Lecture 4

Examples of TMs and Computers vs Turing machines

Turing Machine for Parity

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Example: Construct a TM for *PARITY* = $\{x \mid x$ is a binary string with odd number of $1\text{s}\}$

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Solution:

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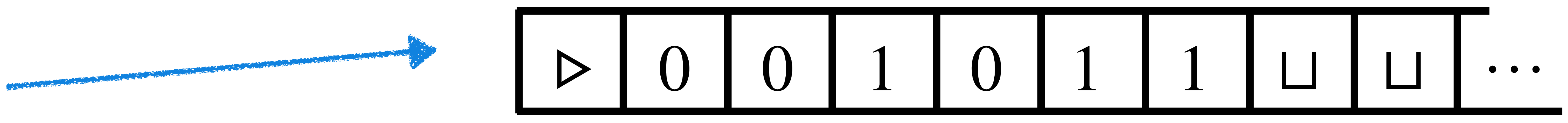

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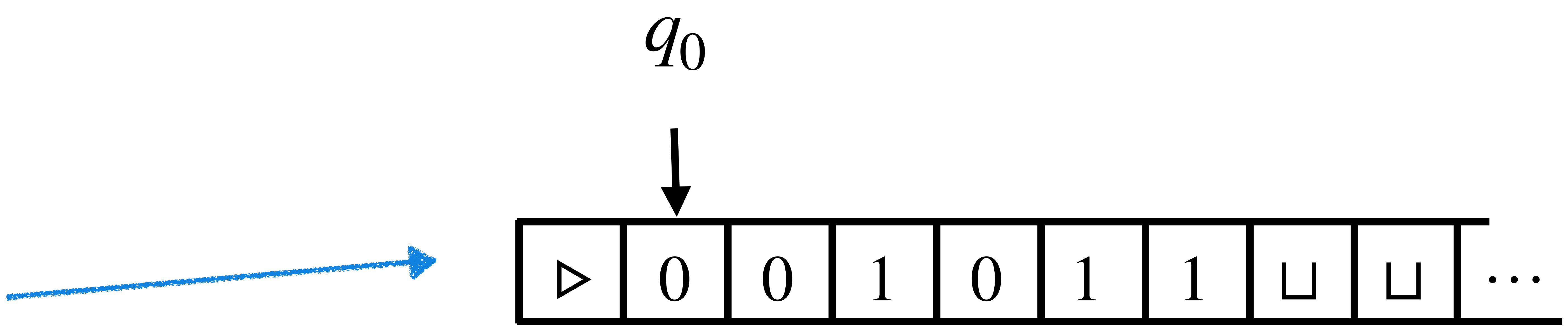

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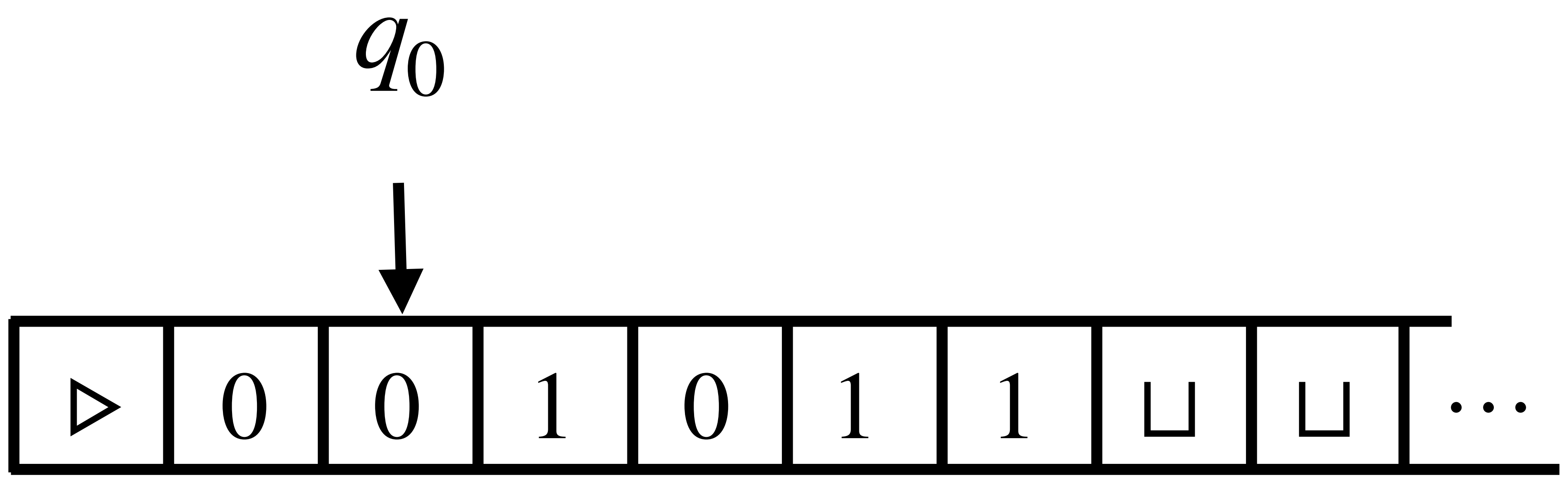

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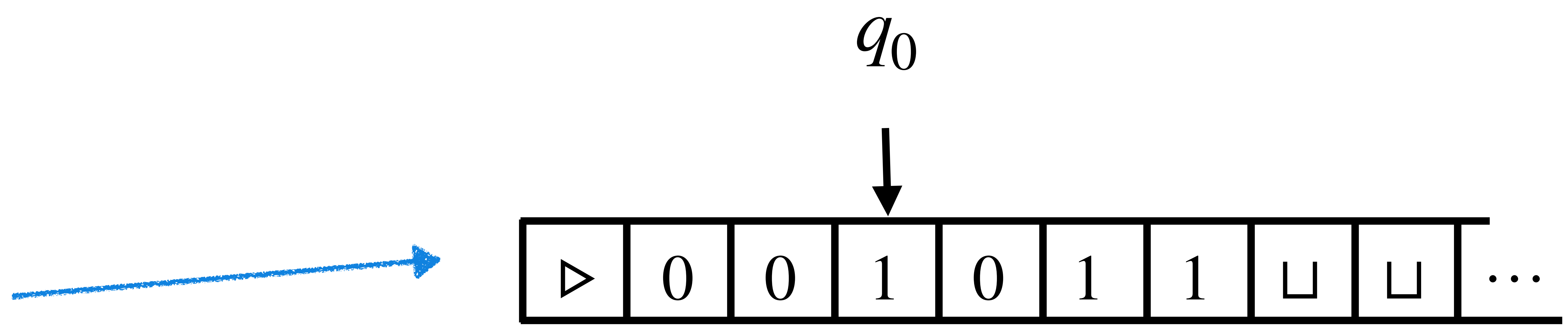

