continuum

Mathematics in India: Ancient to Modern World

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I, Prof. Madhu Pruthi, hereby declare that the particulars given are true to the best of my knowledge and belief.

Date: April 2025   Prof. Madhu Pruthi

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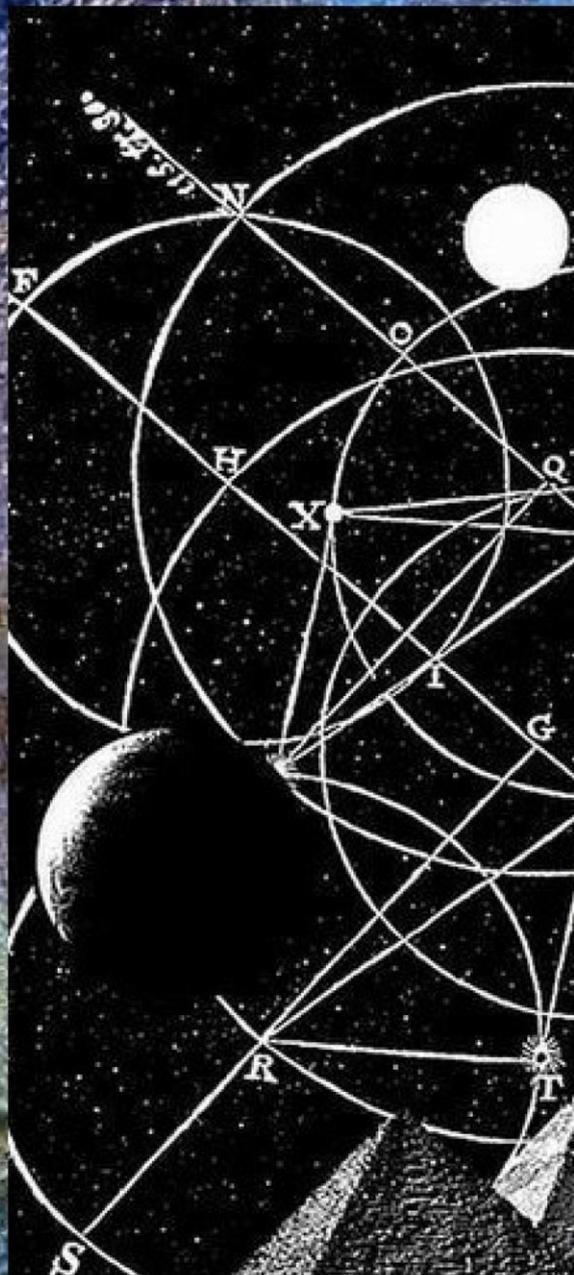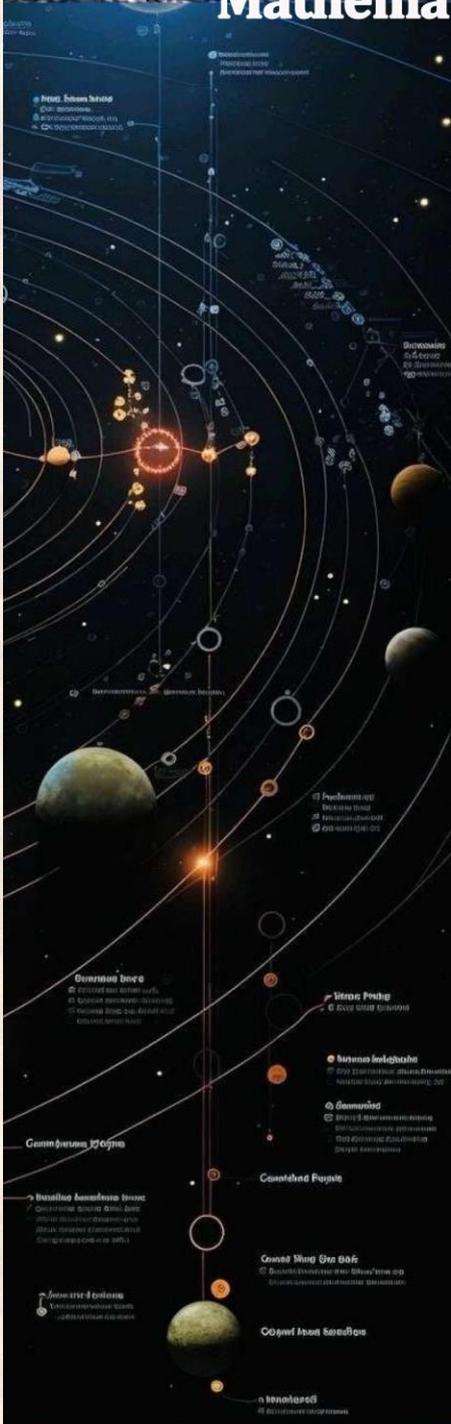
(University of Delhi)

Department of Mathematics

CONTINUUM

Mathematics in India: Ancient to Modern World

"Only Knowledge can provide salvation"

The Annual Magazine

2025

EDITORIAL BOARD

MESSAGE FROM THE PRINCIPAL'S DESK

Prof. Madhu Pruthi
Principal

It gives me immense pleasure to present the latest edition of Continuum 2025, the annual magazine of the Department of Mathematics, Keshav Mahavidyalaya. This year's theme, "Mathematics in India: Ancient to Modern World" celebrates our nation's remarkable legacy in mathematics — from the pioneering brilliance of Aryabhata to the innovations shaping the present and future.

The Department of Mathematics has consistently exemplified academic excellence, blending analytical rigor with creative thinking. This magazine is a reflection of that spirit — a testament to the dedication, passion, and collaborative efforts of our students and faculty. Each article not only explores mathematical ideas but also showcases a deep enthusiasm for learning and discovery.

I extend my sincere appreciation to the editorial team for their meticulous work and to the faculty members for their unwavering support and mentorship. Together, they continue to foster an environment where young minds can thrive and excel.

May Continuum 2025 inspire its readers and continue to be a source of knowledge, curiosity, and pride for our academic community.

With best wishes

MESSAGE FROM THE VICE-PRINCIPAL AND TEACHER-IN-CHARGE'S DESK

Prof. Arpana Sharma
Vice-Principal
and
Teacher-in-Charge

It is with great enthusiasm that I present the latest edition of Continuum, our cherished magazine from the Department of Mathematics at Keshav Mahavidyalaya. This year's theme "Mathematics in India: Ancient to Modern World" takes us on a fascinating journey — from the timeless insights of ancient scholars to the groundbreaking innovations of today.

This publication stands as a vibrant reflection of the dedication, creativity, and collaborative spirit of our department. The guidance of our faculty, the enthusiasm of our students, and the tireless efforts of the editorial team have transformed ideas into a meaningful celebration of knowledge.

I take immense pride in the way our students and faculty continue to transform challenges into opportunities for growth and learning. Their dedication, enthusiasm, and innovative spirit shine through every page of this publication, exemplifying our commitment to holistic education and academic excellence.

My heartfelt congratulations to the Editor, editorial board, and all faculty members for their exemplary work. May this edition continue to inspire curiosity, spark innovation, and deepen our appreciation for the rich legacy of mathematics.

MESSAGE FROM THE EDITOR-IN-CHIEF'S DESK

Dr. Ashish Bansal
Editor-in-Chief

Dear students, welcome to this fresh edition of Continuum, our annual magazine celebrating the transformative journey of mathematics at Keshav Mahavidyalaya. This year's theme, "Mathematics in India: Ancient to Modern World," invites you to explore a remarkable continuum where age-old wisdom gracefully converges with modern innovation.

Mathematics is more than a study of numbers and theorems — it is a timeless narrative interwoven into our cultural heritage. Ancient Indian mathematicians laid the foundation for ideas that continue to inspire today's breakthroughs, and each article in this edition pays tribute to that enduring legacy. I would also like to extend a special note of appreciation to our dynamic student editorial team. Their fresh perspectives, enthusiasm, and creative spirit have added a unique voice to this publication, making Continuum a true collaborative masterpiece.

Within these pages, you will discover the elegant dance of numbers and the spirit of inquiry that defines our discipline. Let the harmonious blend of ancient insights and modern perspectives ignite your passion for discovery and inspire you to contribute to the evolving legacy of mathematics.

ABOUT THE DEPARTMENT

Mathematics fosters analytical thinking and equips individuals with the ability to tackle real world challenges logically. The Department of Mathematics at Keshav Mahavidyalaya offers key academic programs, including B.Sc. (H) Mathematics and B.Sc. (Prog.) Mathematical Sciences, as well as the interdisciplinary B.Sc. (Prog) Physical Sciences, which is conducted in collaboration with the Departments of Physics and Computer Science. The department boasts a team of highly qualified and experienced faculty members dedicated to imparting their expertise to students. These accomplished educators not only guide students in their academic pursuits but also provide mentorship for career advancement. Through mentor-mentee initiatives, faculty members extend their support beyond academics, helping students navigate personal and family-related challenges. To enhance students' comprehension and practical application of concepts, the department integrates hands-on learning through the Information and Communication Technologies (ICT) Lab. These interactive lab sessions cultivate logical reasoning and analytical skills, making learning more engaging and thought-provoking. Additionally, the Department of Mathematics has been hosting its annual mathematics event, MODULUS, since 2008. This event provides students and faculty an opportunity to engage in stimulating workshops, learning sessions, and competitions. The event is designed to strengthen students' logical and mathematical aptitude while boosting their confidence. As an inter-college gathering, MODULUS features a variety of enriching activities, including guest lectures and seminars. Many of our students have consistently achieved top ranks in university examinations. They have excelled across various domains, securing placements in esteemed organizations. Furthermore, a significant number of graduates pursue postgraduate studies at prestigious universities in India and abroad, continuing their academic and professional growth.

FACULTY AT THE DEPARTMENT

Prof. Rubina Mittal
Position: Professor
Teaching Experience: 30 years
Highest Qualification: Ph.D., University of Delhi
Areas of Research Interest: Optimization, Quality Management and Reliability

Dr. Rajni Mendiratta
Position: Associate Professor
Teaching Experience: 30 years
Highest Qualification: Ph.D., University of Delhi
Areas of Research Interest: Geometric Function Theory, Complex Analysis

Prof. Arpana Sharma
Position: Professor
Teaching Experience: 29 years
Highest Qualification: Ph.D., University of Delhi
Areas of Research Interest: Operations Research, Mathematical Modelling

Prof. Ritu Arora
Position: Professor
Teaching Experience: 22 years
Highest Qualification: Ph.D., University of Delhi
Areas of Research Interest: Optimization, Operations Research, Mathematical Programming

Dr. Ashish Bansal
Position: Associate Professor
Teaching Experience: 15 years
Highest Qualification: Ph.D., University of Delhi
Areas of Research Interest: Harmonic Analysis, Uncertainty Principles, Representation Theory of Locally Compact Groups and Nilpotent Lie groups

	Prof. Dhanpal Singh **Position: Professor** **Teaching Experience: 15 years** **Highest Qualification: Ph.D., CCS University Meerut** **Areas of Research Interest: Operations Research, Mathematical Modelling**
	Dr. Richie Aggarwal **Position: Assistant Professor** **Teaching Experience: 11 years** **Highest Qualification: Ph.D., University of Delhi** **Areas of Research Interest: Optimization, Mathematical Modelling, Innovation Diffusion Models**
	Dr. Ram Chander Verma **Position: Assistant Professor** **Teaching Experience: 11 years** **Highest Qualification: Ph.D., Guru Jambheswar University of Science & Technology** **Areas of Research Interest: Solid Mechanics**
	Dr. Panjabi Singh **Position: Associate Professor** **Teaching Experience: 9 years** **Highest Qualification: Ph.D., J.S. University, Shikohabad** **Areas of Research Interest: Fluid Dynamics**
	Mr. Deepak Kumar Meena **Position: Assistant Professor** **Teaching Experience: 6 years** **Highest Qualification: M.Sc. Mathematics, IIT Roorkee** **Areas of Research Interest: Applied Mathematics**
	Dr. Janson Antony A **Position: Assistant Professor** **Teaching Experience: 3 years** **Highest Qualification: Ph.D., University of Delhi** **Areas of Research Interest: Operator Spaces, Operator Algebras, Linear Dynamics**

STUDENTS' WORKSHOP ON
REAL LIFE APPLICATIONS OF MATHEMATICS

"Mathematics is not just a subject, but a tool for understanding the world. Its real-life applications in medicine, finance, and environmental sustainability demonstrate its impact on our daily lives. Mathematics is the language of science, describing the world's intricacies and unlocking its potential."

—Galileo Galilei

To highlight the importance of Mathematics in Real Life, MODULUS - The Mathematics society of Keshav Mahavidyalaya conducted a workshop titled "Real Life Applications of Mathematics" on November 13, 2024. The promotion of the workshop was done through our social media handles (@mathsoc_kmv) which encourages the students to attend the event. The event aimed to provide valuable insights of mathematics in the real and technological world. More than 100 students registered for event got benefitted.

The workshop emphasized the presence of Dr. Ashish Bansal, Associate Professor, Department of Mathematics, Keshav Mahavidyalaya, as our honorable speaker. He shared his experiences, expertise, and advice with the attendees. The event commenced with a brief introduction of the topic by Dr. Bansal, setting the tone for an enriching session. Following this, he delivered an engaging presentation exploring real-world examples of mathematics, captivating the audience's interest.

The workshop provided students with detailed information about the different aspects of mathematics in the real world. Topics such as cryptography, cybersecurity, and data analysis were discussed, showcasing the practical applications of mathematics in various fields. The presentation also included numerous case studies and hands-on activities, significantly enhancing student participation.

During the event, Dr. Bansal expressed his love and passion for mathematics, which he stated has always kept him motivated in his work and profession. His enthusiasm for the subject inspired participants to delve deeper into its applications and appreciate its role in everyday scenarios. This workshop successfully demonstrated the significance of mathematics in real-life scenarios, providing innovative techniques and insights that motivated participants to explore its applications further.

STUDENTS' WORKSHOP ON RESEARCH METHODOLOGY

"The secret of success in research is the successful management of failure. For if you never fail, you are probably not doing research at all. Each failure is a lesson, a stepping stone that refines your approach and brings you closer to meaningful discovery."

MODULUS - The mathematics society of Keshav Mahavidyalaya organised a workshop on "Research Methodology" on 20th March 2025.

The workshops basically aimed for the undergraduates to understand what exactly 4th year of their BSc program is for, what are the scopes and advantages of it. More than 120 students of the department attended the workshop and got good guidance for their career. The workshop highlighted the esteemed presence of Dr. Ranjana Jain, Associate Professor in the University of Delhi, as our distinguished speaker. She captivated the audience by sharing her valuable experiences, insights, and expert advice. The event contained a full pack knowledge of what research really is, especially in mathematics. She started with explaining what 'standing on the shoulders of giants' means. The highlight of the talk was to see the importance of doing a good literature survey to find out open problems or fresh ideas to do research. A few topics which would be suitable for undergraduate students to do research in and a few sample journals where they can publish their research work were also included.

The examples of research work done by undergraduate students from various parts of the country were extremely motivating for the audience. She also explained the importance of giving credits to authors whenever we use any content of their work. The different aspects of plagiarism were discussed in detail, which plays a great role as the students have to prepare a dissertation at the end of their 4th year.

The curiosity of the audience, both students and teachers, was clear from the questions they asked the speaker at the end of the program. The interaction was highly motivating, everyone in the audience agreed on keeping a good research atmosphere in the department in the coming days.

INAUGURATION OF
ANANT-THE RESEARCH CELL

We proudly inaugurated **Anant – The Research Cell of the Department of Mathematics**. This initiative aims to foster a research-oriented mindset among students, providing them with opportunities to explore advanced mathematical concepts, engage in academic discussions, and contribute to innovative research in the field. Through Anant, we aspire to cultivate a strong foundation for analytical thinking and scholarly pursuits within our department.

Furthermore, Anant will serve as a platform for students to collaborate with faculty members and peers on cutting-edge research projects. By encouraging participation in seminars, workshops, and conferences, we aim to create an environment that nurtures curiosity and academic excellence. This initiative will also facilitate interdisciplinary connections, allowing students to explore the vast applications of mathematics in various scientific and technological domains.

In addition to research activities, Anant will host guest lectures and panel discussions featuring esteemed mathematicians and researchers from around the world. These interactions will provide valuable insights into contemporary mathematical challenges and inspire students to contribute to the ever-evolving landscape of the discipline. With this initiative, we envision a thriving research community that empowers students to push the boundaries of mathematical knowledge and innovation.

CAREER GUIDANCE 2.0

"Man cannot discover new oceans unless he has the courage to lose sight of the shore."   *—Andre Gide*

MODULUS – The Mathematics Society of Keshav Mahavidyalaya hosted an enlightening session titled "Strategic Career Guidance 2.0" on March 28, 2025.

The session was designed to help undergraduate students explore various career opportunities, understand potential career paths, and make well-informed decisions about their future. We received 100+ registrations for the session, and all attendees gained valuable insights for their professional journey.

The session was enriched by the **esteemed presence** of our distinguished speakers: Mr. Dhruv Goyal – a visionary entrepreneur who transforms innovative ideas into successful ventures, and Ms. Sanya Jain – an inspiring scholar who motivates young minds to strive for excellence. They captivated the audience by sharing their journeys, valuable experiences, and insights.

Ms. Sanya Jain provided valuable insights on various entrance exams like CUET PG and discussed different career options. She also spoke about balancing college life with the preparation for competitive exams and described how she overcame her weaknesses through continuous and dedicated efforts.

Moving forward, Mr. Dhruv Goyal inspired the audience by sharing the journey of his newly founded organization, Tricore Revenue, which he started in his second year UG alongside his academic journey, showcasing the power of hard work and innovation.

After sharing their experiences, we had a Q&A round. Mr. Dhruv Goyal emphasized the importance of leadership qualities and skills in achieving success and making a meaningful impact in our lives. Meanwhile, Ms. Sanya Jain highlighted the significance of dedicated study and the importance of choosing the right career path for a successful future.

The session effectively emphasized career planning, skill development, and informed decision-making. Through the insightful experiences shared by our speakers, the participants learned about different career opportunities and the importance of choosing the right path for success.

# THE HISTORY AND DEVELOPMENT OF INDIAN MATHEMATICS

Dr. Ashish Bansal
Associate Professor

Indian mathematics has a rich and profound history, stretching back thousands of years. From ancient texts to contributions that shaped modern mathematical theory, Indian mathematicians made pioneering advances in arithmetic, algebra, geometry, and even calculus. This article may be considered as a preface to this magazine. Through this article, we delve into the history and development of Indian mathematics, highlighting key figures, achievements, and milestones.

The Sulba Sutras (800 BCE - 400 BCE), part of the larger Vedic tradition, are the earliest known Indian mathematical texts. These texts provided geometric methods for constructing altars and were based on practical measurement techniques. The Sulba Sutras contained advanced knowledge of Pythagoras' theorem, geometric shapes, and the Pythagorean triples.

Early Beginnings: The Vedic Period (1500 BCE - 500 BCE)

The earliest evidence of Indian mathematics can be traced back to the Vedic period, which is primarily known for its religious and philosophical texts. Although the Vedas were more concerned with rituals and hymns, they also contained mathematical concepts, especially related to the construction of altars. These early texts reveal a keen interest in measurements, geometry, and numbers.
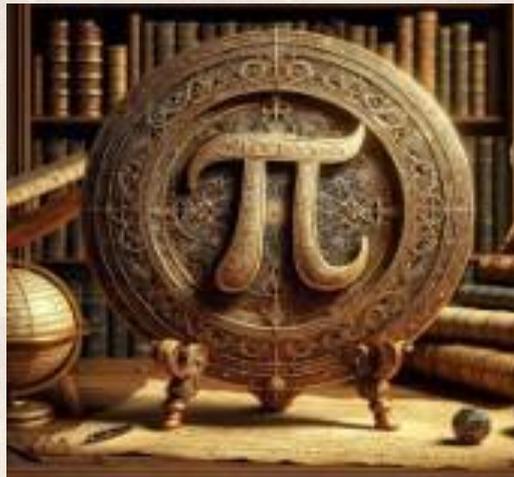

Classical Period: The Rise of Indian Mathematics (500 BCE - 1200 CE)

During the classical period, Indian mathematics saw substantial development, especially with the rise of the Decimal Number System and zero, which would later revolutionize mathematics globally.

Aryabhata (476 - 550 CE), one of the most influential Indian mathematicians, made significant contributions in the fields of astronomy and mathematics. In his work Aryabhatiya, he described the approximation for pi (π) and explained the concept of zero as a placeholder.
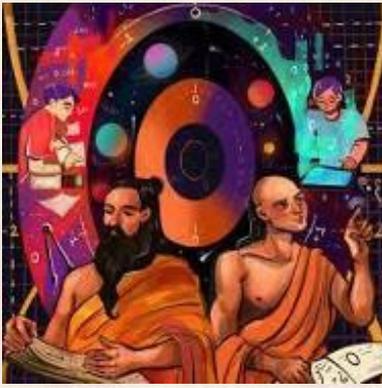
Aryabhata also made advances in trigonometry, laying the foundation for the sine function, and presented a formula for the area of a triangle.

Brahmagupta (598 - 668 CE), another towering figure, made remarkable contributions to algebra and number theory. His book Brahmasphutasiddhanta described the rules for arithmetic with negative numbers and provided solutions for quadratic equations. Brahmagupta's work also laid the groundwork for the modern concept of zero as both a number and a symbol for absence.

Bhaskara I (600 - 680 CE) and Bhaskara II (1114 - 1185 CE), also known as Bhaskaracharya, were prominent mathematicians who worked on a variety of mathematical problems. Bhaskara II's most famous work, Lilavati, includes algebraic and arithmetic problems that were not only theoretical but practical. Bhaskara II also discovered a version of the **Pythagorean theorem** and advanced concepts in calculus, such as the derivative and the notion of instantaneous motion.

The rich history of Mathematics in the Indian Subcontinent
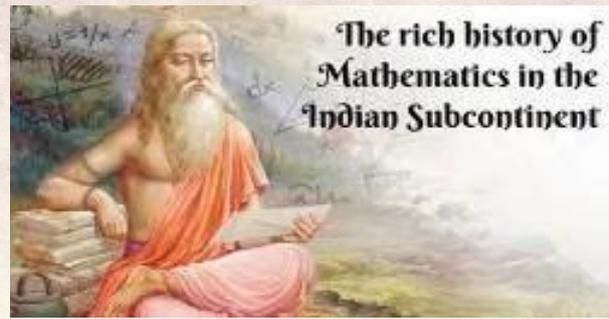
Medieval Period: Mathematical Refinements and Spread of Knowledge (1200 CE - 1600 CE)

The period between 1200 CE and 1600 CE saw the continued development and refinement of Indian mathematics. Indian mathematicians further expanded on algebraic and geometric concepts. **The Kerala School of Mathematics,** established between the 14th and 16th centuries, was particularly influential in the development of mathematical analysis. Madhava of **Sangamagrama (1340 - 1425 CE)**, the founder of the Kerala School, made pioneering contributions to infinite series, including the development of the Taylor series for trigonometric functions such as sine, cosine, and arctangent. This work would lay the groundwork for the development of calculus, which was later formalized in Europe by Isaac Newton and Gottfried Leibniz in the 17th century.

The Kerala mathematicians also worked on infinite series expansions for π\pi, discovering highly accurate approximations long before similar discoveries were made in Europe.

Modern Period: Interaction with European Mathematics (1600 CE - 1800 CE)

During the colonial period, Indian mathematics began to interact with European mathematical traditions. Indian scholars contributed significantly to the global mathematical discourse, particularly through the transmission of knowledge via trade routes and European interactions. One of the significant exchanges occurred when **Ramanujan (1887 - 1920)**, a self-taught Indian mathematician, made exceptional contributions to number theory. His work on infinite series, continued fractions, and modular forms earned him recognition from prominent mathematicians like G.H. Hardy.

Key Contributions of Indian Mathematics

1. **Decimal Number System:** Indian mathematicians are credited with the invention and popularization of the decimal number system, which includes the use of zero. This system was later adopted worldwide and is the foundation for modern mathematics.

2. **Zero and Infinity:** Indian scholars introduced the concept of zero as a digit and a number, fundamentally changing arithmetic operations. Similarly, their work on infinity influenced both mathematical theory and philosophical thought.

3. **Algebra:** Many of the foundational ideas in algebra, including solving quadratic equations, came from Indian mathematicians. Brahmagupta and Bhaskara II made important advancements in this field.

4. **Trigonometry:** Indian mathematicians, such as Aryabhata and Madhava, contributed significantly to the development of trigonometry. They defined trigonometric functions and explored their properties, laying the foundation for modern trigonometry.

5. **Calculus:** The Kerala School's work on infinite series and calculus predates European developments by centuries. Madhava's approach to infinite series expansions for trigonometric functions was a precursor to the calculus that emerged in the West.

Conclusion

Indian mathematics has made a significant impact on the history of mathematics and has influenced modern mathematical thought in numerous ways. From the early geometrical knowledge of the Sulba Sutras to the revolutionary ideas in calculus and algebra, Indian mathematicians have contributed to foundational concepts that are still widely used today. The mathematical innovations that emerged from India over the centuries helped lay the groundwork for many of the developments that followed in Europe and across the world. We should be proud to be an Indian.
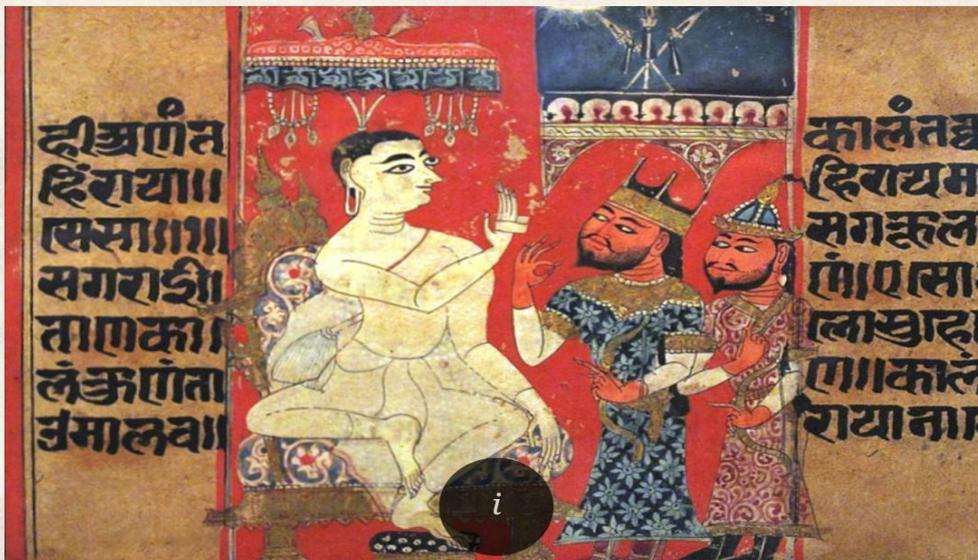
MATHEMATICS AS A COMPASS: A FARWELL NOTE

Prof. Rubina Mittal
Professor

As I bid farewell to my tenure at the Department of Mathematics at Keshav Mahavidyalaya, I find myself reflecting on the journey we have shared—one filled with equations, explorations, and endless possibilities. It has been my privilege to witness the transformative power of mathematics, not merely as a field of study, but as a way of thinking, problem-solving, and optimizing life itself.

Over the years, I have urged my students to perceive mathematics beyond the confines of textbooks and examinations. Mathematics is a tool that equips us to navigate complexities, make informed decisions, and craft efficient solutions in diverse domains. Whether it is through optimization, linear programming, or quality management, the applications of mathematical principles extend far beyond the classroom and into the very fabric of industries, economies, and societies. I have always believed that learning is a lifelong process, and in that spirit, I encourage you to continuously upskill yourself.

The world is evolving at an unprecedented pace, and those who harness the power of analytical thinking and problem-solving will always find themselves at the forefront of innovation. Time is a resource as finite as any other; use it wisely. Seek knowledge not for grades alone, but for the ability to shape your own future.

Mathematics and Operations research has taught us that optimization is key—whether in problem-solving or in life itself. Optimize your time, your learning, and your aspirations. There will always be constraints, but just as in a well-formulated mathematical model, the key is to find the optimal path within those constraints.

