Mathologic

2019

From the Principal's desk...

It's my proud privilege to write preamble for Mathema, the annual magazine of the Department of Mathematics.

To discover the innate capabilities of these budding mathematicians it's desirable to carefully craft interactions and activities within and outside the classroom. This helps to impart formal education, but with a difference.

We also want to inculcate noble values of discipline and unity in these young ladies. The vision is to produce conscientious, smart and confident citizens of India who will go out into the world and make us proud! As educators, we aim to provide a platform which explores and strengthens the potential which is innate in every individual but awaiting expression. Publishing these periodicals is a tiny step towards our goal.

I congratulate the entire editorial team and contributors for the upcoming issue of 'Mathologic' 2019 and enthusiastically look forward to reading our students' perspective on various issues undertaken.

- Dr Promila Kumar

From the Faculty advisors

Welcome to the 2nd issue of our magazine. We hope it brings something for every reader interested in mathematics.This year also the magazine has been designed and conceptualised by the students. Our is aim to encourage creativity of thought among students so that they learn and grow in every aspect.

Published annually ,Mathematics Magazine "Mathalogic" offers a lively exposition on a wide range of mathematical topics, presented in an appealing expository style accessible to both teachers and students of collegiate mathematics. This magazine publishes arcticles revealing deep and fundamental connections between several branches of mathematics.

Our special thanks to Principal Dr. Promila Kumar for her continuous support and guidance. We convey a word of thanks to Ms. Arnima Chauhan with her entire editorial team for their efforts with special mention to Ms.Tanisha Negi for the very philosophical cover design. We extend our sincere thanks to Ms.Tanya Kalra our student president and her team for their strentous effort.

Continued progress must remain our mission. We must keep enhancing our capabilities and must expand our footprint, in terms of quality and quantity.This magazine is a perfect example of vision of scale, speed and skill. This shows that we can be the best.

We wish us every success, as we strive to master the contents of this magazine and conquer new frontiers. Let us take inspiration from today's success ,dedicate ourselves to accelerate our progress and we are confident we can!
Thank You and Best Wishes!

-Ms.Pooja Gupta (Convenor)
-Mr.Narender Kumar (Co-Convenor)

Editor's Angle

It gives me immense joy to introduce to our fellow readers, the second edition of Mathologic-The annual magazine of the Department of Mathematics,Gargi College.

This magazine was only initiated last year in the form of a newsletter and stands tall as proof to how far we have come in just 365 days.
The magazine would provide a glimpse of the various events conducted in the past year, ranging from Career counseling session to various activities held during Anant and Scintillations. The counseling program that we conducted gave students insights into different fields they can pursue, including the recent domain of Actuarial sciences. This year, we saw huge footfall in Pictionary and Quiz Up- both of which challenged the inner mathematician in every individual.

This was the first time after several years that the mathematics department had a full house, hence making the moments of organising the various events and promoting our department that much more memorable and cherishable.

We hope this magazine brings something new for every reader,as it has for every one of us involved in its making.
All the best!

- Arnima Chauhan
Editor of Mathologic (2019) and General secretoty of Mathema (2018-19)

MATHEMA - The Mathematics Association

(2018-2019)

Faculty Advisors
Ms. Pooja Gupta
Mr. Narender Kumar

President : ***Tanya kalra***
Vice President : ***Madhurika Ahuja***
General Sec : ***Arnima Chauhan , Nikita Hans***
Treasurer : ***Sadhvi Mehra Rupanshi Sadana***
Proctor : ***Priti Sangwan, Nandini Dwivedi***
Coordinator for co- curricular activity : ***Diksha***
Co- coordinator : ***Shalini Toppo***
IT Coordinator : ***Rabina Divya , Mohini S. Jena***

Words of Wisdom from the Principal

Dr. Promila Kumar

Being the principle of a reputed college must be challenging, what is your key to tackle such challenges?

Tackle the things by listening to a person with patience and calm and the things can be sorted. Also however big the problem is, if you are centered, calm and patient you get a result and that could be a good result.

How has your experience as a principle been so far?

It's wonderful! Students, staff they have been very very cooperative. I'm blessed that I belong to this college where I am getting so much of support and love .

If you were to write a mission statement for your department, that is mathematics, what might it be?

I want the girls to be equipped with academics. Along with academics, they should be honest and they should apply wisdom. Since they are the students of mathematics, throughout their life they should remember that every problem has a solution.

