CFG

Q: $L = \{ w \in \{a,b,c\}^* : w = a^i b^j c^k$, where $i=j$ or $j=k$ and $i,j,k \geq 0 \}$

Starting variable → should be at first line

$S \longrightarrow X \mid Y$

$i=j$, $a^i b^i c^k$

$X \longrightarrow PQ$

$P \longrightarrow aPb \mid \epsilon$

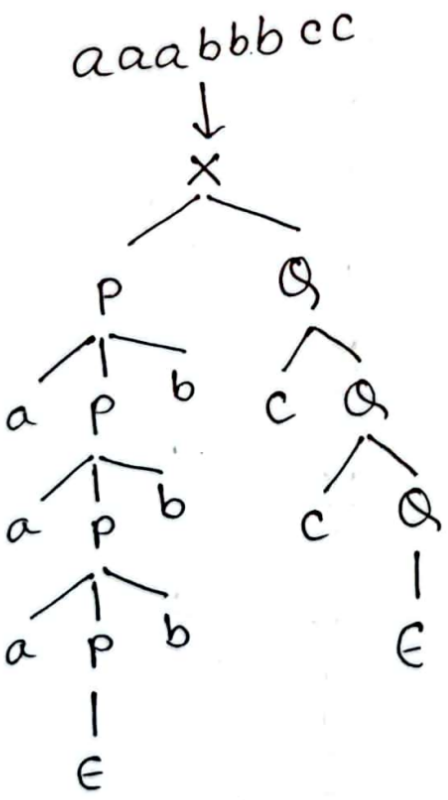
$Q \longrightarrow cQ \mid \epsilon$

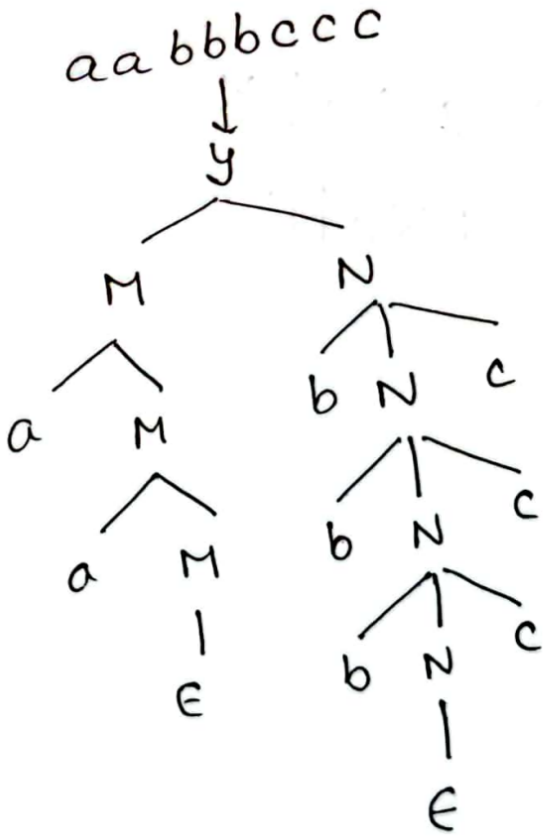
$Y \longrightarrow MN$

$M \longrightarrow aM \mid \epsilon$

$N \longrightarrow bNc \mid \epsilon$

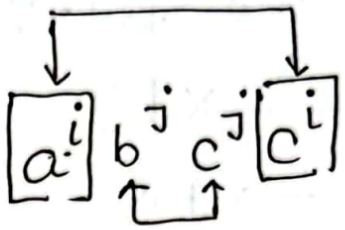
$j=k$, $a^i b^k c^k$





Q: $L = \{\omega \in \{a,b,c\}^* : \omega = a^i b^j c^k$, where $i+j=k$ and $i, j \geq 0\}$

