CS & IT ENGINEERING

Theory of Computation

Push Down Automata

Lecture No. 4

By- DEVA Sir

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01 PDA & DPDA

02 → Identify DPDA / PDA ?

03 → Construction

04 → Identify language accepted by m/c ?

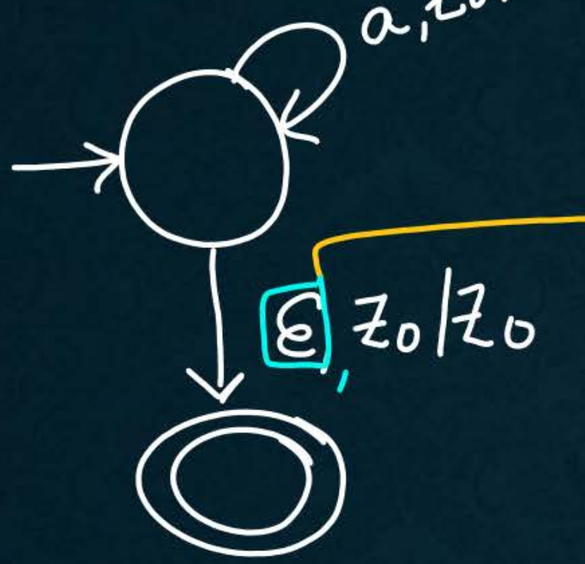
05

Identify DPDA or not.
PDA or not.

DPDA ✓

PDA ✓

(1)



special, it represents end of i/p

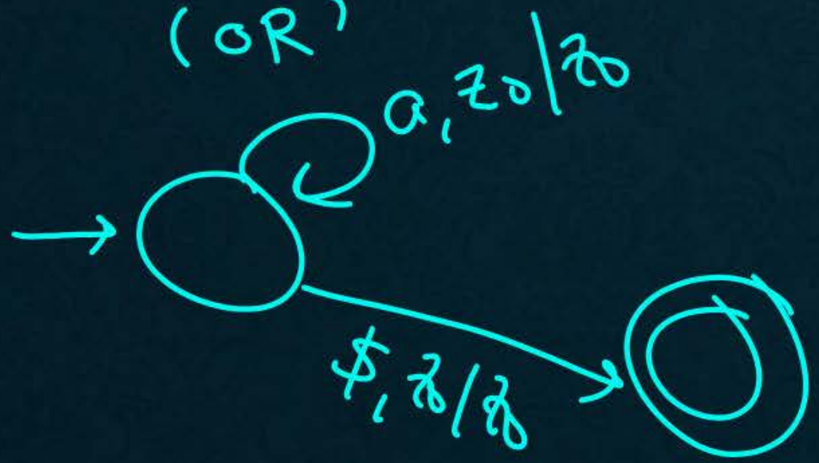
abab$ end of i/p

ε

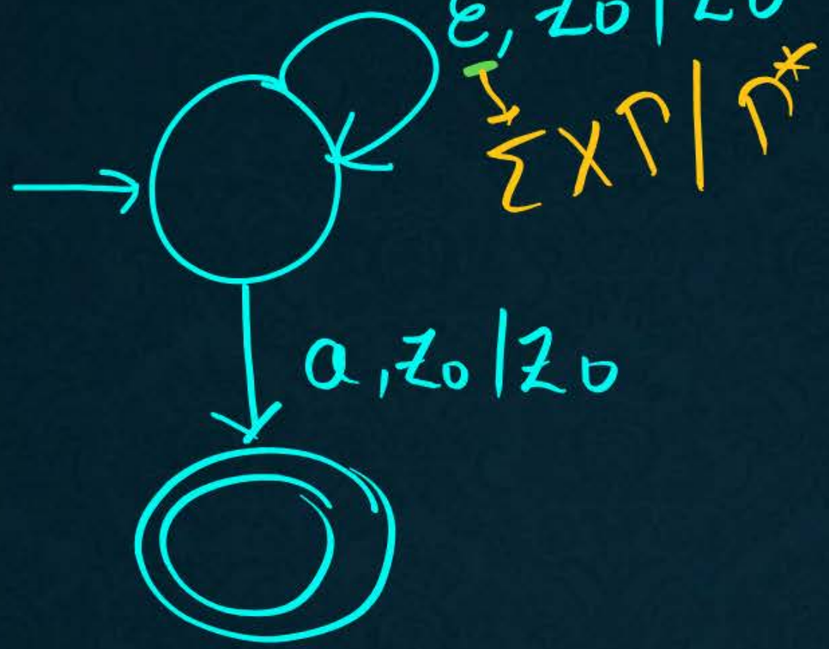
In DPDA

We assume special transition requires to represent end of i/p

(OR)



(2)



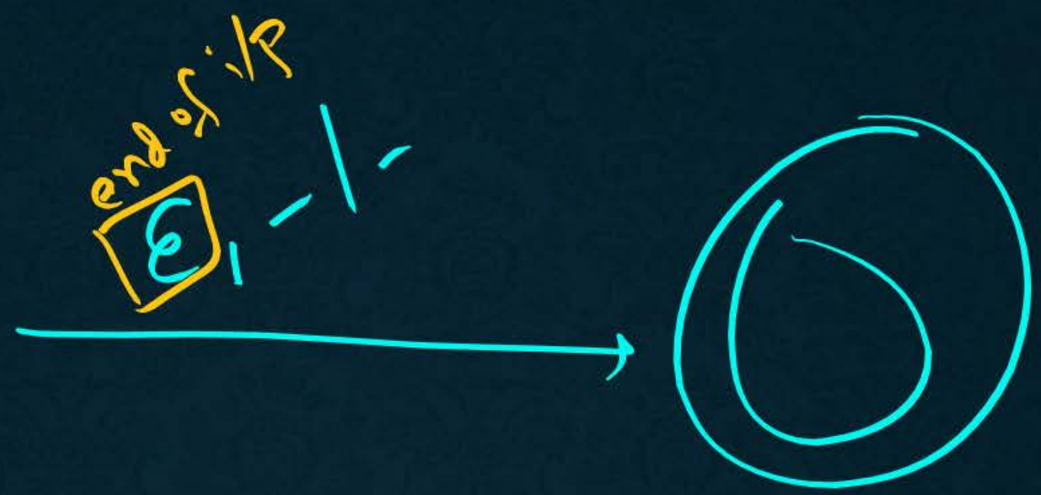
PDA ✓

DPDA ✗

(3)

DPDA ✓

PDA ✓



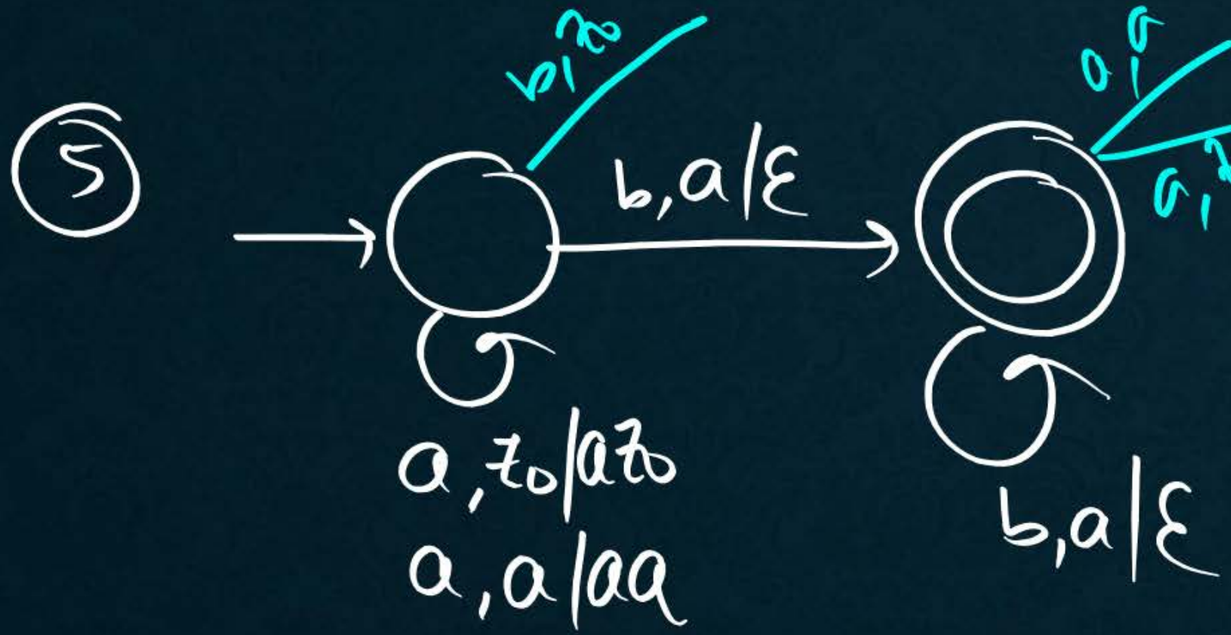
It is allowed in DFA

(4)

PDA ✓

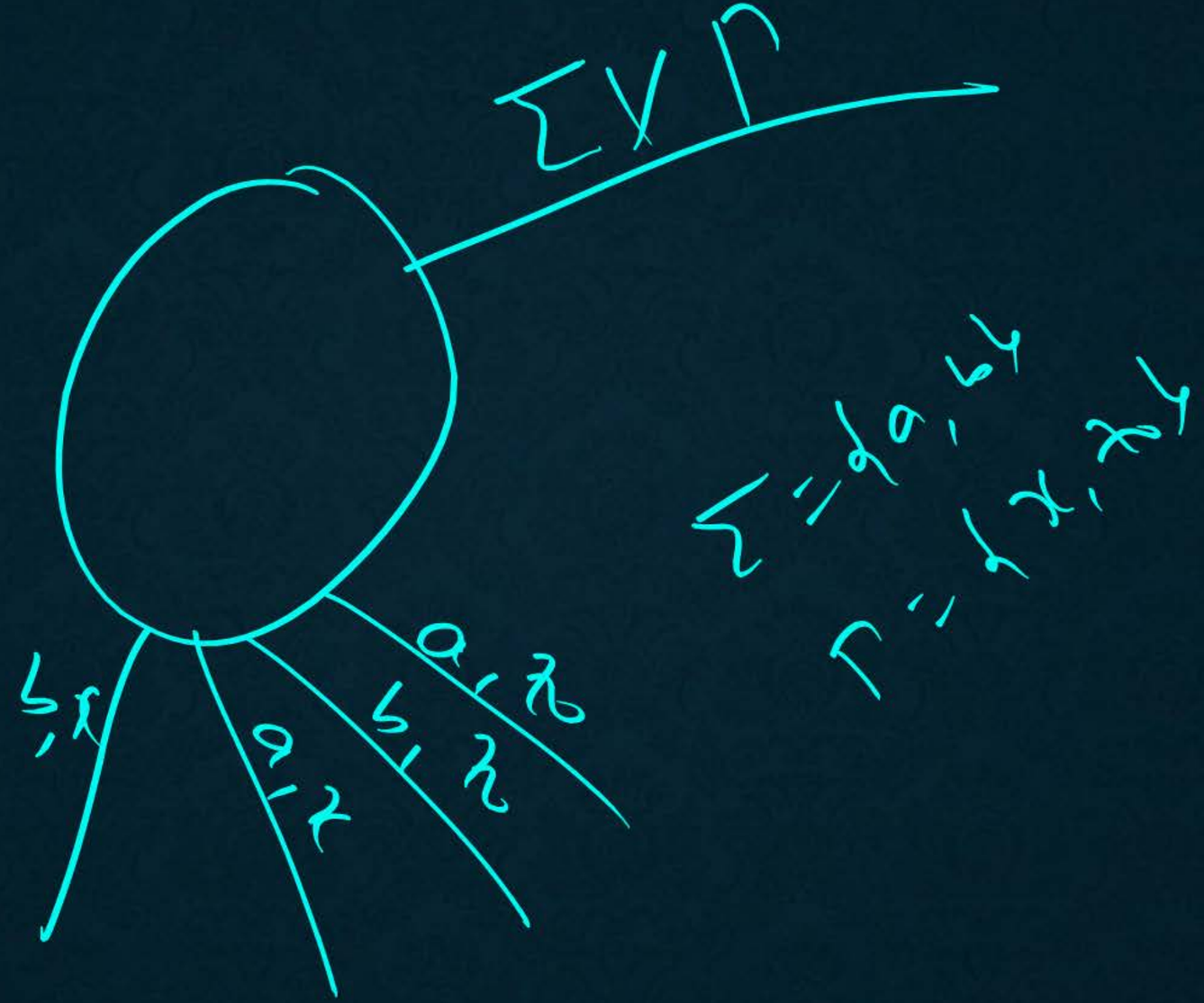
DPDA ✗

(5)



