REGULAR GRAMMAR

- A grammar is said to be Regular Grammar (RG) if in that grammar all the productions have any number of terminals and at the most one variable.

- Regular grammar are of two types

Regular Grammar (RG)

① Right Linear Grammar (RLG) ② Left Linear Grammar (LLG)

* **Right Linear Grammar (RLG)**

- If in the grammar, all the productions are in the following form :

$$A \rightarrow \alpha B \quad \text{or} \quad A \rightarrow \alpha$$

where,

$A, B \Rightarrow$ non-terminates or variables

$\alpha \Rightarrow$ terminal

then the grammar is said to be Right Linear Grammar (RLG)

e.g : $A \rightarrow aA \mid bB \mid b$

* **Left Linear Grammar (LLG)**

- If in the grammar, all the productions are of the form

$$A \rightarrow B\alpha \quad \text{or} \quad A \rightarrow \alpha$$

where,

$A, B \Rightarrow$ non-terminals or variables

$\alpha \Rightarrow$ terminal

then the grammar is said to be Left Linear Grammar (LLG)

e.g: $A \rightarrow Aa \mid Bb \mid b$

* Converting RLG to FA :

Step 1 : Number of states in TD = Number of variables + 1 in RLG.

Step 2 :

Production	Transition
$A \to aB$	$\delta(A, a) \to B$
$A \to \alpha$	$\delta(A, \alpha) \Rightarrow$ Final state

Step 3 : If start state has epsilon (ϵ) as its one of the production, i.e. $S \to \epsilon$ then make start state also a final state.

Step 4 : The above transition diagram would be probably a NFA. So convert it into DFA and then min DFA.

NFA $\longrightarrow$ DFA $\longrightarrow$ min DFA.

Q. Design FA for the following

$S \to 0A \mid 1B \mid 0$

$A \to 0S \mid 1$

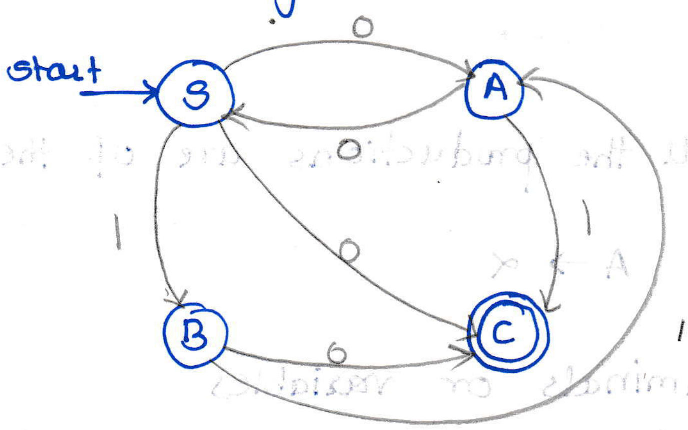
$B \to 1A \mid 0$

$\to$

No. of variables = S, A, B = 3

$\therefore$ No of states = 4 (one for final state).

Transition Diagram :



* Converting FA to RLG :

step 1: Associate variables like S, A, B, etc. with state names

step 2: Replace the transitions by productions as shown below:

Transition	Production
$\delta(A,a) = B$	$A \to aB$

if B is a final state then add production $A \to a$

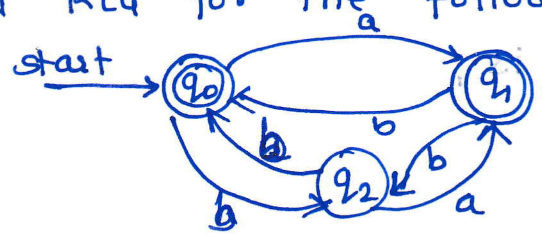
$\therefore$

Transition	Production
$\delta(A,a) = B$	$A \to aB \mid a$

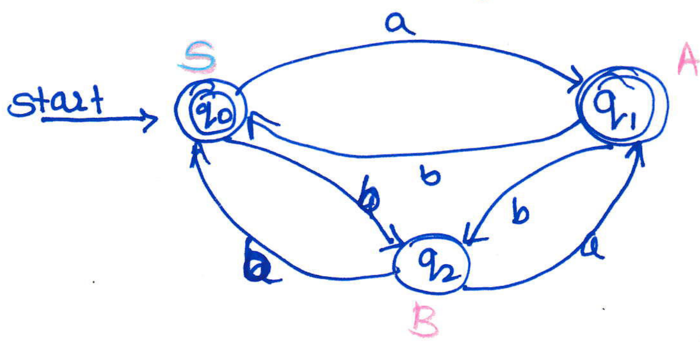
step 3: If start state is a final state then add ϵ as production to the start variable i.e. $S \to \epsilon$

step 4: Eliminate unit ϵ useless productions.

