

Homework Assignment #10

Due: December 5, 2023 at 7:00 p.m.

- [3] 1. The goal of this question is to show that the context-free languages are closed under the Kleene star operator. Suppose $G = \langle V, \Sigma, R, S \rangle$ is a grammar for some language L . Give a precise definition of a grammar $G' = \langle V', \Sigma', R', S' \rangle$ for L^* .

You do not have to formally prove that your answer is correct, but you should give a brief explanation of why G' is a CFG for L^* .

2. Consider the following context-free grammar G with starting symbol S and terminals 0 and 1.

$$\begin{aligned} S &\rightarrow 0S \mid 1A \\ A &\rightarrow 1S \mid 0B \mid \varepsilon \\ B &\rightarrow 0A \mid 1B \end{aligned}$$

- [2] (a) Fill in the following table with yes/no answers to say whether each 4-bit string is generated by G or not.

string	generated?
0000	
0001	
0010	
0011	
0100	
0101	
0110	
0111	
1000	
1001	
1010	
1011	

- [2] (b) If x is a binary string, let $val(x)$ be the number represented by x in binary. For example, $val(10110) = 22$. What simple property of $val(x)$ determines whether x is generated by G or not? You do not have to prove your answer is correct.
- [2] (c) Draw a DFA with three states that accepts the language generated by G .
Hint: looking back at an earlier assignment might be helpful here.
- [2] (d) Relabel the states of your DFA as S, A, B .
Describe the connection between your DFA and G .