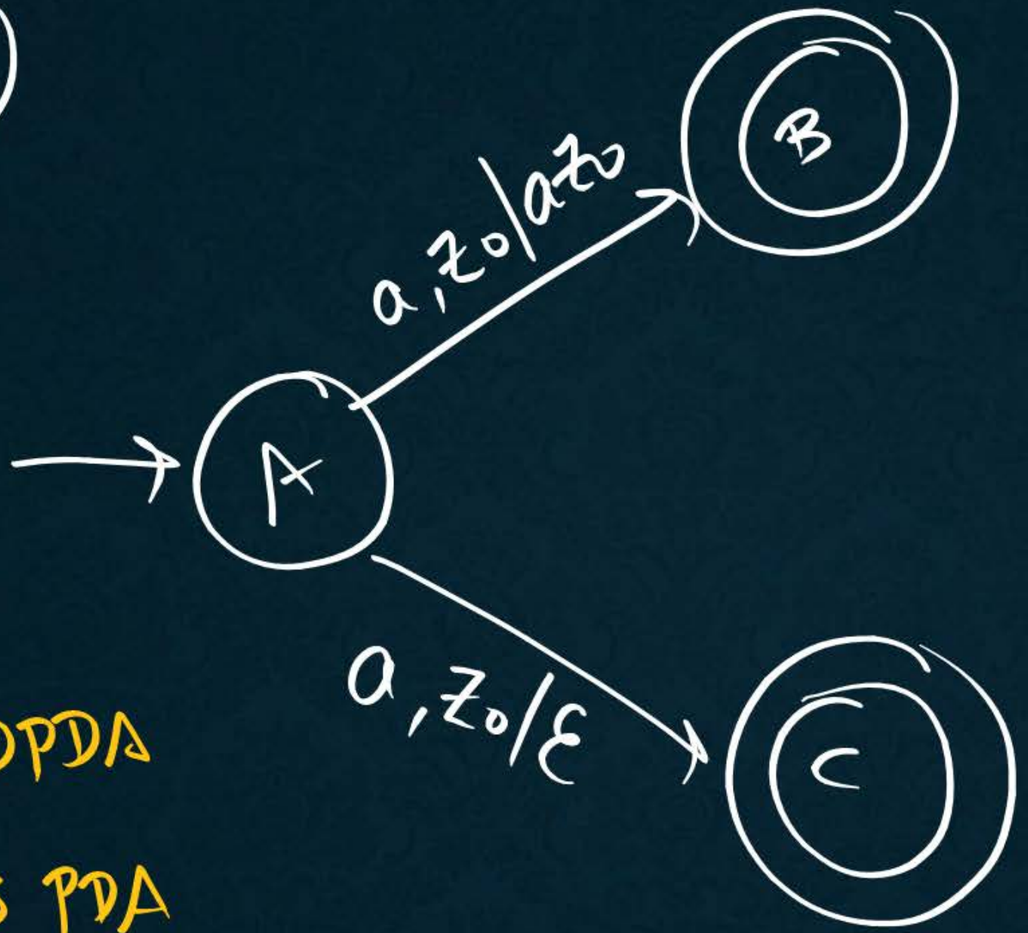
DPDA ✓

PDA ✓


ΣXP
Σ = {a, b}
P = {X, Z}
b, X
a, Z
b, Z
a, Z

***

6



$Q \times \Sigma \times \Gamma \longrightarrow Q \times \Gamma^*$

fails

not DPDA

It is PDA

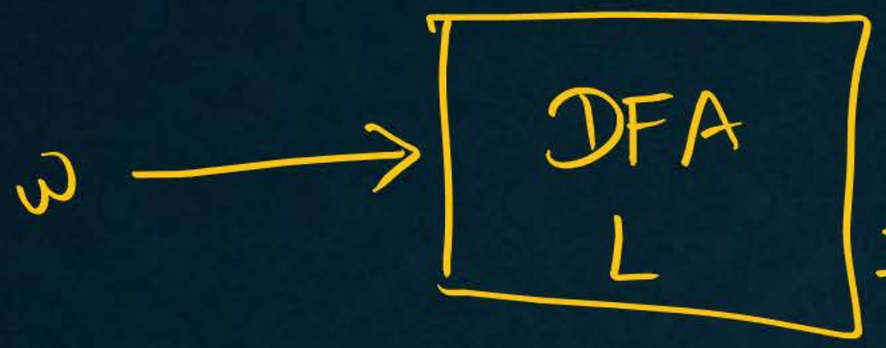
$Q \times \Sigma_\varepsilon \times \Gamma^* \longrightarrow 2^{Q \times \Gamma^*}$

$\delta(A, a, z_0) = (B, a z_0)$

$Q \times \Sigma \times \Gamma^*$

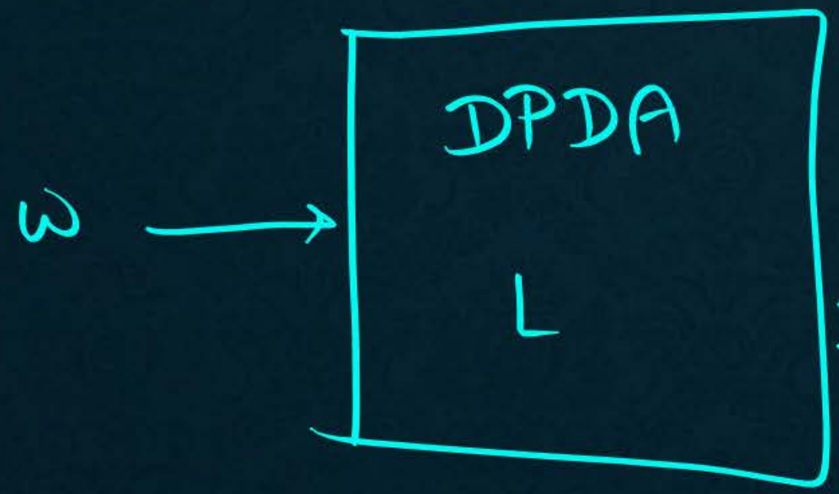
OR

(C, ε)



If $w \in L$, exactly 1 path, halts at final

If $w \notin L$, exactly 1 path, halts at nonfinal



If $w \in L$, exactly 1 path, halts at final

If $w \notin L$, exactly 1 path or Zero paths, halts at nonfinal

(atmost 1 path)

