

# Applications of Mathematics in Computer Science Engineering

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**Abstract** - Mathematics as a whole is a very important and basic subject to understand the concepts of computer science engineering. Concepts such as binary mathematics, linear algebra, statistics, calculus, discrete mathematics have their own significance in the field of engineering, especially in computer science engineering. The automata languages and programs logic are highly dependent on the theories of mathematics. The objective of the paper is to show wide use of Mathematics in Computer Science engineering without which development of any full-fledged software is quite impossible. The present article also provides an intuition to the CSE aspirants towards the importance and significance of Mathematics in their particular fields. The authors try to remove erroneous notion of some computer subject's aspirants about the marginal use of Mathematics in their stream.

**Key Words:** Binary Mathematics, Linear Algebra, Calculus, Discrete Mathematics, Probability and Randomness.

## I. INTRODUCTION

Computer science engineering is an engineering discipline in which the basics that engulfs many mathematical and scientific concepts, computation, programming language and programming design. Computer science engineering has been applied in every home and office in the 21st century. Mathematics and computer science engineering seem irrelevant to each other but they are the roots of the same tree. An engineering student who is expert in algebra, calculus, statistics and discrete mathematics can graduate engineering with distinction. Learning these concepts will help students to understand and create the algorithms more efficiently. To create a program which locks a particular file or folder, we include statistics and probability logic while creating programs. In the same way algebra is used to create basic programs. Learning and understanding mathematics' concepts makes an engineer a perfect engineer [1], [2],[3].

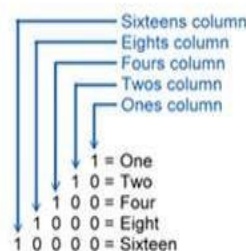
Mathematics is the most foundational subject in computer science engineering. The level of mathematics depends upon the work a computer science engineer takes up. With some basic knowledge of mathematics such as arithmetic, one can develop basic mobile applications. To develop operating systems, computer security or anything of such kind, requires high mathematical knowledge. Computer science engineers learn and apply different mathematical concepts at suitable places. Those engineers who are experts in advanced arithmetic and matrices can design an image recognition for medical diagnostics. Here are a few basic mathematical topics which are essential for a computer science engineer. [4], [5],[6].

## II. COMPUTER SCIENCE AND MATHEMATICS

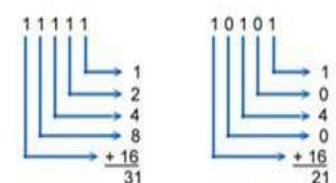
### Binary Mathematics

According to digital electronics and mathematics, binary numbers are defined as the string of two specific digits or symbols which are '0' and '1'. The binary numbers are also expressed in base two numeral systems. The base two system is the positional notation with 2 as a radix. Binary math is the most essential and basic concept used in computer science engineering. All the computer languages are based on the two digit number system used in digital encoding. A computer science engineer can apply binary mathematics at various places. For example, the images which appear on a computer screen have been encoded with a binary line for each pixel. If, for instance, the screen which is being used is 16-bit code, then each pixel has been told what color to display on which bits are 0s and 1s. Subsequently,  $2^{16}$  represents 65,536 different colors. In this way, binary mathematics are used in numerous ways.[9]

### BINARY NUMBERING :



### EXAMPLE BINARY TO DECIMAL :



### Linear algebra

Computer science engineers or software engineers completely rely on algorithms. They create algorithms before they create a program. The programs also include logic in them where algebra, as whole, is used. An algorithm takes a user from specific input to the correct output. There are many mathematical algebraic concepts which are used in computer science engineering. They are operations, exponents, factoring, racial expressions, linear and polynomial expressions, polynomials, rectangular coordinates, quadratic expressions, graphs and various algebraic expressions. These are the concepts which are used to complete scientific computations and execute numerical programs[8].

