Consider the context free grammar (CFG) G is as follows:

$S \rightarrow aSb \mid bY \mid Ya$
$Y \rightarrow bY \mid aY \mid \varepsilon$

Language L (G) for the G is as follows:

Consider the productions in the grammar

$S \rightarrow aSb$
$S \rightarrow bY$
$S \rightarrow Ya$
$Y \rightarrow bY$
$Y \rightarrow aY$
$Y \rightarrow \varepsilon$

Case 1:

Consider production $S \rightarrow Ya$ to derive the language.

Substitute Y with production $Y \rightarrow \varepsilon$ then

$S \rightarrow \in a$

$S \rightarrow a$

Case 2:

Consider production $S \rightarrow bY$ to derive the language.

Substitute Y with production $Y \rightarrow \varepsilon$ then

$S \rightarrow \in b$

$S \rightarrow b$

Case 3:

Consider production $S \rightarrow aSb$ to derive the language

Substitute S with production $S \rightarrow bY$ then

$S \rightarrow abYb$

Substitute Y with production $Y \rightarrow bY$ then

$S \rightarrow abbYb$

Substitute Y with production $Y \rightarrow \varepsilon$ then

$S \rightarrow abb \in b$

$S \rightarrow abbb$

Case 4:

Consider production $S \rightarrow bY$ to derive the language.

Substitute Y with production $Y \rightarrow bY$ then

$S \rightarrow bbY$

Substitute Y with production $Y \rightarrow \varepsilon$ then

$S \rightarrow bb \in$

$S \rightarrow bb$

Therefore form the Case 1, Case 2, Case 3 and Case 4 the language obtained is as follows:

$L(G) = \{a, b, abbb, bb...\}$

Using the grammar G, many more strings can be generated.

Description of the L (G) is as follows:

The grammar G generates a language $L(G)$ consists of the strings which are described as follows:

• Strings with consecutive number of **a**'s with a length ranging from 1 to infinity.

• Strings with consecutive number of **b's** with a length ranging from 1 to infinity.

• String with start symbol **a** followed by number of **b's**.

• Strings with start symbol **b** followed by number of **a's.**

• Strings with **a** as start symbol and **b** as end symbol.

• Strings with **b** as start symbol and **a** as end symbol.

• Strings that contains the same start and end symbols. For example, $aba,\ bab$ etc.

From the above description as $L(G)$ is generating all the possible combination of a's and b's except $a^i b^i\ where\ i \geq 0$. The $L(G)$ does not produce strings like $\in,\ ab,\ aabb,\ aaabbb \ldots$

The complements of $L(G)$ i.e. $\overline{L(G)}$ = $\{\in,\ ab,\ aabb,\ aaabbb \ldots\}$

The grammar for $\overline{L(G)}$ is $a^i b^i\ where\ i \geq 0$.

Therefore, the CFG G' for $\overline{L(G)}$ is as follows:

$S \rightarrow aSb \mid \in$