

write Φ in place of -

in question of nfa to dfa and nfa null to dfa.



Never blindly trust anything.

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

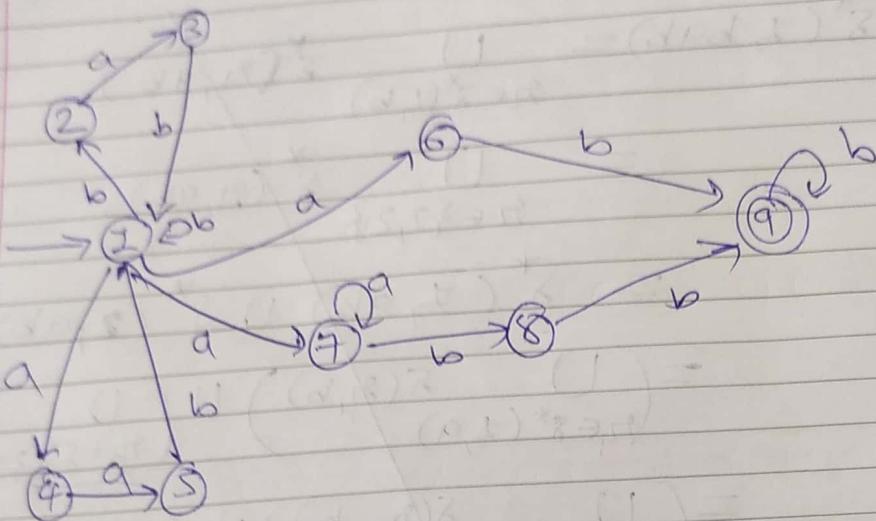
Thank You
18BCE120.

Tutorial - 4

Not ~~sure~~ sure that this solution is 100% correct method.

But "Something is better than Nothing."

[II]



$$a. \delta^*(1, bb)$$

$$\Rightarrow \delta^*(1, bb) = \bigcup_{n \in \delta^*(1, b)} \delta(n, b)$$

$$= \bigcup_{n \in \{1, 2\}} \delta(n, b)$$

$$= \delta(1, b) \cup \delta(2, b)$$

$$= \{1, 2\} \cup \{\}$$

$$\delta^*(1, bb) = \{1, 2\}$$

any
other states $\{1, 2\}$.

$$\textcircled{c} \quad \delta^*(1, aabb) \quad \text{--- (1)}$$

$$\Rightarrow \delta^*(1, aabb) = \bigcup_{r \in \delta^*}$$

$$\textcircled{b} \quad \delta^*(1, bab)$$

$$\delta^*(1, bab) = \bigcup_{r \in \delta^*(1, ba)} \delta(r, b) \quad - \textcircled{2}$$

$$\delta^*(1, ba) = \bigcup_{r \in \delta^*(1, b)} \delta(r, a)$$

$$= \bigcup_{r \in \{1, 2\}} \delta(r, a)$$

$$= \delta(1, a) \cup \delta(2, a)$$

$$= \{4, 6, 7\} \cup \{3\}$$

$$\textcircled{d} \quad \delta^*(1, ba) = \{3, 4, 6, 7\} \quad - \textcircled{2}$$

\Rightarrow from $\textcircled{1}$ value of $\delta^*(1, ba)$ to $\textcircled{2}$

$$\delta^*(1, bab) = \bigcup_{r \in \{3, 4, 6, 7\}} \delta(r, b)$$

$$= \delta(3, b) \cup \delta(4, b) \cup \delta(6, b) \cup \delta(7, b)$$

$$= \{1, 8, 9\} \cup \{3\} \cup \{6\} \cup \{7\}$$

$$\delta^*(1, bab) = \{1, 8, 9\}$$

Answer

$$\textcircled{C} \quad \delta^*(1,99bb).$$

$$\delta^*(1,99bb) = \bigcup_{r \in \delta^*(1,99b)} \delta(r, b) \quad \text{--- ①}$$

$$\delta^*(1,99b) = \bigcup_{r \in \delta^*(1,99)} \delta(r, b) \quad \text{--- ②}$$

$$\delta^*(1,99) = \bigcup_{r \in \delta^*(1,9)} \delta(r, 9)$$

$$= \bigcup_{r \in \{4, 6, 7\}} \delta(r, 9)$$

$$= \delta(4, 9) \cup \delta(6, 9) \cup \delta(7, 9)$$

$$(P,S)_8 = \{5\} \cup \{3\} \cup \{7\}$$

$$\delta^*(1,99) = \{5, 7\} \quad \text{--- ③}$$

\Rightarrow from ③ value of $\delta^*(1,99)$ into ②.

$$\delta^*(1,99b) = \bigcup_{r \in \{5, 7\}} \delta(r, b)$$

$$= \delta(5, b) \cup \delta(7, b)$$

$$= \{2\} \cup \{8\}$$

$$\delta^*(1,99b) = \{1, 8\} \quad \text{--- ④}$$

from ④ value of $\delta^*(1, aab)$ into ②

$$\begin{aligned}\delta^*(1, aabb) &= \bigcup_{r \in \{1, 8\}} \delta(r, b) \\ &= \delta(1, b) \cup \delta(8, b) \\ &= \{1, 2\} \cup \{9\}\end{aligned}$$

$$\delta^*(1, aabb) = \{1, 2, 9\}$$

Any

② $\delta^*(1, aabbba)$

$$\Rightarrow \delta^*(1, aabbba) = \bigcup_{r \in \delta^*(1, aabb)} \delta(r, a) \rightarrow ①$$

$$\delta^*(1, aabb) = \bigcup_{r \in \delta^*(1, aabb)} \delta(r, a) \rightarrow ②$$

\Rightarrow As, we have value of $\delta^*(1, aabb)$ from previous question, I am using directly.

