

Chapter 6: Simplification of CFG

[Exercise]

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Remove λ -productions

1. $S \rightarrow a \mid Xb \mid aYa$
 $X \rightarrow Y \mid \lambda$
 $Y \rightarrow b \mid X$

2. $S \rightarrow XaY \mid YY \mid aX \mid$
 ZYX
 $X \rightarrow Za \mid bZ \mid ZZ \mid Yb$
 $Y \rightarrow Ya \mid XY \mid \lambda$
 $Z \rightarrow aX \mid YYY$

3. $S \rightarrow Xa$
 $X \rightarrow aX \mid bX \mid \lambda$

4. $S \rightarrow XY$
 $X \rightarrow Zb$
 $Y \rightarrow bW$
 $Z \rightarrow AB$

$W \rightarrow Z$
 $A \rightarrow aA \mid bA \mid \lambda$
 $B \rightarrow Ba \mid Bb$

5. $S \rightarrow aS \mid bS \mid a \mid b$
 $X \rightarrow aX \mid a \mid \lambda$

6. $S \rightarrow aS \mid bX$
 $X \rightarrow aX \mid \lambda$

Remove Unit-productions

$$\begin{aligned} 1. \quad & S \rightarrow A \mid bb \\ & A \rightarrow B \mid b \\ & B \rightarrow S \mid a \end{aligned}$$

$$\begin{aligned} 2. \quad & S \rightarrow X_1 \mid X_2aX_2b \mid aSb \mid b \\ & X_1 \rightarrow X_2X_2 \\ & X_2 \rightarrow aX_2 \mid aaX_1 \end{aligned}$$

$$\begin{aligned} 3. \quad & S \rightarrow XY \\ & X \rightarrow XX \mid a \\ & Y \rightarrow YY \mid b \end{aligned}$$

$$\begin{aligned} 4. \quad & S \rightarrow aX \mid Yb \\ & X \rightarrow S \\ & Y \rightarrow bY \mid b \end{aligned}$$

$$\begin{aligned} 5. \quad & S \rightarrow AA \\ & A \rightarrow B \mid BB \\ & B \rightarrow abB \mid b \mid bb \end{aligned}$$

$$\begin{aligned} 6. \quad & S \rightarrow AB \\ & A \rightarrow B \\ & B \rightarrow aB \mid Bb \mid \lambda \end{aligned}$$

Remove Useless-productions

1. $S \rightarrow aS \mid AB$

$$A \rightarrow bA$$

$$B \rightarrow AA$$

2. $S \rightarrow a \mid aA \mid B \mid C$

$$A \rightarrow aB \mid \lambda$$

$$B \rightarrow Aa$$

$$C \rightarrow cCD$$

$$D \rightarrow ddd$$

Do simplification

Remove all unit-production, useless-production, and all λ - *production* from:

$$S \rightarrow aA \mid aBB$$

$$A \rightarrow aaA \mid \lambda$$

$$B \rightarrow bB \mid bbC$$

$$C \rightarrow B$$