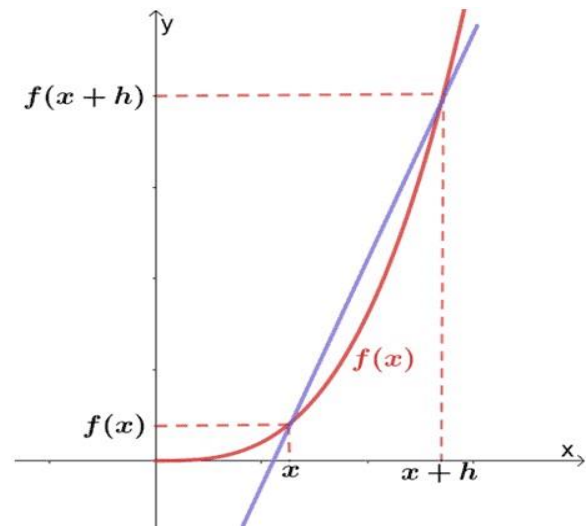
### III. PROBABILITY AND THE RANDOMNESS

Statistics is a vast concept of applied mathematics that uses Probability theory to generalize the collected sample data. Statistics is also defined as the study of collecting, analyzing, skewness, regression, variance, analysis of variance and kurtosis. Statistics also plays a vital role in computer science engineering. It is used in vision and image analysis, data mining, speech recognition traffic modeling and data compression. For example, a software developer develops a program which detects the user’s face and voice to access the protected data.[7] The learner uses statistics in his/her program’s logic to develop the program of such kind.



### IV. CALCULUS

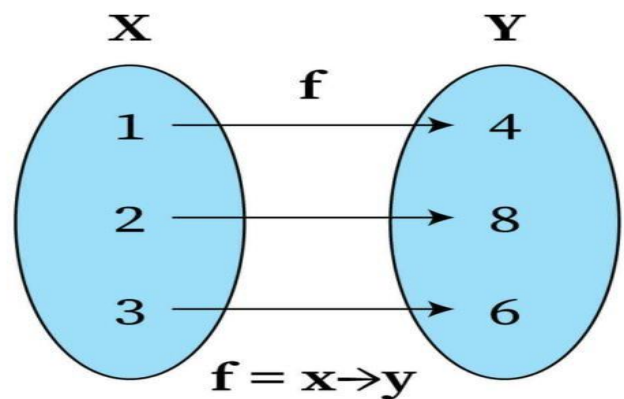
Calculus is a branch of mathematics which defines the rates of change and summation of many small factors to determine the factor as a whole. The calculus is broadly divided into two parts. They are integral calculus and differential calculus. These two types of integral help one to figure out the rate of change. Calculus is vastly used in computer science engineering as designing simulations, creating effective algorithms, improving problem solving programs, developing accurate graphs etc.[8]



### V. DISCRETE MATHEMATICS

Discrete mathematics is the branch of mathematics which deals with the objects that can consider distinct, separated values. Thus, discrete math is tangible math. The concepts of discrete math include probability, logic, number theory, combinatorics, logic, and graph theory. Discrete mathematics can also be used to test multiple algorithms. Discrete mathematics is theoretically used in computer science engineering, which is relevant to computing.[10] The quantification of information is described using information theory. Coding theory and information theory are closely related to each other.

### Discrete Mathematics



### VI. CONCLUSION

Anyone who learns and understands the concepts precisely which are stated above will understand the other related subjects of computer science engineering with an ease and thus it pave the way for full comprehensibility, expertise and innovation. The mathematical concepts are not only restricted to computer engineering but also cater to the need of day to day real life problems. The role of mathematics for a software engineer in a corporate world is very essential and inevitable in all aspects. Mathematical knowledge enhances logical thinking and reasoning power and opens wide scope for effective algorithms, programs and soft wares development. The engineers have to prove

their mettle through mathematical knowledge in their screening interview also whether it is technical or non-technical, one has to create the logical programs, algorithms and software by using basic and advanced mathematical concepts. Computer science engineering and mathematics seem to be completely two different fields but without mathematics it is quite difficult to become an expert software engineer or software developer. The present paper focused on the wide use and large application of mathematics in computer science engineering by giving miscellaneous examples. The essence of Mathematics can be understood by emerging technologies like Data sciences, artificial intelligence and Machine learning.

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