

Introduction to Theoretical Computer Science

Exercise tasks

Preparation for final exam – part 1

**Faculty of Electrical Engineering and Computing
University of Zagreb**

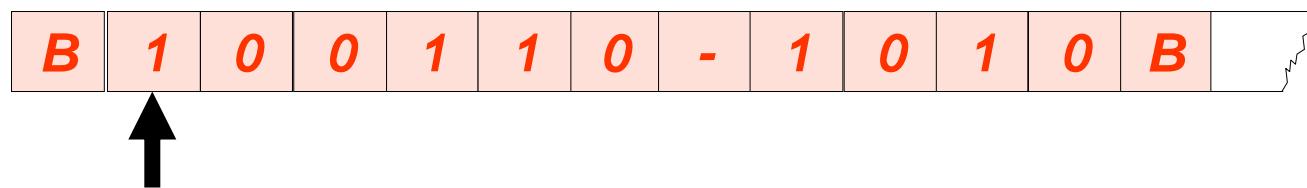


Task 27

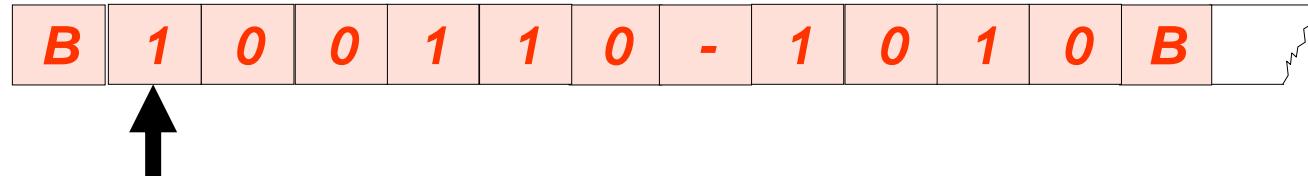
- Construct a simple Turing machine which subtracts two binary numbers written on tape. The most significant digit is on the left, and the numbers are separated with character $-$. The second number is subtracted from the first and the first number is larger than the second. The head is at the beginning of the input sequence and there are blank spaces on both sides of the input sequence.

$$\text{TM } M = (Q, \Sigma, \Gamma, \delta, q_0, B, F)$$

Initial state:



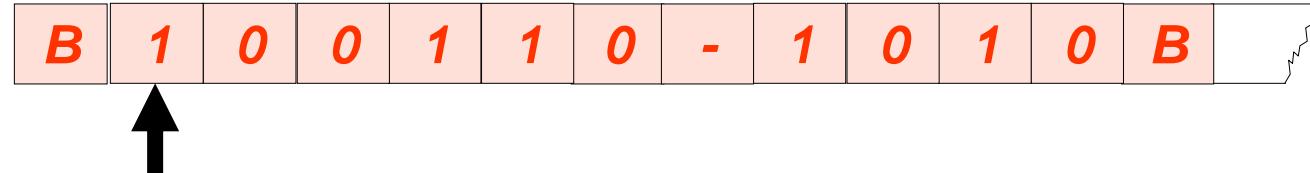
Task 27



IDEA

- One track is enough (simple form of TM)
- **q0** and **q1** - moving to the far right symbol, deleting
- **q2** and **q3** - read the far right 0, or 1; moving towards left
- **q4** and **q5** - skipping the minus symbol by reading 0, or 1
 - subtracting from the corresponding bit of the first number
 - **J (ones)** and **N (zeros)** are written down
 - **q6** -
if borrowing from previous bit, all bits are complemented before 1 appears
 - going back with q0
- **q7, q8** and **q9** – for the end

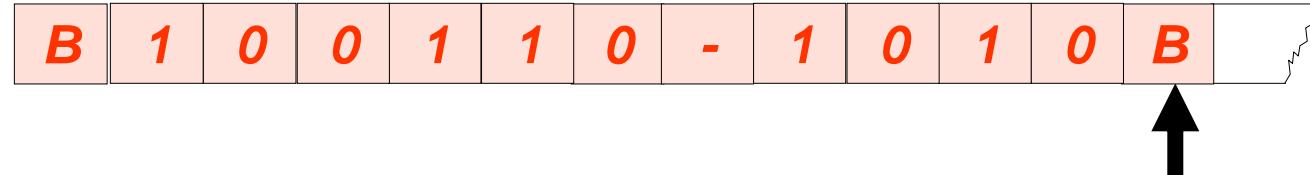
Task 27



- q_0 and q_1 - moving to the far right symbol, deleting

	0	1	-	N	J	B
q_0						
q_1						
q_2						
q_3						
q_4						
q_5						
q_6						
q_7						
q_8						

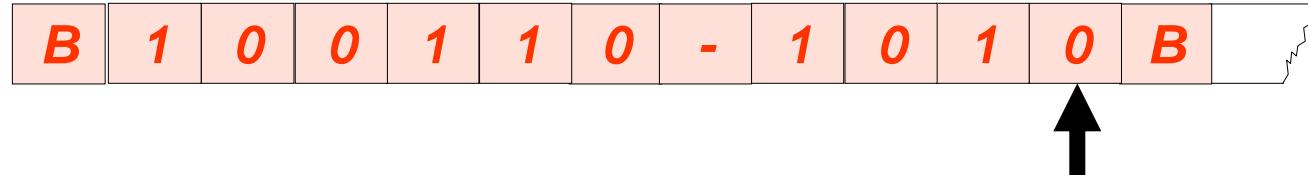
Task 27



- q_0 and q_1 - moving to the far right symbol, deleting

	0	1	-	N	J	B
q_0	$q_0, 0, R$	$q_0, 1, R$	$q_0, -, R$	q_0, N, R	q_0, J, R	q_1, B, L
q_1						
q_2						
q_3						
q_4						
q_5						
q_6						
q_7						
q_8						

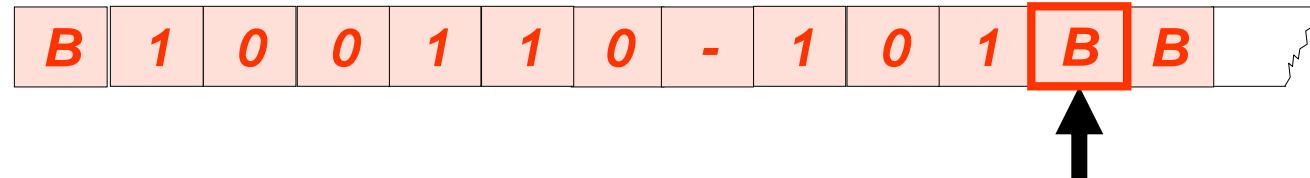
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- q_0 and q_1 - moving to the far right symbol, deleting

	0	1	-	N	J	B
q_0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1						
q2						
q3						
q4						
q5						
q6						
q7						
q8						

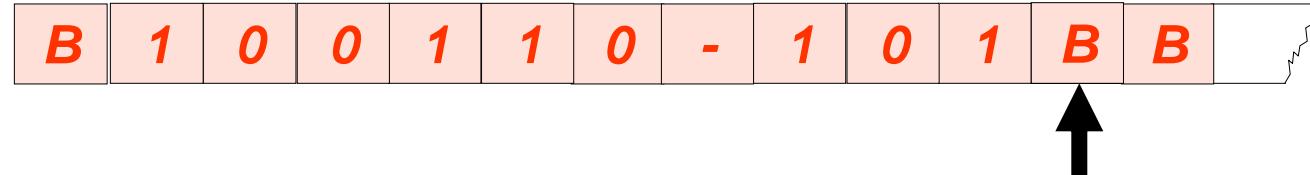
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- q_0 and q_1 - moving to the far right symbol, deleting

	0	1	-	N	J	B
q_0	$q_0, 0, R$	$q_0, 1, R$	$q_0, -, R$	q_0, N, R	q_0, J, R	q_1, B, L
q_1	q_2, B, L	q_3, B, L	q_7, B, L			
q_2						
q_3						
q_4						
q_5						
q_6						
q_7						
q_8						

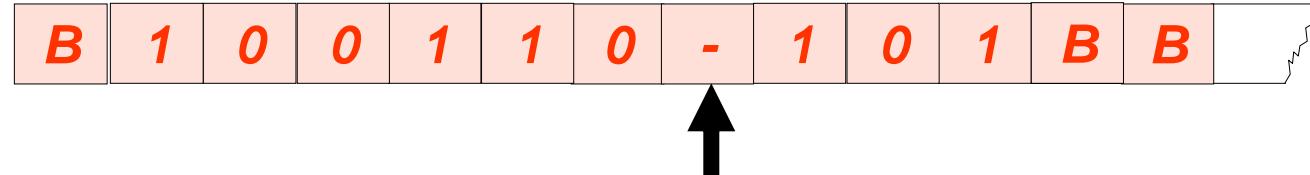
Task 27



- q_2 and q_3 - read the far right 0, or 1
 - moving towards left until the -

	0	1	-	N	J	B
q_0	$q_0, 0, R$	$q_0, 1, R$	$q_0, -, R$	q_0, N, R	q_0, J, R	q_1, B, L
q_1	q_2, B, L	q_3, B, L	q_7, B, L			
q_2						
q_3						
q_4						
q_5						
q_6						
q_7						
q_8						

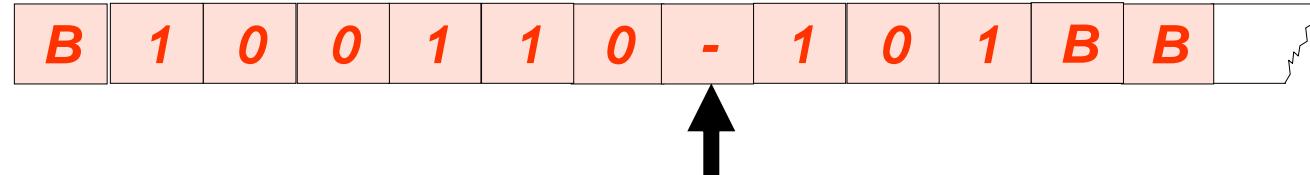
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	0	1	-	N	J	B
q_0	$q_0, 0, R$	$q_0, 1, R$	$q_0, -, R$	q_0, N, R	q_0, J, R	q_1, B, L
q_1	q_2, B, L	q_3, B, L	q_7, B, L			
q_2	$q_2, 0, L$	$q_2, 1, L$	$q_4, -, L$			
q_3						
q_4						
q_5						
q_6						
q_7						
q_8						

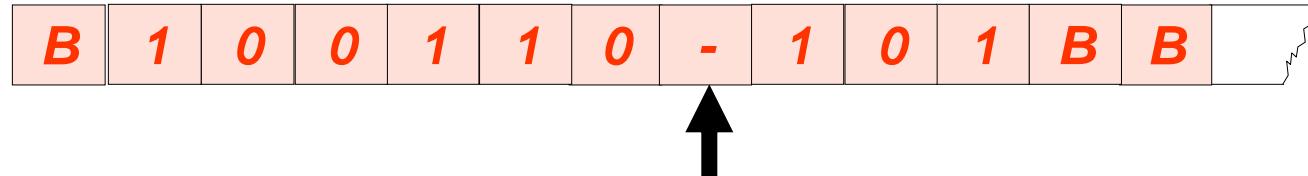
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q_1	q_2, B, L	q_3, B, L	q_7, B, L			
q_2	$q_2, 0, L$	$q_2, 1, L$	$q_4, -, L$			
q_3	$q_3, 0, L$	$q_3, 1, L$	$q_5, -, L$			
q_4						
q_5						
q_6						
q_7						
q_8						

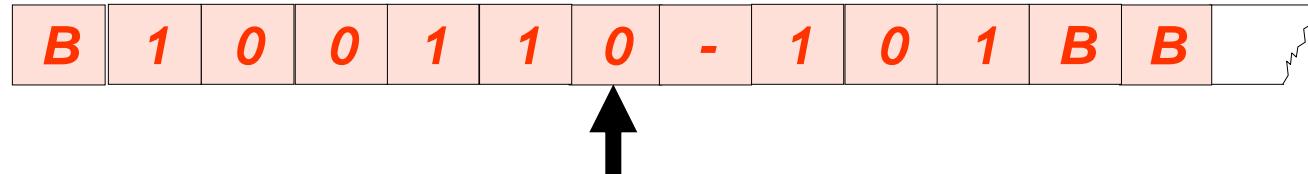
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- **q4** and **q5** - skipping the minus symbol by reading 0, or 1
 - positioning on the according bit of the minuend
 - subtraction, writing down result **J (one)** and **N (zero)**
 - **q6** – borrowing occurs

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4						
q5						
q6						
q7						
q8						

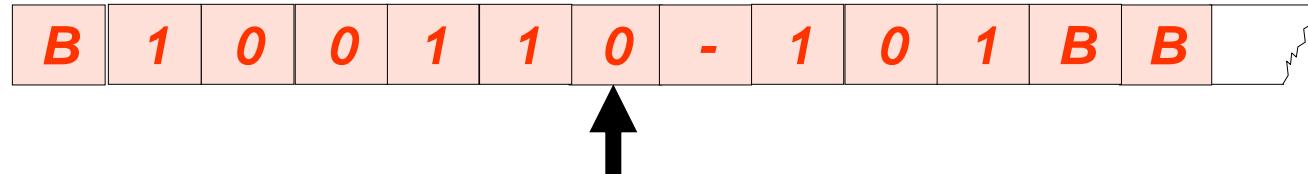
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q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5						
q6						
q7						
q8						

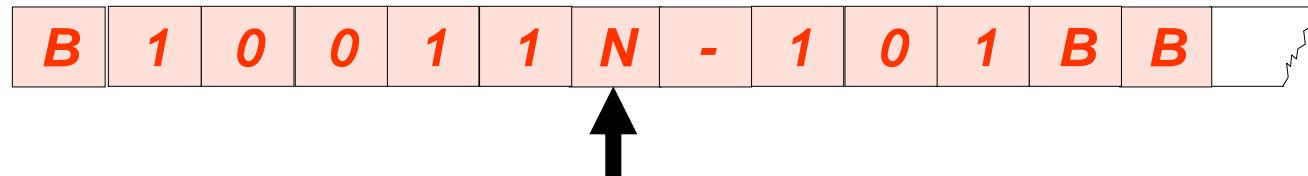
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q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

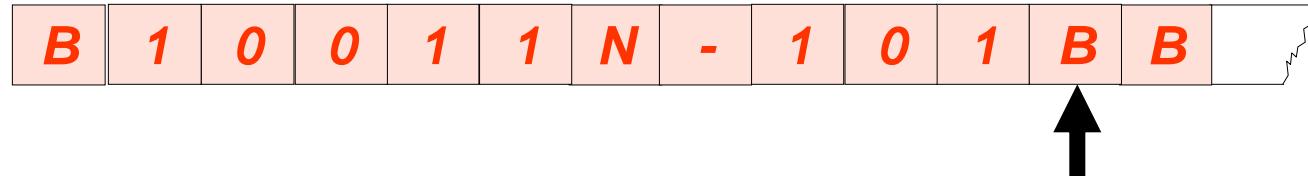
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q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

