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A STUDY INTO THE CUTTING-EDGE ADVANCEMENTS IN MATHEMATICS WITH REFERENCE TO COMPUTER SCIENCE

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Abstract

Mathematical research in the ancient world was especially interesting when put in the context of philosophical ideas. No country has ever thrived without investing heavily in its children's education. It is crucial to achieving this requirement in order to be classified as a "Developed Nation" within a certain time limit. Allocating sufficient funds to Math and Computer Science programs at all educational levels is essential. In contrast to the study of mathematics for practical purposes, pure mathematics focuses only on the study of mathematical ideas themselves. Although the inspiration for these ideas sometimes comes from real-world problems, and the solutions often have practical applications, pure mathematicians are not typically driven by the potential utility of their work. Mathematics has been essential in the IT revolution. There are many examples of how computer science has contributed to modern life, including the information technology sector, the manufacturing sector, satellites, electronic banking and commerce, the communication revolution, the global positioning system (GPS), the geographic information system (GIS), remote sensing, and many more.

Keywords: Mathematics, Education, Computer Science, Pure mathematics, Applied Mathematics, Real-world Applications, Practical Applications, Information Technology, Satellites, E-Banking, E-Commerce, Communication Technology, Remote Sensing, etc.

I. Introduction

Mathematics was an interesting topic to master in the ancient world since it was often studied in conjunction with philosophical themes. Pythagoras, Aristotle, and Thales of Miletus are just a handful of the most well-known names in the history of philosophy. Bertrand Russell, who won the Nobel Prize and is still a professor, has joined the ranks of the most prominent philosophers in more recent times.

Topics like Statics, Dynamics, Hydrostatics, Hydrodynamics, Fluid Mechanics, Magneto-Hydrodynamics, Differential Equations, Astrophysics, Theory of Relativity and Cosmology, Field Theories, and many more are discussed in Applied Mathematics. On the other hand, subjects like algebra, trigonometry, analysis, calculus, geometry, topology, and so on are discussed in pure mathematics. The realm of applied mathematics has a larger scope[I].

People's thoughts in every region of the world are continually coming up with new points of view on a broad range of topics. These new points of view are being generated by people's ideas. It may become difficult for the human intellect to keep up with the rapid speed of the industry as a result of the exponential proliferation of new technology. As a result, it would seem that people of all various cultures are starting to believe that subsequent generations are growing less clever than the generations who came before them. The fact that younger generations are becoming more dependent on calculating machines including computers, rather than cultivating their mental ability and intellect, is a glaring drawback of the technological advancement that has primarily been achieved by industrialized countries. This is because younger generations would rather rely on calculating machines including computers than develop their mental ability and intellect. When it comes to doing mathematical operations, such as adding and subtracting, the younger generation of today prefers to use their smartphones instead of more traditional calculators. This is because smartphones are more convenient. For individuals to cultivate their mental ability, it is vital to combat the unhealthy dependency on calculators that some people have developed.

Due to the widespread application of mathematical ideas throughout many subfields of scientific research, the fields of mathematics and physics have a mutually beneficial connection. Not much longer after that, a subfield of mathematics that would later become known as statistics started to take shape. Throughout history, a variety of distinct subfields of mathematics have emerged, such as business mathematics, econometrics, biomathematics, operations research, and many more [II].

The study of mathematical ideas in isolation, without consideration of their application in other areas, is referred to as “pure mathematics”. Even though real-world problems might serve as a source of motivation for the development of new ideas, pure mathematicians are not often driven by the potential application of their work in the actual world. One of the reasons for this may be because the process of deducing the results of applying basic principles is not only attractive but also cognitively hard. This is one reason that might be given. The study of mathematical concepts with seemingly paradoxical properties, such as non-Euclidean geometries, Cantor's theory of infinite sets, and Russell's paradox, was not referred to as “pure mathematics” until the early 1900s when the term “pure mathematics” was first used to describe the field of study. Although the origins of pure mathematics may be traced back to Ancient Greece, the phrase “pure mathematics” did not come into use until the 1900s to denote the study of these ideas.

This gave rise to the idea that we have to reconsider what it means to be mathematically rigorous and re-create mathematics using axiomatic procedures from the ground up. As a direct result of this, we have been working on it. This led to a significant number of mathematicians shifting their attention away from applied mathematics and toward pure mathematics, which was a direct result of this development.

