CS 581: Theory of Computation
Fall 2009
Final exam
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This is a closed-notes, closed-book exam.

1. True or False

   (a) All terminating functions are primitive recursive.

   (b) All primitive recursive functions are terminating.

   (c) The Post Correspondence problem is undecidable.

   (d) The acceptance problem for DFAs is decidable.

   (e) The acceptance problem for PDAs is decidable.

   (f) The acceptance problem for Turing Machines is decidable.

   (g) The complement of a regular language is regular.

   (h) The complement of a context free language is context free.

   (i) The complement of a decidable language is decidable

   (j) The complement of a Turing-recognizable language is Turing-recognizable.

2. CFL construction

   (a) Construct a PDA (or CFG) accepting (or generating) the language:

   $$A = \{a^i b^j c^k | i = j + k \lor i + j = k\}$$

   (b) Justify your construction

   (c) Illustrate your construction on the strings *aabccc* and *aaabbc*.

3. Rice's Theorem

   (a) State Rice's theorem. You may give either the version in the book (language properties) or the one presented in lecture (index sets).

   (b) Give the definition of a language property or an index set.

   (c) Prove Rice's theorem.

   (d) Give a trivial example that is decidable by Rice's theorem.

   (e) Give a non-trivial example that is undecidable by Rice's theorem.

4. Primitive Recursion

   (a) Sketch the definition of the primitive recursive functions

   (b) Argue systematically that all primitive recursive functions are Turing computable