CS & IT ENGINEERING

Theory of Computation

Lecture No.- 03

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Topics to be Covered

Topic Regular Expression

Topic Finite Automata

Topic Regular Grammar

Regular Languages : MCQ

$L_2/L_1 = 10/0^* = \{10/\varepsilon, 10/0, 10/00, \ldots\}$

$10 \quad 1 \quad \phi$

$= \{10, 1\}$

Q29. Suppose $L_1 = 0^*$

$L_2 = 10$

$L_3 = \{1^m 0^m \mid m \geq 0\}$

$L_4 = 1^*$

$[(L_2/L_1) - L_4] = \{10, 1\} - 1^* = \{10\}$

If $L_5 = ((L_2/L_1) - L_4) - \bar{L}_3$ Then, the language L_5 will be:

$\{10\} - \bar{L}_3 = \{10\}$

A ϕ

B $\{10\}$

C 1^*

D $\{\in\}$

$$L_3 = 1^n 0^n$$

$$= \{\varepsilon, \boxed{10}, 1100, 111000, 11110000, \ldots\}$$

$$\overline{L_3} = \underbrace{(0+1)^* - L_3}$$

$$\{10\} - \overline{L_3} = \{10\}$$

$10\% = 1$

$$uv/v = u$$

$10.\varepsilon/\varepsilon = 10$

$\square\square/\square = 1$

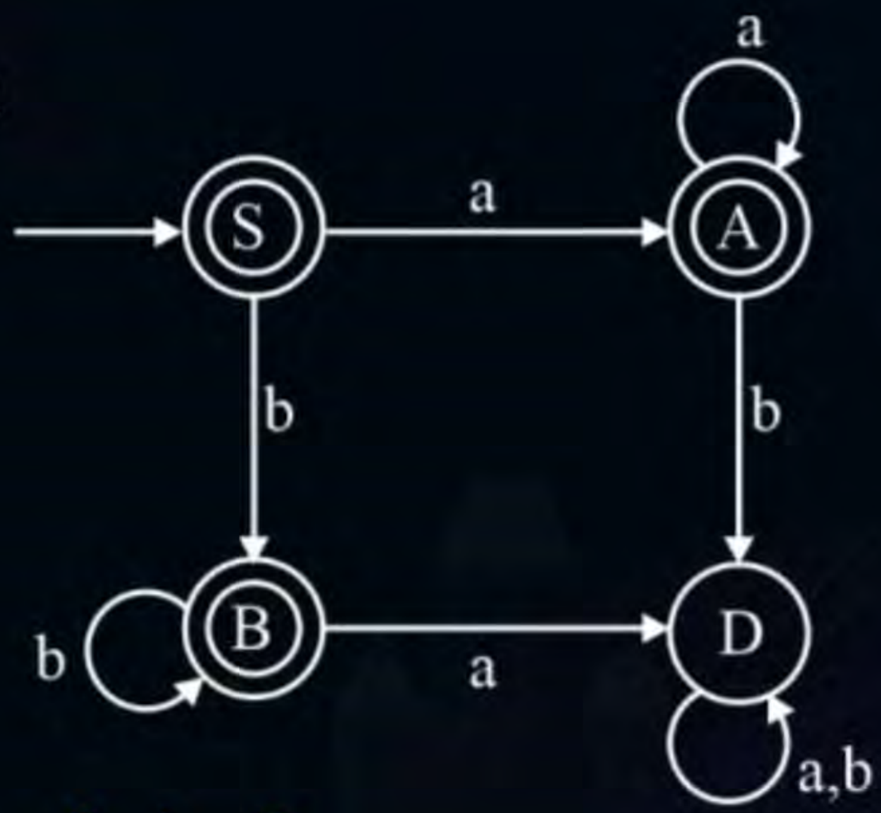
$\varepsilon.\square\square/\square\square = \varepsilon$

Regular Languages : NAT

Q30. The number of states in the minimum sized DFA that accepts the language defined by the regular expression (00 + 111)* is_____.

Regular Languages : MSQ

Q31. Which of the following regular expression is equivalent to the finite automaton?



A $(a + b)^* a + (a + b)^* b$

B $a^* + b^*$

C $\in + a^+ + b^+$

D $\in + aa^* + bb^*$

$S + A + B$

$\varepsilon + aa^* + bb^*$

Regular Languages : NAT

Q32. Consider grammar G:

$a^7 S a^7 \Rightarrow a^{14}$

G:

$S \rightarrow aSa \mid a \mid b \mid \in$

Let $L = \{w \mid w \in L(G) \text{ and } |w| = 14\}$

Then how many strings are possible in L? ____.

