Assignment 2

Advanced Computing Concepts for Engineering

Due April 5th, 2017

The work that you turn in for this assignment must represent your individual effort. You are welcome to help your fellow students understand the material of the course and the meaning of the assignment questions, however, the answer that you submit must be created by you alone.

Q0 [4] Consider a language over the alphabet $\{0, 1\}$ that represents a three input ‘or’ function[1]. The first three symbols of each string represent the inputs and the fourth is the output. This pattern may repeat any number of times. To put is another way, all strings are a multiple of 4 in length and the fourth item of each quartet is 1, if any of the previous three is 1, and is 0, if all previous three are 0. The following strings are in the language

ϵ
0000
0101 1011
0000 1001 0111 0000

(a)[2] Draw an NDFR for this language.

(b)[2] Give a regular expression for the same language.

Q1 [3] Classification.

Consider C identifiers. Some otherwise legitimate identifiers are actually reserved words. Create a DFR with accepting states F that can be partitioned into subsets F_{rw} and F_{id} so that the machine ends in F_{rw} if the input is in {“if”, “int”, “for”} and the machine ends in state F_{id} if the string is in any other string in $M; M^*$for $M =$ {“f”, “i”, “n”, “o”, “r”, “t”, “x”}.

Q2 [14] Constructions

Start with the regular expression $x = (\mathsf{a};\mathsf{b} \mid \mathsf{a};\mathsf{c})^*$ where $\{\mathsf{a}, \mathsf{b}, \mathsf{c}\}$ is an alphabet of 3 characters.

(a) [2] List all strings of length 4 or less in $L(x)$.

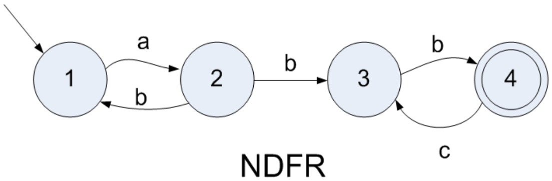
(b) [6] Convert x to an NDFR. Show your work. [Hint. Use Thompson’s algorithm.]

(c) [6] Convert the NDFR from part (b) to a DFR using the subset construction algorithm. Show your work.

Q3 [6] Constructing an RE

Convert the following NDFR to a regular expression. Show the automaton after each step of the reduction algorithm.

[1] For the purpose of ‘or-ing’ the bits, we treat bit value 1 as representing true and bit value 0 as representing false.



NDFR

Q4 [8] Negation and Intersection

For this question assume that the alphabet is S.

(a) [4] Show that if M is a regular language over S, then $\overline{M} = S^* - M = \{s \in S^* \mid s \notin M\}$ is a regular language.

(b) [4] Show that if M and N are regular languages, then $M \cap N$ is also a regular language.

Q5 [4] Turing machines

Design a Turing Machine to multiply together two positive numbers given in unary. For example the input for multiplying 2 by 3 would be ...bb$\underline{1}$1b111bb... (with the location of the head underlined) and the output would be ...bb$\underline{1}$11111bb.... The alphabet can include additional symbols.

Q6 [8]

Suppose Professor X claims to have written a program that can read a function f written in Java and determine whether or or not that function returns 0 when run on any given argument. Show that professor X is mistaken. [Hint: Show how you could use professor X's program to create a program that determines whether or not a Turing machine will halt on a given input tape.]