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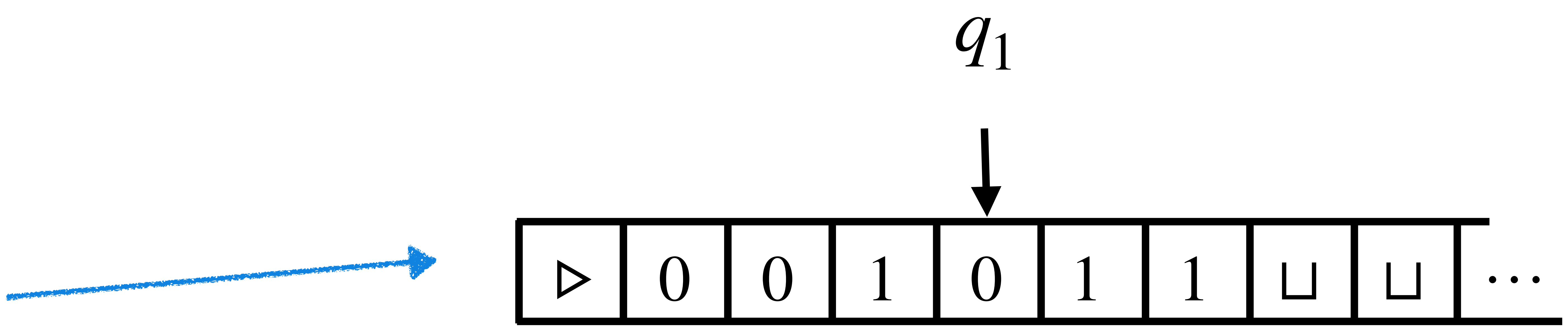

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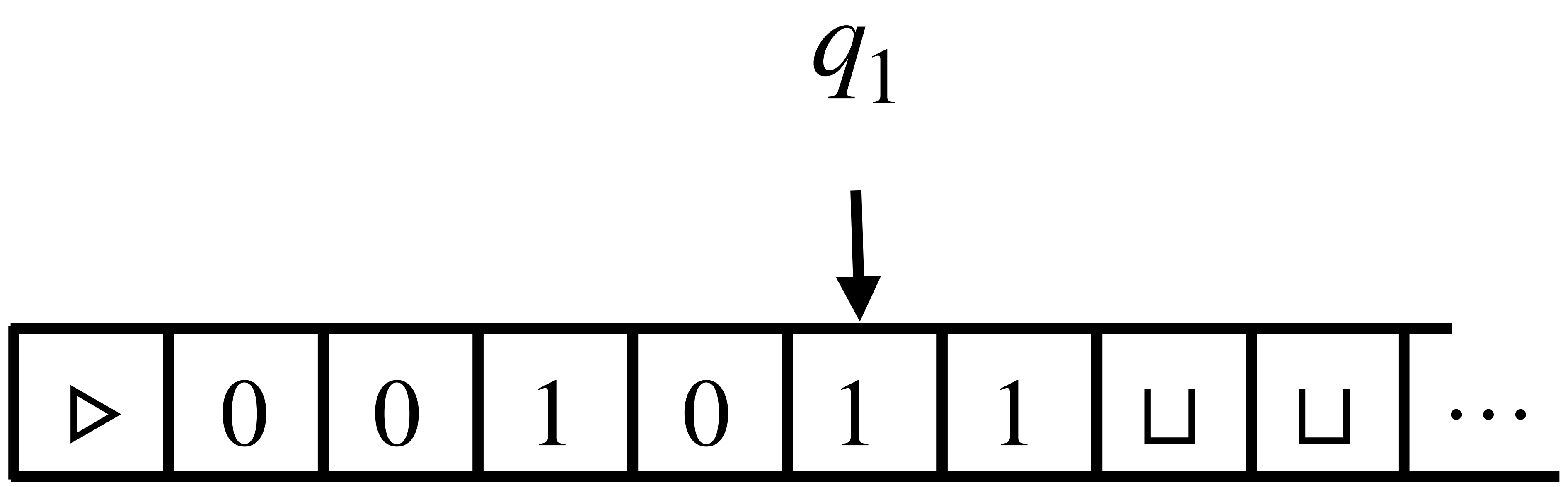

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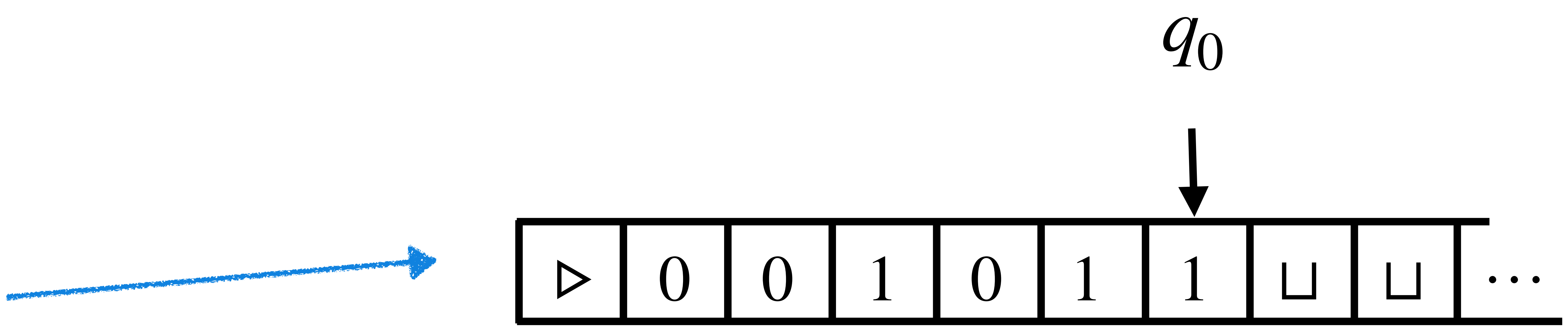

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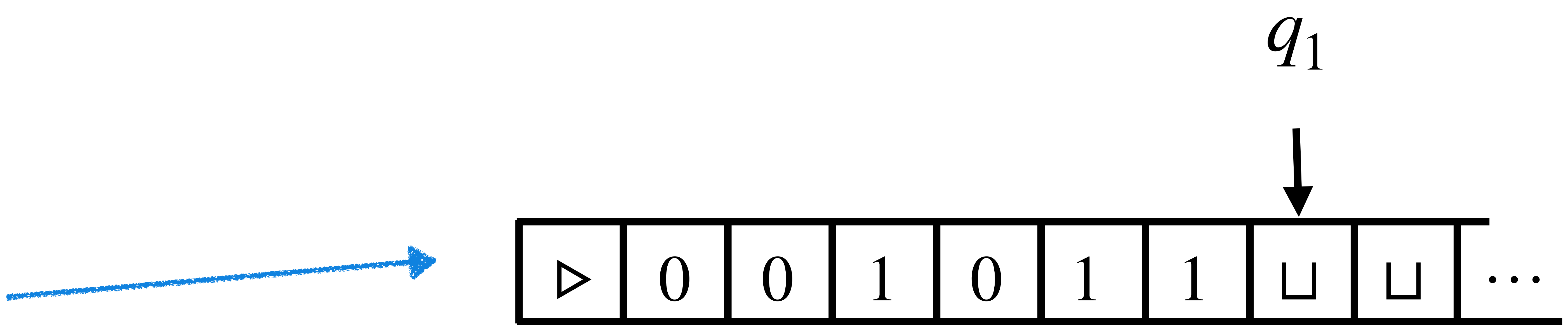

