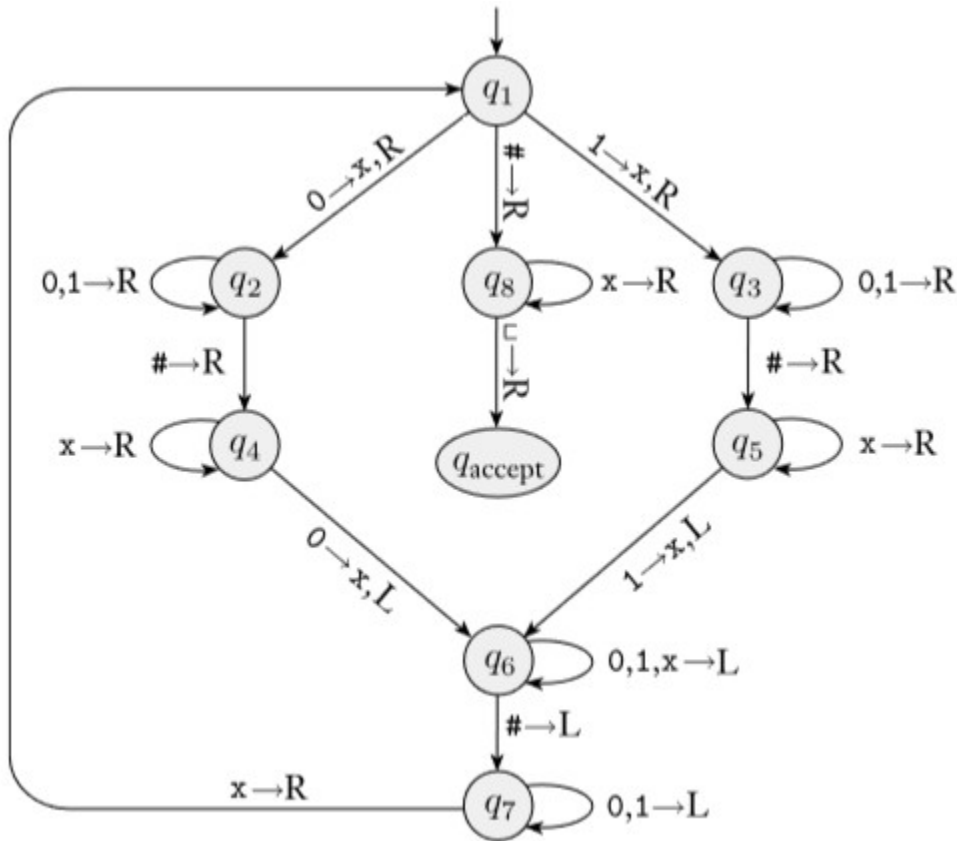


Assignment 3

1/ Given the Turing machine



In each of the parts, give the sequence of configurations that M1 enters when started on the indicated input string.

a. 11.

$q_1 11$

$\Rightarrow x q_3 1$

$\Rightarrow x 1 q_3 \square$

No transition is available for q_3 on $\square$, so M1 halts and rejects.

b. 1#1.

$q_1 1\#1$

$\Rightarrow x q_3 \#1$

$\Rightarrow x\# q_5 1$

$\Rightarrow x q_6 \#x$

$\Rightarrow q_7 x\#x$

$\Rightarrow x q_1 \#x$

$\Rightarrow x\# q_8 x$

$\Rightarrow x\#x q_8 \square$

$\Rightarrow x\#x\square q_{\text{accept}} \square$

M1 accepts 1#1

c. 1##1.

$q_1 1##1$

$\Rightarrow x q_3 ##1$

$\Rightarrow x\# q_5 \#1$

No transition is available for q_5 on $\#$, so M1 halts and rejects.

d. 10#11.

