CS & IT ENGINEERING

Theory of Computation

Regular Languages [redacted]

Lecture No.- 13

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Recap of Previous Lecture

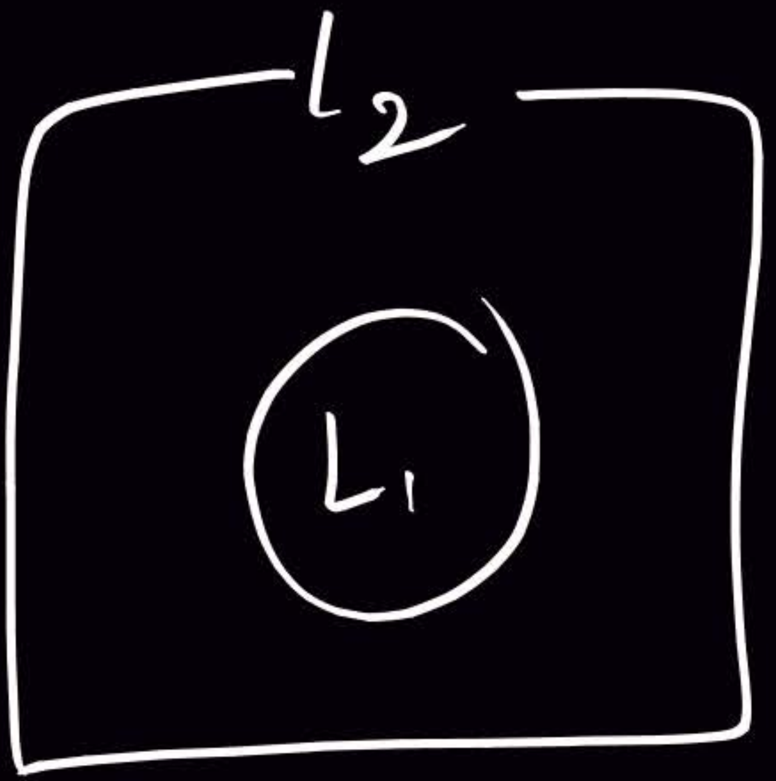
Topic Regular Expressions GATE PYQs

Topics to be Covered

Topic Practice on Regular Expressions

$L_1 = \{a, ab\}$

$L_2 = \{a, b, ab, bbb\}$



$L_1 \subset L_2$

$L_2 \supset L_1$

Q1 $R_1 = a^*$ $R_2 = (aa)^*$

MSQ

TRUE ?

(A) $L(R_1) = L(R_2)$

(B) $L(R_1) \subset L(R_2)$

(C) $L(R_1) \supset L(R_2)$

(D) $L(R_1) \neq L(R_2)$

Q2 $L_1 = a^* + b^*$, $L_2 = a^* b^*$

FALSE ?

MSQ

(A) $L_1 = L_2$ FALSE

(B) $L_1^* = L_2^*$ TRUE

(C) $L_1 \subset L_2$ TRUE

(D) $L_1 \neq L_2$ TRUE

$L_1 = \{a^*, b^*\}$

$= \{\varepsilon, a, a^2, \dots, b, b^2, \dots\}$

$L_2 = \{a^*, b^*, a^+ b^+\}$

$= L_1 \cup \{a^+ b^+\}$

$$L_1^* = (a^* + b^*)^* = (a+b)^*$$

$$L_2^* = (a^* b^*)^* = (a+b)^*$$

Q3 $L = (a+b)^*$. Find equivalent expressions.

MSQ

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

(B) $(b^*a)^*b^*$

(C) $a^*(ba^*)^*$

(D) $b^*(ab^*)^*$

Q4 $L = (a+b)^*$

MSQ

Equivalent to L ?

(A) $(a^*+b)^+ = \{\varepsilon, a, b, aa, ab, ba, bb, \ldots\} = (a+b)^*$

(B) $(a^*+b)^* =$ "

(C) $(a+b^*)^+ =$ "

(D) $(a+b^*)^* =$ "

$\underline{bb}\,\underline{aab}\,\underline{a}$

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

$$(\quad)^3 = (a^0 b^2)^1 (a^2 b^1)^1 (a^1 b^0)^1$$

$\varepsilon\, bb \quad aa\, b \quad a\, \varepsilon$

Q5 $L = (a+b)^*$

Equivalent to L ?

