CS323 Assignment3

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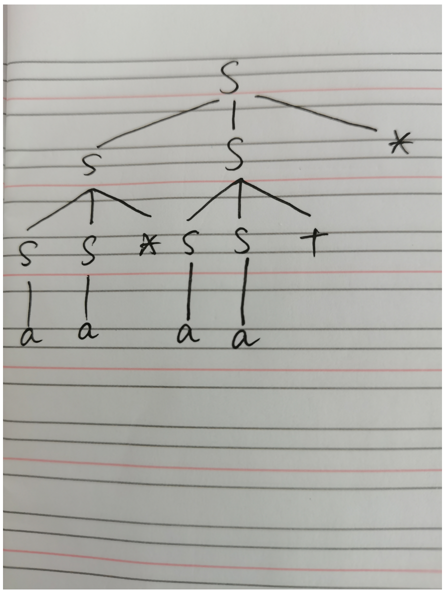
Required Exercise

Exercise1

1. $S \Rightarrow SS* \Rightarrow SS*S* \Rightarrow aS*S* \Rightarrow aa*S* \Rightarrow aa*SS+* \Rightarrow aa*aS+* \Rightarrow aa*aa+*$
2. $S \Rightarrow SS* \Rightarrow SSS+* \Rightarrow SSa+* \Rightarrow Saa+* \Rightarrow SS*aa+* \Rightarrow Sa*aa+* \Rightarrow aa*aa+*$
3. 

4. $S \rightarrow aS'$

   $S' \rightarrow S + S' \mid S\ *S' \mid \epsilon$
5. No.

Exercise 2

1. For the **FIRST sets**, since $S \rightarrow aB$, $a \in FIRST(S)$. So $FIRST(S) = \{a\}$. Since $B \rightarrow S*B$, everything in $FIRST(S)$ is in $FIRST(B)$, so $FIRST(S) \subseteq FIRST(B)$. As $B \rightarrow \epsilon$, $\epsilon \in FIRST(S)$. So $FIRST(S) = \{a\}$ and $FIRST(B) = \{a, \epsilon\}$.

   For the **FOLLOW sets**, since $B \rightarrow S*B$, $* \in FOLLOW(S)$. So $FOLLOW(S) = \{*, \$\}$. Since $S \rightarrow aB$, $FOLLOW(S) \subseteq FOLLOW(B)$. $FOLLOW(B) = \{*, \$\}$.

   Therefore, **FIRST sets:** $S : \{a\} \quad B : \{a, \epsilon\}$, **FOLLOW sets:** $S : \{*, \$\} \quad B : \{*, \$\}$

Next, construct the predictive parsing table G:

As for $S \rightarrow aB$, $FIRST(aB) = FIRST(a) = \{a\}$. Add $S \rightarrow aB$ to $G[S, a]$.

As for $B \rightarrow S*B$, $FIRST(S*B) = FIRST(S) = \{a\}$. Add $B \rightarrow S*B$ to $G[B, a]$.

As for $B \to \epsilon$, $FOLLOW(B) = \{*, \$\}$. Add $B \to \epsilon$ to $G[B, *]$ and $B \to \epsilon$ to $G[B, \$]$.

Therefore, the predictive parsing table G is as follows:

Non-terminal	**Input symbol**		
	a	$*$	$\$$
S	$S \to aB$		
B	$B \to S * B$	$B \to \epsilon$	$B \to \epsilon$

2. Since there is no conflicts in the predictive parsing table G, it is ambiguous. So the grammar is $LL(1)$.
3.

MATCHED	STACK	INPUT	ACTION
	$S\$$	$aaaa***\$$	
	$aB\$$	$aaaa***\$$	output $S \to aB$
a	$B\$$	$aaa***\$$	match a
a	$S*B\$$	$aaa***\$$	output $B \to S*B$
a	$aB*B\$$	$aaa***\$$	output $S \to aB$
aa	$B*B\$$	$aa***\$$	match a
aa	$S*B*B\$$	$aa***\$$	output $B \to S*B$
aa	$aB*B*B\$$	$aa***\$$	output $S \to aB$
aaa	$B*B*B\$$	$a***\$$	match a
aaa	$S*B*B*B\$$	$a***\$$	output $B \to S*B$
aaa	$aB*B*B*B\$$	$a***\$$	output $S \to aB$
$aaaa$	$B*B*B*B\$$	$***\$$	match a
$aaaa$	$*B*B*B\$$	$***\$$	output $S \to \epsilon$
$aaaa*$	$B*B*B\$$	$**\$$	match $*$
$aaaa*$	$*B*B\$$	$**\$$	output $S \to \epsilon$
$aaaa**$	$B*B\$$	$*\$$	match $*$
$aaaa**$	$*B\$$	$*\$$	output $S \to \epsilon$
$aaaa***$	$B\$$	$\$$	match $*$
$aaaa***$	$\$$	$\$$	output $S \to \epsilon$

Therefore, $LL(1)$ parser accept the input string $aaaa***$.

Optional Exercise

1. Consider a completely symmetric context-free grammar G':

   $S \to +SS \mid \to *SS \mid a$

   First, Since $FIRST(+SS) = +$, $FIRST(*SS) = *$ and $FIRST(a) = a$, they are not equal to each other. Second, $+SS$, $*SS$ and a can not derive the empty string.

   By the definition of $LL(1)$ Grammar, G' is $LL(1)$ Grammar. So G' is not ambiguous. Obviously, since G and G' is symmetric to each other, G is not ambiguous.