

Name: _____

USC loginid (no SSN): _____

CS 410 Midterm Exam
Spring 2003 [Bono]
March 10, 2003

There are 5 problems on the exam, with 52 points total available. There are 6 pages to the exam, including this one; make sure you have all of them. If you need additional space to write any answers, you may use the backs of pages (just direct us to look there).

Put your name and loginid at the top of the exam. Please read over the whole test before beginning. Good luck!

	value	score
Problem 1	12 pts.	
Problem 2	10 pts.	
Problem 3	20 pts.	
Problem 4	5 pts.	
Problem 5	5 pts.	
TOTAL	52 pts.	

Problem 1 [12 pts.]

1. Circle the choice that best describes the output of *flex*.
 - a. sequence of tokens
 - b. DFA
 - c. parser
 - d. semantic analyzer
2. Circle the choice that best describes the input to *flex*.
 - a. set of regular expressions
 - b. Cool program
 - c. sequence of Cool lexemes
 - d. context free grammar
3. Circle the choice that best describes the input to *bison*.
 - a. set of regular expressions
 - b. Cool program
 - c. sequence of valid Cool lexemes
 - d. context free grammar
4. Circle the choice that best describes the output of *bison*.
 - a. sequence of tokens
 - b. DFA
 - c. parser
 - d. Accept or Reject
5. Circle the choice that is a regular expression for the set of all strings over the alphabet { a } that has an even number of a's.
 - a. aa^*
 - b. $(aa)^*$
 - c. aa^*a
 - d. $a(aa)^*$
6. Circle the choice that best describes the language defined by the following grammar:

$$\begin{array}{l} A \rightarrow x A x \\ \quad | y \end{array}$$

- a. x^+yx^+
- b. x^*yx^*
- c. an even number of x's
- d. zero or more x's followed by a y, followed by the same number of x's again

Problem 2 [10 pts.]

Part A [5]. Use Thompson's construction to build an NFA from the following regular expression:

$(aa)^*$

Part B [5]. Use subset construction to build a DFA equivalent to the NFA you gave in part A. Show your work.

Problem 4 [5 pts]

Show that the following grammar is ambiguous.

$$\begin{aligned} A &\rightarrow A \mathbf{x} B \\ &\quad | \mathbf{x} \\ B &\rightarrow \mathbf{x} B \\ &\quad | \mathbf{x} \end{aligned}$$

Problem 5 [5 pts.]

Write semantic rules for the grammar below to compute the Boolean attribute $A.\text{even}_x$, which is true iff the sentence parsed has an even number of x 's.

Note: the subscript below is only to distinguish different instances of the same nonterminal in a single production.

$A \rightarrow \mathbf{x} A_1 \mathbf{y}$

| \mathbf{z}