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Assignment No. 3

Q.1 Explain chomskey Hierarchy in detail.

⇒ • A grammer can be classified on the basis of production rules.

• Chomskey classified grammers into the following types :

1. Type 3 : Regular Grammer
2. Type 2 : Context Free Grammer
3. Type 1 : Context Sensitive Grammer
4. Type 0 : Unrestricted Grammer.

• Type 3 OR Regular Grammer

⇒ A grammer is called type 3 or regular grammer if all its production are of the following forms :

$$A \rightarrow \varepsilon$$
$$A \rightarrow a$$
$$A \rightarrow aB$$
$$B \rightarrow Ba$$

Where, $a \in \Sigma$ and $A, B \in V$

→ A language generated by Type 3 grammer is known as regular language.

- Type 2 OR Context Free Grammer

⇒ A grammer is called Type 2 or context free grammer if all its production are of following form –

$$A \rightarrow \alpha$$

Where, $A \in V$ and $\alpha \in (V \cup T)^*$

V is set of variables and T is set of terminals.

→ The language generated by Type 2 grammer is called as a context free language, a regular language but not the reverse.

- Type 1 OR Context Sensitive Grammer

⇒ A grammer is called a Type 1 or context sensitive grammer if all its production are of the following form –

$$\alpha \rightarrow \beta,$$

Where, β is atleast as long as α

- Type 0 or Unrestricted Grammer

⇒ Productions can be written without any restriction in a unrestricted grammer.

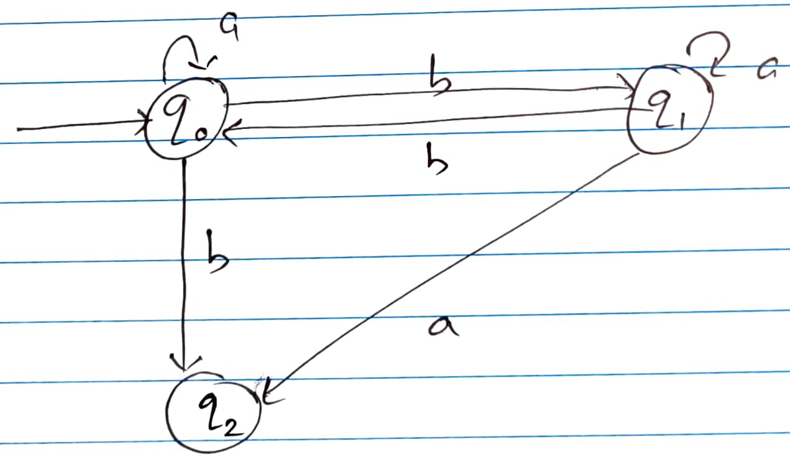
- If there is production of the $\alpha \to \beta$, the length of α could be more than length of β.
- Every grammer also is a Type 0 Grammer.
- A Type 2 Grammer is also a Type 1 Grammer.
- A Type 3 Grammer is also a Type 2 Grammer.

Q.2 Construct Finite Automata recognize L(G) where G is grammer given by -

$S \to aS \mid bA \mid b$

$A \to aA \mid bS \mid a$

⇒ Solⁿ :-



We can write Automata as -

$M(Q, \Sigma, \delta, q_0, F)$

$Q = \{q_0, q_1, q_2\}$,

$\Sigma = \{a, b\}$

$q_0 = q_0$

$F = q_2$

Transition table (δ)

$\Rightarrow$

	a	b
q_0	$\{q_0\}$	$\{q_1, q_2\}$
q_1	$\{q_1, q_2\}$	$\{q_0\}$
q_2	$\emptyset$	$\emptyset$

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Q.3 Consider the following grammar :

S → iCtS | iCtSeS | a

C → b

⇒ Soln :-

For string 'ibtibtaea' find following -

i) LMD

ii) RMD

iii) Parse Tree

iv) Check if above grammar is abiguous

⇒ Soln :-

i) LMD

⇒

S → iCtS .... [S → iCtS]

S → ibtS .... [C → b]

S → ibtiCtSeS .... [S → iCtSeS]

S → ibtibtSeS .... [C → b]

S → ibtibtaeS .... [S → a]