$$\begin{aligned}\delta^*(1, aabb) &= \bigcup_{r \in \{1, 2, 9\}} \delta(r, a) \\ &= \delta(1, a) \cup \delta(2, a) \cup \delta(9, a) \\ &= \{4, 6, 7\} \cup \{3\} \cup \{\}\end{aligned}$$

$$\delta^*(1, aabbba) = \{3, 4, 6, 7\} \rightarrow \textcircled{3}$$

from \textcircled{3} value of $\delta^*(1, aabbba)$ into \textcircled{2}

$$\delta^*(1, aabbba) = \bigcup_{r \in \{3, 4, 6, 7\}} \delta(r, b)$$

$$= \delta(3, b) \cup \delta(4, b) \cup \delta(6, b) \cup \delta(7, b)$$

$$= \{2\} \cup \{3\} \cup \{9\} \cup \{8\}$$

$$\delta^*(1, aabbba) = \{2, 8, 9\} \quad \cancel{\{4\}} \quad \text{Ans}$$

~~→ from \textcircled{4} value of $\delta^*(1, aabbba)$ into \textcircled{1}~~

$$\delta^*(1, aabbba)$$

$$\textcircled{e} \quad \delta^*(1, ab)$$

$$\Rightarrow \delta^*(1, ab) = \bigcup_{r \in \delta^*(1, a)} \delta(r, b)$$

$$\delta^*(1, ab) = \bigcup_{r \in \delta^*(1, a)} \delta(r, b)$$

$$= \bigcup_{n \in \{4, 6, 7\}} \delta(n, b)$$

$$= \delta(4, b) \cup \delta(6, b) \cup \delta(7, b)$$

$$= \{ \} \cup \{ \} \cup \{ \}$$

$$\delta^*(1, ab) = \{8, 9\} \quad \text{--- } \textcircled{2}$$

\Rightarrow sum value of $\delta^*(1, ab)$ to $\textcircled{2}$

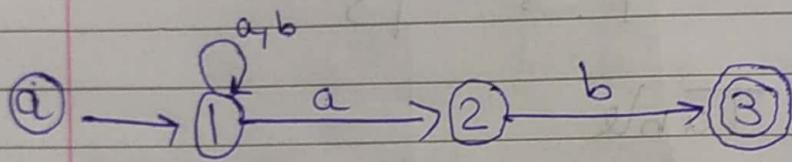
$$\delta^*(1, aba) = \bigcup_{q \in \{8, 9\}} \delta(q, a).$$

$$= \delta(8, a) \cup \delta(9, a)$$

$$= \{ \} \cup \{ \}$$

$$\delta^*(1, aba) = \{ \} \quad \text{Any}$$

2 NFA to DFA



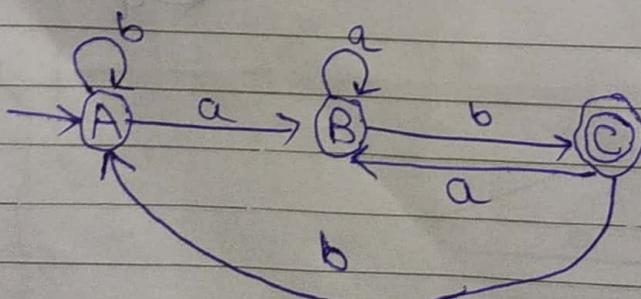
NFA Transition table

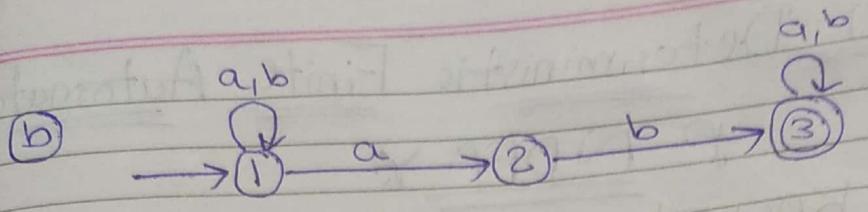
current state	a	b
1	2	1
2	-	3
3	-	-

DFA Transition table

current state	a	b
1 (A)	2 (B)	1 (A)
2 (B)	2 (B)	2 (C)
3 (C)	2 (B)	1 (A)

DFA diag Transition diagram





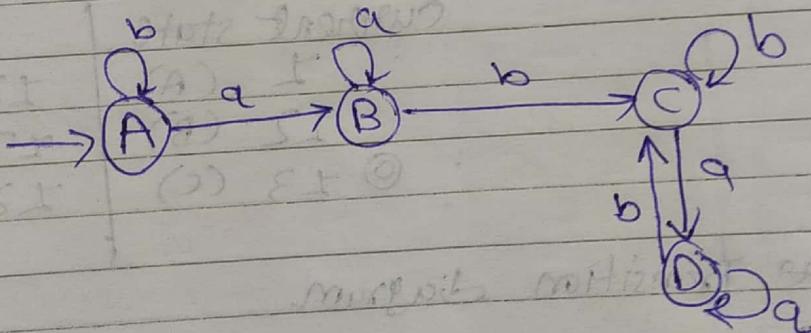
NFA Transition Table

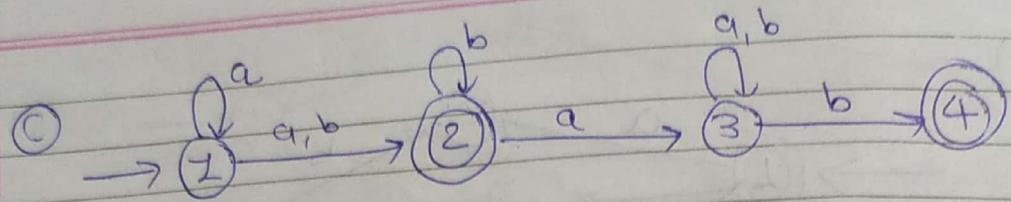
current state	a	b
1	2	1
2	1	3
3	3	3

DFA Transition Table

current state	a	b
1 (A)	2 (B)	1 (A)
2 (B)	2 (B)	1 (C)
1 (C)	1 (D)	1 (C)
0 (D)	1 (D)	1 (E)

