(V, Σ, R, S)

V variables
Σ terminals
R rules $V \longrightarrow (V \cup \Sigma)^*$
$S \in V$

$V \cap \Sigma = \emptyset$

derivation

$A \rightarrow 0A1$

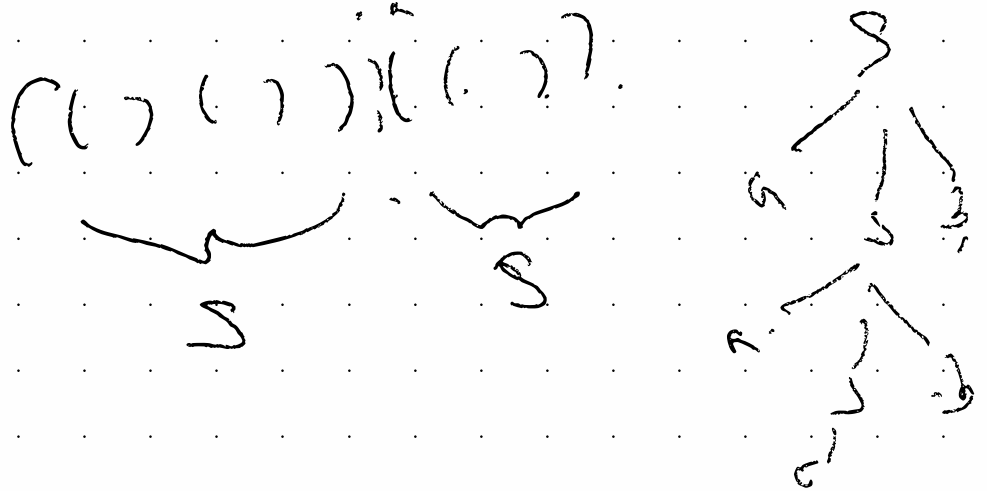
$A \rightarrow B$

$B \rightarrow \#$

$A \rightarrow 0A1 \Rightarrow 0B1 \rightarrow$

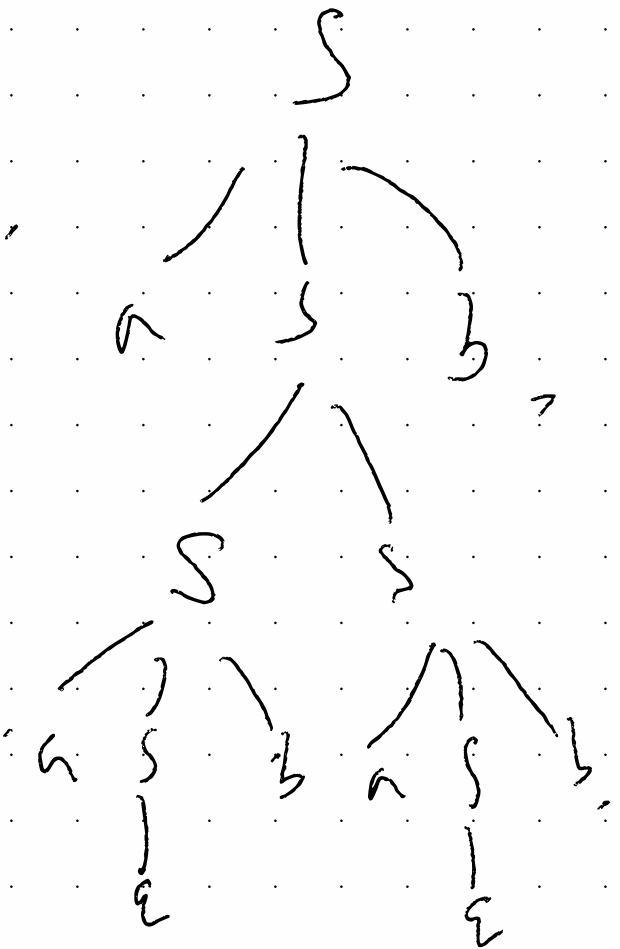
$G_3 = \langle \{S\}, \{a, b\}, R, S \rangle$

