

TOC

classmate

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Hardave R. Shale

18-3-20

* Turing Machine :-

- Finite automata :- finite no. of states
:- limited no. of transitions
Limitation of FA :- we can't construct "FA" for those language in which there is comparison between elements
- PDA :- It is FA with one state
Limitation of PDA :- we can't construct the PDA for those languages where more than one memory comparisons are there between the elements & for those language in which strings are generated in FIFO manner
- was invented by Alan Turing in 1936
- TM :- ~~it is the~~ accepts recursive enumerable language
= :- all the formal languages are accepted
- in TM three things are there :-
 - (1) infinite ~~state~~ ^{tape} :- ~~we~~ it is the ~~tab~~ ^{tape} where we can store 'n' no. of strings
 - (2) read & write capability :-
 - (3) turn around capability :- TM has a "head".
:- The head can move upward/downward, it can move from right/left side ~~for~~ of the string

→ In PDA as string ends there must be ϵ

→ infinite ^{tape} consists infinite cells on which it contains flag symbols & head pointer

- after completing the string flag symbols come
- head pointer shows which ~~cell~~ is currently being read & can move L/R

TM consists of 7 tuples

(1) Q :- finite set of ~~set~~ states

(2) T :- ~~tape~~ alphabet, The alphabets which are used in the tape

(3) \square :- blank symbol

(4) Σ :- input alphabet

(5) δ :- $Q \times T \rightarrow Q \times T \times \{L, R\}$
 $\uparrow \quad \quad \quad \uparrow \quad \quad \quad \leftarrow$ Right side
 Left side

(6) q_0 :- initial state

(7) F :- ~~set~~ set of final state

* TM = FA + Data structure

* Comparison

| Automata | Stack Data structure | Deterministic / Non Deterministic |
|----------|----------------------|-----------------------------------|
| FA | No data structure | Deterministic |
| PDA | LIFO | Non-Deterministic |
| TM | Infinite Tape | Deterministic |

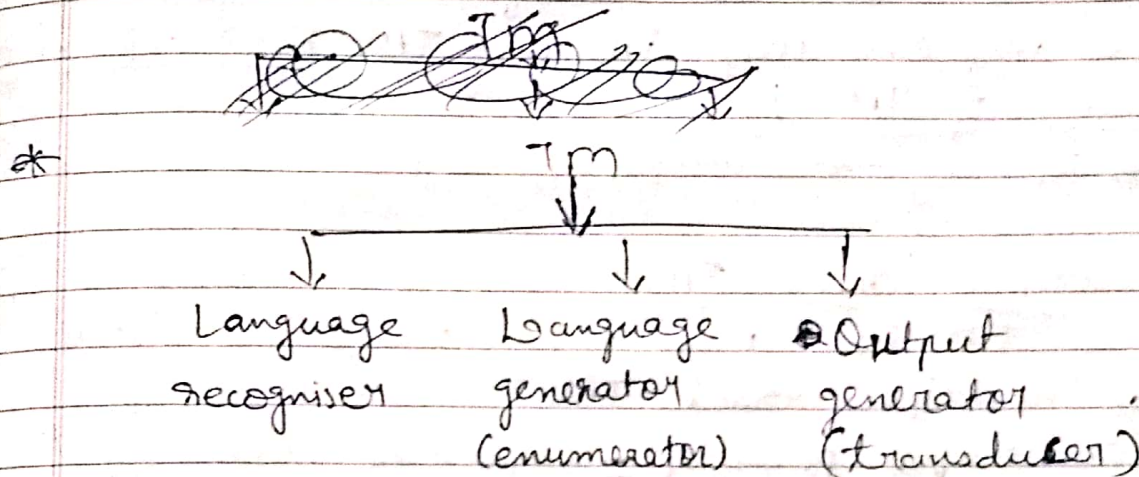
* TM :-

→ Time complexity $T(n) = O(n \log n)$

= Time complexity refers to the measure of the number of times the tape moves when the machine is initialized for some input symbols

→ Space complexity $S(n) = O(n)$

- Space complexity is the no. of cells of the tape written.



(1) Language recogniser :-

- The TM which accepts or rejects formal language that kind of TM is known as the TM as a language recogniser. [reads L to R]
- after reading the complete string if it halts in, final state \Rightarrow string is accepted & non final state \Rightarrow string is rejected.
- acceptance mechanism is as a final state mechanism same as FA.

(2) Language generator [Enumerator] :-

- It is called enumerator because as TM reads the string & for that corresponding string it generates another string so it can enumerate in any order [canonical, alphabetical]

(3) Output generator :-

- it is a TM in which takes string as an input & produce the output as another string

* Variation of TM:-

- ① → Whatever the modification is going to be implemented in any TM, the expressive power of TM is always same.
- ~~Every TM accepts any language~~

① Multiple Track TM:-

- if TM has more than one track \Rightarrow it is a multiple track TM.
- expressive power of Multitrack TM = expressive power of Single track TM

② Two-way infinite tape TM:-

- TM can move in both the directions [L/R]
- can be ~~simulated~~ simulated by one-way infinite tape TM.

③ Multiple tape TM:-

- TM has multiple tapes from where you can restore the inputs, but it has a single head.
- controlled by single head.
- can be simulated by single tape TM.

④ Multiple-tape Multi-head TM:-

- TM has multiple tapes & multiple heads, each tape is controlled by a separate head.
- can be simulated by standard TM.

(5) Multi-dimensional Tape & TM:-

- TM has multi-dimensional tape where ~~head~~ head can move left/right/up/down
- can be simulated by one-dimensional TM

(6) Multi-head ~~TM~~ TM:-

- TM has two or more heads to read the symbols on the same tape.
- In one step all the heads sense the scanned symbols & move or write independently.
- can be ~~simulated~~ simulated by single head TM.

(7) Non-deterministic TM:-

- has a single, one way infinite tape.
- for a given state & input symbol has one choice to move, each ~~one~~ choice from several choices of path that it might follow for a given input string.
- A non deterministic TM is equivalent to deterministic TM.