CS323 Assignment 3

1 Requirements

You are expected to complete all required homework exercises and encouraged to complete the optional ones. For submission, please put all your answers in a single PDF file and submit it via the assignment channel on SAKAI. The name of the file should follow the format "**studentID_A#**" (e.g., 30003554_A3). **The submission deadline is 11:55 PM, November 1, 2022.** Late submissions are allowed within one week after the deadline (grace period). If you submit your assignment during the grace period, your score will be 80% of the score you could get if the submission was made in time. Assignment submitted after the grace period will not be graded, meaning that you will get a zero for the assignment.

2 Required Exercises (100 points)

Exercise 1 (Grammar Basics): Consider the following context-free grammar G:

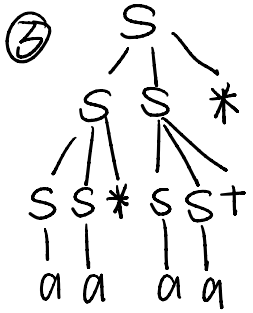
$$S \to SS+ \mid SS* \mid a$$

1. Give a leftmost derivation for the string $aa*aa+*$. [10 points]
2. Give a rightmost derivation for the string $aa*aa+*$. [10 points]
3. Give a parse tree for the string $aa*aa+*$. [10 points]
4. Give an equivalent grammar without immediate left recursions. [10 points]
5. Is the grammar ambiguous? [10 points]

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 $S \to aS'$
$S' \to S+S' \mid S*S' \mid \epsilon$

⑤ It is unambiguous

EX2: ①

$S \to aB$

$B \to S * B \mid \epsilon$

First: First(S) = First(aB) = First(SB) = {a}

First(B) = {a, ε}

Follow: Follow(S) = {$, *}

Follow(B) = {$, *}

For S→aB, a ∈ First(aB), ∴ put S→aB into M(S,a)

For B→S*B, a ∈ First(SB), ∴ put B→SB into M(B,a).

For B→ε, ε in First(B), foreach terminal in Follow(B), that is put B→ε into M(B,$), M(B,*)

	a	*	$
S	S→aB		
B	B→S*B	B→ε	B→ε

② Yes

③

3. Can an LL(1) parser accept the input string $aaaa$***? If yes, please list the moves made by the parser; otherwise, state the reason. Before parsing, please resolve conflicts in the parsing table if any. [20 points]

Matched	Stack	Input	action
	S$	aaaa***$	S->aB
a	aB	aaaa***$	match a
a	B$	aaa***$	B->S*B
a	S*B$	aaa***$	S->aB
a	aB*B$	aaa***$	match a
aa	B*B$	aa***$	B->S*B
aa	S*B*B$	aa***$	S->aB
aa	aB*B*B$	aa***$	match a
aaa	B*B*B$	a***$	B->S*B
aaa	S*B*B*B$	a***$	S->aB
aaa	aB*B*B*B$	a***$	match a
aaaa	B*B*B*B$	***$	B-> ϵ
aaaa	*B*B*B$	***$	match *
aaaa*	B*B*B$	**$	B-> ϵ
aaaa*	*B*B$	**$	match *
aaaa**	B*B$	*$	B-> ϵ
aaaa**	*B$	*$	match *
aaaa***	B$	$	B-> ϵ
aaaa***	$	$	

Exercise 2 (Top-Down Parsing): Consider the following grammar G:

$$S \to aB$$

$$B \to S * B \mid \epsilon$$

1. Construct the predictive parsing table for G. Please put down the detailed steps, including the calculation of FIRST and FOLLOW sets. [25 points]
2. Is the grammar LL(1)? [5 points]
3. Can an LL(1) parser accept the input string $aaaa***$? If yes, please list the moves made by the parser; otherwise, state the reason. Before parsing, please resolve conflicts in the parsing table if any. [20 points]

3 Optional Exercise (10 bonus points)

1. Justify your answer to Question 5 of Exercise 1. You do not need to provide a very rigorous proof. Informal explanations/examples are also acceptable.

For an ambiguous grammar, we can find two leftmost/rightmost derivation for it. Let w be any string that can be derived by the language. Suppose we want to find a rightmost derivation. when we choose production in each step, we should always consider the terminal that is currently unmatched and on the far right. if it is a, we choose S→a; if it is + we choose S→SS+ if it is *, we choose S→aa*, so there are only one choice each step. so the parse tree construted should be unque