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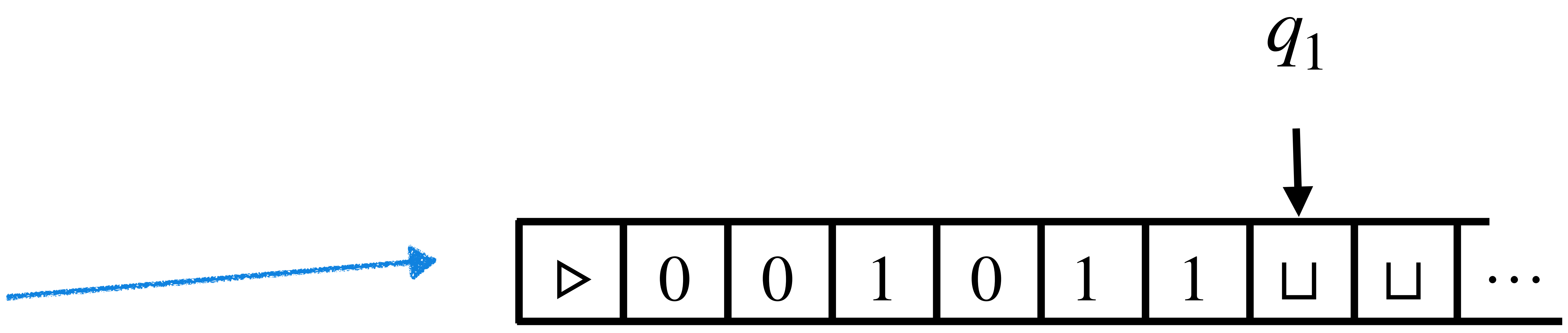

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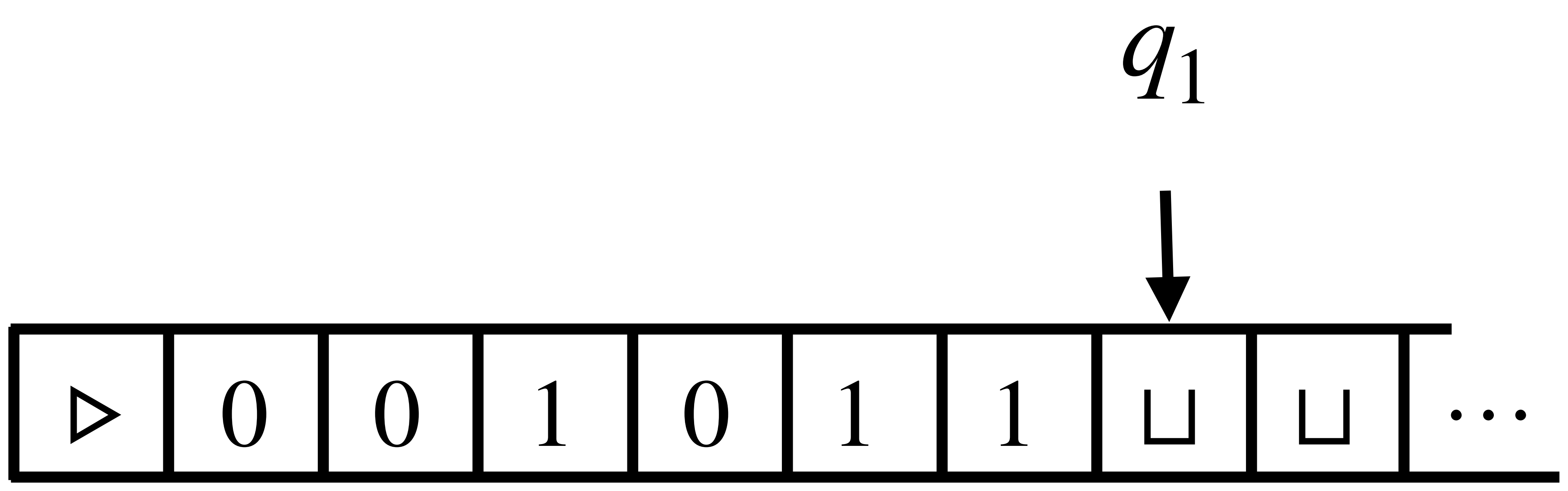

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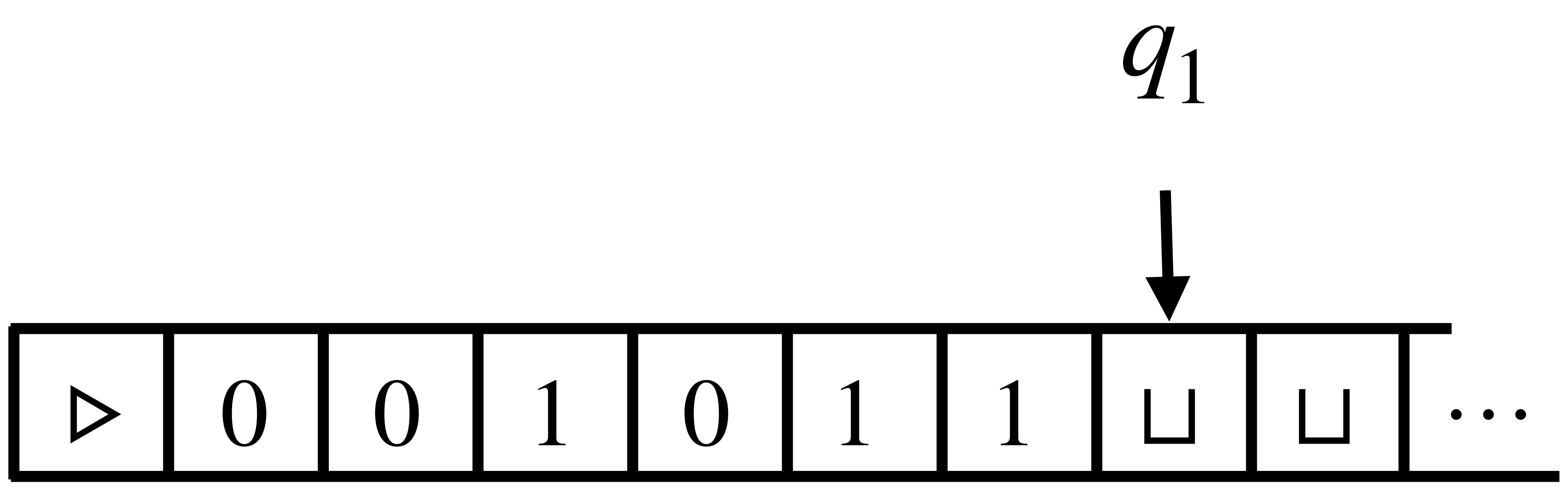

