CS & IT ENGINEERING

Theory of Computation

Regular Languages

Lecture No.- 17

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Recap of Previous Lecture

Topic Model-I (Easy: Phi, Sigma*, only epsilon, Sigma^{+})

Topic Important concepts of DFA

Topics to be Covered

Topic Construction of DFA Model II (Length)

Topic Construction of DFA Model III (No. of symbols)

Topic Construction of DFA Model IV (Over 1 symbol)

Construction of DFA

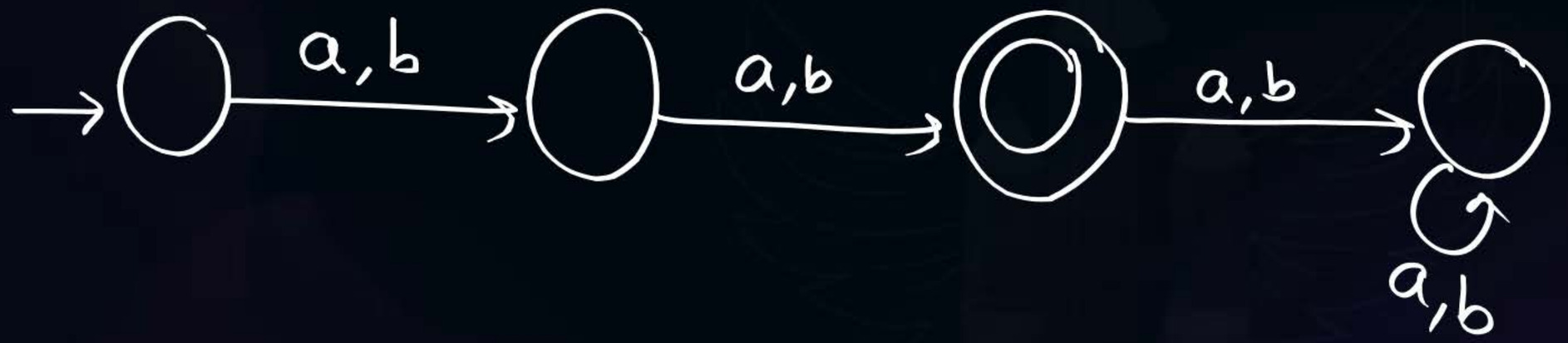
Model - II [Length based]

(17) Set of all strings having exactly 2 length over $\Sigma = \{a, b\}$.

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

$$= aa + ab + ba + bb$$

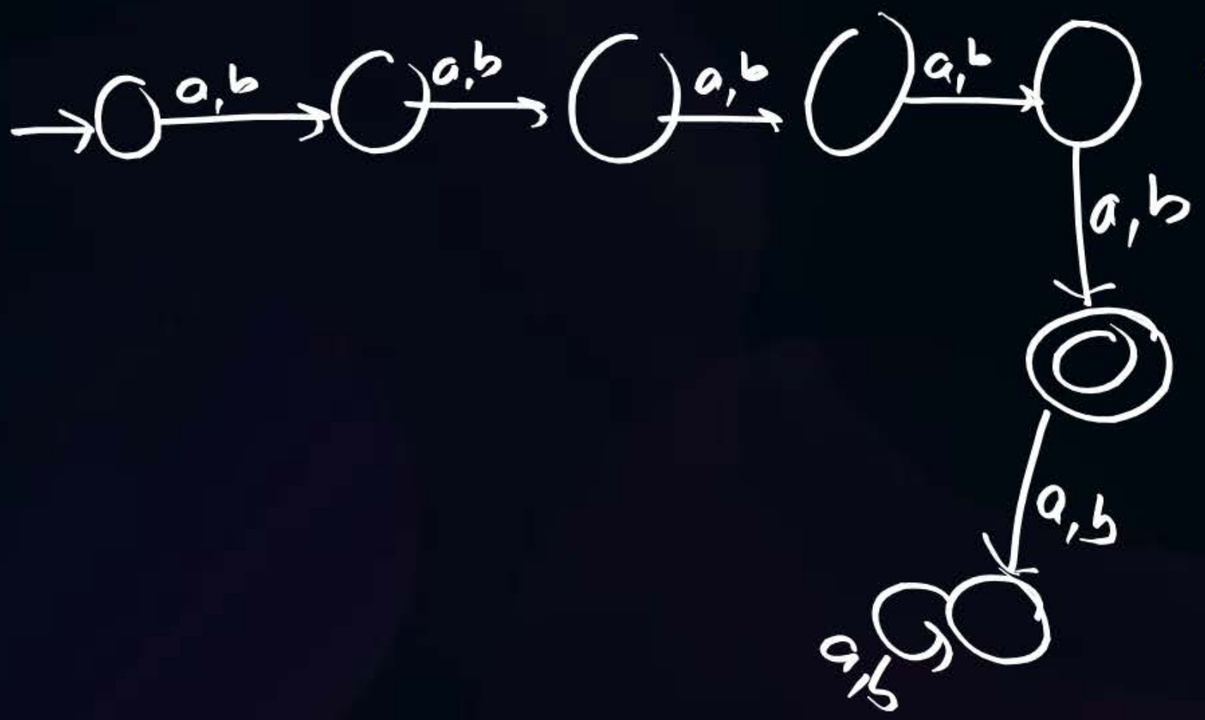
= 4 states in min DFA



Construction of DFA Model - II [Length based]

(20) Set of all strings having exactly 5 length over $\Sigma = \{a, b\}$.

