

CSEN 1002

## Task 3: Fallback Deterministic Finite Automata

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Operation

1 Operation

2 Examples

# Operation

- A fallback DFA with actions operates like the standard DFA, moving only L, and pushing every state it enters onto the stack with every transition.
- This continues until the DFA runs out of input.
- If it runs out of input in state  $q_a \in F$ , it executes  $A(q_a)$  and halts.
- If it runs out of input in  $q_r \notin F$ , it
  1. continues to simultaneously pop the stack and move L one step to the left until the stack gets empty or some  $q_a \in F$  is popped.
  2. In the first case, the DFA executes  $A(q_r)$  and halts.
  3. In the second case it does the following.
    1. Executes  $A(q_a)$  (with lex being the string extending from R to L).
    2. Moves L one step to the right.
    3. Moves R to where L is.
    4. Empties the stack.
    5. Enters  $q_0$ .

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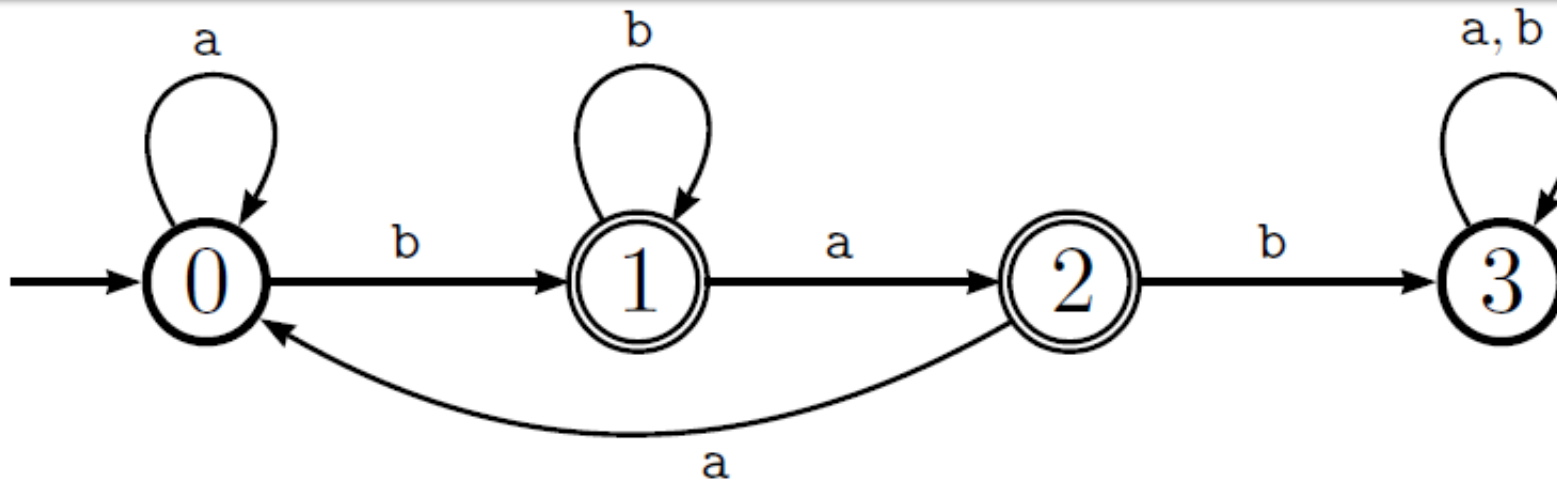
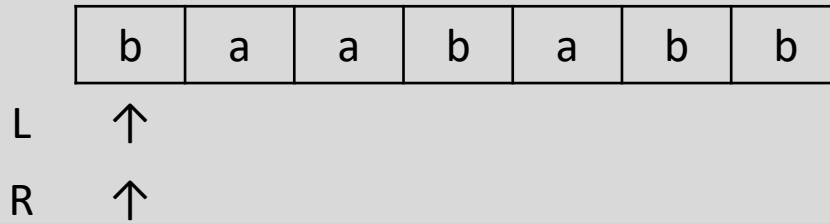
Examples

1 Operation

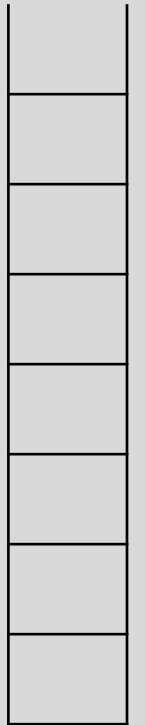
2 Examples

# Examples

Example I: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

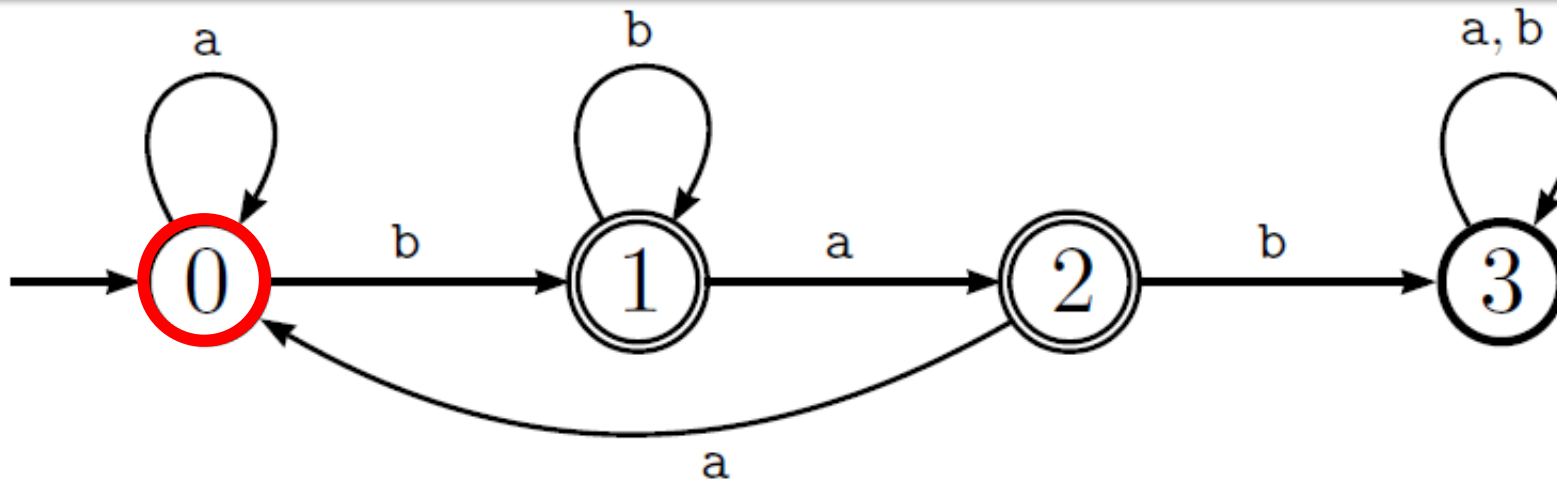
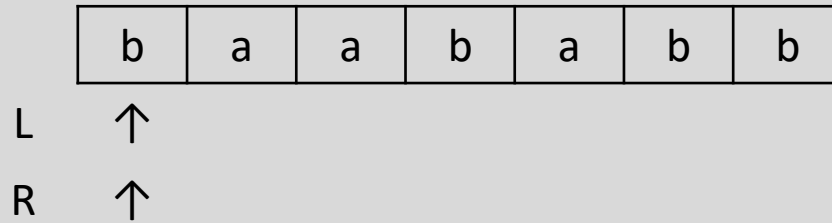


Stack

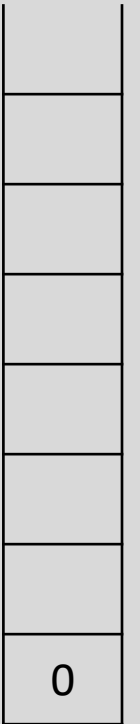


# Examples

Example I: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

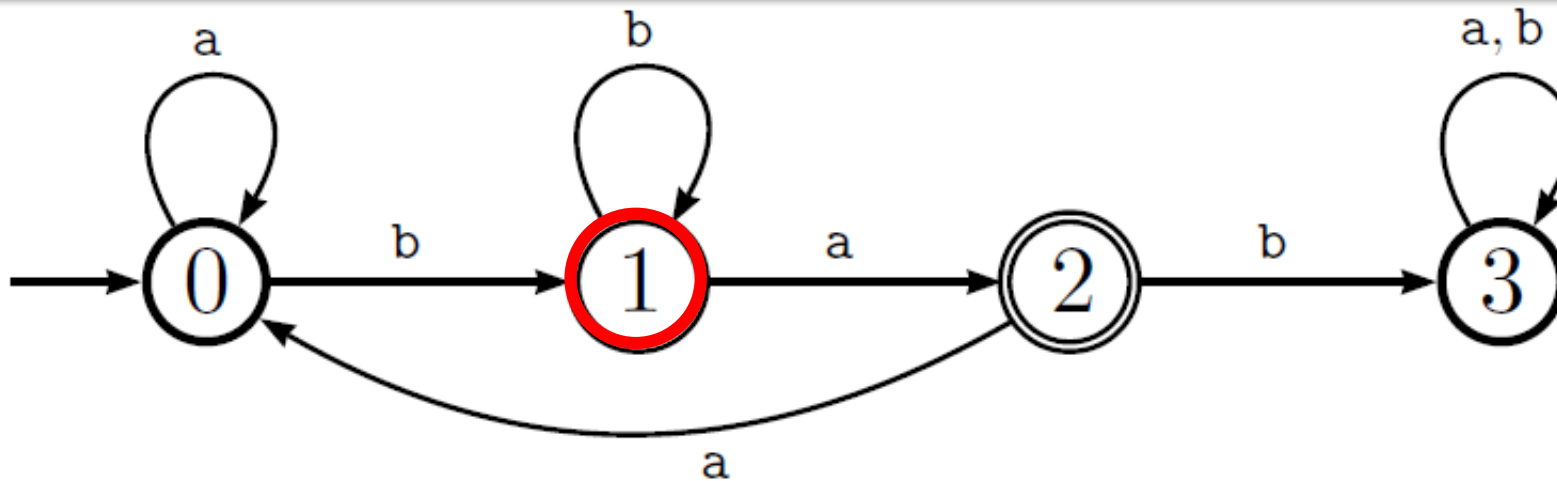
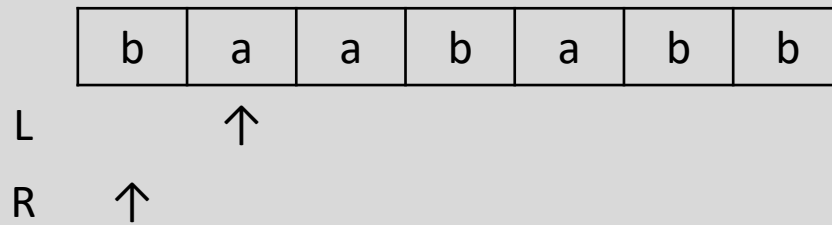


Stack

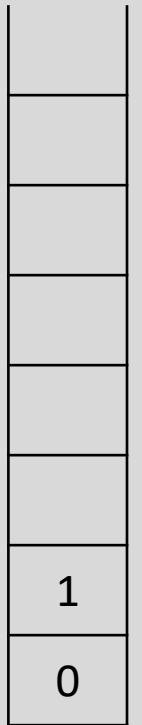


# Examples

Example I: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



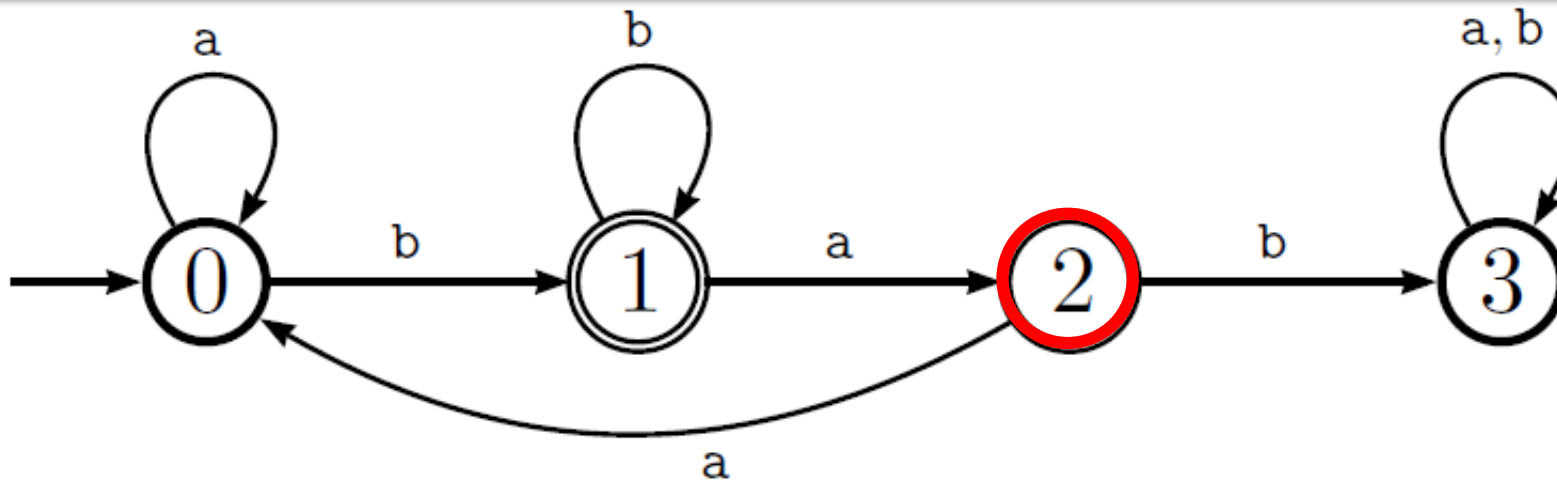
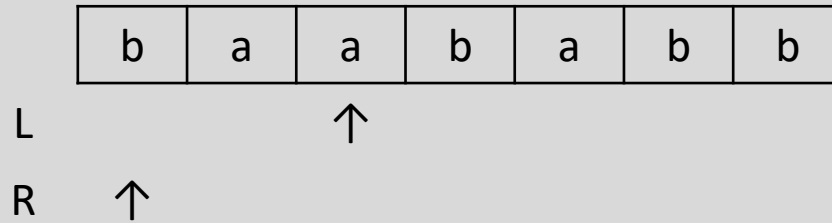
Stack



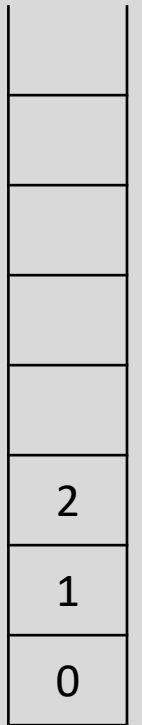


# Examples

Example I: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

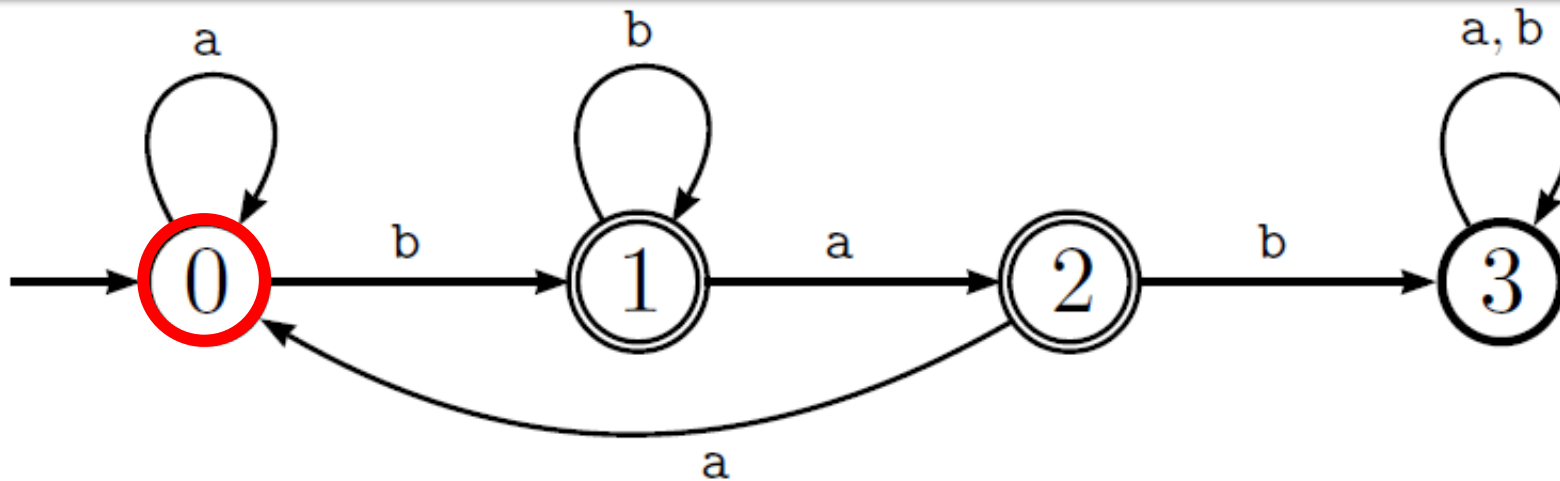
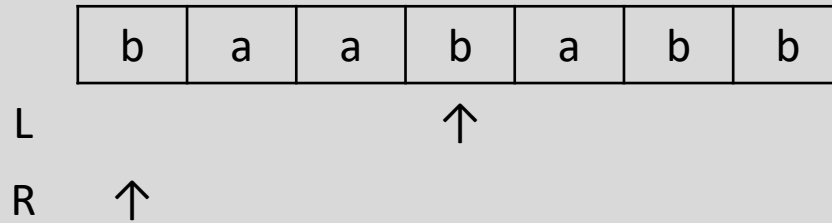


