Mathematics

Mathematics is the mother of science. It applies the principles of physics and natural sciences for analysis, design, manufacturing and maintenance of systems. Mathematicians seek out patterns and formulate new conjectures. Mathematicians resolve the truth or falsity of conjectures by mathematical proof. Through the use of abstraction and logical reasoning, mathematics developed from counting, calculation, measurement, and the systematic study of the shapes and motions of physical objects. Practical mathematics has been a human activity for as far back as written records exists. Mathematics is used throughout the world as an essential tool in many fields, including natural science, engineering, medicine, and the social sciences. It is one of the oldest and broadest disciplines. The mathematician may design a component, a system or a process. Mathematics is used throughout the world as an essential tool in many fields, including natural science, engineering, medicine, and the social sciences.

Applied mathematics, the branch of mathematics concerned with application of mathematical knowledge to other fields, inspires and makes use of new mathematical discoveries, which has led to the development of entirely new mathematical disciplines, such as statistics and game theory. Mathematicians also engage in pure mathematics, or mathematics for its own sake, without having any application in mind. There is no clear line separating pure and applied mathematics, and practical applications for what began as pure mathematics are often discovered. Mathematicians will analyze their design using the principles of motion, energy, and force to insure the prod Mathematicians are needed in the environmental and bio-medical fields. Indeed virtually every product or service in modern life has probably been touched in some way by a mathematician.

Mathematics is the abstract study of topics such as quantity (numbers), structure, space, and change. It is used throughout the world as an essential tool in many fields, including natural science, engineering, medicine, finance and the social sciences. When mathematical structures are good models of real phenomena, then mathematical reasoning can provide insight or predictions about nature. Through the use of abstraction and logic, mathematics developed from counting, calculation, measurement, and the systematic study of the shapes and motions of physical objects. The research required to solve mathematical problems can take years or even centuries of sustained inquiry.

Galileo Galilei (1564–1642) said, "The universe cannot be read until we have learned the language and become familiar with the characters in which it is written. It is written in mathematical language, and the letters are triangles, circles and other geometrical figures, without which means it is humanly impossible to comprehend a single word. Without these, one is wandering about in a dark labyrinth." **Carl Friedrich Gauss** (1777–1855) referred to mathematics as "the Queen of the Sciences". **Benjamin Peirce** (1809–1880) called mathematics "the science that draws necessary conclusions". **David Hilbert** said of mathematics: "We are not speaking here of arbitrariness in any sense. Mathematics is not like a game whose tasks are determined by arbitrarily stipulated rules. Rather, it is a conceptual system possessing internal necessity that can only be so and by no means otherwise." **Albert Einstein** (1879–1955) stated that "as far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality." French mathematician **Claire Voisin** stated "there is creative drive in mathematics, it's all about movement trying to express itself." It is applicable in various traditional fields of engineering: mechanical and electrical engineering are among them. Mathematics is used in computer engineering too.

Mathematical logic is used in the decision making, so it is used in computer programming. As Venn diagrams are helpful in understanding the concepts of logic, they are also helpful in the programming. For instance, De Morgan's laws are used in writing statements involving decisions and Venn diagrams are helpful in understanding these laws.

Calculations are also important in the science of computers. The text you read on the computer screen is presented in a particular format. Calculations are certainly needed for these.
Geometry is used in the development of graphics. Actually a graphics screen resembles the co-ordinate plane. Just as we have points in the co-ordinate plane, we have pixels on the graphics screen. Though there are endlessly many points in any bounded part of the plane, while the number of pixels on the graphics screen is limited, yet the techniques of coordinate geometry can be used in drawing various figures on the graphics screen.

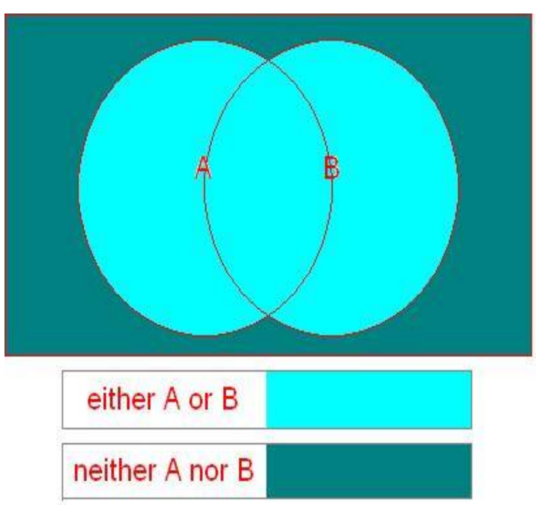
Various transformations play a part in the development of software. Two such transformations are famous as 'pop and push transformations'. As the graphs are useful in understanding different kinds of transformations, these help understand, in particular the Pop and Push transformations too.

