CS & IT ENGINEERING

Theory of Computation

Regular Languages

Lecture No.- 18

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Recap of Previous Lecture

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

Topics to be Covered

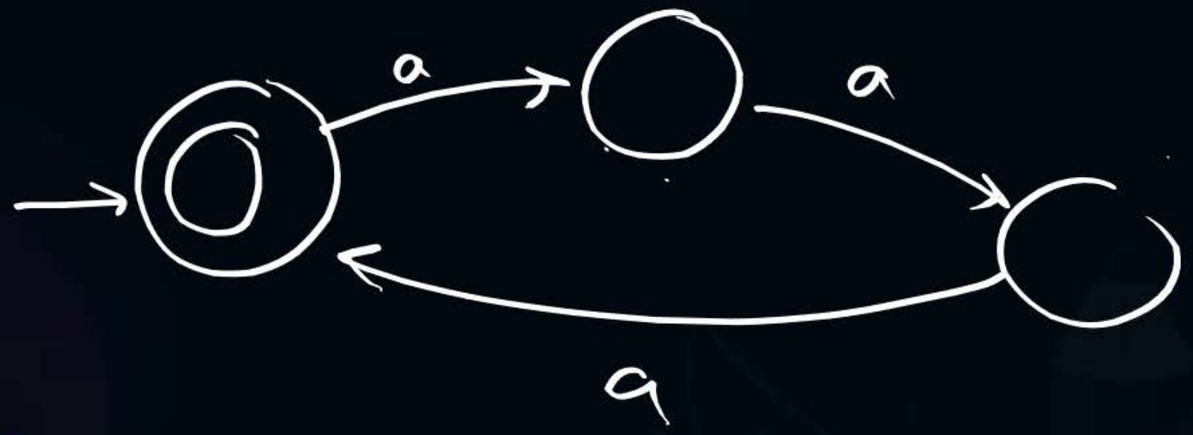
- Topic: Construction of DFA Model IV (Over 1 symbol)
- Topic: Construction of DFA Model V (Sequence based)
- Topic: Construction of DFA Model VI (Length & Remainder)
- Topic: Construction of DFA Model VII (Symbols & Remainder)

Construction of DFA

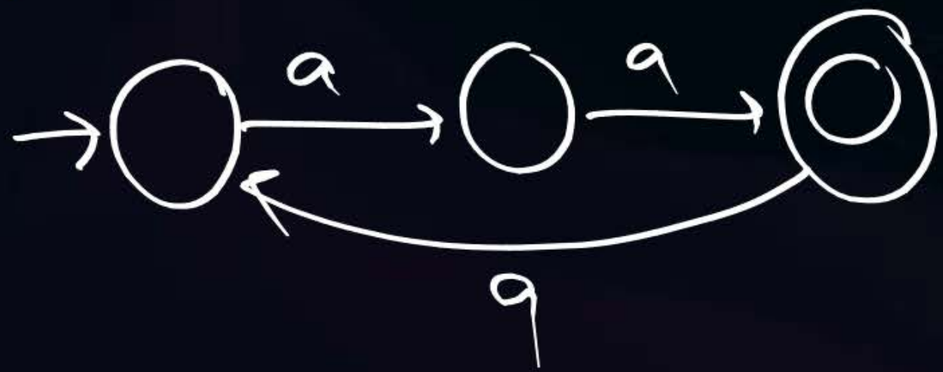
(29) $\{a^{3n} \mid n \geq 0\} = \{\varepsilon, a^3, a^6, a^9, \ldots\}$

