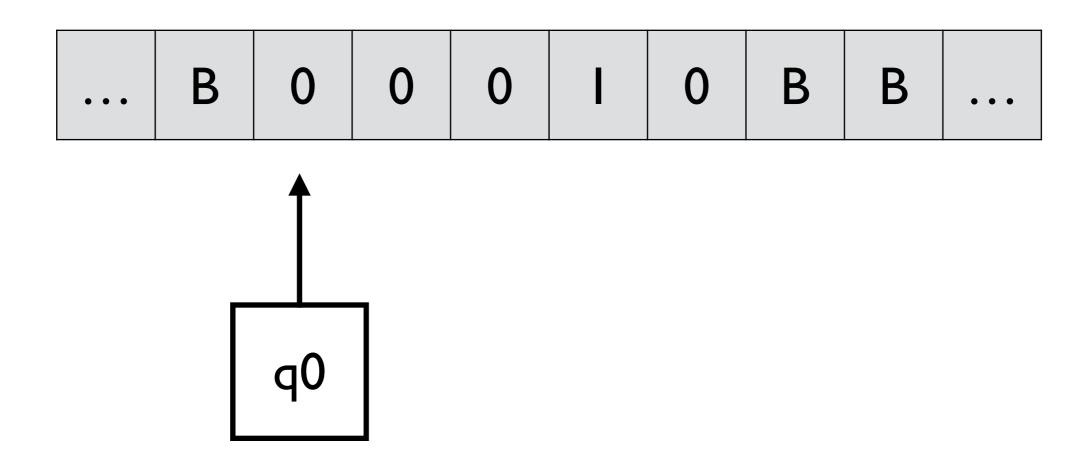
## **Example 4.** Design a Turing machine that computes f(m, n).

$$f(m,n) = max(m-n,0) = if m \ge n then m-n else 0$$

$$M = (\{q_0, q_1, \dots, q_6\}, \{0, 1\}, \{0, 1, B\}, \delta, q_0, B, \{q_6\})$$

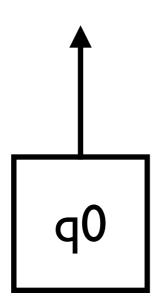
Initial machine configuration: e.g., f(3,1)



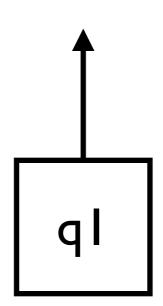
When the machine halts:

e.g., f(3,2)

• • •	В	0	0	0	_	0	В	В	• • •
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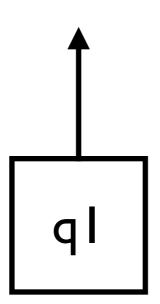




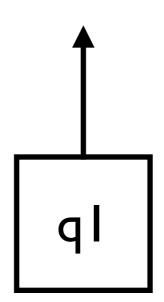


	0	$\mid 1 \mid$	B
$\overline{q_0}$	$(q_1, B, R)$	$(q_5, B, R)$	
		$ (q_2,1,R) $	
		$(q_2, 1, R)$	
		$ (q_3,1,L) $	
$q_4$	$(q_4,0,L)$	$ (q_4, B, L) $	$(q_6,0,R)$
		$ (q_5, B, R) $	
$q_6$			

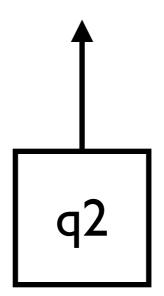






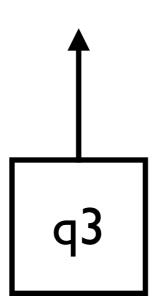




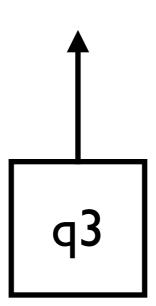


	0	1	$\mid B \mid$
	$(q_1, B, R)$	`	
$q_1$	$(q_1, 0, R)$	$(q_2, 1, R)$	
	$(q_3, 1, L)$		
$q_3$	$(q_3, 0, L)$	$(q_3, 1, L)$	$ (q_0, B, R) $
$q_4$	$(q_4, 0, L)$	$ (q_4, B, L) $	$(q_6, 0, R)$
$q_5$	$(q_5, B, R)$	$ (q_5, B, R) $	$(q_6, B, R)$
$q_6$			



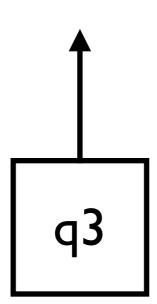






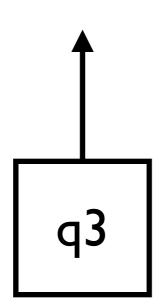
	0	1	B
		$(q_5, B, R)$	
$q_1$	$(q_1,0,R)$	$(q_2,1,R)$	
$q_2$	$(q_3,1,L)$	$(q_2, 1, R)$	$(q_4, B, L)$
$q_3$	$(q_3,0,L)$	$(q_3,1,L)$	$(q_0, B, R)$
$q_4$	$(q_4,0,L)$	$(q_4, B, L)$	$(q_6,0,R)$
$q_5$	$(q_5, B, R)$	$(q_5, B, R)$	$(q_6, B, R)$
$q_6$			



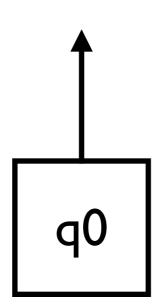


	0	1	B
	` '	$(q_5, B, R)$	
$q_1$	$(q_1,0,R)$	$(q_2, 1, R)$	
$q_2$	$(q_3,1,L)$	$(q_2, 1, R)$	$(q_4, B, L)$
		$ (q_3,1,L) $	
$q_4$	$(q_4,0,L)$	$ (q_4, B, L) $	$(q_6,0,R)$
		$ (q_5, B, R) $	
$q_6$			



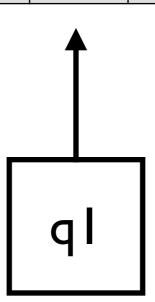




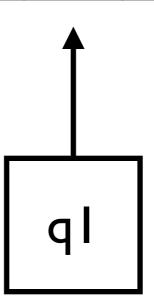


	0	1	$\mid B \mid$
	$(q_1, B, R)$	`	
$q_1$	$(q_1, 0, R)$	$(q_2, 1, R)$	
	$(q_3, 1, L)$		
$q_3$	$(q_3, 0, L)$	$(q_3, 1, L)$	$ (q_0, B, R) $
$q_4$	$(q_4, 0, L)$	$ (q_4, B, L) $	$(q_6, 0, R)$
$q_5$	$(q_5, B, R)$	$ (q_5, B, R) $	$(q_6, B, R)$
$q_6$			

