

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

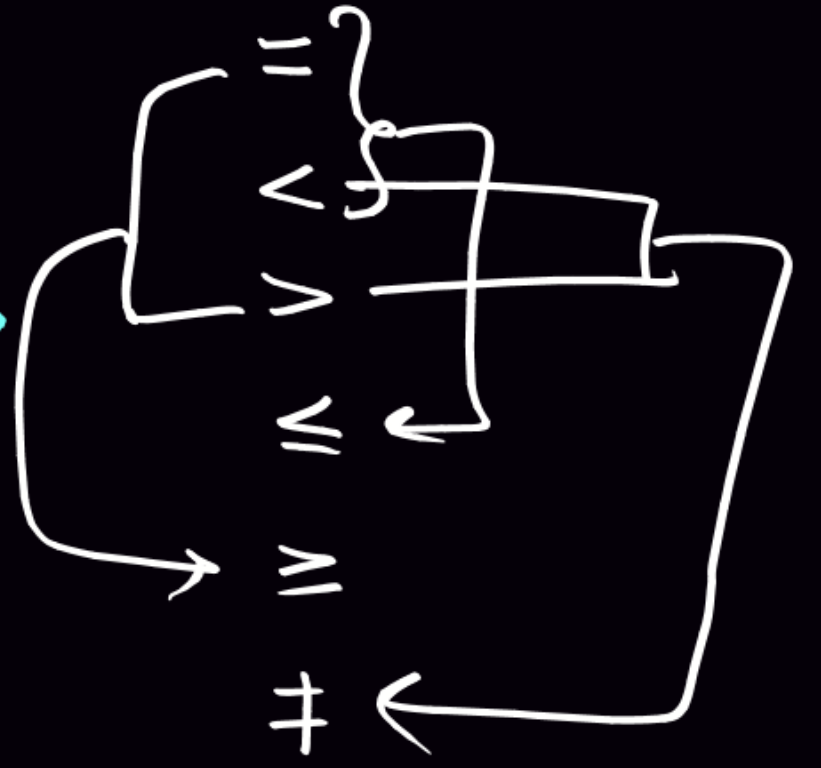
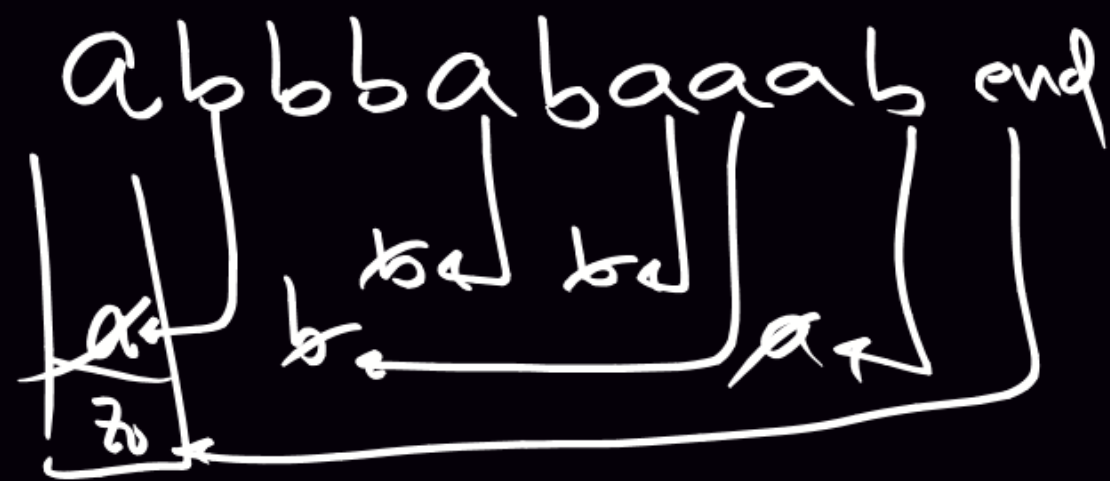
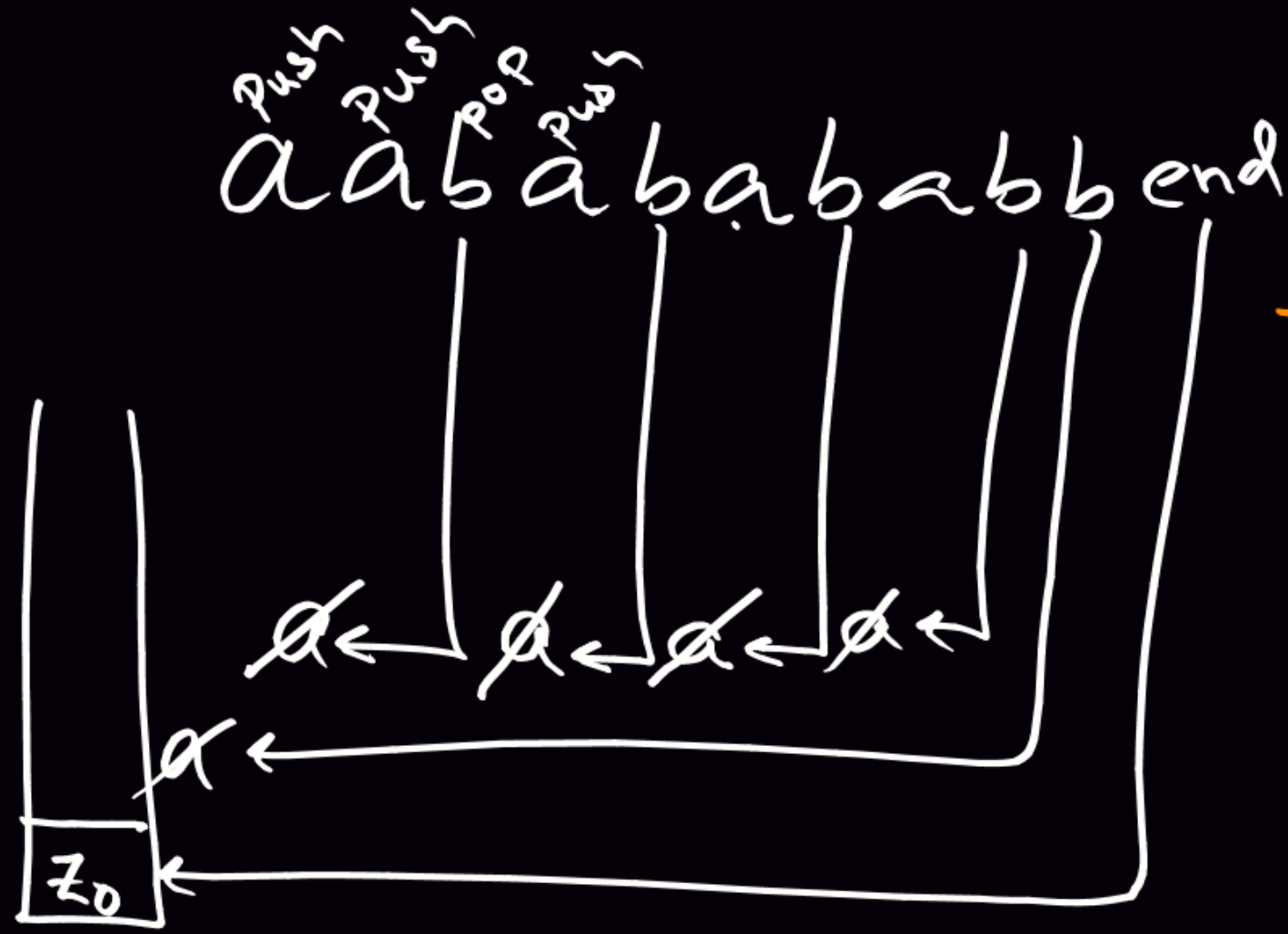
$$6) \{ b^n a^n | n \geq 1 \}$$

