SW 5: Pushdown Automata & Algebraic Languages

Exercise 1 Define the pushdown automata recognizing the following languages:

$L_1 = \{ a^i(ab)^i c^k \mid i,k>0\}$

$L_2 = \{ wcw^R \mid w \in \{a,b\}^*\}$

Exercise 2 Let G be the following grammar, which allows recognizing lists.:

S → { Liste }
Liste → Liste , Liste | Nb
Nb → 0 | 1 | 0 Nb | 1 Nb

- Give the derivation tree, as well as a left derivation and a right derivation of the word w = {10, 0, 00}
- Show that G is ambiguous

Exercise 3: Transform the following grammar into a reduced and clean grammar without unit rules:.

$$
\begin{aligned}
S &\rightarrow AB \mid CA \\
A &\rightarrow a \mid b \mid \varepsilon \\
B &\rightarrow BC \mid DB \\
C &\rightarrow E \mid \varepsilon \\
D &\rightarrow a \mid d \\
E &\rightarrow aB \mid c \mid d \mid \varepsilon
\end{aligned}
$$

Exercise 4 : Make the following grammars ε-free and non-left-recursive:

1. G1
S → AS / bB
A → a / ε
B → aB / a / ε

2.G2
S → aSSB | ASC | a,
A → AAB | B | C,
B → a | ε,
C → AC | CB }

3.G3
A → Bac / Bb
B → Bc / Ad / ε

4. G4
S → Aa / b
A →Ac / Sd / ε

Exercise 5 : Transform the following grammars into Chomsky Normal Form

G1 :
S → ABCD
A→ ε | aA
B→ Ab
C→ A | aaB
D→ aA |B

G2:
S → aBCb | Bb
B→ abB |C
C→ aa | Da |aBB | ε
D→ aD

G3:
S → ASB | ε
A→ a| aAS
B→ SbS | A | bb

Exercise 6: Eliminate left recursion from the following grammars

S → AB	S → Aa | B	S → Aa | Bb | c
A → Aa | b	A → Bb | Sc | ϵ	A → Bd | ϵ
B → c	B → d	B → Ae | ϵ

Exercise 7 Convert the following grammars to Greibach Normal Form

G1	S →BA A →BB | a B →AA	G2	S →AB | a A →BS B →AA |b	G3	S →AB | a A →BS |b B →SA |a	G4	S →CA | BB B →SB |b A →a C →b

Exercise 8:

Prove that the languages above are not algebraic

a. $L = \{a^i b^j c^k \mid i < j < k\}$

b. $L = \{a^i b^j \mid j = i^2\}$