

Advanced Sequence Analysis
Summer 2019

Exercises

Number 6 (24.05.2019), Discussion: 31.05.2019

1. Let G be the following grammar:

$$\begin{aligned} E &\rightarrow E + T \mid T \\ T &\rightarrow T \times F \mid F \\ F &\rightarrow (E) \mid a \end{aligned}$$

Give parse trees and derivations for each string:

- (a) a
- (b) $a+a$
- (c) $a+a+a$
- (d) $((a))$

2. Answer each part for the following context-free grammar G :

$$\begin{aligned} R &\rightarrow XRX \mid S \\ S &\rightarrow aTb \mid bTa \\ T &\rightarrow XTX \mid X \mid \varepsilon \\ X &\rightarrow a \mid b \end{aligned}$$

- (a) What are the variables and terminals of G ? Which is the start variable of G ?
 - (b) Give three strings in $L(G)$. Give three strings not in $L(G)$.
 - (c) True or false: $T \Rightarrow aba$.
 - (d) True or false: $T \xRightarrow{*} aba$.
 - (e) True or false: $XXX \xRightarrow{*} aba$.
 - (f) True or false: $S \xRightarrow{*} \varepsilon$.
 - (g) Give a description in English of $L(G)$.
3. Give context-free grammars that generate the following languages. Consider the alphabet $\Sigma = \{0, 1\}$.
- (a) $\{w \mid w \text{ contains at least three } 1\text{s}\}$
 - (b) $\{w \mid w \text{ starts and ends with the same symbol}\}$
 - (c) $\{w \mid w^R, \text{ that is, } w \text{ is palindrome}\}$
4. Give a context-free grammar that generates the language $A = \{a^i b^j c^k \mid i = j \text{ or } j = k, \text{ where } i, j, k \geq 0\}$. Is your grammar ambiguous? Why or why not?
5. Convert the following grammar to the Chomsky normal form.

$$\begin{aligned} S &\rightarrow ASB \mid \varepsilon \\ A &\rightarrow aAS \mid a \\ B &\rightarrow SbS \mid A \mid bb \end{aligned}$$