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|----|---------|---|
| 16 | 15/3/24 | write CFG for given language. |
| 17 | 15/3/24 | write leftmost & rightmost. |
| 18 | 15/3/24 | Eliminate ϵ , unit production & useless ^{symbols} |
| 19 | 15/3/24 | Convert the grammar to CNF |
| 20 | 15/3/24 | Convert the grammar to CNF |

15/8/24

day-3

Experiment 16

- 16) Write CFG for language given below,
- set of all strings that start with a & end with b over $\Sigma = \{a, b\}$.
 - set of all strings over $\Sigma = \{a, b\}$ having 'aa' as a substring.
 - set of all binary strings that start & end with different digits.

AIM: To write CFG for given languages.

Procedure:

- i) start with a & end with b
 $\Sigma = \{a, b\}$. $L = \{ab, aab, abb, \dots\}$

CFG: $S \rightarrow aB$
 $B \rightarrow aB \mid b \mid \epsilon$

- ii) 'aa' as a substring

$\Sigma = \{a, b\}$ $L = \{aa, aag, aab, baag, \dots\}$

CFG: $S \rightarrow xaay \mid xyaa$
 $x \rightarrow ax \mid bx \mid \epsilon$
 $y \rightarrow ay \mid by \mid \epsilon$

- (iii) start & end with different digits

$\Sigma = \{0, 1\}$, $L = \{01, 10, 001, 110, \dots\}$

CFG: $S \rightarrow 0A \mid 1B$
 $A \rightarrow 0A \mid 1A \mid \epsilon$
 $B \rightarrow 0B \mid 1B \mid \epsilon$

Result: This CF4 for given language is written successfully,

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Experiment 17.

- (7) Write leftmost & right most derivations & draw parse tree for the string.

id + id * id from the CFG

$E \rightarrow E + E \mid E * E \mid (E) \mid id.$

Aim: To write lmd & rmd & draw parse tree for the string given below

Procedure:

$$E \rightarrow E * E$$

$$\Rightarrow E + E * E$$

$$\Rightarrow id + E * E$$

$$\Rightarrow id + id * E$$

$$\Rightarrow id + id * id$$

$$E \Rightarrow id \quad E * E$$

$$\Rightarrow E * id$$

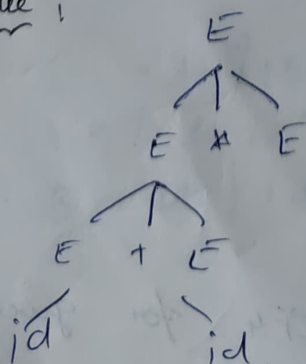
$$\Rightarrow E + E * id$$

$$\Rightarrow E + id * id$$

$$\Rightarrow id + id * id$$

Diagram:

Parse tree:



initially, the initial string is
 empty. The string is built
 by adding characters to the end.
 The string is built by adding
 characters to the end.
 The string is built by adding
 characters to the end.

The string is built by adding
 characters to the end.

The string is built by adding
 characters to the end.

The string is built by adding
 characters to the end.

initially	string
empty	empty
add 'A'	A
add 'A'	AA
add 'A'	AAA
add 'A'	AAAA

The string is built by adding
 characters to the end.

Result:
 thus, the final string is built successfully.

18) Eliminate ϵ -productions, unit productions & useless symbols from grammar

$$\begin{aligned} S &\rightarrow A s B / \epsilon \\ A &\rightarrow a A s / a \\ B &\rightarrow s b s / A / b b. \end{aligned}$$

Aim:

To eliminate ϵ -productions, unit productions & useless symbols from given grammar.

Procedure:

step 1: Eliminating ϵ -productions

S is nullable

$$S \rightarrow A s B / AB$$

$$A \rightarrow a A s / a A / a$$

$$B \rightarrow s b s / s b / b / A / b b.$$

step 2: Eliminating unit productions.

unit pairs	Productions
(S, S)	$S \rightarrow A s B / AB$
(A, A)	$A \rightarrow a A s / a A / a$
(B, B)	$B \rightarrow s b s / s b / b / b b$
(B, A)	$B \rightarrow a A s / a A / a$

Final grammar.

$$S \rightarrow A s B / AB$$

$$A \rightarrow a A s / a A / a$$

$$B \rightarrow s b s / s b / b / b b / a A s / a A / a$$

step 3: Eliminate useless symbols
there are no useless symbols.

Result: Thus, the ϵ -productions, unit productions
& useless symbols eliminated successfully

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Experiment 19

- 19) Convert the given grammar to CNF
 $S \rightarrow aSA \mid bSB \mid a \mid b$.

Aim: To convert given grammar to CNF

CNF: $A \rightarrow BC$ and $A \rightarrow a$

Procedure:

1. The given grammar is optimized
2. Introduce the Productions.

$$A \rightarrow a$$

$$B \rightarrow b$$

3. Rewrite the grammar

$$S \rightarrow AS \mid BS \mid a \mid b$$

$$A \rightarrow a$$

$$B \rightarrow b$$

4. Break productions

$$S \rightarrow AP_1 \mid BP_2 \mid a \mid b$$

$$P_1 \rightarrow SA$$

$$P_2 \rightarrow SB$$

$$A \rightarrow a$$

$$B \rightarrow b$$

Production	Left Hand Side
$S \rightarrow AB$	(1,1)
$A \rightarrow AC$	(1,1)
$A \rightarrow BC$	(1,1)
$B \rightarrow AC$	(1,1)
$B \rightarrow BC$	(1,1)
$C \rightarrow AC$	(1,1)
$C \rightarrow BC$	(1,1)

Result: Thus the given grammar is converted to CNF successfully,

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Experiment 20

20) Convert the given grammar to CNF

$$S \rightarrow ABA$$

$$A \rightarrow aA/\epsilon$$

$$B \rightarrow bB/c$$

Aim: To convert given grammar to CNF

QNF) $A \rightarrow a x$ or $A \rightarrow a$

Procedure:

1. Eliminate ϵ -production

S, A, B are nullable

$$S \rightarrow ABA/AB/BA/AA/A/B$$

$$A \rightarrow aA/b$$

$$B \rightarrow bB/b$$

2. Eliminate unit productions

unit pairs	Productions
(S, S)	$S \rightarrow ABA/AB/BA/AA$
(S, A)	$S \rightarrow aA/a$
(S, B)	$S \rightarrow bB/b$
(A, A)	$A \rightarrow aA/b$
(B, B)	$B \rightarrow bB/b$

Final grammar is

$$S \rightarrow ABA / BA / AB / AA / aA / a / bB / b.$$

$$A \rightarrow aA / a$$

$$B \rightarrow bB / b.$$

[$(A \& B)$ are in (nt)]

a/ Lemma 3,

Sub $A \& B$ productions in S

$$S \rightarrow aABA / aBA / bBA / bA \quad \& \quad aAB / aB / aAA / aA / a / bB / b.$$

$$A \rightarrow aA / b$$

$$B \rightarrow bB / b.$$

Result: Thus the given grammar is converted to NFA successfully.