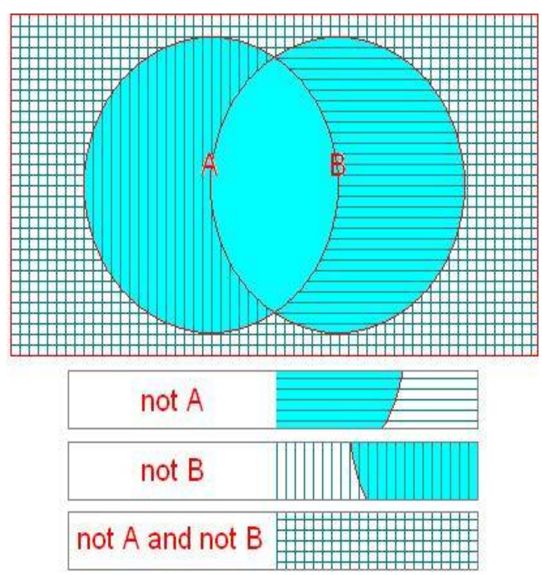
The classical computer programming language namely 'the C language' makes a lot of use of mathematics. Different graphics commands of this language are based on the mathematical logic. The commands for making the background make use of hexadecimal numbers.

To know about the role of mathematics in computer programming in detail and to see illustrations of Venn diagrams and graphs, you can visit **Mathematics in Computer Programming**.

Mathematics has played an important role in the old streams of engineering such as mechanical and electrical engineering. Mathematical methods are being used in the computer-programming too. We will illustrate some of these methods here.

See, it is well known that mathematical logic helps in the decision making. Suppose we happen to use the statement, 'if neither n is greater than 5 nor m is less than 4, then p=p+1'. To write this in a programming language, we will have to translate it into the form, 'if n is not greater than 5 and m is not less than 4, then p=p+1', which will be actually written as 'if n<=5 and m>=4, then p=p+1'. The logic used here is a De Morgan's Law, according to which 'neither A nor B' is equivalent to 'not A and not B'.





Mathematical calculations too play a part in the programming. Suppose there is a data file containing text data, which is to be read and displayed on the screen in a particular format. For this mathematical calculations will be needed.

When we make use of graphics for getting visual outputs and making the software user friendly, co-ordinate geometry plays its role. Let us see how:

Actually graphics screen is a matrix of pixels. The pixels are arranged in columns and rows; each pixel is thus assigned an ordered pair of numbers, . Thus the graphics screen can also be regarded as a set of these ordered pairs. In this way it is somewhat similar to the co-ordinate plane. Hence co-ordinate geometry can be used for drawing various figures on the graphics screen.

Comparison of a Graphics Screen and the Co-ordinate Plane

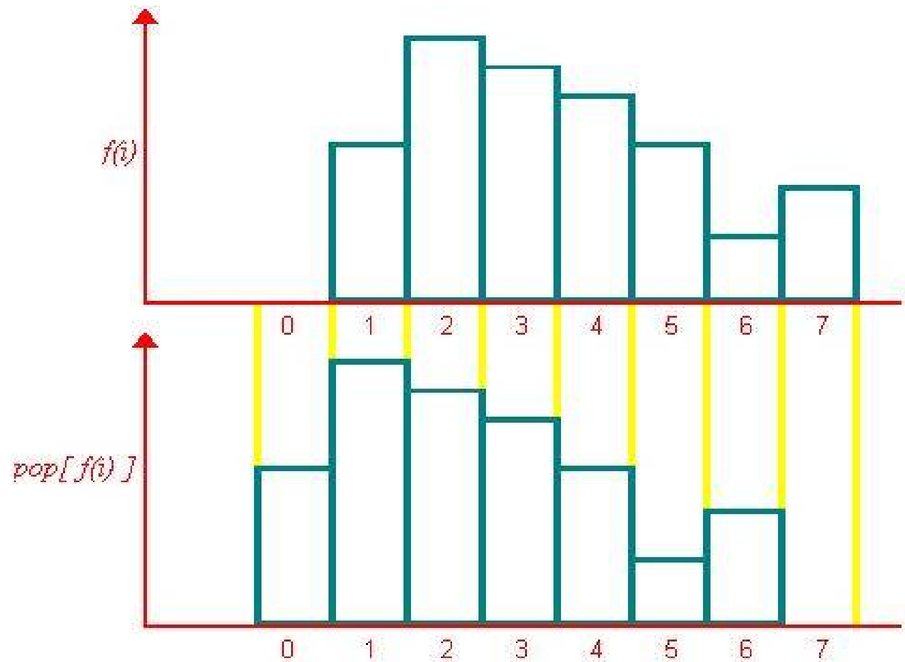
However as said above, the graphics screen is somewhat similar to the co-ordinate plane. So there is some difference too. To understand the difference, note that our three dimensional space is a continuum of points. The co-ordinate plane, being a subset of the space, is also a continuum of points; of course a two dimensional one. On the contrast, the graphics screen is a discrete structure. Here in lies even the scope of the development of (discrete) co-ordinate geometry similar to the traditional co-ordinate geometry.