Q Find RLG for the following



→ Associate variables with each state.



Convert into RLG :

$S \to aA \mid bB \mid a \mid \epsilon$ → As A is a final state (step 2) → start state is final state (step 3)

$A \to bS \mid bB \mid b$ → As S is also a final state.

$B \to bS \mid b \mid aA \mid a$ → As A is final state.

As S is final state

* Converting RLG to LLG

Step 1: Rewrite RLG so that all productions are of the form $A \to aB$ or $A \to a$

step 2: Draw transition diagram with vertices & labelled as $(V, \cup\{\varepsilon\})$ and transition labelled as $(T, \cup\{\varepsilon$
variable   Terminal

step 3: Interchange the position of start and final state & reverse directions of all transitions

step 4: Rewrite the Grammar in LLG.

Q. Find LLG for the following:

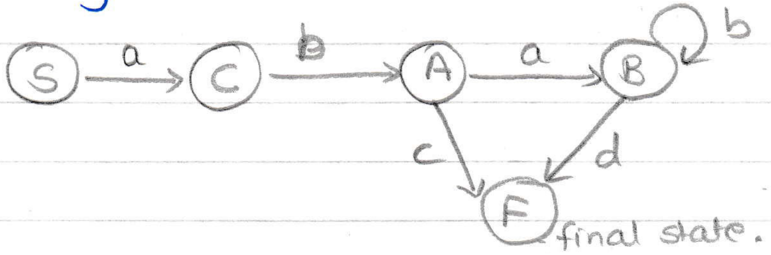
$S \to abA$
$A \to aB \mid c$
$B \to bB \mid d$

→

Rewrite all productions in the form $A \to aB$ or $A \to$

∴ $S \to aC$
$C \to bA$
$A \to aB$
$A \to c$
$B \to bB$
$B \to d$

Converting RLG to TD:



* Converting LLG to RLG :

step 1 : Represent the LLG using transition diagram.
The no. of states = no. of variables +1 (for final

step 2 : Interchange the start state and final state.

step 3 : Reverse the directions of all transitions.