Stack

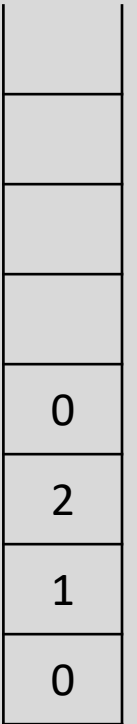


# Examples

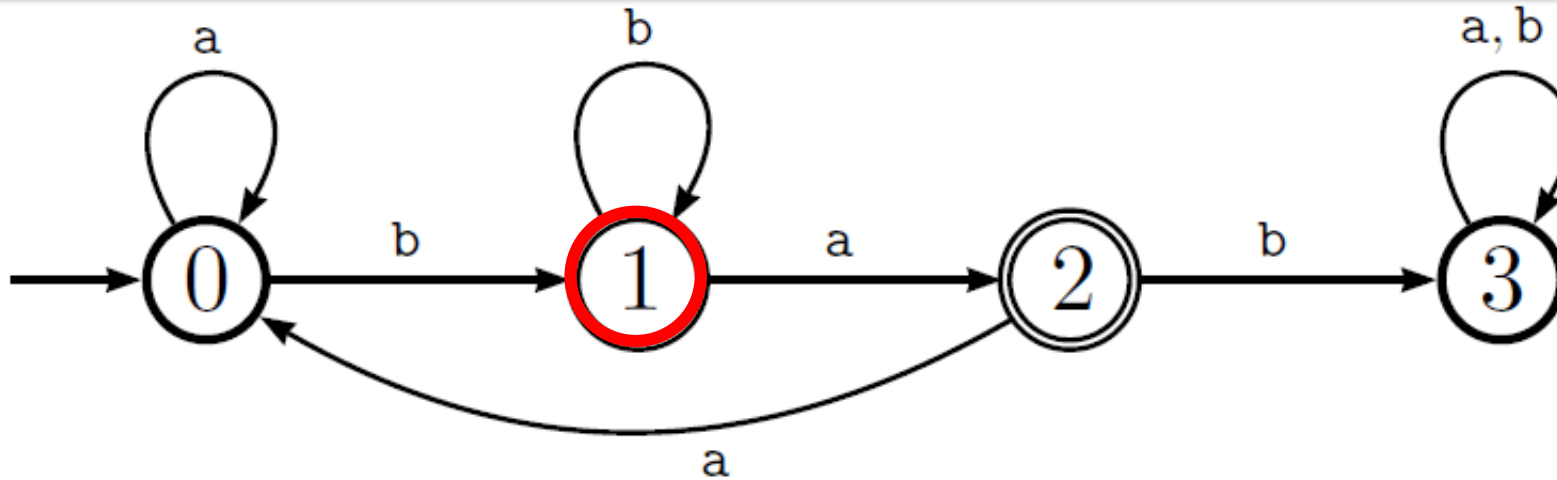
Example I: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



Stack



	b	a	a	b	a	b	b
L					↑		
R	↑						



1
0
2
1
0

b	a	a	b	a	b	b
---	---	---	---	---	---	---

## R



2

1

0

2

1

0

b	a	a	b	a	b	b
---	---	---	---	---	---	---

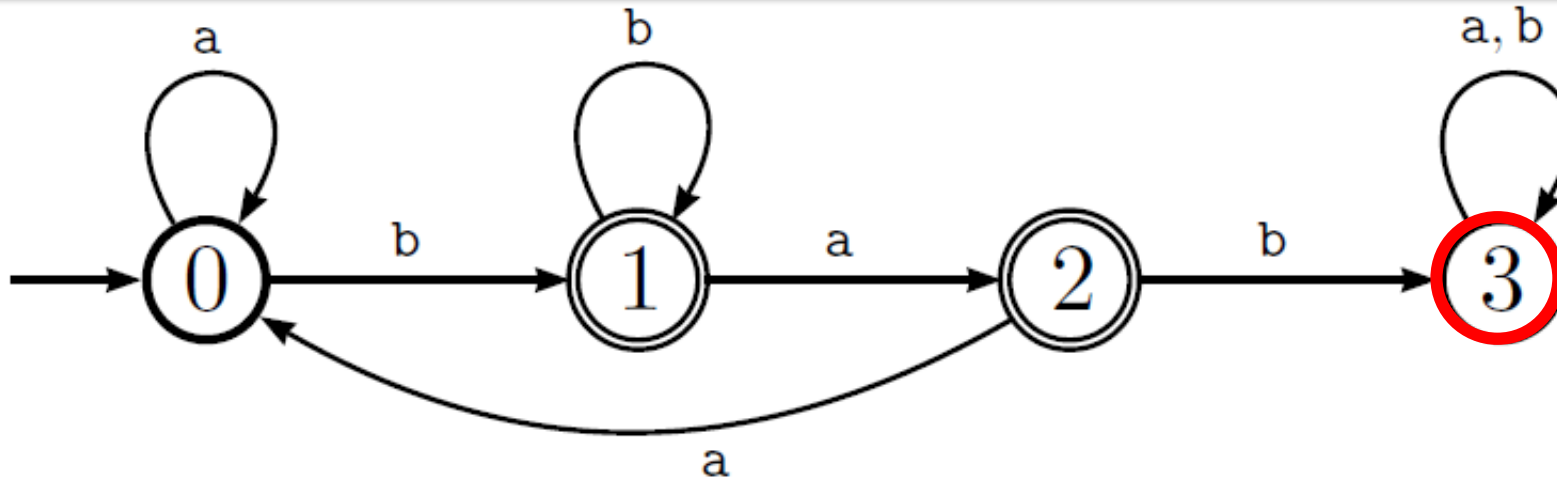
## R



0

b	a	a	b	a	b	b
---	---	---	---	---	---	---

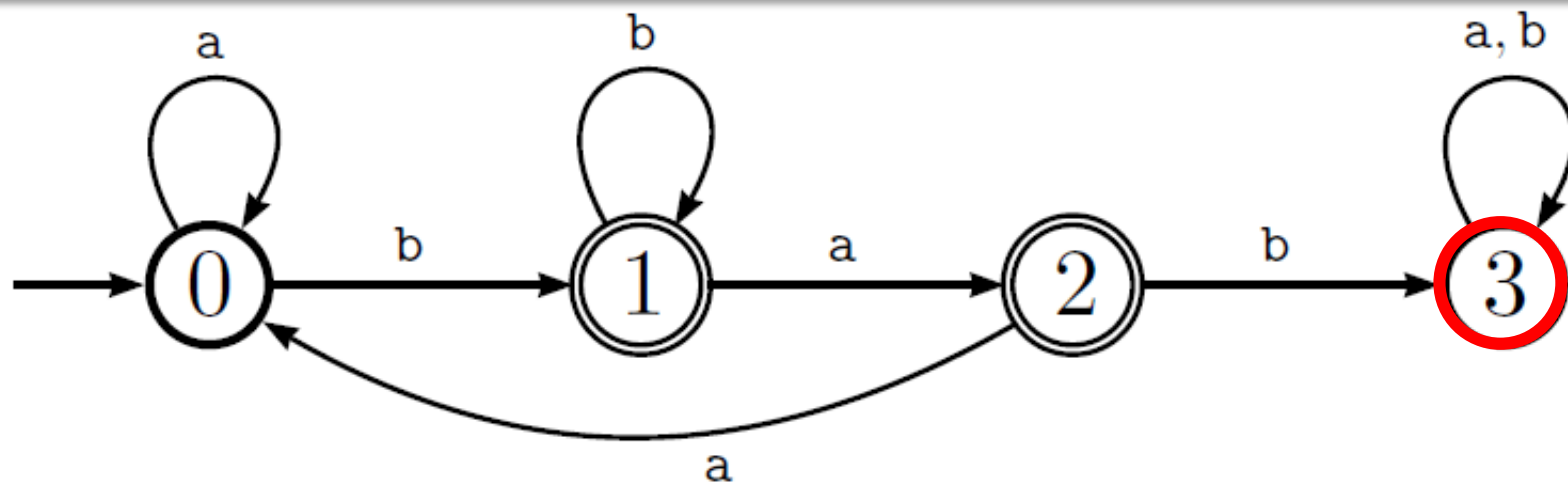
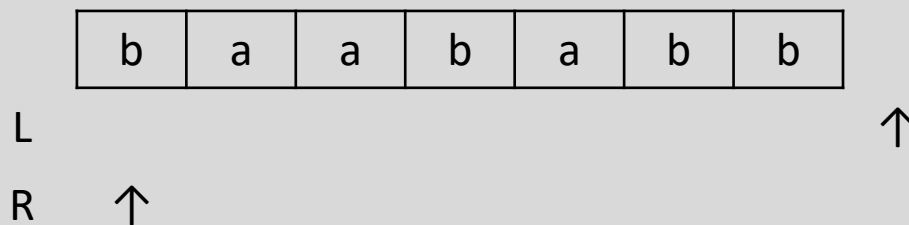
## R



3
3
2
1
0
2
1
0

# Examples

Example I: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



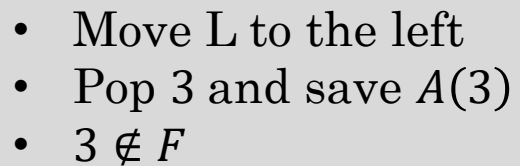
- simultaneously pop the stack and move L one step to the left until the stack gets empty or some  $q_a \in F$  is popped

Stack

3
3
2
1
0
2
1
0

b	a	a	b	a	b	b
---	---	---	---	---	---	---

R

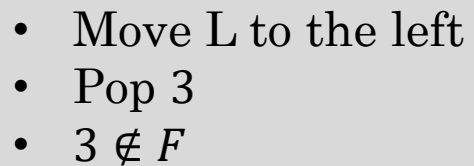


3
3
2
1
0
2
1
0



b	a	a	b	a	b	b
---	---	---	---	---	---	---

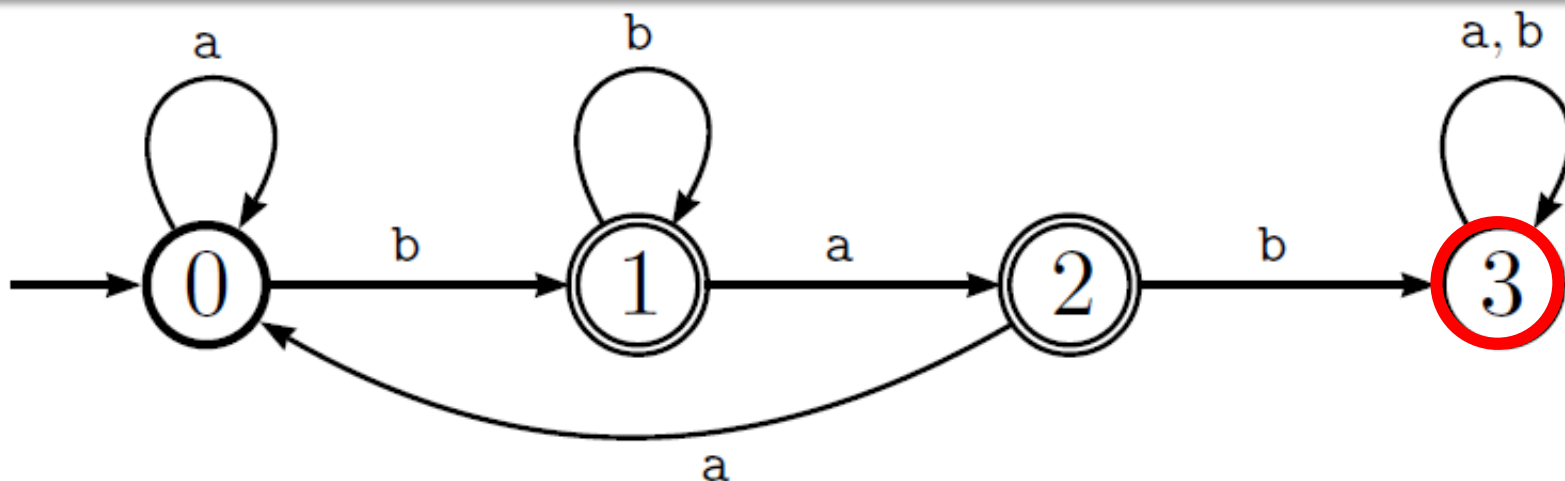
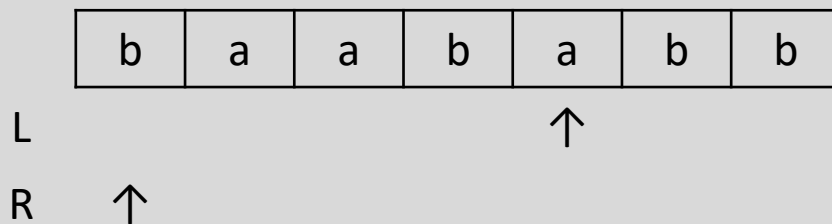
## R



3
2
1
0
2
1
0

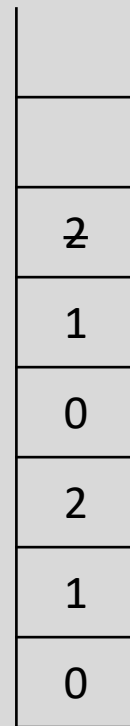
# Examples

Example I: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



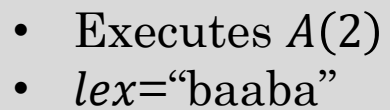
- Move L to the left
- Pop 2
- $2 \in F$

Stack



b	a	a	b	a	b	b
---	---	---	---	---	---	---

## R



2
1
0
2
1
0

# Examples

**Example I:** 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

Output: baaba,2

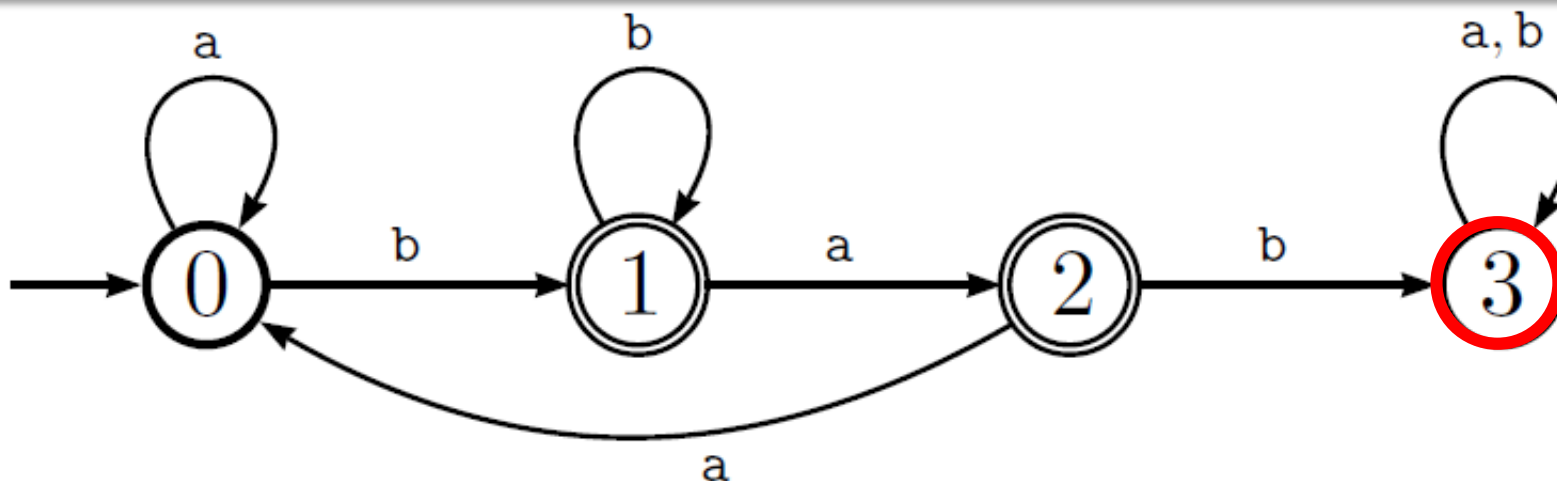
b	a	a	b	a	b	b
---	---	---	---	---	---	---

L

↑

R

↑



- Move L one step to the right
- Move R to where L is

**Stack**

2
1
0
2
1
0

# Examples

Example I: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

Output: baaba,2

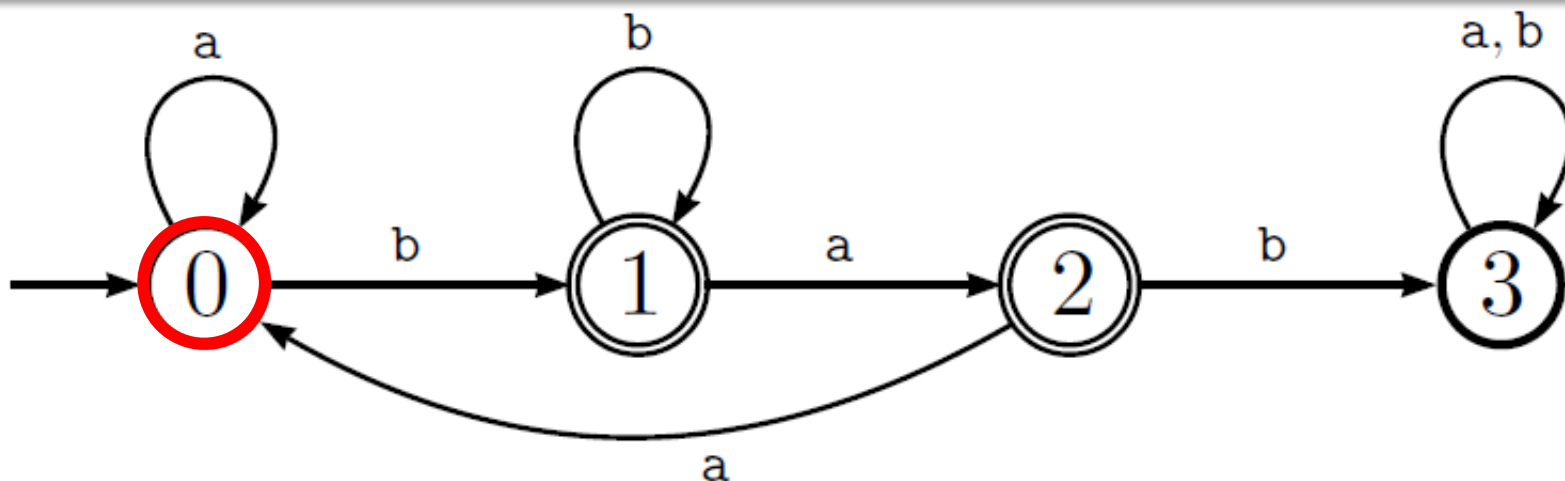
b	a	a	b	a	b	b
---	---	---	---	---	---	---