$$7) \{ a^n b^{2n} \}$$

$$8) \{ a^{2n} b^n \}$$

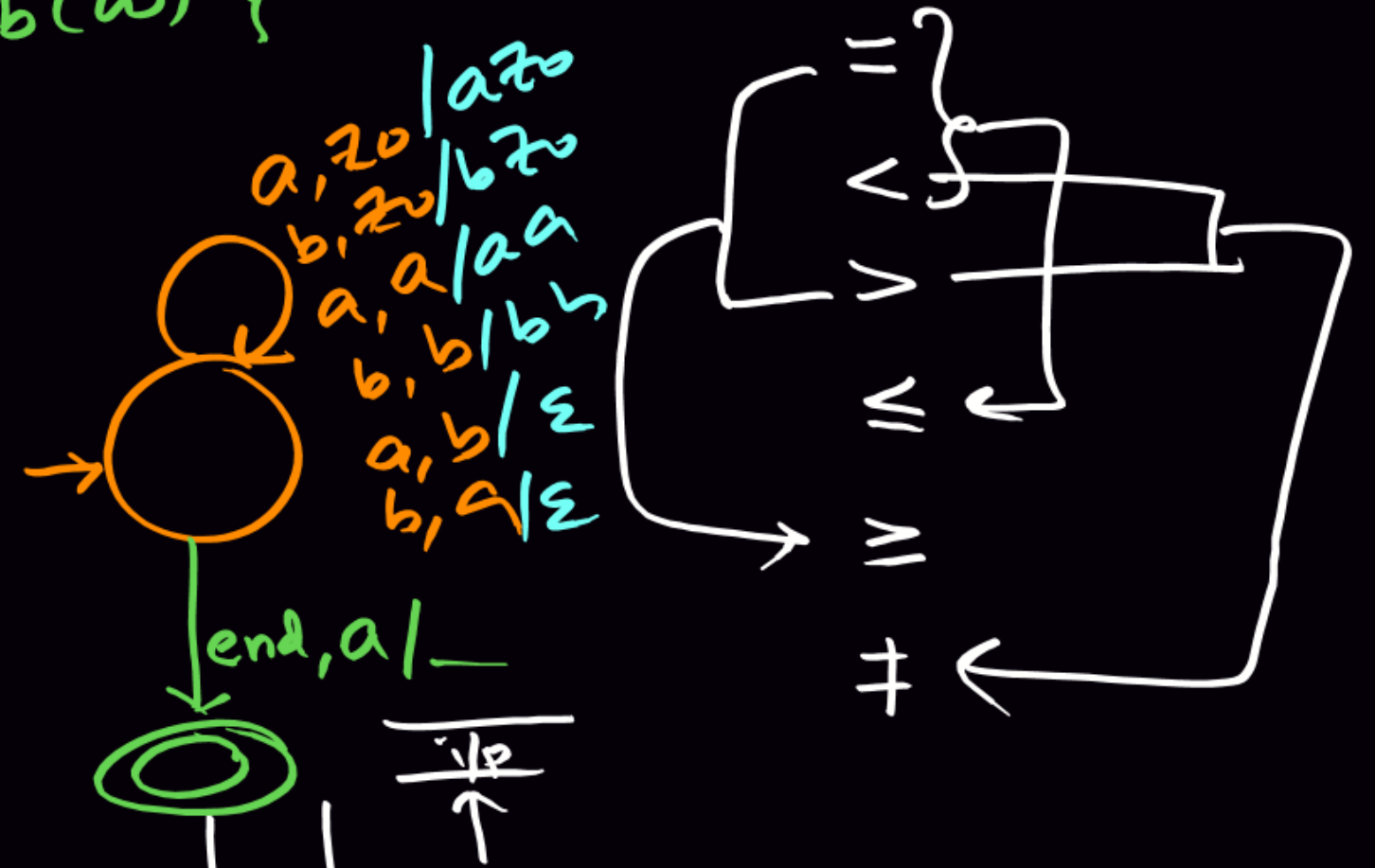
H.W.

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



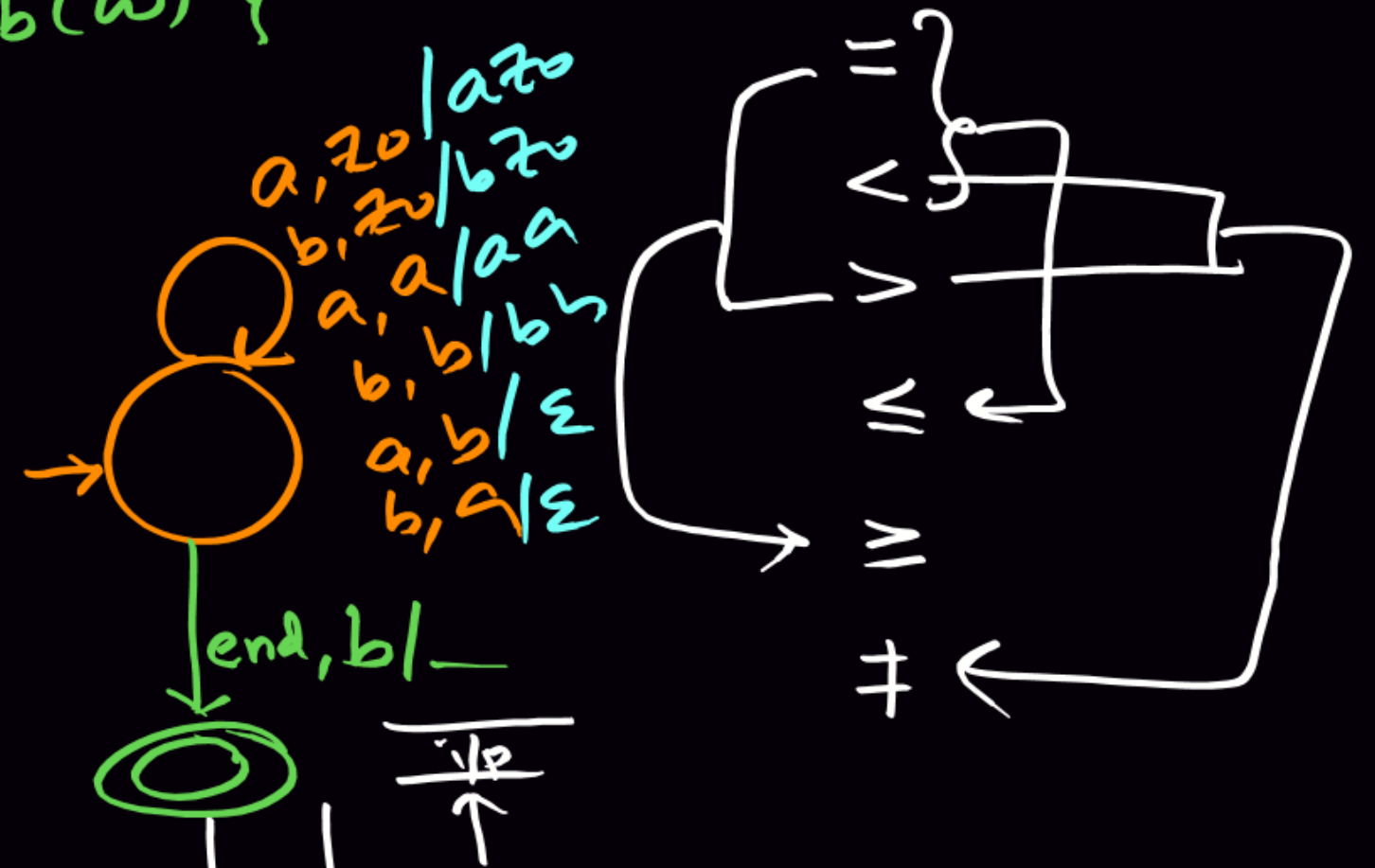
- I) If $i/p == tos$, push i/p
Inc pointer
- II) If $i/p \neq tos$, pop i/p
- III) If $i/p = end$ and $tos = z_0$,
Accept

