

Exercise 1. Context-free grammars

The grammar $e ::= e + e \mid e * e \mid (e) \mid \text{NUMBER}$ generates the set of arithmetic expressions with $+$, $*$, parentheses, and numbers. The grammar is ambiguous, since, for example, $\text{NUMBER} + \text{NUMBER} * \text{NUMBER}$ has multiple derivations.

Construct an equivalent unambiguous grammar.

Exercise 2. Pushdown-automata

Construct a PDA equivalent to the following grammar (the capital letters represent terminals).

$$\begin{aligned} s &::= Aaa \\ a &::= As \mid Bs \mid A \end{aligned}$$