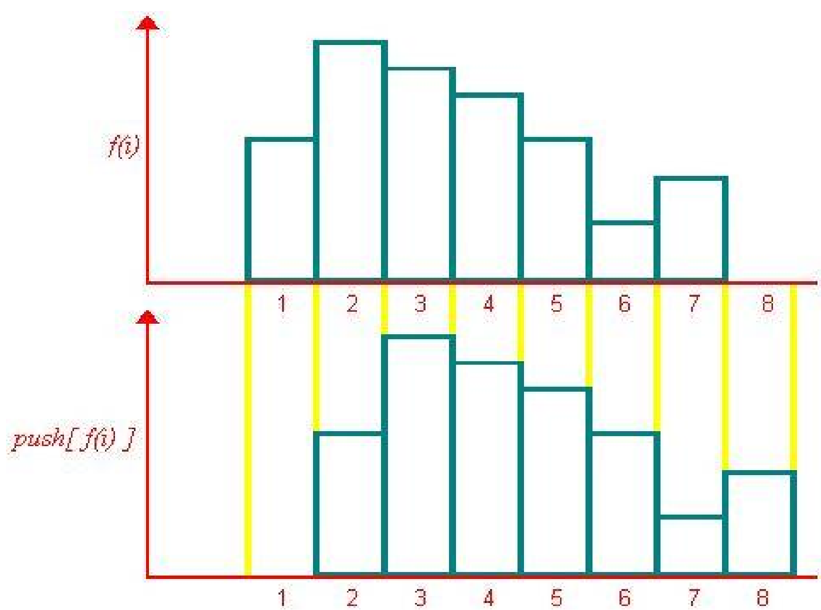
Pop and Push Transformations

Further, there are two transformations namely pop and push, which can be used to control the movement of graphics objects. Let a graphics object be represented with the help of a function f of i, where i varies from 1 to n.

Pop transforms f in such a way that pop of f at 0 equals f(1), pop of f at 1 equals f(2), pop of f at 2 equals f(3), and so on. Ultimately we have pop of f at n equal to 0. In the following illustration, n is 7, so pop of f at 7 equals 0. Thus pop transformation represents movement towards left by one pixel. By using this transformation repeatedly, the object can be moved left by any number of pixels.

Push transforms f in such a way that push of f at 1 is 0, push of f at 2 equals f(1), push of f at 3 equals f(2), and so on. Ultimately we have push of f at n+1 equal to f(n). As in the illustration, n is 7, so push of f at 8 equals f(7). Thus push transformation represents movement towards right by one pixel. By using this transformation repeatedly, the object can be moved right by any number of pixels.





Mathematics in C Programming

Up to now, we have illustrated the use of mathematical methods in the science of programming without regard to any programming language. Now we will illustrate the use of mathematics in C programming. But why should we take up C language? It is because, C is very important language. Its importance is understood by observing a similarity between programming and 'building-blocks', a game of children.

In a 'building-blocks' set, there are several kinds of blocks. There are (say) blocks representing bricks, doors and windows etc. These blocks are the units of a system. Using these, a child can make many kinds of buildings. But if, instead, some different kinds of rooms are already built in, which are to be used as units, then the child will be able to make a comparatively lesser kinds of buildings. Of course his task will become easier. Similar is the case of programming languages. Languages like C have a large number of basic commands. We can do many kinds of programming with the help of these commands. While the languages like flash facilitate specialized programming tasks, but cannot be used to do as many kinds of programming as can be done using C. For, in these languages, inbuilt routines have replaced the basic commands.
Now let us consider the C graphics. There are OR_PUT, AND_PUT, XOR_PUT and NOT_PUT commands. These commands work according to the rules of mathematical logic.

Further, in C there is a method of formation of background with the help of tiles. A tile of 8 X 8 size is represented by 8 binary strings, each of 8-bit length. These binary strings are represented by corresponding hexadecimal numbers. Thus a string of 8 hexadecimal numbers controls the formation of a tile and hence whole of the background.

Mathematical and technical lines are similar. Just like we have axioms in mathematics, we have basic facts of technology. As we prove the existence of a new mathematical object with the help of axioms, we make design of a new machine (or instrument) with the help of the basic facts of technology. Finally as we find the mathematical object which existence has been proved, we construct the technical object (machine or instrument) which design has been made.