1

Regular Languages : MCQ

Q33. (a) Consider two languages L_1 and L_2 on = $\Sigma\{a, b\}$.

$L_1 = \{aa, ab\}$ and $L_2 = \{aa, ab, abab\}$ then which of the following is true?

$L_1 \subset L_2$

A $L_1^* \subset L_2^*$

B $L_2^* \subset L_1^*$

C $L_1^* = L_2^*$

D $(L_1 \cup L_2)^* = (a+b)^*$

$L_1^* = (aa+ab)^*$

$L_2^* = (aa+ab+abab)^* = L_1^*$

Regular Languages : MCQ

Q33. (b) Consider two languages L_1 and L_2 on = $\Sigma\{a, b\}$.

$L_1 = \{aa, ab\}$ and $L_2 = \{aa, ab, abab\}$ then which of the following is true?

A $L_1^* \subseteq L_2^*$

B $L_2^* \subseteq L_1^*$

C $L_1^* = L_2^*$

D $(L_1 \cup L_2)^* = (a+b)^*$

Regular Languages : MSQ

Q34. Which of the following is/are correct regular expression for L = {starting and ending with a}?

with

$L = \{w \mid w \in \{a,b\}^*, w \text{ starting \& ending with } a\}$

$= \{a, aa, aaa, aba, \ldots\}$

A. $a\,(a + b)^*\,a$ → a is missing

B. $a\,(a + b)^*\,a + a$