$n=0 \quad n=1$

$\{a^2, a^5, \ldots\}$



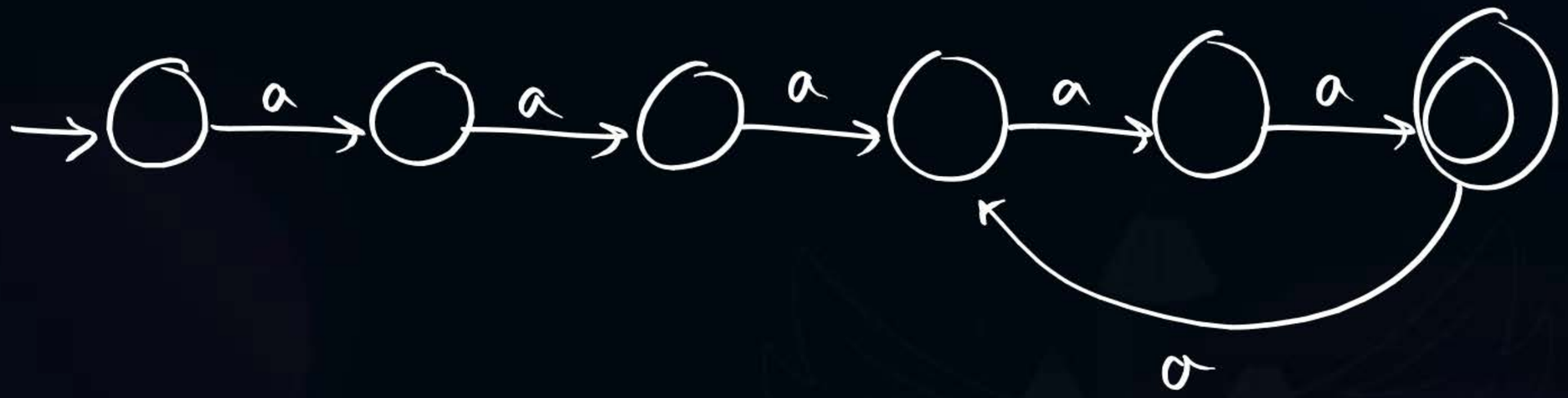
(30) $\{a^{3n+2} \mid n \geq 0\}$



Construction of DFA

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

cycle

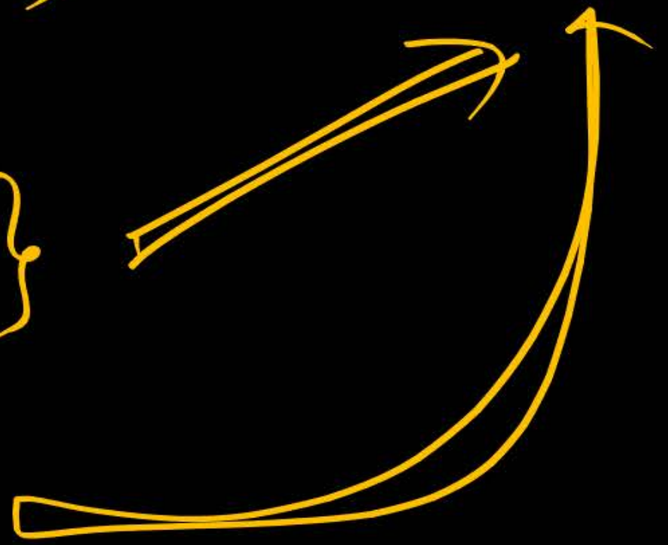


≥ 6 states.

$\{a^{3n+2} \mid n \geq 0\} \Rightarrow$ 3 states

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

$\{a^{3n} \mid n \geq 0\}$



Note:

$\{a^{K_1 n + K_2} \mid n \geq 0,\ K_1 > K_2\}$ (K_2 → remainder)