DFA Transition diagram





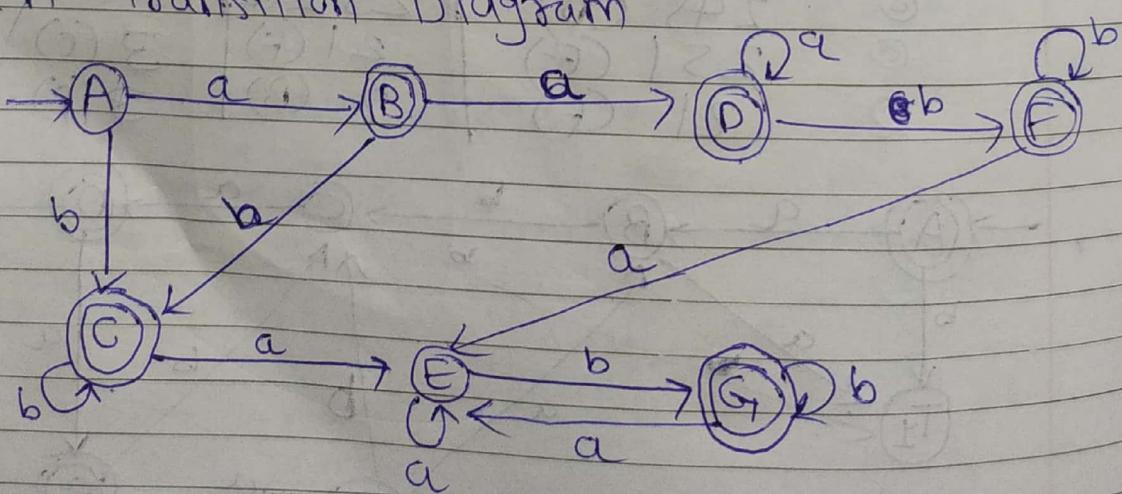
NFA Transition Table

Current state		a	b
①	1	12	2
②	2	3	2
③	3	3	34
④	4	-	-

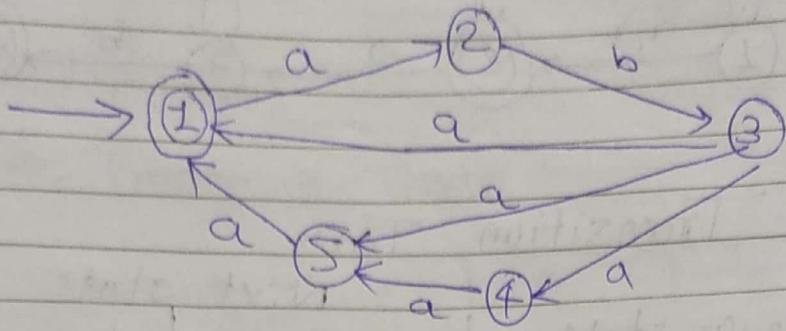
DFA Transition Table

Current state		Next state	
1	(A)	12 (B)	2 (C)
②	12 (B)	123 (D)	2 (C)
③	2 (C)	3 (E)	2 (C)
④	123 (D)	123 (D)	234 (F)
⑤	13 (E)	3 (E)	34 (G)
⑥	234 (F)	3 (E)	234 (F)
⑦	34 (G)	3 (E)	34 (G)

DFA Transition Diagram



d)

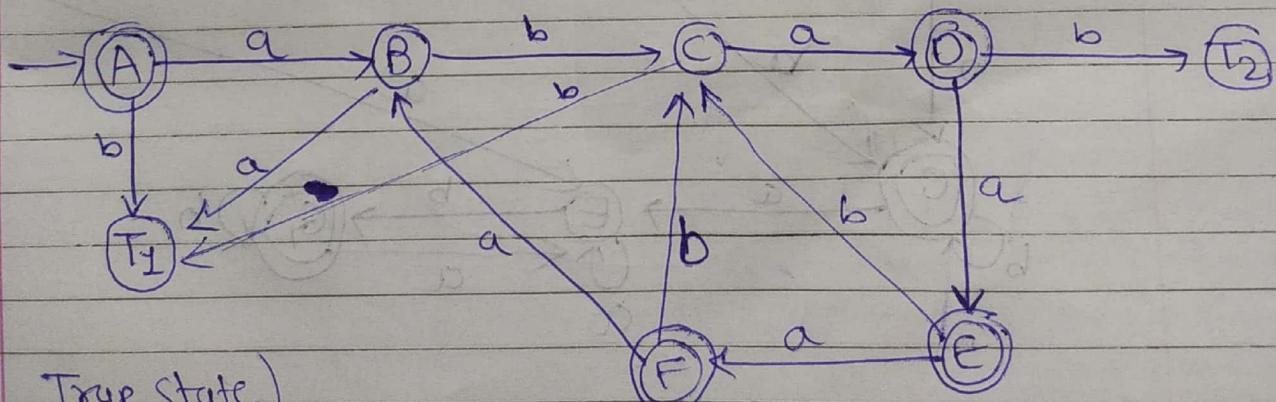


NFA Transition Table

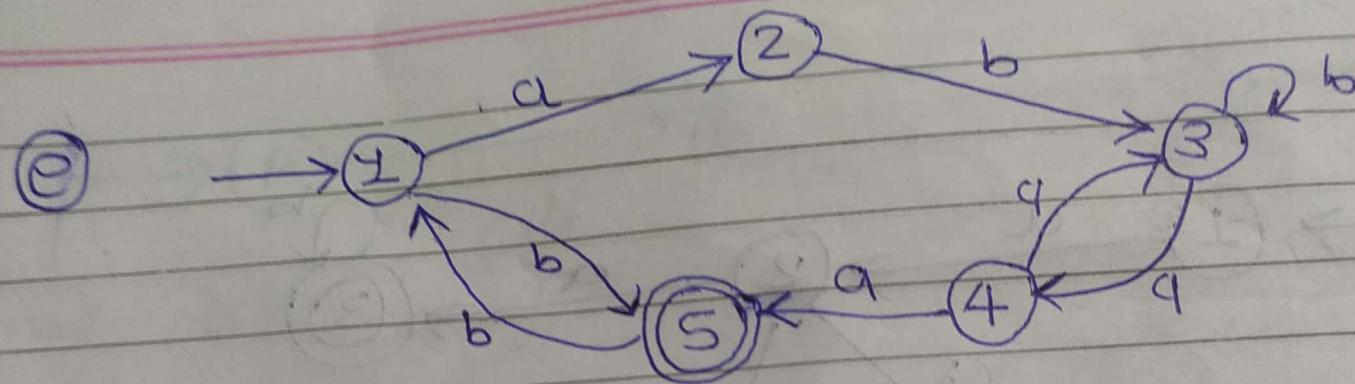
current state	next state	
	a	b
1	2	-
2	-	3
3	1, 4, 5	-
4	5	-
5	1	-

DFA Transition Table

current state	next state	
	a	b
1 (A)	2 (B)	-
2 (B)	-	3 (C)
3 (C)	1, 4, 5 (D)	-
4 (D)	2, 5 (E)	-
5 (E)	2 (F)	3 (C)
2 (F)	2 (B)	3 (C)



(T₁, T₂ Trap state)



