CS & IT ENGINEERING

Theory of Computation
Finite Automata

Lecture No. 8

By- DEVA Sir

01 DFA-Model III (No.of Symbols)

02 DFA-Model IV (Length & Remainder)

03 DFA-Model V (Symbols & Remainder)

04 DFA-Model VI (Sequence)

05 DFA-Model VII (Sequence & Number of Symbols)

06 DFA-Model VIII (Multiple Conditions on Symbols)

Model-7 : [Sequence, No. of Symbols]

① $\{a^m b^n \mid m=1, n=1\}$

② $\{a^m b^n \mid m=1, n\geq 1\}$

③ $\{a^m b^n \mid m\geq 1, n\geq 1\}$

④ $\{a^m b^n \mid m\leq 1, n=1\}$

⑤ $\{a^m b^n \mid m\leq 1, n\leq 1\}$

⑥ $\{a^m b^n \mid m=\text{even}, n=1\}$

⑦ $\{a^m b^n \mid m=\text{odd}, n=1\}$

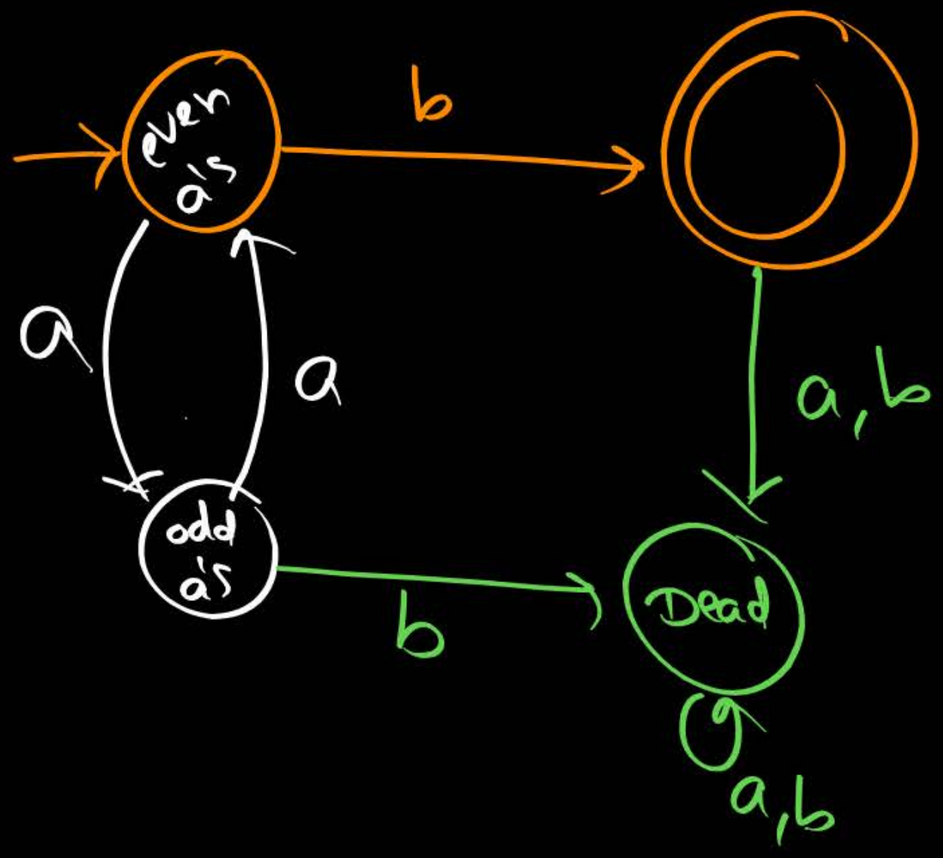
⑧ $\{a^m b^n \mid m=1, n=\text{even}\}$
$a^1\ b^{\text{even}}$

⑨ $\{a^m b^n \mid m=\text{even}, n=\text{even}\}$

⑩ H.W. $\{a^m b^n \mid m=\text{even}, n=\text{odd}\}$

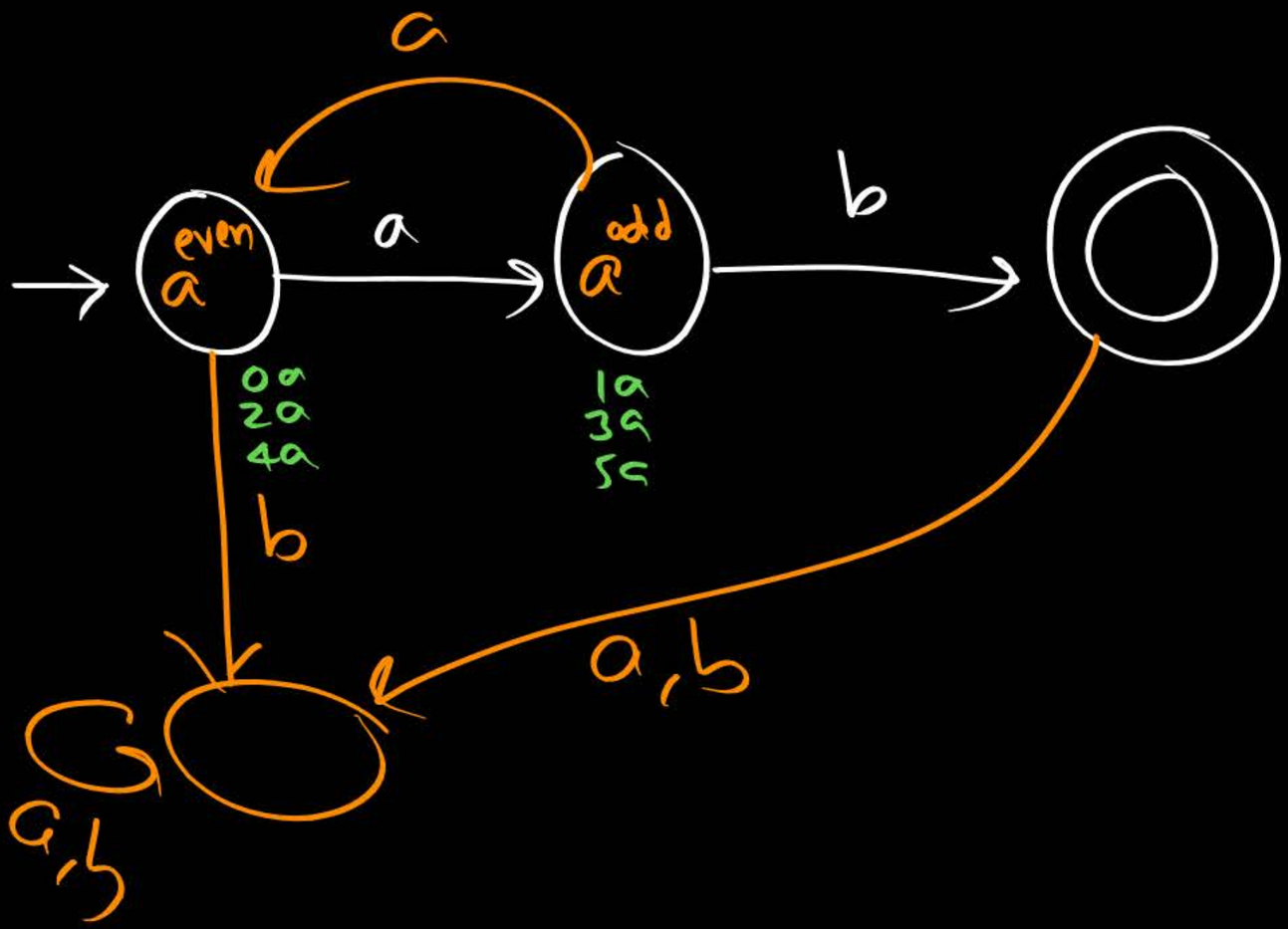
H.W.

