CS46, Swarthmore College, Spring 2014
Homework 3 (due Thursday 13 February)
Your Name(s) Here

This assignment consists of two parts: a written homework and a programming portion.

Part 1: Written homework

1. Sipser 1.27: Read the informal description of the finite state transducer in exercise 1.24. Draw the state diagram of the FST on the alphabet $\Sigma = \{a, b\}$ which flips the symbols of the input for every odd position, but leaves the even positions unchanged. For example, on input *aabb* the output should be *abba*.

2. Sipser 1.31: For any string $w = w_1 w_2 \cdots w_n$, the reverse of w, w^R is the string w in reverse order, e.g., $w^R = w_n \cdots w_2 w_1$. For a language L, define $L^R = \{w^R | w \in L\}$. Show that if L is a regular language, then L^R is also regular. This implies regular languages are closed under reversal.

3. Sipser 1.41: For languages A and B, let the *perfect shuffle* of A and B be the language $\{w | w = a_1 b_1 \cdots a_k b_k,\ \text{where } a_1 \cdots a_k \in A \text{ and } b_1 \cdots b_k \in B,\ \text{and each } a_i, b_i \in \Sigma\}$. Show that regular languages are closed under perfect shuffles.

4. Prove or disprove the following "identities" regarding regular expressions.

   (a) $(R^* S^*)^* = (R \cup S)^*$

   (b) $(R \cup S)^* = R^* \cup S^*$

   (c) $(R \cup S)^* S = (R^* S)^*$

Part 2: Programming Exercise

Implement a generic NFA simulator in the programming language of your choice. I recommend python and the examples here will use python. Your code should accept two files as input; a machine description, and a list of input strings to test. A full writeup appears on the course website.