NFA Transition Table

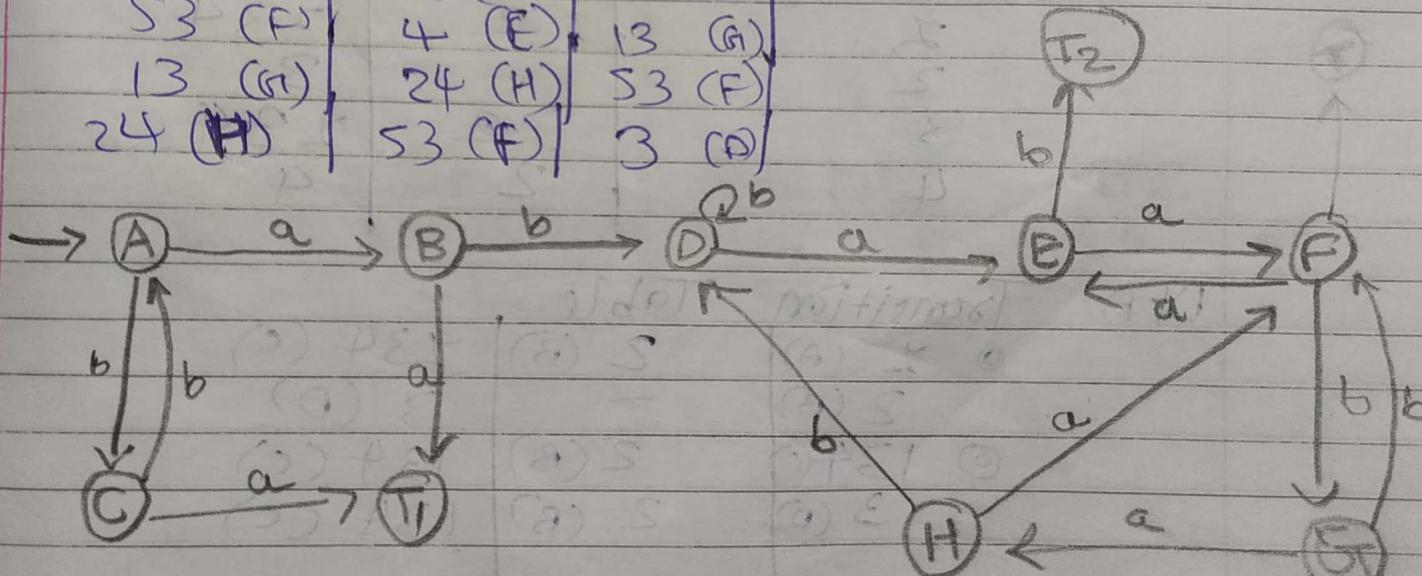
current state	a	b
0	-	-
1	2	5
2	-	3
3	4	3
4	53	-
5	-	51

e)

continue

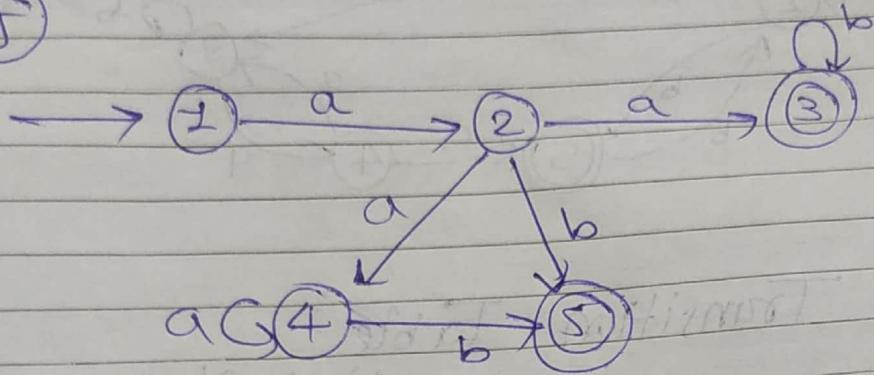
~~DFA~~ Transition Table

Current State	Next State	
	a	b
1 (A)	2 (B)	5 (C)
2 (B)	-	3 (D)
5 (C)	-	2 (A)
3 (D)	4 (E)	3 (D)
4 (E)	53 (F)	-
53 (F)	4 (E)	13 (G)
13 (G)	24 (H)	53 (F)
24 (H)	53 (F)	3 (D)



(T₁, T₂ Trap state)

F

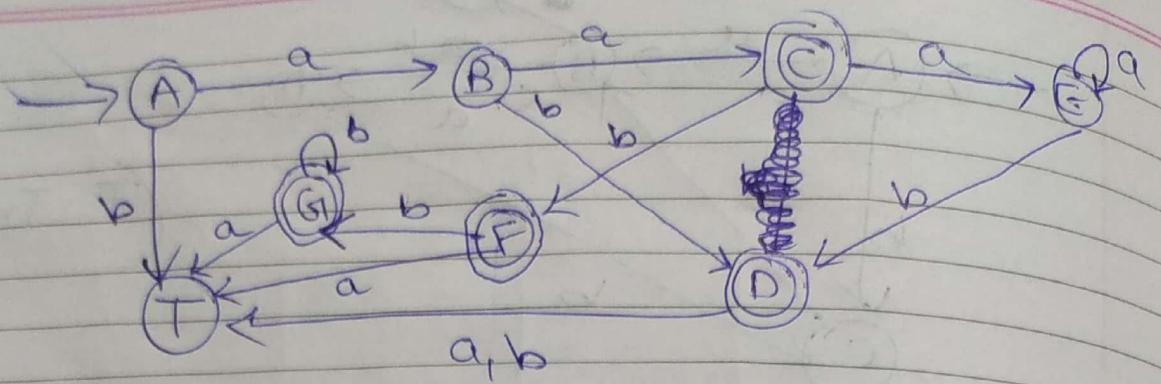


NFA Transition Table

Current State	Next state	
	a	b
1	2	-
2	3, 4	5
3	-	-
4	-	5
5	-	-

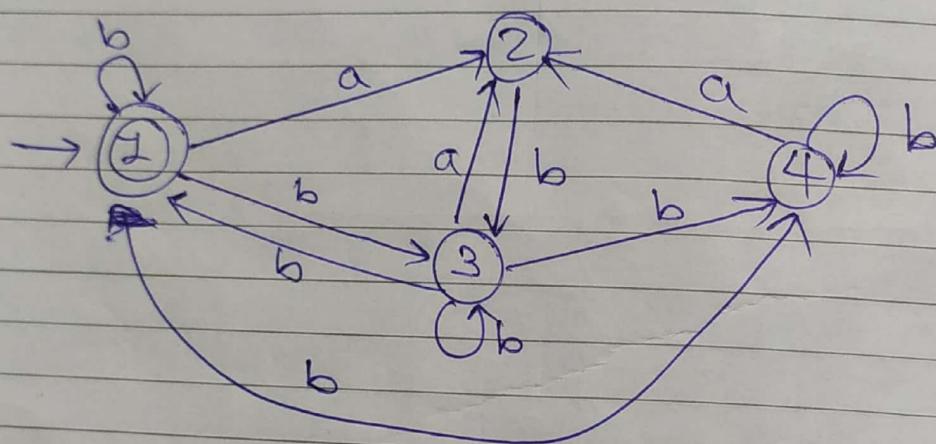
DFA Transition Table

Current State	Next state	
	a	b
1 (A)	2 (B)	-
2 (B)	3, 4 (C)	5 (D)
3, 4 (C)	4 (E)	3, 5 (F)
5 (D)	-	5 (D)
4 (E)	4 (E)	3 (G)
3, 5 (F)	-	3 (G)
3 (G)	-	-