Zero paths

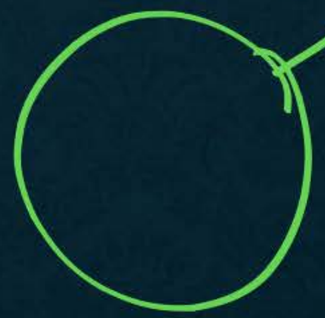
⇓

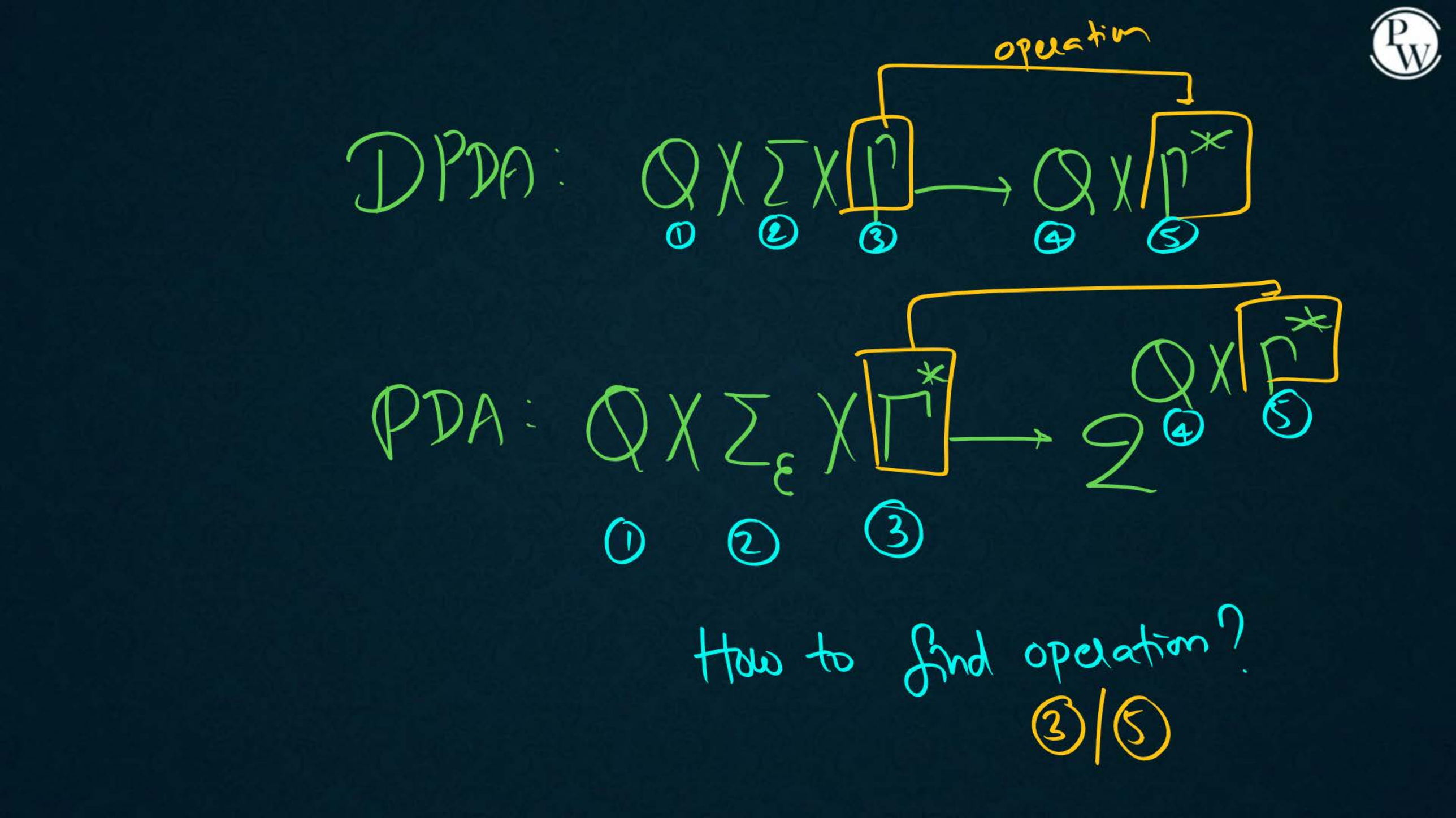
always convertible to 1 path

Σ r

$a_{i,b}$ is writing

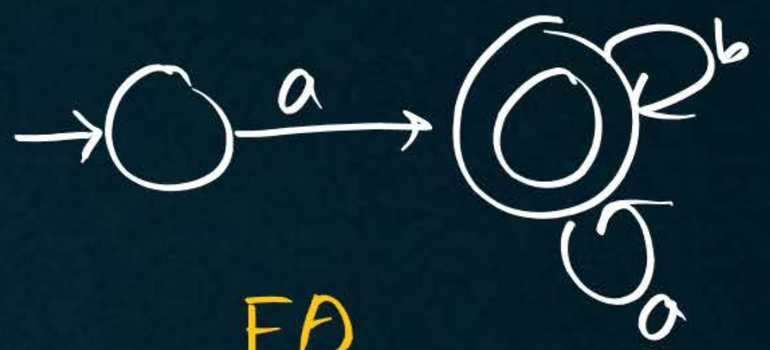
assume it is going to dead state



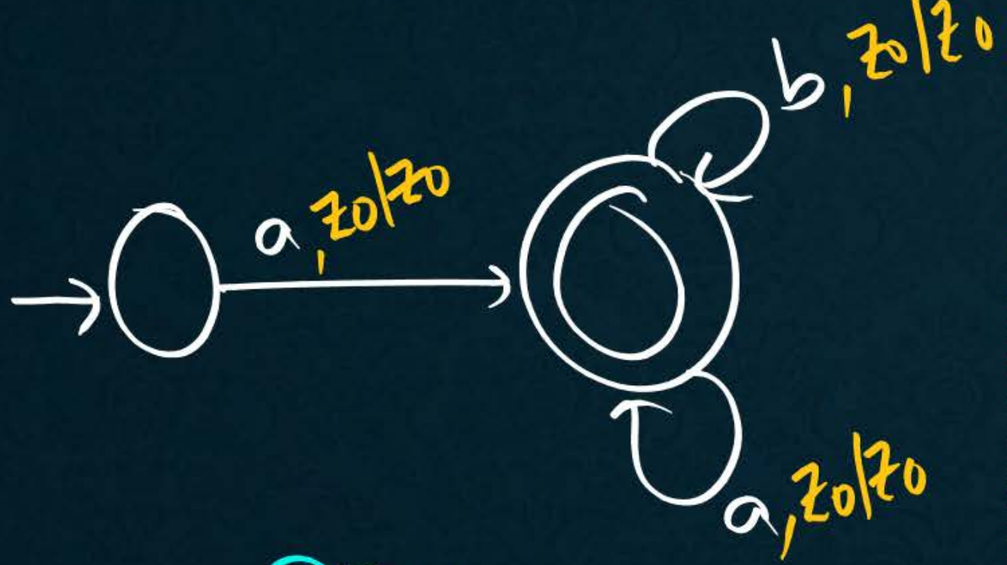

operation
DPDA: Q X Σ X Γ → Q X Γ*
1 2 3 4 5
PDA: Q X Σε X Γ* → 2^(Q X Γ*)
1 2 3 4 5
How to find operation?
3/5

Construction of PDA & DPDA:

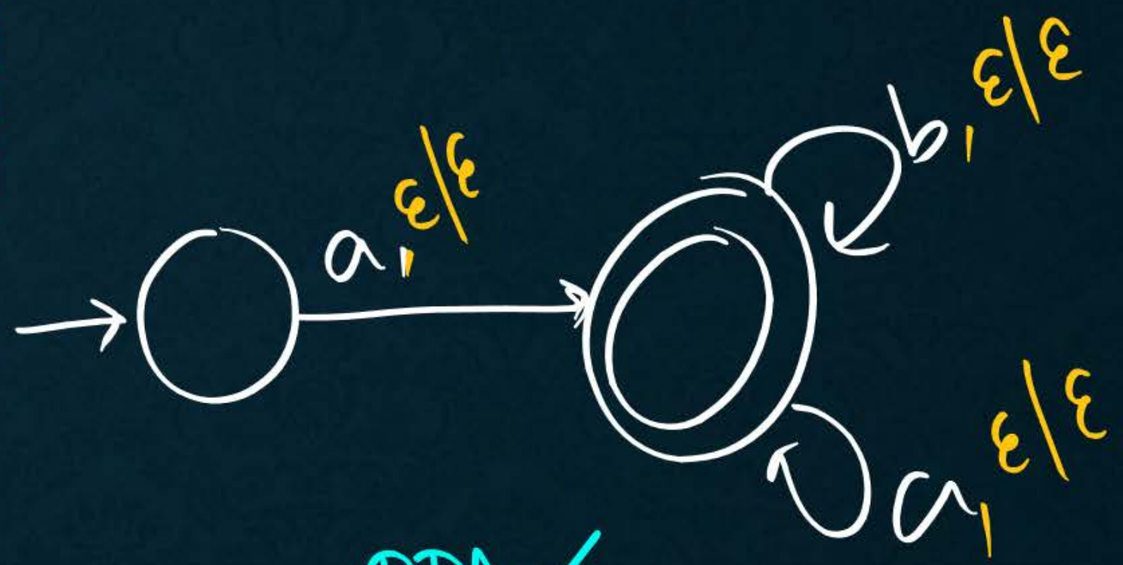
① $L = a(a+b)^*$



FA



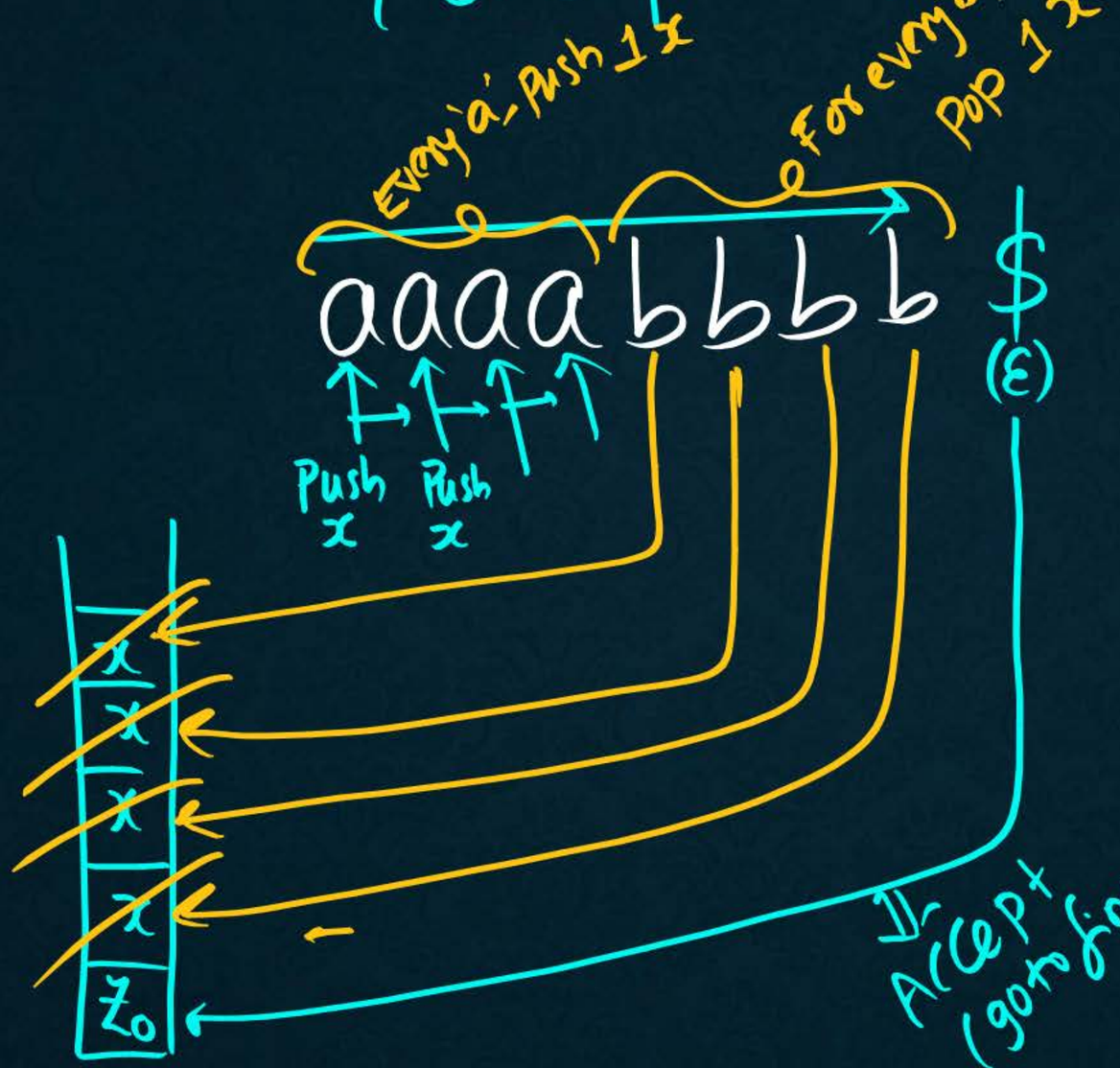
DPDA ✓
PDA ✓



PDA ✓
DPDA ✗

Note : Every FA is convertible to DPDA & PDA

② $L = \{ a^n b^n \mid n \geq 1 \}$

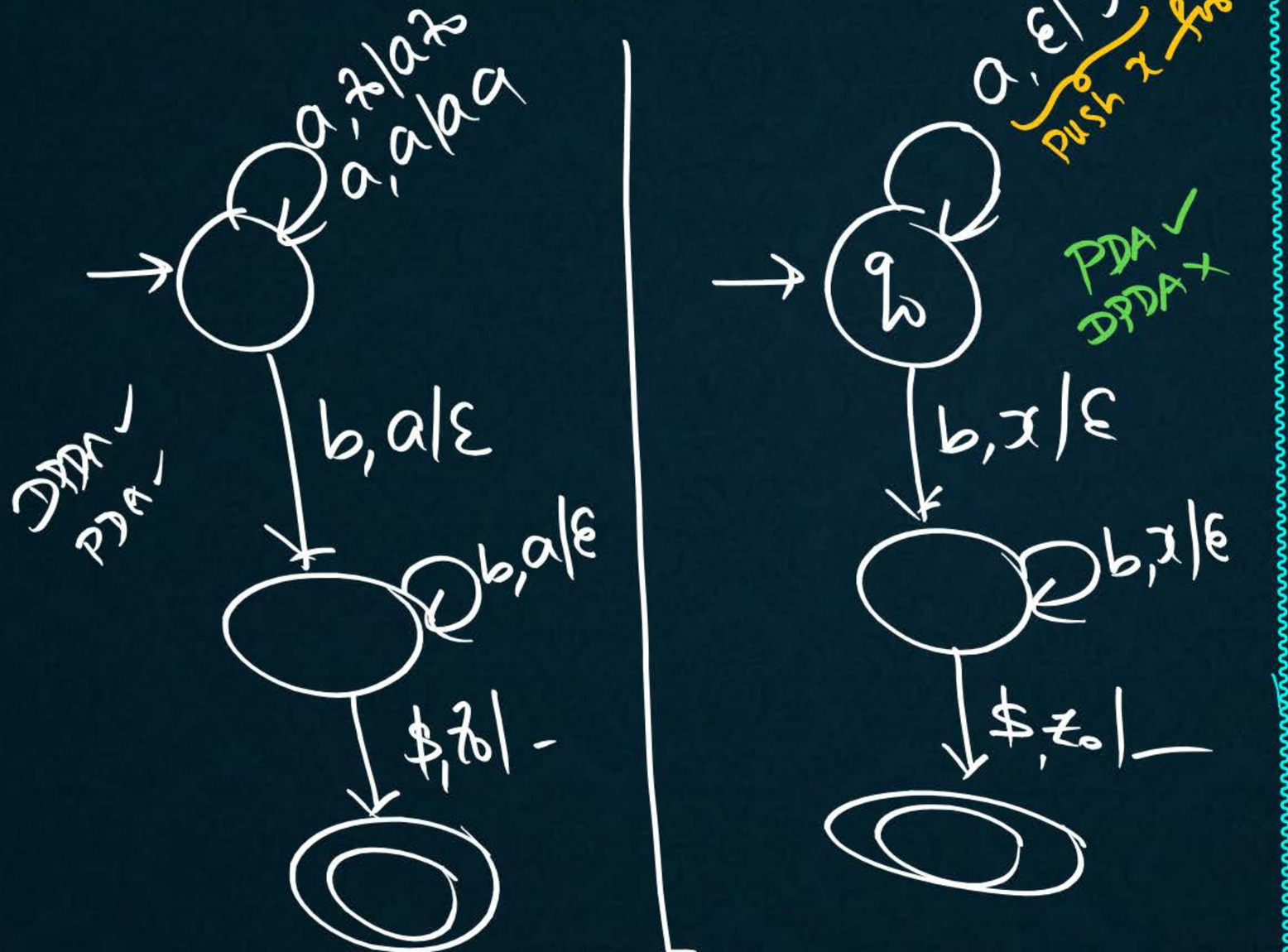


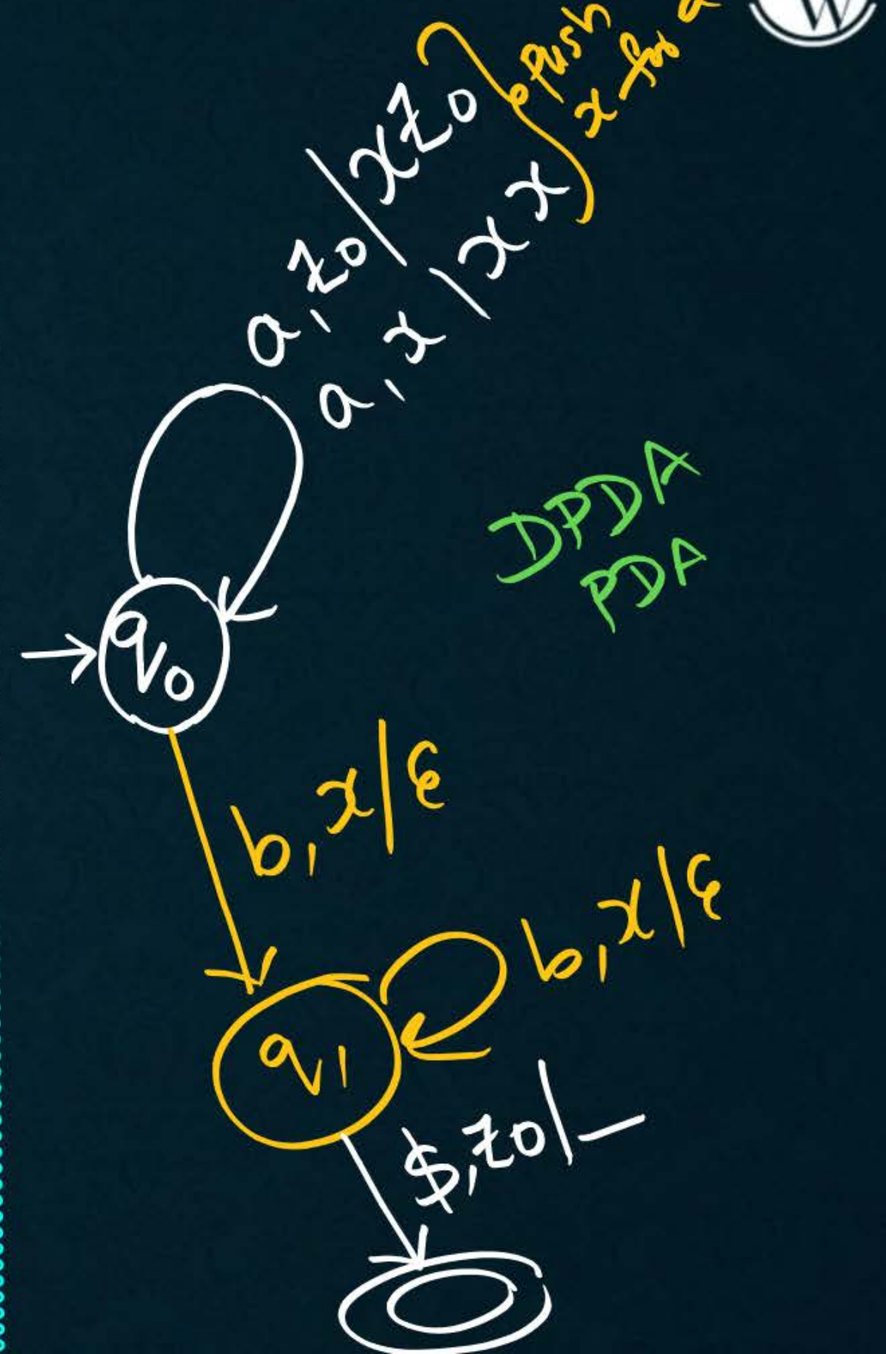
Step1 ✓ : Take bigger valid string

Step2 ✓ : Make logic using stack

Step3 : Construct PDA