⑥ $a^{even}b \Rightarrow (aa)^*b \Rightarrow \{b, a^2b, a^4b, a^6b \ldots\}$



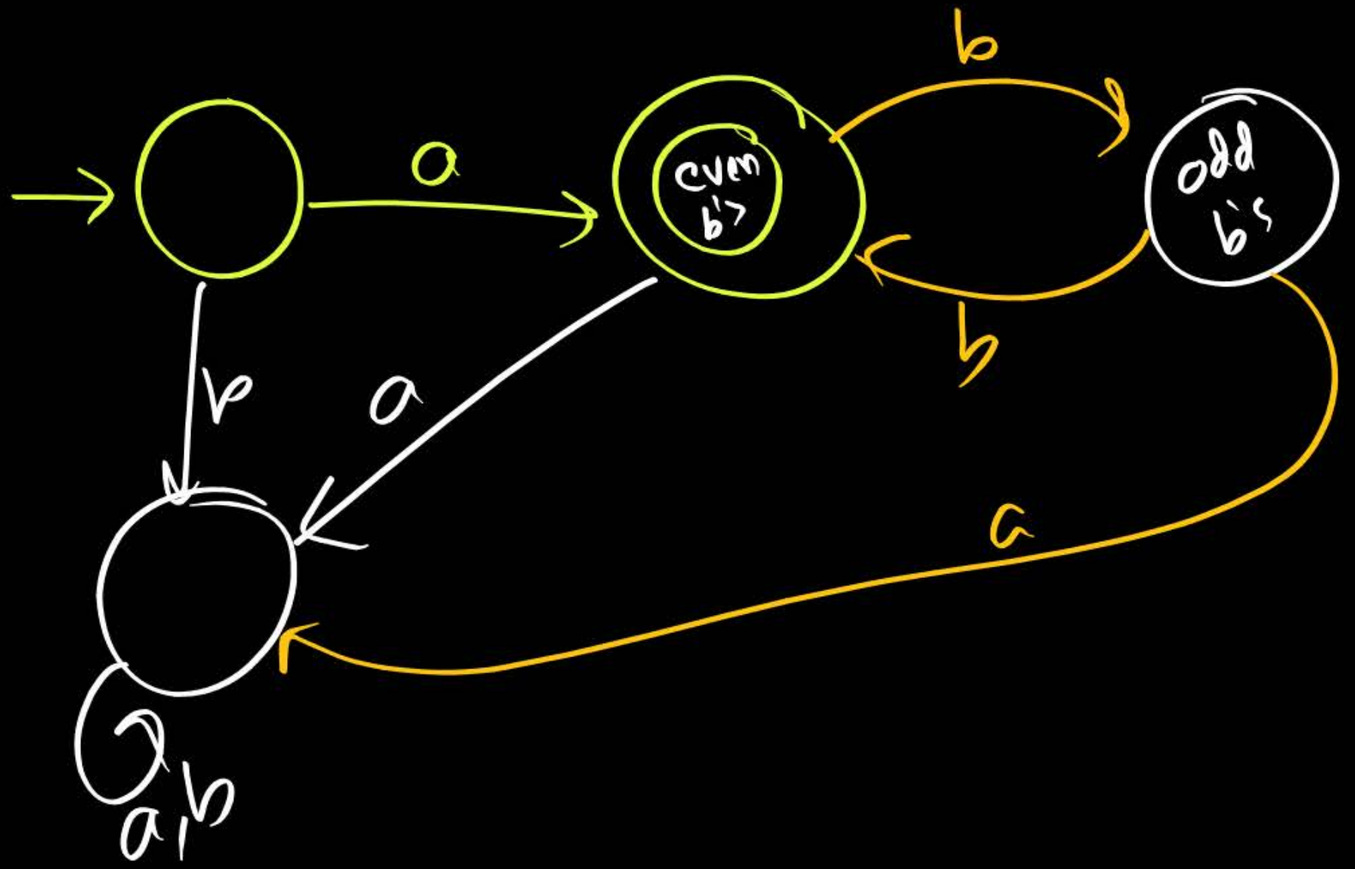
(7) $a^{odd}\,b \Rightarrow \underbrace{a(aa)^*}_{odd}\,\underbrace{b}_{1} \Rightarrow \{ab, a^3b, a^5b, a^7b, \ldots\}$