What are your expectations from the students of Mathematics department? And are your expectations being met?

The expectations are that they should do well in their life, in academics as well as in their personal life. And when they grow old in their domestic life wherever they go, they should do well. And how far they have met the expectations, I can't comment on this because it's too early to comment as there are only a few batches but I am 100% sure everyone is doing their best .

Most of the students hesitate to participate in the extra curricular activities being from the science stream. How would you encourage them for active participation?

Look,coming from science stream they think they have no time. It's not the question of having the time or not, it is about time management. You spend so much time on social media these days that you have no time for extracurricular activities. You should know how to distribute your time. And the thing that they have to work very hard, every student, every subject needs hard work. So, it can be managed. It is only about the balance.
them

With the emergence of numerous diverse career opportunities in Mathematics, what steps would you like to take to educate the students about the same?

We already have placement cell here and we have counselling sessions. So if the students and especially mathematics students, if they want such type of guidance we can organise a counselling session. If they want us to educate i.e. department can educate them then department can equip themselves first and then tell the students. That can be arranged,you just need to show your interests.

With the advent of computerisation and improving technologies, what developments can be made in the curriculum to make the students aware of the same?

Earlier we used to have Vedic Mathematics as an add-on course in the college. If you want you can do it again. You can have a latest workshop which helps you in Mathematica typing.

You do a lot of work on it. But then there's also Matlab available. It only depends on what the students want. Are they truly enthusiastic to do something. If they show their enthusiasm we are there to help at the level of our department as well as at the level of college.

When we did Vedic Mathematics it was for the whole college.

And many science as well as commerce students also joined. Even now the science department has introduced a course on Ayurveda, Vedic Mathematics was a part of it. So such initiatives are already happening in the college but if the students are keen for non-particular kind of things or they shortlist certain things that they want this, we can make a module and do it for them.

Finally, what words of wisdom would you like to share with students and teachers?

Ans. That you've to be equipped with knowledge, and then you have to learn to be patient. Do time management. Use your knowledge with wisdom. That is very important.

Interviewed by:
Arnima Chauhan
Rabina Divya
Mohini S Jena

A word with the Union President

Ms. Tanya Kalra

What have been the goals/ key areas on which Mathema has worked this year?

The major key areas on which Mathema has worked this year was to encourage students to participate and contribute to the development of our Department. Then was to create more awareness among the students about the various fields in maths.

When you'd contested the elections for the post of department president, what were your expectations from this position of responsibility?

My expectation based on the description and interview was that my post would involve duties usually including working with students to resolve problems and fill the loopholes in the maths department of our college and most importantly to encourage more and more practical/research based maths workshops in order to help them grow in this subject.

We know that you've been a part of the association for 3 years now. So, how have you seen the objectives of Mathema change over the years?

Since it was the first year of our department when I became the part of Mathema, our main objective was to atleast create more awareness about our department on different platforms and then in the following years our objective was to focus on holding more and more competitions/seminars in order to help the students to grow and make them aware of the various aspects of Mathematics in real world.

What tips would you give them to manage both academics and co-curricular activities simultaneously?

First and foremost one has to find a Balance as It is never a good idea to only focus on one particular area. Then one needs to develop a schedule and needs to prioritize the tasks. And finally one should have a right attitude Most importantly and it is essential to believe that you can manage your time and be optimistic.

With the emergence of numerous, diverse career opportunities in mathematics, what steps has Mathema taken to educate the students about the same?

This year Mathema conducted a career counselling session by Mr. Manish Malik ,who is a prominent figure in the fast growing domain of actuarial sciences. He covered various career options available for the mathematics students and opened up new avenues for them.

With the advent of computerisation and the growing need of IT- trained mathematicians, what developments can be made in the college curriculum to prepare the students for the same?

The main development should be to encourage more and more of practical research work in mathematics because incredibly useful concepts like cryptography,calculus and image and signal processing have and continue to come from mathematics and are helping people solve real-world problems and hence it would help students grow and make them fit for the IT industry.

Q7. As its almost time to pass the beacon to your successors, what would be your words of wisdom for them?

"The voice that tells you 'you can't' is usually lying. The one that says you can't do it all at once usually isn't." – Marsha Wright. So, you just need to be calm and have faith in yourself in order to make a change and help Mathematics department to grow and remember 'balance' is the most important factor.

