CS & IT ENGINEERING

Theory of Computation

Finite Automata:

Doubt Clearing Session

Lecture No. 20

By- DEVA Sir

TOPICS TO BE COVERED

01 Regulars and Non Regulars

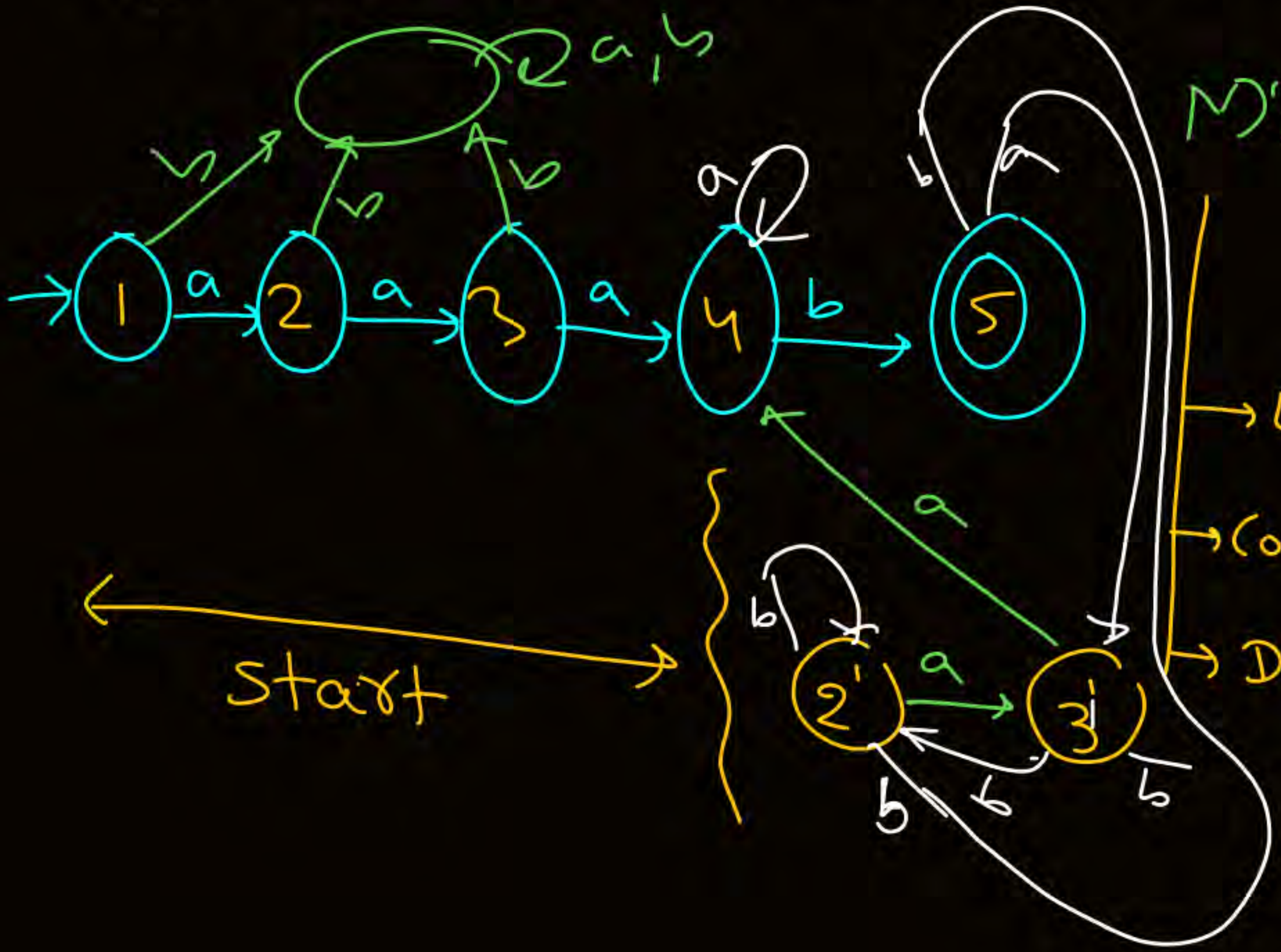
02 FA Construction

03 Regular Grammar

04 Regular Expressions

05 Conversions

① Starts with aaa & ends with aab



Min = aaab

ends

Starts

→ Len = 4 ⇒ 5 states

→ Common = 2 ⇒ 2 states

→ Dead ⇒ 1 state

8 states

aaaaab

8 states

Note: starts with aaab and ends with abba

Important: aaababba

→ 8 len

+2

9 states + 1 Dead

$\boxed{\text{10 States}}$

min = aaabba

ends

starts

→ min len = 6 ⟹ 7 states

→ Common symbols = 2 ⟹ 2 states

→ Dead ⟹ 1 state

10 state

Starts with aaa & ends with bbb

min = $\underbrace{aaa}\overbrace{bbb}$

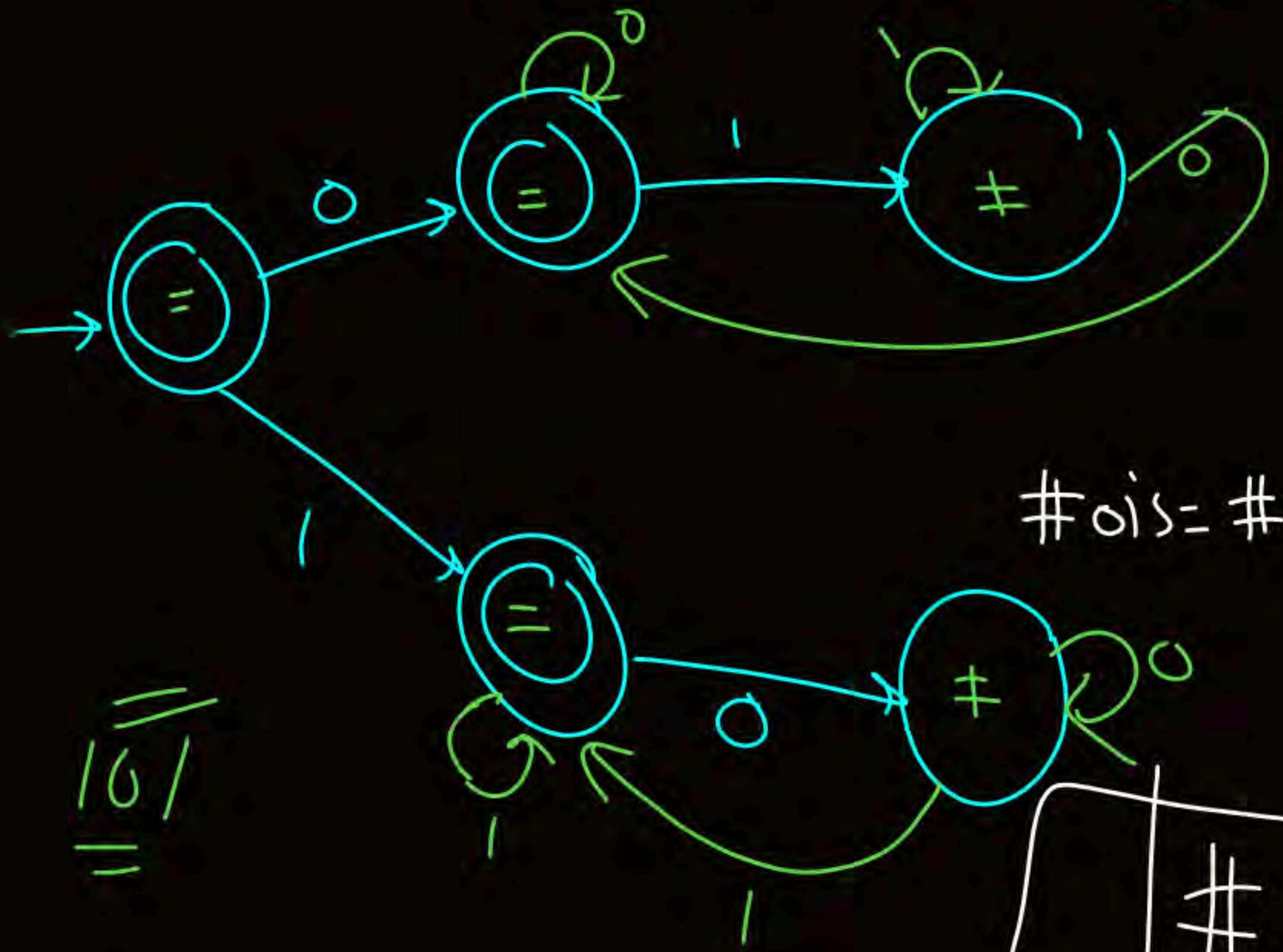
→ min len = 6 ⟹ 7 states

→ Dead ⟹ 1 state

8 states

② $L = \{ w \mid w \in \{0,1\}^*, \underbrace{\#_{01}(w) = \#_{10}(w)}\}$

$= \{ \varepsilon, 0, 1, 00, \cancel{01}, \cancel{10}, 11, 000, \cancel{001}, 010, \cancel{011}, \dots \}$



