ALC assignment:

① (a) $S \rightarrow AS_1$

$S_1 \rightarrow S_1S_1 \mid 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9 \mid \epsilon$

$A \rightarrow + \mid -$

(b) $S \rightarrow BaB \mid BaBaB.$

$B \rightarrow bB \mid \epsilon$

(c) $S \rightarrow ASB \mid BSA \mid \epsilon$

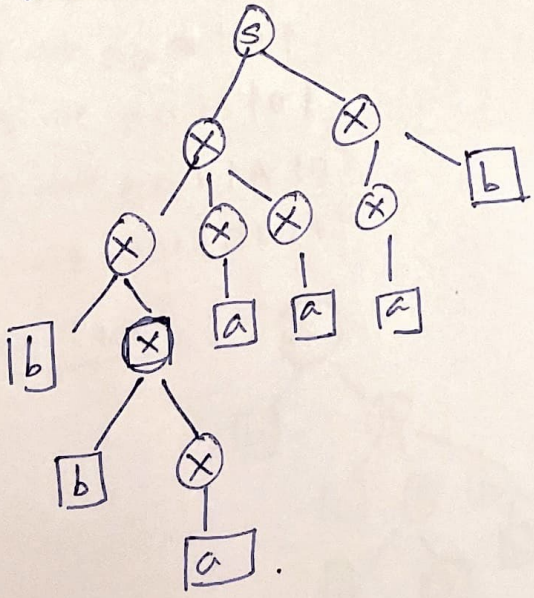
$A \rightarrow (A \mid \epsilon$

$B \rightarrow B) \mid \epsilon$

② $S \rightarrow XX$

$X \rightarrow XXX \mid bX \mid Xb \mid a.$

$w = bbaaaab.$



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$S \rightarrow 0B \mid 1A$

$A \rightarrow 0 \mid 0S \mid 1AA$

$B \rightarrow 1 \mid 1S \mid 0B1B$

$w = 00110101$

leftmost derivation

$S \rightarrow 0B$

$S \rightarrow 0DBB$

$S \rightarrow 00 \mid B$

$S \rightarrow 001 \mid S$

$S \rightarrow 0011 \mid 0B$

$S \rightarrow 00110 \mid S$

$S \rightarrow 00110 \mid 0B$

$S \rightarrow 00110101$

Rightmost derivation

$S \rightarrow 0B$

$S \rightarrow 00BB$

$S \rightarrow 00B1S$

$S \rightarrow 00B10B$

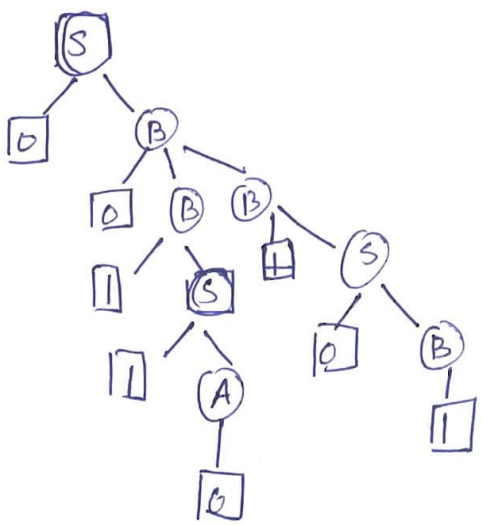
$S \rightarrow 00B101$

$S \rightarrow 00S101$

$S \rightarrow 001A101$

$S \rightarrow 00110101$

Parse tree:



(4)

$S \rightarrow 0B \mid 1X$

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

$B \rightarrow 0SB \mid 1BX$

$X \rightarrow SBD \mid 01$

remove D from X since no rule definition.

& Also remove A since you cannot reach A from any other production rule.

$S \rightarrow 0B \mid 1X$

$B \rightarrow 0SB \mid 1BX$

$X \rightarrow SB \mid 01$

(6)

$S \rightarrow ABAC$

$A \rightarrow 0A \mid \epsilon$

$B \rightarrow 1B \mid \epsilon$

$C \rightarrow 1$

Nullable elements = {A, B}.

