

Sheet 6 solutions!

$$1] S \rightarrow X1X1X1X$$

$$X \rightarrow 0X \mid 1X \mid \epsilon$$

Solution

① Eliminate ϵ :

$$S \rightarrow X1X1X1X \mid 1X1X1X \mid X11X1X \mid X1X11X \mid \dots$$

$$X \rightarrow 0X \mid 1X \mid 0 \mid 1$$

② Remove Unit Production \rightarrow Don't have

③ Apply Conversion for long production into short.

$$\text{let } X1 = F$$

$$1X = K$$

$$\therefore S \rightarrow$$

F F F X	K K K	F K K
F F K	F F F	

$$\text{let } FF = L$$

$$KK = M$$

$$FX = H$$

$$\therefore S \rightarrow$$

LH	MK	FM	LK	LF
----	----	----	----	----

$$X \rightarrow 0X \mid 1X \mid 0 \mid 1$$

④ More terminals \rightarrow Don't have.

Final Grammar is

$$S \rightarrow LH \mid MK \mid FM \mid LK \mid LF$$

$$X \rightarrow 0X \mid 1X \mid 0 \mid 1$$

$$L \rightarrow FF, M \rightarrow KK, H \rightarrow FX$$

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

it can generate any Binary string with @ least three ones

①

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

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

$$A \rightarrow aASA \mid a \mid \text{aSA} \mid \text{aAS} \mid \text{aS}$$

$$B \rightarrow sbS \mid A \mid bb$$

Solution

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

$$\textcircled{1} S' \rightarrow S, S \rightarrow ASB, A \rightarrow aASA \mid a \mid \epsilon \\ B \rightarrow sbS \mid A \mid bb$$

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 $S' \rightarrow S$

$$\begin{aligned} S' &\rightarrow ASB \mid SB \mid AS \mid \epsilon \\ A &\rightarrow aASA \mid aSA \mid aAS \mid a \\ B &\rightarrow sbS \mid A \mid bb \end{aligned}$$

$$\begin{aligned} S' &\rightarrow S \\ B &\rightarrow TS \mid ER \mid WR \mid ES \mid a \mid QQ \\ A &\rightarrow ER \mid WR \mid ES \mid a \\ S &\rightarrow YB \mid SB \mid AS \\ E &\rightarrow WA \\ R &\rightarrow SA, T \rightarrow SQ, Y \rightarrow AS \\ Q &\rightarrow b \\ W &\rightarrow a \end{aligned}$$

3] Eliminate any unit production

unit production cases:

$S \rightarrow S \rightarrow$ Just remove it

$$B \rightarrow A \rightarrow A$$

$A \rightarrow aASA$

$B \rightarrow sbS$

$$B \rightarrow sbS \mid aASA \mid aSA \mid aAS \mid a$$

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

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

(2]

[4] Convert any long term to short term & More terms

$\therefore A \rightarrow a A S A$ we can not have small var here

assume $l \rightarrow a$

assume $M \rightarrow l A$, $N \rightarrow S A$ $\therefore A \rightarrow M N$

$A \rightarrow a S A$ will be $A \rightarrow l N$

$A \rightarrow a A S$ let $o \rightarrow A S$ $A \rightarrow l o$

$A \rightarrow l o \mid l N \mid M N \mid a$
 $B \rightarrow A S$
 $M \rightarrow l A$
 $N \rightarrow S A, l \rightarrow a$ ①

$S' \rightarrow S$
 $B \rightarrow T S \mid E R \mid W R \mid E S \mid a \mid Q Q$
 $A \rightarrow E R \mid W R \mid E S \mid a$
 $S \rightarrow Y B \mid S B \mid A S$
 $E \rightarrow W A$
 $R \rightarrow S A, T \rightarrow S Q, Y \rightarrow A S$
 $Q \rightarrow b$
 $W \rightarrow a$

$S \rightarrow A S B \mid S B \mid A S$ $S \rightarrow o B \mid S B \mid A S$ ②

$B \rightarrow S B S \mid A \mid b b$

I know that we converted this but for simplicity now

let $H \rightarrow b$

$Q \rightarrow S H$

$B \rightarrow Q S \mid l o \mid l N \mid M N \mid H H$

$S \rightarrow o B \mid S B \mid A S$

$o \rightarrow A S, M \rightarrow l A, N \rightarrow S A, l \rightarrow a$

$S' \rightarrow S$

$A \rightarrow l o \mid l N \mid M N \mid a$

Final Grammar



<https://www.spearhead-training.com>



(Q3) For aaabbbcc apply NLP & tell if it is parseable or not & if yes show its parse tree.

$$S \rightarrow AB$$

A → CD CF

$B \rightarrow C \mid EB$
small

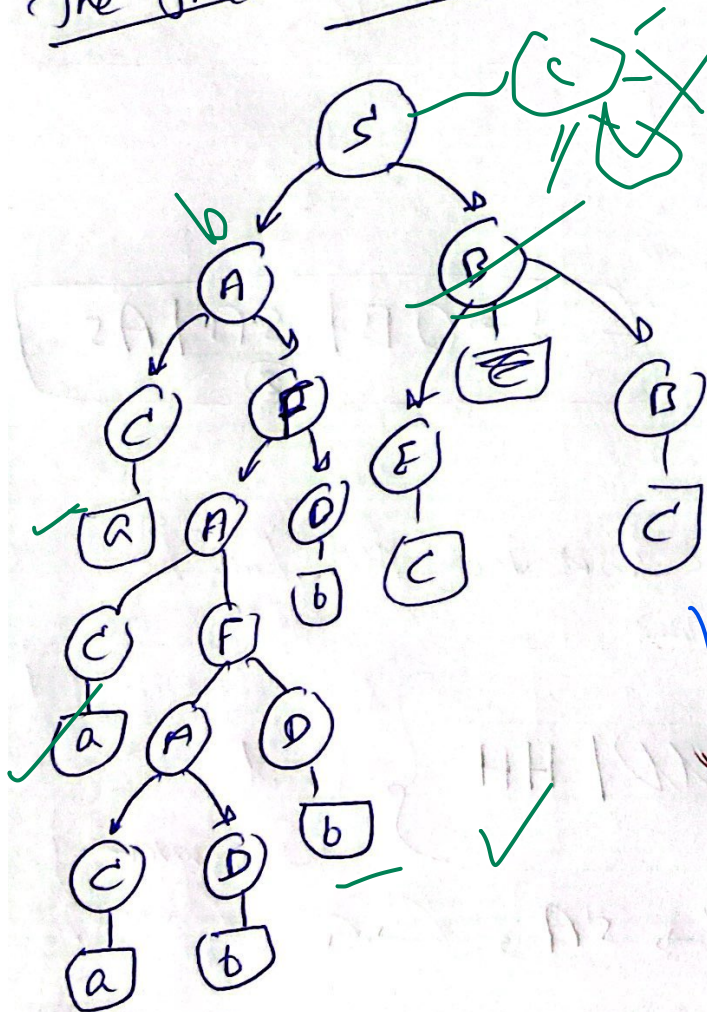
$$C \rightarrow a$$

$\phi \rightarrow b$

$$f \rightarrow c$$
$$f \rightarrow AD$$

It is Parsable

The Tree Top bottom



this is the
only possible
Parse Tree

21/11/24

4