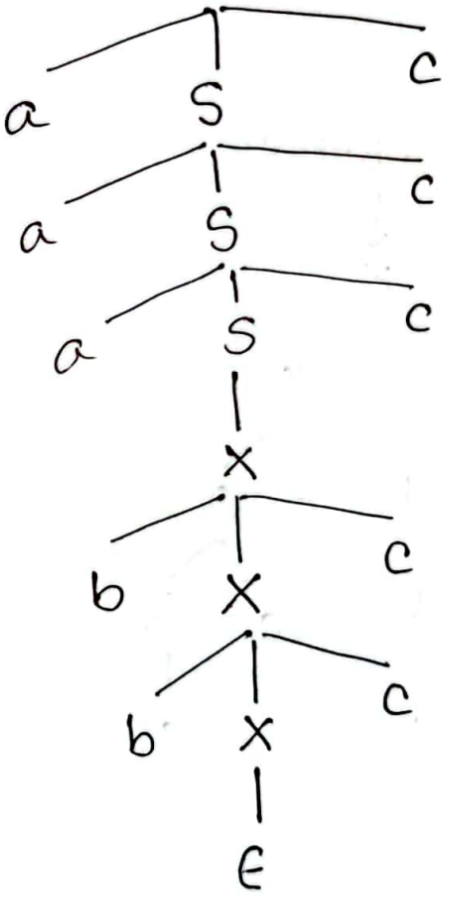
$$\omega = a^i b^j c^k$$
$$= a^i b^j c^{i+j}$$
$$= a^i b^j c^i c^j$$
$$= a^i b^j c^j c^i$$



$S \longrightarrow aSc \mid X$

$X \longrightarrow bXc \mid \epsilon$

aaa bb cc ~~ccc~~ ~~aaa~~



Qs: $L = \{\omega \in \{0,1\}^* : \omega = 0^i 1^j 0^k$, where $j = i+k$ and $i, k \geq 0\}$

$\omega = 0^i 1^j 0^k$

$= 0^i 1^{i+k} 0^k$

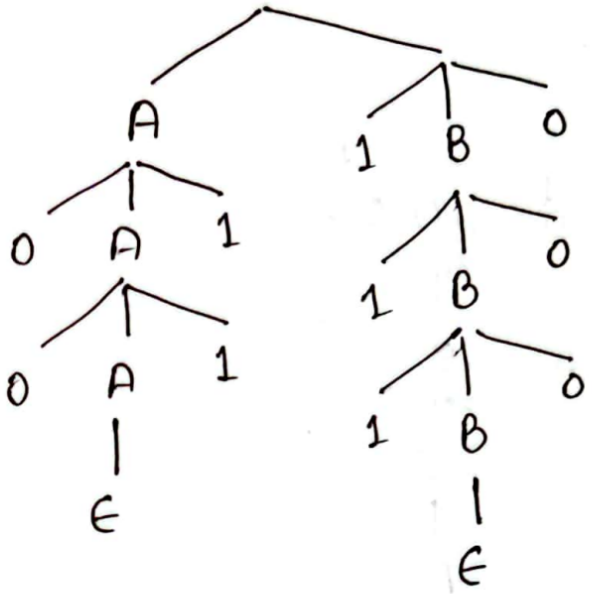
$= 0^i 1^i 1^k 0^k$

$S \longrightarrow AB$

$A \longrightarrow 0A1 \mid \epsilon$

$B \longrightarrow 1B0 \mid \epsilon$

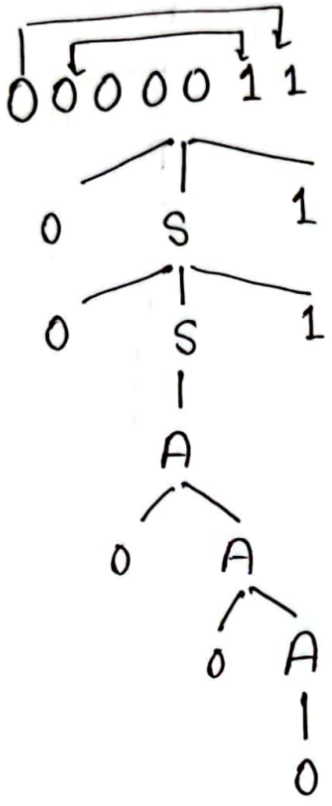
$\frac{0^2}{00} \; \frac{1^2}{11} \; \frac{1^3}{111} \; \frac{0^3}{000}$



Qs: $L = \{\omega \in \{0,1\}^* : \omega = 0^m 1^n$, where $m > n, m \geq 1$ and $n \geq 0\}$

