Lecture 25 :- Revision.

Killing Null.

$A \to \lambda$.

$S \to AB / B$.

$B \to aa$

~~$A \to \lambda$.~~

Killing UNIT.

$A \to a$.

$B \to A \Rightarrow B \to a$

$B \to C \to A \Rightarrow B \to a$

Removing Useless productions.

1- Non-Reachable.

The production that can never take part in the derivation of any string

$A \to bc$ where A is not reachable from S.

$S \to BC / aa / bb$.

$B \to a$

$C \to ac$

$A \to bc$.

2- Non terminating Substitution.

A Variable (non-terminal) that can never take part in the derivation of any string.

$B \to aB$.

Ex:- Remove all Useless productions from the Grammer.

$S \to aS / A / C$

$\to A \to a$

$\to B \to aa$ ✗

Step 1:- find all productions that ends on terminal.

→ B → aa ✗

C → aCa

Non-Reachable =

B → aa.

After Removing of Non-Reachable.

✓ S → aS | A | ~~X~~.

A → a

C → aCa X.

Step2:- Identify Rules of the form.

Non-terminal → term + Non-terminal.

C → aCa.

S → C → aCa

→ aaCaa.

→ aaaCaaa

→ - ——-

After Removing Non-terminating Production.

S → aS | A

A → a

CHOMSKY NORMAL FORM. (CNF).

A CFG is in CNF if every Production is in one of the three forms.

1- A → BC B & C are Not Starting Variables.

2→ A → a

3→ S → ∧ S is the Starting Variable.

Ex:- S → AS | a

A → SA | b.

"Given a CFG, How to Convert it into CNF"

Step 1:- Add a new Variable S_0, add the production $S_0 \to S$.

Step 2:- Eliminate Null productions.

Step 3:- " UNIT "

Step 4:- Add rules of the form $V_t \to t$ for every terminal t. and replace t with V_t.

Step 5:- Transform the remaining rules to the form $A \to BC$.

$V \to A_1A_2A_3A_4A_5 \to B_1A_3A_4A_5 \to B_2A_4A_5$

$\to B_3A_5$.

$B_1 \to A_1A_2$.

$B_2 \to B_1A_3$.

$B_3 \to B_2A_4$.

Ex:- $S \to CSC \mid B$ Terminal = $\{0, 1\}$.

$C \to 00 \mid \lambda$

$B \to 02B \mid 1$.

Step 1:-

$S_0 \to S$.

$S \to CSC \mid B$

$C \to 00 \mid \lambda$

$B \to 02B \mid 1$.

Step 2:- Eliminate Null productions.

$S_0 \to S$. $C \to \lambda$.

$S \to CSC \mid B \mid CS \mid SC \mid S$

$C \to 00 \mid \cancel{\lambda}$

$B \rightarrow 02B \mid 1.$

Step 3:- Eliminate Unit Production.

$S_0 \rightarrow S.$ $\quad S \rightarrow S.$ $\quad S \rightarrow 1.$

$S \rightarrow CSC \mid S \mid CS \mid SC \mid S$

$C \rightarrow 00$

$B \rightarrow 02B \mid 1.$

$S_0 \rightarrow CSC \mid 02B \mid 1 \mid CS \mid SC.$

$S \rightarrow CSC \mid 1 \mid CS \mid SC \mid 02B.$

$C \rightarrow 00$

$B \rightarrow 02B \mid 1.$

Step 4:- Create V_t for every terminal t.

$S_0 \rightarrow CSC \mid Z02B \mid 1 \mid CS \mid SC.$

$S \rightarrow CSC \mid 1 \mid CS \mid SC \mid Z02B.$

$C \rightarrow ZZ$
00

$B \rightarrow Z02B \mid 1.$

$Z \rightarrow 0$

$S_0 \rightarrow CSC \mid Z1\,1B \mid 1 \mid CS \mid SC.$

$S \rightarrow CSC \mid 1 \mid CS \mid SC \mid Z1B.$

$C \rightarrow ZZ$

$B \rightarrow Z1B \mid 1.$

$Z \rightarrow 0$

Y → 1.

S0 → CSC | ZYB | Y | CS | SC.

S → CSC | Y | CS | SC | ZYB.

C → ZZ

B → ZYB | Y.

Z → 0

Y → 1.

Step 5 :- Take care of long Rules.

S0 → DC | EB | Y | D | SC.

S → DC | Y | D | SC | EB.

C → ZZ

B → EB | Y.

Z → 0 ✓

Y → 1 ✓

D → CS. ✓

E → ZY ✓