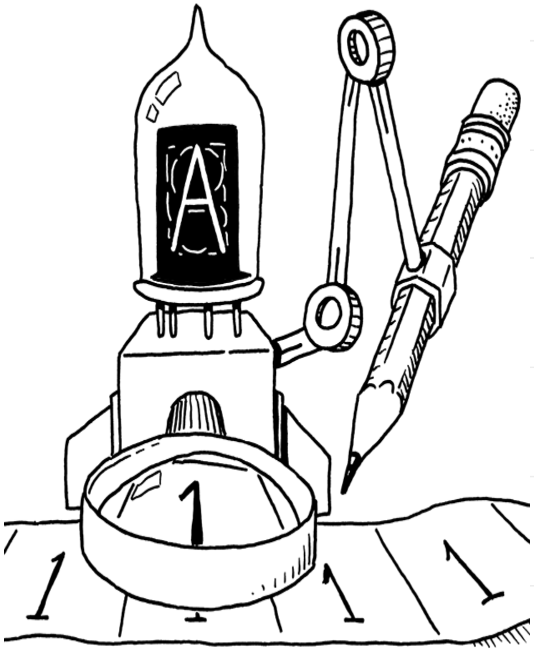
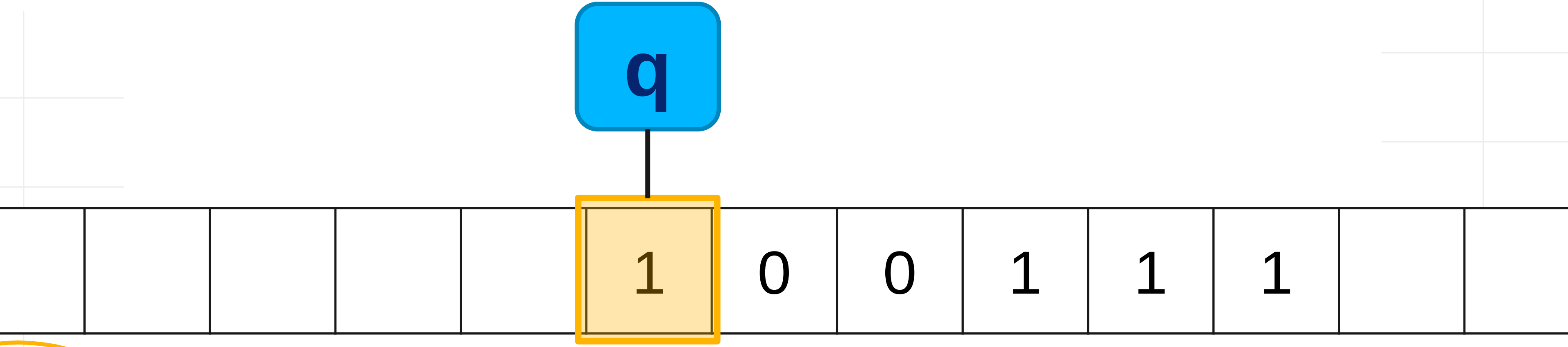
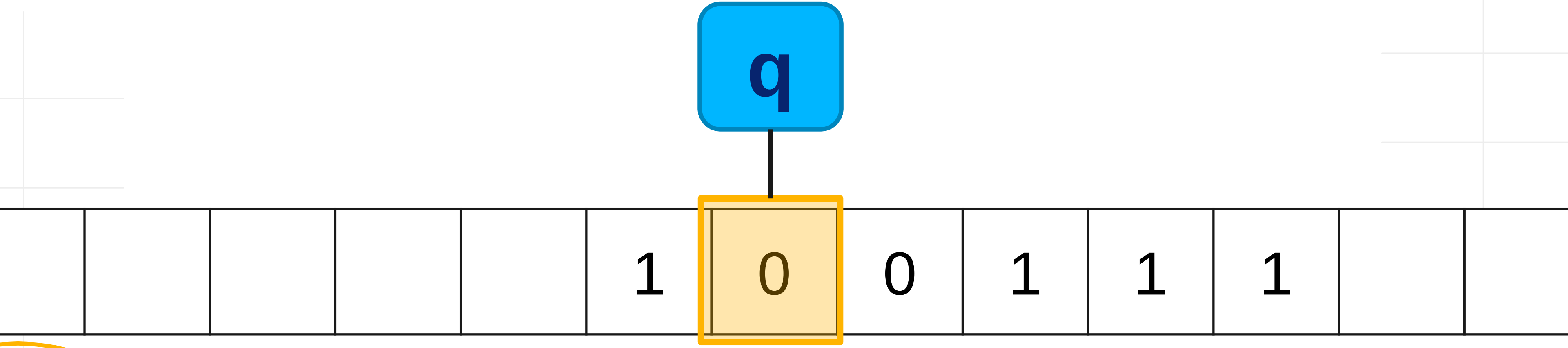