(T - Trapstate)

⑧



NFA Transition Table

Current state	Next state	
	a	b
1	2	1, 3, 4
2	-	3
3	2	1, 3, 4
4	2	4

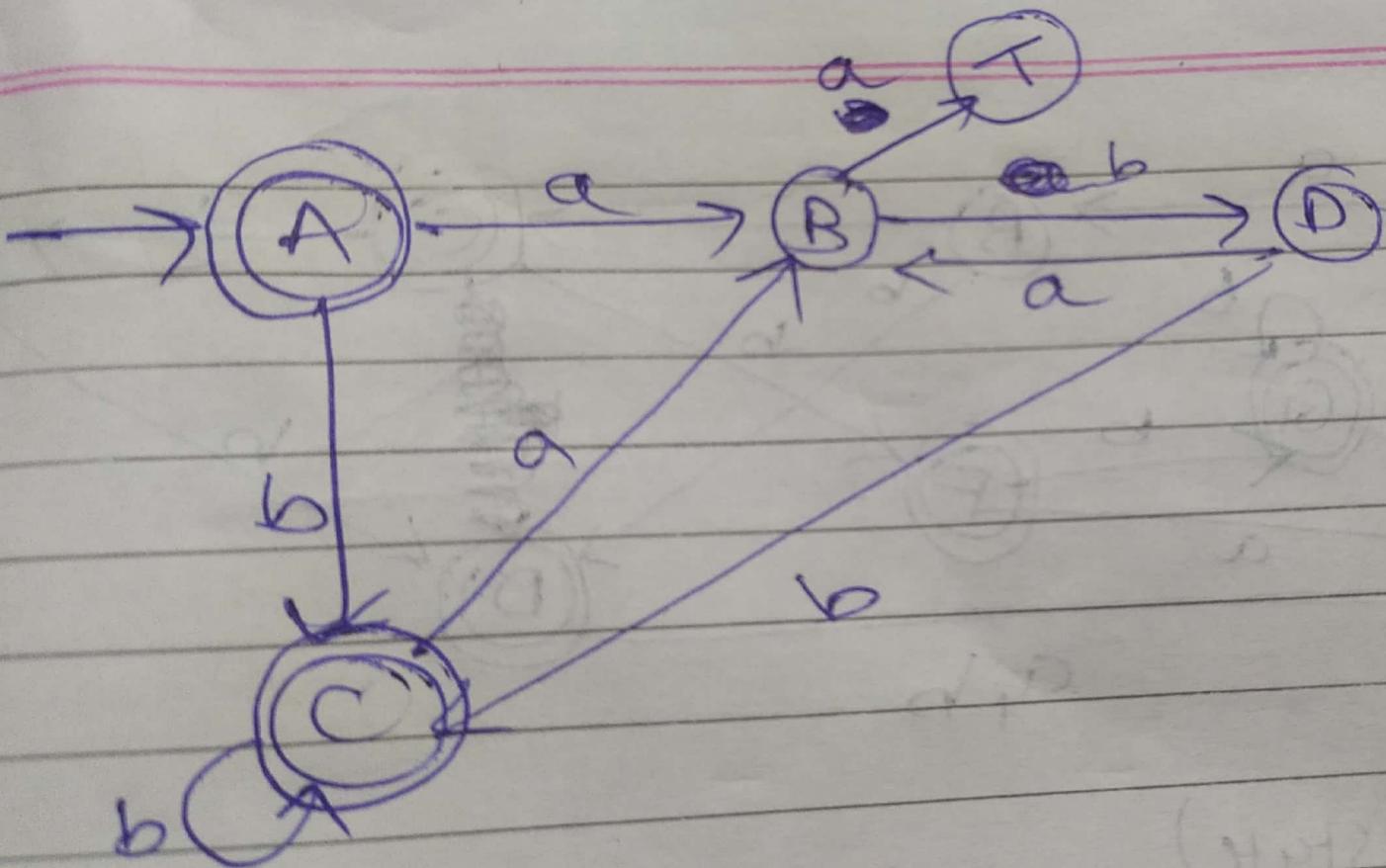
DFA Transition

① 1 (A)
2 (B)

② 134 (C)
3 (D)

Table

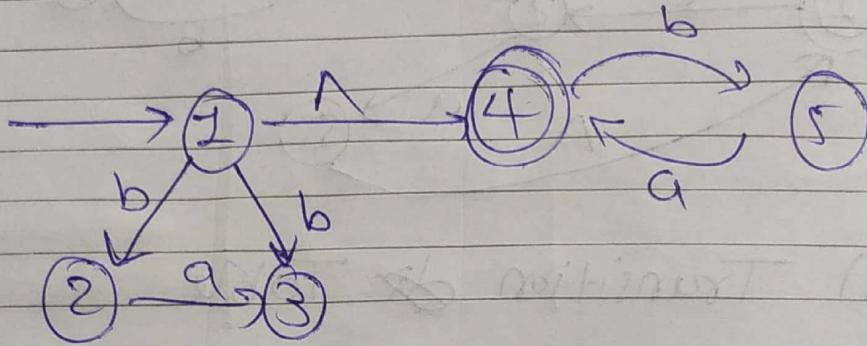
2 (B)	134 (C)
-	3 (D)
2 (B)	134 (C)
2 (B)	134 (C)



