

# Context Free Grammar (CFG)

①

$$G = (V, T, P, S)$$

③  $P$  = finite set of productions rules.

①  $V \rightarrow$  Set of variables

$$V \neq \emptyset$$

$$|V| = \text{finite}$$

②  $T$  = Set of terminals

$$T \neq \emptyset$$

$$|T| = \text{finite}$$

$$V \cap T = \emptyset$$

④  $S$  = Starting Variable

$$S \in V$$

P

Example:-

$$G = (\{E\}, \{+, *, (, ), id\}, P, E)$$

(CFG)

②

P:-

$$E \rightarrow E + E$$

$$E \rightarrow E * E$$

$$E \rightarrow (E)$$

$$E \rightarrow id$$

P

Example:-

$$G = (\{E\}, \{+, *, (, ), id\}, P, E)$$

CFG

②-③

P:-

$$E \rightarrow E + E$$

$$E \rightarrow E * E$$

$$E \rightarrow (E)$$

$$E \rightarrow id$$

$$E \Rightarrow E * E$$

$$\Rightarrow (E) * E$$

$$\Rightarrow (E) * id$$

$$\Rightarrow (E + E) * id$$

$$\Rightarrow \cancel{(E)} * (E + id) * id$$

$$\Rightarrow \underline{\underline{(id + id) * id}}$$

P

Example:-

Palindromes

④

$\epsilon, 0, 1$

$\epsilon, 0, 1, 00, 11, 010, 0110, 101, 1001 \dots \text{etc.}$

$$G_{\text{pal}} = (\{ \epsilon \}, \{ 0, 1 \}, P, \epsilon)$$

P:- ? ?

P

Example:-

Palindromes

④⑤

$\epsilon, 0, 1$

$\epsilon, 0, 1, 00, 11, 010, 0110, 101, 1001 \dots \text{etc.}$

$$G_{\text{pal}} = (\{E\}, \{0, 1\}, P, E)$$

P:- ? ?

P:-  $E \rightarrow \epsilon / 0 / 1 / 0E0 / 1E1 \quad \checkmark$

$E \rightarrow \epsilon$

$E \rightarrow 0$

$E \rightarrow 1$

$E \rightarrow 0E0$

$E \rightarrow 1E1$

P.

(CFG)

$$G = (V, T, P, S)$$

$$A \rightarrow \alpha A \alpha / \epsilon$$

$$A \Rightarrow \alpha A \alpha \Rightarrow \alpha \alpha A \alpha \alpha \Rightarrow \alpha \alpha \alpha$$

$$A \xRightarrow[G]{*} \alpha \alpha \alpha$$

$$G = (V, T, P, S)$$

⑥

$$L(G) = \{ w \in T^* / S \xRightarrow[G]{*} w \}$$

↳ Language of the CFG  $G$ .

Q

Example:-  $G = (V, T, P, S)$

⑦

$$V = \{S\} \quad T = \{a, b\}$$

$$P = \{S \rightarrow asb \mid ab\}$$

$$L(G) = ?$$

Q

Example:-  $G = (V, T, P, S)$

⑦⑧

$$V = \{S\} \quad T = \{a, b\}$$

$$P = \{S \rightarrow asb \mid ab\}$$

$$\begin{aligned} S &\Rightarrow ab \\ S &\stackrel{*}{\Rightarrow} a^2 b^2 \\ S &\stackrel{*}{\Rightarrow} a^3 b^3 \\ &\vdots \end{aligned}$$

$$L(G) = ? ?$$

$$L(G) = \{ab, a^2 b^2, a^3 b^3, \dots, a^n b^n\} \\ n \geq 1$$

$$\therefore L(G) = \{a^n b^n \mid n \geq 1\}$$

Q