P S G College of Technology

Dept. of Applied Maths & Computational Sciences

III M.Sc [SS] – 18XW31 – MFOC – Grammar, Automata, PDA, TM – P Sheet 6

1) Let V = {S, A, B, a, b} and T = {a, b} Determine whether G = (V, T, S, P) is a type 0 grammar but not a type I grammar, a type 1 grammar but not a type 2 grammar, or a type 2 grammar but not a type 3 grammar if P, the set of productions, is
   a) S → aAB, A → Bb, B → A.
   b) S →ABa, AB →a.
   c) S → aA, A → a, A → b.
   d) S →aA, aA → B, B → aA, A → b.
2) Find the language generated by the following grammars :
   a) Let G = ({B, S}, { x, y, z, 0, 1 },S, {S → xBz, B→ y | 0B1 }) Derive the word x00y11z.
   b) Let G = (N, T, P, S) where N = { B, S } T = { a, b, x, y, z },
      P: {S -> xBz, B -> aybb | aBb | Bb }
   c) Let G = (N, T, P, S) where N = { D, J, K, S } T = { a, b, c, d, e, f }
      P : {S ->DK, D -> J | aDd, J ->λ | bJc, K ->λ | eKf }
   d) Let G = ({S,A,B,C},{0,1,2}, S, {S→C, C→0CAB, C→ λ , BA→AB, 0A→01, 1A→11, 1B→12, 2B→22 })
   e) Determine whether the word cbab belongs to language generated by G=({,A,B,C,S},{a,b,c}, S, {S→AB; A→Ca; B→Ba; B→Cb; B→b; C→cb; C→b})
3) For the following grammars and target strings, decide whether or not the word is generated by the grammar:
   a) S →SS, S→a, S→bb; w=abba
   b) S→XS, X→XX, X →a, S→b. w=baab
   c) S→AB | CD | a | b, A→a, B→SA, C→DS, D→b; w=bababab
4) Define a grammar for each of the following languages.
   a) L = { $a^{n+1}bc^n / \ n \in N$}
   b) $L1 = \{a^n / \ n \in \mathbb{N}\} \cup L2 = \{bc^n / \ n \in \mathbb{N}\}$
   c) L = { $a^{n+1}(bc)^n \mid n \in \mathbb{N}$}.
   d) L = {$a^i b^j c^k \ d^m \ / \ i = k \ and \ j = m$ }
5) Let G = (V, T, S, P) be the phrase-structure grammar with V = {O, 1, A, B, S}, T = (O, 1} and set of productions P consisting of S→ OA, S→1A, A →OB, B→1A, B→ 1.
   a) Show that 10101 belongs to the language generated by G.
   b) Show that 10110 does not belong to the language generated by G.
   c) What is the language generated by G?
6) Give NFAs with the specified number of states recognizing the following languages.
   a. The language {ω | ω ends with 00} with three states.
   b. The language {0} with two states.
   c. The language 0*1*0*0 with three states.
   d. The language { λ } with one state.
   e. The set of all strings where pairs of adjacent 0s must be separated by at least one 1, except in the last four characters.
   f. The set of all strings that do not contain the substring 000.
7) Give state diagrams of DFAs recognizing the following languages. The alphabet is {0, 1}.
   a. {ω | ω begin with a 1 and ends with a 0}
   b. {ω | ω contains at least three 1s}
   c. {ω | ω contains the substring 0101, i.e., ω = x0101y for some x and y}.
   d. {ω | ω has length at least 3 and its third symbol is a 0}.

e. {ω | ω starts with 0 and has odd length, or starts with 1 and has even length}
f. {ω | ω doesn't contain the substring 110}.
g. {ω | the length of ω is at most 5}.
h. {ω | ω is any string except 11 and 111}.
i. {ω |every odd position of ω is a 1}.
j. {ω | ω contains at least two 0s and most one 1}.
k. {λ, 0} .
l. {ω | ω contains an even number of 0s, or exactly two 1s}.
m. The empty set.
n. All strings except the empty string.

8) The formal description of a DFA *M* is ({q_1 ,q_2 ,q_3, q_4 ,q_5}, {u, d},δ, q_3, { q_3}), where δ is given by the following table. Give the state diagram of this machine.

	u	d
q1	q1	q2
q2	q1	q3
q3	q2	q4
q4	q3	q5
q5	q4	q5

9) Show that each of the following grammars is ambiguous:
   a) S → SabS |λ.
   b) S → SbS | A A → a | aA.
10) Let s=(0,1) . Give RG corresponding to the set
   a) (00, 010, 0110, 011110, …)
   b) (0, 001, 000, 00001, 00000, 0000001,…)
11) Construct PDA for the following:
   a. L = {$a^m b^{m+n} c^n$; m>=0,n>=1 } by final state
   b. L = {$a^n b^{2n}$; n>=1} by empty stack.
   c. L = {$a^{2n} b^{3n}$ / n >=0} by final state.
   d. L = { ww^R ; w ϵ { a, b}+ }
12) Construct TM for the following:
   a. L = {$a^m b^n$; m,n>=1 }.
   b. L on {a, b} given by L = {w / w is a multiple of 3 }
   c. L = {$0^n 1^n$; n>=1 }
   d. To accept all bit strings that consist of an even number of 1s.
   e. L = {$1^n 2^n 3^n$; n>=1 }
   f. L = {0,1}* ending with 010.
   g. To find an even palindrome over {0,1}
   h. To copy a string of 1s. Input: B11111B; Output : B1111111111B
   i. To do addition. Input:B111011B Output: B11111B
   j. To do proper subtraction. Input:B1111011B Output: B11B
   k. To perform n mod 2.
   l. To convert a number to its binary equivalent. (from 11111 to 101)
   m. To perform string concatenation.

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