Min = ab



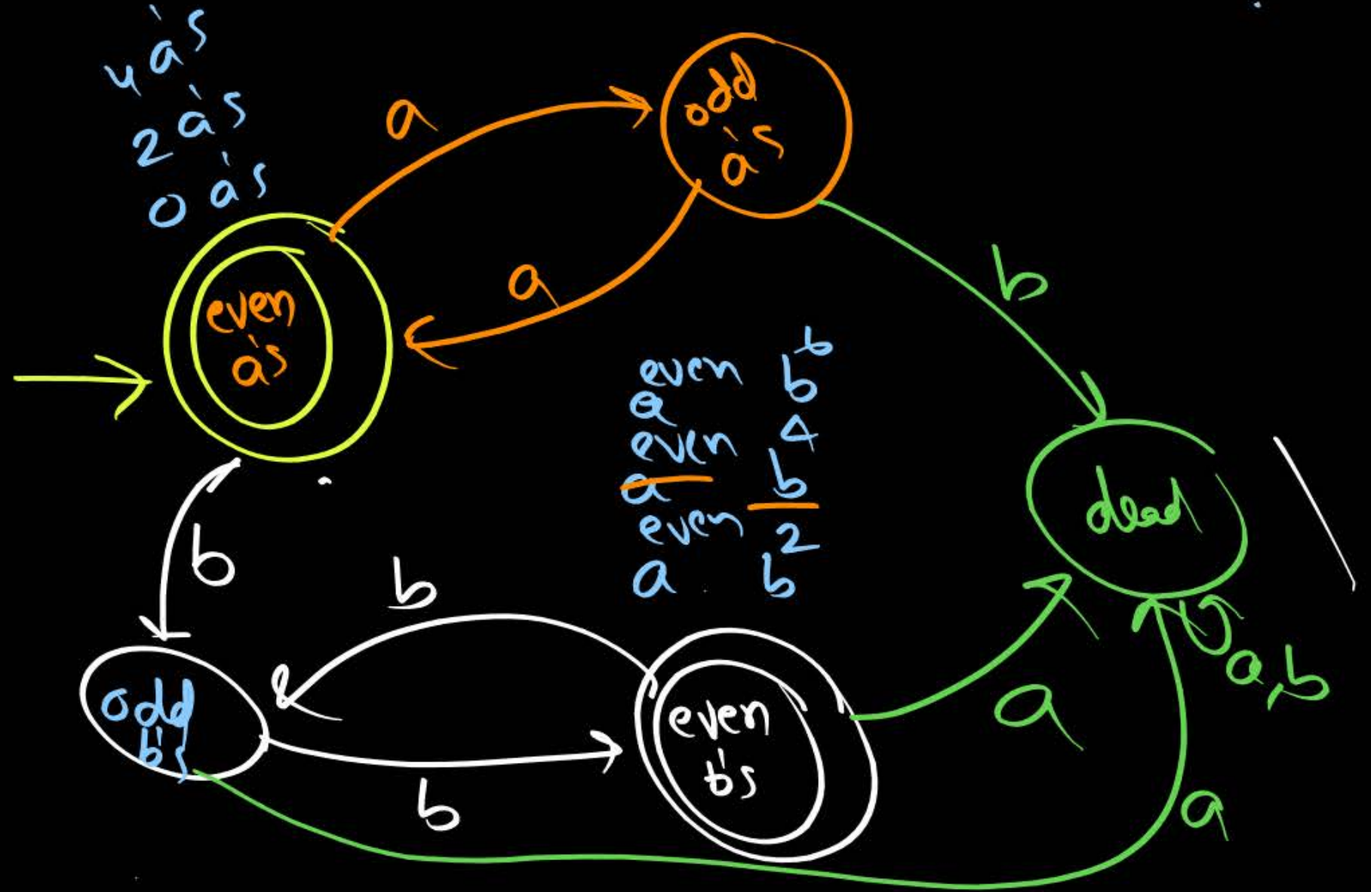
(8) $a^1 b^{even} = a(bb)^* \Rightarrow \{a, ab^2, ab^4, \ldots\}$

