280 - THE2

Student Information

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Q1

a)

I couldn't find a simpler grammar; so, I created the rules such that they are representing all possible combinations.

Let context-free grammar for L_1 be G_1.
$G_1 = (V, \sum, R, S)$ where,
$V = \{S, a, b\}$
$\sum = \{a, b\}$
$R = \{S \rightarrow e|Sabb|Sbab|Sbba|abbS|babS|bbaS|aSbb|bSab|bSba|abSb|baSb|bbSa\}$

b)

Let context-free grammar for L_2 be G_2.
$G_2 = (V, \sum, R, S)$ where,
$V = \{S, a, b\}$
$\sum = \{a, b\}$
$R = \{S \rightarrow aaSb|aSb|e\}$

c)

Let M be the PDA that accepts L_1
$M = (\{p, q\}, \sum, V, \Delta, p, \{q\})$ where,
$\sum = \{a, b\}$
$V = \{S, a, b\}$
$\Delta = \{((p, e, e), (q, S)), ((p, e, S), (q, e)),$
$((q, e, S), (q, Sabb)), ((q, e, S), (q, Sbab)), ((q, e, S), (q, Sbba)),$
$((q, e, S), (q, abbS)), ((q, e, S), (q, babS)), ((q, e, S), (q, bbaS)),$
$((q, e, S), (q, aSbb)), ((q, e, S), (q, bSab)), ((q, e, S), (q, bSba)),$
$((q, e, S), (q, abSb)), ((q, e, S), (q, baSb)), ((q, e, S), (q, bbSa))$
$((q, a, a), (q, e)), ((q, b, b), (q, e))\}$

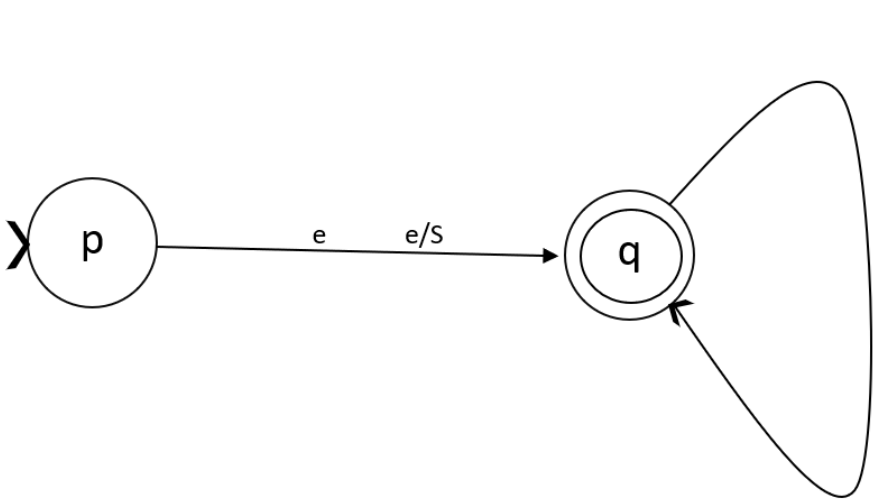

Figure 1: PDA of L_1

d)

I used the construction for union of two context-free grammars.

Changing the names of the elements for G_1 and G_2, and they become,
$G_1 = (V_1, \sum_1, R_1, S_1)$ and $G_2 = (V_2, \sum_2, R_2, S_2)$

Let the context-free grammar for L_3 be G_3.
$G_3 = (V_3, \sum_3, R_3, S_3)$ where,
$V_3 = V_1 \cup V_2 \cup S_3 = \{S_1, S_2, S_3, a, b\}$
$\sum_3 = \{a, b\}$
$R_3 = \{S_3 \rightarrow S_1|S_2,$
$S_1 \rightarrow e|S_1abb|S_1bab|S_1bba|abbS_1|babS_1|bbaS_1|aS_1bb|bS_1ab|bS_1ba|abS_1b|baS_1b|bbS_1a,$
$S_2 \rightarrow aaS_2b|aS_2b|e\}$

Q2

a)

Consider the string 00111. We can create 2 different left-most derivations and the corresponding parse trees for this string as below;
1) $S \rightarrow AS \rightarrow A1S \rightarrow 0A11S \rightarrow 00111S \rightarrow 00111$

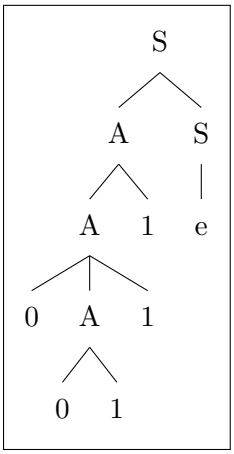

Figure 2: 1^{st} derivation's parse tree

2) $S \rightarrow AS \rightarrow 0A1S \rightarrow 0A11S \rightarrow 00111S \rightarrow 00111$

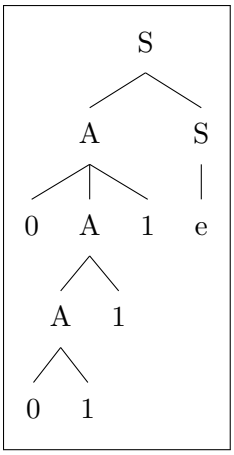

Figure 3: 2^{nd} derivation's parse tree

Since there exist 2 different parse trees for the same string, the grammar is ambiguous.

b)

Let G_2 be the unambiguous grammar for $L(G_1)$ such that;

$G_2 = (V_2, \sum_2, R_2, S_2)$ where;
$V_2 = \{0, 1, S_2, B, C\}$
$\sum_2 = \{0, 1\}$
$R_2 = \{S_2 \rightarrow CS_2,$
$C \rightarrow 0C1|01B,$
$B \rightarrow 1B|e\}$

c)

Leftmost derivation of the string 00111 is;
$S_2 \rightarrow CS_2 \rightarrow 0C1S_2 \rightarrow 001B1S_2 \rightarrow 0011B1S_2 \rightarrow 00111S_2 \rightarrow 00111$

Corresponding parse tree is below;

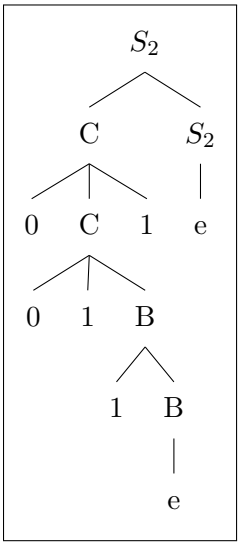

Figure 4: Parse tree of the grammar from part b.