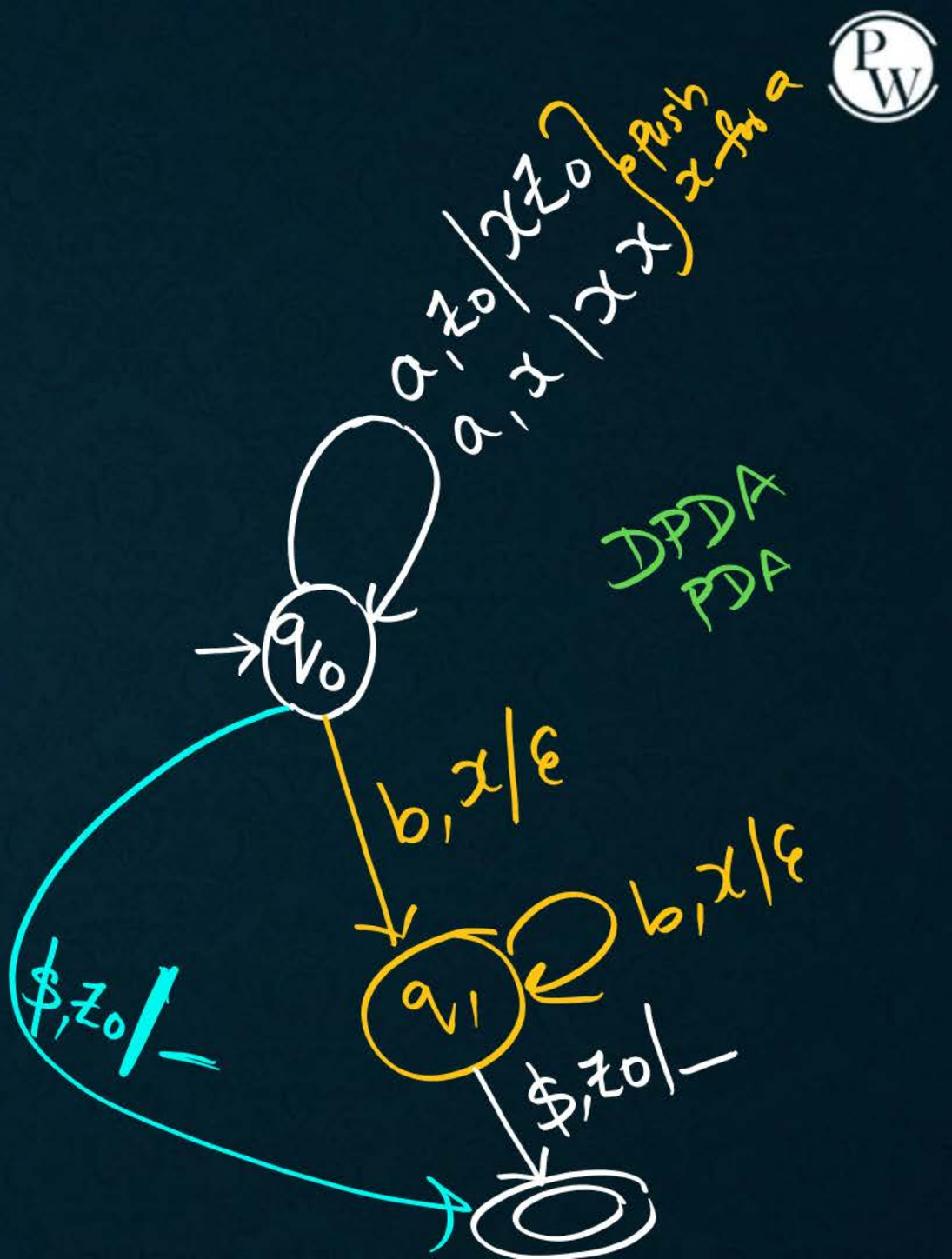
② $L = \{ a^n b^n \mid n \geq 1 \}$

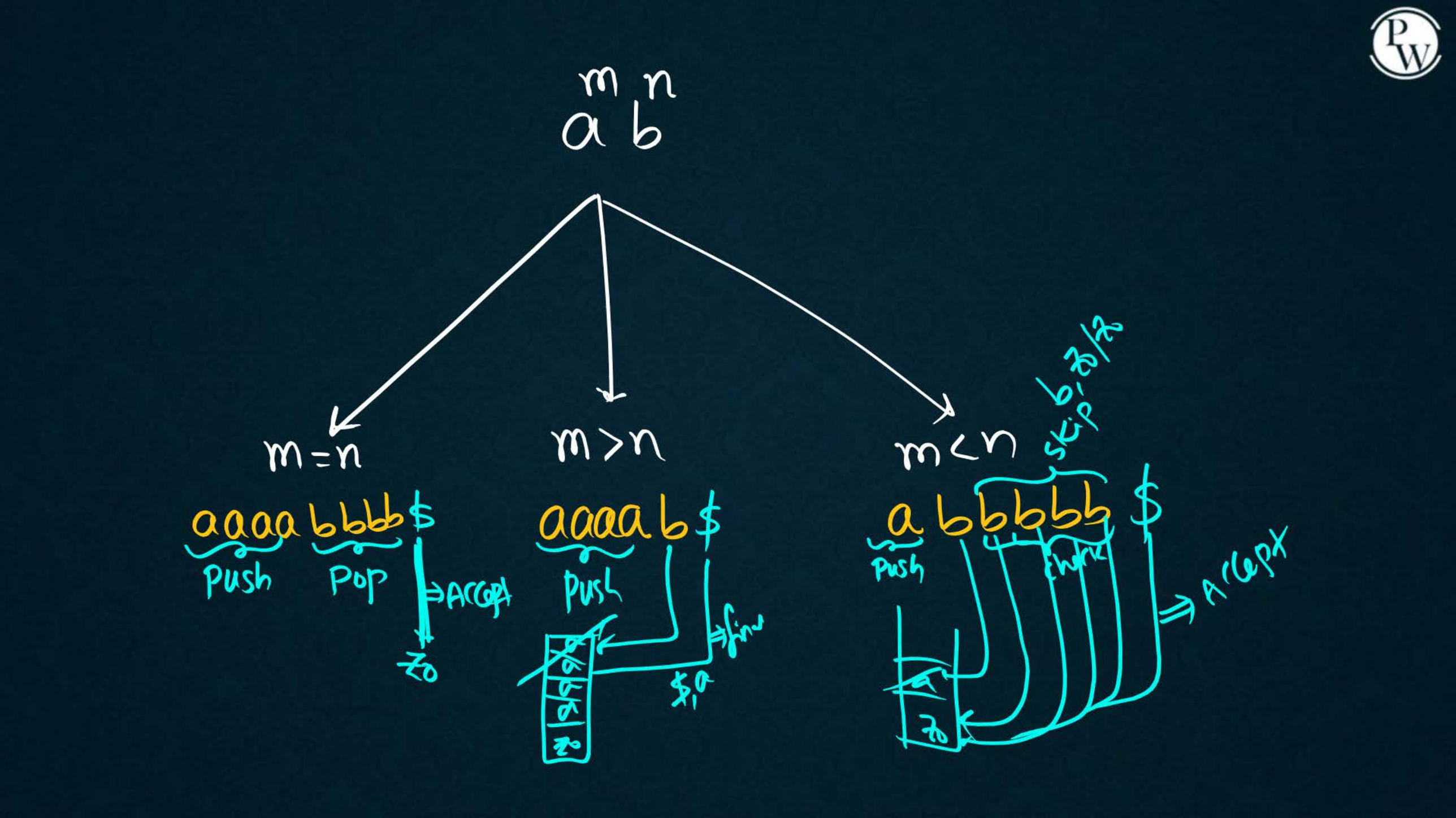




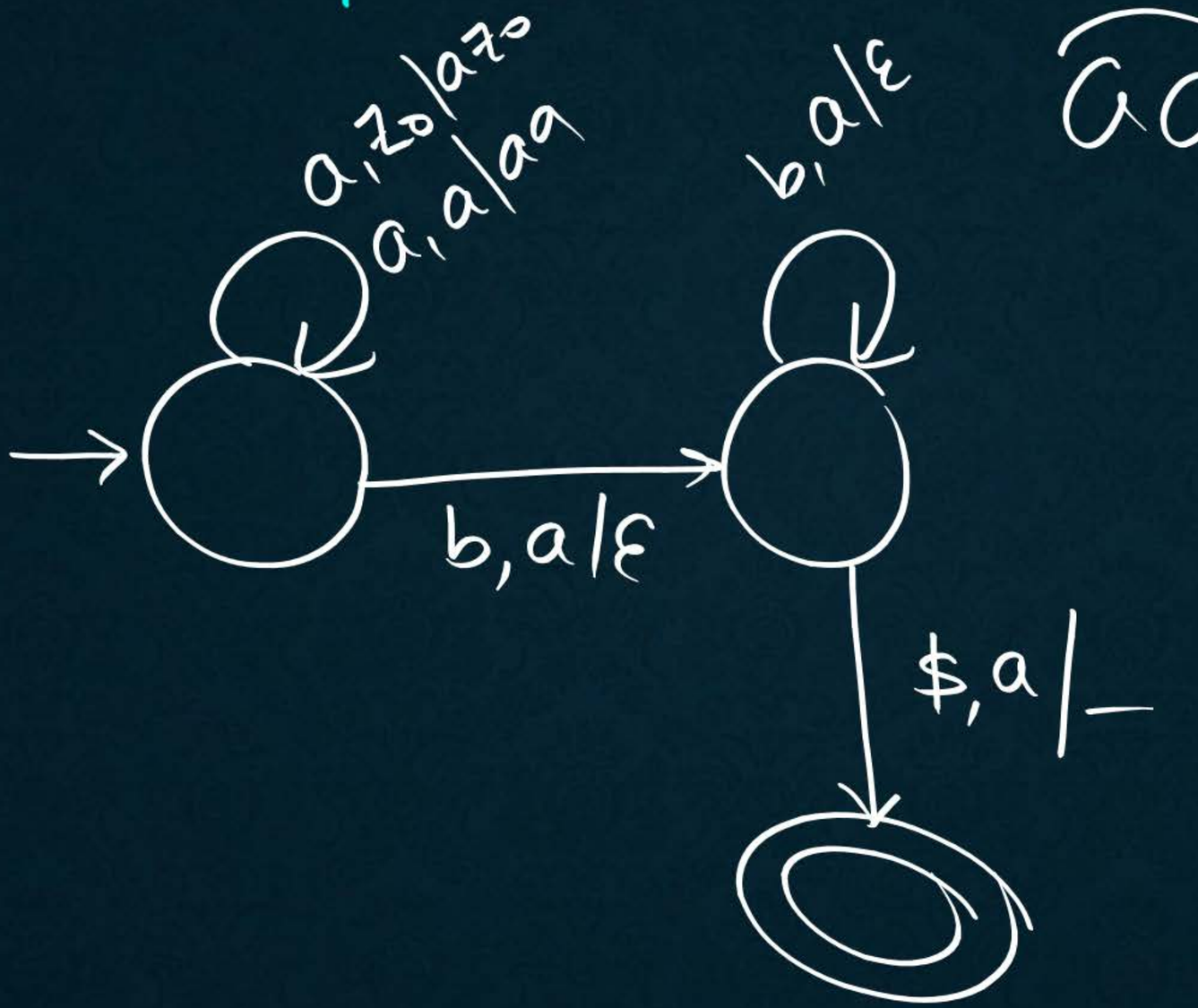
(3) $L = \{a^n b^n \mid n \geq 0\}$

$= (2) \cup \{\epsilon\}$

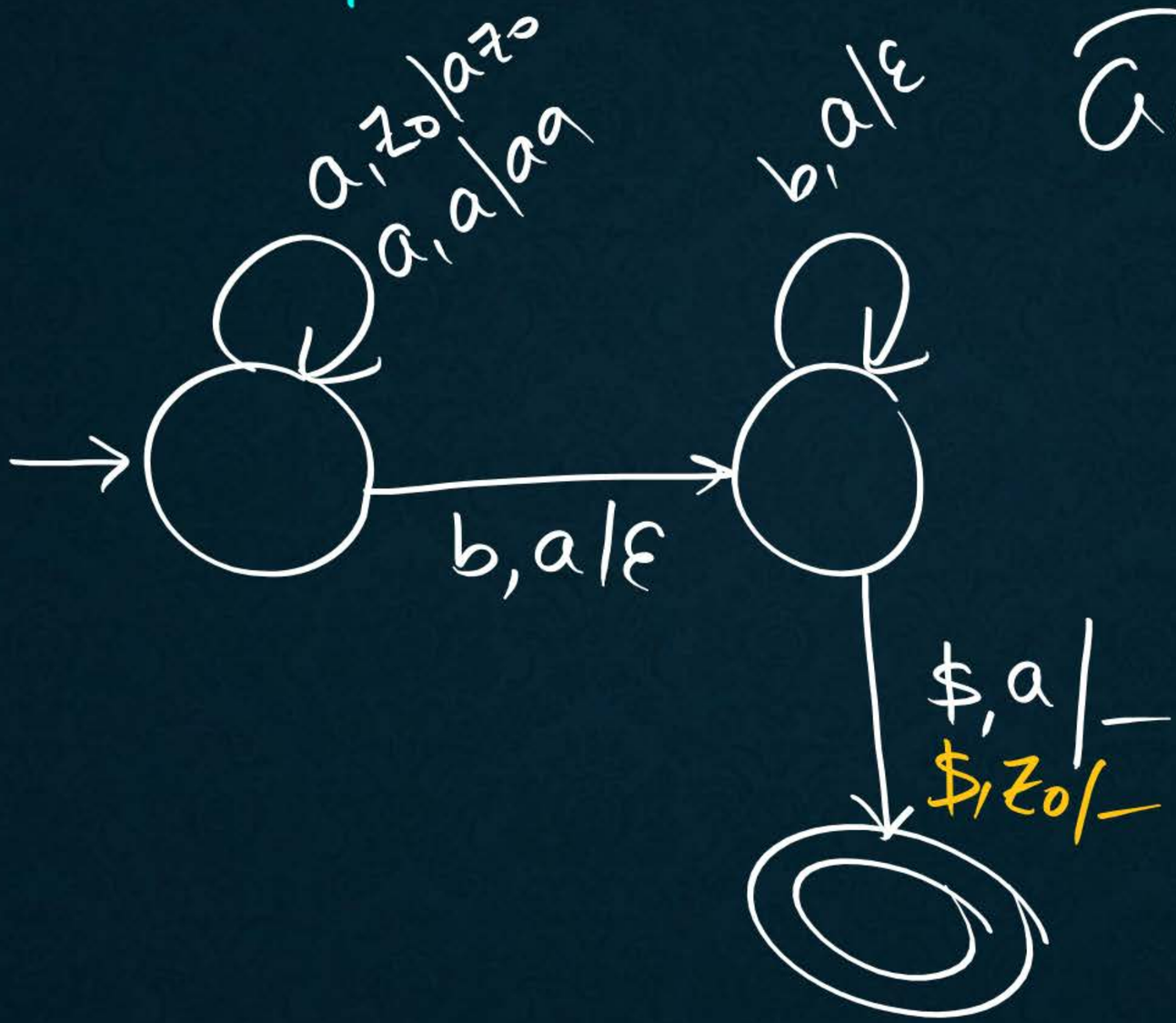


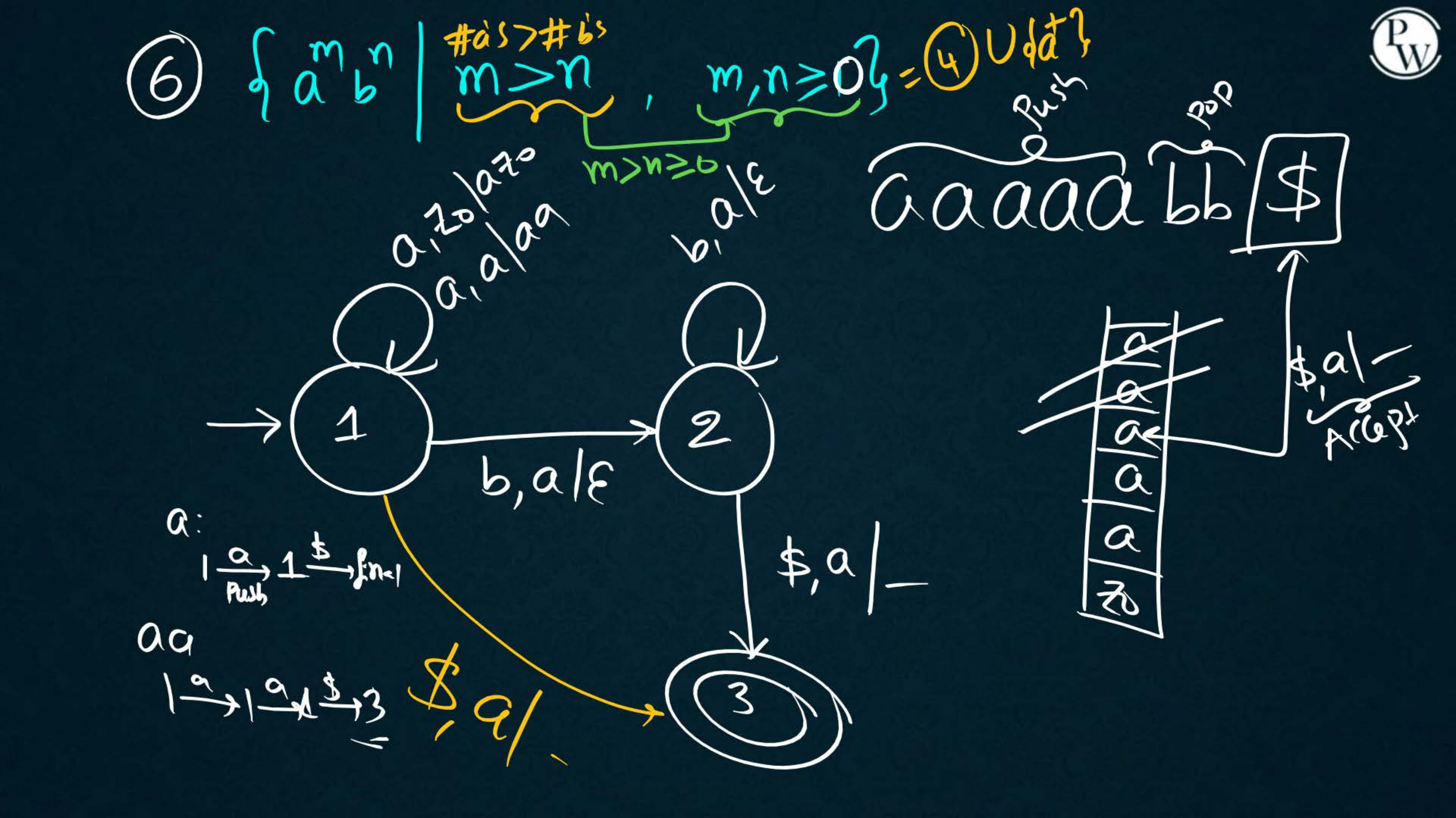

m n
a b
m = n
m > n
m < n
aaaa bbbb $
Push
Pop
Accept
Z0
aaaa b $
Push
$, a
a b b b b $
Push
skip b, a/ε
Z0
Accept