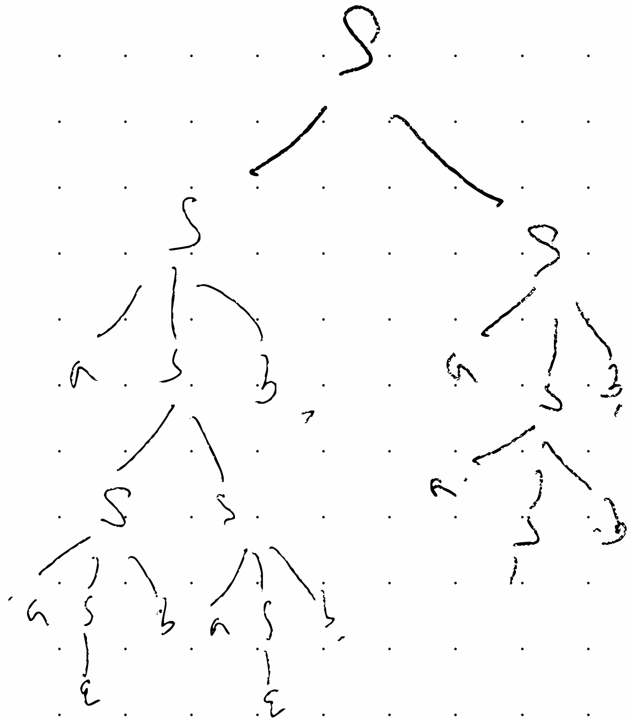
$S \to aSb \mid SS \mid \varepsilon$



(( ) ( ))

a a b a b





a a b a b b a a b b

(( ) ( )) (( ))

$\{ s \in \{0,1\}^* \mid \#\text{ of } 0\text{'s} = \#\text{ of } 1\text{'s} \}$

$S \to \varepsilon \mid SS \mid 0S1 \mid 1S0$

check this out for me.

