Regular expression

L = {w/w starts with 0 & ends with 1}

$$0 \cdot (0 \cup 1)^* \cdot 1$$

L = { w/w contains substring 101}

$$\cancel{(001)^* \, 101 \, (001)^*}$$

$$(0 \cup 1)^* \, 101 \, (0 \cup 1)^*$$

L = { w/w contains at least Three 1}

$$(0 \cup 1)^* \, 1 \, (0 \cup 1)^* \, 1 \, (0 \cup 1)^* \, 1 \, (0 \cup 1)^*$$

L = { w/w contains exactly three 1}

$$0^* 1 0^* 1 0^* 1 0^*$$

$\cup$

$\cdot$

$*$

Regular Expression

$\cup$

$\cdot$

$*$

1. $L = \{w / w$ starts with 0 and ends with 1$\}$

$$0 \cdot (0 \cup 1)^* \cdot 1$$

2. $L = \{w / w$ starts and ends with same symbol$\}$

$$0 \cdot (0 \cup 1)^* \cdot 0 \cup 1 \cdot (0 \cup 1)^* \cdot 1$$

3. $L = \{w / w$ contains at least three characters$\}$

$$(0 \cup 1) \cdot (0 \cup 1) \cdot (0 \cup 1) \cdot (0 \cup 1)^*$$

4. $L = \{w / w$ contains at least three 1's$\}$

$$(0 \cup 1)^* 1 (0 \cup 1)^* 1 (0 \cup 1)^* 1 (0 \cup 1)^*$$

5. $L = \{w / w$ contains exactly three 1$\}$

$$0^* \cdot 1 \cdot 0^* \cdot 1 \cdot 0^* 1 \cdot 0^*$$

6. $L = \{w \mid w$ contains at most three 1's$\}$

$$0^* \cup 0^*10^* \cup 0^*10^*10^* \cup 0^*10^*10^*10^*$$

7. $L = \{w/w$ contains even no. of charecters$\}$

$$\left((0\cup 1)(0\cup 1)\right)^*$$

8. $L = \{w/w$ contains odd no. of characters$\}$

$$\cancel{(0\cup 1)^*(0\cup 1)^*(0\cup 1)^*}$$

$$\left((0\cup 1)(0\cup 1)\cancel{(0\cup 1)}\right)^*(0\cup 1)$$

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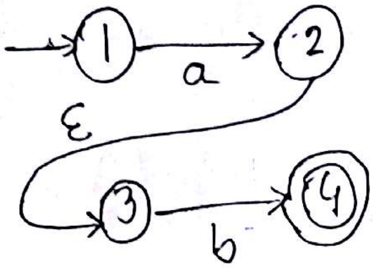
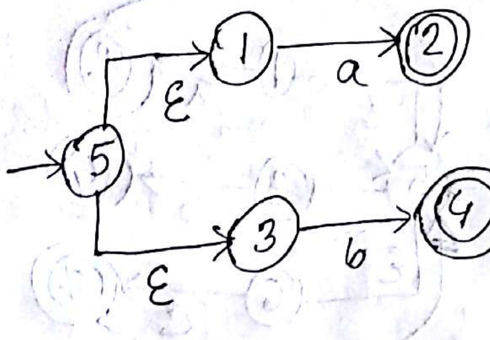
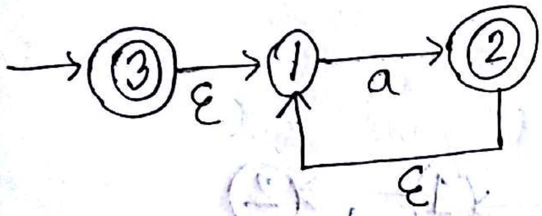
$a \cdot b$



$a \cup b$



a^*



1. $\cancel{(a \cup b)}(a \cup b \cup c)^*$
2. $abc \cup cba$
3. $(a^*b \cup b^*a)c$
4. $a^* . b^* . c^*$
5. $((a \cup b) \cdot (b \cup c) \cdot (c \cup d))^*$

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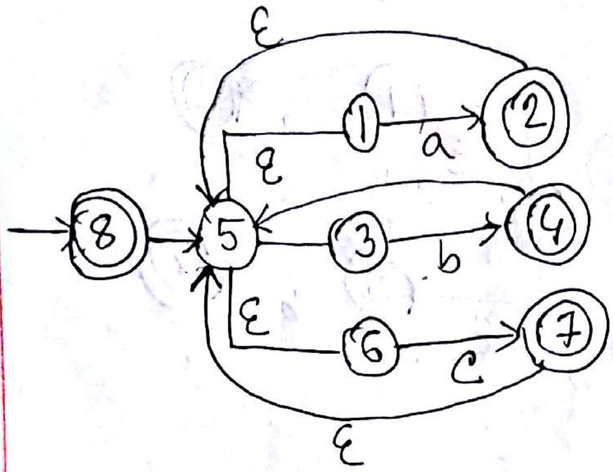
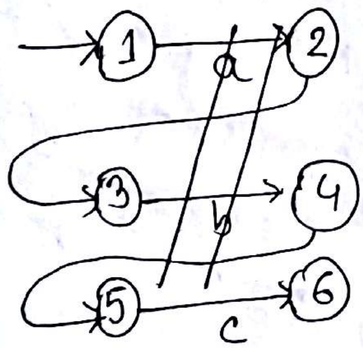
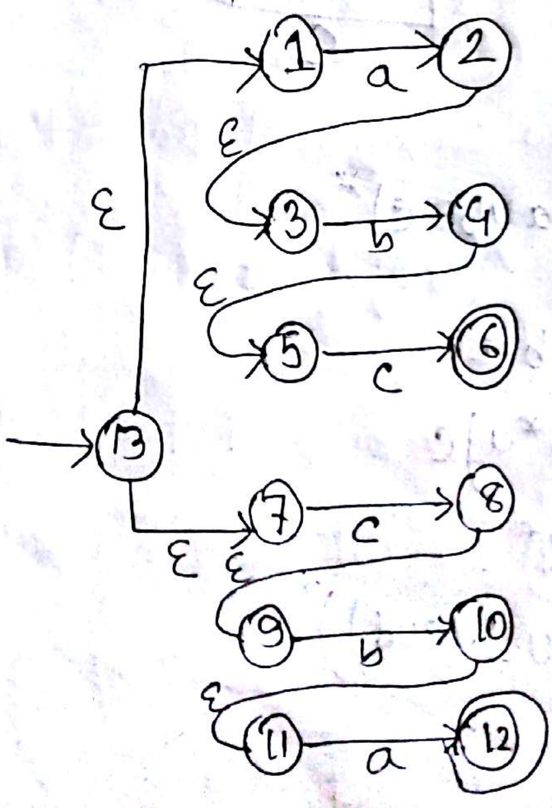
1. $(a \cup b \cup c)^*$

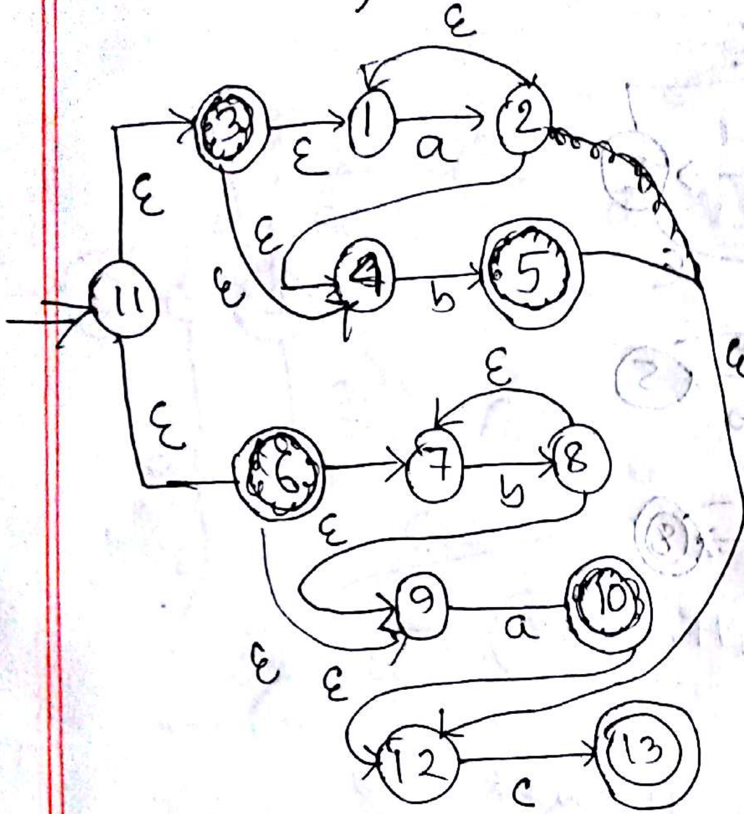


2. $abc \cup cba$

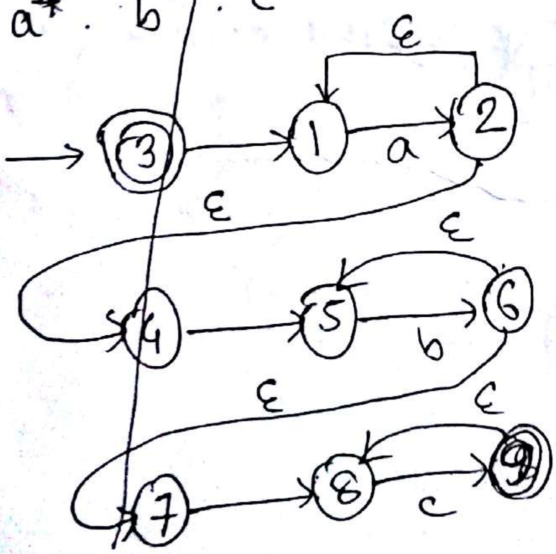




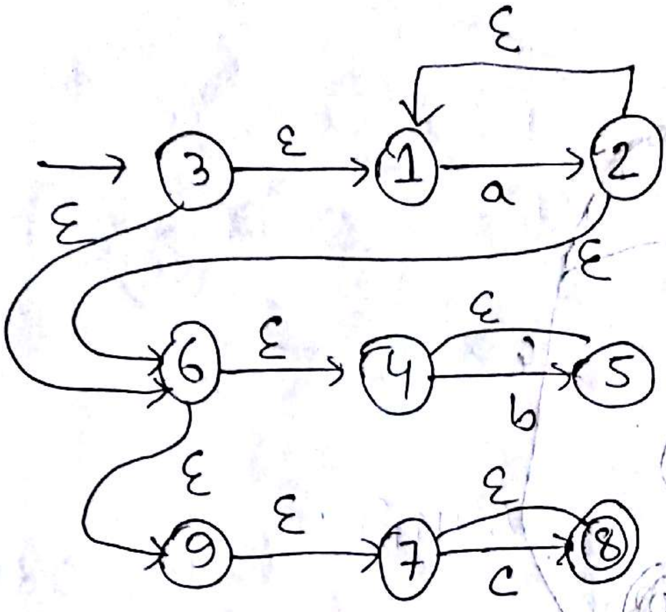
3. $(a^*b \cup b^*a)c$.