$\Downarrow$

K_1 states in min DFA

Construction of DFA

$\{a^{3n+3} \mid n \geq 0\} \Rightarrow$ 4 states in minDFA

$\{a^{3n+4} \mid n \geq 0\} \Rightarrow$ 5 states

$\{a^{3n+5} \mid n \geq 0\} \Rightarrow$ 6 states

$\{a^{3n+6} \mid n \geq 0\} \Rightarrow$ 7 states

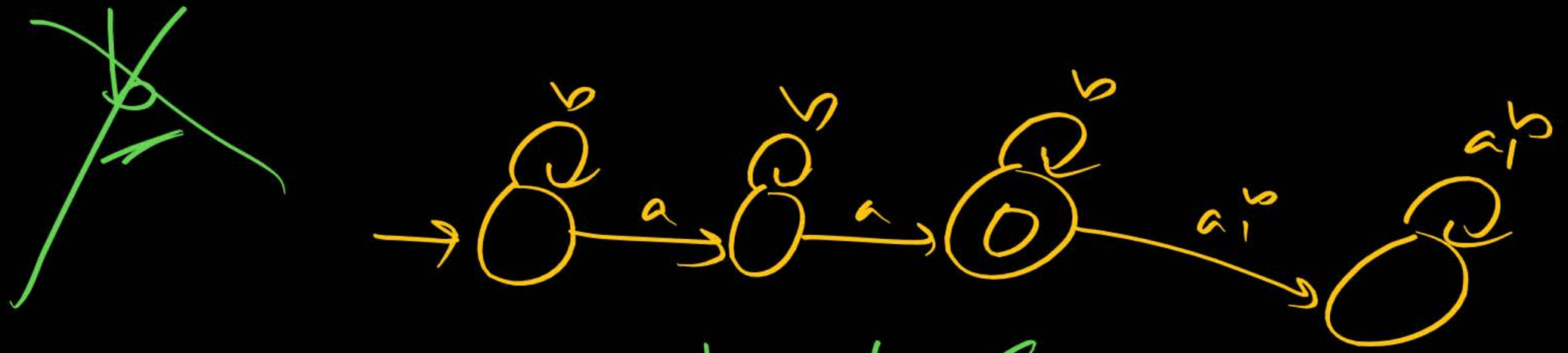
Note:

$\{a^{K_1 n + K_2} \mid n \geq 0, K_1 \leq K_2\}$

$\Downarrow$

$K_2 + 1$ States

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



Min = aa

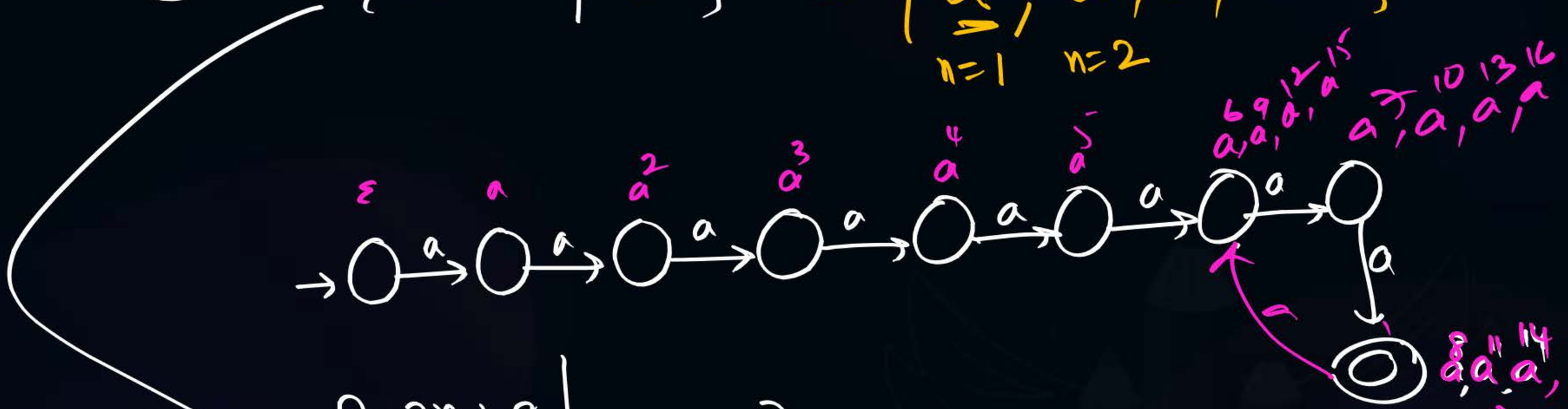
baab ✓

{aa, baa, aba, aab, ...}

Construction of DFA

(33) $\{a^{3n+5} \mid n \geq 1\} = \{a^8, a^{11}, a^{14}, \ldots\}$

$n=1$ $n=2$

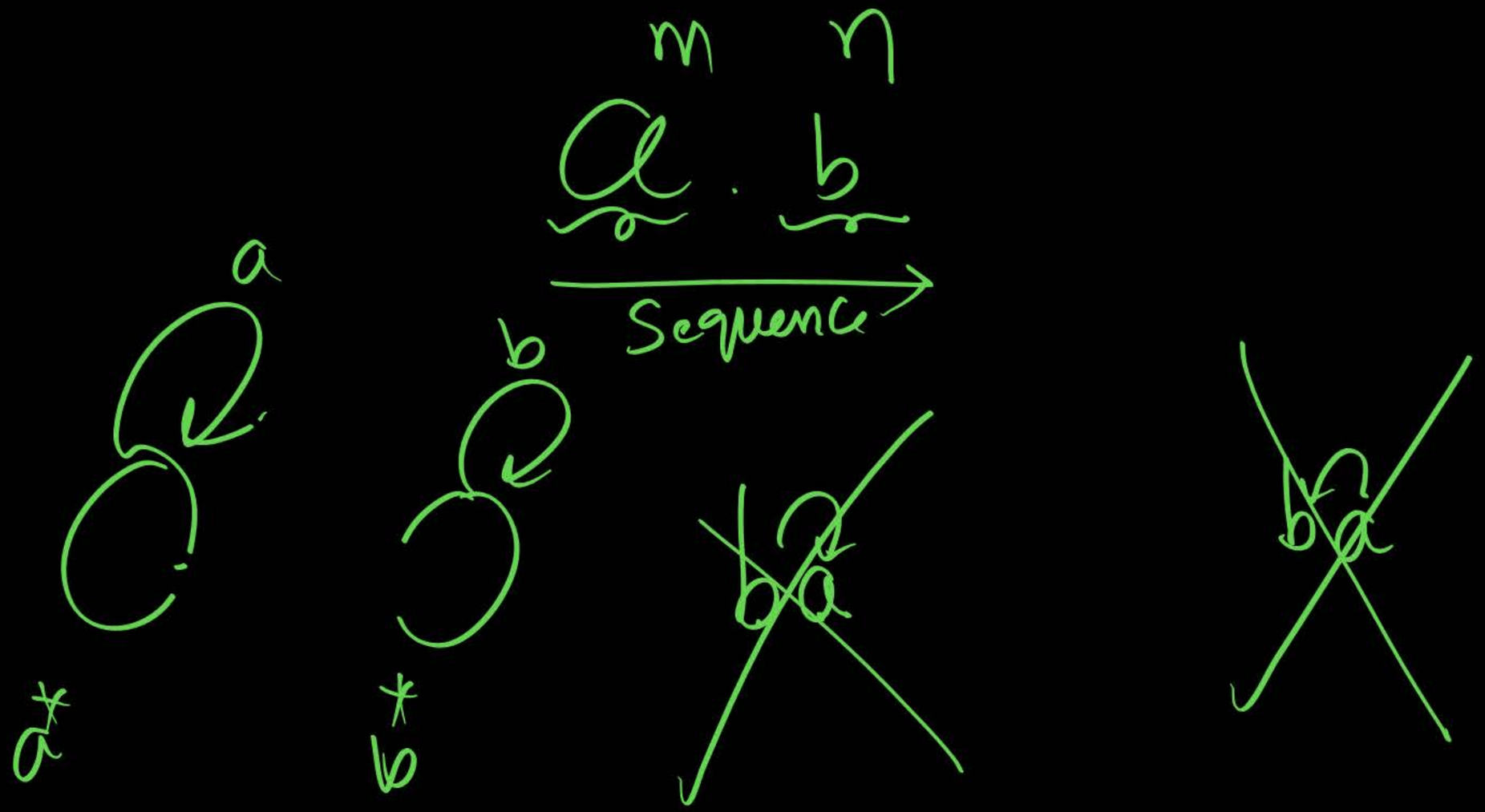


$\{a^{3n+8} \mid n \geq 0\}$

$n=0 \Rightarrow a^8$

$n=1 \Rightarrow a^{11}$

$\Rightarrow$ 9 states


m n
a . b
Sequence
a
b
a*
b*
b a
b a

Construction of DFA

Model-II [Sequence based] :

