Problem

Examine the formal definition of a Turing machine to answer the following questions, and explain your reasoning.

a. Can a Turing machine ever write the blank symbol $\sqcup$ on its tape?

b. Can the tape alphabet Γ be the same as the input alphabet Σ?

c. Can a Turing machine's head *ever* be in the same location in two successive steps?

d. Can a Turing machine contain just a single state?

Step-by-step solution

Step 1 of 4

(a) **Yes.** A Turing machine can write the blank symbol $\sqcup$ on its tape.

According to the definition, a Turing machine is a 7 – tuple $(Q,\Sigma,\Gamma,\delta,q_0,q_{accept,}q_{reject})$

Where Q,Σ,Γ are all finite sets.

Σ is the input alphabet not containing the blank symbol $\sqcup$.

But Γ is the tape alphabet, where $\sqcup \in \Gamma$ and $\Sigma \subseteq \Gamma$.

A Turing machine can write any characters in Γ on its tape.

Thus Turing machine can write blank symbol on its tape.

Comment

Step 2 of 4

(b) **No.** The tape alphabet Γ never same as input alphabet Σ

Because tape alphabet Γ contains blank symbol $\sqcup$ where as input alphabet does not contain blank symbol.

Always Σ is subset of Γ, but never same as Σ.

Comment

Step 3 of 4

(c) **Yes.** Turing machines head be in the same location in two successive steps.

When the Turing machines head is at the left _end of the tape, if Turing machine again try to move left side then Turing machine's head is in the same location as previous can move.

Comment

Step 4 of 4

(d) **No.**

According to definition, A Turing machine is a 7- tuple ($(Q,\Sigma,\Gamma,\delta,q_0,q_{accept},q_{reject})$

Where Q is the set of states.

q_{accept} is the accept state and is belongs to Q

q_{reject} is the reject state and is belongs to Q.

But $q_{accept} \neq q_{reject}$

Thus there must be two distinct states q_{accept} and q_{reject}

So, a Turing machine contains at least two states.

Comment