LINEAR BOUNDED AUTOMATA (Module IV)

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Linear Bounded Automata

A linear bounded automaton is a **multi-track non-deterministic Turing machine** with a tape of some bounded **finite length.**

Length = function (Length of the initial input string, constant c)

Here,

Memory information ≤ c × Input information

- The computation is restricted to the constant bounded area.
- The input alphabet contains two special symbols which serve as **left end markers and right end markers** which mean the transitions neither move to the left of the left end marker nor to the right of the right end marker of the tape.

A linear bounded automaton can be defined as an **8-tuple (Q, X, ∑, q_0, ML, MR, δ, F)** where

Q is a finite set of states

X is the tape alphabet

∑ is the input alphabet

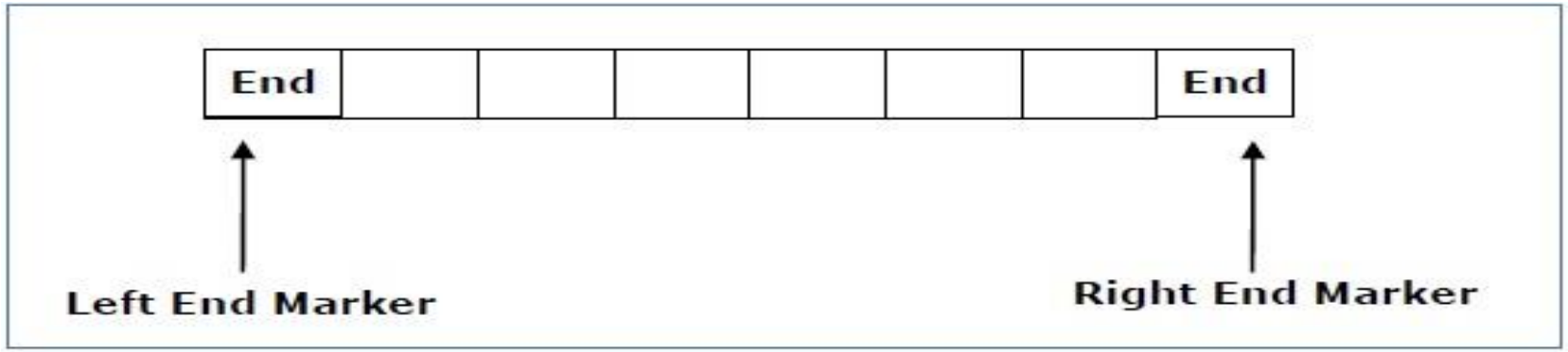
q_0 is the initial state

M_L is the left end marker

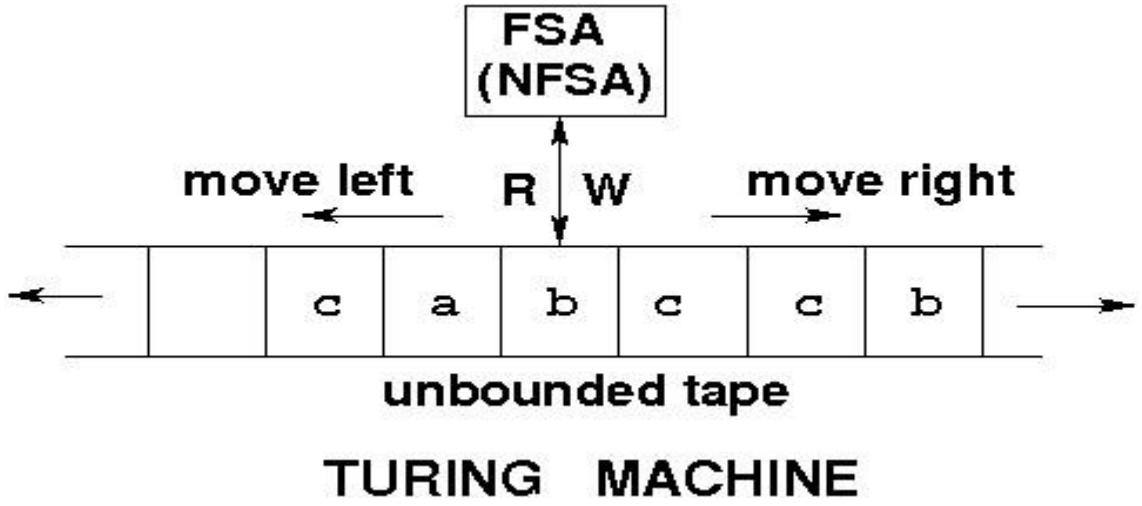
M_R is the right end marker where $M_R \neq M_L$

δ is a transition function which maps each pair (state, tape symbol) to (state, tape symbol, Constant 'c') where c can be 0 or +1 or -1

F is the set of final states



- A deterministic linear bounded automaton is always **context-sensitive** and the linear bounded automaton with empty language is **undecidable.**

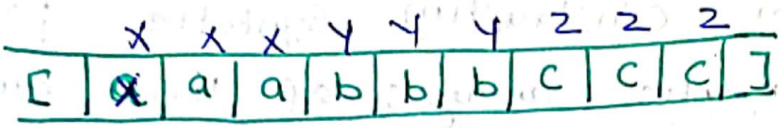


TURING MACHINE

Example:

Construct Linear Bounded Automata for $a^n b^n c^n$ where $n \geq 1$.