On the other hand, practically all mathematical theories continued to be inspired by issues emanating either from the actual world or from more particular subfields of mathematics. This was true for almost all mathematical theories. A significant number of mathematical ideas that, at first glance, did not seem to be tied to any practical application have found their way into fields such as physics and computer science. These fields include the study of space and time and how they work. Isaac Newton, a well-known scientist who worked in the early days of science, was the one who first established that the orbits of the planets are, in fact, conic sections. Apollonius was the first person to study conic sections, which are a kind of curve that may be found in geometry. The RSA cryptosystem, which is used often to maintain the security of communications conducted over the internet, is based on the fact that it is difficult to factor in huge numbers. This is because factoring in large numbers requires a lot of time and effort.

As a direct result of this, the demarcation line that separates pure mathematics and applied mathematics is now more of a question of the point of view of a philosopher or the judgement of a mathematician than it is a hard and fast boundary. For instance, there are some people working in an applied mathematics department who believe themselves to be pure mathematicians. Other people in the same department work in applied mathematics.

The idea of generality is very important in the field of pure mathematics, and research in this subfield of mathematics often follows a pattern that moves in the direction of gaining more and more generality over time. The applications and benefits of generalization that are listed below are a few examples:

If we first generalize mathematical theorems and structures, we will probably be able to grasp them more clearly and concisely. When the proofs and arguments that are being provided are more general, it is possible for them to be streamlined and made simpler so that they are easier to digest. By minimizing repetition in mathematical calculations, it is feasible to save both time and effort. Either by demonstrating a general conclusion as opposed to specific particular examples or by merging findings from many subfields of mathematical research, this may be accomplished.

In mathematics, the idea of generality may be helpful in discovering connections between different subjects that, at first appearance, seem to have little bearing on one another. Research into the manifestations of this shared structural base may be found in certain subfields of mathematics, such as category theory. The effect that focusing one's attention on the bigger picture has on one's innate intuitive capacities is not only contingent on the specific problem at hand but also on the individual's preferred method of intellectual pursuit. The impact can range from having no effect at all to having a significant negative impact. Some individuals are under the assumption that generalizations make it more difficult to utilize their intuition; yet, generalizations may also be useful when they give comparisons to areas in which a person already has a strong intuitive understanding.

Mathematical purists and practicing mathematicians have always had opposing opinions about the appropriate method to categorize one another about mathematics. Even though it has been misunderstood on several occasions, G.H. Hardy's article “A Mathematician's Apology”, which was first published in 1940, is considered to be one of the most well-known instances of this subject in the contemporary era. In this sense, the word “apology” has the antiquated meaning of “defend”, or “explain”, which is comparable to the way in which Plato’s Apology is read.

The notion that Hardy did not find the branch of mathematics known as applied mathematics to be interesting or exciting in any way is commonly believed and accepted. Even though Hardy favored pure mathematics, which he frequently compared to painting and poetry, he believed that the only real difference between pure mathematics and applied mathematics was the fact that the former attempted to express physical truth within a mathematical framework, while the latter expressed truths that were independent of the physical world. Hardy held the belief that the only real difference between pure mathematics and applied mathematics was the fact that the former attempted to express physical truth within a mathematical framework. This was only one of several philosophical speculations that Hardy put up. Hardy differentiated between “genuine” mathematics, “which has enduring artistic worth”, and “the boring and fundamental components of mathematics”, which had a function in practical application. “Genuine” mathematics “has lasting aesthetic value”, According to Hardy, “genuine” mathematics has “enduring artistic merit”.

Even though Hardy considered physicists like Einstein and Dirac to be “genuine” mathematicians, he maintained that “boring” mathematics was the only kind of mathematics that had any actual value. This was because at the time he wrote his Apology, he considered that general relativity and quantum physics were “useless”. Consequently, this result occurred. In addition, Hardy temporarily accepted the potential that certain types of beautiful, “real” mathematics may be beneficial at some time in the future. He did this in the same way as the unexpected advent of the application of matrix theory and group theory to physics had been a surprise.

In the Erlangen curriculum, geometry was seen as an example of generality since it included the study of space in conjunction with a set of transformations. As a result of this, it was able to include topology and several other types of geometry in addition to non-Euclidean geometries. Algebra, which is the study of numbers, may serve as a stepping stone to abstract algebra, which can be studied at the collegiate level. Calculus, which is the study of functions, may ultimately lead to studying mathematical analysis and functional analysis. On the other hand, learning calculus might lead to studying functions. There are several sub-specialties that fall under each of these more abstract schools of mathematics, and there are many linkages that can be drawn between pure mathematics and applied mathematics. The significance of abstract painting as a movement was already well-established by the middle of the twentieth century [III].