C. $a\,(a + bb^*a)^*$ — a ✓, aa ✓, aaa ✓, aba ✓

D. $a\,(a + bb^*a + aa)^*$

$a(a+b)^*a \Rightarrow \min = aa$

It can't generate all strings

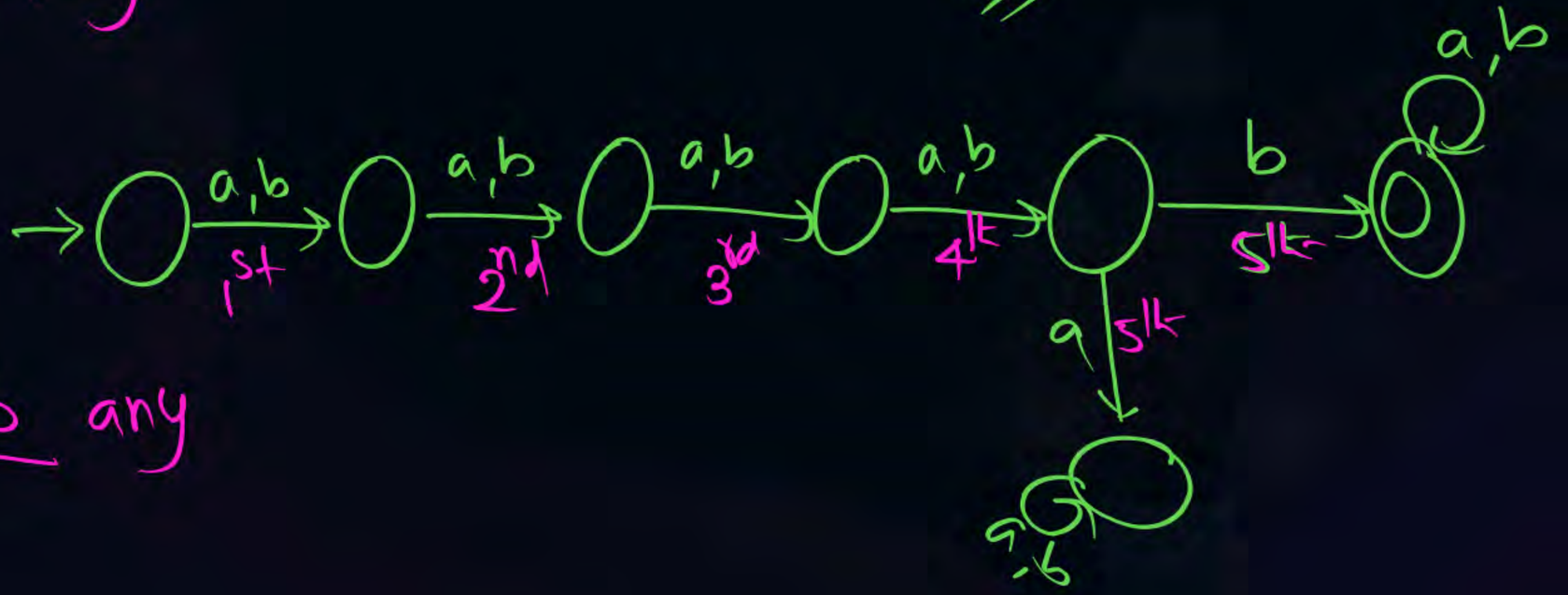
a is missing

Regular Languages : NAT

Q35. How many minimal states are needed in DFA to design a language over $\Sigma = \{a, b\}$ where 5^{th} symbol from left is b?____

$(a+b)^4 b (a+b)^*$

$5 + 2 = 7$



a/b a/b a/b a/b b any

Regular Exp & FA : NAT

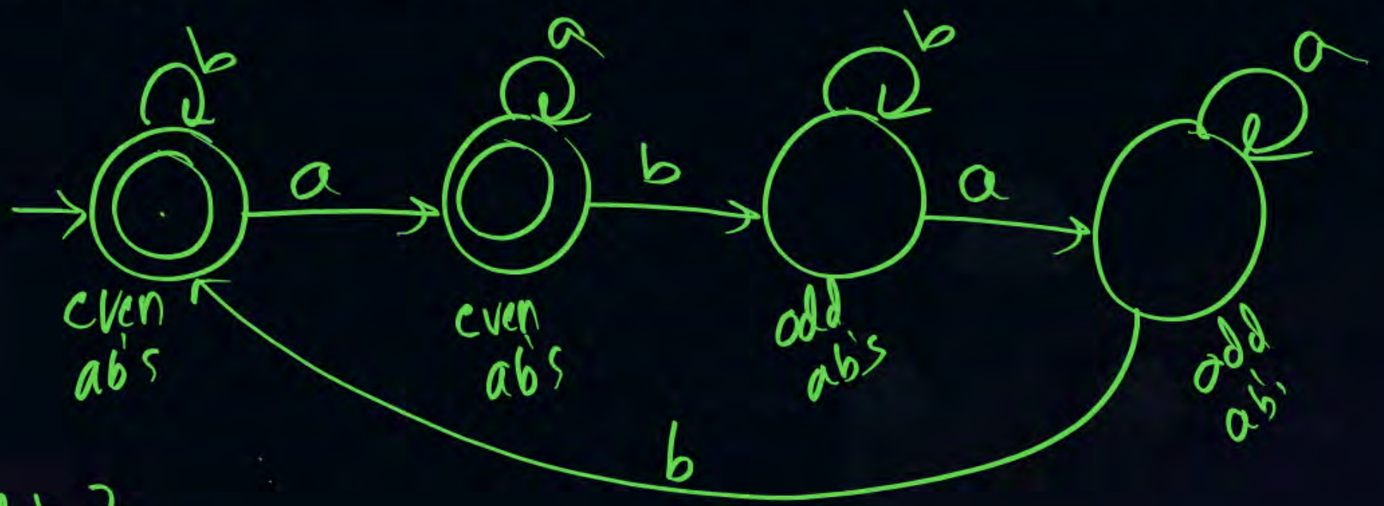
Q36. The number of minimal states in DFA that accepts all the strings over $\Sigma = \{a, b\}$. Where "2nd symbol from right hand side is a" are____.

K

$2^K = 2^2 \Rightarrow 4$ //

Regular Languages : NAT

Q37. Construct a minimal DFA that accepts all the strings over Σ = {a, b}. where, number of occurrence of substring "ab" is even. If number of trap states are x, number of final states are y and number of non-final states are z then the value of "xy + z" is ____.