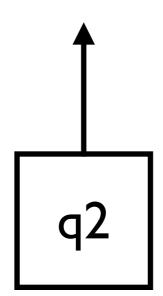




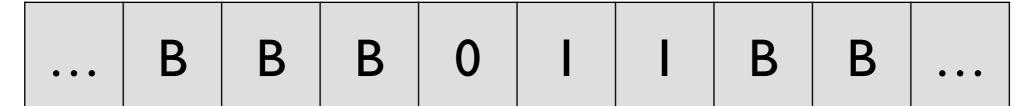


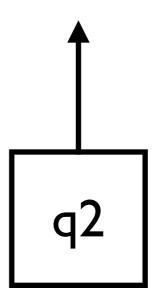




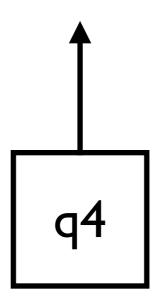


	0	1	B
		$(q_5, B, R)$	
$q_1$	$(q_1,0,R)$	$(q_2,1,R)$	
$q_2$	$(q_3,1,L)$	$(q_2,1,R)$	$(q_4, B, L)$
$q_3$	$(q_3,0,L)$	$(q_3,1,L)$	$(q_0, B, R)$
$q_4$	$(q_4,0,L)$	$(q_4, B, L)$	$(q_6,0,R)$
$q_5$	$(q_5, B, R)$	$(q_5, B, R)$	$(q_6, B, R)$
$q_6$			

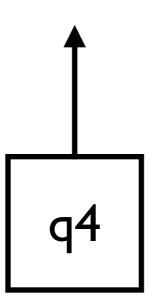




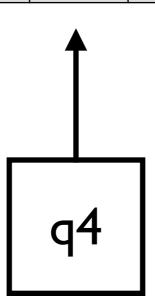




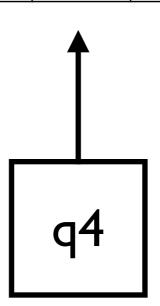




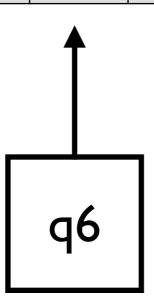




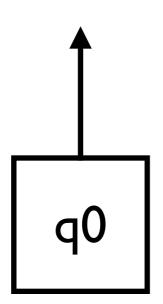






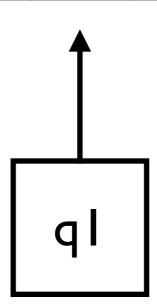


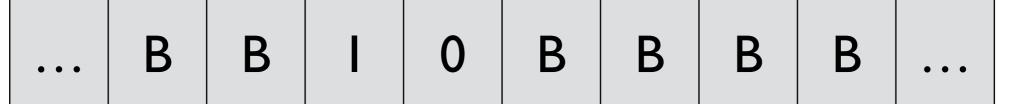
e.g., f(I,I)

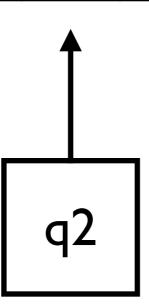


	0	1	$\mid B \mid$
	$(q_1, B, R)$		I
$q_1$	$(q_1,0,R)$	$ (q_2,1,R) $	
$q_2$	$(q_3, 1, L)$	$(q_2, 1, R)$	$ (q_4, B, L) $
$q_3$	$(q_3,0,L)$	$(q_3, 1, L)$	$ (q_0, B, R) $
	$(q_4,0,L)$		
$q_5$	$ (q_5, B, R) $	$ (q_5, B, R) $	$ (q_6, B, R) $
$q_6$			

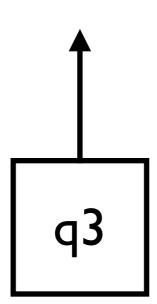






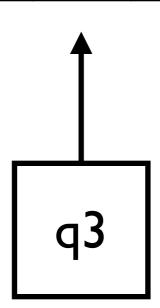




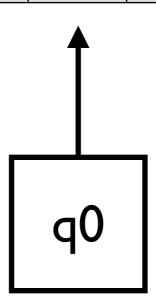


	0	1	B
		$(q_5, B, R)$	
		$(q_2, 1, R)$	
$q_2$	$(q_3, 1, L)$	$(q_2, 1, R)$	$(q_4, B, L)$
$q_3$	$(q_3,0,L)$	$ (q_3,1,L) $	$(q_0, B, R)$
$q_4$	$(q_4,0,L)$	$ (q_4, B, L) $	$(q_6,0,R)$
$q_5$	$ (q_5, B, R) $	$ (q_5, B, R) $	$(q_6, B, R)$
$q_6$			



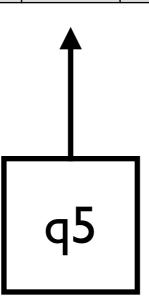






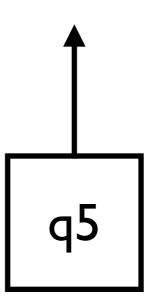
	0	1	B
		$(q_5, B, R)$	
		$(q_2, 1, R)$	
$q_2$	$(q_3, 1, L)$	$(q_2, 1, R)$	$(q_4, B, L)$
$q_3$	$(q_3,0,L)$	$ (q_3,1,L) $	$(q_0, B, R)$
$q_4$	$(q_4,0,L)$	$ (q_4, B, L) $	$(q_6,0,R)$
$q_5$	$ (q_5, B, R) $	$ (q_5, B, R) $	$(q_6, B, R)$
$q_6$			



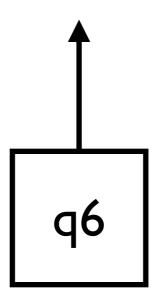


	0	1	$\mid B \mid$
	$(q_1, B, R)$		I
	$(q_1,0,R)$		
$q_2$	$(q_3,1,L)$	$(q_2, 1, R)$	$ (q_4, B, L) $
$q_3$	$(q_3,0,L)$	$(q_3, 1, L)$	$ (q_0, B, R) $
	$(q_4,0,L)$		
$q_5$	$ (q_5, B, R) $	$ (q_5, B, R) $	$ (q_6, B, R) $
$q_6$			



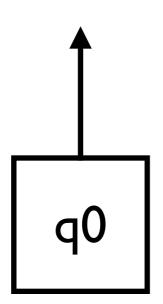






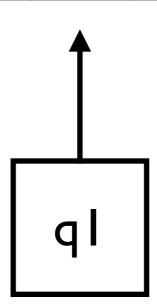
e.g., f(1,2)

• • •	В	0	I	0	0	В	В	В	• • •
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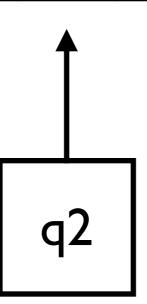


	0	1	$\mid B \mid$
	$(q_1, B, R)$		I
$q_1$	$(q_1,0,R)$	$ (q_2,1,R) $	
$q_2$	$(q_3, 1, L)$	$(q_2, 1, R)$	$ (q_4, B, L) $
$q_3$	$(q_3,0,L)$	$(q_3, 1, L)$	$ (q_0, B, R) $
	$(q_4,0,L)$		
$q_5$	$ (q_5, B, R) $	$ (q_5, B, R) $	$ (q_6, B, R) $
$q_6$			

