CFG
Context Free Grammer

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CFG stands for context free grammar. It is a formal grammar which is used to generate all possible patterns of strings in a given FL.

Context free grammer G can be defined by 4 tuple

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

→ G is Grammer which consists of a set of production rule. It is used to generate the string of a language.

→ T is the final set of Terminal symbol. It is denoted by lower case letters.

→ V is the final set of non-Terminal symbol. It is represented by capital letters.

→ P is set of production rules which is used for replacing non terminal symbols (on left side of production in a string with other terminals of non-terminal symbols (on right side of production)

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→ S is the start symbol used to device the string.

Ex 1 Construct ~~as~~ CFG for the language having any no. of a's over the set $\Sigma = \{a\}$

Sol^n: $\Sigma = \{a\}$

$L = \{\varepsilon, a, aa, aaa \ldots\}$

$R.E. = a^*$ ~~suppose~~

Production Rule :

$S \to aS$ — ①

$S \to \varepsilon$ — ②

Suppose I need to derive a i/p string = 'aaaaaa'

$\Rightarrow$ S (According to the ~~~~ rule we have to start with S, start symbol)

s is replaced with aS → aS

$\Rightarrow aaS$ | $S \to aS$

$\Rightarrow aaaS$ | $S \to$

$\Rightarrow aaaaS$

$\Rightarrow aaaaaS$

$\Rightarrow aaaaaa\boxed{S}$

$\Rightarrow aaaaaa\varepsilon$ | $S \to \varepsilon$

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Ex 2. Construct a CFG for language
$L = \{ W C W^R \mid \text{where } W \in (a,b)^* \}$

W — string, C — const, WR — Reverse string

Sol^n

$L = \{ aacaa, bcb, abcba, abbcbba \ldots \}$

Reverse

Reverse

The grammer could be

$S \to aSa$ — ①
$S \to bSb$ — ②
$S \to c$ — ③

Let assume i/p = "abbcbba"

$S \to aSa$
$S \to abSba$
$S \to abbSbba$
$S \to abbcbba$

Ex 3. Construct a CFG for the language
$L = a^n b^{2n}$ where $n >= 1$

Sol^n

$L = \{ \underset{ab^2}{abb}, \underset{a^2b^4}{aabbbb}, \underset{a^3b^6}{aaabbbbbb} \ldots$
(n=1, n=2, n=3)

The grammer could be

$S \to aSbb$
$S \to abb$

i/p aaabbbbbb

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$S \rightarrow aSbb$

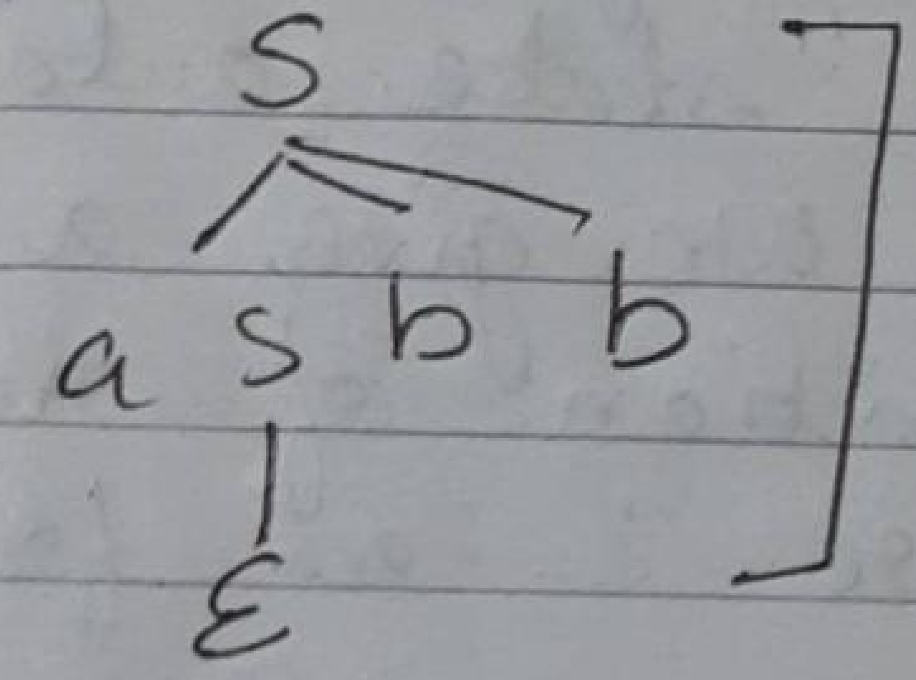
$\Rightarrow aaSbbbb \quad (S \rightarrow aSbb)$

~~$\Rightarrow aaaSbbbbbb$~~

$\Rightarrow aaabbbbbb \quad (S \rightarrow abb)$

parse tree

a bb



parse tree

Ex. Find a grammar generating $L = \{a^n b^n c^i \mid n \geq 1, i \geq 0\}$

Soln: $S \rightarrow A$, $A \rightarrow ab$, $A \rightarrow aAb$, $S \rightarrow Sc$

Ex. Let $G = (\{S, A_1\}, \{0, 1, 2\}, P, S)$ where P consists of $S \rightarrow 0SA_12$, $S \rightarrow 012$, $2A_1 \rightarrow A_12$, $1A_1 \rightarrow 11$

show that $L(G) = \{0^n 1^n 2^n \mid n \geq 1\}$