However, when put into practice, these developments resulted in a significant departure from the rules of physics, notably between the years 1950 and 1983. This divergence was most noticeable between the years 1950 and 1983. Vladimir Arnold is one of the critics who argue that there was an excessive amount of attention paid to Hilbert and not nearly enough attention paid to Poincare.

Vladimir Arnold considers this to be the case. These are the kind of arguments that have been made in retrospect. It would seem that this topic is still being discussed, with string theory advancing in one direction and discrete mathematics moving back toward proof as the essential concept.

In spite of what experts in either subject may have we think, there is a substantial degree of overlap between the domains of pure mathematics and computer science. This is true even though the two fields are often treated as separate entities. As someone who works in the software development industry while also seeking a degree in mathematics, we will find the field of pure applied mathematics in programming to be of a level of interest that is extremely high indeed. During my studies during the summer, we will get the opportunity to delve into the fascinating discipline of pure applied mathematics in computer science. We will find it to be a really fascinating area. It was something that piqued my curiosity quite a bit.

To both portray and abstract logical relationships, mathematicians utilize powerful metaphors that are referred to as “mathematical objects”. Addition, subtraction, multiplication, and division are the four basic arithmetic operations that are essential to gaining a rudimentary grasp of mathematics and are used often in day-to-day life. Mathematicians are responsible for the development of abstract algebras. These mathematicians formulated, in general words, the rules that numbers and operations are expected to comply with. These serve as models for other groupings of things that have well-defined connections between the many components that make up the group. Mathematicians have extended the notion of abstract geometry to encompass forms, as well as broadened the scope of the idea of topological space to include surfaces. Both of these occurrences are connected to one another [IV].

The breadth of human knowledge may be broadened as a result of the revelation of regularities via mathematical analysis that was previously concealed from our view. Math is now much more than just adding and subtracting; it now includes scientific data, measurements, and observations; inference, deduction, and evidence; and mathematical models of natural events, human behavior, and social systems. Math is now much more than just adding and subtracting; it is now. Math today encompasses a great deal more than only adding and subtracting numbers; it is presently. Work in mathematics requires more than just adding and subtracting numbers; in addition to that, it requires recognizing patterns, proving ideas, and making decisions based on relevant evidence. The origins of the mathematical theory are found in the investigation and documentation of patterns, both in behavior and in behavior patterns. Not just molecules and cells, but also things like numbers, probability, shapes, algorithms, and evolution are taken into consideration. This theory's purview encompasses all of these things and more. Even though mathematics is a field that focuses on abstract ideas and uses reasoning rather than empirical evidence to decide what is true, it does utilize techniques such as observation, simulation, and experimentation to arrive at its results. This is because mathematics is a field that relies on logic to determine what is true rather than empirical evidence. Because the mathematics can be used in so many different contexts, it serves a unique role in the classroom that is unmatched by any other topic. When it is at its finest, mathematics develops theorems and notions that are not just useful and helpful, but also beautiful and meaningful.

The scientific method is a way of doing research and drawing conclusions that makes heavy use of mathematical theorems as a rock-solid basis. In addition to providing theorems and theories, mathematics also offers a wide variety of novel ways of thinking, such as modelling, abstraction, optimization, logical analysis, concluding facts, and the use of symbols.

Some of the theorems and theories that can be found in mathematics are as follows: These are only a few instances among many more. Mathematics has a long tradition of being admired for its aesthetic appeal in addition to being appreciated for its practical utility. This adoration predates the modern appreciation of mathematics for its aesthetic appeal. This is because mathematics is an essential part of the way things are done in Western society. Abstract ideas such as symmetry, evidence, and the ability to adapt to new circumstances have benefited from the development of human intelligence and growth during the last three thousand years. These are only some of the many different kinds of abstract concepts that have benefitted. Mathematics is a fundamental component of every civilization on the planet, just as language, religious practice, and musical creation are.

Mathematics is the study of the structure and how it may be utilized to solve problems. The primary emphasis of mathematics is on the structure. It is fairly uncommon for students to not learn how to solve equations, trigonometry problems, analytic geometry problems, or calculus problems until they have graduated from high school or until they have finished the first year or two of college. These particular subdisciplines of mathematics are regarded as being of marginal significance. Subjects such as spaces with differentiable or integrable functions, geometric ideas like as surfaces, manifolds, and topological spaces, and algebraic systems such as groups and vector spaces are some of the topics that are covered in more advanced courses. Mathematical models that are generated from such structures are utilized in an attempt to explain and forecast events in a broad range of academic fields and subfields. These models are employed. Mathematics has been around since antiquity and has a significant influence on our modern lives; it is a broad discipline that includes numerous topics that are, unfortunately, mainly unknown to those who are not trained in the area. This is because mathematics is a broad discipline that includes numerous topics. This is because mathematics is a large field that encompasses a great deal of subject matter[V].

