Chomsky Normal Form

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1. Is the following grammar in Chomsky Normal Form (CNF)? Justify your answer

   $S \to AB$
   $A \to 0A \,|\, 0$
   $B \to 1B \,|\, 1$

2. Consider the following grammar

   $S \to AB \,|\, CD$
   $A \to BC \,|\, a$
   $B \to AC \,|\, C$
   $C \to AB \,|\, CD$
   $D \to AC \,|\, d$

   (a) Identify variables that derive nothing

   (b) Eliminate the useless variables in part a) and then eliminate the symbols that become unreachable. What is the resulting grammar

3. Start with with the following grammar

   $S \to 0A0 \,|\, 1B1 \,|\, BB$
   $A \to C$
   $B \to S \,|\, A$
   $C \to S \,|\, \epsilon$

   (a) Eliminate ϵ-productions and show resulting grammar

   (b) Eliminate unit-productions in grammar from a) and write the resulting grammar

   (c) Eliminate any useless symbols from the grammar from b) and write the resulting grammar

   (d) Put the resulting grammar into Chomsky Normal Form