L

↑

R

↑



- Empty the stack
- Enter  $q_0$

Stack



# Examples

Example I: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

Output: baaba,2

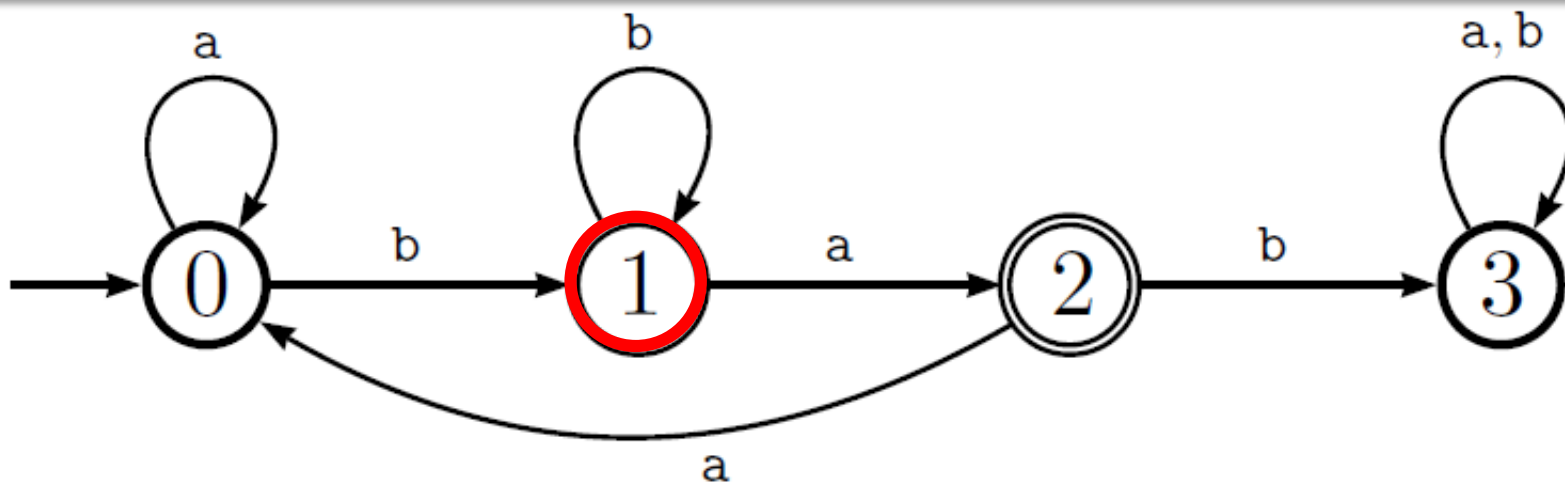
b	a	a	b	a	b	b
---	---	---	---	---	---	---

L

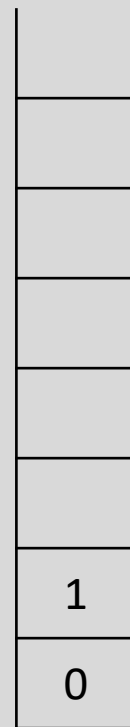
↑

R

↑



Stack



# Examples

Example I: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

Output: baaba,2

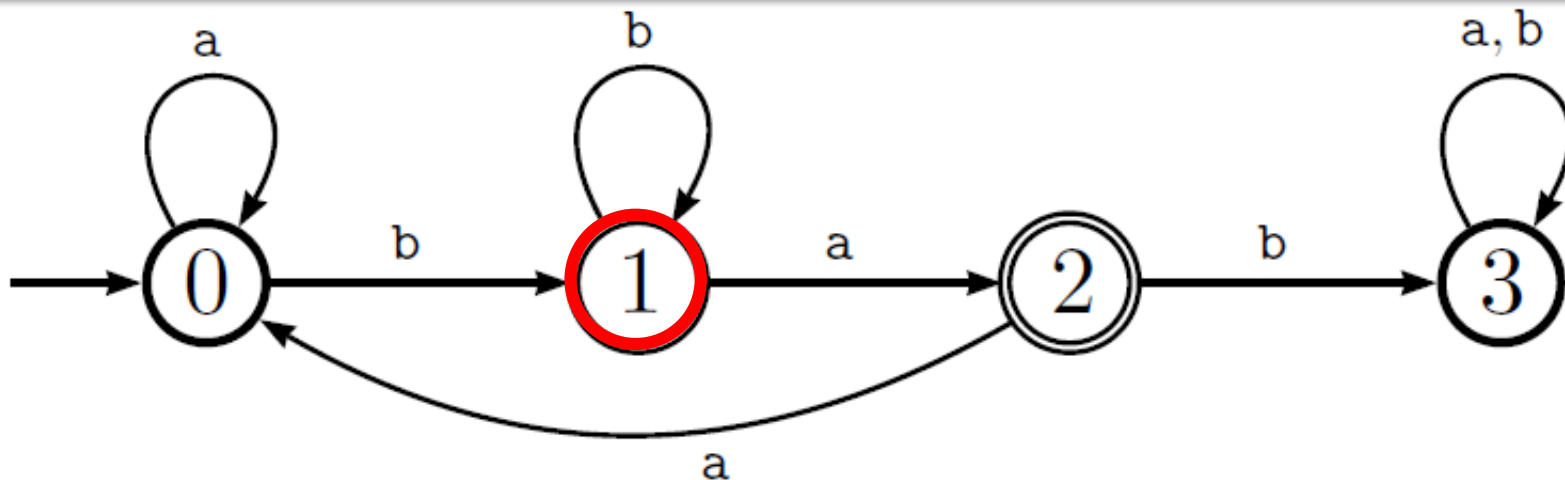
b	a	a	b	a	b	b
---	---	---	---	---	---	---

L

↑

R

↑



Stack



# Examples

**Example I:** 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

Output: baaba,2

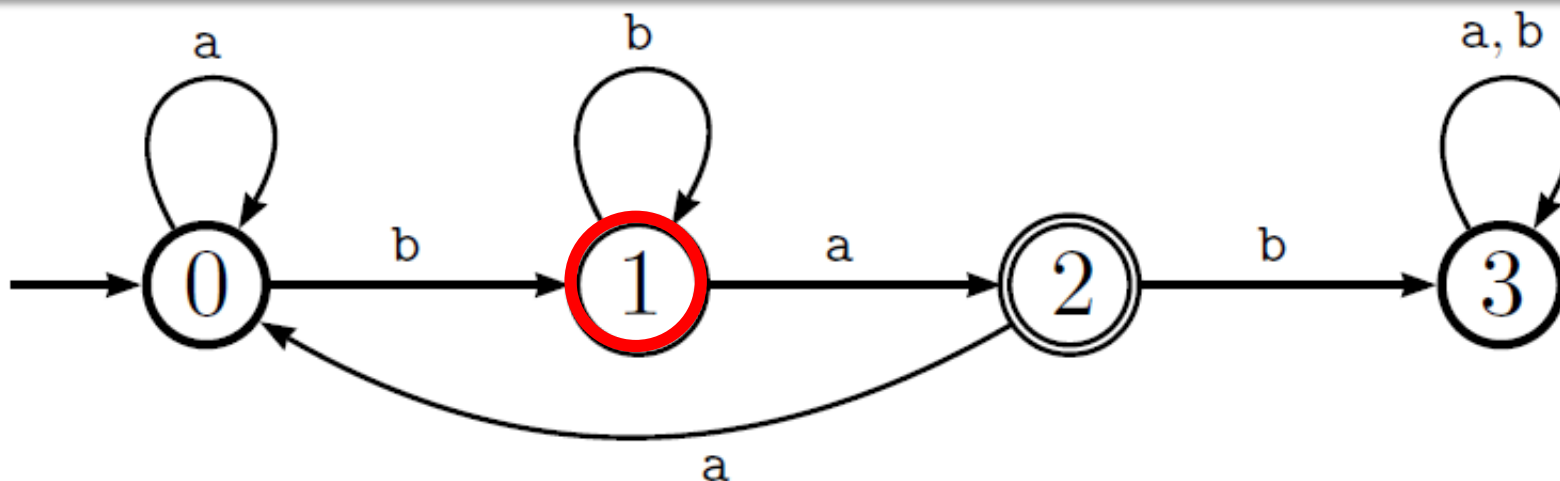
b	a	a	b	a	b	b
---	---	---	---	---	---	---

L

R

↑

↑



- simultaneously pop the stack and move L one step to the left until the stack gets empty or some  $q_a \in F$  is popped

**Stack**

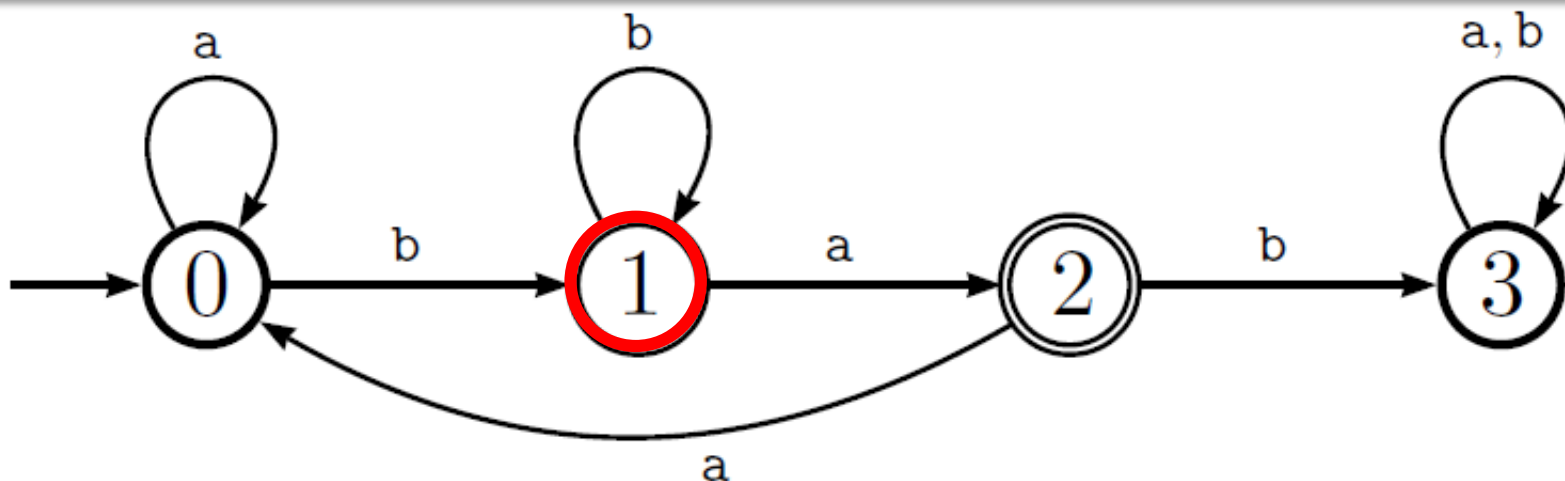
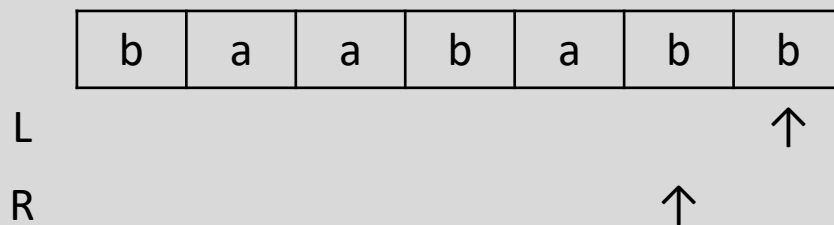




# Examples

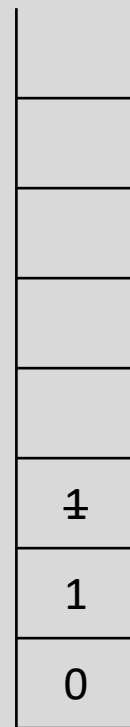
Example I: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

Output: baaba,2



- Move L to the left
- Pop 1
- $1 \in F$

Stack



# Examples

**Example I:** 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

Output: baaba,2

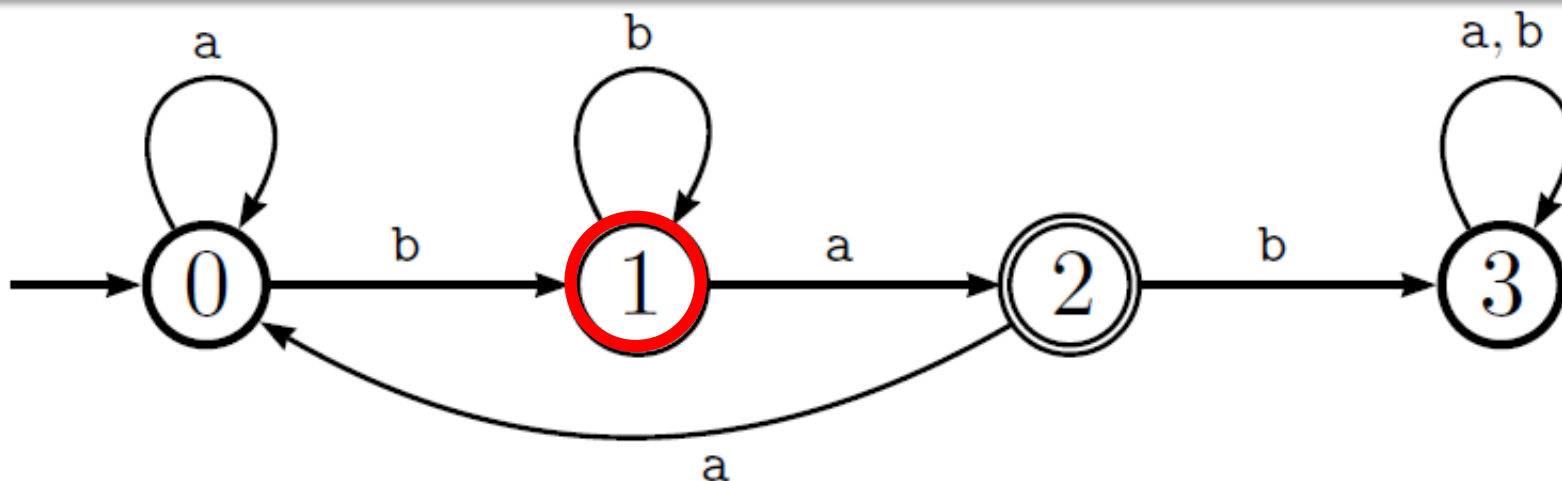
b	a	a	b	a	b	b
---	---	---	---	---	---	---

L

↑

R

↑



- Executes  $A(1)$  and halts.
- $lex = "bb"$

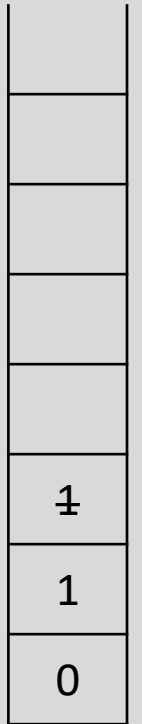
**Stack**



b	a	a	b	a	b	b
---	---	---	---	---	---	---

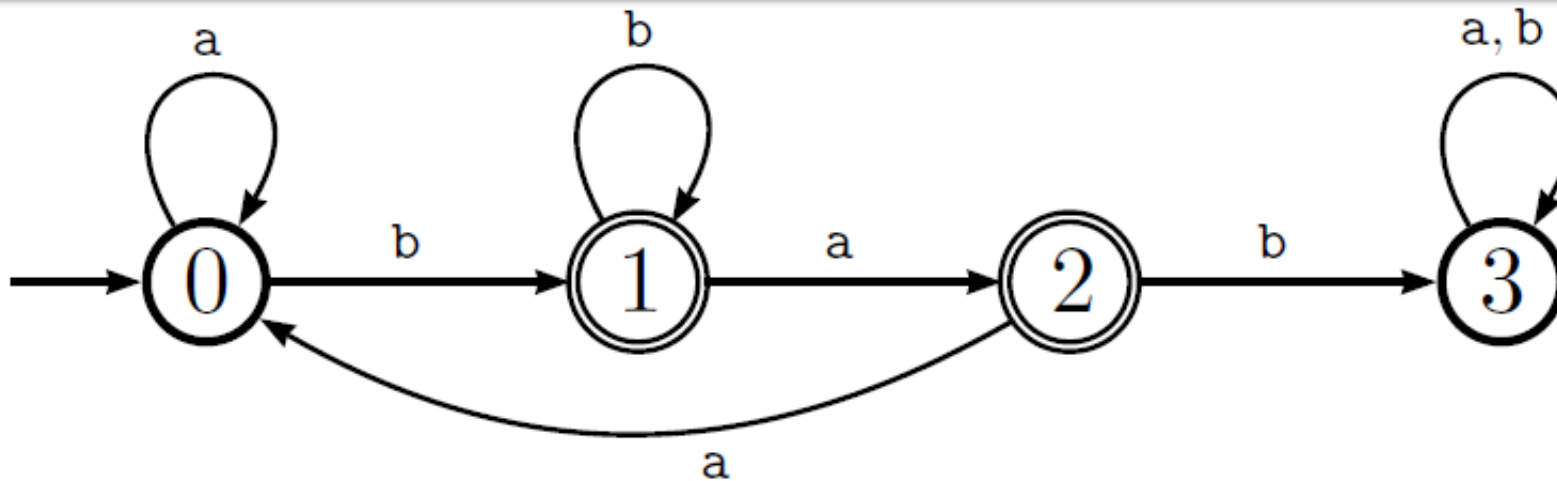
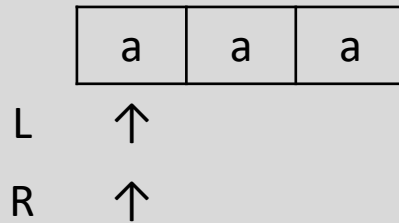