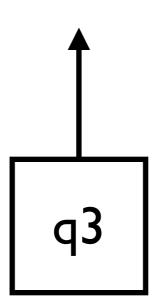




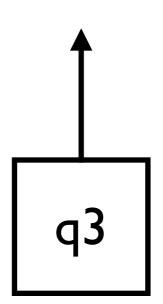




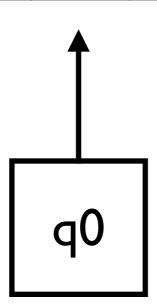




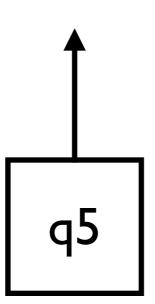




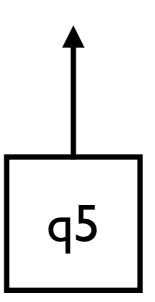




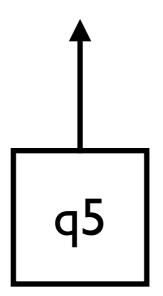




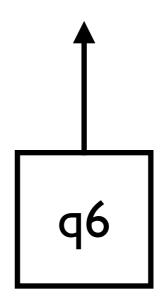






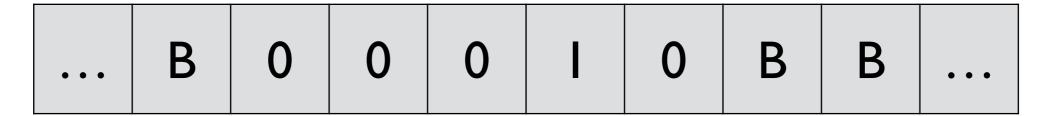


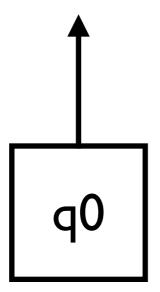




## Example, revisited

e.g., f(3,2)



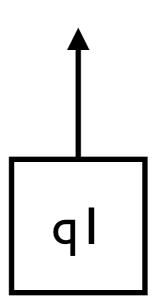


Scanned 0 in q0, the cycle must repeat:

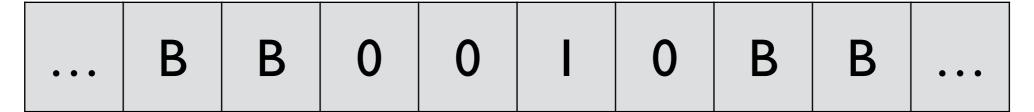
- I. replace 0 by B
- 2. move right
- 3. enter ql

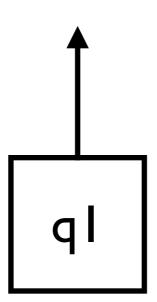
		0	1	B
			$(q_5, B, R)$	
9	21	$(q_1,0,R)$	$(q_2, 1, R)$	
Q	2	$(q_3,1,L)$	$(q_2, 1, R)$	$(q_4, B, L)$
Q	23	$(q_3,0,L)$	$(q_3, 1, L)$	$ (q_0, B, R) $
Q	24	$(q_4,0,L)$	$ (q_4, B, L) $	$(q_6, 0, R)$
9	25	$(q_5, B, R)$	$ (q_5, B, R) $	$ (q_6, B, R) $
Q	<i>[</i> 6]			





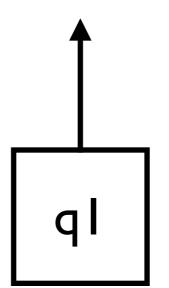
In q I, search right, looking for leftmost I





In q I, search right, looking for leftmost I

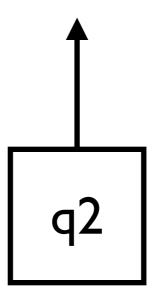




When found, enter q2

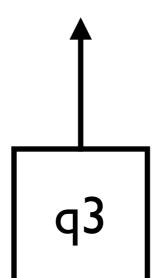
• • •	В	В	0	0	I	0	В	В	• • •

- In q2, move right until it finds 0
- When found, change it by I
- enter q3



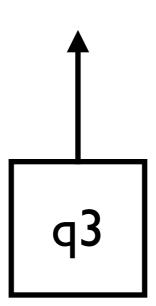
	0	1	B
		$(q_5, B, R)$	
		$(q_2, 1, R)$	
$q_2$	$(q_3,1,L)$	$(q_2, 1, R)$	$(q_4, B, L)$
$q_3$	$(q_3,0,L)$	$ (q_3,1,L) $	$(q_0, B, R)$
$q_4$	$(q_4,0,L)$	$ (q_4, B, L) $	$(q_6,0,R)$
$q_5$	$ (q_5, B, R) $	$ (q_5, B, R) $	$(q_6, B, R)$
$q_6$			





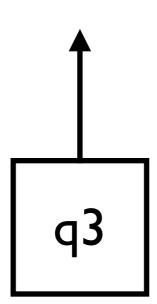
In q3, move left until it find B





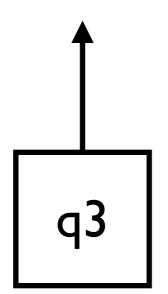
	0	1	B
		$(q_5, B, R)$	
$q_1$	$(q_1,0,R)$	$(q_2,1,R)$	
$q_2$	$(q_3,1,L)$	$(q_2, 1, R)$	$(q_4, B, L)$
$q_3$	$(q_3,0,L)$	$(q_3,1,L)$	$ (q_0, B, R) $
$q_4$	$(q_4,0,L)$	$(q_4, B, L)$	$(q_6, 0, R)$
$q_5$	$(q_5, B, R)$	$(q_5, B, R)$	$ (q_6, B, R) $
$q_6$			





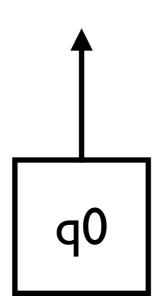
	0	1	B
	` '	$(q_5, B, R)$	I
$q_1$	$(q_1,0,R)$	$(q_2, 1, R)$	
$q_2$	$(q_3,1,L)$	$(q_2, 1, R)$	$(q_4, B, L)$
		$(q_3, 1, L)$	
$q_4$	$(q_4,0,L)$	$ (q_4, B, L) $	$(q_6, 0, R)$
		$ (q_5, B, R) $	
$q_6$			



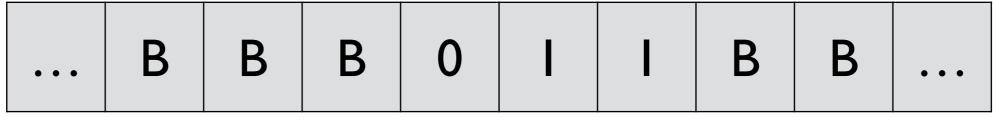


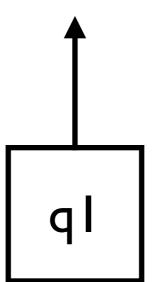
When B found, enter q0 and begin the cycle



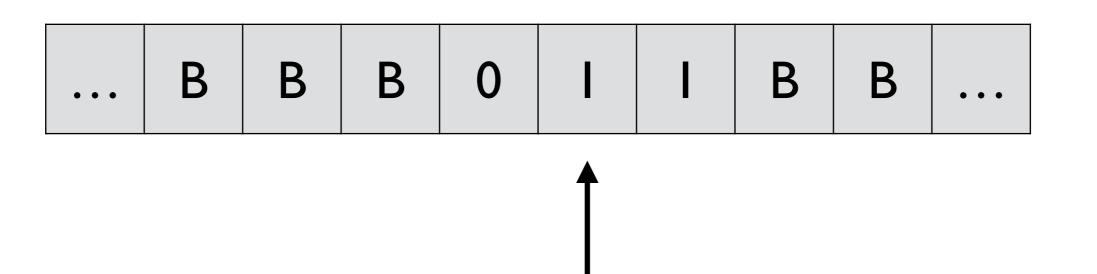


Begin a new cycle.

