

~~Ques~~

Long Answer.

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Ques 2

A context free grammar is said to be in chomsky normal form if all of its productions are of form.

$$A \rightarrow BC \text{ or } A \rightarrow a$$

where A, B, C are non-terminals & a is a terminal

From here we infer -

- 1) To be in CNF, all the production must derive either two non-terminals or a single terminal.
- 2) CNF restricts the number of symbols on the right side of production to be two
- 3) The two symbols must be non-terminals or single terminals.

The steps are —

• Eliminate ϵ production

- 1) Reduce the grammar completely by
 - Eliminating ϵ production
 - Eliminating unit productions
 - Eliminating useless productions

- 2) Replace each production of the form
 $A \rightarrow B_1 B_2 B_3 \dots B_n$ where $n > 2$
 with $A_1 \rightarrow B_1 C$ where $C \rightarrow B_2 B_3 \dots B_n$.

Repeat this for all the production having more than two variable on RHS

- 3) Replace each production of form
 $A \rightarrow aB$ with $A \rightarrow XB$ and $X \rightarrow a$.
 Repeat this for all production of form
 $A \rightarrow aB$.

example:

$$S \rightarrow a | aA | B$$

$$A \rightarrow aBB | \epsilon$$

$$B \rightarrow Aa | b$$

conversion

$$\begin{aligned} \text{i)} \quad S_1 &\rightarrow S \\ S &\rightarrow a | aA | B \\ A &\rightarrow aBB | \epsilon \\ B &\rightarrow Aa | B \end{aligned}$$

$$\begin{aligned} \text{ii)} \quad S_1 &\rightarrow S \\ S &\rightarrow a | aA | B \\ A &\rightarrow aBB \\ B &\rightarrow Aa | b | a. \end{aligned}$$

(iv) $S \rightarrow S$
 $S \rightarrow a|aA|Aa|b$
 $A \rightarrow aBB$
 $B \rightarrow Aa|b|a$

(v) $S_0 \rightarrow a|aA|Aa|b$
 $S \rightarrow a|aA|Aa|b$
 $A \rightarrow aBB$
 $B \rightarrow Aa|b|a$

(vi) $S_0 \rightarrow a|xA|AX|b$
 $S \rightarrow a|xA|AX|b$
 $A \rightarrow xBB$
 $B \rightarrow AX|b|a$
 $x \rightarrow a$

(vii) $S_0 \rightarrow a|xA|AX|b$
 $S \rightarrow a|xA|AX|b$
 $A \rightarrow xB$
 $B \rightarrow Ax|b|a$
 $x \rightarrow a$
 $R \rightarrow xB$