C5: The Emptiness Problem for Context-Free Languages

Task: Using the marking algorithm, check whether the following grammars generate empty languages or not:

(a)
$$\begin{aligned} S &\to XU \mid UW \\ U &\to SaW \mid VbU \mid SbX \\ V &\to U \mid ab \mid XW \\ W &\to bXaUb \mid VbX \mid SX \\ X &\to bV \mid WX \end{aligned}$$

(b)
$$\begin{aligned} S &\to AC \mid DA \\ A &\to SbC \mid BaB \mid AaD \\ B &\to A \mid ba \mid DC \\ C &\to aDbAa \mid BaD \mid SD \\ D &\to aB \mid CD \end{aligned}$$

C6: Closure Properties of Context-Free Languages

Task: Show that context-free languages are closed under the reversal operation.

C7: Construction of Pushdown Automata

Task: Construct a PDA that accepts the language

$$\{a^k b^l c^{k+l} \mid k, l \geq 1\}.$$