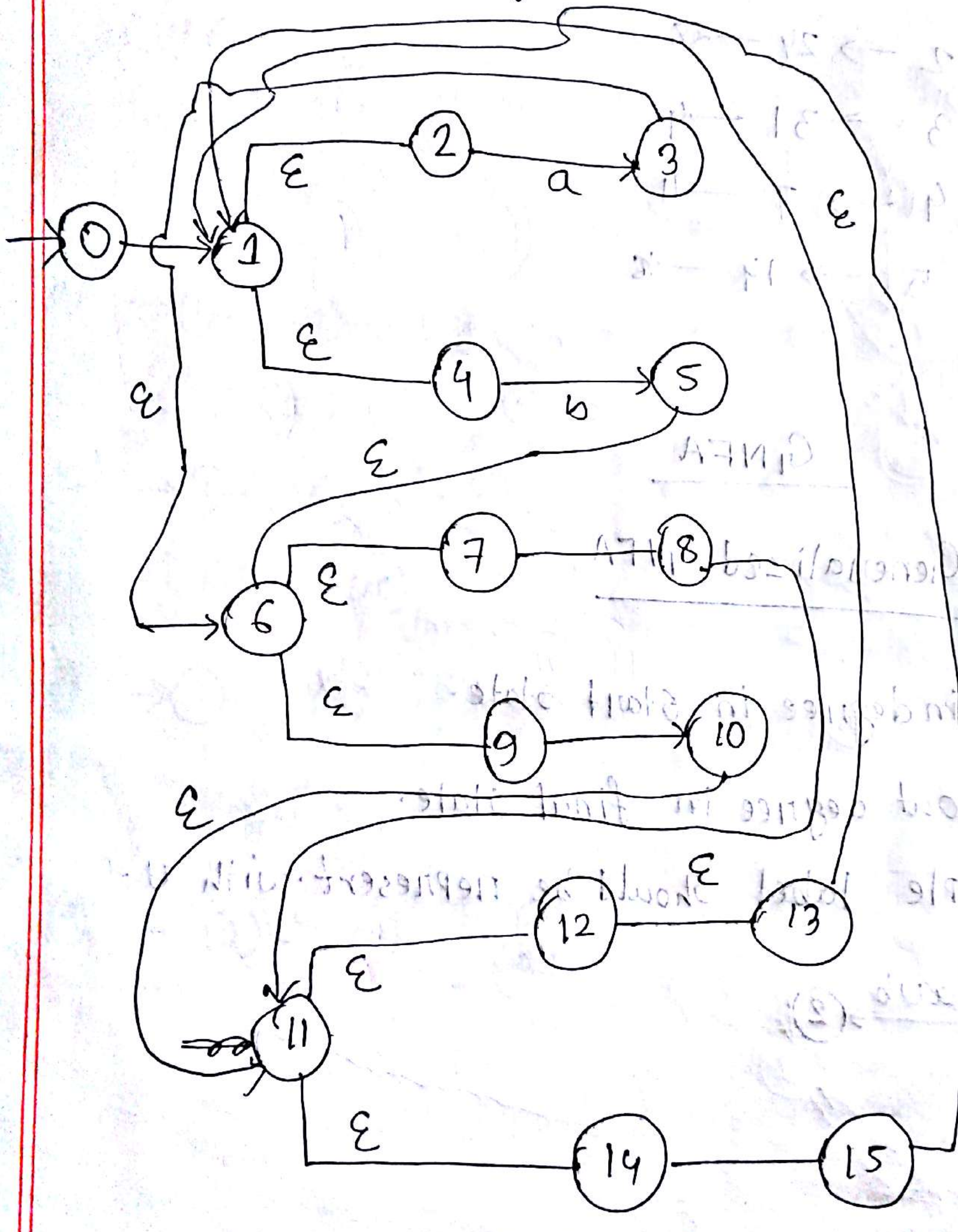
4. $a^* . b^* . c^*$.



4. $a^*. b^*. c^*$



5. $((a \cup b) \cdot (b \cup c) \cdot (c \cup d))^*$



week 1 → 17 — 21

week 2 → 24 — 28

" 3 → 31 — 4

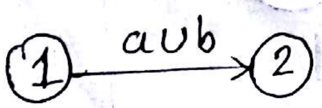
" 4 → 7 — 11

" 5 → 14 — 18

GNFA

Generalized - NFA

1. No indegree in start state.
2. No out degree in final state.
3. Multiple label should be represent with U.



DFA → RE

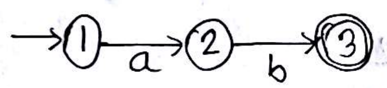
↓

GNFA

↓

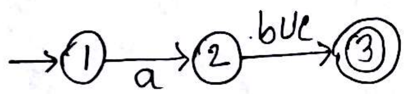
RE

(1)



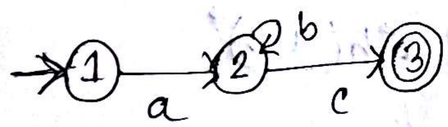
$a \cdot b$

(2)



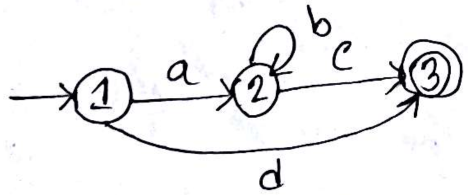
$a \cdot (b \cup c)$

(3)



$a \cdot b^* \cdot c$

(4)



$(a \cdot b^* \cdot c) \cup d$

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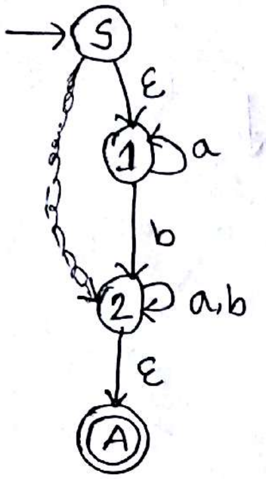
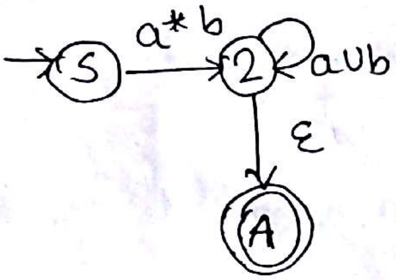
DFA থেকে GNFA তে convert.

