

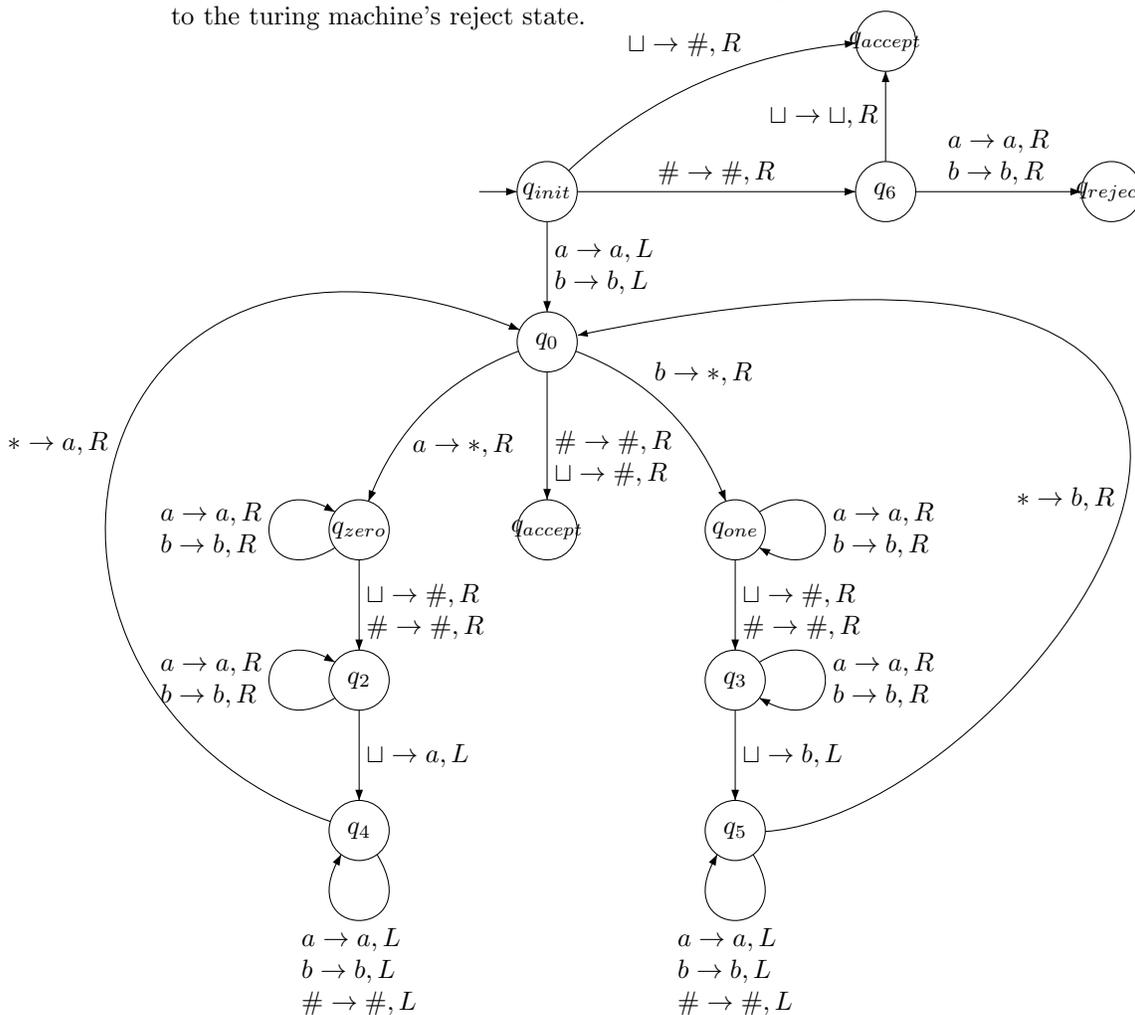
B501 Assignment 4

Enrique Areyan

For the following questions, please give detailed state transition diagrams of the Turing Machines.

- (10 points) Construct a Turing Machine which given input string w ($w \in \{a, b\}^*$), outputs $w\#w$.

