CS & IT ENGINEERING

Theory of Computation

Lecture No.- 02

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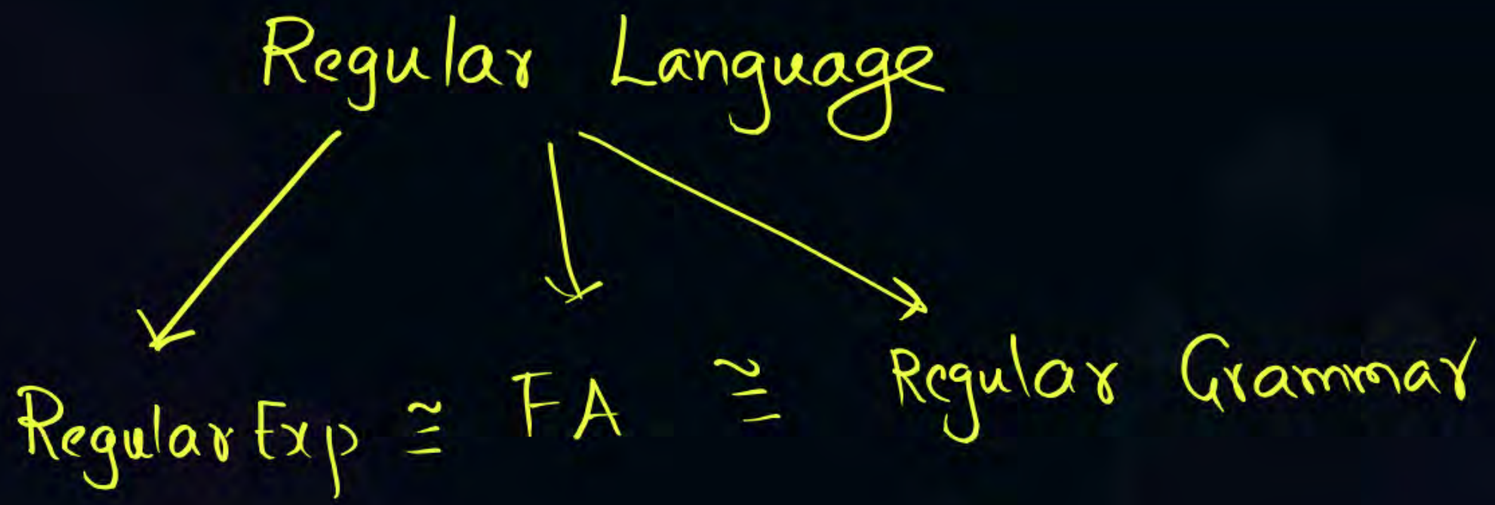
Topics to be Covered

Topic Regular Expression

Topic Finite Automata

Regular Expression & Finite Automata



Regular Exp & FA : MCQ

$L = \{\varepsilon, b^*, aa, b^*ab^*ab^*, \ldots\}$

Q15. Consider the following regular language L:

L = {w | number of a's (w) mod 3 ≠ 1 where w ∈ (a, b)*}

DEVA SIR PW

Which one of the following represents above language L?

$n_a(\omega) \% 3 = 0 \text{ or } 2$

A $(\in + b^* ab^* ab^* + ab^*)\ (a + b)^* = (a+b)^*$

B $[(b^* ab^* ab^* ab^*)^* + b^*].(b^*ab^*ab^*)$

C $[(b^*a\ b^*a\ b^*ab^*)^* + (b^* + \in + b^*ab^*ab^*)]$

D $[b^*a\ b^*ab\ ^*\ ab^*)^* + b^*]\ (\in + b^*ab^*ab^*)]$

$\varepsilon\ a\ \varepsilon\ a\ \varepsilon\ a\ b$

3k, 0 a's, 2 a's

ε, aa

5 a's not poss.

#a's = 0, 2, 3, 5, 6, 8, ...

$n_a(\omega) \% 3 \neq 1$

#a's ≠ 1, 4, 7, 10, ...

$\#a's \,\%\, 3 = 0 \text{ or } 2$

$\Sigma = \{a, b\}$

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

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

Regular Exp & FA : MCQ

Q16. Which of the following represents set of all strings starts and ends with different symbols over a's and b's?

A. a(a + b)* b

B. a(a + b)* a + b(a + b)* b

C. a(a + b)* b + b(a + b)* a

D. None of these

Regular Exp & FA : MCQ

Q17. Which of the following is TRUE ?