101

w → $\#01's = \#10's$ | $\#01's = \#10's + 1$ | $\#10's = \#01's + 1$

011111

0101

100000

$$\boxed{\left| \#10's - \#01's \right| \leq 1}$$

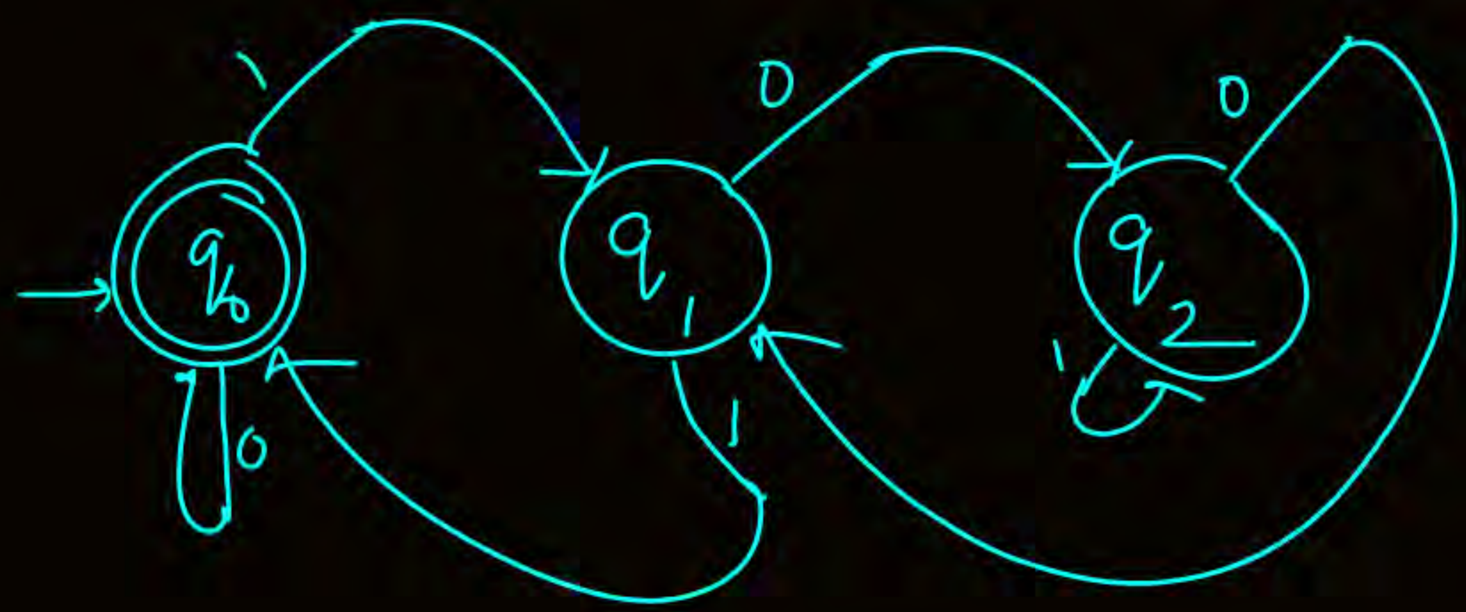
$$\#_a(\omega)$$

$$n_a(\omega)$$

no. of a's in ω

③ $\{ w \mid w \in \{0,1\}^*, \text{Decimal}(w) \text{ is div by } \boxed{3} \}$

$q_0 \quad q_1 \quad q_2$



Bin	Dec	remainder
101	5	2
100	4	1
0	0	$0 \Rightarrow q_0$
1	1	$1 \Rightarrow q_1$
10	2	$2 \Rightarrow q_2$
11	3	$0 \Rightarrow q_0$

	0	1
$\rightarrow q_0$	q_0	q_1
q_1	q_2	q_0
q_2	q_1	q_2

Note: 1) $\{ w \mid w \in \{0,1\}^*, \text{ Dec}(w) \text{ is div by } \underbrace{1024}_{2^{10}} \}$

$L =$

$2^{10} \Rightarrow$ 11 states (10+1)

2) $\{ w \mid w \in \{0,1\}^*, \text{ Dec}(w) \text{ is div by } \underbrace{64}_{2^6} \} \Rightarrow$ 7 states

$L = \epsilon + 0 + 00 + 000 + 0000 + 00000 +$

$1^*000000$

div by 1024

$$b^{12} \quad b^{11} \quad b^{10} \quad \boxed{\underbrace{b^9 \; b^8 \; b^7 \; b^6 \; b^5 \; b^4 \; b^3 \; b^2 \; b^1 \; b^0}_{\text{there should be no 1 from } b^9 \text{ to } b^0}}$$

ends with ten 0's $\Rightarrow$ 11 states

Note: 1) $\{ w \mid w \in \{0,1,2\}^*, \ Dec(w) \text{ is div by } 81 \}$

$81 \times 3^3 \quad 81 \times 3^2 \quad 81 \times 3 \quad 3 \times 3$

$$\underbrace{3^{7} \ \ 3^{6} \ \ 3^5 \ \ 3^4}_{0} \ \ \underbrace{3^3 \ \ 3^2 \ \ 3^1 \ \ 3^0}_{0}$$

there should be only zero's

$3^4 = 81$

ends with 4 zero's

$\Downarrow$

5 states

$$L = \varepsilon + 0 + 00 + 000 + (1+2)^* 0000$$

4 Why $(ww^R)^R \neq w^{Rev} w$?

$\Downarrow$

$|\Sigma| > 1$

need not be equal

over 1 symbol

$(ww^R)^R = w^{Rev} w$

$(ww)^R = ww$

$ww = ww$

$$\boxed{\begin{aligned} w &= ab \\ w^R &= ba \end{aligned}}$$

$(ab.ba)^R \neq baab$

$oba \neq baab$

5

$$S \rightarrow AB$$
$$A \rightarrow a$$
$$B \rightarrow b$$

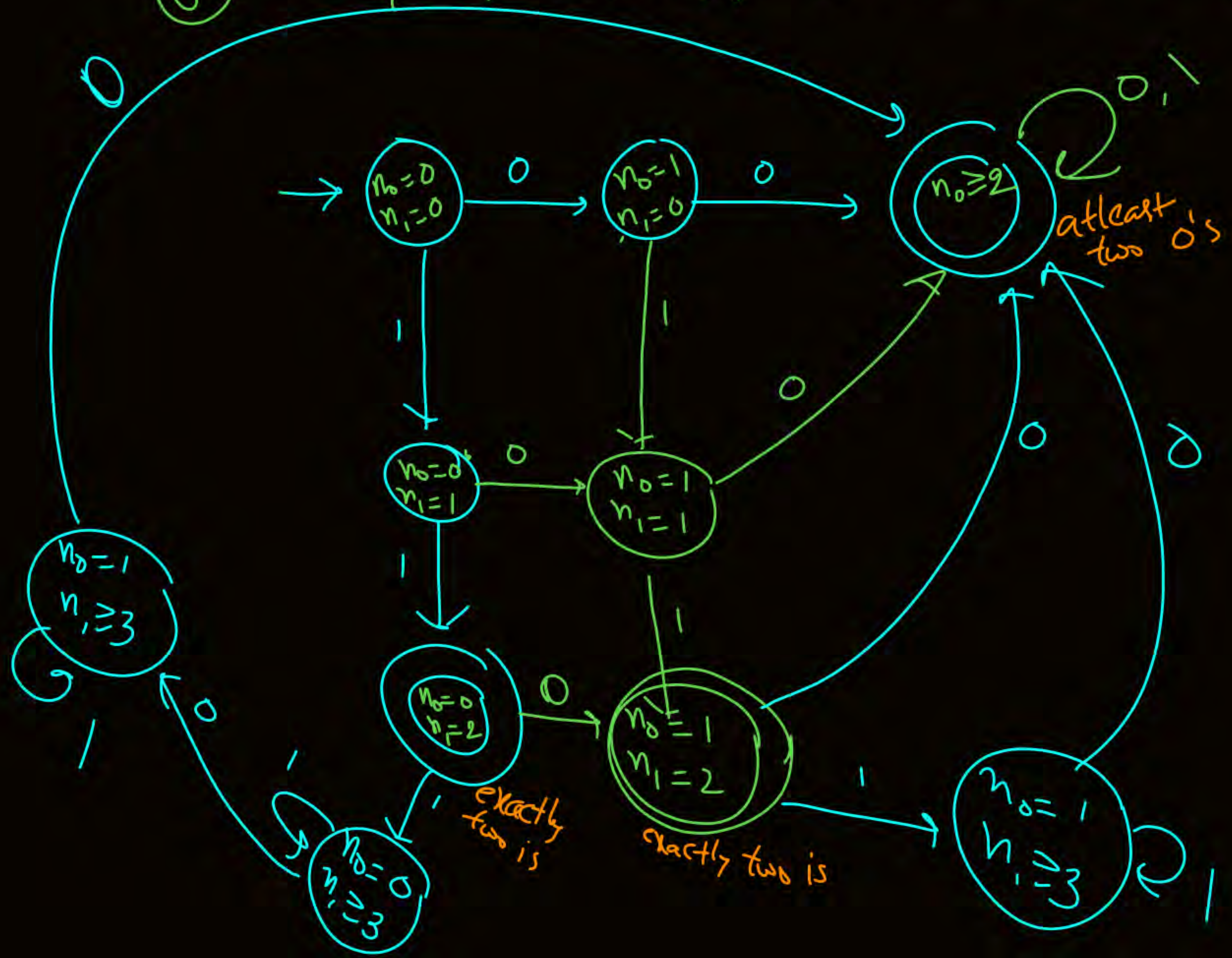
$L = \{ab\}$

Fin lang

reg lang

Not Regular Grammar

⑥ $\{ w \mid w \in \{0,1\}^*,$ w has atleast 2 zero's, or exactly 2 one's $\}$



min = 00
11

Pumping Lemma for Regular Languages

- The pumping lemma is a property of a regular language.
- It is used to prove the non-regularity of certain languages.
- Regular languages always satisfy the pumping lemma.
- If Pumping Lemma satisfied for any language, then it need not be regular.
- This is only useful for infinite languages since all finite languages are regular.