5) $\{w \mid w \in (a+b)^*, n_a(w) > n_b(w)\}$



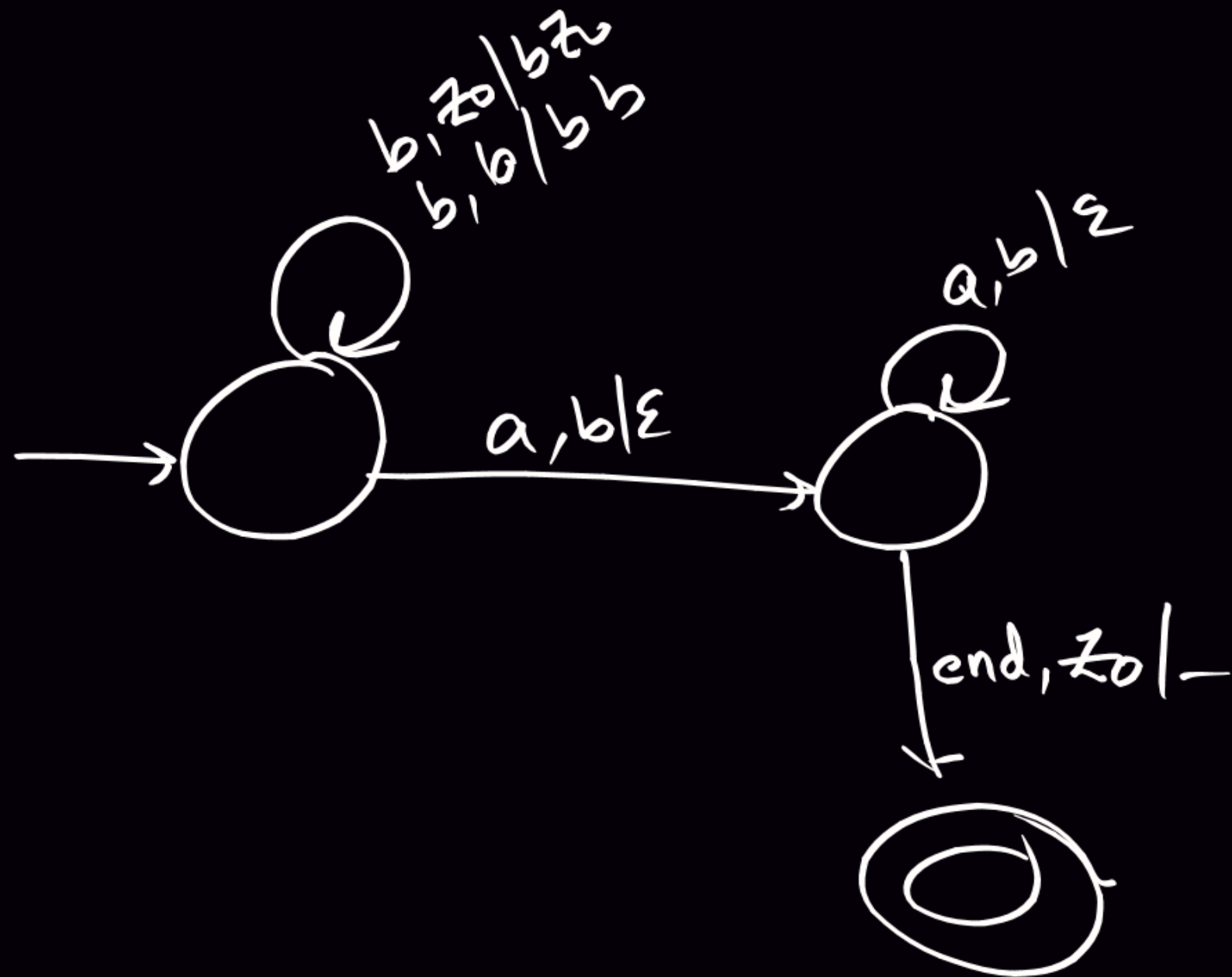
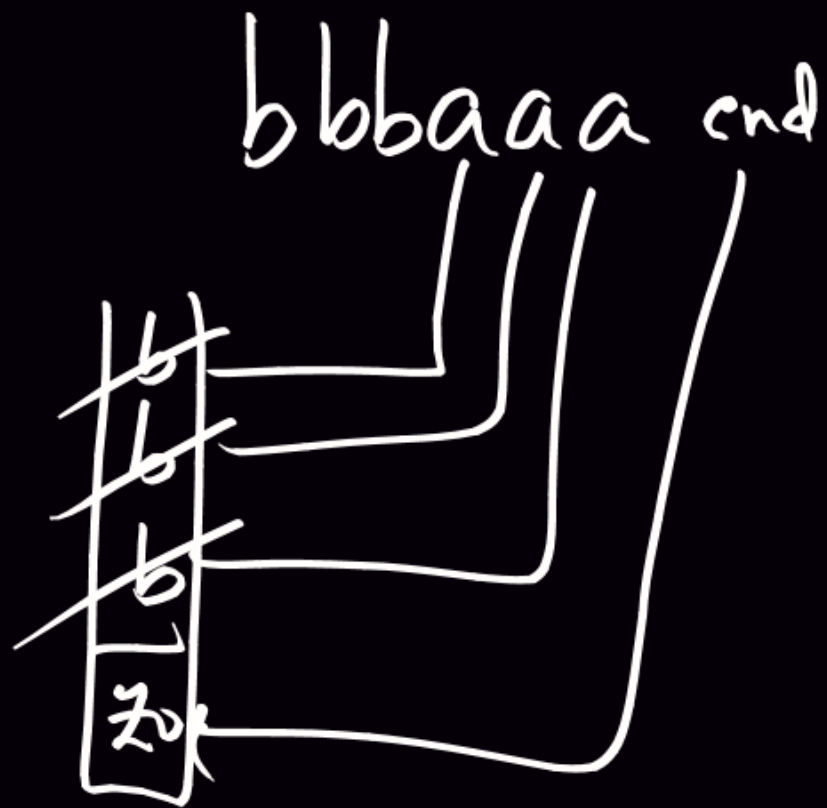
- I) If $i/p == tos$, push i/p
Inc pointer
- II) If $i/p \neq tos$, pop i/p
- III) If $i/p = end$ and $tos = z_0$,
Accept

