* DFA to Right Linear Regular grammar :-

① Rename $q_0 \in Q$ as $S \in V$

② Rename States of Q as $A, B, C, D, \ldots \in V$

③ Creating set of production P

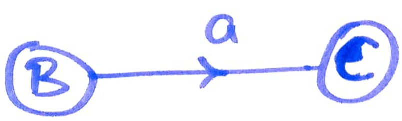
$$Q \rightarrow V \quad ; \quad q_0 \rightarrow S$$

- DFA $M = \{Q, \Sigma, \delta, q_0, F\}$

$$\Downarrow \qquad\qquad \Downarrow$$

$$G = \{V, T, P, S\}$$

ⓘ If $q_0 \in F$ then add production $S \rightarrow \epsilon$ to P

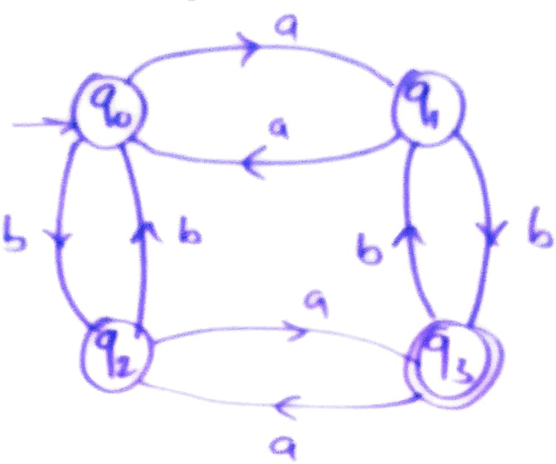


$B \rightarrow aC$ add it

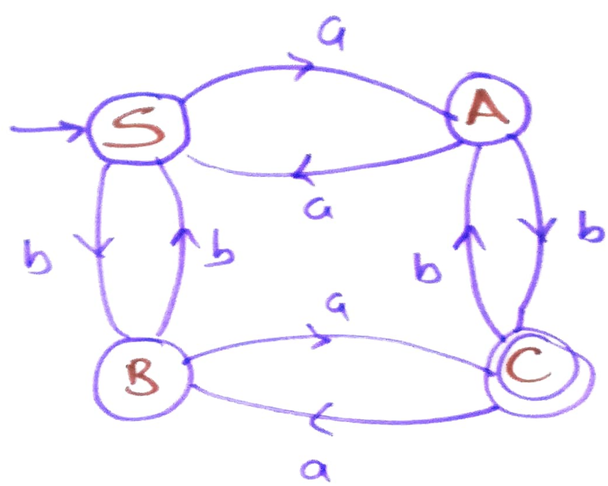
$B \rightarrow aC$
$B \rightarrow a$ } production

