Student Information

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Answer 1

a)

$G_1 = (V, \Sigma, R, S)$ where

$V = \{S, a, b\}$,
$\Sigma = \{a, b\}$,
S is the start symbol ,
$R = \{S \rightarrow SaSbSbS|SbSaSbS|SbSbSaS|\epsilon\}$

such that $L(G_1) = L_1$.

b)

$G_2 = (V, \Sigma, R, S)$ where

$V = \{S, a, b\}$,
$\Sigma = \{a, b\}$,
S is the start symbol ,
$R = \{S \rightarrow aSb|aaSb|\epsilon\}$

such that $L(G_2) = L_2$.

c)

Let's introduce a Nondeterministic Pushdown Automaton M such that $L(M) = L_1$

$M = (K, \Sigma, V, \Delta, s, F)$ where ,

$K = \{p, q\}$
$\Sigma = \{a, b\}$
$V = \{a, b, S\}$
$s = p$
$F = \{q\}$

$\Delta =$ {
$((p, \epsilon, \epsilon), (q, S))$,
$((q, \epsilon, S), (q, SaSbSbS))$,
$((q, \epsilon, S), (q, SbSaSbS))$,
$((q, \epsilon, S), (q, SbSbSaS))$,
$((q, \epsilon, S), (q, \epsilon))$,
$((q, a, a), (q, \epsilon))$,
$((q, b, b), (q, \epsilon))$
}

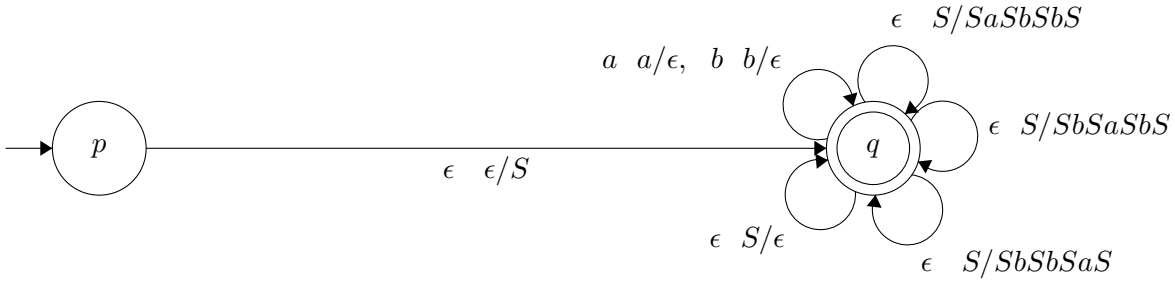

Figure: State Diagram of M

Be careful that $(a \quad a/\epsilon)$ **and** $(b \quad b/\epsilon)$ **has been shown on the same loop for simplicity !**

d)

$G_3 = (V, \Sigma, R, S)$ where

$V = \{S, S_1, S_2, a, b\}$,
$\Sigma = \{a, b\}$,
S is the start symbol ,
$R = \{$
$S \to S_1 | S_2,$
$S_1 \to S_1 a S_1 b S_1 b S_1 | S_1 b S_1 a S_1 b S_1 | S_1 b S_1 b S_1 a S_1 | \epsilon,$
$S_2 \to a S_2 b | a a S_2 b | \epsilon$
$\}$

such that $L(G_3) = L_3 = L_1 \cup L_2$.

Answer 2

a)

Consider the string $w = 00111 \in L(G_1)$:

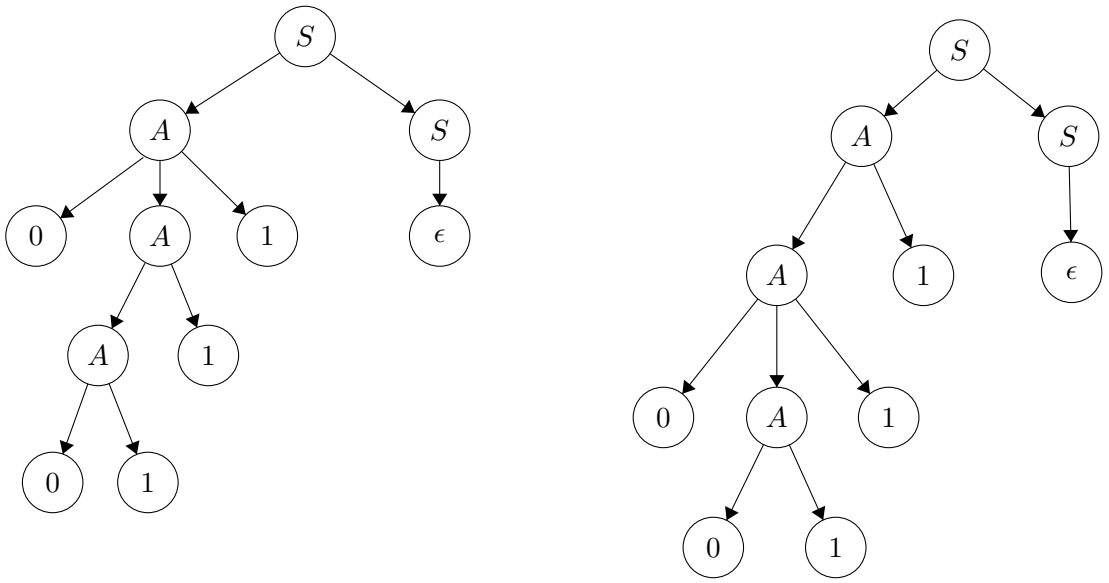

Figure 1 - 2: Two different parse trees for W

Since G_1 has two distinct parse trees, which are drawn above, for the string $w = 00111$. The grammar G_1 is ambiguous.

b)

Let's introduce an unambiguous grammar G_2 such that $L(G_1) = L(G_2)$:

$G_2 = (V, \Sigma, R, S)$ where

$V = \{S, A, B, 0, 1\}$,
$\Sigma = \{0, 1\}$,
S is the start symbol ,
$R = \{$
$S \to AS|\epsilon,$
$A \to A1|B,$
$B \to 0B1|01$
$\}$

c)

Left-most derivation :

$$S \implies AS \implies A1S \implies B1S \implies 0B11S \implies 00111S \implies 00111$$

Corrsponding parse tree:

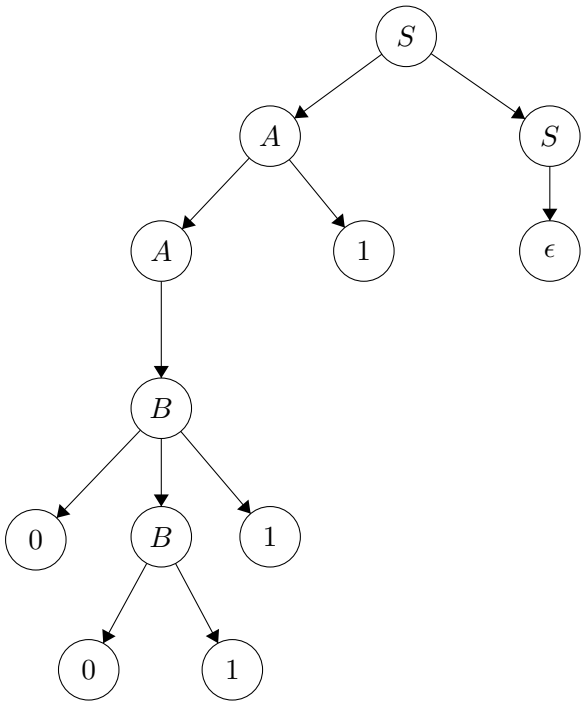

Figure: Corresponding parse tree