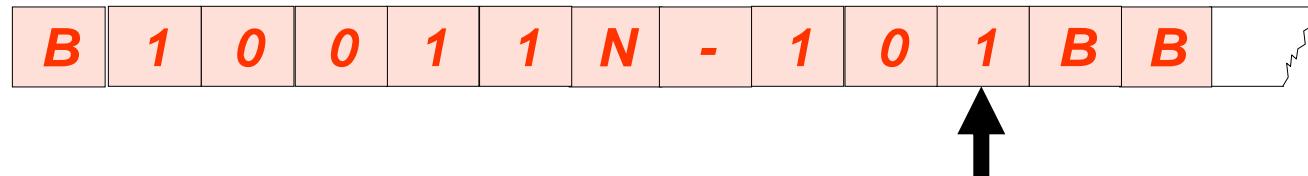
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	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

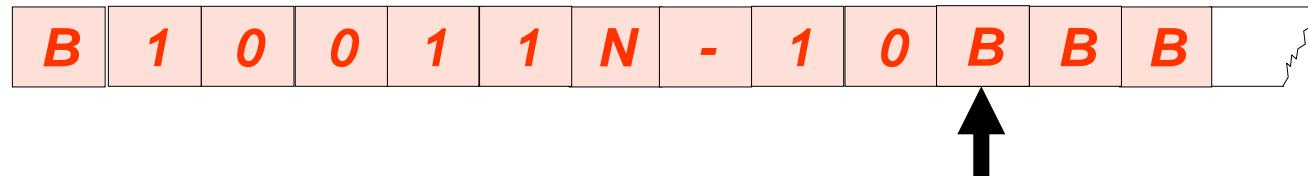
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q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

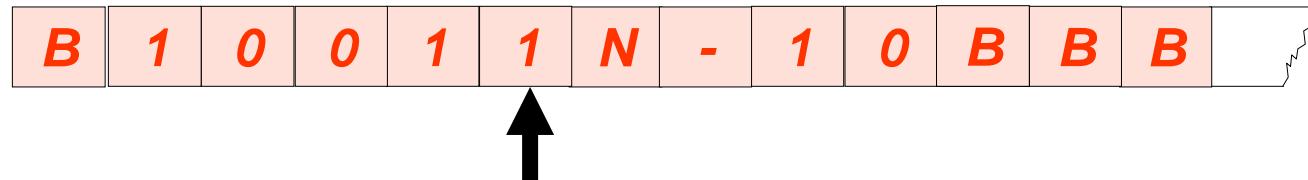
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q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

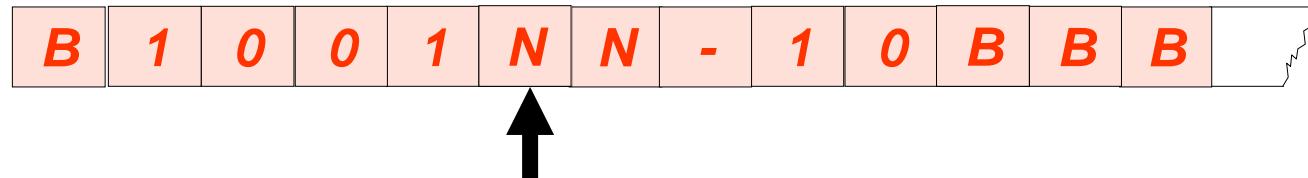
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q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

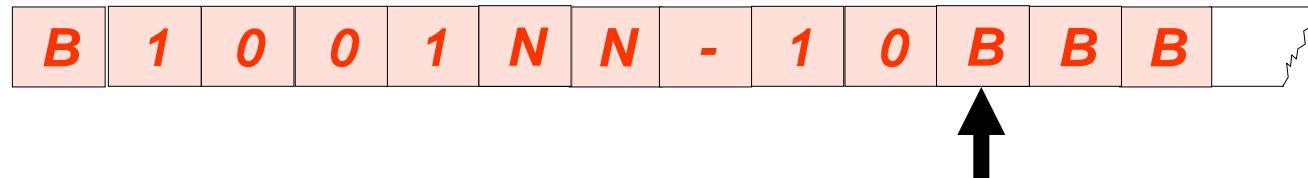
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q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

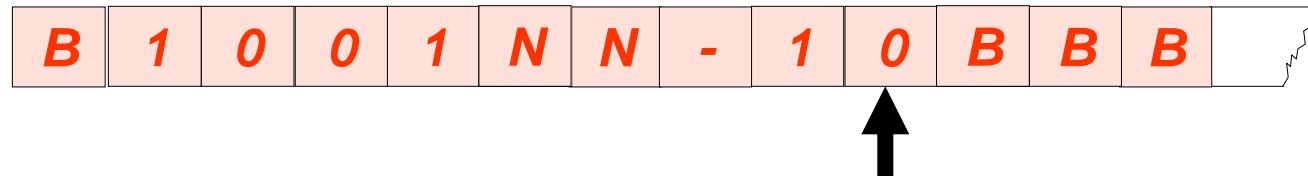
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q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
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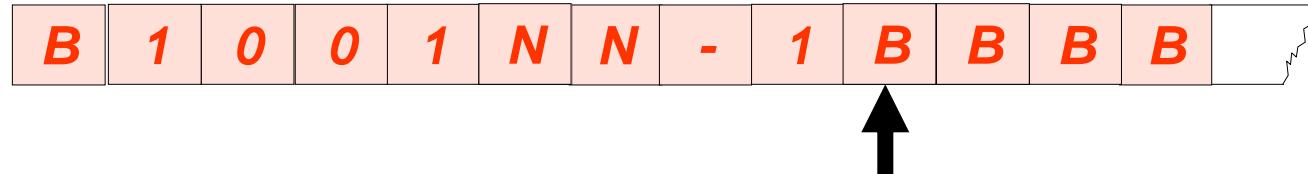
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q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
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q6						
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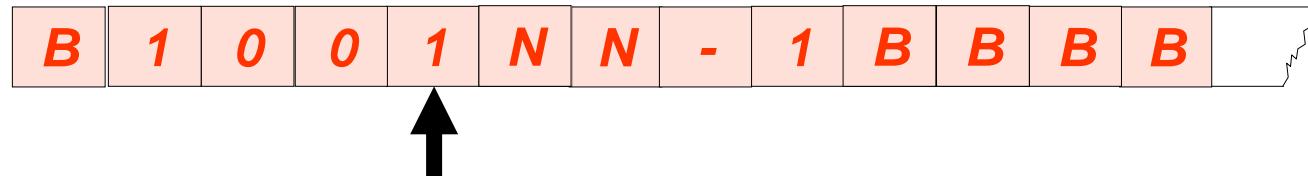
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q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
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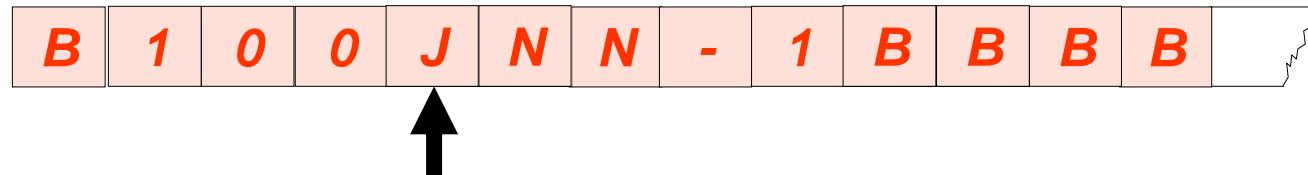
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q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
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q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
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q6						
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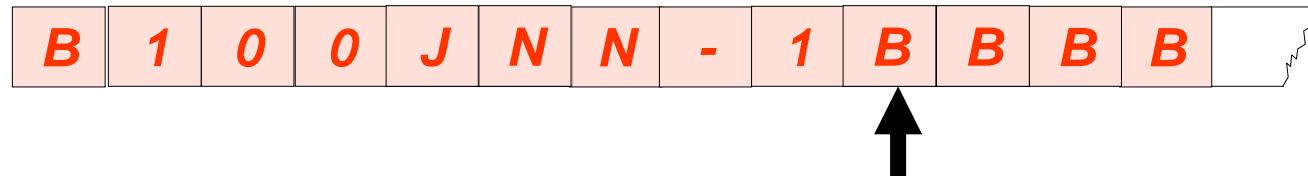
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q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
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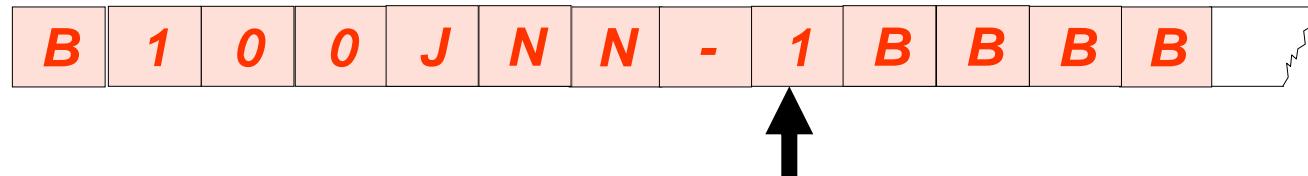
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q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
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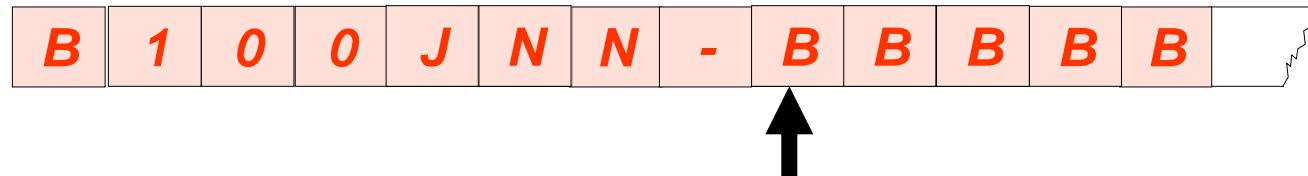
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q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

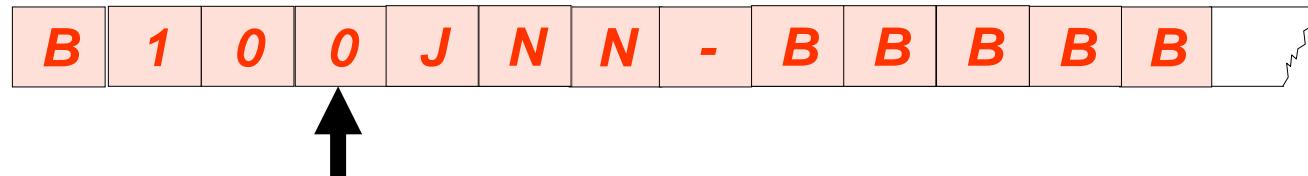
Task 27



- **q4** and **q5** - skipping the minus symbol by reading 0, or 1
 - positioning on the according bit of the minuend
 - subtraction, writing down result **J (one)** and **N (zero)**
 - **q6** – borrowing occurs

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

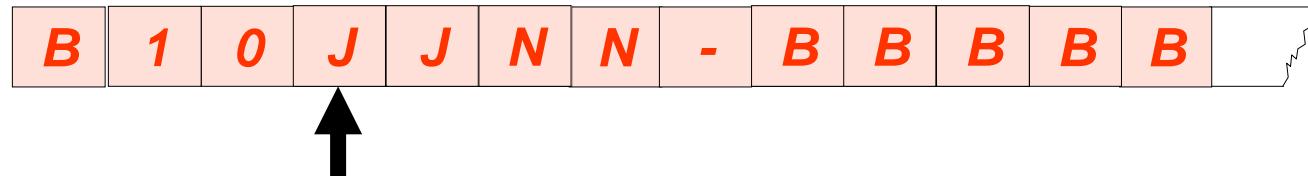
Task 27



- **q4** and **q5** - skipping the minus symbol by reading 0, or 1
 - positioning on the according bit of the minuend
 - subtraction, writing down result **J (one)** and **N (zero)**
 - **q6** – borrowing occurs

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

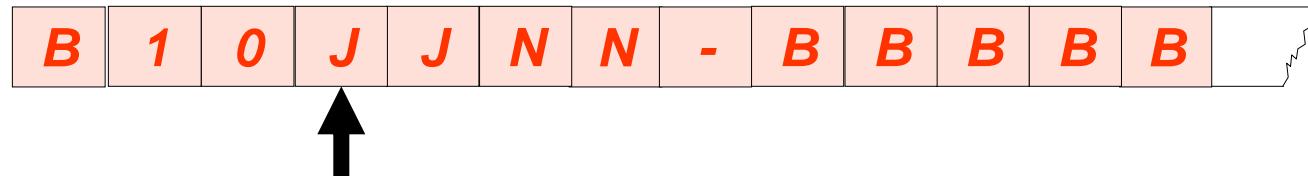
Task 27



- **q4** and **q5** - skipping the minus symbol by reading 0, or 1
 - positioning on the according bit of the minuend
 - subtraction, writing down result **J (one)** and **N (zero)**
 - **q6** – borrowing occurs

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

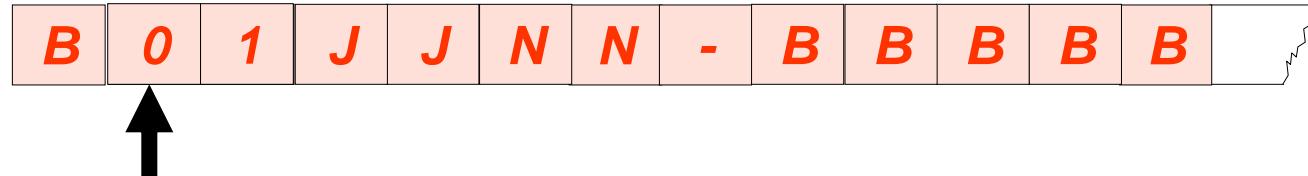
Task 27



- q6 - borrowing from the previous bit is necessary
 - all bits are complemented before 1 appears
 - going back with q0 and q1

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6						
q7						
q8						

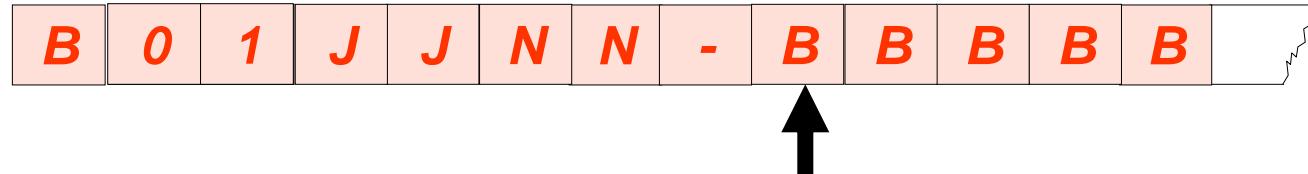
Task 27



- q6 - borrowing from the previous bit is necessary
 - all bits are complemented before 1 appears
 - going back with q0 and q1

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6	q6, 1, L	q0, 0, R				
q7						
q8						

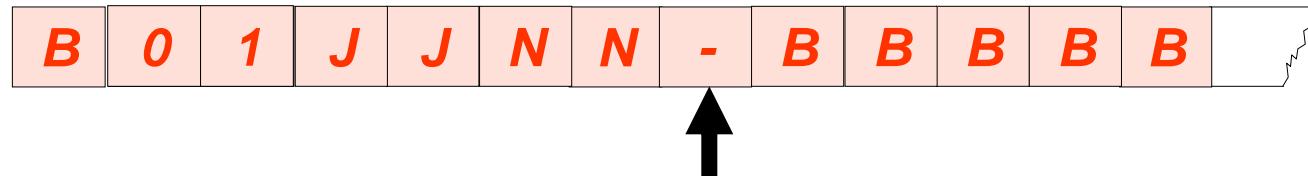
Task 27



- q6 - borrowing from the previous bit is necessary
 - all bits are complemented before 1 appears
 - going back with q0 and q1