# Stack

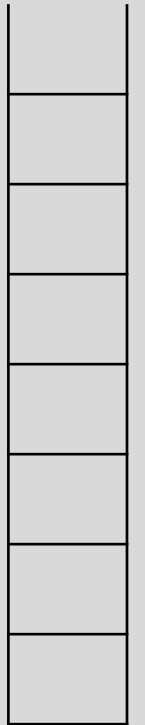


# Examples

Example II: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

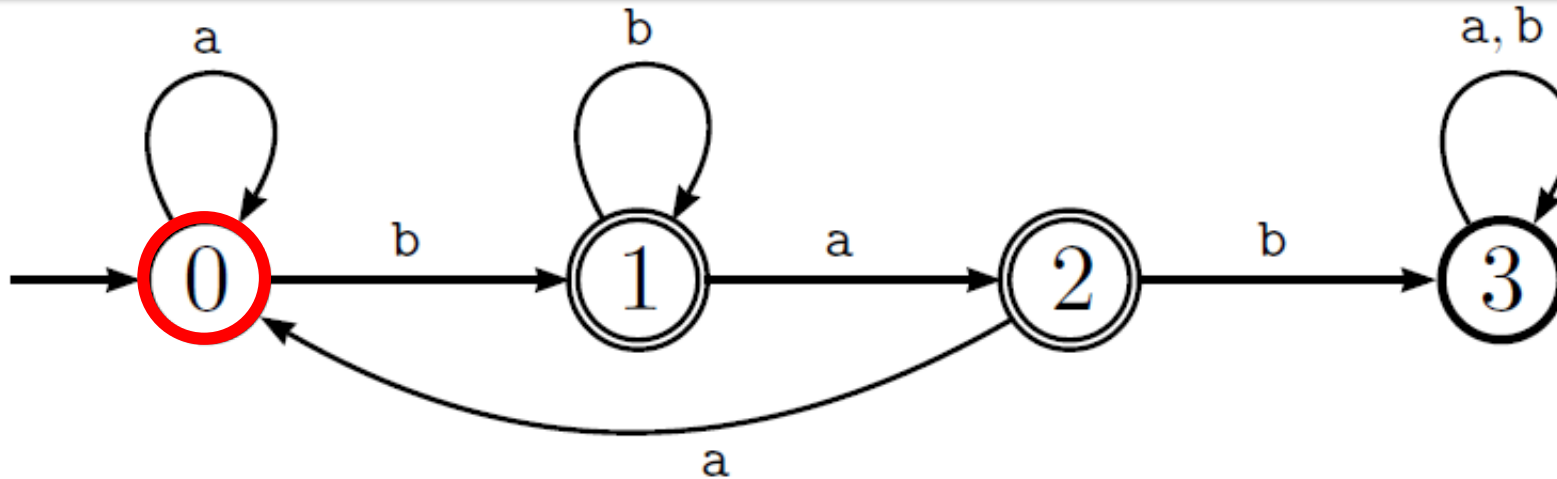
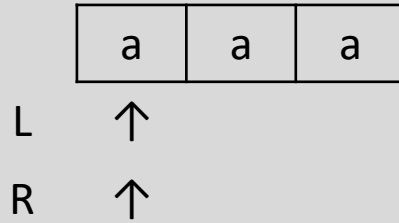


Stack

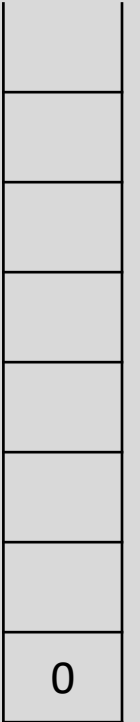


# Examples

Example II: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

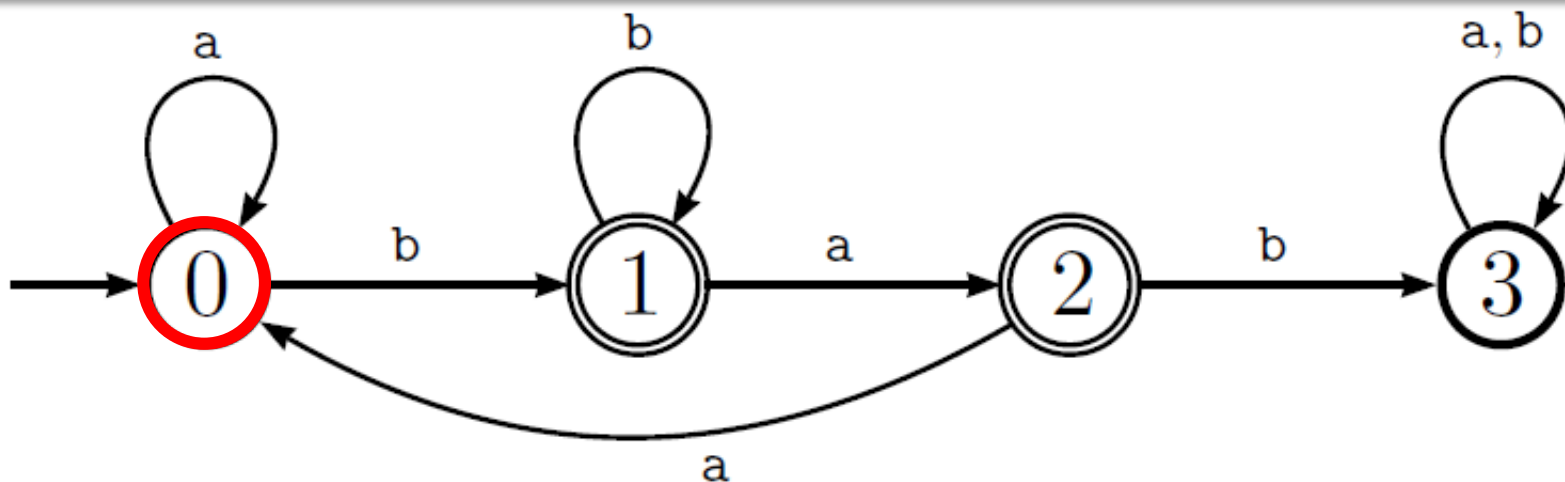
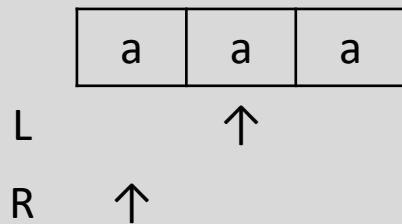


Stack



# Examples

Example II: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

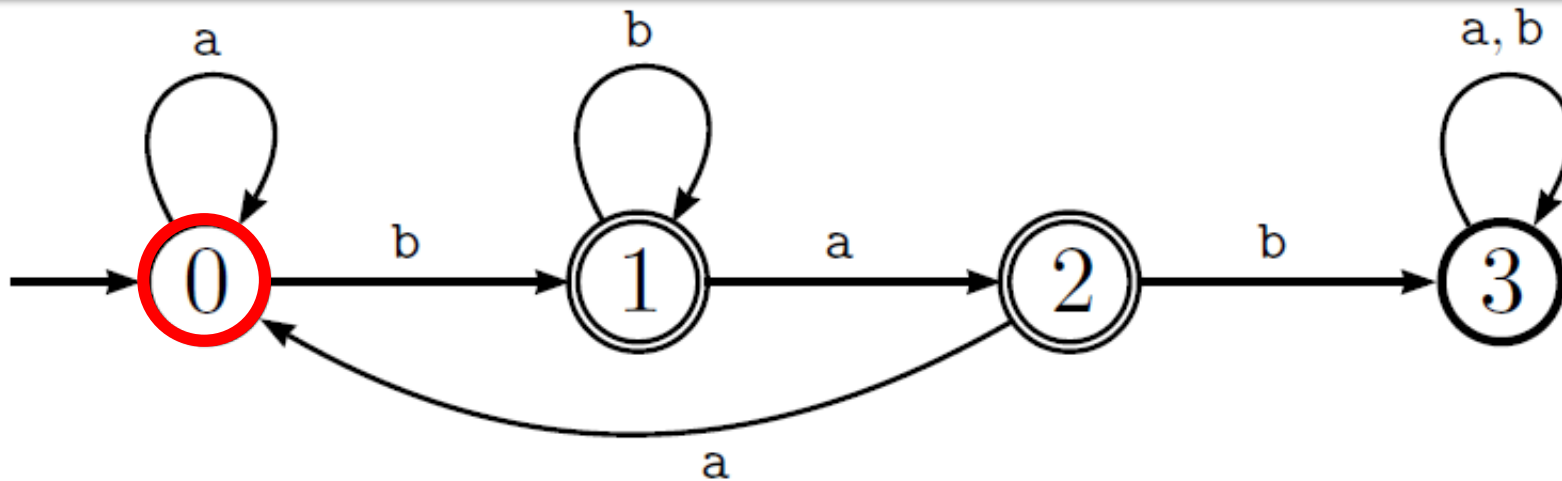
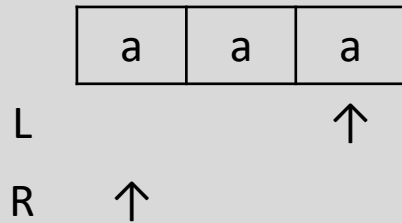


Stack

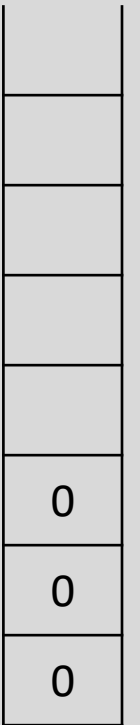


# Examples

Example II: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

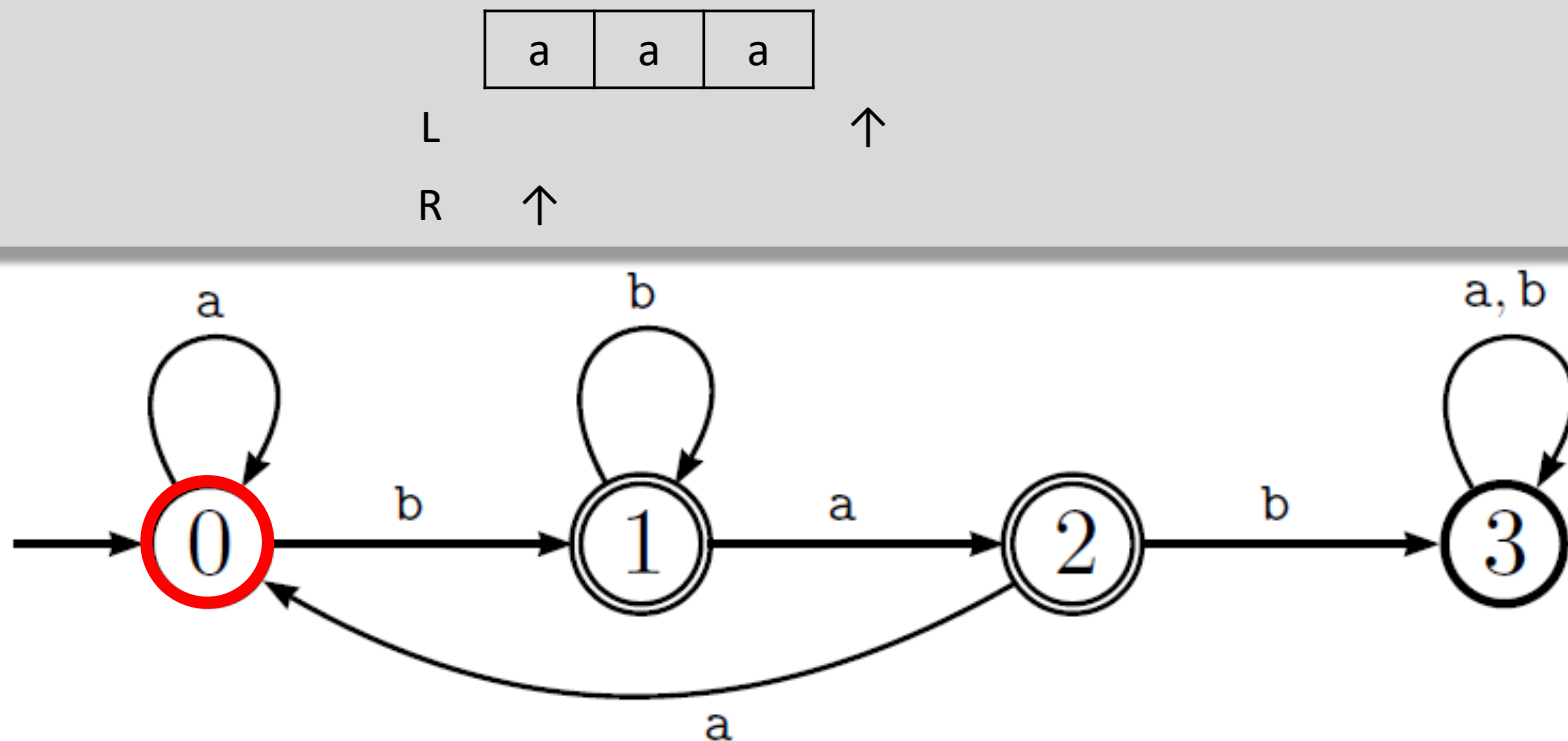


Stack

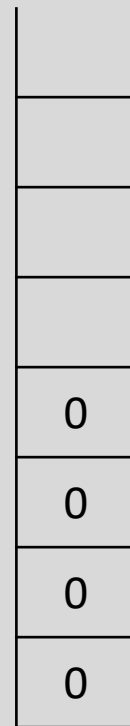


# Examples

Example II: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



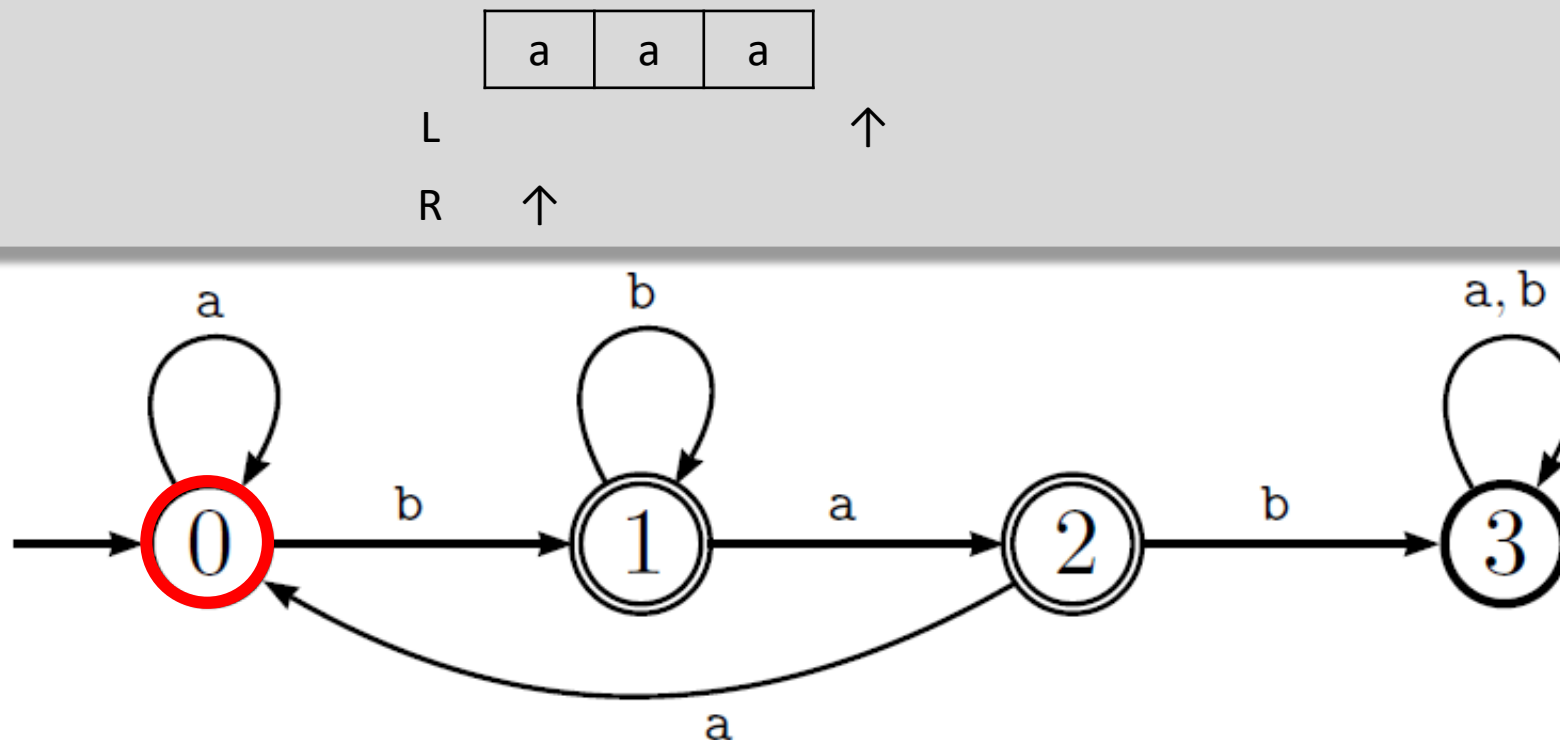
Stack





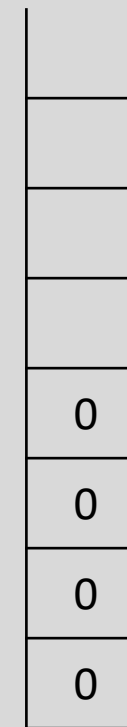
# Examples

Example II:  $0;1;2;3\#a;b\#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3\#0\#1;2$



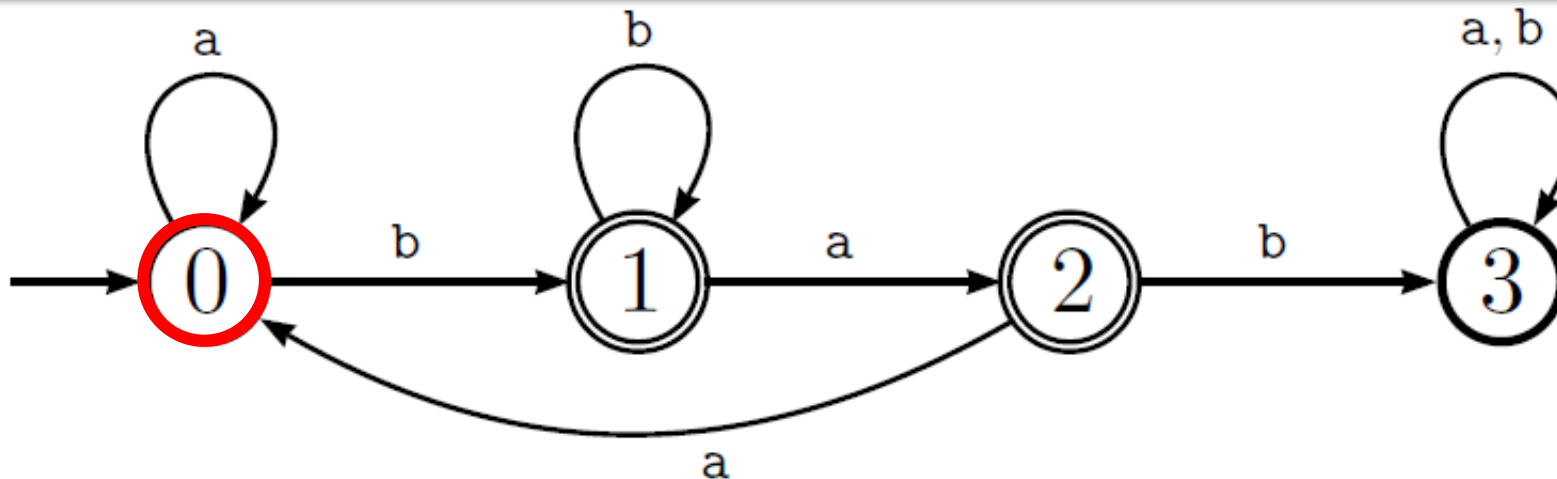
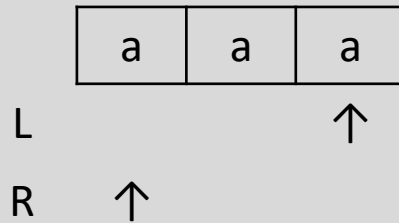
- simultaneously pop the stack and move L one step to the left until the stack gets empty or some  $q_a \in F$  is popped

