Never blindly trust anything.

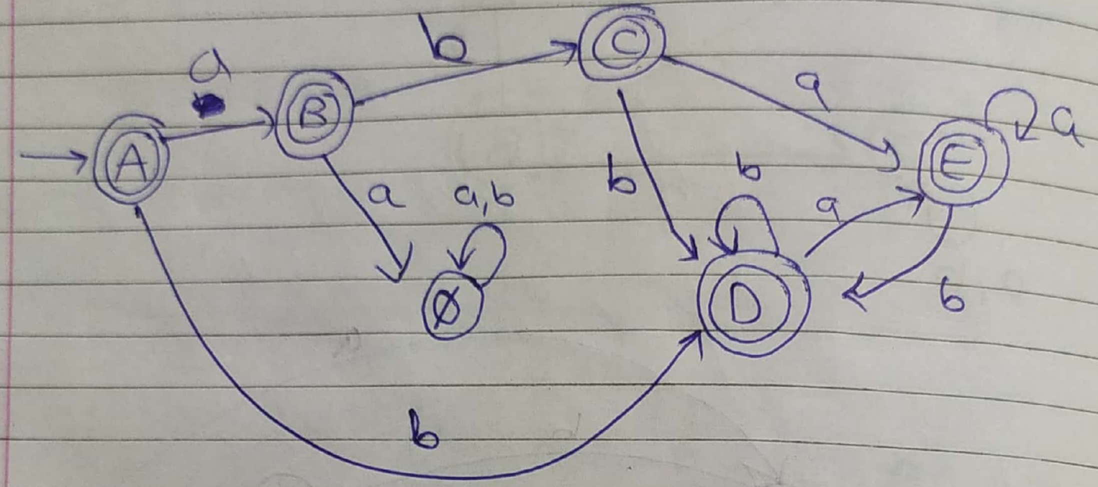
If you find any mistake, kindly correct it and if possible inform in our grp too.

Thank you
18BCE120.

Plz, don't download, use directly from drive, ~~[illegible]~~ So that If you get most recent and updated answers.

Tutorial - 5

1 Minimize FAs



Transition Table

~~① Removal of a unnecessary state~~

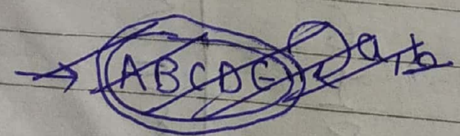
Current State	Next State a	Next State b
→ ⊙ A	B	D
⊙ B	φ	C
⊙ C	E	D
⊙ D	E	D
⊙ E	E	D
φ	φ	φ

① Remove unreachable state... E Not ✗

② partition in equivalance class.

$\Pi_0 = \{\phi\}, \{A, B, C, D, E\}$

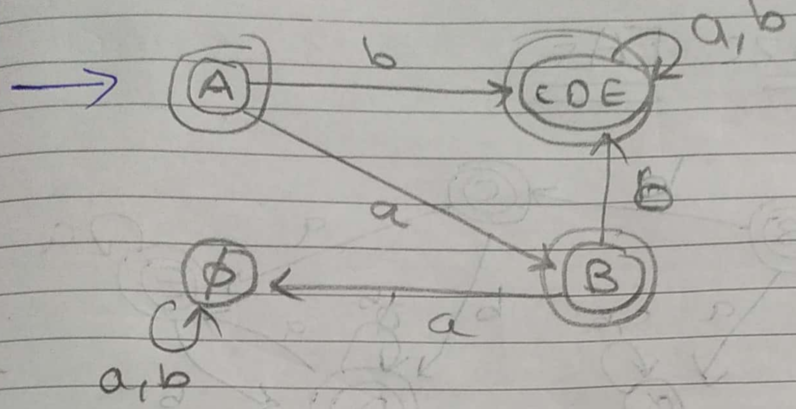
→



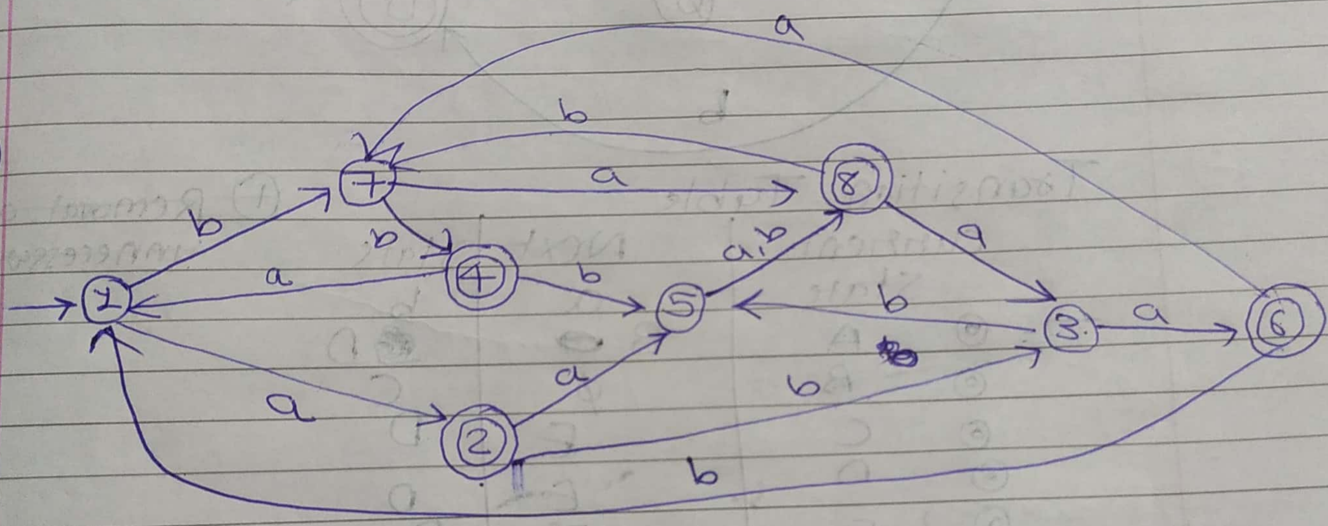
$\Pi_1 = \{\phi\}, \{A, C, D, E\}, \{B\}$