One of the most significant frontiers in today's world is the rise of Artificial Intelligence (AI). AI tools are rapidly transforming industries, from finance to healthcare, and at the core of these advancements lies mathematics. For students of mathematics, learning AI and machine learning techniques will open new avenues for innovation and problem-solving. Understanding algorithms, data analytics, and predictive modeling will not only enhance your career prospects but also allow you to contribute meaningfully to the evolving technological landscape. Embrace AI as a powerful extension of mathematical thinking, and you will find yourself at the cutting edge of the future.

While I may no longer walk the corridors of this esteemed institution, my heart will always remain with the students and colleagues who made this journey meaningful. The spirit of mathematics, with its beauty, logic, and boundless applications, will continue to guide you. It is not a goodbye, but rather an invitation to carry forward the ideals we have cherished together.

"WITH MY WARMEST REGARDS AND BEST WISHES"

ANCIENT INDIAN MATHEMATICS: A GIFT TO WORLD

Dr. Rajni Mendiratta
Associate Professor

"Brahmins on the banks of Ganges are entitled to some credits" - F. Cajori

Mathematics, in ancient Indian times, developed along three branches Algebra, Arithmetic and Geometry. As per findings of famous algebraist A Seidenberg, mathematics has its origin in India prior to Rig Veda. Sulba-sutras of Baudhayana, Apastamba and Katyayana had been estimated to have been composed around 800 BC. Sulba authors emphasised that they were merely stating facts already known to the composers of the early Vedic age.

In the Sulba-sutras, we see an explicit statement of the 'Pythagoras' theorem and its applications in various geometric constructions. Pythagoras theorem was known in other ancient civilizations like the Babylonian, but the emphasis there was on the numerical and not so much on the proper geometric aspect while in the Sulba sutras one sees depth in both aspects - especially the geometric. Apart from the knowledge, skill and ingenuity in geometry and geometric algebra, the Vedic civilization was strong in the computational aspects of mathematics as well.

During the period 600 BC - 300 AD, the Greeks made profound contributions to mathematics - they pioneered the axiomatic approach that is characteristic of modern mathematics, created the magnificent edifice of Euclidean geometry, founded trigonometry, number theory, and brought out the intrinsic Beauty of pure mathematics. Also, based on the foundation provided by Euclid, conic sections and integration were introduced due to Archimedes and Apollonius. But after this brilliant phase of the Greeks, creative mathematics virtually came to a halt in the West till the modern revival.

On the other hand, the Indian contribution, which began from the earliest times, continued vigorously right up to the 1600 AD, especially in arithmetic, algebra and trigonometry. Indian mathematics used to be held in high esteem by scholars. For instance, a manuscript found in a Spanish monastery (976 AD) records: "The Indians have an extremely subtle and penetrating intellect, and when it comes to arithmetic, geometry and other such advanced disciplines, other ideas must make way for theirs. The best proof of this is the nine symbols with which they represent each number no matter how large." The Decimal Notation and Arithmetic India gave to the world is a priceless gift system. This profound anonymous Indian innovation is unsurpassed for sheer brilliance of abstract thought and utility as a practical invention. The decimal system has a deceptive simplicity. It has an economy in the number of symbols used as well as the space occupied by a written number, an ability to effortlessly express arbitrarily

large numbers and, above all, computational facility. Thus, the twelve-digit Roman number (DCCCLXXXVIII) is simply 888 in the decimal system!

Most of the standard results in basic arithmetic are of Indian origin. This includes systematic and neat techniques of the fundamental arithmetic operations: addition, subtraction, multiplication, division, taking squares and cubes, and extracting square and cube roots; the rules of operations with fractions and surds; various rules on ratio and proportion like the rule of three; and several commercial and related problems like income and expenditure, profit and loss, simple and compound interest, discount, partnership, computations of the average impurities of gold, speeds and distances, and the mixture and cistern problems similar to those found in modern texts. The Indian methods of performing long multiplications and divisions were introduced in Europe as late as the 14th century AD. The concept of zero existed by the time of Pingala (dated 200 BC). There is terminology for all multiples of ten up to 1018 in early Vedic literature, the Ramayana has term all the way up to 1055, and the Jaina-Buddhist texts show frequent use of large numbers up to10140! for their measurements of space and time. Expressions of such large numbers are not found in the contemporary works of other nations. Even the brilliant Greeks had no terminology for denominations above the myriad 104 while the Roman terminology stopped with the mile 103. The structure of the Sanskrit numeral system and the Indian love for large numbers must have triggered the creation of the decimal system. Due to the absence of good notations, the Greeks were not strong in the computational aspects of mathematics - one of the factors responsible for the eventual decline of Greek mathematics. Leonardo Fibonacci of Pisa (1170-1250), the first major European mathematician of the second millennium, played a major role in the spread of the Indian numeral system in Europe. The Indian notation and arithmetic eventually got standardised in Europe during the 16th-17th century. The decimal system stimulated and accelerated trade and commerce as well as astronomy and mathematics.

It is no coincidence that the mathematical and scientific. renaissance began in Europe only after the Indian notation was adopted. Indeed, the decimal notation is the very pillar of all modern civilization. While geometry was invented during the origin of the Vedic rituals, its axiomatisation and further development was done by the Greeks. The height reached by the Greeks in geometry by the time of Apollonius (260-170 BC) was not matched by any subsequent ancient or medieval civilisation. But progress in geometry soon reached a point of stagnation. Between the times of Pappus (300 AD) - the last big name in Greek geometry - and modern Europe, Brahmagupta's brilliant theorems (628 AD) on cyclic quadrilaterals constitute the solitary gems in the history of geometry. Further progress needed new techniques, in fact a completely new approach in mathematics. This was provided by the emergence and development of a new discipline - algebra. It is only after the establishment of an algebra culture in European mathematics during the16th. century AD that a resurgence began in geometry through its algebraisation by Descartes and Fermat in early 17th century. In fact, the assimilation and refinement of algebra had also set the stage for the remarkable strides in number theory and calculus in Europe from the 17th century.

After evolution through several stages, algebra has now come to play a key role in modern mathematics both as an independent area in its own right as well as an indispensable tool in

other fields. In fact, the 20th century witnessed a vigorous phase of 'algebraisation of mathematics'. Indians began a systematic use of symbols to denote unknown quantities and arithmetic operations. The four arithmetic operations were denoted by "yu", "ksh" "gu" and "bha" which are the first letters (or a little modification) of the corresponding Sanskrit words yuta (addition), ksaya (subtraction), guna (multiplication) and bhaga (division); similarly "ka" was used for karani (root), while the first letters of the names of different colours were used to denote different unknown variables. This introduction of symbolic representation was an important step in the rapid advancement of mathematics. While a rudimentary use of symbols can also be seen in the Greek texts of Diophantus, it is in India that algebraic formalism achieved full development. The Indians classified and made a detailed study of equations (which were called sami-karana) , introduced negative numbers together with the rules for arithmetic operations involving zero and negative numbers, discovered results on surds, dexscribed solutions of linear and quadratic equations, gave formulae for arithmetic and geometric progression as well as identitites involving summation of finite series, and applied several useful results on permutation and combinations including the formulae for permutation and combination.

Thanks to the early of the existence of negative numbers, the Indians could give a unified treatment of the various forms of quadratic equations (with positive coefficients), i.e., $ax^2 + bx = c$, $ax^2 + c = bx$, $bx + c = ax^2$. The Indians were the first to recognise that a quadratic equation has two roots. Sridharacharya (750 AD) gave the well-known method of solving a quadratic equation by completing the square - an idea with far-reaching consequences in mathematics. The Pascal's triangle for quick computation of ^nC_r is described by Halayudha in the 10th century AD as Meru Prastara 700 years before it was stated by Pascal! The algebraisation of the study of infinitesimal changes led to the discovery of key principles of calculus by the time of Bhaskaracharya (1150 AD). Although the Greeks founded trigonometry, their progress was halted due to the absence of adequate algebraic machinery and notations. Indians invented the sine and cosine functions, discovered most of the standard formulae and identitites, including the basic formula for sin(A $\pm$ B), and constructed fairly accurate sine tables. Brahmagupta (628 AD) and Govindaswami (880 AD) gave interpolation formulae for calculating the sines of intermediate angles from sine tables.

Remarkable approximations for π are given in Indian texts including 3.1416 of Aryabhata (499 AD), 3.14159265359 of Madhava (14th century AD) and 355/113 of Nilakanta (1500 AD). Ananonymous work Karanapaddhati (believed to have been written by Putumana Somayajin in the 15th century AD) gives the value 3.14159265358979324 which is correct up to seventeen decimal places. The tradition of excellence and originality in Indian trigonometry reached a high peak in the outstanding results of Madhavacharya (1340-1425) on the power series expansions of trigonometric functions. Three centuries before Gregory (1667), Madhava had described the series.

$$\theta = \tan\theta - \frac{\tan^3\theta}{3} + \frac{\tan^5\theta}{5} - \cdots \quad (|\tan\theta| \leq 1)$$

His proof, as presented in Yuktibhasa, involves the idea of integration as the limit of a summation and corresponds to the modern method of expansion and term by-term integration. A crucial step is the use of the result

$$\lim_{n\to\infty} (1^p + 2^p + \cdots + (n-1)^p) / n^{p+1} = 1/(p + 1).$$

The explicit statement that $(|\sin \theta| \leq 1)$ reveals the level of sophistication in the understanding of infinite series including an awareness of convergence. Madhava also discovered the beautiful formula

$$\pi/4 = 1 - 1/3 + 1/5 - 1/7 + \ldots$$

obtained by putting $\theta = \pi/4$ in the Madhava-Gregory series. This series was rediscovered three centuries later by Leibniz (1674). As one of the first applications of his newly invented calculus, Leibniz was thrilled at the discovery of this series which was the first of the results giving a connection between π and unit fractions. Madhava also described the series:

$$\pi /\sqrt{12} = 1 - 1/3.3 + 1/5.3^2 - 1/7.3^3 + \ldots$$

first given in Europe by A Sharp (1717). Again, three hundered years before Newton (1676 AD), Madhava had described the well-known power series expansions Sine and Cos Series. These series were used to construct accurate sine and cosine tables for calculations in astronomy.

Unfortunately, the original texts of several outstanding mathematicians like Sridhara, Padmanabha, Jayadeva and Madhava have not been found yet - it is only through the occasional reference to some of their results in subsequent commentaries that we get a glimpse of their work. Madhava's contributions are mentioned in several later texts including the Tantra Samgraha (1500) of the great astronomer Nilakanta Somayaji (1445-1545) who gave the heliocentric model before Copernicus, the Yuktibhasa (1540) of Jyesthadeva (1500-1610) and the anonymous Karanapaddhati. All these texts themselves were discovered by Charles Whish and published only in 1835. Among ancient mathematicians whose texts have been found, special mention may be made of Aryabhata, Brahmagupta and Bhaskaracharya.

All of them were eminent astronomers as well. Indians virtually took no part in the rapid development of mathematics that took place during the 17th -19th century - this period coincided with the general stagnation in the national life. Thus, while high-school mathematics, especially in arithmetic and algebra, is mostly of Indian origin, one rarely comes across Indian names in college and university courses as most of that mathematics was created during the period ranging from late 17th to early 20th century. should we forget the culture and greatness of India's millenniums because of the ignorance and weakness of all that India was going through under various civic and national disturbances. We are proud of our Indian heritage.

VEDIC MATHEMATICS IN MODERN ERA

Mr. Deepak Meena
Assistant Professor

Vedic Mathematics is an ancient scheme based on 16 formulas (sutras). These are easy and simple methods for fast mental calculations. Many researchers have worked on it for its usefulness in various branches like engineering, astronomy, mathematics. Vedic mathematics helps in faster and accurate mental calculations. By these 16 sutras and 13 up sutras. One can solve any difficult equation in addition, division, multiplication, algebra, trigonometry, square, square root, cube, cube root only by mental calculations.

Today's era is fastest growing & ever changings era. In competitive exams like UPSC, GPSC, CET, GATE, JEE & many other Vedic mathematics help in faster mental calculations & helps to reduce time to solve difficult mathematical equations. Vedic mathematics also solve mathematical anxiety among school children & regain interest in math by making mathematics easier. In modern time many researches carried out in many universities of India & abroad on usefulness of India & abroad on usefulness of Vedic mathematics.

Many universities have started courses based on Vedic mathematics, yoga & Vedic literature which gain interest on vedic subject of students. Many schools included Vedic mathematics & yoga in their curriculum. Which is accepted by students & parent & teachers well. This article deals with exhaustive review of literature based on Vedic mathematics. It shows Vedic mathematics can be useful for fastest growing & even changing world in modern era. Vedic mathematics algorithm can be proved efficient for faster mental calculations & for competitive exams. Vedic mathematics, a set of supposedly ancient techniques that help even the most numerically challenged to conquer difficult sums, is surging in popularity in India.

Several thousand teachers have been recruited for private college courses. Its supporters believe Vedic mathematics could become a major export like yoga and curry. He marked India's successful mission to Mars last year by claiming its ancient vedic scientists had conceived of air travel thousands of years before the wright Brothers made their first flight. It was a reference to a disputed 'veda' which described ancient air travel between Indian cities and to other planets. The simplicity of Vedic mathematics means that calculations can be carried out mentally. There are many advantages in using a flexible mental system. Pupils can invent their own methods; they are not limited to one 'correct' method. This leads to more creative, interested and intelligent pupils. Interest in the vedic system is growing in education where mathematics teachers are looking for something better and finding the vedic system is the answer.

THE MTTS PROGRAMME – NURTURING UNDERGRADUATE MATHEMATICS EDUCATION IN INDIA SINCE THE LAST THREE DECADES

Dr. Janson Antony A
Assistant Professor

A widely known criticism on the current education system is that even now we are following the same old teaching methodologies of ancient times. In fact, if this claim was true, then it would have been a better situation! But that is not the case. The major contrast between those ancient and the modern systems is that the education in ancient times was not just aimed at passing on the knowledge acquired till then, but also to explore new knowledge through research. A student joining such an institution was supposed to quickly complete the basic education and then proceed to do research. Even though it is difficult to imagine the routine in those days, where education may have been only possible mostly during the day time, it is reasonable to assume that the scholars used to live together at the place of study to maximize the use of resources. An example is Nalanda, a Buddhist monastery that was located at Magadha (modern-day Bihar), operated for over thousand years during 5th-15th century AD, which is considered as the world's first residential university specialized in mathematics, astronomy, vedas, logic, medicine, etc.

Currently, since a lot of information is already accumulated in every discipline, the elementary education itself takes at least 10 years. In those initial years, the teachers are forced to focus on passing on information than encouraging the students to explore on their own. This is a disadvantage of the modern education system. And, when a student comes for higher education, it is difficult to get into a premier institute having rich facilities. Considering the population in India, students from rural areas struggle more in this regard. Even worldwide, the situation is not very different. Implementing a completely different methodology in higher education is a huge task that may take decades to see success. And, hence it is important to find alternatives. Even though there are means for finding great talents and prodigies through competitive exams like the kinds of the Mathematics Olympiad, there is a need in every country for a national level initiative to enrich the education system in every discipline apart from the regular education. It is our pride to have such a unique programme to have initiated in India and is successfully running regularly for the past 30 years.

The Mathematics Training and Talent Search (MTTS) programme, started as a 4 week long summer training for undergraduate mathematics students in India, is currently expanding and is being organized not just in summer but throughout the year at various venues in the nook and corner of the country giving opportunity for high quality training to students. Recently,

after the COVID19 lockdown time, online camps are also being held annually. As the name of the programme suggests, it is first a training and then a talent search program, not the other way. During a program, the participants (2nd/3rd year undergraduate and 1st year postgraduate students learning mathematics as a core discipline) go through rigorous training by experts from various premier institutes of the country. In an offline camp, all the participants (except possibly a few local participants) and the faculty members stay for the whole program at a particular venue, an academic institute, and the students get the opportunity to interact with each other and with the teachers not just during the classroom hours but also during the breaks, even during breakfast/lunch/dinner sessions.

What is unique for the MTTS teaching methodology?

- Students are trained to think on their own rather than bombarding them with a lot of information.
- Special emphasis is on training the students to ask the correct questions rather than finding answers.
- The instructors keep asking small questions that lead the students to come up with an answer or ideas on their own.
- In an MTTS classroom, there are around 40-45 students at an average and at least 5 experienced teachers/mentors all of whom stay in the classroom throughout the day during all the sessions. In an OFCM (online) programme, around 10 experienced mentors will be present in a camp of around 50-60 students.
- Since all the teachers are present during all the sessions, even if one particular faculty is explaining something in the class, the other faculty members also freely add their ideas without resulting in any ego clash between the faculty members.
- Almost every lecture is followed by a group discussion session of not less than half an hour duration and the students recall whatever was discussed in the previous session and add their own

examples and ideas. Even though the teachers do not engage in the discussion sessions, they're also present in the class to help the students if needed.

- There are no exams during the program and hence the students are free from exam pressure, and they learn the subject for the joy of doing it rather than for securing marks or grades.
- As there is no particular syllabus for the teachers to complete, they also take their time going deep into the topic and clearing every doubt from the students.

The programme has been very successful that at the end of every program, the students mention their gratitude for changing their way of looking at the subject and for training them to do mathematics instead of passive learning. Most of the participants keep that enthusiasm and choose Mathematics for higher studies. Among the thousands of students who have benefitted till now many have joined reputed institutes as researchers and teachers. It is also important to note that those who do not choose Mathematics as their career and join other areas also appreciate the effect of the program in designing their critical thinking skills that help them throughout their life.

The summer camp is being held every year without a miss since its inception in 1993. With the enormous financial support from the National Board for Higher Mathematics (NBHM) and the donations received by the MTTS Trust, the programme is made accessible for the students without any registration fee. The food and accommodation are also completely free of cost. A reasonable amount of the travel expenses of the participants also gets paid. Due to this, the programme has been accessible to those students who are financially backward, who misses an opportunity to get quality education from reputed institutions admission to which now-a-days require enrolling for coaching classes that are not affordable for many. But, after being trained by the MTTS programme, most of these students perform better than the other students who

get the so-called 'entrance exam coaching', and successfully join and complete their higher education in those 'reputed' institutes.

The main aim of the MTTS programme is to improve the mathematics teaching methodology in the country. The 30 years of efforts are being reflected and the results are widely visible; the mathematics department of almost every educational institute in India has people who have benefitted or associated with the programme, and that makes a difference in the way the students at those places are being trained.

What are the various programmes being held?

- MTTS Annual Summer Camp
  Duration: 4 weeks. Conducted in 3 levels: Level O for 2nd year undergraduate students, Level I for 3rd year undergraduate students, Level II for 4th year undergraduate and 1st year postgraduate students.

- Initiation into Mathematics (InitMath) Camp
  Duration: 1 week. Known earlier as Mini MTTS programme, conducted regionwise having participants from 3-4 neighboring states. This is for 2nd year undergraduate students.

- Online Foundation Course in Mathematics (OFCM)
  Duration: 3 weeks. Being conducted every year since 2020, in 6 regional camps, around 350 participants in total.

- Online Short Courses
  As follow—up to the OFCM programmes

- Pedagogical Training for Mathematics Teachers (PTMT)
  Duration: 1 week. For undergraduate and postgraduate teachers.

- MTTS Overture
  Duration: 2 days. Recently introduced. Conducted regionally over 25 places a year, for 2nd year undergraduate students.

The MTTS faculty also produce Mathematics content like books, expository articles and video lectures that reflect the MTTS teaching methodology. Curry Leaf, the MTTS Alumni Club also organizes lectures and events regularly.

Where can you find more information about the programme and upcoming events?

- https://mtts.org.in/ (The official website)
- https://4dspace.mtts.org.in/expository-articles-list.php (Expository articles, short articles for ug-pg students written by Prof. S. Kumaresan who is the founder and the director of the programme.)
- https://mtts.org.in/downloads/mtts2024-souvenir (MTTS 2024 Souvenir having information of all events held last year)
- https://sites.google.com/view/curryleaf/ (Math Club of MTTS Alumni)

JAIN MATHEMATICS

JAIN MATHEMATICS AND MODERN MATHEMATICS

Sneha Ahuja
B.Sc. (H) Mathematics
VI Sem

Mathematics has been an important part of human knowledge for centuries. Different civilizations have contributed to its growth, and one of the most fascinating contributions comes from Jain mathematics. This ancient Indian mathematical tradition developed thousands of years ago and introduced concepts that were far ahead of its time. On the other hand, Modern Mathematics has evolved significantly, covering various branches like algebra, calculus, and geometry. Despite the advancements, some of the ideas from Jain mathematics still influence modern mathematical thinking. This article explores Jain mathematics in detail and compares it with modern mathematical practices. It dates to around 500 BCE and is found in sacred texts called the Agamas.

Jain scholars believed that numbers had deep meanings and that mathematical ideas could be used to understand the universe. They studied different types of numbers, patterns, and the concept of infinity, which was quite advanced for their time.

For your knowledge, Jain mathematicians were among the first to think about infinity in a structured way. They recognized that infinity could be of different types, such as infinitely large and infinitely small. This is like what modern mathematicians' study in calculus and set theory, where different sizes of infinity are considered. Also, the study of counting, arranging, and selecting objects, was explored in Jain mathematics long before it became a separate field.

Jain texts discuss different ways of arranging numbers, which is very similar to what we see in modern combinatorial studies. Jain mathematics also explored ideas similar to logarithms, which are now commonly used in computer science and engineering.

Above mentioned were few contributions of Jain Mathematics in the world of numbers. Moving towards Modern Mathematics, it has developed from ancient mathematical knowledge and has expanded into various fields. It consists of various branches, including algebra, calculus, geometry, probability, statistics, and computational mathematics. This article reflects the core concepts, history, and applications of modern mathematics, showcasing its importance in the contemporary world.

JAIN MATHEMATICS IN MODERN WORLD

Keshav
B.Sc. (H) Mathematics
VI Sem

Jain mathematics developed by ancient Jain scholars has made remarkable contributions that continue to influence various fields of modern science and technology. Rooted in logical analysis, combinatorics and the concept of infinity. Jain mathematical principles have found relevance in computer science, artificial intelligence, finance and even modern physics. This introduction mirrors modern mathematical concepts like Georg Cantor's set theory and the classification of infinity in calculus and topology.

Today, these ideas are fundamental in areas like quantum mechanics and artificial intelligence where complex calculations and infinite sets are frequently used.

Another key area where Jain mathematics remains relevant is in combinatorics and probability theory. Jain texts contain early discussions on permutations and combinations, which are essential in modern data science, cryptography and machine learning algorithms. These principles are now used in everything from encryption protocols in cybersecurity to optimization algorithms in AI-driven decision-making systems.

Jain mathematicians also made significant contributions to numerical approximations. Their approximation of π (pi) as 3.1622, while not perfectly accurate, represents one of the earliest recorded attempts to estimate irrational numbers. Such approximations laid the foundation for later advancements in engineering, architecture and physics, where precise calculations are crucial.

Moreover, Jain mathematical thought is deeply linked to logic and reasoning. The doctrine of Syādvāda, which emphasizes conditional logic, aligns closely with modern fuzzy logic systems used in artificial intelligence and robotics. Unlike traditional binary logic, fuzzy logic allows computers to handle uncertainty and approximate reasoning making it essential in applications like self-driving cars and medical diagnostic systems.

Jain mathematics was not just a theoretical pursuit but also had practical applications, which continue to resonate in today's technological advancements. Whether in set theory, probability, AI, numerical analysis, the legacy of Jain mathematicians remains deeply embedded in the modern world, demonstrating how ancient knowledge can still shape contemporary innovations.

MORE ABOUT JAIN MATHEMATICS

Ishika Diwan
B.Sc. (H) Mathematics
VI Sem

"From the smallest unit to the vast infinity, Jain mathematicians explored the universe through the language of numbers."

Significance of Jain Mathematics:

Jain mathematics (400 BCE–200 CE) played a crucial role in ancient Indian numerical and geometric advancements. Jain scholars like Acharya Bhadrabahu explored enumerable, innumerable, and infinite numbers, predating modern set theory.

They even classified different types of infinity, a concept essential in both mathematics and cosmology.

Jain scholars also made strides in **geometry and mensuration**, approximating **π (pi) as 3.162** and developing formulas for areas of circles and ellipses. The *Surya Prajnapti* contained arithmetic and geometric progressions used in astronomical calculations.

A major contribution was in **permutations and combinations**, recorded in texts like the *Anuyogadvara Sutra*. For example, arranging three objects — A, B, and C — yields: $3! = 3 \times 2 \times 1 = 6$

Ancient Insight:

Some Jain texts suggest the use of logarithmic calculations centuries before they were formally developed in Europe. These were used to analyse vast cosmic time cycles. There is so much more to explore about Jain mathematics its deep connections with philosophy, astronomy, and computation are vast and fascinating, far beyond what can be covered here.

Jain mathematics deeply influenced later scholars like Aryabhata and Brahmagupta, leaving behind a legacy that continues to inspire modern mathematical thought.

Influence on Later Mathematics:

The work of Jain mathematicians influenced later Indian scholars deeply, including:

* Mahavira (9th century CE), who composed Ganit Saar Sangrah, further developing Jain mathematical concepts.

* Bhaskara II (12th century CE), who developed upon previous Indian mathematical theories.

* Kerala School of Mathematics, which subsequently led to calculus and infinite series. Jain mathematical concepts, especially those concerning infinity, sequences, and combinatorics, also resonated in contemporary mathematical thinking.

Conclusion

Jain mathematics is an intriguing and neglected aspect of India's mathematical legacy. Jain mathematicians' systematic treatment of huge numbers, infinity, and combinatorial mathematics is a reflection of their intellectual acuity and vision. The work of these mathematicians remains relevant in many areas of mathematics today, reminding us of the fertility and diversity of mathematical knowledge's sources.
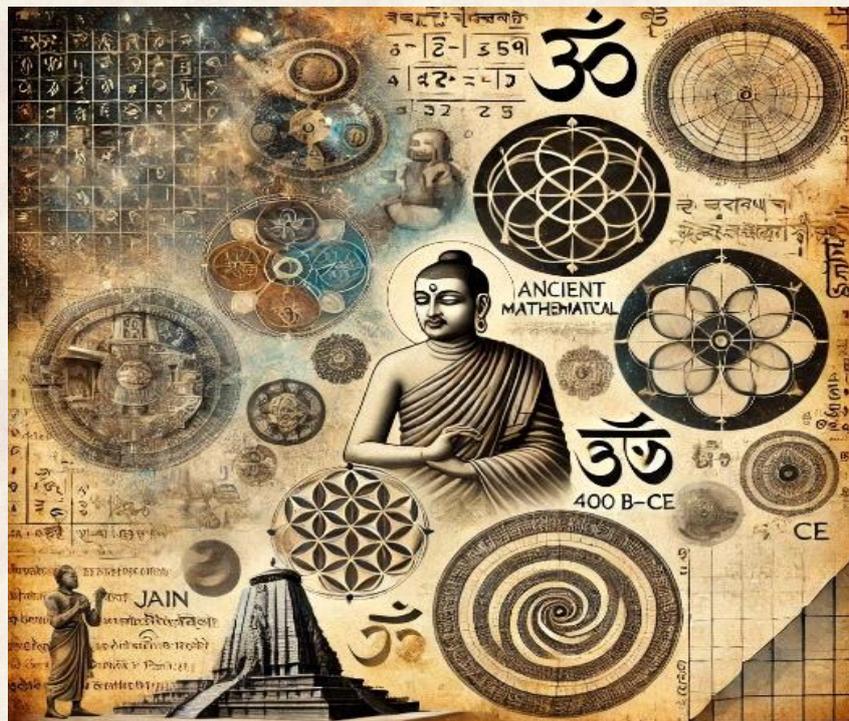
JAIN MATHEMATICS: A SPLENDID CONTRIBUTION TO ANCIENT INDIAN MATHEMATICS

Akshita Jain
B.Sc. (H) Mathematics
VI Sem

Mathematics has never been an insignificant aspect of Indian scientific and philosophical thinking. Of the numerous contributions made by ancient Indian scholars, Jain mathematics stands apart for its distinct way of looking at numbers, infinity, and combinatorial techniques developed by Jain monks and scholars between the 6th century BCE and the 10th century CE, Jain mathematics primarily emerged to support religious and cosmological studies. However, its influence extended beyond religion, shaping various mathematical concepts that remain relevant today.

