

Compiler Construction

⇒ Grammar types :-

[1] type 0 ..

[2] type 1 → Context statement.

[3] type 2 → CFG.

[4] type 3 → Regular.

⇒ Normal forms :-

a) It's Restriction

- 1 → nonrecursive start symbol → $S \rightarrow aS$ "x".
- 2 → Eliminate chain rules → only for start symbol.
- 3 → Eliminate λ rules → only start symbol could have λ .
- 4 → useless symbols.

Examples :-

[1] Nonrecursive start symbol :-

$G: S \rightarrow aS / bA$

1. Mark the recursive start symbol → $S \rightarrow aS$.

$A \rightarrow aAb / a$

2. Eliminate it.

So ...

$G': S' \rightarrow S$

$S \rightarrow aS / bA$

$A \rightarrow aAb / a$

[2] Eliminate chain rules :-

$G: A \rightarrow aA / a / B$

1. Mark the problem → " $A \rightarrow B$ ".

$B \rightarrow bB / b$

2. Replace each " B " with its grammar

" $B \rightarrow bB / b$ "

So ...

$G': A \rightarrow aA / a / bB / b$

$B \rightarrow bB / b$

Eliminate λ rules:-

$$G: S \rightarrow SaB / aB$$

$$B \rightarrow bB / \lambda$$

1. Mark the Problem " $B \rightarrow \lambda$ ".

2. Replace each B in start symbol with its grammar if λ , Sa , bB , $SabbB$.

So

$$1. S \rightarrow SaB$$

$$SabbB$$

$$Sa$$

$$SabbB \wedge Sab$$

$$2. \text{let } B \rightarrow bB / \lambda$$

$$\text{be } B \rightarrow bB / b$$

So

$$G': S \rightarrow SaB / Sa / aB / a$$

$$B \rightarrow bB / b$$

Useless Symbols:-

$$G: S \rightarrow AC / BS / B$$

$$A \rightarrow aA / aF$$

$$B \rightarrow CF / b$$

$$C \rightarrow CC / D$$

$$D \rightarrow aD / BD / C$$

$$E \rightarrow aA / BSA$$

$$F \rightarrow bB / b$$

1. Search for terminals that will stop the grammar "b",

Term $\rightarrow \{B, F\}$.

2. Mark symbols that will help reaching them, be only a capital letter "B" or a capital letter with small one "aA", "aF", "aA" $\rightarrow \{B, F, S, A, E\}$.

So

$$C \rightarrow CC / D$$

$$D \rightarrow aD / BD / C$$

} useless symbols.

3. Remove any symbols don't match rule num. 2, "AC, CF".

So

$$G': S \rightarrow BS / B, E \rightarrow aA / BSA$$

$$A \rightarrow aA / aF, F \rightarrow bB / b$$

$$B \rightarrow b$$

b) Normal form types:

1. Chomsky \rightarrow two capital letters or a small one.

$$\begin{array}{l} \checkmark \quad A \rightarrow BC \\ \quad \quad A \rightarrow a \end{array} \quad \left\{ \quad \begin{array}{l} A \rightarrow aB / Ba \\ A \rightarrow aAB \end{array} \right. \quad \times$$

Ex:

$$G: S \rightarrow aAB / aA / bB$$

$$A \rightarrow aAb / aB / a$$

$$B \rightarrow bA / b$$

1. Mark true symbols $\rightarrow "A \rightarrow a"$,
"B $\rightarrow b"$.

2. Change wrong ones.

So...

$$\text{let: } T_1 \rightarrow a, T_2 \rightarrow b$$

$$S \rightarrow T_1 AB / T_1 A / T_2 B$$

$$A \rightarrow T_1 A T_2 / T_1 B / a$$

$$B \rightarrow T_2 A / b$$

So...

$$\text{let: } T_3 \rightarrow AB$$

$$T_4 \rightarrow A T_2$$

So...

$$G': S \rightarrow T_1 T_3 / T_1 A / T_2 B$$

$$A \rightarrow T_1 T_4 / T_1 B / a$$

$$B \rightarrow T_2 A / b$$

$$T_1 \rightarrow a$$

$$T_2 \rightarrow b$$

$$T_3 \rightarrow AB$$

$$T_4 \rightarrow A T_2$$

2. Greibach \rightarrow a small letter and any number of capital ones.

" $S \rightarrow a A_1 A_2 A_3 \dots A_n$ ", or a small letter.

$$\begin{array}{l} \checkmark \quad A \rightarrow aAB \\ \quad \quad A \rightarrow a \end{array} \quad \left\{ \quad \begin{array}{l} A \rightarrow a a B \\ B \rightarrow a A B b \end{array} \right. \quad \times$$

Ex:

$$G: S \rightarrow aAB / aA / Bb$$

$$A \rightarrow aAb / aB / a$$

$$B \rightarrow bA / b$$

1. Mark True Symbol $S \rightarrow Bb$ $\Rightarrow "S \rightarrow aAB / aA", "A \rightarrow aB / a"$

2. change wrong ones.

So

1. let: $T_1 \rightarrow b$ 2. Replace "B" in " $S \rightarrow Bb$ " with itsgrammar " $B \rightarrow bA / b$ " $\rightarrow Bb \rightarrow bAb$ 3. Use $T_1 \rightarrow b$ in num 2. $\rightarrow bb$

So

$$G': S \rightarrow aAB / aA / bAT_1 / bT_1$$

$$A \rightarrow aAT_1 / aB / a$$

$$B \rightarrow bA / b$$

$$T_1 \rightarrow b$$