The study of pure mathematics should primarily be pursued to enhance one's understanding of mathematical concepts. Therefore, at first glance, pure mathematics might appear to be unrelated to the real world and too abstract to be of any practical use. On the other hand, developments in pure mathematics have led to a broad range of applications that are useful in many different settings. This is because pure mathematics is becoming more and more abstract. Algebra, analysis, geometry, and logic are four classic subfields of study that have been around for a very long period. However, throughout the history of mathematics, some of the most exciting developments have emerged as a result of interaction across diverse fields. This has been the case for several different domains. This has been the situation all along.

Algebra is a discipline of mathematics that focuses on the study of very abstract mathematical structures. Its name comes from the word “algebra”, which means “to analyze”. One field of study is called algebra. Examples of these kinds of structures include groups, rings, and fields, amongst others. Integers, polynomials, and matrices are some of the most popular forms of structures, and these structures extend the characteristics of those sorts of structures. Algebra’s approach, which is both abstract and universal, has shown to be useful in the process of problem-solving across a wide range of disciplines, not only in mathematics. For instance, if we want to trisect an angle, we can’t use a straightedge and compass since doing so would require us to cut through the vertex of the angle, which is something that can only be shown by the use of algebraic methods.

In their respective spheres of study, the subfields of quantum mechanics and physical chemistry have found significant applications for group theory. In addition to this, coding theory and cryptography, two additional contemporary areas of research, have discovered applications for algebra [VI].

During analysis, we look at processes that may continue for an infinite amount of time. As a consequence of this, the focus is not on isolated occurrences but rather on continuous processes. Calculus is the field of mathematics that analyses continuous change. Calculus includes both differential and integral analysis. It is constructed from the bottom up, with the most basic ideas, such as function and limit, being used as a starting point. One's comprehension of functions in both real and complex variables may be broadened and improved via the use of analysis. The field is very ubiquitous, and it may be used in a large range of applications that include the whole of both pure mathematics and applied mathematics. This makes the field extremely important.

The study of shapes and the qualities that they retain after being subjected to a wide range of transformations, including curves and surfaces and their higher-dimensional counterparts is what geometry is all about. Geometry is the study of shapes and the qualities that they retain after being subjected to a wide range of transformations. The study of forms and the attributes that they maintain after being exposed to a broad variety of changes is the focus of the field of study known as geometry. In their daily work, the mathematical disciplines of geometry and topology often draw upon ideas and methods derived from algebra and analysis. The study of geometry is pertinent to this conversation since it assists us in comprehending nature as well as the organization of spatial connections, both of which are vital. The discipline of mathematics is constructed on the bedrock of logical reasoning. The nature of mathematical truth and proof, the process by which mathematical claims are established, and the sorts of things that may be shown within a mathematical framework are some of the topics that are researched in this area of inquiry. According to a well-known theorem that is ascribed to Kurt Goedel, there are true assertions that can neither be proven nor refuted. These claims cannot be verified in any way. According to this theorem, there are statements of this kind present in every logical system that is exhaustive enough to encompass mathematical concepts. The study of computability is one of the several significant applications of logic that are relevant to computer technology.

Although the field of computer science did not advance in the same manner that mathematics did, it did grow in a great many other areas at the same time. A sizeable portion of the programs that we use daily is composed of what is known as "object-oriented" software. The ones and zeroes that allow us to traverse the internet and switch on the parking sensors in our automobiles are neatly organized and interact with one another in a manner that is determined by a predetermined set of rules. This allows us to do both of these things. Polymorphism and generic programming make it possible for programmers to design templates that describe the expected behavior and appearance of a specific kind of object. These templates can be used to create programs. The meanings of these two concepts are frequently confused with one another. comparable to anything that can be found within the realm of mathematics.

Converting between the two should not be too difficult since “object-oriented” is a feature that is shared by both mathematical ideas and computer languages.

In pure mathematics, the focus is on proving theorems by using techniques that are precise from a mathematical standpoint, deducing conclusions using logic, and abstracting concepts. If we have a background in mathematics, it may help us think more creatively and critically whether we will be trying to solve a problem or analyze some information. This is true whether we will be trying to solve the issue or analyze the information. Algebraic structures and the qualities that characterize them at all levels of complexity, from the most basic to the most sophisticated, are the major focus of the research that is conducted in this particular area of study.

