Ist Quiz on Turing Machines
Solution

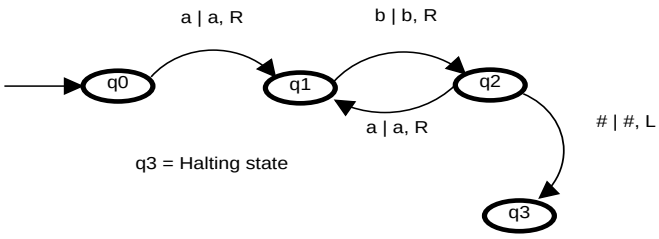
CS 340

Q.1.Define and explain the Turing's Thesis. Why it is called Thesis. (2 points)

The Turing's thesis states that every solvable problem can be effectively solved using Turing machine. Where effective means accurate, algorithmic(mechanical) procedure. Since TM is an algorithm, every problem which can be represented by algorithm, is solvable using TM.

More and more evidence has been found that every problem solution matches closely to TM. The Turing's proposal is a thesis, because no one has ever proved it wrong. However, neither any one has succeeded to proved it true by any formal method. Therefore, unless some one proves it false, it is true.

Q. 2. Design a TM to recognize the string $(ab)^+$**.** (2 points)

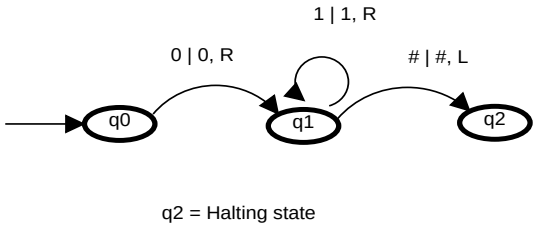


Let $M = (Q, \Sigma, \delta, q_0, \Gamma, H)$. The transition function can be specified as:

$$\delta(q_0, a) = (a, q_1, R)$$
$$\delta(q_1, b) = (b, q_2, R)$$
$$\delta(q_2, a) = (a, q_1, R)$$
$$\delta(q_2, \#) = (\#, q_3, L)$$
$$H = \{q_3\}$$

Note: The halting state in this case is accepting state. If there is an input $\Sigma \times Q$, which requires a transition outside above, M crashes, without accepting.

Q.3. Design a TM to recognize language $\{01^n | n \geq 0\}$**.** (3 points)



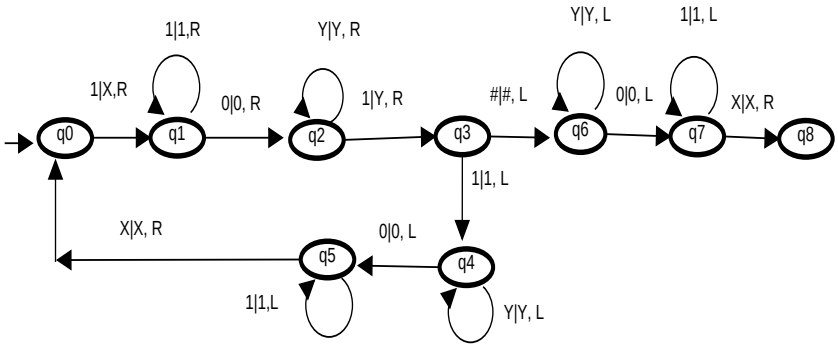
Let $M = (Q, \Sigma, \delta, q_0, \Gamma, H)$. The transition function can be specified as:

$$\delta(q_0, 0) = (0, q_1, R)$$

$$\delta(q_1, 1) = (1, q_1, R)$$
$$\delta(q_1, \#) = (\#, q_2, L)$$
$$H = \{q_2\}$$

Note: The halting state in this case is accepting state. If there is an input $\Sigma \times Q$, which requires a transition outside above, *M* crashes, without accepting.

Q.4. Design a TM to demonstrate subtraction of *9* and *4* resulting to *5*. (3 points)



1 1 1 1 1 1 1 1 1 0 1 1 1 1 # Initial Content of one tape machine
X 1 1 1 1 1 1 1 1 0 Y 1 1 1 #
X X 1 1 1 1 1 1 1 0 Y Y 1 1 #
X X X 1 1 1 1 1 1 0 Y Y Y 1 #
X X X X 1 1 1 1 1 0 Y Y Y Y #
X X X X **1** 1 1 1 1 0 Y Y Y Y # Final Content. R-W head at leftmost 1 (=5).

$H = \{q_8\}$

Note: The machine will work for arbitrary size nonzero numbers, with first number larger than second. The final results remains on tape, with head pointing to its beginning (boldfaced 1).