Principles of Programming Languages

Homework #2

This homework will cover the topics of Context-free Grammars (CFGs). There are 5 questions in total. Answer questions 1 to 4 while question 5 is a bonus question. You should answer each question using CFGs for the given language descriptions. Your answers should be written in the "antlr4 .g4" files format.

Some test cases are provided for you to verify, DO NOT change these test cases.

Context-free Grammar Questions

1- For a given alphabet Σ={a,b}, define a language where every string contains exactly two 'a's and any number of 'b's, including none.

- Example: **Valid:** aa, aab , baa, baab, abba, babab. **Invalid**: ", aaa, b , abb , aabba.

2- For given alphabet ∑{0, 1}, define a language that accepts the binary strings for $0^a\ 1^b\ 0^c$, where $a + b = c$.

- Example: **Valid**: 0100, 001000, 111000, 000000 **Invalid**: 010, 101000, 0011000, 11100.

3- Given w∈{0,1}∗, define a CFG for the language where every string has an even number of '1's.

- Example: **Valid**: 00,1010,1111,1100,001100. **Invalid**: 1, 1011,0100,101010.

4- For a given alphabet Σ={a,b}, define a context-free grammar for the language
$L=\{a^n b^m a^n \mid n \geq 1, m \geq 0\}$

- Example: **Valid**: aa, aba, aabaa, aabbaa **Invalid**: a, abb, aabbba, aaa.

5- (BONUS) For a given alphabet Σ={0,1}, define a language where the string length is a prime number.

- Example: **Valid**: 11, 111, 10101, **Invalid**: 0000,111111,01010101