Interviewed by:
Mohini S Jena
Diksha

THE HISTORY OF BANNED NUMBERS

- Mohini S Jena, 2nd Year

They say the pen is mightier than the sword, and authorities have often agreed. From outlawed religious tracts and revolutionary manifestos to censored and burned books, we know the potential power of words to overturn the social order. But as strange as it may seem, some numbers have also been considered dangerous enough to ban. The mathematician Pythagoras and his school of followers found numerical patterns in shapes, music and stars for them, mathematics held the deepest secrets of the universe. But an Pythagorean named Hippasus discovered something disturbing.

Some quantities like the diagonal of a square with sides of length 1 couldn't be expressed by any combination of whole numbers or fractions. These numbers which we call irrational numbers, were perceived as threat to the Pythagorean notion of a perfect universe. They imagined a reality that could be described with rational numerical .Historians write that Hippasus was exiled for publicizing his findings, while legends claimed he was drowned as punishment from the gods.

In the middle ages while Europe was still using Roman numerals ,other cultures had developed positional systems that included a symbol for 0.When Arab travelers brought this system to the bustling Manheim city of Italy. Its advantages for merchants and bankers was clear. But the authorities were more worried.

Hindu Arabic numeral were considered easier to forge or alter, especially since they were less familiar to consumers than to merchants .At a time when money lending was regarded with suspicion. In the 13th century, Florence banned the use of Hindu-Arabic numerical for record keeping .negative numbers were dismissed as absurd for a long time, and prominent mathematicians like Gerolami Cardano avoided using 0 even though it would have made it much easier to find solutions to cubic and quadratic equations.

Protected information whether copyrights, proprietary materials or state secrets can be represented as numbers This idea gathered attention in 2001 when code that could be used to decrypt DVDs was widely used in the form of large prime numbers.

FLOURISHING NUMERICAL ANALYSIS

- Aastha and Palak, 3rd Year

Prehistory of Numerical Analysis :

Numerical methods deals with approximation i.e.,it gives the effective methods of computing approximate numerical solutions to mathematical solutions. With the help of numerical methods, we can solve complex problems with a great number but of very simple operations which is perfect for a computer to perform.

If we compare numerical methods analytical methods, we see that numerical methods are a better approach as compared to analytical methods. It is because in some cases analytical solutions of a mathematically defined problem is time consuming. If we consider the case of error approximation, numerical solution gave more acceptable response than analytical solution. In cases, when analytical solution is impossible, numerical methods is the best approach.

Many great mathematicians gave their contributions in numerical methods, including Newton, Euler, Lagrange, Gauss, Jacobi, Fourier, and many more.

Contributions by some mathematicians in the field of numerical methods are listed :

1. Contribution by Newton-

Newton proposed a method for finding better approximations to the roots of a real valued function, known as the Newton-Raphson method named after Isaac Newton and Joseph Raphson. Newton's method was first published in 1685 and finally in 1740, Thomas Simpson described Newton's method as an iterative method for solving general non-linear equations. He also proposed Newton Interpolation method, which is used to approximate a given function, whose values are given at tabular points, by a suitable polynomial.

2. Contribution by Joseph- Louis Lagrange-

Lagrange proposed an interpolating polynomial known as Lagrange Interpolating polynomial which is the polynomial of degree less than and equal to (n-1) that passes through 'n' points. The formula of the interpolating polynomial was first discovered by Waring in 1779 and published by Lagrange in 1795.

3. Contribution by Leonhard Euler-

Euler worked for improving numerical approximation of integrals known as Euler Approximations or Euler Method. This method is used for solving ordinary differential equations (ODEs) with a given initial value.

4. Contribution by Carl Gustav Jacob Jacobi-
He proposed Jacobi Iterative method used for determining the solutions of a diagonally dominant system of linear equations. In 2014, a refinement of this algorithm, called scheduled relaxation Jacobi method was published. This method provides improvement for solving elliptic equations on two and three dimensional cartesian grids.

Numerical methods is a vast topic which includes a lot more information other than those discussed above, like dividend differences, difference operators, LU decomposition which is a factor ization of a given square matrix into one upper triangular matrix and one lower triangular matrix such that the product of these two gives the original matrix.
Numerical methods are used to solve the problems which are impossible or extremely difficult to solve analytically.

Further numerical methods can be used for:

1. Finding roots of equations-
Bisection method, Newton-Raphson method, Fixed point iteration method, etc.

2. Solving ODEs-
Euler method, Mid-point method, etc.

3. Finding values of integrals-
Mid-point, Trapezoidal rule, Simpson's rule.

4. Interpolation-
Lagrange interpolation, Newton interpolation, etc.

Advances in numerical methods provides a balanced presentation of the latest concepts in the fields of applied mathematics, electrical and electronic engineering. It includes many new mathematical applications in modeling and simulation, systems theory, circuits, electronics, control and signal processing.