Stack



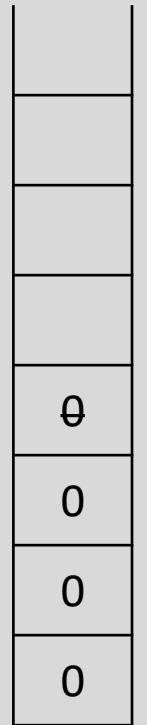
# Examples

Example II: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



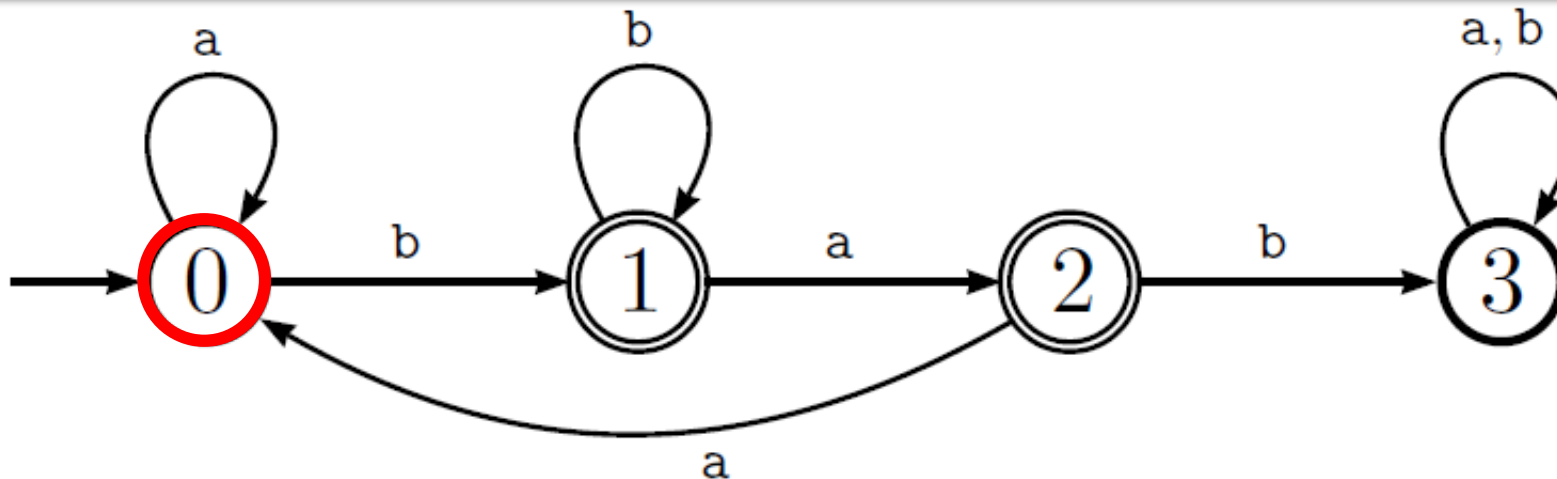
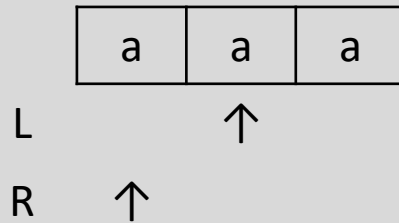
- Move L to the left
- Pop 0 and save  $A(0)$
- $0 \notin F$

Stack



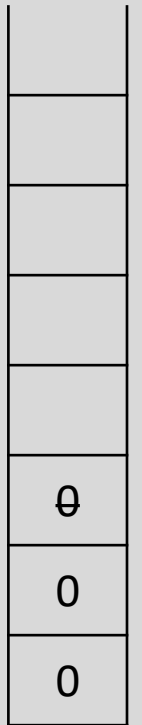
# Examples

Example II: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



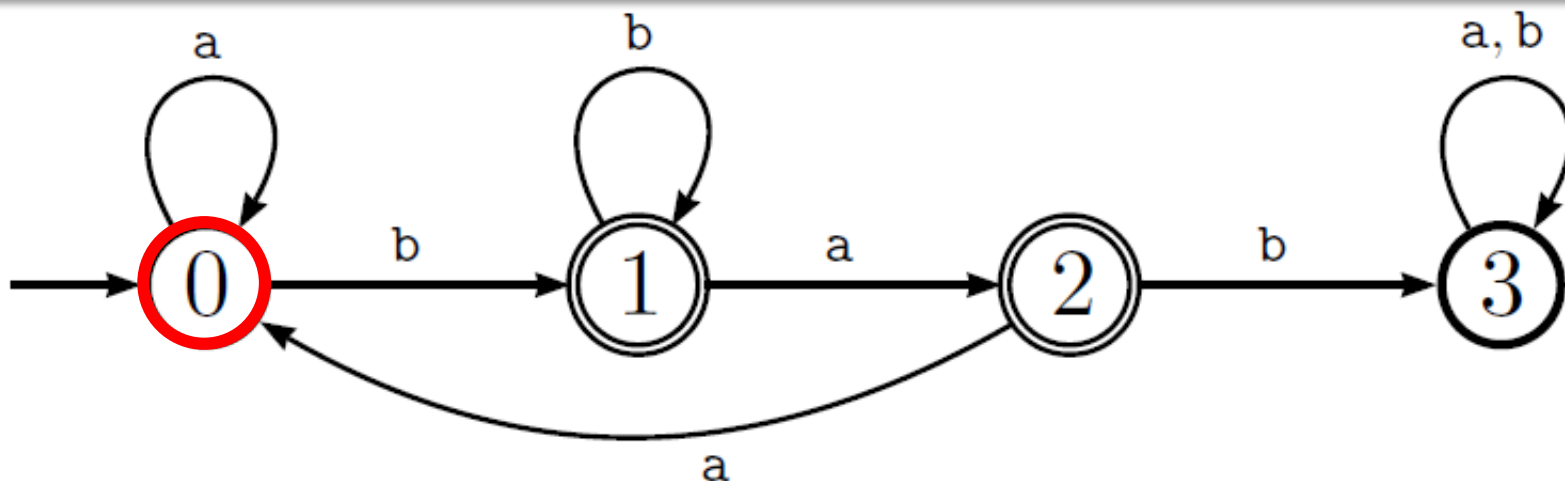
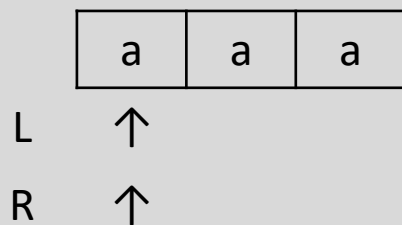
- Move L to the left
- Pop 0
- $0 \notin F$

Stack



# Examples

Example II: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



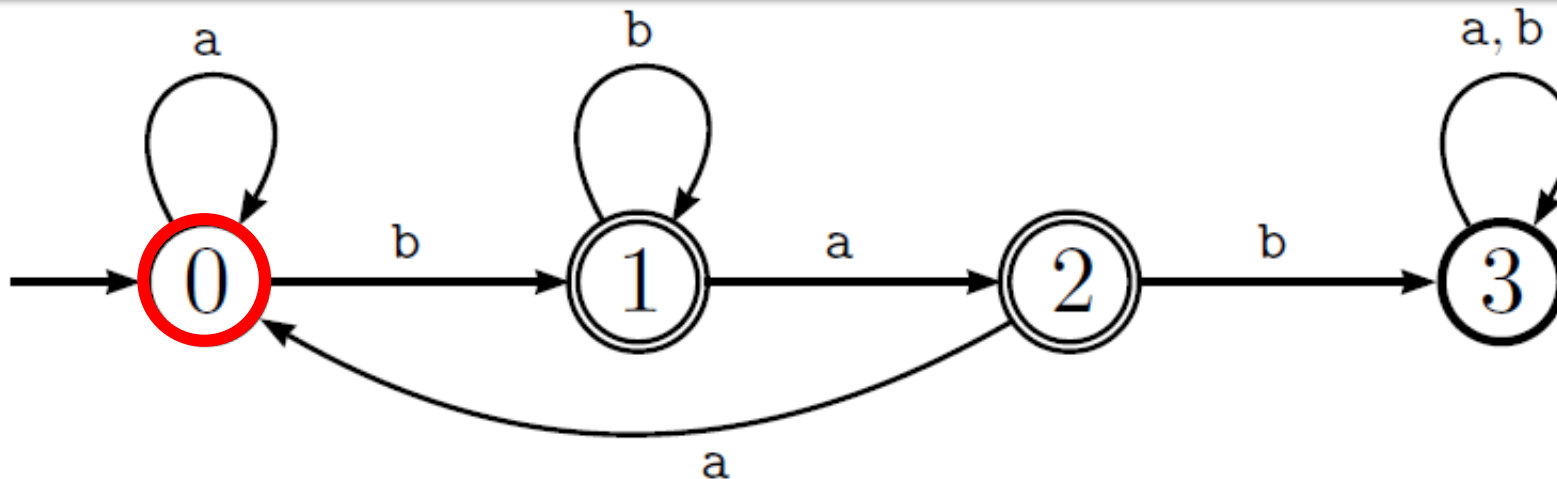
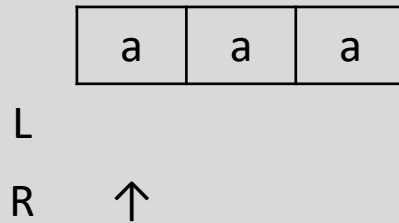
- Move L to the left
- Pop 0
- $0 \notin F$

Stack



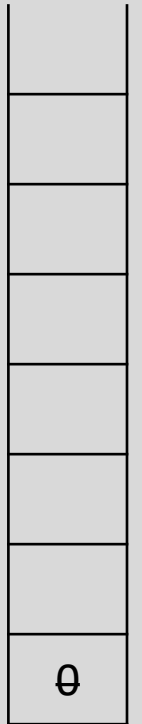
# Examples

Example II: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



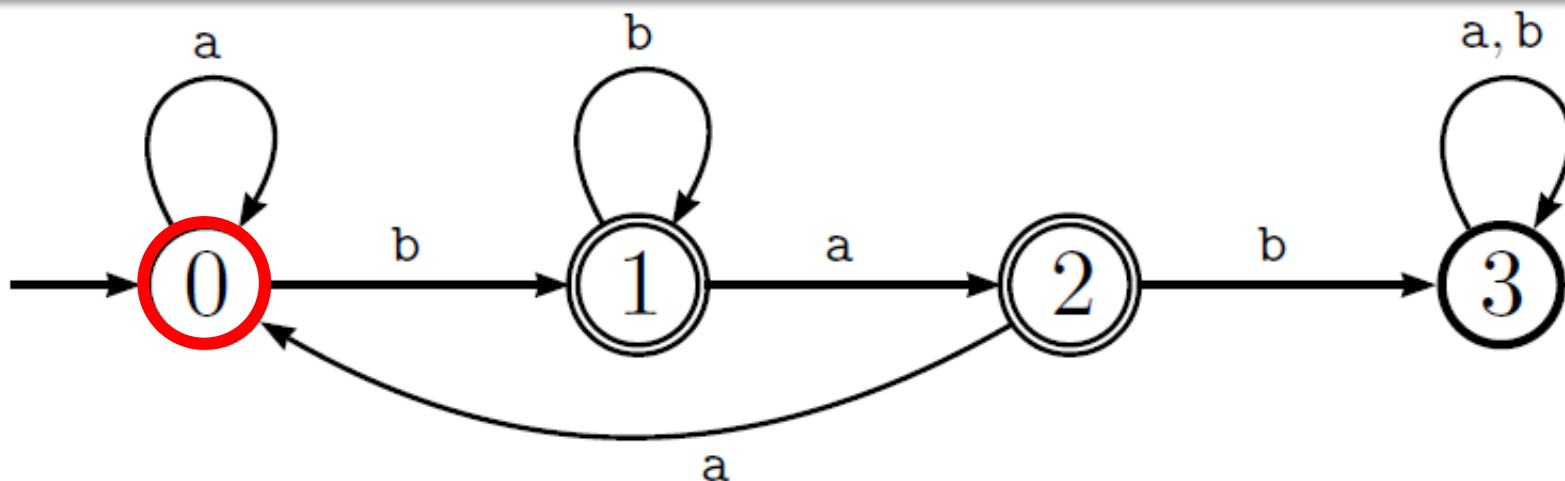
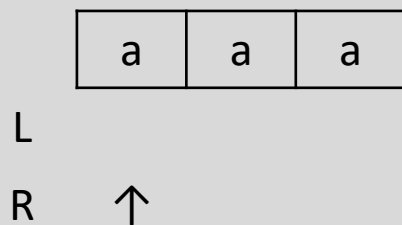
- Move L to the left
- Pop 0
- $0 \notin F$

Stack



# Examples

Example II: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



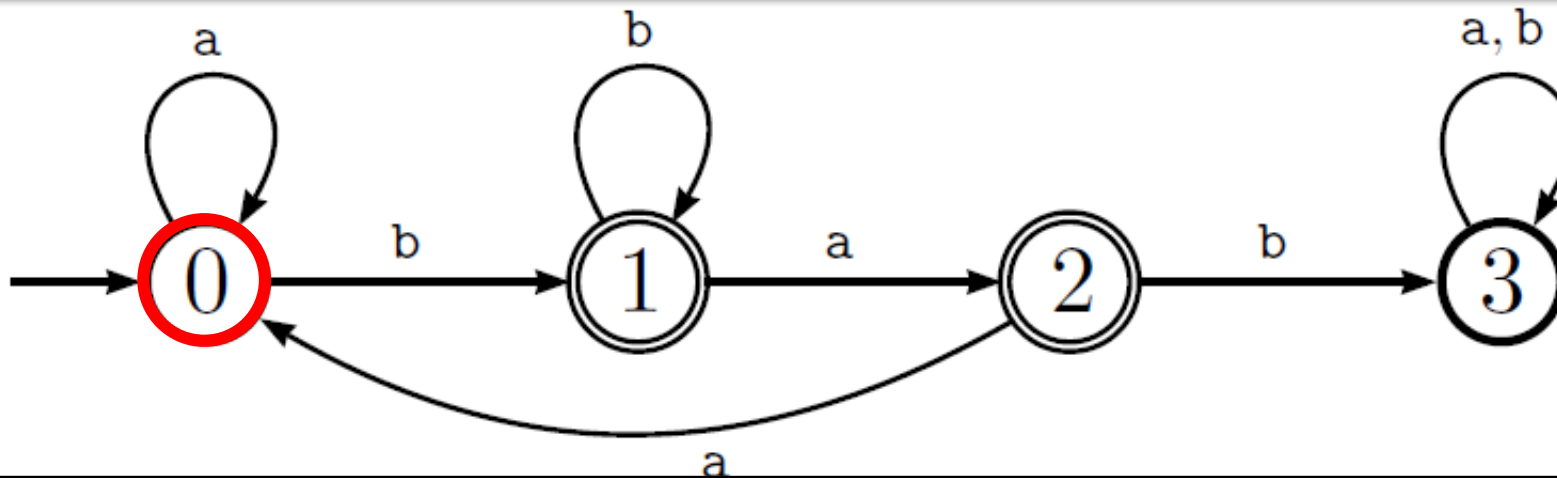
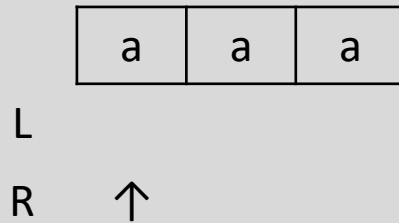
- *Stack is Empty*
- Executes  $A(0)$  (*Saved previously*) and halts.
- $lex = \text{"aaa"}$

Stack



# Examples

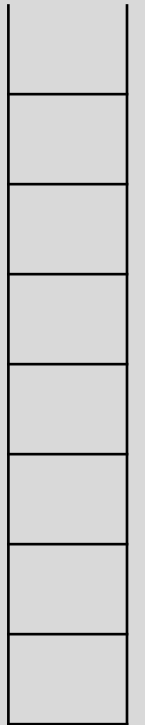
Example II: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



Output

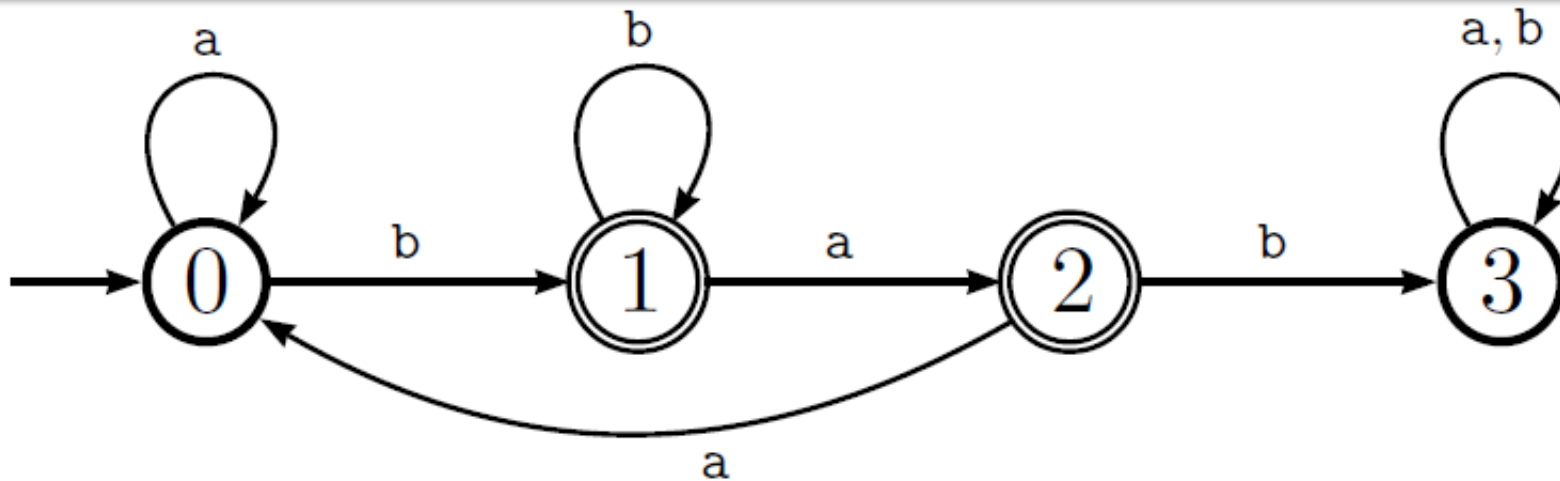
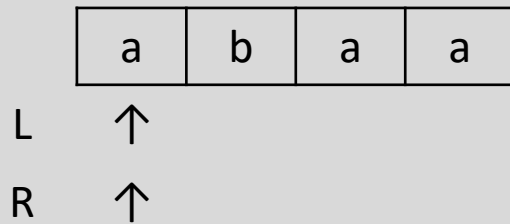
aaa,0