5) $\{w \mid w \in (a+b)^*, n_a(w) < n_b(w)\}$

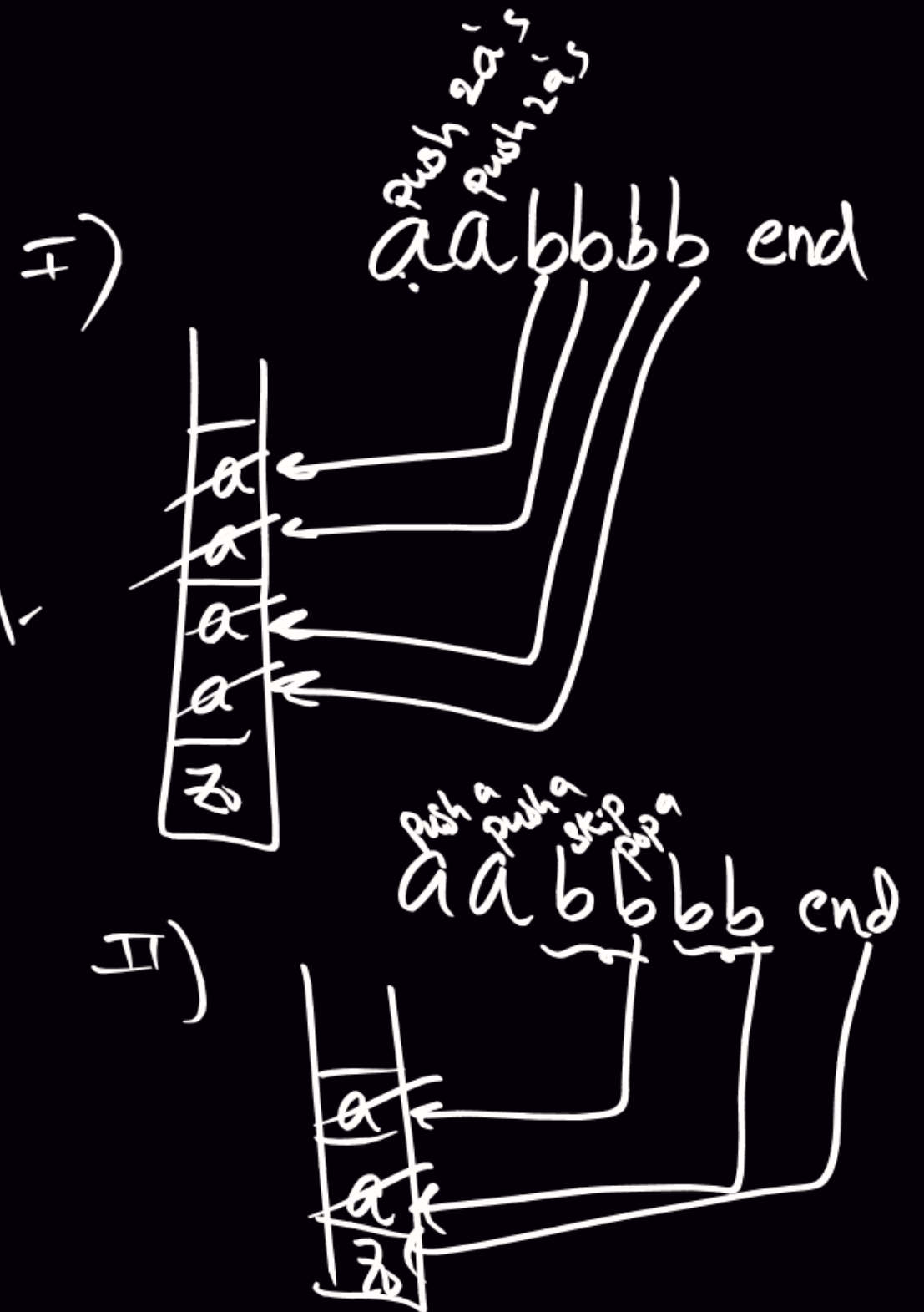
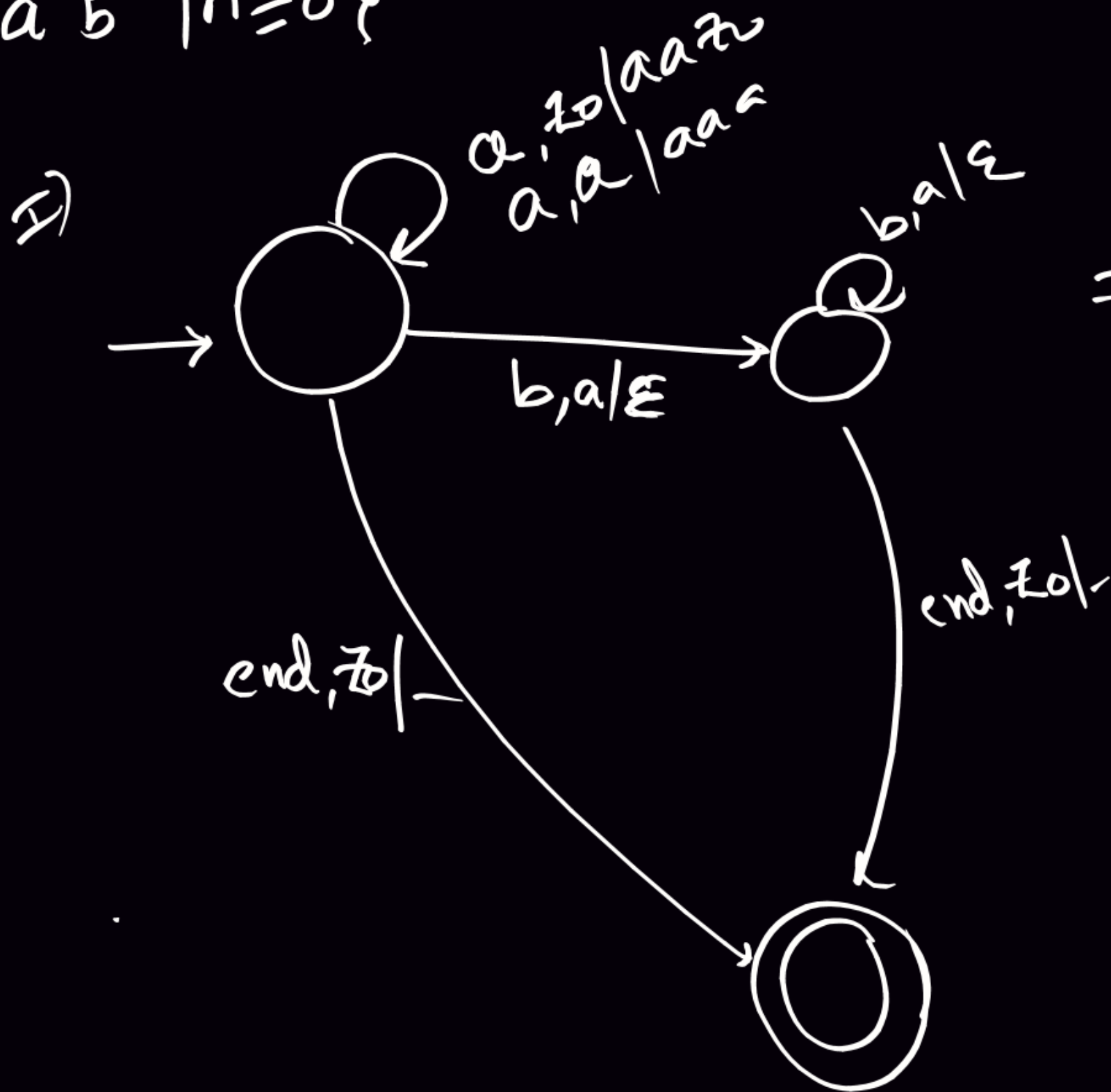


- I) If $i/p == tos$, push i/p
Inc pointer
- II) If $i/p \neq tos$, pop i/p
- III) If $i/p = end$ and $tos = z_0$,
Accept