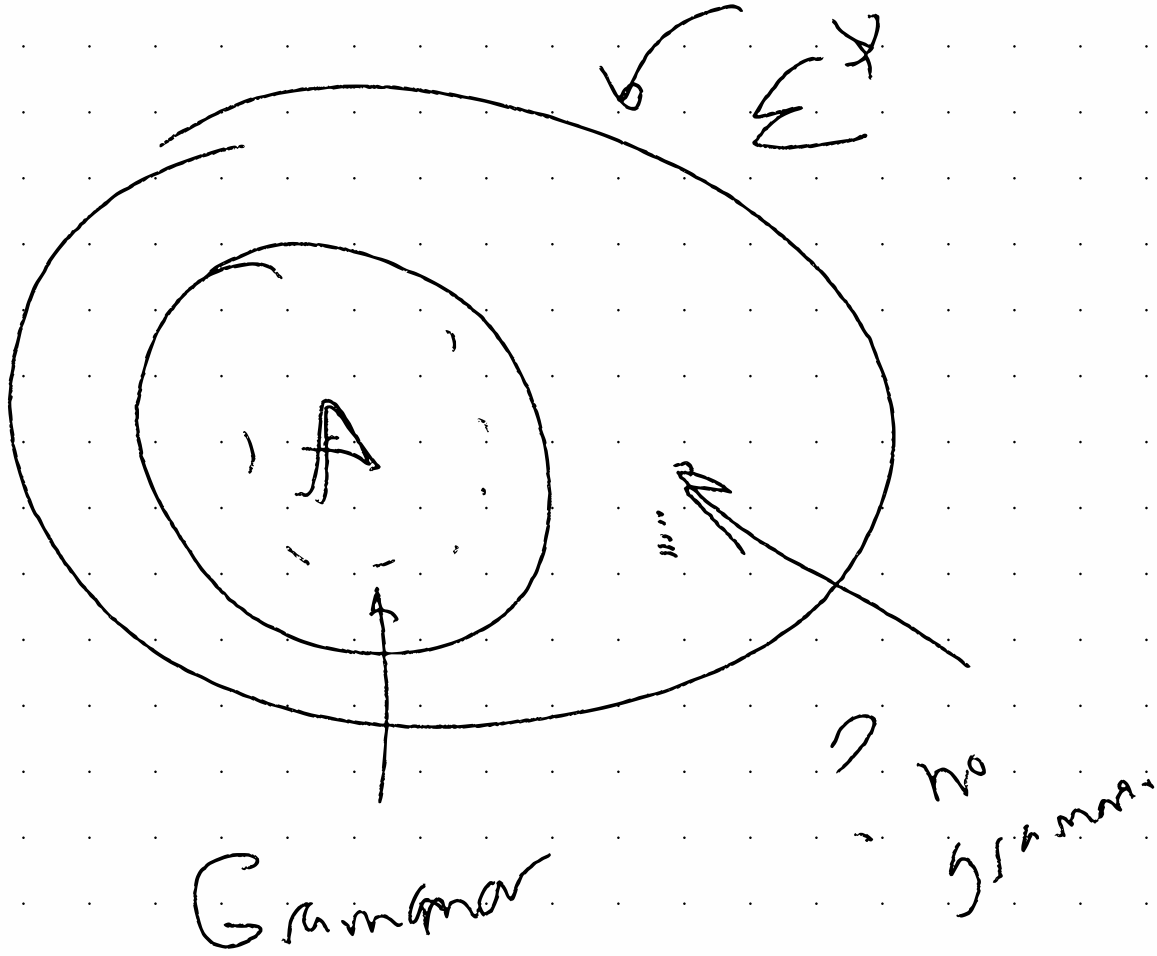
Closure properties

$A \subseteq \Sigma^*$ if A regular

$\Leftarrow$

$\Rightarrow A^*$ is also regular

$\cup$ $\cap$ $\circ$, complement-


Σ^*
A
Grammar

CFL's are not closed by complement,

there might be no grammar for un-grammatical statements