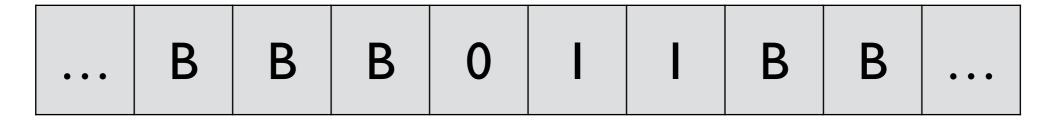




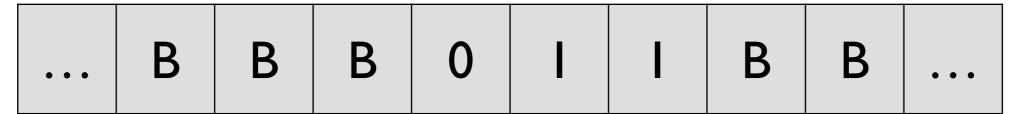
look for leftmost I



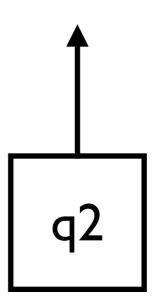
When found, enter q2



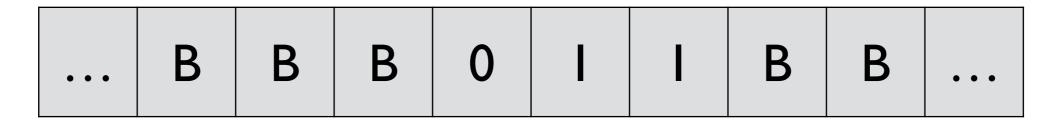
move right until it finds 0



- No more 0's.
- All n 0's changed to I
- n+1 0's changed to B
- m-(n+1) 0's on the tape
- replace all I's by B and put one 0

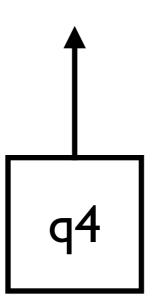


	0	1	B
		$(q_5, B, R)$	
$q_1$	$(q_1,0,R)$	$(q_2, 1, R)$	
$q_2$	$(q_3, 1, L)$	$(q_2, 1, R)$	$(q_4, B, L)$
$q_3$	$(q_3, 0, L)$	$(q_3, 1, L)$	$ (q_0, B, R) $
$q_4$	$(q_4,0,L)$	$ (q_4, B, L) $	$(q_6, 0, R)$
$q_5$	$(q_5, B, R)$	$(q_5, B, R)$	$ (q_6, B, R) $
$q_6$			

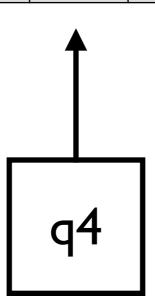


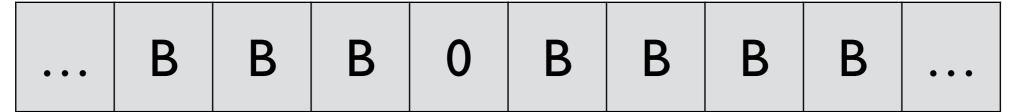
move left, changing I by B, until it finds B

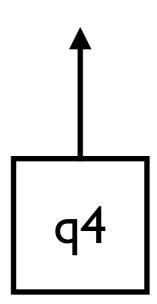






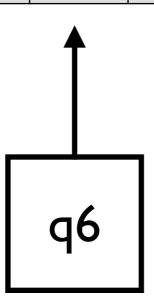




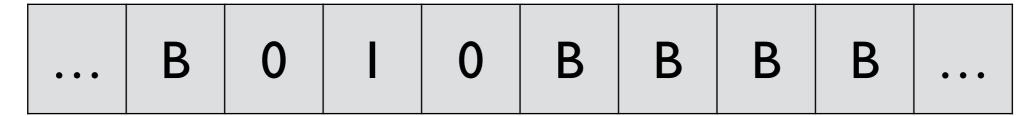


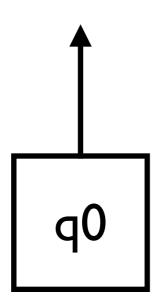
- change that B by 0
- enter the final state



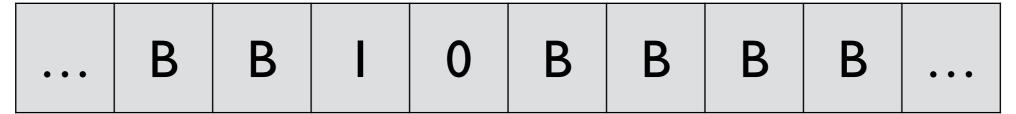


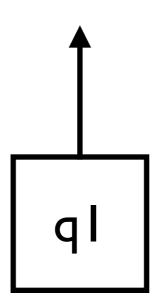
e.g., f(I,I)





- change 0 by B
- enter ql



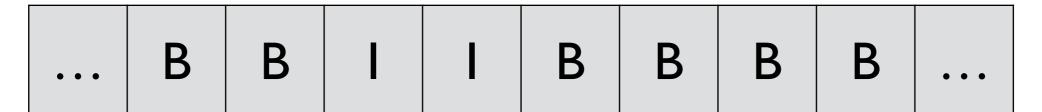


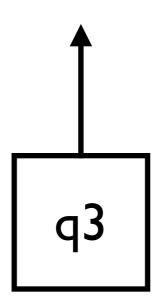
- look for the leftmost I
- when found, enter q2



q2

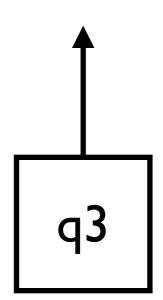
- move right until it finds 0
- when found, that 0 by I
- enter q3





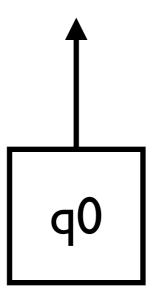
move left until it finds B





when B found, begin the cycle

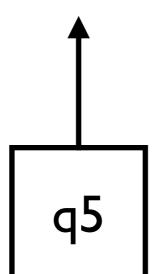




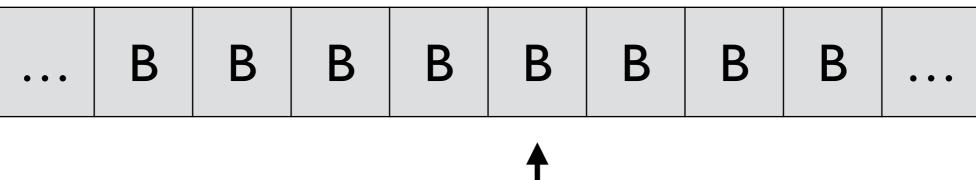
- cannot find 0 in q0
- n >= m
- replace I by B
- enter q5

	0	1	B
		$(q_5, B, R)$	
$q_1$	$(q_1,0,R)$	$(q_2, 1, R)$	
$q_2$	$(q_3,1,L)$	$(q_2, 1, R)$	$(q_4, B, L)$
$q_3$	$(q_3,0,L)$	$ (q_3,1,L) $	$(q_0, B, R)$
$q_4$	$(q_4,0,L)$	$ (q_4, B, L) $	$(q_6,0,R)$
$q_5$	$(q_5, B, R)$	$ (q_5, B, R) $	$(q_6, B, R)$
$q_6$			