Solution:



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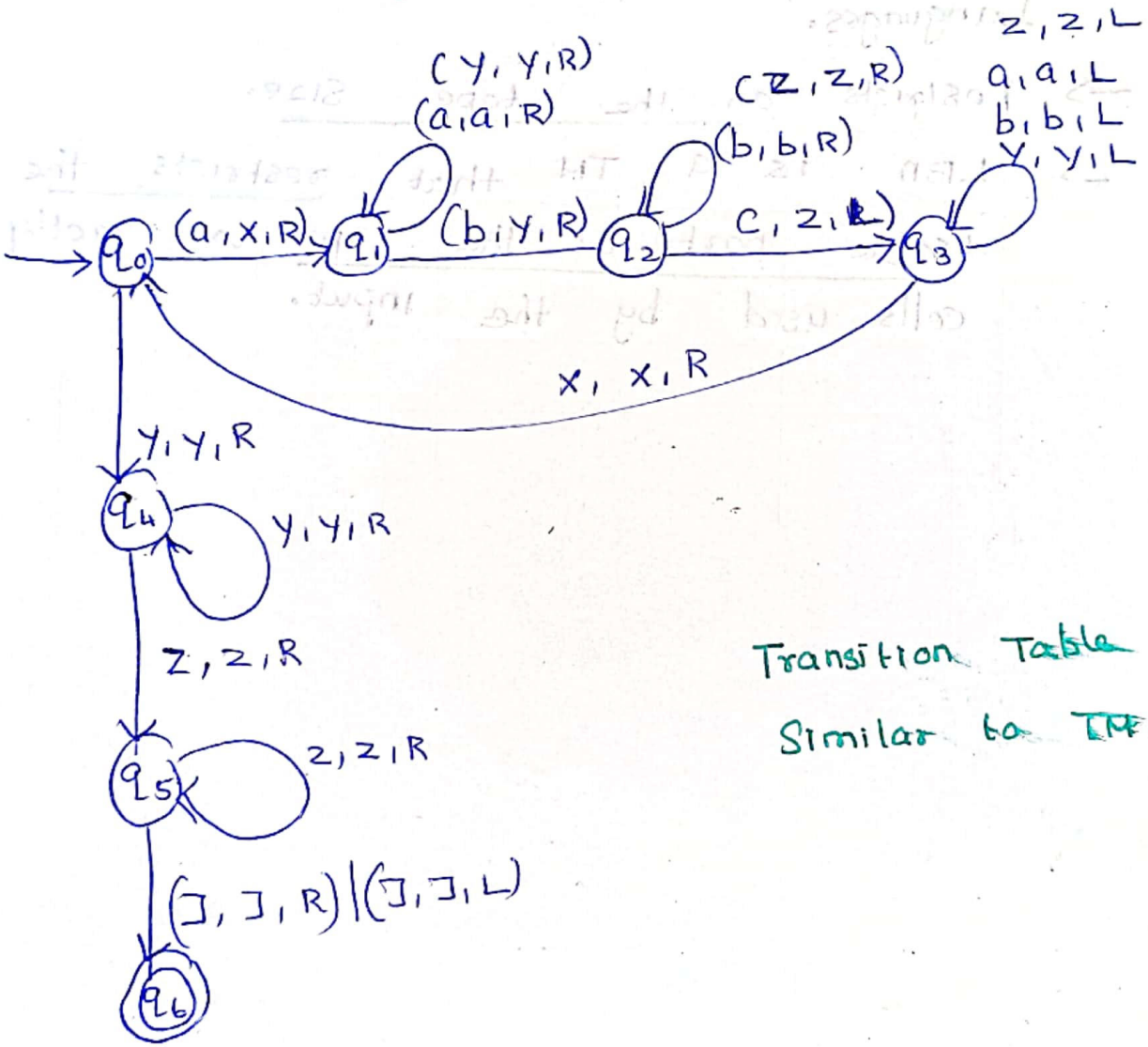
Transition Diagram:



Transition Table is Similar to TM.

→ Turing machine is more powerful than linear bounded automata.

→ Finite automata can generate regular languages,

→ Pushdown automata can generate Context-free languages.

→ Linear Bounded automata can generate Context Sensitive languages.

→ Turing machines can generate recursively enumerable languages.

→ LBA for constructing Syntatic parse trees for Semantic analysis of the compiler. for recognition of context Sensitive Languages.

→ Restricts on the tape size.

→ LBA is a TM that restricts the usable part of the tape to exactly the cells used by the input.