FILS

Course: Compiler Techniques

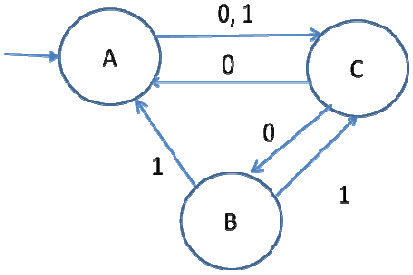
Homework #1

FLA review

1. Construct a grammar over {a, b, c} whose language is $\{a^n b^m c^{2n+m} \mid n, m>0\}$.
2. Let N be an NFA with n states and let M be a DFA with m states recognizing the same language. Which of the followings is necessary true?
   (A) $m <= 2^n$.
   (B) n<=m.
   (C) M has one accept state.
   (D) $m=2^n$.
3. Construct a DFA that takes inputs of 0 and 1 and accepts only strings with even number of 0 and odd number of 1.
4. Design one DFA which takes 0s and 1s as input string and accepts that binary number which is divisible by 3.
5. Construct a DFA equivalent to $M=(\{a_1, a_2, a_3, a_4\}, \{0, 1\}, d, q_1, \{q_4\})$ where d is given below:

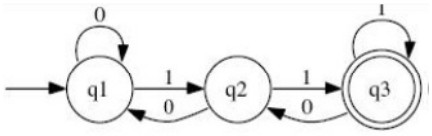
State	0	1
q_1	q_1,q_2	q_1
q_2	q_3	q_2
q_3	q_4	q_4
q_4		q_3

6. Construct a DFA against the following NFA.



7. Given a state diagram of DFA M1. Is 000111 accepted? But 10110? What set of strings accepts M1?

M1:



8. Find a deterministic finite-state automaton that recognizes each of the following sets.
   a) {0}
   b) {1, 00}
   c) $\{1^n \mid n = 2, 3, 4, \ldots\}$
9. Find a non-deterministic finite-state automaton that recognizes each of the following sets.
   a) {0}
   b) {1, 00}
   c) $\{1^n \mid n = 2, 3, 4, \ldots\}$
10. For each of the following regular expressions r construct finite automata recognizing the language L(r):
    (a) a^*

(b) $(a^\star + b^\star)$.
(c) $(a\ b)^\star$.
(d) $(a^\star + b^\star)\ (a\ b)^\star$.
(e) $(a \mid b)^\star$.
(f) $(a^\star \mid b^\star)^\star$.
(g) $((\varepsilon \mid a)\ b^\star)^\star$.
(h) (a+b)*(aa+bb)(a+b)*

11. Convert the linear grammar below with start symbol q_0 and productions

$q_0 \rightarrow \varepsilon$
$q_0 \rightarrow abq_0$
$q_0 \rightarrow cq_1$
$q_1 \rightarrow ab$

into an NFA with ε -transitions whose language is that generated by the grammar and then into a regular grammar.

12. Write a program that builds deterministic finite-state automaton from regular expressions, using a table of ε -transitions. You can use any programming language.

a. Implement a representation (e.g. class) of the deterministic finite-state automaton.
b. Build the prefix form of the initial regular expression.
c. Build the transition table.
d. Test the DFA.

13. Construct the minimum automaton of the following DFA.

State	0	1
q_1 (initial)	q_2	q_6
q_2	q_7	q_3
q_3 (final)	q_1	q_3
q_4	q_3	q_7
q_5	q_8	q_6
q_6	q_3	q_7
q_7	q_7	q_5
q_8	q_7	q_3

14. Consider the CFG: S->0S0| 00. Calculate the language generated by it.

15. Consider the CFG: S->aSAb| ε A->bA| ε . Calculate the language generated by it.

16. Consider the ambiguous CFG:

E->E+E

E->(E*E)

E->id

Which of the following strings have more than one parsing tree when parsed according to the above grammar:

a. id+id+id+id

b. id+(id*(id*id))

c. (id*(id*id))+id

d. ((id*id+id)*id)

17. Well-balanced parenthesis. Write a context-free grammar that generates a well-balanced sequence of parenthesis like: (), ()(()), ((()) ((() ())).

18. What is the maximum number of **reduce** moves that can be taken by a bottom-up parser for a grammar with no ε and unit-productions (no A->B production) to parse a tree string with n tokens?

a. n/2

b. n-1

c. 2n-1

d. 2^n

19. For each of the following languages, indicate whether the language is regular, context-free or context-sensitive, and provide a generative grammar.

a. $L = \{a^n b^n \mid n \geq 0\}$

b. $L = \{a^m b^n \mid m > 0 \wedge n \geq 0\}$

c. All strings over {a, b, c} that contain an even number of a's.

d. $L = \{w \mid |w| \text{ is odd}\}$

20. Let G = (V, Σ, R, S) be a context-free grammar such that V = {E, T, F},

Σ = {a, +, *,(,)}, S = E and R is:

$E \rightarrow E + T \mid T$

$T \rightarrow T * F \mid F$

$F \rightarrow (E) \mid a$

Give parse trees and leftmost derivations for the following strings.

a. a

b. a*(a+a)

c. a+a+a

d. ((a+(a)))

21. Answer each part for the following context-free grammar.

$R \rightarrow XRX \mid S$

$S \rightarrow aTb \mid bTa$

$T \rightarrow XT\ X \mid X \mid \varepsilon$

$X \rightarrow a \mid b$

a. What are the variables and terminals of G? Which is the start symbol?

b. Give three examples of strings in L(G).

c. Give three examples of strings not in L(G).