

Recitation #4 – Worksheet

Grammars

1. Consider the context-free grammar $G = (\{S\}, \{a\}, S, P)$:

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

- a. Show how the string $aa + a^*$ can be generated by this grammar.
- b. Construct a parse tree for this string.
- c. What language does this grammar generate? Justify your answer!

2. Write an unambiguous grammar that leads to correct parse trees for the language consisting of expressions involving the operand **id** and the operators described below.

Operator	Associativity	Precedence	Binary / Unary
!	Left to right	Highest (4)	Binary
@	Right to left	High (3)	Unary
^	Right to left	Medium (2)	Binary
#	Left to right	Lowest (1)	Binary

Parentheses are also allowed, with their usual interpretation.

3. The following grammar contains occurrences of left recursion. Rewrite it so that there is no left recursion. Also do left factoring to remove rules for a single non-terminal that start with the same sequence of symbols.

$$G = (\{A_1, A_2, A_3\}, \{a, b\}, A_1, P)$$

where the production rules P are:

$$A_1 \rightarrow A_1aa \mid A_2b$$

$$A_2 \rightarrow A_1aa \mid A_2A_3b$$

$$A_3 \rightarrow aA_3b \mid ab$$