Origins and Development

Jain mathematics was firmly based on the Jain philosophy of logic, order, and accurate quantification of the universe. Jain scholars required sophisticated mathematical methods to explain cosmic cycles, calculations of time, and spatial dimensions, which resulted in the formulation of new mathematical techniques.

The mathematical concepts of Jainism were documented in books like:

• Sthananga Sutra (circa 3rd century BCE)
• Anuyogadvara Sutra
• Tiloyapannatti (by Yativṛṣabha, 5th century CE)
• Ganit Saar Sangrah (by Mahavira, 9th century CE)

These works covered many mathematical subjects, such as arithmetic, geometry, combinatorics, and the theory of infinity.
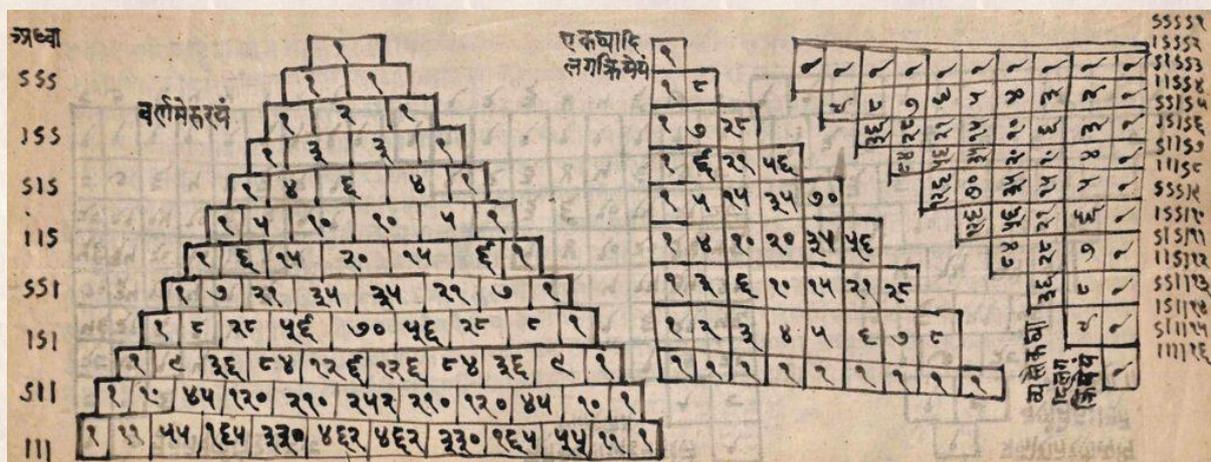
Important Contributions of Jain Mathematics

1. Theory of Large Numbers and Infinity

Jain scholars were the first to categorize and define large numbers in a systematic manner. They came up with a system of infinities, which was an important piece of mathematics at that time. Jain works detail different kinds of infinities, such as:

• Asankhyata (countably but very big numbers)

• Ananta (true infinity, uncountable)

These concepts were earlier than corresponding western mathematical debates and helped shape subsequent Indian mathematical advancements.

2. Logarithmic and Exponential Growth

Jain mathematicians had to deal with big numbers and wrote about exponential growth, which was a critical concept in later algebra and calculus. They wrote numbers in orders of magnitude by using recursive formulas, anticipating logarithmic ideas.

3. Combinatorics and the Fibonacci Sequence

Hemachandra, a 12th century Jain mathematician, learned sequences of numbers known later in Europe as the Fibonacci sequence. He used these sequences to study the rhythmic patterns of Sanskrit poetry, showing an early appreciation of combinatorial mathematics.

4. Permutations and Combinations

Permutations and combinations were studied in Jain texts with respect to the systematic placement of objects and enumerating possibilities, providing the basis for permutations and combinations. These would later form the centerpiece of probability theory and statistics.

5. Geometry and Measurement

Jain mathematicians contributed significantly to geometry through the creation of formulas for measuring areas and volumes of different shapes of geometry, such as:

• Circles and ellipses

• Cylinders and cones

• Three-dimensional solids

These measurements found special application in temple building and architectural design.

6. Time and Cosmology Calculations

Jain mathematicians developed astronomical and cosmological time cycles, computing vast periods of time reaching trillions of years. Their precise categorizations of time cycles (Kalpas) were mathematically designed and reflected profound insight into numerical hierarchies.

GLOBAL IMPACT:

Unrecognized Genius Indian mathematics traveled through Arabic translations, influencing European algebra and number systems. While the Kerala School's calculus-like methods remained largely unknown to the West, its contributions were revolutionary.

Conclusion

India's medieval and early modern mathematicians reshaped the world of numbers. Their discoveries, far ahead of their time, remain a testament to India's mathematical genius an unsung but unparalleled legacy.

HISTORY OF JAIN MATHEMATICS

Vansh Jain
B.Sc. (P) Physical Science
IV Sem

Jain mathematics significantly contributed to the development of Indian mathematics demonstrating advancements in various areas. Operations involving logarithmic functions to base two, achieved through squaring, square root extraction, and raising to finite or infinite powers, were a hallmark of their approach. The tendency to repeat these operations generated new sets of mathematical constructs.

A notable achievement was the development of an early form of Pascal's triangle, known as Meru Prastara, centuries before Pascal. The Jain formulation was based on the simple formula: $^{n+1}C_r = {}^nC_r + {}^nC_{r-1}$. Additionally, the Jain works contained correct formulas for permutations and combinations, such as $^nC_1 = 1$, $^nC_2 = n(n-1)/1.2$, and $^nC_3 = n(n-1)(n-2)/1.2.3$, as well as $^nP_1 = n$, $^nP_2 = n(n-1)$, and $^nP_3 = n(n-1)(n-2)$.

In astronomical science, Jain contributions were less advanced. While they associated eclipses with demons like Rahu and Dhruv Rahu, some astronomical calculations were quite accurate. The Surya Prajnapti, for instance, provided a precise measurement of a lunar month. However, the field saw significant advancement only with the arrival of Aryabhata.

Permutations and combinations held a prominent place in Jain mathematical thought. The Sthananga Sutra introduced these concepts, while the Bhagabati Sutra provided rules for calculating permutations and combinations. Specifically, it detailed the number of permutations and combinations of 1, 2, and 3 elements selected from a set of 'n' elements, with calculations for n = 2, 3, and 4. The text indicated that these calculations could be extended to larger values of 'n'.

Furthermore, Jain mathematicians explored the concept of logarithms and gradually understood the law of indices, as detailed in the Anuyoga Dwara Sutra. While there was initial confusion regarding the value of π, it was eventually determined to be equivalent to $\sqrt{10}$.

The Buddhist school, though less prominent than the Jain school, also played a role in the development of mathematics. Evidence suggests that Buddhist scholars were proficient in the decimal place value system, and knowledge of Ganita was considered important.

In conclusion, Jain mathematics had a considerable influence on Indian mathematics, particularly in the areas of permutations, combinations, logarithms, and sequences, contributing significantly to the foundations of these mathematical concepts.
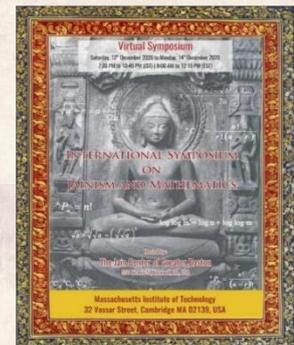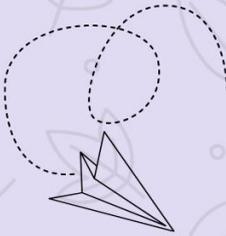
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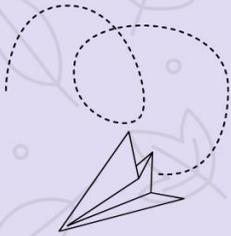
"India's Math: A Timeless Thread"

From temple walls to cosmic charts,
India wove math's finest arts.
Zero was not just void or none,
But the start where all begun.

Aryabhata, bold and wise,
Mapped the heavens, tamed the skies.
With whispered sines and lunar lore,
He opened knowledge's endless door.

Brahmagupta's pen so keen,
Dared to ask what "nothing" means.
Negative sums, the unseen trade,
A world of debt and gain he laid.

In Kerala's halls, where wisdom swayed,
Calculus danced in silent shade.
Centuries passed before the West,
Claimed the math they knew the best.

Yet still, from past to future bright,
India's math is guiding light.
Ancient roots, but visions new,
Numbers tell what time once knew

~Sajal Agrawal
B.Sc Physical Science
Sem VI

"The Dance of Geometry"

Circles spin and angles meet,
Lines stretch long, sharp and neat.
Triangles rise with edges keen,
Squares stand firm—so bold, so clean.

Curves embrace the endless sky,
Spirals twist as dreams fly by.
Shapes in nature, patterns bright,
Geometry paints the world in light.

From towering domes to waves at sea,
Every form is symmetry.
A hidden rhythm, a measured art,
Geometry lives in every part!

~Sanskriti Gupta
B.Sc Mathematical Science
Sem VI

"India's Gift to Number's Lore"

In sacred lands where sages dreamed,
Mathematics first had softly gleamed.
From Vedic hymns to wisdom vast,
A legacy that still holds fast.

Zero was born in India's mind,
A gift to all of humankind.
From Aryabhata's guiding light,
To calculus in Kerala's might.

The roots of math, so strong and free,
India's gift to eternity.

~Aman Pratap Singh
B.Sc (hons) Mathematics
Sem II

"Numbers of the Vedic Age"

In ages past, so wise and grand,
Maths was shaped by thoughtful hand.
Sages watched the stars above,
Finding patterns filled with love.

Zero was not just a name,
But a force that changed the game.
From simple counts to numbers vast,
Their wisdom still is holding fast.

They measured Earth, they mapped the skies,
With logic clear and seeking eyes.
From lines to squares, from roots to sums,
Their knowledge sings, it never numbs.

Oh, Vedic minds, so sharp, so free,
Their math still guides both you and me.
In every count, in every sign,
Their echoes stand the test of time.

~Prince Kaushik
B.Sc (hons) Mathematics
Sem II
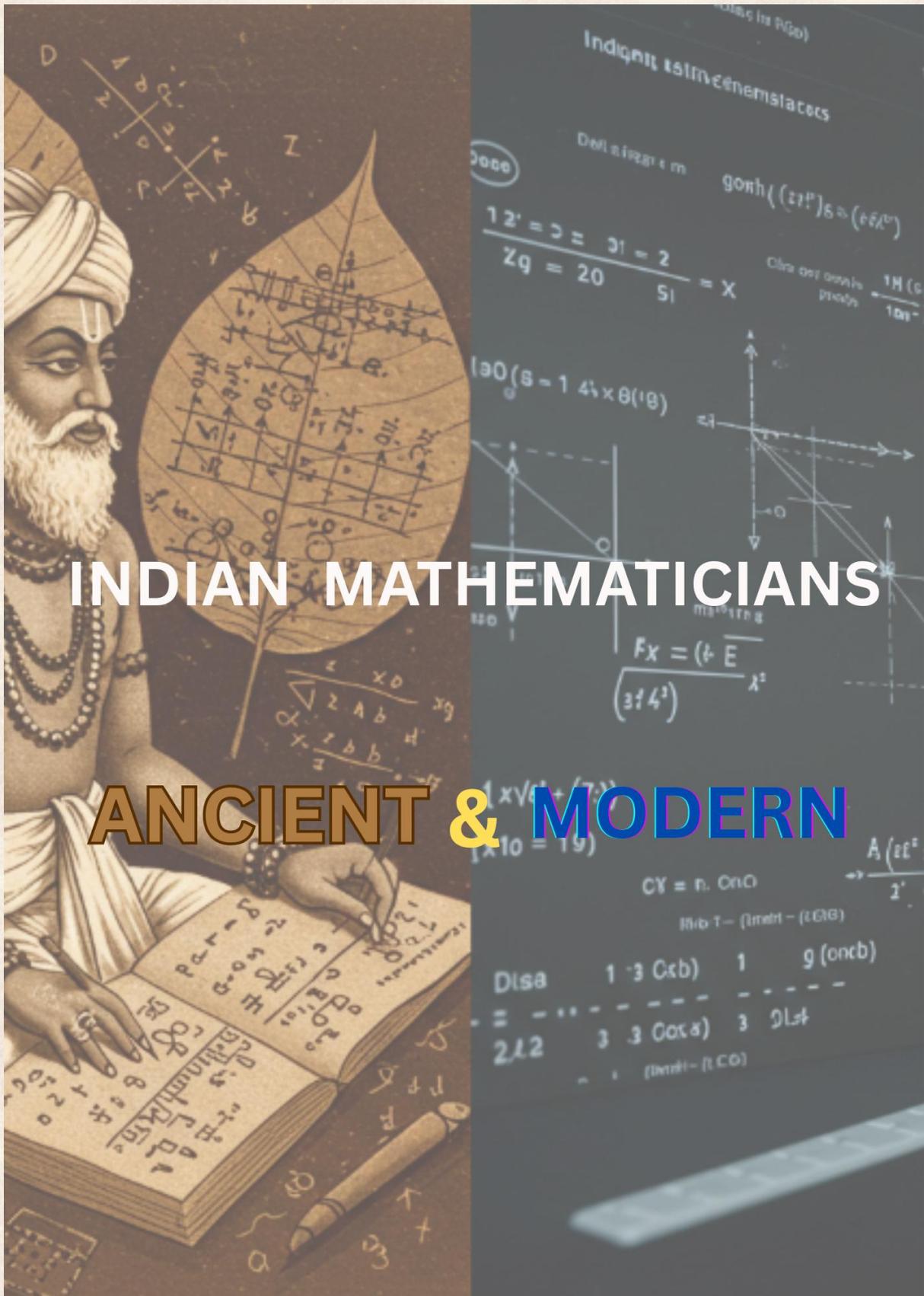
INDIAN MATHEMATICIANS

ANCIENT & MODERN

PINGALA: THE EARLY GENIUS WHO BLENDED POETRY AND MATHEMATICS (200 BCE – 300 BCE)

Misha Gupta
B.Sc. (P) Physical Science
VI Sem

Pingala, an old Indian scientist from about 200 BCE to 300 BCE, is individual of the first figures to bring together the worlds of arithmetic and expression. His gifts were pioneering not only in the study of Sanskrit expressive but too in forming early plans about arithmetic. Pingala's most influential work, Chandahshastra (The Science of Meter), investigated the makeup of versification and advanced the fundamentals for a deeper understanding of combinatorics and twofold structures—ideas that would have a colossal impact centuries later. n old India, poetry was not almost dispute, but likewise about music. Pingala's work directed on the patterns of short and long syllables, presented as laghu (short) and guide (long), that form the elementary building blocks of related to poetic composition rhythm.

By resolving these alliances, he established a foundation for understanding the form of expressive—helping poets art verses with a sense of balance and unity.

His itemized categorization of meters was as well just imaginative; it accompanied by virtue of what arithmetic maybe applied to expressive. By arranging syllables in distinguishing patterns, Pingala considered expressive as two together a skill and an erudition, a novel plan for his opportunity.

Combinatorics and Binary Systems Ahead of Its Time

Pingala's survey of syllabic patterns in expressive proceeded further speech. His arrangement of organizing short and long syllables shares correspondences with up-to-date-epoch combinatorics.

The habit he linked these two types of syllables—thinking of bureaucracy as twofold parts (accompanying short syllables as "0" and long syllables as "1")—reflected the basic principles of twofold wholes, that would later be important to the happening of calculations.

This early introduce combinatorics was pioneering. Pingala's method of deeming the attainable mixtures of short and long syllables indicated later numerical progresses. Although he didn't evolve a thorough twofold numeral order as we see it contemporary, welcome plans set the entertainment industry for the numerical ideas that would equal define new electronics.
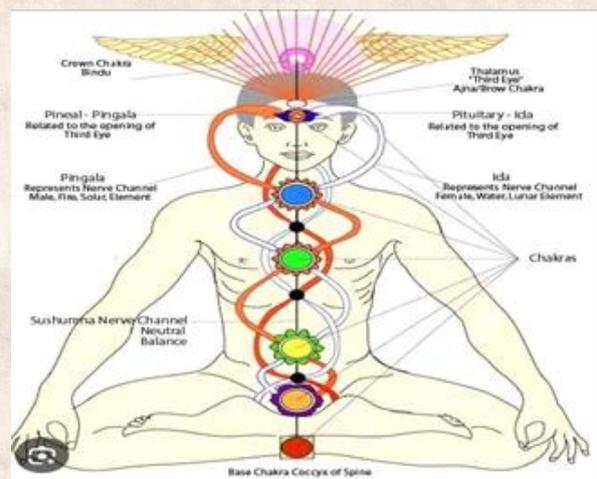
Pingala's Lasting Impact on Indian Mathematics

While Pingala is most legendary for welcome introduce versification, welcome offerings still had a lasting influence on Indian arithmetic. His study of patterns and numbers affected later mathematicians like Brahmagupta and Bhaskara I, the one erected on akin plans in fields like astrophysics and arithmetic. Although Pingala didn't use the exact character system we guide Indian arithmetic contemporary, welcome work forged a institution for the growth of those schemes.

The ideas of positional value and nothing that arose in later Indian arithmetic can trace their intellectual ancestries back to Pingala's survey of patterns and alliances. In many habits, he was in front of his period, setting the children for a numerical transformation. From the orient to the West: How Pingala's Ideas Spread Although Pingala's work waited broadly mysterious in the West for centuries, welcome influence someday attained further India. His early investigation of twofold-like schemes predated whole of European intellectuals like Gottfried Wilhelm Leibniz, who would later organize the twofold integer scheme in the 17th of one hundred years, a vital element of new calculating.
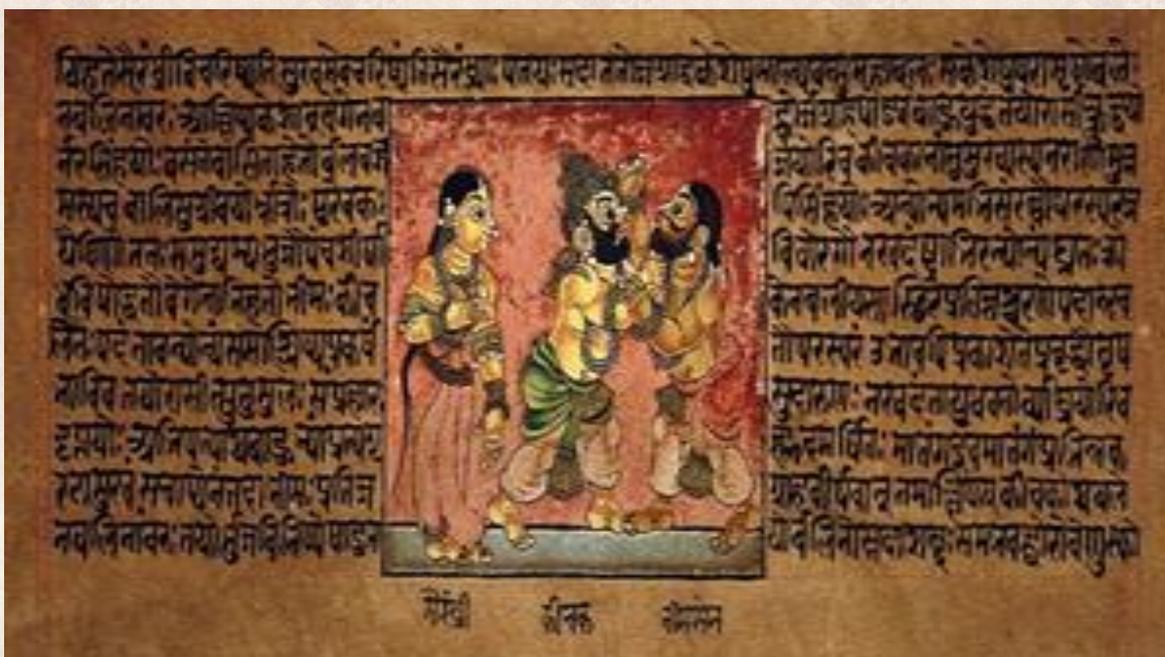
Pingala's work likewise influenced language rules, specifically in the study of way something is said and the cadenced form of speech. His approach to resolving the sounds and makeup of expressive helped shape the understanding of style in two together Eastern and Western attitudes.

A Trailblazer for Both Poetry and Mathematics

Pingala was a real intellectual pioneer, mixing the cunning of expressive accompanying the learning of mathematics in a habit that was in front of welcome occasion.

SOME INDIAN MATHEMATICIANS

Falak Bhardwaj
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BRAHMAGUPTA

Brahmagupta (c. 598 – c. 668 CE) was a great Indian mathematician and astronomer who made significant contributions to mathematics, especially in arithmetic, algebra, and astronomy. His work provided the basis for modern mathematics and was subsequently passed on to the Islamic world and Europe, where it influenced many generations of scholars. Brahmagupta was the greatest Indian mathematician of his era. He contributed to astronomy and most significantly to number systems, such as algorithms for finding square roots and solving quadratic equations.

Brahmagupta, son of Jisnugupta, composed significant books on mathematics and astronomy. Specifically, he composed Brahmasphutasiddhanta in 628. It was composed in 25 chapters, and Brahmagupta informs us in the book that he composed it at Bhillamala, which is now the city of Bhinmal. This was the capital of the Gurjara dynasty lands.

Brahmagupta was appointed as the chief of the Ujjain astronomical observatory, which was the leading mathematical center of ancient India during this period. Renowned mathematicians like Varahamihira had conducted work there and established a powerful school of mathematical astronomy. Apart from the Brahmasphutasiddhanta, Brahmagupta has another mathematics and astronomy work known as the Khandakhadyaka, completed in 665 when he was 67. These texts featured extraordinary concepts that influenced the progress of mathematical history. The Brahmasphutasiddhanta has 25 chapters, but the first ten chapters appear to constitute what most historians think was an initial version of Brahmagupta's treatise, and there are some manuscripts that have only these chapters. These ten chapters fall in the typical subjects of Indian mathematical astronomy works of the era, ranging from mean longitudes of the planets, to planetary true longitudes, to problems of diurnal rotation, through to lunar and solar eclipses, planetary risings and settings, the moon's crescent and shadow, and planetary conjunctions. The remaining fifteen chapters are seemingly an important addition and cover studies of prior works in astronomy and some rigorous mathematical argumentation.

Brahmagupta's knowledge of the number systems was much greater than the others of that time. In Brahmasphutasiddhanta, zero was defined by him as the product of subtracting a number from itself. He was the first to use rules of arithmetic with zero and negative numbers. According to him, when zero is added to or subtracted from a number, the number is the same, and a number multiplied by zero is zero. He also established rules for handling positive and negative numbers, which he called fortunes and debts, respectively. His work on quadratic

equations was noteworthy; he solved them using techniques that were centuries ahead of European methods.

His quadratic formula for solving quadratic equations was as follows:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Brahmagupta also introduced a formula for the area of a cyclic quadrilateral:

$$A = \sqrt{(s - a)(s - b)(s - c)(s - d)}$$

where 's' is the semi-perimeter, $s = (a + b + c + d) \div 2$.

He also solved indeterminate equations, setting the stage for subsequent developments in algebra. His pre-Newtonian theory of gravity as an attractive force is more than nine centuries older than Newton's. His work was felt beyond India since his works were translated into Arabic and Islamic scholars read them. His ideas on zero and algebra were adopted in Islamic mathematics and ultimately found their way to Europe via translations of Arabic manuscripts. But most of his original works were incorporated and accredited to subsequent scholars, especially in the Islamic community and Europe, where Al-Khwarizmi took the lead from him. Most of Brahmagupta's pioneering findings were subsequently borrowed and accredited to international scholars, who in the process denied him credit for what he had pioneered. His systems of the decimal system and rules of algebra remained extensively applied despite numerous European scholars expanding on the work he started but not referring to him for crediting him. The availability of his works in Arabic enabled the world of Islam to gain greatly from his mathematical concepts, but his identity was frequently overshadowed by scholars who re-published his concepts with their names. This period oversight entails that Brahmagupta's huge mathematical contributions were virtually unknown outside India for centuries. For all this, however, his legacy is long-lasting since his ideas are still central in contemporary mathematics and astronomy. His birthplace, Bhinmal, is a silent witness to his brilliance, and the Ujjain observatory itself is a testament to India's rich mathematical heritage.

SATYENDRA NATH BOSE

Satyendra Nath Bose (1894-1974) was a brilliant Indian mathematician and physicist renowned for his contributions to quantum mechanics that formed the basis of Bose-Einstein statistics and bosons. His pioneering work was pivotal in the formation of contemporary physics, with numerous subsequent findings in particle physics and condensed matter physics.

Bose was born in Calcutta (now Kolkata), India, in 1894. He was gifted with exceptional mathematical abilities from a young age and performed well in his studies. He graduated from Presidency College and then joined the University of Calcutta, where he worked under the guidance of renowned scientists such as Meghnad Saha. He soon earned a reputation for his profound knowledge of advanced mathematics and physics. His greatest contribution was in 1924 when he formulated a new method of counting particles that follow certain quantum rules.

He submitted his paper on quantum statistics to Albert Einstein, who saw its significance at once. Einstein translated the paper into German and ensured
its publication, giving rise to what is currently referred to as Bose-Einstein statistics. This finding resulted in the theoretical prediction of a new form of matter, the Bose-Einstein Condensate (BEC), which was confirmed experimentally many years later in 1995. Bose's equations changed quantum mechanics. He suggested that some particles, now referred to as bosons, obey statistical laws other than fermions. The Bose-Einstein distribution is expressed as:

$$N(E) = \frac{1}{e^{\frac{E-\mu}{kT}} - 1}$$

where the number of particles at an energy level is the chemical potential, is Boltzmann's constant, and is temperature. This equation controls the behavior of bosons and is central to much of physics, including superconductivity, superfluidity, and quantum optics.
Bose's contribution also went into Planck's law for blackbody radiation:

$$I(v,T) = \frac{2hv^3}{c^2} \cdot \frac{1}{e^{hv/kT} - 1}$$

Where is the spectral radiance, is Planck's constant, is the radiation frequency, and is the velocity of light. This formula was an important component of quantum mechanics and statistical physics.
Although his revolutionary work, Bose never received the Nobel Prize, even though several physicists later developed upon his ideas and were rewarded with the award for similar findings. His work was frequently overshadowed by Western researchers, and most of his work went under-appreciated throughout his life.
Bose pursued further studies in theoretical physics and developed diverse interests such as X-ray crystallography, statistical mechanics, and unified field theories. He was also actively involved in encouraging scientific studies in India and guided several generations of physicists toward the path and contributed to setting up institutions like the Saha Institute of Nuclear Physics. Bose collaborated with other scientists across the world and assisted in advances in nuclear physics as well as solid-state physics.

Later in life, Bose's work towards the development of quantum mechanics was well appreciated, and he was awarded many honors, including the Padma Vibhushan, which is one of India's highest civilian awards. His passion for science and his pioneering research in quantum statistics motivated generations of physicists to come. His work continues to be remembered through the basic principles that he introduced. The "boson" term was named after him, and his work is still fundamental to the study of the quantum world. Bose-Einstein condensates have made it possible to make quantum computers and low- temperature physics possible. Satyendra Nath Bose's contributions to science continue to influence modern physics, placing him among the all-time great scientific minds.