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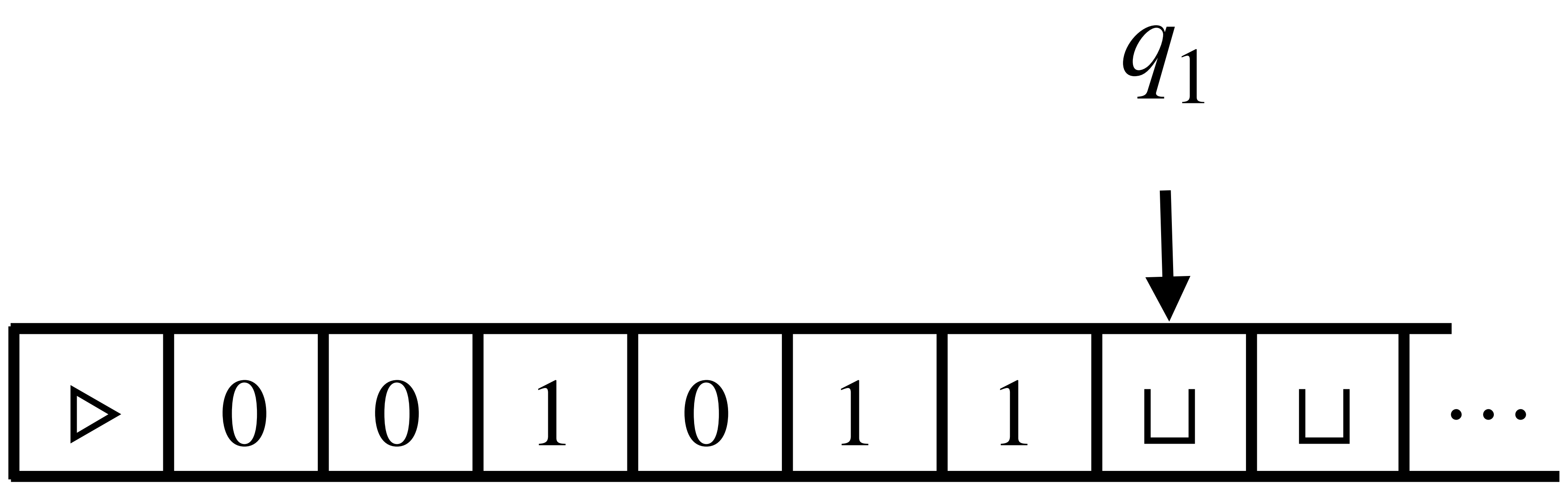

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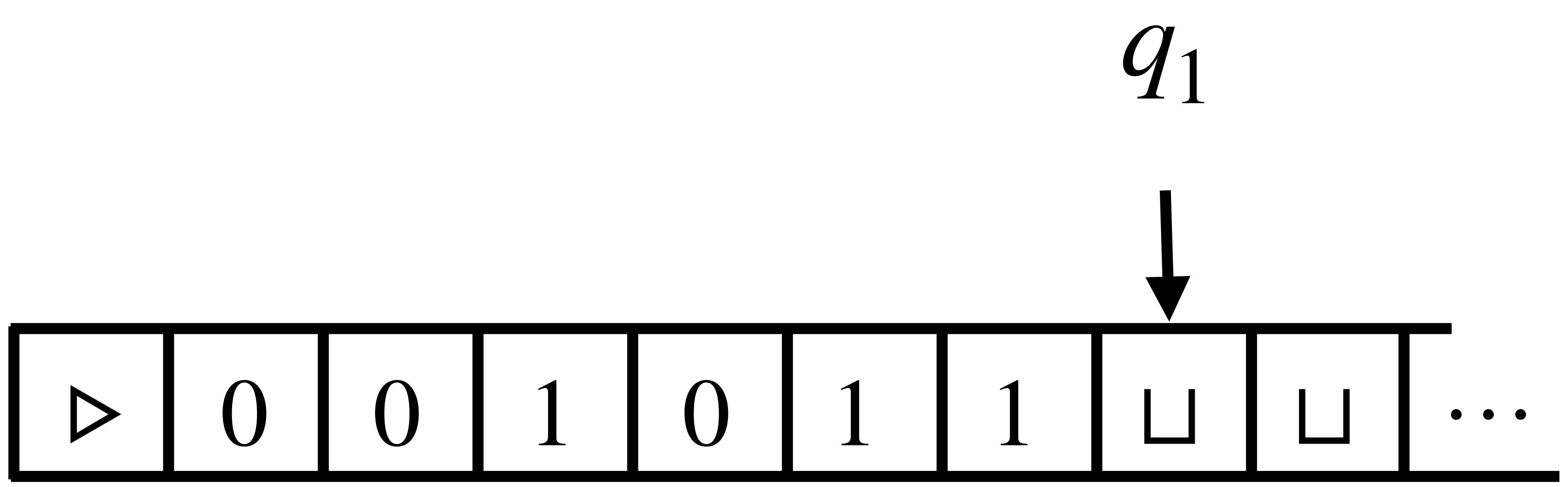

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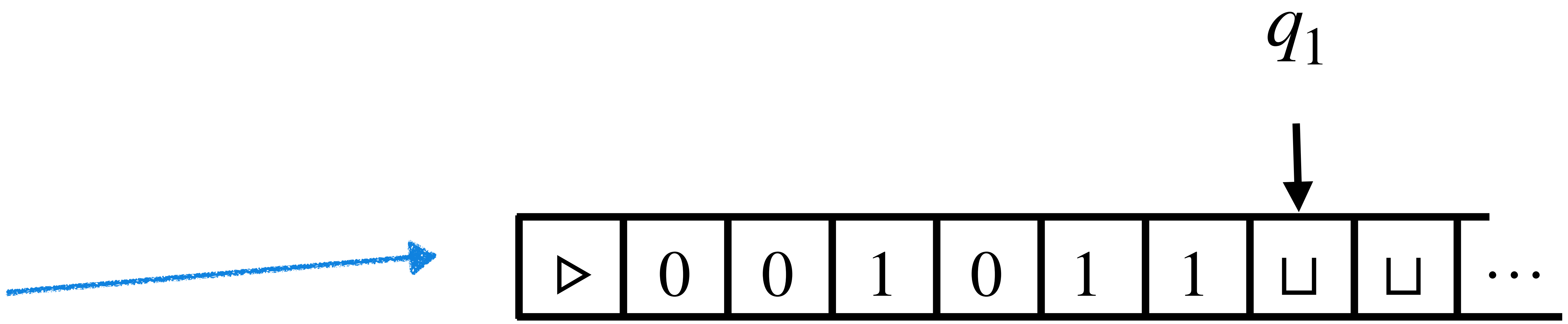

