Problem

A ***queue automaton*** is like a push-down automaton except that the stack is replaced by a queue. A ***queue*** is a tape allowing symbols to be written only on the left-hand end and read only at the right-hand end. Each write operation (we'll call it a *push*) adds a symbol to the left-hand end of the queue and each read operation (we'll call it a *pull*) reads and removes a symbol at the right-hand end. As with a PDA, the input is placed on a separate read-only input tape, and the head on the input tape can move only from left to right. The input tape contains a cell with a blank symbol following the input, so that the end of the input can be detected. A queue automaton accepts its input by entering a special accept state at any time. Show that a language can be recognized by a deterministic queue automaton iff the language is Turing-recognizable.

Step-by-step solution

Step 1 of 3

The equivalence between the queue automaton Q and the Turing machine M is required to be shown.

It means it is required to be shown that the language that can be recognized by the automaton, it can also be recognized by the Turing machine and vice versa.

This can be done by showing simulation which means that simulate the automaton Q to behave exactly like the Turing machine M and vice versa.

Comment

Step 2 of 3

The Automaton can be simulated by the Turing machine as follows:

Consider the entire tape as a queue. One by one each symbol is altered and the movement of the tape takes place to the right. If more than one numbers are to be pushed in the queue, then it is done by shifting contents to the right. If the end of the tape is reached, the leftmost symbol of the tape is approached.

Comment

Step 3 of 3

The Turing machine can be simulated by the automaton as follows:

The alphabet of the Turing machine M is expanded by inserting an extra symbol. A left end marker # is inserted to the queue. The symbols are pushed to left and read (popped) from the right.

Comment