II. Role of Mathematics in Human endeavor

The mathematical analysis aids our understanding of the world by drawing attention to underlying relationships and patterns. Contemporary mathematics encompasses a wide range of topics, from scientific data and measurements to inference and proof, as well as mathematical models of the physical world, human behavior, and social interactions. Math is therefore about much more than just numbers and shapes. One definition of mathematics is “the study of everything that can be counted”. Some of us may believe that counting is a very important skill for us to have. Mathematics is essential for counting things like the members of our families, the students in our classrooms, the rupees in our wallets, the runs scored in a cricket game, and the weeks, months, and years that pass. Essential math skills include accurate counting, adding, subtracting, multiplying, and dividing [VII].

Mathematical laws govern even the workings of nature. We are highly attuned to the symmetry present in our surroundings and have a deep appreciation for patterns. Research everything in nature to see if there is any symmetry or pattern. The transition from one state to another, such as day to night, summer to winter, etc. We may find almost infinite instances of symmetry, forms, and patterns in nature, particularly among plants. Numerous creatures, objects, photographs, and other things provide such instances. The time the sun rises and sets is consistent every day. There's a magic hour when we can finally see the stars. Physics and astronomy, like all other branches of natural science, use mathematics as a basic tool. This topic has strong ties to Earth and the natural world.

1. Mathematics and Its Importance in Brain Growth

No other topic challenges students' brains as mathematics does, making math education crucial for intellectual growth. Developing one's ability to think critically is facilitated through problem-solving. It takes some serious mental exertion to solve mathematical puzzles. Whenever a kid is presented with a math issue, his or her mind naturally gravitates toward finding a solution. The creative and constructive processes behind each mathematical problem need a certain sequence. As a result, arithmetic helps kids grow their full brains. Mathematical training also fosters a practical, analytical mindset that may be put to use in many other areas of life. Motivates one to be self-reliant, patient, and resolute. The condition also inspires intrepidness and creativity.

2. Math's Importance in Advancing our Career

Education's primary goal is to provide young people with the skills they need to get a stable income and establish their own lives. If we want to get there, math is the single most important subject. Engineering, architecture, banking, commerce, agriculture, tailoring, carpentry, surveying, and office work are just some of the occupations that rely heavily on mathematics, and this course helps students be ready for those and more.

3. Mathematical Contributions to Moral Development

An integral element of living, morality is influenced by factors such as context, circumstance, and individuality. Students' moral growth may be aided by studying mathematics since mathematical literacy is associated with positive character traits. All the qualities essential to building a solid persona are fostered there. The youngster is working on developing qualities like tidiness and realism.

4. What Mathematics Can Do for our Soul

It seems that mathematics has the most potential for fostering the development of introspective skills and, for those who are more susceptible, a feeling of the beauty of a solution. Solving mathematical puzzles is fun, particularly when the solutions are accurate. At that age, every kid is happy, secure, and confident in their abilities. An adamant "math hater" may fail to appreciate the beauty of a particularly elegant solution. That way, the kid feels praised, accomplished, and happy with his or her achievements. As a result, math encourages students' intellectual growth, allows them to pursue their many passions, and makes better use of their spare time [VIII].

5. Math's Importance to Civilization's Progress

This helps the student understand how mathematics has played a role in shaping human culture throughout history. Someone with this understanding may see the value of mathematics in the arts and the elevating of human existence.

6. Math's Role in a Better Education System:

The educational system, including mathematics, has a significant impact on the lives of young people. Math is a prerequisite for practically every subject taught in American schools and universities, including Physics, Chemistry, Life-Science, Economics, Business and Accountancy, Geography, History, Psychology, Architecture, Design, Computers, Statistics, Business, etc. Tailoring, carpeting, cooking, cosmetics, sports, agriculture, etc. all need a basic understanding of mathematics. Conductors, shopkeepers, truckers, musicians, magicians, and cashiers are just some of the many professions that put basic math skills to work every day.

7. Mathematical Contributions to Social Progress

Human survival depends on the help of others since humans are social creatures. Working together helps we become more sociable. It has been suggested that learning to work together on projects might help with social development in general. Understanding mathematics is essential for social interaction due to the reciprocal nature of the process. Mathematical expertise is crucial in the commercial and manufacturing industries. Changes in social structure brought about by contemporary conveniences like transportation networks, communication channels, and scientific and technological advancements may be directly attributed to the development of mathematics. As such, mathematics has been crucial to our growth as a species and our capacity to comprehend how it got here. A society, or human society, is a significant social group of people who live in the same physical or virtual location, are governed by the same governmental system, and adhere to the same cultural norms and values. A society, in a broad sense, may be seen as an economic, social, or industrial system comprised of different kinds of people.

