

$$1) m = (\{q_0, q_1\}, \{0, 1\}, \{x, z_0\}, \delta, q_0, z_0, \phi)$$

where δ is given by.

$$\delta(q_0, 0, z_0) = \delta(q_0, x, z_0)$$

$$\delta(q_0, 0, x) = \delta(q_0, x, x)$$

$$\delta(q_0, 1, x) = \delta(q_1, \epsilon, x)$$

$$\delta(q_1, \epsilon, x) = \delta(q_1, \epsilon, \epsilon)$$

$$\delta(q_1, \epsilon, z_0) = \delta(q_1, \epsilon, \epsilon)$$

construct a CFG.

We find CFG $G = (V, T, P, S)$

$$V = \{S, [q_0, x, q_0], [q_0, x, q_1], [q_1, x, q_0], [q_1, x, q_1], [q_0, z_0, q_0], [q_0, z_0, q_1], [q_1, z_0, q_0], [q_1, z_0, q_1]\}$$

$$T = \text{set of inputs } (\epsilon) \quad T = \{0, 1\}$$

$P = \text{set of transition}$

$$q_0 \quad x \quad q_0$$

$$q_0 \quad x \quad q_1$$

$$q_1 \quad x \quad q_0$$

$$q_1 \quad x \quad q_1$$

$$q_0 \quad z_0 \quad q_0$$

$$q_0 \quad z_0 \quad q_1$$

$$q_1 \quad z_0 \quad q_0$$

$$q_1 \quad z_0 \quad q_1$$

$$1) \delta(q_0, 0, z_0) = (q_0, x, z_0)$$

$$[q_0, z_0, q_0] \Rightarrow 0 [q_0, x, q_0] [q_0, z_0, q_0]$$

$$[q_0, z_0, q_0] \rightarrow 0 [q_0, x, q_1] [q_1, z_0, q_0]$$

$$[q_1, z_0, q_1] \rightarrow 0 [q_0, x, q_0] [q_0, z_0, q_1]$$

$$[q_1, z_0, q_1] \rightarrow 0 [q_0, x, q_1] [q_1, z_0, q_1]$$

$$2) \delta(q_0, 0, x) = (q_0, x, x)$$

$$[q_0, x, q_0] \rightarrow 0 [q_0, x, q_0] [q_0, x, q_0]$$

$$[q_0, x, q_0] \rightarrow 0 [q_0, x, q_1] [q_1, x, q_0]$$

$$[q_0, x, q_1] \rightarrow 0 [q_0, x, q_0] [q_0, x, q_1]$$

$$[q_0, x, q_1] \rightarrow 0 [q_0, x, q_1] [q_1, x, q_1]$$

$$3) d(q_0, 1, x) = \{ (q, t) \}. \quad 4) d(q_1, 1, x) = \{ (q, t) \}.$$

$$[q_0, x, q_1] \rightarrow 1. \quad [q_1, x, q_1] \rightarrow 1.$$

$$5) d(q_1, t, x) = \{ (q, t) \}. \quad 6) d(q_1, t, z_0) = \{ (q, t) \}.$$

$$[q_1, x, q_1] \rightarrow t \quad [q_1, z_0, q_1] \rightarrow t$$

$$S \rightarrow [q_0, z_0, q_0]$$

$$S \rightarrow [q_0, z_0, q_1].$$

6)

(ii) $L = \{ a^n b^n c^n \mid n > 0 \}$ is not a CFL

$$L = \{ a b c \} \text{ for } n=1$$

$$L = \{ a b c, a a b b c c \} \text{ for } n=2.$$

$$L = \{ a b c, a a b b c c, a a a b b b c c c \} \text{ for } n=3.$$

Let L be context free language, then $w \in L$.

$$w = a a a b b b c c c \rightarrow a^3 b^3 c^3 \in L.$$

$$|w| \geq n.$$

$$n \geq 3$$

split the string into 5 parts

$$w \in UVxyz.$$

$$\begin{array}{ccccccc} a & a & a & b & b & b & c & c & c \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ u & v & x & y & z & & & & \end{array}$$

$$u \rightarrow a \quad v \rightarrow aa \quad x \rightarrow bb \quad y \rightarrow bc$$

$$z \rightarrow cc.$$

$$|vy| \neq 0$$

$$|vxy| \leq n.$$

$$uv^kxy^kz \notin L.$$

\hookrightarrow not CFL

$$|vy| = 4 \quad 4 \neq 0 \quad \therefore \text{not CFL}$$

$$|vxy| = 6 \quad 6 \leq 9$$

$$k=1 \quad a a a b b b c c c \rightarrow a^3 b^3 c^3 \in L.$$

$k=2$

$a a a a a b b b b b c c c \rightarrow a^5 b^3 c b c^3 \in L$.