$x = 0$

$y = 2$

$z = 2$

$xy + z$

$0 + 2 = 2$

$$L = \{\varepsilon, a, b, aa, ab, ba, bb, aaa, aab, \ldots\}$$

$$= \{w \mid n_{ab}(w) = \text{even}\}$$

$$\#_{ab}(w) = \text{even}$$

$$= 0, 2, 4, 6, 8, \ldots$$

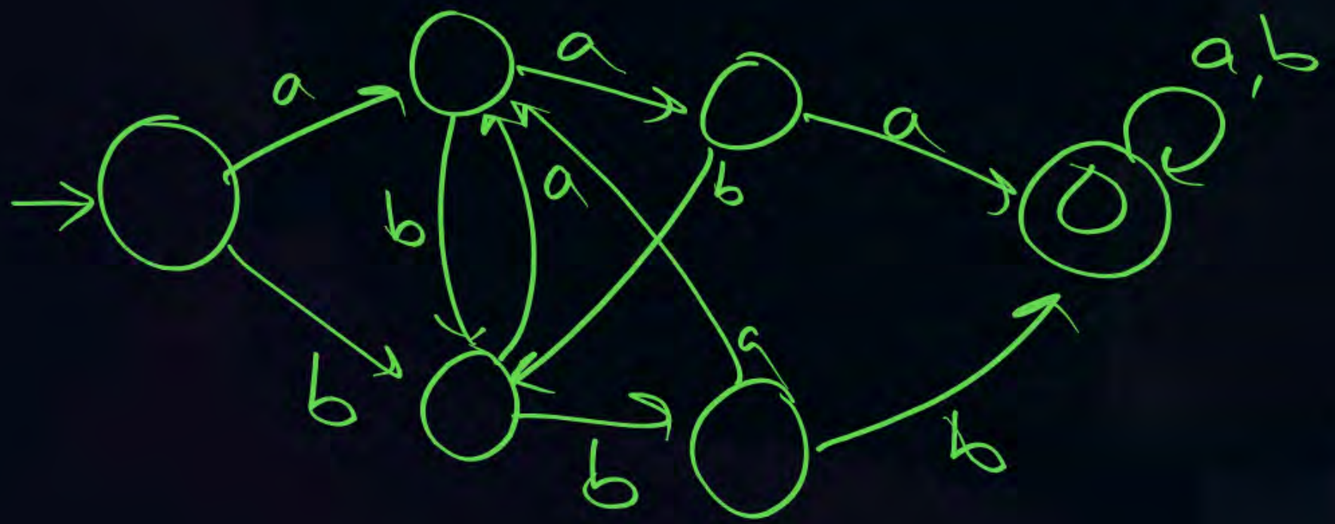
Regular Languages : NAT

Q38. How many minimal states are needed to design a DFA that accepts language over $\Sigma = \{a, b\}$. Where each string contains "aaa or bbb" as a substring? ____

(a)

$L = \{aaa, bbb, \ldots\}$

$= 6$ //

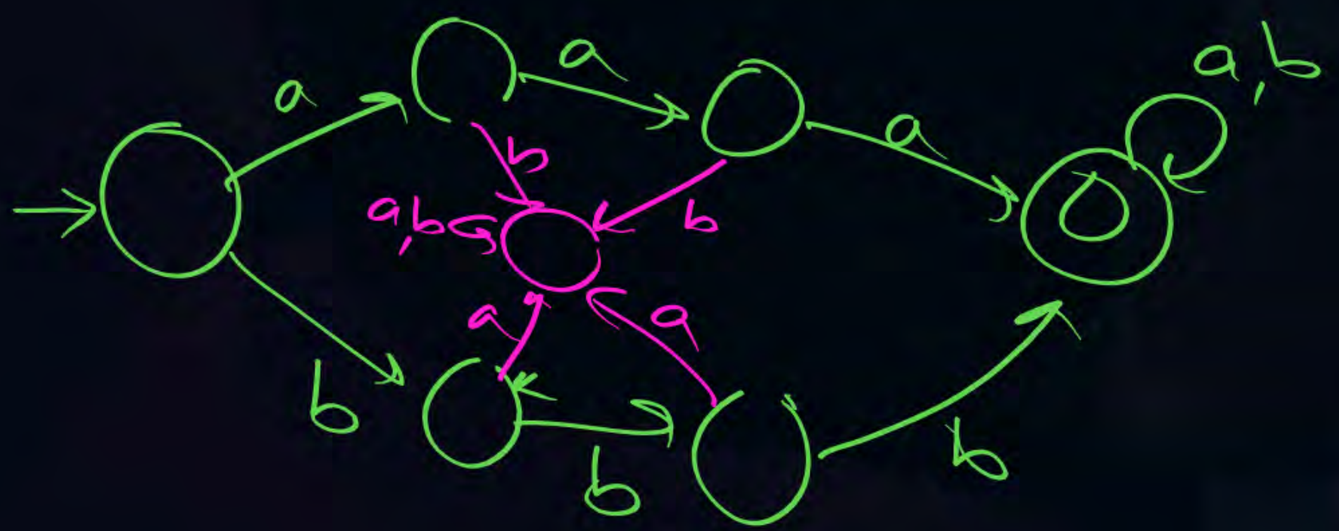


Regular Languages : NAT

Q38. How many minimal states are needed to design a DFA that accepts language over $\Sigma = \{a, b\}$. Where each string ~~contains~~ starts with "aaa or bbb" as a substring? ____