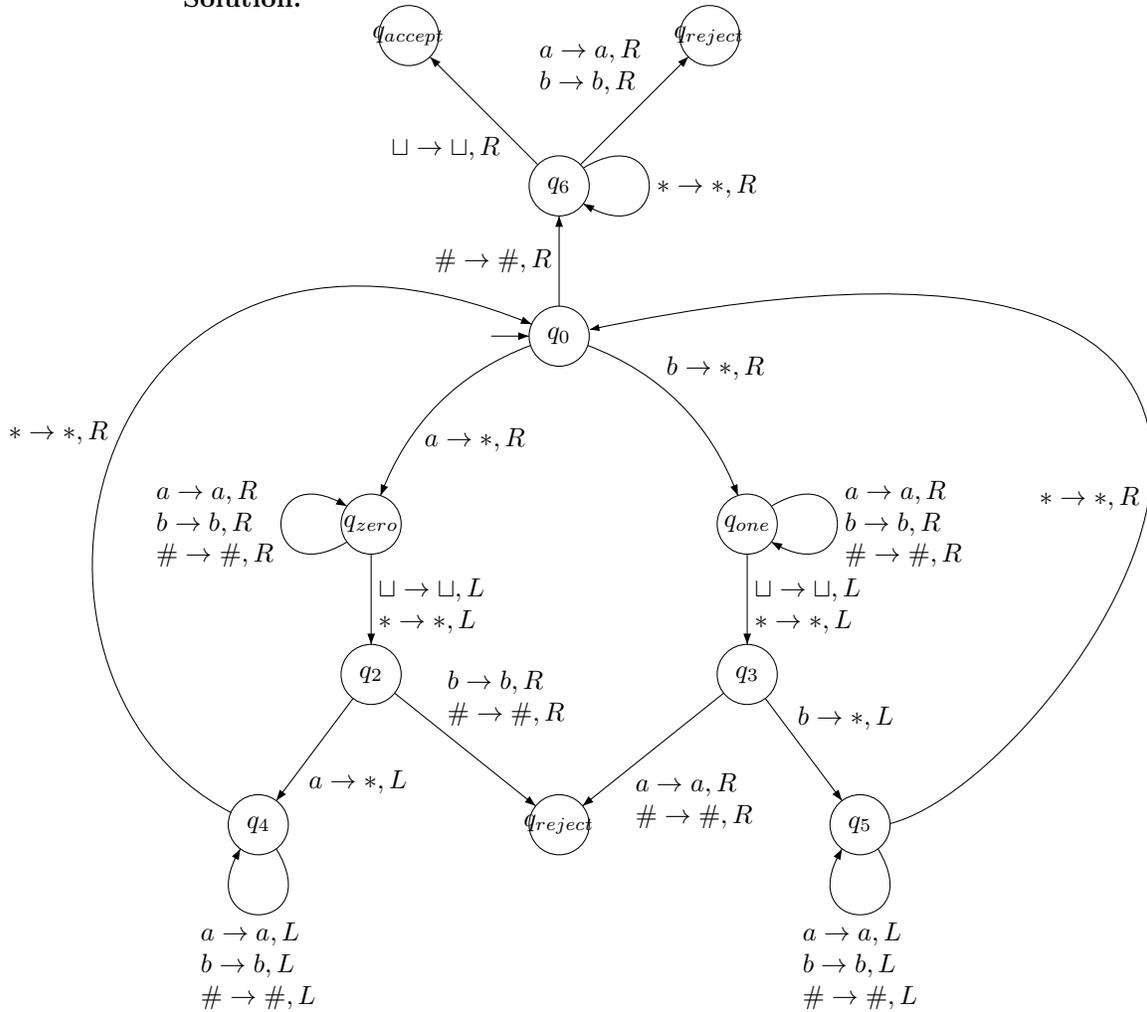
Solution: NOTE: In all my solutions all the missing arrows should point to the turing machine's reject state.



I have two states q_{accept} in the diagram, but these are really the same (I just put two in order to make the diagram easier on the eye).