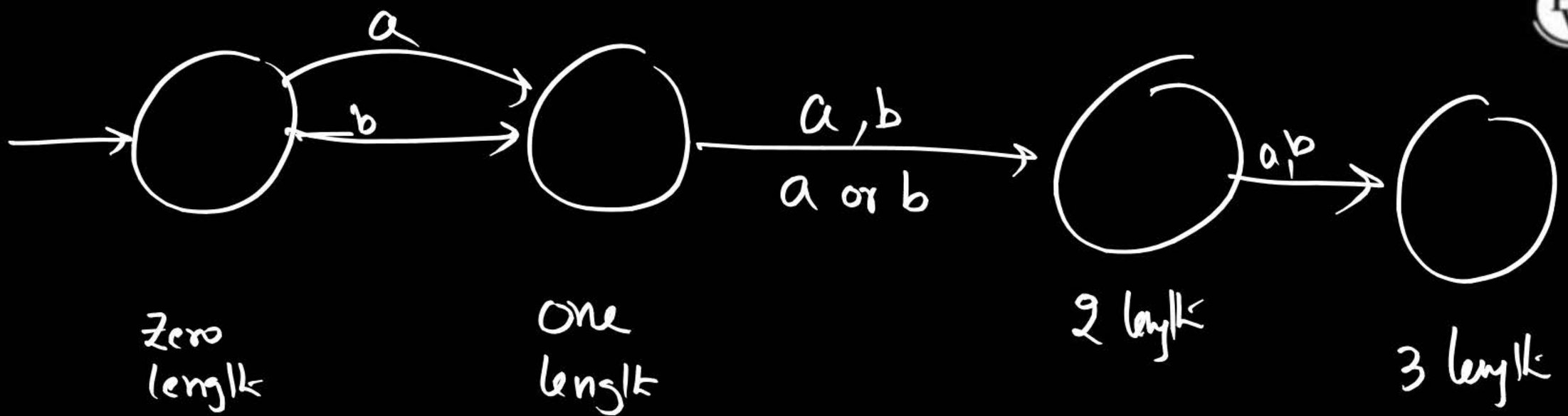
$$L = \{ w \mid w \in (a+b)^*, \ |w| = 5 \} = (a+b)^5$$



Exactly 5 length

$= (5+1) + 1_{\text{trap}}$

$= 7$ states



$|a| = 1$

$|b| = 1$

Concept for length

Construction of DFA

(18) $\{w \mid w \in \{a,b\}^*, |w| \leq 2\} = (\varepsilon + a + b)^2$

Atmost 2 length

Construction of DFA

(19) $\{w \mid w \in \{a,b\}^*, |w| \geq 2\} = (a+b)^2 (a+b)^*$

$= 2, 3, 4, \ldots$

Construction of DFA

Note : No. of states in min DFA

I) $|w| = K$ (K: constant; $|w|$: string) $\Rightarrow$ K+2

II) $|w| \leq K$ $\Rightarrow$ K+2

III) $|w| \geq K$ $\Rightarrow$ K+1

IV) $|w| < K \Rightarrow |w| \leq (K-1) \Rightarrow (K-1)+2 = K+1$

V) $|w| > K \Rightarrow |w| \geq (K+1) \Rightarrow (K+1)+1 = K+2$

Construction of DFA

Model - III [No. of Symbols]

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

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

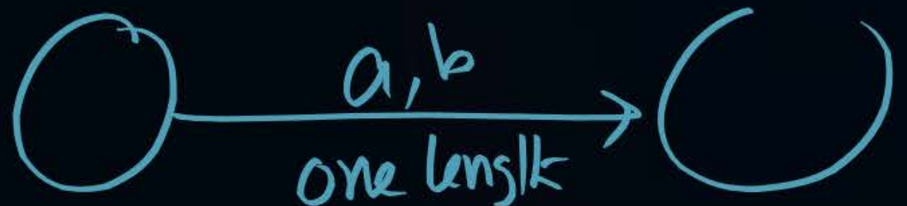
$n_a(w) = 2$

$\#_a(w) = 2$

no. of as $(w) = 2$

Construction of DFA

Length:



If we want to remember symbol 'a' then change state only for 'a'.