Stack

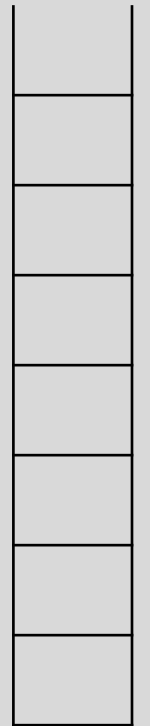


# Examples

Example III: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



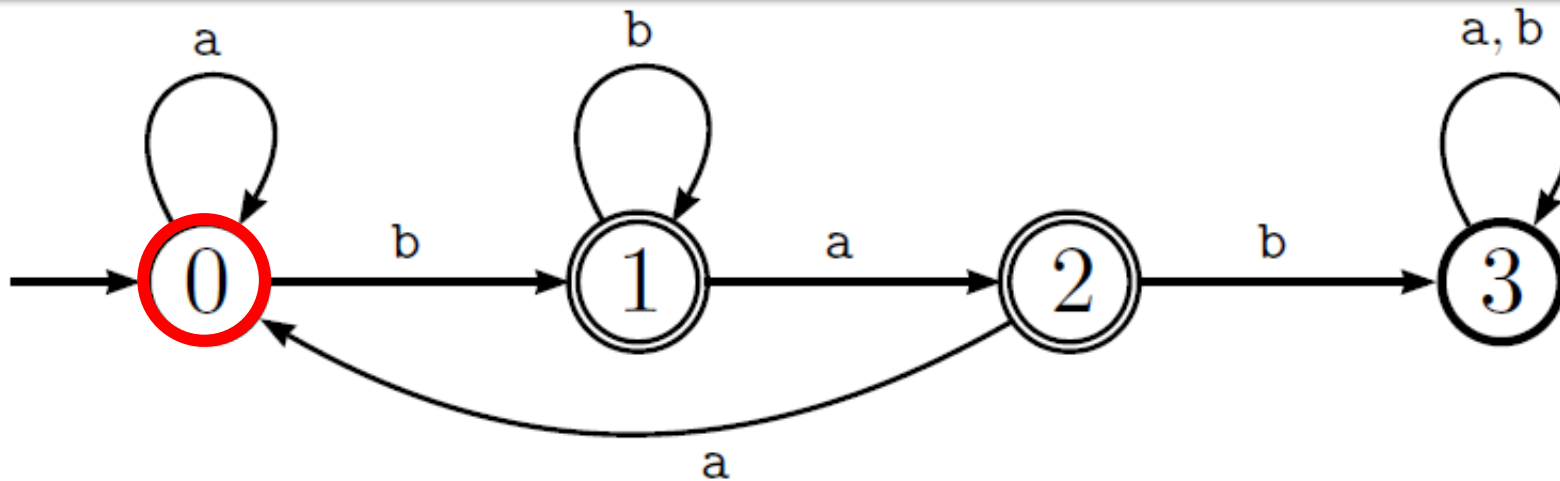
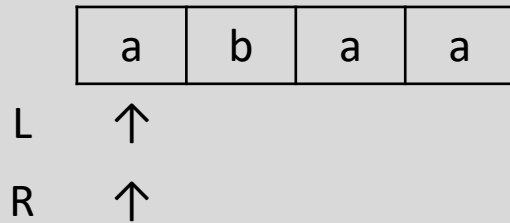
Stack



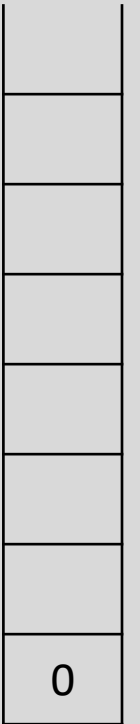


# Examples

Example III: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

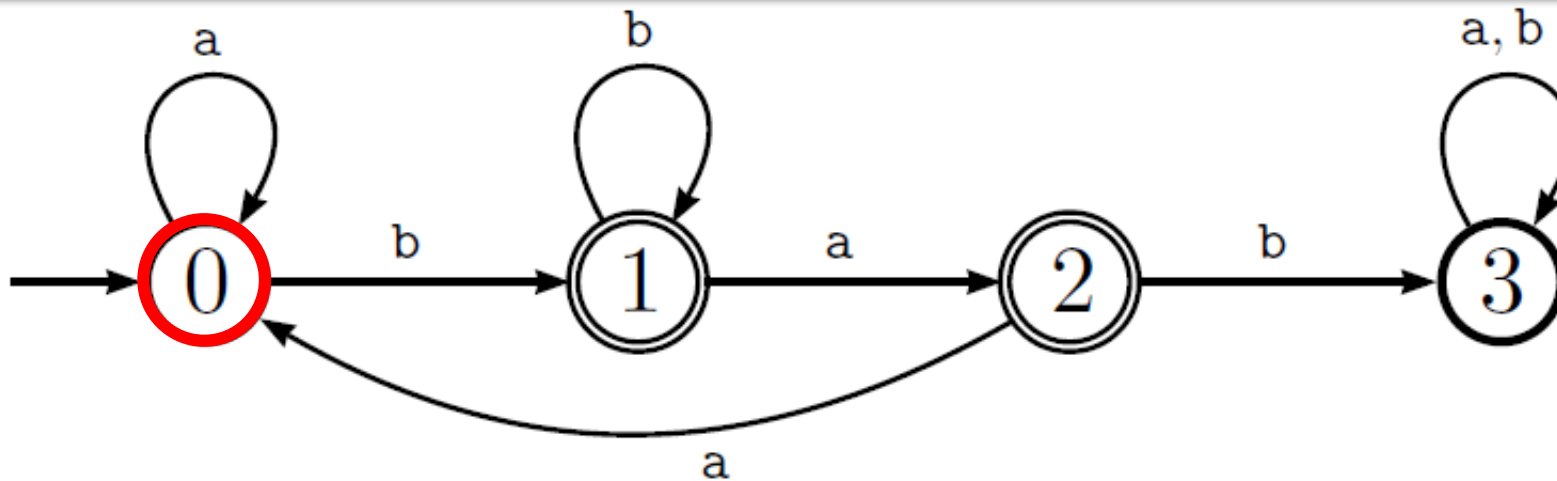
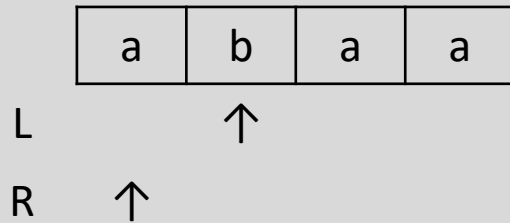


Stack

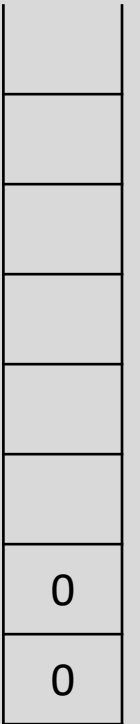


# Examples

Example III: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

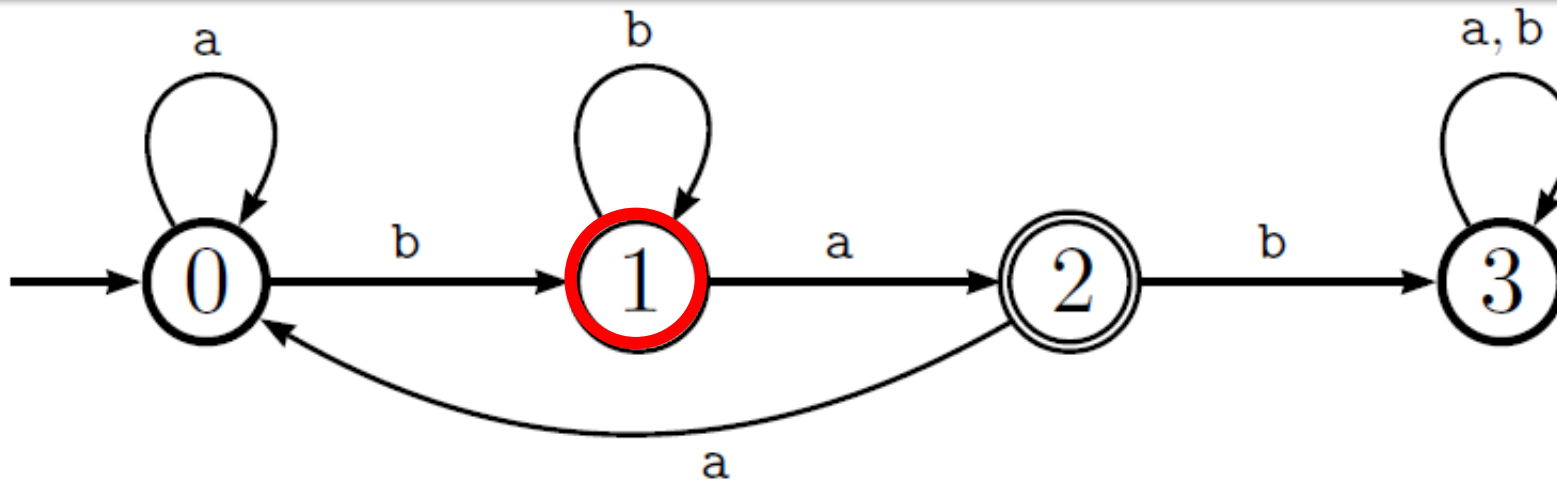
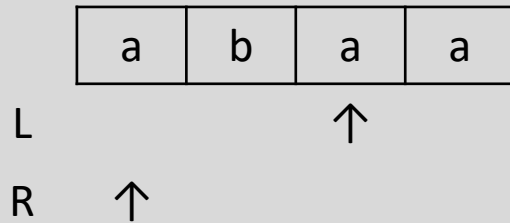


Stack



# Examples

Example III: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

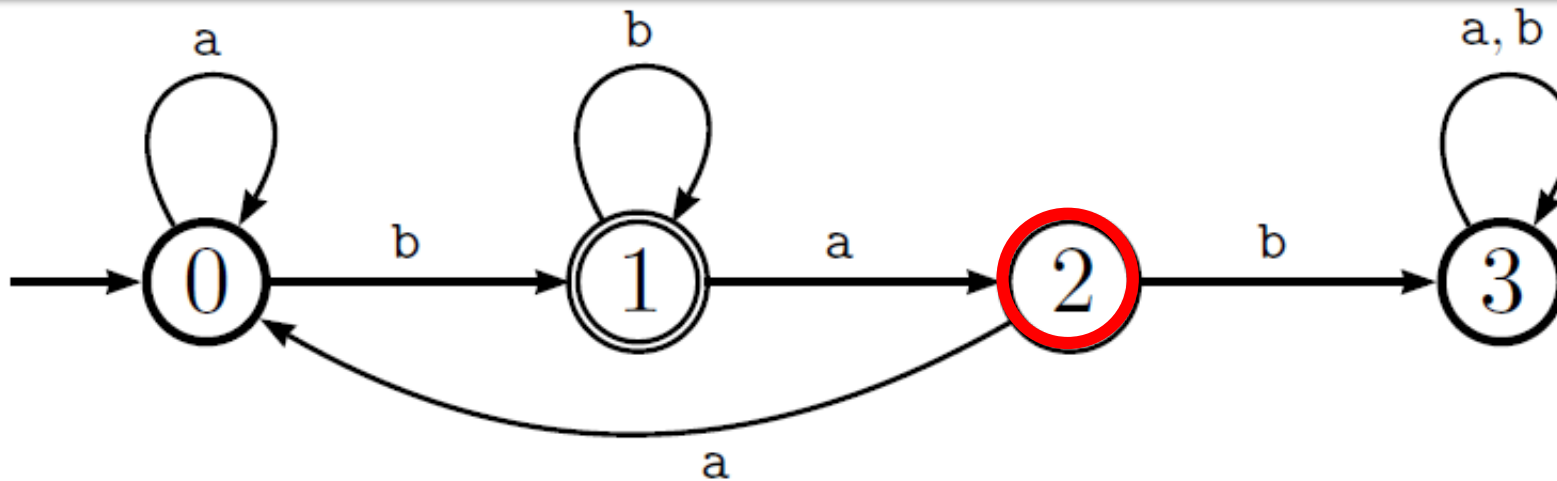
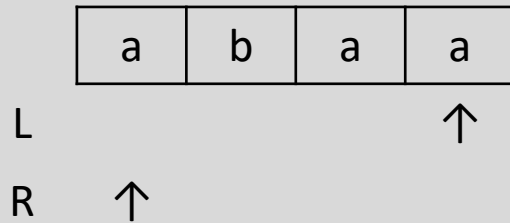