MSQ

(A) $(a^* b^*)^* = \{\varepsilon, a, b, aa, ab, ba, bb, \ldots\} = (a+b)^*$

(B) $(a^* b^*)^+ = \{\varepsilon, a, b, aa, ab, ba, bb, \ldots\} = (a+b)^*$

(C) $(a^+ b^+)^* = \{\varepsilon, \cancel{a}, \cancel{b}, \cancel{aa}, ab, \cancel{ba}, \cancel{bb}, \ldots\}$

(D) $(a^+ b^+)^+ = \{\cancel{\varepsilon}, \cancel{a}, \cancel{b}, \ldots\}$

Q6 $L = (a+b)^*$

MSQ

Equivalent to L ?

(A) $(a^* b^* a^*)^* = \{\varepsilon, a, b, \ldots\}$

(B) $(b^* a^* (bb)^*)^* = \{\varepsilon, a, b, \ldots\}$

(C) $(a^* b^* b^* a^* a^* a^* b^*)^* = \{\varepsilon, a, b, \ldots\}$

(D) $(a^* b^* (aa)^* (bb)^* b^*)^* = \{\varepsilon, a, b, \ldots\}$

$= (a+b)^*$

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

$$\underline{a}\,\underline{b} \Rightarrow (\quad)^2 = \underbrace{\left(b^0 a^1 (bb)^0\right)}_{a} \underbrace{\left(b^1 a^0 (bb)^0\right)}_{b}$$

Q7

$L = \{ w \mid w \in \{a,b\}^*,\ n_a(w) = 2 \}$

= Set of all strings where every string has exactly 2 a's.

MSQ

$= \{aa, aba, baa, aab, \ldots\}$

(A) aa ✗

(B) $b^* a b^* a$ ✗

(C) $\boxed{b^* a}\boxed{b^* a} b^*$ ✓

(D) $(b^* a)^2 b^*$ ✓

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

Q8 $L = \{ w \mid \underbrace{w \in a^*}, \; n_a(w) = 2 \}$

$w \in \{ \varepsilon, a, \underline{a^2}, a^3, \ldots \}$

(A) aa

(B) ab^*a

(C) $b^*ab^*ab^*$

(D) aab^*

L is over $\Sigma = \{a\}$

Q 9 $L = \{ bw \mid w \in (aa)^*, \; n_a(w) \le 2 \}$

Equivalent to L ?

(A) $\{\varepsilon, a, a^2\}$

(B) $\{b, ba, ba^2\}$

(C) $\{b, ba^2\}$

(D) None

$$L = \Big\{ \underbrace{bw}_{\text{String}} \;\Big|\; w \in \{\varepsilon, aa, a^4, \dots\}, \; n_a(w) \le 2 \Big\}$$

$$= \{ b\varepsilon, baa \} = \{ b, baa \}$$

$$= \{ b, ba^2 \}$$

Q10 $L = \{ w_1 w_2 \mid w_1, w_2 \in \{a,b\}^* \} = ?$

MSQ

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

(B) $(a+b)^* \cdot (a+b)^* = (a+b)^*$

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

(D) $(a+b)^* \cdot b^* = (a+b)^*$

Q11.

MSQ

$\{ww \mid w \in \{a,b\}^*\} = ?$

No regular Exp

Not regular language

(A) $(a+b)^*$ ✗

(B) $(a+b)^* . (a+b)^*$ ✗

(C) $(a+b)^* . (a+b)$ ✗

(D) None ✓

$$\{\underline{w_1}\,\underline{w_2} \mid w_1, w_2 \in \{a,b\}^*\} = \{\varepsilon, a, b, aa, ab, ba, \ldots\}$$
$$= (a+b)^*$$

$$\{\underbrace{\underline{w}\,\underline{w}}_{\text{same}} \mid w \in \{a,b\}^*\} = \{\varepsilon, \cancel{a}, \cancel{b}, aa, \cancel{ab}, \cancel{ba}, bb, \ldots\}$$

$$\begin{array}{cc} ww & ww \\ \varepsilon\,\varepsilon & a\,a \end{array}$$

Q 12

$L_1 = a^* b^*$

$L_2 = b^* a^*$

MSQ

TRUE?

$L_1 \neq L_2$

(A) $L_1 = L_2$

(B) $L_1^* = L_2^*$

(C) $L_1^+ = L_2^+$

(D) $L_1 \neq L_2$

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

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

2 mins Summary

Topic Regular Expressions

THANK - YOU