(b)

= 7 //



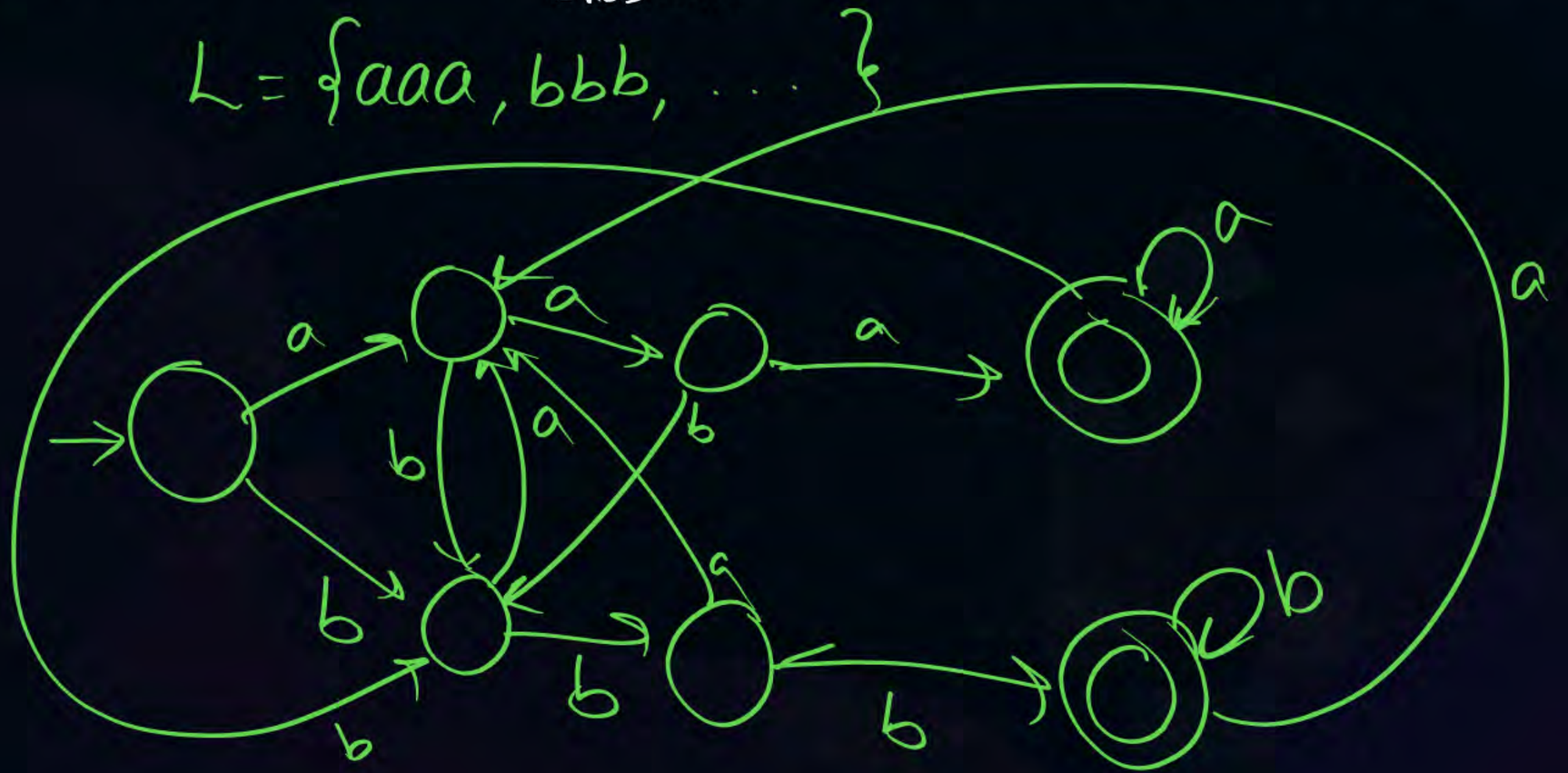
Regular Languages : NAT

Q38. How many minimal states are needed to design a DFA that accepts language over $\Sigma = \{a, b\}$. Where each string ~~contains~~ ends with "aaa or bbb" as a substring? ____

