Name_____

CS 383
Final Exam
May 11, 2017

Questions 3 and 5, which have 2 parts, are worth 20 points each; the other 6 questions are worth 10 points each.

Please write and sign the Honor Pledge on the last page when you are finished with the exam.

1. Identify the six languages below as
   - R = regular
   - C = context-free but not regular
   - D = recursive (decidable) but not context-free
   - E = recursively enumerable but not recursive
   - U = not recursively enumerable

   You don't need to justify your answers.

   a. $\{0^n1^n \mid n >= 0\}$

   b. The set of anagrams (whether meaningful or not) of "Tom Marvolo Riddle"

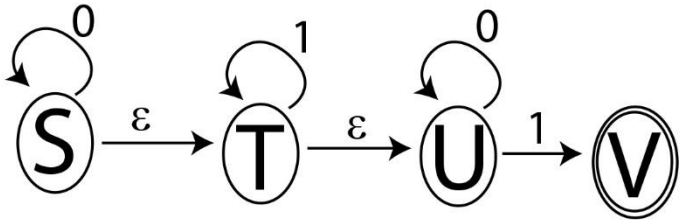
   c. $\{0^n1^m0^n1^m \mid n,m >= 0\}$

   d. {m | m is a valid encoding of a Turing Machine} (Remember that we encoded a transition $\delta(q_i,t_j)=(q_k,t_L,d_m)$ as $0^i10^j10^k10^L10^m1$ and encoded the TM as a sequence of transitions followed by the final state).

   e. The universal language. (The universal language is the set of (M,w) pairs such that M accepts w.)

   f. The complement of the diagonal language (The diagonal language is the set of Turing Machines that don't accept their own descriptions.)

2. Convert this ε-NFA to a DFA.



3. This concerns the language $\{0^n1^m20^m1^n \mid n,m >= 0 \}$
    a. Give a grammar for this language.

    b. Construct a PDA that accepts this language by final state.

4. Show that the set of strings in (0+1)* with an even number of 0s and an even number of 1s is regular

5. Show that the language $\{0^n1^n0^n \mid n > 0\}$ is not context-free but $\{0^n1^n1^n \mid n > 0\}$ is context-free.

6. Describe a TM that accepts the language $\{(0^n1)^n \mid n > 0\}$. For example, 01, 001001, and 000100010001 are all string in this language. You can use a multi-track or multi-tape TM if you wish. You don't need to draw the states of the automaton, just describe it in simple steps that could be performed by a TM.

7. Consider the language $\mathcal{L}$ = {(m,w) | m is the description of a Turing Machine M and M halts on input w without accepting w}. It is easy to see (and you don't need to show) that $\mathcal{L}$ is recursively enumerable. Show that $\mathcal{L}$ is not recursive.

8. What is the difference between NP-Completeness and Decidability? That is a question in our exit interview for graduating seniors and you wouldn't want to get it wrong ….

You can use this as extra space for any problem.

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