①



$S \to 1 \to 2$

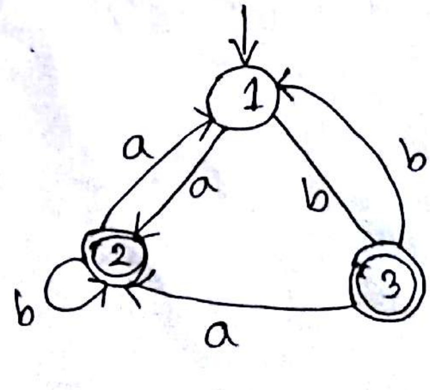
$\varepsilon \cdot a^* \cdot b$

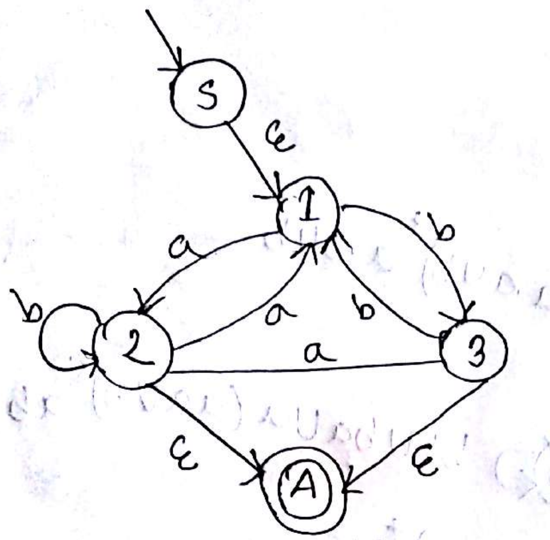


$S \to 2 \to A$

$a^*b(a \cup b)^*$

②





$S \to 1 \to 2 = \varepsilon \cdot a = a$

$S \to 1 \to 3 = \varepsilon \cdot b = b$

$2 \to 1 \to 2 = a \cdot a$

$2 \to 1 \to 3 = a \cdot b$

$3 \to 1 \to 2 = b \cdot a$

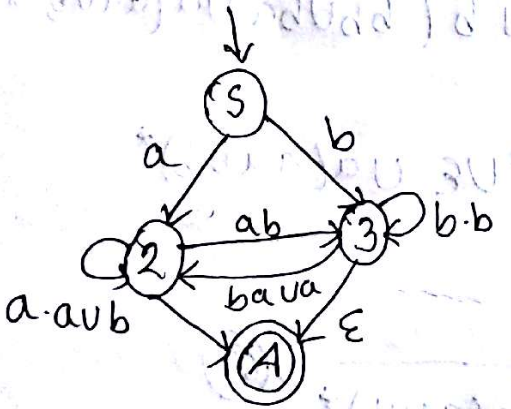
$3 \to 1 \to 3 = b \cdot b$

$\Rightarrow$

$2 \to 2 \to a \cdot a \cup b$

$3 \to 2 = b \cdot a \cup a$

1 বাদ দিয়ে



$S \to 2 \to A = a(a.a \cup b)^* \cdot \varepsilon$

$S \to 2 \to 3 = a(a \cdot a \cup b)^* a \cdot b$

$3 \to 2 \to A = b.a \cup a(a \cdot a \cup b)^* \cdot \varepsilon$

$3 \to 2 \to 3 = b.a \cup a(a.a \cup b)^* ab$

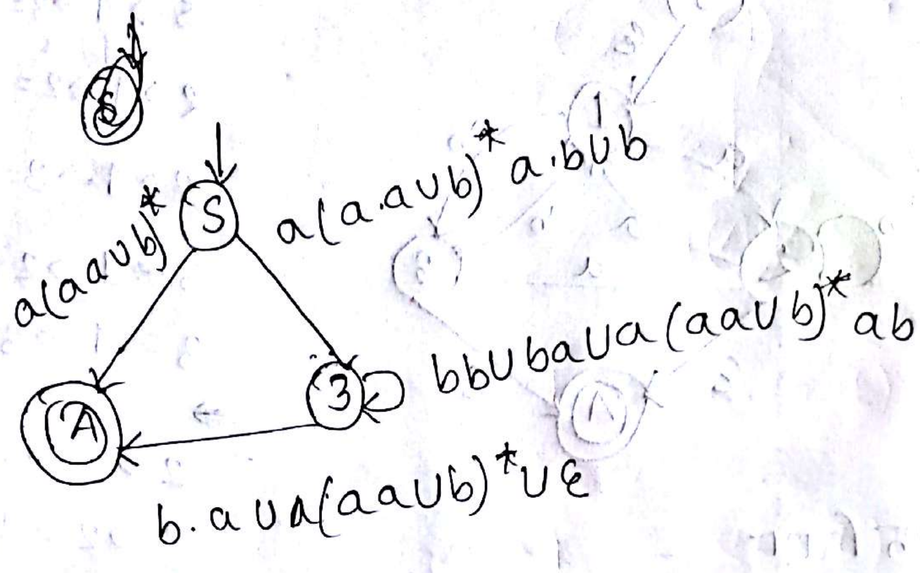
$\Rightarrow$

$S \to 3 = a(a.a \cup b)^* a.b \cup b$

$3 \to A = b.a \cup a(a.a \cup b)^* \cdot \varepsilon \cup \varepsilon$

$3 \to 3 = b.b \cup b.a \cup a(a.a \cup b)^* a.b$

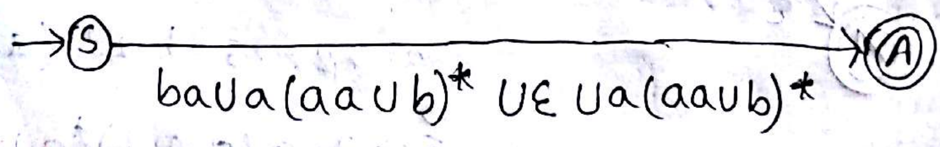
২ বাদ দিয়ে



$S \to 3 \to A = a(aa\cup b)^* ab \cup b\,(\,bb \cup ba \cup a(aa\cup b)^* ab)^*$

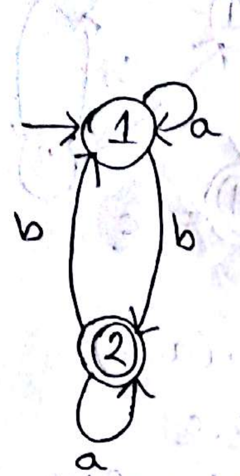
$\Rightarrow$

$S \to A = ba \cup a(aa\cup b)^* \cup \varepsilon \cup a(aa\cup b)^*$

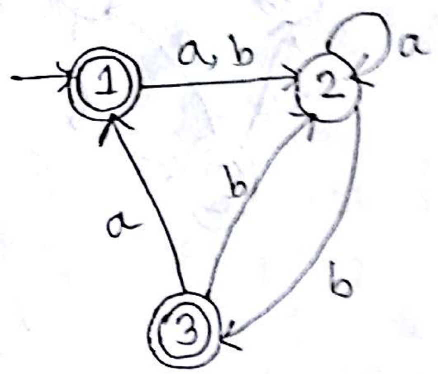


Exercise:

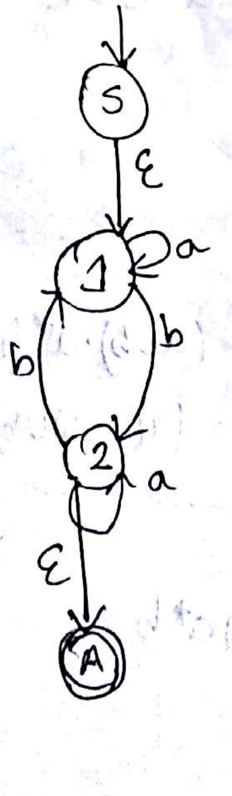
(1)



(2)



(1)

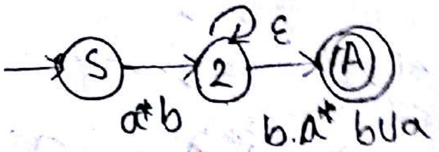


$S \to 1 \to 2 = \varepsilon . a^* . b = a^* . b$

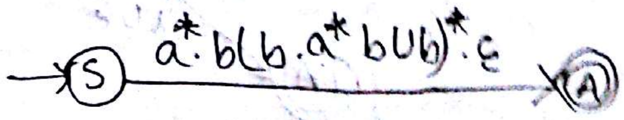
$2 \to 1 \to 2 = b . a^* . b$

$2 \to 2 = b . a^* b \cup a$

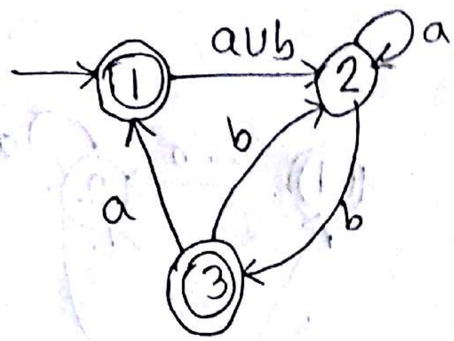
1 বাদ দিয়ে

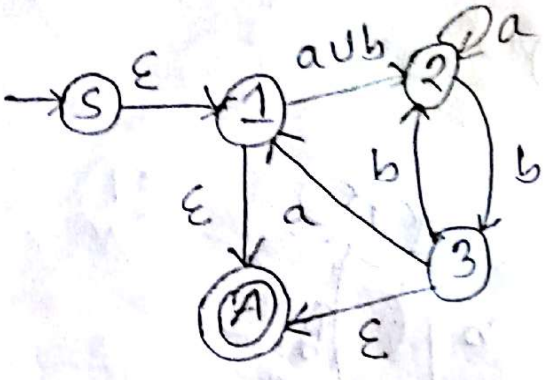


$S \to 2 \to A = a^* b(b . a^* b \cup a)^* . \varepsilon$



(2)





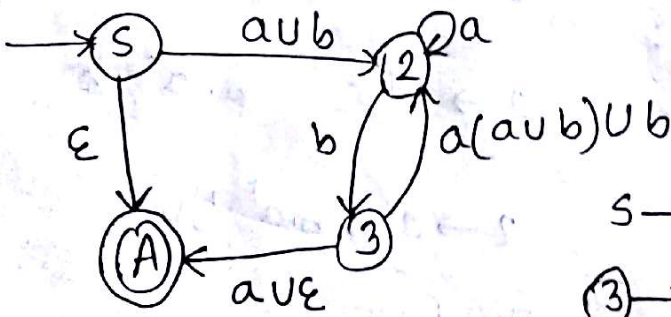
$S\to 1\to 2 = \varepsilon\cdot(a\cup b)$

