TUTORIAL – 2A

(CONTEXT-FREE LANGUAGES & PUSH-DOWN AUTOMATA)

Problem-1

What context-free languages will be generated by the following two (separate) CFGs,

G = < {S, A, B}, {a, b, c}, P, S >,

where P consists of the following production rules?

(a) S → ASB|ε, A → a,   B → bb|b

(b) S → abScB|ε,   B → bB|b

Problem-2

Define the context-free grammars for the following context-free languages?

Are your defined CFGs ambiguous / non-ambiguous?

- $L = \{\ a^i\ b^j\ c^k\ |\ i,j,k \geq 0,\ \text{and } i=j \text{ or } i=k\ \}$
- $L' = \{\ a^i\ b^j\ c^k\ |\ i,j,k \geq 0,\ \text{and } i+j = k\ \}$

Problem-3

Which of the following language(s) is/are context-free? Give justifications.

- $L_1 = \{\, a^m\, b^n \mid m,n \geq 0,\ m = 2n \,\}$
- $L_2 = \{\, a^m\, b^n \mid m,n \geq 0,\ m \neq 2n \,\}$
- $L_3 = \{\, a^m\, b^m\, c^{m+n} \mid m,n \geq 1 \,\}$
- $L_4 = \{\, a^m\, b^n\, c^{m+n} \mid m,n \geq 1 \,\}$
- $L_5 = \{\, a^l\, b^m\, c^n \mid l \geq 0,\ l < m \text{ and } l < n \,\}$

Problem-4

Consider the two CFGs G and G' with the start symbols S and S' and with the only productions:

Productions of G : $\qquad$ S→aS|B, B→bB|b

Productions of G': $\qquad$ S'→aA'|bB', A'→aA'|B', B'→bB'|ε

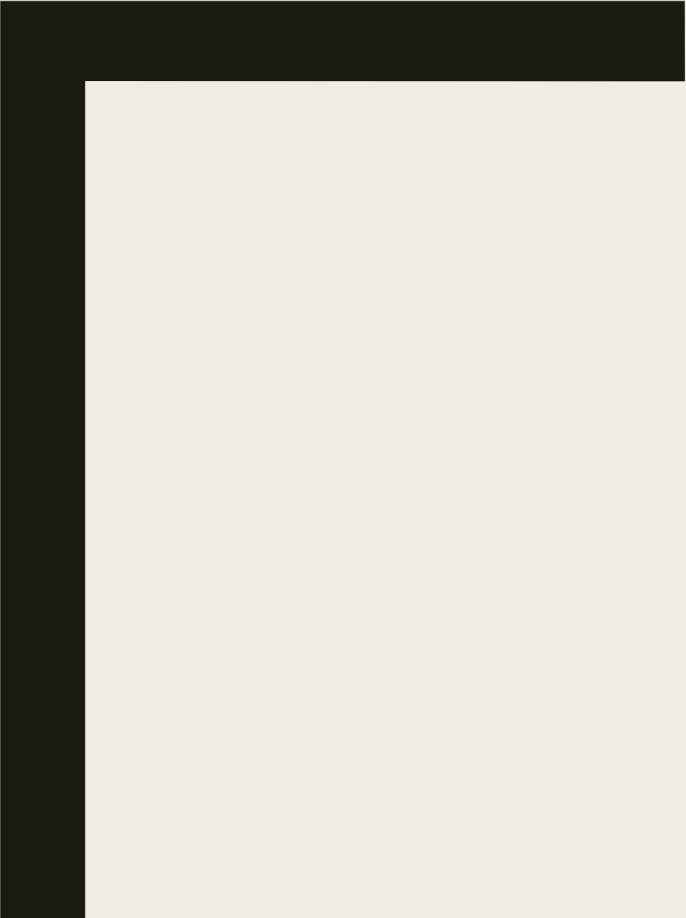Prove that, L(G) ⊂ L(G'), i.e., L(G) is strictly contained in L(G').

Problem-5

Prove that, the following context-free grammar,

G = ({S}, {a, b, c}, P, S), is ambiguous.

Here, the production rules (P) are given as:

S → aS | aSbS | c.

Construct a non-ambiguous grammar, G', that derives the same language.

Also prove L(G) = L(G').

THANK YOU !