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6	q6, 1, L	q0, 0, R				
q7						
q8						

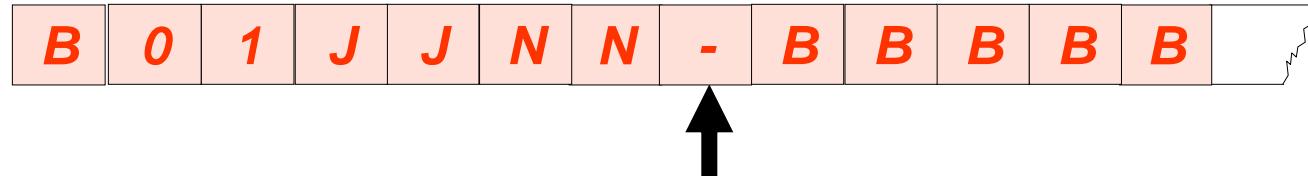
Task 27



- q6 - borrowing from the previous bit is necessary
 - all bits are complemented before 1 appears
 - going back with q0 and q1

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6	q6, 1, L	q0, 0, R				
q7						
q8						

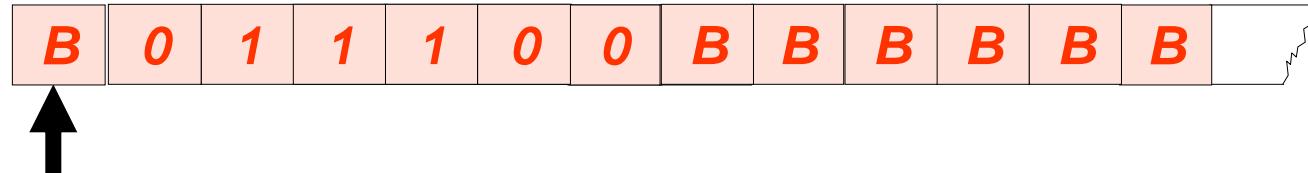
Task 27



- q7 – deleted the subtrahend
 - deleting “-”
 - converting the result to 0 and 1

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6	q6, 1, L	q0, 0, R				
q7						
q8						

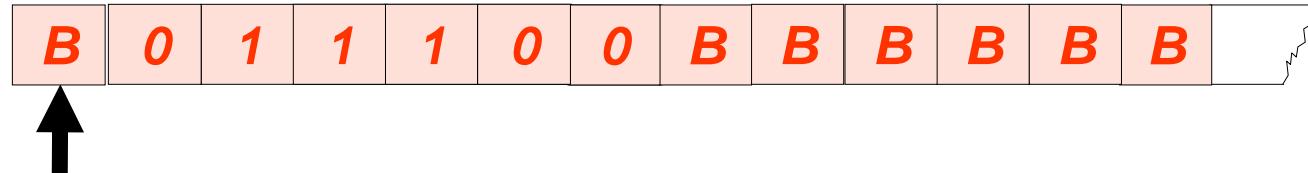
Task 27



- q7 – deleted the subtrahend
 - deleting “-”
 - converting the result to 0 and 1

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6	q6, 1, L	q0, 0, R				
q7	q7, 0, L	q7, 1, L		q7, 0, L	q7, 1, L	q8, B, R
q8						

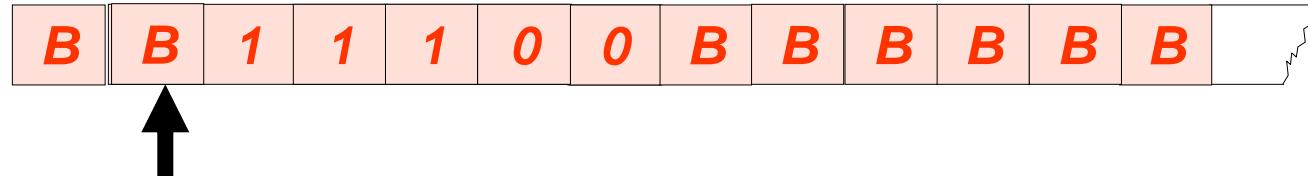
Task 27



- q8 - reached the left blank space
 - deleting leading zeros
 - q9 – finish in accepting state

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6	q6, 1, L	q0, 0, R				
q7	q7, 0, L	q7, 1, L		q7, 0, L	q7, 1, L	q8, B, R
q8						

Task 27



- q8 - reached the left blank space
 - deleting leading zeros
 - q9 – finish in accepting state

	0	1	-	N	J	B
q0	q0, 0, R	q0, 1, R	q0, -, R	q0, N, R	q0, J, R	q1, B, L
q1	q2, B, L	q3, B, L	q7, B, L			
q2	q2, 0, L	q2, 1, L	q4, -, L			
q3	q3, 0, L	q3, 1, L	q5, -, L			
q4	q0, N, R	q0, J, R		q4, N, L	q4, J, L	
q5	q6, J, L	q0, N, R		q5, N, L	q5, J, L	
q6	q6, 1, L	q0, 0, R				
q7	q7, 0, L	q7, 1, L		q7, 0, L	q7, 1, L	q8, B, R
q8	q8, B, R	q9, 1, L				q9, 0, L

Task 28

- Construct a Turing machine that generates exponents of number 2. The value of a single number is represented by the according number of ones on tape. Numbers are separated by separator \$. On the input tape of Turing machine there is initially a sequence \$1. There are blank spaces on both sides of the input sequence.

$$\text{TM } M = (Q, \Sigma, \Gamma, \delta, q_0, B, F)$$

Initial:



Result:



Task 28

\$	1	\$	1	1	\$	1	1	1	1	\$...
----	---	----	---	---	----	---	---	---	---	----	-----

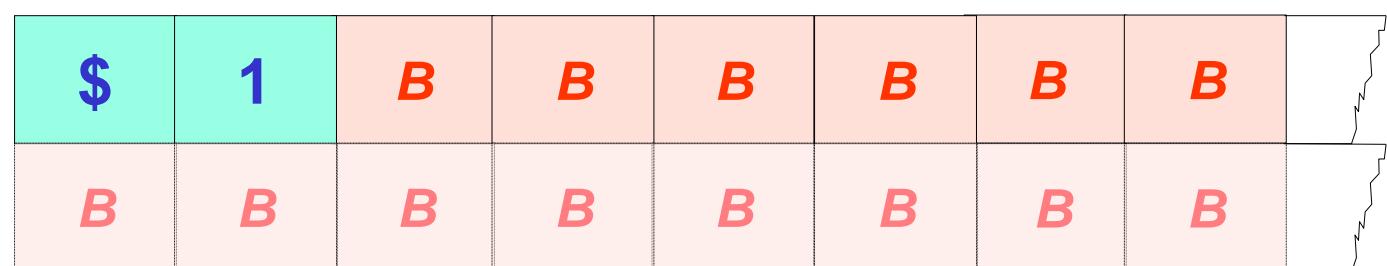
IDEA:

For each 1 from the previously generated sequence, generate two new 1s.

$$\text{TM } M = (Q, \Sigma, \Gamma, \delta, q_0, B, F)$$

Turing machine with one tape with two tracks:

Main – input-output track



Auxiliary– marking track



Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	B	B	B	B	B	B	B	B	B	B	B
B	B	B	B	B	B	B	B	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	B	B	B	B	B	B	B	B	B	B	B
B	*	B	B	B	B	B	B	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	\$	B	B	B	B	B	B	B	B	B	B
B	*	B	B	B	B	B	B	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	\$	1	1	B	B	B	B	B	B	B
B	*	B	B	B	B	B	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	\$	1	1	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	\$	1	1	\$	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	\$	1	1	\$	1	1	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	\$	1	1	\$	1	1	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	\$	1	1	\$	1	1	1	1	B	B
B	*	B	*	*	B	B	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	\$	1	1	\$	1	1	1	1	B	B
B	*	B	*	*	B	*	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	\$	1	1	\$	1	1	1	1	\$	B
B	*	B	*	*	B	*	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	\$	1	1	\$	1	1	1	1	\$	---
B	*	B	*	*	B	*	B	B	B	B	B

Task 28

IDEA:

For each 1 from the previously generated sequence, generate two new 1s at the end of the tape.

\$	1	\$	1	1	\$	1	1	1	1	\$	---
B	*	B	*	*	B	*	*	*	*	B	B

Task 28

[1, B]

[B, B]

[\$, B]

[1, *]

Construction of TM:

\$	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

↑

Task 28

Construction of TM:

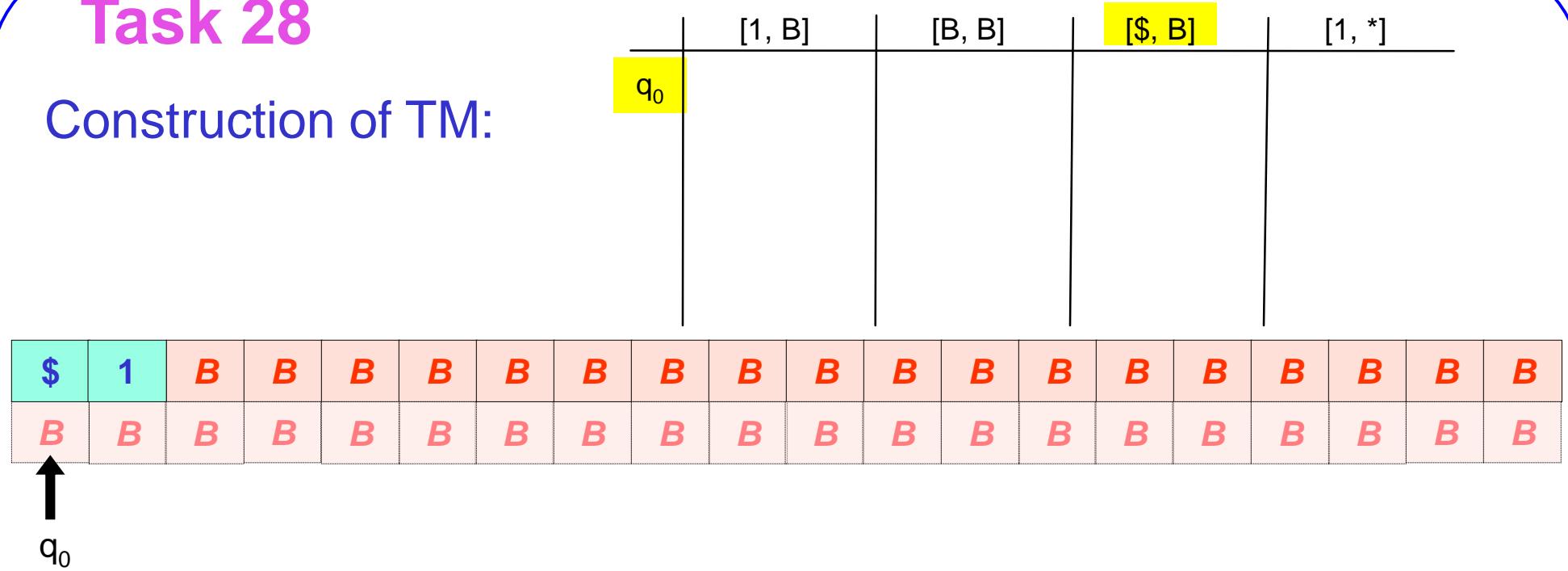
	[1, B]	[B, B]	[\$, B]	[1, *]
q_0				

\$	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

q_0

Task 28

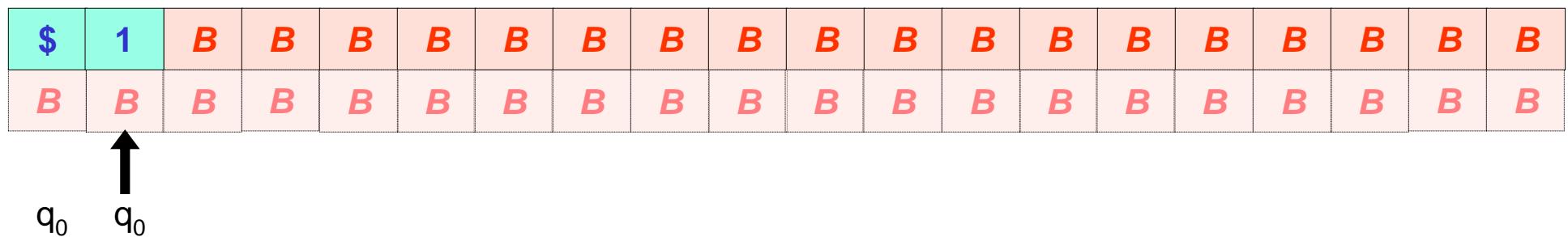
Construction of TM:



Task 28

Construction of TM:

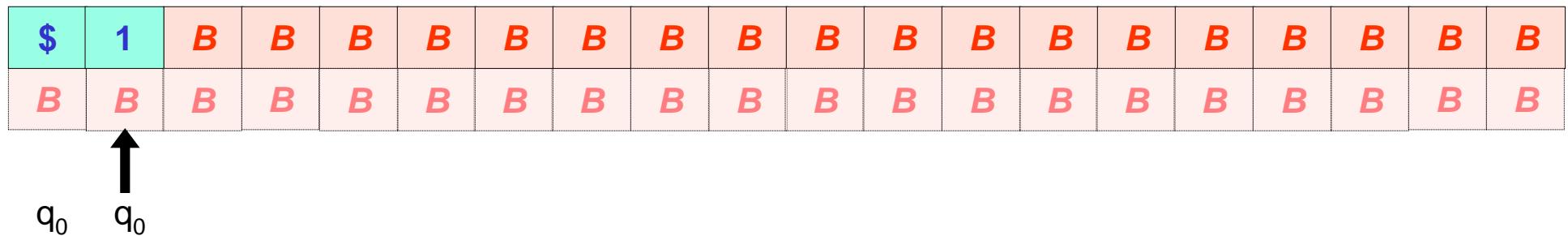
	[1, B]	[B, B]	[\$, B]	[1, *]
q_0			$q_0, [\$, B], R$	