Stack

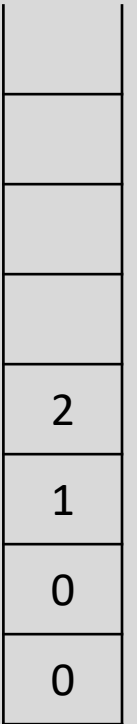


# Examples

Example III: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

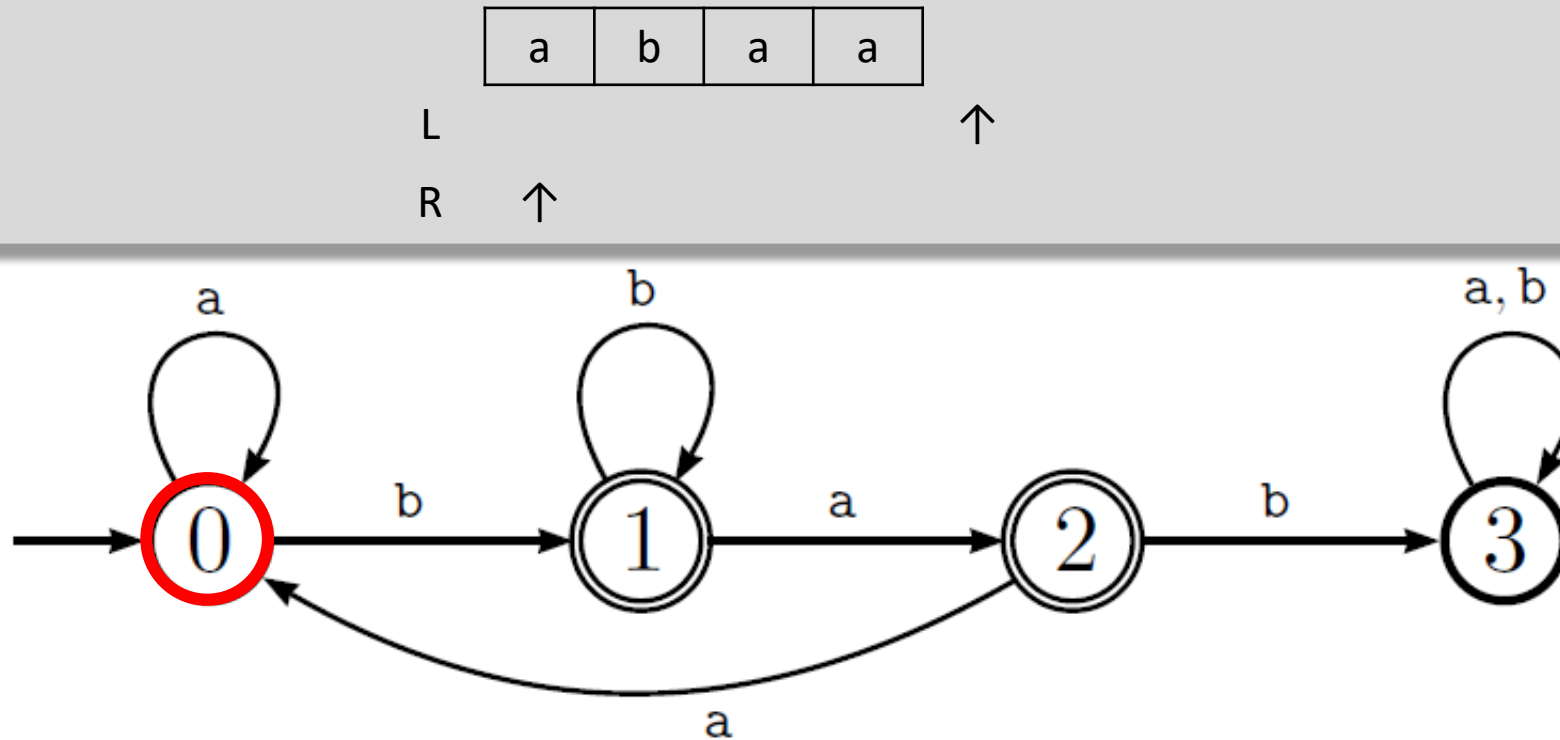


Stack

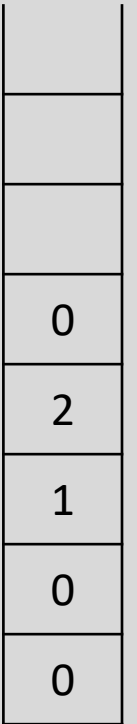


# Examples

Example III: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

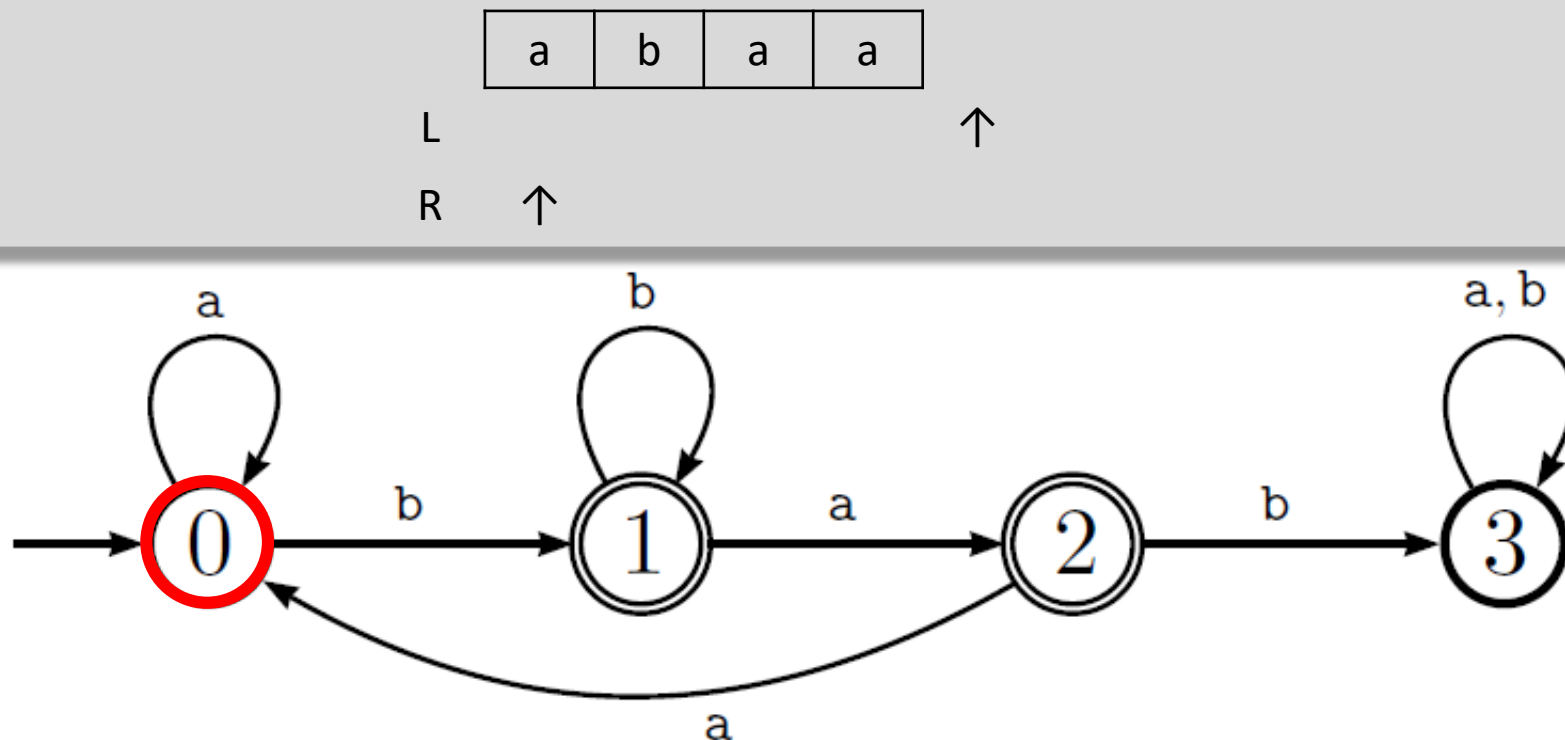


Stack



# Examples

Example III: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



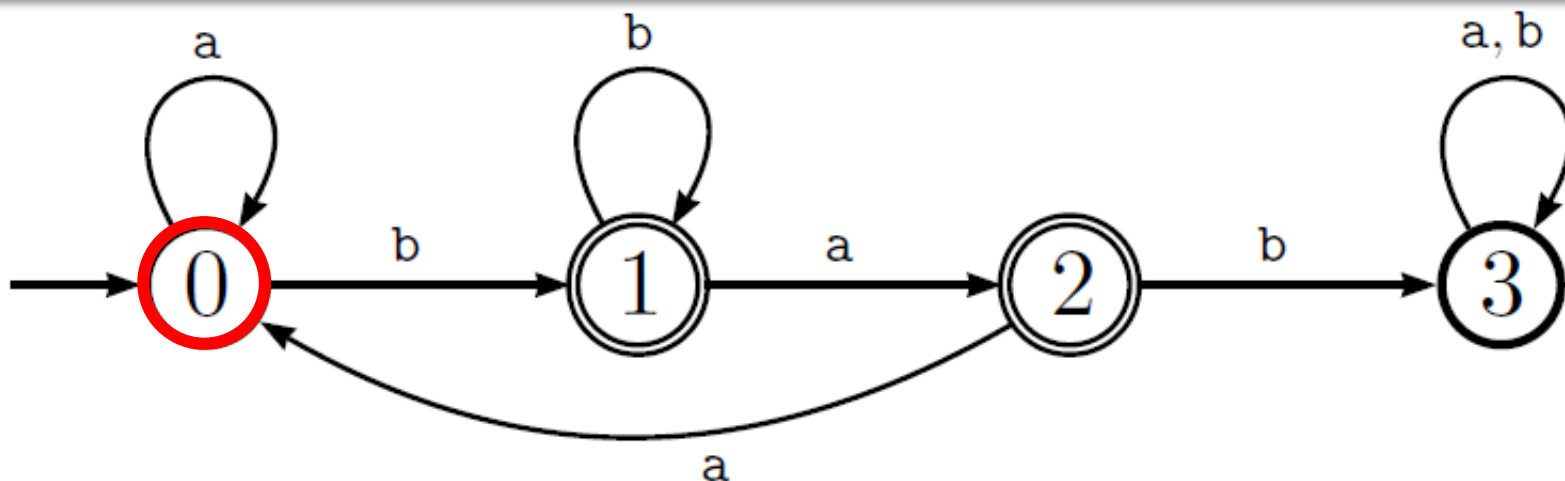
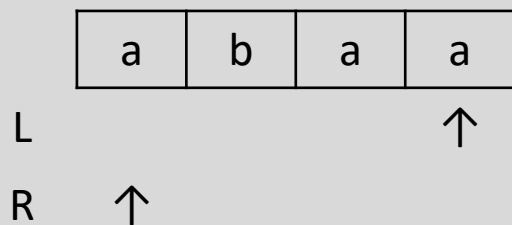
- simultaneously pop the stack and move L one step to the left until the stack gets empty or some  $q_a \in F$  is popped

Stack



# Examples

Example III: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



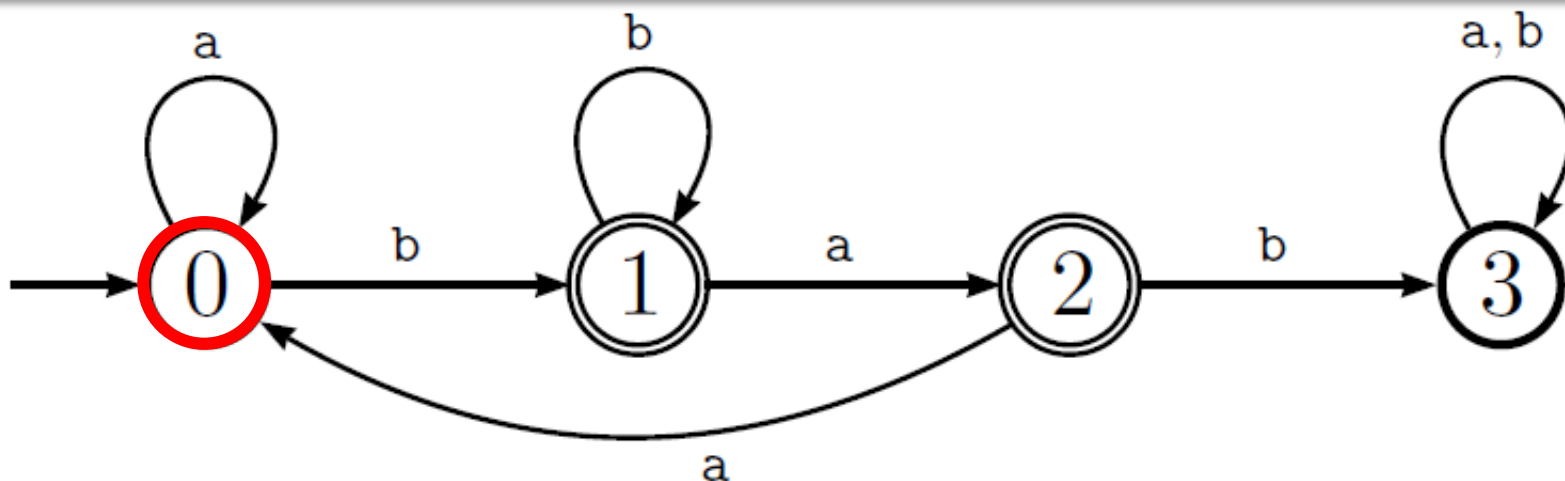
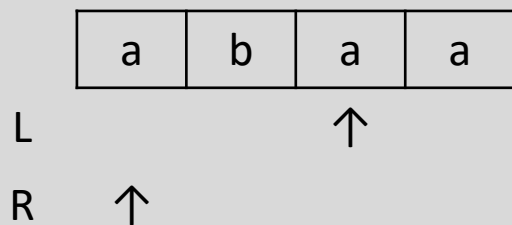
- Move L to the left
- Pop 0 and save  $A(0)$
- $0 \notin F$

Stack



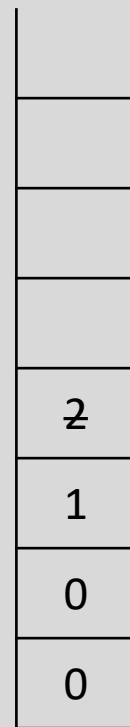
# Examples

Example III: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



- Move L to the left
- Pop 2
- $2 \in F$

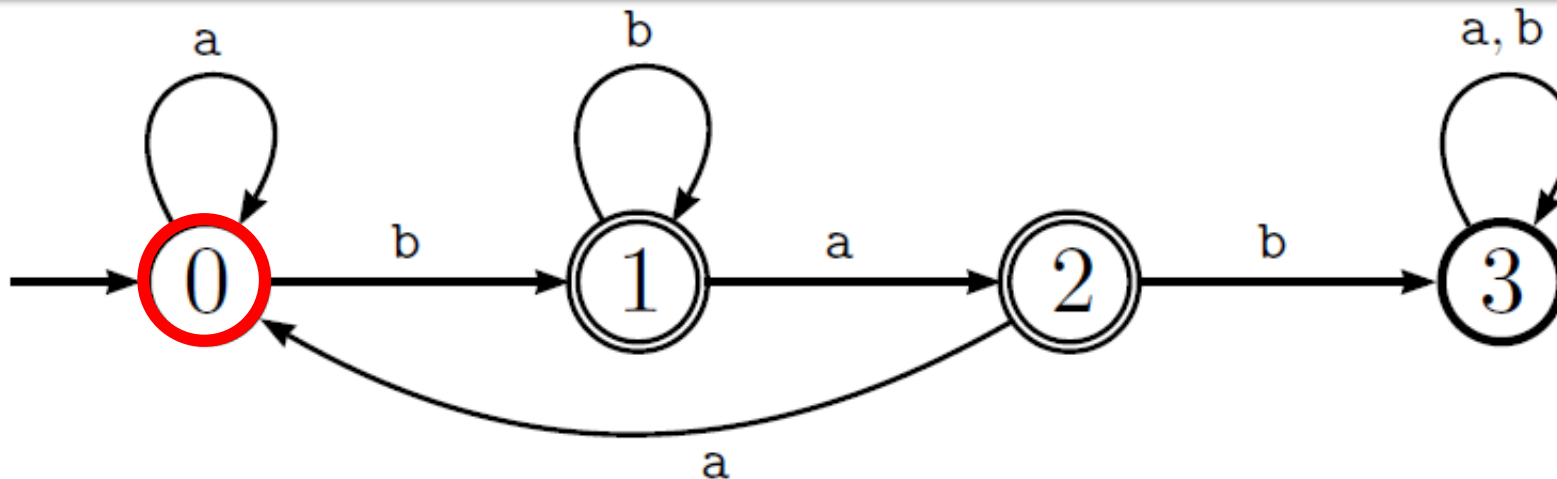
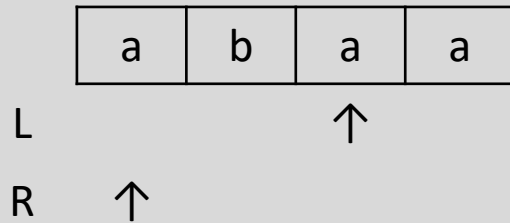
Stack





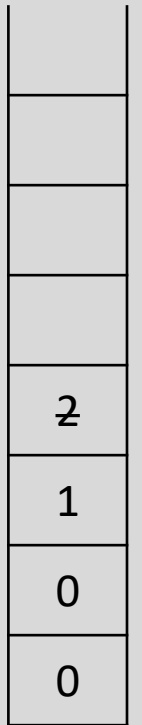
# Examples

Example III: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

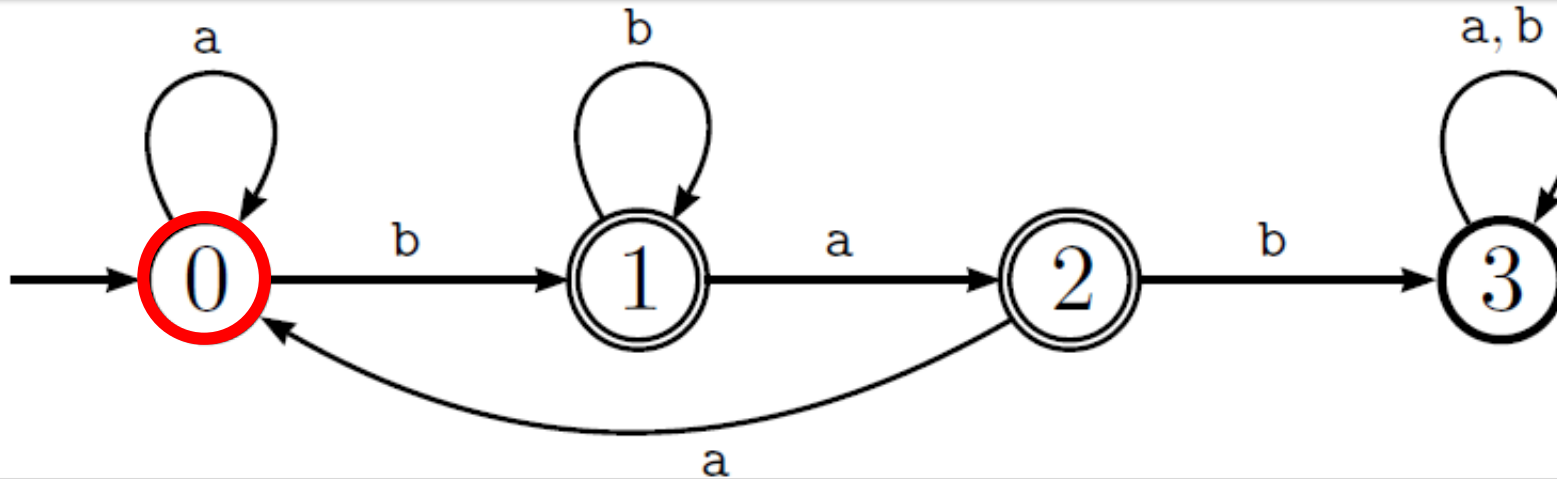


- Executes  $A(2)$
- $lex = \text{"aba"}$

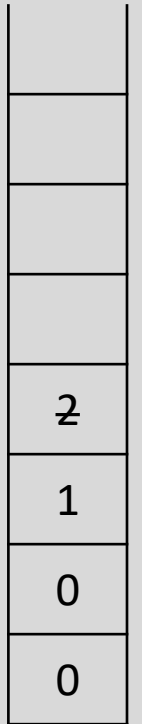
Stack



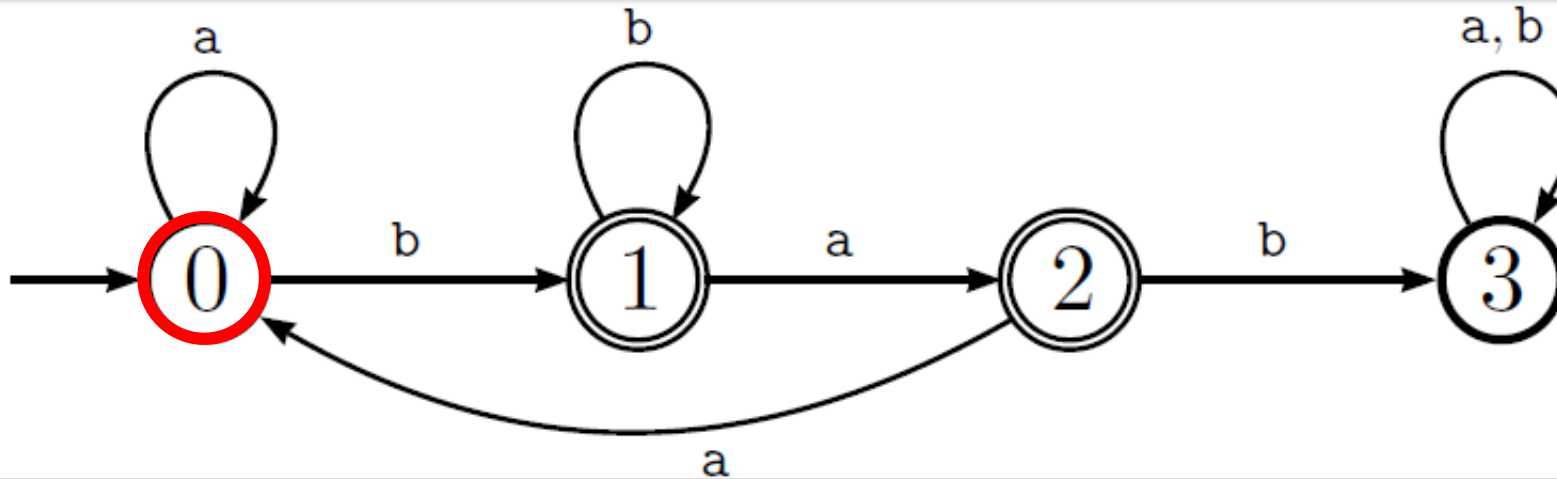
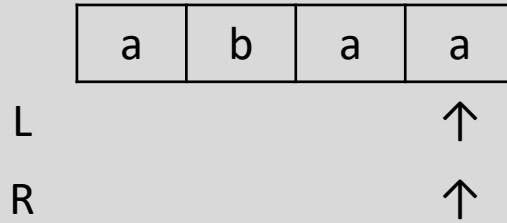
Output: aba,2