$\Pi_2 = \{\phi\}, \{A\}, \{C, D, E\} \{B\}$

$\Pi_3 = \{\phi\}, \{A\}, \{C, D, E\} \{B\}$



(2)



DFA Transition Table

current state	Next state a	b
1	2	7
2	5	3
3	6	5
4	1	5
5	8	8
6	7	1
7	8	4
8	3	7

① Remove unreachable state (if any)

② partition in equivalance class

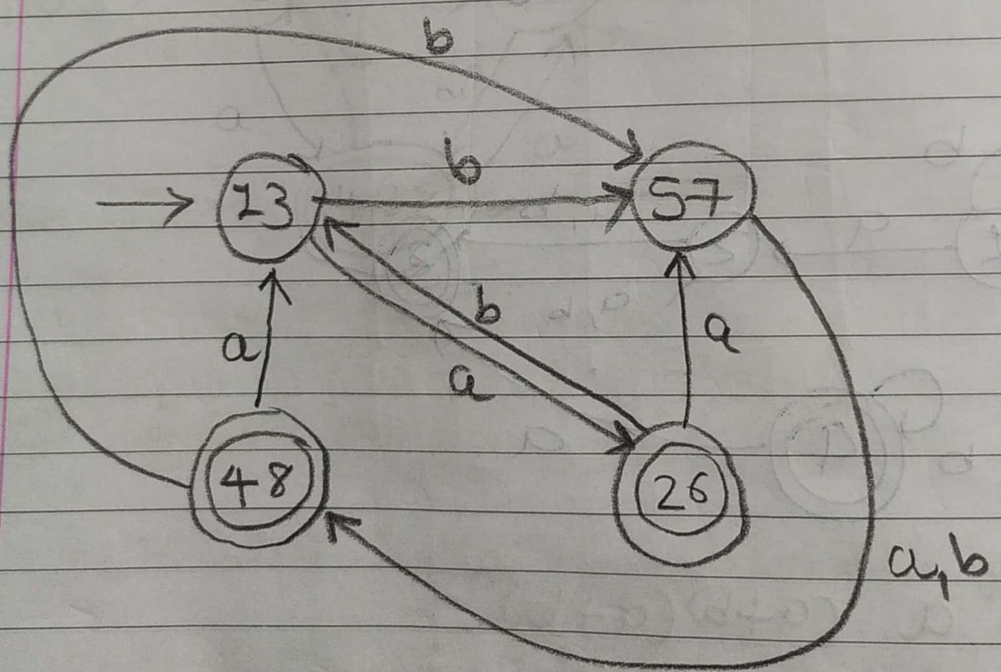
$\Pi_0 = \{1, 3, 5, 7\}\ \{2, 4, 6, 8\}$

$\Pi_1 = \{1, 3\}, \{5, 7\},$

$\{2, 4, 6, 8\}$

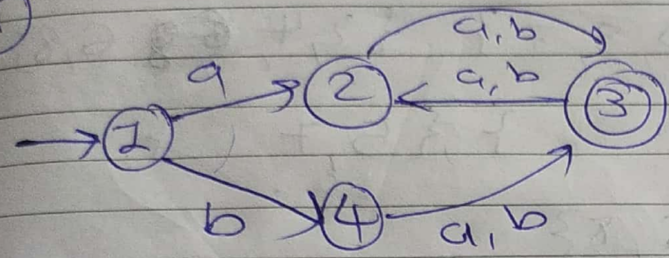
$\Pi_2 = \{1, 3\}\ \{5, 7\}\ \{2, 6\}\ \{4, 8\}$

$\Pi_3 = \{1, 3\}\ \{5, 7\}\ \{26\}\ \{4, 8\}$



② Which Languages are accepted by the following automata [Regular Expression]

(i)

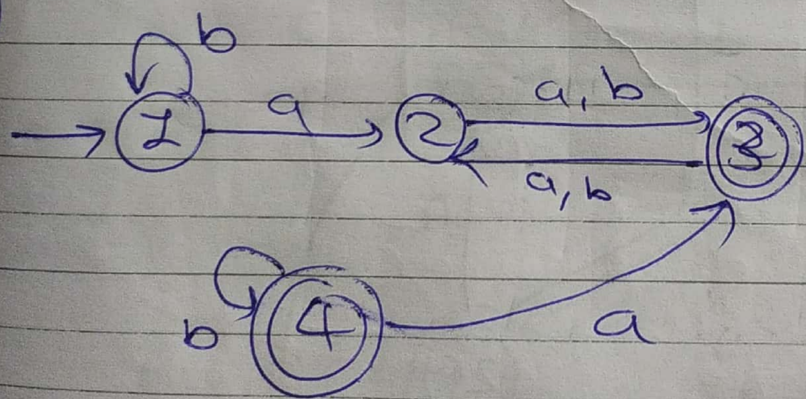


$$a\left((a+b)(a+b)^*\right) + b\left((a+b)(a+b)^*\right)$$

$$L = (a+b)(a+b)\cancel{(a+b)^*}\left((a+b)(a+b)\right)^*$$

~~$L: (a+b)(a+b)(a+b)^*$ $\Sigma(a,b)$~~

(ii)