prove reg ✓

prove non reg ✓

→ P.L. is used to prove regular or non regular

→ P.L. is not used to check language is reg or not

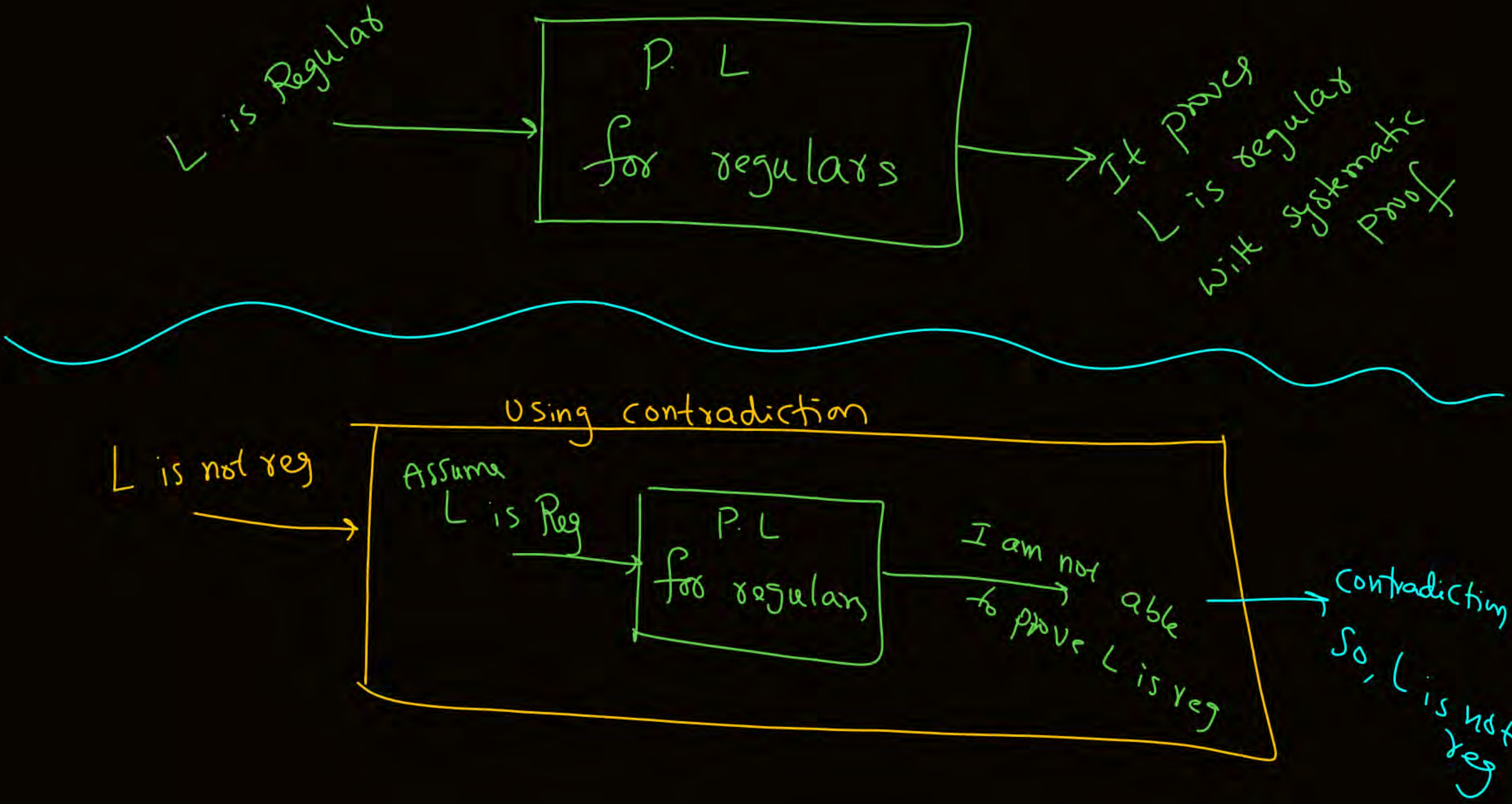
→ If you know that lang is reg then you can use P.L. to prove it.

→ " " " " notreg " " " "

Every finite lang is Regular

Some inf languages are regular.

Some inf languages are not regular.


L is Regular
P. L
for regulars
It proves
L is regular
with systematic
proof
Using contradiction
L is not reg
Assume
L is Reg
P. L
for regulars
I am not able
to prove L is reg
contradiction
So, L is not
reg

Some loop definitely exist

$\forall i \geq 0,\ xy^iz \in L$

L is inf
and
L is reg

min 3 length
$\boxed{|w| \geq \text{no. of states}}$ string to detect loop

3 states

(don't consider dead state)

Pumping Lemma for Regular Languages

min no. of states (P) in DFA (ignore dead state)

L is regular language iff

- FA with p states holds string w belongs to L.
- For all strings w belongs to L with |w|>=p
- There exist division of w into three parts: w=xyz such that the following conditions are held:

$w \in L$

$|w| \geq P$

- $|x.y| \leq p$ (length of x + length of y is $\leq p$)
- $|y|! = 0$ (x,z can be null, but y cannot be null, and the length of $y \geq 1$)
- $xy^iz \in L \; \forall \, i \geq 0$

L is Reg

P is no. of states in FA

~~$\forall$~~ choose $w \in L$

$|w| \geq P$

$w = x.y.z$

$x \; y \; z$

$|xy| \leq P$

$|y| \neq 0$

$\forall i, \; xy^iz \in L$

L is Reg

P → no. of states in min FA

Choose w, $|w| \geq P$
$\forall w \in L$

w → x y z

i) $|xy| \leq P$
ii) $|y| \neq 0$ [$y \neq \varepsilon$]

$\forall i \geq 0$, $xy^iz \in L$ iff L is Regular

Pumping Constant ≥ no. of states in FA

x and z can be ε

may be $|x| = 0$, $|z| = 0$ } depends on your requirements

① $L = ab(a+b)^*$

$|w| \geq 3$

$|w| \geq 3$

L is Reg $\longrightarrow$ $\boxed{\text{P.L}}$ $\longrightarrow$ L is Regular with proof

$w = abab$

$ab \quad a \quad b$

$ab(a)^i b \in L$

$\forall i$

$w = aba \in L$

$x \quad y \quad z$

$ab \quad a \quad \varepsilon$

$\forall i,\ ab(a)^i \varepsilon \in L$

$x\,y^i\,z$

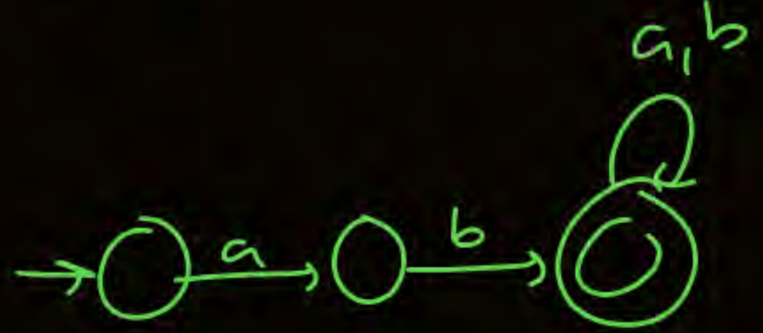
$i=0 \Rightarrow ab$

$i=1 \Rightarrow aba$

$i=2 \Rightarrow abaa$

$\vdots$

$\in L$



3 ✓
4 ✓
5 ✓
6 ✓
7 ✓

3 states

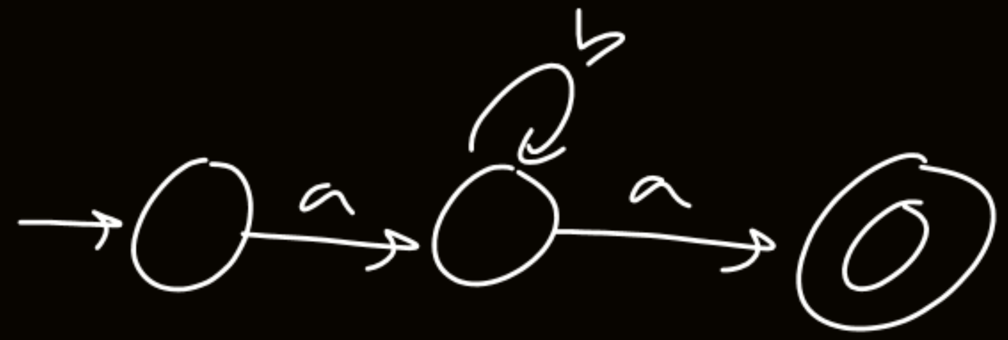
$|w| \geq 3$
(P)

Which of the following can be pumping constant?

~~A)~~ 2   ~~C)~~ 7

~~B)~~ 5   ~~D)~~ 1

② $L = ab^*a$



Choose w with min 3 length

3 states

$|w| \geq 3$

$w = abba$

$|w| = 4 \geq 3$

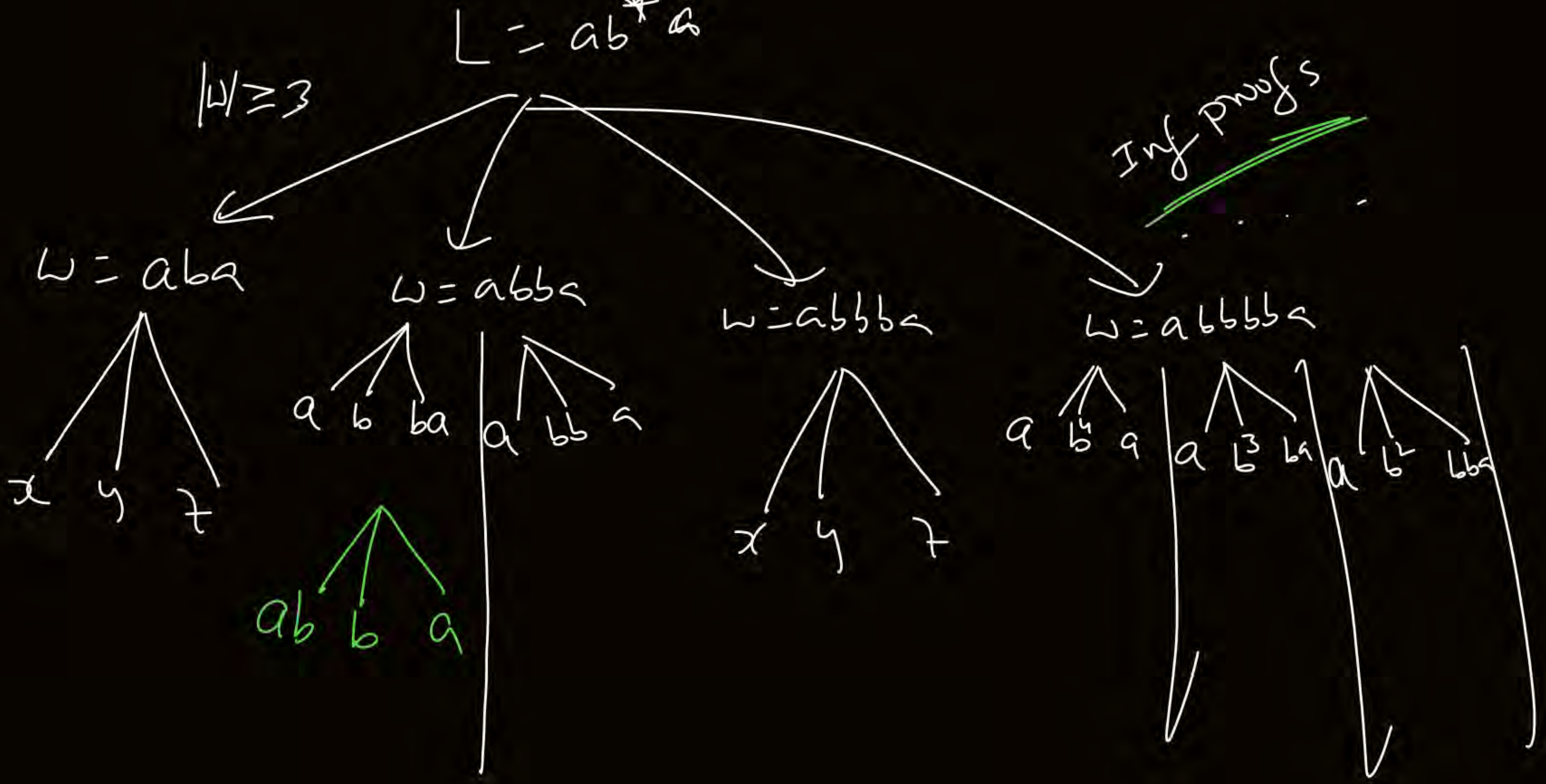
x	y	z	
a	b	ba	$\Rightarrow a(b)^i ba \in L$
a	bb	a	$\Rightarrow a(bb)^i a \in L$