(C)

$L = \{aaa, bbb, \ldots\}$

= 7 //



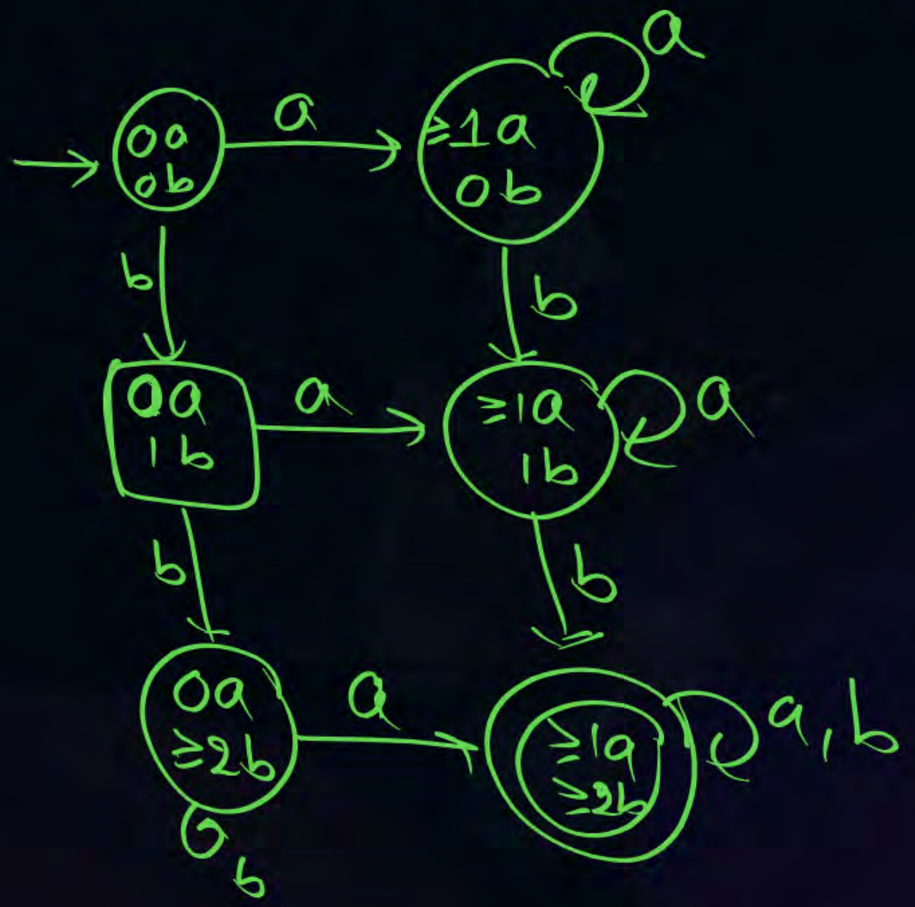
Regular Languages : NAT

Q39. Consider the language (L) over $\Sigma = \{a, b\}$ if number of a's in a string is at least 1 and number of b's in a string is at least 2 then total number of states in a minimal DFA is _____