③

NFA \rightarrow DFA

a



NFA \rightarrow DFA Transition Table

current state	a	b	λ
1	2	3	4
2	3	-	-
3	-	-	-
4	-	5	-
5	4	-	-

$$\lambda\text{-closure}(1) = \{1, 4\}$$

$$\lambda\text{-closure}(2) = \{2\}$$

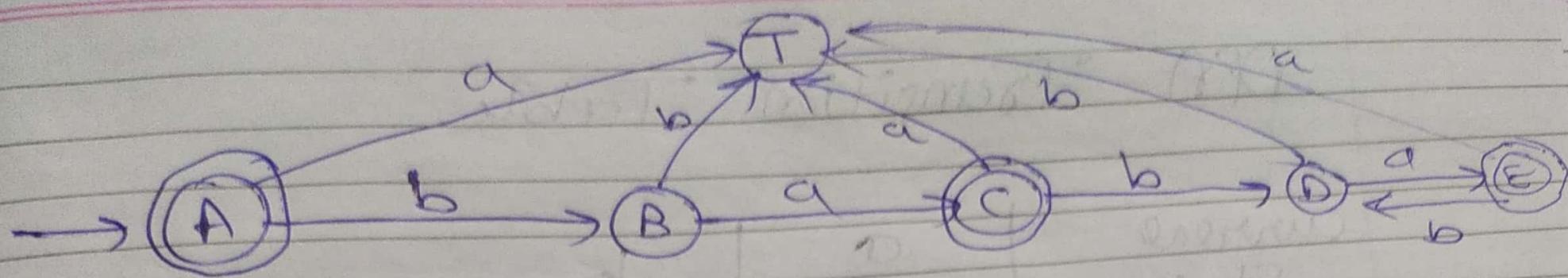
$$\lambda\text{-closure}(3) = \{3\}$$

$$\lambda\text{-closure}(4) = \{4\}$$

$$\lambda\text{-closure}(5) = \{5\}$$

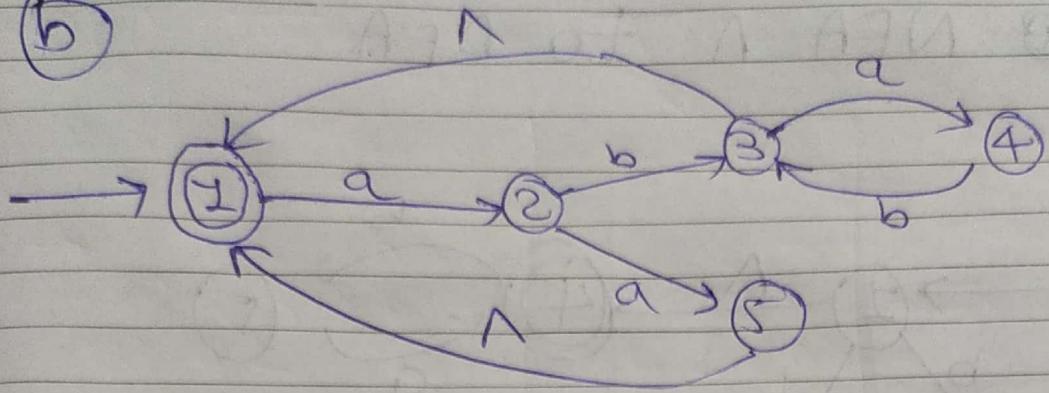
DFA Transition Table

current state	a	b	λ
1 (A)	-	235 (B)	-
235 (B)	34 (C)	-	-
34 (C)	-	5 (D)	-
5 (D)	4 (E)	-	-
4 (E)	-	5 (D)	-



(DFA Transition Diagram)

(b)



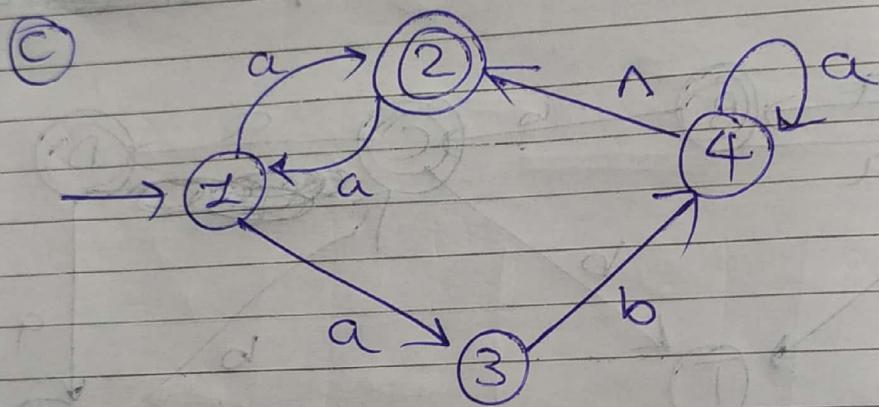
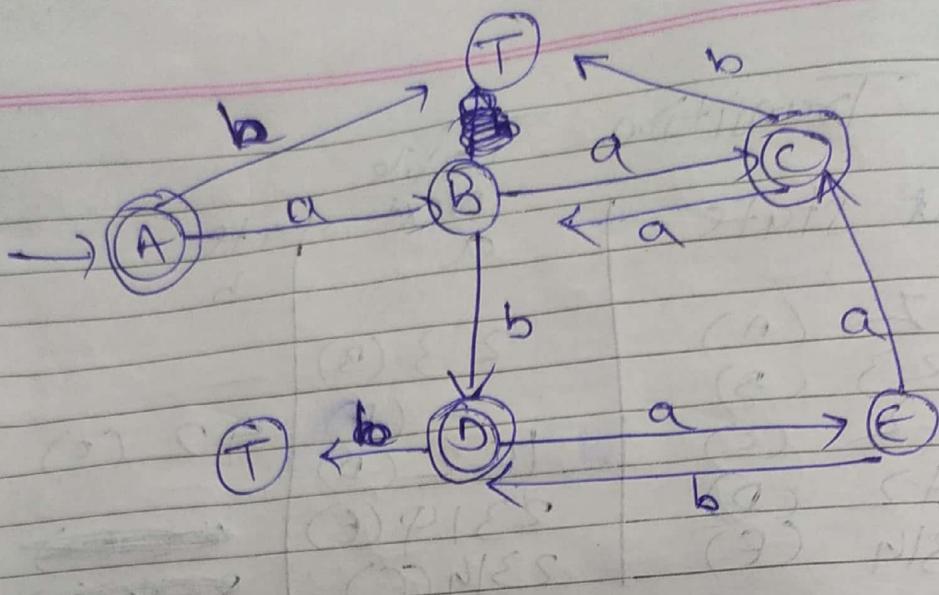
NFA - A Transition Table

current state	next state		
	a	b	λ
1	2	-	5
2	3	4	-
3	-	1	5
4	5	-	-
5	-	-	-

$$\begin{aligned}
 \lambda\text{-closure } (1) &= \{ 2, 3, 5 \} \\
 \lambda\text{-closure } (2) &= \{ 1, 2 \} \\
 \lambda\text{-closure } (3) &= \{ 1, 3 \} \\
 \lambda\text{-closure } (4) &= \{ 5 \} \\
 \lambda\text{-closure } (5) &= \{ 5 \}
 \end{aligned}$$