Min = a

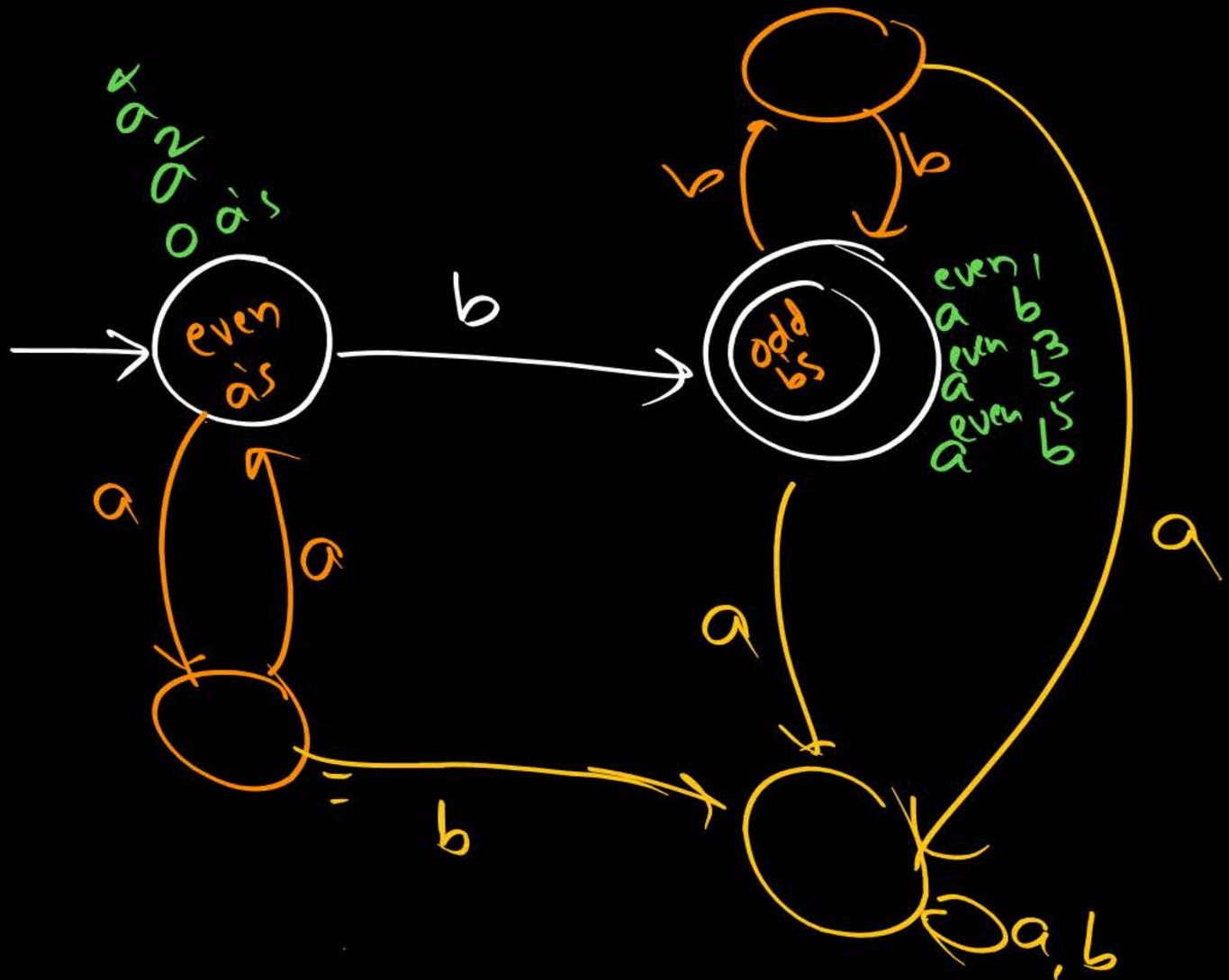


(9) $\xrightarrow{a^{\text{even}}\ b^{\text{even}}} = (aa)^*(bb)^*$

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



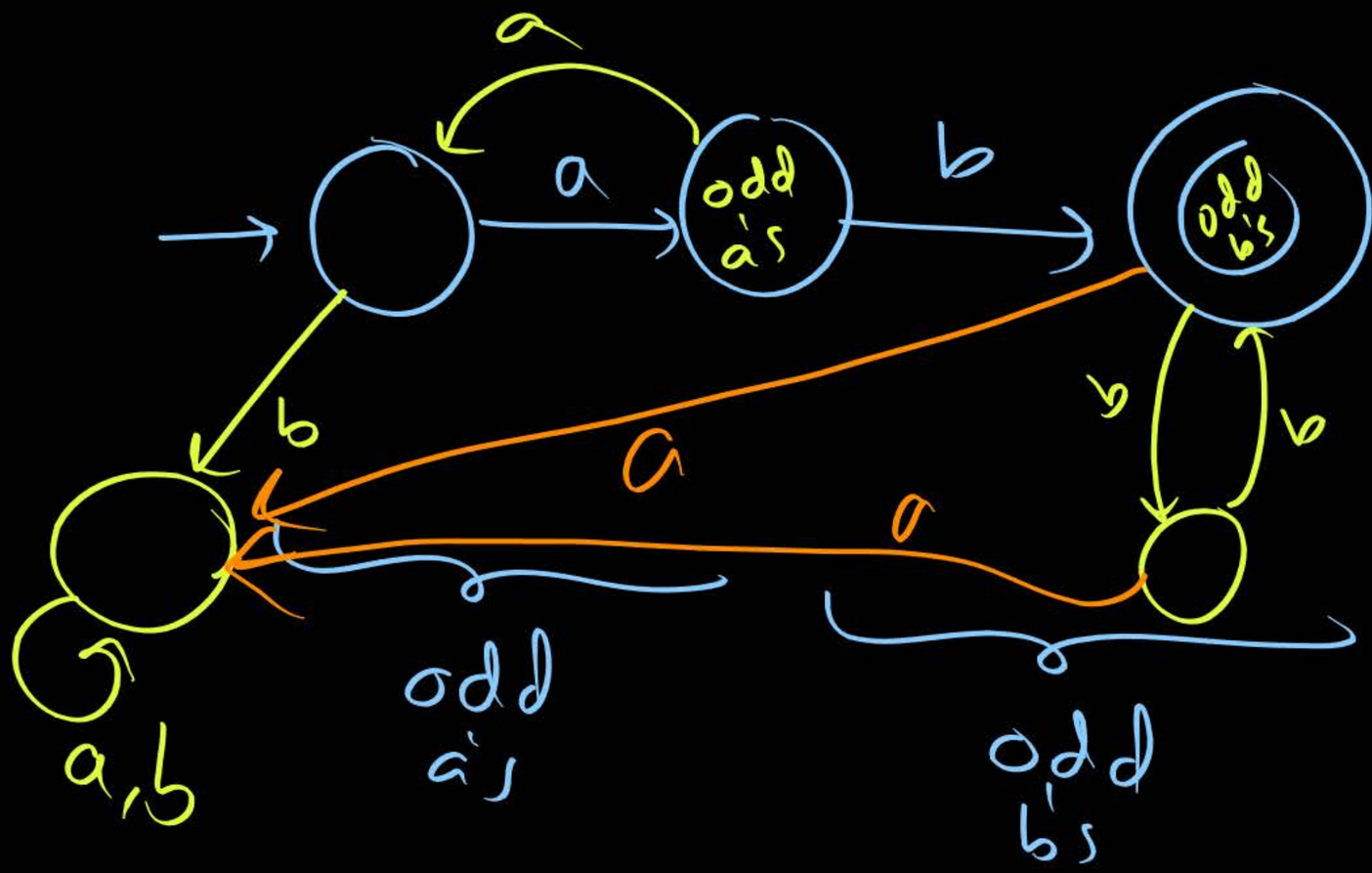
(10) $a^{\text{even}}\ b^{\text{odd}} = (aa)^*\ b\ (bb)^*$



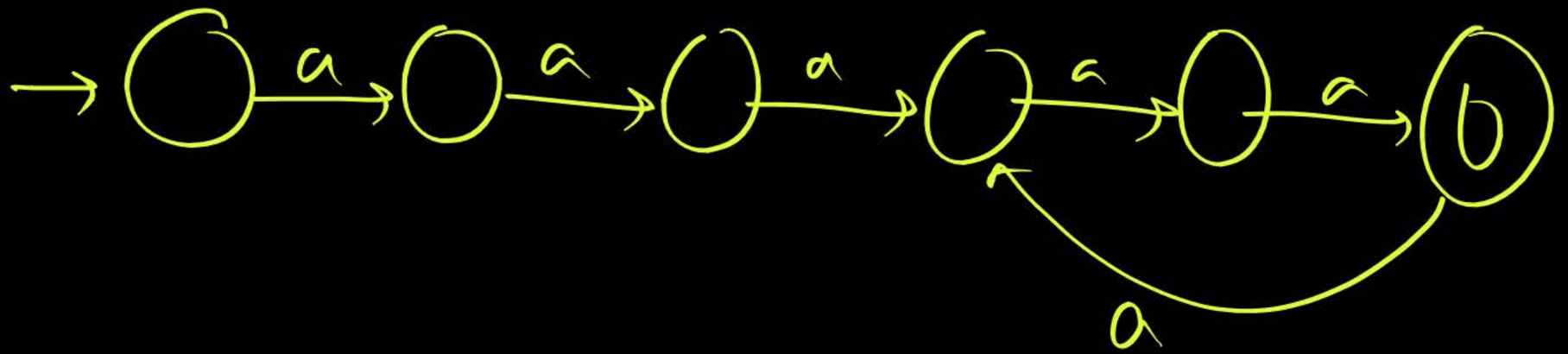
Min = b

(11) $a^{odd}\,b^{odd} = a(aa)^*\,b(bb)^*$

$= \{ab, a^3b, ab^3, a^3b^3, a^5b^3, a^5b^1, a^3b^1, b^5b^3, \ldots\}$



$$\{a^{3n+5} \mid n \geq 0\} = \{a^5, a^8, a^{11}, a^{14}, \ldots\}$$



Model - VIII [Multiple conditions, No. of symbols]