INDIAN MATHEMATICIANS

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SRINIVASA RAMANUJAN AIYANGAR

Srinivasa Ramanujan Aiyangar was an Indian mathematician. He is regarded as one of the greatest mathematicians of all time. He was born on 22 December, 1887 in Erode, Tamil Nadu, India. He was raised in Kumbakonam, a city in Tamil Nadu. His parents were Komalatammal and Kuppuswamy Srinivasa Aiyangar. He showed an extraordinary interest in mathematics from an early age. He only loved studying mathematics. Despite excelling in the subject, he struggled with other disciplines, which led to academic difficulties. His education was inconsistent due to financial struggles and his mathematics. Ramanujan did his schooling from Kumbakonam Town High School, where he excelled in mathematics. In 1904, he passed his matriculation exam with high scores and earned a scholarship to Government Arts College, Kumbakonam. There he focused solely on mathematics, neglecting other subjects. He lost his scholarship when he failed in subjects like English and Sanskrit and he had to drop out in 1905. In order to complete his education, he enrolled in Pachaiyappa's College, Madras. He again excelled in mathematics, but failed in non-mathematical subjects which led to another dropout in 1907. Then he left his formal education and started his mathematical research independently and formulated original results. In 1909, at the age of 21 years, he was married to Janaki Ammal. In 1913, he wrote a letter to G.H Hardy, a British mathematician presenting his work. His work eventually caught Hardy's attention and he was invited to England in 1914. He completed his graduation from Trinity College, Cambridge. There Hardy tutored him and he worked with Hardy and J.E. Littlewood and made great contributions to number theory, infinite series, continued fractions, mathematical analysis, and modular forms. He developed formulas for partition functions, prime numbers, and mock theta functions. Ramanujan's partition formula for any partition function p(x) is

$$p(x) \approx \frac{1}{4n\sqrt{3}} e^{\pi\sqrt{2n/3}}$$

Ramanujan's approximation for Euler's constant is

$$\gamma = \frac{4}{5} - \sum_{k=1}^{\infty} \frac{(-1)^k}{k(k+1)}$$

He also worked out the Riemann series, the elliptical integrals, hypergeometric series, the functional equations of the zeta function and his own theory of divergent series. Some formulae of continued fraction by Ramanujan are given below:

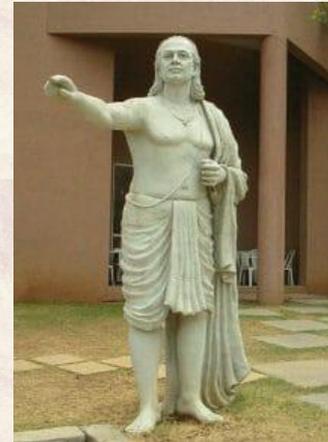$$e = 2 + \cfrac{1}{1 + \cfrac{1}{2 + \cfrac{1}{3 + \cfrac{1}{4 + \cdots}}}}$$

$$\frac{1}{\pi} = \frac{\sqrt{8}}{99}\left(1 + \cfrac{1}{3 + \cfrac{1}{3 + \cfrac{1}{3 + 3 + \cdots}}}\right)$$

$$\sqrt{n} = 1 + \cfrac{(n-1)}{2 + \cfrac{(n-2)}{2 + \cfrac{(n-3)}{2 + \cdots}}}$$

He also discovered several rapidly converging series for π. He found a value for the sum of such series using a technique which he himself invented, now called Ramanujan summation. He solved various mathematical problems which were considered unsolvable. Ramanujan's magnificent formula for π is given below:

$$\frac{1}{\pi} = \frac{2\sqrt{2}}{9801}\sum_{n=0}^{\infty}\frac{(4n)!(1103 + 26390n)}{(n!)^4\,396^{4n}} \quad \text{or} \quad \pi = \frac{9801}{1103\sqrt{8}}$$

He prepared his thesis on Highly Composite Numbers and he was awarded a Bachelor of Science by Research degree (now equivalent to a Ph.D.) in 1916. He was awarded the 'Fellow of the Royal Society' in 1918. During his short life, he independently compiled nearly 3,900 results which were mostly identities and equations and most of these results have been proven correct. He was the first Indian to be elected as a fellow of Trinity College, Cambridge. In 1918, due to the British climate Ramanujan had suffered from tuberculosis and his health deteriorated. He lay ailing in a clinic near London when Hardy came to visit him. In order to cheer up Ramanujan, Hardy said that he had arrived in a taxi with a number 1729 and he described the number as a dull one. To Hardy's surprise, Ramanujan replied, "No, Hardy, it's a very interesting number! It's the smallest number which is expressible as the sum of two cubes in two different ways." The number 1729 can be represented as 1 cubed + 12 cubed and 9 cubed + 10 cubed. This number is called "Ramanujan-Hardy number" or "taxi-cab number".

$$1729 = 1^3 + 12^3 = 9^3 + 10^3$$

He returned to India in 1919 due to his declining health. He continued working in the field of mathematics until his death on April 26, 1920, at the age of 32. His notebook which was filled with thousands of results, remained an invaluable resource for mathematicians. Later many of his formulas were proved correct and have applications in modern physics, cryptography, and computer science. The "Ramanujan Prime" and "Ramanujan-Hardy Number" are well-known mathematical concepts. He also provided an approximation for Euler's constant. Ramanujan also constructed a famous magic square where the sum of each row, column, and diagonal is 139. His birth date, 22 December is celebrated as National Mathematics Day in India. His last letters to Hardy, written in January 1920, showed that he was still continuing to produce new mathematical ideas and theorems. His "lost notebook" contained the discoveries from the last year of his life and it was rediscovered in 1976. His work continues to inspire mathematicians worldwide. No doubt Srinivasa Ramanujan is the most famous mathematician of the modern era in India.

ARYABHATA

Aryabhata was an Indian mathematician and astronomer who lived around 476-550 CE. He was the first of the major mathematician-astronomers from the classical age of Indian mathematicians and Indian astronomy. He was born in 476 CE in Patliputra, Gupta Empire (present-day Patna, Bihar, India). His parents were Sri Bandu Bapu Athawale and Srimati Honsabai Athawale. Some scholars believe that he may have been associated with the famous Nalanda University. He had a keen interest in the fields of Mathematics and Astronomy. He composed his work Aryabhatiya when he was 23 years old. In Aryabhatiya, he mentioned a significant astronomical calculation related to the Kali Yuga. He stated that the Kali Yuga began at midnight on Friday, February 18, 3102 BCE. This date is crucial in Hindu chronology and it is considered as the starting point of the current age in Hindu cosmology. Later his calculations influenced Indian astronomers like Varahamihira, Brahmagupta, and Bhaskara I. His calculation about the Kali Yuga was accepted and it is still referenced in Hindu calendrical systems. Aryabhata used a place-value system and introduced a method which is similar to the modern decimal system. He invented the decimal system and used "zero" as a placeholder. He approximated the value of pi which was 3.1416, remarkably close to the modern value of 3.14159.
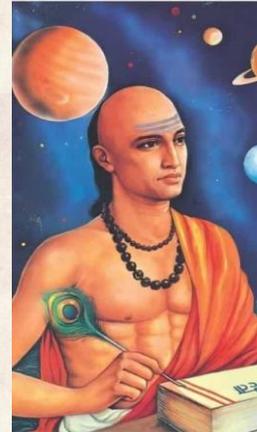
$$\pi \approx \frac{62832}{20000} = 3.1416$$

Aryabhata discovered various trigonometric functions like sine, cosine, tangent etc. He also gave approximations for sine values.

$$\sin x \approx x - \frac{x^3}{3!} + \frac{x^5}{5!}$$

He also defined the area of the right-angled triangle as the half of the product of base and perpendicular which is the same as the standard formula used today.

$$Area\ of\ Triangle = \frac{1}{2} \times base \times height$$

Aryabhata constructed a table of sines calling them "Ardhya-Jaya" (half chord values) using the Pythagorean theorem. He formulated simplified formulas for the summation of a series of squares and cubes. The formula for the sum of arithmetic series by Aryabhata is given below:

$$S = \frac{n}{2} \times (2a + (n-1)d)$$

where S= sum of the series, n = number of terms, a = first term and d = common difference. He also contributed to the study of quadratic polynomial equations and provided solutions for the single variable quadratic equations and worked on intermediate equations. He also gave formulas for the circumference of a circle and the length of the chord in a circle.

$$circumference\ of\ circle = 2\pi r \qquad L = 2r \sin\frac{\theta}{2}$$

where r = radius of the circle, θ = angle subtended at the centre by the chord.

Aryabhata was the first to suggest that the Earth rotates on it's axis and explained the apparent movement of the stars. He explained that the lunar and solar eclipses occur due to the Earth's

shadow on the Moon and the Moon's shadow on the Earth. He stated that the planets follow elliptical orbits, predating some Western astronomers by centuries. He also calculated the time period of a year is 365.25858 days which is close to the modern value of 365.25636 days. Aryabhata's most famous work is the "Aryabhatiya", written in Sanskrit in 499 CE. It consists of four sections which covers mathematics, astronomy, and timekeeping. He calculated the length of the sidereal year. His work was highly influenced in India and later in the Islamic world. His ideas contributed to the advancement of mathematics and astronomy in the medieval Islamic world and later in Europe. India's first satellite, Aryabhata (1975) was named in his honor. His works also influenced later Indian mathematicians like Bhaskara I and Bhramagupta. His contribution made him one of the greatest mathematicians and astronomers in Indian history.

BHASKARA II

Bhaskara II (1114-1185 CE) also known as Bhaskaracharya was an Indian polymath, mathematician, astronomer and engineer. He was born in 1114 CE in Biddur, Bijapur, Karnataka, India. He belonged to the Shaiva Brahmin family. The II has been appended to his name to distinguish him from the 7th century astronomer Bhaskara I. He was trained in mathematics and astronomy by his father, Maheswara, who was also a mathematician. Later he also taught mathematics to his son, Loksamudra. He was the first mathematician who wrote a work with full and systematic use of the decimal number system. He later became the head of the astronomical observatory in Ujjain, which was the most prestigious mathematical center for learning in medieval India at that time. Bhaskara developed an understanding of calculus, the number systems, and solving equations, which were not achieved anywhere else in the world. He fully recognized and used "zero" in mathematical operations. He worked with both positive and negative numbers and provided rules for arithmetic calculations involving zero. He solved quadratic, cubic and quartic equations and introduced a method called Chakravala method for solving Pell's equation: $x^2 - Ny^2 = 1$

He had a keen interest in Algebra, arithmetic and trigonometry. Bhaskara's work "Shiddhanta Siromani" which he wrote at the age of 36 comprises 1450 verses. It is divided into four parts which are as follows:

- Lilavati: A work on arithmetic, geometry and the solutions of intermediate equations.
- Bijaganita: A treatise on Algebra.
- Goladhyaya: It is related to the mathematics of spheres.
- Grahaganita: It is the mathematics of planets.

It is believed that Lilavati was his daughter's name. Lilavati consists of 13 chapters which includes several methods of computing such as multiplication, squares, and progressions. It is written in the form of poems.

Bijaganita is a work containing 12 chapters. It is all about algebra including the positive and negative square roots of numbers. He expanded the previous works by Aryabhata and Brahmagupta. He also improved the Kuttak methods for solving equations. He also concluded that dividing by zero would produce infinity. He connected infinity with lord Vishnu who is referred to as Ananta (endless) and Acyuta (firm). During pralaya (cosmic dissolution) being merged in him and during srishti (creation) emerging out of him, he remains unaffected.

Likewise, nothing happens to infinity if any number is added or subtracted from it. It remains unchanged.

The third book Grahaganita deals with mathematical astronomy. It consists of 12 chapters. Most of its concepts were derived from the earlier works of Aryabhata. He describes the heliocentric view of the solar system and elliptical orbits of planets by using Brahmagupta's law of gravity. He also discusses topics related to mean and true longitudes and latitudes of the planets. He also examines planetary conjunctions, the orbits of the Sun and the Moon. He also calculated the length of the year which was accurate by a minute.

His final book Goladhyaya contains 13 chapters. It is all about spheres and similar shapes. It also consists of topics like cosmography, geography, seasons, planetary movements, eclipses and lunar crescents. He also found sine values for many angles from 18 to 36 degrees. He also discussed instruments named Gol yantra, Nadi valay, Ghatika yantra, Shanku, Yashti yantra, Chakra, Chaap, Turiya, and Phalak yantra. He found it useful to calculate accurate time and understand many astronomical phenomena.

The Indian Space Research Organization (ISRO) named its Bhaskara II satellite in his honor. His work influenced Indian, Islamic and Persian mathematicians. Bhaskara II was one the greatest mathematicians of medieval India and his works remain relevant even today.
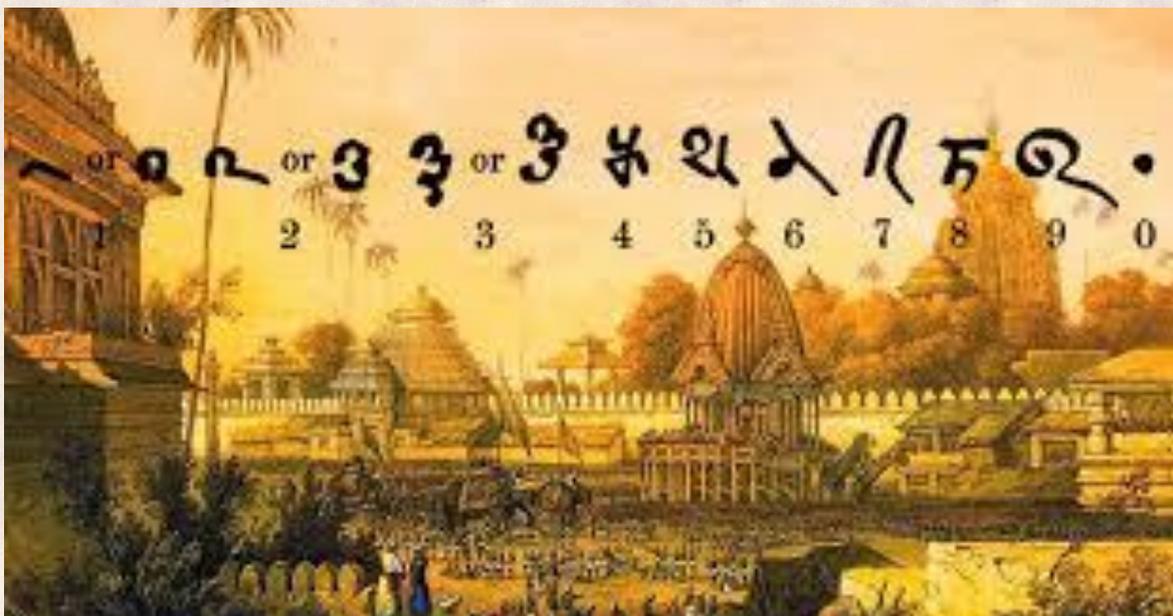
CONTEMPORARY INDIAN MATHEMATICS: (2000 - PRESENT)

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India, a land of rich scientific and mathematical heritage faced a major setback due to some unfortunate reasons. Even after the establishment of democracy in 1947, the socio-political scenarios took a long and effortful journey to shape the India we are living in today. The establishment and restructuring of the institutions played a crucial role in doing so. The current developments and reputation of Indian mathematics are a result of all such efforts.

Let's now get some insights into the major mathematical achievements in the last two and half decades. Since 25 years have passed, this is a good time to analyze this period of mathematics. In 2011, an amazing research paper was published by **Prof. Kannan Soundararajan**. He provided significant insights into the behavior *of multiplicative functions and the zeroes of L-functions.*

In 2013 **Prof. Arul Shankar** with **Prof. Manjul Bhargava** (renowned American mathematician) made a groundbreaking contribution to understanding the average *rank of elliptic curves ()* through innovative techniques using the geometry of numbers and theory of prehomogeneous vector spaces. In the same year, **Prof. Mahesh Kakde** provided proof for the main conjecture of *the non-commutative Iwasawa theory for totally real fields.*

It was in 2014, when **Prof. Neena Gupta** solved the *Zariski cancellation problem for positive characteristic,* a fundamental question in Algebraic Geometry that remained open since 1949. **Prof. Ritabrata Munshi** 2015 developed an innovative method for the *sub-convexity problem*, which concerns *obtaining bounds for L-functions* other than those predicted by the Riemann hypothesis.

The research mentioned above has been extremely appreciated by mathematical learners around the globe. Indians are certainly showing their potential for the global advancement of

mathematics. Many Indian mathematicians have received awards and recognition for their works. But this is not all, we the students of mathematical sciences, are the ones who are going to be the flag bearers of the Indian Mathematics. Indian Government along with various other institutions is taking initiatives to promote the Research and Development scene in the country. Brilliant minds with sparkling ideas must step forward for the future of mathematical research.

NILAKANTHA SOMAYAJI

Nilakantha Somayaji was a prominent Indian mathematician and astronomer from the state of **Kerala**. His work is part of the broader tradition of the Kerala school of astronomy and mathematics.

He was born on **14ᵗʰ June 1444** into a Nambutiri brahmin family near a small village named '**Tiruvalla'** in Kerala And his family was considered to be a descendant of followers of Vedic religion they were worshipper of the God **'Soma'** who was considered the Lord of planets and healer of this diseases. He had the brother whose name was **Shankara** father **Jata Vedas** and wife **Arya.** Besides this he had also two son named **Ram** and **Dakshinamurti**.

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His birth name was '**Kelallur Nilakantha'** and he later acquired the title so **Somayaji** after performing the **Somayajna** ritual an important Vedic ceremony.

Contributions to Mathematics and Astronomy

(1) Nilakantha wrote extensively on astronomy most notably in his work '**Tantrasangraha'** (meaning collection of texts) was completed **1501** and provided a detailed account of planetary motions, eclipses, **Suryagrahan** and **Chandragrahan** and other astronomical phenomena.

(2) Tantrasangraha has **8 chapters** and total **432 Sanskrit verses.** It describes movement of planets various positions of the Sun.

(3) Another work of Nilakantha **Golasar** has **56 Sanskrit verses** and shows how mathematical calculation are done for calculation of astronomical data. And **Siddant Darpan** has **34 Sanskrit verses** and describes a planetary pattern besides this

(4) Chandrachhaya Ganita has **31 verses** and described the methods of calculations of the distance of the zenith of the Moon.

His concept

(1) **Neel kantha series for π:** Nilakantha derived a remarkable series for approximating the value of π which is written a

$$\pi = 3 + 4/2 \times 3 \times 4 - 4/4 \times 5 \times 6 + 4/6 \times 7 \times 8 - \ldots.$$
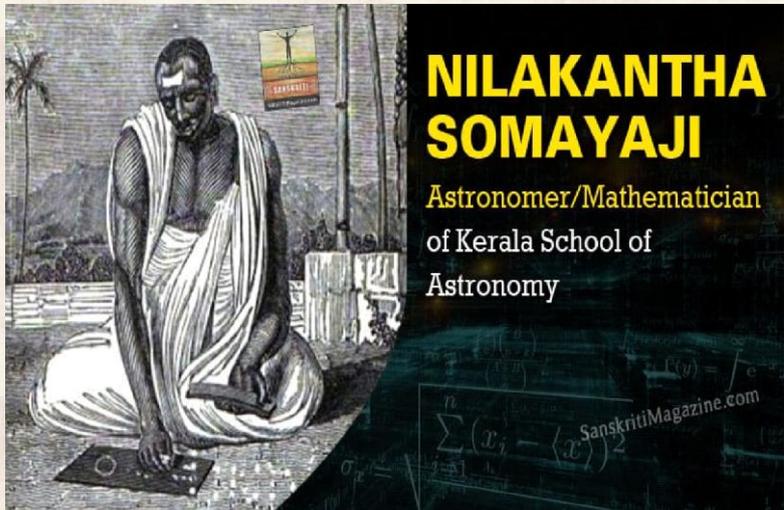
This series which involves adding and subtracting fractions of products of consecutive integers.

(2) Formula for circumference of a circle: Nilakantha contact arrived of formula for the circumference of a circle using the infinite series for π

$$\textbf{C=}\boldsymbol{\pi}\textbf{d} \qquad \text{where} \quad \textbf{C=}\text{circumference,} \ \textbf{d=}\text{Diameter}$$

(3) Concept of the sine and cosine: In addition to his work on π Nilakantha is also credited with early contributions to the development of **trigonometric function**. He worked on the **sine function** and provides key method for calculating the sine and **cosine of angles** arc central concept in both astronomy and later developments in mathematics.

(4) Horizon based geometric theory: His geometric theory placed **Earth at the center** with the sun moon and planets revolving around. Although the **heliocentric model** with **the Sun** at the center after replaced it in the West Nilakantha **geometric model** was a significant step in Indian astronomical thought.

Legacy

Kerala school of mathematics: His work laid the groundwork for later scholars in this tradition such as Madhava, Jyesthadeva, Nilakantha Somayaji. Nilakantha lived a long life and passed away in 1544 leaving behind a rich legacy of scholar that continues to be studied and admired.

Conclusion

Nilakantha Somayaji holds a unique place in the history of Indian mathematics and astronomy his work not only enriched Indian math but also gave direction to world math his theories and text remain important success for mathematics and astronomers even today.

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INDIAN MATHEMATICIANS AND THEIR MAJOR CONTRIBUTIONS

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In our history of mathematics great names are considerable for growth of this field and subject. Actually, mathematics doesn't only mean to study complex problems but also solving real world problems. The great names contributed to make things easier for us the list of names is too big so, today we are going to discuss about Indian Mathematicians who made great contribution.

Bhashkaracharya I

Bhaskara (also known as Bhaskara don't confuse it with another mathematician Bhaskara II) was born 600 B.C. in in Saurashtra (in Gujrat)

He has done great works like Hindu-Arabic decimal system, trigonometry, quadrilaterals, linear equations and much more.

The most Important mathematical contribution of Bhaskara I concerns the representation of numbers in a positional numeral system.

The first positional representations had been known to Indian astronomers approximately 500 years before Bhaskara's work.

However, these numbers were written not in figures, but in words or allegories and were organized in verses. For instance, the number 1 was given as moon, since it exists only once the number 2 was represented by wings, twins, or eyes since they always occur in pairs, the number 5 was given by the 5 senses which is called Gyanendriya in Hindu mythology.

Similar to our current decimal system, these words were aligned such that each number assigns the factor of the power of ten corresponding to its position, only in reverse order: the higher powers were to the right of the lower ones.

Bhaskara's numeral system was truly positional, in contrast to word representations, where the same word could represent multiple values (such as 40 or 400). He often explained a number
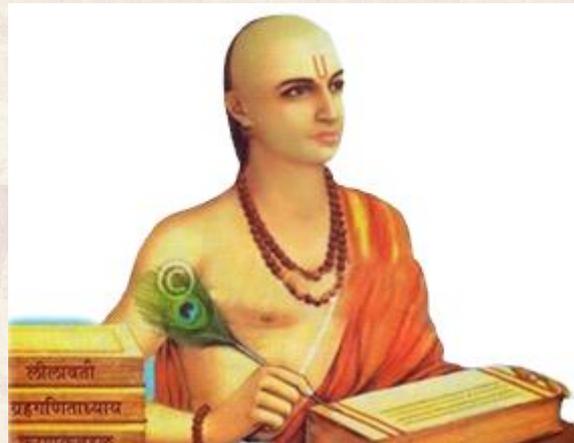
given in his numeral system by stating ankair api ("in figures this reads"), and then repeating it written with the first nine Brahmi numerals, using a small circle for the zero.

Contrary to the word system, however, his numerals were written in descending values from left to right, exactly as we do it today. Therefore, since at least 629, the decimal system was definitely known to Indian scholars. Presumably, Bhaskara did not invent it, but he was the first to openly use the Brahmi numerals in a scientific contribution in Sanskrit and it becomes base for today's decimal system.

P.C. Mahalanobis (Prasanta Chandra Mahalanobis)

P.C. Mahalanobis was born on 29th June, 1893 in Culcutta(now Kolkata, West Bengal).

In his life as a mathematician he got Padma Vibhushan (1968), Officer of the Order of the British Empire (1942), Fellow of the Royal Society, Weldon Memorial Prize (1944) for his work.

Mahalanobis received his early schooling at the Brahmo Boys School in Calcutta, graduating in 1908. He joined the Presidency College, then affiliated with the University of Calcutta, where he was taught by teachers who included Jagadish Chandra Bose, and Prafulla Chandra Ray.

Others attending were Meghnad Saha, a year junior, and Subhas Chandra Bose, two years his junior at college.

Mahalanobis received a Bachelor of Science degree with honours in physics in 1912. He left for England in 1913 to join the University of London.

He done great work like – Statistical system, Statistical techniques, Economic Planning, Participated in international conference and collaborations.

Mahalanobis distance is one of the most widely used metrics to find how much a point diverges from a distribution, based on measurements in multiple dimensions. It is widely used In the field of cluster analysis and classification.

For his contributions in mathematics specially in statistics June 29, Mahalanobis' birth anniversary is celebrated as National Statistics Day.
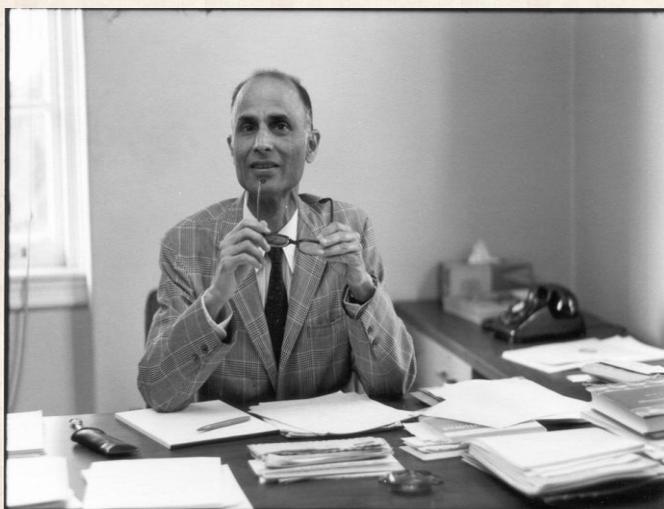
Harish Chandra

Harish Chandra Mehrotra was born on 11th October 1923 (Kanpur, Uttar Pradesh).

He is well known for his fundamental work in representation theory, especially harmonic analysis on semisimple Lie groups.

In his career as mathematician and physicist he contributed to this field by devloping :-

Harish-Chandra's c-function.

Harish-Chandra's character formula.

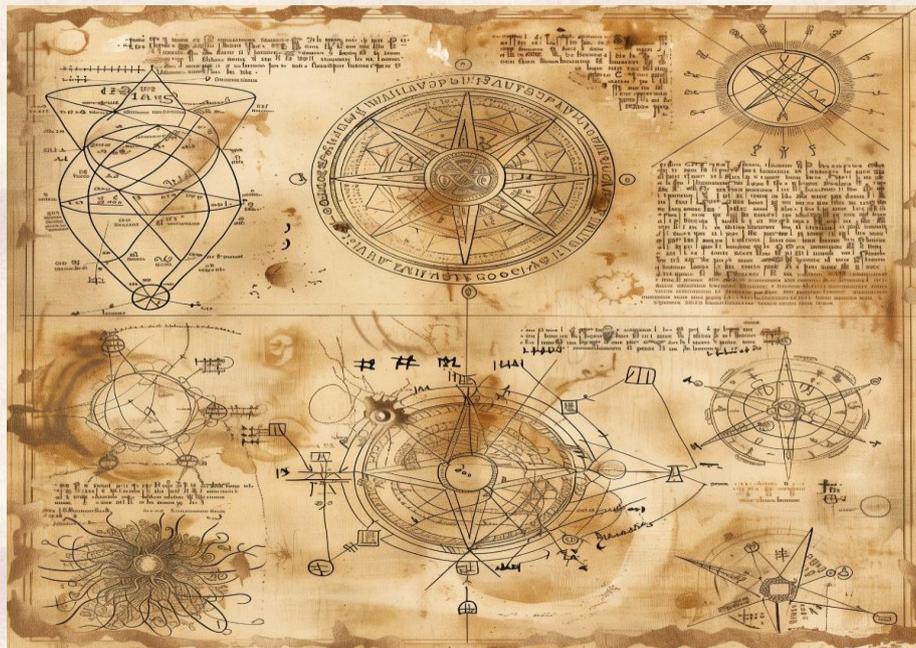Harish-Chandra homomorphism, isomorphism.

Harish-Chandra module.

Harish – Chandra's regularity theorem.

Harish – Chandra's Schwartz space.

Harish – Chandra transformation.

Harish – Chandra's function.

He also won Fellow of the Royal Society, Cole Prize in Algebra (1954), and Srinivasa Ramanujan Medal.

THE CONCEPT OF ZERO: BRAHMAGUPTA'S REVOLUTIONARY IDEA

Kirti Mishra
B.Sc. (P) Physical Science
II Sem

In the vast tapestry of human history, few ideas have had as profound an impact on the intellectual and technological progress of civilization as the concept of zero. The notion of zero not only redefined mathematics but also laid the foundation for many scientific advancements. One of the pivotal figures in this mathematical revolution was the Indian mathematician and astronomer, Brahmagupta.

The Birth of Zero

The concept of zero as both a placeholder and a number in its own right was a groundbreaking development in the world of mathematics. Before Brahmagupta, ancient civilizations like the Babylonians and Mayans had symbols for zero, but it was not universally recognized as a number with its own value. Zero's true potential remained untapped until the work of Indian mathematicians.

Brahmagupta: The Pioneer

Brahmagupta, born in 598 CE in the region of present-day Rajasthan, India, was a prominent mathematician and astronomer. His seminal work, "Brahmasphutasiddhanta" (The Opening of the Universe), written in 628 CE, is one of the first known documents to treat zero as a number in its own right and discuss its mathematical operations.

