CS581 – Theory of Computation – HW5

Tuesday, May 7, 2013
due in class Tuesday, May 14, 2013

Answer each question below. You will turn this homework in using D2L. In addition, you may also turn in a paper copy in class. In this case the TA will mark up your homework with comments and return the comments to you.

You may format your answers using some document processing software, or you may write it up with pencil and paper and scan it. In either case submit a pdf document. Be sure your submission is clearly identified as Homework 5, and contains your name and your email on the first line. The first line should look like:

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1. **Context Free Pumping Lemma.**

   - State the CF pumping lemma. Be sure and get the correct sequence of foralls and exists. (8 points)
   - Use the lemma to prove that the languages below are not context free. (15 points each)
     (a) $L = \{a^n\, b\, c^n\, d^n \mid n \geq 0\}$
     (b) The language of all palindromes over $\{0, 1\}$ containing an equal number of 0s and 1s.

     When you choose your string, be sure and break your argument in to cases, one for each possible way that your string could be broken into $xuyvz$.

2. **Exercise 3.1, page 159**. This exercise concerns the Turing machine M2 listed below (Example 3.7 in the text). In each of the three parts, give the sequence of configurations that the Turing machine enters when started on the indicated input string. (8 points each)

   (a) "0"
   (b) "00"
   (c) "000"

(d) "000000"

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Turing machine M2
     Q      {q1, q2, q3, q4, q5, accept, reject}
     Sigma  {0, x, _}
     Gamma  {0}
     Delta  q1 0 ->  (_, R, q2)
            q1 _ ->  (_, R, reject)
            q1 x ->  (x, R, reject)
            q2 x ->  (x, R, q2)
            q2 _ ->  (_, R, accept)
            q2 0 ->  (x, R, q3)
            q3 x ->  (x, R, q3)
            q3 0 ->  (0, R, q4)
            q3 _ ->  (_, L, q5)
            q4 x ->  (x, R, q4)
            q4 _ ->  (_, R, reject)
            q4 0 ->  (x, R, q3)
            q5 0 ->  (0, L, q5)
            q5 x ->  (x, L, q5)
            q5 _ ->  (_, R, q2)
     q0     q1
     Accept accept
     Reject reject
     Blank  _
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3. **Problem 3.12 (page 161).** A turing machine with left reset is similar to an ordinary Turing machine, but the transition function has the form $\delta : Q \times \Gamma \to Q \times \Gamma \times \{R, \text{RESET}\}$, when the machine is in state Q reading an a the machine's head jumps to the left hand end of the tape, after it writes b on the tape, and enters state r. Note that these machines do not have usual ability to move the head one symbol left. Show that Turing machines with left reset recognize the class of Turing recognizable languages. (30 points)