$S\to 1\to A = \varepsilon\cdot\varepsilon$

$3\to 1\to 2 = a(a\cup b)\cup b$

$3\to 1\to A = a\cdot\varepsilon\cup\varepsilon$

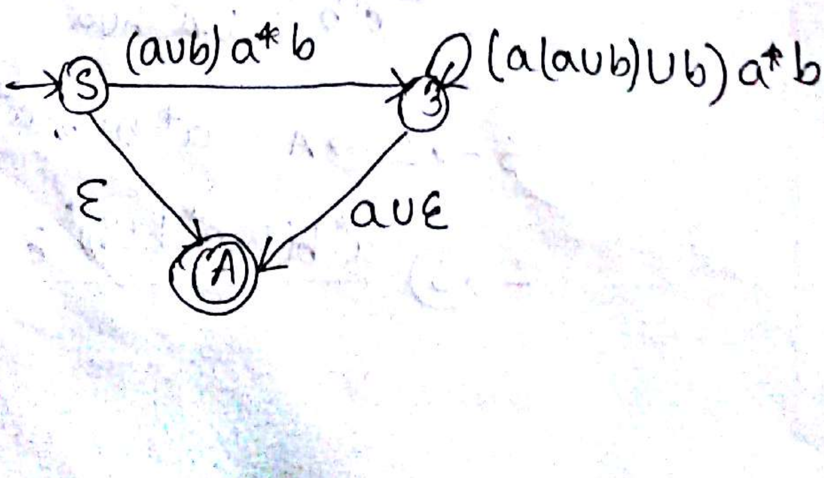
1 বাদ দিয়ে



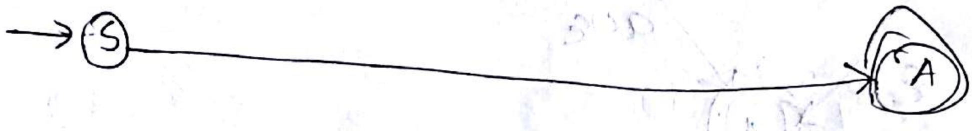
$S\to 2\to 3 = (a\cup b)\cdot a^* b$

$3\to 2\to 3 = (a(a\cup b)\cup b)\cdot a^* b$

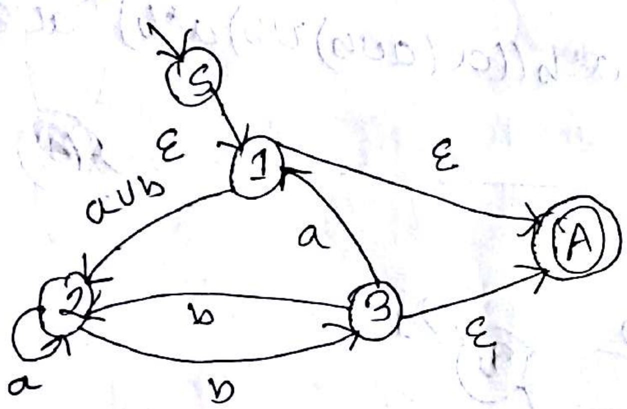
2 বাদ দিয়ে



$S \to 3 \to A = (a \cup b) \cdot a^* b \, ((a(a \cup b) \cup b) a^* b)^* \, a \cup \varepsilon \cdot \cup \varepsilon$



24-7.2016



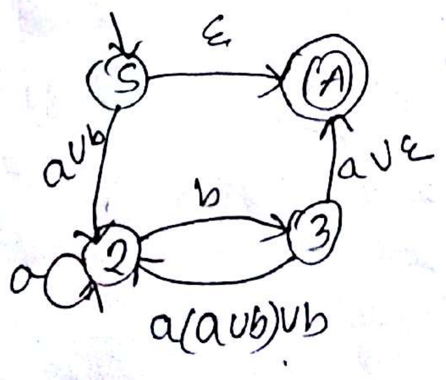
$S \longrightarrow A \longrightarrow \varepsilon . \varepsilon \to \varepsilon$

$S \to 2 \longrightarrow \varepsilon . (a \cup b) \to \underline{a \cup b}$

$3 \longrightarrow A \to \underline{a . \varepsilon} \to a \cup \varepsilon$

$3 \longrightarrow 2 \longrightarrow \cancel{a} \, a . (a \cup b) \cup b$

$\boxed{a . \varepsilon \cup \varepsilon}$

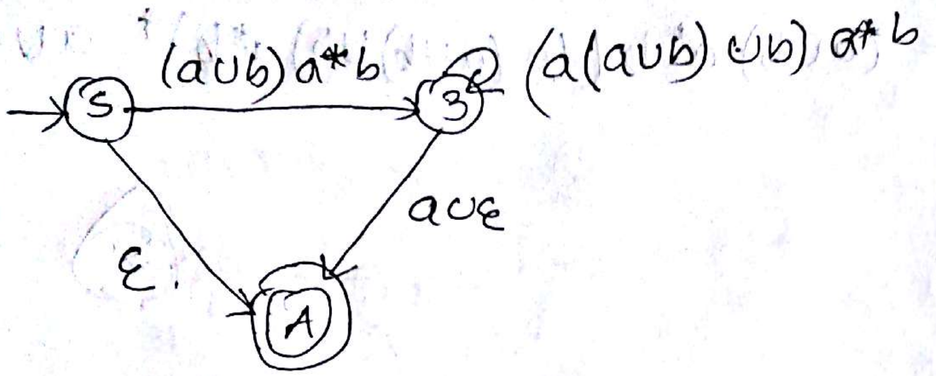


~~$S \to A \to \varepsilon$~~

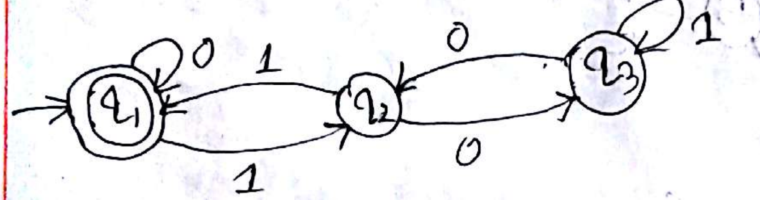
~~$S \to 2 \to$~~

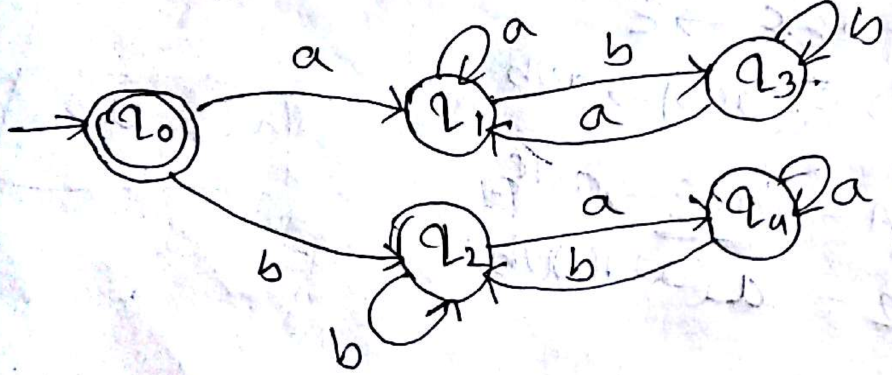
$S \to 2 \to 3 = (a \cup b) . a^* b$

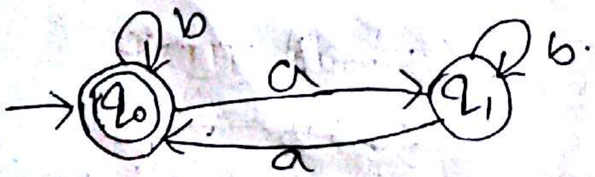
$3 \to 2 \to 3 = (a(a \cup b) \cup b) . a^* b$



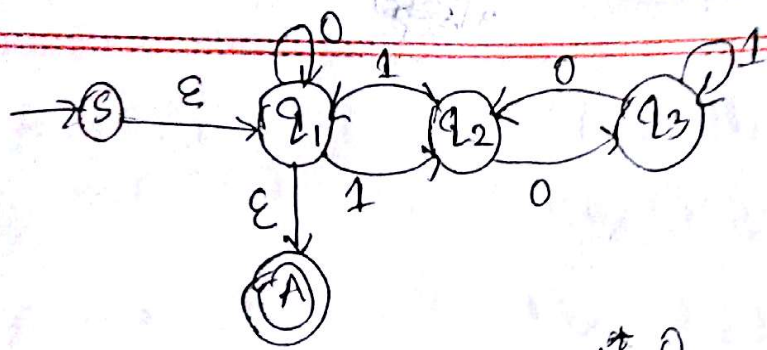
$S \to 3 \to A = (a \cup b)\, a^* b\,((a(a\cup b) \cup b)\, a^* b)^* \, a \cup \varepsilon \cdot \cup \varepsilon$

1. 

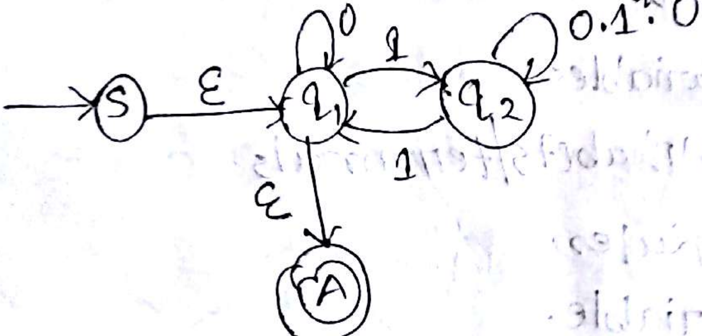
2. 

3. 

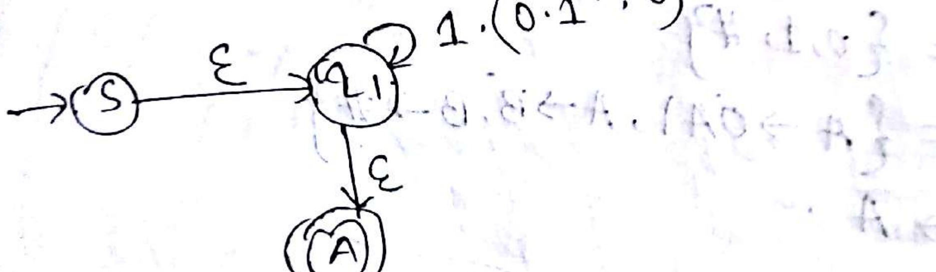
1.



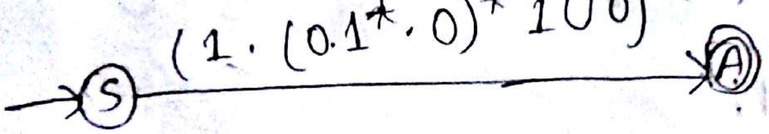
$q_2 \rightarrow q_3 \rightarrow q_2 : 0.1^*.0$



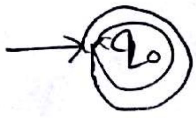
$q_1 \rightarrow \cancel{q_2} \rightarrow q_1 : 1.(0.1^*.0)^*.1 \cup 0$



$S \rightarrow \cancel{q_1} \rightarrow A : \varepsilon.(1(0.1^*.0)^*.1 \cup 0)^*.\varepsilon$



2.