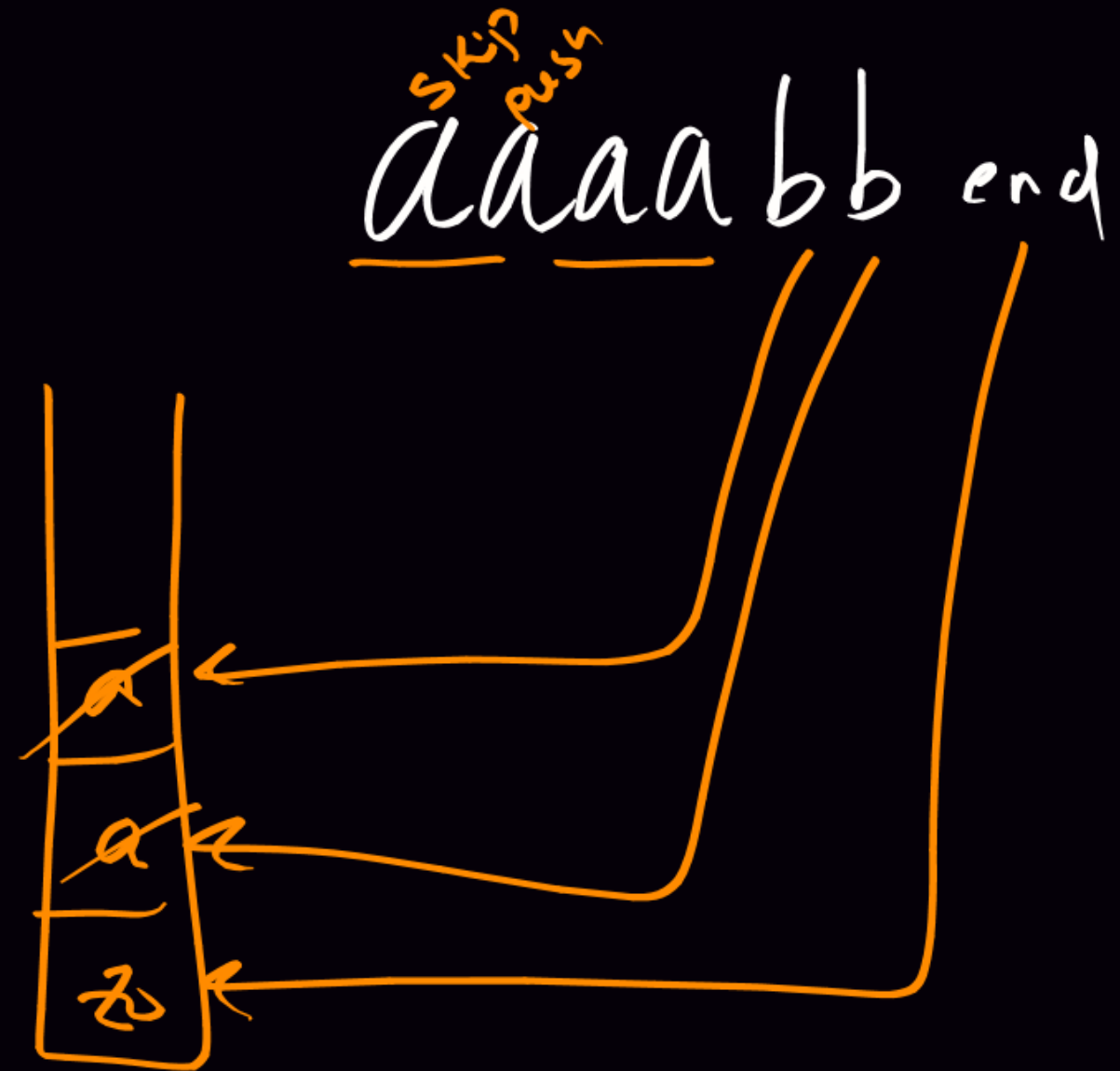
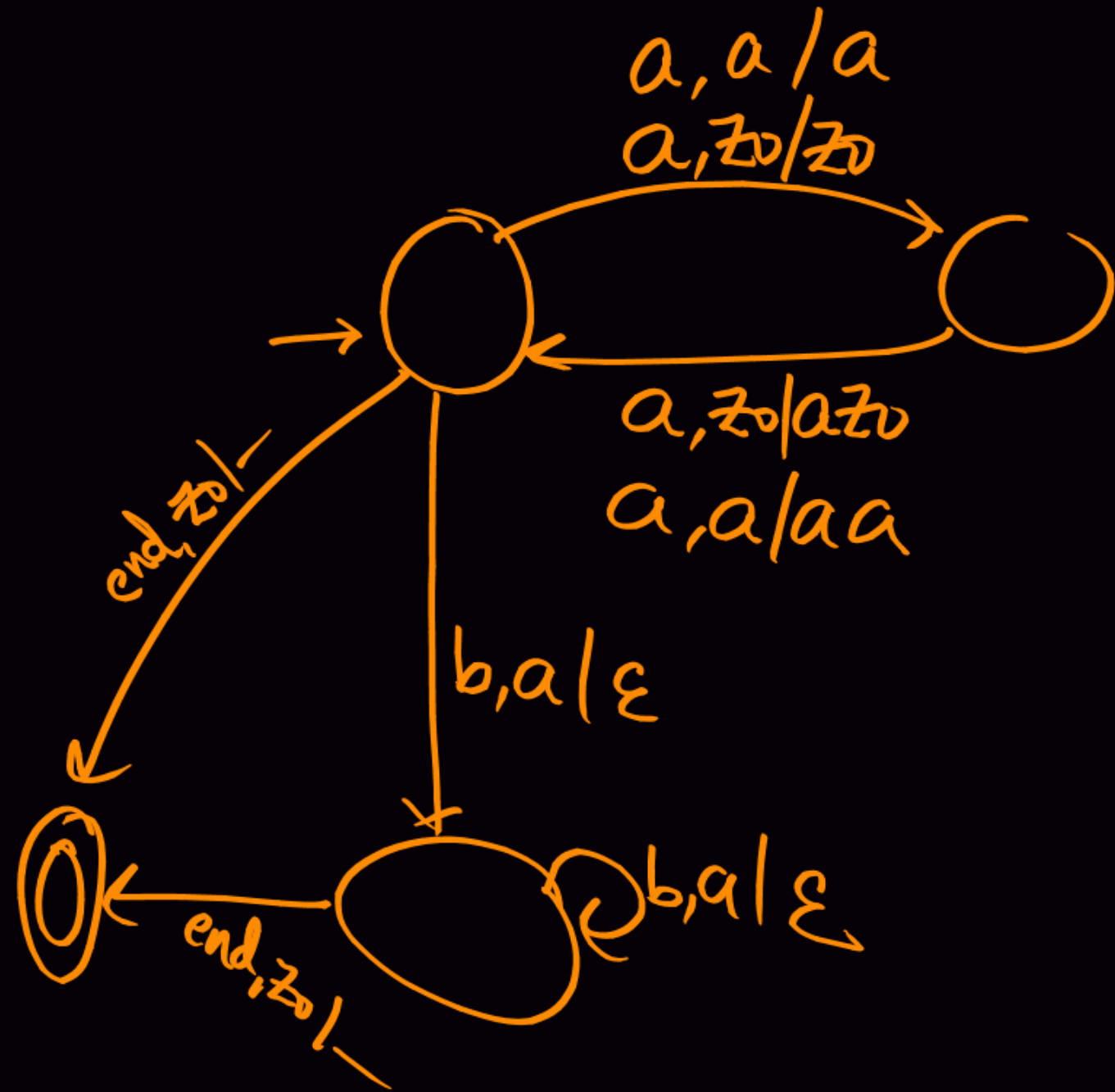
6) $\{b^n a^n / n \geq 1\}$



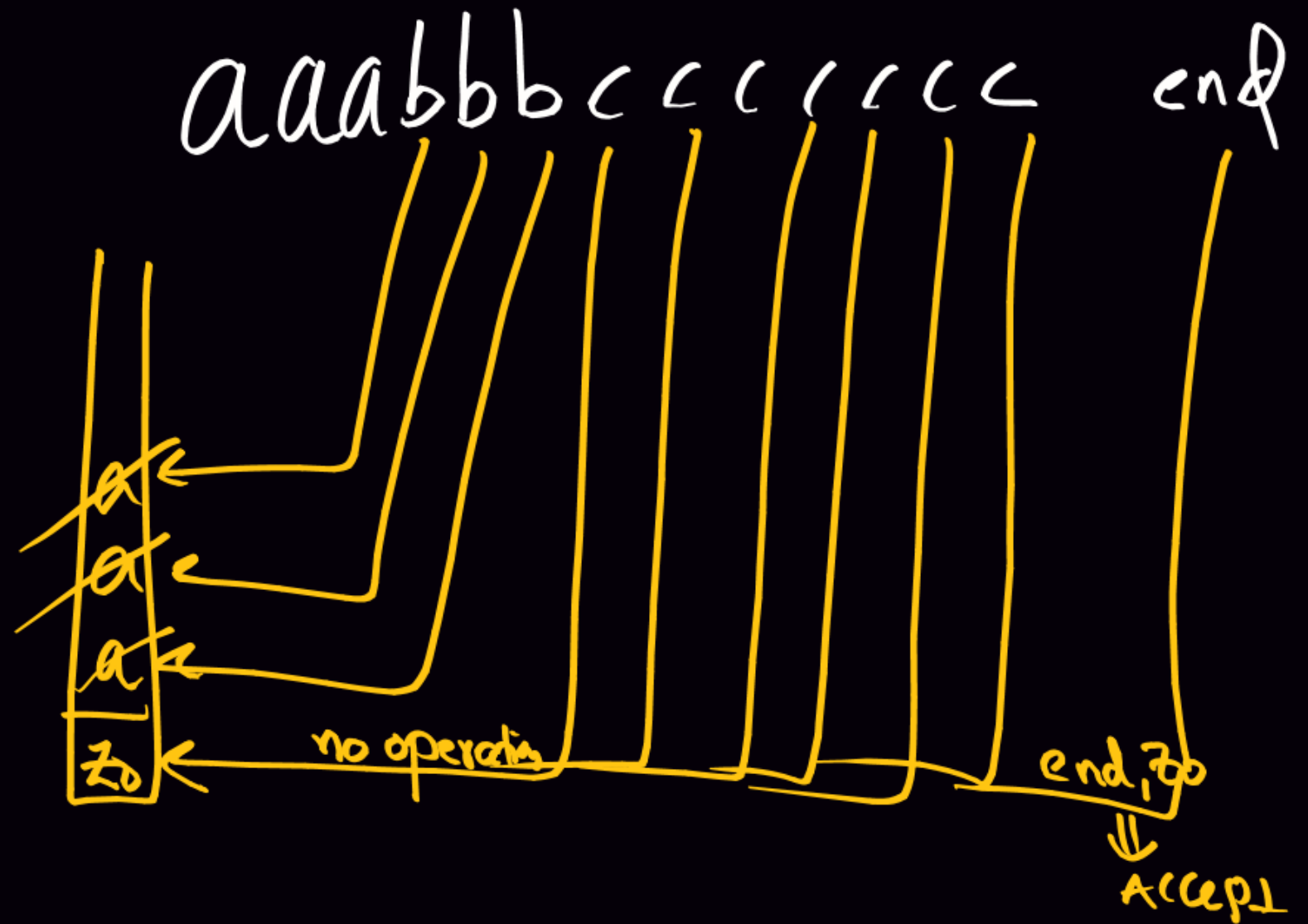
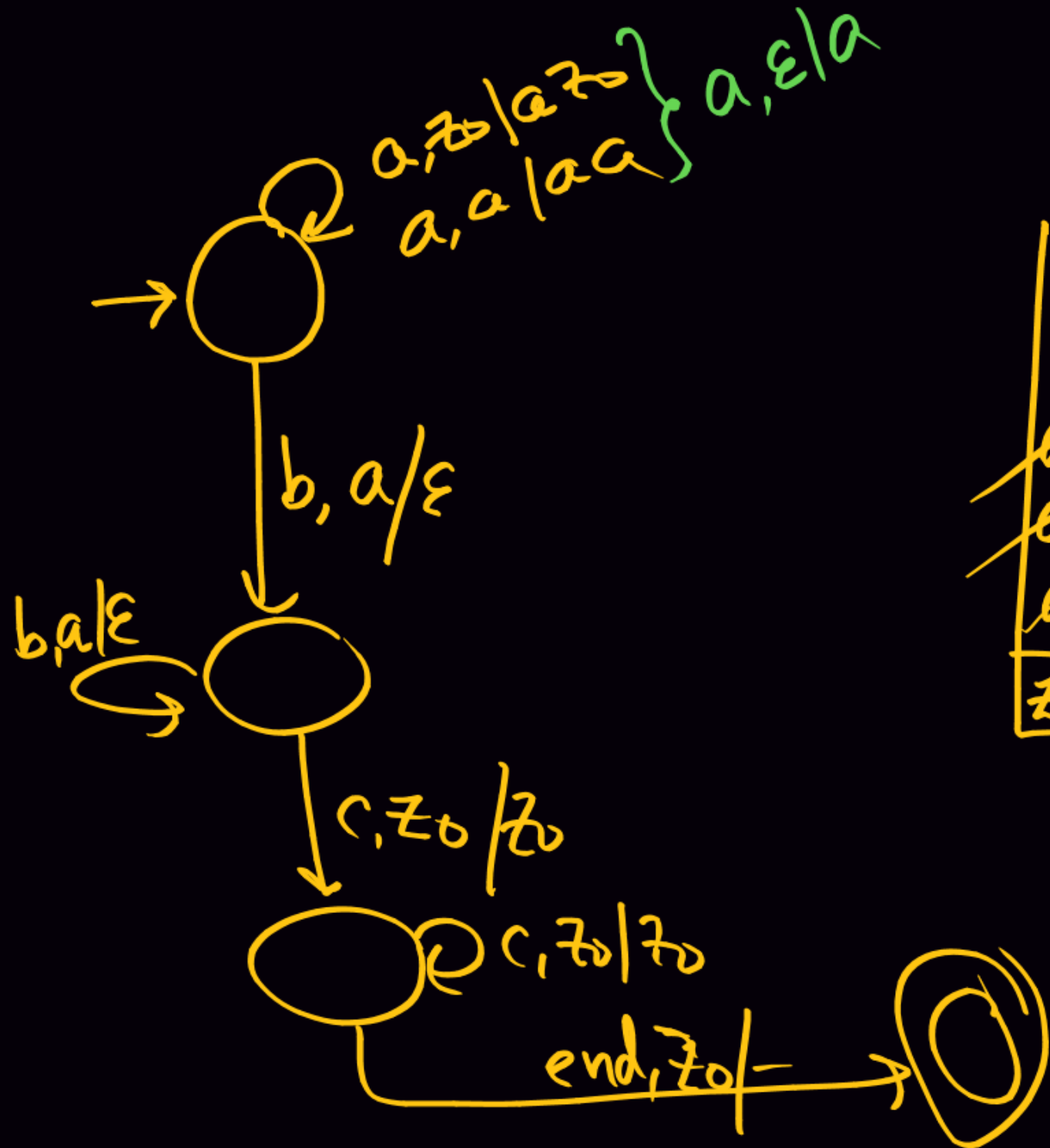
7) $\{a^n b^n \mid n \geq 0\}$



