(1)

$S \rightarrow aXbX$

$X \rightarrow aY \mid bY \mid \epsilon$

$Y \rightarrow X \mid c$

Eliminating ϵ

$S \rightarrow aXbX \mid abX \mid aXb \mid ab$

$X \rightarrow aY \mid bY$

$Y \rightarrow c \mid X \mid \epsilon$

$S \rightarrow aXbX \mid abX \mid aXb \mid ab$

$X \rightarrow aY \mid bY \mid a \mid b$

$Y \rightarrow c \mid X$

Eliminating Unit Productions

$S \rightarrow aXbX \mid abX \mid aXb \mid ab$

$X \rightarrow aY \mid bY \mid a \mid b$

$Y \rightarrow c \mid aY \mid bY \mid a \mid b$

$A \rightarrow a$

$B \rightarrow b$

$S \rightarrow AXBX \mid ABX \mid AXB \mid AB$

$X \rightarrow AY \mid BY \mid a \mid b$

$Y \rightarrow c \mid AY \mid BY \mid a \mid b$

$U \rightarrow AX$

$V \rightarrow BX$

$S \rightarrow UV \mid AV \mid UB \mid AB$

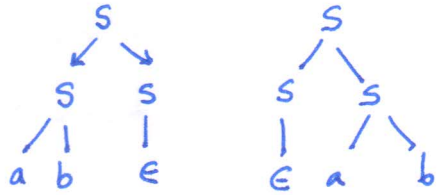
$X \rightarrow AY \mid BY \mid a \mid b$

$Y \rightarrow c \mid AY \mid BY \mid a \mid b$

$A \rightarrow a$

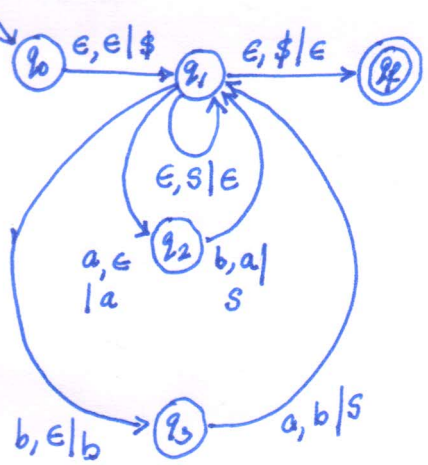
$B \rightarrow b$

(2) I. G is ambiguous (B)



II false S cannot produce aabb

III



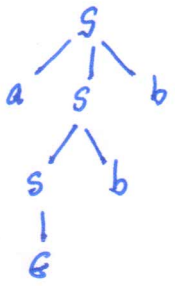
(3) ~~(B)~~

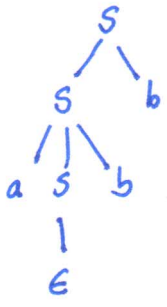
(C) false. $L=\{w w^r \mid w \in \{0,1\}^*\}$ cannot be accepted by a det. acc.

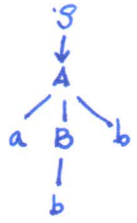
(4) $L_S = \{\epsilon, b, ab, abb, aabb, aabbb, \ldots\}$

(a) $= \{w \mid w \in \{a,b\}^* \wedge w$ has a's followed by b's and $\#b's \geq \#a's\}$

(b) $w = abb$







(c) $S \to aB \mid B \mid \epsilon$

$B \to Bb \mid Sb \mid b$

$S \to A \mid B$

$A \to aAb \mid aBb \mid \epsilon$

$B \to bB \mid b$

(5) L_1 :

$S_1 \rightarrow 0S_1 1 \mid 0 \mid 1 \mid$ ~~$0Z1$~~ $Y \mid Z$

~~A~~ $\rightarrow 0Z \mid 0$

~~Y~~ $\rightarrow 1Y \mid 1$

L_2 :

$S_2 \rightarrow 00S_2 1 \mid 0$

(c)