lecture 22:- Sessional.

lecture 23:- - Removing Null productions.
- " Unit "

Null Production:- In a given CFG, we call a non-terminal N Nullable, if ∃ a production $N \to \lambda$ or ∃ a production $N \to \dots \to \lambda$.
① ∃ $N \to \lambda$. or.
② ∃ $N \to \dots \to \lambda$.

Ex:- $S \to Xa$, $X \to aX \mid bX \mid \lambda$. $X \to \lambda$.

New Rules.

1) $S \to Xa$ $S \to a$. $S \to Xa \mid a$
2) $X \to aX$ $X \to a$ $X \to aX \mid bX \mid a \mid b$.
3) $X \to bX$ $X \to b$.

Ex:- CFG.
$S \to XY$
$X \to Zb$
$Y \to bW$
$Z \to AB$
$W \to Z$
$A \to aA \mid bA \mid \lambda$.
$B \to Ba \mid Bb \mid \lambda$.

$A \to \lambda$, $B \to \lambda$
$\to Z \to \lambda$.
$\to W \to \lambda$.

$X \to Zb$
$Y \to bW$
$Z \to AB$.
$W \to Z$
$A \to aA$
$A \to bA$
$B \to Ba$
$B \to Bb$

New Productions.
$X \to b$.
$Y \to b$.
$Z \to B \wedge Z \to A$.
Removed.
$A \to a$.
$A \to b$.
$B \to a$
$B \to b$.

New CFG.
$S \to XY$
$X \to Zb \mid b$.
$Y \to bW \mid b$.
$Z \to AB \mid A \mid B$
$W \to Z$. → Indirectly Nullable.
$A \to aA \mid bA \mid a \mid b$.
$B \to Ba \mid Bb \mid a \mid b$.

Directly Nullable = Remove.
In " " = Do not Remove but substituted.

Killing Unit Production.

UNIT PRODUCTION:- Nonterminal → one Non-Terminal.

$S \to A \to B$.

$S \to A$.
$A \to B$.
$X \to R$.

$S \to aA$ X.
$X \to b$ X
$X \to bb \mid aa$ X
$X \to bb$ X
$X \to aa$ X.

Ex:- CFG.

$S \to A \mid bb$.
$A \to B \mid b$.
$B \to S \mid a$.

Non. UNIT

$S \to bb$.
$A \to b$
$B \to a$.

UNIT

$S \to A$
$A \to B$
$B \to S$.

$S \to A$
$S \to A \to B$
$A \to B$
$A \to B \to S$
$B \to S$.
$B \to S \to A$.

$S \to b$.
$S \to a$.
$A \to a$.
$A \to bb$.
$B \to bb$.
$B \to b$.

$S \to bb \mid a \mid b$.
$A \to b \mid a \mid bb$.
$B \to a \mid b \mid bb$.

Simplified CFG without Recursion.

Remove Unit Production.

Ex. $M \to N \mid QNnqQ$
$N \to nqN \mid n$.
$Q \to qQ \mid \lambda$.

UNIT.
$M \to N$. $M \to n$.
$M \to nqN$.

$M \to n \mid nqN \mid QNnqQ$.
$N \to nqN \mid n$.
$Q \to qQ \mid \lambda$.

Ex:- $S \to Aa \mid B \mid c$
$B \to A \mid bb$
$A \to a \mid bc \mid B$.

Non UNIT
$S \to Aa$
$S \to c$.
$B \to bb$.
$A \to a$
$A \to bc$.

UNIT.
$S \to B$
$S \to B \to A$.
$B \to A$.
$A \to B$.

$S \to bb$.
$S \to a \mid bc$.
$B \to a$
$B \to bc$
$A \to bb$.

New CFG.

$S \to Aa \mid bb \mid c \mid a \mid bc$.
$B \to a \mid bc \mid bb$
$A \to a \mid bc \mid bb$.

Null Productions:- $A \to \lambda$. → Delete them.
$A \to B \to C \to \lambda$ → Replace. but don't delete.

Null Productions:- $A \to \lambda$. → Delete these.

$A \to B \to C \to \lambda$. → Replace. but don't delete.

UNIT Products $A \to B$. $B \to S_1 | S_2$ --- Replace.

$A \to B \to C \to \cdots \to X$. A with $X \to S_1 | S_2 \cdots$