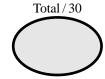
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Name:	
Login:	@ucsc.edu

No books; No calculator; No computer; No email; No internet; No notes; No phone. Neatness counts! Do your scratch work elsewhere and enter only your final answer into the spaces provided.

- 1. Draw a *deterministic* finite αὐτόματον for each of the following **flex** expressions. Use as few states as possible. If you use Thompson's construction, etc., for this question, do it on scratch paper. Show only the final answer. [5✓]
 - (i) ab+|c
 - (ii) a*bc*
 - (iii) ab?c*
 - (iv) d+.d*
 - (v) x(x|d)*
- 2. Write a scanner using flex, which recognizes the following language. Assume a global variable linenr, which is used to count lines. Assume, but do not write, a function setyylval, which takes a token code as an argument and properly assignes to yylval. [5]
 - (a) A sequence of one or more decimal digits is referred to by the token code INT.
 - (b) The four arithmetic operators +, -, *, and /, for which their own character codes are used.
 - (c) Spaces, tabs, and newlines are ignored, but newlines are counted.
 - (d) A comment is two slashes (//) followed by all characters up to but not including the next newline.
 - (e) Identifiers (IDENT) consist of letters (upper or lower case) and digits, but may not begin with a digit.
 - (f) Any invalid characters should cause the function badchar to be called. Nothing is returned in this case.

3. Draw abstract syntax trees for each of the following C expressions. [2✔]

(a) a*b*c+d

(b) (a+b)*(c+d)

4. Given the grammar shown here, write a hand-coded parser for expr. Assume the existence of the functions match, maketree, and term. Remember that the notation {} indicates zero or more occurrences of what is inside the braces. [2✔]

expr → term {+ term}

- 5. Given the regular expression ab c*
 - (a) Using Thompson's construction, draw the NFA, and fill in each state with a small integer. [21]
 - (b) For each state, list its ε -closure. [2 \checkmark]
 - (c) Convert the NFA into a DFA using the subset algorithm. Do not minimize. [21]

Multiple choice. To the *left* of each question, write the letter that indicates your answer. Write 'Z' if you don't want to risk a wrong answer. Wrong answers are worth negative points. [11]

number of		× 1 =	= <i>a</i>
correct answers			
number of		× ½ =	= <i>b</i>
wrong answers			
number of		× 0 =	0
missing answers			
column total	11		= c
$c = \max(a - b, 0)$			

- 1. What **flex** expression matches one or more **x**s followed by one **y**?
 - (A) x*y
 - (B) x+y
 - (C) x?y
 - (D) $\mathbf{x} | \mathbf{y}$
- 2. How many tokens are there in the following line of Java code?

out.printf ("Hello, world!%n");

- (A) 6
- (B) 7
- (C) 8
- (D) 9
- 3. Which one of the following patterns can accept the fewest number of letters?
 - (A) a*b*
 - (B) a*b+
 - (C) a+b*
 - (D) a+b+
- 4. According to Thompson's construction, which of the following will generate the largest number of states?
 - (A) (a)
 - (B) a*
 - (C) ab
 - (D) a | b
- 5. What kind of language does a parser generally use?
 - (A) regular
 - (B) context free
 - (C) context sensitive
 - (D) unrestricted

- 6. In C, what is printed by:
 int main () {
 printf ("%s\n", "3333" + 2);
 return 0;
 }
 (A) 23
 - (A) 33
 - (B) 3333
 - (C) Nothing: this program won't compile.
 - (D) Segmentation Fault (core dumped)
- 7. Which one of the following **flex** actions is obviously wrong?
 - (A) return "=";
 - (B) return '=';
 - (C) return *yytext;
 - (D) return EQ;
- 8. What is the worst case number of states in an NFA constructed via Thompson's construction for a regex *r* when used to scan a string *s*? (The notation |*r*| means: the length of *r*.)
 - (A) $O(2^{|r|})$
 - (B) O(|r|)
 - (C) $O(|r|^2)$
 - (D) $O(|r| \times |s|)$
- 9. Putting reserved words into a **flex** grammar instead of embedding them in the string table will have what effect?
 - (A) Make the DFA run more quikly..
 - (B) Make the DFA run more slowly.
 - (C) Make the DFA take up less space in memory.
 - (D) Make the DFA take up more space in memory.
- 10. Which of the following context-free grammar rules shows that + is left associative?
 - (A) $E + T \rightarrow E$
 - (B) $E \rightarrow E + E$
 - (C) $E \rightarrow E + T$
 - (D) $E \rightarrow T + E$
- 11. Who wrote the first C compiler?
 - (A) Alfred Aho, Peter Weinberger, and Brian Kernighan.
 - (B) Brian Kernighan and Dennis Ritchie.
 - (C) Grace Hopper and John Backus.
 - (D) Ken Thompson and Dennis Ritchie.