Quiz 6A: Context-Free Grammar

CS 212 Nature of Computation

Habib University — Fall 2023

Total Marks: 10 | Date: September 27, 2023
Duration: 10 minutes | Time: 830–840h

Student ID: _____

Student Name: _____

1. (10 points) Prove or disprove the following claim.

   Claim 1. *Every context-free grammar in Chomsky Normal Form is unambiguous.*

Solution: We disprove the claim by contradiction.

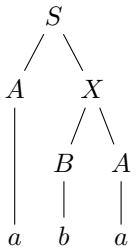
Proof. Assume that every context-free grammar in Chomsky Normal Form is unambiguous.
Let L be an inherently ambiguous context-free language.
Let G be a CFG in Chomsky Normal Form that represents L.
Then G is ambiguous. $\perp$ □

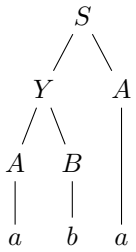
Solution: Here is another proof by contradiction that uses a counter-example.

Proof. Assume that every context-free grammar in Chomsky Normal Form is unambiguous.
Consider the following grammar which is in CNF.

$$\begin{aligned} S &\Longrightarrow AX \\ S &\Longrightarrow YA \\ X &\Longrightarrow BA \\ Y &\Longrightarrow AB \\ A &\Longrightarrow a \\ B &\Longrightarrow b \end{aligned}$$

Then the following 2 distinct parse trees can be built for the string, *aba*.





So, the grammar is ambiguous. $\perp$ □