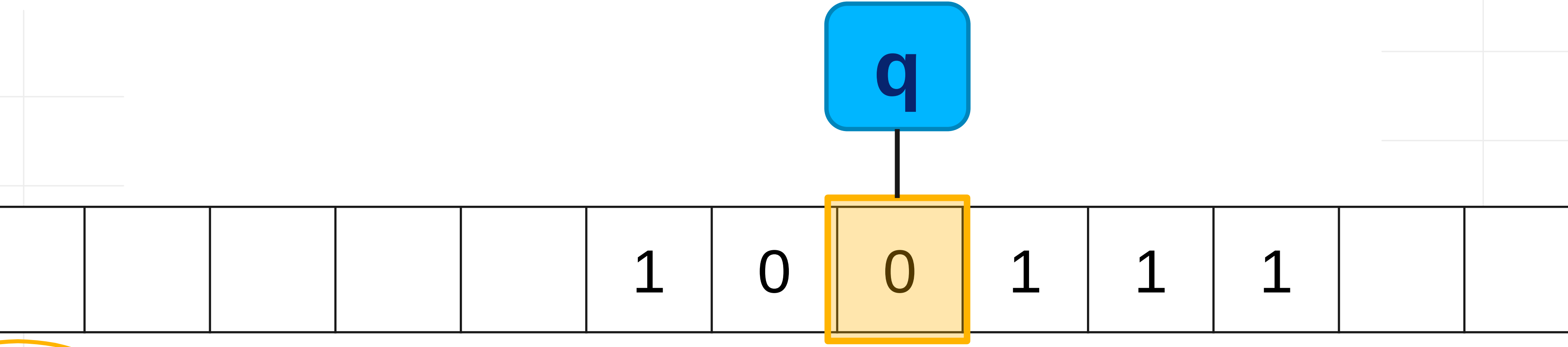
The Turing Machine

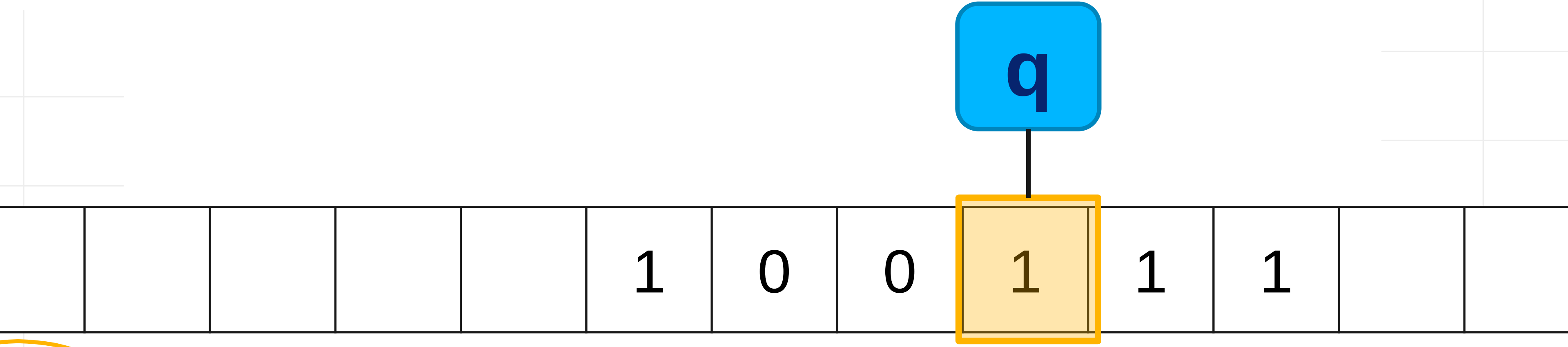
Analiza Algoritmilor

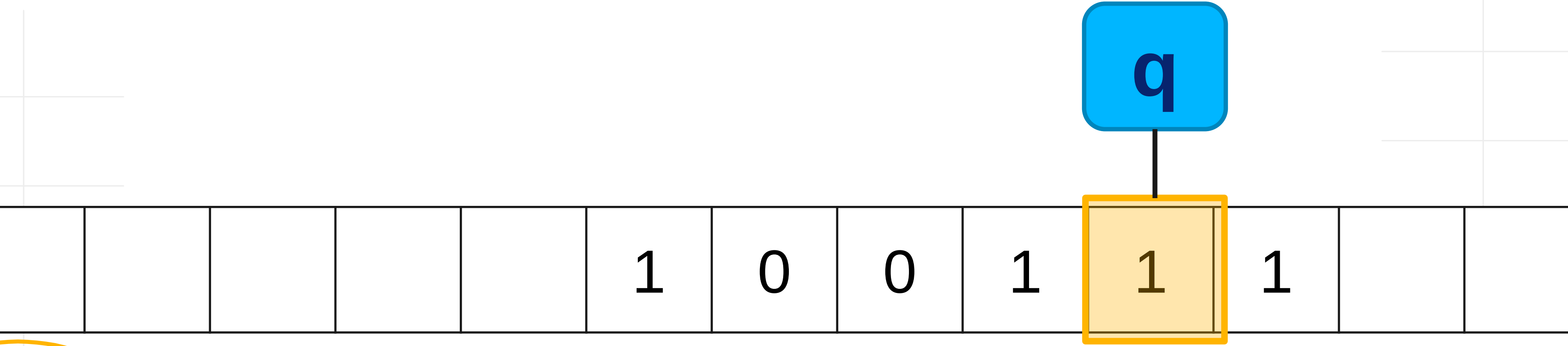