CFG

4 tuple (V, Σ, R, S)

$V \rightarrow$ set of Variables.

$\Sigma \rightarrow$ set of Alphabets/terminals.

$R \rightarrow$ set of Rules.

$S \rightarrow$ start variable.

$V = \{A, B\}$

$\Sigma = \{0, 1, \#\}$

$R = \{A \rightarrow 0A1, A \rightarrow B, B \rightarrow \#\}$

$S \rightarrow A$.

Derivation

Leftmost

Rightmost.

000#111

$A \rightarrow 0A1 \mid B$

$B \rightarrow \#$

$A \to 0A1$

$\to 00A11$

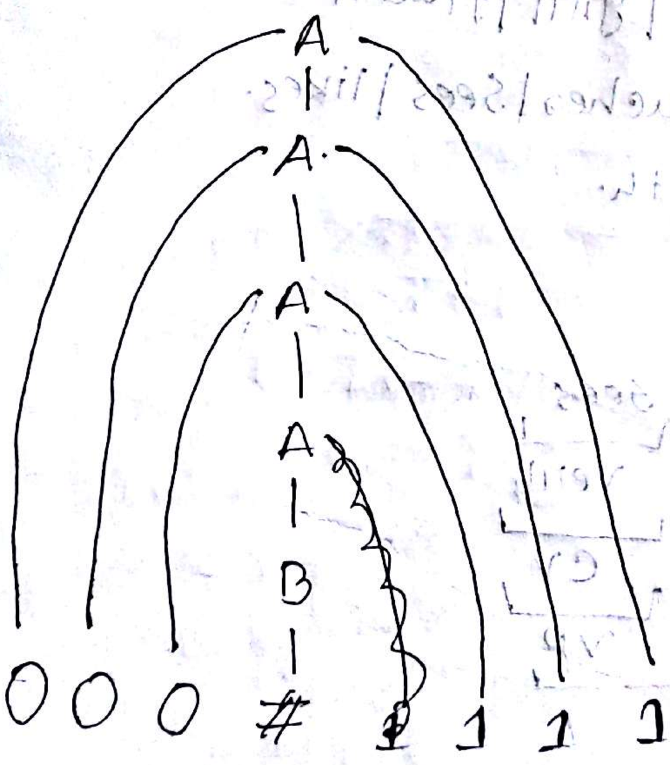
$A \to 0A1$

$\to 00A11$

$\to 000A111$

$\to 000B111$

$\to 000\#111$



<Sen> → <NP><VP>

<NP> → <CN>|<CN><PP>

<VP> → <CV>|<CV><PP>

<PP> → <Prep><CN>

<CN> → <Art><Noun>

<CV> → <verb>|<verb><NP>

<Art> → a|the

<Noun> → boy|girl|flower.

<verb> → touches|sees|likes.

<PrP> → with.

a boy sees

Art noun verb

CN CV

NP VP

Sen.

Sen → <NP> <VP>

→ <CN> <VP>

→ <Art><Noun> <VP>

→ a <Noun> ~~<verb>~~ <VP>

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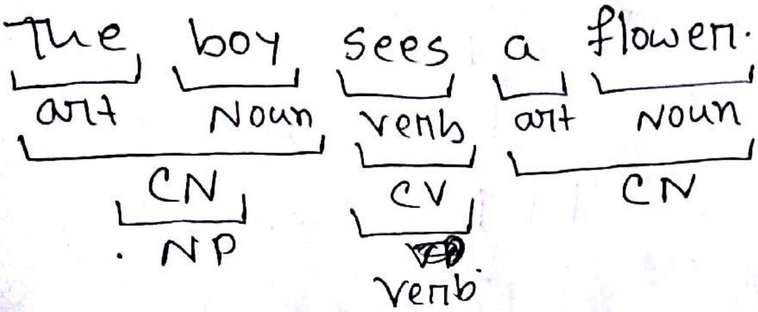
→ a boy ~~<verb>~~ <VP>
→ a boy ~~sees~~ <CV>
→ a boy <verb>
→ a boy sees.



Sen → <NP> <VP>
→ <CN> <VP>
→ <Art> <Noun> <VP>
→ a <Noun> <VP>
→ a boy <VP>
→ a boy <CV>
→ a boy <V> <NP>
→ a boy sees <NP> <CN>
→ a boy sees <Art> <Noun>
→ a boy sees a <Noun>
→ a boy sees a flower.

$E \rightarrow E+T \mid T$

$T \rightarrow T \times F \mid F$

$F \rightarrow (E) \mid a.$

1. (a)
2. $(a+a) \times a$
3. $(a+a \times a)$
4. $((a+a))$.

1. $(a) \longrightarrow$

$F \rightarrow (E)$
$\rightarrow (T)$
$\rightarrow (F)$
$\rightarrow (a)$

2. $(a+a) \times a$

$\cancel{F \rightarrow (E)}$
$\cancel{\rightarrow (E+T)}$
$\cancel{\rightarrow (T+T \times F}$

$\cancel{E \rightarrow E+T}$
$T \rightarrow T \times F$
$\rightarrow F \times a \rightarrow F \times F$
$\rightarrow (E) \times a$
$\rightarrow (E+T) \times a$
$\rightarrow (T+F) \times a$
$\rightarrow (F+a) \times a$
$\rightarrow (a+a) \times a.$

3. $(a+a \times a)$

$F \rightarrow (E)$
$\rightarrow (E+T)$
$\rightarrow (E+T \times F).$
$\rightarrow (T+F \times a)$
$\rightarrow (F+a \times a)$
$\rightarrow (a+a \times a).$

4. $((a+a))$

$F \rightarrow (E)$

$\rightarrow \cancel{(E+T)}$

$\rightarrow (T)$

$\rightarrow (F)$

$\rightarrow ((E))$

$\rightarrow ((E+T))$

$\rightarrow ((T+F)) \rightarrow ((T+T))$

$\rightarrow ((F+a)) \rightarrow ((F+T))$

$\rightarrow ((a+a)) \rightarrow ((a+T))$

$\rightarrow ((a+F))$

$\rightarrow ((a+a))$

3. $(a+a\times a)$

$F \rightarrow (E)$

$\rightarrow (E+T) \rightarrow \cancel{(T+T)}$

$\rightarrow \cancel{(E+F)} \rightarrow (E+T)$

$\rightarrow \cancel{(E+T} \rightarrow (T+T)$

$\rightarrow (T+T) \rightarrow (F+T)$

$\rightarrow (F+T\times F) \rightarrow (a+T)$

$\rightarrow (a+F\times a) \rightarrow (a+T\times F)$

$\rightarrow (a+F a\times a \rightarrow (a+F\times F)$

$\rightarrow (a+a\times F)$

$\rightarrow (a+a\times a).$

2. $(a+a)\times a$

$E \to E+T$ $\quad$ $E \to T$

$\to T+T$ $\quad$ $\to T \times F$

$\to F+T$ $\quad$ $\to F \times F$

$\to$ $\quad$ $\to (E) \times F$

$\to (E+T) \times F$

$\to (T+T) \times F$

$\to (F+T) \times F$

$\to (a+T) \times F$

$\to (a+F) \times F$

$\to (a+a) \times F$

$\to (a+a) \times a$

$L = \{w / w$ starts and ends with same symbol$\}$

$(0 \cup 1)^*$

$R \to 0R \mid 1R \cdot 1 \varepsilon$

$L = \{w / w$ starts and ends with same symbol$\}$

$S \rightarrow 0R0 \mid 1R1$

$R \rightarrow 0R \mid 1R \mid \varepsilon$

$L = \{w$ contains at least three $1\}$

$S \rightarrow R1\ R1\ R1\ R$

$R \rightarrow 0R \mid 1R \mid \varepsilon.$

$L = \{w$ contains exactly three $1\}$

$S \rightarrow R1\ R1\ R1\ R$

$S \rightarrow 0R \mid \varepsilon.$

$L = \{w / w$ contains substring $101\}$

$\underbrace{R \rightarrow \varepsilon \mid 0R \mid 1R}_{(0 \cup 1)^*}$ $\qquad$ $\underbrace{0(0 \cup 1)^* 0 \cup 1(0 \cup 1)^* 1}_{S \rightarrow 0R0 \mid 1R1.}$

$\underbrace{R \rightarrow \varepsilon \mid 0R}_{0^*}$

$L = \{w /$ length of w is even$\}$

$L = \{w /$ length of w is odd$\}$

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$L = \{ w | w$ contains substring $101 \}$

$S \rightarrow R101R$

$R \rightarrow \varepsilon | 0R | 1R$

$L = \{ w | $ length of w is even$\}$

$S \rightarrow \cancel{RR} \varepsilon | RRS$ $(0 \cup 1)(0 \cup 1)$

$R \rightarrow 0/1$

$S \rightarrow \varepsilon | RRS$

$R \rightarrow 0 | 1$

$L = \{ w | $ length of w is odd$\}$

$((0 \cup 1)(0 \cup 1))^{*}(0 \cup 1)$

$S \rightarrow AR$

$A \rightarrow \varepsilon | RRA$

$R \rightarrow 0 | 1$

$L = \{ w | w = a^m b^n$ and $m = n \}$

$a^m \; b^n \quad m = n$

$a^i \; b^j \; c^k$

$S \rightarrow \varepsilon | ab | asb$

$S \rightarrow \varepsilon | asb$

$L = \{ w / w = a^m b^n \text{ and } m = 2n \}$

$S \to \varepsilon \mid aaSb$

$L = \{ w \mid$ length of w is odd and middle symbol is $0 \}$

$S \to 0 \mid 0S0 \mid 1S0 \mid 0S1 \mid 1S1$.