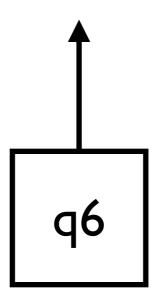




In q5, change all 0's and 1's to B





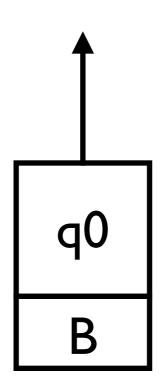


**Example 5.** Design a Turing machine that accepts  $01^* + 10^*$ .

$$M = (\{q_0, q_1\} \times \{0, 1, B\}, \{0, 1\}, \{0, 1, B\}, \delta, (q_0, B), B, \{(q_1, B)\})$$

- 1.  $\delta((q_0, B), a) = ((q_1, a), a, R)$  for a = 0
- 2.  $\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$
- 3.  $\delta((q_1, a), B) = ((q_1, B), B, R)$

B 0	1 1 1	ВВВ	• • •
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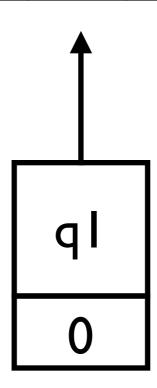


1. 
$$\delta((q_0, B), a) = ((q_1, a), a, R)$$
 for  $a = 0$  or  $a = 1$ 

2. 
$$\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$$

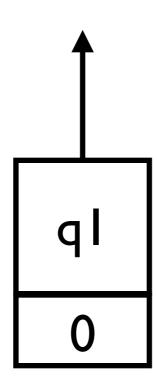
3. 
$$\delta((q_1, a), B) = ((q_1, B), B, R)$$





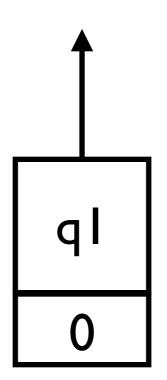
- 1.  $\delta((q_0, B), a) = ((q_1, a), a, R)$  for a = 0 or a = 1
- 2.  $\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$
- 3.  $\delta((q_1, a), B) = ((q_1, B), B, R)$





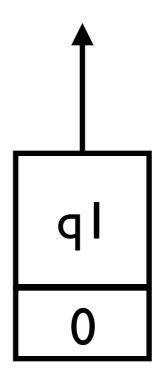
- 1.  $\delta((q_0, B), a) = ((q_1, a), a, R)$  for a = 0 or a = 1
- 2.  $\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$
- 3.  $\delta((q_1, a), B) = ((q_1, B), B, R)$





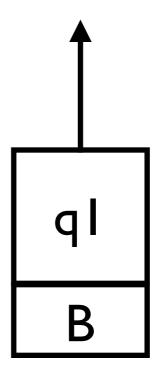
- 1.  $\delta((q_0, B), a) = ((q_1, a), a, R)$  for a = 0 or a = 1
- 2.  $\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$
- 3.  $\delta((q_1, a), B) = ((q_1, B), B, R)$





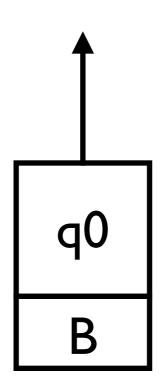
- 1.  $\delta((q_0, B), a) = ((q_1, a), a, R)$  for a = 0 or a = 1
- 2.  $\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$
- 3.  $\delta((q_1, a), B) = ((q_1, B), B, R)$





- 1.  $\delta((q_0, B), a) = ((q_1, a), a, R)$  for a = 0 or a = 1
- 2.  $\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$
- 3.  $\delta((q_1, a), B) = ((q_1, B), B, R)$

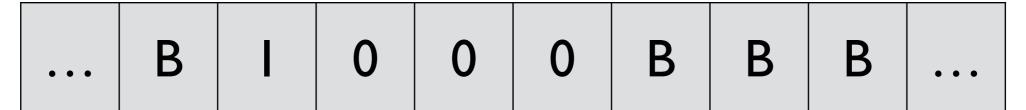
B   I   0   0   B   B   B
---------------------------

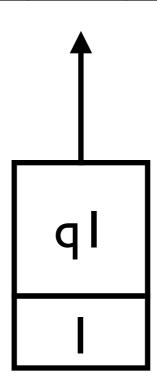


1. 
$$\delta((q_0, B), a) = ((q_1, a), a, R)$$
 for  $a = 0$  or  $a = 1$ 

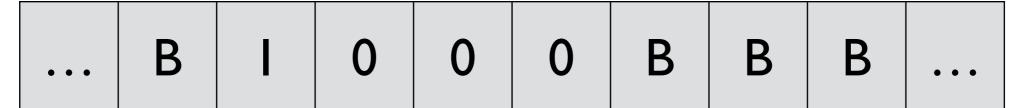
2. 
$$\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$$

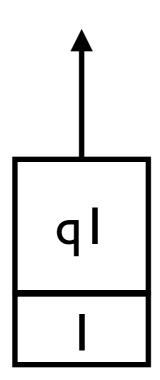
3. 
$$\delta((q_1, a), B) = ((q_1, B), B, R)$$





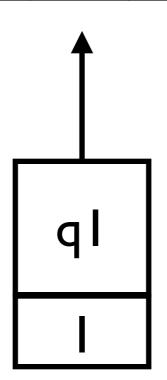
- 1.  $\delta((q_0, B), a) = ((q_1, a), a, R)$  for a = 0 or a = 1
- 2.  $\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$
- 3.  $\delta((q_1, a), B) = ((q_1, B), B, R)$



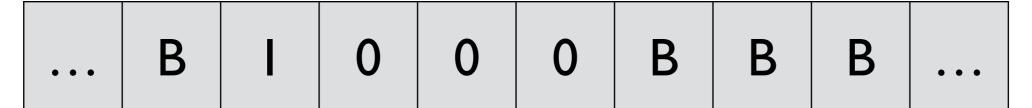


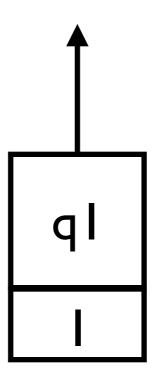
- 1.  $\delta((q_0, B), a) = ((q_1, a), a, R)$  for a = 0 or a = 1
- 2.  $\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$
- 3.  $\delta((q_1, a), B) = ((q_1, B), B, R)$





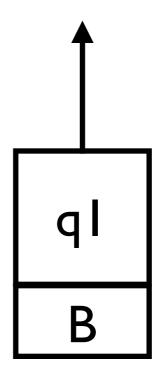
- 1.  $\delta((q_0, B), a) = ((q_1, a), a, R)$  for a = 0 or a = 1
- 2.  $\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$
- 3.  $\delta((q_1, a), B) = ((q_1, B), B, R)$





- 1.  $\delta((q_0, B), a) = ((q_1, a), a, R)$  for a = 0 or a = 1
- 2.  $\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$
- 3.  $\delta((q_1, a), B) = ((q_1, B), B, R)$

