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Given Grammar G_4 is

$$E \to E+T \mid T$$
$$T \to T \times F \mid F$$
$$F \to (E) \mid a$$

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*.

a)

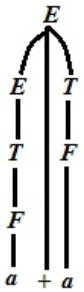
The parse tree to generate string a is as follows:

The derivation for the string a is as follows:

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

b)

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

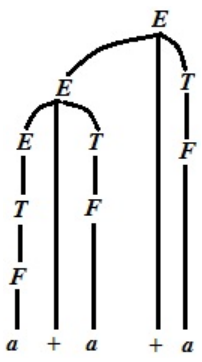


The derivation for the string $a+a$ is as follows:

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

c)

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

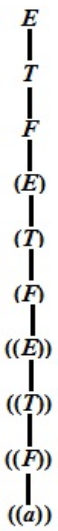


The derivation for the string $a+a+a$ is as follows:

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

d)

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



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

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