L10: Equivalence of Non-Deterministic and Deterministic TMs (TM: Turing Machine)

2.22) Let $C = \{x\#y \mid x, y \in \{0,1\}^* \text{ and } x \neq y\}$. Show that C is a Context-free language.

Given that a string $x\#y$ is in language C if and only if $x \neq y$ or strings x and y vary at some specific position; Such as for i-index value of x is different from the character value of y.

It is not very complex to form a Context free grammar which produce all strings of the form $x\#y$ with $x \neq y$.

The Context free grammar is as follows:

$S \rightarrow A\#B \mid B\#A$

$A \rightarrow TAT \mid 0$

$B \rightarrow TBT \mid 1$

$T \rightarrow 0 \mid 1$

As the grammar for C is defined in terms of Context free grammar. The language produces a string that contains $x\#y$, and x and y are different character for same index position.

Hence, it is proved that C is Context Free Language.