Don't choose this way

abba

ab	a	ε

X


L = ab*a
|w| ≥ 3
Inf proofs
w = aba
x y z
w = abba
a b ba
a bb a
ab b a
w = abbba
x y z
w = abbbba
a b^4 a
a b^3 ba
a b^2 bba

P.L. also can be used to prove non regulars using contradiction.

L is not reg

$\Downarrow$

Assume L is Reg

$\downarrow$

$\boxed{\text{P.L}}$

$\downarrow$

I am not able to prove L is Regular

$\Downarrow$ Contradiction occurs.

L is not regular

$L = a^n b^n$ is not reg [given]

Step 1: Assume L is Reg

Step 2: Choose $w = a^n b^n$

Step 3: Divide w into 3 parts

$$a^n b^n \to a^{n-1} \quad a \quad b^n$$

Step 4: $\forall i \geq 0 \quad a^{n-1} a^i b^n \in L$ iff L is reg

$i=0 \Rightarrow a^{n-1} b^n \notin L$, L is not reg

$L = a^n b^n$

$w = aaabbb$

$\varepsilon \quad aaabbb \quad \varepsilon$

xy^iz

$\varepsilon\,(aaabbb)^i\,\varepsilon$

$i=0 \Rightarrow\ \in L$

$i=1 \Rightarrow\ \in L$

$i=2 \Rightarrow aaabbbaaabbb \notin L$

$\Downarrow$

$w = aaabbb$

$a^2 \quad a \quad b^3$

$\forall i \geq 0 \quad a^2 a^i b^3 \in L$ iff L is Reg

Some i, $a^2 a^i b^3 \notin L$, so L is not reg

$i=0 \Rightarrow a^2 b^3 \notin L$

Pumping Lemma for Regular Languages

Reg → P.L for reg → L is Reg

Given

with proof

Non-Reg → Assume L is Reg → P.L for reg → I am not able to prove

Given

Some i, $xy^iz \notin L$ → L is not reg

Using Contradiction

Myhill Nerode Theorem

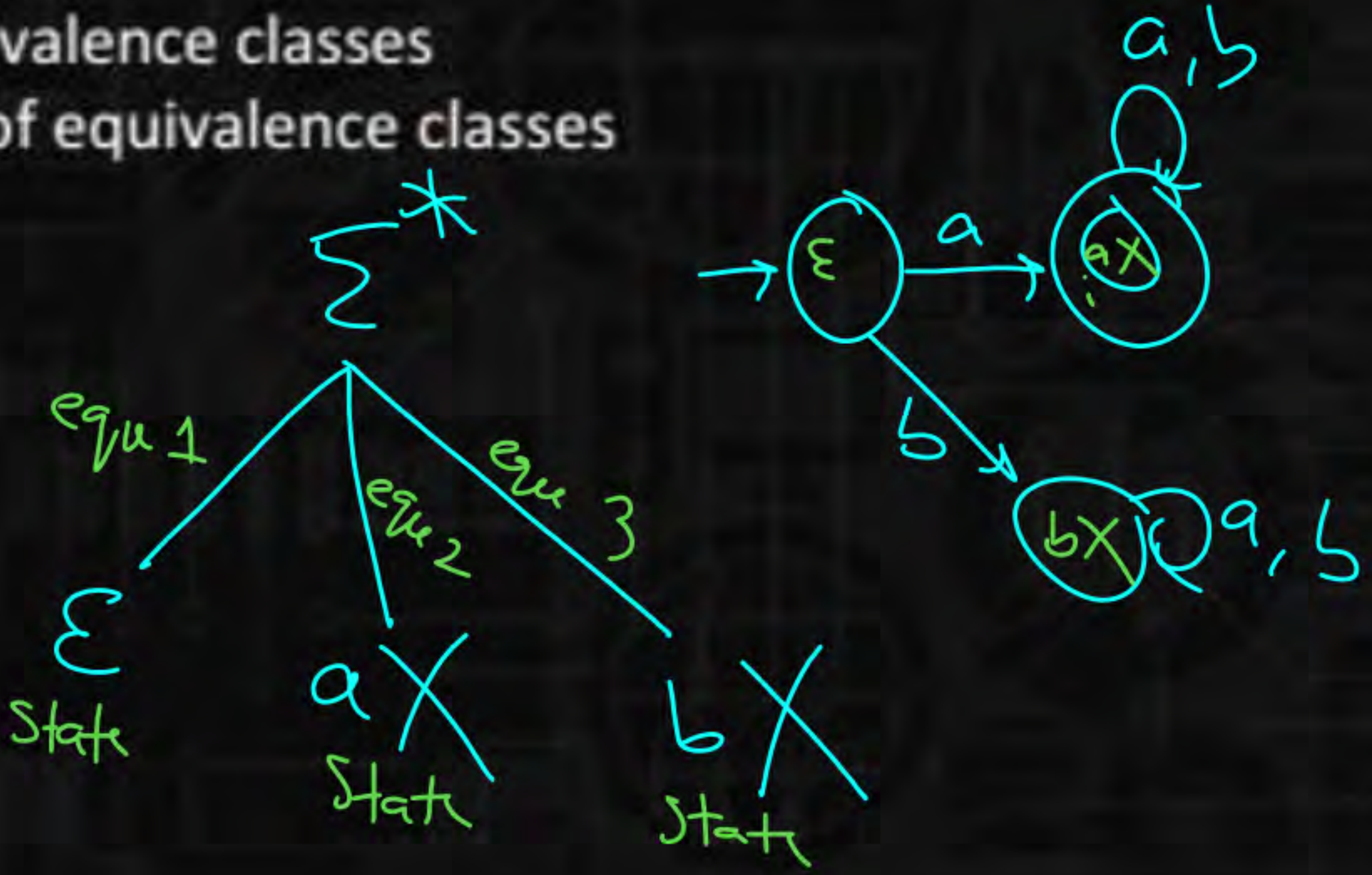
A language is regular if and only if $\equiv_L$ partitions Σ^* into finitely many equivalence classes. If $\equiv_L$ partitions Σ^* into n equivalence classes, then a minimal DFA recognizing L has exactly **n** states.

If L is $\boxed{\text{non regular}}$ then L never satisfies Myhill Nerode Theorem.
If L is regular then L has $\boxed{\text{finite number}}$ of equivalence classes
If L is non regular then L has infinite number of equivalence classes

$$L = a(a+b)^*$$

$\Downarrow$

3 equivalence classes



$L = a(a+b)^*$

$\Downarrow$

3 states in min DFA

P_1, P_2, P_3

Σ^*

P_1 | P_2 | P_3
ε | aX | bX

I) $P_1 \cup P_2 \cup P_3 = \Sigma^*$

II) $P_1 \cap P_2 = \phi$

$P_1 \cap P_3 = \phi$

$P_2 \cap P_3 = \phi$

Languages

(81) $\{w \mid w \in \{0,1\}^*,\ n_0(w) = n_1(w)\}$ ⇒ Not reg

(82) $\{w \mid w \in \{0,1\}^*,\ n_{00}(w) = n_{11}(w)\}$ ⇒ Not reg

***(83) $\{w \mid w \in \{0,1\}^*,\ n_{\boxed{01}}(w) = n_{\boxed{10}}(w)\}$ ⇒ Regular (Try DFA for this)

(84) $\{w \mid w \in \{0,1\}^*,\ n_{00}(w) = n_{01}(w)\}$ ⇒ Not regular

***(85) $\{w \mid w \in \{0,1\}^*,\ n_{\boxed{001}}(w) = n_{\boxed{100}}(w)\}$ ⇒ Regular

***(86) $\{w \mid w \in \{0,1\}^*,\ n_{110}(w) = n_{011}(w)\}$

(87) $\{w \mid w \in \{0,1\}^*,\ n_{000}(w) = n_{111}(w)$ ⇒ Not regular

(88) $\{w \mid w \in \{0,1\}^*,\ n_{\boxed{001}}(w) \leq n_{\boxed{100}}(w)\}$ ⇒ Regular

(89) $\{w \mid w \in \{0,1\}^*,\ n_{\boxed{001}}(w) \neq n_{\boxed{100}}(w)\}$

(90) $\{w \mid w \in \{0,1\}^*,\ n_{00}(w) \neq n_{11}(w)\}$ ⇒ Not reg

H.W.