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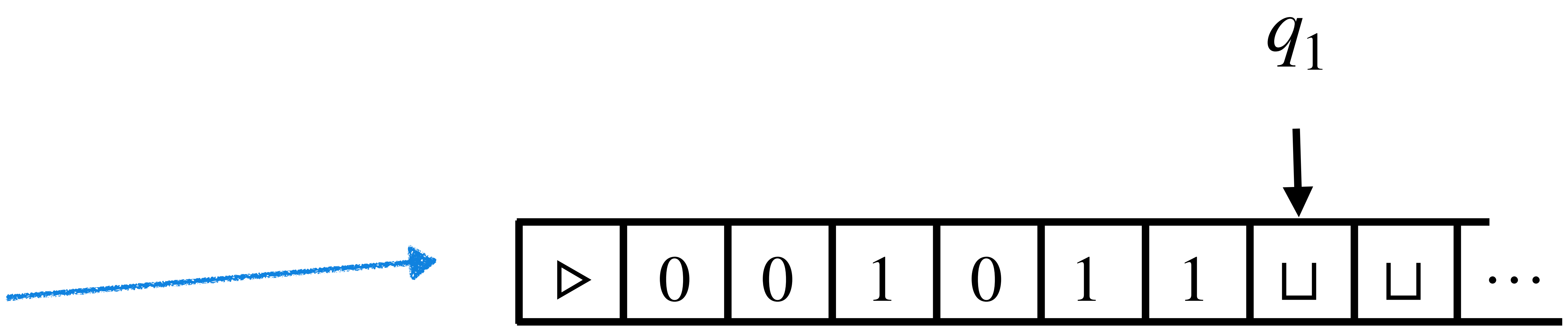

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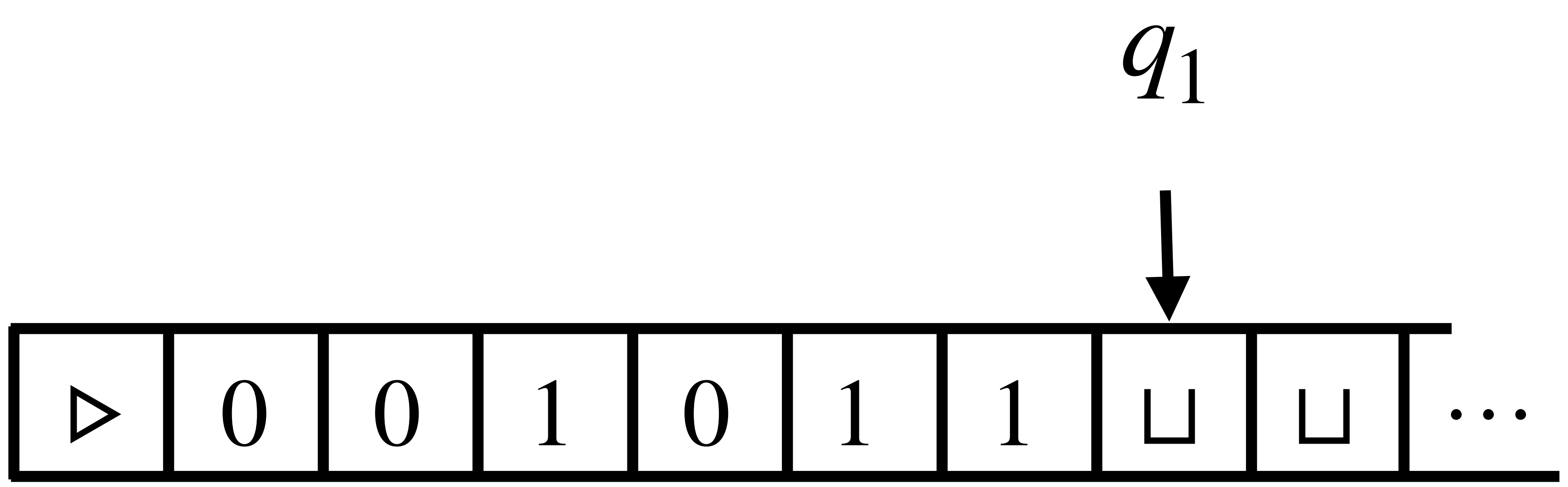

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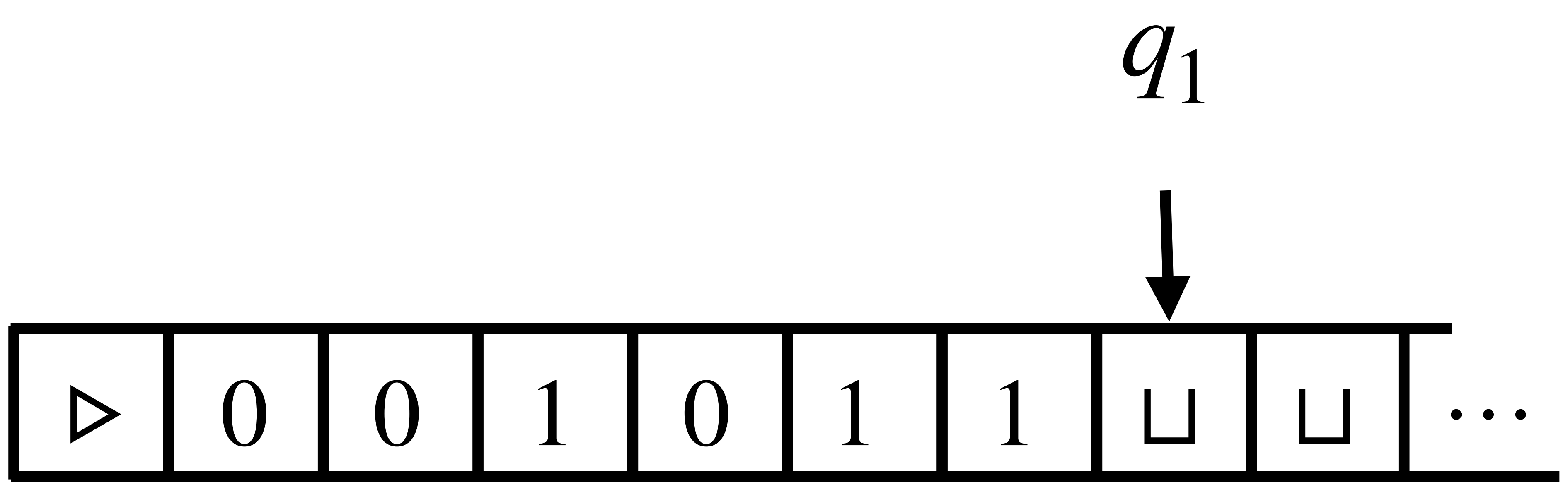

