

**Exercise 4.2.1:** Consider the context-free grammar:

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

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.

**Exercise 4.2.2:** Repeat Exercise 4.2.1 for each of the following grammars and strings:

- a)  $S \rightarrow 0 S 1 \mid 0 1$  with string 000111.
- b)  $S \rightarrow + S S \mid * S S \mid a$  with string  $+ * aaa$ .
- ! c)  $S \rightarrow S ( S ) S \mid \epsilon$  with string  $((()))$ .
- ! d)  $S \rightarrow S + S \mid S S \mid ( S ) \mid S * \mid a$  with string  $(a + a) * a$ .
- ! e)  $S \rightarrow ( L ) \mid a$  and  $L \rightarrow L , S \mid S$  with string  $((a, a), a, (a))$ .

## Exercise 4.3

- برای گرامرهای سوال های قبل
- First Follow ها را به دست بیاورید
- LL(1) parser طراحی کنید
- هر جا لازم بود فاکتورگیری چپ یا حذف بازگشتی چپ انجام دهید

**Exercise 4.6.2:** Construct the SLR sets of items for the (augmented) grammar of Exercise 4.2.1. Compute the GOTO function for these sets of items. Show the parsing table for this grammar. Is the grammar SLR?

**Exercise 4.6.3:** Show the actions of your parsing table from Exercise 4.6.2 on the input  $aa * a +$ .

**Exercise 4.6.5:** Show that the following grammar:

$$\begin{array}{lcl} S & \rightarrow & A a A b \mid B b B a \\ A & \rightarrow & \epsilon \\ B & \rightarrow & \epsilon \end{array}$$

is LL(1) but not SLR(1).

**Exercise 4.6.6:** Show that the following grammar:

$$\begin{array}{lcl} S & \rightarrow & S A \mid A \\ A & \rightarrow & a \end{array}$$

is SLR(1) but not LL(1).