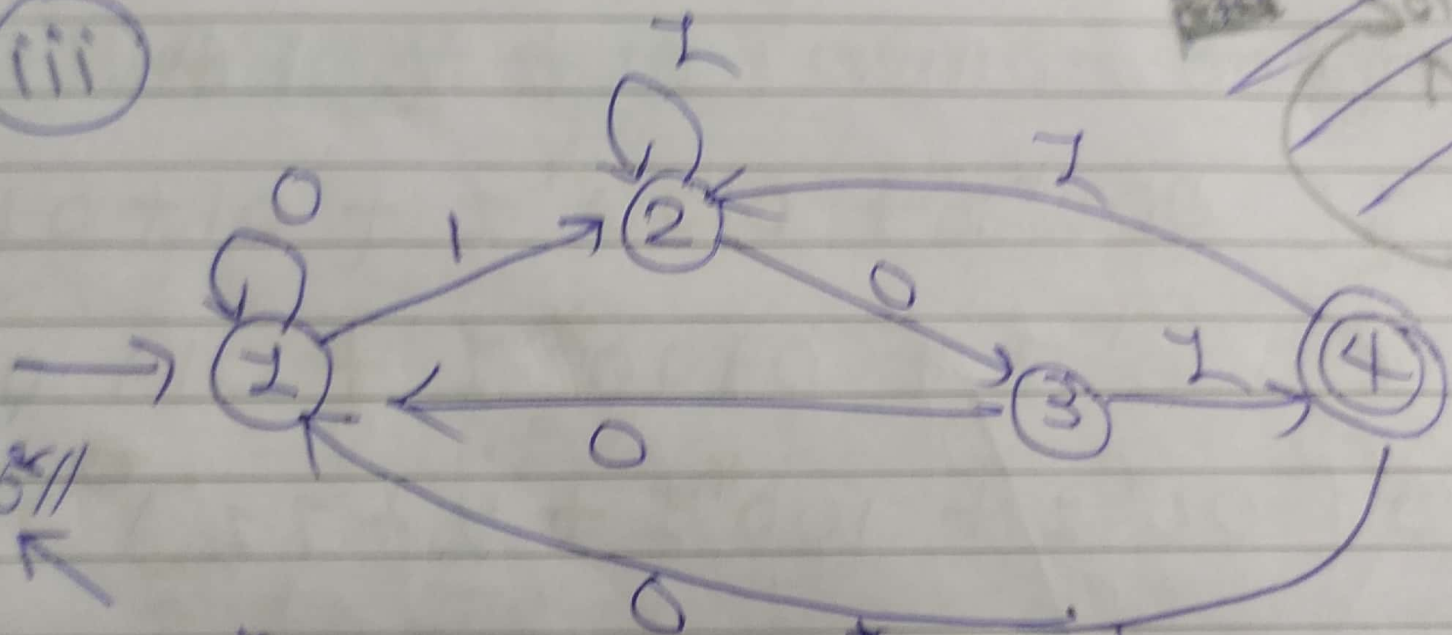
$$= \cancel{b^* a (a+b)(a+b)^*}$$

$$= b^* a (a+b)\left((a+b)(a+b)\right)^*$$

(iii)

~~Solve Nahi ho raha~~

$(0+1)^*101$



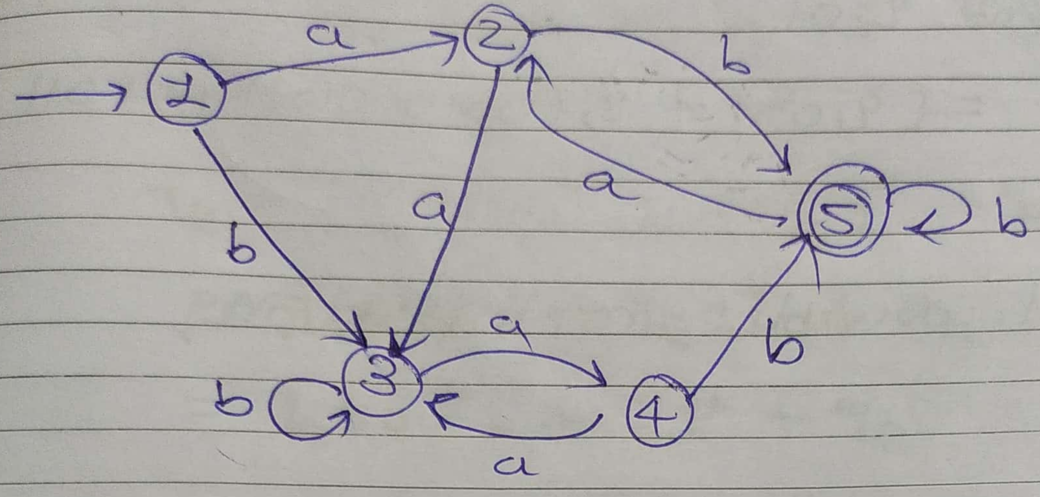
0^*//

answer $0^*1\,((00+01)0^*1+1)^*\,01$

(Thanks)