Mathematical Operations with Zero

Brahmagupta's genius lay in his formalization of arithmetic operations involving zero. He defined rules for addition, subtraction, multiplication, and division with zero, which were revolutionary for their time. For example:

- **Addition:** Adding zero to any number leaves the number unchanged.

- **Subtraction:** Subtracting zero from any number leaves the number unchanged.

- **Multiplication:** Multiplying any number by zero gives zero.

- **Division:** Brahmagupta acknowledged the undefined nature of division by zero, a concept that even modern mathematics grapples with.

Zero in Algebra and Beyond

Brahmagupta's work did not stop at simple arithmetic. He extended the use of zero to algebra, effectively laying the groundwork for modern algebraic theory. His rules for dealing with negative numbers and zero in equations were a significant leap forward, allowing for more complex and abstract mathematical thinking.

The Legacy of Zero

The concept of zero gradually spread from India to the Islamic world, and then to Europe, profoundly influencing the development of mathematics, science, and engineering. The adoption of zero and the decimal number system, which Brahmagupta helped formalize, revolutionized computation and paved the way for advancements in various fields.

Conclusion

Brahmagupta's revolutionary idea of zero transcended the boundaries of mathematics and became a cornerstone of human knowledge. His pioneering work laid the foundation for the modern numerical and algebraic systems that we rely on today. The concept of zero, once a mere placeholder, transformed into a symbol of infinite possibilities, thanks to the brilliance and foresight of Brahmagupta.
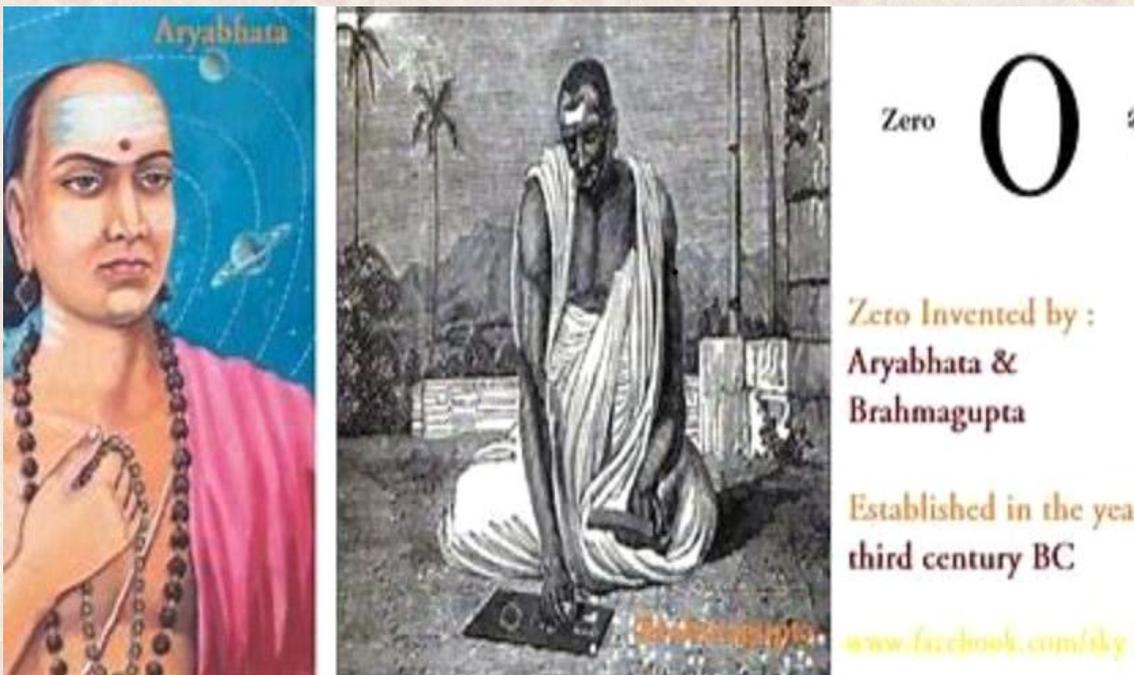
VARAHAMIHIRA
(505 – 587 CE)

Varahamihira was an Indian Mathematician, Astronomer and Astrologer who lived during the Gupta Empire. He was one of the "9 Gems" (Navaratnas) In the court of king Vikramaditya (Possibly Chandragupta II).

Varahamihira was born on 20 / 21 March 505 CE (Common Era) in Ujjain, Madhya Pradesh, India. Ujjain was an important centre of learning Astrology and Astronomy during his time approx 6th century. "Varaha" Refers to the boar incarnation of Lord Vishnu & "Mihira" means "SUN" in Sanskrit. His father was Adityadasa a learned Brahmin scholar and Astrologer.

Anant
B.Sc. (H) Mathematics
II Sem

MAJOR CONTRIBUTIONS OF VARAHAMHIHIRA
1) ASTRONOMY & MATHEMATICS
Pancha-Siddhantika (The Five Astronomical Treatises)
Pancha-Siddhantika) is one of Varāhamihira's most important works on astronomy, written around 550 CE. It is a comparative study of five major astronomical traditions used in India at that time. This text helped standardize and refine astronomical calculations, planetary motions, and timekeeping.

The Five Astronomical Systems
Varāhamihira analyzed and improved the accuracy of the following five Siddhantas (astronomical treatises):

1. Surya Siddhanta – Indian Origin
   A foundational Indian astronomical text.
   Describes solar system, planetary motions, and eclipses.
   Uses trigonometry and sine functions for calculations.
   This system is still used in modern Hindu calendar calculations.

2. Paulisa Siddhanta– Greek-Persian Influence
   Based on the work of Greek astronomer Paul of Alexandria (3rd century CE).
   Introduced Hellenistic (Greek) mathematical techniques.
   Used a system of epicycles to explain planetary motion.

3. Romaka Siddhanta– Roman-Greek Influence
   Likely brought to India by Roman or Alexandrian scholars.
   Uses Greek astronomical tables.
   Focuses on lunar and solar calculations.

4. Vasishtha Siddhanta – Indian Vedic Tradition
    Based on Vedic-era astronomical knowledge.
    Uses a luni-solar calendar for timekeeping.
    Describes planetary positions and conjunctions.

5. Paitamaha Siddhanta– Ancient Indian System
    Possibly the oldest of the five systems.
    Based on mythological and traditional astronomy.
    Mentions precession of the equinoxes (a concept later refined in modern astronomy).

2) Varāhamihira's Contributions to Trigonometry & Geometry
Varāhamihira made significant advancements in trigonometry and geometry, improving upon earlier works by Indian mathematicians like Aryabhata. His contributions laid the foundation for future developments in spherical geometry, trigonometric functions, and combinatorics.

1. Contributions to Trigonometry
⬥ Improved Sine Tables
Expanded on Aryabhata's sine tables, improving accuracy.
Used interpolation techniques to find sine values for intermediate angles.

⬥ Use of Trigonometric Functions
Used sine (Jya), cosine (Kojya), and versine (Utkramajya) in astronomical calculations.
Applied these functions to calculate planetary positions and eclipses.

⬥ Concepts of Half-Angle Formulas
Developed trigonometric formulas similar to modern half-angle identities.
His work helped in computing lunar and solar eclipses with greater precision.

2. Contributions to Geometry
⬥ Approximation of Pi (π)
He worked with circular measurements and contributed to the early approximations of π.
Used π in calculating the circumference and area of circles.

⬥ Use of Pascal's Triangle & Binomial Coefficients
Introduced concepts similar to Pascal's Triangle in combinatorial mathematics.
Used binomial coefficients in astronomical and geometrical calculations.

⬥ Spherical Geometry
Applied spherical trigonometry to astronomical models.

Helped in determining time zones, planetary distances, and celestial coordinates.
His trigonometric work influenced later Indian mathematicians like Brahmagupta and Bhaskara I.

3.) Varāhamihira's Contributions to Astrology

Varāhamihira made significant contributions to Vedic astrology, which is the system of astrology practiced in India. His works laid the foundation for understanding the influence of celestial bodies on human lives and the natural world. He is best known for his detailed texts on horoscopes, planetary positions, and their effects.

1. Brihat Jataka (Brihat Jātaka)

One of Varāhamihira's most famous astrological texts is the Brihat Jataka, considered a foundational work in Vedic astrology.

Key Features of Brihat Jataka:
Horoscopic Astrology: The text deals with birth charts (horoscopes), where the positions of planets at the time of a person's birth are analyzed to predict their life events.

Planetary Influences: It explains how the positions of the Sun, Moon, and planets at the time of birth influence personality traits, destiny, career, relationships, and health.

Dasha System: It elaborates on the Dasha system, a method used to predict the timing of events in a person's life, based on the planetary periods or cycles.

Nakshatras: The book also discusses the 27 lunar mansions (Nakshatras) and their role in astrology, contributing to the understanding of astrological timing.

Interpretation of Planetary Aspects: Brihat Jataka also provides insights into the aspects (drishti) between planets and their effects.

वराहमिहिरविरचिता
बृहत्संहिता
THE BRIHAT SAMHITĀ
OF
VARĀHA MIHIRA
(Text with English Translation, Notes and Index)

Edited
Jagdish Shastri

2. Laghu Jataka (Laghu Jātaka)

Varāhamihira also authored a simplified version of Brihat Jataka, called the Laghu Jataka, meant for beginner astrologers. It provides a concise, straightforward approach to astrology, focusing on key principles like:
Planetary Significance
Basic Horoscope Interpretation
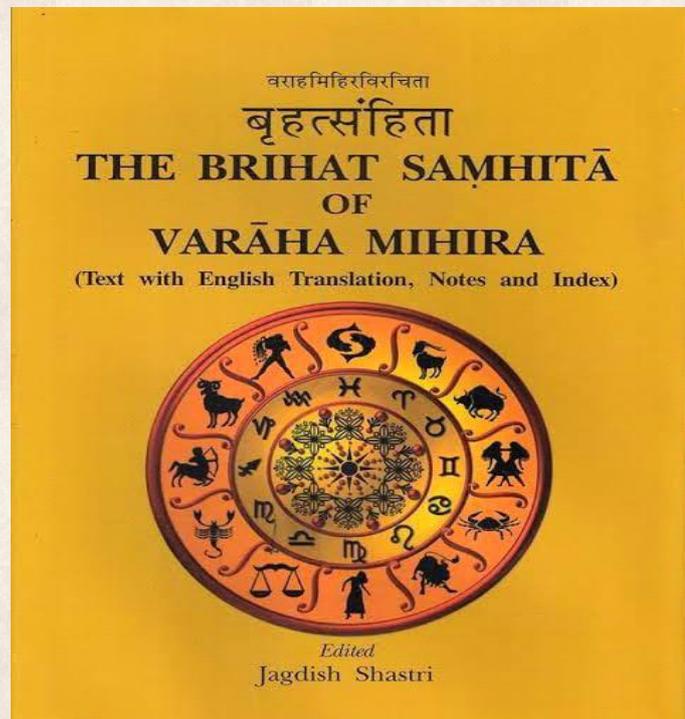
3. Influence of Planetary Positions

Varāhamihira's astrological system is built on the idea that the positions of the planets at birth determine various aspects of a person's life. His Brihat Samhita also connects astrology with natural phenomena, like:

    Weather patterns
    Agricultural predictions
    Natural disasters (like earthquakes)
    Planetary Combinations (Yogas)

Varāhamihira elaborated on the concept of planetary combinations or Yogas, where specific alignments of planets can bring about favorable or unfavorable outcomes in a person's life. He categorized these combinations into:

Rajayogas (Kingship Yogas): Beneficial combinations leading to prosperity and fame.

Dhanayogas (Wealth Yogas): Combinations leading to wealth and financial success.

4. Principles of Muhurta (Auspicious Timing)

Varāhamihira contributed to the science of Muhurta, which involves choosing auspicious moments for important activities, such as marriage, starting a business, or moving into a new home. He believed that aligning actions with cosmic cycles would yield better outcomes.
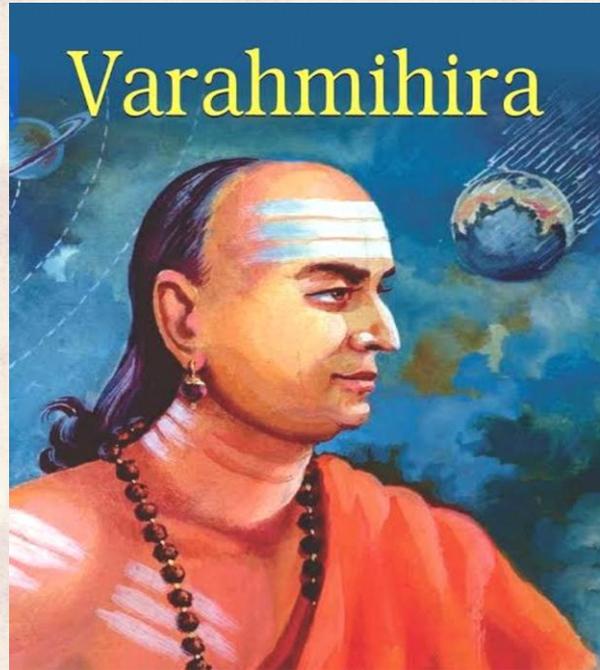
5. Brihat Samhita (Encyclopedia of Natural Science)

Though primarily an astronomical and astrological work, the Brihat Samhita also deals with the relationship between astrology and daily life, including:

Gemology: How gemstones influence people based on their astrological signs.

Architectural Design: How Vastu Shastra (Indian architecture) and the positions of celestial bodies affect the structures.

6. Influence on Later Astrologers

Varāhamihira's works influenced later Indian astrologers like Brahmagupta, Bhaskara I, and Kalyanvarman.His writings were later translated into Persian and Arabic, impacting Islamic astrology as well.Varāhamihira's integration of astronomy and astrology into a comprehensive system had a lasting impact on Indian astrology, with many of his ideas still in practice today.
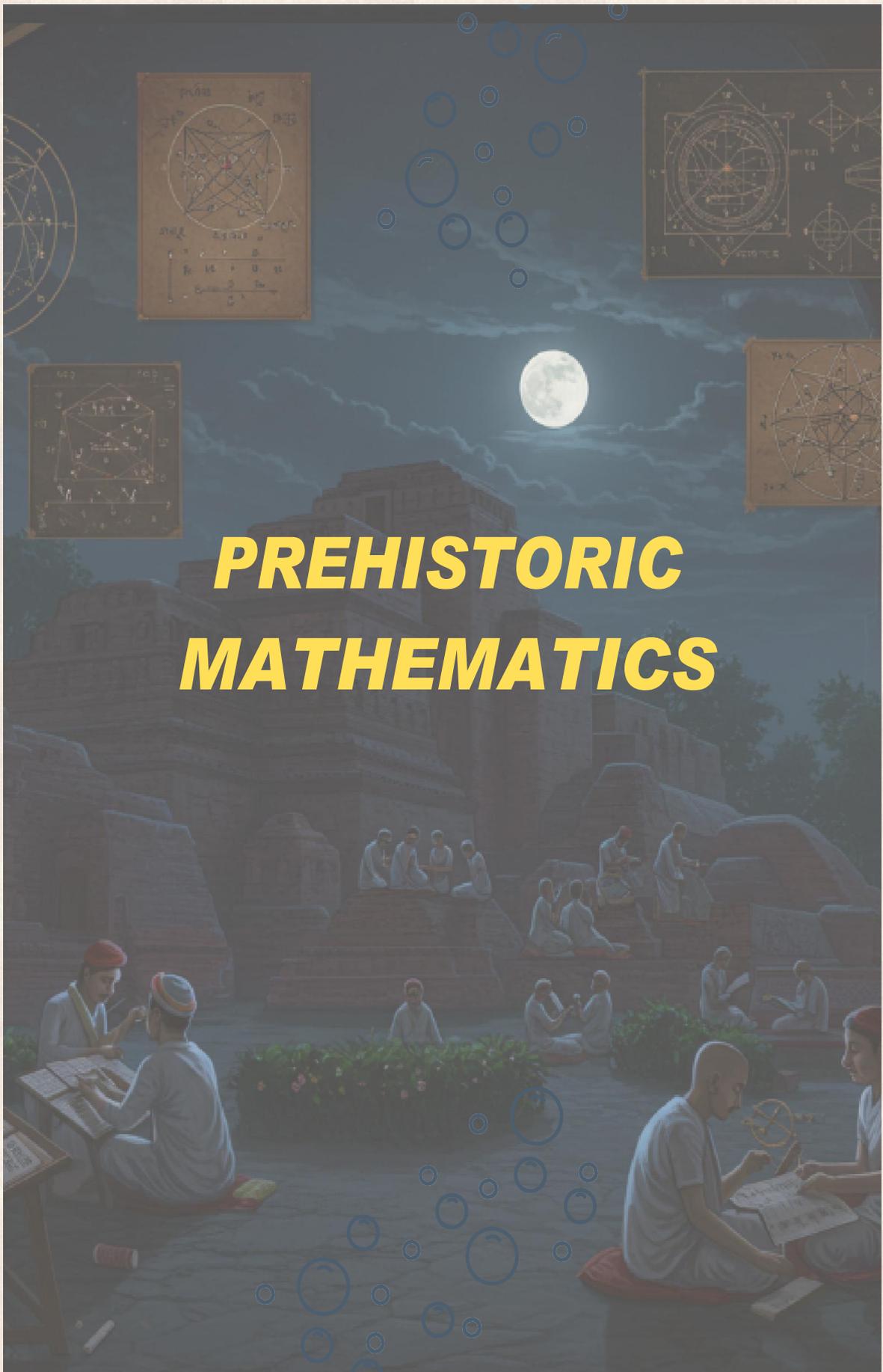
PREHISTORIC MATHEMATICS

MATHEMATICS AND PHILOSOPHY: INSIGHTS FROM INDIAN LOGIC AND NYĀYA

Sajal Agarwal
B.Sc. (P) Physical Science
VI Sem

Indian philosophy has long celebrated the union of rigorous reasoning with the beauty of abstract thought—a union vividly embodied in the Nyāya school of logic. Rooted in the ancient texts known as the Nyāya Sūtras, this philosophical tradition not only delved into the nature of knowledge and inference but also anticipated many of the critical methods that underpin modern mathematical reasoning.

At its core, the Nyāya system is a celebration of systematic inquiry. Its elaborate framework for pramāṇa, or valid means of knowledge, laid out the rules for what constitutes reliable evidence. This rigorous approach to establishing truth through direct perception, inference, comparison, and authoritative testimony mirrors the axiomatic systems in mathematics where each theorem builds upon carefully established premises. The Nyāya philosophers, like Akṣapāda Gautama, devised methods of debate and analysis that resonate with the deductive structures found in mathematical proofs.

What makes this confluence of mathematics and philosophy so compelling is the way Nyāya thought nurtured the spirit of inquiry. Just as mathematicians today use logic to navigate abstract problems, ancient Indian scholars applied similar strategies to dissect complex metaphysical questions. They viewed logic not merely as a tool for debate but as a universal language—a bridge connecting the tangible with the abstract, the empirical with the speculative. This philosophical rigor fostered an intellectual culture where the art of reasoning became both a pathway to discovering the cosmos and a means to appreciate the elegance of mathematical order.

Moreover, the Nyāya tradition's emphasis on clarity and precision laid early foundations for what would eventually evolve into formal logic, influencing later developments in both Indian and global intellectual thought. It reminds us that the pursuit of mathematical truth is not isolated from broader philosophical questions; rather, it is intertwined with humanity's enduring quest to understand reality itself.

In celebrating the insights of Nyāya, we are reminded that mathematics is not just about numbers or equations—it is a profound, philosophically rich exploration of patterns, structures, and the essence of truth. This legacy encourages contemporary scholars to blend creative intuition with analytical precision, echoing the timeless dialogue between mathematics and philosophy.

MATHEMATICS IN ANCIENT INDIA

Ramesh Kumar
B.Sc. (P) Math. Science
VI Sem

Mathematics in Ancient India is characterized by significant contributions to number systems, trigonometry, and astronomical calculations.

Number System

1. Indus Valley Civilization: The earliest numerical evidence dates back to 2500-1500 BCE, where symbols were used for counting and recording quantities.

2. Brahmi Numerals: Emerging around the 3rd century BCE, the Brahmi script introduced symbols for numbers, marking one of the earliest written numeral systems in India.

3. Kharosthi Numeral System: Active from the 3rd century BCE to the 3rd century CE, this positional decimal system utilized symbols for numbers and included a representation for zero, similar to modern numeral systems.

4. Decimal System: India's most notable contribution is the decimal numeral system based on ten symbols (0-9). The concept of zero as both a placeholder and a standalone number was developed here, simplifying arithmetic and forming the basis of modern mathematics.

5. Influence on Other Cultures: The decimal system spread from India to the Islamic world and then to Europe, significantly impacting global mathematics through scholars like Al-Khwarizmi.

The Kerala School of Mathematics and Astronomy

Flourishing between the 14th and 16th centuries CE, made groundbreaking contributions:

Trigonometry: Developed infinite series expansions for trigonometric functions, predating European calculus.

Calculation Techniques: Innovative methods for calculating planetary positions and predicting celestial events.

Mathematical Literature: Produced significant texts like "Yuktibhāṣā" and "Tantrasangraha," which documented their findings.

Calendar Reforms: Improved accuracy in calendar systems based on astronomical observations.

The Kerala School built upon earlier traditions from mathematicians like Aryabhata and Brahmagupta, expanding existing knowledge with new methodologies.

Dattatreya Ramachandra Kaprekar

Kaprekar is renowned for discovering the Kaprekar Constant (6174) in 1949. He demonstrated that by repeatedly arranging digits of any four-digit number (with non-repeating digits) in descending and ascending order and subtracting the two results, one would eventually arrive at 6174. For example:
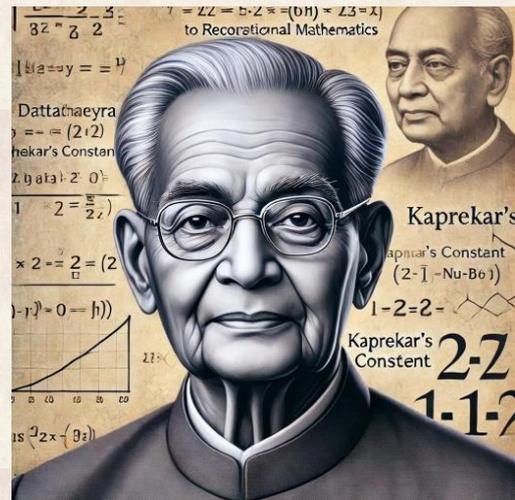
1. Start with 1234:

   - 4321 - 1234 = 3087

2. Repeat:

   - 8730 - 0378 = 8352
   - 8532 - 2358 = 6174

Once reached, repeating the process will always yield 6174.

In summary, ancient Indian mathematics laid foundational concepts that have profoundly influenced global mathematical practices and theory.

ANCIENT INDIAN ASTRONOMICAL MATHEMATICS

Ancient Indian astronomy is one of the most impressive intellectual traditions in history. There was no need to observe the stars. It was deeply mathematical. Indian astronomers used complex calculations to follow the development of heavenly movement, prediction of solar eclipses, and even the development of planetary motion models. Their discoveries not only remained in India but also influenced scientists around the world, shaping ways of understanding today's space.

Mahir Bhatia
B.Sc. (P) Math. Science
VI Sem

Early Indian Astronomy

Indian astronomy dates back to the Vedic period around 1500 BC. Rigveda, one of the oldest existing texts, refers to the events of heaven and the movement of planets. However, everything was composed around 1200 BC. It was the beginning of a long and incredible trip to Indian mathematical astronomy.

How Mathematics Shaped Indian Astronomy

Mathematics has played a major role in promoting Indian astronomy. Indian scientists have already used decimal and then influenced mathematics worldwide. They have developed trigonometric functions such as Sine (Jya) and Cosine (Kojya).

One of the biggest names in this area was Aryabhata (476 AD). In his book Aryabhatiya, innovative ideas were presented, such as the Earth's rotatio n on its axis and the actual causes of solar and lunar eclipses. He also gave a close approximation of π (pi) and the equations of planetary revolution.
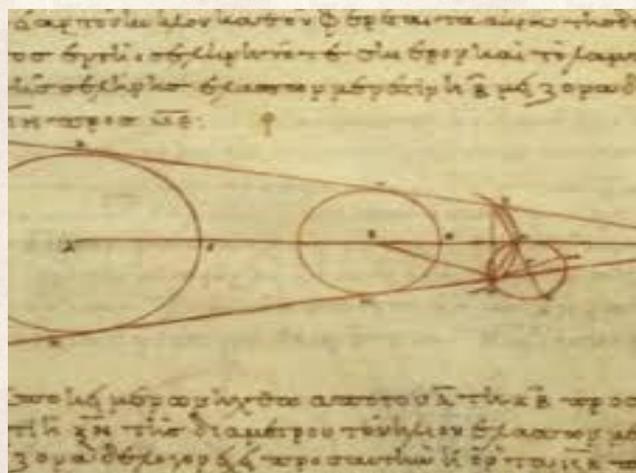
Era of Siddhantic Astronomy

After Aryabhata, Indian astronomy passed through the so-called tradition of Siddhanta. Scientists wrote detailed astronomical texts called Siddhantas. This improved previous ideas and refined planetary models.One of the most famous texts was Brahmasphutasiddhanta (628). He also developed rules for algebraic and quadratic equations required for accurate astronomical calculations. Another important work was Pancha-Siddhantika by Varahamihira (6th century), which combined the knowledge of five different astronomical schools. His work helped to improve the calculations of planetary movements and solar eclipses.
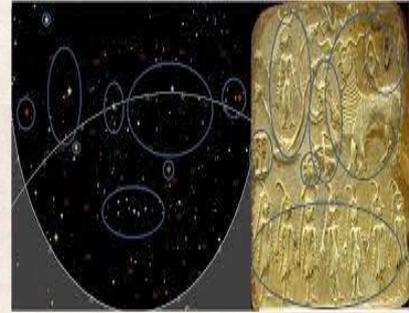
The Impact on the World

India's astronomical knowledge did not end in the subcontinent. During the Golden Age of Islam (8th to 12th centuries), Indian texts were translated into Arabic and influenced legendary scientists such as Al-Khwarizmi and Al-Biruni. Trigonometry and numerical systems developed in India found their way to Europe through Arabic translations, shaping modern mathematics and astronomy.

Conclusion

Ancient Indian astronomy was ahead of its time. It wasn't just about looking at the stars—it was a combination of acute observations and mathematical accuracy. Indian astronomers have proven that mathematics is indeed the language of the universe and have developed concepts that affect the whole world. Even today, their heritage continues to inspire mathematicians and astronomers around the world.
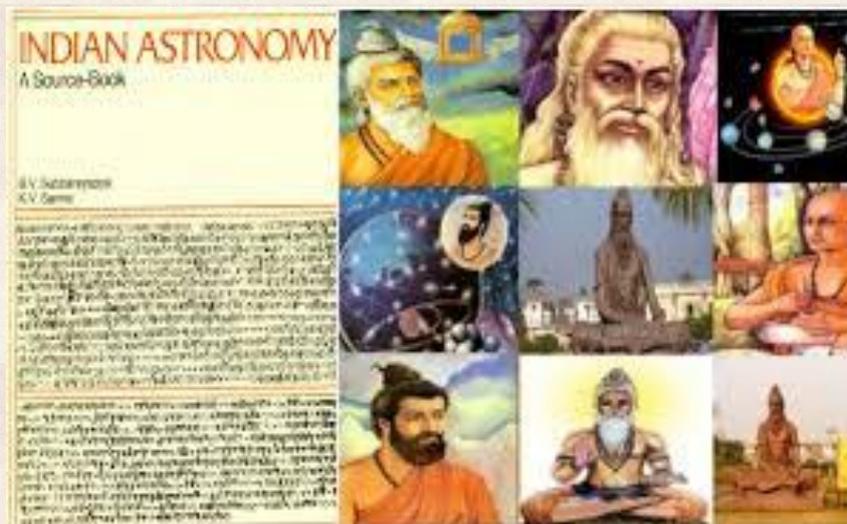
MATHEMATICAL MYSTICISM: THE INTERSECTION OF NUMBERS AND SPIRITUALITY IN ANCIENT INDIA

Aditi Sharma
B.Sc. (P) Math. Science
VI Sem

Mathematics is often viewed as a purely logical, objective field of study, concerned with numbers, formulas, and calculations. However, in ancient India, mathematics and spirituality were not separate entities but were intricately woven together, with numbers being regarded as the key to understanding the universe and the divine. The concept of *mathematical mysticism* in ancient India reflects this profound connection between numerical patterns and spiritual beliefs. The use of mathematics in religious rituals, cosmology, and philosophical thought reveals a worldview in which numbers were not just tools of measurement, but gateways to understanding the cosmos and the nature of existence itself.