B I 0 0 B B
-------------



1. 
$$\delta((q_0, B), a) = ((q_1, a), a, R)$$
 for  $a = 0$  or  $a = 1$ 

2. 
$$\delta((q_1, a), \bar{a}) = ((q_1, a), \bar{a}, R)$$

3. 
$$\delta((q_1, a), B) = ((q_1, B), B, R)$$

**Example 6.** Design a Turing machine that accepts  $L = \{wcw \mid w \in \{0, 1\}^+\}$ .

$$M = (Q, \Sigma, \Gamma, \delta, (q_1, B), (B, B), \{q_9, B\})$$

$$- \{q_1, q_2, \dots, q_9\} \times \{0, 1, B\}$$

$$- \Gamma = \{B, *\} \times \{0, 1, c, B\}$$

$$- \Sigma = \{(B, 0), (B, 1), (B, c)\}$$

$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

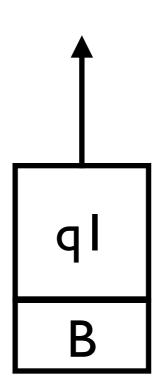
$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, a), (B, a)) = ((q_3, a), (B, a), (B, a), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, a), ($$

• • •	В	В	В	В	В	В	В	В	• • •
• • •	В	0		С	0	I	В	В	• • •



$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_4, B), (*, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_4, B), (*, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_4, B), (*, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_4, B), (*, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_4, B), (*, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_4, B), (*, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_5, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

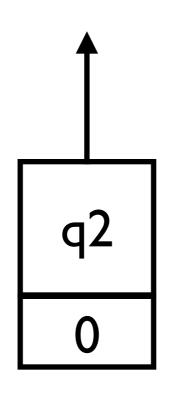
$$\delta((q_5, B), (*, a)) = ((q_7, B), (*, a), R)$$

$$\delta((q_7, B), (B, c)) = ((q_8, B), (B, c), R)$$

$$\delta((q_8, B), (*, a)) = ((q_9, B), (*, a), R)$$

$$\delta((q_8, B), (B, B)) = ((q_9, B), (B, B), R)$$

• • •	В	*	В	В	В	В	В	В	• • •
• • •	В	0		С	0		В	В	• • •



In q2, moves right, looking for c

$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_4, B), (B, a)) = ((q_4, B), (B, a), R)$$

$$\delta((q_5, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

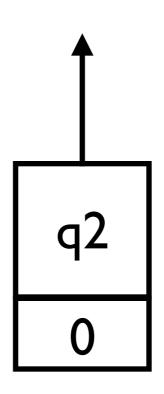
$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_1, B), (B, a)) = ($$

• • •	В	*	В	В	В	В	В	В	• • •
• • •	В	0		С	0	I	В	В	• • •



## When found,

- enter q3
- continue right

$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, a), R)$$

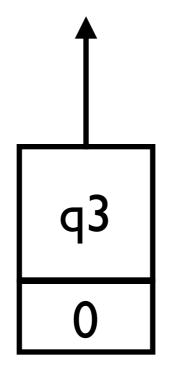
$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, a), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, a), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, a), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), R)$$

• • •	В	*	В	В	В	В	В	В	• • •
• • •	В	0		С	0	I	В	В	• • •



In q3, look for the first unchecked symbol

$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_4, B), (*, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_4, B), (B, c)) = ((q_5, B), (B, c), L)$$

$$\delta((q_5, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

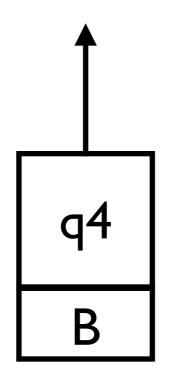
$$\delta((q_5, B), (*, a)) = ((q_7, B), (*, a), R)$$

$$\delta((q_7, B), (B, c)) = ((q_8, B), (B, c), R)$$

$$\delta((q_8, B), (*, a)) = ((q_8, B), (*, a), R)$$

$$\delta((q_8, B), (B, B)) = ((q_9, B), (B, B), R)$$

• • •	В	*	В	В	*	В	В	В	• • •
• • •	В	0		С	0		В	В	• • •



- In q4, move left until it finds c
- When found, enter q5

$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_4, B), (B, a)) = ((q_4, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

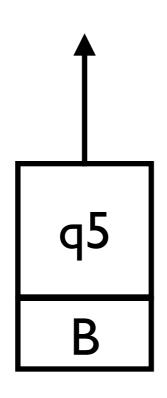
$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ($$

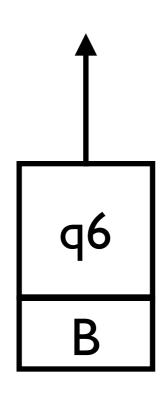
• • •	В	*	В	В	*	В	В	В	• • •
• • •	В	0		С	0		В	В	• • •



- If there is some unchecked symbol, enter q6

$$\delta((q_1,B),(B,a)) = ((q_2,a),(*,a),R)$$
 
$$\delta((q_2,a),(B,b)) = ((q_2,a),(B,b),R)$$
 
$$\delta((q_2,a),(B,c)) = ((q_3,a),(B,c),R)$$
 
$$\delta((q_3,a),(*,b)) = ((q_3,a),(*,b),R)$$
 
$$\delta((q_3,a),(B,a)) = ((q_4,B),(*,a),L)$$
 
$$\delta((q_4,B),(*,a)) = ((q_4,B),(*,a),L)$$
 
$$\delta((q_4,B),(B,c)) = ((q_4,B),(*,a),L)$$
 
$$\delta((q_4,B),(B,c)) = ((q_4,B),(*,a),L)$$
 
$$\delta((q_4,B),(B,c)) = ((q_4,B),(*,a),L)$$
 
$$\delta((q_4,B),(*,a)) = ((q_4,B),(*,a),R)$$
 
$$\delta((q_4,B),(*,a),R)$$
 
$$\delta((q_4,B),(*,a),R)$$
 
$$\delta((q_4,B),(*,a),R)$$
 
$$\delta((q_4$$

• • •	В	*	В	В	*	В	В	В	• • •
• • •	В	0	I	С	0		В	В	• • •



- In q6, move left and look for the first unchecked symbol

$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_4, B), (B, a)) = ((q_4, B), (B, a), R)$$

$$\delta((q_5, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

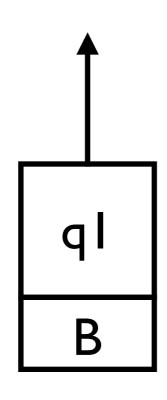
$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a))$$

• • •	В	*	В	В	*	В	В	В	• • •
• • •	В	0	ı	С	0		В	В	• • •



- Repeat the cycle

$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_4, B), (B, a)) = ((q_4, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

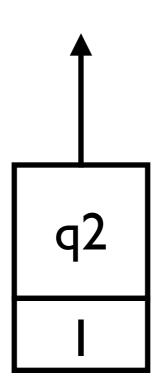
$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ((q_6, B), (*, a), R)$$

$$\delta((q_6, B), (*, a)) = ($$

• • •	В	*	*	В	*	В	В	В	• • •
• • •	В	0	I	С	0	I	В	В	• • •



$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_4, B), (B, a)) = ((q_4, B), (B, a)) = ((q_4, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_5, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