3) Minimize the following FAs

(a)



DFA Transition Table

Current state	Next state a	b
1	2	3
2	3	5
3	4	3
4	3	5
5	2	5

(1) Remove unreachable state (if any)

(2) Partition in equivalence class

$\Pi_0 = \{1,2,3,4\}\ \{5\}$

$\Pi_1 = \{1,3,\ \}\ \{2,4\ \}\ \{5\}$

$\Pi_2 = \{1,3\}\ \{2,4\}\ \{5\}$

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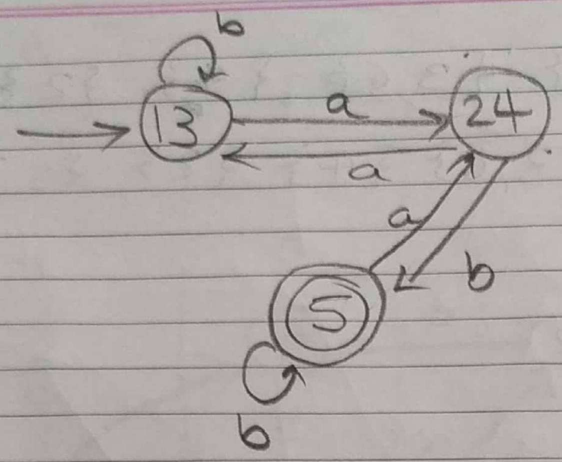
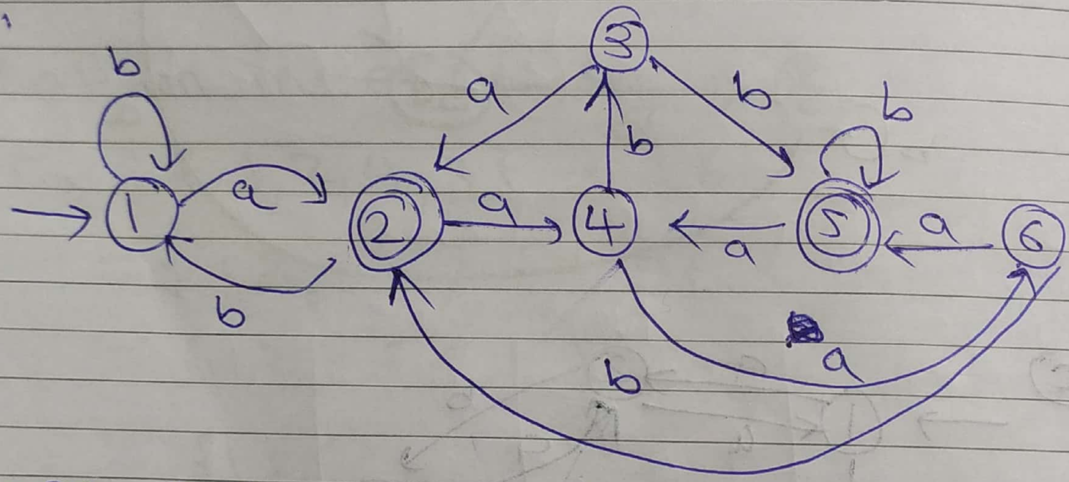


(b)



DFA Transition Table

Current state	Next state a	Next state b
1	2	1
2	4	1
3	2	5
4	6	3
5	4	5
6	5	2

(2) Partition in equivalance class.

$\Pi_0 = \{1, 3, 4, 6\} \; \{2, 5\}$

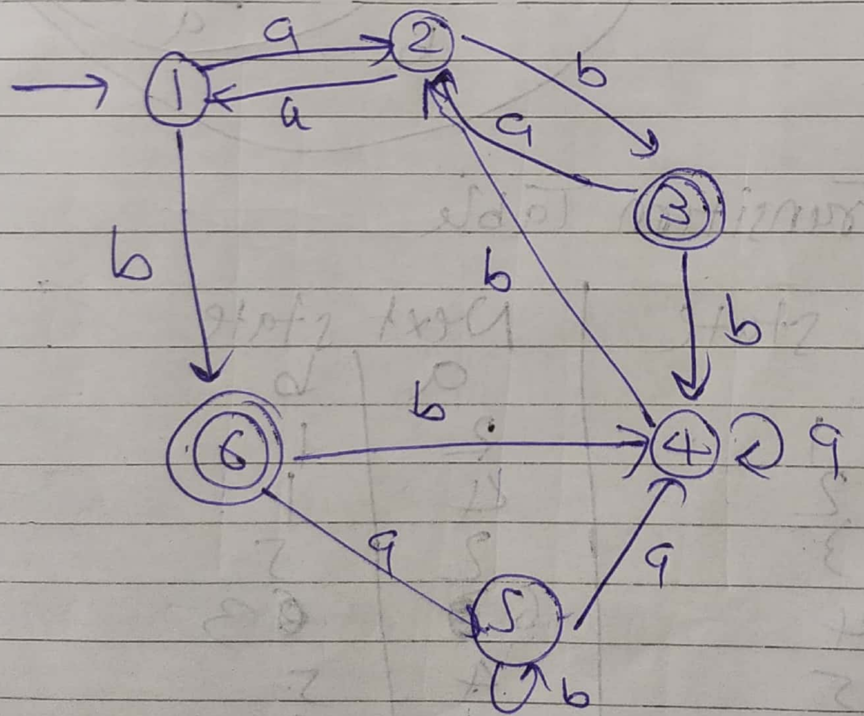
$\Pi_1 = \{1\} \{3,6\} \{4\} \{2\} \{5\}$

