Assignment 3

1 Requirements

You are expected to complete all required exercises and encouraged to complete the optional ones. For submission, please put all your answers in a PDF file. The name of the file should follow the format "studentID__assignmentNumber"

(e.g., 2021111054__assignment3). **The sub- mission deadline is 11:59 PM, October 15, 2023**.

2 Required Exercises (100 points)

Exercise 1(Grammar Basics)

Consider the following context-free grammar G:

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

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

Exercise 2(Top-Down Parsing)

Consider the following grammar G:

$$S \rightarrow aB$$
$$B \rightarrow S+B \mid \epsilon$$

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 Exercises (10 bonus points)

Exercise 1

Consider the following context-free grammar:

短语→ 人 | 短语动词短语
动词→ 喜欢 | 讨厌
人→ 你 | 我 | 他

The grammar can produce sentences such as “我喜欢你”. Is the grammar ambiguous? If yes, please give one sentence and its multiple parse trees. If no, state the reason. [5 points for the yes/no answer and 15 points for the justification]