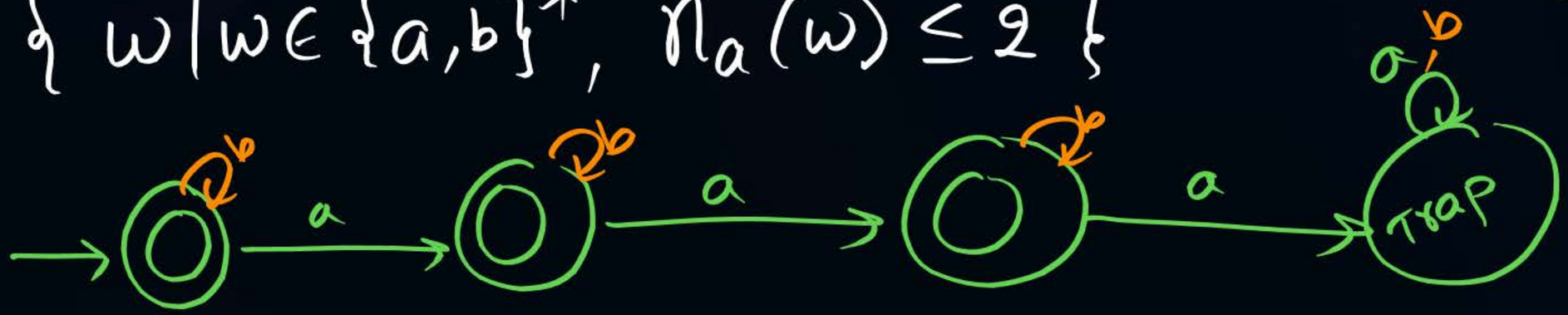
Symbol

a

Construction of DFA

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

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



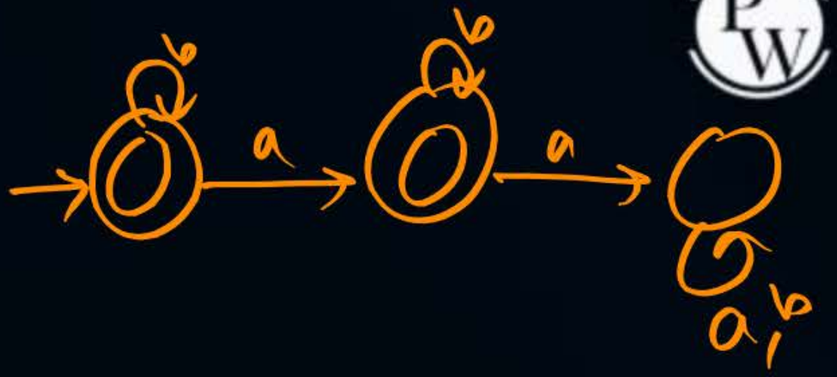
(23) $\{w \mid w \in \{a,b\}^*, n_a(w) \geq 2\}$

$\Sigma^* a \Sigma^* a \Sigma^*$

Construction of DFA

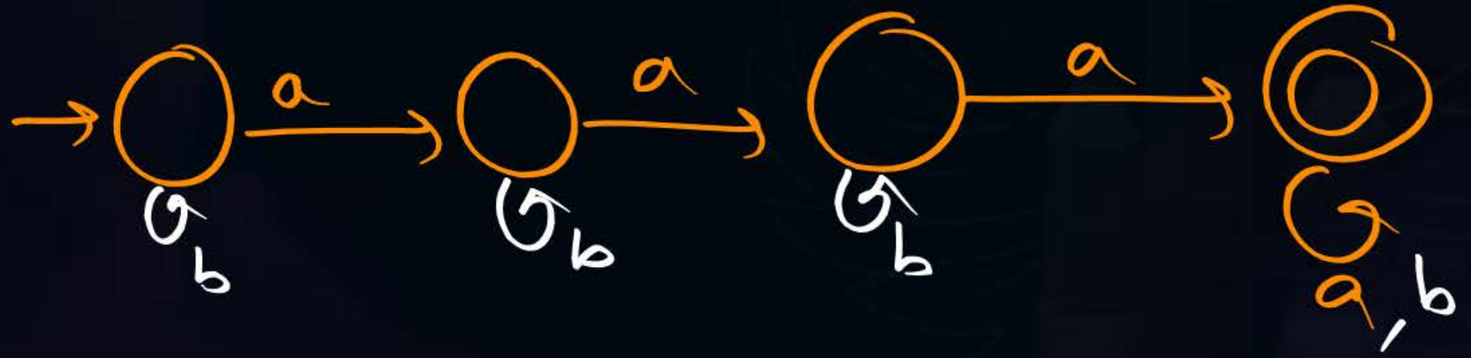
(24) $\{w \mid w \in \{a,b\}^*, \underbrace{n_a(w) < 2}_{n_a(w) \leq 1}\}$