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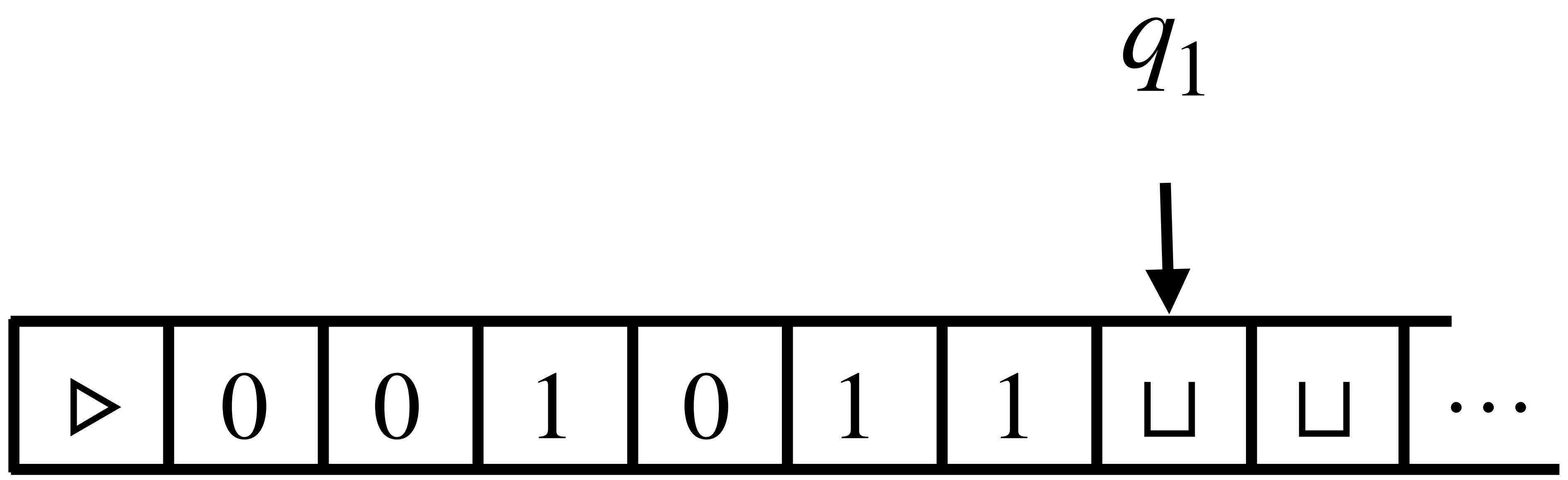

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Turing Machine for Palindrome

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Example: Construct a TM for *PALIN* = $\{x \mid x$ is a palindromic binary string$\}$

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Example: Construct a TM for *PALIN* = $\{x \mid x$ is a palindromic binary string$\}$

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Idea: Copy the input tape to a work tape.

. . .

Turing Machine for Palindrome

Example: Construct a TM for *PALIN* = $\{x \mid x$ is a palindromic binary string$\}$

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Idea: Copy the input tape to a work tape. Keep the input tape head to the leftmost bit

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Turing machine:

- Three tapes.

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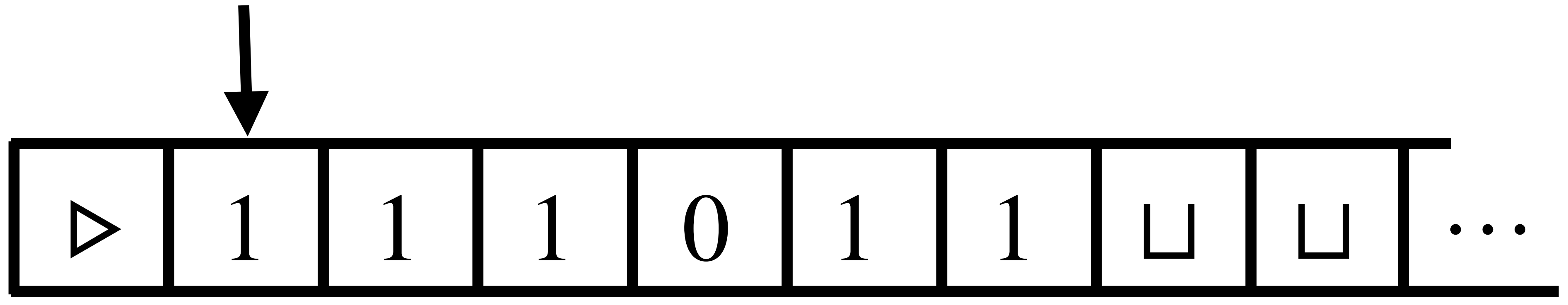

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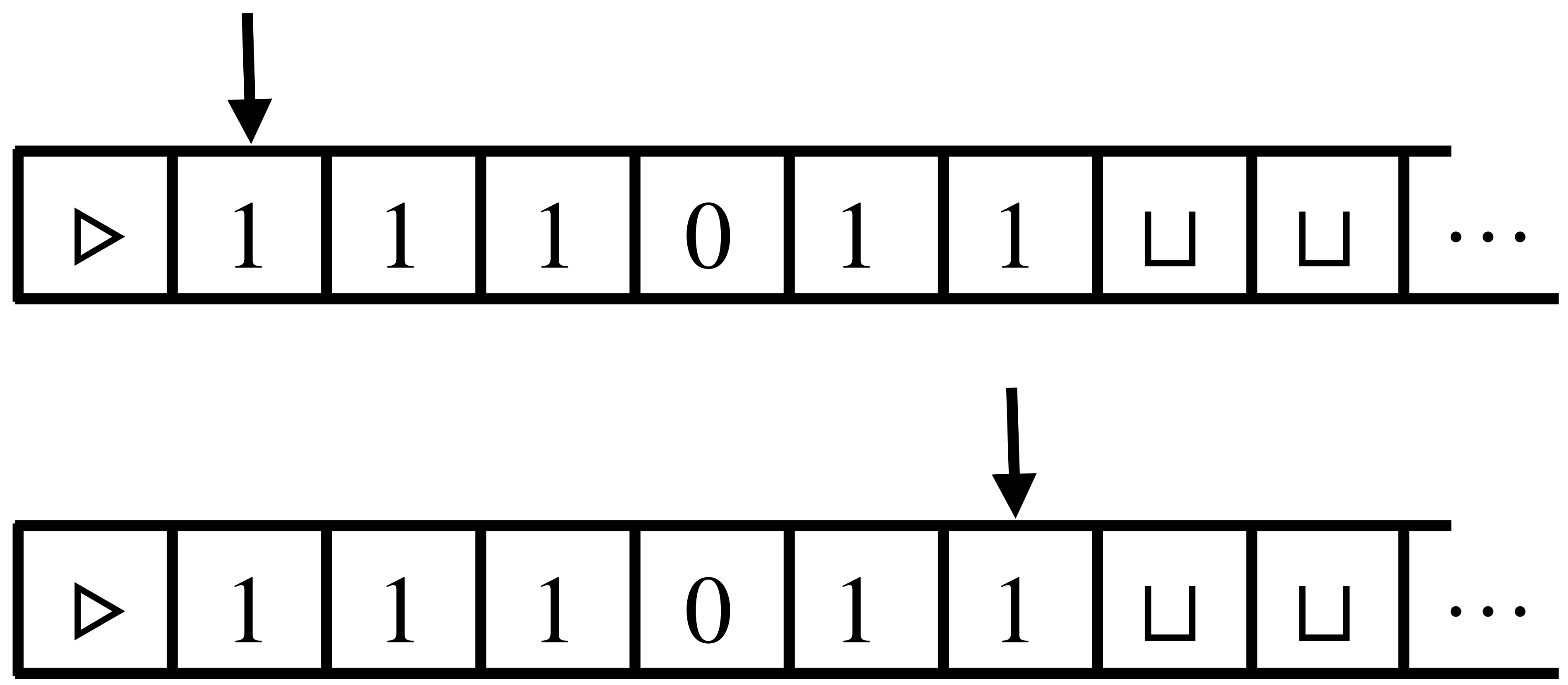