$C \rightarrow \epsilon$

① Give RLG for the DFA



→ i> Rename the states, we get



ii> Set of productions are :-

$S \rightarrow aA \mid bB$

$A \rightarrow aS \mid bC \mid \underline{b}$

$B \rightarrow bS \mid aC \mid \underline{a}$

$C \rightarrow aB \mid bA$

Final state C

$A \rightarrow bC$

$A \rightarrow b$

Right linear grammar to DFA:-

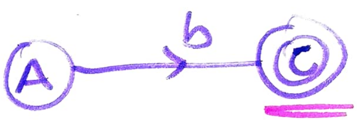
$A \to aB \Rightarrow$

$A \to aB|a \Rightarrow$

⇒ Every transition entering B terminates in B

⇒ A production of the form $A \to \epsilon$ will make A as final state as –

⇒ An independent production of the form $A \to b$



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① $S \to 0A|1B$

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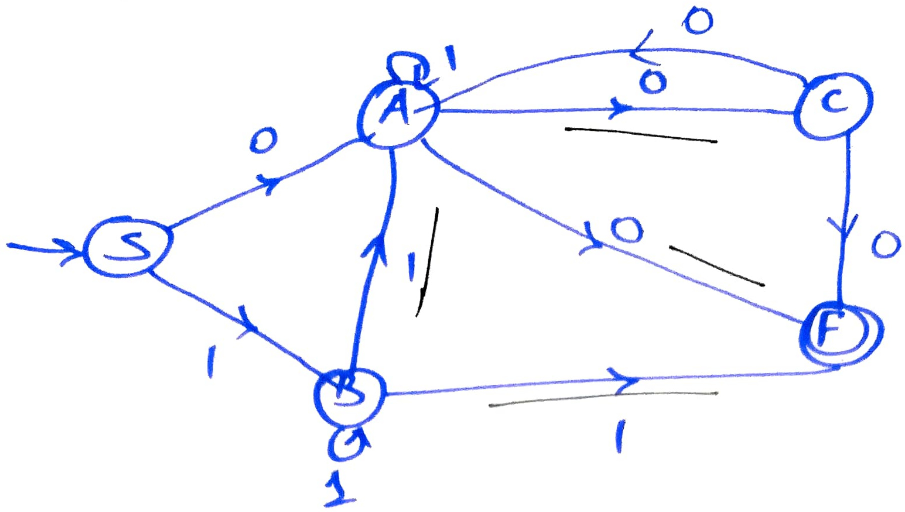
$A \to 0C|1A|0$

$B \to 1B|1A|1$

$C \to 0|0A$

→ A new Final state F requires for

$A \to 0$, $B \to 1$, $C \to 0$

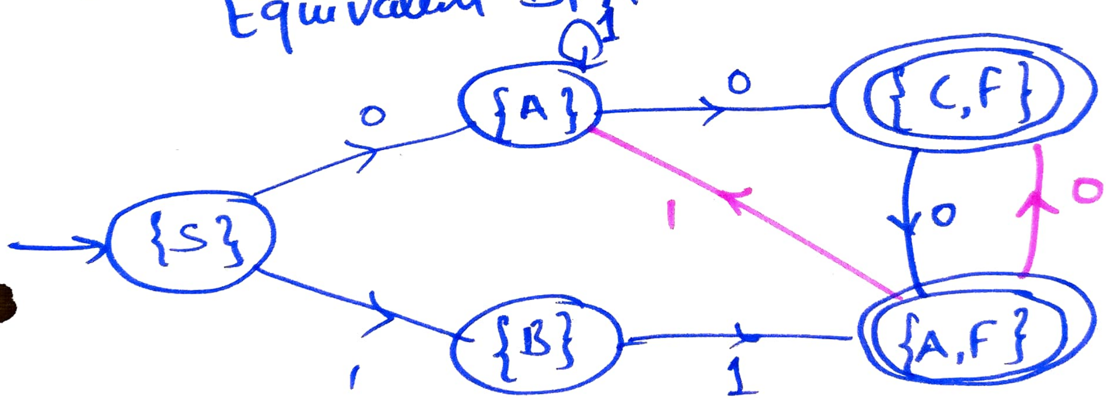


From,
$$\left.\begin{array}{l} A \to C \\ A \to F \end{array}\right\} 0 \Rightarrow \{C, F\}$$

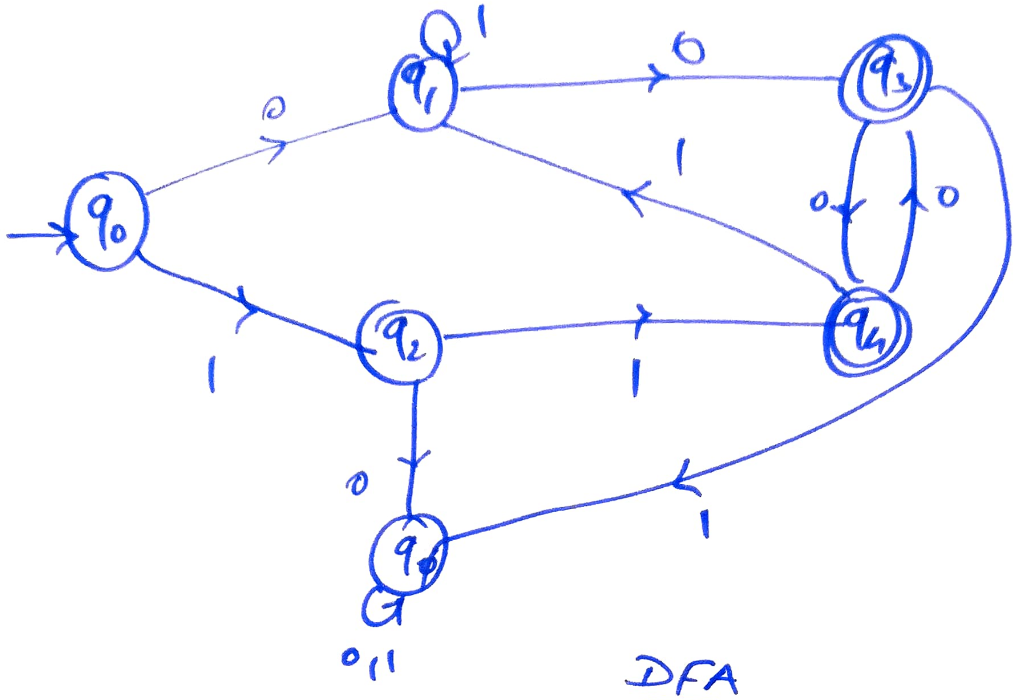
$$\left.\begin{array}{l} B \to A \\ B \to F \end{array}\right\} 1 \Rightarrow \{A, F\}$$