$\Pi_1 = \{1\} \{3,6\} \{4\} \{2\}, \{5\}$

$\Pi_2 = \{1\} \{3\} \{6\} \{4\} \{2\} \{5\}$

Answer same as question

(c)



DFA Transition Table

Current State	Next state a	Next state b
1	2	6
2	1	3
3	2	4
4	4	2
5	4	5
6	5	4

Partition in equivalance class

$\Pi_0 = \{1,2,4,5\}\ \{3,6\}$

$= \{1,2\}\ \{4,5\}\ \{3,6\}$

$= \{1,2\}\ \{4\}\ \{5\}\ \{3\}\ \{6\}$

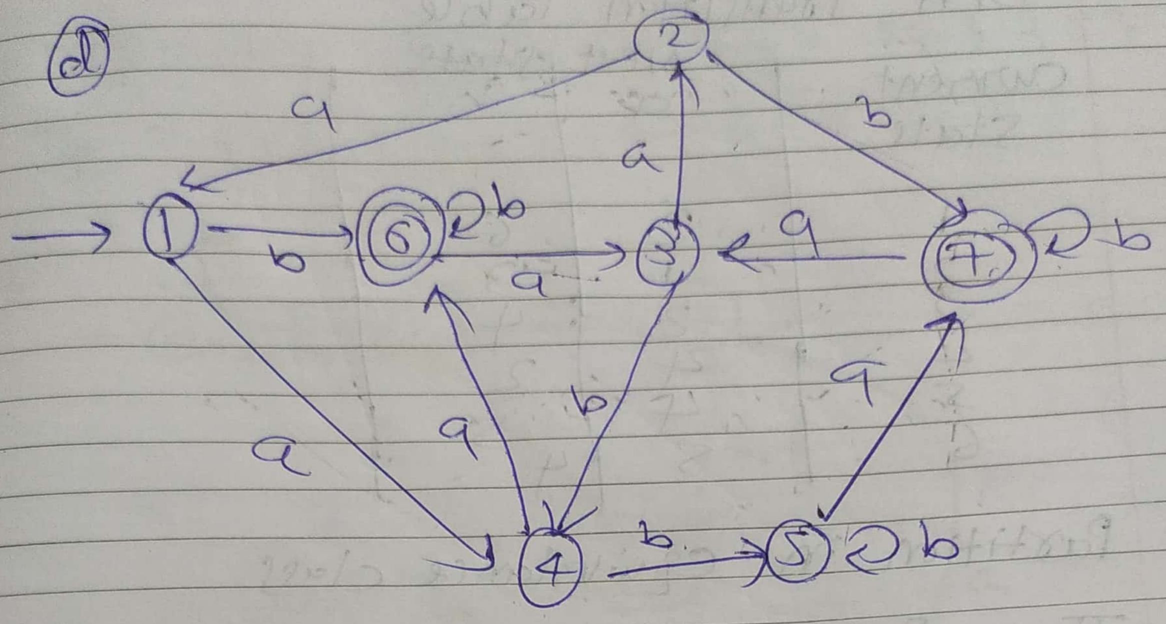
$= \{1\}\ \{2\}\ \{4\}\ \{5\}\ \{3\}\ \{6\}$

$\Rightarrow$ Same as given no change as ~~there are no equivalance class.~~

~~No~~ minimization possible

Not

(d)



DFA Transition Table

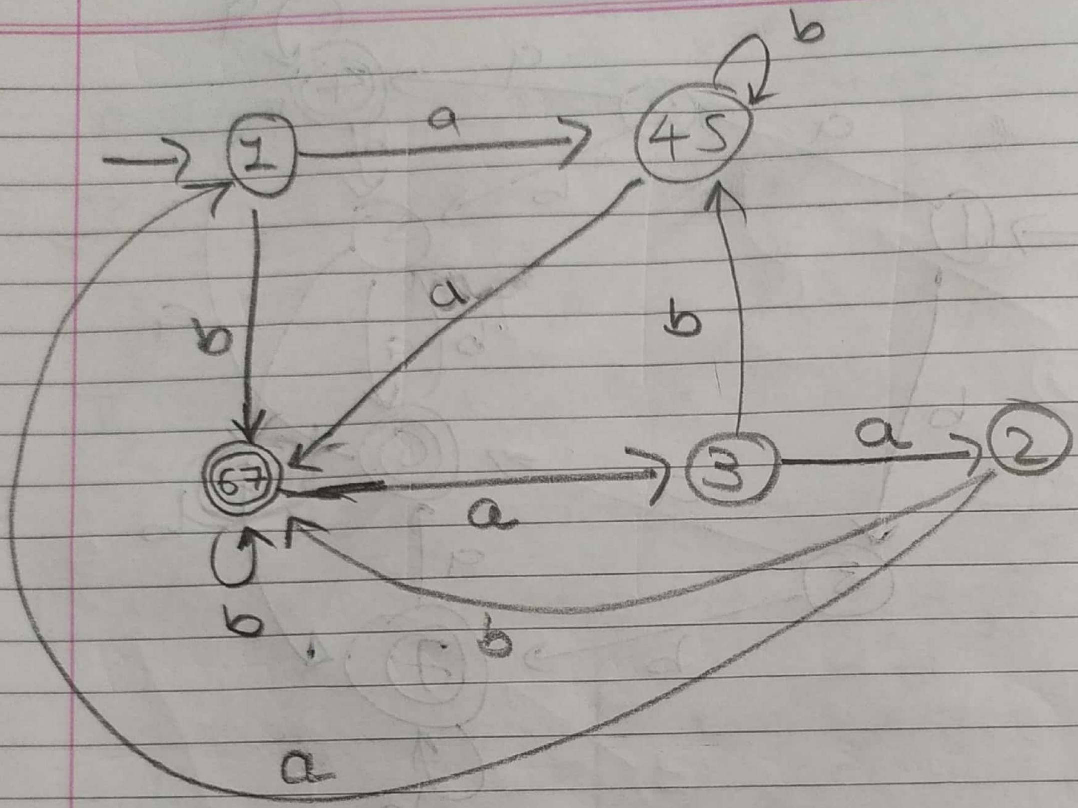
Current state	Next state a	b
1	4	6
2	1	7
3	2	4
4	6	5
5	7	5
6	3	6
7	3	7