Why is every Reg.
Lang also a CFL ?

?

$$\left(V^A, \Sigma, R^A, S^A \in V^A\right)$$
$$\left(V^B, \Sigma, R^B, S^B \in V^B\right)$$

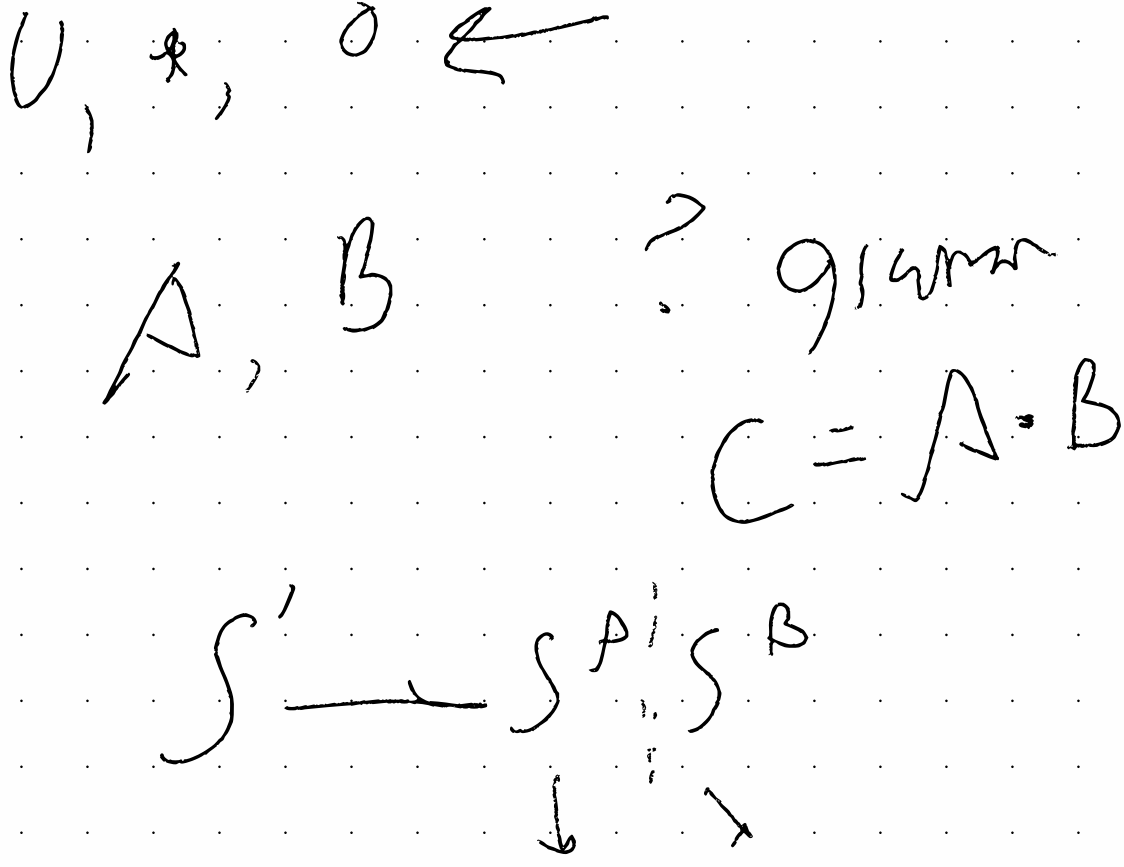
$$S \longrightarrow S^A \mid S^B \qquad V = V^A \amalg V^B$$
$$R = R^A \amalg R^B$$

