Problem

Recall the CFG G_4 that we gave in Example 2.4. For convenience, let's rename its variables with single letters as follows.

$$
\begin{aligned}
E &\to E + T \mid T \\
T &\to T \times F \mid F \\
F &\to (E) \mid \mathtt{a}
\end{aligned}
$$

Give parse trees and derivations for each string.

a. a

b. a+a

c. a+a+a

d. ((a))

Step-by-step solution

Step 1 of 8

Given Grammar G_4 is

$$
\begin{aligned}
E &\to E + T \mid T \\
T &\to T \times F \mid F \\
F &\to (E) \mid a
\end{aligned}
$$

Derivation: The sequence of substitutions to obtain a string is called a *derivation*.

Parse Tree: The pictorial representation of derivation of a string is a *parse tree*.

Comment

Step 2 of 8

a)

The parse tree to generate string a is as follows:

Comment

Step 3 of 8

The derivation for the string a is as follows:

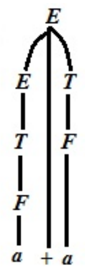
$E \Rightarrow T$
$E \Rightarrow F$
$E \Rightarrow a$

Comment

Step 4 of 8

b)

The parse tree to generate string $a+a$ is as follows:



Comment

Step 5 of 8

The derivation for the string $a+a$ is as follows:

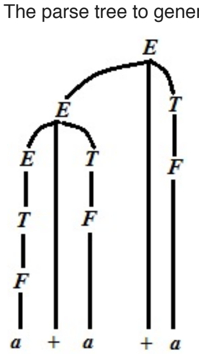
$E \Rightarrow E+T$
$E \Rightarrow T+T$
$E \Rightarrow F+T$
$E \Rightarrow a+T$
$E \Rightarrow a+F$
$E \Rightarrow a+a$

Comment

Step 6 of 8

c)

The parse tree to generate string $a+a+a$ is as follows:



The derivation for the string $a+a+a$ is as follows:

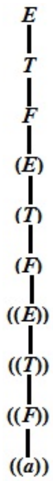
$E \Rightarrow E+T$
$E \Rightarrow E+T+T$
$E \Rightarrow T+T+T$
$E \Rightarrow F+T+T$
$E \Rightarrow a+T+T$
$E \Rightarrow a+F+T$
$E \Rightarrow a+a+T$
$E \Rightarrow a+a+F$
$E \Rightarrow a+a+a$

Comment

Step 7 of 8

d)

The parse tree to generate string $((a))$is as follows:



Comment

Step 8 of 8

The derivation for the string $((a))$is as follows:

$E \Rightarrow T$
$E \Rightarrow F$
$E \Rightarrow (E)$
$E \Rightarrow (T)$
$E \Rightarrow (F)$
$E \Rightarrow ((E))$
$E \Rightarrow ((T))$
$E \Rightarrow ((F))$
$E \Rightarrow ((a))$

Comments (2)