$Id: cmps104a-2015q4-exam1.mm,v 1.53 2015-10-20 15:05:57-07 - - $

page 1 page 2 page 3 Total / 32

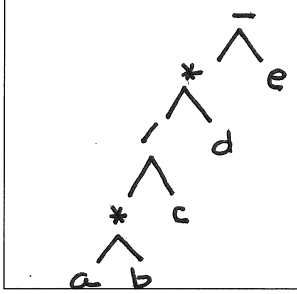
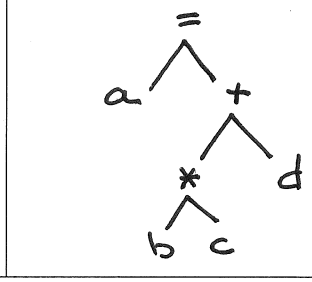
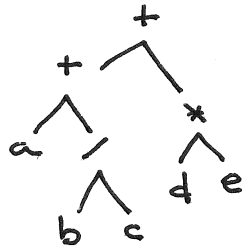
Please print clearly :

Name : SOLUTION

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 ***abstract syntax trees*** for each of the following C expressions : **[3✓]**

`a * b / c * d - e`	`a = b * c + d`	`a + b / c + d * e`
		

2. Write `flex` regular expressions for each of the following : **[5✓]**

   (a) A number which consists of a sequence of decimal digits, possibly with a decimal point. If a decimal point appears, it must be preceded and followed by digits. A number has an optional exponent, which is the letter "e" in upper- or lower-case, followed by an optional minus sign, and then one or more digits.

   `[0-9]+\.?[0-9]+([Ee]-?[0-9]+)?`

   (b) A quoted string which starts and ends with a double quote. Between the quotes may be zero or more occurrences of any character except a newline. If a backslash or a quote appears in the string, it must be excaped by a backslash.

   `\"([^"\\\n]|\\[\\"])*\"`

   (c) Write two patterns in the correct order. One is the keyword `if`, which may not be recognized as an identifier. The other is an identifier which consists of one or more upper- or lower-case letters or decimal digits, but which may not begin with a digit.

   `"if"`
   `[a-zA-Z][a-zA-Z0-9]*`

   (d) Write two patterns : one matches a correct octal constant in C, and the other matches a correct hexadecimal constant in C.

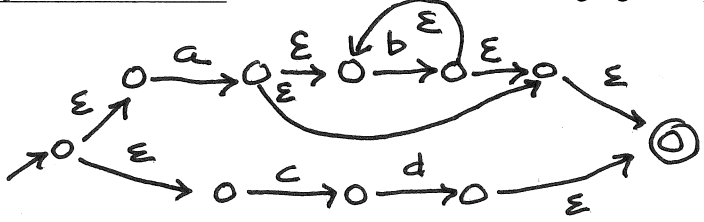
   `0[0-7]*`
   `0[Xx][0-9A-Fa-f]+`

   (e) A pattern which recognizes a list-extracting function in Scheme. The first letter is always a lower-case "c" and the last letter is always a lower-case "r". Between them are one or more occurrences of either the lower-case letters "a" or "d". Examples : `car`, `cdr`, `caar`, `cadr`, `cdar`, `cddr`, etc.

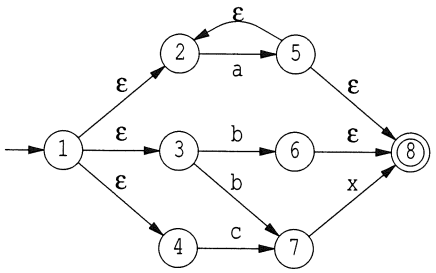
   `c[ad]+r`

3. Using ***Thompson's construction***, draw the NFA from the following regular expression. **[2✓]**

`ab*|cd`



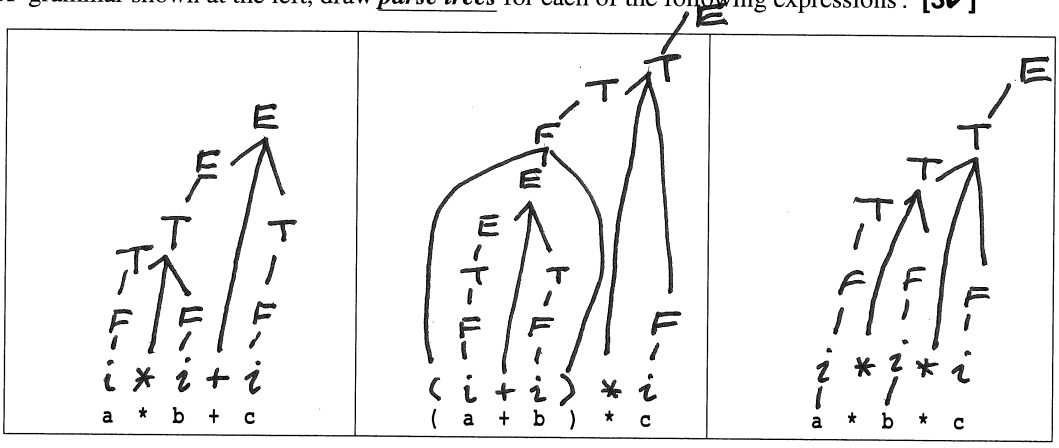
4. Given the NFA shown here, compute the ε-closure of each state and fill in the table. **[2✓]**