8. The Role of Mathematics in National Prosperity:

The importance of mathematics in the current world cannot be overstated. It's the bedrock of economics and the key to understanding the world around us. It is crucial in the fields of physics, engineering, business, finance, and other IT-related fields. It's also getting more and more attention in the medical, biological, and social sciences. Most advances in science and industry are grounded in mathematics. The development and control of complex technological systems rely heavily on mathematical inputs and outcomes. More and more contemporary structures and processes are too complicated for human understanding without resorting to mathematics [IX].

9. Math’s Role in the Development of New Scientific Understanding and Technological Innovations: Mathematics’ “functional” nature results from its use as the lingua franca of the STEM disciplines and its centrality to their progress. Indeed, one might argue that modern science and technology would not exist without this kind of participation, which dates back to the very beginnings of mathematics. Recent

years have seen a remarkable expansion in the application of mathematical techniques in the social, medical, and physical sciences; this has solidified mathematics' place in all school curricula and created a high demand for mathematical education at the collegiate level. Much of the need may be traced back to the requirement for mathematical and statistical modelling of occurrences. In addition to its central position in the physical sciences, such modelling also makes substantial contributions to the fields of biology, medicine, psychology, economics, and business. In both the 20th and 21st centuries, math has been effectively used to advance scientific knowledge and technological development [X].

10. Math's value to the scientific and technological communities continues to rise. Despite the growing importance of STEM subjects, mathematics instruction remains vital in K-12, postsecondary, and professional contexts. It's a yearly tradition for there to be a big deal when test results are released in mathematics. A number of areas where female students have underachieved are now under the spotlight as a consequence of these findings. Because of this, women have changed their academic focus and career path. Their inability to perform up to requirements has been blamed on a deficiency in their mathematical literacy. This is the understanding that what society requires in terms of productive individuals has changed very little, if at all, in response to what is taught in schools. Gender disparities in this area included concerns about unequal representation in the workforce and in higher education. The importance of learning mathematics is growing as our society shifts toward a more technological and quantitative mindset.

11. How Math Helps People Grow Spiritually and Culturally:

However, the cultural importance of mathematics is mostly dictated by its perceived educational usefulness, even though mathematics possesses inherent beauty and aesthetic appeal. Mathematics is considered educationally valuable in a culture that places a premium on logical thinking and behavior, and its achievements and structures are widely recognized as being among the greatest intellectual achievements of the human race. Many people believe that learning mathematics may help students become more creative thinkers and problem solvers, which is a valuable asset in achieving the greater goals of learning and developing one's mind [XI].

12. How Math Helped Advance Medicine and Farming:

Agriculture, ecology, epidemiology, tumors, and heart model simulations, DNA sequencing, and gene technologies all rely heavily on mathematics. Various diagnostic and sensor technologies rely on it as well as medical devices.

There are several ways in which mathematics stands out as remarkable. Math is distinct from other disciplines because of its centrality to the study of science, technology, and engineering and its status as an abstract universal language. Second, it has already been shown that mathematics is crucial in many other contexts, including the economic sector and everyday life.

III. Poincaré Conjecture and Network Topologies

The Poincaré Conjecture, presented by Henri Poincaré in 1904, draws the same result for manifolds in three dimensions. According to the Poincaré Conjecture, the simplest connected compact 3-manifold must be a sphere [XII].

In the year 1904, French mathematician Henri Poincaré was the first to formally distinguish topology from the sciences of analysis (the branch of mathematics that developed from calculus) and geometry. The field of topology can largely be traced back to him. Topology is sometimes referred to as "rubber sheet geometry" due to its focus on the characteristics of surfaces that may be stretched in any direction. Repairing tears is also forbidden.

Things we're used to dealing with, like ourselves and the vast majority of other items, often have three dimensions. However, they are restricted to using just two surfaces. A topologically unique property of boundaryless two-dimensional surfaces is their hole count this includes surfaces that loop around and close in on themselves, such as human skin. In contrast to the torus, which is perforated all around, a spherical one contains no holes. The transformation from a sphere to a torus is impossible, and vice versa.

The discussion of three-dimensional things with flat surfaces just begins here, however. Because of their malleability, curved 3D regions might be used to represent the border of 4D objects, for instance. Even though laypeople have only sketchy mental ideas of such domains, mathematicians may describe and analyze them using symbolic language. The reason is that symbolic language is more abstract than human cognition. Poincaré developed a powerful tool called the "basic group" that can detect anomalies like holes, twists, and other features in multi-dimensional spaces. He proposed the idea that any significant topology concealed in three-dimensional space would be easily seen by even the most fundamental group. The border of the ball's 4D space is a hypersphere, hence any 3D space with a "trivial" basic group must be a hypersphere [XIII].