When $k=2$.

The string is not belong to L so the language is not CFL

2). Soln:

$L = \{ 0^n, n \mid n \geq 1 \}$.

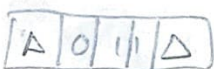
$L = \{ 01, 0011, 000111, \dots \}$

$\Delta \rightarrow \text{Blank}$.

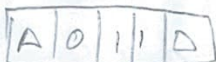
Let take 0011.



$(q_0, 0) = (q_1, A, R)$.



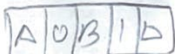
$(q_1, 0) = (q_1, 0, R)$



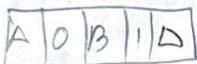
$(q_1, 1) = (q_2, B, L)$



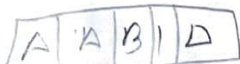
$(q_2, 0) = (q_2, 0, L)$.



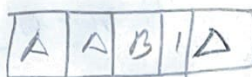
$(q_2, A) = (q_0, A, R)$



$(q_0, 0) = (q_1, A, R)$.



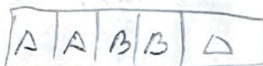
$(q_1, B) = (q_1, B, R)$



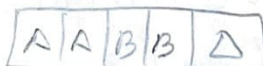
$(q_1, 1) = (q_2, B, L)$.



$(q_2, B) = (q_2, B, L)$



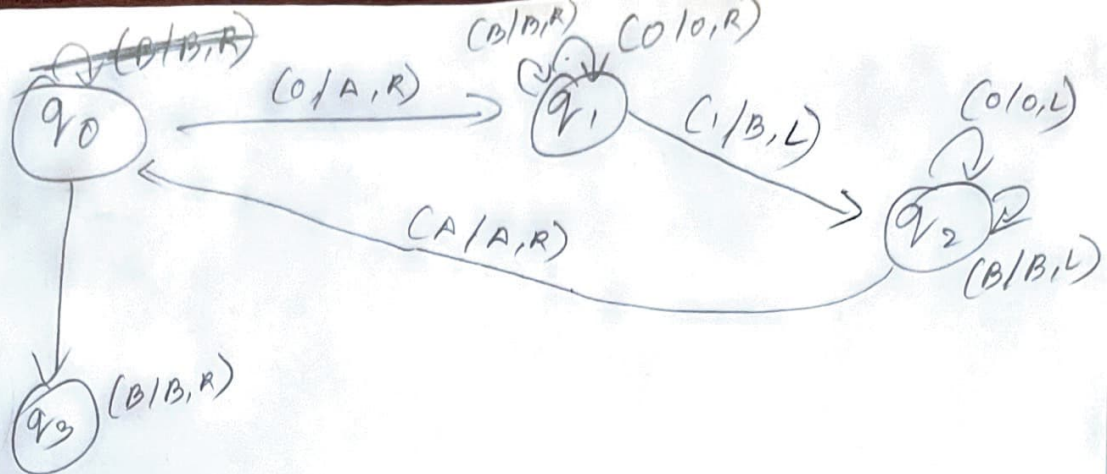
$(q_2, A) = (q_0, A, R)$



$(q_0, B) = (q_3, B, R)$



$\frac{I/O}{\downarrow} / \frac{A, R}{\downarrow} \frac{L, R}{\downarrow}$
In OP DIR.



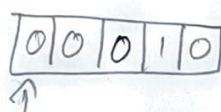
②. Addition :

Let take $3 + 1 = 4$.

$$0^m + 0^n = 0^{m+n}$$

$$m=3 \quad n=1 \quad m+n=4.$$

$$W = 00010$$



$q_0 0 0 0 1 0$

$0 q_0 0 0 1 0$

$0 0 q_0 0 1 0$

$0 0 0 q_0 1 0$

$0 0 0 q_1 0$

$0 0 0 0 q_1 0 B$

$0 0 0 0 0 q_1 B$

$0 0 0 0 0 q_2 0$

$0 0 0 0 0 q_3 B$