A $1(11)^* = (1(11)^*)^*$

Min = 1 | Min = ε

B $(11)^* = (1(11)^*)^*$

ε, 11 | ε, 1, 11, ...

1 not possible

C $(1(11)^*)^* = 1^*$

ε, 1, 11, 111, ... | ε, 1, 11, 111, ...

D $(11)^* = 1^*$

even | All

Regular Exp & FA : MCQ

Q18. Consider the following regular expression given below:

$R_1 = (01 + (1 + 01)0)^* (1 + 01)$

$R_2 = (01)^* (1 + 01) (0(01)^* (0 + 01))^*$

Which of the following is correct about R_1 and R_2?

A. String "0110" generated by R_2 but not R_1.

B. String "0110" generated by R_1 but not R_2.

C. Both expression generates the same language.

D. None of these

Regular Exp & FA : MCQ

Q19. Suppose the ~~length~~ size of language $|L_1| = 5$ and $|L_2| = 4$ then, which of the following is correct?

$|L_1L_2| \geq 8$

$L_1 = \{a, b, c, d, e\}$

$L_2 = \{f, g, h, i\}$

$8 \leq |L_1L_2| \leq 20$

$L_1L_2 = \{$ 5 × 4 , ... $\}$.

20 strings

A $|L_1 . L_2| \geq 5$

B $|L_1 . L_2| \geq 20$

C $|L_1 . L_2| \geq 9$

D $|L_1 . L_2| \leq 20$

Regular Exp & FA : MCQ

Q20. Choose correct Statement.

A $R + \phi = R \cdot \phi$ ✗

B $R + R = R \cdot R$ ✗

C $R + \varepsilon = R + \phi$ ✗

D $R + R = R \cdot \varepsilon$

Regular Exp & FA : MCQ

Q20. ~~Choose correct statement.~~
Which of the following is possible for some R ?

A. $R + \phi = R \cdot \phi$ possible when $R = \phi$ $\quad \phi + \phi = \phi \cdot \phi$ (ϕ = ϕ)

B. $R + R = R \cdot R$ possible when $R = \varepsilon$

C. $R + \varepsilon = R + \phi$

D. $R + R = R \cdot \varepsilon$

Regular Exp & FA : NAT

Q21. Consider the following regular expressions R:

$R = (ab^* + ba^*)^* (ba^* + ab^*)$ $= (a+b)^+ \Rightarrow$ 2 states

Number of states are needed to design a DFA for above expression R is _____.

H.W.:

$R = (ab^+ + ba^+)^* (ba^* + ab^*)$

ε ✗, a ✓, b ✓, aa ✗, ab ✓, ba ✓, bb ✗, ...

Regular Exp & FA : MCQ

Q22. Consider the following deterministic finite automata (DFA):

In above DFA {S} is starting state and F_1 and F_2 are final states.

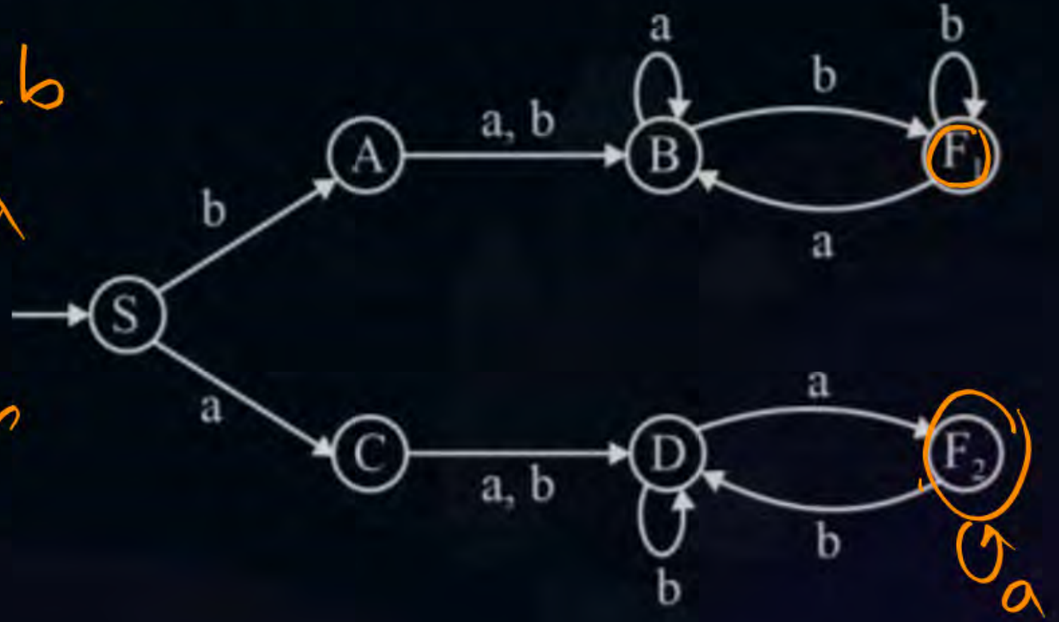
Which of the following language belong to above DFA?

