CS21004 - Tutorial 5

March 1st, 2016

1. Consider the following grammar:

$$S \rightarrow aSbS|bSaS|\epsilon$$

Does this grammar generate the set of all strings with equal number of a's and b's? If no, give a counter-example. If yes, you must prove this.

2. Consider the following grammar:

$$
\begin{aligned}
S &\rightarrow aSa|A|C \\
A &\rightarrow bBb|bCb|E \\
B &\rightarrow bBb|\epsilon \\
C &\rightarrow aC|bC \\
D &\rightarrow aD|\epsilon \\
E &\rightarrow bb|bEb
\end{aligned}
$$

Give an equivalent grammar in Chomsky Normal Form (CNF). Remember to remove all useless variables.

3. Consider the following languages. Prove that these are not context-free:

$L_1 = \{a^l b^m c^n | l, m, n \geq 0, l \geq n \text{ and } m \geq n\}$

$L_2 = \{0^n 1^m | n, m \geq 0, m = n^2\}$.