Trent University

Computing and Information Systems 3050H

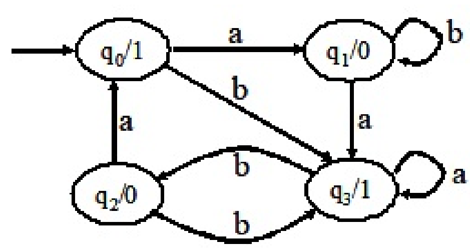
Fall 2020

Assignment 2: Due November 6, 2020

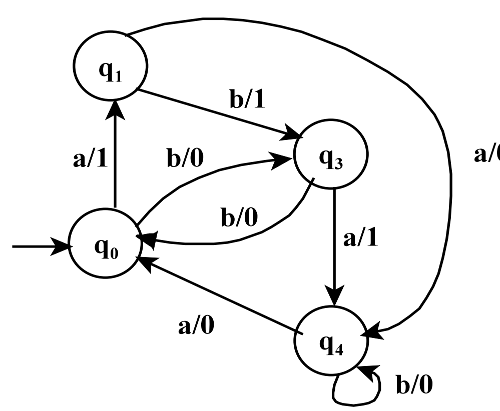
1) Consider the following two languages over the alphabet $\Sigma = \{a, b\}$: L_1 is the language of all words with an even number of *b*'s and L_2 is the language of all words that ends with the substring *ab*.
   a) Using the trial and effort method we demonstrated in lecture, draw FA_1: a machine that L_1 and FA_2: a machine that accepts L_2.
   b) Using the algorithm providing by Kleene's Theorem, construct the FA machine that accepts $L_1 + L_2$.

2) Draw a Moore Machine to "count" the occurrences double letters (i.e. *aa* or *bb*) in words over the alphabet $\Sigma=\{a ,b\}$. As discussed in Module 2, Finite Automata with Output, simply output a 1 at the end position of the desired substrings from the input string. For example, the input string *abaaabb* would output 00001101.

3) Convert the following Moore Machine into a Mealy Machine.

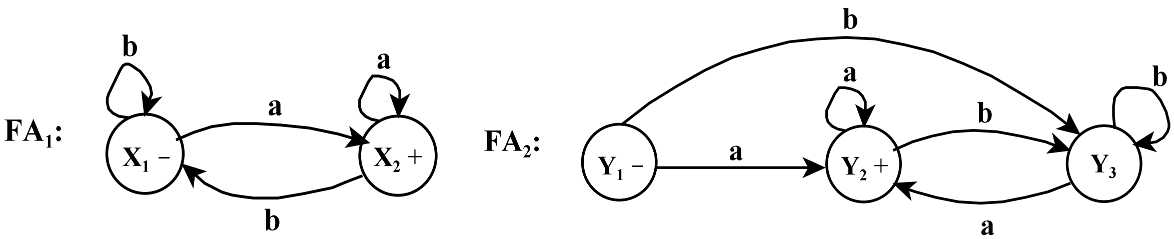


4) Convert the following Mealy Machine into a Moore Machine.



5) Consider the following languages over the alphabet $\Sigma=\{a ,b\}$: L_1 is the language of all words that contain the substring *ab* while L_2 is the language of all words with an even number of letters. Draw finite automata for L_1 and L_2 and using one of the two algorithms we discussed in Module 3, Regular Languages, construct the finite automata that accepts $L_1 \cap L_2$.

6) Are the languages accepted by the following FAs equivalent? Using the algorithm discussed in Module 3, Decidability Problems to prove your answer.



7) Use the pumping lemma to prove the following language is nonregular:

$L = \{a^n b^{2n}\} = \{abb, aabbbb, aaabbbbbb, \ldots\}$

8) Find CFGs that for these regular languages over the alphabet $\Sigma = \{a, b\}$. Draw a Finite Automata first and use this to create the CFG.

(a) The language of all words that consist only of double letters (*aa* or *bb*).

(b) The set of all words that begin with the letter *b* and contains an odd number of *a*'s or begin with the letter *a* and contains an even number of *b*'s.