

Computer Science 411
Homework 8: Turing Machines
Fall 2015
Due 11/02/2015

For each of the following questions, use the Visual Automata Simulator software (free-ware, link to the .jar file from the class page) to create the appropriate Turing machine. Assume that the tape starts with a blank, followed by the input string w , with the tape head pointing to the blank before the input string, as so: $\#w$, where w is the input string and $\#$ stands for a blank. Submit your files to your subversion repository under the directory cs411. Name the files $\{\text{yourlastname}\}7.\{\text{problemnumber}\}.tm$ (so if I was in the class, I would name the files galles8.1.tm, galles8.2.tm, etc.)

1. (8 points) Create a Turing machine that removes all of the c 's from a string of a 's, b 's, and c 's, shifting the a 's and b 's to the left. Your machine should halt with the tape head on the blank to the left of the new string. You may use extra symbols in your solution, but your machine should halt with only a 's, b 's, and blanks ($\#$) on the tape. For instance, the tape $\#accbabcc$ would be transformed into $\#abab$, and the tape $\#bbbccaaca$ would be transformed into $\#bbbaaa$
2. (8 points) Create a Turing machine that decides the language $L =$ all strings in $\{a, b\}^*$ that contain twice as many a 's as b 's. So, aab , $baabaa$, $ababaa$, $aabbaa$, and ϵ are all in L , while $abba$, ab , $abaa$, and aa are all not in L . The contents of the tape after the computation do not matter. Come and see me if you have any questions!
3. (8 points) Write a machine that computes the function $f(w) = w^R$, where $w \in \{a, b\}^*$. You can assume that the tape starts out initially as $\#w$.