Practice Set - TOC

08 February 2024 00:55

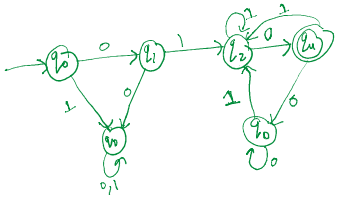
TOC Solution – Vaibhav Singh (Section-11) CSE-core (Asia Tiwari)

Q1. DFA → Even No. of a's or Even No. of b's

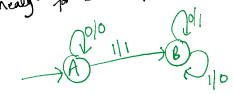
Ans {ε, aa, bb, aab, aba, baa, abb, bab, baa, aabb, ...}

Q2. DFA → Starting with 01 and end with 10 (01(01)*10)

Ans



Q3. Mealy – for 2's complement



Q5. Mealy – for 1's complement

Q6. $S \rightarrow aSS \mid aSaS \mid aSab \mid b$

find left factoring for the given grammar.

Q7. find derivation of string id1+id2*id3 for the grammar where, $E \rightarrow E+E \mid E*E \mid id$

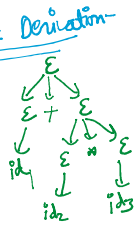
Ans (i) Left Derivation –

$E \rightarrow E+E$
$\rightarrow id+E$
$\rightarrow id+E*E$
$\rightarrow id_1+id_2*E$
$\rightarrow id_1+id_2*id_3$

Right Derivation –

$E \rightarrow E+E$
$\rightarrow E+E*E$
$\rightarrow E+E*id_3$
$\rightarrow E+id_2*id_3$
$\rightarrow id_1+id_2*id_3$

Parse Derivation –



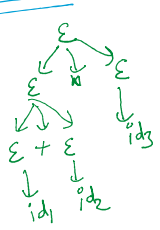
(ii) Left Derivation –

$E \rightarrow E*E$
$\rightarrow E+E*E$
$\rightarrow id_1+E*E$
$\rightarrow id_1+id_2*E$
$\rightarrow id_1+id_2*id_3$

Right Derivation –

$E \rightarrow E*E$
$\rightarrow E+E*E$
$\rightarrow E+E*id_3$
$\rightarrow E+id_2*id_3$
$\rightarrow id_1+id_2*id_3$

Parse Derivation –



→ E+E
→ id1+E*E
→ id1+id2*E
→ id1+id2*id3

→ E+E
→ E+id2*id3
→ id1+id2*id3

E + E
↓ ↓
id1 id2

Q8 CFG to GNF

S → CB | AB
A → a | AA
B → b
C → d

Step 1: Unit Productions ✓
Null Productions ✓

Step 2: CNF ✓

Step 3:

S → CB | AB A → a | AA B → b C → d	S with A_1 C with A_2 B with A_3 A with A_4

$A_1 \rightarrow A_2 A_3 \mid A_4 A_3$
$A_4 \rightarrow a \mid A_4 A_4$
$A_3 \rightarrow b$
$A_2 \rightarrow d$

Step 4:
(i) $A_1 \rightarrow A_2 A_3 \mid A_4 A_3$ ✓
(ii) $A_4 \rightarrow a \mid A_4 A_4$ ✗

Step 5: (i)
$A_4 \rightarrow a \mid A_4 A_4$
$Z = A_4 \mid A_4 Z$
$A_4 \rightarrow a \mid aZ$

Now, The Grammar is—
$A_1 \rightarrow A_2 A_3 \mid A_4 A_3$
$A_4 \rightarrow a \mid aZ$
$A_3 \rightarrow b$
$A_2 \rightarrow d$
$Z \rightarrow A_4 \mid A_4 Z$

(ii) $A_1 \rightarrow A_2 A_3 \mid A_4 A_3$
$A_1 \rightarrow d A_3 / aA_3 / aZA_3$
$Z \rightarrow A_4 \mid A_4 Z$
$Z \rightarrow a \mid aZ \mid aZ \mid aZZ$

→ Now, The Grammar is—
$A_1 \rightarrow dA_3 \mid aA_3 \mid aZA_3$
$A_2 \rightarrow d$
$A_3 \rightarrow b$
$A_4 \rightarrow a \mid aZ$
$Z \rightarrow a \mid aZ \mid aZZ$