					1	0	0	1	1	1		

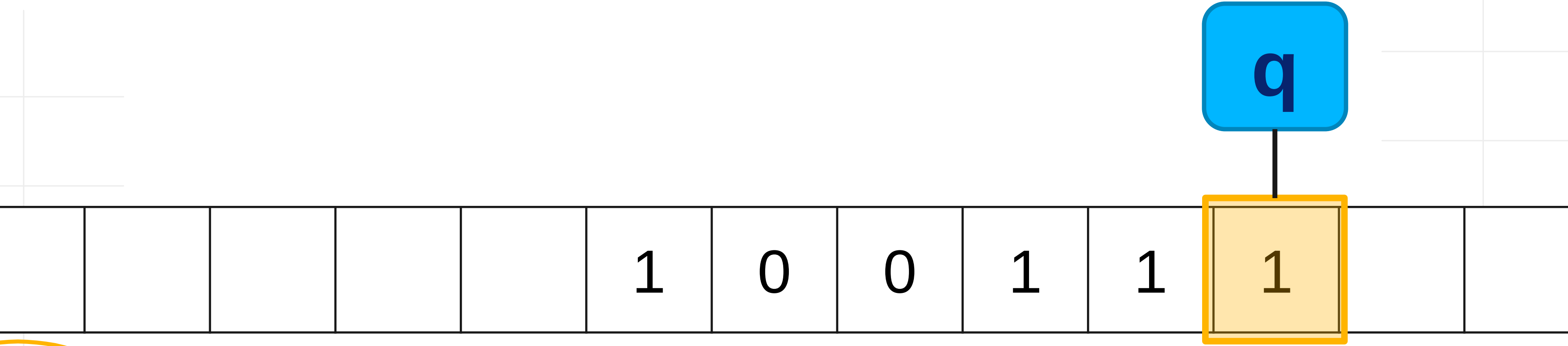

q
1
0
0
1
1
1


q
1 0 0 1 1 1

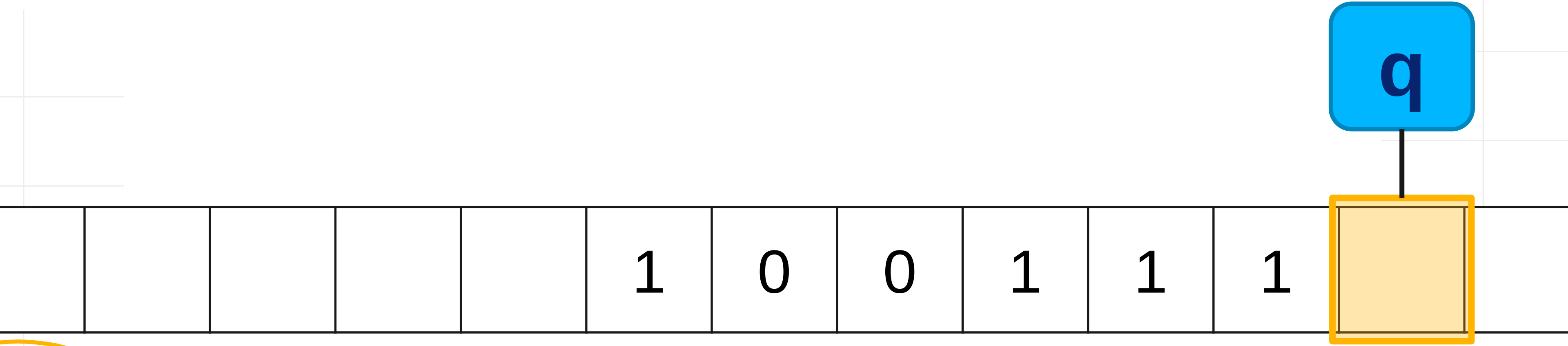

q
1 0 0 1 1 1

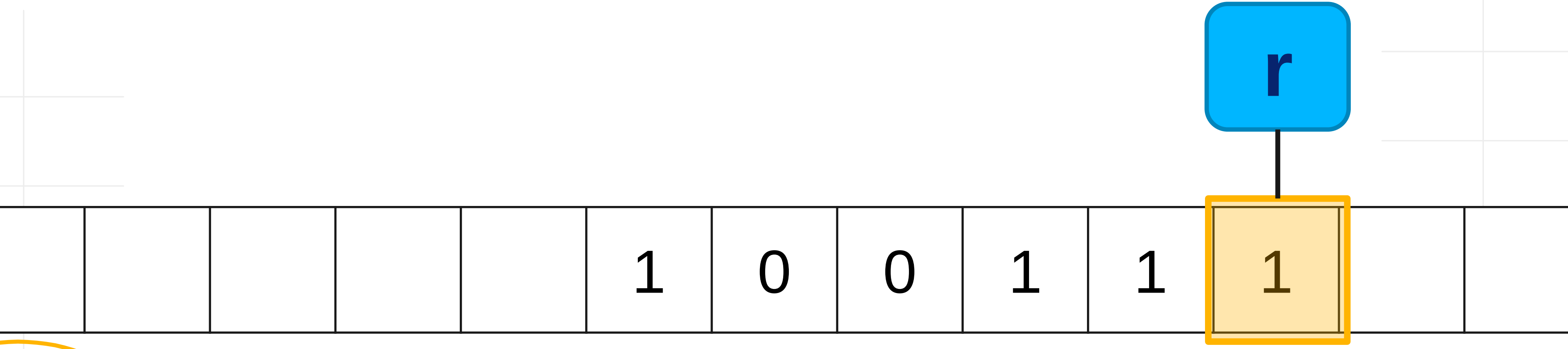