(34) $\{a^+ b^+\}$

(35) $\{a^+ b^*\}$

(36) $\{a^* b^+\}$

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

Construction of DFA

(34) $\{a^+ b^+\} = \{a^m b^n \mid m \geq 1, n \geq 1\}$

$= \{ab, a^2b, ab^2, a^2b^2, a^3b, a^2b^2, ab^3, \ldots\}$

$= \{ab, aab, abb, aabb, \ldots\}$

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

$= \{w \mid w \in \{a^+ b^+\}\}$

Construction of DFA

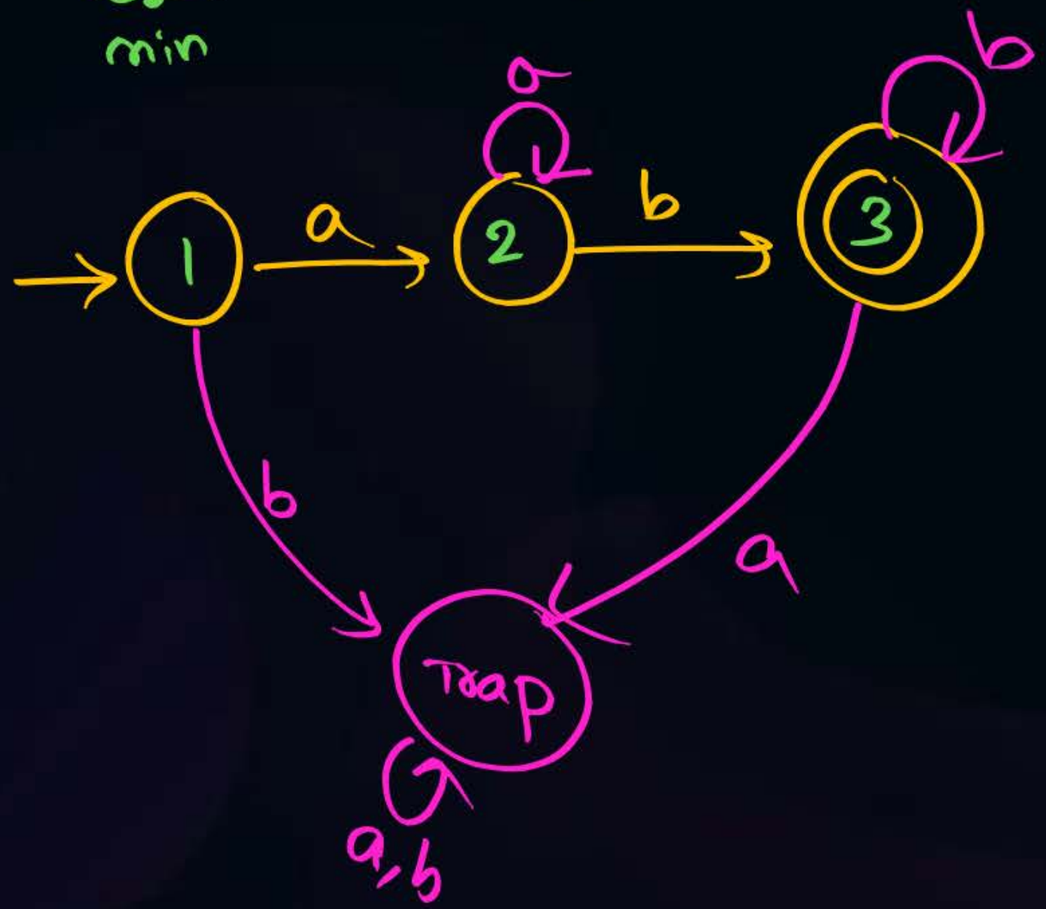
(34) $\{a^+b^+\}$

a never appears after b

b never appears before a

{ab, ... }
min

Min = ab



1 $\xrightarrow{b}$? ✓

2 $\xrightarrow{a}$?

3 $\xrightarrow{a}$?

3 $\xrightarrow{b}$?

