lecture   25.   Revision.

1-   Eliminating   Null   Productions.

$$A \rightarrow \lambda.$$

$$S \rightarrow aA \mid b \mid bb \cdot \mid a.$$
$$\overline{A \rightarrow \lambda.}$$

2-   Removing   UNIT   Productions.

$$A \rightarrow B$$ $$B \rightarrow a \mid bb \mid aC.$$
$$A \rightarrow a \mid bb \mid aA.$$

$$A \rightarrow B \rightarrow C \rightarrow D.$$

$$A \rightarrow \underline{\hspace{2cm}}.$$

$$B \rightarrow a \mid bb \mid aA$$
$$D \rightarrow \underline{\hspace{2cm}}$$
$$A \rightarrow B \rightarrow C \rightarrow \boxed{A}.$$

Removing   Useless   Productions.

1   Non- Reachable :-
        The   production   which   can   never   take
    part   in   the   derivation   of   any   string.
Ex:- $A \rightarrow bc$

$$S \rightarrow a \mid B \mid aB.$$
$$B \rightarrow b$$
$$\boxed{A \rightarrow bc}.$$ $$\rightarrow Non   Reachable.$$

2-.   Non — Terminating :-
    A   Variable (Non- Terminal)   that   can   never
    take   part   in   derivation   of   any   string.

$$B \rightarrow bB.$$
$$bbB$$
$$bbbB$$
$$bbbbB$$
$$\underline{}$$
$$\equiv$$

Ex: Remove   all   Useless   Productions.

$S \rightarrow aS \mid A \mid C$ Ch... N... R... h...

EK: Remove all Useless Productions.

$$S \rightarrow aS \mid A \mid \frac{C}{X}.$$

$$A \rightarrow a$$
$$X B \rightarrow aa \ X.$$
$$* C \rightarrow aCa \ *$$

$$S \rightarrow C \rightarrow aCa$$
$$aaCaa.$$
$$aaaCaaa$$
$$-$$
$$-$$
$$-$$

$$S \rightarrow aS \mid A$$
$$A \rightarrow a$$

Step1: Non-Reachable.
          X.
Step2: Non-Terminating.
          *

CHOMSKY   Normal   Form (CNF).

A CFG is in CNF if every rule is in of the forms. (one)

  1-. $A \rightarrow BC.$ B & C are not starting Variables.

  2-. $A \rightarrow a$

  3- $S \rightarrow \lambda.$ S is the Starting Variable.

" How to Convert a CFG to CNF "

  Step1:- Introduce a New Rule $S_0 \rightarrow S.$

  Step2: Remove all Null Productions.

  Step3:- " " UNIT Productions.

  Step4:- Add rules of the form $V_t \rightarrow t$
               $t:$ terminal.
               $V_t:$ Non-terminal.

  Step5: Transform the remaining rules to the form
               $A \rightarrow BC.$

$B \rightarrow aba$

$\rightarrow a$
$D \rightarrow b.$
$B \rightarrow CDC.$

Step 3: Transform the remaining values to the form $A \to BC$.

$V \to A_1 A_2 A_3 \overset{x}{A_4} A_5 \to B_1 A_3 \overset{x}{A_4} A_5 \to B_2 \overset{x}{A_4} A_5 \to B_3 A_5.$

$B_1 \to A_1 A_2 \checkmark$

$B_2 \to B_1 A_3 \checkmark$

$B_3 \to B_2 A_4 \checkmark$

Ex:-
$$S \to CSC \mid B$$
$$C \to 00 \mid \lambda.$$
$$B \to 01 B \mid 1.$$

Terminals $= \{0, 1\}$.

Step 1
$$S_0 \to S.$$
$$S \to CSC \mid B$$
$$C \to 00 \mid \lambda.$$
$$B \to 01 B \mid 1.$$

Step 2:-
$$S_0 \to S.$$
$$S \to CSC \mid B \mid SC \mid CS \mid S.$$
$$C \to 00 \, \cancel{\mid \lambda}.$$
$$B \to 01 B \mid 1.$$

$C \to \lambda.$

Step 3:- $CSC \mid 01B \mid 1 \mid SC \mid CS$ $S \to B$
$$S_0 \to S. \qquad \boxed{01B \mid 1}$$
$$S \to CSC \mid B \mid SC \mid CS \mid \overset{\cdot}{S}.$$ $B \to$
$$C \to 00$$
$$B \to 01 B \mid 1.$$ $A \to B \to C \to A.$

$$S_0 \to CSC \mid 01B \mid 1 \mid SC \mid CS$$
$$S \to CSC \mid 01 B \mid 1 \mid SC \mid CS$$
$$C \to 00$$
$$B \to 01 B \mid 1.$$

Step 4:-   Create $V_t \to t$ for every t.
$$S_0 \to CSC \mid \cancel{0}01B \mid 1 \mid SC \mid CS$$
$$S \to CSC \mid \cancel{0}01 B \mid 1 \mid SC \mid CS$$

$C \rightarrow$ ~~ZZ~~ ~~$\emptyset\emptyset$~~

$B \rightarrow$ $Z\emptyset1\ B\ |\ 1.$

$Z \rightarrow 0$

$A \rightarrow a.$

$S_0 \rightarrow csc\ |ZAB|1|\ sc\ |\ cs$

$S \rightarrow\quad CSC\ |ZAB|1\ |\ sc\ |\ cs$

$C \rightarrow\quad zz$

$B \rightarrow\quad ZA\ B\ |1.$

$Z \rightarrow 0$

$A \rightarrow 1.$

Step 5 :-   Take Care of the long Rules.

$$\overset{D}{\overbrace{}}\ \overset{E}{\overbrace{}}$$

$S_0 \rightarrow \boxed{csc}\ |\boxed{ZAB}|1|\ sc\ |\ cs$

$S \rightarrow\quad D\boxed{CS}C\ |\ \boxed{ZA}B\ |1\ |\ sc\ |\ cs$

$C \rightarrow\quad zz$

$B \rightarrow\quad \boxed{ZA}\ B\ |1.$
$\qquad\qquad\quad\ _{E.}$

$Z \rightarrow 0$

$A \rightarrow 1.$

$D \rightarrow cs.$

$E \rightarrow ZA.$

$S_0 \rightarrow\qquad DC\ |\ EB\ |1\ |\ SC\ |\ CS$

$S \rightarrow\qquad DC\ |\ EB\ |1\ |\ SC\ |\ CS.$

$C \rightarrow\qquad ZZ$

$B \rightarrow\qquad EB|1$

$Z \rightarrow\qquad 0$

$A \rightarrow\qquad 1$

$D \rightarrow\qquad CS$

$E \rightarrow\qquad ZA.$

Ex :-

$A \rightarrow BAB\ |B|\ \lambda$

$B \rightarrow 00\ |\lambda.$

$A =$ Start.

Terminal $= \{0\}.$

Sbd :- $C \quad - A$

Step 1:
$$S_0 \rightarrow A$$
$$A \rightarrow BAB \mid B \mid \lambda$$
$$B \rightarrow 00 \mid \lambda.$$

Step 2:

$$S_0 \rightarrow A \mid \lambda.$$
$$A \rightarrow BAB \mid B \mid \lambda \quad \mid \overset{X}{\overset{.}{\underset{B}{AB}}} \mid BA \mid A \mid \lambda. \mid BB.$$
$$B \rightarrow 00 \mid \lambda.$$

Next lecture

$$A \rightarrow \lambda$$
$$B \rightarrow \lambda!$$