Step II :-

Equivalent DFA



$S, A, B, \{C, F\}$ & $\{A, F\}$ are renamed as q_0, q_1, q_2, q_3, q_4 & a dead state q_ϕ is introduced to handle ϕ transitions

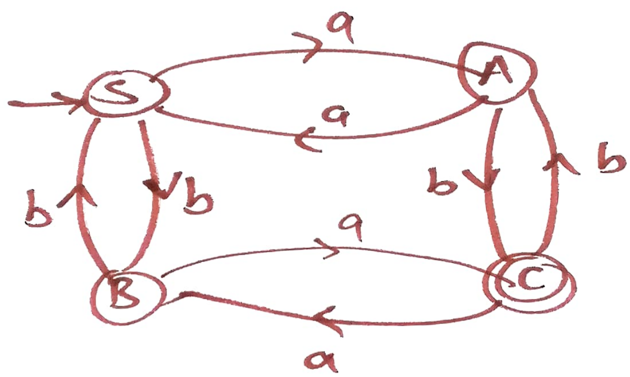


DFA

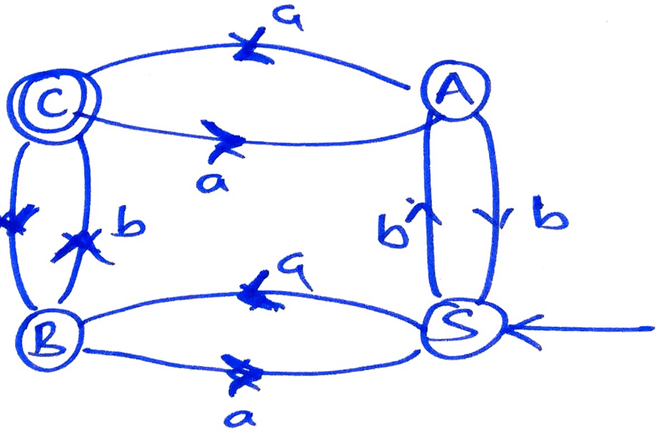
* DFA to Left Linear Grammar :-

1. Interchange the starting state & final state
2. Reverse the direction of all transitions
3. Write the grammar from transition graph in left linear form.

→



→



S → Ba | Ab

A → Sb | Ca | a

B → Sa | Cb | b

C → Bb | Aa

* Left linear grammar to DFA:-

1) Draw a transition graph from the given left linear grammar.

2) Reverse the direction of all the transition

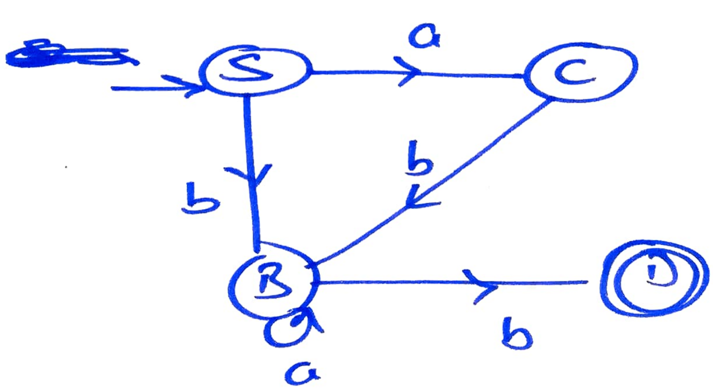
3) Interchange starting state & final state

