$L = \{a^n b^n \mid n \geq 0\}$ find CFG in CNF

$G = \{V, T, P, S\}$

$V = \{S\}$

$S = S$

$T = \{a, b, \epsilon\}$

Productions :

$$S \rightarrow aSb \mid \epsilon$$

CNF : (CNF will not have ϵ)

Step 1: Simplify Grammar by eliminating useless symbols/ episilon

Nullable variable = $\{S\}$ ... ∵ contains ϵ

$S \rightarrow aSb \mid A$

$A \rightarrow ab$

Step 2: Simplify RHS of production

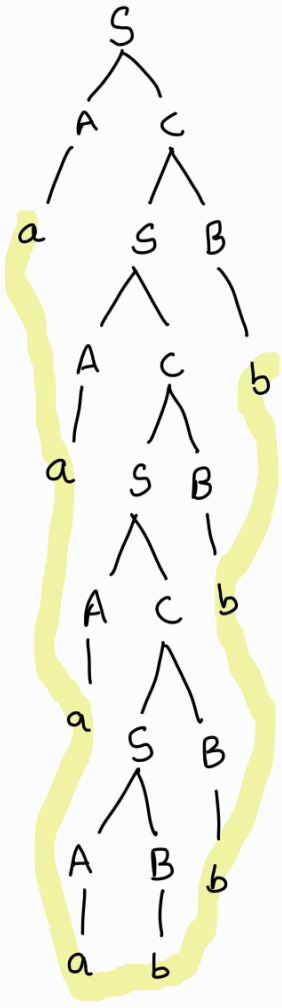
$S \rightarrow AB \mid AC$

$A \rightarrow a$

$B \rightarrow b$

$C \rightarrow SB$

Q. Derive a^4b^4



a^4b^4

Find CFG for $a^n b^{2n}$ where $n \geq 0$

CFG:

$G = \{V, T, P, S\}$

$V = \{S\}$

$T = \{a, b, \epsilon\}$

$S = S$

Productions:

$S \rightarrow aSbb \mid \epsilon$

② Find CFG for $L = a^n b^m \mid n \neq m$

$S \rightarrow aSb \mid A \mid B \quad | \quad A \rightarrow Aa \mid \epsilon \quad | \quad B \rightarrow Bb \mid \epsilon$

$G = \{V, T, P, S\}$

$V = \{S\}$

$T = \{a, b, \epsilon\}$

$S = \{s\}$

Productions:

$L_1 \Rightarrow$ for $L = a^n b^m \mid n > m$

$S_1 \rightarrow aSb \mid A$

$A \rightarrow Aa \mid \epsilon$

for $L_2 \Rightarrow L = a^n b^m \mid n < m$

$S_2 \rightarrow aSb \mid B$

$B \rightarrow Bb \mid \epsilon$

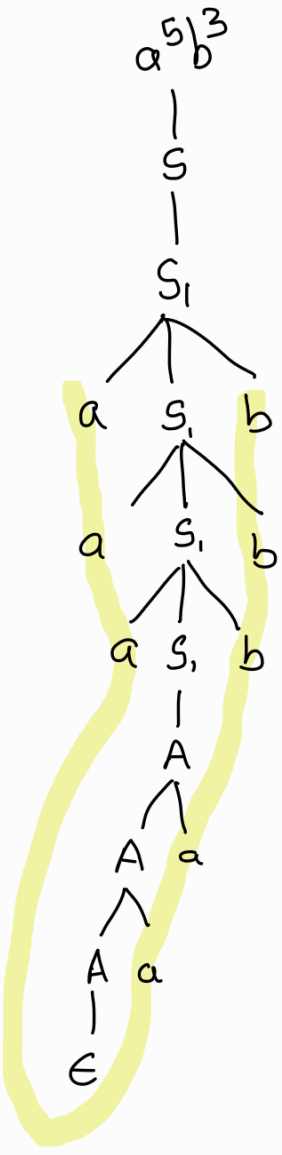
$S \rightarrow S_1 \mid S_2$

$S_1 \rightarrow aS_1b \mid A$

$A \rightarrow Aa \mid \epsilon$

$S_2 \rightarrow aS_2b \mid B$

$B \rightarrow Bb \mid \epsilon$



Ma'am's Solution →

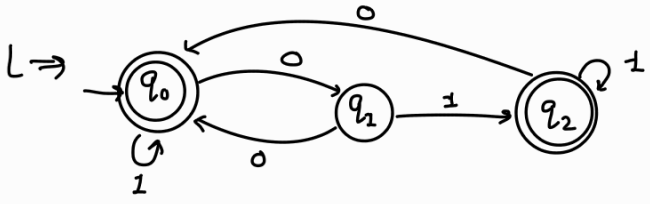
$S \rightarrow aSb \mid SS \mid \epsilon$

string → a aabbb

$S \Rightarrow aSb$
$\Rightarrow aaSbb$
$\Rightarrow aaa\epsilon bbb$
$\Rightarrow aaabbb$