S → ibtibtaea .... [S → a]

ii) RMD

⇒

S → iCtS ... [S → iCtS]

S → iCtiCtSeS ... [S → iCtSeS]

S → iCtiCtSea ... [S → a]

S → iCtiCtaea .... [S → a]

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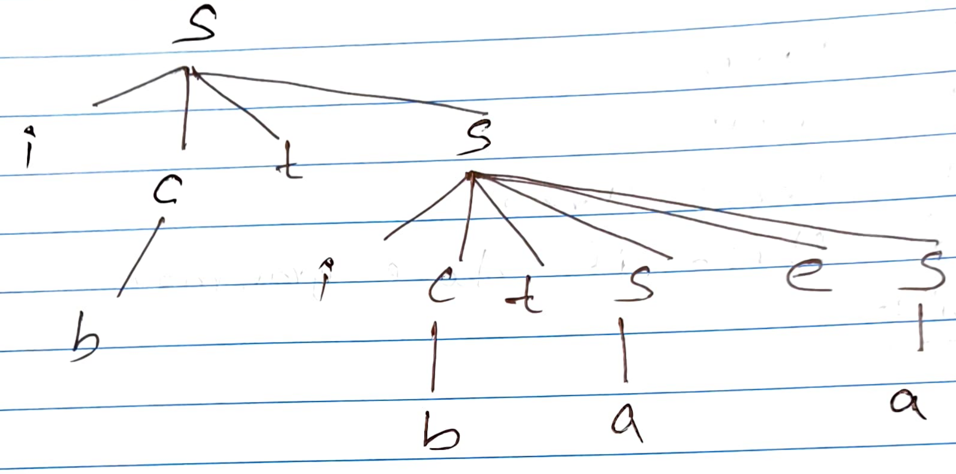
$S \rightarrow iCtebtaea$ ...... $[C \rightarrow b]$

$S \rightarrow ibtebtaea$ ..... $[C \rightarrow b]$

iii) Parse Tree

⇒



iv) The above grammar is ambiguous grammar due to loughing if problem.

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Q.4 Convert the following grammar to CNF form:

$S \to ABA$

$A \to aA \mid bA \mid \epsilon$

$B \to bB \mid aA \mid \epsilon$

⇒ Soln :-

1. The non-terminals $\{S, A, B\}$ are nullable. Null productions are removed. The resulting grammer is:

$S \to ABA \mid BA \mid AB \mid AA \mid A \mid B$

$A \to aA \mid bA \mid a \mid b$

$B \to bB \mid aA \mid b \mid a$

2. Removing unit productions, we get

$S \to ABA \mid BA \mid AB \mid AA \mid aA \mid bA \mid a \mid b \mid bB \mid aA$

$A \to aA \mid bA \mid a \mid b$

$B \to bB \mid aA \mid b \mid a$

3. Every symbol in α, in production of the form $A \to \alpha$ where ~~$|\alpha|$~~ $|\alpha| \geq 2$ should be a variable. This can be done by adding two productions:

$C_a \to a$

$C_b \to b$

The set of productions after above changes is :

$S \to ABA \mid BA \mid AB \mid AA \mid C_aA \mid C_bA \mid a \mid b \mid C_bB \mid C_aA$
$A \to C_aA \mid C_bA \mid a \mid b$
$B \to C_bA \mid C_aA \mid b \mid a$
$C_a \to a, \quad C_b \to b$

4. Finding an equivalent CNF :

Original Production	Equivalent production in CNF
$S \to ABA$	$S \to AC_1, \quad C_1 \to BA$
$S \to BA \mid AB \mid AA \mid C_aA \mid C_bA \mid a \mid b \mid C_bB \mid C_aA$	$S \to BA \mid AB \mid AA \mid C_aA \mid C_bA \mid a \mid b \mid C_bB \mid C_aA$
$A \to C_aA \mid C_bA \mid a \mid b$	$A \to C_aA \mid C_bA \mid a \mid b$
$B \to C_bB \mid C_aA \mid b \mid a$	$B \to C_bB \mid C_aA \mid b \mid a$
$C_a \to a$	$C_a \to a$
$C_b \to b$	$C_b \to b$