$$a^{\dagger} b^{\dagger} = a a^{*} b b^{*}$$

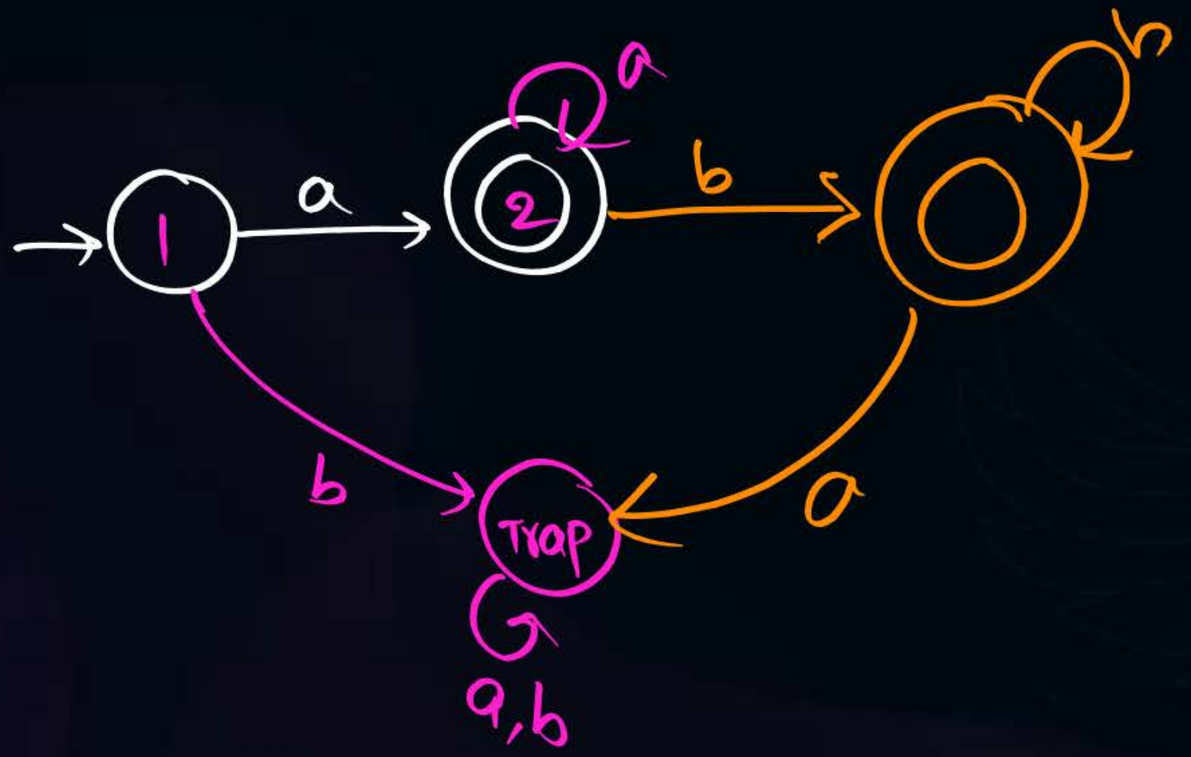
$$= a^{*} a b^{*} b$$

$$= a a^{*} b^{*} b$$

Construction of DFA

(35) $\{a^+b^*\} = \{a^m b^n \mid m \geq 1, n \geq 0\}$

$= \{a, aa, ab, aaa, aab, abb, \ldots\}$



$1 \xrightarrow{b} ?$ ✓

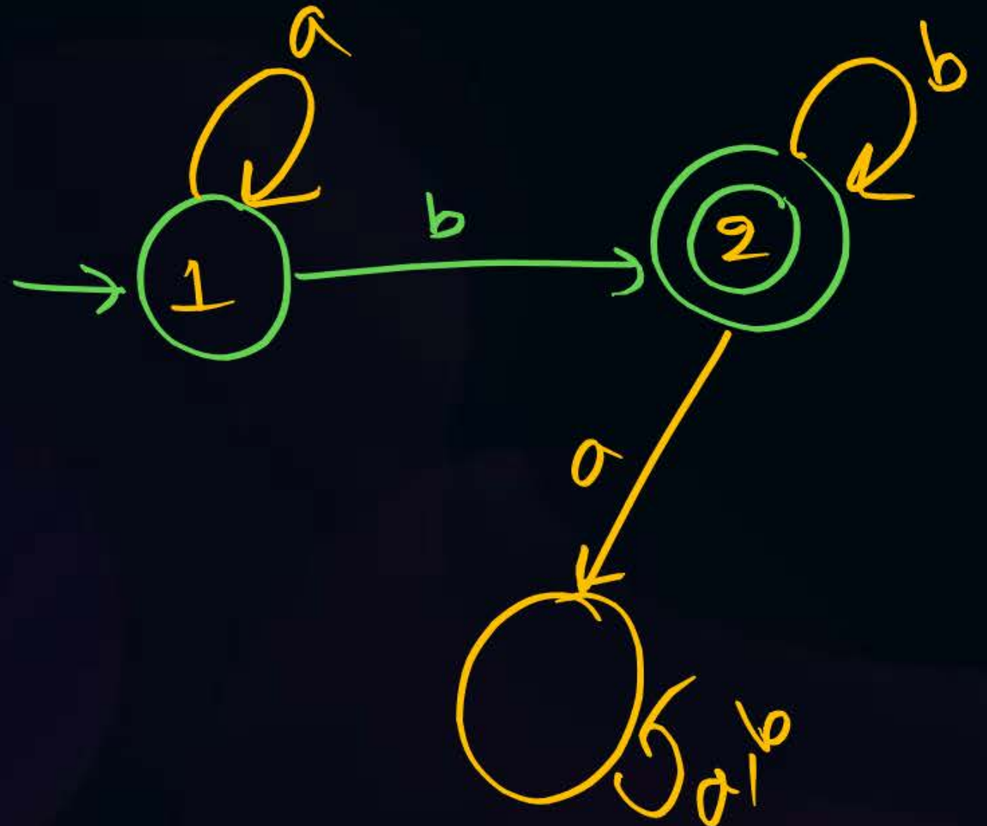
$2 \xrightarrow{a} ?$ ✓

$2 \xrightarrow{b} ?$

Construction of DFA

(36) $\{a^* b^+\} = \{a^m b^n \mid m \geq 0, n \geq 1\}$

