Computer Science 81, Spring 2009
Assignment 9
Due Mon. April 13
Please work each problem on a separate sheet.

1. [10 points] Sipser book, Exercise 1.4f:

1.4 Each of the following languages is the intersection of two simpler languages. In each part, construct DFAs for the simpler languages, then combine them using the construction discussed in footnote 3 (page 46) to give the state diagram of a DFA for the language given. In all parts $\Sigma = \{a, b\}$.

f. $\{w \mid w$ has an odd number of a's and ends with a b$\}$

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2. [10 points] Sipser book, Exercise 1.5f:

1.5 Each of the following languages is the complement of a simpler language. In each part, construct a DFA for the simpler language, then use it to give the state diagram of a DFA for the language given. In all parts $\Sigma = \{a, b\}$.

f. $\{w \mid w$ is any string not in $a^* \cup b^*\}$

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3. [5 points] Give a regular expression for the complement language above.

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4. [10 points] Sipser book, Exercise 1.19b:

1.19 Use the procedure described in Lemma 1.55 to convert the following regular expressions to nondeterministic finite automata.

b. $(((00)^*(11)) \cup 01)^*$

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5. [10 points] Convert the NFA in the previous problem to a DFA and minimize it.

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6. [20 points] Sipser book, Problem 1.43b. ***Also, give a non-trivial example.***

1.43 Let A be any language. Define $DROP\text{-}OUT(A)$ to be the language containing all strings that can be obtained by removing one symbol from a string in A. Thus, $DROP\text{-}OUT(A) = \{xz \mid xyz \in A$ where $x, z \in \Sigma^*, y \in \Sigma\}$. Show that the class of regular languages is closed under the DROP-OUT operation. Give both a proof by picture and a more formal proof by construction as in Theorem 1.47.

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7. [15 points] As in problem 6, except for MEGA-DROP-OUT:
MEGA-DROP-OUT(A) = $\{xz \mid \exists y \in \Sigma^*\ xyz \in A\}$

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8. [10 points] Sipser book, Problem 1.45:

*__1.45__ Let $A/B = \{w \mid wx \in A$ for some $x \in B\}$. Show that if A is regular and B is any language then A/B is regular.

(over, please)

9. [10 points] Sipser book, Problem 1.53:

1.53 Let $\Sigma = \{0, 1, +, =\}$ and

$$ADD = \{x{=}y{+}z \mid x, y, z \text{ are binary integers, and } x \text{ is the sum of } y \text{ and } z\}.$$

Show that ADD is not regular.