William Thurston, a current professor at Cornell University, developed the theory that each three-dimensional space may be divided into eight alternative geometries, each of which has a separate uniform geometry, back in 1982. As a result of this concept, the geometrization hypothesis was developed.

So long as Thurston's finding holds true, the Poincaré problem will be answered. The reason for this is that only one of the eight possible geometries—the sphere—can have a trivial fundamental group. In 1982, Columbia University professor and expert on the topic Richard Hamilton proposed a plausible method for proving it. He proposed beginning the process at any uneven area and letting it progress toward a smoother one.

Ultimately, this procedure would yield an area that has been "geometrized" in the Thurston fashion. Since Hamilton's equation for geometric development mimics the heat equation from physics, it is named "Ricci flow" after an early differential geometer named Gregorio Ricci-Curbastro. This action was taken to better control the influx. The Ricci flow may be recognized by the fact that areas of high curvature tend to spread out into regions of lower curvature, resulting in a uniform curvature throughout the whole space.

Hamilton's technique works very well when applied to 2D surfaces. The trend of more narrow “necks” like the one seen on the cover of this issue will only increase in the coming years. However, in three-dimensional spaces, Ricci flow may run into obstacles. Pinch-off capabilities of necks allow for the area to be segmented into zones of different uniform shapes. Hamilton was a pioneer in the study of Ricci flow, but he was unable to stop the singularities from popping up. Because of this, it seemed that all research-related activity ceased somewhere in the middle of the 1990s. When the Poincaré problem was chosen as one of the Millennium Prize themes in 2000, each carrying a financial prize of one million dollars, most mathematicians assumed that no substantial advance would be made in this field by the end of that year [XIV].

The Ricci flow is a geometric flow important to differential geometry. It is a technique for fixing errors in the metric of a Riemannian manifold by distorting the metric in a way analogous to the way heat spreads.

Put another way, the Ricci flow equations may be used to provide an entropy-based quantitative measure of the geometric flow that Poincare and Perelman hypothesized and demonstrated, respectively (these are non-linear diffusion equations). Consistent with the ideas and premises put out by Perelman, social networks that have formed through time tend to have comparable geometric features. A great understanding of a node’s reach and the virality of a particular social network post may be gained by calculating its entropy and how closely it is tied to the geometric flow of the network.

Perelman’s and other topological proofs might benefit from the usage of social networks for the most reliable checks. The topological transformation equations may also be used to modify social networks such that information flows more smoothly via selected nodes. In social networks, certain nodes play the role of catalysts, accelerating the spread of information, while others play the role of dampeners, slowing it down. Some nodes in social networks behave similarly to the geometrical objects studied for the Navier-Stokes equation and Perelman's work [XV].

Perhaps due to the scarcity of real-world use cases for topological behavior in societal contexts, this topic has received very little attention. But social networks are surrogates for all communication in the real world, and they are governed by several topological phenomena that we should be aware of if we are to improve upon existing structures and generate more catalysts and fewer dampening agents for the increased information flow provided by marketing agencies via social networks.

IV. Conclusion

It is impossible to overstate the importance of mathematics to the growth of both the individual and the human species. Mathematical comprehension of space-time, the physical world, and its natural patterns, as well as the capacity to calculate, which is linked to the efficacy of technology and the efficiency of social organization, demonstrate the significance of mathematics to the development of civilization.

Understanding the natural world and its patterns is important to developing both of these abilities. The people of a society are the ones who establish its government and figure out how to put its natural resources to good use in building its infrastructure. The people that make up a society are responsible for creating it. As a consequence, we will look at how mathematics contributes to personal and societal growth.

Mathematical reasoning aids in grasping the relevance of one's ideas and inferences. A reference to the branch of learning and living deals with quantitative and arithmetic considerations. It has become an integral part of our modern society and pervades every facet of our daily lives.

The tremendous growth in computing power is primarily attributable to mathematical discoveries. Using computers has greatly improved the following areas:

Manufacturing, information technology, satellites, electronic banking and electronic commerce, the communication revolution, global positioning system (GPS), geographic information system (GIS), and remote sensing are all examples of related sectors.

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Conflict of Interest:

The authors declare that no conflict of interest to report the present study.

References

I. A. Ali, S. Talpur and S. Narejo, "Detecting Faulty Sensors by Analyzing the Uncertain Data Using Probabilistic Database," 2020 3rd International Conference on Computing, Mathematics and Engineering Technologies (iCoMET), 2020, pp. 1-7, doi: 10.1109/iCoMET48670.2020.9074069.

