

Simplification of a Grammar

①

- * Elimination of Null production
- * Elimination of Unit production
- * Elimination of Useless symbols

Elimination of Null production

①

$$S \rightarrow AB$$

$$A \rightarrow aA | \epsilon$$

$$B \rightarrow b$$

A have prod containing ϵ
 $A \rightarrow aA \rightarrow$ substitute A in ϵ in A prod
 $\rightarrow a\epsilon$

$S \rightarrow AB \rightarrow$ substitute A in ϵ in S prod
 $\rightarrow \epsilon B \rightarrow B$

Now the grammar is

$$S \rightarrow AB | B$$

$$A \rightarrow aA | a$$

$$B \rightarrow b$$

Elimination of Unit production

①

$$S \rightarrow AB$$

$$A \rightarrow B$$

$$B \rightarrow a|b.$$

$A \rightarrow B$ is unit production.

This can be replaced by $a|b$.

CFG:

$$\therefore S \rightarrow AB$$

$$A \rightarrow a|b$$

$$B \rightarrow a|b.$$

②

$$S \rightarrow AB$$

$$A \rightarrow a$$

$$B \rightarrow C|b$$

$$C \rightarrow D$$

$$D \rightarrow E$$

$$E \rightarrow a$$

$C \rightarrow D, D \rightarrow E, D \rightarrow E, B \rightarrow C$ are unit production

$$\therefore S \rightarrow AB$$

$$A \rightarrow a$$

$$B \rightarrow a|b$$

$$C \rightarrow a$$

$$D \rightarrow a$$

$$E \rightarrow a$$

Elimination of Useless Symbol

(2)

- Identifying Non generating Symbol
- Identifying Non reachable Symbol

Eg: ① $E \rightarrow eB|e$
 $A \rightarrow a.$

Generating:

$$E \rightarrow e$$

$$A \rightarrow a$$

Reachable:

A is not reachable

Final Soln: $E \rightarrow e$

②

$$S \rightarrow aAa|aBc$$

$$A \rightarrow aS|bD$$

$$B \rightarrow aBa|b$$

$$C \rightarrow abb|DD$$

$$D \rightarrow aDa$$

$$E \rightarrow Fb$$

$$F \rightarrow C$$

Generating Terminal $\{a, b\}$

Non Terminal $\{S, A, B, C, E, F\}$

$B \rightarrow b$, generating B

$C \rightarrow abb$, generating C

$S \rightarrow ABC$, S is generating

$A \rightarrow AB$, A is generating

$F \rightarrow C$ C is generating

$E \rightarrow Fb$ E is generating.

$\therefore A \rightarrow bD$, $C \rightarrow DD$, $D \rightarrow aDa$ can be eliminated

Soln after generating symbols generation

$S \rightarrow aAa \mid aBC$

$A \rightarrow aS$

$B \rightarrow aBa \mid b$

$C \rightarrow abb$

$E \rightarrow Fb$

$F \rightarrow C$

Reachable:

(3)

S is start symbol, S is reachable

A is reachable

B is reachable

C is reachable

D + F are generating but not reachable
from start symbol S

∴ Final soln is: $S \rightarrow aAa / aBe$

$A \rightarrow aS$

$B \rightarrow aBa / b$

$C \rightarrow abb.$