① $\{w \mid w \in \{a,b\}^*,\ n_a(w) = 1,\ n_b(w) = 2\}$

② $\{w \mid$ " $,\ n_a(w) \geq 1,\ n_b(w) \geq 2\}$

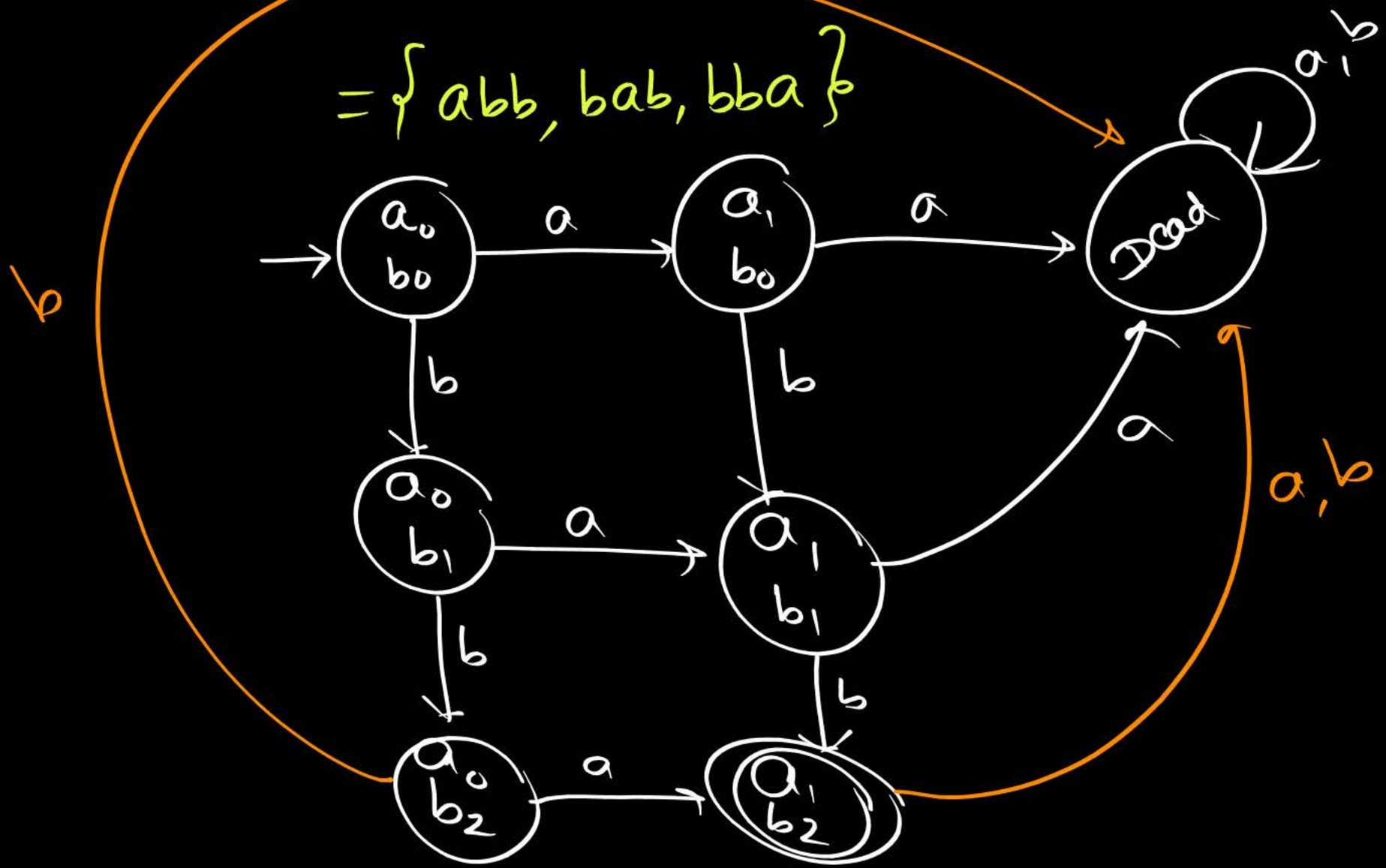
③ $\{w \mid$ " $,\ n_a(w) \leq 1,\ n_b(w) = 2\}$

④ $\{w \mid$ " $,\ n_a(w) \leq 1,\ n_b(w) \leq 2\}$

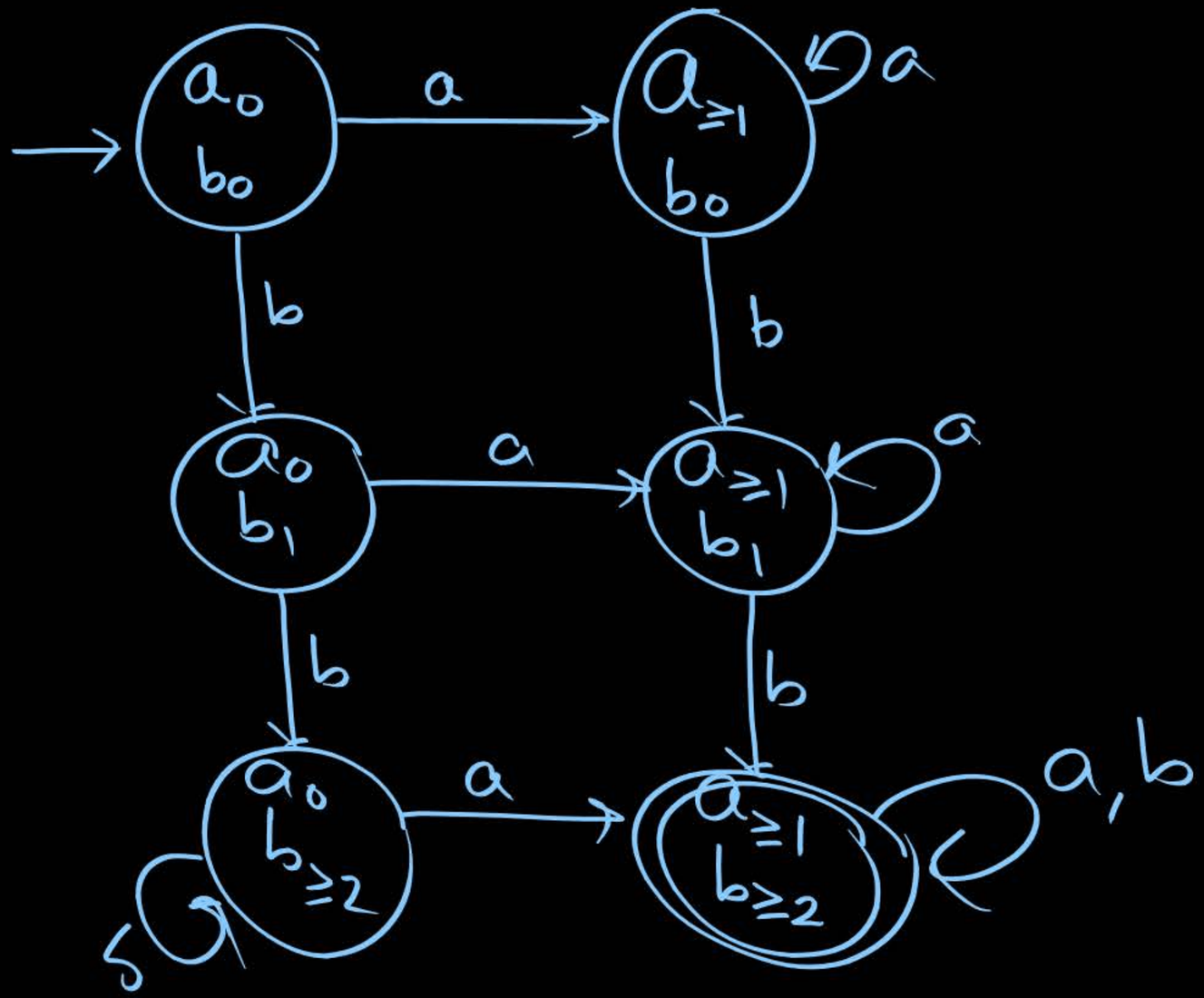
⑤ $\{w \mid$ " $,\ n_a(w) \geq 1,\ n_b(w) \leq 2\}$

