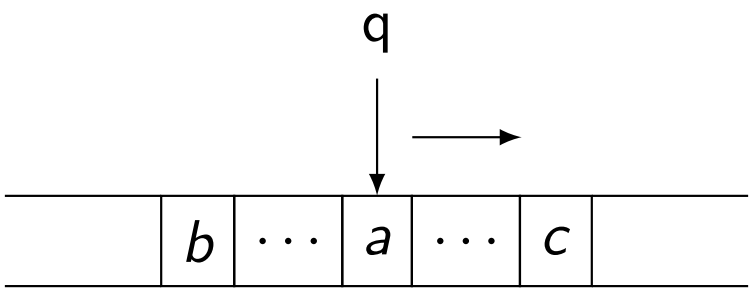
Turing machines

What is a Turing machine? (Informal description.)



Read and write on the input tape. Head moves left/right.

The tape is infinite.

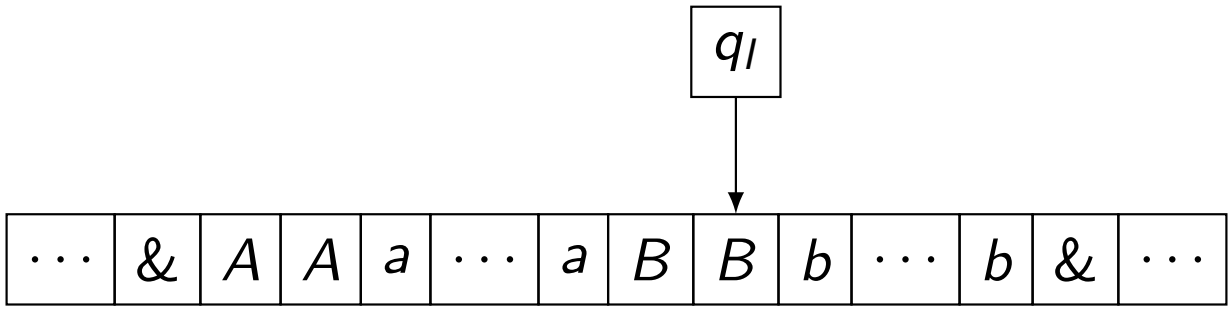
A special symbol & to indicate blank cells.

Initially all cells blank except the part where the input is written.

Special states for accepting and rejecting.

Example

$L_{a,b} = \{a^n b^n \mid n \geq 0\}$.



Formal definition

Definition

A Turing machine (TM) is given by $M = (Q, \Sigma, \Gamma, \delta, q_0, q_f, q_{rej})$

Q:	set of states	Σ:	input alphabet
q_0:	start state	Γ:	tape alphabet, $\Sigma \subseteq \Gamma$, & $\in \Gamma$
q_{acc}:	accept state	q_{rej}:	reject state

$\delta \subseteq Q \times \Gamma \times Q \times \Gamma \times \{L, R\}$.

Understanding δ

For a $q \in Q, a \in \Gamma$ if $\delta(q, a) = (p, b, L)$,

then p is the new state of the machine,

b is the letter with which a gets overwritten,

the head moves to the left of the current position.

Turing machine for a non-context free language

Example

$$\mathrm{EQ} = \{w \cdot \# \cdot w \mid w \in \Sigma^*\}.$$

Give a full description of a Turing machine for the above language.