(45) $S \rightarrow aS \mid A$ $\Rightarrow a^* b^* c^*$

$A \rightarrow bA \mid B$ $= b^* c^*$

$B \rightarrow cB \mid \varepsilon$ c^*

(46) $S \rightarrow aS \mid bS \mid cS \mid d$

(47) $S \rightarrow aA \mid \varepsilon$ $\Rightarrow S \rightarrow abS \mid \varepsilon$

$A \rightarrow bS$

$L(A) = bS$

$L = (ab)^*$

(48) $S \rightarrow aA$

$A \rightarrow bS \mid \varepsilon$

(49) $S \rightarrow aA \mid aB \mid aD$

$A \rightarrow bA \mid \varepsilon$

$B \rightarrow cB \mid \varepsilon$

$D \rightarrow dD \mid \varepsilon$

(50) $S \rightarrow aS \mid A$

$A \rightarrow \# B$

$B \rightarrow aB \mid \varepsilon$

Q

Let $L = \{ w \in (0 + 1)^* \mid w$ has even number of 1s$\}$, i.e., L is the set of all bit strings with even number of 1s. Which one of the regular expressions below represents L? [2010: 2 Marks]

(A) $(0^*10^*1)^*$

(B) $0^*(10^*10^*)^*$

(C) $0^*(10^*1)^*0^*$

(D) $0^*1(10^*1)^*10^*$

Q

Let P be a regular language and Q be a context- free language such that $Q \subseteq P$. (For example, let P be the language represented by the regular expression $p^* q^*$ and Q be $\{p^n q^n \mid n \in N\}$. Then which of the following is ALWAYS regular?

[2011: 1 Mark]

(A) $P \cap Q$

(B) $\Sigma^* - P$

(C) $P - Q$

(D) $\Sigma^* - Q$

Q

Given the language $L = \{ab, aa, baa\}$, which of the following strings are in L^*?

1.	abaabaaabaa	2.	aaaabaaaa
3.	baaaaabaaaab	4.	baaaaabaa

[2012: 1 Mark]

(A) 1, 2 and 3

(B) 2, 3 and 4

(C) 1, 2 and 4

(D) 1, 3 and 4

Q

Consider the languages $L_1 = \phi$ and $L_2 = \{a\}$. Which one of the following represents $L_1L_2^* \cup L_1^*$?

[2013: 1 Mark]

(A) $\{\varepsilon\}$

(B) ϕ

(C) a^*

(D) (ε, a)

Q

The length of the shortest string NOT in the language (over $\Sigma = \{a, b\}$) of the following regular expression is __________.

$$a^*b^*(ba)^*a^*$$

[2014-Set3: 1 Mark]

Q

Consider alphabet $\Sigma = \{0, 1\}$, the null/empty string λ and the sets of strings X_0, X_1 and X_2 generated by the corresponding non-terminals of a regular grammar. X_0, X_1 and X_2 are related as follows:

[2015-Set2: 2 Marks]

$$X_0 = 1X_1$$
$$X_1 = 0X_1 + 1X_2$$
$$X_2 = 0X_1 + \{\lambda\}$$

Which one of the following choices precisely represents the strings in X_0?

(A) $10\,(0^* + (10)^*)1$

(B) $10\,(0^* + (10)^*)^*1$

(C) $1(0 + 10)^*1$

(D) $10\,(0 + 10)^*1 + 110\,(0 + 10)^*1$

Q

Which one of the following regular expressions represents the language: *the set of all binary strings having two consecutive 0s and two consecutive 1s*?

[2016-Set1: 1 Mark]

(A) $(0 + 1)^*0011(0 + 1)^* + (0 + 1)^*1100(0 + 1)^*$

(B) $(0 + 1)^*(00(0 + 1)^*11 + 11(0 + 1)^*00)(0 + 1)^*$

(C) $(0 + 1)^*00(0 + 1)^* + (0 + 1)^*11(0 + 1)^*$

(D) $00(0 + 1)^*11 + 11(0 + 1)^*00$

Q

Which one of the following regular expression represents the set of all binary strings with an odd number of 1's?

[2020: 1 Mark]

A. $(0^*10^*10^*)^*0^*1$

B. $10^*(0^*10^*10^*)^*$

C. $((0+1)^*1(0+1)^*1)^*10^*$

D. $(0^*10^*10^*)^*10^*$

Q

Which of the following regular expressions represents(s) the set of all binary numbers that are divisible by three? Assume that the strings ϵ is divisible by three. [2021-Set2-MSQ: 2 Marks]

(A) $(0^*(1(01^*0)^*1)^*)$

(B) $(0 + 1(01^*0)^* 1)^*$

(C) $(0 + 11 + 10(1 + 00)^*01)^*$

(D) $(0 + 11 + 11(1 + 00)^*00)^*$

Q

Let w be any string of length n in $\{0, 1\}^*$. Let L be the set of all substrings of w. What is the minimum number of states in a non-deterministic finite automaton that accepts L?

[2010: 2 Marks]

A. $n-1$

B. n

C. $n+1$

D. 2^{n-1}

Q

The lexical analysis for a modern computer language such as Java needs the power of which one of the following machine models in a necessary and sufficient sense?

[2011: 1 Marks]

(A) Finite state automata

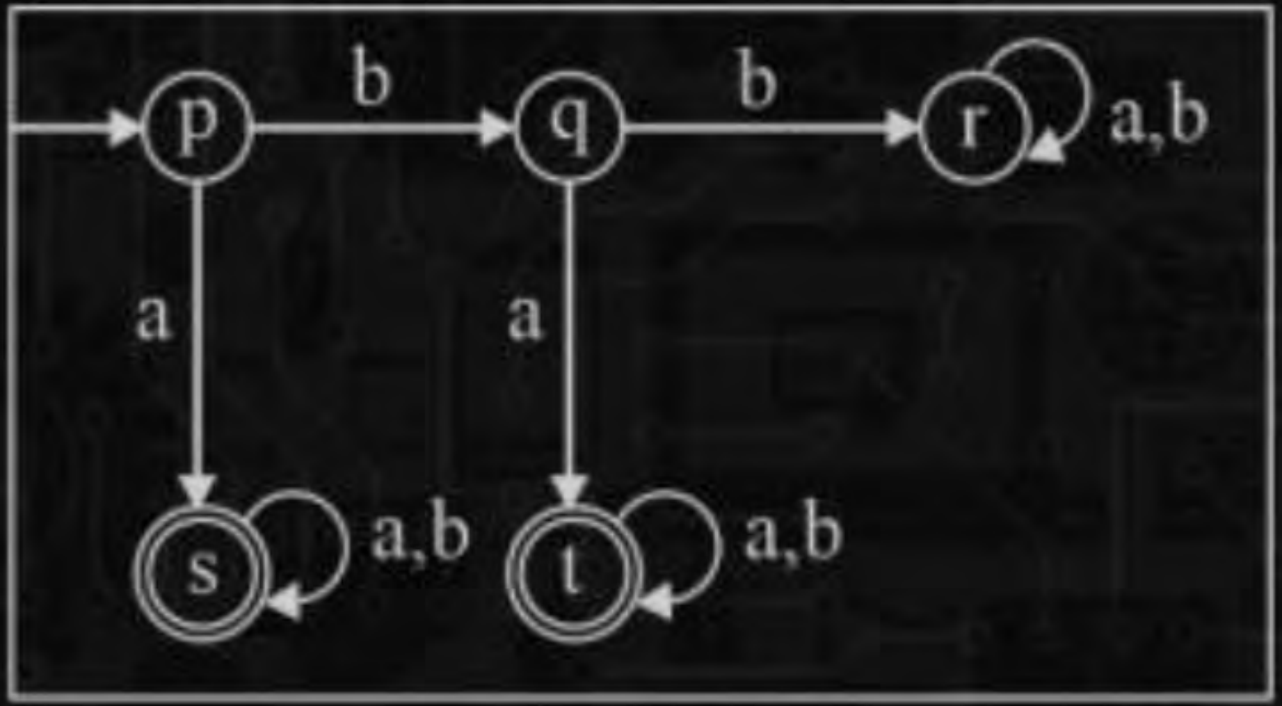
(B) Deterministic pushdown automata

(C) Non-deterministic pushdown automata

(D) Turing machine

Q

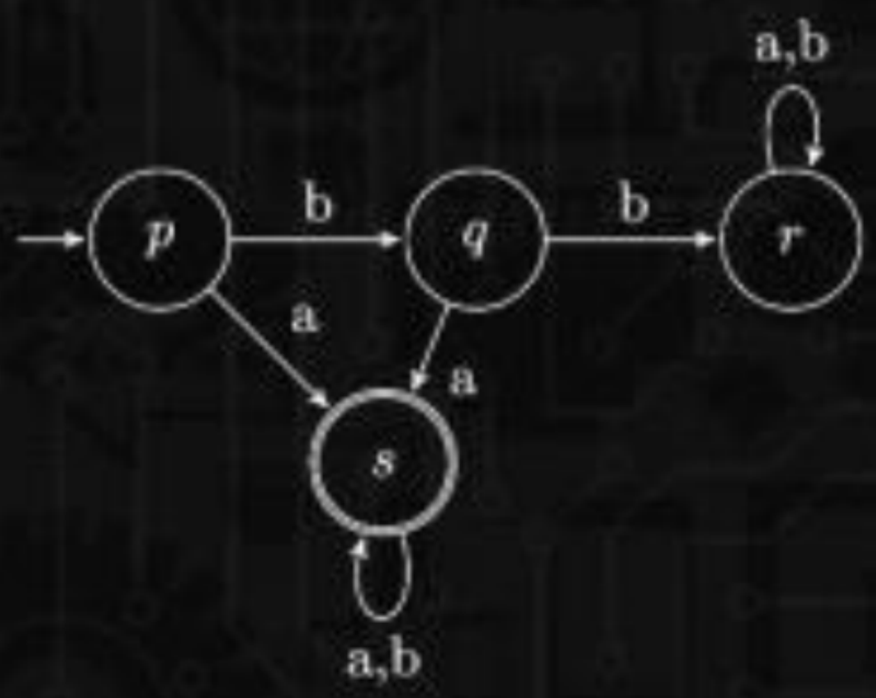
A deterministic finite automaton (DFA) D with alphabet $\Sigma = \{a, b\}$ is given below:



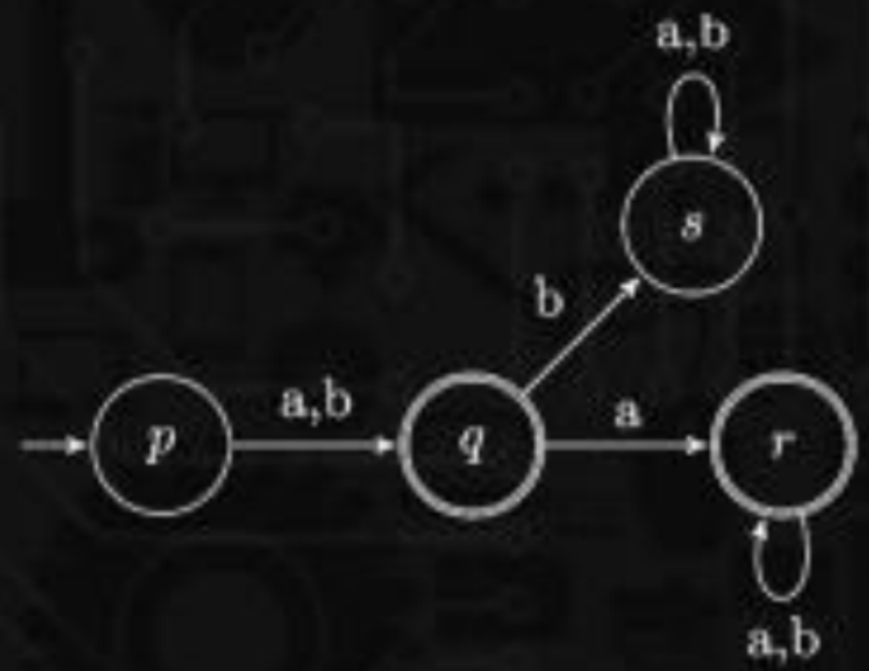
Which of the following finite state machines is a valid minimal DFA which accepts the same language as D?

[2011:2 Mark]

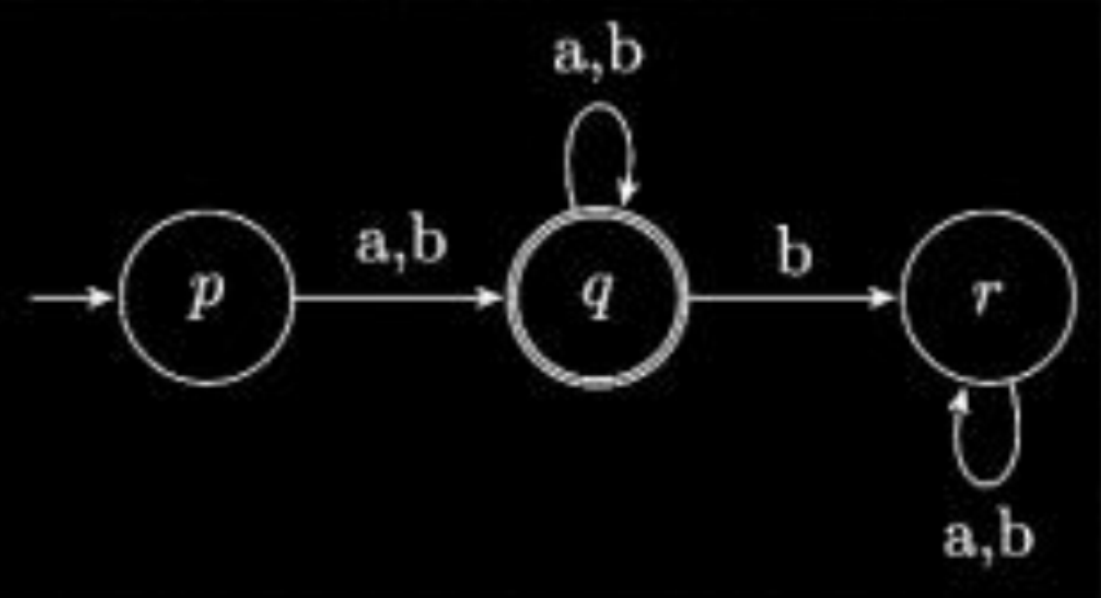
A



B



C

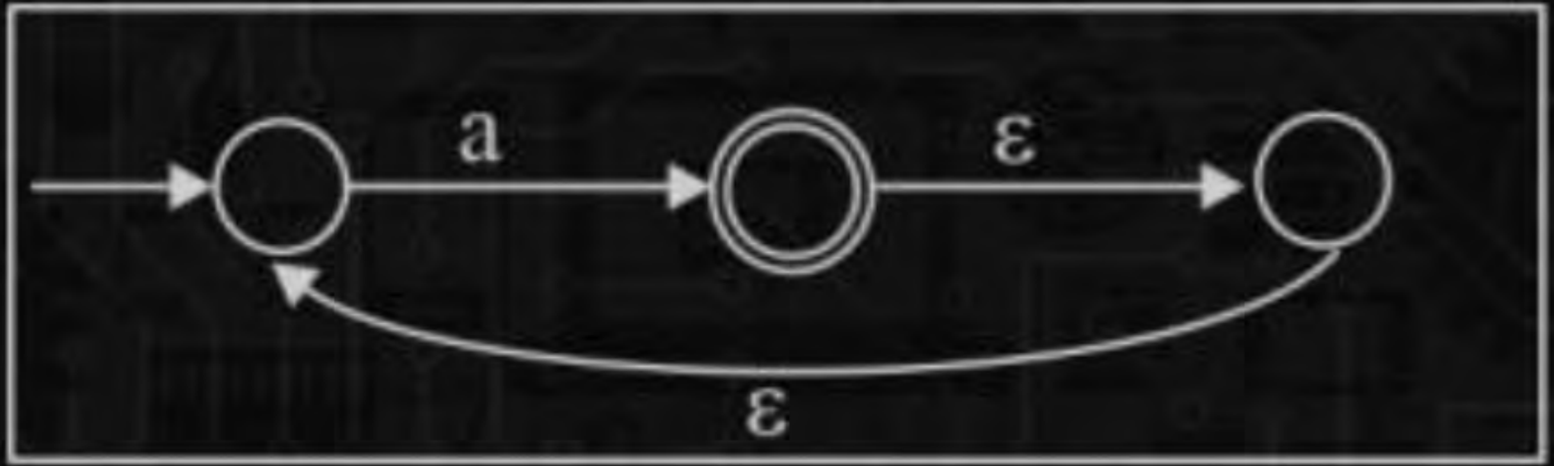


D

Q

What is the complement of the language accepted by the NFA shown below? Assume $\Sigma = \{a\}$ and ε is the empty string.

[2012: 1 Mark]



(A) $\varnothing$

(B) $\{\varepsilon\}$

(C) a^*

(D) $\{a, \varepsilon\}$

Q

Consider the set of strings on $\{0, 1\}$ in which, every substring of 3 symbols has at most two zeros. For example, 001110 and 011001 are in the language, but 100010 is not. All strings of length less than 3 are also in the language. A partially complete DFA that accepts this language is shown below.

The missing arcs in the DFA are? [2012: 2 Marks]

A

	00	01	10	11	q
00	1	0			
01				1	
10	0				
11			0		

B

	00	01	10	11	q
00		0			1
01		1			
10				0	
11		0			

C

	00	01	10	11	q
00		1			0
01		1			
10			0		
11		0			

D

	00	01	10	11	q
00		1			0
01				1	
10	0				
11			0		

Q

Consider the DFA A given below:

Which of the following are **FALSE**?

1. Complement of L(A) is context-free.
2. $L(A) = L((11^*0 + 0)(0 + 1)^*0^*1^*)$
3. For the language accepted by A, A is the minimal DFA.
4. A accepts all strings over $\{0, 1\}$ of length at least 2.

[2013: 1 Mark]

(A) 1 and 3 only

(B) 2 and 4 only

(C) 2 and 3 only

(D) 3 and 4 only

Q

Which one of the following is TRUE? [2014-Set1: 1 Mark]

(A) The language $L = \{a^n b^n \mid n \geq 0\}$ is regular.

(B) The language $L = \{a^n \mid n \text{ is prime}\}$ is regular.

(C) The language $L = \{w \mid w \text{ has } 3k + 1 \text{ b's for some } k \in \mathbb{N} \text{ with } \Sigma = \{a, b\}\}$ is regular.

(D) The language $L = \{ww \mid w \in \Sigma^* \text{ with } \Sigma = \{0, 1\}\}$ is regular.

Q

Which of the regular expressions given below represent the following DFA?

I. $0^*1(1 + 00^*1)^*$

II. $0^*1^*1 + 11^*0^*1^*$

III. $(0 + 1)^*1$

[2014-Set1: 2 Mark]

A. I and II only

B. I and III only

C. II and III only

D. I, II, and III

Q

If $L_1 = \{a^n \mid n \geq 0\}$ and $L_2 = \{b^n \mid n \geq 0\}$, consider

I. $L_1 \cdot L_2$ is a regular language

II. $L_1 \cdot L_2 = \{a^n b^n \mid n \geq 0\}$

Which one of the following is CORRECT?

[2014-Set2: 1 Mark]

(A) Only I

(B) Only II

(C) Both I and II

(D) Neither I nor II

Q

Let $L_1 = \{\omega \in \{0,1\}^* \mid \omega$ has at least as many occurrences of (110) 's as (011)'s$\}$. Let $L_2 = \{\omega \in \{0,1\}^* \mid \omega$, has at least as many occurrences of (000)'s as (111)'s$\}$. Which one of the following is TRUE?

