Computer Science 81, Spring 2013

Assignment 7

Due Monday. April 1 2013, by 10 PM (no foolin')

Note that we are switching to Monday night due dates, to make better use of our grutors.

Also, we are going to begin using the Sipser book. Please read Chapter 1. Review any items in Chapter 0 that are unfamiliar.

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 1. (exercise 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.

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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.