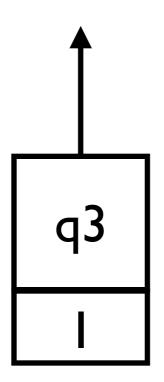
$$\delta((q_5, B), (*, a)) = ((q_7, B), (*, a), R)$$

$$\delta((q_7, B), (B, c)) = ((q_8, B), (B, c), R)$$

$$\delta((q_8, B), (*, a)) = ((q_9, B), (*, a), R)$$

$$\delta((q_8, B), (B, B)) = ((q_9, B), (B, B), R)$$

• • •	В	*	*	В	*	В	В	В	• • •
• • •	В	0	I	С	0	I	В	В	• • •



$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

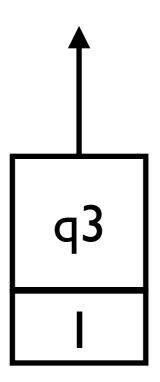
$$\delta((q_3, a), (B, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_4, B), (*, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_4, B), (B, c)) = ((q_5, B), (B, c), L)$$

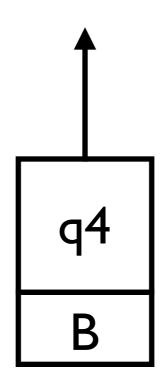
$$\begin{array}{ll} \delta((q_1,B),(B,a)) = ((q_2,a),(*,a),R) & \delta((q_5,B),(B,a)) = ((q_6,B),(B,a),L) \\ \delta((q_2,a),(B,b)) = ((q_2,a),(B,b),R) & \delta((q_6,B),(B,a)) = ((q_6,B),(B,a),L) \\ \delta((q_2,a),(B,c)) = ((q_3,a),(B,c),R) & \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_3,a),(*,b)) = ((q_3,a),(*,b),R) & \delta((q_6,B),(*,a)) = ((q_1,B),(*,a),R) \\ \delta((q_3,a),(B,a)) = ((q_4,B),(*,a),L) & \delta((q_5,B),(*,a)) = ((q_7,B),(*,a),R) \\ \delta((q_4,B),(*,a)) = ((q_4,B),(*,a),L) & \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_6,B),(*,a),R) \\ \delta((q_6,B),$$

• • •	В	*	*	В	*	В	В	В	• • •
• • •	В	0	1	С	0	I	В	В	• • •



$$\begin{split} \delta((q_1,B),(B,a)) &= ((q_2,a),(*,a),R) \\ \delta((q_2,a),(B,b)) &= ((q_2,a),(B,b),R) \\ \delta((q_2,a),(B,c)) &= ((q_3,a),(B,c),R) \\ \delta((q_3,a),(*,b)) &= ((q_3,a),(*,b),R) \\ \delta((q_3,a),(B,a)) &= ((q_4,B),(*,a),L) \\ \delta((q_4,B),(*,a)) &= ((q_4,B),(*,a),L) \\ \delta((q_4,B),(B,c)) &= ((q_5,B),(B,c),L) \end{split} \qquad \begin{array}{l} \delta((q_5,B),(B,a)) &= ((q_6,B),(B,a),L) \\ \delta((q_6,B),(B,a)) &= ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) &= ((q_1,B),(*,a),R) \\ \delta((q_6,B),(*,a)) &= ((q_1,B),(*,a),R) \\ \delta((q_5,B),(*,a)) &= ((q_1,B),(*,a),R) \\ \delta((q_5,B),(*,a)) &= ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) &= ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) &= ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) &= ((q_6,B),(*,a),R) \\ \delta((q_6,B),(*,a)) &= ((q_6,B),(*,a),$$

• • •	В	*	*	В	*	*	В	В	• • •
• • •	В	0		C	0	I	В	В	• • •



$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

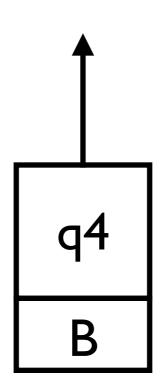
$$\delta((q_3, a), (B, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_4, B), (*, a)) = ((q_4, B), (*, a), L)$$

$$\delta((q_4, B), (B, c)) = ((q_5, B), (B, c), L)$$

$$\begin{array}{ll} \delta((q_1,B),(B,a)) = ((q_2,a),(*,a),R) & \delta((q_5,B),(B,a)) = ((q_6,B),(B,a),L) \\ \delta((q_2,a),(B,b)) = ((q_2,a),(B,b),R) & \delta((q_6,B),(B,a)) = ((q_6,B),(B,a),L) \\ \delta((q_2,a),(B,c)) = ((q_3,a),(B,c),R) & \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_3,a),(*,b)) = ((q_3,a),(*,b),R) & \delta((q_6,B),(*,a)) = ((q_1,B),(*,a),R) \\ \delta((q_3,a),(B,a)) = ((q_3,a),(*,b),R) & \delta((q_5,B),(*,a)) = ((q_7,B),(*,a),R) \\ \delta((q_3,a),(B,a)) = ((q_4,B),(*,a),L) & \delta((q_5,B),(B,c)) = ((q_7,B),(*,a),R) \\ \delta((q_7,B),(B,c)) = ((q_8,B),(B,c),R) \\ \delta((q_4,B),(*,a)) = ((q_4,B),(*,a),L) & \delta((q_8,B),(*,a)) = ((q_8,B),(*,a),R) \\ \delta((q_8,B),$$

• • •	В	*	*	В	*	*	В	В	• • •
• • •	В	0		C	0	I	В	В	• • •



$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, a), (B$$

$$\delta((q_5, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (*, a)) = ((q_1, B), (*, a), R)$$

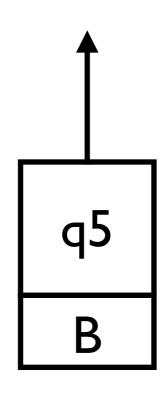
$$\delta((q_5, B), (*, a)) = ((q_7, B), (*, a), R)$$

$$\delta((q_7, B), (B, c)) = ((q_8, B), (B, c), R)$$

$$\delta((q_8, B), (*, a)) = ((q_9, B), (*, a), R)$$

$$\delta((q_8, B), (B, B)) = ((q_9, B), (B, B), R)$$

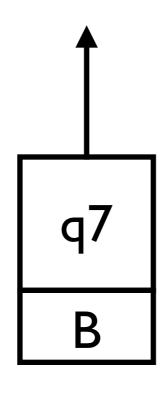
• • •	В	*	*	В	*	*	В	В	• • •
• • •	В	0		С	0		В	В	• • •



- If every symbols are checked, move right and enter q7

$$\begin{array}{ll} \delta((q_1,B),(B,a)) = ((q_2,a),(*,a),R) \\ \delta((q_2,a),(B,b)) = ((q_2,a),(B,b),R) \\ \delta((q_2,a),(B,c)) = ((q_3,a),(B,c),R) \\ \delta((q_3,a),(*,b)) = ((q_3,a),(*,b),R) \\ \delta((q_3,a),(B,a)) = ((q_4,B),(*,a),L) \\ \delta((q_4,B),(*,a)) = ((q_4,B),(*,a),L) \\ \delta((q_4,B),(B,c)) = ((q_5,B),(B,c),L) \\ \end{array} \begin{array}{ll} \delta((q_5,B),(B,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(B,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_1,B),(*,a),R) \\ \delta((q_5,B),(*,a)) = ((q_1,B),(*,a),R) \\ \delta((q_5,B),(*,a)) = ((q_1,B),(*,a),R) \\ \delta((q_5,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_1,B),(*,a),R) \\ \delta((q_5,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_6,B),(*,a),R) \\ \delta($$