Task 28

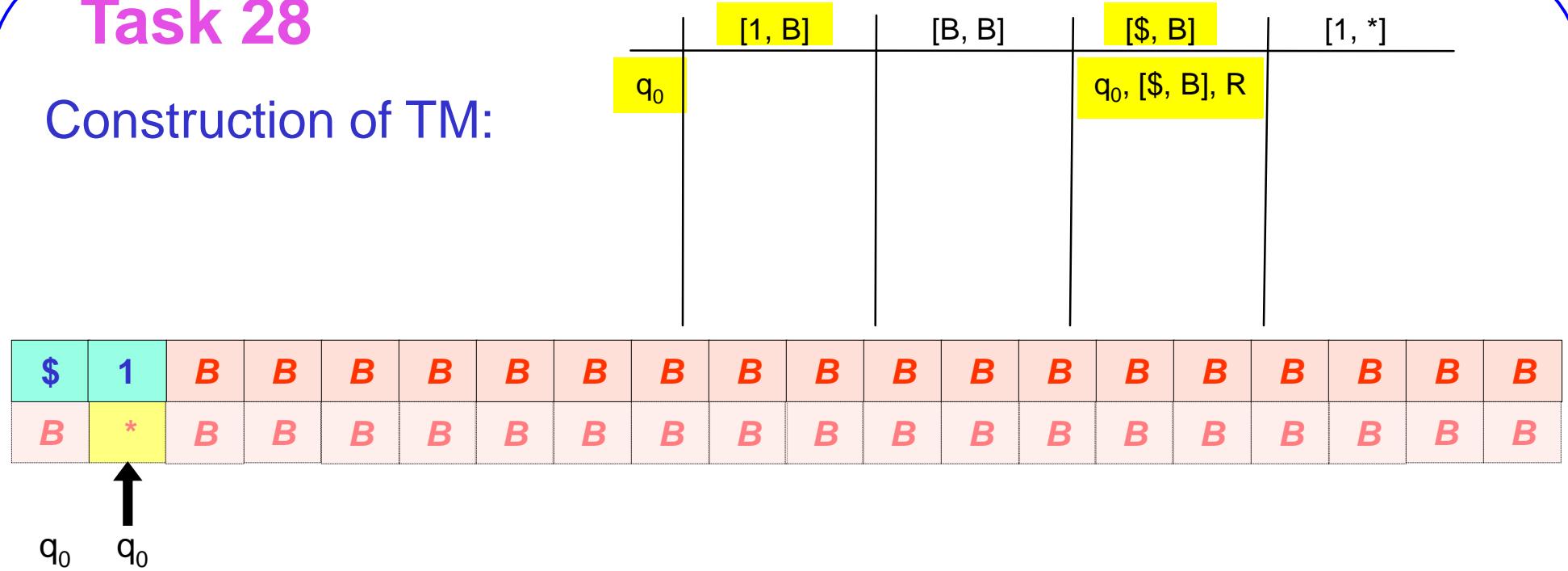
Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q_0			$q_0, [\$, B], R$	



Task 28

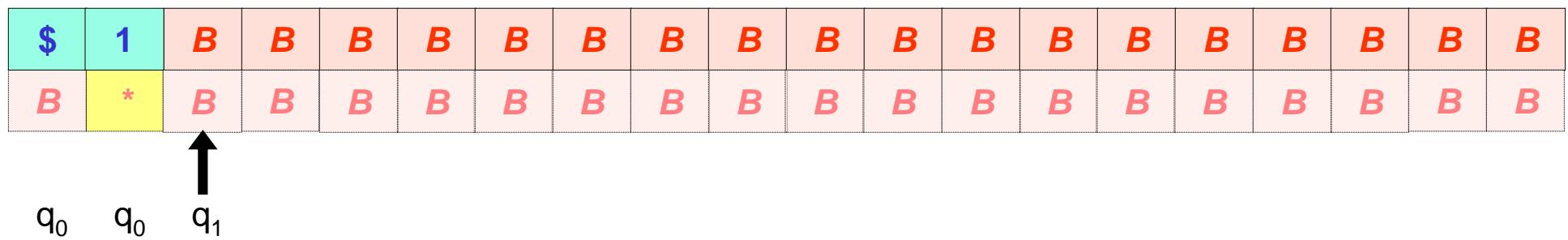
Construction of TM:



Task 28

Construction of TM:

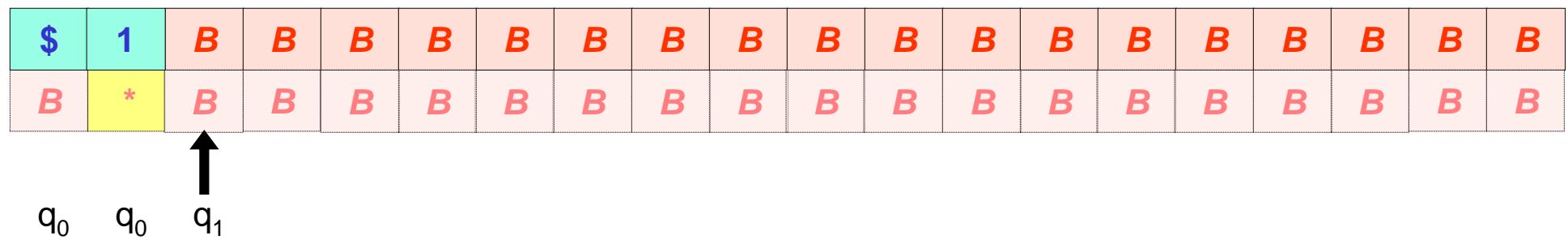
	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	



Task 28

Construction of TM:

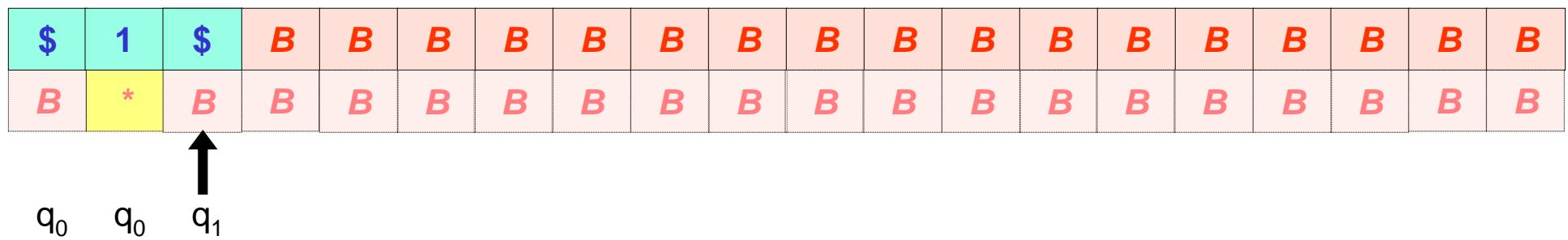
	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁				



Task 28

Construction of TM:

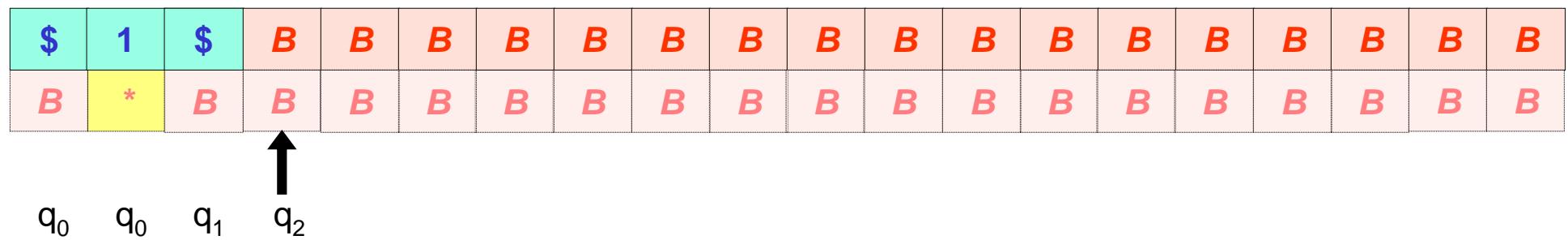
	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁				



Task 28

Construction of TM:

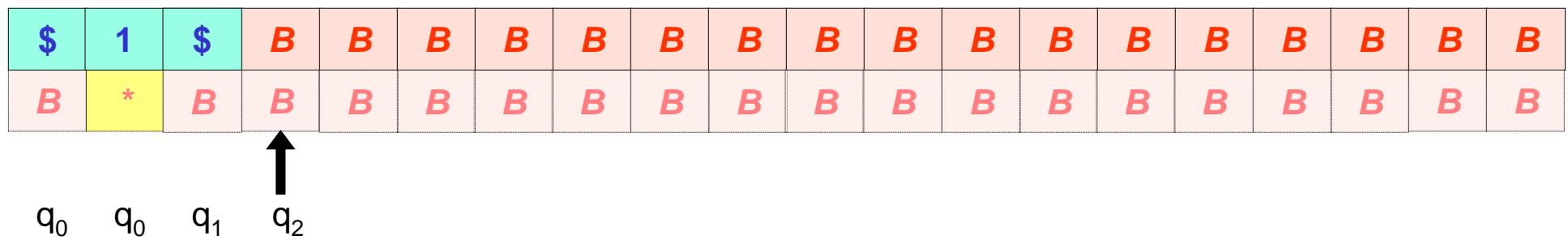
	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		



Task 28

Construction of TM:

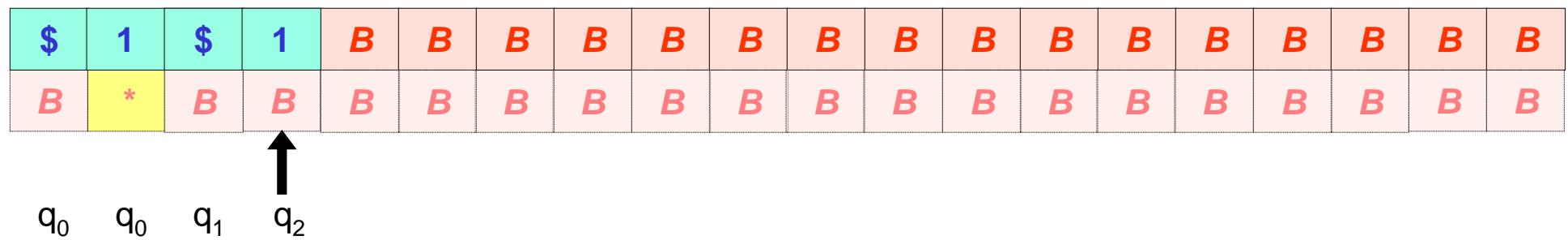
	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂				



Task 28

Construction of TM:

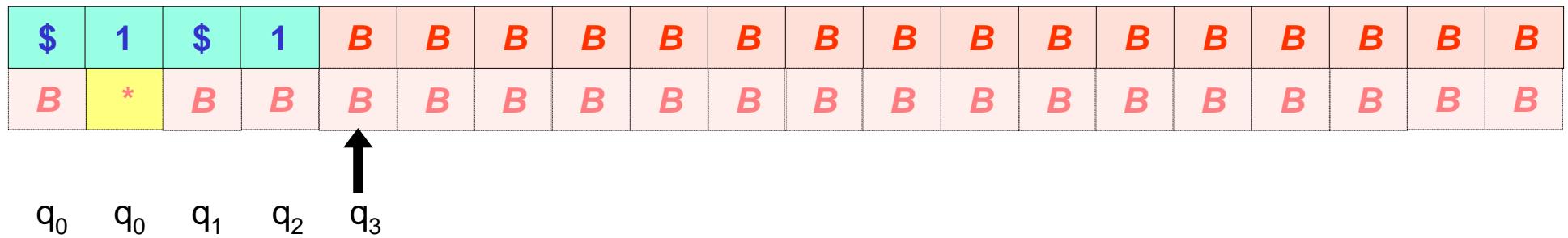
	[1, B]	[B, B]	[\$, B]	[1, *]
q_0	$q_1, [1, *], R$		$q_0, [\$, B], R$	
q_1		$q_2, [\$, B], R$		
q_2				



Task 28

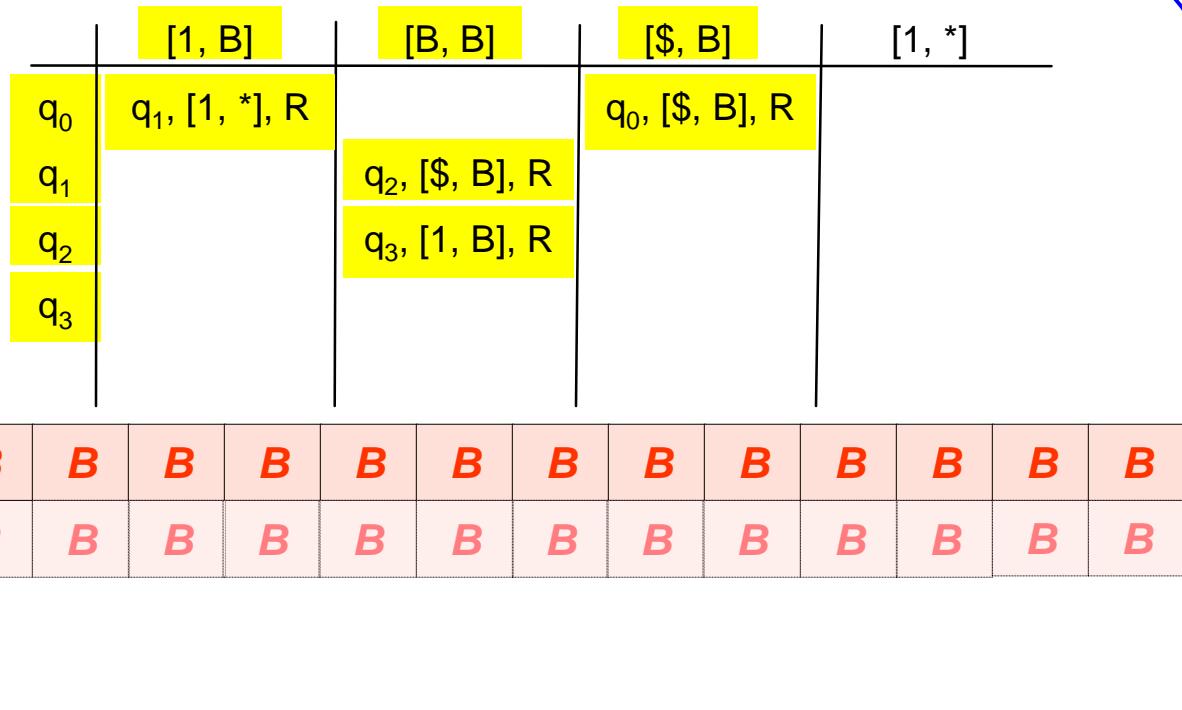
Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		



Task 28

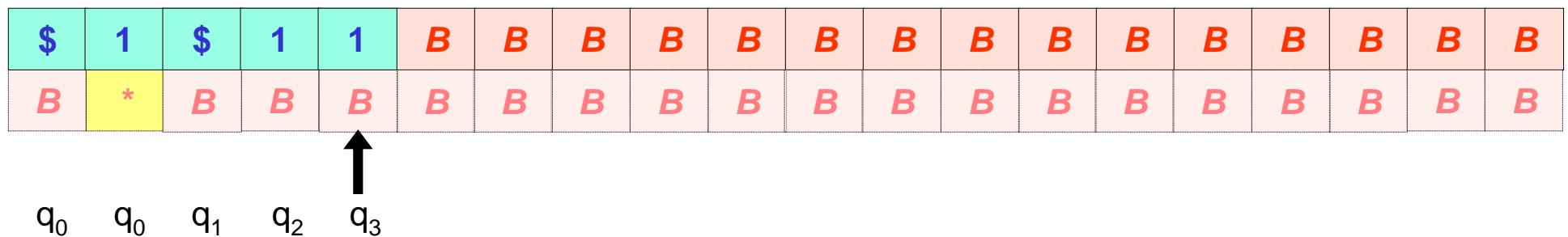
Construction of TM:



Task 28

Construction of TM:

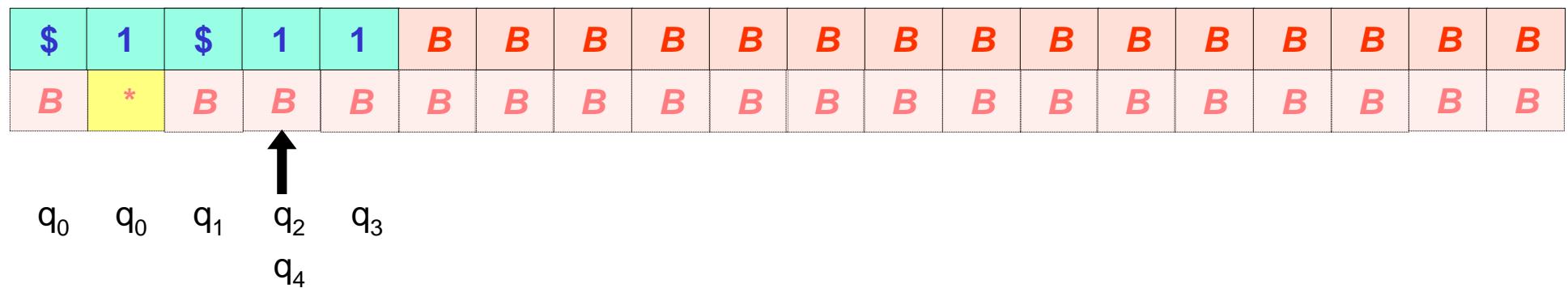
	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃				



Task 28

Construction of TM:

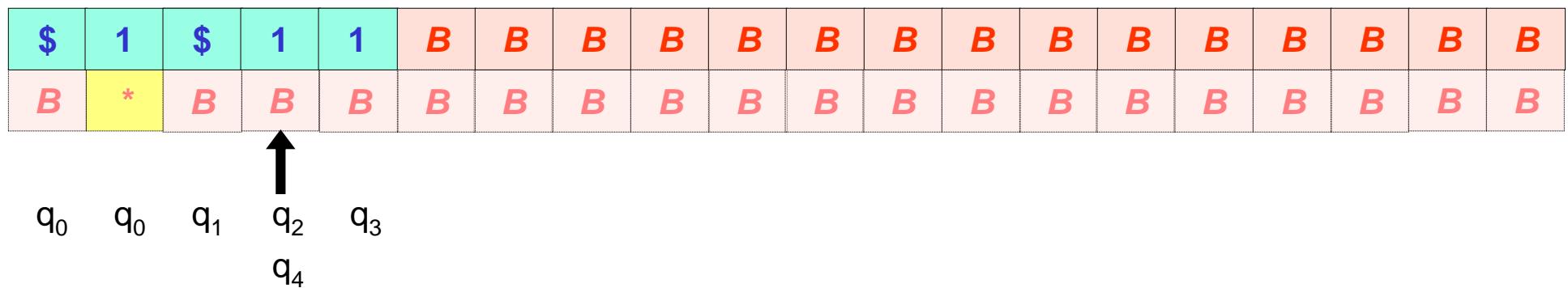
	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		



Task 28

Construction of TM:

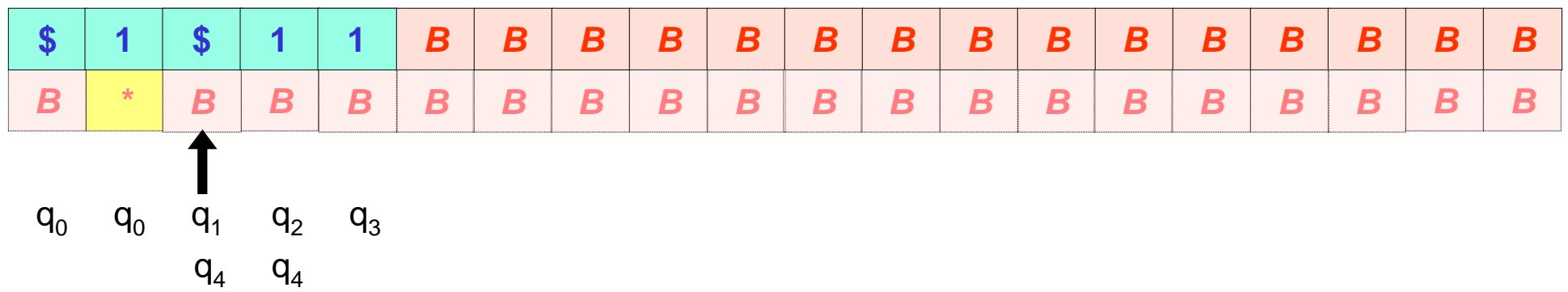
	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄				



Task 28

Construction of TM:

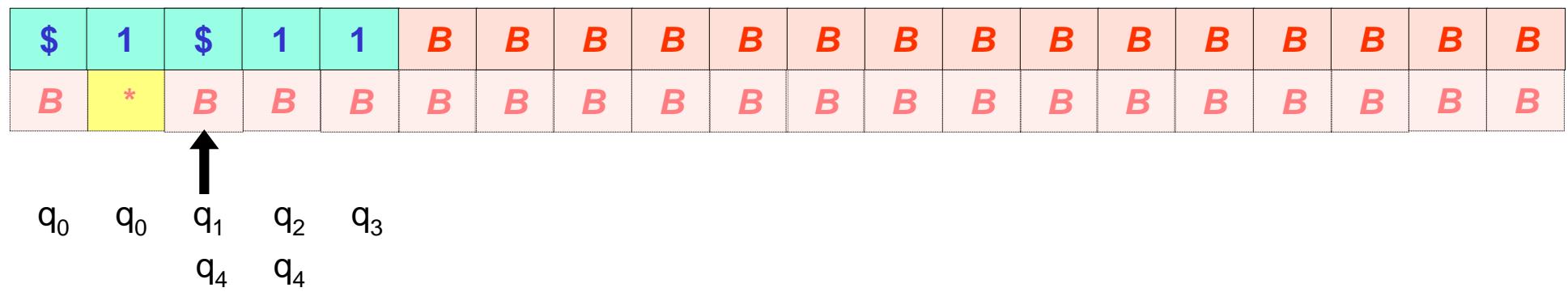
	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L			



Task 28

Construction of TM:

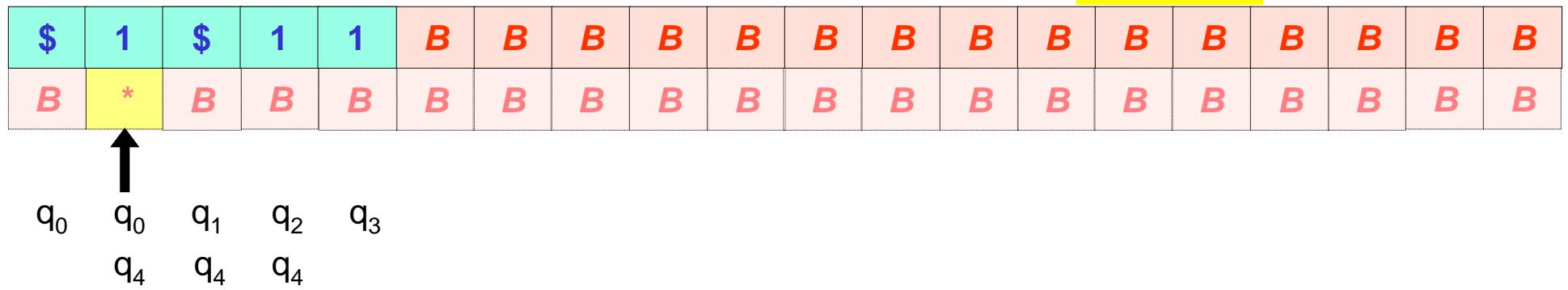
	[1, B]	[B, B]	[\$, B]	[1, *]
q_0	$q_1, [1, *], R$		$q_0, [\$, B], R$	
q_1		$q_2, [\$, B], R$		
q_2		$q_3, [1, B], R$		
q_3		$q_4, [1, B], L$		
q_4	$q_4, [1, B], L$			



Task 28

Construction of TM:

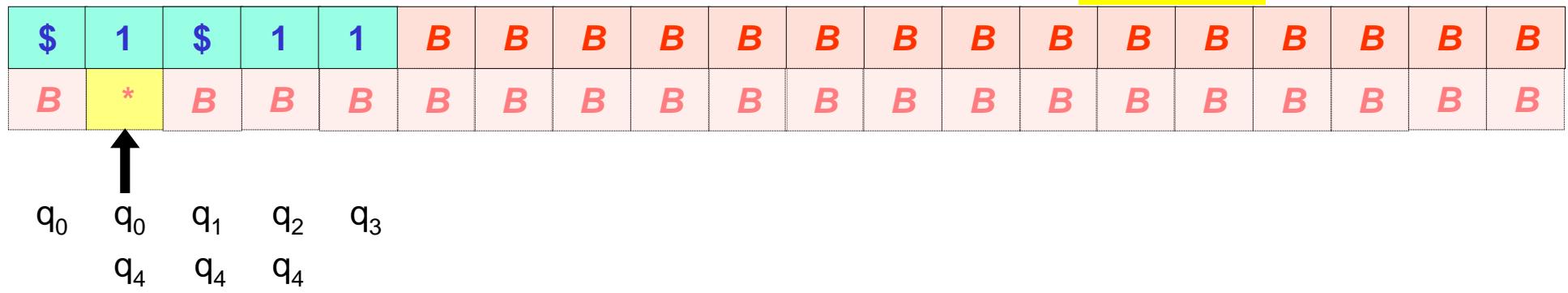
	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	



Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	

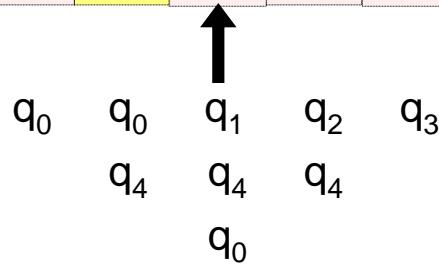


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

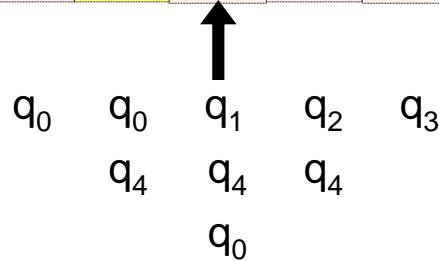


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

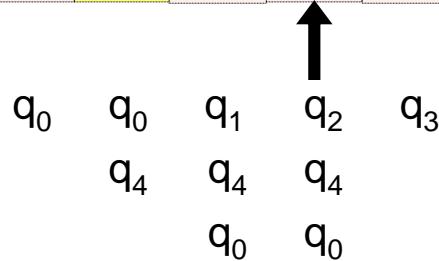


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

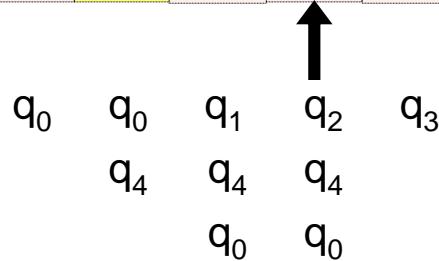


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

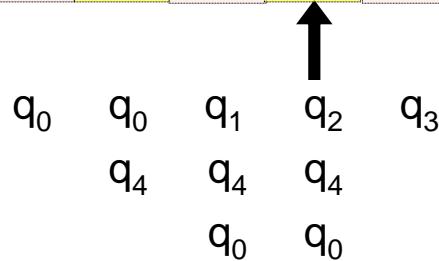


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

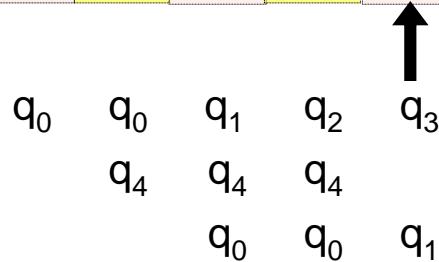


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

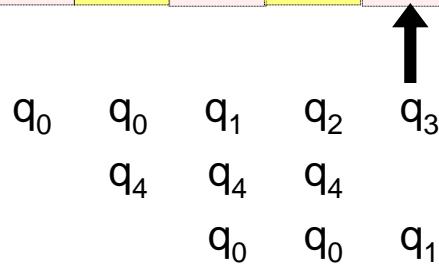


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁		q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

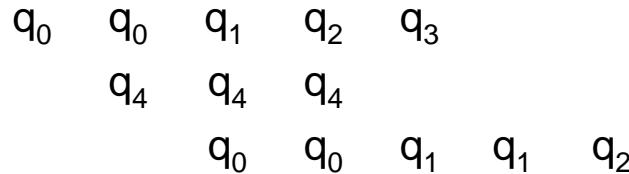
q₀ q₀ q₁ q₁

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

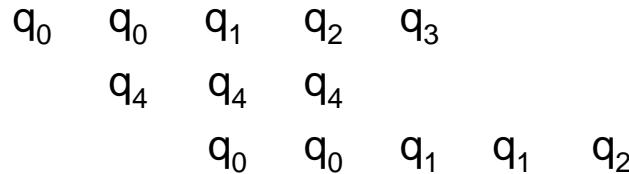


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

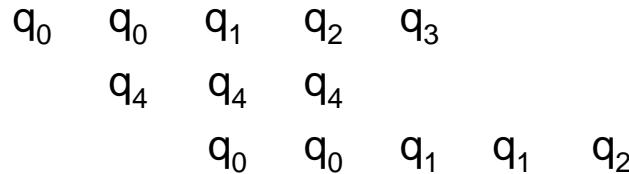


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q_0	$q_1, [1, *], R$		$q_0, [\$, B], R$	
q_1	$q_1, [1, B], R$	$q_2, [\$, B], R$		
q_2		$q_3, [1, B], R$		
q_3		$q_4, [1, B], L$		
q_4	$q_4, [1, B], L$		$q_4, [\$, B], L$	$q_0, [1, *], R$

\$	1	\$	1	1	\$	1	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q_0	q_0	q_1	q_2	q_3
q_4	q_4	q_4		
q_0	q_0	q_1	q_1	q_2

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q_0	$q_1, [1, *], R$		$q_0, [\$, B], R$	
q_1	$q_1, [1, B], R$	$q_2, [\$, B], R$		
q_2		$q_3, [1, B], R$		
q_3		$q_4, [1, B], L$		
q_4	$q_4, [1, B], L$		$q_4, [\$, B], L$	$q_0, [1, *], R$

\$	1	\$	1	1	\$	1	B	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q_0	q_0	q_1	q_2	q_3
q_4	q_4	q_4		
q_0	q_0	q_1	q_1	q_2

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



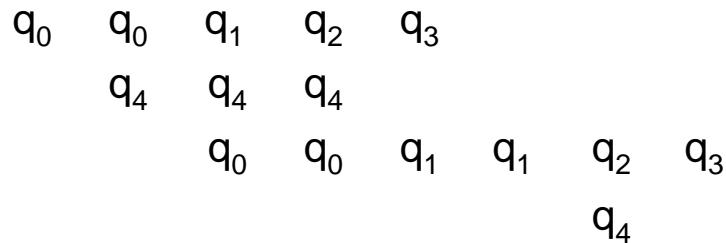
q ₀	q ₀	q ₁	q ₂	q ₃	
q ₄	q ₄	q ₄			
q ₀	q ₀	q ₁	q ₁	q ₂	q ₃

