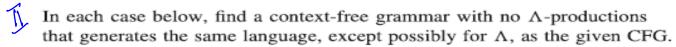
What language over  $\{a, b\}$  does the CFG with productions

 $S \rightarrow aaS \mid bbS \mid Saa \mid Sbb \mid abSab \mid abSba \mid baSba \mid baSab \mid \Lambda$  generate? Prove your answer.

Is this grammar ambiguous?



a. 
$$S \rightarrow AB \mid \Lambda$$

$$A \rightarrow aASb \mid a$$

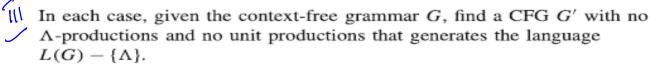
$$B \rightarrow bS$$

b. 
$$S \rightarrow AB \mid ABC$$

$$A \rightarrow BA \mid BC \mid \Lambda \mid a$$

$$B \to AC \mid CB \mid \Lambda \mid b$$

$$C \rightarrow BC \mid AB \mid A \mid c$$



a. G has productions

$$S \rightarrow ABA \qquad A \rightarrow aA \mid \Lambda \qquad B \rightarrow bB \mid \Lambda$$

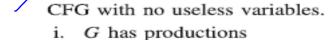
b. G has productions

$$S \rightarrow aSa \mid bSb \mid \Lambda$$
  $A \rightarrow aBb \mid bBa$   $B \rightarrow aB \mid bB \mid \Lambda$ 

c. G has productions

$$S \rightarrow A \mid B \mid C$$
  $A \rightarrow aAa \mid B$   $B \rightarrow bB \mid bb$   $C \rightarrow aCaa \mid D$   $D \rightarrow baD \mid abD \mid aa$ 

In each case, given the context-free grammar G, find an equivalent



$$S \rightarrow ABC \mid BaB \qquad A \rightarrow aA \mid BaC \mid aaa$$
  
 $B \rightarrow bBb \mid a \qquad C \rightarrow CA \mid AC$ 

ii. G has productions

$$S \rightarrow AB \mid AC \quad A \rightarrow aAb \mid bAa \mid a \quad B \rightarrow bbA \mid aaB \mid AB$$
  
 $C \rightarrow abCa \mid aDb \quad D \rightarrow bD \mid aC$ 

In each case below, given the context-free grammar G, find a CFG  $G_1$  in Chomsky normal form generating  $L(G) - \{\Lambda\}$ .

a. G has productions  $S \rightarrow SS \mid (S) \mid \Lambda$ 

b. G has productions  $S \rightarrow S(S) \mid \Lambda$ 

c. G has productions

$$S \rightarrow AaA \mid CA \mid BaB \quad A \rightarrow aaBa \mid CDA \mid aa \mid DC$$
 
$$B \rightarrow bB \mid bAB \mid bb \mid aS \quad C \rightarrow Ca \mid bC \mid D \quad D \rightarrow bD \mid \Lambda$$



Find a Greibach normal-form grammar equivalent to the following CFG:

$$S \rightarrow AA \mid 0$$

$$A \rightarrow SS \mid 1$$



Page 2/2