- # Stack

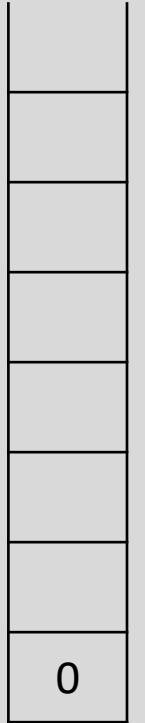


Output: aba,2



- Empty the stack
- Enter  $q_0$

# Stack



# Examples

**Example III:** 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

Output: aba,2

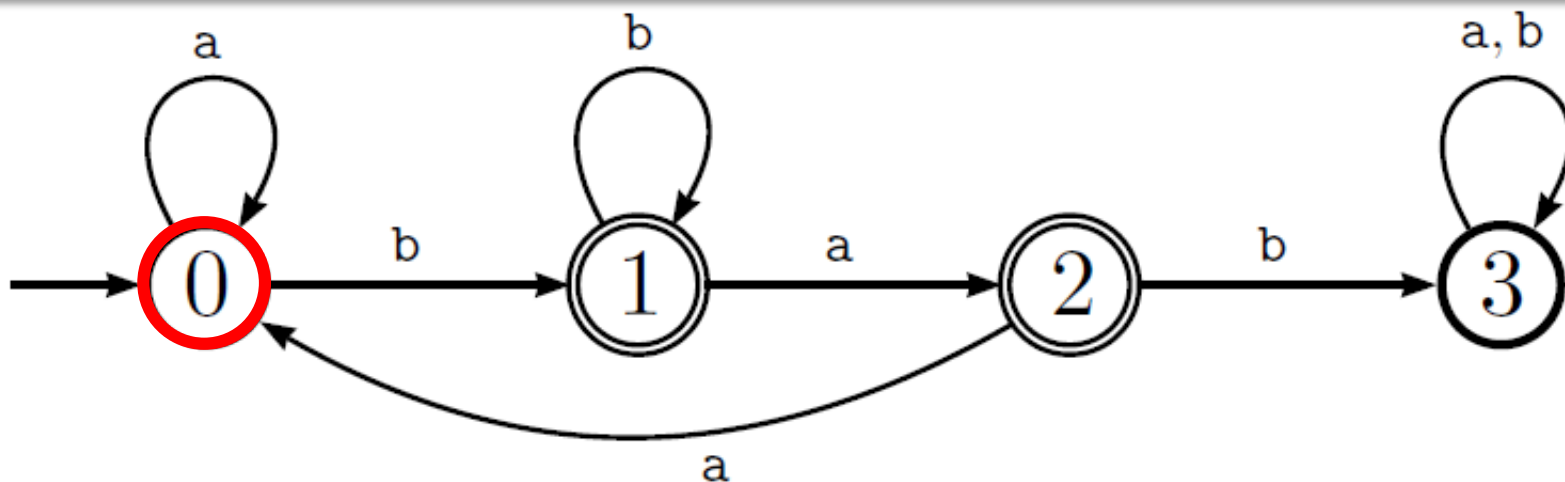
a	b	a	a
---	---	---	---

L

↑

R

↑



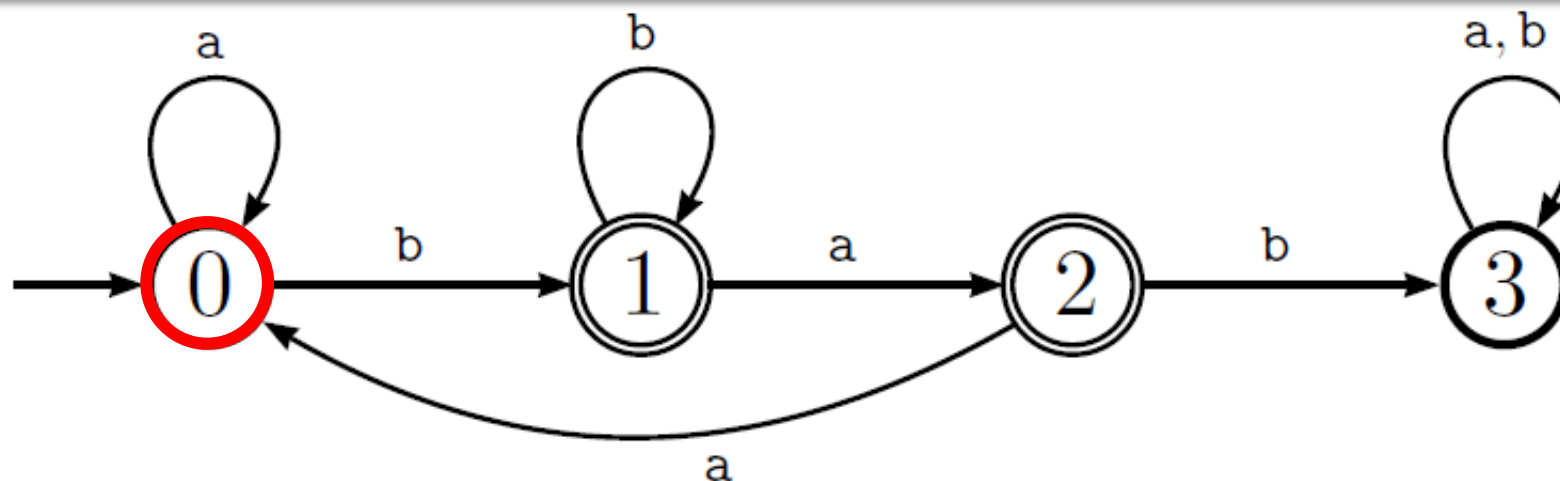
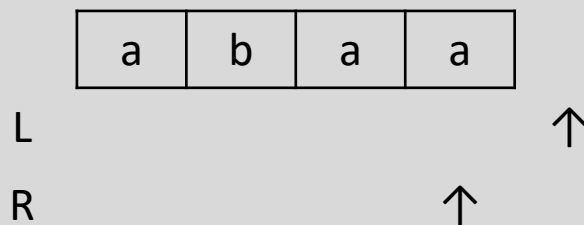
Stack



# Examples

**Example III:** 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

Output: aba,2

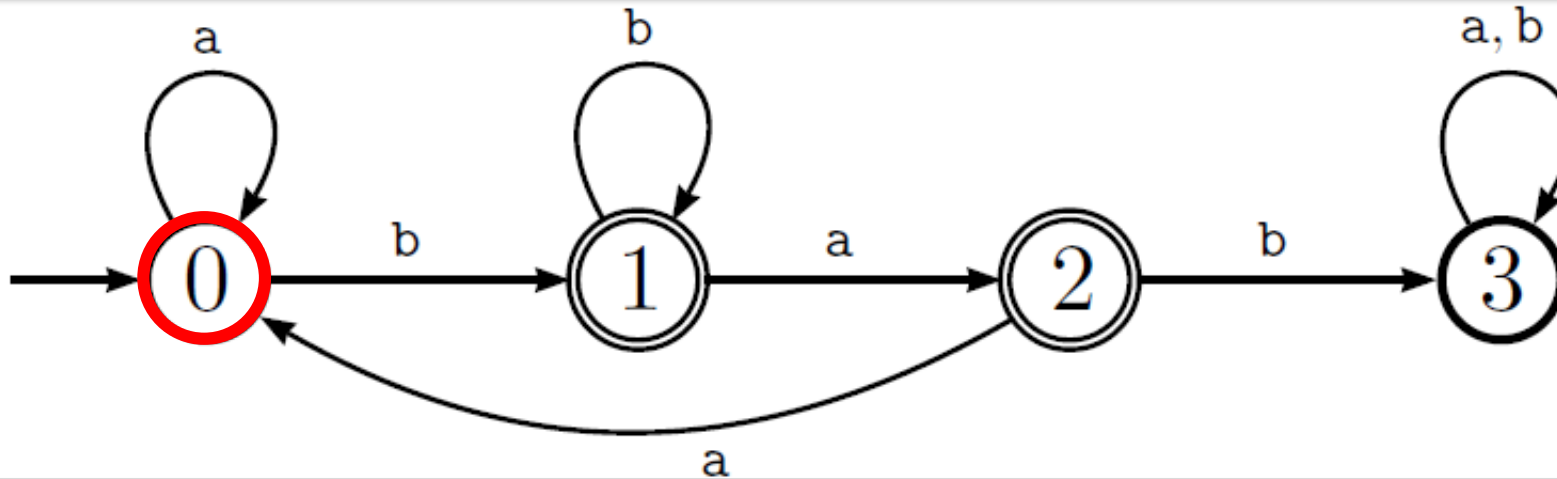
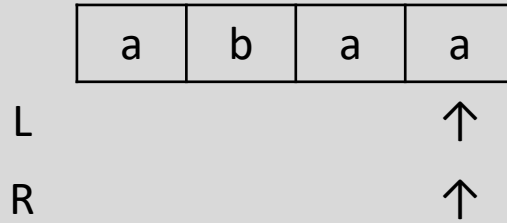


- simultaneously pop the stack and move L one step to the left until the stack gets empty or some  $q_a \in F$  is popped

**Stack**

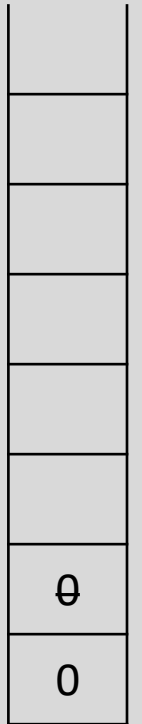


Output: aba,2



- Move  $L$  to the left
- Pop 0 and save  $A(0)$
- $0 \notin F$

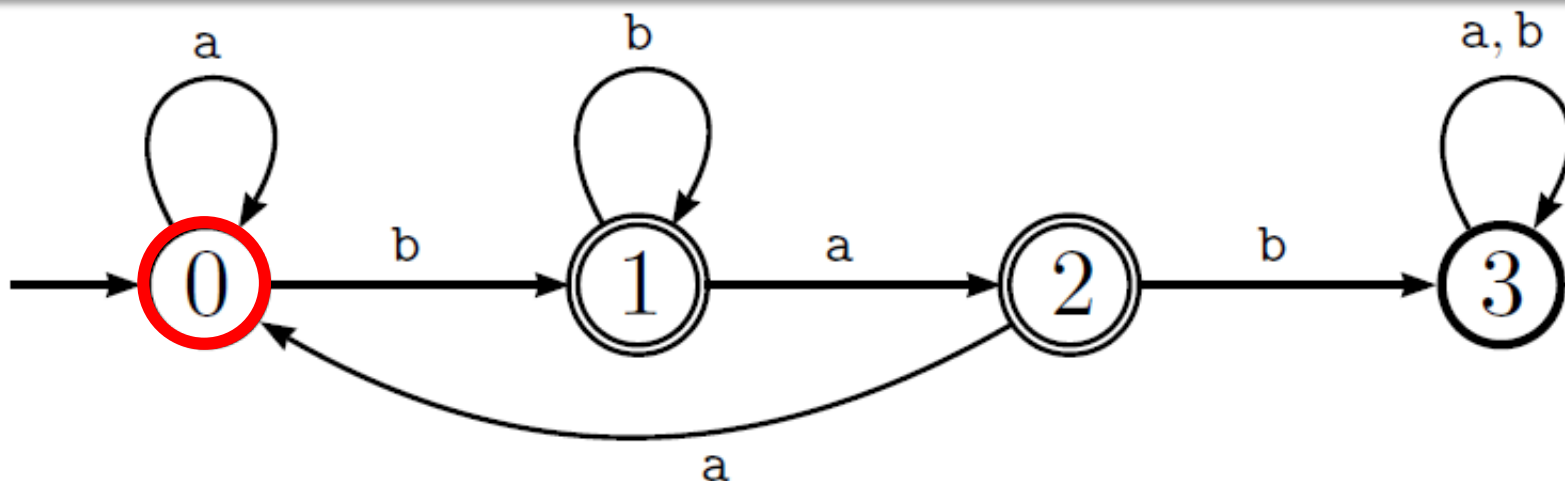
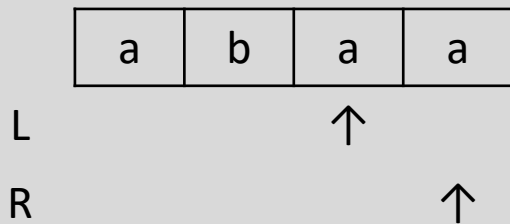
# Stack



# Examples

**Example III:** 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

Output: aba,2



- Move L to the left
- Pop 0
- $0 \notin F$

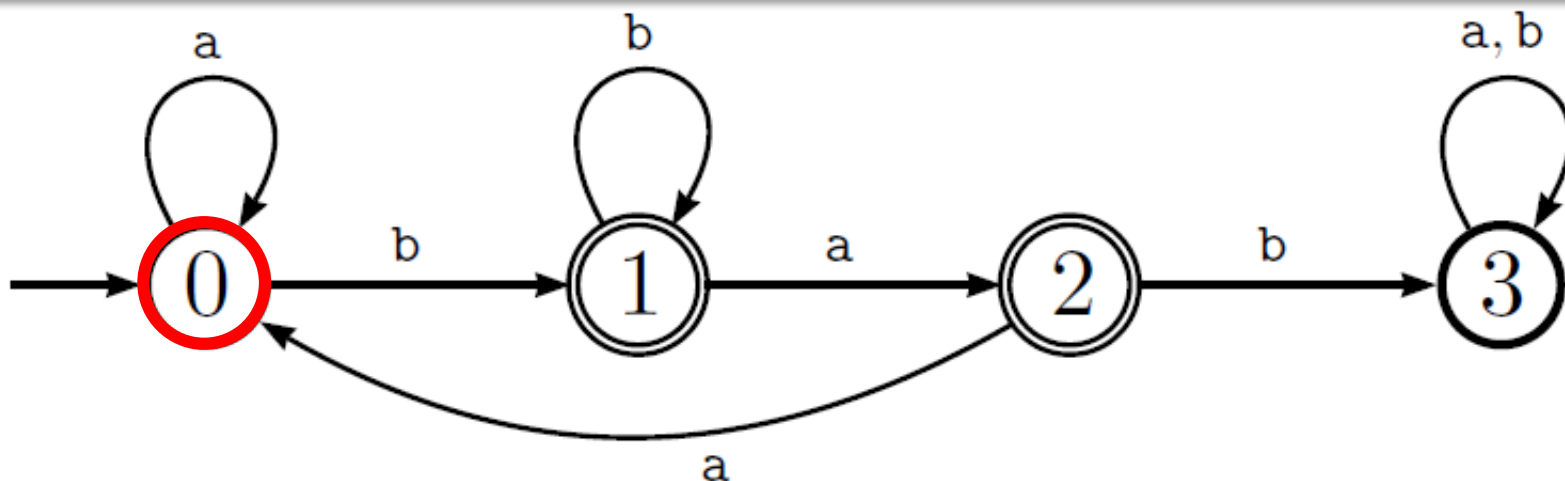
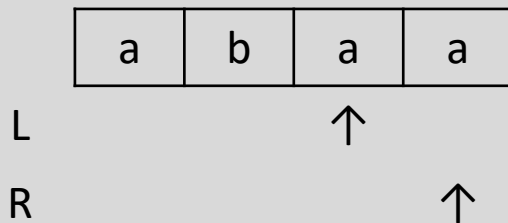
Stack



# Examples

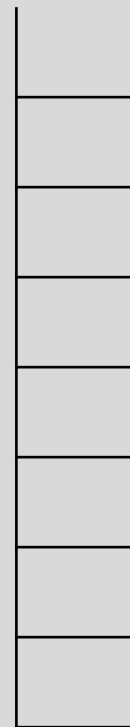
**Example III:** 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2

Output: aba,2



- *Stack is Empty*
- Executes  $A(0)$  (*Saved previously*) and halts.
- $lex = "a"$

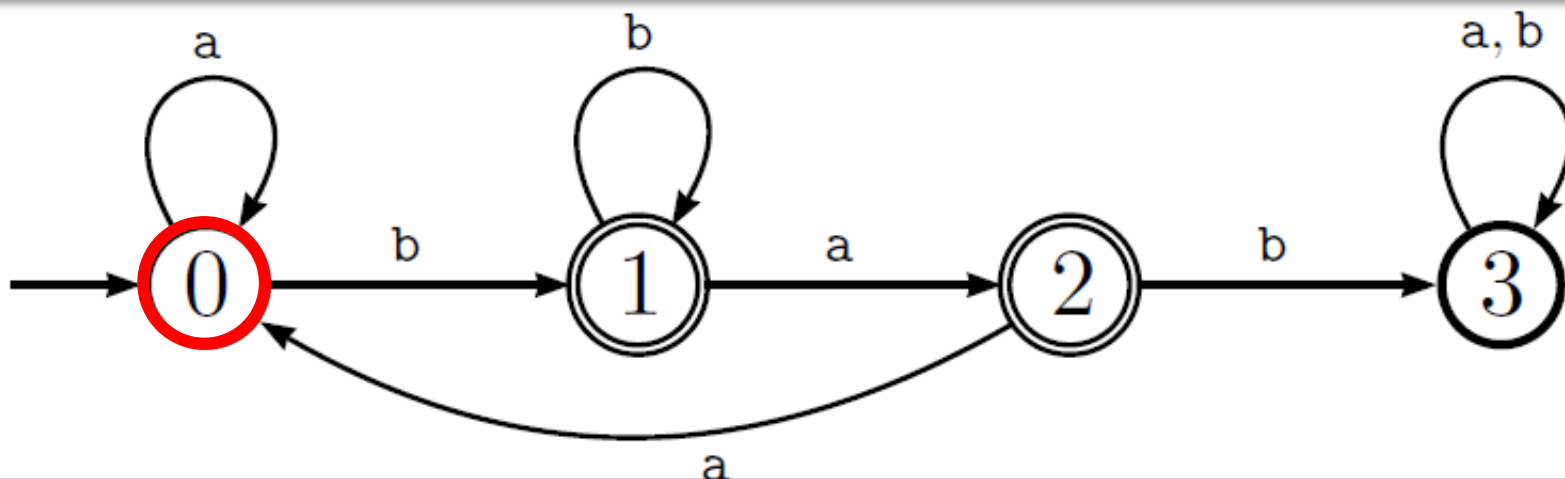
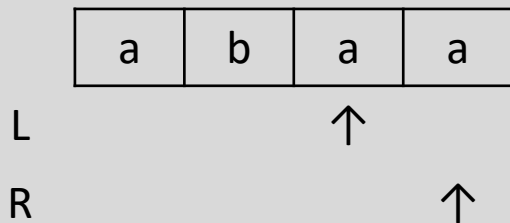
Stack





# Examples

Example III: 0;1;2;3#a;b#0,a,0;0,b,1;1,a,2;1,b,1;2,a,0;2,b,3;3,a,3;3,b,3#0#1;2



Output

aba,2;a,0

Stack