④ $\{a^m b^n \mid m > n \;,\; m, n \geq 1\}$



(5) $\{a^m b^n \mid m \geq n \;,\; m,n \geq 1\}$

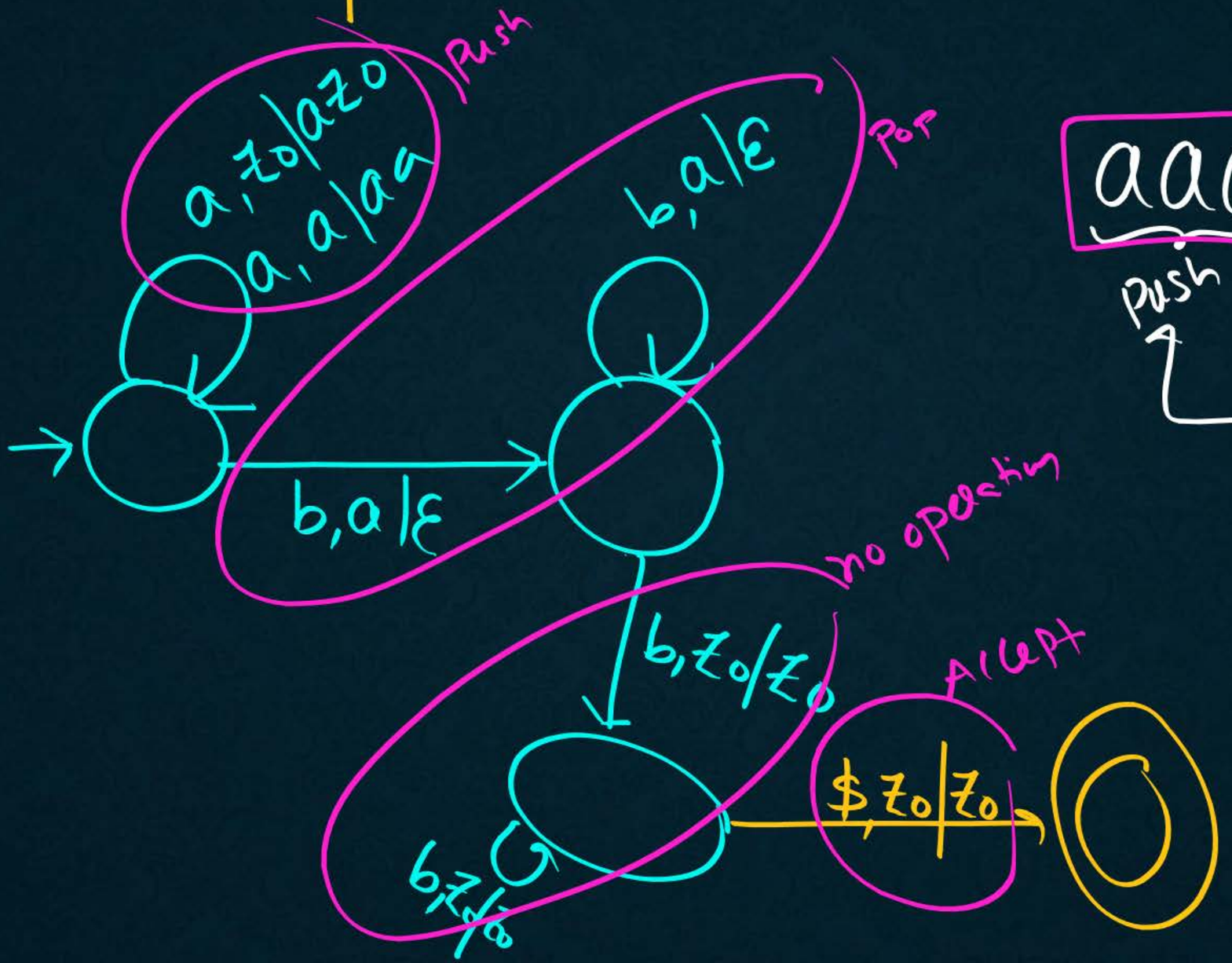


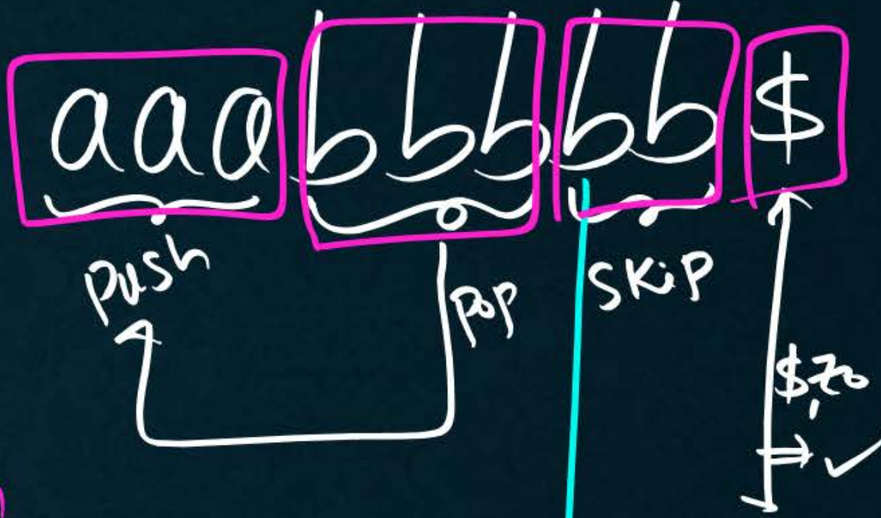

6 { a^m b^n | #a's > #b's
m > n , m, n ≥ 0 } = (4) Ud ?
m > n ≥ 0
a, Z0 / a Z0
a, a / aa
b, a / ε
1
2
3
b, a / ε
$, a / —
a:
1 —a/Push→ 1 —$→ final
aa
1 —a→ 1 —a→ 1 —$→ 3
$, a / —
Push
Pop
a a a a a b b $
a
a
a
a
a
Z0
$, a / —
Accept

