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Simplification of Grammar

- Elimination of useless Non terminals
- Elimination of Unit productions.
- Elimination of ϵ-productions (Nullable Non-terminals)

* see TOC Notes.

1) $S \to AC \mid SB$
$A \to bASC \mid a$
$B \to aSB \mid bBC$
$C \to Bc \mid ad$

2) $A \to xyz \mid XyzZ$
$X \to Xz \mid xYx$
$Y \to yYy \mid XZ$
$Z \to Zy \mid z$

3) $S \to aB \mid bX$
$A \to BAd \mid bSX \mid a$
$B \to aSB \mid bBX$
$X \to SBD \mid aBa \mid ad$

4) $S \to aC \mid SB$
$A \to bSCa$
$B \to aSB \mid bBC$
$C \to aBC \mid ad$

5) $S \to 0 \mid A$
$A \to AB$
$B \to 1$

6) $S \to AB \mid CA$
$B \to BC \mid AB$
$A \to a$
$C \to aB \mid b$

7) $S \to ABA$
$A \to aA \mid \epsilon$
$B \to bB \mid \epsilon$

8) $A \to aBb \mid bBa$
$B \to aB \mid bB \mid \epsilon$

9) $S \to XY$
$X \to aW$
$Y \to bZ$
$W \to Z$
$Z \to AB$
$A \to aA \mid \epsilon$
$B \to bB \mid \epsilon$

10) $S \to AB$
$A \to 0$
$B \to C \mid 1$
$C \to D$
$D \to E$
$E \to 0$

11) $I \to a \mid b \mid Ia \mid Ib \mid I0 \mid I1$

$F \to I \mid (E)$

$T \to F \mid T*F$

$E \to T \mid E+T$

12) $S \to 0B \mid 1X$

$A \to BA1 \mid 1SX \mid 0$

$B \to 0SB \mid 1BX$

$X \to SBD \mid 0B0 \mid 01$

13) $A \to abc \mid Xbcc$

$X \to Xc \mid aYc$

$Y \to bYb \mid Xc$

$Z \to Zb \mid c$

14) $S \to A \mid B \mid C$

$A \to aAa \mid B$

$B \to bB \mid bb$

$C \to aCaa \mid D$

$D \to baD \mid abD \mid aa$

15) $S \to aS \mid A \mid c$

$A \to a$

$B \to aa$

$C \to acb$

16) $S \to aC \mid B$

$A \to bCCa$

$B \to aSB \mid bBC$

$C \to aBC \mid ad$

17) $S \to ABC \mid BaB$

$A \to aA \mid BaC \mid aaa$

$B \to bBb \mid a$

$C \to CA \mid AC$

18) $S \to aAa \mid \epsilon$

$A \to abS \mid \epsilon$

19) $S \to A$

$A \to Bb \mid Cd$

$B \to aB \mid \epsilon$

$C \to cC \mid \epsilon$

20) $S \to iEtSS' \mid a$

$S' \to eS \mid \epsilon$

$E \to b$

21) $S \to Abc \mid ad$

$A \to eS \mid Cr \mid \epsilon$

$C \to \$ \mid p \mid \epsilon$