q
1 0 0 1 1 1

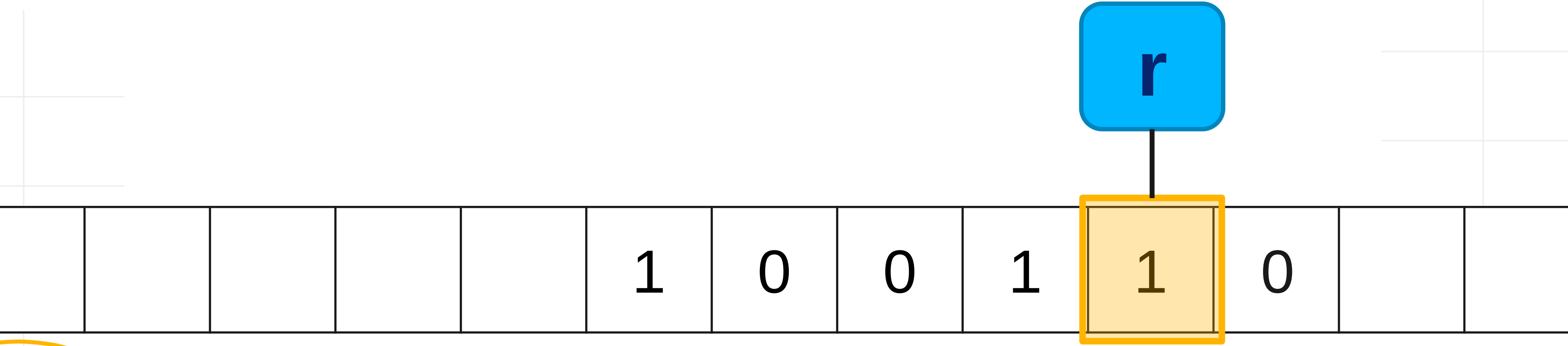

q
1
0
0
1
1
1

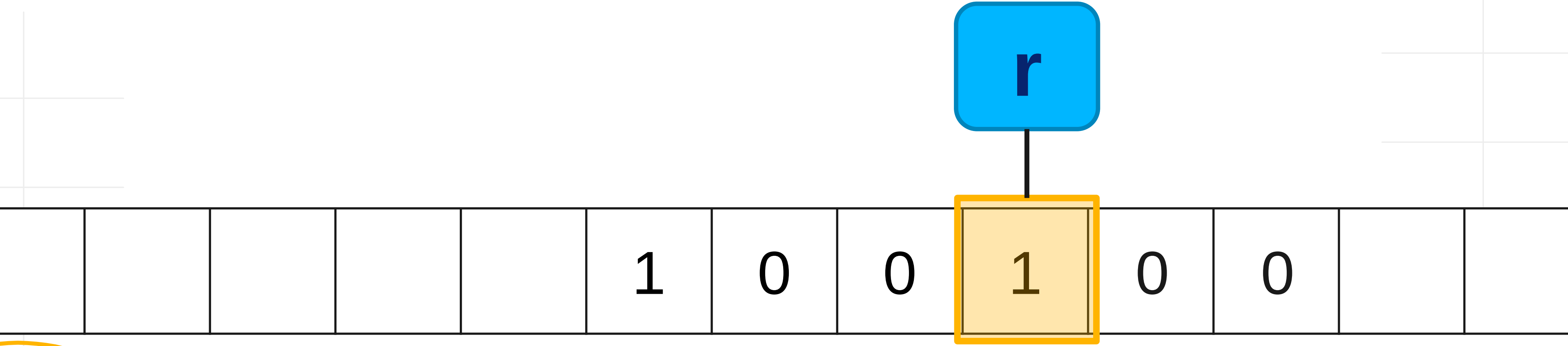


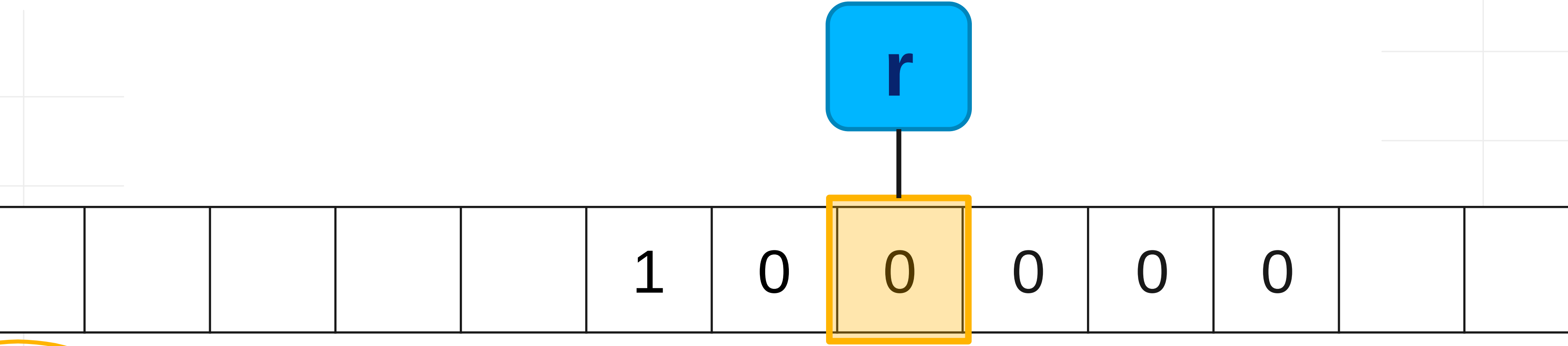
q
1