8) $\{a^{2^n} b^n | n \geq 0\}$



a) $\{a^n b^n c^+ | n \geq 1\}$



$$10) \{a^n b^n c^n \mid n \geq 1\}$$

Diagram illustrating the stack operations for $\{a^n b^n c^n \mid n \geq 1\}$. The string $a^n b^n c^n$ is shown with brackets under a^n and b^n . Above a^n , the operations "push a's" and "skip a's" are written. Above b^n , the operations "push b's" and "pop b's" are written.

$$11) \{a^n b^n c^n \mid n \geq 1\}$$

Diagram illustrating the stack operations for $\{a^n b^n c^n \mid n \geq 1\}$. The string $a^n b^n c^n$ is shown with brackets under a^n and b^n . Above a^n , the operations "skip a's" and "push a's" are written. Above b^n , the operations "push b's" and "pop b's" are written.

$$12) \{a^n b^n c^k d^k \mid n, k \geq 1\}$$

Diagram illustrating the stack operations for $\{a^n b^n c^k d^k \mid n, k \geq 1\}$. The string $a^n b^n c^k d^k$ is shown with brackets under a^n and b^n . Above a^n , the operations "push a's" and "pop a's" are written. Above b^n , the operations "push b's" and "pop b's" are written.

$$13) \{a^n b^k c^k d^n \mid n, k \geq 1\}$$

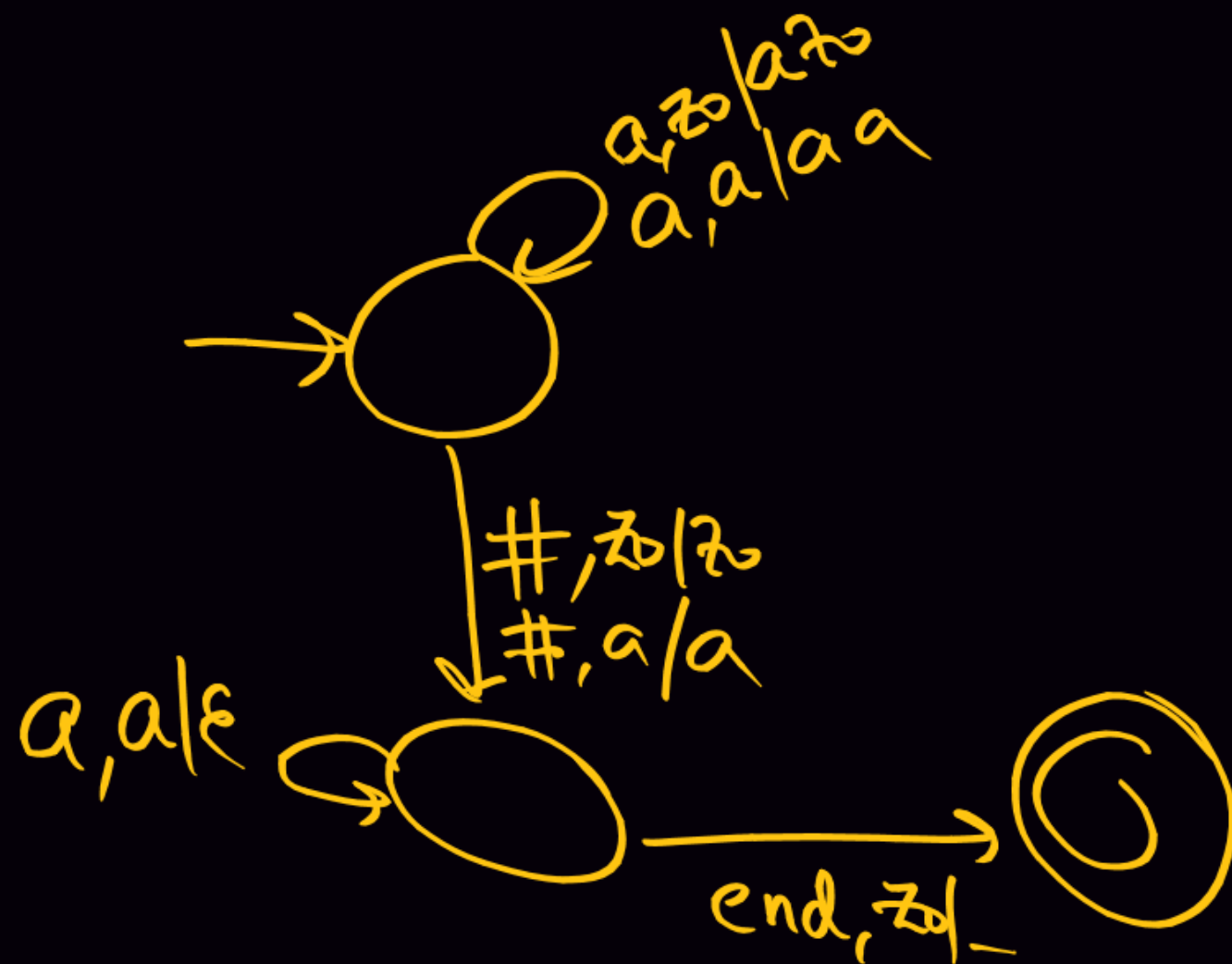
Diagram illustrating the stack operations for $\{a^n b^k c^k d^n \mid n, k \geq 1\}$. The string $a^n b^k c^k d^n$ is shown with brackets under a^n and b^k . Above a^n , the operations "push" and "pop" are written. Above b^k , the operations "push" and "pop" are written.

