(I) $AO ::= 1B1$

$\lambda AO ::= \lambda 1B1$ No context

(II) $1B1 ::= 101$ $1B1 ::= 111$

(III) $P = \{S ::= 1B \mid 1,\ B ::= 0S\}$

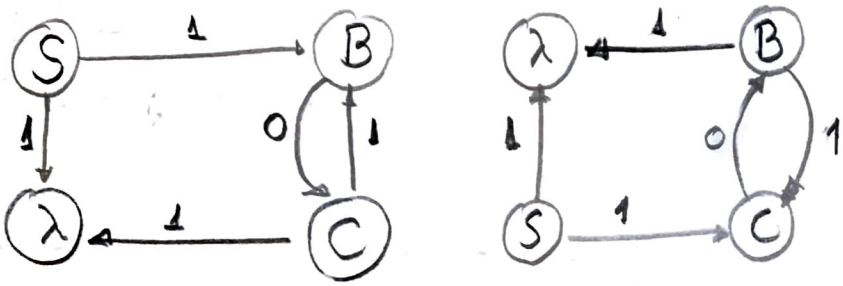
1. ~~$B ::= 0S$~~

2 and 3. $C ::= 1B \mid 1$

4. $B ::= 0C$

New $P = \{S ::= 1B \mid 1,\ C ::= 1B \mid 1,$
$B ::= 0C\}$

(IV)



$P = \{S ::= C1 \mid 1,\ B ::= C1 \mid 1,\ C ::= B0\}$

(2.1) (I)

$\{S ::= a,\ S ::= aB,\ C ::= Sa,\ B ::= b\}$

C: unreachable

$\therefore$ never on the right side

$\{S ::= a,\ S ::= aB,\ C ::= Sa,\ D ::= DC,\ B ::= b\}$

C, D: unreachable both, but they appear on a right side

(II) CNF example

$P = \{ A ::= aBDd,\ D ::= d \mid a,\ B ::= e \}$

$D ::= d \mid a$, $B ::= e$: CNF

Transforming $A ::= aBDd$,

$A ::= DBDd$ WRONG — also produces d

New E

new rule → $A ::= EBDd$, $E ::= a$ ← new rule

new rule → $A ::= EBDF$ $F ::= d$ ← new rule

New G

new rule → $A ::= GDF$ $G ::= EB$ ← new rule

New H

new rule → $A ::= GH$ $H ::= DF$ ← new rule

$P' = \{ A ::= GH,\ G ::= EB,\ H ::= DF,\ E ::= a,\ F ::= d,$
$D ::= d \mid a,\ B ::= e \}$

↑ in CNF

(I)

$$A ::= \beta_1 \mid \beta_2 \mid \beta_1 X \mid \beta_2 X$$
$$X ::= \alpha_1 \mid \alpha_2 \mid \alpha_1 X \mid \alpha_2 X$$

TRANSFORM

$$A ::= A\alpha_1 \mid A\alpha_2 \mid \beta_1 \mid \beta_2$$

Example

$$A ::= ABc \mid Ab \mid DFa$$

$$A ::= \overbrace{DFa}^{\beta_1} \mid \overbrace{DFa}^{\beta_1} X$$

$$X ::= \underbrace{Bc}_{\alpha_1} \mid \underbrace{b}_{\alpha_2} \mid \underbrace{Bc}_{\alpha_1} X \mid \underbrace{b}_{\alpha_2} X$$

(II)

$$P = \{ A ::= \overset{①}{BCa},\ B ::= \overset{②}{Cb},\ C ::= \overset{③}{Ab},\ B ::= a,\ C ::= b \}$$

$\Sigma_{NT} = \{ A, B, C \}$ ← ordered set

A precedes B in ① B precedes C in ②

but C precedes A in ③

Contradiction in the order in the set, but it is the best ordering