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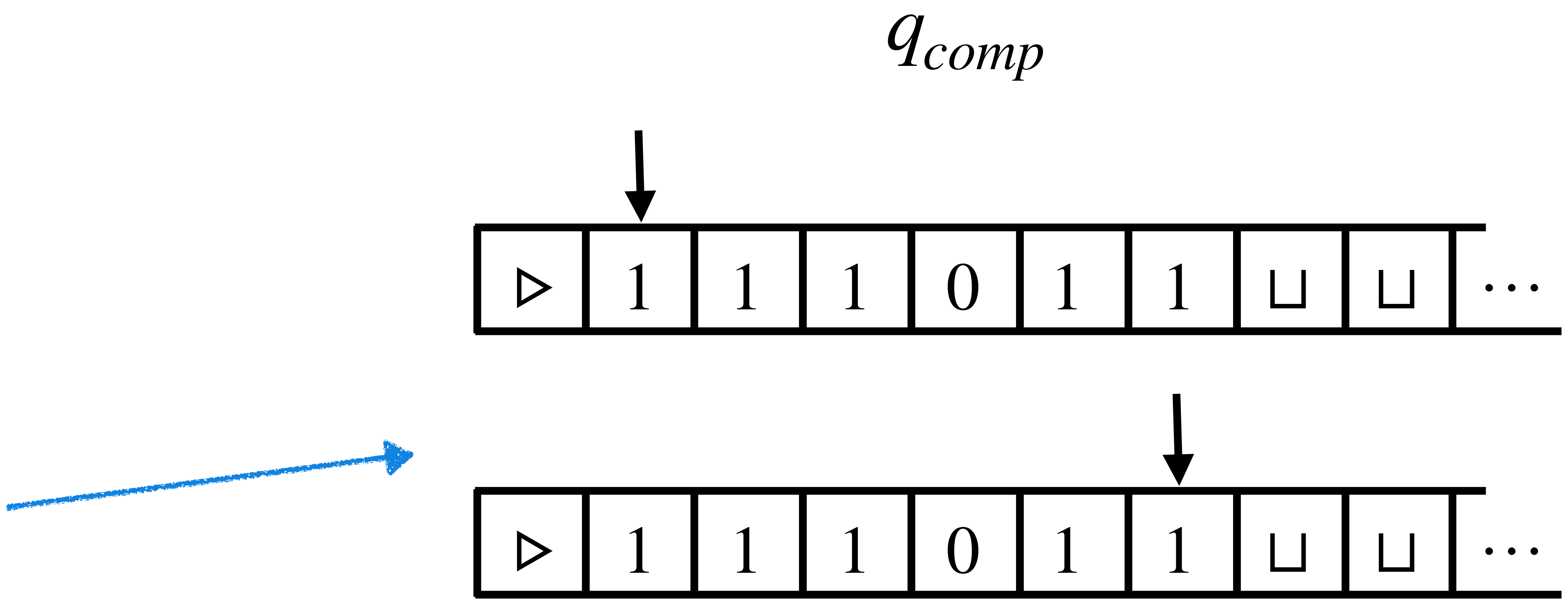

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Turing Machine for Palindrome

Example: Construct a TM for *PALIN* = $\{x \mid x$ is a palindromic binary string$\}$

Solution:

Idea: Copy the input tape to a work tape. Keep the input tape head to the leftmost bit and the work tape head to the rightmost bit. Start comparing bits while appropriately shifting tape heads.

Turing machine:

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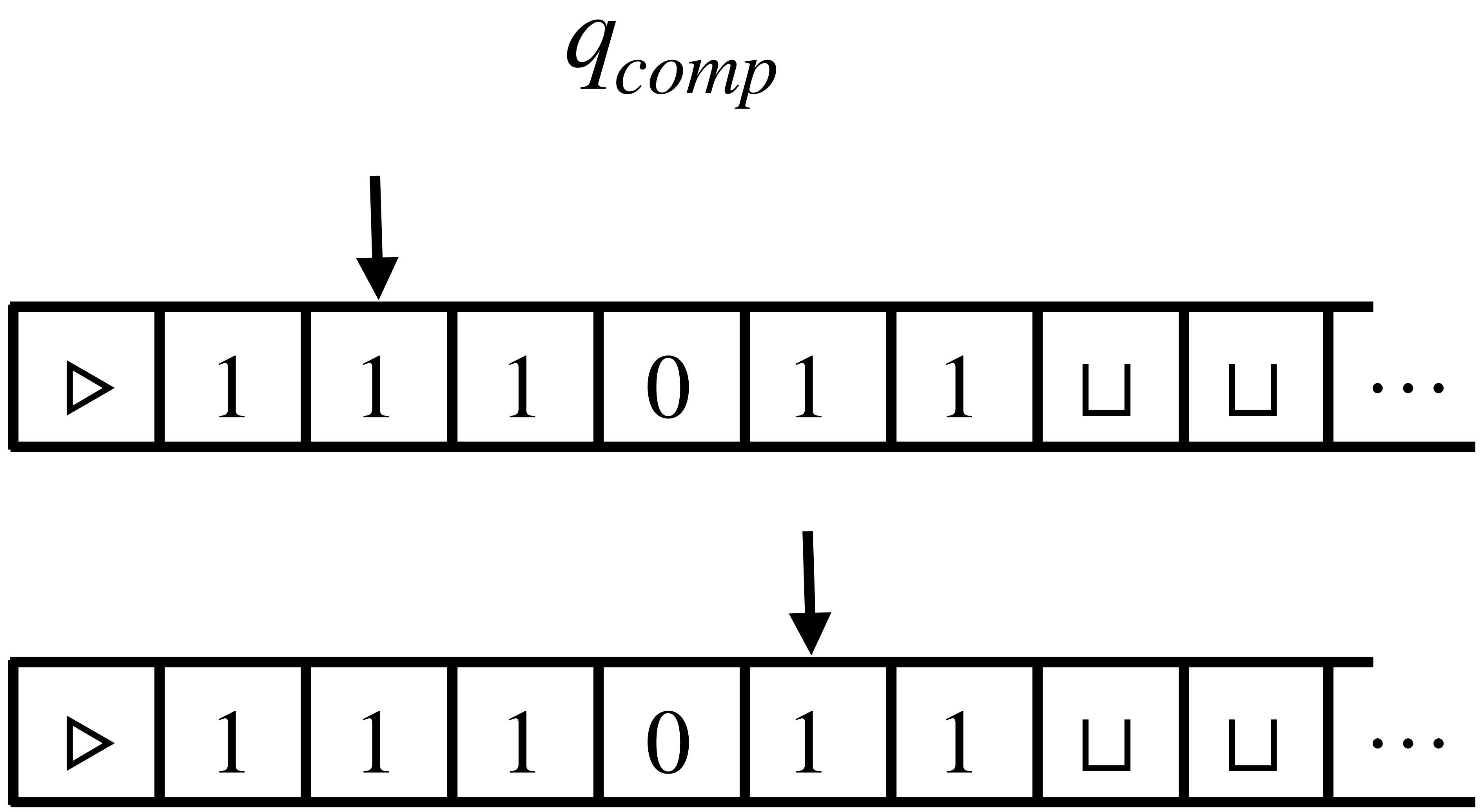

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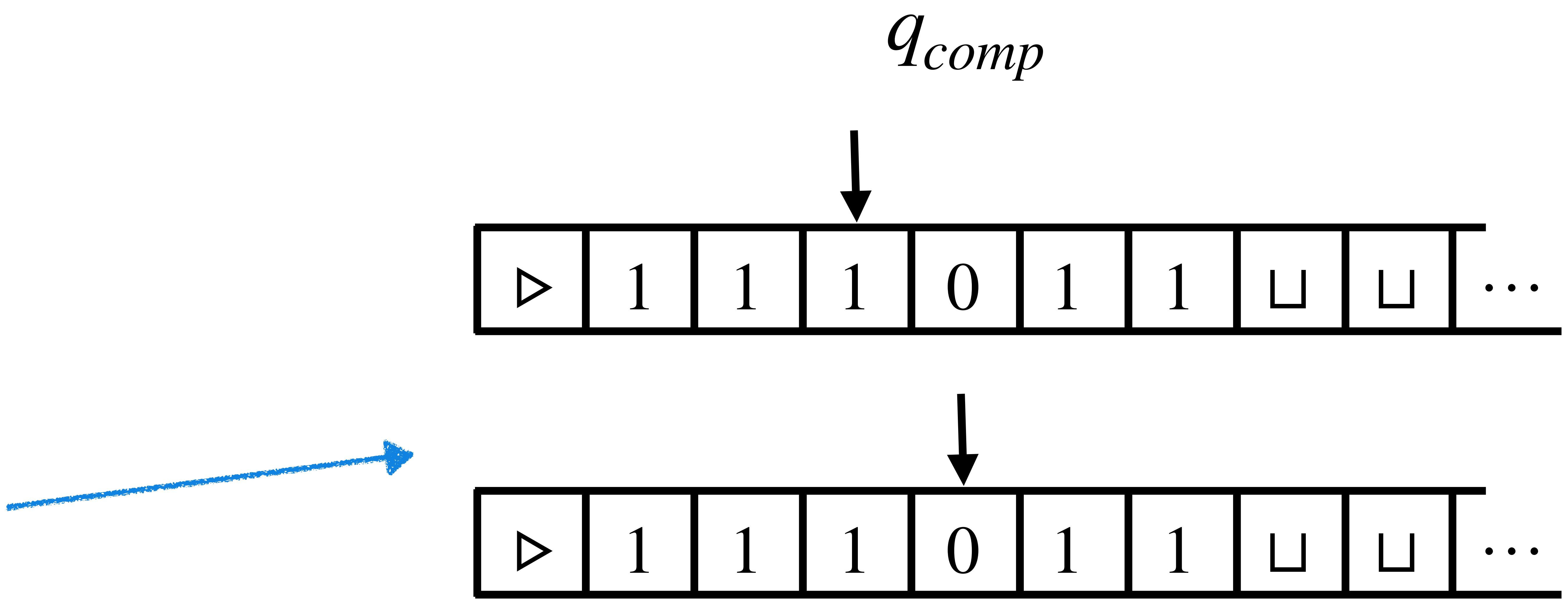

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$(q_{copy}, \sqcup, \sqcup, \sqcup) = (q_{left}, \sqcup, \sqcup, L, L, S)$

$(q_{left}, 0/1, 0/1, \sqcup) = (q_{left}, 0/1, \sqcup, L, S, S)$

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$(q_{copy}, \sqcup, \sqcup, \sqcup) = (q_{left}, \sqcup, \sqcup, L, L, S)$

$(q_{left}, 0/1, 0/1, \sqcup) = (q_{left}, 0/1, \sqcup, L, S, S)$ $\quad (q_{left}, \triangleright, 0/1, \sqcup) = (q_{comp}, 0/1, \sqcup, R, S, S)$

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Q: Can we solve PALIN using two tapes?

Computer vs Turing Machine

Computer vs Turing Machine

Simulating a Computer by Turing machine

Computer vs Turing Machine

Simulating a Computer by Turing machine

High-level language programs can be translated into a assembly language program which

Computer vs Turing Machine

Simulating a Computer by Turing machine

High-level language programs can be translated into a assembly language program which is a **finite sequence** of instructions of type:

Computer vs Turing Machine

Simulating a Computer by Turing machine

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Computer vs Turing Machine

Simulating a Computer by Turing machine

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Computer vs Turing Machine

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Computer vs Turing Machine

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Simulating a Turing machine by Computer

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Computer vs Turing Machine

Simulating a Turing machine by Computer

A C program with infinite memory can be written that simulates a Turing machine where:

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Computer vs Turing Machine

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A C program with infinite memory can be written that simulates a Turing machine where:

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Computer vs Turing Machine

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- Turing machines are used to **prove non-existence of an (efficient) effective procedure** that decides a given language because of their simple mathematical structure.