0
0
1
1
1

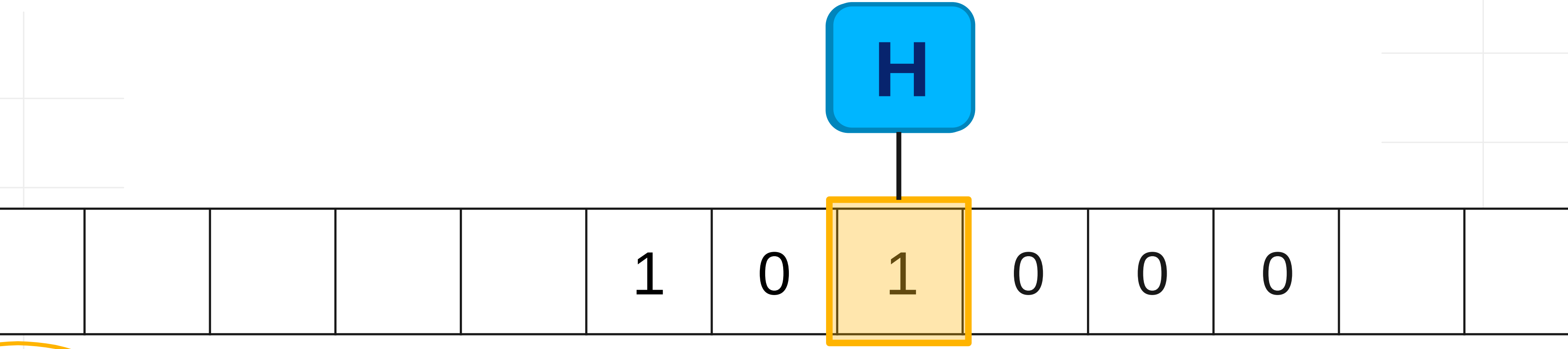

q
1
0
0
1
1
1


r
1 0 0 1 1 1


r
1
0
0
1
1
0


r
1 0 0 1 0 0


r
1
0
0
0
0
0


H
1
0
1
0
0
0

Formal definition

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

Formal definition

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

Finite **set of states** the machine “can be in”