Q9 CFG for—

(i) $L = \{ a^n b^n \mid n >= 1 \}$

Ans $L = \{ ab, aabb, aaabbb, \dots \}$

$S \rightarrow aSb$
$S \rightarrow ab$

(ii) $L = \{ a^m b^n \mid m = 2n, n >= 0 \}$
$L = \{ a^{2n} b^n \}$
$L = \{ \epsilon, aab, aaaabb, aaaaaabbb, \dots \}$

$S \rightarrow aaSb$
$S \rightarrow aab$
$S \rightarrow \epsilon$

Q10 Design PDA $\{ 2n, n \mid n >= 0 \}$

$S \to \dots$

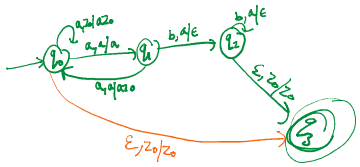
$S \to aab$

$S \to \epsilon$

Q10 Design PDA

$L = \{ a^{2m} b^m \mid m \geq 0 \}$

$L = \{ \epsilon,\ aab,\ aaaabb,\ aaaaaabbb, \dots \}$



Q11 CFG to CNF

$S \to ASB$

$A \to aAS \mid a \mid \epsilon$

$B \to SbS \mid A \mid bb$

Step 1:

(i) P: $S \to ASB$, $A \to aAS \mid a \mid \epsilon$, $B \to SbS \mid A \mid bb$, $S' \to S$

Step 2:

(i) $A \to aAS \mid a \mid \epsilon$

$S' \to S$

$S \to ASB \mid SB$

$A \to aAS \mid a \mid aS$

$B \to SbS \mid A \mid bb \mid \epsilon$

(ii) $B \to SbS \mid A \mid bb \mid \epsilon$

$S \to ASB \mid SB \mid AS \mid S$

$A \to aAS \mid a \mid aS$

$B \to SbS \mid A \mid bb$

$S' \to S$

Step 3:

(i) $S \to S$

$S \to ASB \mid SB \mid AS$

$A \to aAS \mid a \mid aS$

$B \to SbS \mid A \mid bb$

$S' \to S$

(ii) $B \to A$

$S \to ASB \mid SB \mid AS$

$A \to aAS \mid a \mid aS$

$B \to aAS \mid a \mid aS$

$S' \to S$

(iii) $S' \to S$

$S \to ASB \mid SB \mid AS$

$A \to aAS \mid a \mid aS$

$B \to aAS \mid a \mid aS$

$S' \to ASB \mid SB \mid AS$

Step 4:

$S \to ASB \mid SB \mid AS$

$A \to aAS \mid a \mid aS$

$B \to aAS \mid a \mid aS$

$S' \to ASB \mid SB \mid AS$

$X \to 'AS'$

$S \to XB \mid SB \mid AS$

$A \to aX \mid a \mid aS$

$B \to aX \mid a \mid aS$

$S' \to XB \mid SB \mid AS$

Step 5:

$S \to XB \mid SB \mid AS$

$A \to aX \mid a \mid aS$

$B \to aX \mid a \mid aS$

Step 2

$S \to XB|SB|AS$
$A \to aX|a|aS$
$B \to aX|a|aS$
$S' \to XB|SB|AS$
$X \to SA$

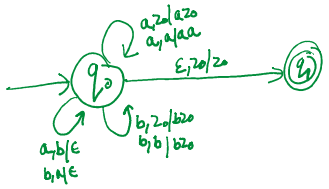
$A \to aX|aS$
$B \to aX|aS$

$A \to YX|YS$
$B \to YX|YS$

Now, This is CNF –

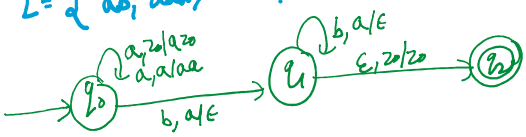
$A \to YX|YS|a$
$B \to YX|YS|a$
$S \to XB|SB|AS$
$S' \to XB|SB|AS$
$X \to SA$
$Y \to a$