#a's ≥ 1
#b's ≥ 2

L = {abb, bab, bba, . . . }

= 6 //

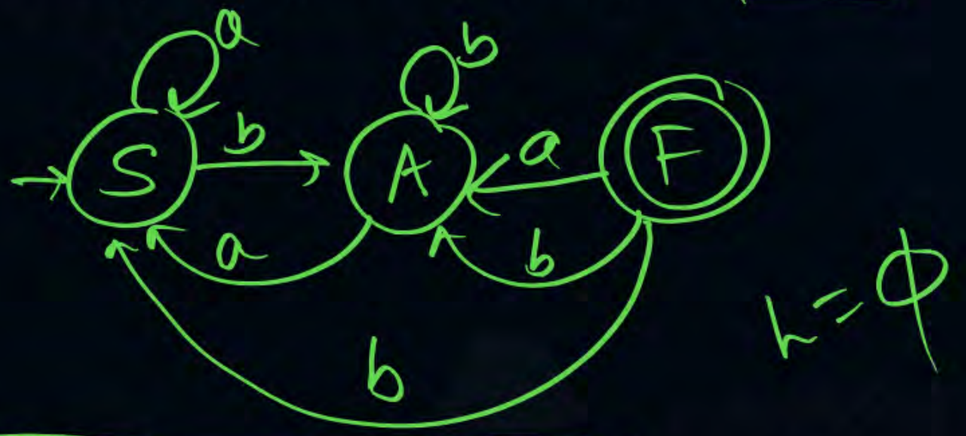


Regular Languages : MCQ

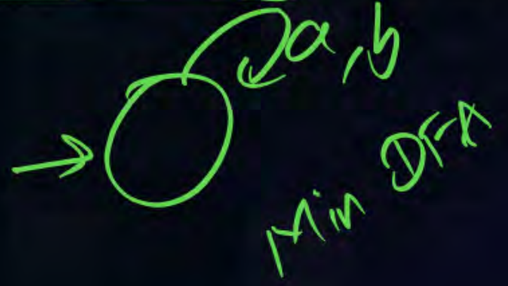
Q40. Consider the following transition table (T) on input alphabet {a, b} for NFA.

T:

δ	a	b
→ S	{S}	{A}
A	{S}	{A}
*F	{A}	{S,A}



How many states are needed to design equivalent minimal DFA for above NFA?



A 4

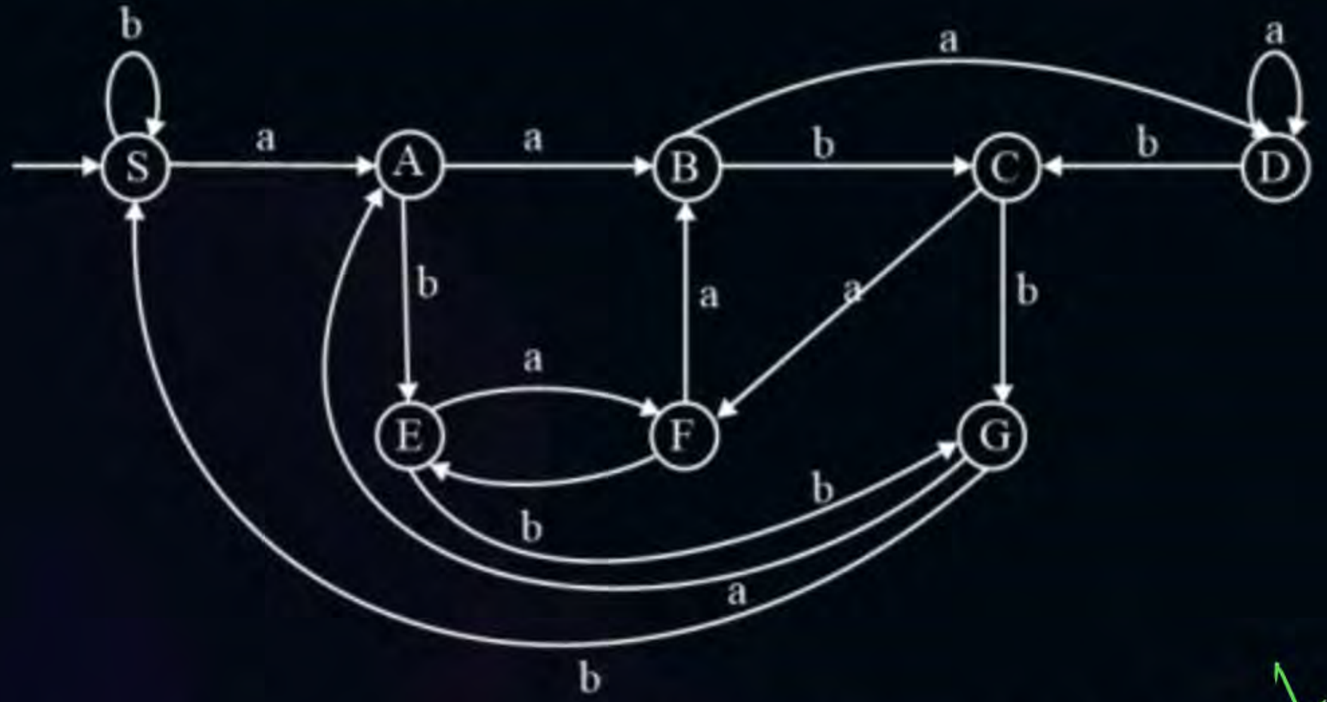
B 1

C 2

D 3

Regular Languages : NAT

Q41. Consider the following DFA.