4) Carry out conversion from FA to DFA

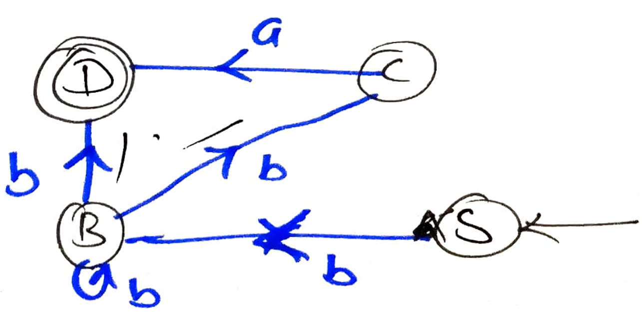
(1) $S \rightarrow Ca \mid Bb$
$C \rightarrow Bb$
$B \rightarrow Ba \mid b$

$B \rightarrow b$ so one more state is added as final state

$\Rightarrow$ (1)



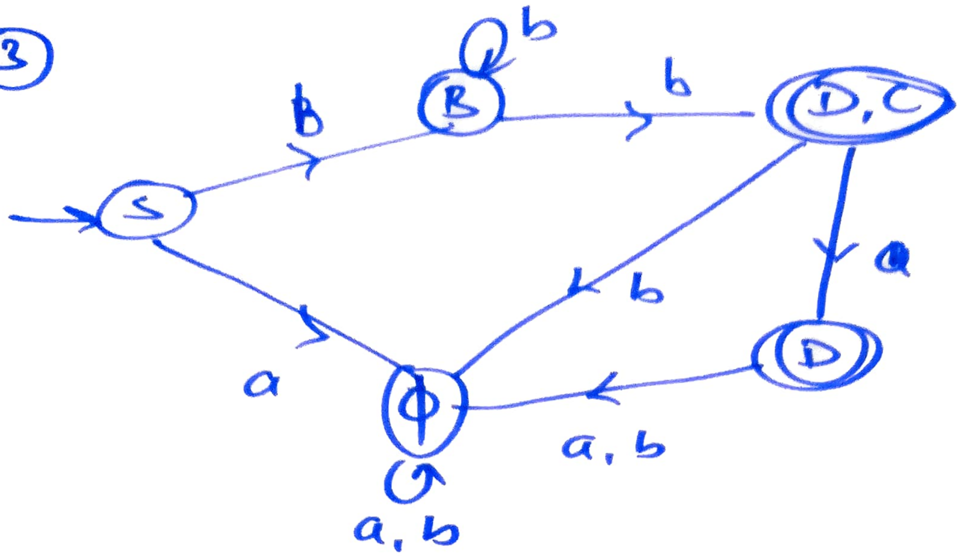
(2) Reverse the direction & interchange starting & final states



$\left.\begin{array}{l} B \rightarrow D \\ B \rightarrow C \end{array}\right\} b$

$\{D, C\}$

③



Rename the states S, B, $\{D, C\}$, D as

$q_0, q_1, q_2, q_3, q_\phi$

* Construct DFA accept the language generated by the left linear grammar.