DFA Transition Table

current state	a	b
0 1 (A)	2 (B)	-
1 2 (B)	51 (C)	31 (D)
0 51 (C)	2 (B)	-
0 31 (D)	24 (E)	-
24 (E)	51 (C)	31 (D)



NFA -> Transition Table

current state	Next state		
	a	b	n
1	2,3	-	-
2	1	-	-
3	-	4	-
4	4	-	2

\cap -closure (1) = Σ^*

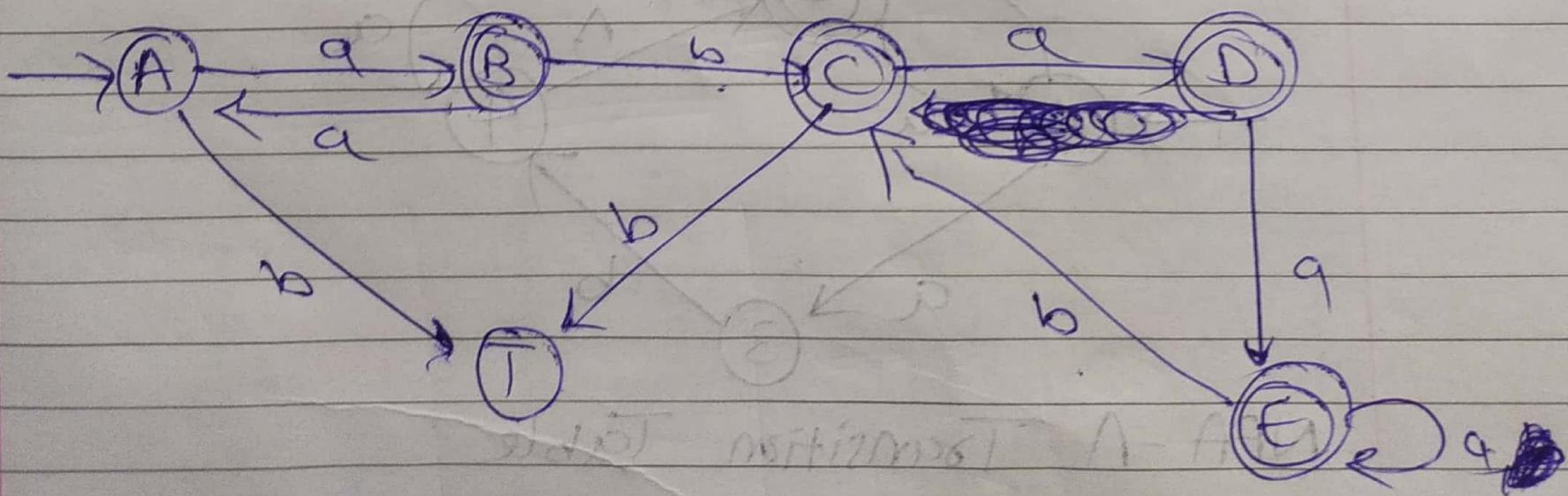
\cap - " (2) = Σ^*

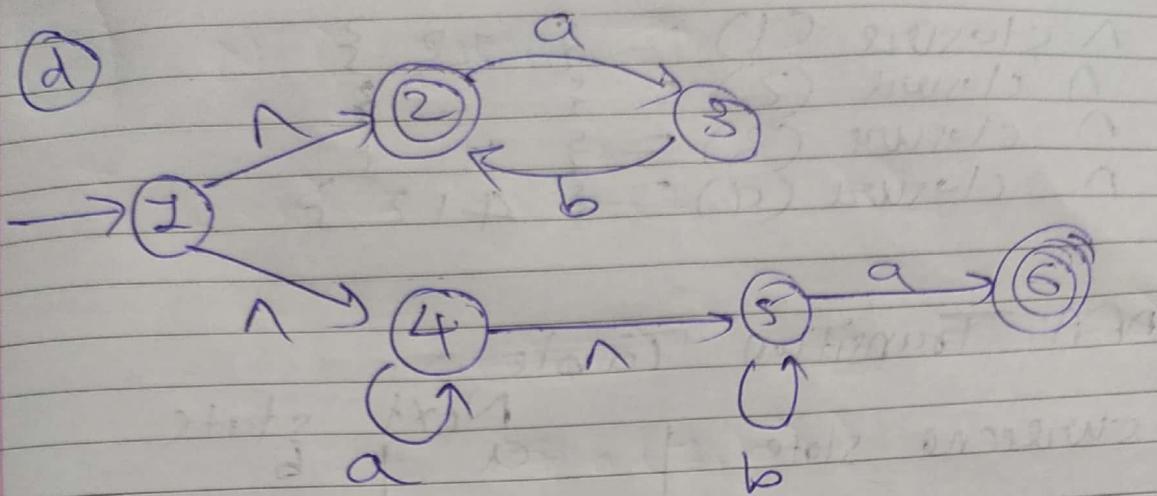
\cap - " (3) = Σ^*

\cap - " (4) = Σ^*

DFA Transition Table

Current state	Next state	
	a	b
z (A)	23 (B)	-
① 23 (B)	z (A)	42 (C)
② 42 (C)	142 (D)	-
③ 142 (D)	2314 (E)	-
④ 2314 (E)	2314 (E)	42 (C)