$S \rightarrow ABAC \mid BC \mid AAC \mid C.$

$A \rightarrow 0A \mid 0$

$B \rightarrow 1B \mid 1$

$C \rightarrow 1$

8.

9) $S \rightarrow abAB.$

$A \rightarrow bAB \mid \epsilon$

$B \rightarrow Baa \mid A \mid \epsilon$

removing null productions

$S \rightarrow abAB \mid abB \mid abA \mid ab.$

$A \rightarrow bAB \mid bB.$

$B \rightarrow Baa \mid aa \mid A.$

removing unit productions $B \rightarrow A$

$B \rightarrow Baa \mid aa \mid bAB \mid bB.$

$S \rightarrow YAB \mid YB \mid YA \mid Y$

$A \rightarrow ZAB \mid ZB.$

$B \rightarrow BXX \mid XX \mid ZAB \mid ZB.$

$K \rightarrow AB.$

$X \rightarrow a.$

$Z \rightarrow b.$

$Y \rightarrow XZ.$

$L \rightarrow XX$

again;

$S \rightarrow YK \mid YB \mid YA \mid XZ.$

$A \rightarrow ZK \mid ZB.$

$B \rightarrow BL \mid XX \mid ZK \mid ZB$

$K \rightarrow AB$

$Y \rightarrow XZ.$

$L \rightarrow XX$

$X \rightarrow a$

$Z \rightarrow b$

//.

(b)

$S \rightarrow AB \mid aB.$

$A \rightarrow aab \mid a.$

$B \rightarrow bbA$

$S \rightarrow AB \mid XB$

$A \rightarrow XXb \mid X$

$B \rightarrow bbA.$

$X \rightarrow a$

Now let $Y \rightarrow b.$

$S \rightarrow AB \mid XB.$

$A \rightarrow XXY \mid a.$

$B \rightarrow YYA$

$X \rightarrow a$

$Y \rightarrow b.$

Let $K \rightarrow XY$ and $L \rightarrow YA$

so $S \rightarrow AB \mid XB.$

$A \rightarrow XK \mid a.$

$B \rightarrow YL$

$X \rightarrow a$

$Y \rightarrow b$

$K \rightarrow XY$

$L \rightarrow YA.$

(9)

(a) $S \rightarrow AB \mid BC.$

$A \rightarrow aB \mid bA \mid a.$

$B \rightarrow bB \mid cC \mid b.$

$C \rightarrow a.$

Here. $S \rightarrow A_1$

$A \rightarrow A_2$

$B \rightarrow A_3$

$C \rightarrow A_4.$

so

$A_1 \rightarrow A_2A_3 \mid A_3A_4$

$A_2 \rightarrow aA_3 \mid bA_2 \mid a.$

$A_3 \rightarrow bA_3 \mid cA_4 \mid b.$

$A_4 \rightarrow a.$

~~replacing A_3 in first rule~~

~~$A_1 \rightarrow A_2A_3 \mid$~~

Replacing A_2 and A_3 in A_1 rule.

$A_1 \rightarrow aA_3A_3 \mid bA_2A_3 \mid aA_3 \mid bA_3A_4 \mid cA_4A_4 \mid bA_4$

$A_2 \rightarrow aA_3 \mid bA_2 \mid a.$

$A_3 \rightarrow bA_3 \mid cA_4 \mid b.$

$A_4 \rightarrow a.$

(b) $S \rightarrow abaSa \mid aba$

$S_1 \rightarrow S$

$S \rightarrow abaSa \mid aba.$

$S \rightarrow xYsx \mid xY.$

$X \rightarrow a.$

$Y \rightarrow ba.$

Now.

$S \rightarrow aYsX \mid aY$

$X \rightarrow a \quad Y \rightarrow bX$

(10)