$m > n$, $m, n \geq 0$

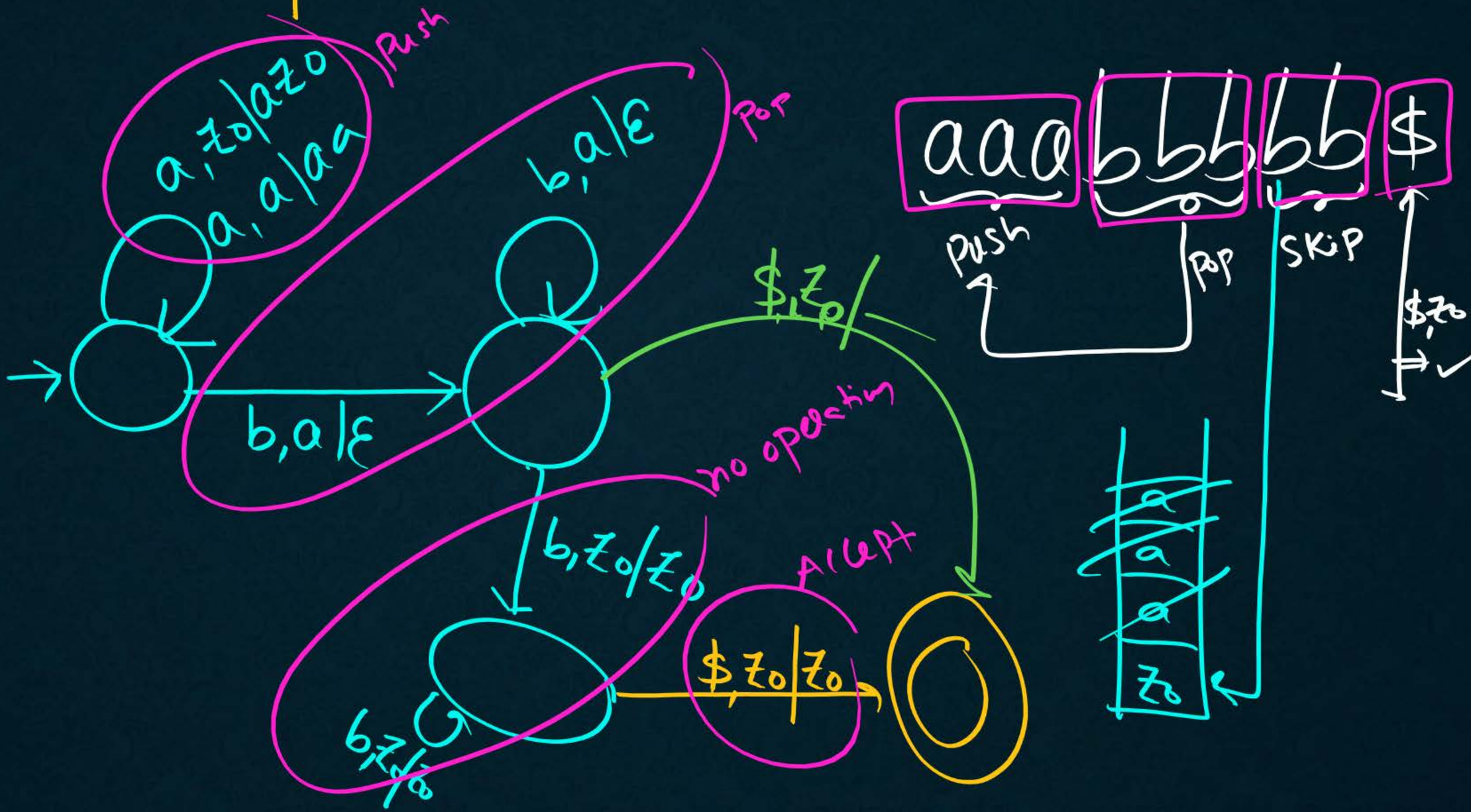
$m > n \geq 0$

(7) $\{a^m b^n \mid m<n, \quad m,n \geq 1\}$

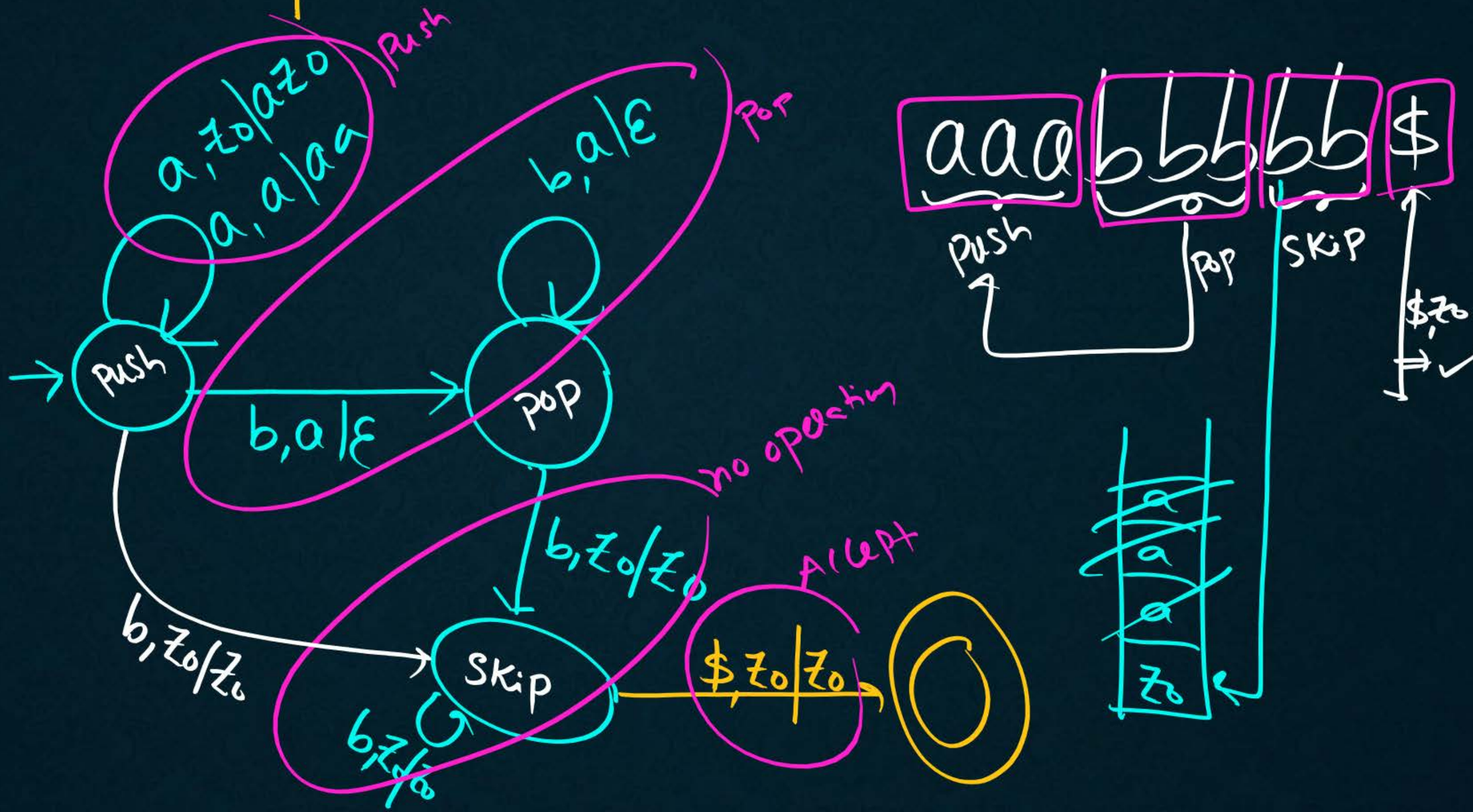




(8) $\{a^m b^n \mid m \leq n, \quad m, n \geq 1\}$



⑨ $\{a^m b^n \mid m<n,\ m,n \geq 0\} = ⑦ \cup \{b^+\}$



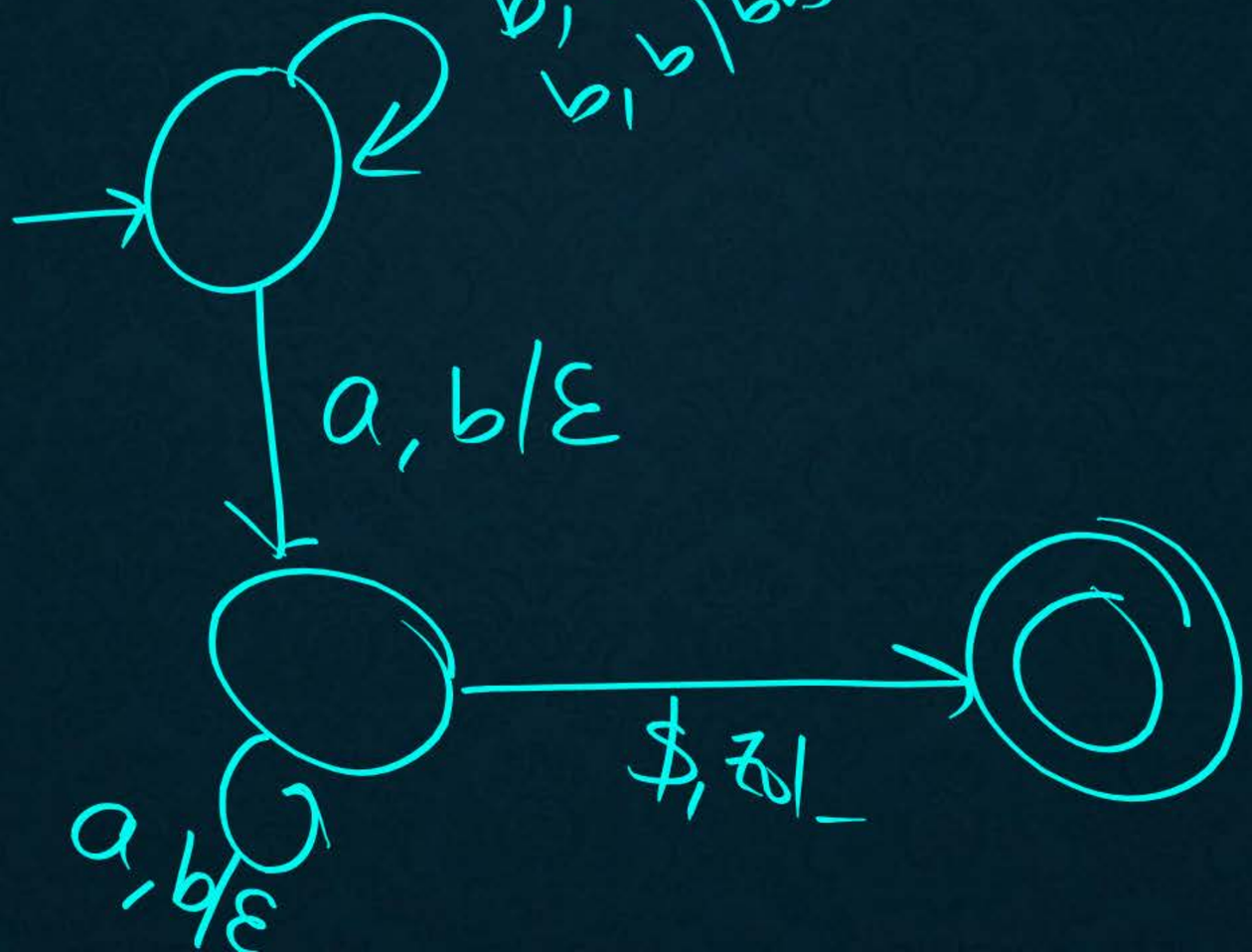
(10) $\{a^m b^n \mid m, n \geq 1, \quad m \neq n\}$