① $\{w \mid w \in \{a,b\}^*,\ n_a(w)=1,\ n_b(w)=2\}$

$= \{abb, bab, bba\}$



② $\{ w \mid w \in \{a,b\}^*,\ \underbrace{n_a(w) \geq 1}_{\text{Min } 1a},\ \underbrace{n_b(w) \geq 2}_{\text{Min } 2b} \}$



$a_1 \Rightarrow a_{\geq 1}$

$b_2 \Rightarrow b_{\geq 2}$

③ $\{w \mid w \in \{a,b\}^*,\ n_a(w) \leq 1,\ n_b(w) \geq 2\}$

Max 1a

Min 2 b's

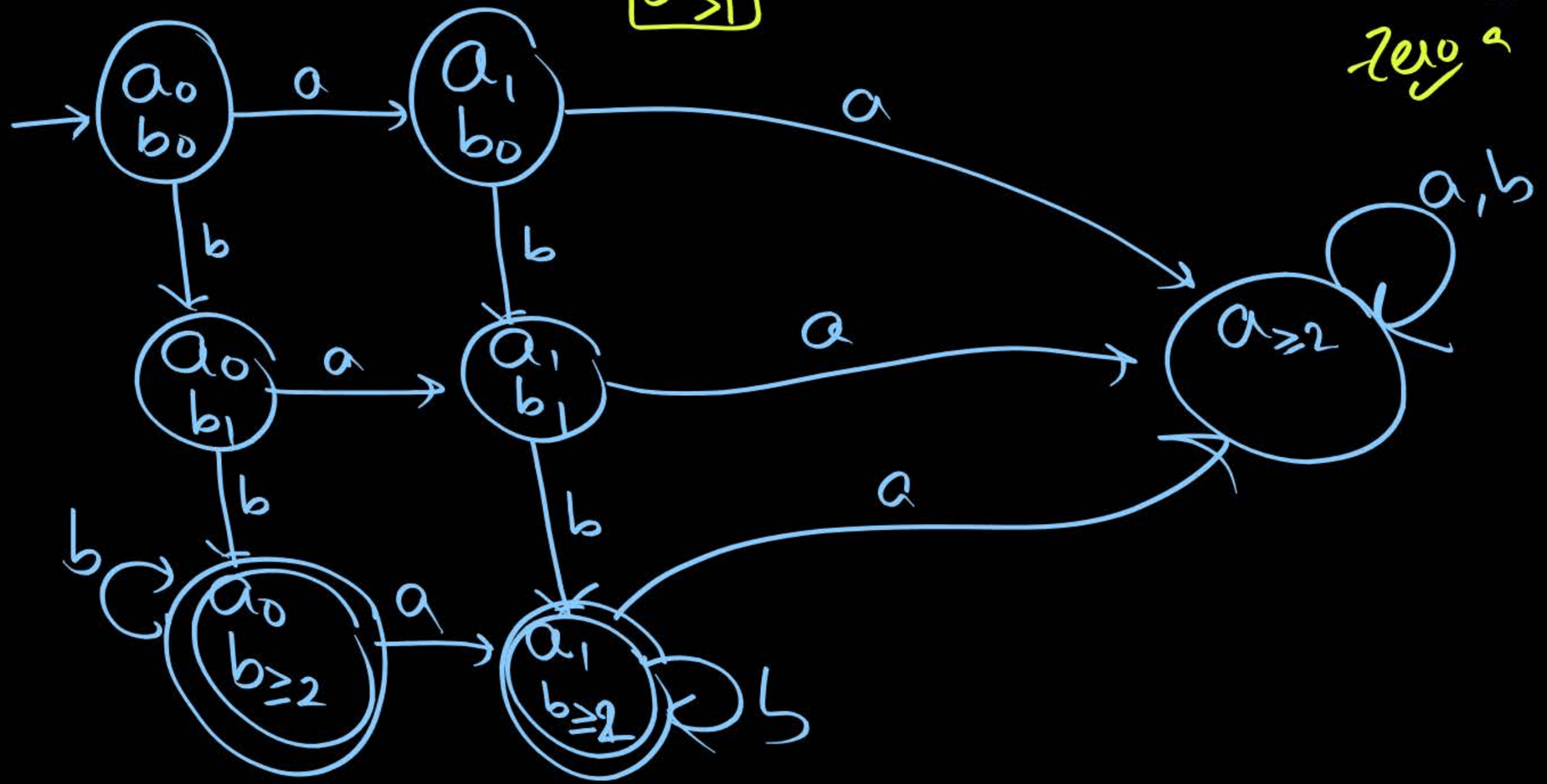
a_0, a_1, $a_{>1}$

b_0, b_1, $b_{\geq 2}$

atmost 1a

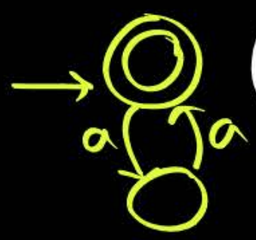
zero a

one a

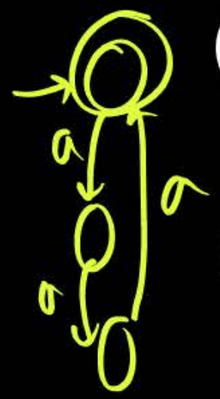


Model - IX [Languages over 1 symbol]

