

## Homework #8 Solution

2.

1. Eliminate Useless Symbols

여기서 useless symbol은 없다. ( $S \rightarrow TU \mid V, V \rightarrow W$  의 문법이 존재하고 terminal을 generate 하기 때문에 모든 symbol이 useful하고 reachable하다.)

2. Eliminate  $\epsilon$ -productions

$S \rightarrow T$

$S \rightarrow U$

$T \rightarrow ab$

$U \rightarrow c$

$V \rightarrow ac$

$W \rightarrow b$

위와 같은 production을 추가하고,  $\epsilon$ -productions을 eliminate시키면 다음과 같이 된다.

$S \rightarrow TU \mid T \mid U \mid V$

$T \rightarrow aTb \mid ab$

$U \rightarrow cU \mid c$

$V \rightarrow aVc \mid ac \mid W$

$W \rightarrow bW \mid b$

3. Eliminate unit productions

$S \rightarrow aTb \mid ab \mid cU \mid c \mid aVc \mid ac \mid bW \mid b$

$V \rightarrow bW \mid b$

위와 같은 production을 추가하고, unit production을 eliminate시키면 다음과 같이 된다.

$S \rightarrow TU \mid aTb \mid ab \mid cU \mid c \mid aVc \mid ac \mid bW \mid b$

$T \rightarrow aTb \mid ab$

$U \rightarrow cU \mid c$

$V \rightarrow aVc \mid ac \mid bW \mid b$

$W \rightarrow bW \mid b$

4. Chomsky normal form으로 만들기 위해서 terminal a,b,c를  $X_a \rightarrow a, X_b \rightarrow b, X_c \rightarrow c$  로 바꾸면

$S \rightarrow TU \mid X_a T X_b \mid X_a X_b \mid X_c U \mid c \mid X_a V X_c \mid X_a X_c \mid X_b W \mid b$

$T \rightarrow X_a T X_b \mid X_a X_b$

$U \rightarrow X_c U \mid c$

$V \rightarrow X_a V X_c \mid X_a X_c \mid X_b W \mid b$

$W \rightarrow X_b W \mid b$

$X_a \rightarrow a$

$X_b \rightarrow b$

$Xc \rightarrow b$

위와 같이 되고 이를 Chomsky normal form으로 만들면 다음과 같다.

$S \rightarrow TU \mid XaY1 \mid XaXb \mid XcU \mid c \mid XaY2 \mid XaXc \mid XbW \mid b$

$Y1 \rightarrow TXb$

$Y2 \rightarrow VXc$

$T \rightarrow XaY1 \mid XaXb$

$U \rightarrow XcU \mid c$

$V \rightarrow XaY2 \mid XaXc \mid XbW \mid b$

$W \rightarrow XbW \mid b$

$Xa \rightarrow a$

$Xb \rightarrow b$

$Xc \rightarrow b$