram illustrating the construction of a Turing Machine (TM) for the language  $L = \{0^n 1^n \mid n \geq 1\}$ . The diagram shows the states and transitions of the TM, which is designed to accept strings of the form  $0^n 1^n$ .

The states are represented by circles, and the transitions are labeled with the input symbol, the action (write, read, move head), and the next state.

The transitions are as follows:

- Start state  $q_0$  (labeled  $1 \rightarrow R$ ) transitions to  $q_1$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_1$  transitions to  $q_2$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_2$  transitions to  $q_3$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_3$  transitions to  $q_4$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_4$  transitions to  $q_5$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_5$  transitions to  $q_6$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_6$  transitions to  $q_7$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_7$  transitions to  $q_8$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_8$  transitions to  $q_9$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_9$  transitions to  $q_{10}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{10}$  transitions to  $q_{11}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{11}$  transitions to  $q_{12}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{12}$  transitions to  $q_{13}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{13}$  transitions to  $q_{14}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{14}$  transitions to  $q_{15}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{15}$  transitions to  $q_{16}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{16}$  transitions to  $q_{17}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{17}$  transitions to  $q_{18}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{18}$  transitions to  $q_{19}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{19}$  transitions to  $q_{20}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{20}$  transitions to  $q_{21}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{21}$  transitions to  $q_{22}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{22}$  transitions to  $q_{23}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{23}$  transitions to  $q_{24}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{24}$  transitions to  $q_{25}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{25}$  transitions to  $q_{26}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{26}$  transitions to  $q_{27}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{27}$  transitions to  $q_{28}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{28}$  transitions to  $q_{29}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{29}$  transitions to  $q_{30}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{30}$  transitions to  $q_{31}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{31}$  transitions to  $q_{32}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{32}$  transitions to  $q_{33}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{33}$  transitions to  $q_{34}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{34}$  transitions to  $q_{35}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{35}$  transitions to  $q_{36}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{36}$  transitions to  $q_{37}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{37}$  transitions to  $q_{38}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{38}$  transitions to  $q_{39}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{39}$  transitions to  $q_{40}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{40}$  transitions to  $q_{41}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{41}$  transitions to  $q_{42}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{42}$  transitions to  $q_{43}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{43}$  transitions to  $q_{44}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{44}$  transitions to  $q_{45}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{45}$  transitions to  $q_{46}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{46}$  transitions to  $q_{47}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{47}$  transitions to  $q_{48}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{48}$  transitions to  $q_{49}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{49}$  transitions to  $q_{50}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{50}$  transitions to  $q_{51}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{51}$  transitions to  $q_{52}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{52}$  transitions to  $q_{53}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{53}$  transitions to  $q_{54}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{54}$  transitions to  $q_{55}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{55}$  transitions to  $q_{56}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{56}$  transitions to  $q_{57}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{57}$  transitions to  $q_{58}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{58}$  transitions to  $q_{59}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{59}$  transitions to  $q_{60}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{60}$  transitions to  $q_{61}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{61}$  transitions to  $q_{62}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{62}$  transitions to  $q_{63}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{63}$  transitions to  $q_{64}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{64}$  transitions to  $q_{65}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{65}$  transitions to  $q_{66}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{66}$  transitions to  $q_{67}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{67}$  transitions to  $q_{68}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{68}$  transitions to  $q_{69}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{69}$  transitions to  $q_{70}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{70}$  transitions to  $q_{71}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{71}$  transitions to  $q_{72}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{72}$  transitions to  $q_{73}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{73}$  transitions to  $q_{74}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{74}$  transitions to  $q_{75}$  on input  $1$  (labeled  $1 \rightarrow 0, L$ ).
- $q_{75}$  transitions to  $q_{76}$  on input  $1$  (labeled  $1 \rightarrow 0, R$ ).
- $q_{76}$  transitions to  $q_{77}$  on input  $0$  (labeled  $0 \rightarrow L$ ).
- $q_{77}$  transitions to  $q_{78}$  on input  $0$  (labeled  $0 \rightarrow R$ ).
- $q_{78}$  transitions to  $q_{79}$  on input  $1$  (labeled  $1 \rightarrow$

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