→ Partition in equivalance class

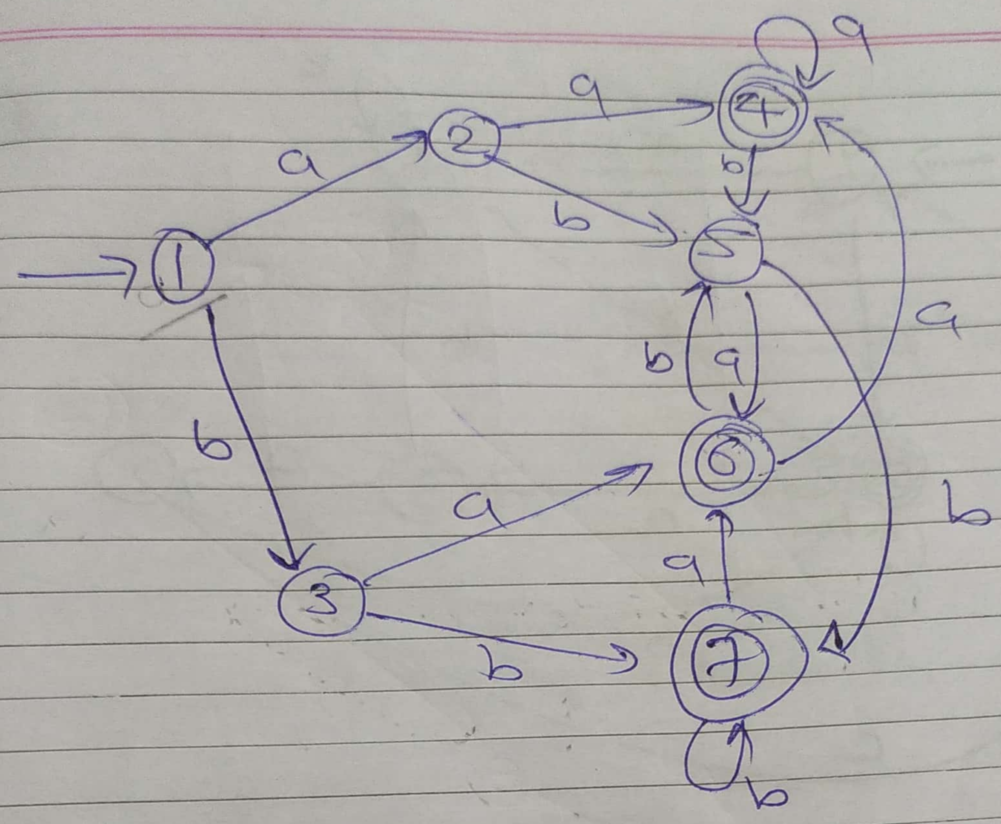
$\Pi_0 = \{1,2,3,4,5\} \{6,7\}$

$\Pi_1 = \{1,2 \quad\} \{3, \quad\} \{4,5\} \{6,7\}$

$\Pi_2 = \{1\} \{2\} \{3\} \{4,5\} \{6,7\}$


1
45
67
3
2
a
b
a
b
a
a
b
b
a
b

(e)