The Sacred Role of Numbers in Vedic Thought

In the Vedic tradition, which spans over 3000 years, numbers were not merely quantitative but were seen as having intrinsic spiritual significance. The Vedas, India's ancient scriptures, imbued numbers with symbolic power. The sacred texts were full of numbers that governed the rhythm of hymns, the construction of altars, and the performance of rituals. The number 3, for example, is a recurring theme throughout the Vedas, symbolizing unity, harmony, and balance. The *Rigveda* mentions the number 3 in many of its hymns, particularly in the context of the three main gods of the Vedic pantheon: Agni, Indra, and Soma.

Similarly, the number 7, representing the seven heavenly bodies or "saptarishi," held deep mystical meaning, embodying completeness and wholeness. The *Atharvaveda* features the idea of *sapta loka* (seven realms) and *sapta rishi* (seven sages), which are viewed as reflections of the spiritual hierarchy of the universe. Numbers were thus not just abstract concepts, but connected to the fabric of reality, acting as metaphysical bridges between the material and the divine.

The Geometry of the Divine: The Role of the Sulba Sutras

One of the most fascinating intersections of mathematics and spirituality in ancient India is seen in the *Sulba Sutras*, texts that outlined the construction of altars for Vedic rituals. These texts, which form part of the broader *Kalpa Sutras*, provide precise geometric instructions for creating altars, many of which are associated with specific religious ceremonies. In these rituals, the geometrical design of the altar was believed to directly influence the outcome of the ritual, linking physical form with spiritual energy.

The *Sulba Sutras* describe various geometrical figures, such as squares, rectangles, and circles, each symbolizing different aspects of the cosmos. For instance, the construction of a square altar was thought to align with the earthly realm, while circular altars represented the divine or celestial realm. The process of constructing these altars was an act of meditation in itself, where geometric precision was a reflection of cosmic order. This blending of mathematics with ritualistic spirituality is a clear example of mathematical mysticism in ancient India.

The Concept of Zero and the Infinite: Bridging the Finite and the Eternal

One of the most profound contributions of ancient Indian mathematics is the concept of zero, which played a pivotal role not only in arithmetic but also in philosophical and spiritual thought. The earliest recorded use of zero appears in the *Brahmasphutasiddhanta* of Brahmagupta, around 628 CE, but the philosophical concept of *shunya* (void or emptiness) can be traced much earlier in Vedic and Upanishadic texts.

In Indian spiritual philosophy, *shunya* represented both the void and the infinite, the space between creation and dissolution. It symbolized the concept of non-being that was also the source of all being, embodying a paradox that resonated deeply with spiritual thought. This philosophical understanding of zero reflects the inherent mysticism of numbers in India, where the void was seen as a conduit for divine energy, and the number itself was considered a symbol of the infinite, bridging the finite world with the eternal.

The Indian understanding of zero profoundly impacted later developments in mathematics, allowing for more sophisticated mathematical operations, such as algebra and calculus. But its roots lay in a spiritual view of the universe, where the infinite and the void were central to understanding the nature of existence.

Sacred Geometry: The Divine Proportions of the Universe

The idea of *sacred geometry* in ancient India is closely tied to the belief that the universe was designed with divine mathematical principles. The ancient Indian tradition of architecture, particularly in the construction of temples and sacred structures, reflects this concept. Temples were not merely physical spaces; they were representations of the cosmos, designed according to specific mathematical principles that aligned with the universe's cosmic order.

The *Vastu Shastra*, an ancient Indian architectural text, outlines the mathematical and geometric principles for building sacred spaces. These texts provide detailed instructions on the dimensions, proportions, and layout of buildings, with the underlying belief that these proportions mirrored the cosmic structure. The precise measurements of temples, including the relationship between their height, width, and depth, were thought to invite divine presence and harmonize the space with the universe.

The Mysticism of Numbers in Indian Philosophy

The ancient Indian philosophers believed in the cyclical nature of time — the concept of *kalachakra* — where time was perceived as an eternal, recurring cycle. This cyclical perception of time reflects the philosophical and spiritual nature of numbers in ancient India, where even the infinite nature of time and existence could be measured and understood through numerical principles.

Legacy of Mathematical Mysticism

The mathematical mysticism of ancient India continues to inspire modern thinkers and practitioners of both mathematics and spirituality. The integration of numbers with spiritual philosophy was not only a unique feature of Indian thought but also an essential part of understanding the nature of the universe. The relationship between geometry, numbers, and the divine, seen in the *Sulba Sutras*, the concept of zero, and sacred architecture, showcases an early understanding of the interconnectedness of all things.

In ancient India, numbers were not just a means of measuring the world; they were believed to hold the keys to the universe itself. Through the lenses of Vedic astronomy, sacred geometry, and the philosophical teachings of the Upanishads, mathematical mysticism offered a way of understanding the world that bridged the material and spiritual realms. The profound connection between mathematics and spirituality in ancient India remains a testament to the depth of Indian intellectual and mystical traditions, providing a timeless example of how numbers can reveal the mysteries of the cosmos and the divine.

MEDIEVAL AND EARLY MODERN MATHEMATICS IN INDIA: A LEGACY OF GENIUS

Chetan Choudhary
B.Sc. (H) Mathematics
IV Sem

Indian mathematics flourished during the medieval and early modern periods, shaping global mathematical thought. From algebra to trigonometry and early calculus, Indian scholars introduced groundbreaking ideas that predated many Western discoveries.

● Medieval Brilliance: Algebra & Trigonometry

Between the 8th and 12th centuries, luminaries like Bhaskara I, Mahavira, and Bhaskara II revolutionized algebra, solving complex quadratic and indeterminate equations. Trigonometry advanced with refined sine tables and formulas, influencing global astronomy. The cyclic method (chakravala) for solving Pell's equation, introduced by Bhaskara II, was centuries ahead of Europe.

● Early Modern Breakthrough: The Kerala School & Proto-Calculus

The Kerala School (14th–16th century), led by Madhava, Nilakantha, and Jyeshthadeva,

anticipated key ideas of calculus. Madhava's infinite series expansions for sine, cosine, and arctangent functions mirror Taylor and Gregory series. His remarkable approximation of π (pi) and early concepts of differentiation and integration were centuries ahead of Newton and Leibniz.

● Global Impact: Unrecognized Genius

Indian mathematics traveled through Arabic translations, influencing European algebra and number systems. While the Kerala School's calculus-like methods remained largely unknown

to the West, its contributions were revolutionary.

● Conclusion

India's medieval and early modern mathematicians reshaped the world of numbers. Their discoveries, far ahead of their time, remain a testament to India's mathematical genius—an unsung but unparalleled legacy.
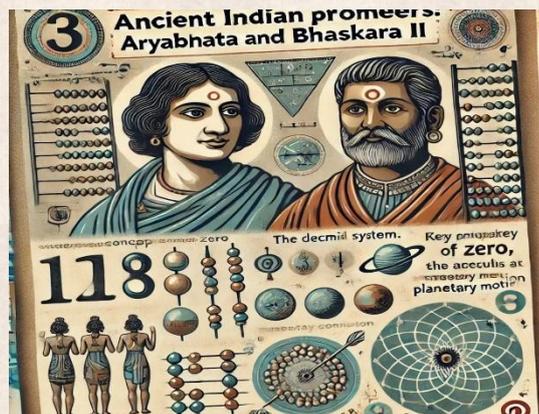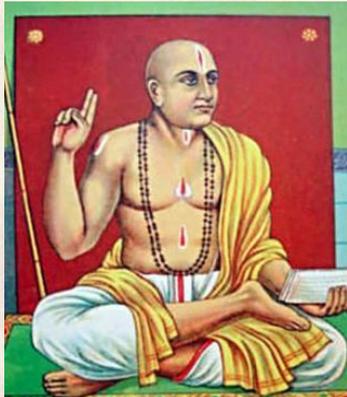
VEDIC PERIOD

Shubhika Srivastav
B.Sc. (P) Physical Science
II Sem

The Vedic age, a primitive time in Indian mathematics, saw a fundamental change from applied purposes to more symbolic and ceremonial interpretation of numeric and geometric concepts.

It was around Vedic mathematics that its deep involvement with ritual ceremonies. The building of sacrificial altars, or vedis, was an extremely exacting and symbolic practice that required scrupulous obedience to exact measure and geometric form. The Sulbasutras thus are mostly interested in the theory of geometry needed in such constructions. They demonstrate a very good grasp of ideas of geometry, including the Pythagorean theorem, much earlier than when it was mathematically formulated by Pythagoras. The texts establish procedures for the construction of squares and rectangles and other figures of geometry, and procedures for changing one figure into another without changing its area. This demonstrates a full grasp of area computation and geometric transformation.

Apart from geometrical construction, the Sulbasutras also indicate the presence of more sophisticated numerical ideas. Square roots, especially square root of 2, are encountered in the texts in terms of approximations. These played an important role in the construction of altars of specific measurements. The Vedic number system, with its refined gradations and naming of large numbers, also speaks of an evolving awareness of the nature of numbers. The system, although employed for a chief ritualistic purpose, sowed the seeds for the future developments in number theory.

Aside from that, the Vedic period also witnessed the arrival of early astronomical observations that incorporated mathematics. Though not mathematical texts per se, Vedic texts contain references to celestial objects and indicate a curiosity for mathematical aspects of the universe. The development of the Vedic calendar with its intricate cycles and computations demonstrates the early fascination with astronomical mathematics.
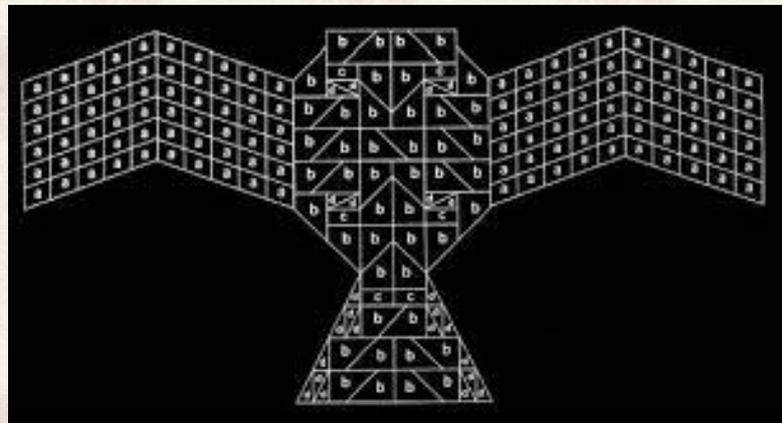
The focus on accuracy and correctness in Vedic mathematics was due to its ritualistic nature. The notion that the success of sacrificial rites was contingent upon the precise establishment of altars created a culture of careful measurement and geometric thought. This ritualistic beginning did not discourage the growth of abstract mathematical ideas, but rather led to a special incentive for the investigation of geometric and numerical principles.

The essence of the Vedic era of Indian mathematics is the synthesis between ritual and abstract thinking. Sulbasutras, with the use of geometry for construction and numerals as approximation, bear some witness to the mathematical proficiency of the age. The epoch, with the attention to exactitude, abstract thinking, and conjoining mathematics and ritual, played an important role in structuring the destiny of Indian mathematics.

"*The Sulbasutras, a sacred rhyme,*
With square root secrets, defying time."

MODERN MATHEMATICS
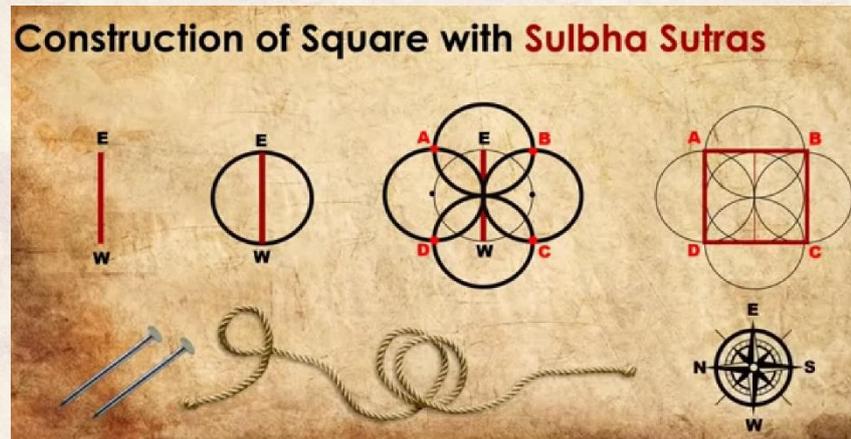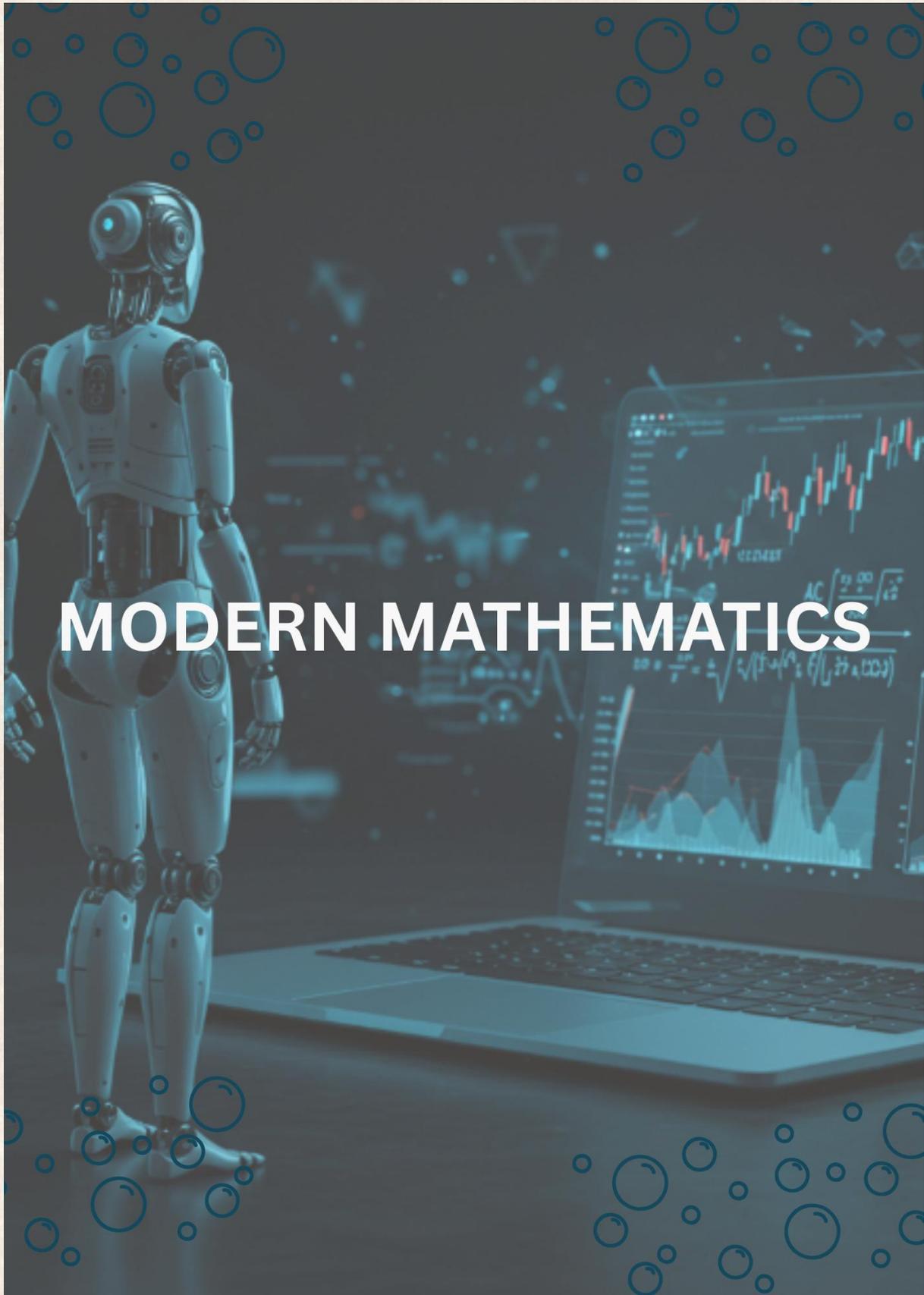
CURRENT MATHEMATICS

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VI Sem

Mathematics currently has several alterations regarding theoretical studies, applications in artificial intelligence (AI), and educational problems. Truly important breakthroughs have come from present-day improvements in graph theory, combinatorics, in addition to number theory, bringing about deeper understandings into mathematical structures. The investigation into constructive mathematics has additionally seen increased force. It points out the requirement of constructing mathematical objects to show their existence, as opposed to depending on any non-constructive techniques.

AI is playing a larger role in mathematics, as noted by Terence Tao and other well-known mathematicians, because AI might be able to work out hard problems. AI systems should function effectively as research assistants, managing routine math work and allowing experts to focus intently on revolutionary problem-solving. Alexander Grothendieck's toposes concept, especially his work, is also being studied for possible use in AI, which might improve machine learning models' ability to understand ideas through meaning, not just data recognition.

Mathematics education faces many challenges despite all these exciting developments. Worries exist that the UK's global leadership regarding innovation, AI, and technology sectors face threats from potential shortages of math teachers, which relate to several recent funding cuts affecting mathematics education. Likewise, in Scotland, the fact that less than half of S4 students have achieved key qualifications is an alarming indication of low pass rates in mathematics.

Mathematics must address some educational problems while also pushing the limits of research. It is important to secure a consistently capable mathematical workforce for fully sustaining innovation. Thoroughly maintaining leadership in a greatly technology-driven world is important as well.
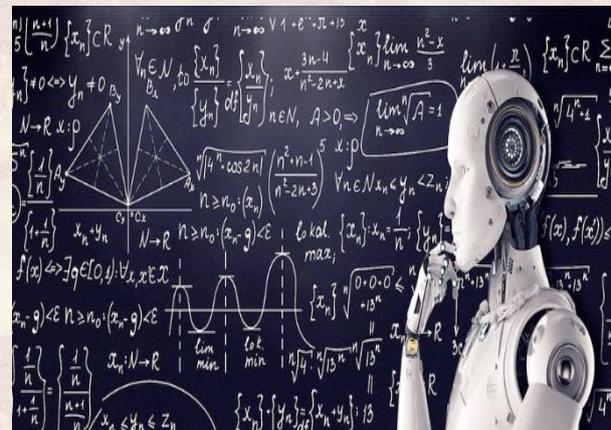
CRYPTOGRAPHY WHERE ABSTRACT MATH MEETS REAL - WORLD SECURITY

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Our online lives are innovated on secrets. From secure online banking to translated messaging, we depend on cryptography to cover our information. And at the core of cryptography is a redoubtable toolkit of contemporary fine ways.

The Prime Number Powerhouse

RSA Encryption This structure block of public- crucial cryptography uses the near-impossibility of factoring big figures into their high factors. Picture multiplying two humongous flowers; simple. But calculating those original flowers from the product, that's insolvable for ultramodern computers. That "one-way function" is the foundation of RSA. The fact that similar large high figures are employed moment in this form of encryption makes it so largely secure. Using figures hundreds of integers long when we're rendering, the sheer quantum of calculations demanded to do so is literally insolvable.

The Elliptic Wind Enigma

Elliptic wind Cryptography (ECC), with the need for speed and effectiveness in the digital age, has taken the centre stage. It leverages elliptic angles, largely advanced fine objects with interesting geometric parcels. ECC provides the same security as RSA but with much lower keys, making it a perfect fit for resource - limited bias similar to smartphones and Internet of Things. The hardness of the "elliptic wind separate logarithm problem" is what makes these systems secure. It's yet another problem that's extremely delicate to break backwards.

Beyond the Basics

There's further to ultramodern cryptography than these abecedarian generalities. It involves sophisticated fine styles similar as Chassis- grounded cryptography Quantum computing-resistant, it leverages the hardness of working some problems on fine structures.

Homomorphic encryption Enabling calculations to be conducted on translated information without the need to decipher, furnishing windows for secure processing of data.
 Zero- knowledge attestations Enabling a party to demonstrate to another that a statement holds, without discovering anything other than the fact of the statement.

The Constant Arms Race

Cryptography is a no way - ending game of cat and mouse. When mathematicians uncover new encryption styles, cryptanalysts go into overdrive trying to break them.

The arrival of amount computing threatens the cryptographic structure oppressively, which has led to a huge thrust in exploration towards amount- resistant algorithms.

In a nutshell, ultramodern mathematics is crucial to erecting secure digital structure. The Parcels of high figures and elliptic angles, coupled with other advanced- position fine generalities, enable us to guard our sensitive data in a world that's getting decreasingly connected.

THE MATHEMATICS BEHIND ARTIFICIAL INTELLIGENCE

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Artificial Intelligence (AI) is revolutionising the world in ways that were once thought impossible. From self-driving cars to voice assistants like Siri and Alexa, AI is enhancing daily life by automating tasks and improving efficiency. But what makes AI function so intelligently? The foundation of AI lies in mathematics. Every AI system, whether simple or advanced, is built on mathematical concepts that enable machines to learn, process data, and make decisions.

The Role of Mathematics in AI

Mathematics is essential for AI as it provides the framework for analysing information and making logical predictions. Unlike human intuition, AI operates strictly on mathematical formulas and computational methods. Some of the key mathematical concepts used in AI include:

1) Algebra — AI systems utilise algebraic equations to structure and analyse data. This helps identify relationships between different variables, which is crucial for predictive models. For instance, weather forecasting uses algebraic principles to estimate temperature, humidity, and other atmospheric conditions.

2) Probability and Statistics — Since AI frequently deals with uncertainty, probability theory is vital in making well-calculated predictions. Statistical methods allow AI to examine extensive datasets and identify patterns, which is why platforms like Netflix and YouTube suggest content based on user preferences.

3) Calculus — Machine learning relies on calculus to refine models and optimise learning processes. Derivatives and gradients guide AI in adjusting itself to improve accuracy over time. For example, facial recognition software enhances detection precision using calculus-based optimisation techniques.

4) Linear Algebra — AI processes large sets of information using matrices and vectors, which are fundamental concepts in linear algebra. This mathematical field is especially crucial in deep learning, where neural networks interpret images, speech, and text efficiently.
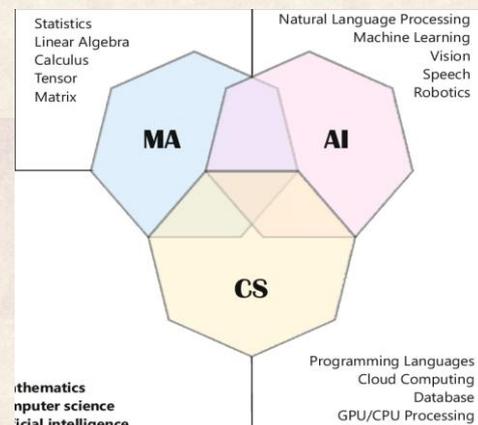
As AI continues to evolve, mathematics will remain its foundation. New developments in mathematical techniques will further enhance AI's capabilities in decision-making, automation, and complex problem-solving. AI may appear to work like magic, but in reality, it

is mathematics that powers every intelligent system. Without core mathematical disciplines like algebra, probability, calculus, and linear algebra, AI as we know it would not exist. Mathematics is truly the driving force behind artificial intelligence.

Real-Life Applications of AI and Mathematics

AI is deeply embedded in everyday life, even if it often goes unnoticed. Some common applications include:

1) Healthcare — AI aids in diagnosing illnesses, analysing medical images, and predicting potential health risks. By recognising trends in patient data, mathematical models help doctors make more accurate assessments.

2) Autonomous Vehicles — Self-driving cars use AI to process sensor data for safe navigation. Mathematical calculations determine distances, detect obstacles, and assist in making split-second driving decisions.

3) Virtual Assistants and Chatbots — AI-driven assistants such as Google Assistant and Alexa rely on natural language processing (NLP), which incorporates statistical methods and linear algebra to understand and generate human-like responses.

The Future of AI and Mathematics

As AI continues to evolve, mathematics will remain its foundation. New developments in mathematical techniques will further enhance AI's capabilities in decision-making, automation, and complex problem-solving. AI may appear to work like magic, but in reality, it is mathematics that powers every intelligent system. Without core mathematical disciplines like algebra, probability, calculus, and linear algebra, AI as we know it would not exist. Mathematics is truly the driving force behind artificial intelligence.
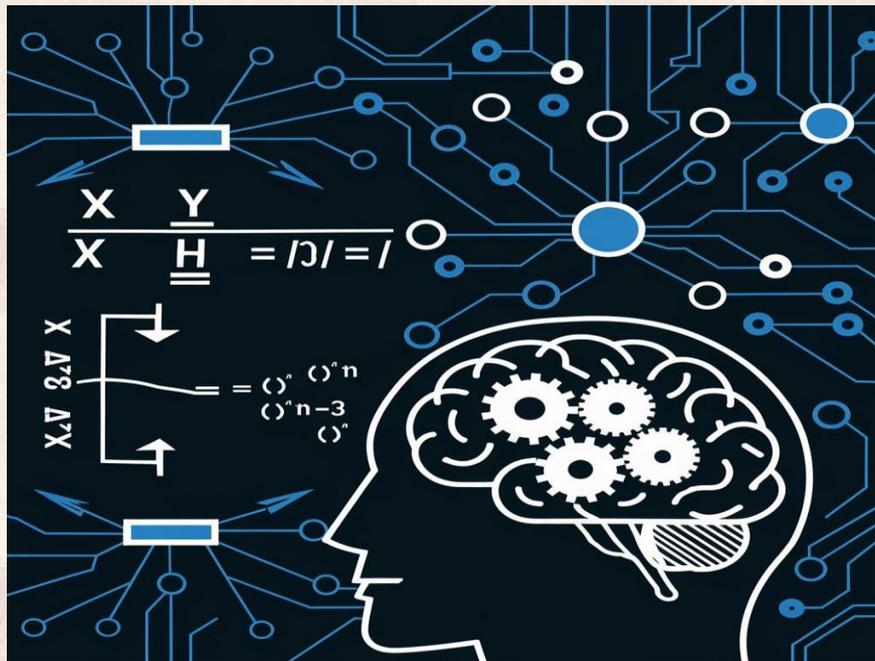
CURRENT MATHEMATICS: INSIGHTS OF LATEST MATHEMATICS

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The field of Mathematics is experiencing significant advancements and challenges across various domains, from educational reforms to the integration of artificial intelligence in mathematical research. The intersection of AI and mathematics has become a focal point of research. The study presents theoretical directions and discusses open problems, emphasizing the need for a rigorous mathematical framework to support the rapid advancements in AI.

Computational Mathematics has also seen significant advances in the last few years. The development of new algorithms and computational methods has enabled researchers to simulate complex systems and analyze large data sets. These advances have applications in fields such as climate modeling, materials science, and finance.

One of the significant breakthroughs in mathematics is the solution to the "P versus NP" problem, a fundamental question in computer science. Mathematics has made progress in understanding the complexity of computational problems, which has important implications for cryptography, optimization and machine learning. Another area of significant advancement is the field of mathematical biology. Researchers have also introduced new mathematical models to understand complex biological systems, such as the behavior of cancer cells and the spread of diseases. These models have the potential to improve the understanding of biological processes and lead to new therapies and treatments.
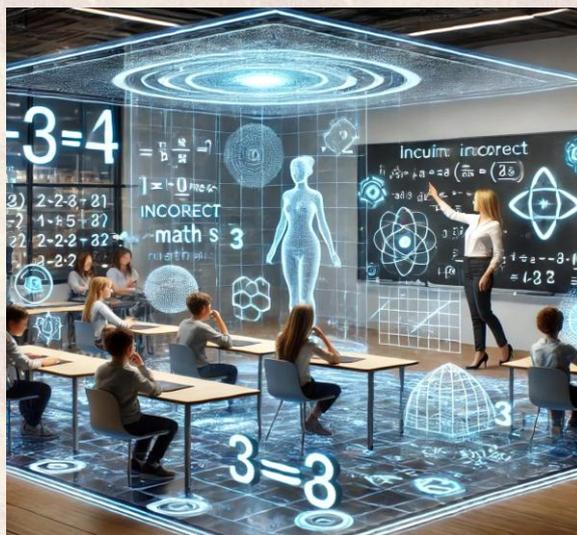
Mathematics also plays a critical role in our understanding of climate change. Researchers use mathematical models to interpret the behavior of the climate system and predict future climate trends. These models take into account complex interactions between atmospheric, oceanic, and terrestrial systems.