$$14) \{a^n b^m c^{n+m} \mid n, m \geq 1\}$$

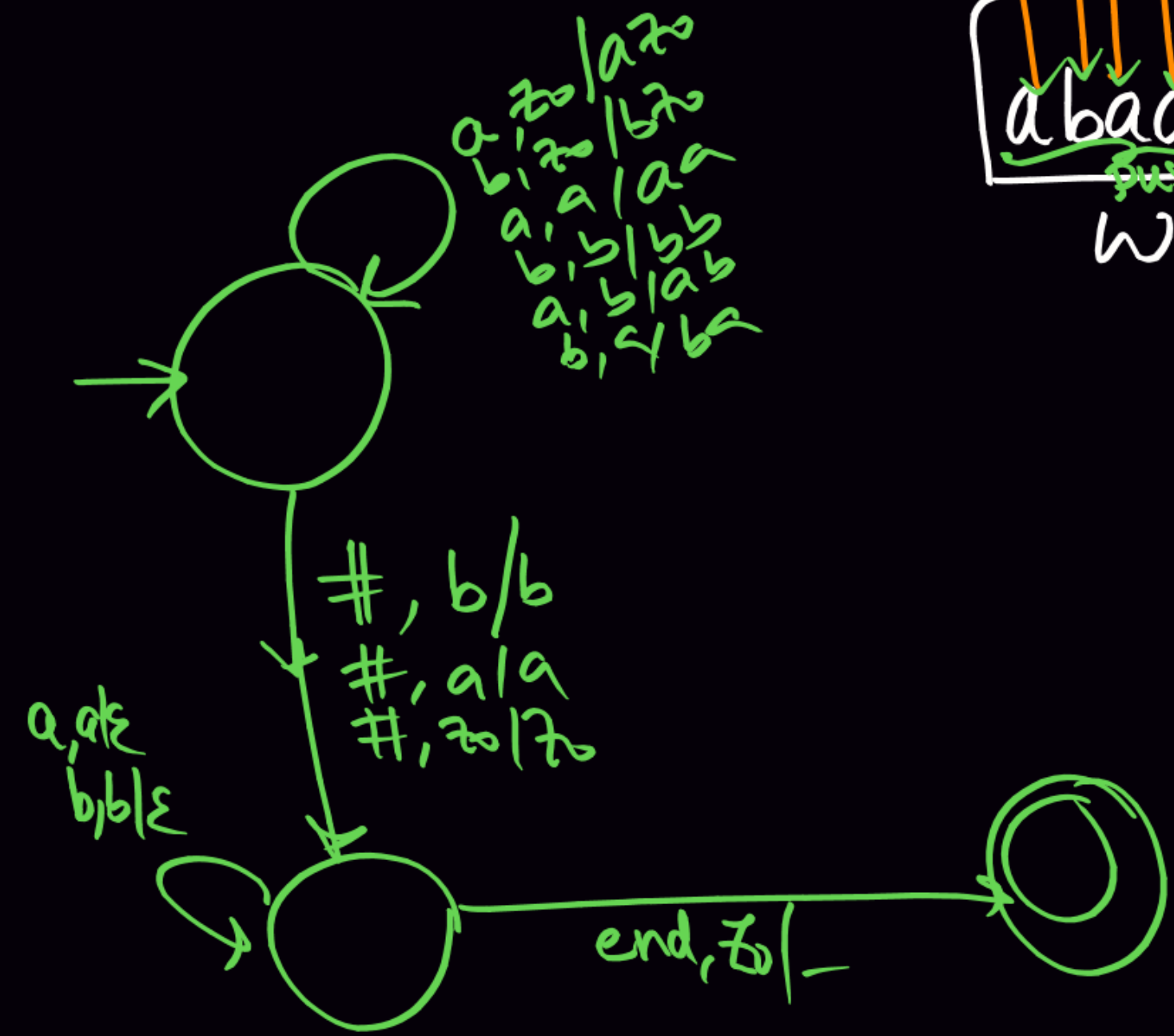
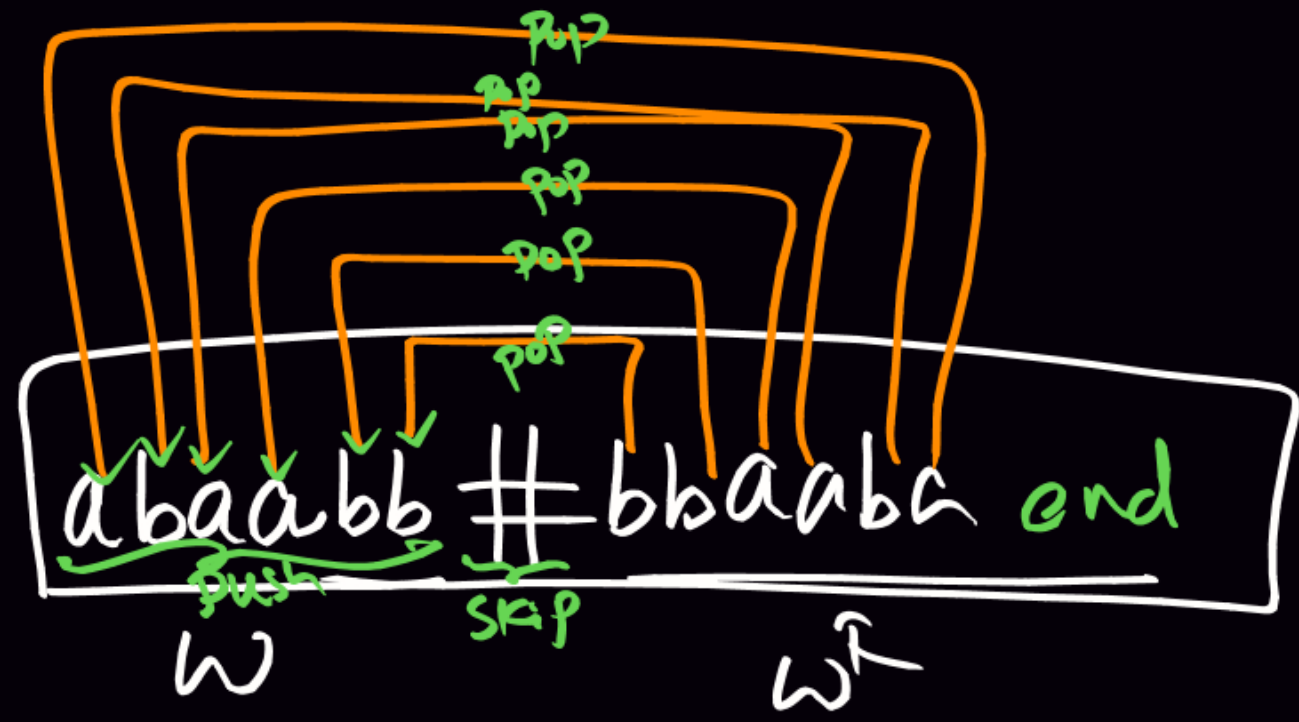
Diagram illustrating the stack operations for $\{a^n b^m c^{n+m} \mid n, m \geq 1\}$. The string $a^n b^m c^{n+m}$ is shown with brackets under a^n and b^m . Above a^n , the operations "push a's" and "pop a's" are written. Above b^m , the operations "push b's" and "pop b's" are written.



$$15) \{w \# w^R \mid w \in a^*\} = \{ \underbrace{a^n}_{\substack{\text{push} \\ a's}} \# \underbrace{a^n}_{\substack{\text{pop} \\ a's}} \mid n \geq 0 \}$$



