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COM501-Advanced Data Structures & Algorithms

Computer Science: Evolution

Till 17th century the tasks such as commuting between places, transporting goods, tax-collection, interest calculation, etc., were human-centric. Largely, machines had no role (little role) to play in day to day activities. On the research front, fundamental research in mathematics and other areas of science were very active. That age witnessed many astonishing results in mathematics and physics. On the professional front, people were involved in teaching, research, preaching, and cultivation. Many fundamental questions were born out of curiosity, such as can a machine commute between places, can a machine perform interest calculation, etc. Majorly, human activities can be classified into physical activity or mental (thinking) activity and in an attempt to automate these activities, over the years engineering was born.

Branches of engineering such as mechanical, civil and electrical were evolved in the last two centuries on the need for automating physical work. Notable discoveries in mechanical engineering include nut, bolt, wheel, engine, etc. In civil engineering, the construction of pyramids, channels, ponds, temples, etc, were considered to be the greatest discoveries which marked the way for modern civil engineering.

While mechanical and other engineering focused on automating physical work, computer science has evolved on the need for automating thinking process. This science is relatively young unlike other engineering fields. Computer science has nice historical roots and in fact the term 'computing' was triggered with the invention of Abacus. During 18th century philosophers George Boole and Aristotle discovered logic programming and subsequently, Boole discovered swithing theory (boolean algebra) which marked the beginning of modern computing. Due to the advancements in electrical engineering, a realization of switching theory had begun during early 19th century using logic gates, transistors, etc and thus digital era has begun. Computing devices such as ENIAC, EDVAC, calculators were invented during 1950-1960. Researchers at IBM were working on a computing device which did computing beyond calculators, for example, computations like sorting, determinant of a matrix, etc. Subsequently, the device was named as 'computer'.

The term 'algorithm' refers to a sequence of logically related instructions to solve a computational problem and these instructions are given to computer using an appropriate programming language. Eventhough *Algorithm* exist in all walks of life, now a days the term is closely binded with the Computer science discipline. Over the years, the term computer science had been researched upon by various researchers and the popular definition due to Gibbs et al. is given below.

"The Central theme of Computer Science is the study of Algorithms and Data structures"

-Norman.E.Gibbs and Allen B.Tucker

Computer Science is the systematic study of algorithms, specifically, their formal, mechanical and linguistic realizations and their applications.

The word 'algorithm' was coined by a Persian author named 'Abu Jafar Mohammad ibu Musa al Khawarizmi'. Algorithm is not only associated with computer science discipline but also with other discplines. For example: there is an algorithm behind activities such as cooking, singing, reading, etc. In short, we say, Algorithms existed at all times in all domains. But in these days we associate algorithms only with the problems that are solved by computers, namely, computational problems. Formally, we define *algorithm* as a sequence of logically related instructions to solve a problem (Computational problem). Computational problems are problems that are solved by the computers. The process that transforms an input to output is called 'Computational thinking'(Algorithmic thinking).

"Bad programmers worry about the code. Good programmers worry about algorithms, data structures and their relationships" - Linus Torvalds

A closer view of Computer Science
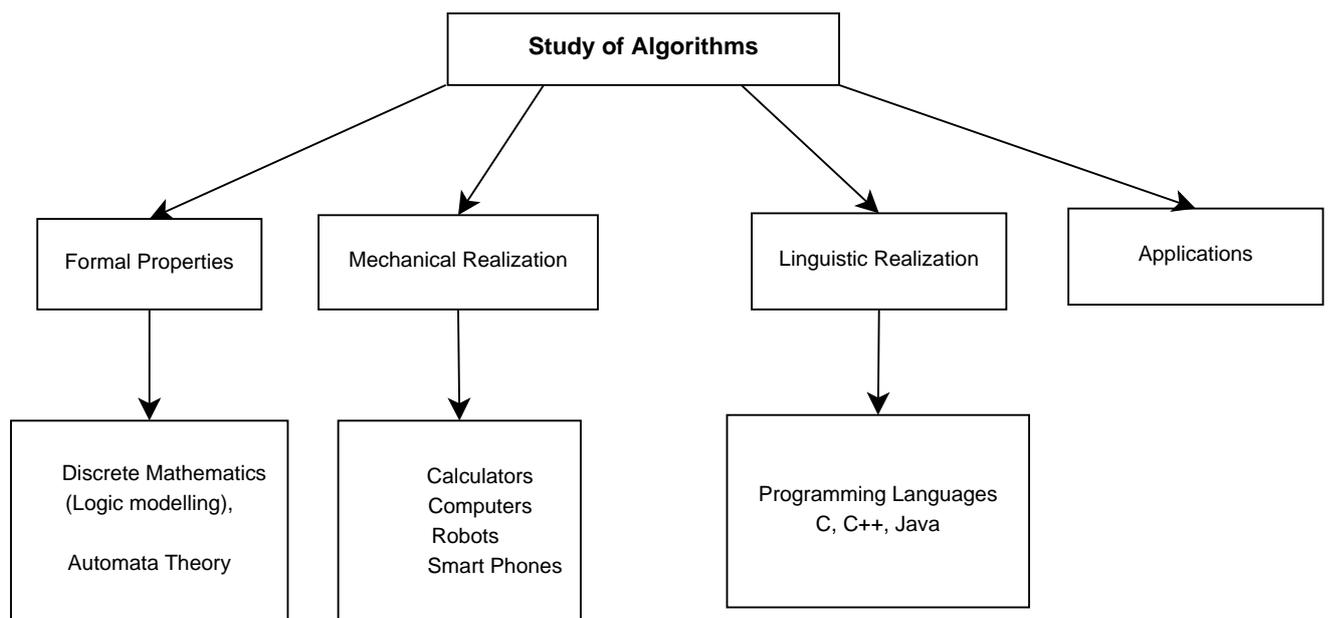
Discoveries at Glance Notable discoveries in the last four decades are listed below.

- From Algorithm study:

1. GCD algorithm (*Euclid*)
2. Algorithm for approximating 'pi ' (*Archimedes*)
3. Finding prime numbers (*Eratosthenes*)
4. Boolean Algorithm (*Logic Programming*)
5. Set Theory(*Logic Programming*)

- On Models (Realizations):

1. Abacus
2. Difference Engine
3. ENIAC (Electronic Numerical Integrator and Computer)
4. EDVAC (Electronic Discrete Variable Automatic Computer)
5. IBM Mainframe
6. IBM Personal Computer

- Linguistic Realization:

1. Input through switches/gears
2. Machine code
3. Assembly Language
4. Structural Programming
5. Object Oriented Programming
6. Web Programming

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2. T.H. Cormen, C.E. Leiserson, R.L.Rivest, C.Stein, Introduction to Algorithms, PHI.
3. Sara Baase, A.V.Gelder, Computer Algorithms, Pearson.
4. First Machine Age, Second Machine Age - Stephen Hawking