- (15 points) Construct a Turing Machine which decides the language $\{w\#w^R \mid w \in \{a, b\}^*\}$. (w^R means the reverse of the string w)

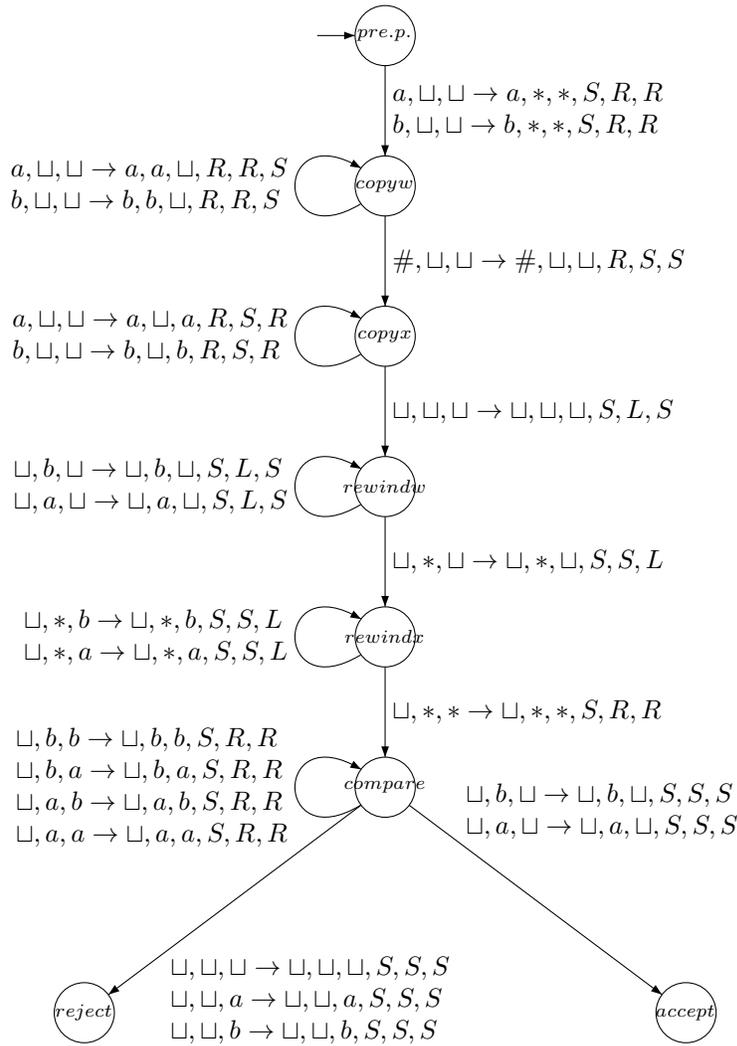
Solution:



Note: All the missing arrows point to the reject state. Also, I have two states q_{reject} in the diagram, but these are really the same (I just put two in order to make the diagram easier on the eye).

- (15 points) Construct a multi-tape Turing Machine which decides the language $\{w\#x \mid w, x \in \{a, b\}^* \text{ and } |w| > |x|\}$. ($|w|$ means the length of string w)

Solution:



For this TM, I am using three tapes, the first for the input $w\#x$, in the second I make a copy of w and in the third a copy of x . I am using the letter S in addition to L and R to indicate that the header should stay in the same place for a given tape.

Before copying w to the 2nd tape and x to the 3rd, the machine marks an $*$ in the first position of both the 2nd and 3rd tape, which will be useful to know where the strings begin. After copying the strings, the machine rewinds the tape position of the 2nd and 3rd tape to the beginning so that the strings can be compared. The comparison moves the head of the 2nd and 3rd tape until one of three general cases happens: (i) both tapes read a blank symbol at the same time (in which case they have the same length, so the machine rejects), (ii) the 3rd tape has a symbol but the 2nd is reading a blank (in which case x is larger than w , so the machine rejects), and (iii) the 2nd tape has a symbol to read but the third is reading a blank (in which case w is larger than x , so the machine accepts).