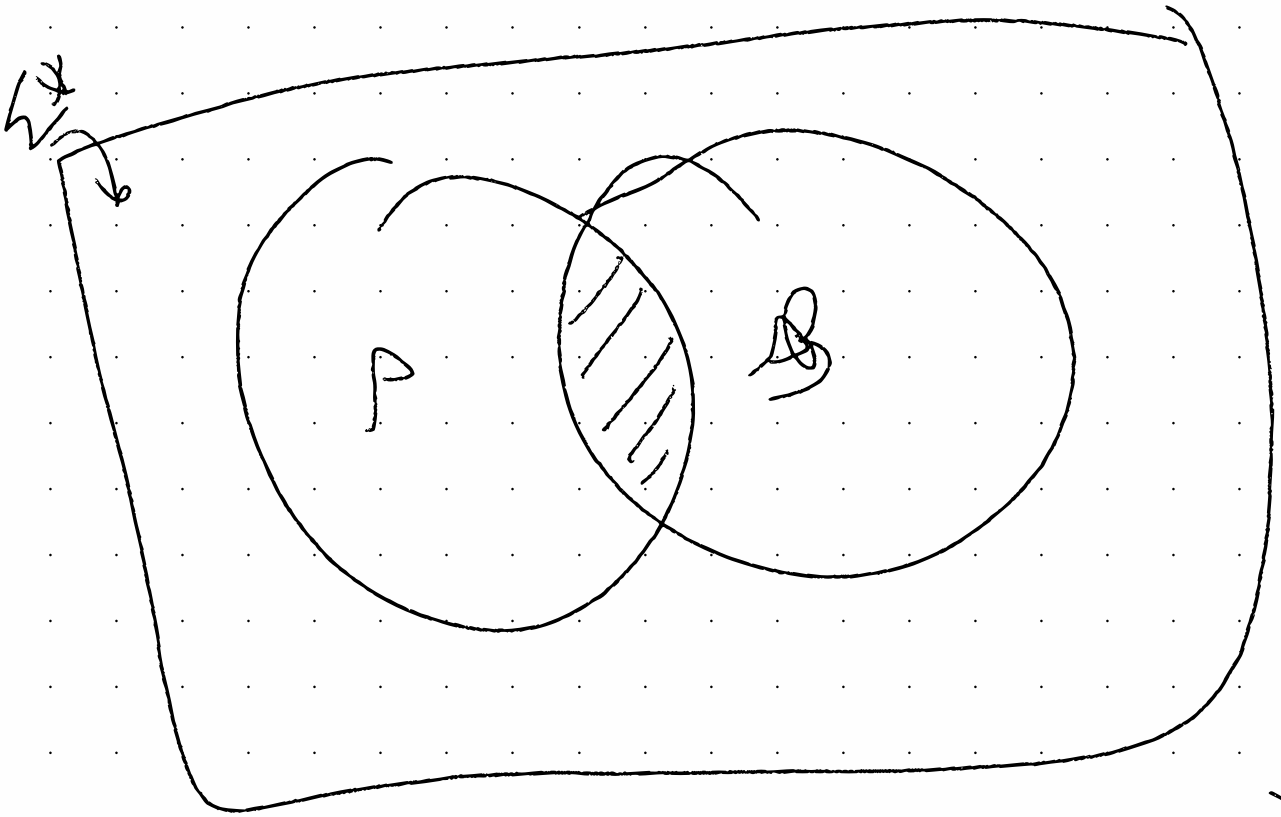
$L = (V, \Sigma, R, S)$

$(L)^*$

$S' \rightarrow S'S \mid \varepsilon$

$S' \rightarrow S'S \rightarrow S'S \rightarrow S'S \rightarrow \varepsilon S \varepsilon S \varepsilon S \varepsilon S$