= 3 states



(25) $\{w \mid w \in \{a,b\}^*, \underbrace{n_a(w) > 2}_{n_a(w) \geq 3}\}$

= 4 states



Construction of DFA

Note :

		No. of states in min DFA
I) $n_a(w) = K$	⇒	K+2
II) $n_a(w) \leq K$	⇒	K+2
III) $n_a(w) \geq K$	⇒	K+1
IV) $n_a(w) < K$	⇒	K+1
V) $n_a(w) > K$	⇒	K+2

($n_a(w)$: No. of a's in string w; K: constant)

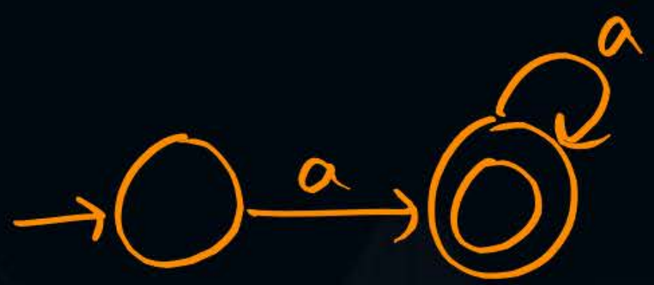
Construction of DFA

Model-IV [over 1 Symbol]

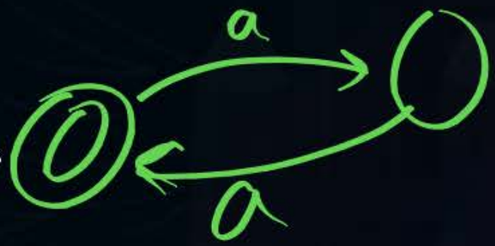
$\Sigma = \{a\}$

(26) $L = \{a^n \mid n \geq 0\} = a^* = \Sigma^*$

(27) $L = \{a^n \mid n \geq 1\} = a^+$



(28) $L = \{a^{2n} \mid n \geq 0\} = (aa)^*$



$= \{\varepsilon, a^2, a^4, a^6, \ldots\}$

Arithmetic progression Series :

I) $0, 1, 2, 3, \ldots$ — $\{a^n \mid n \geq 0\}$

II) $2, 3, 4, 5, \ldots$ — $\{a^n \mid n \geq 2\}$

III) $0, 2, 4, 6, 8, \ldots$ — $\{a^{2n} \mid n \geq 0\}$

IV) $0, 3, 6, 9, 12, \ldots$ — $\{a^{3n} \mid n \geq 0\}$

V) $10, 20, 30, 40, \ldots$ — $\{a^{10n} \mid n \geq 1\}$

$10 \quad 10 \quad 10$

Not A.P. Series :

I) $n!$: $0!, 1!, 2!, 3!, \ldots$ $\quad a^{n!}$

II) 2^n : $2^0, 2^1, 2^2, 2^3, \ldots$ $\quad a^{2^n}$

III) n^2 : $0^2, 1^2, 2^2, 3^2, \ldots$ $\quad a^{n^2}$

IV) n^n : $1^1, 2^2, 3^3, 4^4, \ldots$ $\quad a^{n^n}$

V) Prime : $2, 3, 5, 7, 11, \ldots$ $\quad a^{\text{Prime}}$

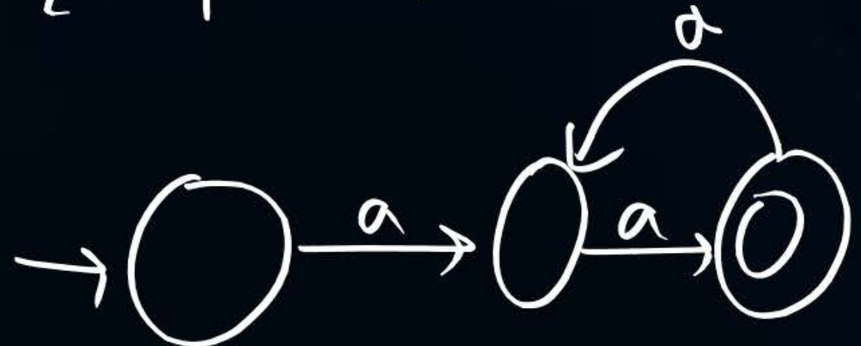
Construction of DFA

(29) $\{a^{3n} \mid n \geq 0\}$

(30) $\{a^{3n+2} \mid n \geq 0\}$

(31) $\{a^{3n+5} \mid n \geq 0\}$

(32) $\{a^{2n} \mid n \geq 1\}$



2 mins Summary

Topic Length based problems

Topic Symbol based problems

Topic One symbol based problems ⇨ Next

THANK - YOU