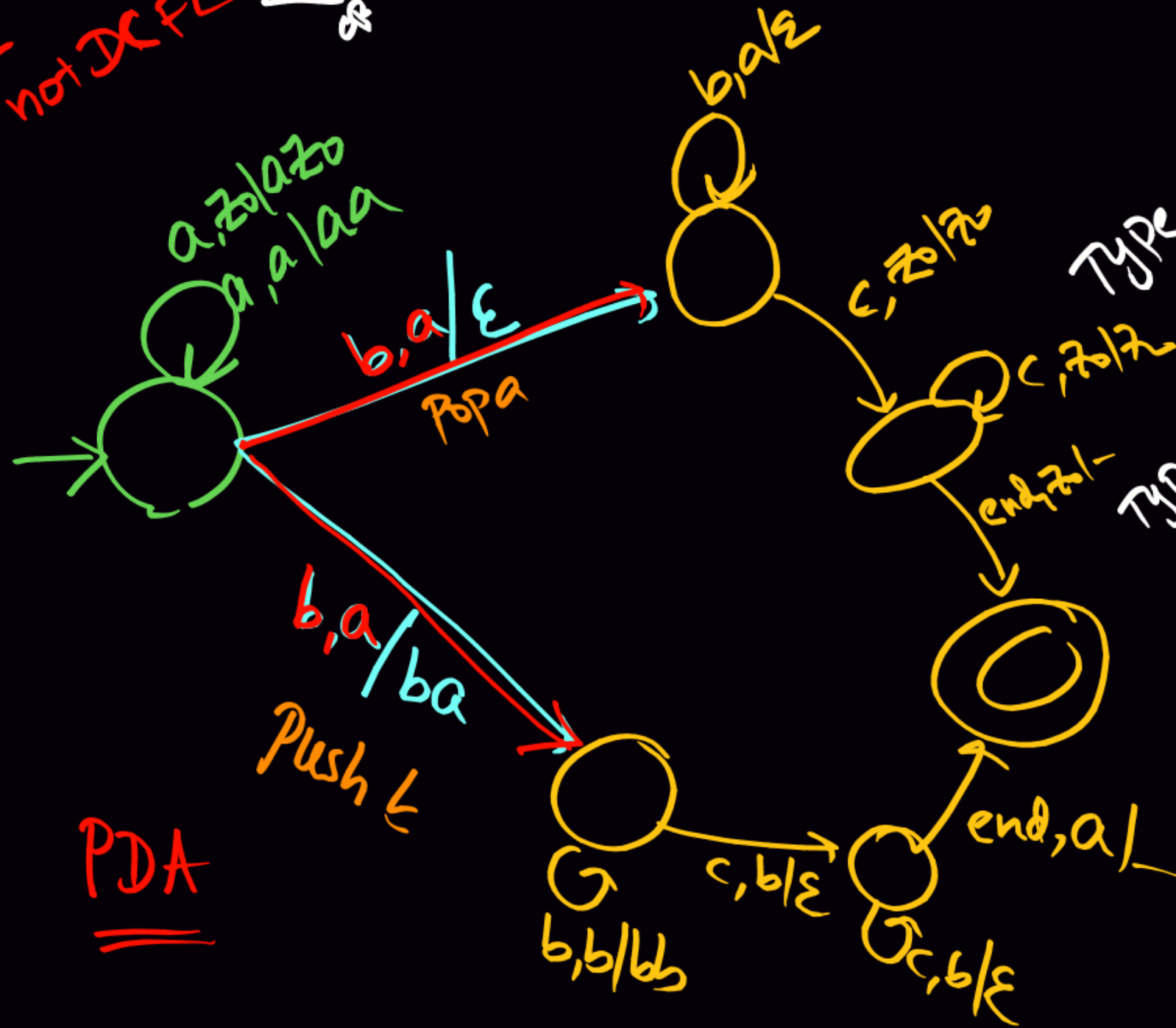
16) $\{w\#w^R \mid w \in (a+b)^*\}$



17) $\{ a^m b^n c^k \mid m, n, k \geq 1, m=n \text{ OR } n=k \}$

CF L
but not DCFL

no DPDA



Type 1:

$aa \boxed{bb} ccc$

Type 2:

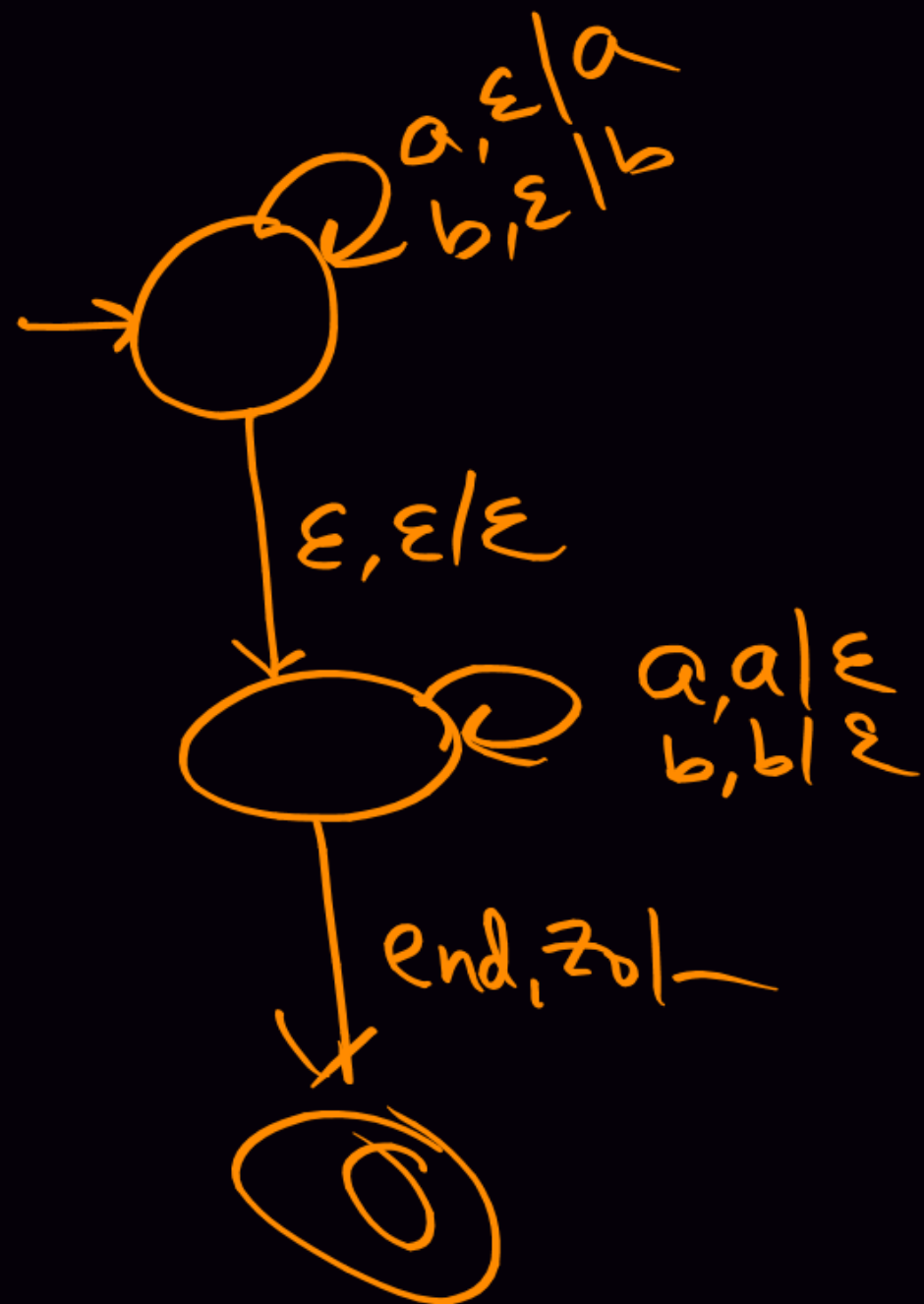
$aa \boxed{bbb} cc$

$aa \boxed{b}$
Push Push

Push b
pop a

18) $\{ww^R \mid w \in (a+b)^*\}$

\downarrow push
 \downarrow pop by match



19) $\{a^m b^n c^k \mid \text{if } m=\text{even then } n=k\}$

H.W.

20) $\{a^m b^n \mid m=2n \text{ OR } n=2m\}$