Innovative approaches to mathematics education are being explored to enhance student engagement and understanding. One such approach involves presenting students with "incorrect problems": problems designed with solutions that do not make sense in real-life contexts or provide contradictions during the solution process. This method encourages critical thinking and motivates students to explore patterns, formulate conjectures, and find solutions beyond memorizing formulas and procedures. A study involving 168 undergraduate engineering students demonstrated that exposure to such problems can provide insights into students' preparedness for "out of the box" thinking and highlight the importance of foundational mathematical skills.

Current mathematics is a vibrant and dynamic field that continues to evolve and expand our understanding of the world. Recent breakthroughs and advances in mathematics have far-reaching implications for various fields, from biology and climate science to computer science and data analysis. As mathematics continues to advance, we can expect new insights and innovations that will shape our understanding of the world and improve our lives.
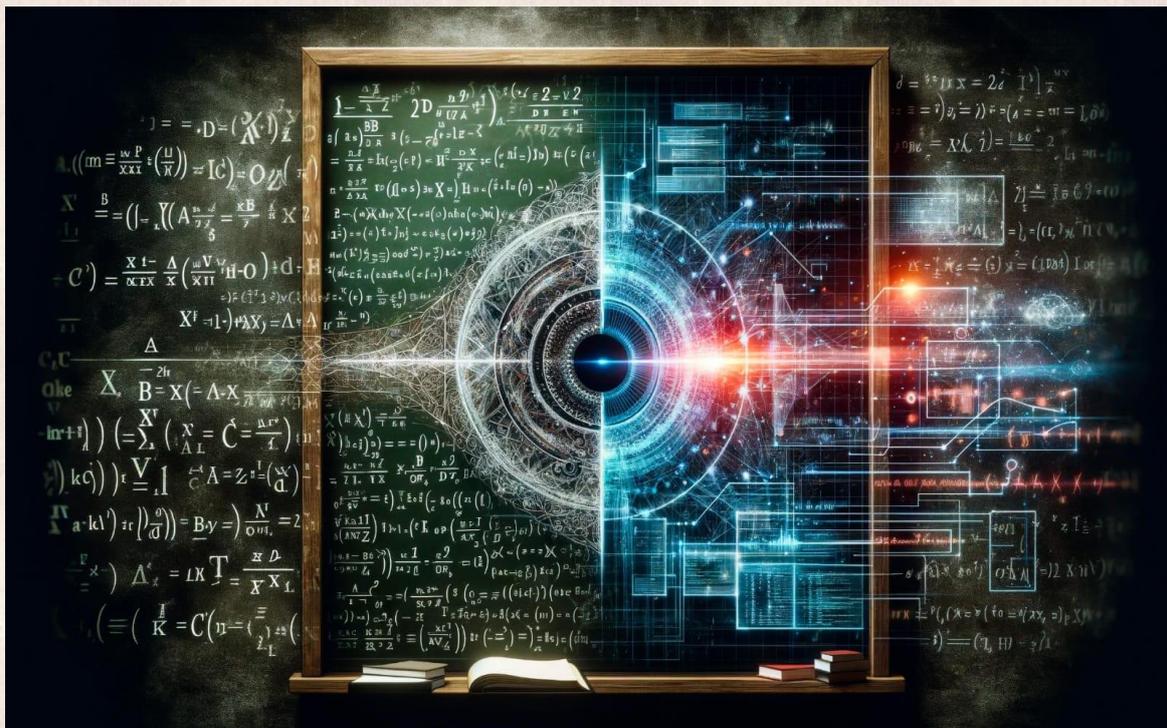
MODERN MATHEMATICS

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II Sem**

While most people think of mathematics as a collection of formulas and calculations, modern mathematics delves into a much deeper, abstract realm, exploring intricate patterns, connections between seemingly disparate fields, and pushing the boundaries of what we can even conceive of as numbers. This article will shed light on a few key areas in modern mathematics, highlighting how it impacts our world beyond the classroom, from cryptography to the study of black holes.

Before We begin with "modern mathematics". We need to understand traditional mathematics. This sort of thing you encountered as a young child: Circles, Triangles, Addition, Subtraction, Equation and their roots. Its primarily studies structures whose interactions have certain patterns. It has significantly evolved from classical approaches, expanding into abstract and applied fields that shape science, technology, and economics. It encompasses various domains such as algebra, geometry, topology, number theory, logic, and applied mathematics. This article explores key areas of modern mathematics, highlights notable mathematicians, and references influential works that have shaped the field.

Modern mathematics teaching methods:-

It includes collaborative learning, problem-solving, and using games and simulations. Methods help students develop skills like teamwork, communication, and creative problem solving.

TEACHING METHODS:-

• **COLLABORATIVE LEARNING:**
  Students work together on group activities, peer teaching, and problem solving.

• **PROBLEM SOLVING:**
  Students learn heuristics and strategies to solve non-routine problems.
  Games: Students play games like quizzes, puzzles, and guessing games to practice math ideas.

• **SIMULATIONS:**
  Students use simulations to explore new math concepts.

KEY AREAS OF MODERN MATHEMATICS:

- **ABSTRACT ALGEBRA:**
  This field extends classical algebra to structures like groups, rings, and fields. It plays a crucial role in cryptography and coding theory.
- **TOPOLOGY:**
  Concerned with properties that remain unchanged under continuous deformations, topology is fundamental in physics and theoretical computer science.
- **NUMBER THEORY:**
  A field with deep historical roots, number theory has modern applications in cryptography and computer security.
- **MATHEMATICAL LOGIC AND FOUNDATIONS:**
  This includes set theory, model theory, and proof theory, providing a rigorous foundation for mathematics.
- **APPLIED MATHEMATICS:**
  Fields like statistics, operations research, and mathematical modeling help solve real-world problems in finance, engineering, and biology.
- **COMPUTATIONAL MATHEMATICS:**
  The rise of computers has led to numerical analysis, machine learning, and algorithm.
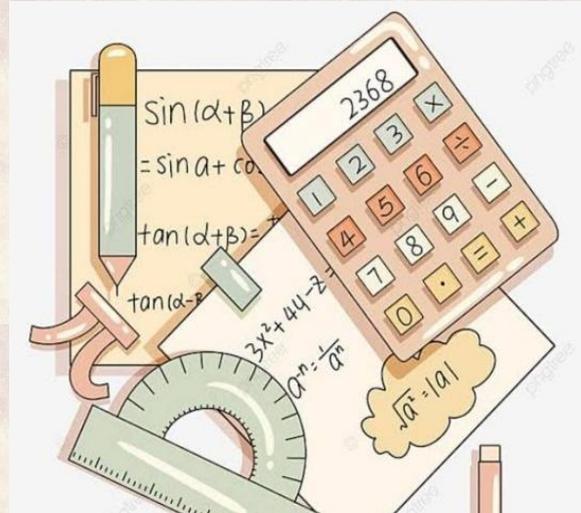
NOTABLE MATHEMATICIANS IN MODERN MATHEMATICS

- John von Neumann (1903–1957): Pioneered game theory, quantum mechanics, and functional analysis.
- André Weil (1906–1998): Contributed to algebraic geometry and number theory, influencing the Bourbaki group.
- Paul Erdős (1913–1996): Known for his extensive work in combinatorics, number theory, and graph theory.
- Alexander Grothendieck (1928–2014): Revolutionized algebraic geometry and category theory.
- Terence Tao (b. 1975): Recognized for contributions across number theory, harmonic analysis, and PDEs.
- Grigori Perelman (b. 1966): Prove the Poincaré conjecture, a landmark achievement in topology.
- Maryam Mirzakhani (1977–2017): Made groundbreaking contributions to hyperbolic geometry and dynamical systems.

IMPACT OF MODERN MATHEMATICS:

•ARTIFICIAL INTELLIGENCE:

Machine learning algorithms rely heavily on advanced mathematical concepts like optimization and probability theory, enabling AI to solve complex problems.

• DATA SCIENCE:

Statistical methods and complex data analysis techniques are essential for extracting insights from large datasets across various fields.

• COMPUTER GRAPHICS:

Mathematical modeling allows for realistic 3D graphics in movies, games, and simulations.

• MEDICAL IMAGING:

Advanced imaging techniques like MRI scans rely on mathematical algorithms to generate detailed images of the human body.
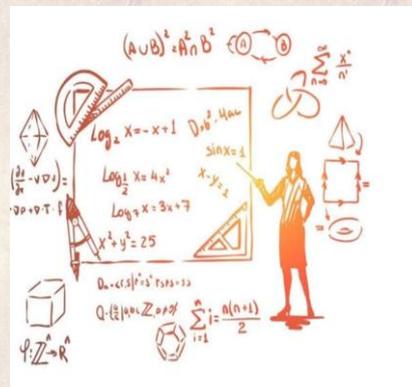
CHALLENGES AND FUTURE DIRECTIONS:

• INTERDISCIPLINARY COLLABORATION

Modern mathematics increasingly requires collaboration with other fields like physics, computer science, and biology to tackle complex problems.

• ACCESSIBILITY AND EDUCATION

Making advanced mathematics concepts more accessible to a wider audience through innovative teaching methods and visualization tools.

CONCLUSION:

Modern mathematics is a vibrant and evolving field, pushing the boundaries of our understanding of patterns and structures in the universe. Its applications extend far beyond the classroom, impacting our lives in countless ways through technological advancements and scientific discoveries.
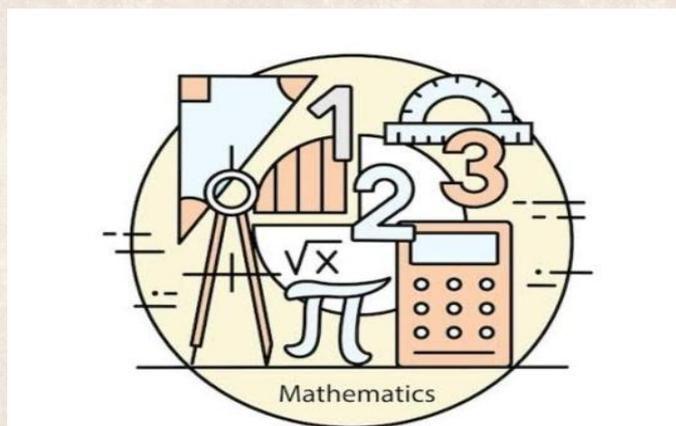
MODERN MATHEMATICS AND QUANTUM COMPUTING

Quantum computing, a rapidly advancing field, harnesses the principles of quantum mechanics to process information in fundamentally new ways. Modern mathematics plays a crucial role in the development and understanding of quantum computing. From quantum algorithms to error correction, mathematical concepts are integral to the functioning of quantum computers.

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Quantum Mechanics and Qubits

At the heart of quantum computing is the qubit, the quantum analogue of the classical bit. Unlike classical bits that can be either 0 or 1, qubits can exist in a superposition of states, thanks to the principles of quantum mechanics. This superposition enables quantum computers to perform multiple calculations simultaneously.

Mathematical Representation:

Qubits are represented using vectors in a complex vector space, known as a Hilbert space. The state of a single qubit can be described by a unit vector in a two-dimensional Hilbert space.

Quantum Gates and Circuits

Quantum gates are the building blocks of quantum circuits, analogous to classical logic gates in traditional computing. These gates manipulate qubits through unitary transformations, which are reversible linear operations represented by unitary matrices.
Examples of Quantum Gates:
 - Hadamard Gate (H): Creates superposition states. Represented by the matrix:
 -Pauli-X Gate (X): Flips the state of a qubit (analogous to the NOT gate in classical computing). Represented by the matrix.

Quantum Algorithms

Quantum algorithms leverage the unique properties of quantum mechanics to solve problems more efficiently than classical algorithms. Some notable quantum algorithms include:
 - Shor's Algorithm: Efficiently factors large integers, posing a potential threat to classical cryptographic systems. It relies on quantum Fourier transforms and modular arithmetic.
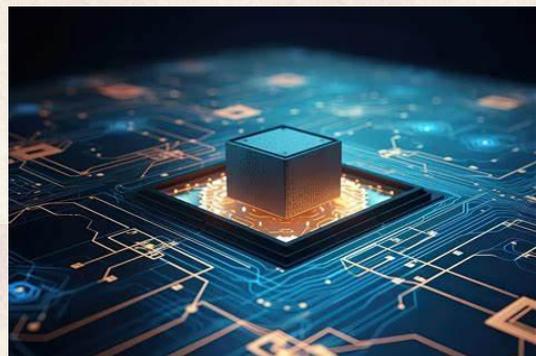
- Grover's Algorithm: Provides a quadratic speedup for unstructured search problems by utilizing amplitude amplification.

Quantum Error Correction
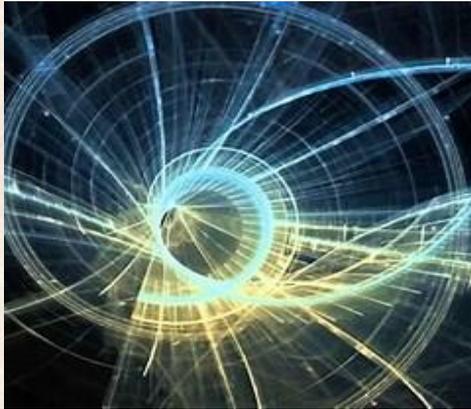
Quantum systems are highly susceptible to errors due to decoherence and quantum noise.

Quantum error correction codes are essential for reliable quantum computation. These codes use entanglement and redundancy to detect and correct errors without directly measuring the qubits, thus preserving quantum coherence.

Example of a Quantum Error Correction Code:

- Shor Code: Protects a single qubit from arbitrary single-qubit errors by encoding it into a superposition of nine qubits. It uses a combination of bit-flip and phase-flip code to correct errors.

Mathematical Challenges

The development of quantum computing poses several mathematical challenges, including:

- Complexity Theory: Understanding the computational complexity of quantum algorithms compared to classical algorithms.
- Quantum Simulation: Accurately simulating quantum systems, which is essential for developing new quantum algorithms and understanding quantum phenomena.
- Optimization: Designing efficient quantum algorithms for optimization problems, which have applications in various fields such as logistics, finance, and machine learning.

Conclusion

Modern mathematics is indispensable in the realm of quantum computing, providing the theoretical foundation and tools necessary for its advancement. As quantum computing continues to evolve, the collaboration between mathematicians, physicists, and computer scientists will be crucial in unlocking its full potential and addressing the challenges that lie ahead.

# MODERN MATHEMATICS: A HUMAN-CENTERED PERSPECTIVE

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Mathematics has always been the backbone of human civilization, shaping everything from architecture to commerce. However, in the 21st century, modern mathematics is more than just numbers and equations — it's a dynamic field that impacts technology, medicine, artificial intelligence, and even social sciences. This article explores the relevance of modern mathematics in today's world, breaking it down in a way that is both professional and approachable.

The Evolution of Modern Mathematics

Mathematics has come a long way from the days of counting stones and drawing geometric shapes in the sand. The modern era has introduced new fields such as topology, mathematical logic, chaos theory, and computational mathematics. These advancements have not only expanded our theoretical understanding but also provided real-world applications in industries like finance, engineering, and data science.
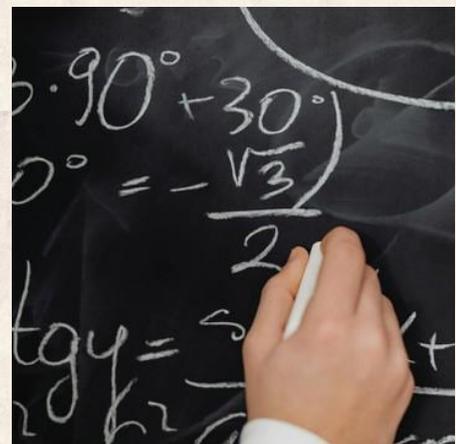
Mathematics in Everyday Life

Despite its complexity, modern mathematics is deeply embedded in our daily lives. From using GPS navigation to predicting weather patterns, mathematical models work behind the scenes to make life more convenient. In finance, mathematical algorithms drive stock market predictions and risk assessments, helping investors make informed decisions. Even in sports analytics, mathematical statistics play a crucial role in player performance analysis.

The Future of Mathematics

The future of mathematics is intertwined with emerging technologies. Quantum computing, for instance, is set to revolutionize data processing, and at its core lies sophisticated mathematical principles. Additionally, artificial intelligence and deep learning models continue to evolve, relying on advanced calculus, linear algebra, and probability theory.

Mathematics is also expanding its role in ethical and philosophical discussions. As artificial intelligence grows in influence, mathematical algorithms must be designed with fairness and accountability in mind. This brings a new dimension to mathematical research, emphasizing its social responsibility.

Conclusion

Modern mathematics is more than an academic subject; it is a fundamental tool that shapes our world. From enhancing technology to solving real-world problems, its influence is undeniable. As we move into an era of even greater technological advancements, mathematics will continue to be at the forefront, guiding humanity toward innovation and discovery. Whether we realize it or not, mathematics is everywhere, silently making our lives better, smarter, and more efficient.

RIDDLES

1.
I am a number, small and neat,
Twice myself is six—so sweet!
Add five, then times four,
Now I am more than before.
Take away ten, divide by two,
What number am I?

2.
I am a number. Multiply me by 3, then subtract 5. Now, divide by 4 and add 7—you get 10. But if you double me first, then subtract 6, you get 8. What number am I?

3.
I add six to eleven, and get five. Why is this correct?

4.
My twin lives at the reverse of my house number. The difference between our house numbers ends in two. What are the lowest possible numbers of our house numbers?

5.
What is the smallest number that increases by 12 when it is flipped and turned upside-down?

6.
Guess the Number!
i) Pick a number between 1 and 10. Do not tell anyone else what number you have chosen. Write the number down if you need to
ii) Double the number
iii) Add 10
iv) Divide by 2
 v) Subtract the number you started with
vi) Add 11

7.
What am I?
I am a number with a couple of friends, quarter a dozen and you'll find me again. What am I?

8.
How many 9's are there between 1 and 100?

RIDDLES

9.
Guess the number!
What is half of 2 plus 2?

10.
What age am I?
I am four times as old as my daughter. In 20 years' time I shall be twice as old as her. How old are we now?

11.
Use the numbers 2, 3, 4 and 5 and the symbols + and = to make a true equation.

12.
Ms. Smyth has 4 daughters. Each of his daughters has a brother. How many children does Ms. Smyth have?

13.
How can you add eight 8's to get the number 1000?

14.
A merchant can place 8 large boxes or 10 small boxes into a carton for shipping. In one shipment, he sent a total of 96 boxes. How many cartons did he ship if there are more large boxes than small boxes?

15.
A couple went for a picnic. They have 5 sons and each son has three sisters. Each sister has one baby. In total how many people went for the picnic?

16.
I am a three-digit number. My second-digit is four times bigger than the third digit and my first digit is three less than the second digit. What number am I?

17.
Two fathers and two sons went fishing one day. At the end of the day, each of them had one fish. There were three fish in total. How is it possible?

18.
I am a number, but when you add 'G' to me, I go away. What number am I?

19.
The number 108 appears frequently in ancient Indian mathematics, astronomy, and spirituality. It is also linked to a special sequence of numbers. Which sequence is it?

20.
There is a four-digit number where, if you arrange its digits in ascending and descending order, subtract them, and repeat, you always reach the same number. What is that number?

RIDDLES

21.
I helped the ancients build temples and altars, where precise measurements were crucial. My name can be traced back to geometric constructions. Who am I?

22.
am the number used by Indian mathematicians like Madhava in their work on infinite series. I helped calculate pi and other constants. What number am I?

23.
I was once the centerpiece of an astronomical calculation that puzzled many. My formula is often attributed to a Greek mathematician, yet my true origin lies in ancient India. I connected the heavens and the Earth. What am I?

24.
I am the infinite series, often associated with the genius who introduced new ways to calculate pi. My discovery shocked the world, though it was centuries before my true value was recognized. Who am I?

25.
I am a technique used by ancient civilizations to solve problems involving proportions, and I was notably used in the ancient Indian text Lilavati. What concept am I?

26.
I am a mathematical constant used to solve problems in number theory, particularly in understanding the distribution of prime numbers. I was the subject of a famous hypothesis by a German mathematician, but my significance has been expanded by Indian mathematicians like Srinivasa Ramanujan. What am I?

EVOLUTION OF ALGEBRA: FROM ANTIQUITY TO MODERN MATHEMATICS
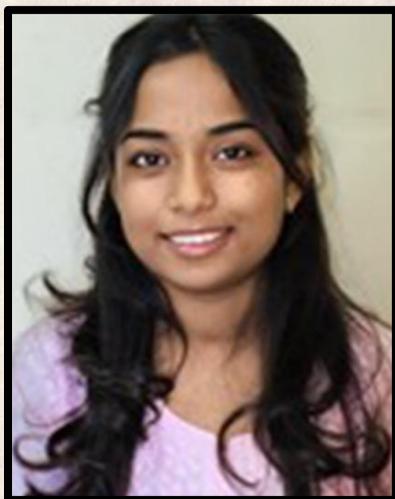
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Algebra has developed over millennia, progressing from a tool for practical calculations in ancient civilizations to a sophisticated and abstract mathematical discipline.

1. Early Foundations (2000 BCE – 500 CE)

Ancient Babylonians and Egyptians used arithmetic techniques to solve equations, particularly for trade and land measurement. The Babylonians employed geometric methods to find solutions to quadratic equations. Greek mathematicians, such as Diophantus, introduced symbolic notation in Arithmetica, a significant step toward modern algebra.

2. The Islamic Golden Age (800 – 1400 CE)

Al-Khwarizmi, often regarded as the "father of algebra," systematized equation-solving techniques in Al-Kitab al-Mukhtasar fi Hisab al-Jabr wal-Muqabala, from which the term "algebra" originates. Mathematicians like Omar Khayyam and Al-Tusi made significant advancements in solving cubic and polynomial equations.

3. Renaissance and the Rise of Symbolic Notation (1500 – 1700 CE)

François Viète introduced the use of letters to represent unknowns and coefficients, paving the way for symbolic algebra. René Descartes connected algebra with geometry by developing Cartesian coordinates. Girolamo Cardano contributed by solving cubic and quartic equations, expanding the scope of algebraic techniques.

4. Modern Abstraction (18th – 20th Century)

Carl Friedrich Gauss proved the Fundamental Theorem of Algebra, establishing a crucial result in mathematical theory. Évariste Galois pioneered group theory, forming the basis of abstract algebra. Emmy Noether further refined algebraic structures, significantly impacting physics and mathematics.

HISTORY OF ALGEBRA

Egyptian Algebra → Babylonian Algebra → Greek Geometrical Algebra ↓ Diophantine Algebra ← Hindu Algebra ← Arabic Algebra ↓ European Algebra after 1500 → Abstract Algebra
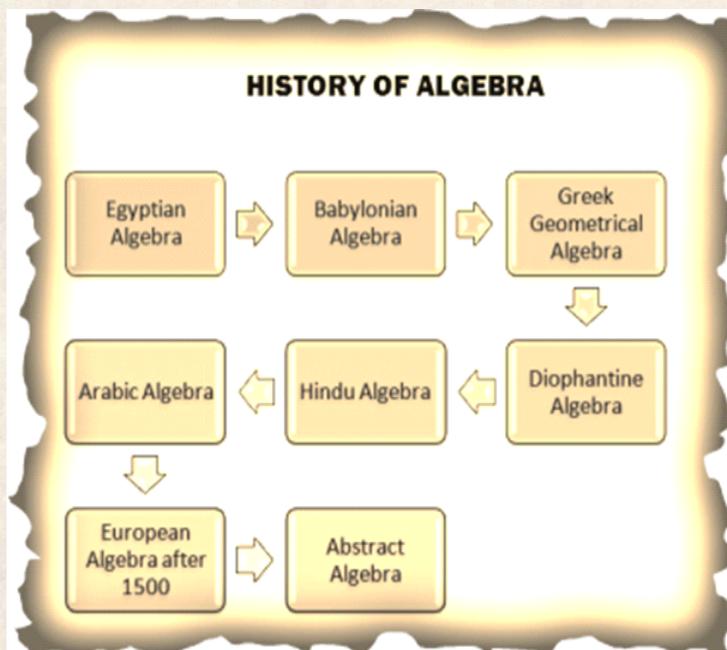
5. Contemporary Developments (20th Century – Present)

Abstract algebra, including the study of groups, rings, and fields, has become a central area of mathematics. Computational algebra now plays a vital role in fields such as cryptography, artificial intelligence, and quantum computing.

Conclusion

Algebra has evolved from a practical problem-solving tool to a fundamental framework in modern science and technology. Its continued development drives advancements in artificial intelligence, secure encryption, and other cutting-edge fields.
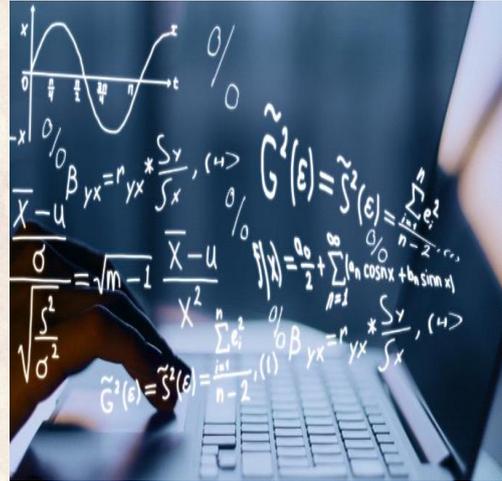
MATHEMATICS IN FINANCE

Garvit Arora
B.Sc. (H) Mathematics
IV Sem

Financial mathematics is the product of applying mathematics to option pricing theory. With the rapid development of the economic situation, the products and derivatives of the financial industry are constantly optimized and new financial markets, the design and pricing of financial derivatives and the analysis of financial mathematics is becoming more and more important. So, it is of practical significance to analyze the specific application of mathematics in the financial field.

The time value of money is an important concept in Financial Management. The Time Value of Money includes the concepts of financial value and discounted present value. While calculating Time Value of Money we have to consider various factors such as the following.

1. Consumer preference: If the amount of satisfaction is the same, people choose to consume now rather than later. Most people are willing to forego their current consumption if they discover they will be able to consume more in future

2. Inflation: Inflations and money's purchasing power are related. Money loses some of its purchasing power over time.

3. Investment opportunity: If an investment produces a regular cash flow, the periodic return can be reinvested to earn an even higher return.

Next, we'll discuss about Quantitative finance.

Quantitative finance is a field that uses mathematical models and computational techniques to understand stock, bonds, derivatives, securities. It applies tools from probability theory, statistics, and computer science to analyze and solve problems in finance. The goal is to develop models that can price financial instruments, manage risk, and identify profitable trading opportunities. However, there are some prerequisites for applying quantitative finance and earning a hefty sum out of it.
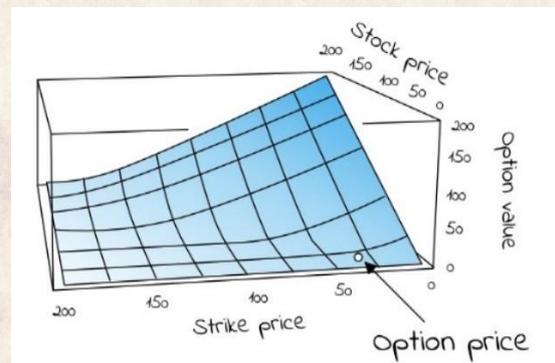
1. Algorithmic Trading: This involves using computer algorithms to execute trades at high speeds and frequencies. Algorithms are designed to identify and exploit market Inefficiencies.

2. Statistical Analysis: Quants use statistical methods to analyze historical data and make predictions about future market movements. We can plot trend analysis graph using the past data to verify that whether the market is overvalued or undervalued.

3. Statistical Arbitrage: This strategy involves using statistical methods to identify and exploit pricing inefficiencies between related securities. It is performed by HFTs (High Frequency Trading) firms to capture the price differences in higher Volumes.

