Chapter 4 Homework

4.1 From $S \to aS \mid bS \mid B$ | $S' \to S$ | $S' \to S \mid \lambda$

$B \to bb \mid C \mid \lambda$ | $S \to aS \mid bS \mid B$ | $S \to aS \mid bS \mid a \mid b \mid B$

$C \to cC \mid \lambda$ | $B \to bb \mid C \mid \lambda$ | $B \to bb \mid C$

$C \to cC \mid \lambda$ | $C \to cC \mid c$

$L(G) = (a \cup b)^* bb \cup (a \cup b)^* c^* = (a \cup b)^* (bb \cup c^*)$

4.3 From $S \to BSA \mid A$ | $S' \to S$ | $S' \to S \mid \lambda$

$A \to aA \mid \lambda$ | $S \to BSA \mid A$ | $S \to BSA \mid SA \mid BS \mid BA \mid S \mid A \mid B$

$B \to Bba \mid \lambda$ | $A \to aA \mid \lambda$ | $A \to aA \mid a$

$B \to Bba \mid \lambda$ | $B \to Bba \mid ba$

$S \to A$: a^+ $\quad S \to B$: $(ba)^+$ $\quad S \to BA$: $(ba)^+ a^+$ $\quad S$: $(a^+ \cup (ba)^+ \cup (ba)^+ a^+)$

$SA \mid BS$: $Sa^+ \cup (ba)^+ S$ $\quad BSA$: $(ba)^+ S a^+$

$L(G) = ((ba)^+ \cup \lambda)\ (a^+ \cup (ba)^+ \cup (ba)^+ a^+)\ (\lambda \cup a^+)$

4.7 From $S \to AS \mid A$ | $S \to AS \mid aA \mid bB \mid cC \mid b$

$A \to aA \mid bB \mid C$ | $A \to aA \mid bB \mid cC \mid b$

$B \to bB \mid b$ | $B \to bB \mid b$

$C \to cC \mid B$ | $C \to cC \mid bB \mid b$

$bB = bb^+$ $\quad cC = c(c^+(bb^+ \cup b) \cup b)$ $\quad b = b$

$aA = a(a^+(bb^+ \cup c(c^+(bb^+ \cup b) \cup b) \cup b))$ $\quad A^+ = (a^+(bb^+ \cup c(c^+(bb^+ \cup b) \cup b) \cup b))^+$

$L(G) = A^+(aA \cup bB \cup cC \cup b) \cup aA \cup bB \cup cC \cup b = (A^+ \cup \lambda)(aA \cup bB \cup cC \cup b)$

4.8 From $S \to A \mid B \mid C$ | $S \to aa \mid bb \mid cc$

$A \to aa \mid B$ | $A \to aa \mid bb \mid cc$

$B \to bb \mid C$ | $B \to aa \mid bb \mid cc$

$C \to cc \mid A$ | $C \to aa \mid bb \mid cc$

$L(G) = aa \cup bb \cup cc$

4.11 From $S \to S' \to S \mid \lambda$ | $S' \to aS \mid bS \mid a \mid b \mid bb \mid cC \mid c \mid \lambda$

$S \to aS \mid bS \mid a \mid b \mid B$ | $S \to aS \mid bS \mid a \mid b \mid bb \mid cC \mid c$

$B \to bb \mid C$ | $B \to bb \mid cC \mid c$

$C \to cC \mid c$ | $C \to cC \mid c$

$L(G) = (a \cup b)^* bb \cup (a \cup b)^* c^* = (a \cup b)^* (bb \cup c^*)$

4.14 From $S \to AA \mid CD \mid bB$ | $S_T \to AA$ | $S_U \to AA$

$A \to aA \mid a$ | $A \to aA \mid a$ | $A \to aA \mid a$

$B \to bB \mid bC$ | $D \to dD \mid d$

$C \to cB$

$D \to dD \mid d$

$L(G) = aa^+$

4.16	From $S \rightarrow ACH \mid BB$	$S_T \rightarrow BB$	$S_U \rightarrow BB$
	$A \rightarrow aA \mid aF$	$A \rightarrow aA \mid aF$	$B \rightarrow b$
	$B \rightarrow CFH \mid b$	$B \rightarrow b$	
	$C \rightarrow aC \mid DH$	$F \rightarrow bB \mid b$	
	$D \rightarrow aD \mid BD \mid Ca$	$H \rightarrow dH \mid d$	
	$F \rightarrow bB \mid b$		
	$H \rightarrow dH \mid d$		

$L(G) = bb$

4.17	From $S \rightarrow A \mid CB$	$S \rightarrow cC \mid c \mid dD \mid d \mid CB$
	$A \rightarrow C \mid D$	$A \rightarrow cC \mid c \mid dD \mid d$
	$B \rightarrow bB \mid b$	$B \rightarrow bB \mid b$
	$C \rightarrow cC \mid c$	$C \rightarrow cC \mid c$
	$D \rightarrow dD \mid d$	$D \rightarrow dD \mid d$