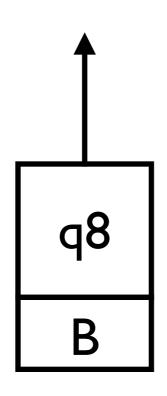
• • •	В	*	*	В	*	*	В	В	• • •
• • •	В	0	I	С	0		В	В	• • •



- If c is found, enter q8

$$\begin{split} \delta((q_1,B),(B,a)) &= ((q_2,a),(*,a),R) \\ \delta((q_2,a),(B,b)) &= ((q_2,a),(B,b),R) \\ \delta((q_2,a),(B,c)) &= ((q_3,a),(B,c),R) \\ \delta((q_3,a),(*,b)) &= ((q_3,a),(*,b),R) \\ \delta((q_3,a),(B,a)) &= ((q_4,B),(*,a),L) \\ \delta((q_4,B),(*,a)) &= ((q_4,B),(*,a),L) \\ \delta((q_4,B),(B,c)) &= ((q_5,B),(B,c),L) \end{split} \qquad \begin{array}{l} \delta((q_5,B),(B,a)) &= ((q_6,B),(B,a),L) \\ \delta((q_6,B),(B,a)) &= ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) &= ((q_1,B),(*,a),R) \\ \delta((q_6,B),(*,a)) &= ((q_1,B),(*,a),R) \\ \delta((q_5,B),(*,a)) &= ((q_7,B),(*,a),R) \\ \delta((q_7,B),(B,c)) &= ((q_8,B),(*,a),R) \\ \delta((q_8,B),(*,a)) &= ((q_8,B),(*,a),R) \\ \delta((q_8,B),(*,a)) &= ((q_9,B),(B,B),R) \end{split}$$

• • •	В	*	*	В	*	*	В	В	• • •
• • •	В	0	I	С	0		В	В	• • •



move right until it finds B

$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_4, B), (B, a)) = ((q_4, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

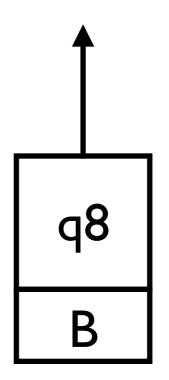
$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), L)$$

$$\delta($$

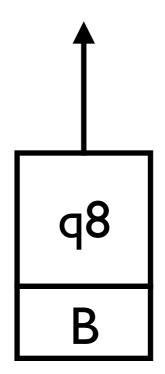
$$\begin{array}{ll} \delta((q_1,B),(B,a)) = ((q_2,a),(*,a),R) & \delta((q_5,B),(B,a)) = ((q_6,B),(B,a),L) \\ \delta((q_2,a),(B,b)) = ((q_2,a),(B,b),R) & \delta((q_6,B),(B,a)) = ((q_6,B),(B,a),L) \\ \delta((q_2,a),(B,c)) = ((q_3,a),(B,c),R) & \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_3,a),(*,b)) = ((q_3,a),(*,b),R) & \delta((q_6,B),(*,a)) = ((q_1,B),(*,a),R) \\ \delta((q_3,a),(B,a)) = ((q_4,B),(*,a),L) & \delta((q_5,B),(*,a)) = ((q_7,B),(*,a),R) \\ \delta((q_4,B),(*,a)) = ((q_4,B),(*,a),L) & \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_1,B),(*,a),R) \\ \delta((q_6,B),(*,a)) = ((q_1,B),(*,a),R) \\ \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_6,B),(*,a)) = ((q_6,B),(*,a),R) \\ \delta((q_6,B),$$

• • •	В	*	*	В	*	*	В	В	• • •
• • •	В	0		C	0	I	В	В	• • •



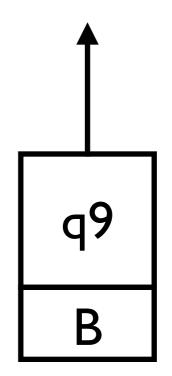
$$\begin{array}{ll} \delta((q_1,B),(B,a)) = ((q_2,a),(*,a),R) & \delta((q_5,B),(B,a)) = ((q_6,B),(B,a),L) \\ \delta((q_2,a),(B,b)) = ((q_2,a),(B,b),R) & \delta((q_6,B),(B,a)) = ((q_6,B),(B,a),L) \\ \delta((q_2,a),(B,c)) = ((q_3,a),(B,c),R) & \delta((q_6,B),(*,a)) = ((q_6,B),(B,a),L) \\ \delta((q_3,a),(*,b)) = ((q_3,a),(*,b),R) & \delta((q_6,B),(*,a)) = ((q_1,B),(*,a),R) \\ \delta((q_3,a),(B,a)) = ((q_4,B),(*,a),L) & \delta((q_5,B),(*,a)) = ((q_7,B),(*,a),R) \\ \delta((q_7,B),(B,c)) = ((q_8,B),(*,a),R) \\ \delta((q_4,B),(*,a)) = ((q_4,B),(*,a),L) & \delta((q_8,B),(*,a)) = ((q_8,B),(*,a),R) \\ \delta((q_4,B),(B,c)) = ((q_5,B),(B,c),L) & \delta((q_8,B),(*,a)) = ((q_9,B),(B,B),R) \end{array}$$

• • •	В	*	*	В	*	*	В	В	• • •
• • •	В	0	I	С	0	I	В	В	• • •



$$\delta((q_1,B),(B,a)) = ((q_2,a),(*,a),R) 
\delta((q_2,a),(B,b)) = ((q_2,a),(B,b),R) 
\delta((q_2,a),(B,c)) = ((q_3,a),(B,c),R) 
\delta((q_3,a),(*,b)) = ((q_3,a),(*,b),R) 
\delta((q_3,a),(B,a)) = ((q_3,a),(*,b),R) 
\delta((q_3,a),(B,a)) = ((q_3,a),(B,c),R) 
\delta((q_4,B),(*,a)) = ((q_4,B),(*,a),L) 
\delta((q_4,B),(*,a)) = ((q_4,B),(*,a),L) 
\delta((q_4,B),(*,a)) = ((q_4,B),(*,a),L) 
\delta((q_4,B),(*,a)) = ((q_4,B),(*,a),L) 
\delta((q_4,B),(*,a)) = ((q_4,B),(*,a),R) 
\delta((q_4,B),(*,a),R) 
\delta$$

• • •	В	*	*	В	*	*	В	В	• • •
• • •	В	0		С	0	I	В	В	• • •



$$\delta((q_1, B), (B, a)) = ((q_2, a), (*, a), R)$$

$$\delta((q_2, a), (B, b)) = ((q_2, a), (B, b), R)$$

$$\delta((q_2, a), (B, c)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (*, b)) = ((q_3, a), (*, b), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_3, a), (B, a)) = ((q_3, a), (B, c), R)$$

$$\delta((q_4, B), (B, a)) = ((q_4, B), (B, a), R)$$

$$\delta((q_4, B), (B, a)) = ((q_4, B), (B, a), R)$$

$$\delta((q_5, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (B, a), R)$$

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$$\delta((q_6, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_1, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a)) = ((q_6, B), (B, a), R)$$

$$\delta((q_6, B), (B, a))$$