$S \rightarrow B1 \mid A0 \mid C0$

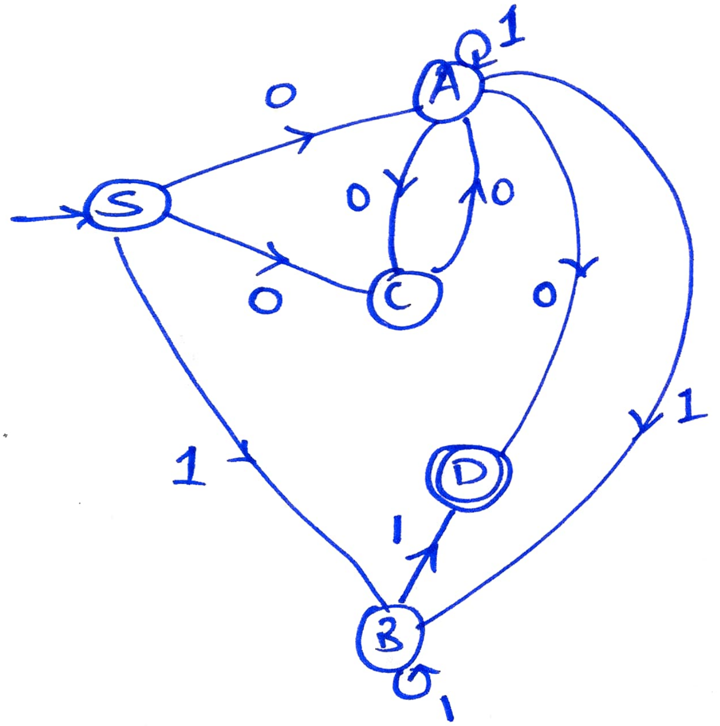
$B \rightarrow B1 \mid \underline{1}$

$A \rightarrow A1 \mid B1 \mid C0 \mid \underline{0}$

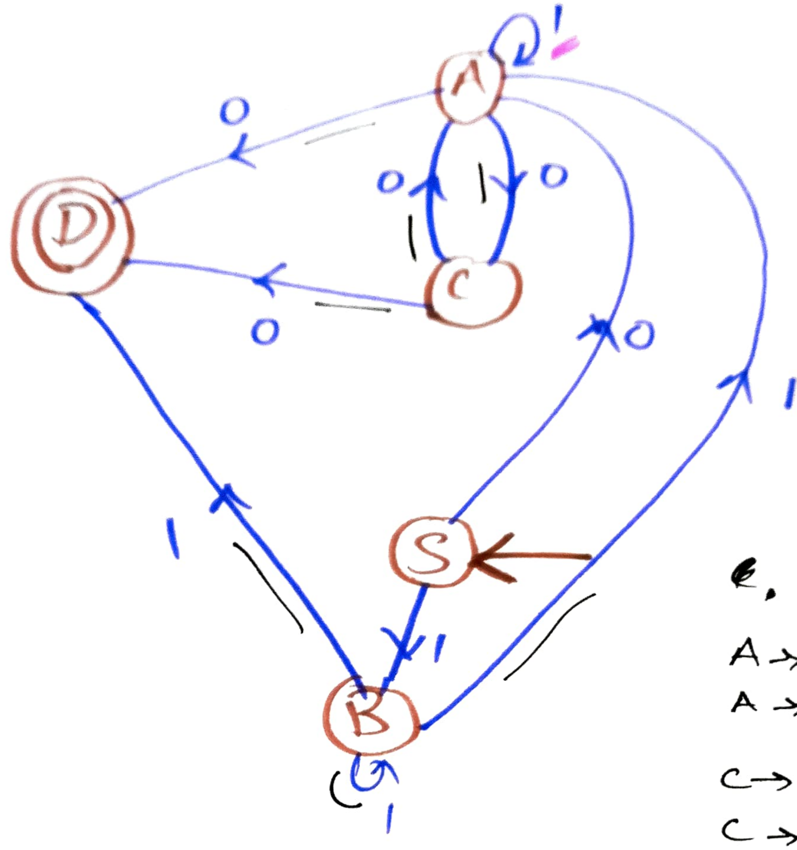
$C \rightarrow A0$

→ Add state D as final state for

Step I: $B \rightarrow 1$, $A \rightarrow 0$



Step 2: Reverse the direction of transitions & interchange starting state & final state.