U, *, 0
A, B
?
C = A * B
S'
S^A
S^B



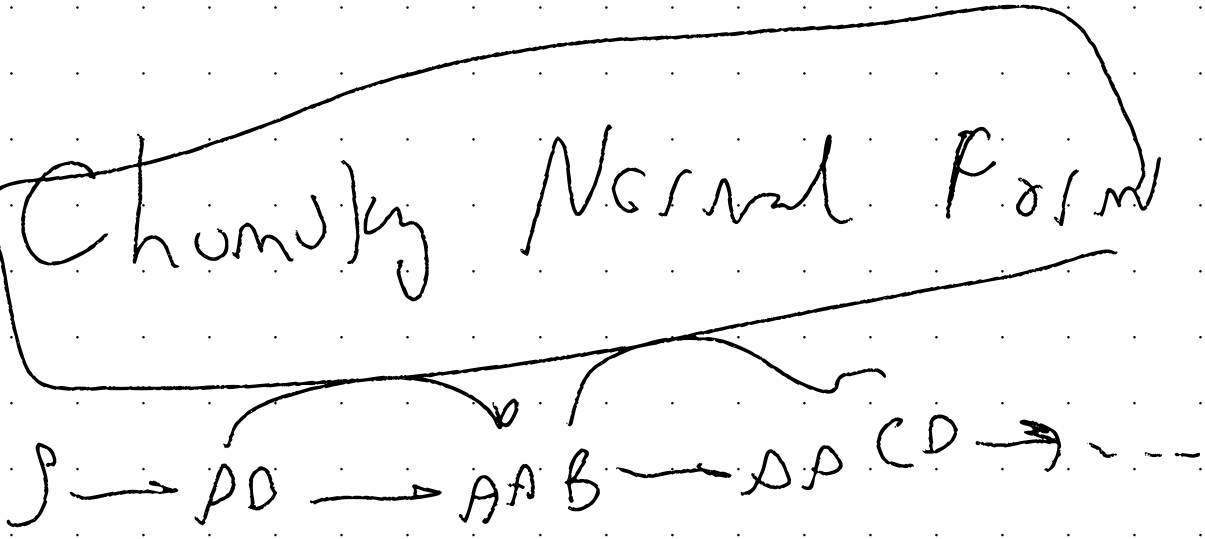
$$P \cap B = \sim(\sim P \vee \sim B)$$

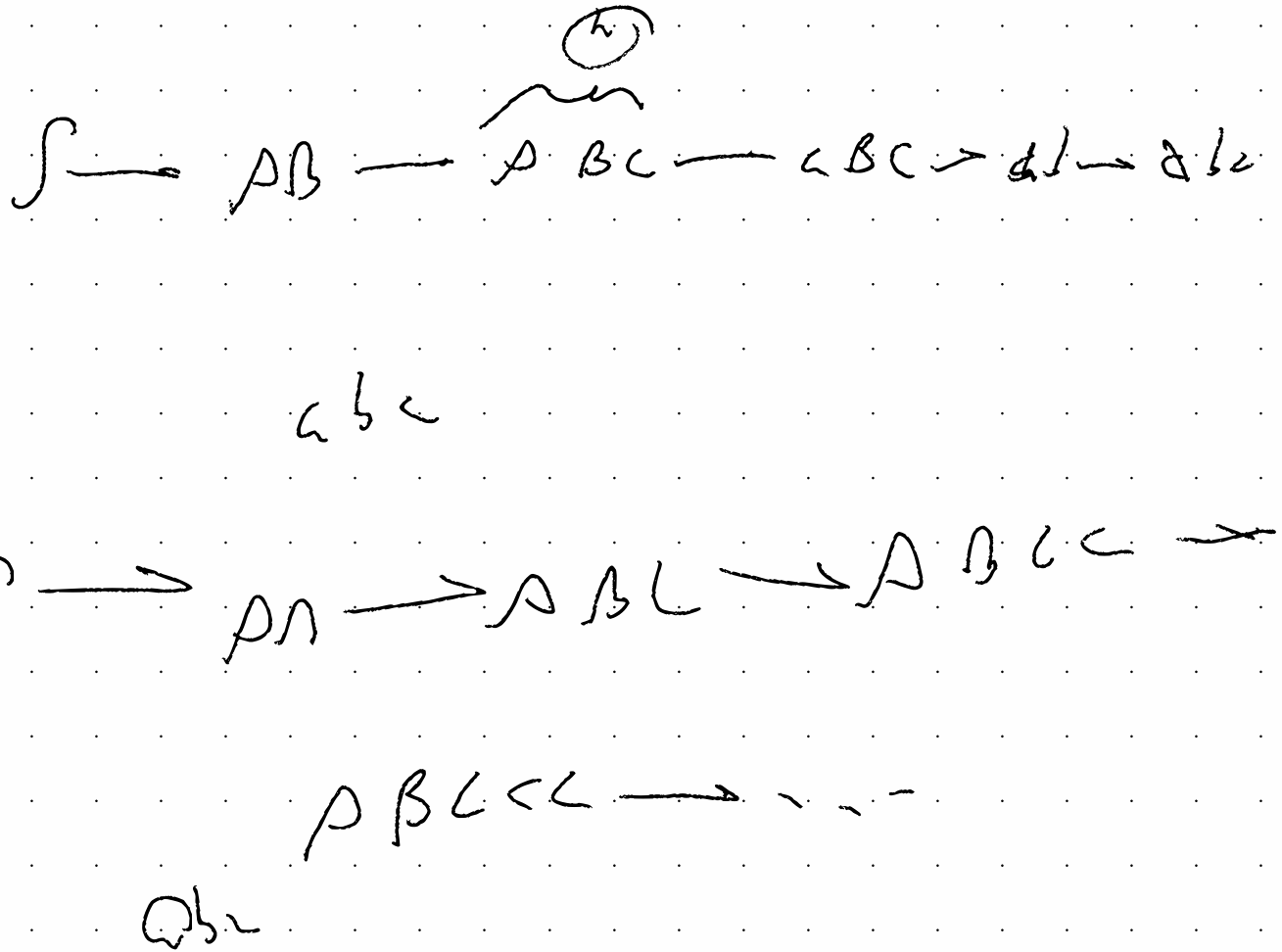
$$X = \{ 0^i 1^i 2^j \mid i, j \geq 0 \}$$

