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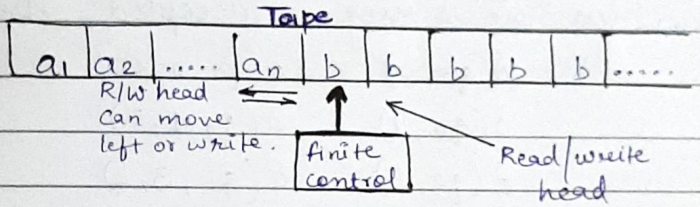
TOC

(Assignment - V)

Q.1 What is Turing Machine ? Explain different types of turing machine in short.

Ans Turing Machine was invented by Alan Turing in 1936 and it is used to accept Recursive Enumerable Languages.
A turing machine consists of a tape of infinite length on which read and writes operation can be performed. The tape consists of infinite cells on which each cell either contains input symbol or a special symbol called blank. It also consists of a head pointer which points to cell currently being read and it can move in both directions.



The different types of turing machines are:

1) Turing machines with 2-dimensional tapes - They have one read write head, one finite control and one two-dimensional tape.
2) Turing machines with multiple tapes - They have one finite control and over one tape with a read-write head for each tape.
3) Turing machines with multiple heads - They have one finite control, one tape, and over one read-write head.
4) Turing machines with infinite tape - They have one finite control and one tape extending in both directions infinitely.
5) Nondeterministic turing machines - They have the ability to perform any action from a given set of actions rather than performing a definite predetermined actions.

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Q.2 Design a TM that accepts the language of odd integers written in binary.

Ans The difference between an odd and even integer is simply the presence or absence of 1 in the LSB i.e. if the binary number contains 1 in LSB it is odd, else it is even.

There will be 3 states q_0, q_1 and final state q_2. The machine will remain in q_0 state and the R/W head will continue to move right in each step, until a B (B = Blank) is encountered, i.e. the R/W head reaches the end of the string, in which case the R/W head will move left one step and changes the state to q_1. If the R/W head points to 1, then the string is accepted, else it isn't.

$$\delta(q_0, 0) = \delta(q_0, 0, R)$$
$$\delta(q_0, 1) = \delta(q_0, 1, R)$$
$$\delta(q_0, B) = \delta(q_1, B, L)$$
$$\delta(q_1, 1) = \delta(q_2, 1, R)$$

Q.3 What are the applications of Turing Machine?

Ans 1) Turing completeness can be measured for a system of instructions, based on how they can simulate a Turing machine.

For ex:- a programming language that can theoretically express all tasks accomplishable by computers is said to be Turing complete.

2) Recently, researchers at Harvard University have created what is termed as chemical Turing machine – basically a vat of chemicals that can theoretically function as a computer.

3) To put this Turing machine in action, the researchers devised a chemical language, based on existing Turing m/c model of language called L3, containing the letters 'a', 'b' and 'c'. Words can be composed through equal combinations of letters, put together in alphabetical order, such as 'abc' or 'aabbcc'.

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4. With this language, it is said to be Turing complete and can be used to solve complex problems. Once it can recognise improper combinations it can act as a fully valid general purpose computer.
5. It's a fairly simple system but what it shows us is immense. They've tried to find out answers about the origin of life on earth, and how a complex chemical computing system such as this could have led to the rise of sentient creatures.
6. This gives researches great insights into how such chemical mixtures have led to biological organisms. They believe that such "naturally occuring computers" would have been the first steps towards life on earth.