$= \{\underset{\text{min}}{b}, ab, bb, \ldots\}$



$1 \xrightarrow{a} ?$ ✓

$q \xrightarrow{a} ?$

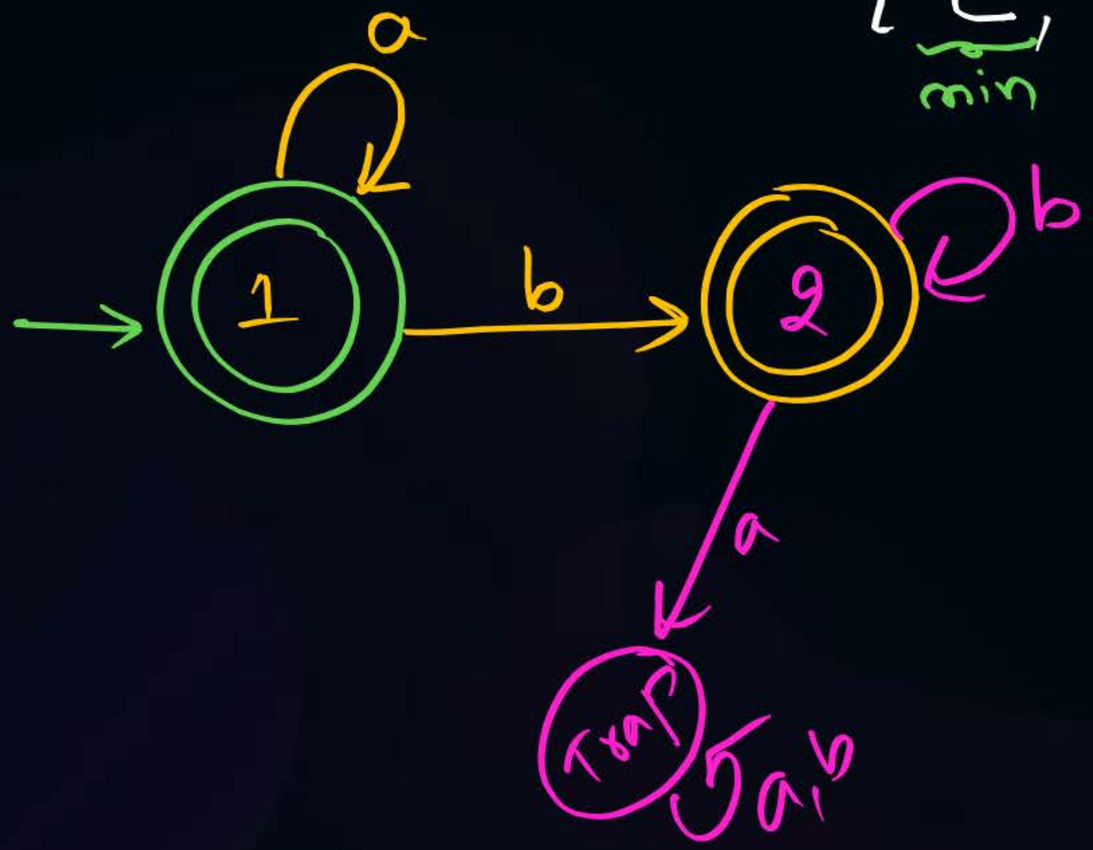
$q \xrightarrow{b} ?$

Construction of DFA

(37) $\{a^* b^*\} = \{a^m b^n \mid m \geq 0, n \geq 0\}$

$= \{\underset{\text{min}}{\varepsilon}, a, b, aa, ab, bb, \ldots\}$

~~ba~~



$1 \xrightarrow{a} ?$

$1 \xrightarrow{b} ?$

$2 \xrightarrow{a} ?$

$2 \xrightarrow{b} ?$

Construction of DFA

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

38. $\{b^+ a^+\}$
39. $\{b^* a^+\}$
40. $\{b^+ a^*\}$
41. $\{b^* a^*\}$
42. $\{a^+ b^+ c^+\}$
43. $\{a^* b^* c^*\}$
44. $\{a^+ b^* c^+\}$
45. $\{c^+ b^+ a^*\}$

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

2 mins Summary

Topic Easy, Length, Number of Symbols, Over 1 symbol

Topic Sequence

Topic Remainder based ⇨ Next

THANK - YOU