$m \neq n$: $m < n$ or $m > n$

(11) $\{a^m b^n \mid m, n \geq 0, \quad m \neq n\}$

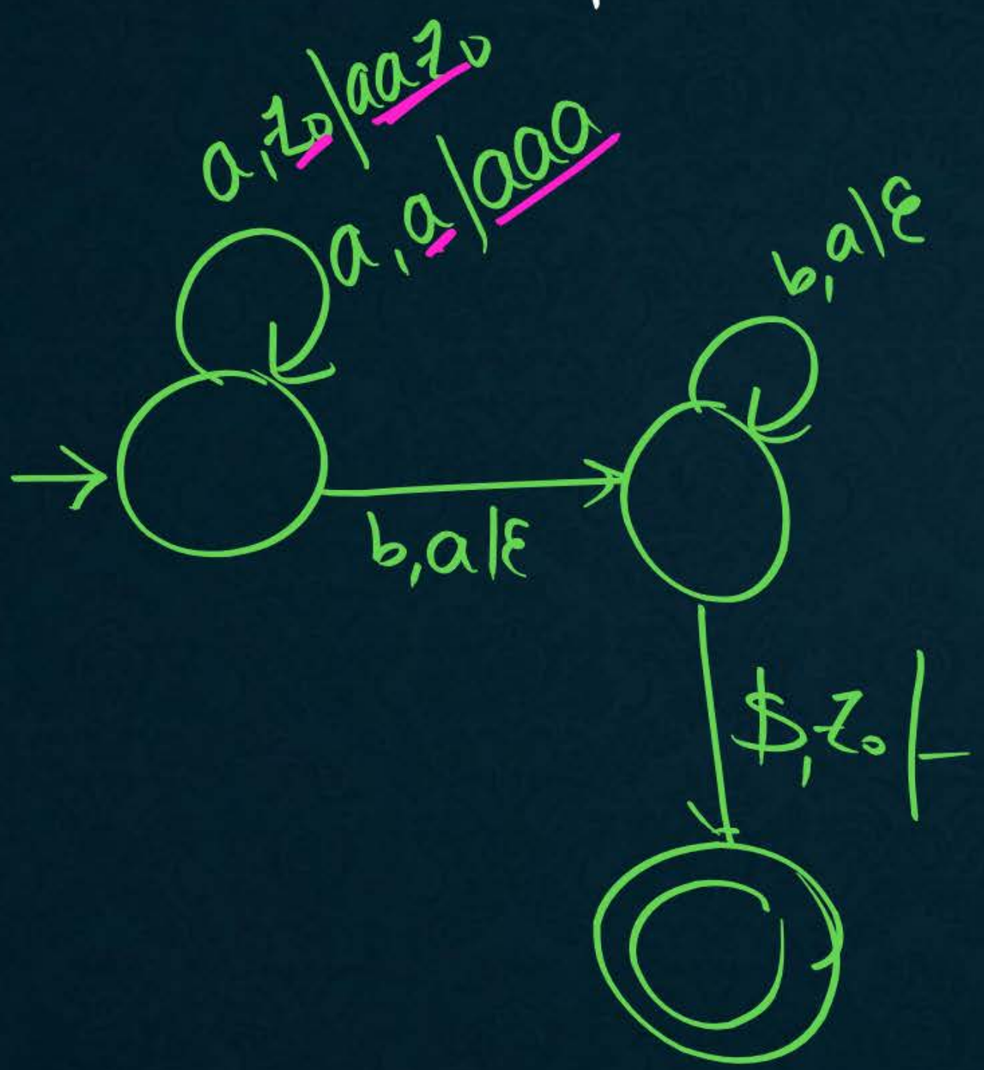
H.W.

(19) $\{b^n a^n \mid n \geq 1\}$

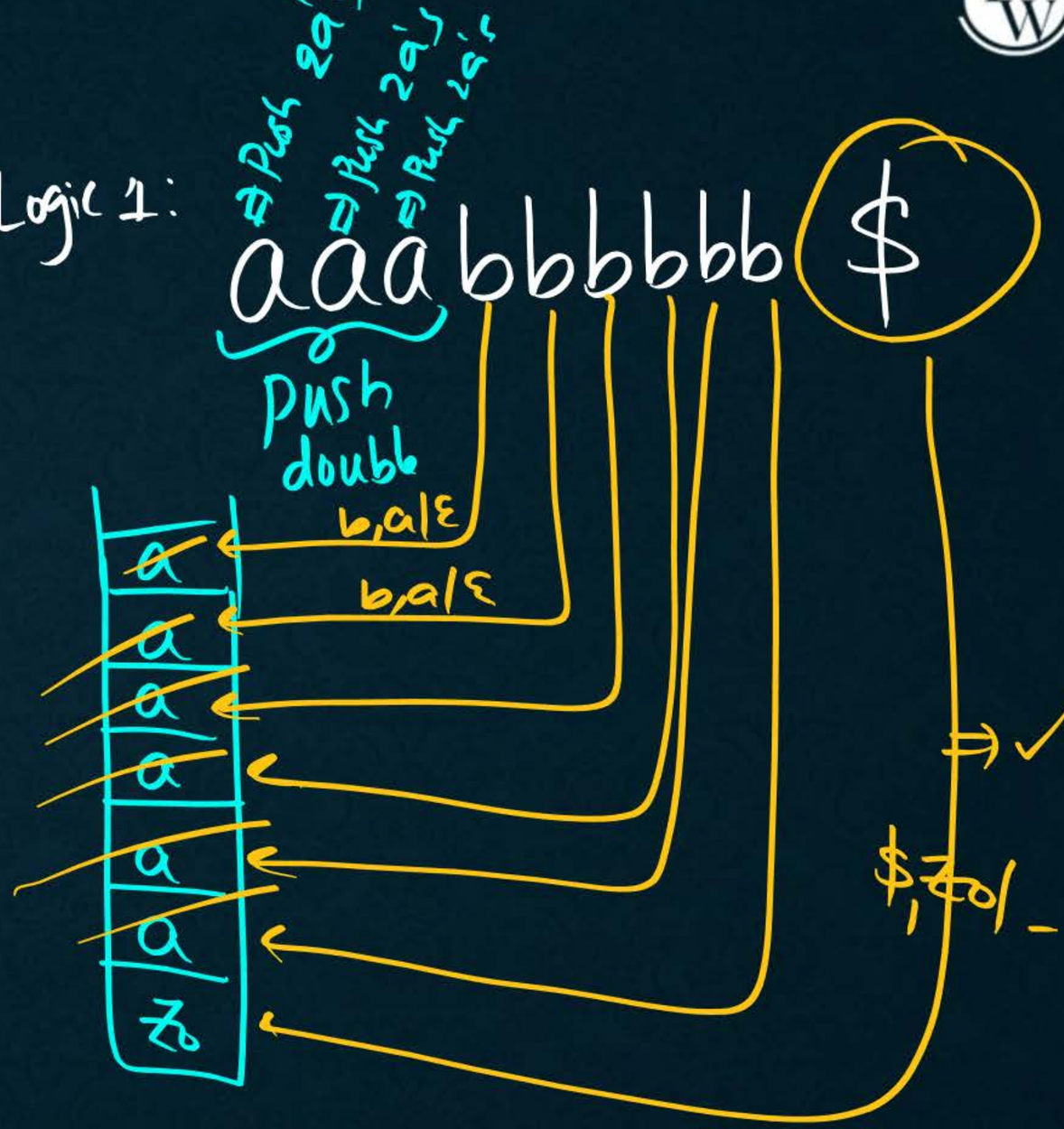


bbbaaa
Push Pop

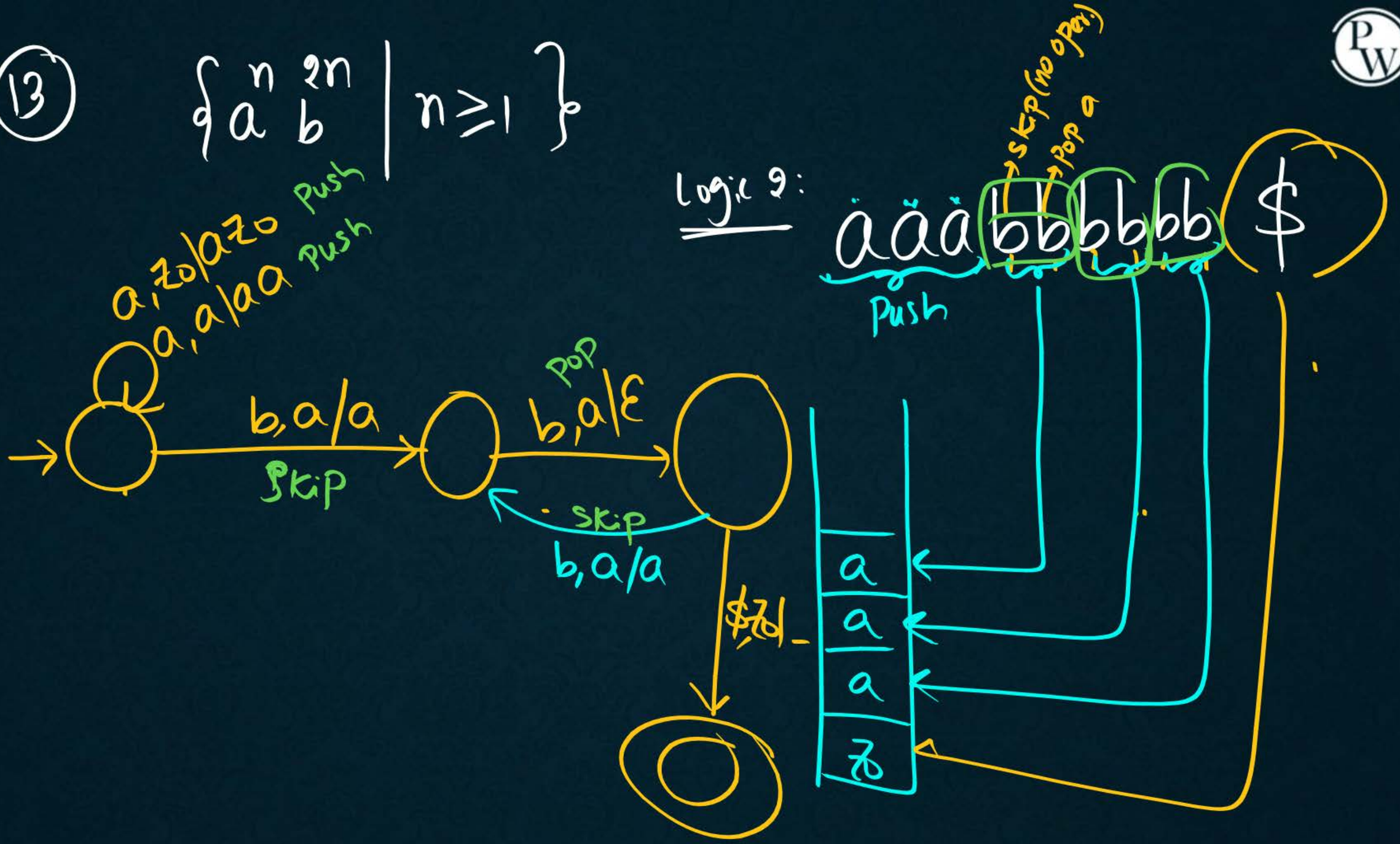
(13) $\{a^n b^{2n} \mid n \geq 1\}$



Logic 1:



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



H.W.

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

(15) $\{a^{n} b^{3n} \mid n \geq 1\}$

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

equal & even

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

(18) $\{w \mid \text{''}, n_a(w) > n_b(w)\}$

(19) $\{w \mid \text{''}, n_a(w) < n_b(w)\}$

(20) $\{w \mid \text{''}, n_a(w) \leq n_b(w)\}$

(21) $\{w \mid \text{''}, n_a(w) \geq n_b(w)\}$

(22) $\{w \mid \text{''}, n_a(w) \neq n_b(w)\}$

Summary

→ DPDA & PDA


THANK YOU
GW
SOLDIERS !