step 4 : Rewrite the RLG from the transition diagram

Q. Write an equivalent RLG from the given LLG.

$S \to C0 \mid A0 \mid B1$

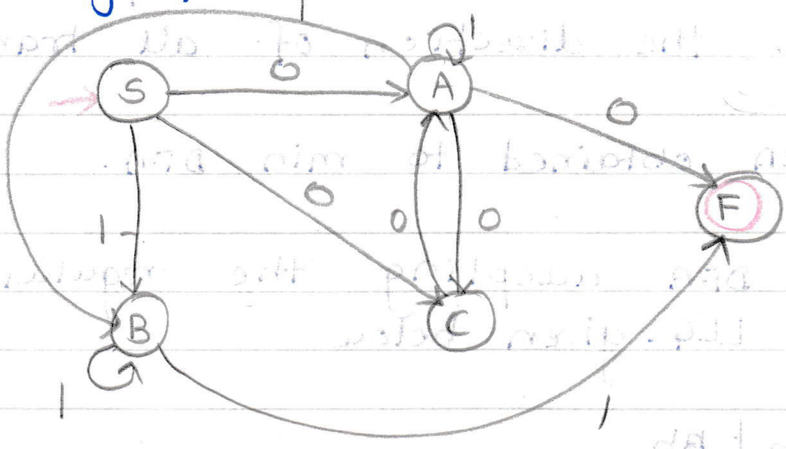
$A \to A1 \mid C0 \mid B1 \mid 0$

$B \to B1 \mid 1$

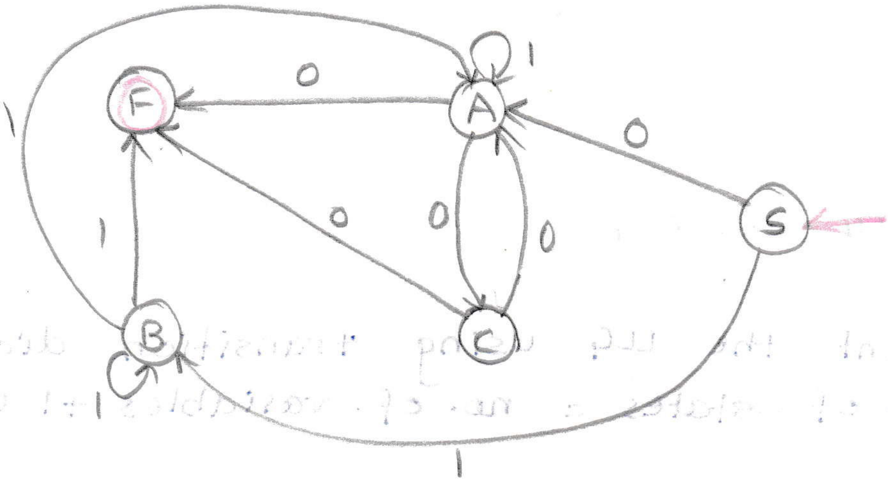
$C \to A0$

→ No. of states = S, A, B, C = 4+1 = 5

TD we get,



Interchanging start state with final state & reversing all directions of the transition diagram.



write RLG from the TD.

$S \rightarrow 0A \mid 1B$
$A \rightarrow 0C \mid 1A \mid 0$
$B \rightarrow 1A \mid 1B \mid 1$
$C \rightarrow 0A \mid 0$

* **Converting LLG to FA :**

Step 1: Draw the TD from the given LLG.
No. of states = No. of variables + 1 (for final state)

Step 2: Interchange the start state with final state and reverse the direction of all transitions.

Step 3: Convert NFA obtained to min DFA.

Q: Construct the DFA accepting the regular lang generated by LLG given below

$S \rightarrow Ca \mid Bb$
$C \rightarrow Bb$
$B \rightarrow Ba \mid b$

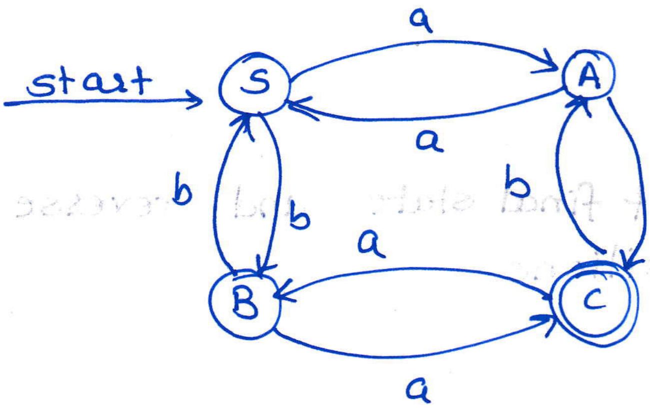
→ No. of states = No. of variables + 1
= S, B, C + 1
= 4

* Converting FA to LLG :

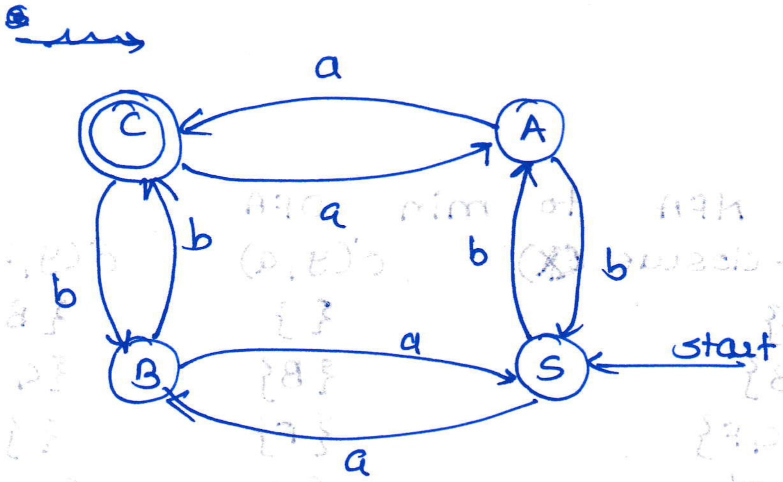
step 1 : Redraw the transition diagram by interchanging the start state with final state & reverse the directions of all the transitions.

step 2 : Write the grammar in LLG from the TD.

Q: Give LLG for the following DFA.



→ step 1 :



Rewrite the LLG &

$S \to Ba \mid Ab$

$A \to Sb \mid Ca \mid a$

$B \to Sa \mid Cb \mid b$

$C \to Aa \mid Bb.$

* RE to RLG :

1) Convert RE to NFA
2) Convert NFA to minimized DFA
3) Convert minimized DFA to RLG

* RLG to RE :

1) Convert RLG to DFA
2) Convet DFA to RE by Arden's method or eliminat^n m

Q. Construct the RLG corresponding to the given RE.

$R = (1+(01)^*)\, 1^* \,(0+1)$