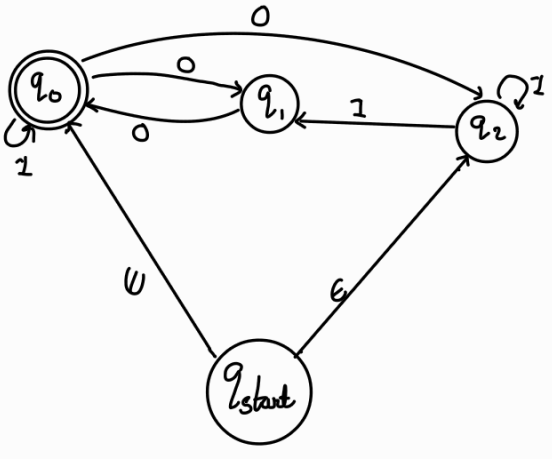
$S \Rightarrow aSb$
$\Rightarrow aSSb$
$\Rightarrow aaSbSb$
$\Rightarrow aaSbSb$
$\Rightarrow aaaSbbSb$
$\Rightarrow aaa\epsilon bbSb$
$\Rightarrow aaabb\epsilon b$
$\Rightarrow aaabbb$

Find Regular expression for L_R



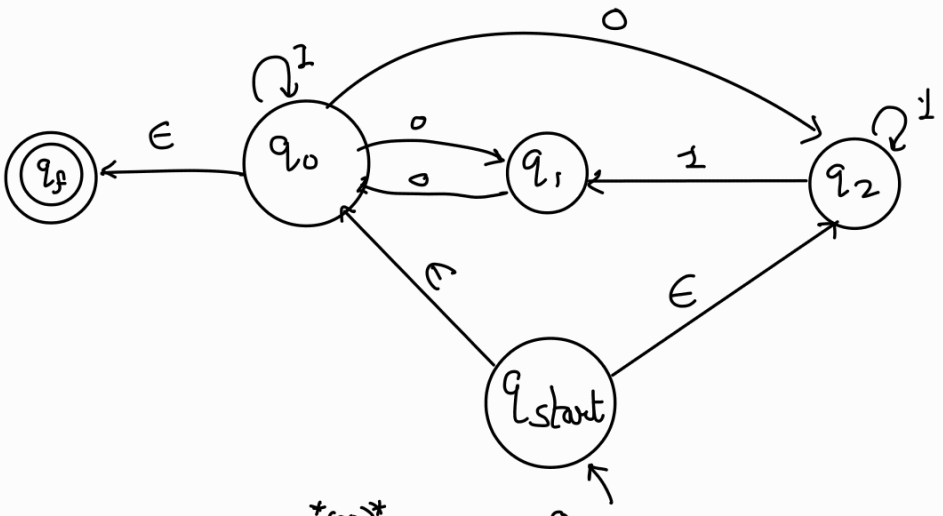
L

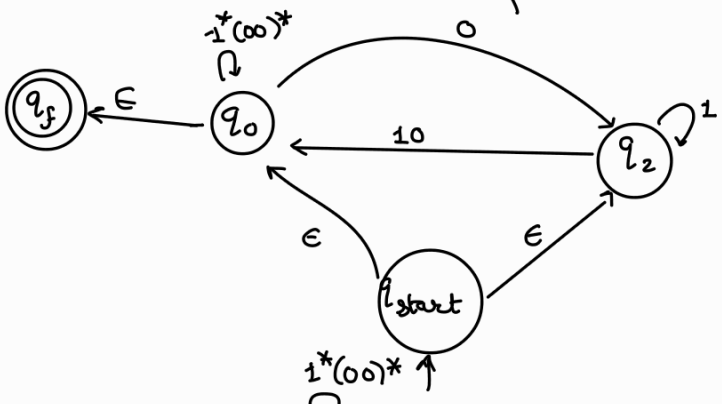
L_R

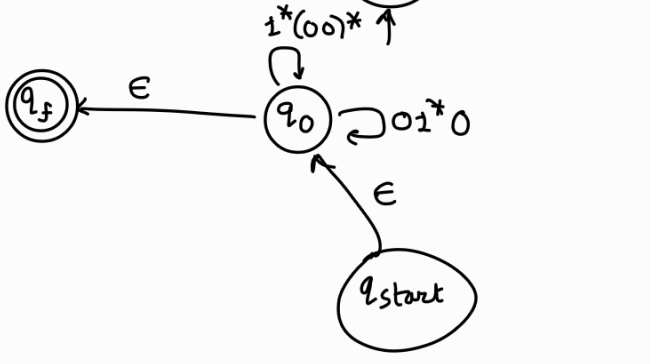


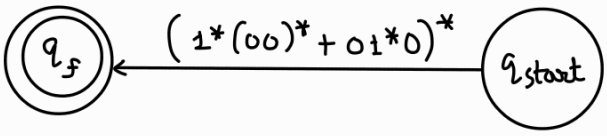
Regular Expression:

Step 3: Final mustn't have any outgoing edges.









$\therefore$ Regex $\Rightarrow (1^*(00)^* + 01^*0)^*$