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CS303 Tutorial 7

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Ans 1:

Given: L1 and L2 are 2 context free languages

To prove: $L1 \cap L2$ need not be context free.

Proof by counter example:

Let $L1 = \{a^n b^n c^m\}$ and $L2 = \{a^m b^n c^n\}$ $m,n \geq 0$

$L1 \cap L2 = \{a^n b^n c^n \mid n \geq 0\}$

Grammar of $L1 \cap L2$ is

$S \to aSBC \mid aBC \mid \epsilon$

$CB \to BC$

$aB \to ab$

$bB \to bb$

$bC \to bc$

$cC \to cc$

The LHS for atleast one production is not single terminal

Hence $L1 \cap L2$ is not a CFL.

Hence proved.

Ans 2:

$L_1 = \{a^n b^n c^m \mid m,n \geq 0\}$ $L_2 = \{a^m b^n c^n \mid m,n \geq 0\}$

$\therefore L_1 \cap L_2 = \{a^n b^n c^n \mid n \geq 0\}$

Grammar of $L_1 \cap L_2$ is

$S \rightarrow aSBC \mid aBC \mid \epsilon$

$CB \rightarrow BC$

$aB \rightarrow ab$

$bB \rightarrow bb$

$bC \rightarrow bc$

$cC \rightarrow cc$

$\because$ the LHS of atleast one production is not single non-terminal, this is not context free grammar.

This is a context sensitive grammar.

Ans 3:

CFL is not closed under complementation

Example:

$L1 = \{a^n b^n c^m \mid m,n \geq 0\}$, $L2 = \{a^m b^n c^n \mid m,n \geq 0\}$

are context free languages.

If CFLs are closed under complementation,

$\overline{L1}$ and $\overline{L2}$ are also CFLs

Then $\overline{L1} \cup \overline{L2}$ would also be a CFL because CFL's are closed under union.

Hence, $\overline{\overline{L1} \cup \overline{L2}} = L1 \cap L2$ must also be CFL by our assumption.

But $L1 \cap L2 = \{a^n b^n c^n \mid n \geq 0\}$ is not CFL

Hence the assumption is wrong and CFLs are not closed under complementation.