Q12 $L = \{ab, ba, aabb, abab, bbaa, baba, \ldots\}$



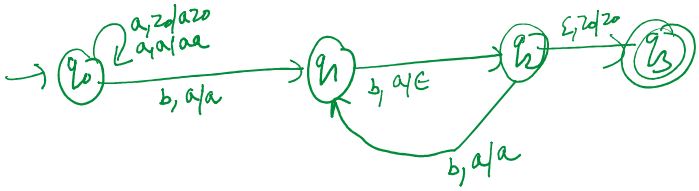
Q13 $L = \{a^n b^n \mid n \geq 1\}$

$L = \{ab, aabb, aaabbb, aaaabbbb, \ldots\}$



Q15 PDA – $L = \{a^n b^{2n} \mid n \geq 1\}$

$L = \{abb, aabbbb, aaabbbbbb, \ldots\}$

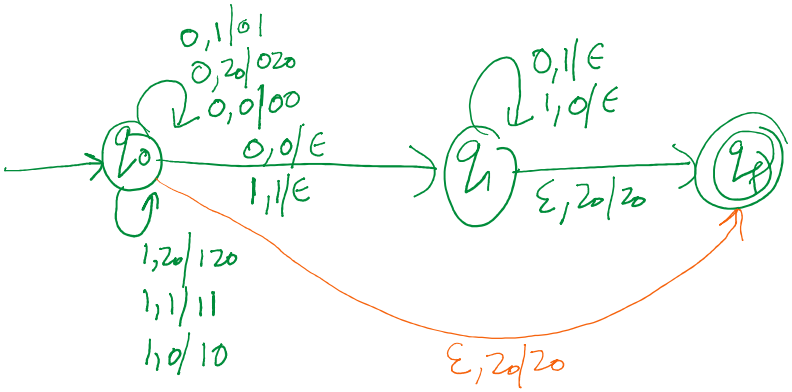


Q16 Similar to Q11

Q17 PDA $L = \{w w^R \mid w \in (0,1)^*\}$

$L = \{\varepsilon, 00, 11, 1001, 0110, \ldots\}$

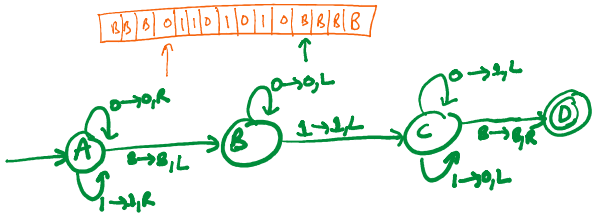
$L = \{\varepsilon, 00, 11, 1001, 0110, \ldots\}$