TAYLOR SERIES

- Km. Shweta Mathur and Pooja Meena, 3rd Year

Taylor's Series is the most important concept of mathematics. By this series we represent a function as an infinite sum of terms that are calculates from the values of the function's derivatives at a single point. The concept of this series which we use in mathematics calculations was given by the Scottland mathematician JAMES GREGORY and this series formally induced by the English mathematician BROOK TAYLOR in 1715.If this series is centered at zero , then that series is called also a Maclaurin Series . This series a special case of Taylor's series , named after him. This name was given by also Scottland mathematician COLIN MACLAURIN , who made extensive use of this special case of this series in 18 th century.

JAMES GREGORY was a Scottish mathematician and astronomer also. He worked an early practical design for the reflecting telescope , who is called the Gregorian telescope. He also made advanced in trigonometry and discovery infinite series representations for several trigonometric functions. He also published statement and proof of the fundamental theorem of calculus. His inventions and discovers are quadrature of the circle and hyperbola , by an infinite converging series, his method for the transformation of curves. He also invented a geometrical demonstration by the help of hyperbola, a very simple converging series for making the logarithms. That is he worked in mathematics field in his life and gave us lots of interesting concepts in mathematics.

BROOK TAYLOR was a Scottish English mathematician, who is the best known for Taylor's series and a Taylor's theorem. He studied mathematics in Cambridge under John Machin and John Keill. In 1708 he obtained a remarkable solution of the problem of the "centre of oscillation", which , however, remained unpublished until may 1714, when his claim to priority was disputed by Johann Bernoulli. Taylor's methodus Incementorum Directa at Inversa added a new branch to higher athematics, now called the "calculus of finite differences".

COLIN MACLAURIN was a Scottish mathematician who made important contributions to geometry and algebra. Maclaurin used Taylor's series to characterize maxima, minima , and points of inflection for infinitely differentiable functions in his Treatise of fluxions. He attributes the series to Taylor , though the series was known before to Newton and Gregory , and n special cases to Madhava of Sangamagrama in 14 th century India. Maclaurin received credit for his use of the series , and the Taylor series expanded around 0 is sometimes known by his name. He also made significant contributions to the gravitation attraction of ellipsoids. He also discovered Euler-Maclaurin formula in which he used it to sum powers of arithmetic progressions, derived Stirling's formula and derived the Newton-Cotes numerical integration formulas which includes Simpson's rule as a special case. He also contributed to the study of elliptic integrals, reducing many intractable integrals to problems of finding arcs for hyperbolas. His work was continued by d'Alembert and Euler, who gave a more concise approach.

PERFECT NUMBERS

- Mohini and Ritu Yadav, 3rd Year

A ***PERFECT NUMBER*** in number theory is that positive integer which is equal to sum of its proper positive divisors excluding the number itself. This sum is also known as aliquot sum. In ancient time Euler proved that q(q+1)/2 is a even perfect number if q is the prime of the form 2^p-1 where p is also a prime. But it is not known whether there are any odd perfect numbers, nor whether infinitely many perfect numbers exist.

EXAMPLE

6 is the first perfect number as its proper divisors are 1, 2 and 3, also 1+2+3=6.
We can also define perfect number as half the sum of all its positive divisors
i.e, (1 + 2 + 3 + 6) \ 2 = 6
Next perfect number is 28.
Proper divisors of 28 are 1, 2, 4, 7, 14
1 + 2 + 4 + 7 + 14 = 28
Then the next perfect number following this is 496 and then 8128

ODD PERFECT NUMBERS

It is not known that whether there is any odd perfect number. As Euclid's rule gives all perfect even numbers this implies that no odd perfect number exists.

EVEN PERFECT NUMBERS

As mentioned above, Euclid proved that 2 p-1 (2 p -1) is an even perfect number whenever 2 p -1 is prime such that
For p = 2: 2 1 (2 2 - 1) = 6
For p = 3: 2 2 (2 3 - 1) = 28
For p = 5: 2 4 (2 5 - 1) = 496
For p = 7: 2 6 (2 7 - 1) = 8128.
This is Euclid – Euler theorem.
Prime number of 2 p -1 also known as Mersenne primes after a monk Marin Mersenne, who studied number theory and perfect numbers.
2 p -1 is prime if and only if p is prime. These types of primes are very rare.