state s	ε-closure(s)
1	1 2 3 4
2	2
3	3
4	4
5	5 2 8
6	6 8
7	7
8	8

5. Given the ETF grammar shown at the left, draw ***parse trees*** for each of the following expressions: **[3✓]**

$E \rightarrow E + T$
$E \rightarrow T$
$T \rightarrow T * F$
$T \rightarrow F$
$F \rightarrow (E)$
$F \rightarrow i$



6. Given the ETF grammar in the previous question and the fact that a grammar $G = \langle V_N, V_T, P, S \rangle$, fill in each of the following: **[1✓]**

V_N = {E T F}, V_T = {+ * ( ) i}, and S = E.

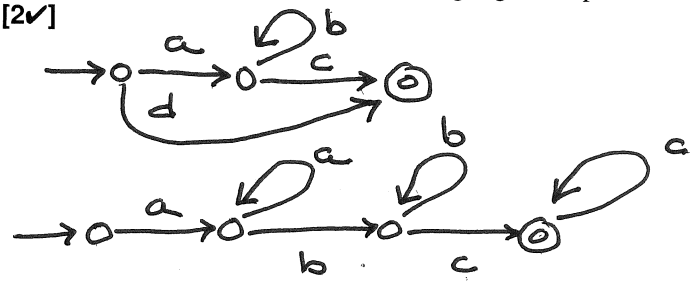
7. Rewrite the ETF grammar from the previous question so that both the + and * operators are right associative, and have the same precedence. **[2✓]**

$E \rightarrow T + E$
$E \rightarrow T * E$
$E \rightarrow T$
$T \rightarrow (E)$
$T \rightarrow i$

8. Draw deterministic finite automata for each of the following regular expressions. Use the ***minimum*** possible number of states. **[2✓]**

(a) `ab*c|d`

(b) `a+b+c+`



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. **[12✔]**

number of correct answers		× 1 =	$= a$
number of wrong answers		× ½ =	$= b$
number of missing answers		× 0 =	0
column total $c = \max(a-b, 0)$	12		$= c$

1. The function `yyparse` implements what kind of machine ?
   (A) Turing machine
   (B) finite state automaton
   (C) linear bounded automaton
   (D) pushdown automaton

D

2. The function `yylex` implements what kind of machine ?
   (A) Turing machine
   (B) finite state automaton
   (C) linear bounded automaton
   (D) pushdown automaton

B

3. What kind of language is recognized by `flex` ?
   (A) context-free
   (B) context-sensitive
   (C) recursively enumerable
   (D) regular

D

4. What kind of language is recognized by `bison` ?
   (A) context-free
   (B) context-sensitive
   (C) recursively enumerable
   (D) regular

A

5. The regex `ab|c*d` is equivalent to :
   (A) `(a(b|c))*d`
   (B) `(ab)|((c*)d)`
   (C) `a((b|c)*)d`
   (D) `a(b|(c*))d`

B

6. Whenever `yylex` returns, what variable points at the lexeme most recently matched ?
   (A) `yydebug`
   (B) `yyin`
   (C) `yylexeme`
   (D) `yytext`

D

7. Given the ETF grammar discussed in class, which rule unambiguously shows that the operator `+` is left associative and can appear multiple times in an expression ?
   (A) $E \rightarrow E + E$
   (B) $E \rightarrow E + T$
   (C) $E \rightarrow T + E$
   (D) $E \rightarrow T + T$

B

8. Access in time $O(1)$ to the string table is provided by :
   (A) `map<string>`
   (B) `set<string>`
   (C) `unordered_map<string>`
   (D) `unordered_set<string>`

D

9. A DFA is constructed from a regular expression r and used to scan a string s. How fast is the scan ?
   (A) $O(1)$
   (B) $O(2^{|r|})$
   (C) $O(|r| \times |s|)$
   (D) $O(|s|)$

D

10. If D is the set of languages recognizable by a DFA, and N is the set of languages recognizable by an NFA, then :
    (A) $D \equiv N$
    (B) $D \subset N$
    (C) $D \supset N$
    (D) Not enough information to decide, because it depends on the particular grammar in question.

A

11. Given a grammar $G = \langle V_N, V_T, P, S \rangle$, tokens returned by `yylex` deal strictly with which set ?
    (A) V_N
    (B) V_T
    (C) P
    (D) S

B

12. Which pattern will recognize a Java or C++ comment ?
    (A) `"//"[^/n]*`
    (B) `"//"[^\n]*`
    (C) `"\\"[^/n]*`
    (D) `"\\"[^\n]*`

B