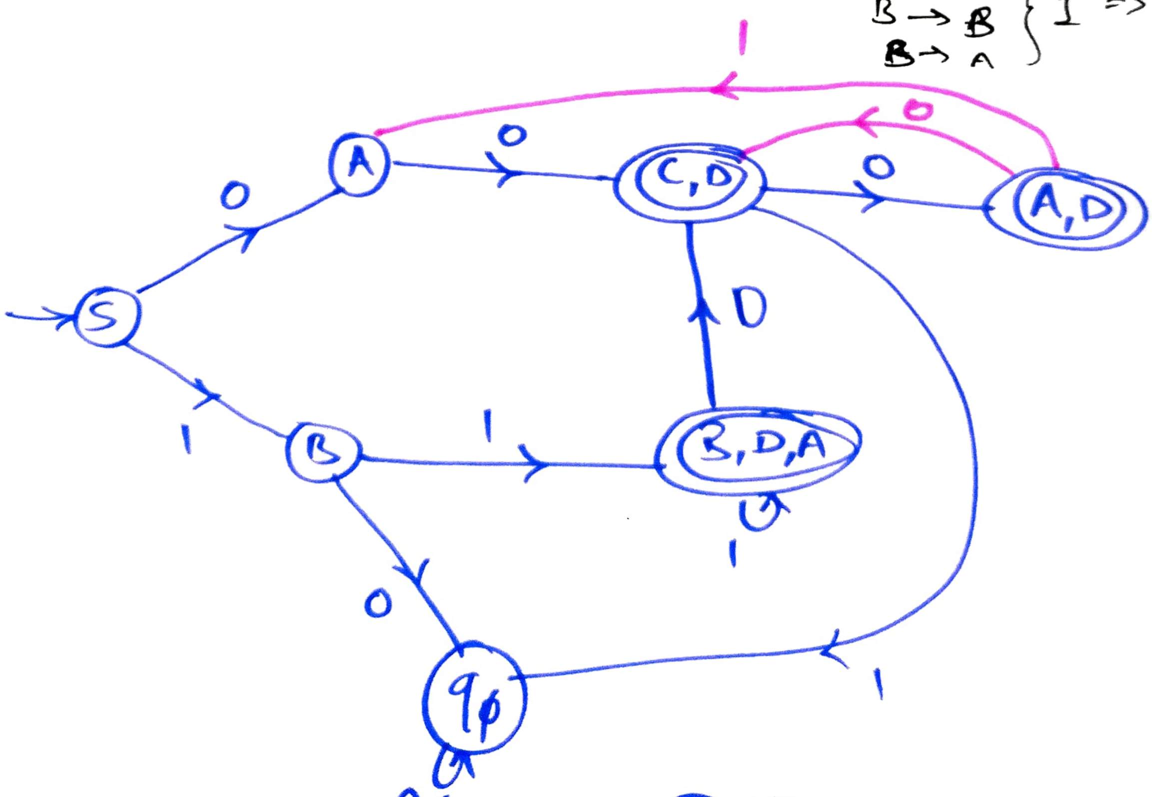
e.

$A \to C$
$A \to D$ } $0 \Rightarrow \{C, D\}$

$C \to A$
$C \to D$ } $0 \Rightarrow \{A, D\}$

$B \to D$
$B \to B$
$B \to A$ } $1 \Rightarrow \{B, D, A\}$

Step 3:-



DFA

* Right Linear Grammar to Left linear grammar:-

1> Represent right linear grammar using transition graph & mark the final state as ε

2> Interchange the start state & the final state

3> Reverse the direction of all transitions ~~graph~~.

4> Write left linear grammar from transition graph.

---

① Convert the following right linear grammar to an equivalent left linear grammar.

:-

$$\left.\begin{array}{l} S \rightarrow bB \mid b \\ B \rightarrow bC \\ B \rightarrow aB \\ C \rightarrow a \\ B \rightarrow b \end{array}\right\} \text{Right linear grammar}$$

