Theory of Computation
Homework 5.
Due Date: Thursday, October 11.

1. If for language $L$ the pumping length is 3 and $a^3b^3 \in L$, then if you choose $s = a^3b^3$ and apply the Pumping Lemma to $s$, how many pairs $x, y$ are there, and what are these pairs?

2. Sipser text, no. 1.55 (2nd edition), 1.38 (1st edition) for the languages $(ab)^*$, $ab(aa^*b)^*b^*$, $abab$.

3. S Let $L$ be a regular language. Define Remove-One-Char($L$) to be the language containing those strings that can be obtained by removing a single character from a string in $L$; more formally:

   \[
   \text{Remove-One-Char} (L) = \{ su | stu \in L, \text{ where } s, u \in \Sigma^*, t \in \Sigma \}.
   \]

   Show that Remove-One-Char($L$) is also regular. It may be helpful to illustrate your construction with a diagram, but you should provide a reasonably precise explanation so that it is completely clear how your construction works. Remember to give a brief justification of why it works, also.

4. Show that the following language is not regular: $B = \{ a^ib^j | i \neq j \}$.

5. Does the proof of the Pumping Lemma work using a $p$-state NFA accepting regular language $L$ instead of a $p$-state DFA? Justify your answer briefly.


Challenge problem (not for credit). Show that the language $E = \{ wxw | w, x \in \{a, b\}^* \}$ is not regular.