$q_1 10\#11$

$\Rightarrow x q_3 0\#11$

$\Rightarrow x0 q_3 \#11$

$\Rightarrow x0\# q_5 11$

$\Rightarrow x0 q_6 \#x1$

$\Rightarrow x q_7 0\#x1$

$\Rightarrow q_7 x0\#x1$

$\Rightarrow x q_1 0\#x1$

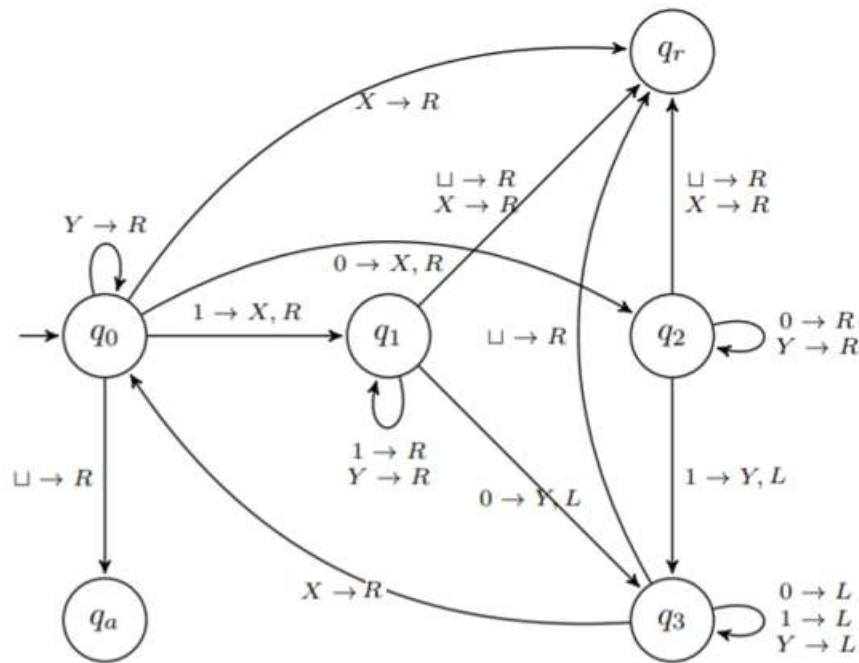
$\Rightarrow xx q_2 \#x1$

$\Rightarrow xx\# q_4 x1$

$\Rightarrow xx\#x q_4 1$

No transition is available for q_4 on 1, M1 halts and rejects.

2/ Given the Turing machine M with the following state diagram:



a/ Describe the language accepted by M

The Turing machine accepts the string if and only if the number of 0s equals the number of 1s.

It matches every 1 in the string with a corresponding 0 (and vice versa)

The process of matching a zero and its corresponding 1 is: mark zero by X, go right until the head reaches the corresponding 1, mark with Y and go left to mark a new pair (0,1) or (1,0).

When the head reaches the rightmost X, it goes right and reaches state q_0 .

b/ Give the sequence of configurations for the input string

0011

q_0 0011

$\Rightarrow$ X q_2 011

$\Rightarrow$ X0 q_2 11

$\Rightarrow$ X0Y q_3 1

$\Rightarrow$ X0 q_3 Y1

$\Rightarrow$ X q_3 0Y1

$\Rightarrow$ q_3 X0Y1

$\Rightarrow$ X q_0 0Y1

$\Rightarrow XXq_2Y1$

$\Rightarrow XXYq_21$

$\Rightarrow XXq_3YY$

$\Rightarrow Xq_3XY$

$\Rightarrow XXq_0YY$

$\Rightarrow XXYq_0Y$

$\Rightarrow XXY\Box q_a\Box$

The TM halts and accepts 0011.

0110

$q_0 0110$

$\Rightarrow X q_2 110$

$\Rightarrow XY q_3 10$

$\Rightarrow X q_3 Y10$

$\Rightarrow q_3 XY10$

$\Rightarrow Xq_0 Y10$

$\Rightarrow XY q_0 10$

$\Rightarrow YXX q_1 0$

$\Rightarrow YXX q_3 Y$

$\Rightarrow XYq_3XY$

$\Rightarrow YXXq_0Y$

$\Rightarrow YXXYq_0\Box$

$\Rightarrow YXXY\Box q_a\Box$

The TM halts and accepts 0110.

c/show that string 10011 is not accepted by M:

10011

$q_0 10011$

$\Rightarrow X q_1 0011$

$\Rightarrow XY q_3 011$

$\Rightarrow XY Xq_2 11$

$\Rightarrow XY XYq_3 1$

$\Rightarrow XYXq_3 Y1$

$\Rightarrow XYq_3 XY1$

$\Rightarrow XYXq_0 Y1$

$\Rightarrow XYXYq_0 1$

$\Rightarrow XYXYXq_1 \square$

$\Rightarrow XYXYX\square q_r \square$

The TM halts and rejects 10011