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Given CFG (Context-free Grammar) is

$$A \rightarrow BAB \mid B \mid \varepsilon$$

$$B \rightarrow 00 \mid \varepsilon$$

Now, construct an equivalent CFG (Context-free Grammar) in Chomsky normal form.

Chomsky normal form:

A context i- free grammar s in **Chomsky normal form** if every rule is of the form

$$A \rightarrow BC$$

$$A \rightarrow a$$

Here, a is terminal,

A, B and C are variables,

In addition, it permits the rule $S \rightarrow \varepsilon$, here S is the start variable.

convert the given CFG into an equivalent CFG in Chomsky normal form.

Let's add a new start variable S_0 and the rule $S_0 \rightarrow A$.

Thus the obtained grammar is

$$S_0 \rightarrow A$$

$$A \rightarrow BAB \mid B \mid \varepsilon$$

$$B \rightarrow 00 \mid \varepsilon$$

In the addition of new start variable guarantees that the start variable doesn't occur on the right-hand side of a rule.

Removing all rules that containing ε .

Removing $A \rightarrow \varepsilon$ and $B \rightarrow \varepsilon$ gives

$$S_0 \rightarrow A \mid \varepsilon$$

$$A \rightarrow BAB \mid BA \mid AB \mid A \mid B \mid BB$$

$$B \rightarrow 00$$

The rule $S_0 \rightarrow \varepsilon$ is accepted since S_0 is the start variable and that is allowed in Chomsky normal form.

Now remove the unit rules.

Removing $A \rightarrow A$ gives

$$S_0 \rightarrow A \mid \varepsilon$$

$$A \rightarrow BAB \mid BA \mid AB \mid B \mid BB$$

$$B \rightarrow 00$$

Removing $S \rightarrow B$ gives

$$S_0 \rightarrow A \mid \varepsilon$$

$$A \rightarrow BAB \mid BA \mid AB \mid 00 \mid BB$$

$$B \rightarrow 00$$

Removing $S_0 \rightarrow S$ gives

$$S_0 \rightarrow BAB \mid BA \mid AB \mid 00 \mid BB \mid \varepsilon$$

$$A \rightarrow BAB \mid BA \mid AB \mid 00 \mid BB$$

$$B \rightarrow 00$$

Now replace ill placed terminals 0 by variable U with new

$$S_0 \rightarrow BAB \mid BA \mid AB \mid UU \mid BB \mid \varepsilon$$

$$A \rightarrow BAB \mid BA \mid AB \mid UU \mid BB$$

$$B \rightarrow UU$$

$$U \rightarrow 0$$

Shorten the right-hand side of rules with only 2 variables each.

To shorten the rules, replace $S_0 \rightarrow BAB$ with two rules $S_0 \rightarrow BA_1$ and $A_1 \rightarrow AB$.

The rule $A \rightarrow BAB$ is replaced by the two rules $A \rightarrow BA_2$ and $A_2 \rightarrow AB$.

After replacing these rules, the final Context-free grammar in Chomsky normal form is $G = (V, \Sigma, R, S_0)$.

Here the set of variables is $V = \{S_0, S, B, U, A_1, A_2\}$,

the start variable is S_0 .

The set of terminals is $\Sigma = \{0\}$, and the rules R are given by

$$S_0 \rightarrow BA_1 \mid BA \mid SB \mid UU \mid BB \mid \varepsilon$$

$$A \rightarrow BA_1 \mid BA \mid SB \mid UU \mid BB$$

$$B \rightarrow UU$$

$$U \rightarrow 0$$

$$A_1 \rightarrow AB$$

This is the final CFG in Chomsky normal form equivalent to the given CFG.