DFA Transition Table

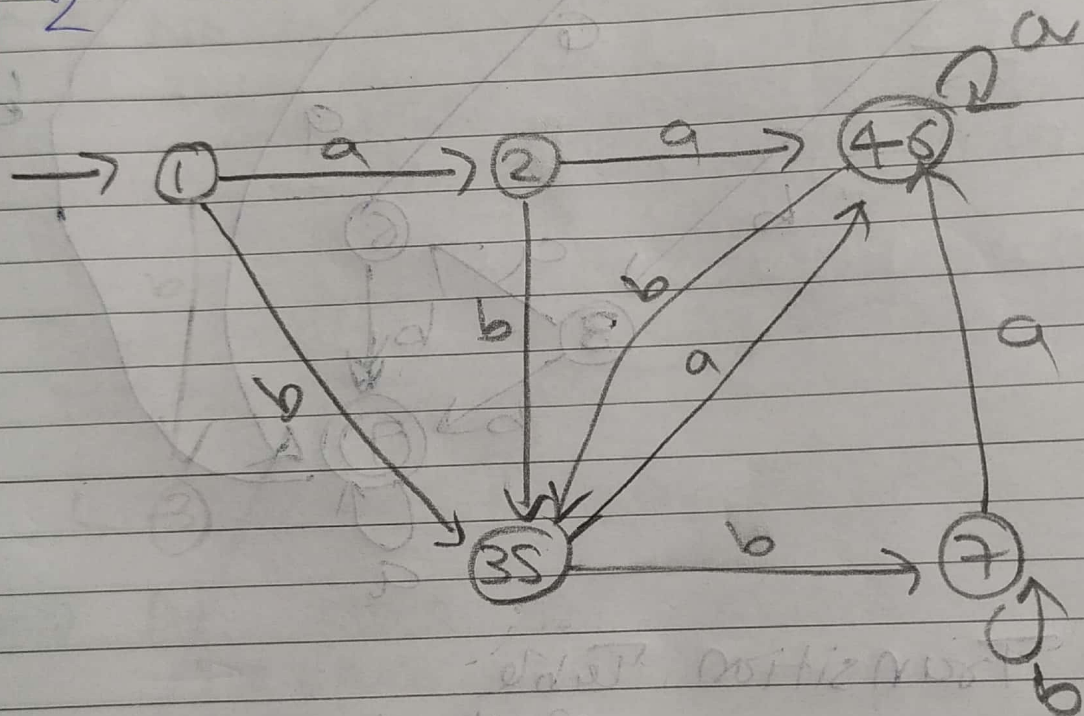
Current State	Next state a	b
1	2	3
2	4	5
3	6	7
4	4	5
5	6	7
6	4	5
7	6	7

partion in equivalance class.

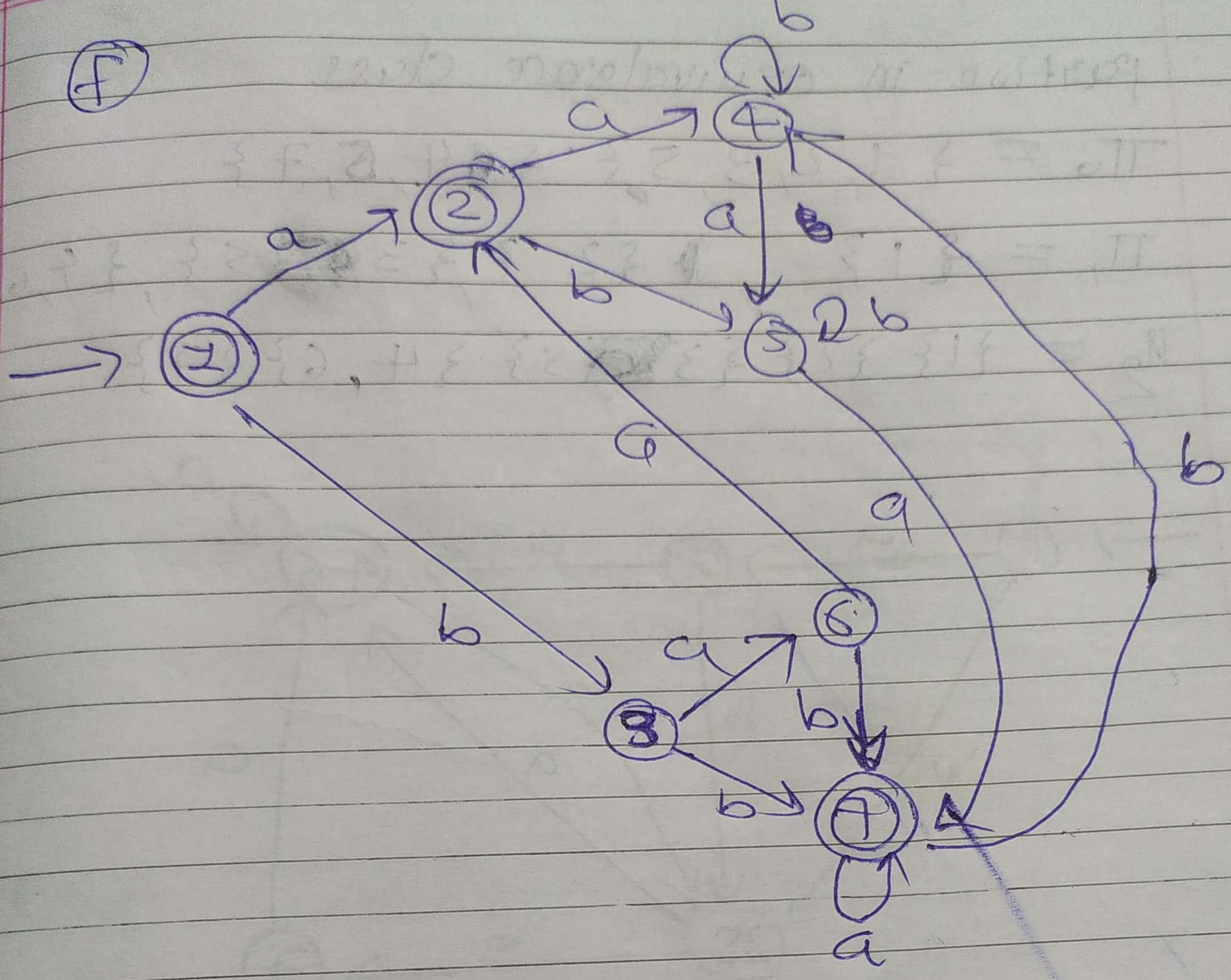
$\Pi_0 = \{1, 2, 3, 5\} \cdot \{4, 6, 7\}$