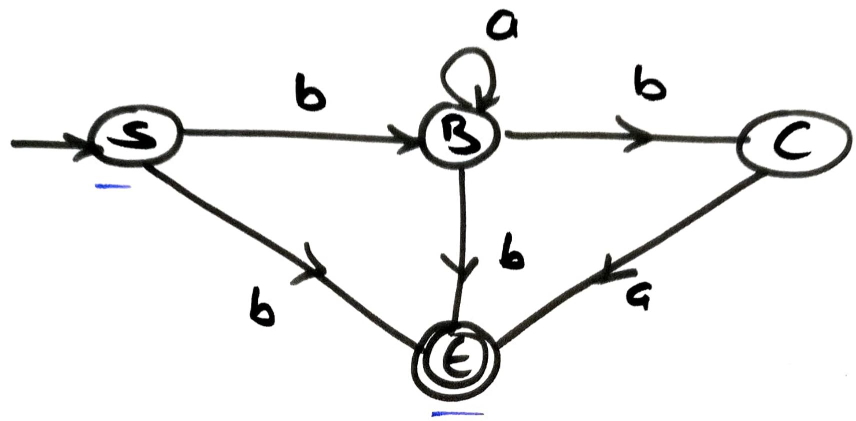
$S \rightarrow bB \mid \underline{b}$

$B \rightarrow bC \mid aB$

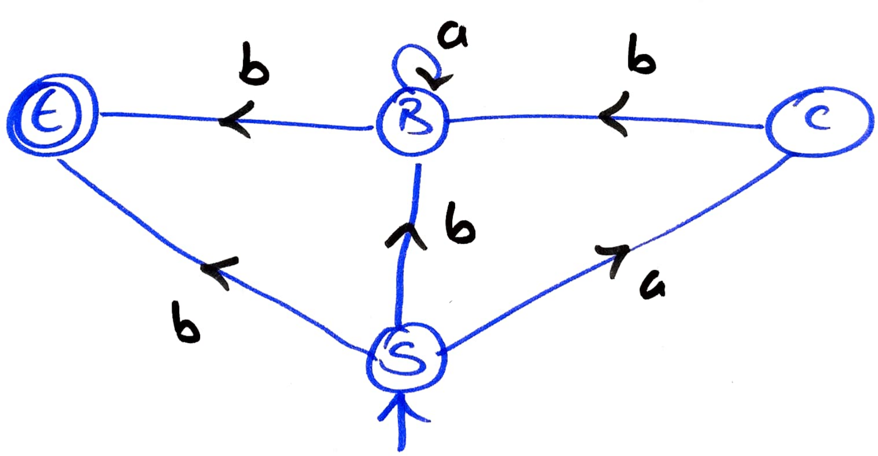
$C \rightarrow \underline{a}$

$B \rightarrow \underline{b}$

1



2 Interchange initial/Starting state & final State And Reverse the direction of transition



3

$S \rightarrow b \mid Bb \mid Ca$

$B \rightarrow b \mid Ba$

$C \rightarrow Bb$

2) For right linear grammar obtain the an equivalent left linear grammar

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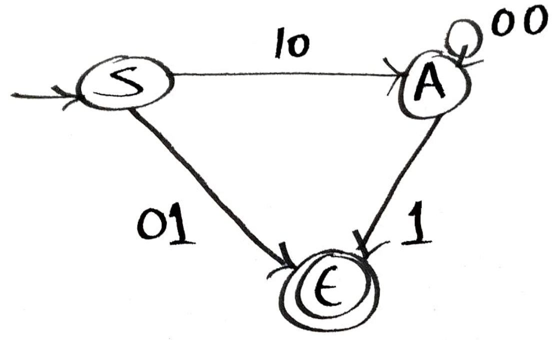
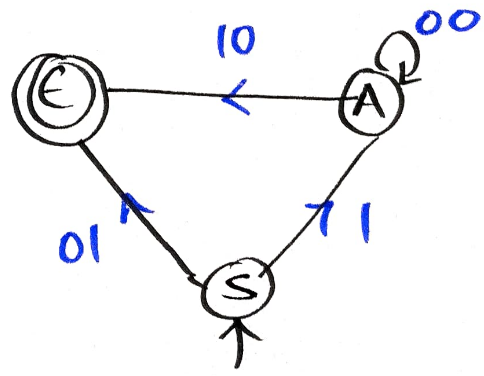
→ $S \to 10A \mid 01$

$A \to 00A \mid 1$

⇒ ①



②



③ $S \to 01 \mid A1$

$A \to A00 \mid 10$

* Left linear grammar to right linear grammar

1) Represent the LLG using a transition graph
   Mark the final state as ⓔ

2) Interchange initial & final state
3) Reverse the direction of all transition
4) write RLG from the transition graph.

① Convert right linear grammar from left linear grammar.