PROBABILITY AND STATISTICS

Ankit Kumar
B.Sc. (P) Math. Science
II Sem

Probability is a branch of mathematics which deal with possibilities, random events, analysis and interpretation. Back in the 17th century probability has its origin in the study of gambling and insurance but now it considers as a very crucial and precious tool of mathematics and natural science. Discovery of statistics has taken place in early 19th century. It is a tool which helps us to get answers with the help of previous data. Statistics has its origin in census count taken thousands of years ago. Its help to analyse data in a very disciplined manner. Probabilities is all about chances whereas statistics is more about how we handle various data using different techniques.

FUNDAMENTALS CONCEPTS OF PROBABILITIES

1. Basic probability rules

The sum of probability of all the entities taking part in an event is always 1.

2. Types of probabilities:

• Classical probabilities

It is a type of probability in which we deal with problem based on logical Reasoning. For example: flipping a coin and rolling a dice etc.

• Empirical probability

It is a type of probability which is based on observed data or say it is the analytical method of probability. For example: weather prediction.

• Conditional probability or bayes method

It is the probability which is used for updating probability based on new information.

• Probability distributions:

1. Binomial distribution: it is used in repeated trials, like coin flips etc.
2. Poisson distribution: it is used for rare event, like accidents in a city etc.
3. Normal distribution: it is used in standardized testing and natural variations etc.

Key statistical concepts

• Descriptive statistics:

In this type of statistics, we use summarizing data using measures like mean, median, and mode.

• Inferential statistics:

In this type of statistics, we use making predictions on sample data.

• Measures of dispersion:

Variance and standard deviation help understand data spread.

• Regression analysis & correlation:

Identifying relationships between variables.

REAL–WORLD APPLICATIONS OF PROBABILITIES & STATISTICS

1. In data science & AI

   Big data analysis, predictive modelling, machine learning rely on statistical methods.

2. In finance

   Economics forecasting, risk management, stock market trends depends on statistical analysis.

3. In engineering

   Quality control and reliability testing use statistical principles to improve products.

4. In sports

   Performance analytics and game strategy optimization utilize probability models.

5. In medicine

   Clinical trials, risk assessment, and epidemiology use probability to test hypotheses.

Conclusion

Probability and statistics are essential mathematical tools that allow us to quantify uncertainty and draw meaningful inferences from data, enabling informed decisions making by providing insights into the likelihood of future events based on analysis of past data; Probability focuses on the theoretical chance of an event occurring, while statistics uses data collection and analysis to draw meaningful conclusions about populations from samples.

INFINITY AND BEYOND: THE DIFFERENT SIZES OF INFINITY

Prince Kaushik
B.Sc. (H) Mathematics
II Sem

Infinity is a big idea that means "never-ending." We often think of infinity as something huge, like space or numbers that go on forever. But did you know that some infinities are actually *bigger* than others? That might sound strange, but maths proves it's true! Let's explore this fascinating idea in a simple way.

The Infinity We Know

Imagine counting: 1, 2, 3, 4, 5, …
You could keep counting forever and never reach the end. This is an example of infinity—the numbers never stop! Mathematicians call this a ***countable infinity*** because, even though it's endless, you can still count it one by one.

Bigger Than Infinity? Yes!

A mathematician named **Georg Cantor** made an amazing discovery that not all infinities are the same size!

Think about all the numbers between 0 and 1. There are not just whole numbers like 1, 2, 3 but also decimals like 0.1, 0.25, and 0.3333. No matter how many numbers you list, there will always be more!

Cantor proved that this type of infinity, which includes all decimals and fractions, is bigger than the infinity of whole numbers. This is called ***uncountable infinity*** because you can't list the numbers one by one.

Two Types of Infinity

Mathematicians talk about two main sizes of infinity:

- **Countable Infinity** – This includes numbers that can be arranged in a list, such as the natural numbers (1, 2, 3, 4, ...) and integers (..., -3, -2, -1, 0 , 1, 2, 3, ...).
- **Uncountable Infinity** – It refers to decimals between 0 and 1 (0.1, 0.01, 0.001, and so on), where there are infinitely many numbers, making it much larger than countable infinity.

Why Does This Matter?

Infinity is not just a cool idea—it helps us understand the universe!
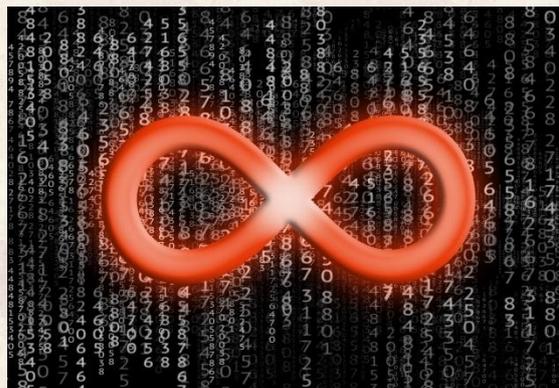
- **In space**: Scientists believe the universe might be infinite based on its shape and expansion. Observations of cosmic microwave background radiation suggest a nearly flat universe, which could mean it extends forever. Since the universe is expanding due to dark energy, it may have no edge, though we can only observe a finite portion.

- **In computers:** In computing, infinity is used in algorithms, programming, and data structures. It helps in calculations involving limits, recursion, and optimization. It's also used in loops, error handling, and artificial intelligence to handle large-scale problems efficiently.

- **In mathematics:** In mathematics, infinity is essential for understanding limits, calculus, and geometry. It helps describe unbounded growth, asymptotes, fractals, and even concepts of time in physics, like infinite sequences and eternal expansion.
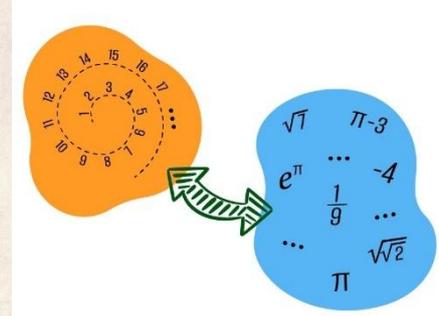
Conclusion

Infinity is not just a single concept—it exists in different sizes, with some infinities being larger than others. Math helps us explore this fascinating and complex idea, shaping our understanding of numbers, space, and even time. In set theory, infinite sets can have different magnitudes, like countable and uncountable infinities. From calculus to cosmology, infinity plays a crucial role in problem-solving and discovery. While infinity itself has no end, our knowledge and exploration of it continue to grow endlessly.
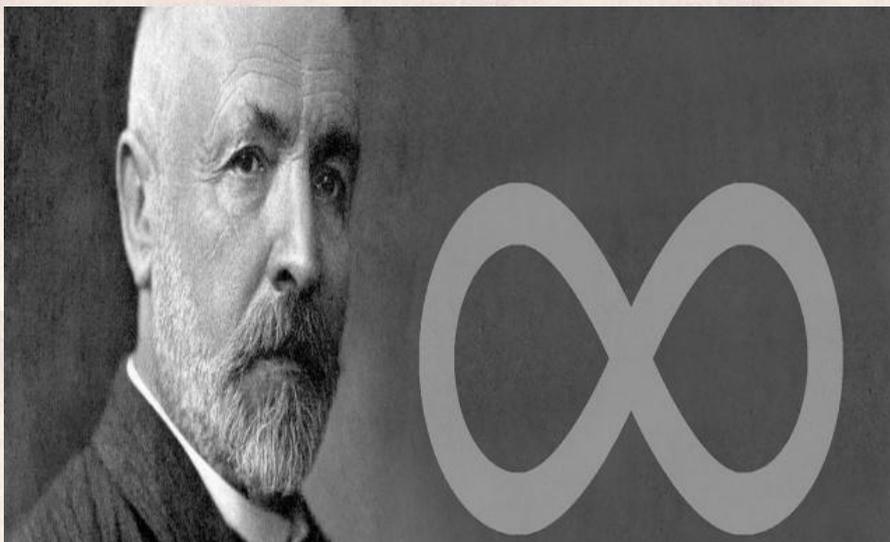
CHAOS THEORY: ORDER WITHIN OBSTACLES

Life is unpredictable. Small changes in situations can lead to very different outcomes. This phenomenon is beautifully recorded in chaos theory, an attractive concept of mathematics and physics, examining how random events are determined by underlying patterns.

Atul Kumar
B.Sc. (H) Mathematics
II Sem

What is Chaos Theory?

Even small variations can cause significant changes in the operation of a system over time. A phenomenon often referred to as the butterfly effect. The idea was popular by meteorologist Edward Lorentz. Edward Lorenz discovered that the weather rounding errors have been reduced.

Chaos theory does not imply complete randomness. Instead, it shows that complex, unpredictable systems still pursue deterministic law. However, these laws make long-term predictions almost impossible due to the extreme sensitivity of the system compared to initial conditions.

Butterfly Effect

Small Cause, Big Effect Butterfly Effects, a Chain of Atmospheric Events that shake his wings in parts of the world but eventually lead to a tornado elsewhere, suggests that it may cause. This example is symbolic and shows how small initial changes increase over time, but this is not done.

This concept includes applications in a variety of fields, from weather forecasting to economics and even relationships. In real life, trivial decisions, such as choosing a particular school, meeting a particular person, or reading a particular book, can change your future in unexpected ways.

Mathematics Behind Chaos

Mathematically, chaotic systems are described using nonlinear equations and fractals. Fractals are self-regeneration patterns that appear to be similar on different scales. The famous fractal, the almond bread set, shows how complexity arises from simple mathematical rules.

Another critical mathematical concept in chaos theory is the strange attractors and the many values that a chaotic system develops. For example, Lorenz attractors visually represent the way weather systems are unpredictable yet structured.

Practical Application of Chaos Theory

1. Weather forecast

The weather system is naturally confusing, so long-term forecasting is a challenge. Even the most advanced models can only predict weather patterns for a few days and a few days until small uncertainty grows into a major deviation.

2. Economic and Stock Markets

Finance markets show chaotic behavior due to research sensitivity, geopolitical events, and global trends. A small change in guidelines or public perception can lead to significant fluctuations in stock prices.

3. Biology and Medicine

Heart rhythm, brain activity, and population dynamics follow chaotic patterns. Irregular heartbeats (arrhythmia) can be better understood using chaos theory, which leads to improved diagnosis and treatment.

4. Psychology and Human Behavior

Human emotions and decision-making processes are influenced by countless variables, yet unpredictable and sampled. This applies to personal relationships, market trends, and even social movements.

5. Engineering and Robotics

Modern engineering includes chaos theory for designing more adaptive and resilient systems. Robots and AI use nonlinear algorithms inspired by chaotic patterns to improve machine learning efficiency.
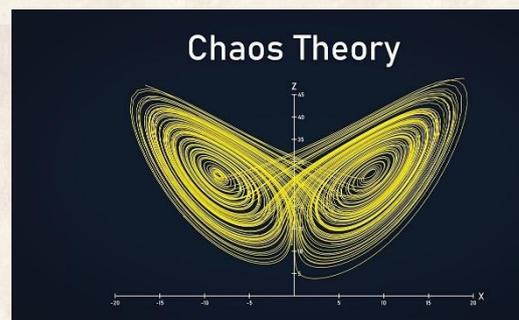
Chaos and the Universe

Is there a fundamental order? In space, galaxies form fractal-like structures, and planets follow a chaotic but critical path. Some scientists believe that chaos theory can reveal "all theories" and contribute to combining physics, biology, and human behavior under a major framework.

Conclusion

Chaos theory reminds us that the world is not so coincidental that it seems that there is a fundamental order among the obvious obstacles. From predicting weather to understanding the complexities of human life, chaos plays an important role in our real-life design. Although you don't have complete control over the chaotic system, it can lead to discoveries and insights.
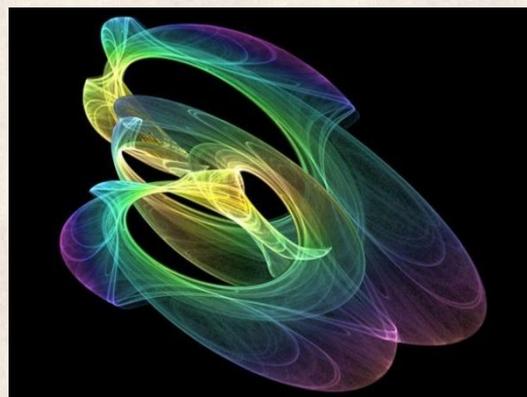
THE PYTHAGOREAN THEOREM: HISTORY & FACTS

The Pythagorean Theorem is one of the most well-known mathematical principles in geometry. It asserts that in a right-angled triangle, the square of the length of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the lengths of the other two sides.

$$P^2 + B^2 = H^2$$

Babylonians

The Babylonians understood the Pythagorean theorem over 1,000 years before Pythagoras. This ancient applied geometry example dates to 1900–1600 B.C. and is showcased on a 3,700-year-old clay tablet, Si.427, excavated in 1894 in Iraq and now housed in the Istanbul Archeological Museum.

Nitika
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II Sem

Key Points:

- **Evidence on clay tablets:** Ancient Babylonian clay tablets showcase sets of numbers that represent Pythagorean triples, which satisfy the equation $[a^2 + b^2 = c^2]$.

- **Land surveying application:** Researchers believe Babylonians used these triples for practical purposes like land surveying and property division, demonstrating their understanding of the geometric principle behind the theorem.

Egyptians

Egyptians used the 3-4-5 triangle for construction, ensuring a perfect right angle using a rope with 12 equally spaced knots.

Key Points:

- **The 3-4-5 Triangle:** The square of the shortest side (3) plus the square of the next side (4) equals the square of the longest side (5).

- **The Rope Method:** Egyptians formed a triangle by holding the knots at the 3, 4, and 5 mark. This technique allowed them to accurately measure and construct straight lines and right angles, crucial for large structures like pyramids.

Chinese Scholars

Ancient Chinese mathematicians understood and used the Pythagorean Theorem, known as the "Gougu Theorem," in their mathematical texts and scientific studies long before Pythagoras.

Key Points:

- **Name:** In Chinese, the Pythagorean Theorem is called the "Gougu Theorem" (勾股定理).
- **Practical applications:** It was used to solve practical problems related to surveying, construction, and astronomy.

Indians

Ancient Indians utilized the Pythagorean theorem, especially for constructing sacrificial altars as detailed in the "Sulba Sutras" – sacred texts meaning "rope-measuring rules."

Key Points:

- **Textual evidence:** The "Sulba Sutras" are the primary source, with the mathematician Baudhayana credited with formulating the theorem in this context.
- **Purpose of the altars:** These altars were built in various shapes like squares, rectangles, and triangles for Vedic rituals using precise geometric calculations from the Pythagorean theorem.
- **Historical significance:** This shows that advanced mathematical concepts were present in ancient Indian culture, potentially predating Greek understanding.
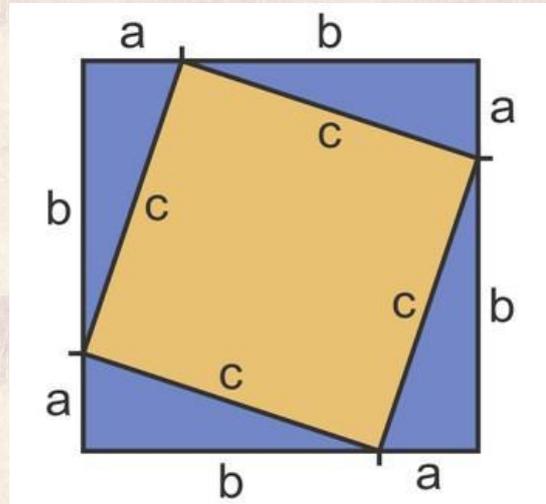
Conclusion

The understanding of the Pythagorean Theorem was not limited to ancient Greece but was independently discovered and applied by multiple civilizations. The Babylonians, Egyptians, Chinese, and Indians all used variations of this mathematical principle in practical fields like surveying, construction, and religious rituals, highlighting its universal nature and fundamental role in human civilization long before Pythagoras.
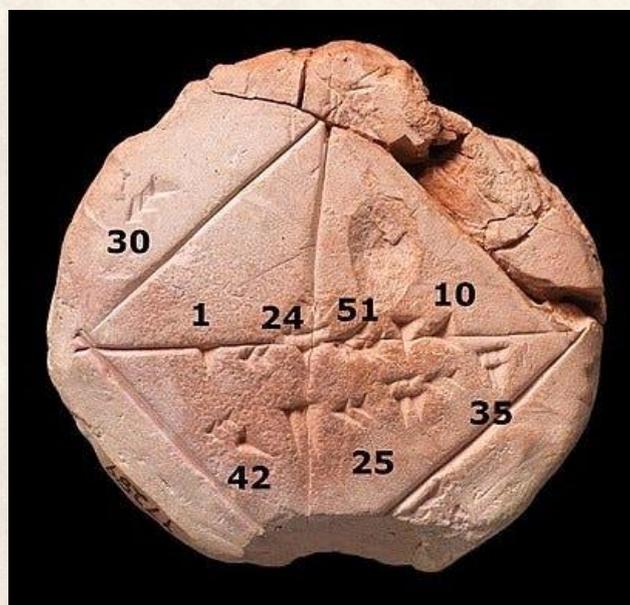
INFLUENTIAL SOCIAL MEDIA

Manan Setia
B.Sc. Math. Science
II Sem

Social media has become an inseparable part of our lives. From the moment we wake up to the time we go to bed, we scroll, like, share, and comment on an endless stream of content. But beyond the memes and viral videos, social media is a powerful force that influences our thoughts, behaviors, and even global events.

The Rise of Social Media Giants

Platforms like Instagram, TikTok, Twitter (now X), YouTube, and Facebook have transformed how we communicate, learn, and even do business. These platforms are no longer just about staying connected with friends; they shape trends, drive movements, and give ordinary people a voice that can reach millions.

Take TikTok, for example. A single 30-second video can catapult an unknown creator into global fame overnight. Similarly, Twitter has become a digital battleground for political debates, while Instagram is a hub for influencers who redefine fashion, fitness, and lifestyle choices.

The Influence of Social Media on Society: Changing How We See the World

Social media has the power to shape opinions and spread awareness. In recent years, we've seen how hashtags like #BlackLivesMatter, #MeToo, and #ClimateAction have brought critical issues to the forefront. These online movements have sparked real-world protests, policy changes, and global discussions.

Redefining Fame and Influence

Gone are the days when only celebrities and politicians had the power to influence society. Now, influencers—regular people who create content—can gain millions of followers and shape trends. A YouTuber can influence more people than a Hollywood star, and a Twitter thread can start a political debate in seconds.

The Impact on Mental Health

While social media connects people, it also comes with challenges. The pressure to look perfect, keep up with trends, and seek validation through likes and shares has contributed to anxiety and depression,

74% of consumers rely on **social media** to influence their **purchasing decisions.**

especially among young people. Many influencers now promote mental health awareness, encouraging people to take breaks and set boundaries.

A New Era of Business and Marketing

For businesses, social media is a goldmine. Brands no longer rely solely on TV ads; instead, they use influencers and targeted social media campaigns to reach their audience. A well-placed TikTok ad or an Instagram partnership can generate more sales than traditional marketing strategies.

The Future of Social Media Influence

With the rise of AI, virtual reality, and the metaverse, social media is evolving faster than ever. Soon, we might be interacting in digital spaces where avatars replace profile pictures, and AI influencers rival human ones. The power of social media will only grow, shaping politics, business, and culture in ways we can't yet imagine.

Final Thoughts

Social media is a double-edged sword. It has the power to inspire, educate, and bring people together, but it also comes with risks like misinformation and mental health challenges. The key is to use it wisely—engage with content that adds value, be mindful of what you share, and remember that the digital world is just one part of reality.

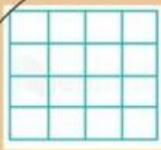What do you think—has social media influenced you in a positive or negative way?

PUZZLES

1.

HOW MANY NO. OF TRIANGLES IN THE SHAPE?
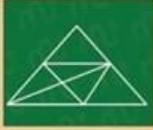
2.

HOW MANY NO. OF SQUARES IN THE FIGURE?

3.

4.

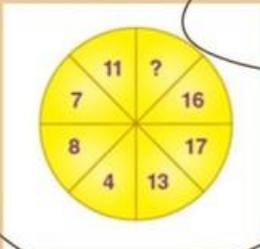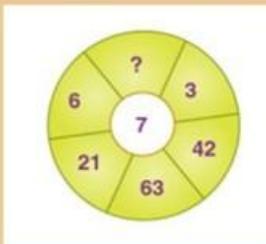IDENTIFY THE NUMBER TO BE WRITTEN IN THE EMPTY PLACE.

PUZZLES

5.

OBSERVE THE FOLLOWING AND FIND THE MISSING VALUE.

| 64 | 5 |
| 40 |

| 81 | 7 |
| 63 |

| ? | 4 |
| 16 |

6.

WHAT IS THE MISSING NUMBER IN THE FOLLOWING PUZZLE?

11	?
7	16
8	17
4	13

7.

WHAT WILL REPLACE THE (?) IN THE FOLLOWING PUZZLE?

?	3
6	7	42
21	63

8.

CONSIDER THE FOLLOWING:

A + B = 15

B × C = 84

C ÷ 4 = 3

B + D = 18

FIND THE VALUE OF D.

RIDDLE ANSWERS

1. 11
2. 7
3. THINK ABOUT THE NUMBERS ON A CLOCK. WHEN IT IS 11 A.M., ADDING SIX HOURS MAKES IT 5 P.M.
4. THE LOWEST POSSIBLE NUMBERS FOR THE HOUSES ARE 19 AND 91. THE DIFFERENCE IS 72.
5. 86
6. 16
7. 3
8. 20
9. 3
10. I AM 40 AND MY DAUGHTER IS 10
11. 2 + 5 = 3 + 4
12. 5
13. 888 + 88 + 8 + 8 + 8 = 1000
14. 11 CARTONS
15. TOTAL MEMBERS = 13 ,COUPLE: 2 PEOPLE ,SONS: 5 , SISTERS: 3 , BABIES: 3
16. 141
17. IT IS BECAUSE THERE WERE ONLY THREE PEOPLE: GRANDFATHER, FATHER, AND SON.
18. ONE
19. THE FIBONACCI SEQUENCE (108 IS A SUM OF THREE CONSECUTIVE FIBONACCI NUMBERS:34 +55+19=108)
20. 6174 (KAPREKAR'S CONSTANT)
21. THE SULBA SUTRAS (ANCIENT TEXTS THAT USED GEOMETRY TO CONSTRUCT ALTARS AND TEMPLES)
22. : 4 (MADHAVA'S INFINITE SERIES FOR PI INVOLVED THE NUMBER 4 IN KEY FORMULAS)
23. THE SINE FUNCTION DEVELOPED IN INDIA BY ARYABHATA AND LATER FORMALIZED IN TRIGONOMETRY
24. RAMANUJAN'S INFINITE SERIES SRINIVASA RAMANUJAN DEVELOPED GROUNDBREAKING SERIES TO APPROXIMATE PI AND MADE SIGNIFICANT CONTRIBUTIONS TO NUMBER THEORY
25. : ALGEBRAIC PROPORTIONS (USED IN INDIAN MATHEMATICS, PARTICULARLY IN THE TEXT LILAVATI WRITTEN BY BHASKARA)
26. RIEMANN ZETA FUNCTION (RAMANUJAN MADE KEY CONTRIBUTIONS TO THE UNDERSTANDING OF THE RIEMANN ZETA FUNCTION, ESPECIALLY AT NEGATIVE INTEGERS)

PUZZLES ANSWERS

1.13
2.30
3.15 , 13 , 16
4.IN THE GIVEN PUZZLES, THE SUM OF THREE NUMBERS (BOTH IN COLUMNS AND ROWS) IS 15 , 4 + X + 2 = 15. HENCE, THE REQUIRED NUMBER IS 9
5.THE GIVEN MATHS PUZZLE HAS THE FOLLOWING PATTERN. $5 \times 8 = 40$; 82 = $8 \times 8 = 64$; $7 \times 9 = 63$; 92 = $9 \times 9 = 81$; $4 \times 4 = 16$; 42 = $4 \times 4 = 16$. THEREFORE, THE MISSING NUMBER IS 16
6.20 (IN THE GIVEN PUZZLES, THE SUM OF TWO NUMBERS IN THE OPPOSITE PORTIONS IS THE SAME. $11 + 13 = 24$; $7 + 17 = 24$; $8 + 16 = 24$; $4 + ? = 24$)
7.: 9 ($6 \times 7 = 42$; $3 \times 7 = 21$; $? \times 7 = 63$; $? = 63/7 = 9$)
8.D = 11

B.Sc. (Hons.) Mathematics

1ST YEAR

2ND YEAR

3RD YEAR

B.Sc. (Prog.) Mathematical Science

1ST YEAR

2ND YEAR

3RD YEAR

B.Sc. (Prog.) Physical Science

1ST YEAR

2ND YEAR

3RD YEAR

FACULTY ACHIEVEMENT

Prof. Rubina Mittal
- **Research Paper on Investigating the impact of effort slippages in system development project published in International Journal of system assurance, engineering and management**
- **Research Paper on Genetic algorithm-based price and warranty optimization in software systems published in Expert systems**
- **Research Paper on a framework for Lean Tool Selection in the label printing industry for sustainable growth published in international journal of System assurance, engineering and Management**

Prof. Arpana Sharma
- **Attended Capacity Building Programme at Liverpool University, UK organised by University of Delhi.**
- **Attended Nurturing Future Leadership Programme at IIM, Vishakhapatnam under MMTTP.**
- **Attended workshop on Stochastic Calculus and Mathematical Finance organised by Rajdhani College.**

Prof. Ritu Arora
- **Research papers published in SCIE Journals.**
- **Presented a research paper in 2nd International Conference on Recent Trends in Mathematics, ICRTM 2025.**

Dr. Ashish Bansal
- **Nominated by University of Delhi for the prestigious international U21 MidCareer Researcher Programme 2024**
- **Working as an Executive Officer at Udhmodya Foundation, the Startup Ecosystem of University of Delhi**
- **Authored latest editions of 11 books on Mathematics**
- **Published research papers in renowned international journals**

	Prof. Dhanpal Singh • **Sitting Academic Council Member University of Delhi** • **Recognised Supervisor University of Delhi** • **Research Papers Published in SCIE Journals**
	Dr. Richie Aggarwal • **Attended 25th International Business Horizon Inbush Era Summit 2025 organised by Amity International Business School.** • **Delivered Guest Talk on Data Visualization using R in Department of BBA Analytics School of Business and Management CHRIST**
	Dr. Janson Antony A • **Served as a Resource Person for the Initiation into Mathematics (InitMath) programmes held at NIT Hamirpur (during 16-09-2024 to 21-09-2024) and at Manipal University Jaipur (during 06-01-2025 to 11-01-2025) organized by the MTTS Trust and funded by NBHM.**

ALUMNI PURSUING FURTHER STUDIES

Anmol Madaan
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University of Delhi

Sanya Jain
Pursuing MOR
University of Delhi

Aastha Bhagat
Pursuing M.Sc.
Mathematics
University of Delhi

Nishant Swami
Pursuing M.Sc.
Mathematics
University of Delhi

Ankit Mugdal
Pursuing M.Sc.
Mathematics
University of Delhi

Mohit Gupta
Pursuing M.Sc.
Mathematics
University of Delhi

Kashish Arora
Pursuing M.Sc.
Mathematics
University of Delhi

Dhruv Sehwal
Pursuing M.Sc.
Mathematics
University of Delhi

Aditi Dahiya
Pursuing M.Sc.
Mathematics
University of Delhi

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**Dhruv Goyal
Founder and CEO at
Tricore Revenue**

**Sanya Jain
Gold Medalist in
B.Sc. Mathematical
Science
University of Delhi**

**Ayushi Gandhi
Placed at Greyamp
Consulting from IIM
Kashipur**

**Vibhor Thakur
AIR-75
IIT Jam MS**

**Sneha
AIR-336
IIT Jam MS
Pursuing
M.Sc. Mathematics
IIT Indore**

**Utkarsh Prajapati
MBA from IIM, Lukhow.
Working as Consultant in
Miebach Consulting,
Banglore**

A GLIMPSE OF DEPARTMENT OF MATHEATICS
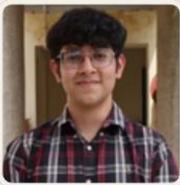
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