Crafting a Compiler
4.7

7. A grammar for infix expressions follows:

$$
\begin{array}{lll}
1 & \text{Start} & \rightarrow E\ \$ \\
2 & E & \rightarrow T\ \text{plus}\ E \\
3 & & |\ T \\
4 & T & \rightarrow T\ \text{times}\ F \\
5 & & |\ F \\
6 & F & \rightarrow (\ E\ ) \\
7 & & |\ \text{num}
\end{array}
$$

(a) Show the leftmost derivation of the following string.

num plus num times num plus num $

(b) Show the rightmost derivation of the following string.

num times num plus num times num $

(c) Describe how this grammar structures expressions, in terms of the precedence and left- or right- associativity of operators.

a)

Start
E$
T plus E $
F plus E $
num plus E $
num plus T plus E $
num plus T times F plus E $
num plus F times F plus E $
num plus num times F plus E $
num plus num times num plus E $
num plus num times num plus T $
num plus num times num plus F $
num plus num times num plus num $

b)

Start
E$
T plus E $
T plus T $
T plus T times F $
T plus T times num $
T plus F times num $
T plus num times num $
T times F plus num times num $
T times num plus num times num $
F times num plus num times num $
num times num plus num times num $

Dragon
4.2.1 a, b,c

Exercise 4.2.1: Consider the context-free grammar:

$$S \rightarrow SS + \mid SS * \mid a$$

and the string $aa + a*$.

   a) Give a leftmost derivation for the string.

   b) Give a rightmost derivation for the string.

   c) Give a parse tree for the string.

  ! d) Is the grammar ambiguous or unambiguous? Justify your answer.

  ! e) Describe the language generated by this grammar.

a)

S
SS*
SS+S*
aS+S*
aa+S*
aa+a*

b)
S
SS*
S a*
SS + a*
Sa +a*
aa+a*

c)