NFA - A Transition Table

current state	a	b	λ
1	-	-	2, 4
2	-	-	-
3	-	-	2
4	-	-	5
5	-	-	-
6	-	-	-

λ -closure (1) = { 1, 2, 4, 5 }

" (2) = { 2 }

" (3) = { 3 }

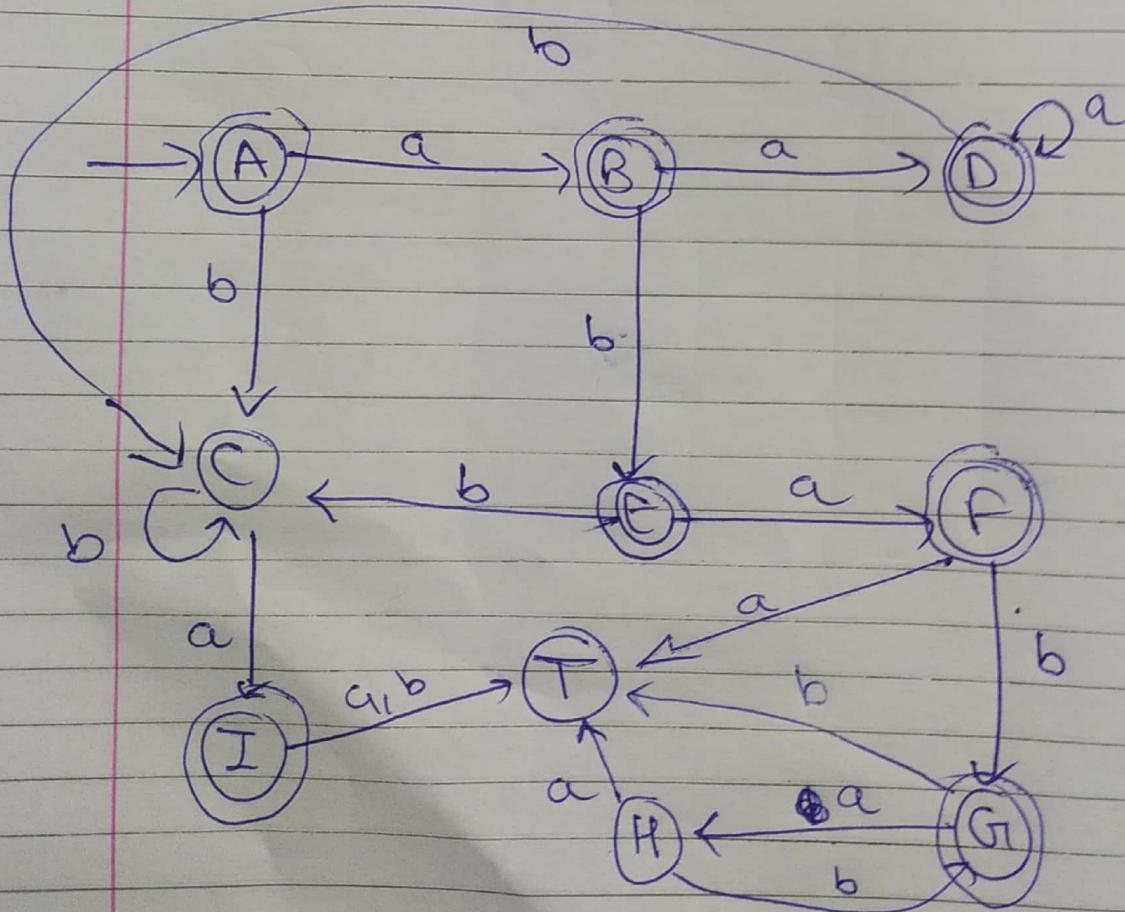
" (4) = { 4, 5 }

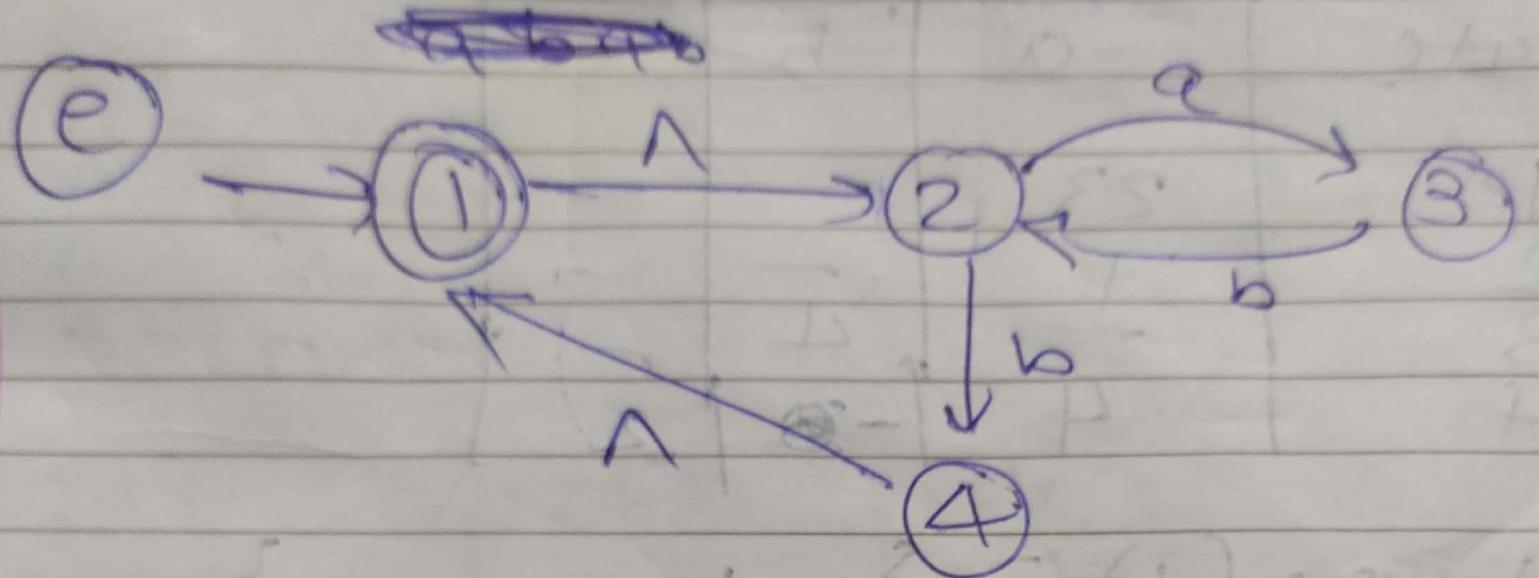
" (5) = { 5 }

" (6) = { 6 }

DFA Transition Table

Current State	a	b
① 124S (A)	3456(B)	5(C)
② 3456 (B)	456(D)	25(E)
③ 5 (C)	6 (I)	5 (C)
④ 456 (D)	456 (D)	5 (C)
⑤ 25 (E)	36 (F)	5 (C)
⑥ 36 (F)	-	2 (G)
⑦ 2 (G)	3 (H)	-
⑧ 3 (H)	-	2 (G)
⑨ 6 (I)	-	-





NFA — △ Transition Table

current state	a	b	△
0	1	-	2
1	2	-	-
2	3	2	-
3	-	-	1
4	-	-	-

$$\begin{aligned}
 \text{closure } (1) &= \{ 12 \} \\
 \text{closure } (2) &= \{ 2 \} \\
 \text{closure } (3) &= \{ 3 \} \\
 \text{closure } (4) &= \{ 412 \}
 \end{aligned}$$

DFA Transition Table

current state	a	b
0 12 (A)	3 (B)	412 (C)
0 3 (B)	2 (D)	
0 412 (C)	412 (C)	
2 (D)	412 (C)	

