Sheet 6 solutions

1] $S \to X1X1X1X$

$X \to 0X \mid 1X \mid \epsilon$

Solution

x1x1x1

1] Eliminate G:

$S \to X1X1X1X \mid 1X1X1X \mid X11X1X \mid X1X11X \mid$

$X \to 0X \mid 1X \mid 0 \mid 1$

2] Remove Unit Production → Don't have

3] Apply Conversion for long Production into short.

let $X1 = F$

$1X = K$

$\therefore S \to$ FFFX | KKK | FKK | FFK | FFF

let $FF = \ell$

$KK = M$

$FX = H$

$\therefore S \to \ell H \mid MK \mid FM \mid \ell K \mid \ell F$

$X \to 0X \mid 1X \mid 0 \mid 1$

4] More terminals → Don't have.

Final Grammar is

$S \to \ell H \mid MK \mid FM \mid \ell K \mid \ell F$

$X \to 0X \mid 1X \mid 0 \mid 1$

$\ell \to FF$, $M \to KK$, $H \to FX$

$F \to X1$, $K \to 1X$

it can generate any Binary string with @ least three ones

2] Convert the following CFG into a grammar in CNF:

$S \rightarrow ASB \mid SB \mid AS \mid S$

$A \rightarrow aASA \mid a \mid \epsilon$ aSA | aAS | aS

$B \rightarrow SbS \mid A \mid bb$

Solution

Note: whenever you see $S \rightarrow \ldots S \ldots$, initiate new var S' & produce S from it

(1) $S' \rightarrow S$, $S \rightarrow ASB$, $A \rightarrow aASA \mid a \mid \epsilon$

$B \rightarrow SbS \mid A \mid bb$

(2) Remove any Nullable variable.

// Here it is obvious that A is Nullable, but we have a case where $B \rightarrow A$, & B also is nullable $S' \rightarrow S$

$S \rightarrow ASB \mid SB \mid AS \mid S$

$A \rightarrow aASA \mid aSA \mid aAS \mid a$

$B \rightarrow SbS \mid A \mid bb$

S` -> S
B -> TS | ER | WR | ES | a | QQ
A -> ER | WR | ES | a
S -> YB | SB | AS
E -> WA
R -> SA, T -> SQ ,Y -> AS
Q -> b
W -> a

(3) Eliminate any Unit Production

unit Production cases:

$S \rightarrow S$ → just remove it

$B \rightarrow A$: $A \rightarrow aASA \mid aSA \mid aAS \mid a$

$B \rightarrow SbS \mid aASA \mid aSA \mid aAS \mid a \mid bb$

$S \rightarrow ASB \mid SB \mid AS$

$A \rightarrow aASA \mid aSA \mid aAS \mid a$

(2)

4 Convert any long term to short term & More terms

∵ $A \to aASA$ ∵ we can not have small var here

assume $l \Rightarrow a$

assume $M \to lA$, $N \to SA$ ∵ $A \to MN$

$A \to aSA$ will be $A \to lN$

$A \to aAS$ let $O \to AS$ $A \to lO$

1- $A \to lO \mid lN \mid MN \mid a$

$O \to AS$

$M \to lA$ (1)

$N \to SA$, $l \to a$

S` -> S
B -> TS | ER | WR | ES | a | QQ
A -> ER | WR | ES | a
S -> YB | SB | AS
E -> WA
R -> SA, T -> SQ ,Y -> AS
Q -> b
W -> a

∵ $S \to ASB \mid SB \mid AS$ → $S \to OB \mid SB \mid AS$ (2)

∵ $B \to SbS \mid A \mid bb$

↳ I know that we converted this but for simplicity now

let $H \to b$

$Q \to SH$

∵ $B \to QS \mid lO \mid lN \mid MN \mid HH$ } Final Grammar

$S \to OB \mid SB \mid AS$

$O \to AS$, $M \to lA$, $N \to SA$, $l \to a$

$S` \to S$

$A \to lO \mid lN \mid MN \mid a$

(3)

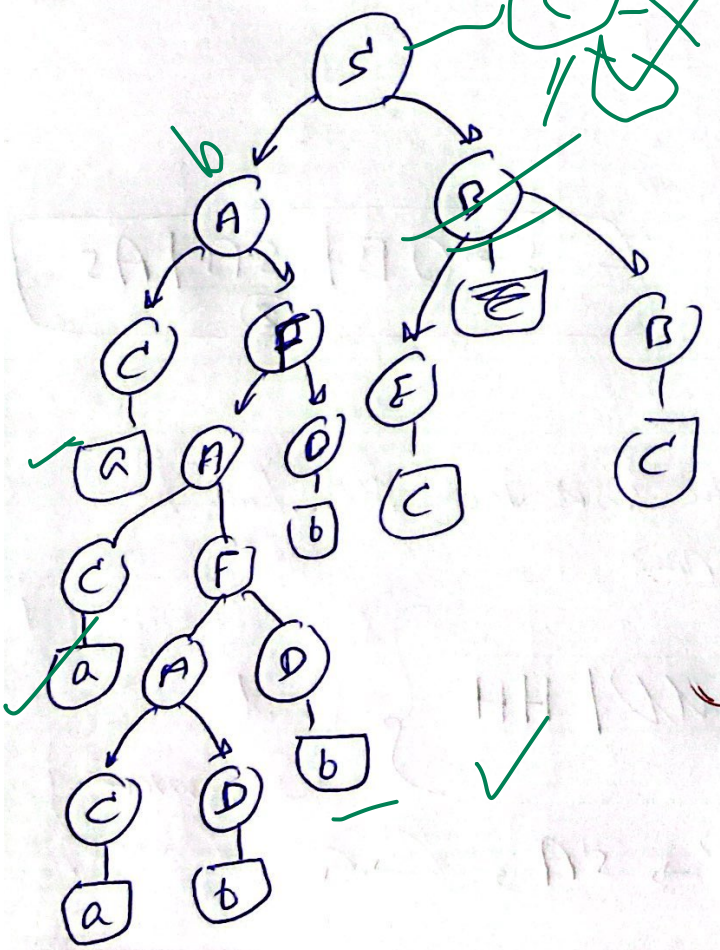
Q3) For aaabbbcc apply CKY & tell if S is parsable or not & if yes show its Parse Trees.

$S \to AB$
$A \to CD \mid CF$
$B \to c \mid ED$
$C \to a$
$D \to b$
$E \to c$
$F \to AD$

	a	a	a	b	b	b	c	c
1	C	∅	∅	∅	∅	A	S	S
2		C	∅	∅	A	F	∅	∅
3			C	A	E	∅	∅	∅
4				D	∅	∅	∅	∅
5					D	∅	∅	∅
6						D	∅	∅
7							B, E	B
8								S, E

∴ It is Parsable

The Tree Top bottom



this is the only possible Parse Tree