

$S \rightarrow TT \mid U$
 $T \rightarrow 0T \mid T0 \mid \#$
 $U \rightarrow 0U00 \mid \#$

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

$E \rightarrow E + T \mid T$
 $T \rightarrow T \times F \mid F$
 $F \rightarrow (E) \mid a$

$S0 \rightarrow S$

$S \rightarrow TT \mid U$
 $T \rightarrow 0T \mid T0 \mid \#$
 $U \rightarrow 0U00 \mid \#$

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$S0 \rightarrow TT \mid U$

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$S0 \rightarrow TT \mid 0U00 \mid \#$
 $S \rightarrow TT \mid 0U00 \mid \#$
 $T \rightarrow 0T \mid T0 \mid \#$
 $U \rightarrow 0U00 \mid \#$

$S0 \rightarrow TT \mid 0R \mid \#$
 $S \rightarrow TT \mid 0R \mid \#$
 $T \rightarrow 0T \mid T0 \mid \#$
 $U \rightarrow 0R \mid \#$
 $R \rightarrow U00$

$S0 \rightarrow TT \mid 0R \mid \#$
 $S \rightarrow TT \mid 0R \mid \#$
 $T \rightarrow 0T \mid T0 \mid \#$
 $U \rightarrow 0R \mid \#$
 $R \rightarrow UX$
 $X \rightarrow 00$
 $S0 \rightarrow TT \mid YR \mid \#$

$$\begin{aligned}
S &\rightarrow TT \mid \textcolor{red}{Y}R \mid \# \\
T &\rightarrow \textcolor{red}{Y}T \mid T\textcolor{red}{Y} \mid \# \\
U &\rightarrow \textcolor{red}{Y}R \mid \# \\
R &\rightarrow UX \\
X &\rightarrow \textcolor{red}{Y}Y \\
\textcolor{red}{Y} &\rightarrow 0
\end{aligned}$$

$$\begin{aligned}
S0 &\rightarrow TT \mid YR \mid \# \\
S &\rightarrow TT \mid YR \mid \# \\
T &\rightarrow YT \mid TY \mid \# \\
U &\rightarrow YR \mid \# \\
R &\rightarrow UX \\
X &\rightarrow YY \\
Y &\rightarrow 0
\end{aligned}$$

$$\textcolor{red}{S0} \rightarrow \textcolor{red}{S}$$

$$\begin{aligned}
S &\rightarrow aSb \mid bY \mid Ya \\
Y &\rightarrow bY \mid aY \mid \epsilon
\end{aligned}$$

$$\begin{aligned}
S0 &\rightarrow S \\
S &\rightarrow aSb \mid bY \mid Ya \mid \textcolor{red}{b} \mid \textcolor{red}{a} \\
Y &\rightarrow bY \mid aY \mid \textcolor{red}{b} \mid \textcolor{red}{a}
\end{aligned}$$

$$\begin{aligned}
S0 &\rightarrow \textcolor{red}{aSb} \mid \textcolor{red}{bY} \mid \textcolor{red}{Ya} \mid \textcolor{red}{b} \mid \textcolor{red}{a} \\
S &\rightarrow aSb \mid bY \mid Ya \mid b \mid a \\
Y &\rightarrow bY \mid aY \mid b \mid a
\end{aligned}$$

$$\begin{aligned}
S0 &\rightarrow a\textcolor{red}{X} \mid bY \mid Ya \mid b \mid a \\
S &\rightarrow a\textcolor{red}{X} \mid bY \mid Ya \mid b \mid a \\
Y &\rightarrow bY \mid aY \mid b \mid a \\
X &\rightarrow Sb
\end{aligned}$$

$$\begin{aligned}
S0 &\rightarrow \textcolor{red}{P}X \mid \textcolor{red}{Q}Y \mid Y\textcolor{red}{P} \mid b \mid a \\
S &\rightarrow \textcolor{red}{P}X \mid \textcolor{red}{Q}Y \mid Y\textcolor{red}{P} \mid b \mid a \\
Y &\rightarrow \textcolor{red}{Q}Y \mid Y\textcolor{red}{P} \mid b \mid a \\
X &\rightarrow S\textcolor{red}{Q} \\
\textcolor{red}{P} &\rightarrow a \\
\textcolor{red}{Q} &\rightarrow b
\end{aligned}$$

$$\begin{aligned}
S0 &\rightarrow PX \mid QY \mid YP \mid b \mid a \\
S &\rightarrow PX \mid QY \mid YP \mid b \mid a \\
Y &\rightarrow QY \mid PY \mid b \mid a \\
X &\rightarrow SQ \\
P &\rightarrow a \\
Q &\rightarrow b
\end{aligned}$$

$S_0 \rightarrow E$

$E \rightarrow E + T \mid T$

$T \rightarrow T \times F \mid F$

$F \rightarrow (E) \mid a$

$S_0 \rightarrow E$

$E \rightarrow E + T \mid T$

$T \rightarrow T \times F \mid F$

$F \rightarrow (E) \mid a$

$S_0 \rightarrow E+T \mid T$

$E \rightarrow E+T \mid T$

$T \rightarrow T \times F \mid F$

$F \rightarrow (E) \mid a$

$S_0 \rightarrow E+T \mid T \times F \mid F$

$E \rightarrow E+T \mid T \times F \mid F$

$T \rightarrow T \times F \mid F$

$F \rightarrow (E) \mid a$

$S_0 \rightarrow E+T \mid T \times F \mid (E) \mid a$

$E \rightarrow E+T \mid T \times F \mid (E) \mid a$

$T \rightarrow T \times F \mid (E) \mid a$

$F \rightarrow (E) \mid a$

$S_0 \rightarrow E+T \mid T \times F \mid (Z \mid a$

$E \rightarrow E+T \mid T \times F \mid (Z \mid a$

$T \rightarrow T \times F \mid (Z \mid a$

$F \rightarrow (Z \mid a$

$Z \rightarrow E)$

$S_0 \rightarrow E W \mid T Y \mid (Z \mid a$

$E \rightarrow E W \mid T Y \mid (Z \mid a$

$T \rightarrow T Y \mid (Z \mid a$

$F \rightarrow (Z \mid a$

$Z \rightarrow E)$

$Y \rightarrow \times F$

$W \rightarrow + T$

$S_0 \rightarrow E W \mid T Y \mid L Z \mid a$

$E \rightarrow E W \mid T Y \mid L Z \mid a$

$T \rightarrow T Y \mid L Z \mid a$

$F \rightarrow L Z \mid a$

$Z \rightarrow E M$

$Y \rightarrow N F$

$W \rightarrow O T$

L → (

M →)

N → ×

O → +

S0 → EW | TY | LZ | a

E → EW | TY | LZ | a

T → TY | LZ | a

F → LZ | a

Z → EM

Y → NF

W → OT

L → (

M →)

N → ×

O → +