A $L = \{wxw^R \mid w, x \in (a, b)^+\}$

B $L = \{ww^Rx \mid w, x \in (a, b)^+\}$

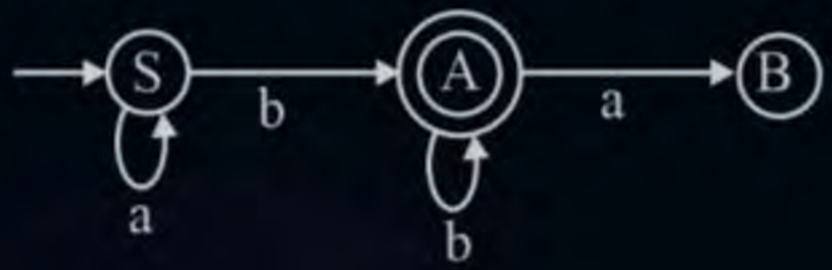
C $L = \{wxw^R \mid w, x \in (a, b)^*\}$

D None of these.



Regular Exp & FA : MSQ

Q23. Consider the following finite automaton F:



$= a^* bb^*$

In above finite automata S is starting state and A is final state. Which of the following is/are correct regular expression for above finite automata?

A) a*bb*a

B) a*b+

C) (b + aa*b) + (b + aa* b) bb*

D) a*bb*

$b + aa^*b + bbb^* + aa^*bbb^*$

$bb \quad bbb \quad a^+bb^+$

$a^0 b^+$ ✓

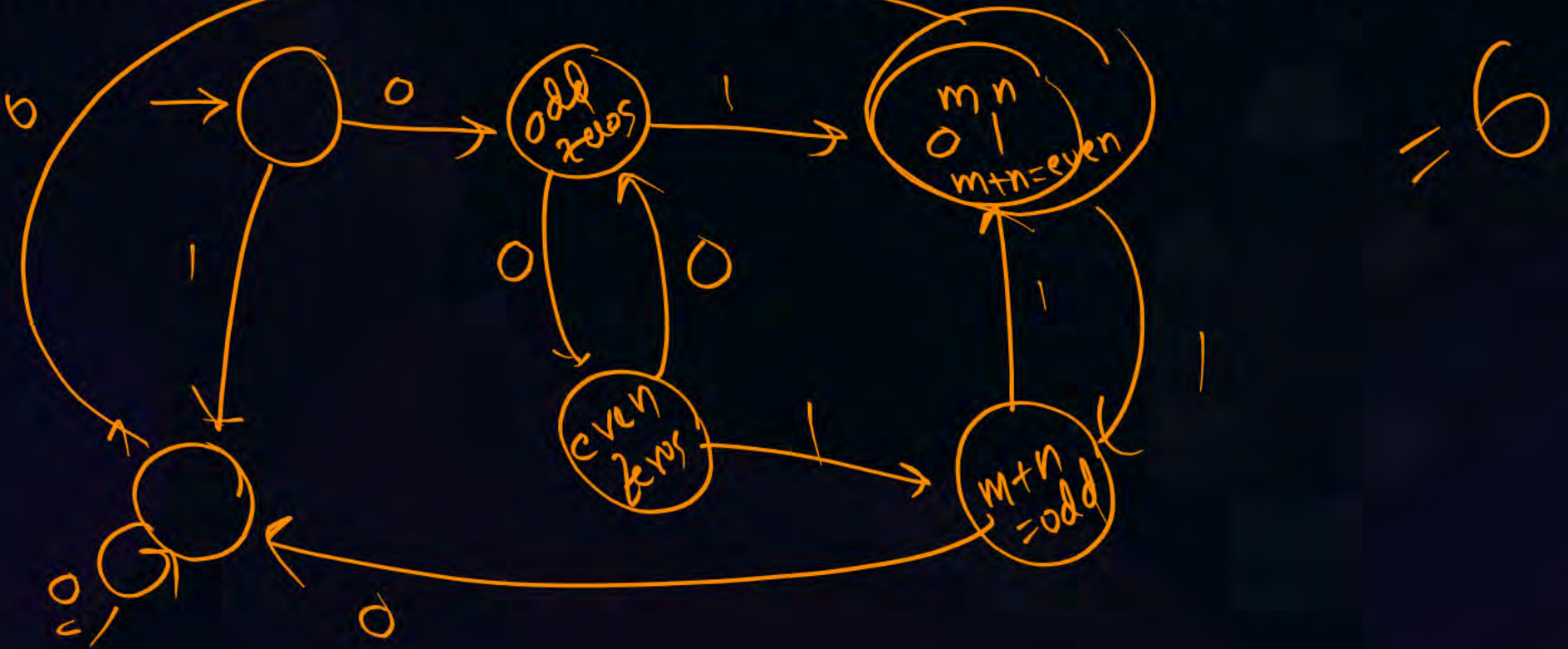
$a^+ b^+$

Regular Exp & FA : NAT

Q24. Consider the language L on $\Sigma = \{0, 1\}$:

$L = \{0^m 1^n \mid m + n = \text{even and } m, n \geq 1\}$ $= \{01, 0011, 0111, 0001, \ldots\}$

The minimum number of states needed for DFA of language L is _____.



$= 6$

Regular Exp & FA : NAT

Q25. Consider the following regular expression R:

$R = (00 + 11 + (01 + 10)\ (00 + 11)^*\ (01 + 10))^*$

Minimum number of states are needed in DFA for above regular expression R is ____.

$2 \times 2 = 4$ states

$L = \{w \mid w \in \{0,1\}^*,\ n_0(w) = \underbrace{\text{even}}_{\text{div by 2}},\ n_1(w) = \underbrace{\text{even}}_{\text{div by 2}}\}$

Regular Exp & FA : MSQ

Q26. Consider the Language L:

$L = \{w \mid |w| \% 99 \leq 27 \text{ where, } w \in \{a, b\}^*\}$

What is the regular expression for above language L?

|w| % 3 ≤ 1

$(a+b)^3 (\varepsilon + a + b)$

A $((a + b)^{27})^* (a + b)^{99}$ $|w| = 27k + 99, k \geq 0$

B $((a + b)^{99})^* (a + b)^{27}$ $|w| = 99k + 27, k \geq 0$

C $((\in + a + b)^{99})^* (\in + a + b)^{27}$ $= (a+b)^*$ $|w| \geq 0$

D $((a + b)^{99})^* (\in + a + b)^{27}$ $|w| = 99k + m, k \geq 0, m \leq 27$

ε ε

$|w| \% 99 \le 27$

$(\Sigma^{99})^* (\varepsilon + \Sigma)^{27}$

$|w| \% 99 = 27$

remainder

$(\Sigma^{99})^* \Sigma^{27}$

$((a+b)^{99})^* (a+b)^{27}$

$|w| \% 99 = 0$

OR

$|w| \% 99 = 1$

OR

$|w| \% 99 = 2$

OR

$|w| \% 99 = 3$

OR

$|w| \% 99 = 27$

$|w| \% 99 = 0$

$(\Sigma^{99})^*$ multiple of 99

$|w| \% 99 = 1$

$|w| = 99k + 1$

$(\Sigma^{99})^* \Sigma$

$|w| \% 99 \le 1$

$(\Sigma^{99})^* (\varepsilon + \Sigma)$

$|w| \% 3 \leq 1$

$|w| = 0, 1, \cancel{2}, 3, 4, \cancel{5}, 6, 7, \cancel{8}, \ldots$

$$\underbrace{\left((\varepsilon+a+b)^{99}\right)^{*}}_{=(a+b)^{*}}$$

ε

$a = \left(\left(\quad\right)^{99}\right)' = \underbrace{(a)'(\varepsilon^{98})'}_{a}$

b

aa

ab

$$\left((a+b)^{99}\right)^{*} \rightarrow \varepsilon,\ (a+b)^{99}$$

Regular Exp & FA : MCQ

Q27. Which of the following regular expression represents the no two consecutive zeros ending with 1?

