Computer Science 81, Spring 2010

Assignment 9

Due Tue. April 6

Please group problems on sheets as follows: (1 2)(3 4)(5 6)(7)(8)

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 $\Sigma = \{\mathtt{a}, \mathtt{b}\}$.

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

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2. [20 points] Sipser book, Problem 1.43b.

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, $DROP\text{-}OUT(A) = \{xz | \ xyz \in A$ 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.

An informal proof will suffice. However, *also illustrate using the DFA in 1.4f.*

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3. [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 $\Sigma = \{\mathtt{a}, \mathtt{b}\}$.

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

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4. [10 points] Give a regular expression for the *complement* of the language in problem 1 (1.4.f).

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5. [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. $(((\mathtt{00})^*(\mathtt{11})) \cup \mathtt{01})^*$

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6. [15 points] Convert the NFA in the previous problem to a DFA and minimize it.

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7. [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.

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8. [15 points] Sipser book, Problem 1.22:

1.22 In certain programming languages, comments appear between delimiters such as `/#` and `#/`. Let C be the language of all valid delimited comment strings. A member of C must begin with `/#` and end with `#/` but have no intervening `#/`. For simplicity, we'll say that the comments themselves are written with only the symbols `a` and `b`; hence the alphabet of C is $\Sigma = \{\mathtt{a}, \mathtt{b}, /, \#\}$.

a. Give a DFA that recognizes C.

b. Give a regular expression that generates C.