[2014-Set2: 2 Marks]

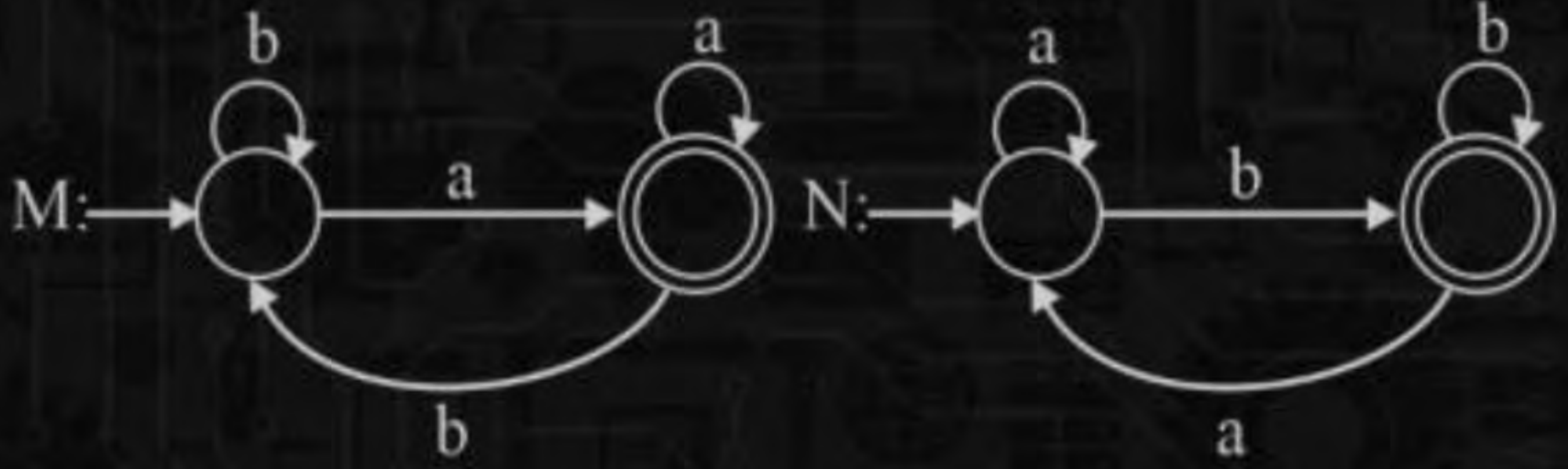
A) L_1 is regular but not L_2

B) L_2 is regular but not L_1

C) Both L_1 and L_2 are regular

D) Neither L_1 nor L_2 are regular

Q



Consider the DFAs M and N given above. The number of states in a minimal DFA that accepts the language $L(M) \cap L(N)$ is

[2015-Set1: 2 Marks]

Q

The number of states in the minimal deterministic finite automaton corresponding the regular expression $(0 + 1)^*(10)$ is______.

[2015-Set2: 2 Marks]

Q

Let L be the language represented by the regular expression $\Sigma^* 0011 \Sigma^*$ where $\Sigma = \{0, 1\}$.
What is the minimum number of states in a DFA that recognizes L'(complement of L)? [2015-Set3: 1 Mark]

A 4

B 5

C 6

D 8

Q

Which of the following languages is/are regular?

L_1: $\{wxw^R \mid w, x \in \{a, b\}^*$ and $|w|, |x| > 0\}$ w^R is the reverse of string w}

L_2: $\{a^n b^m \mid m \neq n$ and $m, n \geq 0\}$

L_3: $\{a^p b^q c^r \mid p, q, r \geq 0\}$

[2015-Set2: 2 Marks]

A) L_1 and L_3 only

B) L_2 only

C) L_2 and L_3 only

D) L_3 only

Q

The number of states in the minimum sized DFA that accepts the language defined by the regular expression $(0 + 1)^* (0 + 1) (0 + 1)^*$ is ______.

[2016-Set2: 1 Mark]

Q

Consider the following two statements:

I. If all states of an NFA are accepting states then the language accepted by the NFA is Σ^*.

II. There exists a regular language A such that for all language B, $A \cap B$ is regular.

[2016-Set2: 2 Marks]

Which one of the following is CORRECT

(A) Only I is true

(B) Only II is true

(C) Both I and II are true

(D) Both I and II are false

Q

Consider the language L given by the regular expression $(a + b)^*b(a + b)$ over the alphabet $\{a, b\}$. The smallest number of states needed in a deterministic finite-state automaton (DFA) accepting L is ____.

[2017-Set1: 2 Marks]

Q

The minimum possible number of states of a deterministic finite automaton that accepts the regular language $L = \{w_1 a w_2 \mid w_1, w_2 \in \{a, b\}^*, |w_1| = 2, |w_2| \geq 3\}$ is _____.

[2017-Set2: 1 Mark]

Q

Let δ denote the transition function and $\hat{\delta}$ denote the extended transition function of the ε-NFA whose transition table is given below:

[2017-Set2: 2 Mark]

δ	ϵ	a	b
$\rightarrow q_0$	$\{q_2\}$	$\{q_1\}$	$\{q_0\}$
q_1	$\{q_2\}$	$\{q_2\}$	$\{q_3\}$
q_2	$\{q_0\}$	ϕ	ϕ
q_3	ϕ	ϕ	$\{q_2\}$

The $\hat{\delta}(q_2, aba)$ is

A. ϕ

B. $\{q_0, q_1, q_3\}$

C. $\{q_0, q_1, q_2\}$

D. $\{q_0, q_2, q_3\}$

Q

Let N be an NFA with n states. Let k be the number of states of a minimal DFA which is equivalent to N. Which one of the following is necessarily true?

[2018: 1 Mark]

(A) $k \geq 2^n$

(B) $k \geq n$

(C) $k \leq n^2$

(D) $k \leq 2^n$

Q

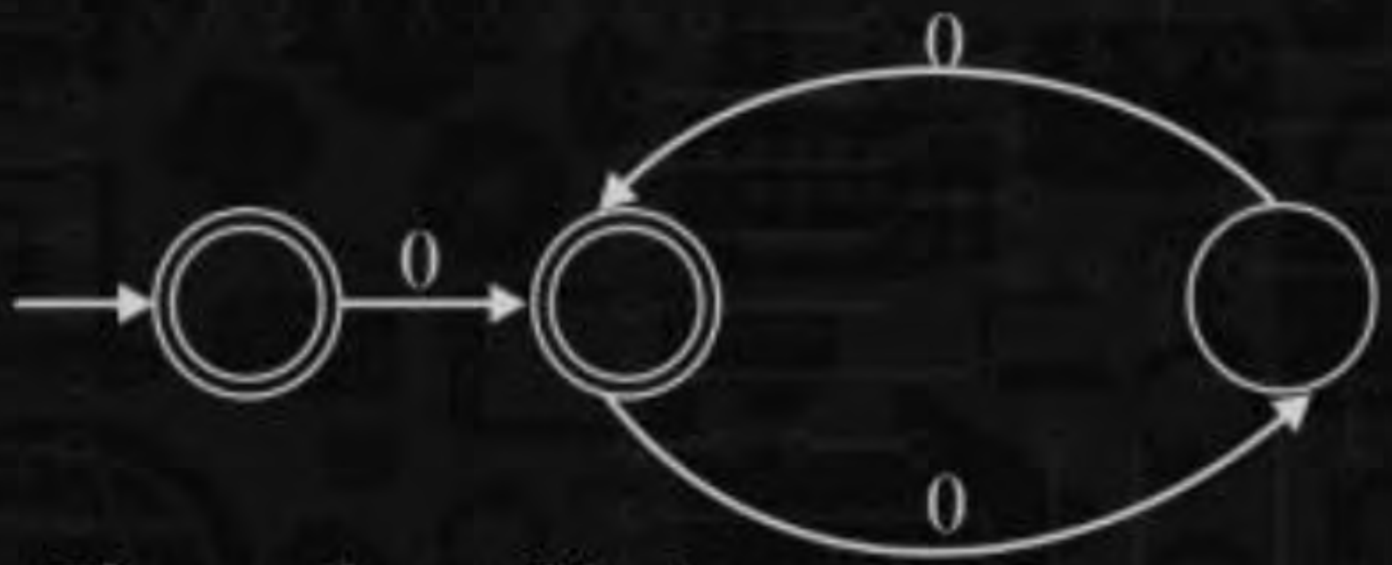
Given a language L, define L^i as follows:

$L^0 = \{\in\}$

$L^i = L^{i-1} \cdot L$ for all $i > 0$

The order of a language L is defined as the smallest k such that $L^k = L^{k+1}$.

Consider the language L_1 (over alphabet 0) accepted by the following automaton



The order of L_1 is ____.

[2018: 2 Marks]

Q

For $\Sigma = \{a, b\}$, let us consider the regular language $L = \{x \mid x = a^{2+3k} \text{ or } x = b^{10+12k}, k \geq 0\}$. Which one of the following can be a pumping length (the constant guaranteed by the pumping lemma) for L?

[2019: 1 Mark]

(A) 9

(B) 24

(C) 3

(D) 5

Q

Let Σ be the set of all bijections from $\{1, \ldots, 5\}$ to $\{1, \ldots, 5\}$, where *id* denotes the identity function, i.e. $id(j) = j, \forall j$.

Let $\circ$ denote composition on functions.

For a string $x = x_1 x_2 \ldots x_n \in \Sigma^n, n \geq 0$, let $\pi(x) = x_1 \circ x_2 \circ \ldots \circ x_n$.

Consider the language $L = \{x \in \Sigma^* \mid \pi(x) = id\}$.

The minimum number of states in any DFA accepting L is _____.

[2019: 2 Marks]

Q

Consider the following language:

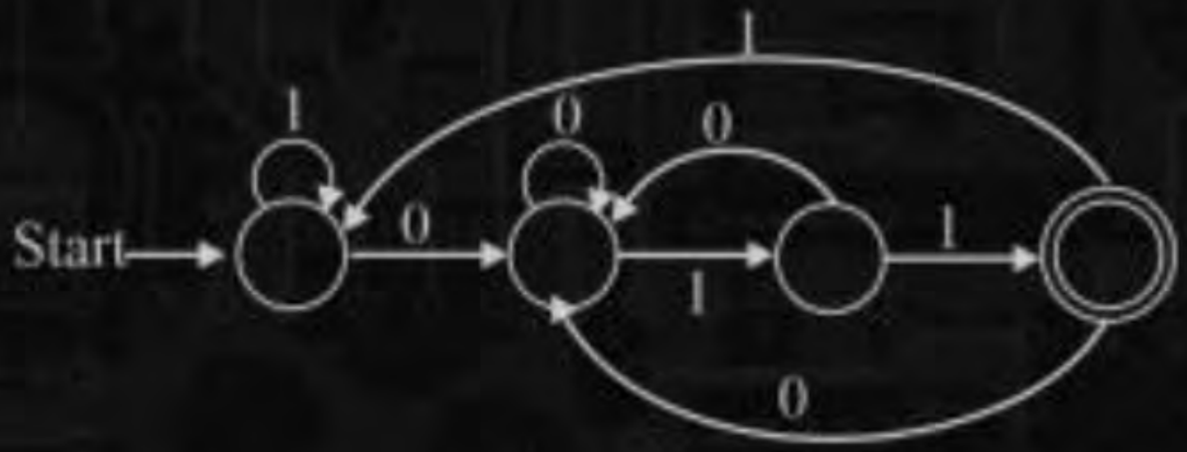
L = $\{x \in \{a, b\}^* \mid$ number of a's in x is divisible by 2 but not divisible by 3$\}$

