

CS & IT ENGINEERING

Theory of Computation

Regular Languages

Lecture No.- 10

A man with a beard and mustache, wearing a black polo shirt, stands with his arms crossed in front of a blurred bookshelf. He is wearing a black watch on his left wrist.

Mallesham Devasane Sir

Recap of Previous Lecture



Topic

Regular Language Vs Regular Expression



Topics to be Covered



Topic

Regular Language Vs Regular Expression





TOPIC:

Home work



$$(39) \quad \{w \mid w \in \{a, b\}^*, n_a(w) = \text{even}\}$$

$$(40) \quad \{w \mid w \in \{a, b\}^*, n_a(w) = \text{odd}\}$$

3^a

$w \in \{a, b\}^*$, $n_a(w) = \text{even}$

~~$(aa)^*$~~
 ~~$\frac{b}{1}$~~

~~$b^*(aa)^*$~~
 ~~$\frac{ab}{2}$~~

~~$(aa)^*b^*$~~
 ~~$\frac{ba}{3}$~~

~~$b^*(aa)^*b^*$~~
 ~~$\frac{a b a}{4}$~~

~~$(a b^* a)^*$~~
 ~~$\frac{b}{5}$~~ valid but not general

~~$b^*(a b^* a)^*$~~
 ~~$\frac{a a b}{6}$~~

~~$b^*(a b^* a)^*b^*$~~
 ~~$\frac{a a b a a}{7}$~~

8
 $b^*(b^* a b^* a b^*)^*b^*$

$$= b^* (\underline{b^*} a \underline{b^*} a \underline{b^*})^* b^*$$

39

$\epsilon \checkmark$
 $b \checkmark$
 $bb \checkmark$
 $bbb \checkmark$
 \vdots
 } zero
 a's

$aa \checkmark$
 $baa \checkmark$
 $aba \checkmark$
 $aab \checkmark$
 $bbaa \checkmark$
 $abab \checkmark$
 $aabb \checkmark$
 \vdots
 } 2 a's

4 a's
✓

6 a's
✓

(39)

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

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

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

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

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

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

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

Important

$\eta_a(\omega) = \text{even}$

$$\cancel{b^*} (\cancel{b^* a b^* a b^*})^* \cancel{b^*}$$

$$\rightarrow b^* ()^0 b^* = b^*$$

$$\rightarrow \underline{b^*} (\underline{b^* a b^* a b^*})^1 \underline{b^*} = b^* a b^* a b^*$$

$$b^* . b^* = b^*$$

$$\rightarrow b^* (\text{---})^2 b^* = \cancel{b^*} \cancel{b^* a b^* a b^*} \cancel{b^*} \cancel{a b^* a b^*} \cancel{b^*}$$

$$= b^* a b^* a b^* a b^*$$

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

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

(40)

$n_a(w) = \text{odd}, w \in \{a, b\}^*$

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

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



TOPIC:



$$(41) \quad \{ w \mid w \in a^*, n_a(w) = \text{even} \}$$

$$R = (aa)^*$$

$$(42) \quad \{ w \mid w \in a^*, n_a(w) = \text{odd} \}$$

$$R = a(aa)^*$$

$$= (aa)^*a$$

$$n_a(w) = \text{odd}$$

$$= a, a^3, a^5, a^7, a^9, \dots$$

$$= a(aa)^*$$

$$= (aa)^* a$$

$$\gamma_a(w) = \text{even}$$

$$= \epsilon, aa, a^4, a^6, a^8, \dots$$

$$= (aa)^*$$

↓

$$(aa)^0 = \epsilon$$

$$(aa)^1 = a^2$$

$$(aa)^2 = a^4$$



TOPIC:

(43) $\{w \mid w \in \{a,b\}^*, n_a(w) \text{ is multiple of } 3\}$

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

(44) $\{w \mid w \in \{a,b\}^*, n_a(w) = 3n+1, n \geq 0\}$

$$\begin{aligned} &= a (aaa)^* \\ &= (aaa)^* a \end{aligned}$$

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

$$n_a(w) \% 3 = 1$$



TOPIC:



$$n_a(w) \% 3 = 1$$

$$= \underbrace{b^* a b^*}_{1} \underbrace{(b^* a b^* a b^* a b^*)_{3n}}_{3n+1 \text{ a's}} b^*$$

$$\begin{aligned} \#a(w) &= 1 & (n=0) \\ &= 4 & (n=1) \\ &= 7 & n=2 \\ &= 10 & n=3 \\ &= 13 & n=4 \\ &\vdots \\ &= \underline{3n+1} \end{aligned}$$



TOPIC:

Home work



(45)

$$\{w \mid w \in \{a, b\}^*, n_a(w) \% 3 = 2\}$$

(46)

$$\{w \mid w \in \{a, b\}^*, n_a(w) \% 5 = 1\}$$



2 mins Summary



Topic

Regular Languages

Topic

Regular Expressions

THANK - YOU