

1. (4) Find a CFG with no useless symbols equivalent to

$$\begin{array}{l} S ::= AB \mid CA \quad B ::= BC \mid AB \\ A ::= a \quad \quad \quad C ::= aB \mid b \end{array}$$

2. (4) Can every CFL without ϵ be generated by a CFG with productions of the form $A ::= BCD$ and $A ::= a$? Explain.
3. (4) The language $\{a^n b^n c^m \mid m \neq n\}$ is not context-free, but the pumping lemma doesn't work. How would you prove it?
4. True/false
- (a) (2) The language $L = \{M \mid M \text{ is a Turing machine description}\}$ is regular.
 - (b) (2) The language $L = \{M \mid M \text{ is a valid Turing machine description}\}$ is regular.
 - (c) (2) Given a Turing machine M , the executions of M are context-free.
 - (d) (2) Every r.e. set is accepted by a TM with at most two nonaccepting states, and one accepting state.