ssumption:

$\in \mathcal{L}(G)$

Pumping Lemma for CFL (Proof of Pumping Lem

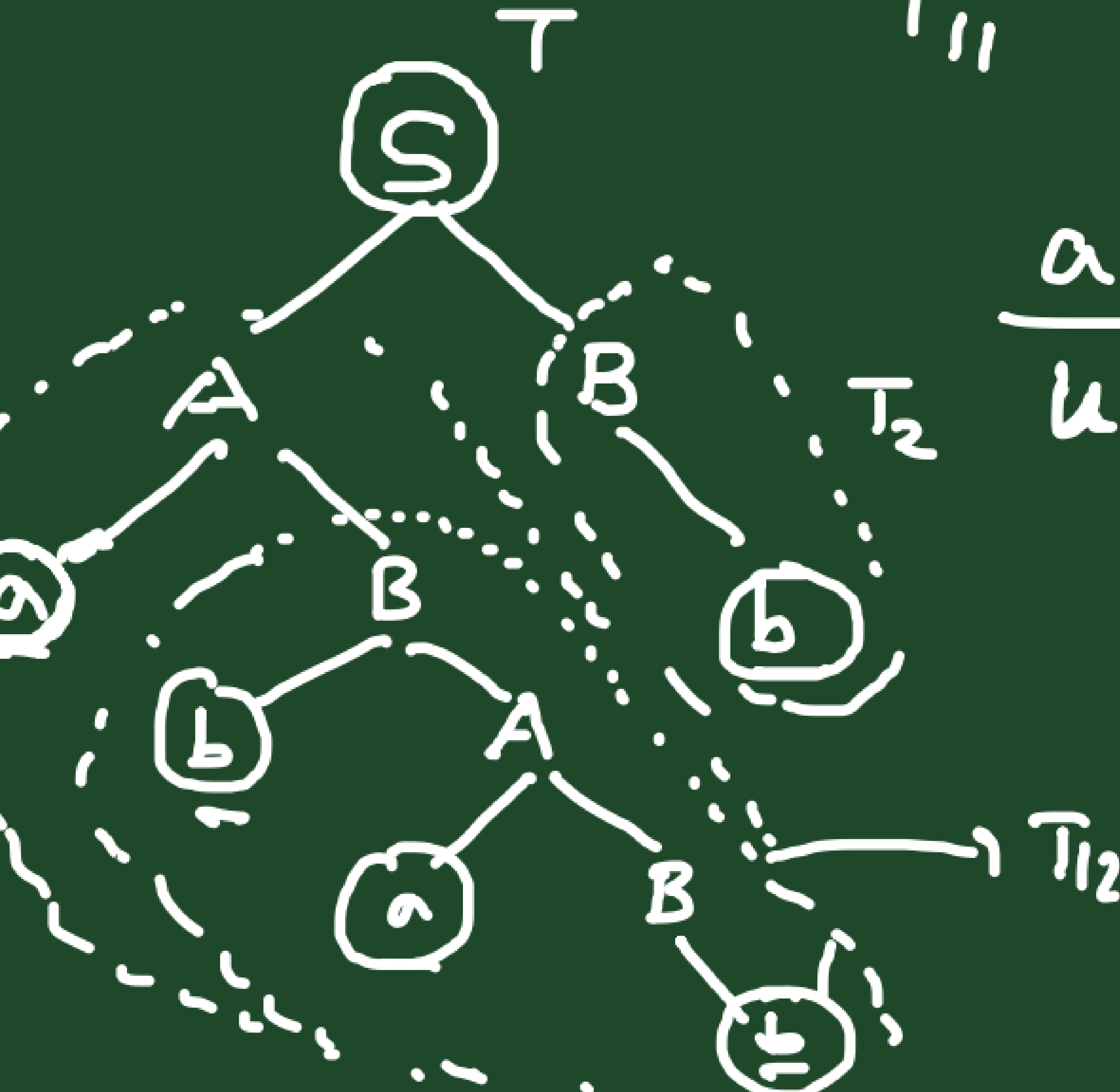
① $|w| \leq 2^{n-1}$

②

T_{11} $\quad$ T_{12} $\quad$ u

$z = \underset{a}{u}\; z_1\; \underset{b}{y}$

ϵ



a	b a	b	b	
u	v	w	x	y

$z_1 = ba$

$|vw$

z is a yield of T

z_1 is a yield of T_{12}

$|v$

Pumping Lemma Infinite Language

$\Longrightarrow$ a B B

$\Longrightarrow$ a b A B

$\Longrightarrow$ a b a B B

$\Longrightarrow$ a b a

$$u v^k w x^k y$$

written as $uvwxy$ for some strings
u, v, w, x, y

(ii) $|vx| \geq 1$ or $vx \notin \epsilon$ or $|vx| > 0$

(iii) $|vwx| \leq n$

(iv) $uv^k wx^k y \in L$ for all $k \geq 0$

Step2

$$z = a^n b^n c^n$$

$$|z| = 3n > n$$

We break z into u, v, w, x, y str

$$z = uvwxy$$

Step 3

$$|vwx| \le n \quad \text{and} \quad |vx| \ge 1$$

& b's than number of c's

case2 $\underline{v = a^i b^j}$ / $\underline{x = b^i c^j}$

ϵ ✓

✓ ϵ

$uv^k w x^k y \notin L$

▷ Illegal substring

$a\ \underline{aa}\ \underline{abab}\ |\ bbccc$

$\notin L$

u v ϵ x y

$\underline{K = 2}$

$|vwx| \leq n$

$|vx| \geq 1$

$\underline{|aab| = }$

Step 2 $\quad z = a^p \qquad |z| = p \geq n$

and we can write

a a a a a a

$z = uvwxy$ for some stri

u, v, w, x, y

$|vwx| \leq n$ and $|vx| \geq 1$

$$|uv^q w x^q y| = |uwy| + q|vx|$$

$$= q + qr$$

$$= \underline{q(1+r)} \text{ is not a prime number}$$

So, $uv^q w x^q y \notin L$. Assumption was wrong. L is not a CFL.

② Complement:

is a CFL and L_2 is a CFL $L_1 \cup L_2$ is a CF

$A \to aA \mid a$

$B \to bB \mid b$

CFL $\mathcal{L}_2$

$\boxed{S \to \underline{S_1} \mid}$

Rename the NTs of G_1

$S_1 \to aS_1 \mid S_1S_1 \mid A_1S_1 \mid \epsilon$

$A_1 \to A_1A_1 \mid b$

Rename the NTs of G_2

$S_2 \to A_2S_2 \mid S_2B_2 \mid \epsilon$

$A_2 \to aA_2 \mid a$, $B_2 \to bB_2$

$$\boxed{S \to S_1 S_2}$$

L is a CFL, L^* is a CFL

$$\boxed{S \to S_1 S \mid \epsilon}$$

$S \to aSa \mid bSb \mid a \mid$

$S_1 \to aS_1a \mid bS_1b \mid a$