All are non finals

⇓

Language is empty

⇓

How many states are possible in minimal DFA? ___ = 1

Regular Languages : MSQ

Q42. Which of the following is/are correct?

A $(r + \in)^* = r^*$

B $(r^* s^*)^* (rs + \in) (r + s)^* + s^* r^* = (r + s)^*$

C $\in + rss^* + rss^* (r + s)^* = (rss^*)^*$

D $(r^* s^*)^+ = (r^+ s^+)^*$

Slide 16

$$(\gamma^* s^*)^+ = \{\underbrace{(\gamma^0 s^0)^1}_{\varepsilon}, \underbrace{(\gamma^1 s^0)^1}_{\gamma}, \underbrace{(\gamma^0 s^1)^1}_{s}, \ldots\}$$

$$(\underline{\gamma}^+ \underline{s}^+)^* = \{\varepsilon, \gamma s, \gamma\gamma s, \gamma s s, \gamma s \gamma s, \ldots\}$$

$$\boxed{\gamma + \varepsilon \neq \gamma} \qquad \boxed{\gamma \cdot \varepsilon = \gamma}$$

Regular Languages : MSQ

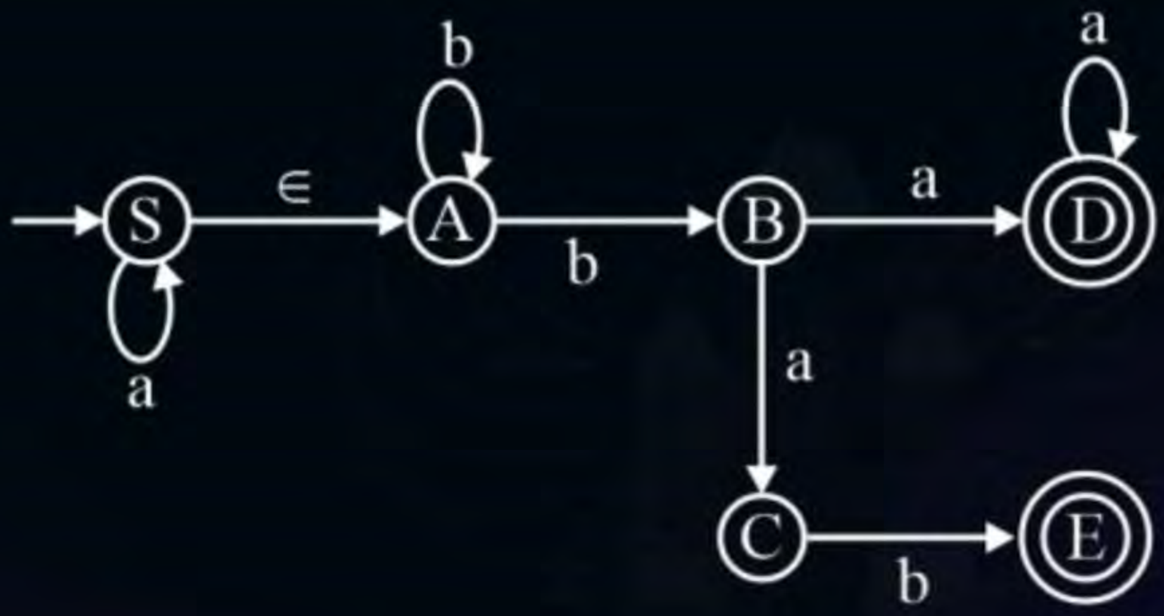
Q43. Consider the following $\in$-NFA:
Which of the following strings are accepted?

A abab

B baab

C bbaa

D abaa



Regular Languages : MCQ

[MCQ]

Q44. let L be the set of all the languages accepted by all grammars where every production is in the form of $V \rightarrow VT^*$ or $V \rightarrow T^*$.
Let Q be the set of all languages accepted by all grammars where every production of grammar is in the form of $V \rightarrow T^*V$ or $V \rightarrow T^*$
Which of the following is correct?
(Note: T is terminals and V is non-terminals)

A $L \geq Q$

B $L \leq Q$

C $L = Q$

D $L \neq Q$

Regular Languages : MSQ

Q45. Consider the following grammar G:

G: $S \rightarrow aS \mid bS \mid aaS \mid bbS \mid a$

Which of the following is correct regular expression for above grammar G?

A $(a + b)^* a$

B $(a + b + aa + bb)^* a$

C $(a + b + aa + bb + ba)^* a$

D None of these

THANK - YOU