Apart from this fundamental similarity between mathematics and engineering, there have been many applications of mathematics in various streams of engineering. Mechanical engineering is one of the oldest and Computer engineering is one of the latest streams, where mathematics finds maximum use.

All computer programs do some form of counting as a small part of a task. Counting a hundred items does not take a long time, even without a computer. However, some computers may have to count a billion items or more. If the counting is not done efficiently, it may take days for a program to finish a report when it should take only minutes. For example, the counting winning lottery numbers of all lottery tickets should involve stopping a ticket count when the minimum number of correct numbers cannot be reached on that particular ticket. When the lottery numbers on each ticket are presorted, the count can be very quick with a divide and conquer strategy. The branch of mathematics called combinatorics gives students the theory needed to code counting programs that include the short cuts that will reduce the run time of the program.

Algorithms

After a count has been completed, a task to do something with the actual number from the count is needed. The number of steps needed to complete a task should be minimized so the computer can return a result faster for a large number of tasks. Again, if a task needs to be done only 20 times, it will not take long even for the slowest computer. However, if the task needs to be done a billion times, an inefficient algorithm with too many steps could take days instead of hours to be completed, even on a million-dollar computer. For example, there are many ways to sort a list of unsorted numbers from lowest to highest, but some algorithms take too many steps, which could cause the program to run much longer than necessary. Learning the mathematics behind algorithms allows students to create efficient steps in their programs.

Automata Theory

Problems in computers are much bigger than just counting and algorithms. Automata theory studies problems that have a finite or infinite number of potential outcomes of varying probability. For example, computers trying to understand the meaning of word with more than one definition would need to analyze the entire sentence or even a paragraph. After all the counting and algorithms on the sentence or paragraph are done, rules to determine the correct definition are needed. The creation of these rules is part of automata theory. Probabilities are assigned to each definition depending on the results of the algorithm portion for the paragraph. Ideally, the probabilities are just 100 percent and 0 percent, but many real-world problems are complicated with no certain outcome. Computer compiler design, parsing and artificial intelligence make heavy use of automata theory.

Postgraduate in Mathematics

Continuing math research is important because

- incredibly useful concepts like cryptography and calculus and image and signal processing have and continue to come from mathematics and are helping people solve real-world problems.
- it is beautiful, and an art form, and more than that, an ancient and collaborative art form, performed by an entire community. Seen in this light it is one of the crowning achievements of our civilization.
- it trains people to think abstractly and to have a skeptical mindset.

Intended Learning Outcomes:

An ability to

- interpret and analyze mathematical and physical statements logically.
- prove or disprove mathematical statements.
- utilize software for computational and organizational purposes.
- demonstrate mathematical reasoning and problem solving.
- apply mathematics to model and solve real life problems
- collect and analyze data and make inferences.
- broaden and deepen mathematical knowledge independently.
- work smoothly as a leader as well as a member in a team.
- communicate mathematical knowledge spontaneously and efficiently.

- carry out the assigned duties quickly, professionally and ethically.

Research in Mathematics:

The significance of mathematics is two-fold, it is essential in the progression of technological innovation and two, it is essential in our knowing of the technicalities of the galaxy. And in here and now you should individuals for self improvement, both psychologically and in the office. Mathematics provides students with a exclusively highly effective set of resources to understand and change the globe. These resources include sensible thinking, problem-solving capabilities, and the capability to think in subjective ways. Arithmetic is essential in lifestyle, many types of career, technological innovation, medication, the economic system, the surroundings and growth, and in public decision-making.

One should also be aware of the extensive significance of Arithmetic, and the way in which it is improving at a amazing rate. Arithmetic is about routine and structure; it is about sensible research, reduction, computation within these styles and components. When styles are found, often in commonly different areas of technological innovation, the mathematics of these styles can be used to describe and control natural events and circumstances. Arithmetic has a persistent impact on our life, and plays a role in the prosperity of the individual.

The research of mathematics can fulfill a number of passions and capabilities. It produces the creativity. It teaches in clear and sensible thought. It is a task, with types of challenging concepts and unresolved problems, because it offers with the questions coming up from complex components. Yet it also has a ongoing drive to generality, to finding the right principles and methods to make challenging things easy, to describing why a situation must be as it is. In so doing, it produces a variety of terminology and concepts, which may then be used to make a essential participation to our knowing and admiration around the globe, and our capability to find and make our way in it.

Increasingly, companies are looking for graduate students with powerful capabilities in thinking and troubleshooting - just the capabilities that are designed in a mathematics and research level.