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

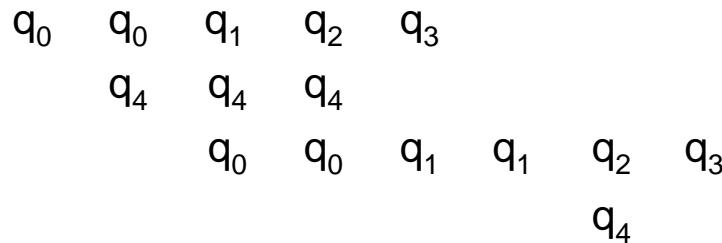


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

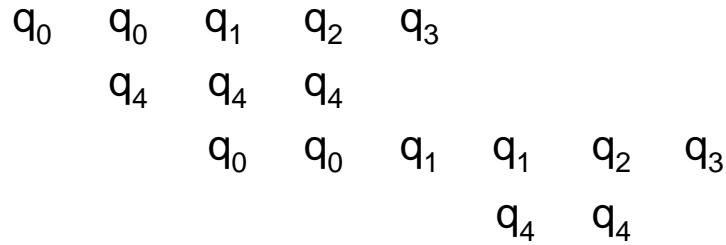


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

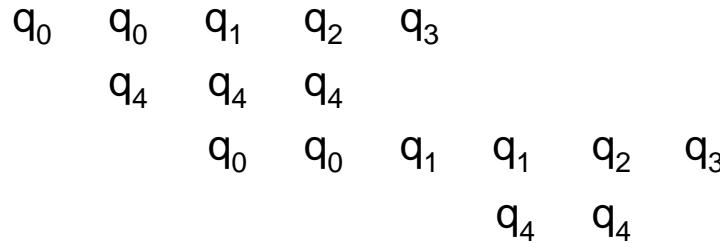


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

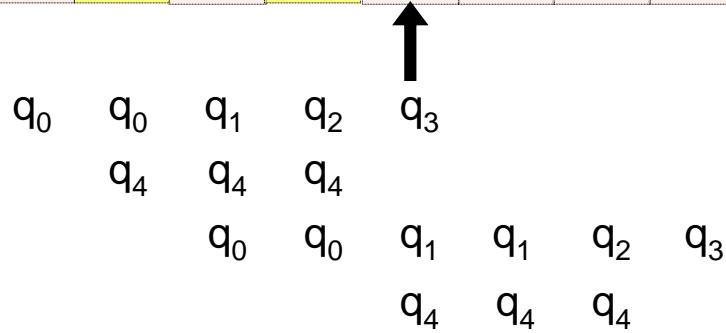


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q_0	$q_1, [1, *], R$		$q_0, [\$, B], R$	
q_1	$q_1, [1, B], R$	$q_2, [\$, B], R$		
q_2		$q_3, [1, B], R$		
q_3		$q_4, [1, B], L$		
q_4	$q_4, [1, B], L$		$q_4, [\$, B], L$	$q_0, [1, *], R$

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

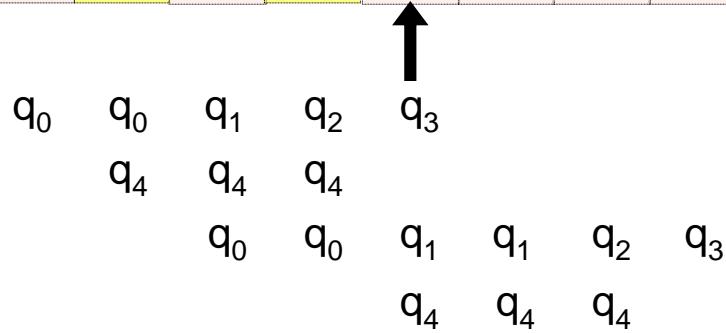


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q_0	$q_1, [1, *], R$		$q_0, [\$, B], R$	
q_1	$q_1, [1, B], R$	$q_2, [\$, B], R$		
q_2		$q_3, [1, B], R$		
q_3		$q_4, [1, B], L$		
q_4	$q_4, [1, B], L$		$q_4, [\$, B], L$	$q_0, [1, *], R$

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

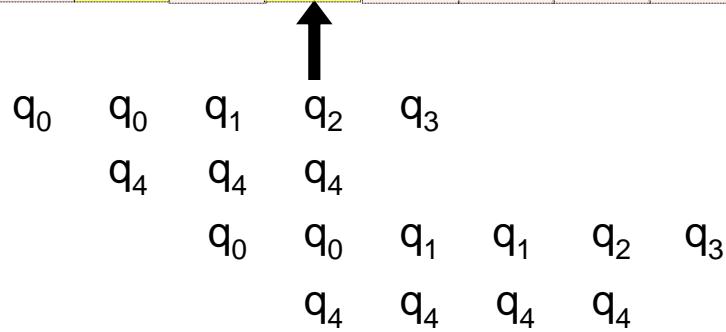


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q_0	$q_1, [1, *], R$		$q_0, [\$, B], R$	
q_1	$q_1, [1, B], R$	$q_2, [\$, B], R$		
q_2		$q_3, [1, B], R$		
q_3		$q_4, [1, B], L$		
q_4	$q_4, [1, B], L$		$q_4, [\$, B], L$	$q_0, [1, *], R$

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

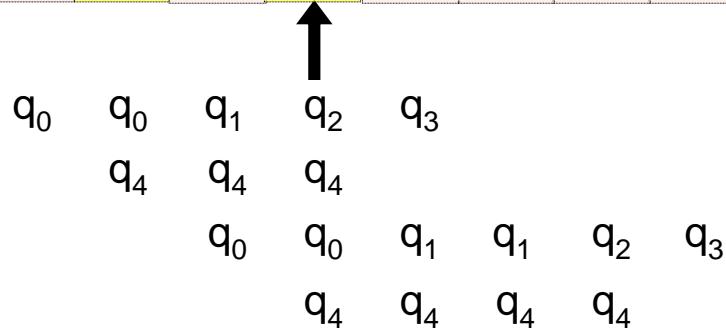


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q_0	$q_1, [1, *], R$		$q_0, [\$, B], R$	
q_1	$q_1, [1, B], R$	$q_2, [\$, B], R$		
q_2		$q_3, [1, B], R$		
q_3		$q_4, [1, B], L$		
q_4	$q_4, [1, B], L$		$q_4, [\$, B], L$	$q_0, [1, *], R$

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

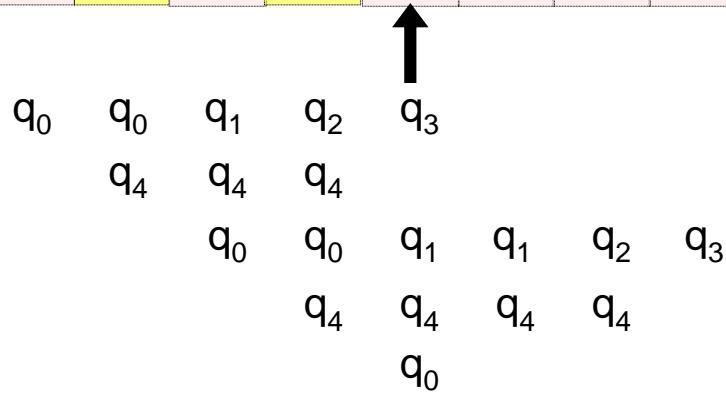


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

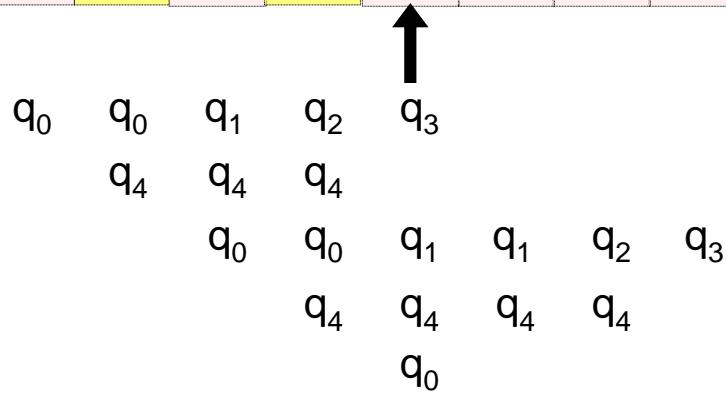


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

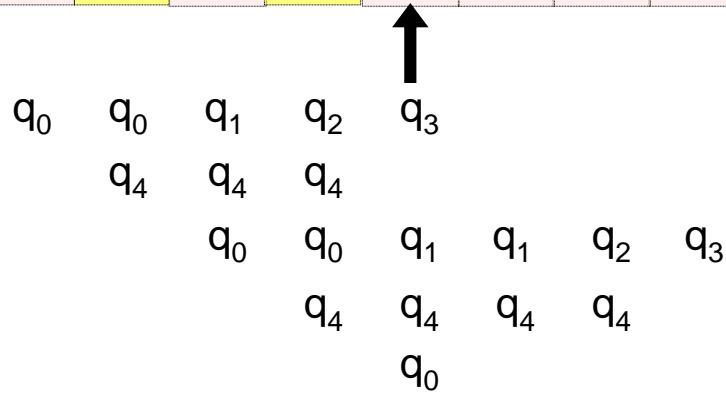


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

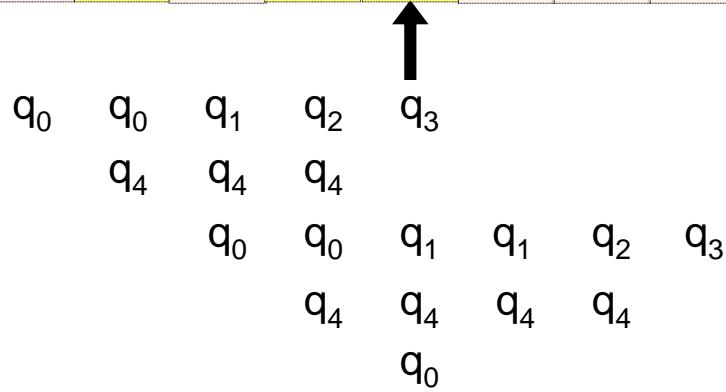


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

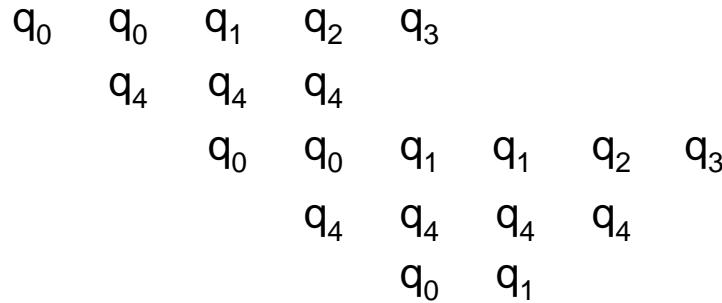


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

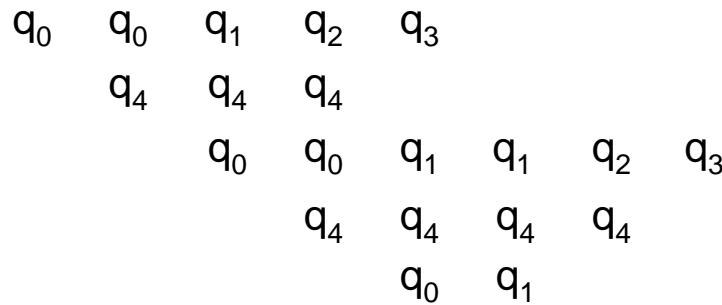


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R		
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

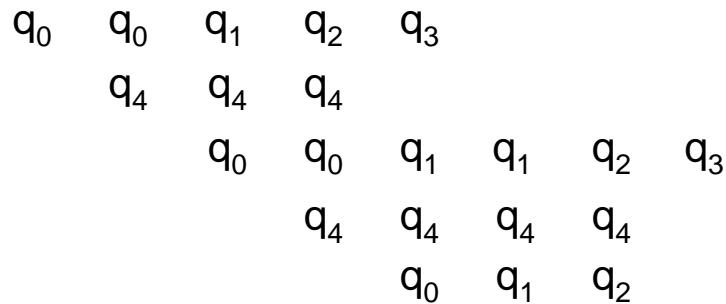


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

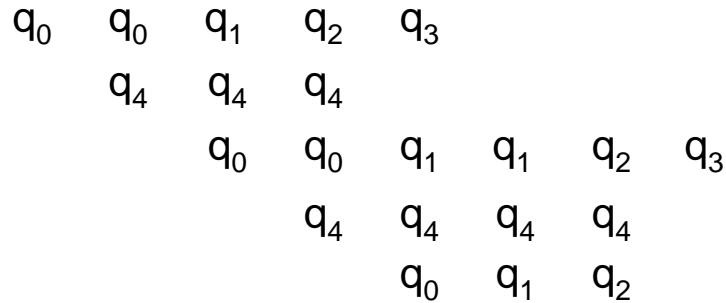


Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂		q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

q₀ q₁ q₂ q₂

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

q₀ q₁ q₂ q₂ q₂

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	B	B	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

q₀ q₁ q₂ q₂ q₂

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	1	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

q₀ q₁ q₂ q₂ q₂

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	1	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

q₀ q₁ q₂ q₂ q₂ q₃

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	1	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

q₀ q₁ q₂ q₂ q₂ q₃

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	1	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

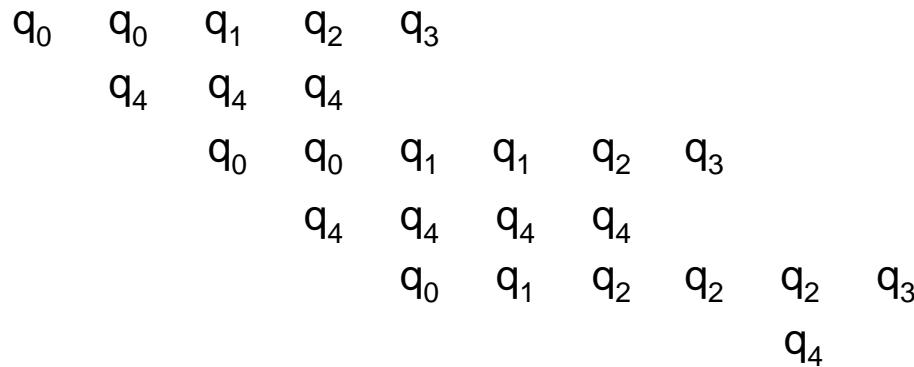
q₀ q₁ q₂ q₂ q₂ q₃

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	1	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B



Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	1	B	B	B	B	B	B	B	B	B	B
B	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

q₀ q₁ q₂ q₂ q₂ q₃

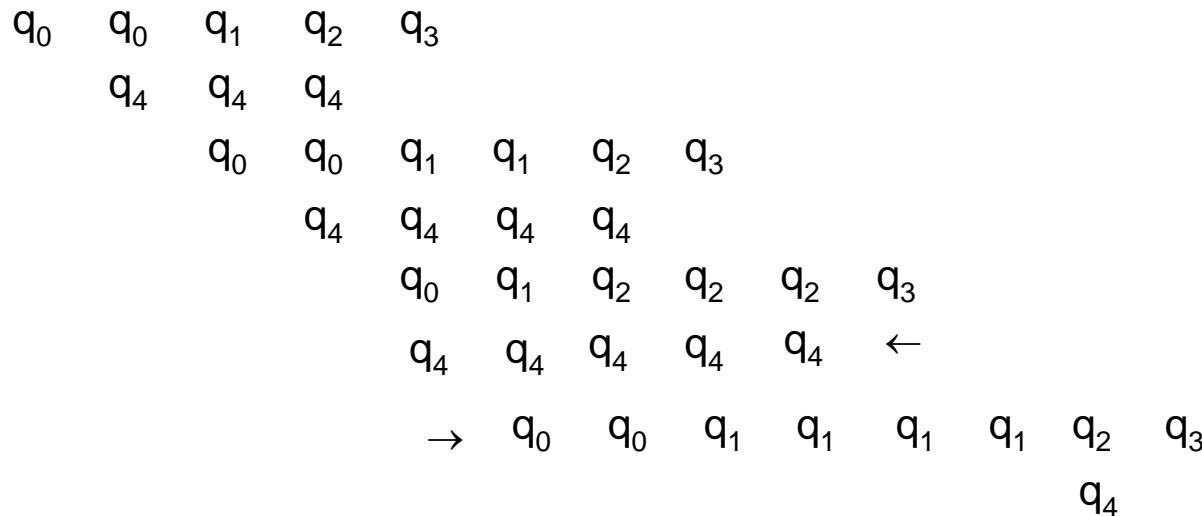
q₄ q₄ q₄ q₄ ←

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	1	1	\$	1	1	B	B	B	B	B	B
B	*	B	*	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B



Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	1	1	\$	1	1	B	B	B	B	B	B
B	*	B	*	*	B	*	B	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

q₀ q₁ q₂ q₂ q₂ q₃

q₄ q₄ q₄ q₄ q₄ ←

→ q₀ q₀ q₁ q₁ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄ q₄ q₄ ←

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	1	1	\$	1	1	1	B	B	B	B
B	*	B	*	*	B	*	*	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

q₀ q₁ q₂ q₂ q₂ q₃

q₄ q₄ q₄ q₄ q₄ ←

→ q₀ q₀ q₁ q₁ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄ q₄ q₄ ←

→ q₀ q₁ q₁ q₁ q₂ q₂ q₃

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R		q ₀ , [\$, B], R	
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R		
q ₃		q ₄ , [1, B], L		
q ₄	q ₄ , [1, B], L		q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	1	1	\$	1	1	1	B	B	B	B
B	*	B	*	*	B	*	*	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

q₀ q₁ q₂ q₂ q₂ q₃

q₄ q₄ q₄ q₄ q₄ ←

→ q₀ q₀ q₁ q₁ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄ q₄ q₄ ←

→ q₀ q₁ q₁ q₁ q₂ q₂ q₃

... ←

Task 28

Construction of TM:

	[1, B]	[B, B]	[\$, B]	[1, *]
q ₀	q ₁ , [1, *], R	-	q ₀ , [\$, B], R	-
q ₁	q ₁ , [1, B], R	q ₂ , [\$, B], R	q ₂ , [\$, B], R	-
q ₂	q ₂ , [1, B], R	q ₃ , [1, B], R	-	-
q ₃	-	q ₄ , [1, B], L	-	-
q ₄	q ₄ , [1, B], L	-	q ₄ , [\$, B], L	q ₀ , [1, *], R

\$	1	\$	1	1	\$	1	1	1	1	\$	1	1	1	1	B	B	B	B
B	*	B	*	*	B	*	*	B	B	B	B	B	B	B	B	B	B	B



q₀ q₀ q₁ q₂ q₃

q₄ q₄ q₄

q₀ q₀ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄

q₀ q₁ q₂ q₂ q₂ q₃

q₄ q₄ q₄ q₄ q₄ ←

→ q₀ q₀ q₁ q₁ q₁ q₁ q₂ q₃

q₄ q₄ q₄ q₄ q₄ q₄ ←

→ q₀ q₁ q₁ q₁ q₂ q₂ q₂ q₃

... ←

Task 28

Turing machine:

	[1, B]	[B, B]	[\$, B]	[1, *]
q_0	$q_1, [1, *], R$	-	$q_0, [\$, B], R$	-
q_1	$q_1, [1, B], R$	$q_2, [\$, B], R$	$q_2, [\$, B], R$	-
q_2	$q_2, [1, B], R$	$q_3, [1, B], R$	-	-
q_3	-	$q_4, [1, B], L$	-	-
q_4	$q_4, [1, B], L$	-	$q_4, [\$, B], L$	$q_0, [1, *], R$

Task 29

Construct Turing machine that accepts sequences from language L. After the Turing machine is finished, the state of the tape must be equal to the initial state. There are blank spaces on both sides of the input sequence.

$$L = \{w \in (a+b+c)^* \mid n_a = n_b = n_c\}$$





P	a	a	b	c	c	b	a	c	b	P
---	---	---	---	---	---	---	---	---	---	---



P	a	a	b	c	c	b	a	c	b	P
---	---	---	---	---	---	---	---	---	---	---

	a	b	c	A	B	C	P
q0							
qa							
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							





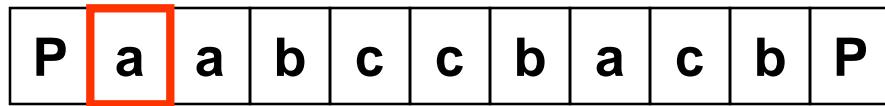
P	a	a	b	c	c	b	a	c	b	P
---	---	---	---	---	---	---	---	---	---	---

Acceptable sequence

	a	b	c	A	B	C	P
q0							
qa							
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							



q0

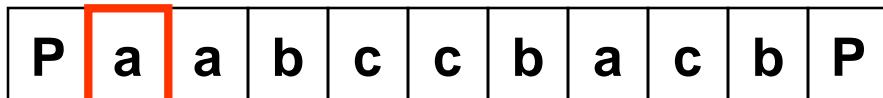


Acceptable sequence

	a	b	c	A	B	C	P
q0							
qa							
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							



q0

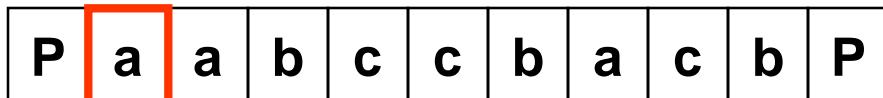


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa							
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							



q0

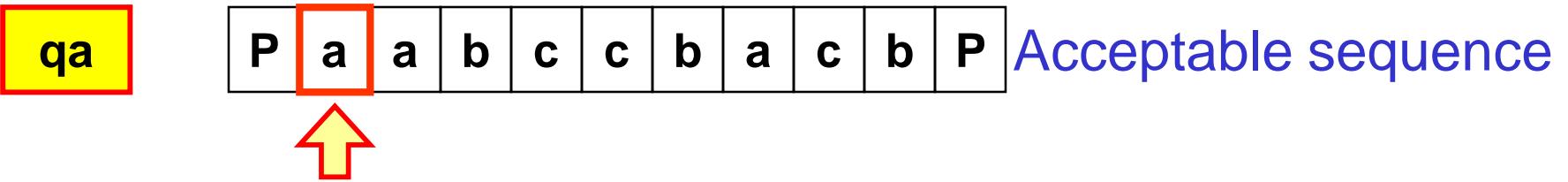


Acceptable sequence



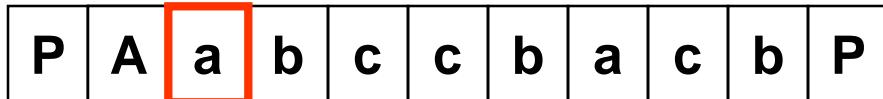
	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa							
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							





	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa							
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							

qa

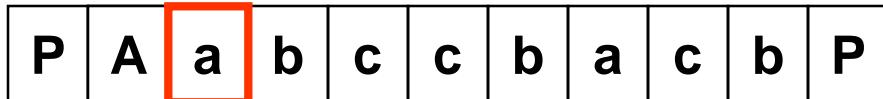


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa							
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							



qa

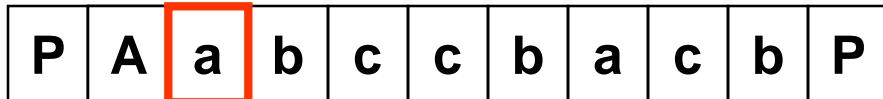


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							



qa

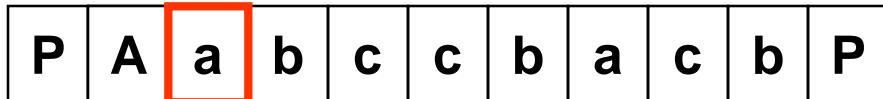


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							



qa



Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							



qa

P A a b c c b a c b P



Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							



qa

P A a b c c b a c b P

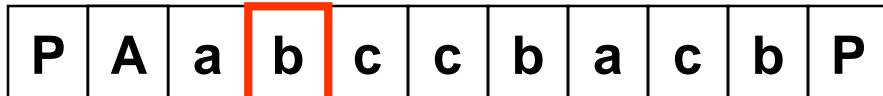


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							



qab



Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							



qab



Acceptable sequence



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab							
qV							
qOC							
qPC							



qab



Acceptable sequence



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV							
qOC							
qPC							

qab



Acceptable sequence



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV							
qOC							
qPC							

qV

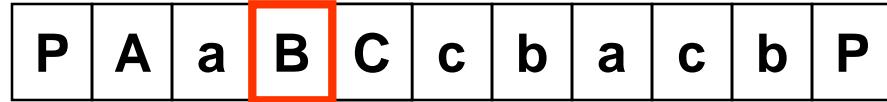


Acceptable sequence



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV							
qOC							
qPC							

qV

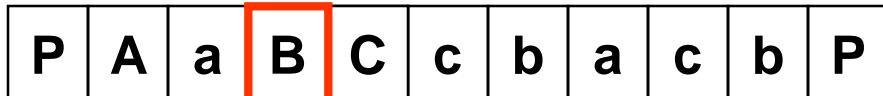


Acceptable sequence



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV							
qOC							
qPC							

qV



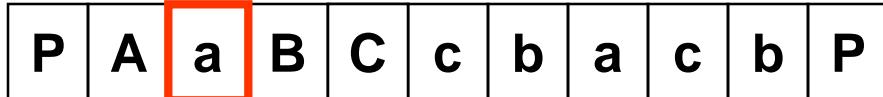
Acceptable sequence



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



qV

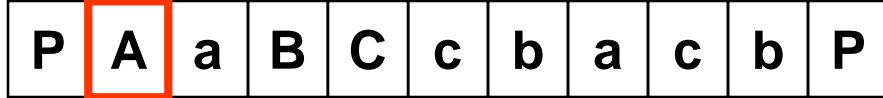


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



qV



Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



qV

P	A	a	B	C	c	b	a	c	b	P
---	---	---	---	---	---	---	---	---	---	---



Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

P A a B C c b a c b P

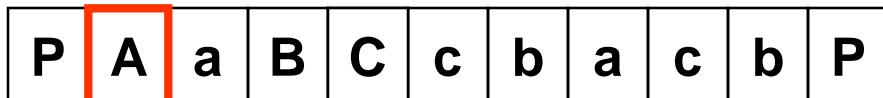


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

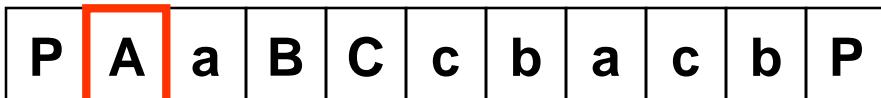


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

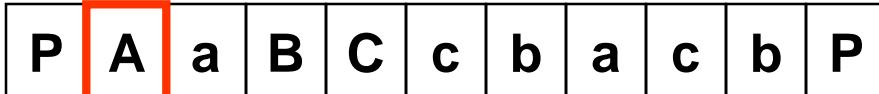


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R				
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

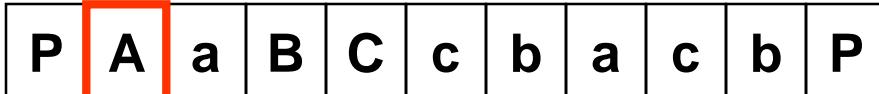


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R				
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

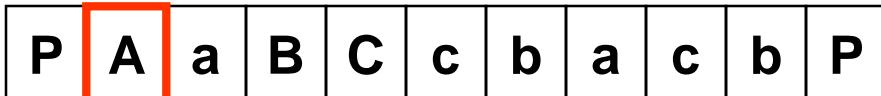


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb							
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

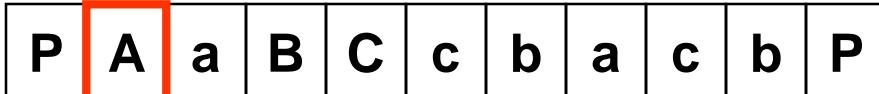


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R				
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

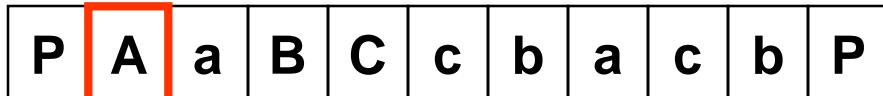


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc							
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

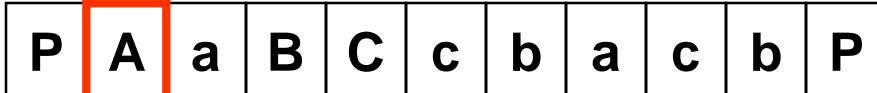


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R				
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

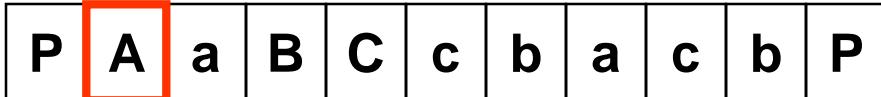


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc							
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



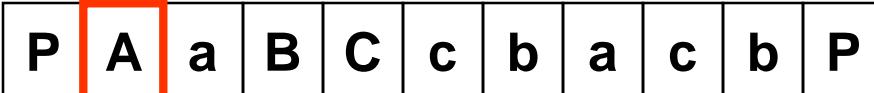
q0



Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R				
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							

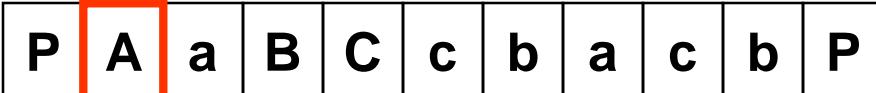


q0

Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac							
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



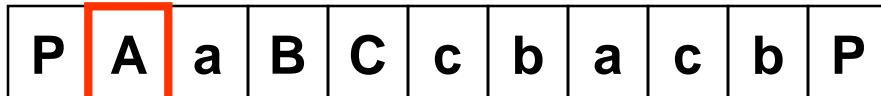
q0

Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R				
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

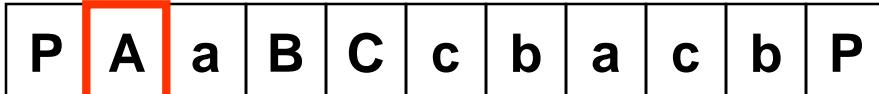


Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L				
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0



Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



qac



Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



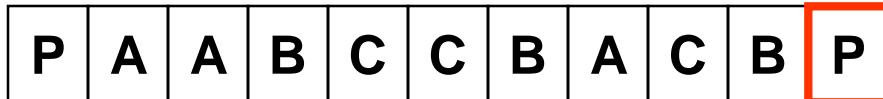
qV

P	A	A	B	C	C	B	a	c	b	P
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Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							

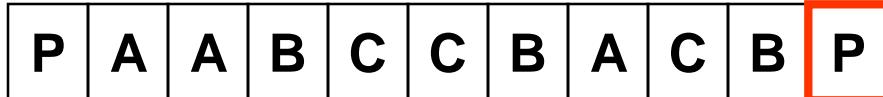


q0

Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							

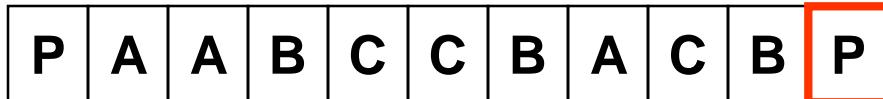


q0

Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC							



q0

Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC				qPC, a, L	qPC, b, L	qPC, c, L	



qPC

P	a	a	b	c	c	b	a	c	b	P
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Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	



qPC

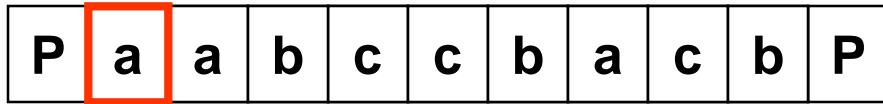
P	a	a	b	c	c	b	a	c	b	P
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Acceptable sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R

qP



Acceptable sequence

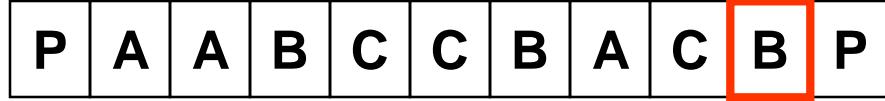
	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R



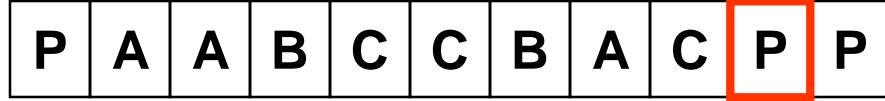


P	A	A	B	C	C	B	A	C	B	P
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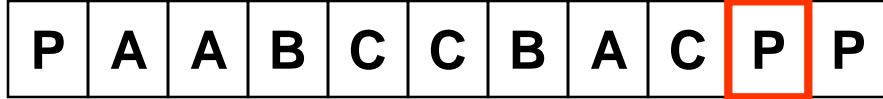
	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R



Unacceptable
sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R





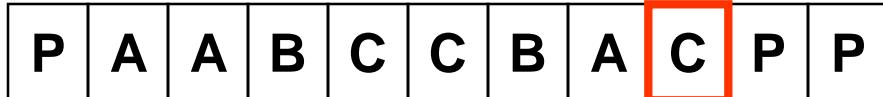
P	A	A	B	C	C	B	A	C	P	P
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Unacceptable
sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R



qac



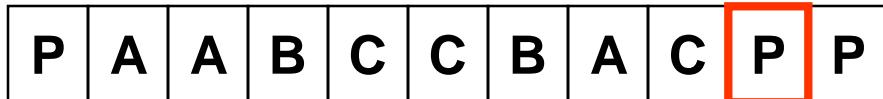
	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R

qac



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R

qac



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	qOC, P, L
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	qOC, P, L
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	qOC, P, L
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	qOC, P, L
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	qOC, P, L
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	qOC, P, L
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R



qac



Unacceptable
sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	qOC, P, L
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	qOC, P, L
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	qOC, P, L
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	qOC, P, L
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	qOC, P, L
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	qOC, P, L
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R



qOC

Unacceptable
sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	qOC, P, L
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	qOC, P, L
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	qOC, P, L
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	qOC, P, L
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	qOC, P, L
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	qOC, P, L
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC							
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R

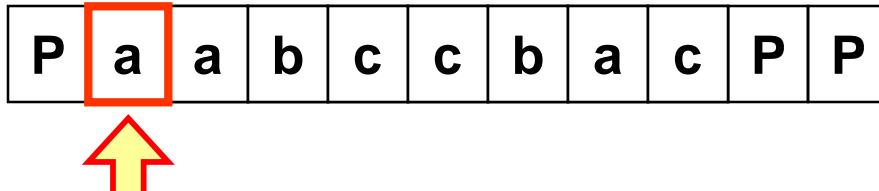


qOC

Unacceptable
sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	qOC, P, L
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	qOC, P, L
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	qOC, P, L
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	qOC, P, L
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	qOC, P, L
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	qOC, P, L
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC	qOC, a, L	qOC, b, L	qOC, c, L	qOC, a, L	qOC, b, L	qOC, c, L	
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R



qOC

Unacceptable
sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	qOC, P, L
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	qOC, P, L
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	qOC, P, L
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	qOC, P, L
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	qOC, P, L
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	qOC, P, L
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC	qOC, a, L	qOC, b, L	qOC, c, L	qOC, a, L	qOC, b, L	qOC, c, L	
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R



qOC

P a a b c c b a c P P



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	qOC, P, L
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	qOC, P, L
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	qOC, P, L
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	qOC, P, L
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	qOC, P, L
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	qOC, P, L
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC	qOC, a, L	qOC, b, L	qOC, c, L	qOC, a, L	qOC, b, L	qOC, c, L	
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R

qOC

P a a b c c b a c P P



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	qOC, P, L
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	qOC, P, L
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	qOC, P, L
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	qOC, P, L
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	qOC, P, L
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	qOC, P, L
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC	qOC, a, L	qOC, b, L	qOC, c, L	qOC, a, L	qOC, b, L	qOC, c, L	-
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R

qOC

P a a b c c b a c P P

X



	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	qOC, P, L
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	qOC, P, L
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	qOC, P, L
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	qOC, P, L
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	qOC, P, L
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	qOC, P, L
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC	qOC, a, L	qOC, b, L	qOC, c, L	qOC, a, L	qOC, b, L	qOC, c, L	-
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R

qOC

P	a	a	b	c	c	b	a	c	P	P
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Unacceptable
sequence

	a	b	c	A	B	C	P
q0	qa, A, R	qb, B, R	qc, C, R	q0, A, R	q0, B, R	q0, C, R	qPC, P, L
qa	qa, a, R	qab, B, R	qac, C, R	qa, A, R	qa, B, R	qa, C, R	qOC, P, L
qb	qab, A, R	qb, b, R	qbc, C, R	qb, A, R	qb, B, R	qb, C, R	qOC, P, L
qc	qac, A, R	qbc, B, R	qc, c, R	qc, A, R	qc, B, R	qc, C, R	qOC, P, L
qbc	qV, A, L	qbc, b, R	qbc, c, R	qbc, A, R	qbc, B, R	qbc, C, R	qOC, P, L
qac	qac, a, R	qV, B, L	qac, c, R	qac, A, R	qac, B, R	qac, C, R	qOC, P, L
qab	qab, a, R	qab, b, R	qV, C, L	qab, A, R	qab, B, R	qab, C, R	qOC, P, L
qV	qV, a, L	qV, b, L	qV, c, L	qV, A, L	qV, B, L	qV, C, L	q0, P, R
qOC	qOC, a, L	qOC, b, L	qOC, c, L	qOC, a, L	qOC, b, L	qOC, c, L	-
qPC	-	-	-	qPC, a, L	qPC, b, L	qPC, c, L	qP, P, R



Task 30

- **Construct grammar that generates sequences from language L.**

Task 30

- Construct grammar that generates sequences from language L.

$$L = \{w \in (a+b+c)^* \mid n_a \neq n_b, n_a \neq n_c, n_b \neq n_c\}$$

Task 30

- **produce the same number of A B and C**

Task 30

- produce the same number of A B and C

$S \rightarrow ABCS$

$A \rightarrow a$

$B \rightarrow b$

$C \rightarrow c$

Task 30

- **remove one symbol**

$S \rightarrow ABCS$

$A \rightarrow a$

$B \rightarrow b$

$C \rightarrow c$

Task 30

- remove one symbol

$S \rightarrow ABCS$

$S \rightarrow ABT$

$A \rightarrow a$

$B \rightarrow b$

$C \rightarrow c$

Task 30

- remove one symbol

$S \rightarrow ABCS$

$T \rightarrow ABT$

$S \rightarrow ABT$

$A \rightarrow a$

$B \rightarrow b$

$C \rightarrow c$

Task 30

- remove one symbol

$S \rightarrow ABCS$

$T \rightarrow ABT$

$A \rightarrow a$

$S \rightarrow ABT$

$B \rightarrow b$

$S \rightarrow ACU$

$C \rightarrow c$

$S \rightarrow BCV$

$U \rightarrow ACU$

$V \rightarrow BCV$



Task 30

- remove second symbol

$S \rightarrow ABCS$

$T \rightarrow ABT$

$A \rightarrow a$

$S \rightarrow ABT$

$B \rightarrow b$

$S \rightarrow ACU$

$C \rightarrow c$

$S \rightarrow BCV$

$U \rightarrow ACU$

$V \rightarrow BCV$



Task 30

- remove second symbol

$S \rightarrow ABCS$

$T \rightarrow ABT$

$A \rightarrow a$

$S \rightarrow ABT$

$T \rightarrow AX$

$B \rightarrow b$

$S \rightarrow ACU$

$U \rightarrow ACU$

$C \rightarrow c$

$S \rightarrow BCV$

$V \rightarrow BCV$



Task 30

- remove second symbol

$S \rightarrow ABCS$

$T \rightarrow ABT$

$X \rightarrow AX$

$A \rightarrow a$

$S \rightarrow ABT$

$T \rightarrow AX$

$B \rightarrow b$

$S \rightarrow ACU$

$C \rightarrow c$

$S \rightarrow BCV$

$U \rightarrow ACU$

$V \rightarrow BCV$

Task 30

- remove second symbol

$S \rightarrow ABCS$

$T \rightarrow ABT$

$X \rightarrow AX$

$A \rightarrow a$

$S \rightarrow ABT$

$T \rightarrow AX$

$X \rightarrow \epsilon$

$B \rightarrow b$

$S \rightarrow ACU$

$C \rightarrow c$

$S \rightarrow BCV$

$U \rightarrow ACU$

$V \rightarrow BCV$

Task 30

- remove second symbol

$S \rightarrow ABCS$

$T \rightarrow ABT$

$X \rightarrow AX$

$A \rightarrow a$

$S \rightarrow ABT$

$T \rightarrow AX$

$X \rightarrow \epsilon$

$B \rightarrow b$

$S \rightarrow ACU$

$T \rightarrow BY$

$Y \rightarrow BY$

$C \rightarrow c$

$S \rightarrow BCV$

$U \rightarrow ACU$

$Y \rightarrow \epsilon$

$V \rightarrow BCV$



Task 30

- remove second symbol

$S \rightarrow ABCS$

$T \rightarrow ABT$

$X \rightarrow AX$

$A \rightarrow a$

$S \rightarrow ABT$

$T \rightarrow AX$

$X \rightarrow \epsilon$

$B \rightarrow b$

$S \rightarrow ACU$

$T \rightarrow BY$

$Y \rightarrow BY$

$C \rightarrow c$

$S \rightarrow BCV$

$U \rightarrow ACU$

$Y \rightarrow \epsilon$

$U \rightarrow AX$

$V \rightarrow BCV$

Task 30

- remove second symbol

$S \rightarrow ABCS$

$T \rightarrow ABT$

$X \rightarrow AX$

$A \rightarrow a$

$S \rightarrow ABT$

$T \rightarrow AX$

$X \rightarrow \epsilon$

$B \rightarrow b$

$S \rightarrow ACU$

$T \rightarrow BY$

$Y \rightarrow BY$

$C \rightarrow c$

$S \rightarrow BCV$

$U \rightarrow ACU$

$Y \rightarrow \epsilon$

$U \rightarrow AX$

$U \rightarrow CZ$

$V \rightarrow BCV$



Task 30

- remove second symbol

$S \rightarrow ABCS$

$T \rightarrow ABT$

$X \rightarrow AX$

$A \rightarrow a$

$S \rightarrow ABT$

$T \rightarrow AX$

$X \rightarrow \epsilon$

$B \rightarrow b$

$S \rightarrow ACU$

$T \rightarrow BY$

$Y \rightarrow BY$

$C \rightarrow c$

$S \rightarrow BCV$

$U \rightarrow ACU$

$Y \rightarrow \epsilon$

$U \rightarrow AX$

$Z \rightarrow CZ$

$U \rightarrow CZ$

$Z \rightarrow \epsilon$

$V \rightarrow BCV$



Task 30

- remove second symbol

$S \rightarrow ABCS$

$T \rightarrow ABT$

$X \rightarrow AX$

$A \rightarrow a$

$S \rightarrow ABT$

$T \rightarrow AX$

$X \rightarrow \epsilon$

$B \rightarrow b$

$S \rightarrow ACU$

$T \rightarrow BY$

$Y \rightarrow BY$

$C \rightarrow c$

$S \rightarrow BCV$

$U \rightarrow ACU$

$Y \rightarrow \epsilon$

$U \rightarrow AX$

$Z \rightarrow CZ$

$U \rightarrow CZ$

$Z \rightarrow \epsilon$

$V \rightarrow BCV$

$V \rightarrow BY$

$V \rightarrow CZ$



Task 30

- adding symbol permutations

$S \rightarrow ABCS$

$T \rightarrow ABT$

$X \rightarrow AX$

$A \rightarrow a$

$S \rightarrow ABT$

$T \rightarrow AX$

$X \rightarrow \epsilon$

$B \rightarrow b$

$S \rightarrow ACU$

$T \rightarrow BY$

$Y \rightarrow BY$

$C \rightarrow c$

$S \rightarrow BCV$

$U \rightarrow ACU$

$Y \rightarrow \epsilon$

$U \rightarrow AX$

$Z \rightarrow CZ$

$U \rightarrow CZ$

$Z \rightarrow \epsilon$

$V \rightarrow BCV$

$V \rightarrow BY$

$V \rightarrow CZ$



Task 30

- adding symbol permutations

$S \rightarrow ABCS$

$S \rightarrow ABT$

$S \rightarrow ACU$

$S \rightarrow BCV$

$T \rightarrow ABT$

$T \rightarrow AX$

$T \rightarrow BY$

$U \rightarrow ACU$

$U \rightarrow AX$

$U \rightarrow CZ$

$V \rightarrow BCV$

$V \rightarrow BY$

$V \rightarrow CZ$

$X \rightarrow AX$

$X \rightarrow \epsilon$

$Y \rightarrow BY$

$Y \rightarrow \epsilon$

$Z \rightarrow CZ$

$Z \rightarrow \epsilon$

$AB \rightarrow BA$

$AC \rightarrow CA$

$BC \rightarrow CB$

$BA \rightarrow AB$

$CA \rightarrow AC$

$CB \rightarrow BC$

$A \rightarrow a$

$B \rightarrow b$

$C \rightarrow c$