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

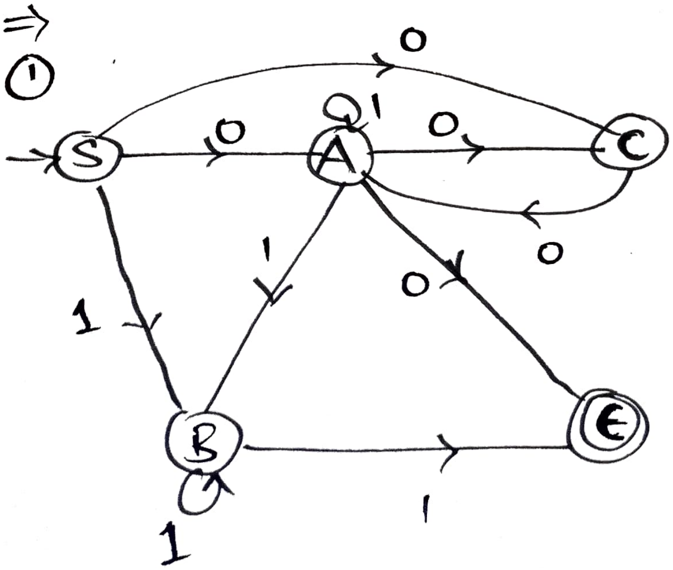
$A \to A1 \mid C0 \mid B1 \mid 0$

$B \to B1 \mid 1$

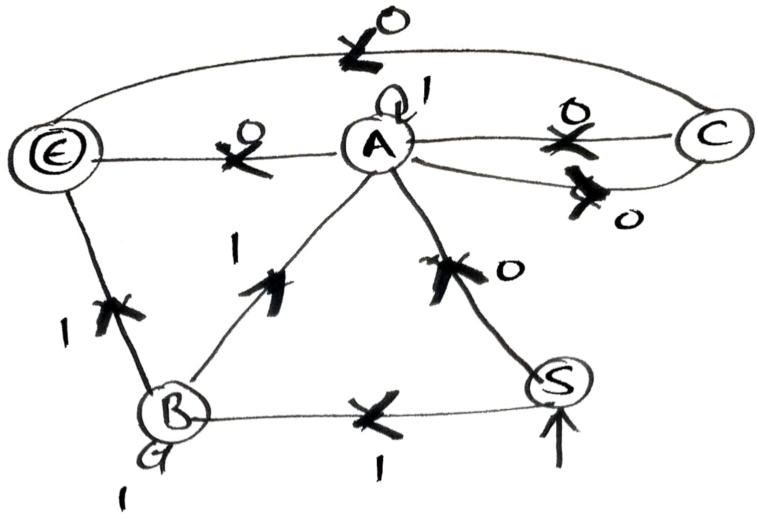
$C \to A0$

LLG

⇒
①



2



3

$S \rightarrow 1B \mid 0A$

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

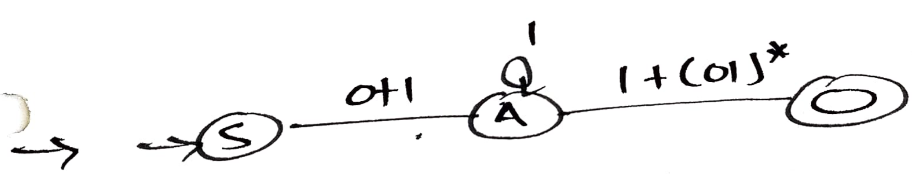
$B \rightarrow 1A \mid 1B \mid 1$

$C \rightarrow 0A \mid 0$

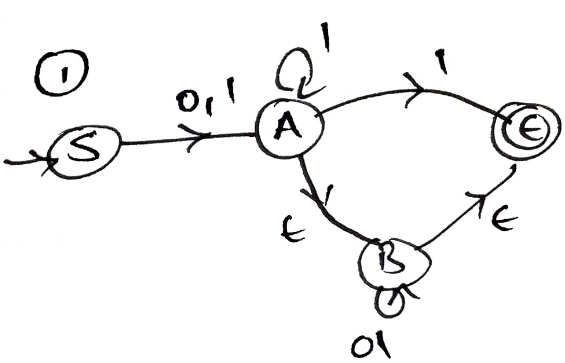
RLG

2 RLG from Regular expression

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



1



2 $S \rightarrow 0A \mid 1A$

$A \rightarrow 1A \mid 1 \mid B$

$B \rightarrow 01B \mid \epsilon$

3 $S \rightarrow 0A \mid 1A \mid 0 \mid 1$

$A \rightarrow 1A \mid 1$

$B \rightarrow 01B \mid 01$

ϵ-transition $B \rightarrow \epsilon$ makes both A & B nullable so ϵ-production $B \rightarrow \epsilon$ is removed