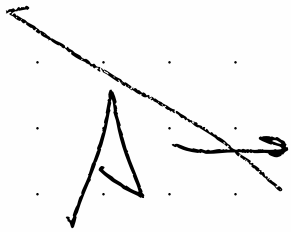
$$Y = \{ 0^i 1^j 2^j \mid i, j \geq 0 \}$$

$$X \cap Y = \{ 0^i 1^i 2^i \mid i \geq 0 \}$$

Chomsky Normal Form





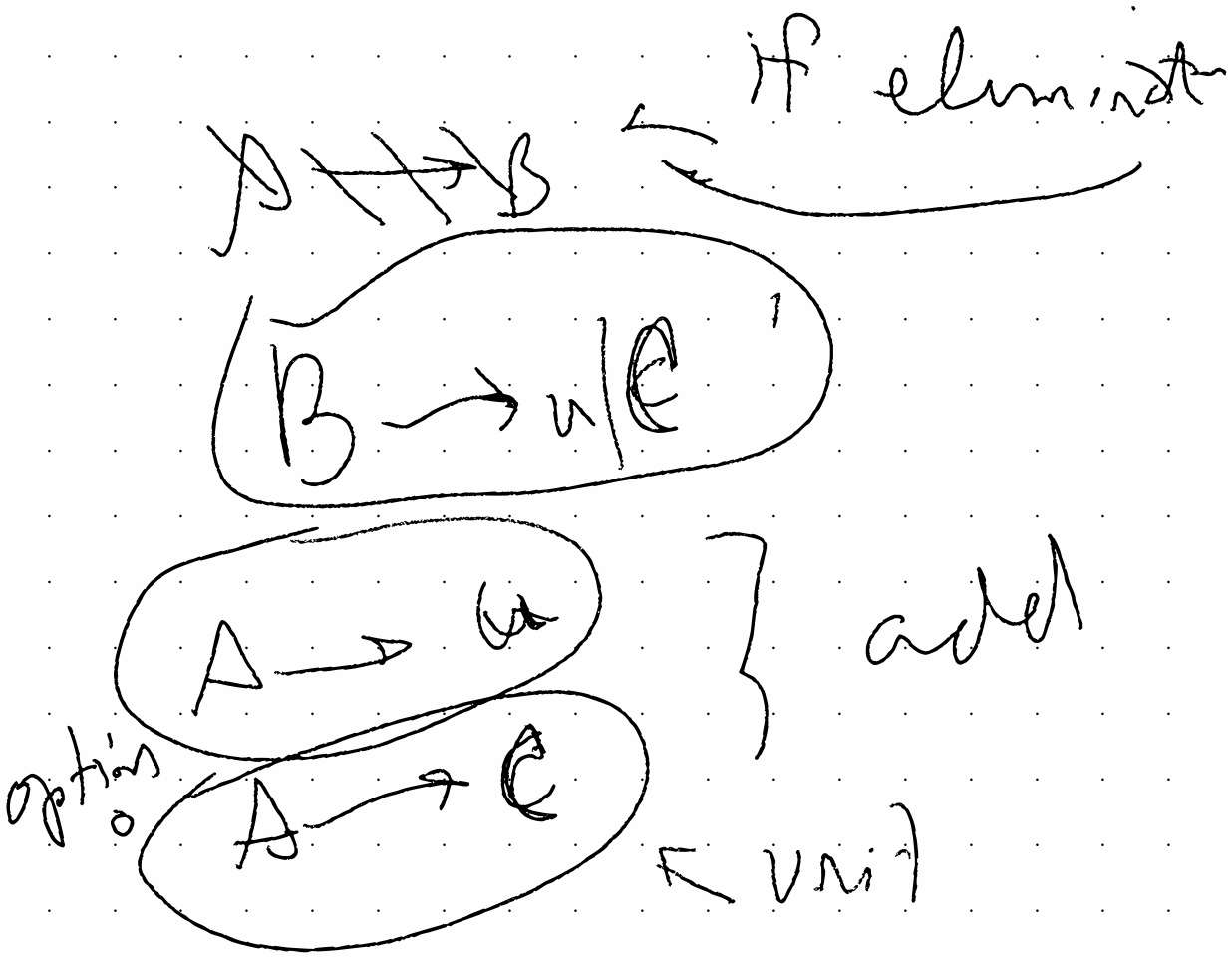


elimite

$R \to uAv \mid uv$

$R \to uAvAw \mid uvAw \mid uAvw$

$\mid uvw \mid \not{\varepsilon} \mid \varepsilon$


if eliminate
A → B
B → u | ε
A → u
A → ε
option
add
unit

$A \longrightarrow u, u_2 \cdots u_k \qquad k \geq 2$

$A \longrightarrow a$ (terminal)