0
0 0 0
0 0 1
1 0 0
1 0 1

$L = \{ w / w$ contains more a's than b's $\}$

$S \to RaR$
$R \to \varepsilon \mid aRb \mid bRa \mid aR$

$L = \{ w / w = a^m b^n \text{ and } m > n \}$

$S \to aSR \mid \varepsilon$
$R \to \varepsilon \mid aRb$

L = { each a in w. is followed by at least one b }.

$S \to \varepsilon \mid abS \mid bS$

$S \to TR \mid RT$

$T \to abT\varepsilon$

$R \to bR \mid \varepsilon$ — o —

$S \to ASA \mid aB$

$A \to B \mid S$

$B \to b \mid \varepsilon$

CFG → CNF

---

1. $S \to aXbX$

$X \to aY \mid bY \mid \varepsilon$

$Y \to X \mid c$.

2. $S \to XaX \mid bX \mid Y$

$X \to XaX \mid XbX \mid \varepsilon$

$Y \to ab$

3. $S \to XaX \mid YY \mid XY$

$X \to b \mid \varepsilon$

$Y \to Xa$

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1. $S \to aXbX$

$X \to aY \mid bY \mid \varepsilon$

$Y \to X \mid c$

$\to$ Remove $X \to \varepsilon$

$S_0 \to S$

$S \to aXbX \mid abX \mid aXb \mid ab$

$X \to aY \mid bY$

$Y \to X \mid c \mid \varepsilon$

$\to$ Remove $Y \to \varepsilon$

$S_0 \to S$

$S \to aXbX \mid abX \mid aXb \mid ab$

$X \to aY \mid bY \mid a \mid b$

$Y \to X \mid c$

$\to$ Remove ~~$X \to aY \mid bY \mid a \mid b$~~ $Y \to X$

$S_0 \to S$

$S \to aXbX \mid abX \mid aXb \mid ab$

$X \to aY \mid bY \mid a \mid b$

$Y \to aY \mid bY \mid a \mid b \mid c$

$\to$ Remove $S_0 \to S$

$S_0 \to aXbX \mid abX \mid aXb \mid ab$

$S \to aXbX \mid abX \mid aXb \mid ab$

$X \to aY \mid bY \mid a \mid b$

$Y \to aY \mid bY \mid a \mid b \mid c$

→ Add $U \to a$

$S_0 \to UXbX \mid UbX \mid UXb \mid Ub$

$S \to UXbX \mid UbX \mid UXb \mid Ub$

$X \to UY \mid bY \mid a \mid b$

$Y \to UY \mid bY \mid a \mid b \mid c$

$U \to a$

→ add $V \to b$

$S_0 \to UXVX \mid UVX \mid UXV \mid UV$

$S \to UXVX \mid UVX \mid UXV \mid UV$

$X \to UY \mid VY \mid a \mid b$

$Y \to UY \mid VY \mid a \mid b \mid c$

$U \to a$

$V \to b$

→ add $W \to UX$

$S_0 \to WVX \mid UVX \mid WV \mid UV$

$S \to WVX \mid UVX \mid WV \mid UV$

$X \to UY \mid VY \mid a \mid b$

$Y \to UY \mid VY \mid a \mid b \mid c$

$U \to a$

$V \to b$

$W \to UX$

→ add $Z \to VX$

$S_0 \to WZ \mid UZ \mid WV \mid UV$

$S \to WZ \mid UZ \mid WV \mid UV$

$X \to UY \mid VY \mid a \mid b$

$Y \to UY \mid VY \mid a \mid b \mid c$

$U \to a$

$V \to b$

$W \to UX$

$Z \to VX$.

3. $S \rightarrow XaX \mid YY \mid XY$

$X \rightarrow b \mid \varepsilon$

$Y \rightarrow Xa$

$\rightarrow$

$S_0 \rightarrow S$

$S \rightarrow XaX \mid YY \mid XY$

$X \rightarrow b \mid \varepsilon$

$Y \rightarrow Xa$

$\rightarrow$

$S_0 \rightarrow S$

$S \rightarrow XaX \mid YY \mid XY \mid aX \mid Xa \mid a \mid Y$

$X \rightarrow b$

$Y \rightarrow Xa \mid \varepsilon$

$\rightarrow$

$S_0 \rightarrow S$

$S \rightarrow XaX \mid YY \mid XY \mid aX \mid Xa \mid a \mid Y \mid X \mid \varepsilon$

$X \rightarrow b$

$Y \rightarrow Xa$

$\rightarrow$

$S_0 \rightarrow S \mid \varepsilon$

$S \rightarrow XaX \mid YY \mid XY \mid aX \mid Xa \mid a \mid Y \mid X$

$X \rightarrow b$

$Y \rightarrow Xa$

$\rightarrow$ ~~S0~~

$S \rightarrow S | \varepsilon$

$S \rightarrow XUX | YY | XY | UX | XU | a | Y | X$

$X \rightarrow b$

$Y \rightarrow XU$

$U \rightarrow a$

$\rightarrow$

$S_0 \rightarrow S | \varepsilon$

$S \rightarrow VX | YY | xY | UX | XU | a | b | Xa$

$X \rightarrow b$

$Y \rightarrow XU$

$U \rightarrow a$

$V \rightarrow XU$

$\rightarrow$ ~~8~~

$S_0 \rightarrow S | \varepsilon$

$S \rightarrow VX | YY | XY | UX | XU | a | b | XU$

$X \rightarrow b$

$Y \rightarrow XU$

$U \rightarrow a$

$V \rightarrow XU$

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2. $S \rightarrow XaX \mid bX \mid Y$

$X \rightarrow XaX \mid XbX \mid \varepsilon$

$Y \rightarrow ab$

$S_0 \rightarrow S$

$S \rightarrow XaX \mid bX \mid Y$

$X \rightarrow XaX \mid XbX \mid \varepsilon$

$Y \rightarrow ab$

Remove $X \rightarrow \varepsilon$

$S_0 \rightarrow S$

$S \rightarrow XaX \mid bX \mid Y \mid aX \mid Xa \mid a \mid b$

$X \rightarrow XaX \mid XbX \mid Xa \mid aX \mid a \mid Xb \mid bX \mid b$

$Y \rightarrow ab$

Remove $S \rightarrow Y$

$S_0 \rightarrow S$

$S \rightarrow XaX \mid bX \mid ab \mid aX \mid Xa \mid a \mid b$

$X \rightarrow XaX \mid XbX \mid Xa \mid aX \mid a \mid Xb \mid bX \mid b$

$Y \rightarrow ab$

Remove $S_0 \rightarrow S$

$S_0 \rightarrow XaX \mid bX \mid ab \mid aX \mid Xa \mid a \mid b$

$S \rightarrow XaX \mid bX \mid ab \mid aX \mid Xa \mid a \mid b$

$X \rightarrow XaX \mid XbX \mid Xa \mid aX \mid a \mid Xb \mid bX \mid b$

$Y \rightarrow ab.$

Scanned by CamScanner

Add

$P \to a \quad R \to b$

$S_0 \to XPX \mid RX \mid PR \mid \cancel{a}PX \mid XP \mid a \mid b$

$S \to XPX \mid RX \mid PR \mid PX \mid XP \mid a \mid b$

$X \to XPX \mid XRX \mid XP \mid PX \mid a \mid XR \mid RX \mid b$

$Y \to \cancel{R}PR$

$P \to a$

$R \to b$

Add $T \to PX \quad U \to RX$

$S_0 \to \cancel{P}XT \mid RX \mid PR \mid PX \mid XP \mid a \mid b$

$S \to XT \mid RX \mid PR \mid PX \mid XP \mid a \mid b$

$X \to XT \mid XU \mid XP \mid PX \mid a \mid XR \mid RX \mid b$

$Y \to PR$

$P \to a$

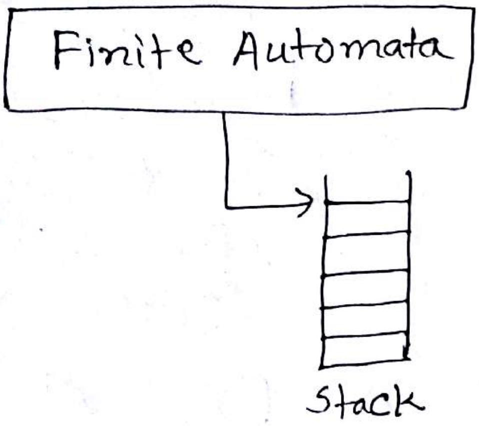
$R \to b$

$T \to PX$

$U \to RX$

TOC

Push Down Automata



$Q \rightarrow$

$\Sigma \rightarrow$

$\delta \rightarrow$

$q_0 \rightarrow$

$F \rightarrow$

$\Gamma \rightarrow$

FA

$\delta : Q \times \Sigma \rightarrow Q$

PDA

$\delta : Q \times \Sigma \times \Gamma \rightarrow Q \times \Gamma$.

$\rightarrow (1) \xrightarrow{a} (2)$

$x, y \rightarrow z$

$x \rightarrow$ input alphabet from Σ.

ε if no input,

ϕ if end of input.

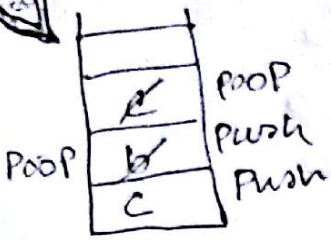
$y \rightarrow$ stack top symbol to be popped.

ε if no pop.

$z \rightarrow$ symbol to be pushed.

ε if no push.