Formal definition

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

Finite set of *symbols* – the **“input alphabet”**

Formal definition

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

Finite set of *symbols* – the **“tape alphabet”**

Formal definition

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

The “blank” symbol

Formal definition

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

Initial state

Formal definition

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

The transition function

$$\delta : Q \times \Gamma \rightarrow Q' \times \Gamma \times \{\leftarrow, -, \rightarrow\}$$

Formal definition

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

The transition function

$$\delta: Q \times \Gamma \rightarrow (Q \cup \{Y, N, H\}) \times \Gamma \times \{\leftarrow, -, \rightarrow\}$$

Checking if a number is even

	0	1	□
q_1			
q_2			

Checking if a number is even

	0	1	$\square$
q_1	$q_1, 0, \rightarrow$	$q_1, 1, \rightarrow$	$q_2, \square, \leftarrow$
q_2	$Y, 0, -$	$N, 1, -$	$N, \square, -$

Using states as memory

	0	1	$\square$
start	$\text{mem}_0, 0, \rightarrow$	$\text{mem}_1, 1, \rightarrow$	$\text{Y}, \square, -$
$\mathbf{mem_0}$	$\text{mem}_0, 0, \rightarrow$	$\text{mem}_0, 1, \rightarrow$	$\text{expect}_0, \square, \leftarrow$
$\mathbf{mem_1}$	$\text{mem}_1, 0, \rightarrow$	$\text{mem}_1, 1, \rightarrow$	$\text{expect}_1, \square, \leftarrow$
$\mathbf{expect_0}$	$Y, 0, -$	$N, 1, -$	$N, \square, -$
$\mathbf{expect_1}$	$N, 0, -$	$Y, 1, -$	$N, \square, -$

Incrementing a number

	0	**1**	$\square$
$\boldsymbol{q_1}$	$q_1, 0, \rightarrow$	$q_1, 1, \rightarrow$	$q_2, \square, \leftarrow$
$\boldsymbol{q_2}$	$\mathrm{H}, 1, -$	$\mathrm{q}_2, 0, \leftarrow$	$\mathrm{H}, 1, -$

Checking for palindromes

	0	**1**	**$\square$**
start	$\mathrm{mem}_0, \square, \rightarrow$	$\mathrm{mem}_1, \square, \rightarrow$	$\mathrm{Y}, \square, -$
$\mathbf{mem}_0$	$\mathrm{mem}_0, 0, \rightarrow$	$\mathrm{mem}_0, 1, \rightarrow$	$\mathrm{expect}_0, \square, \leftarrow$
$\mathbf{mem}_1$	$\mathrm{mem}_1, 0, \rightarrow$	$\mathrm{mem}_1, 1, \rightarrow$	$\mathrm{expect}_1, \square, \leftarrow$
$\mathbf{expect}_0$	$reset, \square, -$	$N, 1, -$	$Y, \square, -$
$\mathbf{expect}_1$	$N, 0, -$	$reset, 1, -$	$Y, \square, -$
reset	$reset, 0, \leftarrow$	$reset, 1, \leftarrow$	$start, \square, \rightarrow$

Same number of 0s and 1s

	0	1	$\square$	X
start	$find_1, \mathrm{X}, \rightarrow$	$find_0, \mathrm{X}, \rightarrow$	$\mathrm{Y}, \square, -$	$\mathrm{start}, \mathrm{X}, \rightarrow$
$\boldsymbol{find_0}$	$reset, \mathrm{X}, \leftarrow$	$find_0, 1, \rightarrow$	$N, \square, -$	$find_0, \mathrm{X}, \rightarrow$
$\boldsymbol{find_1}$	$find_1, 0, \rightarrow$	$reset, 1, \leftarrow$	$N, \square, -$	$find_1, \mathrm{X}, \rightarrow$
$\boldsymbol{reset}$	$reset, 0, \leftarrow$	$reset, 1, \leftarrow$	$start, \square, \rightarrow$	$reset, X, \leftarrow$