CSC 320 Midterm: Oct. 26, 1988

This midterm should take at most 50 minutes to complete, closed book.

1. Consider the following classes of languages:
   - (a) finite
   - (b) regular
   - (c) context-free
   - (d) none of the above

For each of the following languages, select the class from the above list such that L is in the class you choose, but is not in the previous class on the list.

Example:

$L = \{ a^n b^n \}$ The correct answer is (c) since L is context-free, but is not regular.

_____ $L = \{ wcwcw : w \in \{a,b\}^* \}$

_____ $L = \{ w w^R : w \in \{a,b\}^* \}$

_____ $L = a^* b^* \cap \{ w \in \{a,b\}^* : w \text{ has the same number of } a\text{'s and } b\text{'s} \}$

_____ $L = \{ w \in \{0,1\}^* : w \text{ is the decimal notation for } 10^i,\ i \geq 0 \}$

_____ $L = \{ w \in \{a\}^* : |w| \text{ is congruent to } 1 \text{ or } 2 \text{ mod } 8 \}$

_____ $L = (\phi)(a \cup b)^*$

_____ $L = \{ w w^R : w \in \{a\}^* \}$

_____ $L = \text{The complement of } (aa \cup bb)^* (a \cup b)^*$

_____ $L = \{ w : w \text{ is the name of a student writing this exam} \}$

_____ $L = \{ a^{n^2} : n \geq 0 \}$

2. Given that a language L is accepted by a DFA with four states and $aaab \in L$:

(a) Give regular expressions for seven infinite languages $L_1, L_2, \cdots L_7$ such that $L_i \subseteq L$ for at least one value of i.

(b) Prove that L from part (a) is an infinite language.

(c) State what the pumping lemma says about a language accepted by a DFA with four states. What needs to be true in order for you to prove that a language L is NOT accepted by a DFA with four states?

3. (a) Define a context-free grammar.

(b) Give a context-free grammar for $L = \{ a^m c^n b^p : m \leq p \}$.

(c) Use the grammar from part (b) and the construction described in class (or in the text) to create a PDA which accepts L.