$L = \{\varepsilon, 0, 1, 00, 01, 10, 11, 000, 001, \ldots\}$

A $(01 + 10 + 11 + 1)^*$ → ε ✓, 0 ✗

B $(01 + 1)^+$ → ε ✗

C $(01+10+11+1)^*0$ → ε ✗

D None of these

Regular Exp & FA : MCQ

$\Sigma^* 00 \Sigma^* + \Sigma^* 11 \Sigma^*$

Q28. Consider the following regular expression R.

$R = \in + 0\,(10)^*\,(\in + 1) + 1\,(01)^*\,(\in + 0)$

which one of the following languages over the alphabet {0,1} is described by the above regular expression R?

A. Set of all binary strings having either 00 or 11 as a substring. → $\in$ is invalid

B. Set of all binary strings not having 00 as a substring. $\in, 0, 1, 01, 10, 11$

C. Set of all binary strings not having 11 as substring. → 00 should be in R if this option is correct

$00 \notin R$

D. Set of all binary strings neither having 00 nor 11 as a substring.

Regular Exp & FA : MCQ

Q29. Suppose $L_1 = 0^*$

$L_2 = 10$

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

$L_4 = 1^*$

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

A ϕ

B $\{10\}$

C 1^*

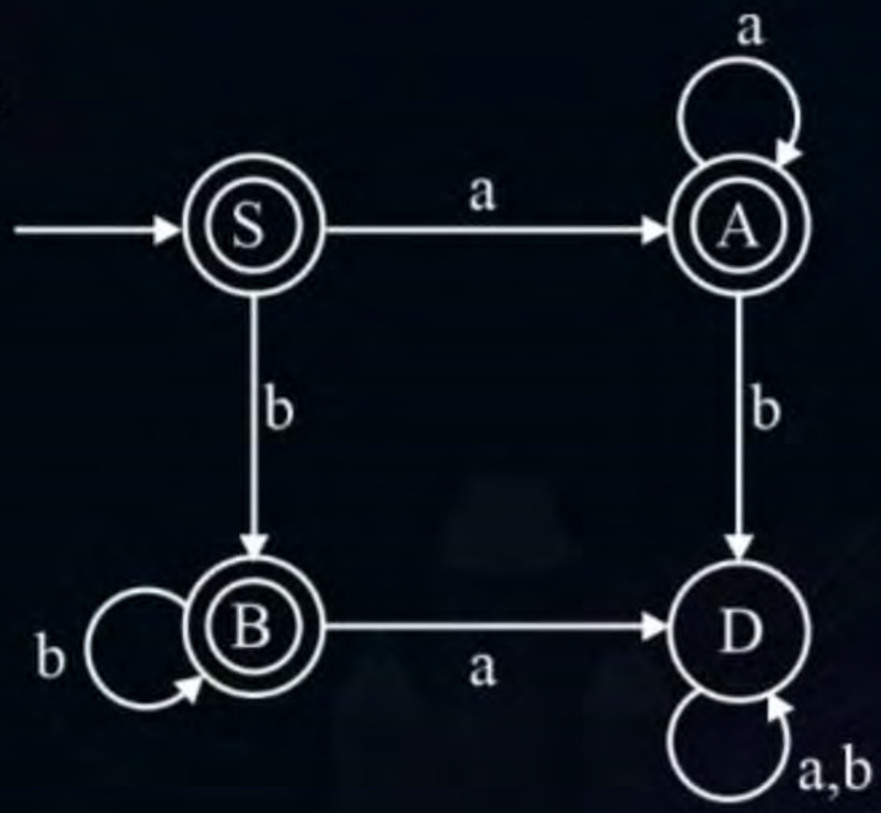
D $\{\in\}$

Regular Exp & FA : NAT

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

Regular Exp & FA : 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 $\in + aa^* + bb^*$

Regular Exp & FA : NAT

Q32. Consider grammar G:

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? _____.

Regular Exp & FA : MCQ

Q33. 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 $L_1^* \subset L_2^*$

B $L_2^* \subset L_1^*$

C $L_1^* = L_2^*$

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

Regular Exp & FA : MSQ

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

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

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

C $a\,(a + bb^*a)^*$

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

THANK - YOU