17 (I) $\Sigma = \{a, b, A, B\}$ ← The alphabet of the grammar

$P = \{ AB ::= ABA,\ B ::= A,\ A :: ab \}$ ← The production rules

$$AB \rightarrow ABA \rightarrow AAA \rightarrow abAA$$

applying $B ::= A$

a derivation

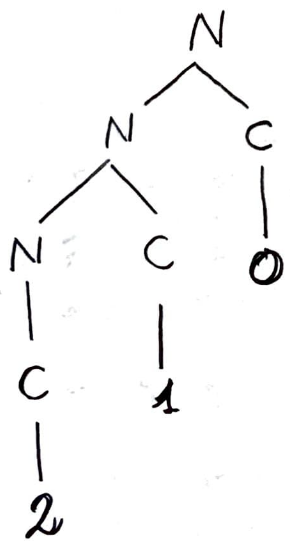
(II) We can write

$$AB \overset{+}{\rightarrow} abAA$$

It is a derivation of length 3

(III) $S \rightarrow AB \rightarrow AxB \rightarrow Axz \rightarrow yxz$

(IV)



Derivation tree

$$N \rightarrow NC \rightarrow NCC \rightarrow CCC \rightarrow 2CC \rightarrow 21C \rightarrow 210$$

Sequence of direct derivations

(I) $G_1 = \{\{1,0\}, \{A\}, A, P\}$

$P = \{ A ::= 10 \}$

$G_2 = \{\{1,0\}, \{A,B,C, A, P\}$

$P = \{ A ::= BC, B ::= 1, C ::= 0 \}$

$G_1 \approx G_2 \quad L(G_1) = L(G_2) = \{10\}$

(II)

$$S \longrightarrow AB \longrightarrow Ax\underline{B} \longrightarrow Ax\overset{u}{\underline{z}} \longrightarrow yxz$$

Call B, U

z is a sentence of the sentential form AxB with respect to B

In the theory x is AX y is λ $\quad \underset{x}{\underline{A}}\, x\, B\, \overset{U}{\underset{y}{\lambda}}$

(II)

Type 0

$P = \{ ABC ::= A, \; A ::= 1, \; B ::= 0, \; C ::= 0 \}$

this rule is not valid for types 1, 2 or 3

Type 1

$P = \{ AB ::= aB, \; A ::= aAB | aB | a, \; B ::= b \}$

this rule is not valid for types 2 or 3

Type 2

$P = \{ A ::= AB, \; A ::= 1, \; B ::= 0 \}$

this rule is not valid for type 3

Type 3

$P = \{ A ::= Ba, \; B ::= b \}$

All the rules valid for one type are valid for the grammars in the upper layers.

19

(I) $S \rightarrow 000S111 \rightarrow 000000S111111 \rightarrow$

$\rightarrow 000000111111$

word of the language

(II)

$ab\,B\,bac ::= ab\,BDF\,bac$

$abBbac ::= ab\,bac$

Compressing rule

(III)

$CB ::= BC$

If the NT is C then

$\lambda CB ::= \lambda BC$

Not equal

If the NT is B

$CB\lambda ::= BC\lambda$

Not equal

(IV)

$A ::= aB$ $\qquad \lambda A\lambda ::= \lambda aB\lambda$