Q16 $L = \{wcw \mid w \in (0,1)+\}$

$L = \{0c0, 1c1, 10c10, 000c000 \ldots\}$

Q20 TM – Binary Value to 2's Complement

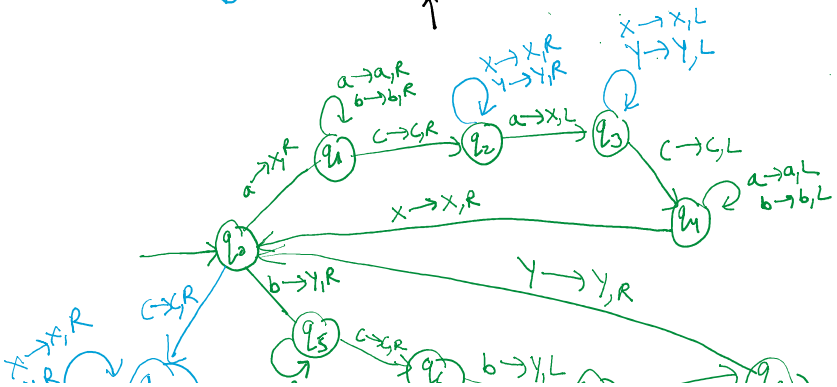


Q21. $L = \{wcw \mid w \in (0,1)^*\}$

$L = \{\varepsilon, 0c0, 1c1, 00c00, 10c10, \ldots\}$

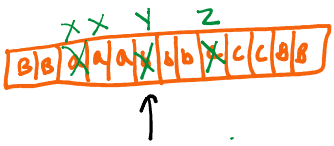
$0 \to a, \; 1 \to b$

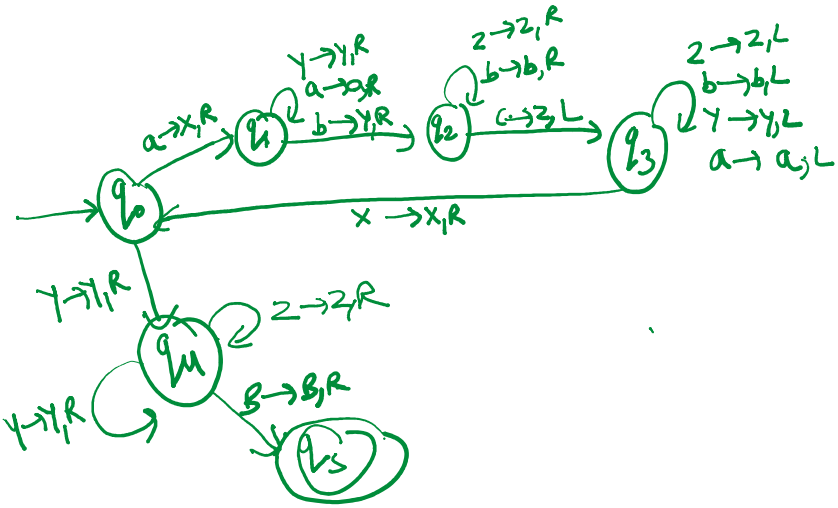
BB ab aabb C ab aabb BB



Q23 $L = \{ a^n b^n c^n \mid n \geq 0 \}$

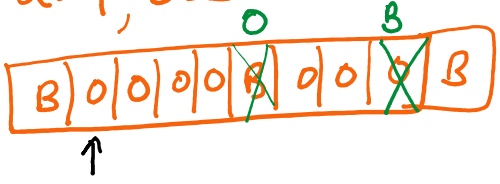
$L = \{ \varepsilon, abc, aabbcc, aaabbbccc \ldots \}$

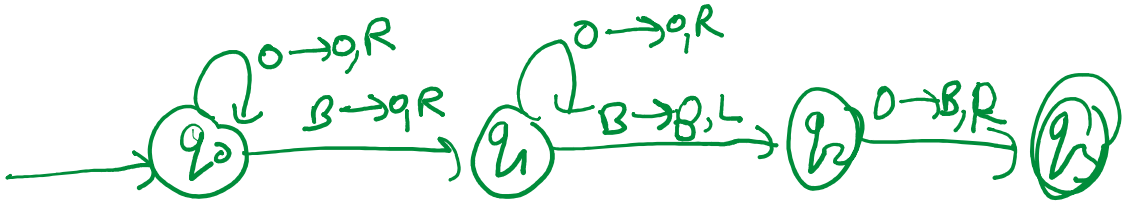




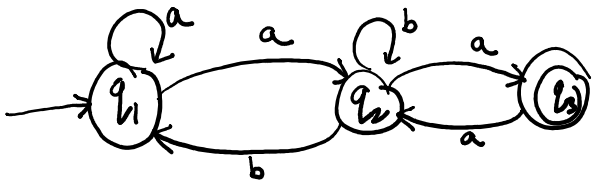
Q24 TM – Adder for Unary Value

$a = 4, b = 3$





Q28



$$q_1 = q_1a + q_2b + \varepsilon \quad \text{—— (i)}$$
$$q_2 = q_2b + q_1a + q_3a \quad \text{—— (ii)}$$
$$q_3 = q_2a \quad \text{—— (iii)}$$

$R = Q + RP$
$R = QP^*$

$$q_2 = q_2b + q_1a + q_3a$$
$$= q_2b + q_1a + q_2aa$$
$$= q_1a + q_2b + q_2aa$$
$$= \underbrace{q_1a}_{Q} + \underbrace{q_2}_{R}\underbrace{(b+aa)}_{P}$$
$$= q_1a(b+aa)^* \quad \text{—— (iv)}$$

$$q_1 = q_1a + q_2b + \varepsilon$$
$$= q_1a + q_1a(b+aa)^*b + \varepsilon$$
$$= \varepsilon + q_1a + q_1a(b+aa)^*b$$
$$= \underbrace{\varepsilon +}_{Q}\ \underbrace{q_1}_{R}\underbrace{(a + a(b+aa)^*b)}_{P}$$
$$= \varepsilon\cdot(a + a(b+aa)^*)b^*$$
$$= (a + a(b+aa)^*)b^*$$

$$q_3 = q_2a$$
$$= (q_1a(b+aa)^*)a$$
$$= (a + a(b+aa)^*)b^*a(b+aa)^*)a$$

Ans

Q30 Same as Q23

Q31 Same as Q24