Student Information

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Answer 1

a) $G_1 = \{V_1, \Sigma_1, R_1, S_1\}$, V_1 = { S_1, a, b } , Σ_1 = { a, b } and

R = { $S_1 \rightarrow S_1aS_1bS_1bS_1$,

$S_1 \rightarrow S_1bS_1aS_1bS_1$,

$S_1 \rightarrow S_1bS_1bS_1aS_1$,

$S_1 \rightarrow$ e }

b) $G_2 = \{V_2, \Sigma_2, R_2, S_2\}$, V_2 = { S_2, K, L, a, b } , Σ_2 = { a, b } and

R_2 = { $S_2 \rightarrow$K | L,

K → KaKaKaK,

K → KaKbKaK,

K → KbKaKaK,

K → L,

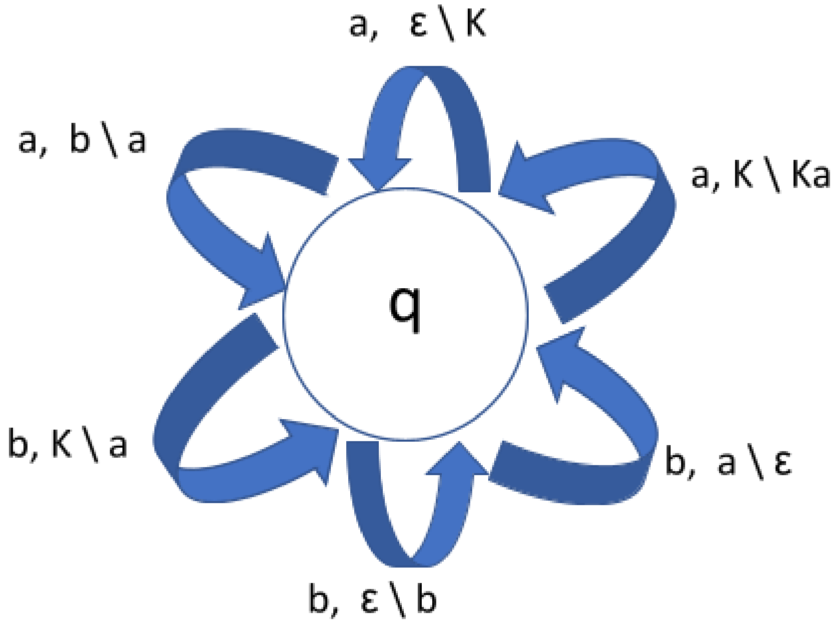
L → LaLbL,

L → LbLaL

L → e }

c) PDA that accepts the L_1 is :

Let $G = \{ V, \Sigma, R, S \}$ and we can construct a PDA M such that $L(G) = L(M)$.
Let $M = (K, \Sigma, \Gamma, \Delta, s, F)$ where
$K = \{ q \}$
$F = \{ q \}$
$\Sigma = \{ a, b \}$
$\Gamma = \{ K, a, b \}$
$\Delta = \{((q,a,e),(q,K)),$
$((q,a,b),(q,a)),$
$((q,a,K),(q,Ka)),$
$((q,b,e),(q,b)),$
$((q,b,K),(q,a)),$
$((q,b,a),(q,e))\}$



d) We define grammar G_3 for $L_3 = L_1 \cup L_2$.
$L(G_3) = L(G_1) \cup L(G_2)$.
Firstly ,we should check L_1 and L_2 have disjoint sets of non-terminals.
$V_1 - \Sigma_1 = \{ S_1\}$
$V_2 - \Sigma_2 = \{ S_2 , K, L\}$
We can conclude their sets of non-terminals are disjoint.
According to the Union property of context-free languages (Theorem 3.5.1):
$G_3 = (V_1 \cup V_2 \cup \{S\}, \Sigma_1 \cup \Sigma_2, R_1 \cup R_2 \cup \{ S\rightarrow S_1 , S\rightarrow S_2\}, S)$
$V_3 = V_1 \cup V_2 \cup \{S\} = \{ S_1, S_2, K, L, a, b \}$
$\Sigma_3 = \Sigma_1 \cup \Sigma_2 = \{ a, b \}$
$R_3 = R_1 \cup R_2 \cup \{ S\rightarrow S_1 , S\rightarrow S_2 \} =\{ S_1 \rightarrow S_1aS_1bS_1bS_1 \mid S_1bS_1aS_1bS_1 \mid S_1bS_1bS_1aS_1 \mid S_1 \rightarrow e\}$
$\cup \{S_2 \rightarrow K \mid L, K \rightarrow KaKaKaK \mid KaKbKaK \mid KbKaKaK \mid L, L \rightarrow LaLbL \mid LbLaL \mid e\}$
$\cup \{ S\rightarrow S_1 , S\rightarrow S_2 \}$

Answer 2

a) Grammars such as G', with strings that have two or more distinct parse trees, are called ambiguous. If we choose sample as "00111" we can draw 2 different parse trees. So, G_1 is ambiguous.

b) The unambiguous grammar for $L(G_1)$:

R = { S → A

A → AA | A1 | T

T → 0T1 | 01 }

c) The leftmost derivation of the string "00111" :

S → A → A1 → 0T1 → 01

Parse Tree :