Scanned by CamScanner



$a, \varepsilon \rightarrow c$

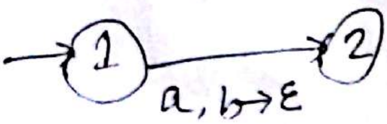
$a, \varepsilon \rightarrow b$

$\varepsilon, \varepsilon \rightarrow c$

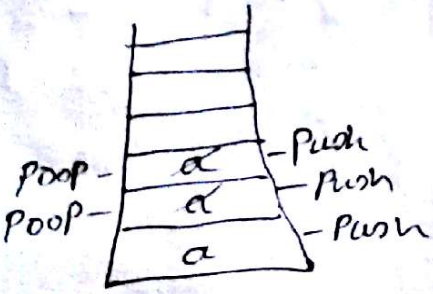
$a, c \rightarrow \varepsilon.$

$\phi, b \rightarrow \varepsilon.$

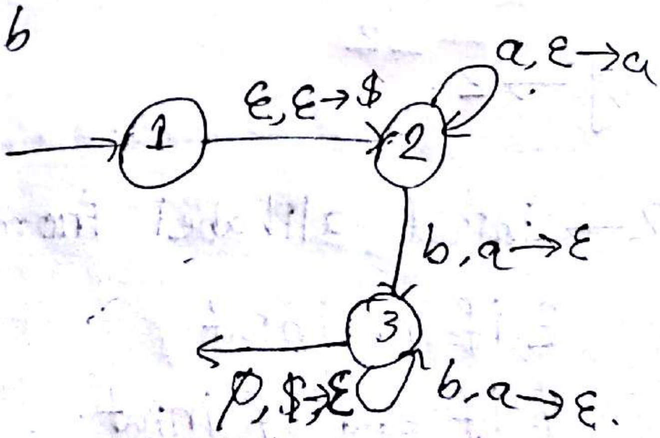
$a, b \rightarrow c$



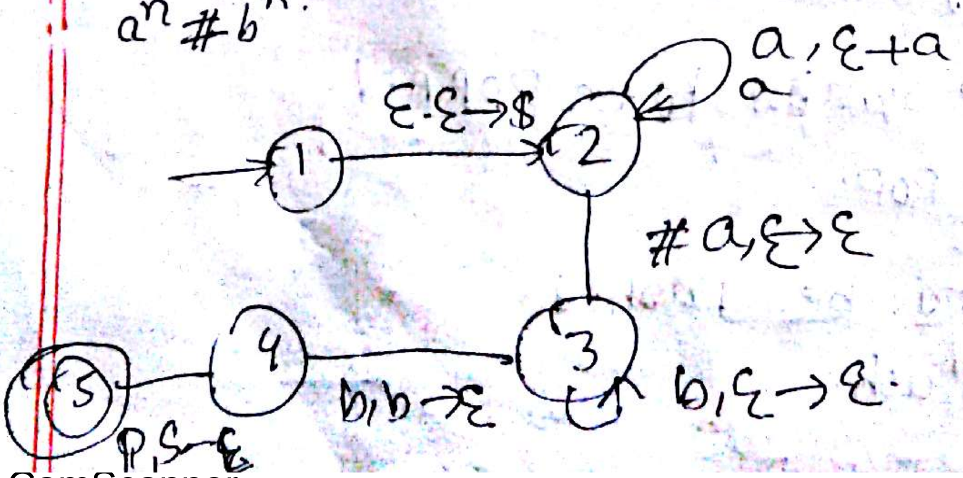
$a^n b^n$



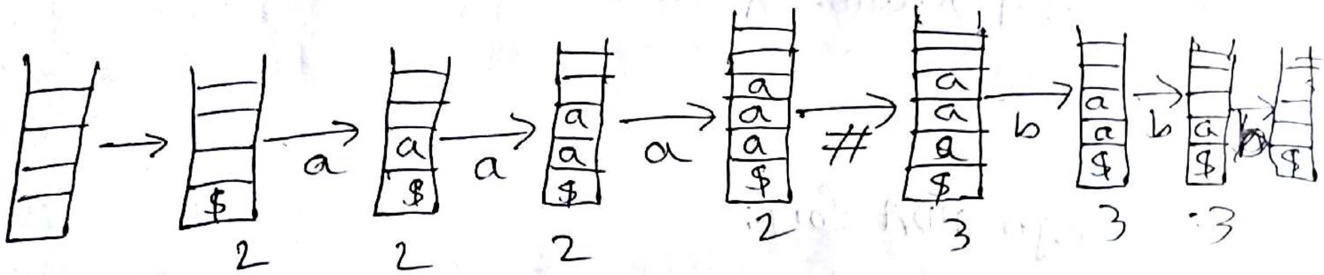
aaabb



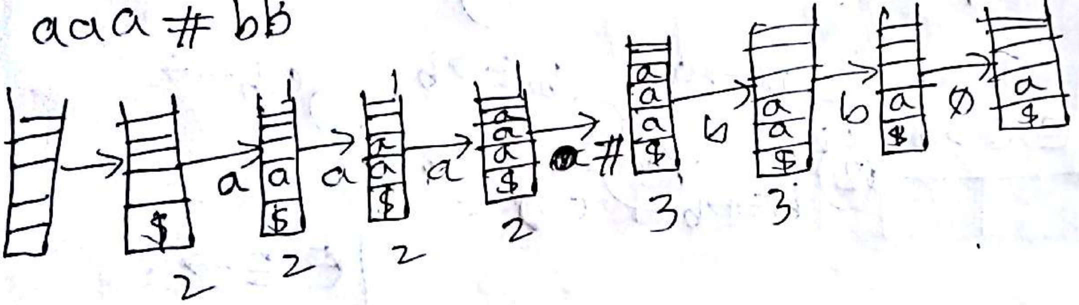
$a^n \# b^n.$



aaa # bbb

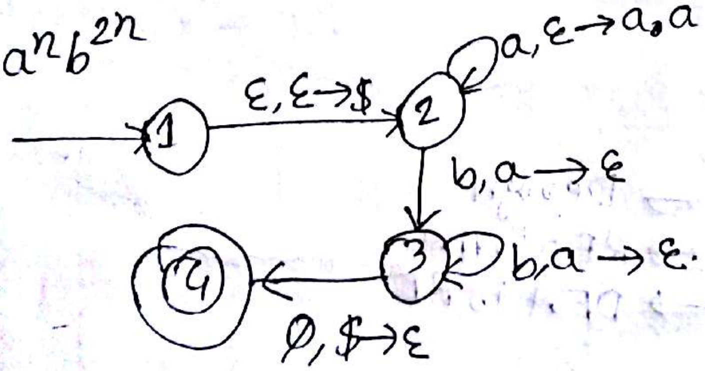


aaa # bb

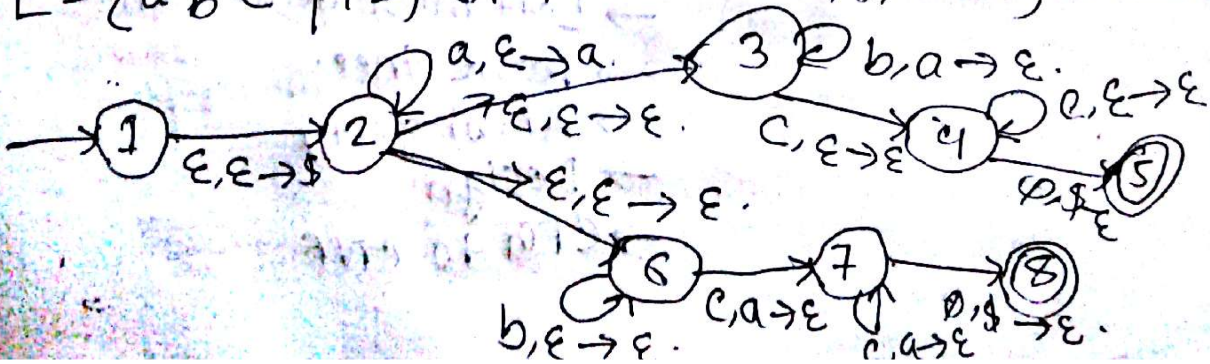


$L = \{ww^r / w \text{ any combination of } a,b\}$

$a^n b^{2n}$



$L = \{a^i b^j c^k \mid i=j \text{ or } i=k \text{ and } i,j,k>0\}$



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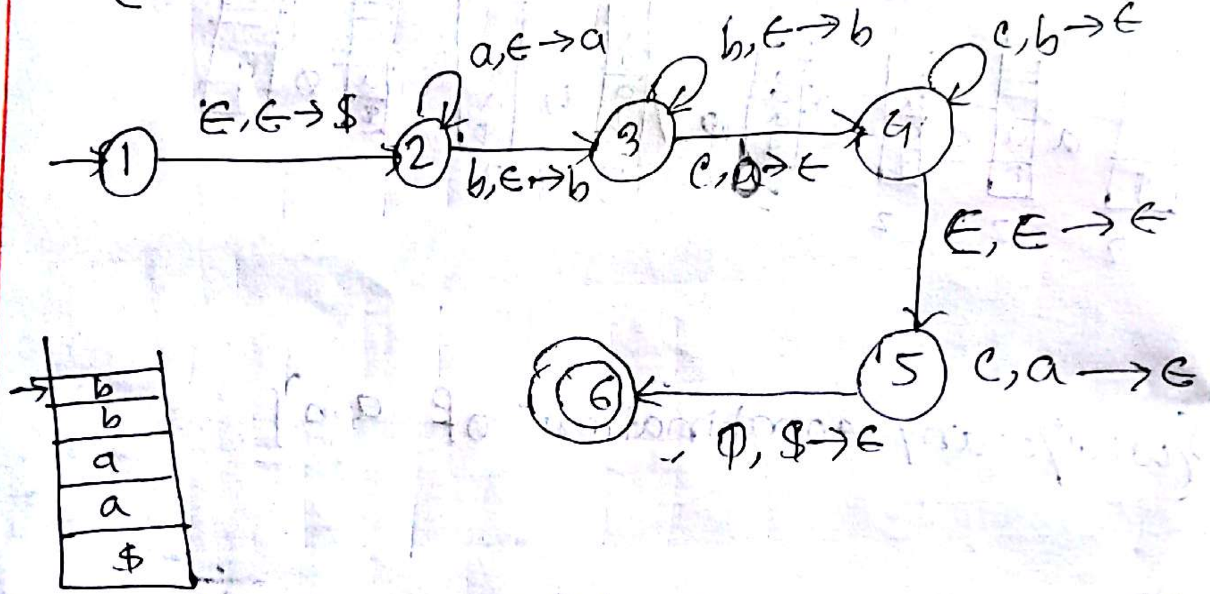
PDN

Label Description

Design.