$S \rightarrow 0S1 \mid A$

$A \rightarrow 0A \mid 0$

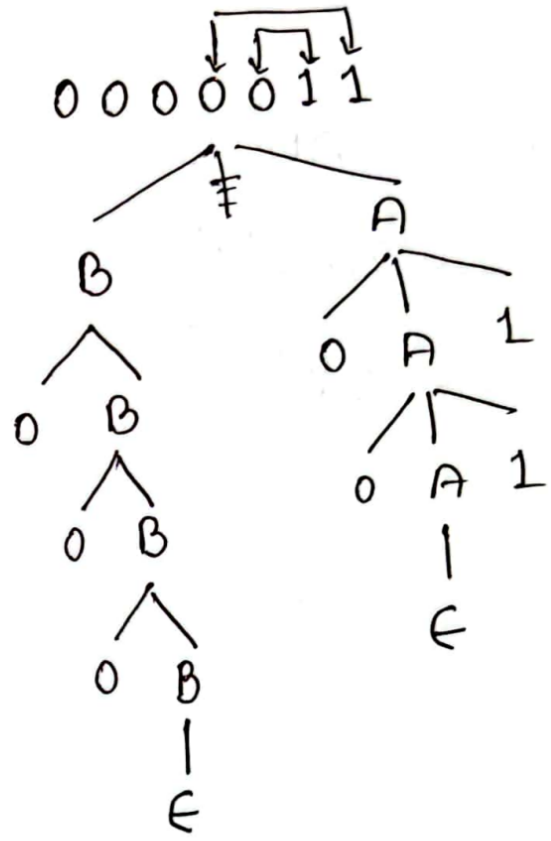


Another approach:

$S \rightarrow BA$

$A \rightarrow 0A1 \mid \epsilon$

$B \rightarrow 0B \mid 0$



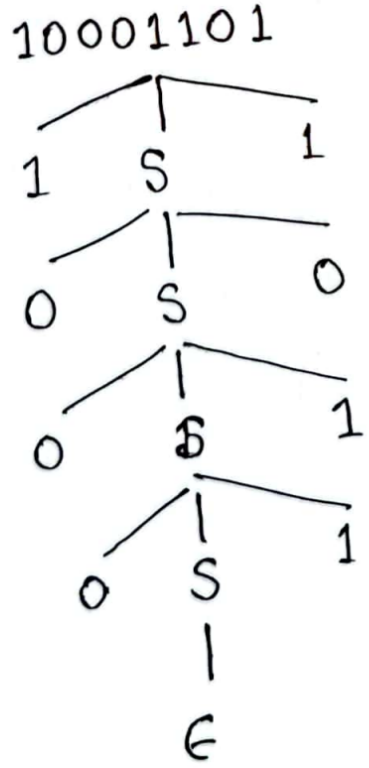
Practice:

$L = \{\omega \in \{0,1\}^* : \omega = 0^m 1^n$, where $m \neq n$ and $m, n \geq 0\}$

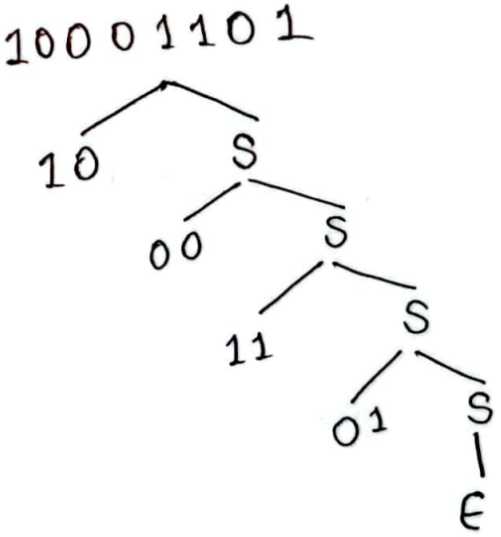
$L = \{\omega \in \{0,1\}^* : \omega = 0^m 1^n$, where $m+n$ = even and $m, n \geq 0\}$

Qs: $L = \{\omega \in \{0,1\}^* :$ the length of ω is Even.$\}$

$S \rightarrow 0S0 \mid 1S0 \mid 0S1 \mid 1S1 \mid \epsilon$



Another Approach:



$S \rightarrow 00S \mid 01S \mid 10S \mid 11S \mid \epsilon$

Practice:

$L = \{w \in \{0,1\}^* :$ the length of w is odd and the mid is $0\}$

$L = \{w \in \{0,1\}^* : w$ contains even numbers of $0s\}$

$L = \{w \in \{0,1\}^* : w$ starts and ends with same symbol$\}$

$L = \{w \in \{0,1\}^* : w$ contains at least ~~three~~ three $1s\}$

$L = \{w \in \{0,1\}^* : w$ contains exactly three $1s\}$

$L = \{w \in \{0,1\}^* : w$ contains at most three $1s\}$