$\Pi_1 = \{1\}, \{2\}, \{3, 5\}, \{4, 6\} \{7\}$

$\Pi_2 = \{1\} \{2\} \{3, 5\} \{4, 6\} \{7\}$



F



DFA Transition Table

Current state	Next state a	Next state b
1	2	3
2	4	5
3	6	7
4	5	4
5	7	5
6	2	7
7	7	4

$\pi_0 = \{3, 4, 5, 6\}\ \{1, 2, 7\}$

$\pi_1 = \{3\}\{4,\}\{5\}\{6\}\ \{1, 7\}\{2,\}$

$\pi_2 = \{3\}, \{4\}, \{5\}, \{6\}, \{1\}, \{7\}\{2\}$

→ No minimization possible

Same as given. answer

Refer GFG or Book or any other site for theory of Pumping lemma

* [1] $L = \{a^i b^i, i \geq 0\}$

→ L is not regular

→ Proof :-

⇒ assume that L is regular.

- ~~pumping length | n~~
- ~~$|s| \neq |a^p| b$~~

⇒ let $x \in L$ and $|x| \geq n$.

So, by pumping lemma there exists

u, v, w such that $|uv| \leq n$ → (1)

$|v| \geq 1$ → (2)

for all $i \geq 0$ $uv^iw \in L$ → (3)

⇒ We show that for all u, v, w above mentioned condition doesn't hold.

⇒ If (1) & (2) hold then $x = a^n b^n$
$= uvw$

So, $u = a^p$

$v = a^q$

$w = a^r b^n$

where, $p + q \leq n$, $q \geq 1$, $r \geq 0$,

$p + q + r = n$.

But then (3) fails for $i=0$.

$uv^0w = uw$

$= a^{p+r} b^n$

$\notin L$ since, $p+r \neq n$.

$\Longrightarrow$ Hence, given language doesn't satisfy pumping lemma the given language is not Regular

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$\boxed{2}$ $L = \{XX, \mid X \in \{0,1\}^*\}$

~~XX~~

→ Assume L is regular language

⟹ According to given condition
XX can be $0^n 1^n$.

hence, let $w = 0^n 1^n$ $n \geq 0$.

Now, the question is
same as previous one.

just replace a by 0 & b by 1

$\boxed{3}$ $L = \{ww_R \mid w \in \{a,b\}^*, |w| \geq 2\}$

→ Assume L is regular

let $x = a^m b^m b^m a^m$, $x \in L$

$u = a^m b^p$
$v = b^q$
$w = b^r a^m$

$p+q+r = 2m$
$p+q \leq 2m$, $q \geq 1$, $r \geq 0$.

for $i=0$,

$x = uv^0w$

$= a^m b^p b^r a^m$

$\notin L$ since, $p+r \neq 2m$

$\Rightarrow$ Hence, given language is not regular as it doesn't satisfy pumping lemma.

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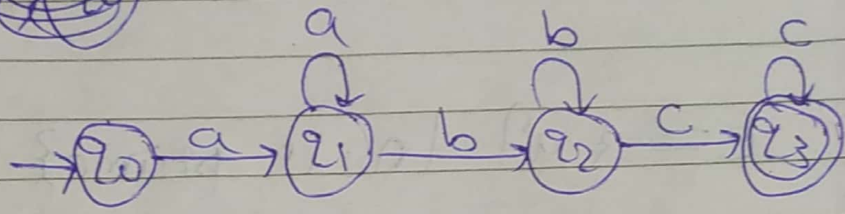
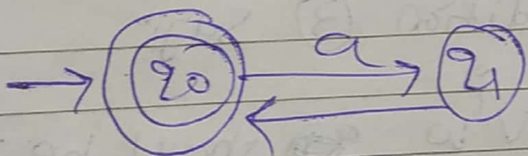
4) $L = \{ a_n b_m c_K \mid n, m, K \geq 1 \}$



⟹ As, we can generate a finite State machine for given Language it is Regular

5) $L = \{ a^n \mid n \text{ is even} \}$



⟹ as, we can generate a finite State machine for given lang it is regular.

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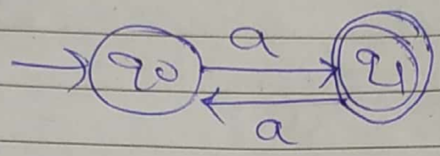
(6) $L = \{a^n \mid n \text{ is odd}\}$



finite state machine

(7) $L = \{a^n \mid n \text{ is prime}\}$

→ $x = a^n$ and this lang. hold condition (1) and (2) then

$x = uvw$ when $u = a^p$
$v = a^s$
$w = a^{n-p-s}$.

as, condition (3) says

uv^iw should be in L.

for $i = n+1$

$uv^{(n+1)}w = a^p \, a^{n+1} \, a^{n-p-s}$

$= a^{n(s+1)}$

now, $n(s+1)$ is not prime as it is divisible by $(s+1)$.

hence, $a^{n(s+1)} \notin L$

∴ given lang. is not Regular