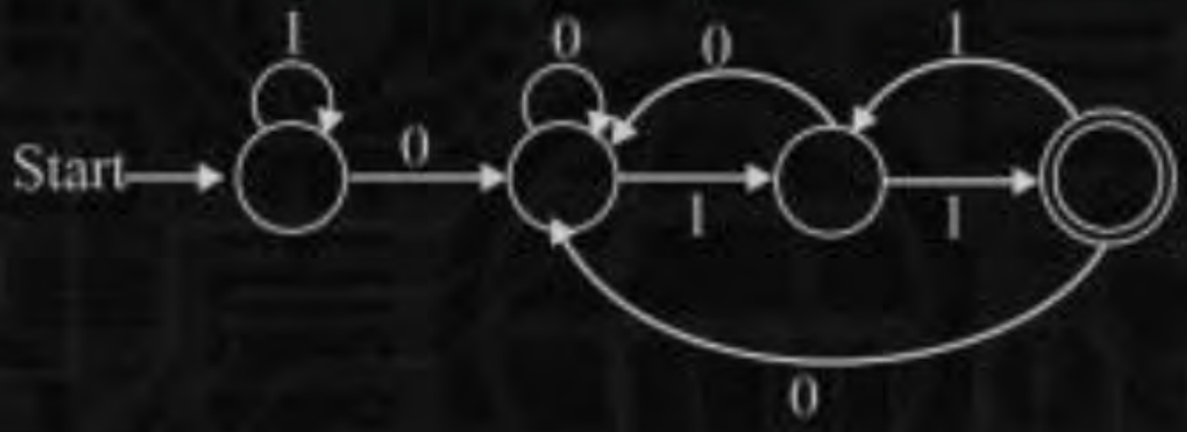
The minimum number of states in a DFA that accepts L is ____.

[2020: 2 Marks]

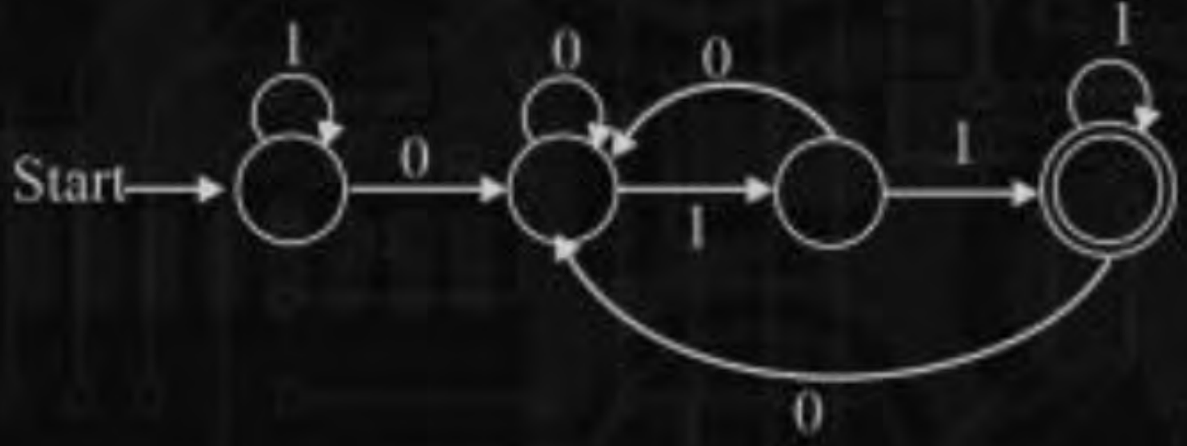
Q

Consider the following language:
$L = \{w \in \{0, 1\}^* \mid w \text{ ends with the substring } 011\}$.
Which one of the following deterministic finite automata accepts L? [2021-Set1: 2 Marks]

(A)


(B)


(C)


(D)


Q

Let $L \subseteq \{0, 1\}^*$ be an arbitrary regular language accepted by a minimal DFA with k states. Which one of the following languages must necessarily be accepted by a minimal DFA with k states?

[2021-Set2: 1 Marks]

(A) $\{0, 1\}^* - L$

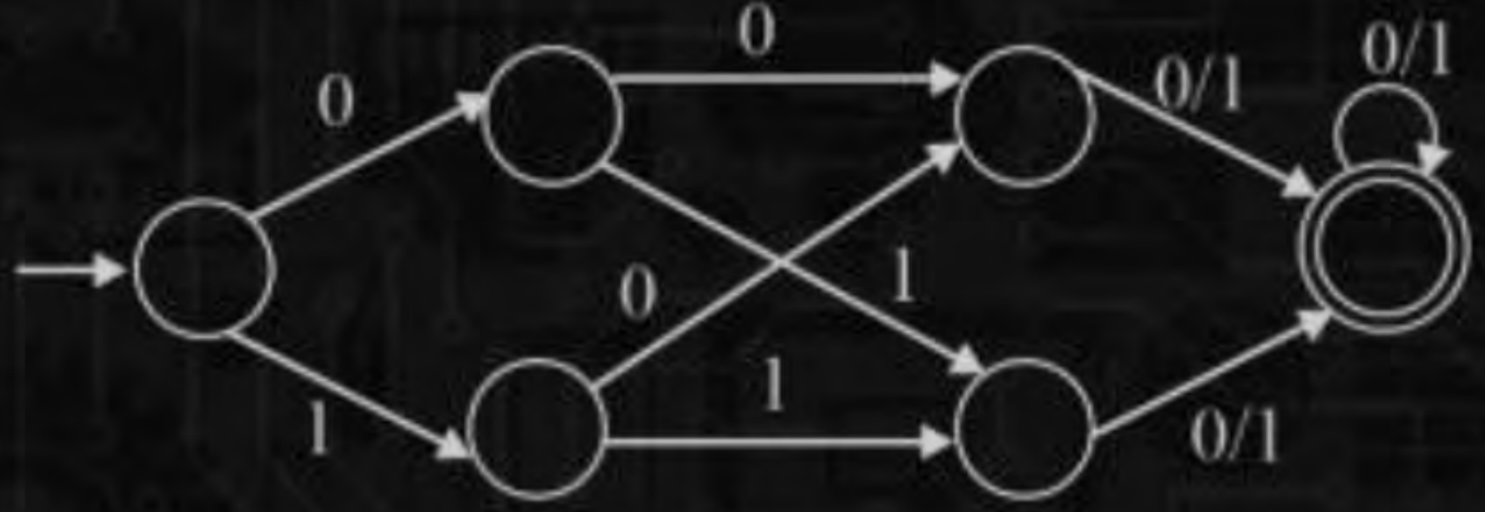
(B) $L \cup \{01\}$

(C) $L \cdot L$

(D) $L - \{01\}$

Q

Consider the following deterministic finite automaton (DFA).



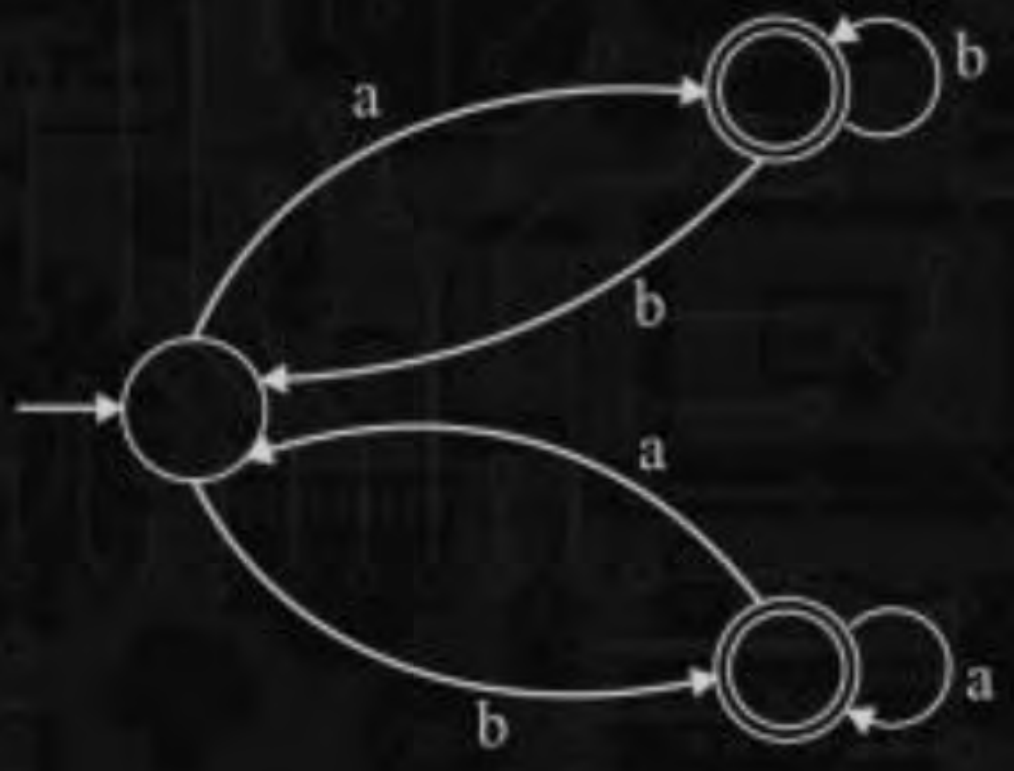
The number of strings of length 8 accepted by the above automaton is____.

[2021-Set2: 1 Marks]

Q

Which one of the following regular expressions correctly represents the language of the finite automaton given below?

[2022: 1 Mark]



(A) $ab^*bab^* + ba^*aba^*$

(B) $(ab^*b)^*ab + (ba^*a)^*ba^*$

(C) $(ab^*b + ba^*a)^*(a^* + b^*)$

(D) $(ba^*a + ab^*b)^*(ab^* + ba^*)$

Summary

- Doubts
- P.L.
- equ classes


THANK YOU GW
SOLDIERS !