$V = TERM = \{B, C, D, S, A\} = REACH = \{S, A, C, B, D\}$

From $S \rightarrow cC \mid c \mid dD \mid d \mid CB$	$S_T \rightarrow cC \mid c \mid dD \mid d \mid CB$	$S_U \rightarrow cC \mid c \mid dD \mid d \mid CB$
$A \rightarrow cC \mid c \mid dD \mid d$	$A \rightarrow cC \mid c \mid dD \mid d$	$B \rightarrow bB \mid b$
$B \rightarrow bB \mid b$	$B \rightarrow bB \mid b$	$C \rightarrow cC \mid c$
$C \rightarrow cC \mid c$	$C \rightarrow cC \mid c$	$D \rightarrow dD \mid d$
$D \rightarrow dD \mid d$	$D \rightarrow dD \mid d$	

4.19	From $S \rightarrow aAbB \mid ABC \mid a$	$S \rightarrow A'T_1 \mid AT_2 \mid a$
	$A \rightarrow aA \mid a$	$T_1 \rightarrow AT_3$
	$B \rightarrow bBcC \mid b$	$T_2 \rightarrow BC$
	$C \rightarrow abc$	$T_3 \rightarrow B'B$
		$A \rightarrow A'A \mid a$
		$B \rightarrow B'T_4 \mid b$
		$T_4 \rightarrow BT_5$
		$T_5 \rightarrow C'C$
		$T_6 \rightarrow A'T_7$
		$T_7 \rightarrow B'C'$
		$A' \rightarrow a'$
		$B' \rightarrow b'$
		$C' \rightarrow c'$

Derivation	Rule
$S \Rightarrow AY$	$S \rightarrow AY$
$\Rightarrow aY$	$A \rightarrow a$
$\Rightarrow aBY$	$Y \rightarrow BY$
$\Rightarrow abY$	$B \rightarrow b$
$\Rightarrow aba$	$Y \rightarrow a$

4.26 From $S \rightarrow AX \mid AY \mid a$

$X \rightarrow AX \mid a$

$Y \rightarrow BY \mid a$

$A \rightarrow a$

$B \rightarrow b$

CYK for string ***abaaa***

X_{11} **{S, X, Y, A}**	X_{12} **Φ**	X_{13} **{S}**	X_{14} **Φ**	X_{15} **Φ**
a	X_{22} **{B}**	X_{23} **{Y}**	X_{24} **Φ**	X_{25} **Φ**
	b	X_{33} **{S, X, Y, A}**	X_{34} **{S, X}**	X_{35} **{S, X}**
		a	X_{44} **{S , X, Y, A}**	X_{45} **{S, X}**
			a	X_{55} **{S, X, Y, A}**
				a

27 Construct an equivalent grammar with leftmost derivations removed

$S \rightarrow A \mid B$

$A \rightarrow aaB \mid Aab \mid Aba$

$B \rightarrow bB \mid Bb \mid aba$

$S' \rightarrow A \mid B$

$A \rightarrow aaBY \mid aaB$

$Y \rightarrow abY \mid baY \mid ab \mid ba$

$B \rightarrow bB \mid abaZ \mid aba$

$Z \rightarrow bZ \mid b$

$B = aba \cup abab^+ \cup b^+aba \cup b^+abab^+$

$aaB = aa(aba \cup abab^+ \cup b^+aba \cup b^+abab^+)$

$aaBY = aa(aba \cup abab^+ \cup b^+aba \cup b^+abab^+)(ab \cup ba)^+$

4.28 From $S \rightarrow A \mid C$

$A \rightarrow AaB \mid AaC \mid B \mid a$

$B \rightarrow Bb \mid Cb$

$C \rightarrow cC \mid c$

$S \rightarrow A \mid C$

$A \rightarrow BY \mid aY \mid B \mid a$

$Y \rightarrow aBY \mid aCY \mid aB \mid aC$

$B \rightarrow CbZ \mid Cb$

$Z \rightarrow bZ \mid b$

$C \rightarrow cC \mid c$

Leftmost derivation for string ***aaccacb***

Derivation	Rule
$S \Rightarrow A$	$S \rightarrow A$
$\Rightarrow aY$	$A \rightarrow aY$
$\Rightarrow aaCY$	$Y \rightarrow aCY$
$\Rightarrow aacCY$	$C \rightarrow cC$
$\Rightarrow aaccY$	$C \rightarrow c$
$\Rightarrow aaccaB$	$Y \rightarrow aB$
$\Rightarrow aaccaCb$	$B \rightarrow Cb$
$\Rightarrow aaccacb$	$C \rightarrow c$