$\Longrightarrow$

$A \not\longrightarrow aB \qquad A \longrightarrow u_a B$

$u_1 \longrightarrow a$

$A \longrightarrow u_a B \longrightarrow aB$

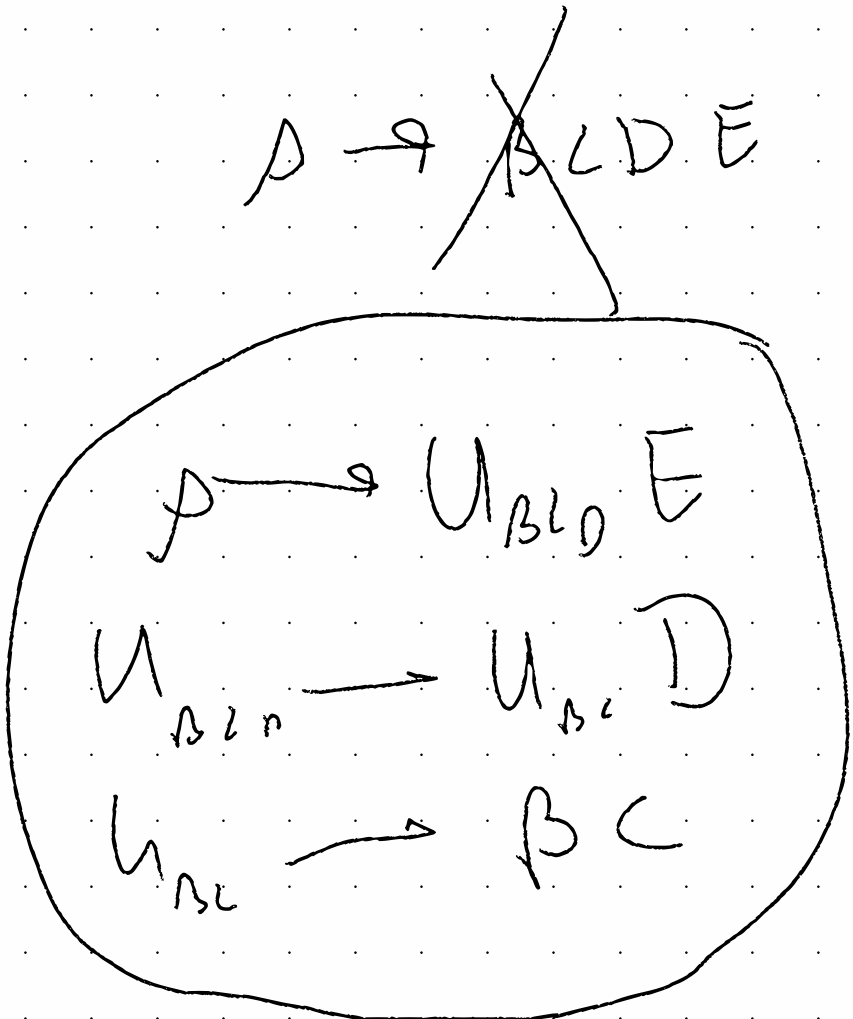
$A \rightarrow u_1, u_2 \dots u_k \quad k \geq 2$

$u_i \in V$

$A \rightarrow BCD$

$A \rightarrow u_{Bc} D$

$u_B \rightarrow Bc$


A → ~~B C D E~~
A → U_BLD E
U_BLn → U_BL D
U_BL → B C