

Variant 18

1. Eliminate ε productions.
2. Eliminate any renaming.
3. Eliminate inaccessible symbols.
4. Eliminate the non productive symbols.
5. Obtain the Chomsky Normal Form.

$G=(VN, VT, P, S)$ $VN=\{S, A, B, C, D\}$ $VT=\{a, b\}$

$P=\{$

- | | |
|------------------------|--------------------------------|
| 1. $S \rightarrow aB$ | 6. $A \rightarrow AS$ |
| 2. $S \rightarrow bA$ | 7. $A \rightarrow bAB$ |
| 3. $S \rightarrow B$ | 8. $A \rightarrow \varepsilon$ |
| 4. $A \rightarrow b$ | 9. $B \rightarrow a$ |
| 5. $A \rightarrow aD$ | 10. $B \rightarrow bS$ |
| 11. $C \rightarrow AB$ | 12. $D \rightarrow BB$ |

1. Eliminate ε productions.

$N\varepsilon = \{A\}$, because we have production rule $A \rightarrow \varepsilon$. After removing A we obtain the following rules (rules marked with red are the new formed rules).

$P^I=\{$

- | | | |
|------------------------|------------------------|------------------------|
| 1. $S \rightarrow aB$ | 6. $A \rightarrow AS$ | 13. $A \rightarrow bB$ |
| 2. $S \rightarrow bA$ | 7. $A \rightarrow bAB$ | 14. $C \rightarrow B$ |
| 3. $S \rightarrow B$ | 8. $A \rightarrow S$ | 15. $S \rightarrow b$ |
| 4. $A \rightarrow b$ | 9. $B \rightarrow a$ | |
| 5. $A \rightarrow aD$ | 10. $B \rightarrow bS$ | |
| 11. $C \rightarrow AB$ | 12. $D \rightarrow BB$ | |

2. Elimination of renaming - Unit Productions:

The renaming from P^I are : $S \rightarrow B, A \rightarrow S, C \rightarrow B$

1) $S \rightarrow B$

$P^{II} = \{$

- $S \rightarrow aB \mid bA \mid b \mid a \mid bS$
 $A \rightarrow b \mid aD \mid AS \mid bAB \mid S \mid bB$
 $B \rightarrow a \mid bS$
 $C \rightarrow AB$
 $D \rightarrow BB \}$

2) $A \rightarrow S$

$P^{II} = \{$

$S \rightarrow aB \mid bA \mid b \mid a \mid bS$

$A \rightarrow b \mid aD \mid AS \mid bAB \mid bB \mid aB \mid bA \mid a \mid bS$

$B \rightarrow a \mid bS$

$C \rightarrow AB$

$D \rightarrow BB \}$

3) $C \rightarrow B$

$P^{II} = \{$

$S \rightarrow aB \mid bA \mid b \mid a \mid bS$

$A \rightarrow b \mid aD \mid AS \mid bAB \mid bB \mid aB \mid bA \mid a \mid bS$

$B \rightarrow a \mid bS$

$C \rightarrow AB \mid a \mid bS$

$D \rightarrow BB \}$

3. Elimination of nonproductive symbols

$NEPROD(G) = VN \setminus PROD(G)$

$VN = \{S, A, B, C, D\}$

$PROD(G) = \{S, A, B, C, D\}$

$NEPROD(G) = \{S, A, B, C, D\} \setminus \{S, A, B, C, D\} = \{\}$

There aren't any nonproductive symbols so nothing changes.

4. Elimination of inaccessible symbols:

$INACCES(G) = (VN \cup VT) \setminus ACCES(G)$

$ACCES(G) = \{S, A, B, D, b, a\}$

$VN = \{S, A, B, C, D\}$

$VT = \{a, b\}$

$INACCES(G) = \{S, A, B, C, D, a, b\} \setminus \{S, A, B, D, b, a\} = \{C\}$

As we can see we have one inaccessible symbol C, so we remove it

$P^{III} = \{$

$S \rightarrow aB \mid bA \mid b \mid a \mid bS$

$A \rightarrow b \mid aD \mid AS \mid bAB \mid bB \mid aB \mid bA \mid a \mid bS$

$B \rightarrow a \mid bS$

$D \rightarrow BB \}$

5. The Chomsky Normal Form

1) Remove productions that have more than 2 variables in RHS

$P^{IV} = \{$

$S \rightarrow aB \mid bA \mid b \mid a \mid bS$

$A \rightarrow b \mid aD \mid AS \mid bA1 \mid bB \mid aB \mid bA \mid a \mid bS$

$B \rightarrow a \mid bS$

$D \rightarrow BB$

$A1 \rightarrow AB \}$

2) Remove productions that have the form $S \rightarrow bS$ from RHS

$P^V = \{$

$S \rightarrow B1B \mid B2A \mid b \mid a \mid B2S$

$A \rightarrow b \mid B1D \mid AS \mid B2A1 \mid B2B \mid B1B \mid B2A \mid a \mid B2S$

$B \rightarrow a \mid B2S$

$D \rightarrow BB$

$A1 \rightarrow AB$

$B1 \rightarrow a$

$B2 \rightarrow b \}$