① $a^* = \{\varepsilon, a, a^2, \ldots\}$



② $(aa)^* = \{\varepsilon, a^2, a^4, a^6, \ldots\}$



③ $\{a^{3n} \mid n \geq 0\} = \{\varepsilon, a^3, a^6, a^9, \ldots\}$

④ $(aa + aaa)^* = \{$

⑤ $(a^3 + a^4)^*$

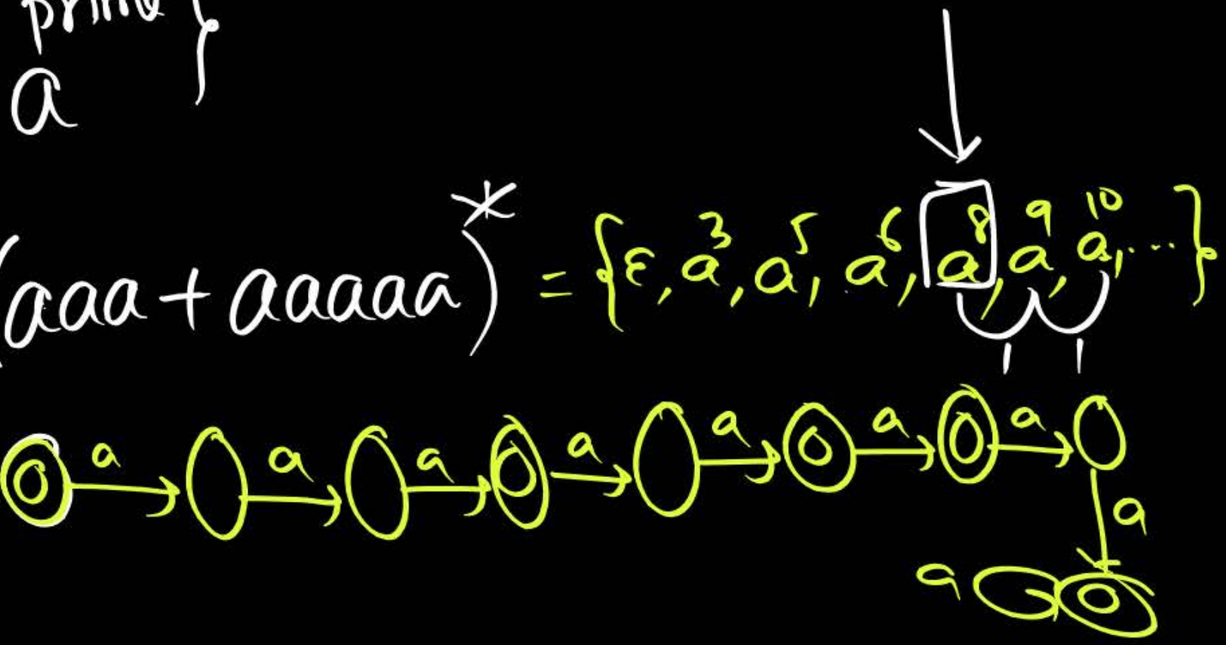
⑤ $\{a^{3n+1} \mid n \geq 0\}$ ⇒ 3 States

⑥ $\{a^{100n+123} \mid n \geq 0\}$ ⇒ 124 States

⑦ $\{a^{\text{prime}}\}^*$

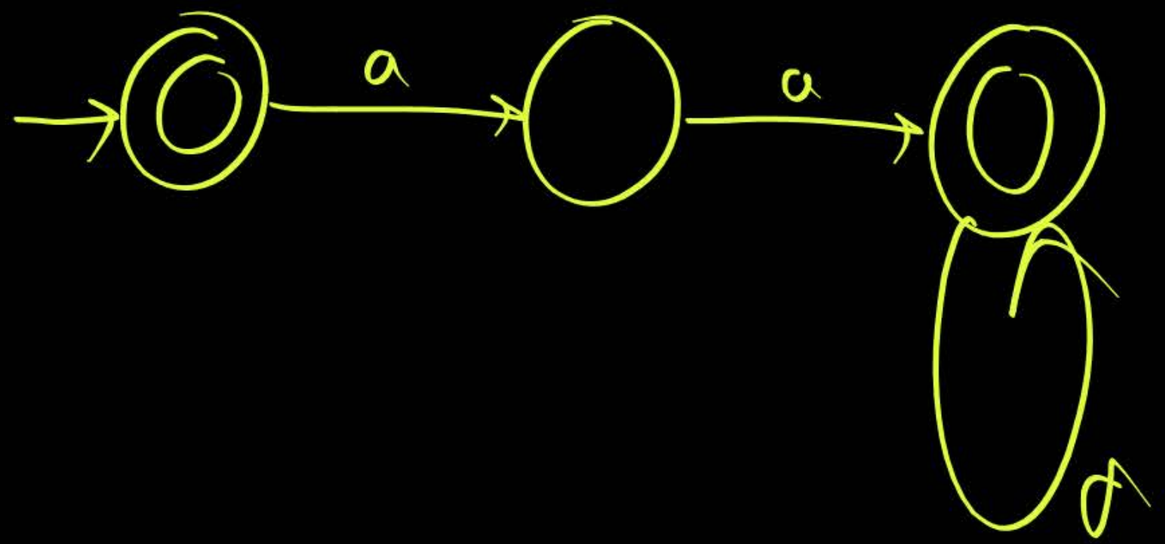
⑧ $(aaa + aaaaa)^* = \{\varepsilon, a^3, a^5, a^6, a^8, a^9, a^{10}, \ldots\}$

GATE



(4) $(a^2 + a^3)^* = (aa + aaa)^* \Rightarrow \{\varepsilon, a^2, a^3, a^4, a^5, \ldots\}$

forms. n.p.



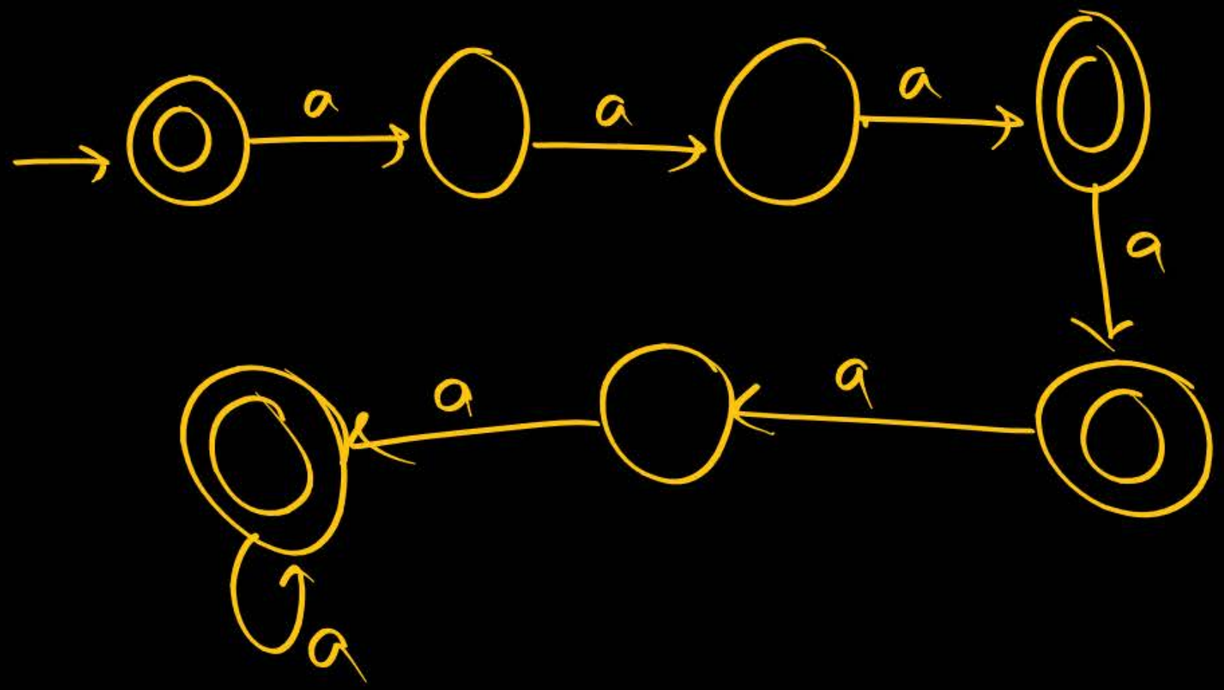
⑤ $(a^3 + a^4)^*$ = { $\varepsilon, a^3, a^4, a^6, a^7, a^8, a^9, a^{10}, \ldots$ }