II. B. Musil, S. Gartner, I. Pesek and M. Krašna, "ICT competences assessment through ICT escape room," 2019 42nd International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), 2019, pp. 622-626, doi: 10.23919/MIPRO.2019.8757043.

III. C. H. Hsu, C. E. Montenegro Marin, R. Gonzalez Crespo and H. F. Mohamed El-sayed, "Guest Editorial Introduction to the Special Section on Social Computing and Social Internet of Things," in IEEE Transactions on Network Science and Engineering, vol. 9, no. 3, pp. 947-949, 1 May-June 2022, doi: 10.1109/TNSE.2022.3167460.

IV. D. Połap, G. Srivastava, A. Jolfaei and R. M. Parizi, "Blockchain Technology and Neural Networks for the Internet of Medical Things," IEEE INFOCOM 2020 - IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS), 2020, pp. 508-513, doi: 10.1109/INFOCOMWKSHPS50562.2020.9162735.

V. H. Dehghani, "The effectiveness of a mobile application “Kalcal” on the learning of mathematics in students with dyscalculia," 2019 International Serious Games Symposium (ISGS), 2019, pp. 1-6, doi: 10.1109/ISGS49501.2019.9047035.

VI. M. de Berg, H. L. Bodlaender, S. Kisfaludi-Bak and S. Kolay, "An ETH-Tight Exact Algorithm for Euclidean TSP," 2018 IEEE 59th Annual Symposium on Foundations of Computer Science (FOCS), 2018, pp. 450-461, doi: 10.1109/FOCS.2018.00050.

VII. M. T. Azhar, M. B. Khan and M. M. Zafar, "Architecture of an Enterprise Project Life Cycle using Hyperledger platform," 2019 13th International Conference on Mathematics, Actuarial Science, Computer Science and Statistics (MACS), 2019, pp. 1-5, doi: 10.1109/MACS48846.2019.9024764.

VIII. R. A. Canessane, R. Dhanalakshmi, B. Pavithra, B. Sasikanth and C. Sandeep, "HUSP Mining Techniques to Detect Most Weighted Disease and Most Affected Diseases for the Healthcare Industry," 2019 Fifth International Conference on Science Technology Engineering and Mathematics (ICONSTEM), 2019, pp. 25-32, doi: 10.1109/ICONSTEM.2019.8918784.

IX. R. A. Canessane, R. Dhanalakshmi, B. Pavithra, B. Sasikanth and C. Sandeep, "HUSP Mining Techniques to Detect Most Weighted Disease and Most Affected Diseases for the Healthcare Industry," 2019 Fifth International Conference on Science Technology Engineering and Mathematics (ICONSTEM), 2019, pp. 25-32, doi: 10.1109/ICONSTEM.2019.8918784.

X. S. Dragoumanos, L. Garcia, D. Schultz and L. Bowlby, "IEEE pre-university science, technology, engineering, and mathematics outreach: Share. Give back. Inspire," in IEEE Potentials, vol. 41, no. 5, pp. 12-14, Sept.-Oct. 2022, doi: 10.1109/MPOT.2022.3181437.

XI. S. H. Said Abdelaziz Abdelrazek, H. B. Kutty Mammi and M. M. Din, "Privilege Escalation Focused Offensive Security Training Platform," 2021 International Conference on Data Science and Its Applications (ICoDSA), 2021, pp. 169-174, doi: 10.1109/ICoDSA53588.2021.9617497.

XII. S. Hu, L. Shuai, Q. Yang and H. Chen, "Study on Wireless Signal Propagation in Residential Outdoor Activity Area Based on Deep Learning," 2021 International Conference on Computer, Control and Robotics (ICCCR), 2021, pp. 225-230, doi: 10.1109/ICCCR49711.2021.9349418.

XIII. S. Mistry and L. Wang, "Efficient Prediction of Heart Disease Using Cross Machine Learning Techniques," 2022 IEEE Asia-Pacific Conference on Image Processing, Electronics and Computers (IPEC), 2022, pp. 1002-1006, doi: 10.1109/IPEC54454.2022.9777309.

XIV. S. Xiong, Q. Cao and W. Si, "Adaptive Path Tracing with Programmable Bloom Filters in Software-Defined Networks," IEEE INFOCOM 2019 - IEEE Conference on Computer Communications, 2019, pp. 496-504, doi: 10.1109/INFOCOM.2019.8737387.

XV. T. Ostojic, "Applicability of knowledge: Motivational factor for beginning learners of programming," 2018 41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), 2018, pp. 0491-0493, doi: 10.23919/MIPRO.2018.8400093.