As well as having the form 2 p-1 (2 p -1), each even number is the (2 p -1)th triangularnumber (number which counts objects arranged in equilateral triangle) and hence equal to the sum of the integers from 1 to 2 p -1 and the (2 p-1)th hexagonal number. (The nth hexagonal number h 0 is the number of distinct dots in a pattern of dots consisting of the outlines of regular hexagons with sides up to n dots, when the hexagons are overlaid so that they share one vertex.)

PAGERANK ALGORITHM

- Nidhi Singh and Nikita Kataria, 3rd Year

How Google answers our queries or how does it finds relevant page for our search ?

At the first glance, it seems like it keeps an idea of all WebPages and when a ser types a query, it counts occurrence of keyword in each web file and display results accordingly. But search engine that relies on page content to retrieve page relevance are easily spammed.
Google uses Page Rank Algorithm for ranking WebPages which saw a major improvement in quality of results.
The fundamental idea behind Page rank Algorithm is that each hyperlink is a recommendation of page for another i.e. the page which has greater number of in links to it is more important than other. So it is basically about the WebPages votes for other WebPages by linking to them and most importantly number of links for a particular page from a high ranked page.

RELATIONSHIP BETWEEN EIGEN VECTORS AND PAGERANK

Before proceeding to the relationship between Eigen vectors and PRA, it will be wise to define eigenvectors
first.

Eigen Vectors : Eigen vectors are the vectors that remain unrotated by a transformation matrix and the eigenvalues are the amount by which the eigenvectors are stretched.

In pagerank, we form certain equations on the basis of certain criteria's. We then convert these equations to a matrix problem and we'll observe that the matrix problem formed is exactly an eigenvector problem.

Rank of any page (r) can be expressed as:
Q'r = r, where Q' is the stochastic matrix

This type of equation is the classic definition of eigenvector problem. And the goal is to find the Eigen value corresponding to the largest Eigen value 1. Therefore, a page rank eigenvector tells how many votes each webpage obtains from other WebPages considering their importances.

USES:

Atlast we'll like to put light on some uses of pagerank other than its social use. In neuroscience (page rank of neuron) , personalized Page rank is used by Twitter,etc.

What is Infinity

- Priya Tripathi and Vibha, 3rd Year

What infinity is, never ending of anything, like numbers, list act as infinity that is; if we can never reach at the end point that means how long we count that does not matter and we can't reach at our claim then it tends to infinity.

For Example:
If we take natural numbers which is not matter how long we count and we can not reach at the end numbers that mean list of the natural number is infinity which is uncountable.

We know that zero is the first number.

If we take 0.2 then 0.02 is smaller than 0.2. Therefore, 0.02 should come before 0.2 and so on, that is if we find a smaller number then we can insert at extra zero after the decimal point. That means listing of numbers by size is infinity.

So , mathematically , If a number greater than countable number then the number tends to infinity. The symbol of the infinity is . Infinity symbol () looks like sideways figure of eight. So, Clearly , Infinity means endless which is not a number but concept of an idea .

Infinity was invented by the English Mathematician, John Wallis in 1657.

In mathematics, infinity is treated as a number but it is not. Example of infinity is either a natural number or a real number which tends to infinity but never reach.

MATHEMATICS IN FORENSIC SCIENCE

-Rabina Divya, 3rd Year

Scientifically it is impossible to analyze forensic evidence without mathematics. From collecting evidence to its measurements and documentation, everywhere mathematics works as an important ingredient to the solution of any case by forensic scientists. There are several ways where mathematics works as a tool to solve the criminal cases, such as:-

DNA Analysis:
Probability is used to determine if there is enough of a DNA match collected from crime spot to convict of the crime .Comparison of fingerprint is done by measuring distances between grooves, and look for the pattern between the fingerprints.

Psycho – physical Detection:
Mathematically the investigators can tell that the suspect is telling truth or not, by measuring the suspect's body responds such as pulse rate, blood pressure and breathing patterns.

Measurement of death timing:
The time of the death of the victim can be known by the forensic scientists by measuring the temperature of the victim and the surrounding areas.

