CSE 322 Winter 2007
Assignment #2

Due: Friday, January 19, 2007

Reading assignment: Finish reading sections 1.1-1.3 of Sipser's book.

Problems:

1. For languages A and B over alphabet Σ, let the *perfect shuffle* of A and B be the language

   $\{w \mid$ there is some $k \geq 0$ such that $w = a_1 b_1 \ldots a_k b_k$ where $a_1 \ldots a_k \in A$ and $b_1 \ldots b_k \in B$, each $a_i, b_i \in \Sigma\}$

   Given DFAs that recognize A and B give a brief intuitive description and then a formal description of how to build a DFA that recognizes the perfect shuffle of A and B.

2. Sipser's book 2nd edition Problem 1.34 (1st edition Problem 1.27). Document the states of your DFA.

3. Sipser's book 2nd edition Problem 1.37 (1st edition Problem 1.30). Explain what your states will be and describe how the transition function will be defined depending on n.

4. Draw NFAs with at most 8 states that recognize each of the following languages. Explain why each of your NFAs is correct. (Full state-by-state documentation may be used as part of this explanation but is not required.)

   (a) The set of all binary strings containing 0110 or 101.

   (b) The set of all binary strings other than 010 or 101.

5. Let $\Sigma = \{a, b\}$. For each $k \geq 1$, let C_k be the language consisting of all strings that contain an 'a' exactly k places from the right-hand end. Thus $C_k = \Sigma^* a \Sigma^{k-1}$. Describe an NFA with $k+1$ states that recognizes C_k, both in terms of a state diagram and a formal description.

6. (**Extra credit**) Sipser's book 2nd edition Problem 1.32 (1st edition Problem 1.25). Document the states of your DFA.

7. (**Extra credit** due Jan 26) Show that if A is recognized by a finite automaton there is a finite automaton that recognizes the set $A_{\frac{1}{2}-}$ of first halves of strings in A, i.e.

$$A_{\frac{1}{2}-} = \{x \ : \ xy \in A \text{ for some } y \text{ with } |x| = |y|\}.$$