CS/Math 387 Midterm Review

Our midterm covers material from the *first six chapters* of Sipser's text (up to but not including the subject of time complexity).

IMPORTANT: You will be asked to prove at least one of the following: (i) Rice's theorem or (ii) A_{TM} is not decidable. So you should have concise well-written proofs for these ready to go without having to think.

The rest of the test will cover the items listed below. Note that there are precise definitions, proofs, methods, and constructions in the list, for which it should be straightforward to study. Expect that some of the problems will be similar to the non-bonus problems assigned for group-work and for homework.

Regular languages.

1. Create a DFA, NFA, or regular expression accepting a given regular language.
2. Convert a given NFA into a DFA.
3. Convert a given NFA into a regular expression.
4. Given DFAs for languages A and B, construct DFAs for $A \cup B$, $A \cap B$, A^c, AB, and A^*.
5. Precisely state the pumping lemma for regular languages.
6. Use the pumping lemma for regular languages to prove a given language is not regular.

Context free languages.

1. Create a CFG or a PDA for a given language.
2. Convert an NFA into a CFG.
3. Precisely state the pumping lemma for context-free languages.
4. Use the pumping lemma for CFLs to prove a given language is not context-free.

Turing machines.

1. Give the precise mathematical definition of a TM.
2. Create the state diagram for a Turing machine accepting a specified language.
3. Prove the that acceptance question for CFGs is decidable.
4. Prove that A_{TM} is not decidable.
5. Precisely define *mapping reducibility*.
6. Apply mapping reducibility in an example.
7. Rice's theorem
   (a) Give a precise statement of Rice's theorem.
   (b) Prove Rice's theorem. (The proof was done in class on Monday of Week 6. Links to notes appear there.
   (c) Apply Rice's theorem to prove a given language is not decidable.