a a a a

a^1 ✗

a^2 ✗

a^5 ✗



(7) $\{a^{\text{prime}}\}^* = \{a^2, a^3, a^5, a^7, a^{11}, a^{13}, \ldots\}^*$

$=$

(4) $= \{\varepsilon, \boxed{a^2}, a^3, a^4, a^5, a^6, a^7, a^8, \ldots\}$

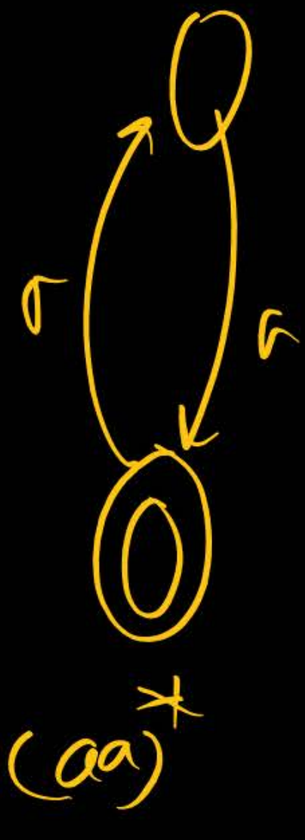
$= a^* - \{a\}$

$= \varepsilon + aaa^*$

$= \overline{\{a\}}$ $= (a^2 + a^3)^*$

Forms A.P.

Not Forms A.P.



2, 4, 6, 8, . . .

9, 11, 13, 15, . . .

+2 +2 +2

0, 1, 2, 5, 8, 11, . . .

start

$2n$ ✓

$3n+100$ ✓

$5n+1234$ ✓

~~n^2~~ $\Rightarrow 1^2, 2^2, 3^2, 4^2, 5^2, \ldots$

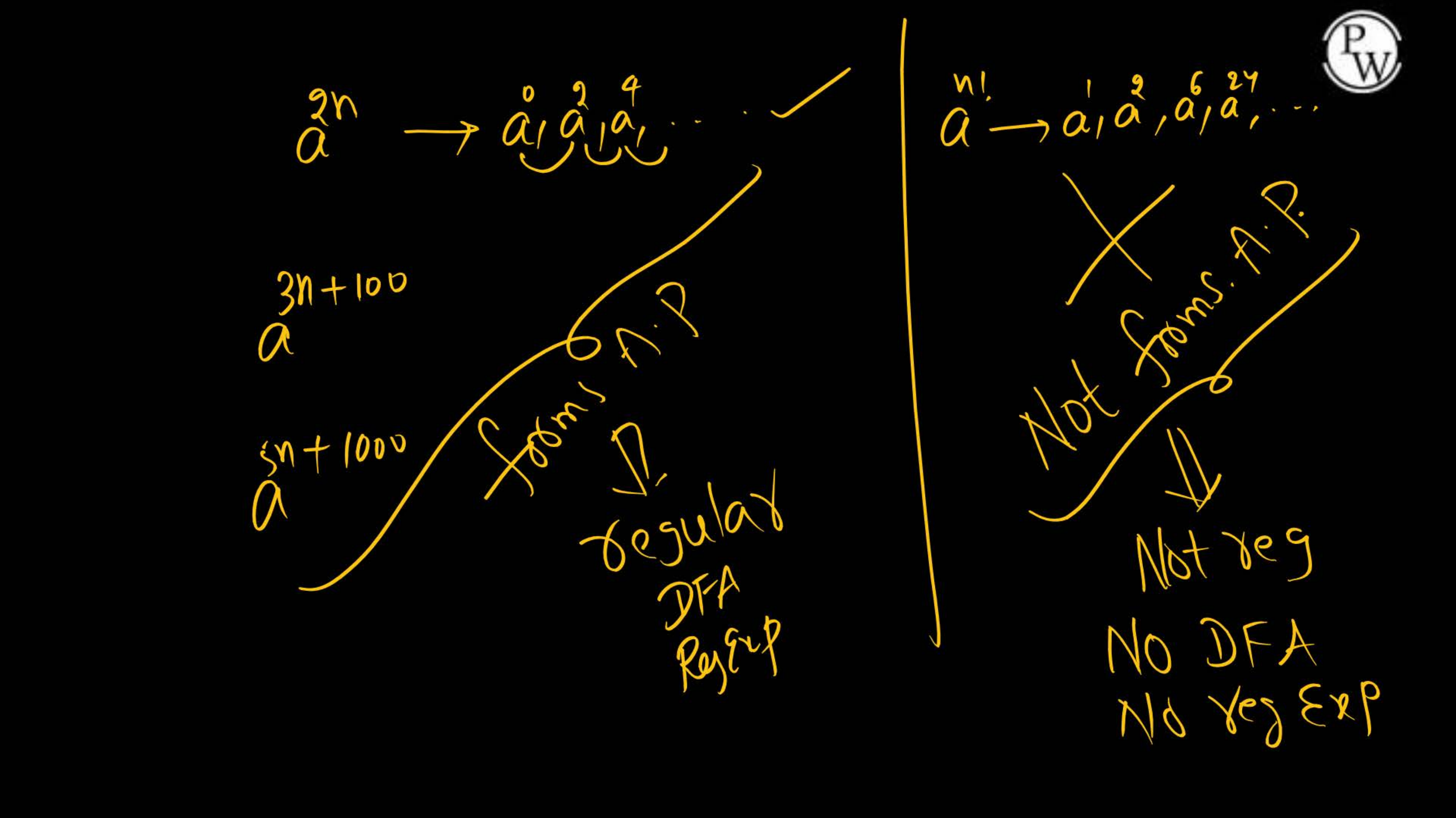
$1, 4, 9, 16, 26, \ldots$ -

~~$n!$~~

~~2^n~~

~~prims~~ $= 2, 3, 5, 7, 11, \ldots$

~~n^n~~


a^{2n} → $a^0, a^2, a^4, \ldots$
a^{3n+100}
$a^{5n+1000}$
forms A.P
∀
Regular
DFA
RegExp
$a^{n!}$ → $a^1, a^2, a^6, a^{24}, \ldots$
Not forms A.P.
∀
Not Reg
No DFA
No Reg Exp

Model-I [Start / end / contain] $\Sigma = \{a, b\}$

1. $L = a(a+b)^*$
2. $L = b(a+b)^*$
3. $L = aaa(a+b)^*$
4. $L = \Sigma^* a \Sigma^*$
5. $L = \Sigma^* aaa \Sigma^*$
6. $L = \Sigma^* a$
7. $\Sigma^* ab$
8. $\Sigma^* aaa$
9. $(aa+bb)\Sigma^*$
10. $\Sigma^*(aa+bb)\Sigma^*$
11. $\Sigma^*(aa+bb)$

H.W.

Summary

- Model - 7 ✓
  - 8 ✓
  - 9 ✓
  - 10 →


THANK YOU
GW
SOLDIERS !