Design PDA for:

$L = \{a^i b^j c^k \mid k = i+j \text{ and } i, j, k > 0\}$



Syllebus

Regular Expression → Design

→ RE of NFA

→ DFA to RE

Context free Grammer → Formal def

→ Left most derivation.

→ Parse tree.

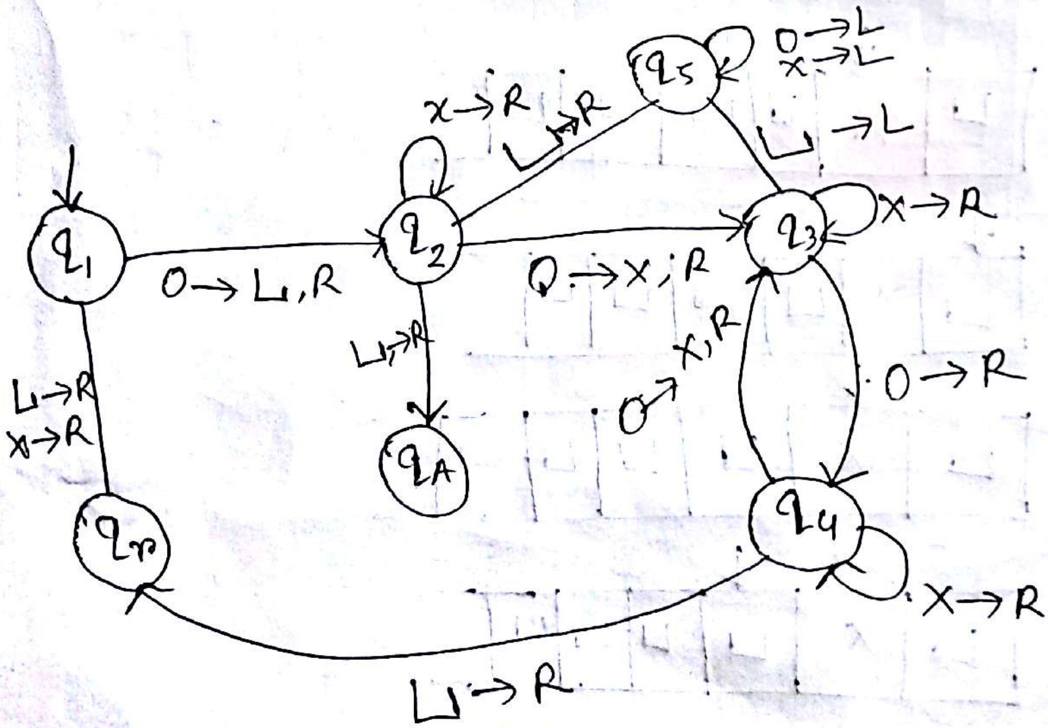
→ Ambigeity

→ Design.

→ CFG to CNF

Push down Automata → Design.
→ Formal def.
→ Simulation.
→ Label desc

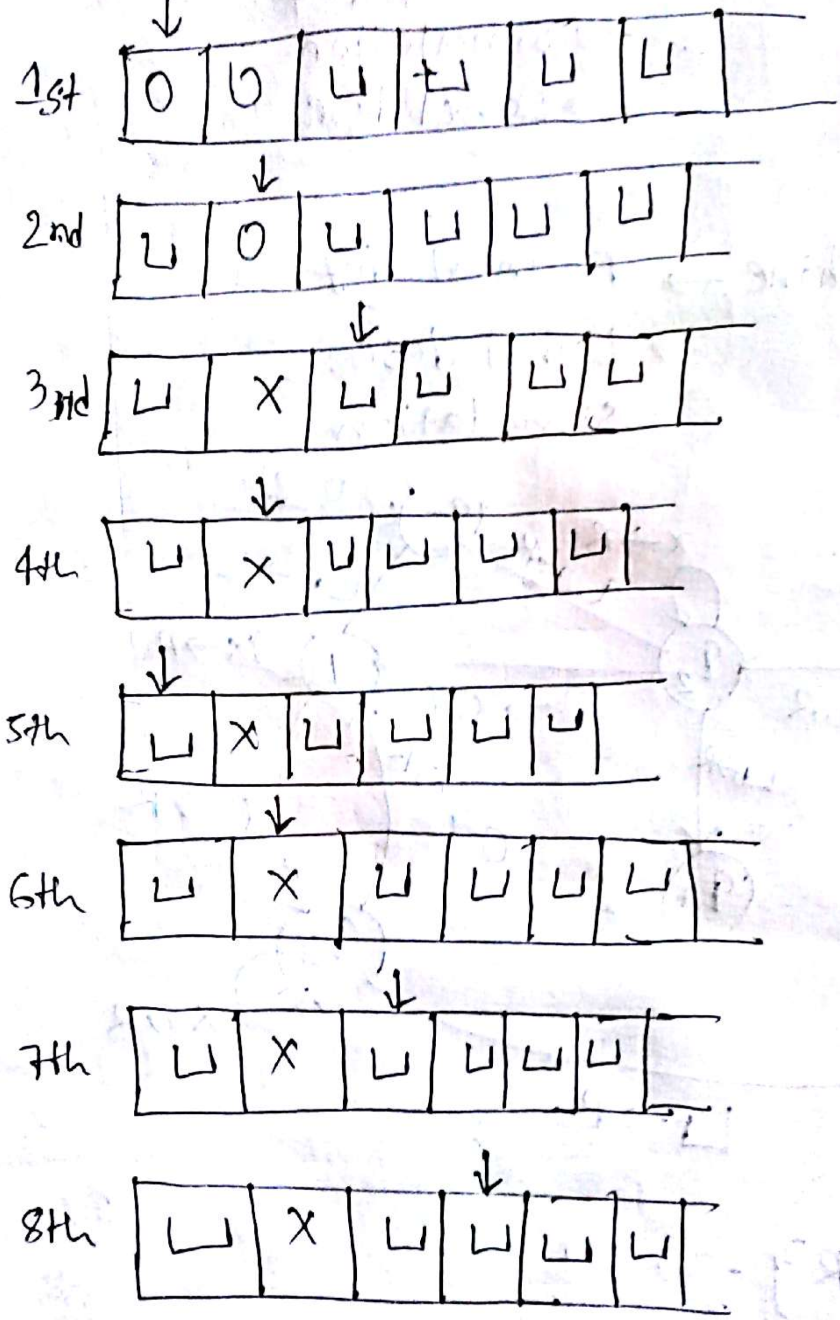
Turing Machine → Formal def.
→ Label desc
→ Simulation.



a → b, {L, R} → move

a → input to read | Γ alphabet.

b → Replace value.


1st 0 0 ⊔ ⊔ ⊔ ⊔
2nd ⊔ 0 ⊔ ⊔ ⊔ ⊔
3rd ⊔ X ⊔ ⊔ ⊔ ⊔
4th ⊔ X ⊔ ⊔ ⊔ ⊔
5th ⊔ X ⊔ ⊔ ⊔ ⊔
6th ⊔ X ⊔ ⊔ ⊔ ⊔
7th ⊔ X ⊔ ⊔ ⊔ ⊔
8th ⊔ X ⊔ ⊔ ⊔ ⊔

0 0 0

q_1	0 0 0
q_2	⊔ 0 0
q_3	⊔ x 0
q_4	⊔ x 0 ⊔
q[illegible]	⊔ x 0 ⊔ ⊔

0 0 0 0

q_1	0 0 0 0
q_2	⊔ 0 0 0
q_3	⊔ x 0 0
q_4	⊔ x 0 0
~~q_5~~	~~⊔ x 0 0 ⊔~~
q_3	⊔ x x ⊔
q_5	⊔ x x ⊔
q_5	⊔ x

0 0 0 0

q_1	0	0	0	0	
q_2	⊔	0	0	0	
q_3	⊔	x	0	0	
q_4	⊔	x	0	0	
q_3	⊔	x	0	x	⊔
q_5	⊔	x	0	x	⊔
q_5	⊔	x	0	x	⊔
q_5	⊔	x	0	x	⊔
q_5	⊔	x	0	x	⊔
q_2	⊔	x	0	x	⊔
q_2	⊔	x	0	x	⊔
q_3	⊔	x	x	x	⊔
q_4	⊔	x	x	x	⊔
q_5	⊔	x	x	x	⊔

q_5	$\sqcup$	X	$\underset{\uparrow}{X}$	X	$\sqcup$	
q_5	$\sqcup$	$\underset{\uparrow}{X}$	X	X	$\sqcup$	
q_5	$\underset{\uparrow}{\sqcup}$	X	X	X	$\sqcup$	
q_2	$\sqcup$	$\underset{\uparrow}{X}$	X	X	$\sqcup$	
q_2	$\sqcup$	X	$\underset{\uparrow}{X}$	X	$\sqcup$	
q_2	$\sqcup$	X	X	$\underset{\uparrow}{X}$	$\sqcup$	
q_2	$\sqcup$	X	X	X	$\underset{\uparrow}{\sqcup}$	
q_A	$\sqcup$	X	X	X	$\sqcup$	$\underset{\uparrow}{\sqcup}$