Lebron James M. Dante

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**Structures and Functions of a**

**Turing Machine.**

A study of computations has evolved continuously ever since the early 20th century. With Turing machine playing a crucial role in developing Computer Science. Alan Turing’s Model not only formalizes the concepts of computation but also places foundation for the field of algorithmic theories. This paper aims to study about the structures and functions of a Turing machine and to shape their capability through different computations. To understand Turing machine is essential for grasping fundamentals of computability and complexity of theories.

**Methods**

Several key components of a Turing machine:

Tape: Tape serves as the input of the working space for the Turing machine. It is capable of a single symbol from a finite alphabet. It is a sequence of large amounts of cells.

Head: A read/write mechanism which moves it from the left to the right along with the tape. Also reads the symbol of the current sell and can modify or change it based on the transition function of the machine.

State Register: it is a state that registers for the machine to start and then it accepts the computation or rejects the input.

Alphabet Tape: Contains All symbols of the alphabet, as well as “blank”.

Functions of a Turing machine

The function of the Turing machine is defined by the sequence of transitions, it goes to current state and the symbol it indicates. Then the machine process until it accepts the input or rejects it.

Initialization: The Machine starts to initialize with the output written on the tape.

Reading: It reads the current tape cell.

Transition: The machine applies the transitional function which writes a new symbol but then moves the head, and changes the states accordingly from the tape.

Halting: it processes repeatedly until the machine reaches the accepting the state or rejecting the state.

**Results**

Problems Solvable by Turing machine.

Arithmetic Operations: Turing machine can only perform basic arithmetic operations such as addition, subtraction, Multiplication and Division on unary symbols. Adding two binary numbers for an example.

Enumerating Recursively Enumerable languages: The set of languages accepted by Turing machines responds exactly to the recursively enumerable languages.

**Discussion**

This Means that the Turing machine only has limited ability to go beyond the computation of specific problems. It requires and provides robust framework and to understand the limits of computation.

Despite the simplicity of the Turing machine, it encapsulates the essence of computation, making it powerful tool for theoretical exploration. Their ability to access any algorithmic process ensures their continues relevance in both academic and practical application.

**References**

References

1. Sipser, M. (2012). *Introduction to the Theory of Computation*. Cengage Learning.
2. Papadimitriou, C. H. (1994). *Computational Complexity*. Addison-Wesley.
3. Lewis, H. R., & Papadimitriou, C. H. (1981). *Elements of the Theory of Computation*. Prentice Hall.
4. <https://en.wikipedia.org/wiki/Turing_machine>
5. <https://study.com/academy/lesson/the-turing-machine-input-output-and-examples.html>
6. <https://www.cs.odu.edu/~toida/nerzic/390teched/tm/definitions.html>
7. [Turing Machines (Stanford Encyclopedia of Philosophy)](https://plato.stanford.edu/entries/turing-machine/)
8. [ScienceDirect](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/turing-machine)