

Theory of Computation

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References:

- Introduction to the Theory of computation: Michael Sipser
- Introduction to Automata Theory Languages, and computation: J. Hopcroft, R. Motwani, and J. Ullman, Pearsons Publications

Introduction

Theory of Computation comprises the **fundamental mathematical properties** of computer **hardware, software**, and certain applications thereof.

The objective of this course is to determine what can and cannot be computed, how quickly, with how much memory, and on which type of computational model?

Central areas of the theory of computation

Three areas

- Automata
- Computability
- Complexity

Complexity

Computer problems come in different varieties; some are easy (ex: sorting), and some are hard (ex: scheduling).

In complexity theory, the objective is to classify problems as easy ones and hard ones.

One achievement of complexity theory is, researchers have discovered an elegant scheme for classifying problems according to their computational difficulty.

Computability

Certain basic problems cannot be solved by computer.

In computability theory the classification of problems is by those that are solvable and those that are not.

Computability theory introduces several of the concepts used in complexity theory.

Automata

Automata theory deals with the definitions and properties of mathematical models of computation.

These models play a role in several applied areas of computer science.

One model, called the finite automation, is used in text processing, compiler, and hardware design.

Another model, called the context-free grammar, is used in programming language and artificial intelligence.