Homework 02

Due: Friday, January 27, 2006

Instructions

1. Please review the homework grading policy outlined in the course information page.
2. On the *first page* of your solution write-up, you *must* make explicit which problems are to be graded for regular credit, which problems are to be graded for extra credit, and which problems you did not attempt. Use a table that looks like this:

Problem	1	2	3	4	5	6	7	8	9	...
Credit	RC	RC	RC	EC	RC	EC	NA	NA	EC	...

   where "RC" denotes "regular credit", "EC" denotes "extra credit", and "NA" denotes "not attempted". Failure to include such a table will result in an arbitrary set of problems being graded for regular credit, no problems being graded for extra credit, and a 5% penalty assessment.
3. You must also write down with whom you worked on the assignment. If this varies from problem to problem, write down this information separately with each problem.

Problems

Required: 5 of the following 8 problems
Points: 20 points per problem

1. Do Exercise 1.7(b,c,d,e,g,h).
2. Let N be the NFA whose transition diagram appears in Exercise 1.16(b) (p. 86).
   a. Give the formal description of N as a 5-tuple (according to Definition 1.37 on p. 53).
   b. Show the computation tree generated when N processes the input string `abb`. Is this string accepted by N? Explain why or why not by referring to this computation tree.
   c. Show the computation tree generated when N processes the input string `baa`. Is this string accepted by N? Explain why or why not by referring to this computation tree.
3. - Do Exercise 1.14.
   - Do Exercise 1.16.
4. Do Exercise 1.18(a,b,c,d,e).
5. Do Exercise 1.18(g,i,j,l,n).
6. Do Problem 1.31.
7. Do Problem 1.32.

8. Given a string w, if $w = xyz$, we say x is a *prefix* of w, z is a *suffix* of w, and y is a *substring* of w. (The strings x, y, and z are allowed to be arbitrary strings, including the empty string, so clearly any prefix or any suffix of w is also a substring of w, and each of ε and w is also a prefix, suffix, and substring of w.) For any language L, define

   - Prefixes$(L) = \{x \mid x \text{ is a prefix of some } w \in L\}$,
   - Suffixes$(L) = \{z \mid z \text{ is a suffix of some } w \in L\}$, and
   - Substrings$(L) = \{y \mid y \text{ is a substring of some } w \in L\}$.

   Prove that if L is regular, then:

   a. Suffixes(L) is regular.

   b. Prefixes(L) is regular.

   c. Substrings(L) is regular.

   Hint: These three results are related and there are several ways to prove them. Probably the easiest approach is to first prove part a using an appropriate construction, then use this result to prove part b, and finally, use parts a and b to prove part c. You may use the result of Problem 1.31.