Height and Distance Measurements:
The weight and height of the suspect can be determined by examining the foot prints . Weight is known by comparing the depth of the foot print to the list of constants and height is known by measuring the length between the foot prints . Time and distance can be used to create a radius in which the suspects could have travelled to and from. The length of the human bones is used to estimate the height of the individual. The following formula is used to determine the person's height:
Man: $h=69.089+2.238f$ (in cm)
Woman: $h=61.412+2.317f$ (in cm) , where f is length of femur bone in cm .

Skid Marks Analysis:
Scientists can determine the speed of the car at the time of crime using the equation $v=\sqrt{d}/k$ where d= length of the skid marked, k= constant based on the car and the friction of the road and v= velocity in miles per hour .

Trajectories and Blood Splatter Analysis:
The trajectory of the falling object (bullet holes or blood splatter) can be known by using geometry. Eg: - the height of the suspect can be known by the angle of impact if the victim suffered a blow on his head. Trigonometry can be used to analyze the blood spatter, which can help in determining how hard the criminal hit the victim.

THE BLACK SCHOLES MERTON MODEL FOR OPTION PRICING

-Tanya Kalra, 3rd Year

Mathematical finance, also known as quantitative finance, is a field of applied mathematics, concerned with mathematical modelling of financial markets. Generally, mathematical finance will derive and extend the mathematical or numerical models without necessarily establishing a link to financial theory, taking observed market prices as input. Mathematical consistency is required, not compatibility with economic theory. Thus, for example, while a financial economist might study the structural reasons why a company may have a certain share price, a financial mathematician may take the share price as a given, and attempt to use calculus to obtain the corresponding value of derivatives of the stock.

French mathematician Louis Bachelier is considered the author of the first scholarly work on mathematical finance, published in 1900. But mathematical finance emerged as a discipline in the 1970s, following the work of Fischer Black, Myron Scholes and Robert Merton on option pricing theory.

The Black Scholes Merton Model For Option Pricing was first mentioned in articles "The pricing of options and Corporate Liabilities" by F.Black and M.Scholes published in the "Journal of Political Economy".It was considered a major breakthrough the area of option pricing and had a tremendous influence on the way traders price and hedge the options.

According to the BSO model the option price and the stock price depend on the same underlying source of uncertainty and we can form a portfolio consisting of the stock and the option which eliminates this source of uncertainty. This pricing model is used to determine the fair price or theoretical value for a call or a put option based on six variables such as volatility, type of option, underlying stock price, time, strike price, and risk-free rate. The quantum of speculation is more in case of stock market derivatives, and hence proper pricing of options eliminates the opportunity for any arbitrage.

The Black Scholes formulas for the prices of European Calls and Puts with strike price X on a non dividend paying stock can be depicted as follows:

Value of a Call

$$C(S_t, t) = N(d_1)S_t - N(d_2)Ke^{-r(T-t)}$$
$$d_1 = \frac{1}{\sigma\sqrt{T-t}}\left[\ln\left(\frac{S_t}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T-t)\right]$$
$$d_2 = d_1 - \sigma\sqrt{T-t}$$

Value of a Put

$$P(S_t, t) = Ke^{-r(T-t)} - S_t + C(S_t, t)$$
$$= N(-d_2)Ke^{-r(T-t)} - N(-d_1)S_t$$

Where,
N(•) is the cumulative distribution function of the standard normal distribution.
T−t is the time to maturity (expressed in years)
St is the spot price of the underlying asset
K is the strike price
r is the risk free rate (annual rate, expressed in terms of continuous compounding)
σ is the volatility of returns of the underlying asset

This is largely used by option traders who buy options that are priced under the formula calculated value, and sell options that are priced higher than the Black-Scholes calculated value.

MATHEMATICS- BROADENING THE HORIZON

- Arnima Chauhan, 3rd Year

Over the past decade or more, there has been a rapid increase in the number of ways the mathematical sciences are used and the types of mathematical ideas being applied. Because many of these growth areas are fostered by the explosion in capabilities for simulation, computation, and data analysis (itself driven by orders-of-magnitude increases in data collection), the related research and its practitioners are often assumed to fall within the umbrella of computer science. But in fact people with varied backgrounds contribute to this work. The process of simulation-based science and engineering is inherently very mathematical, demanding advances in mathematical structures that enable modeling; in algorithm development; in fundamental questions of computing; and in model validation, uncertainty quantification, analysis, and optimization.

Advances in these areas are essential as computational scientists and engineers tackle greater complexity and exploit advanced computing.

These mathematical science aspects demand considerable intellectual depth and are inherently interesting for the mathematical sciences.

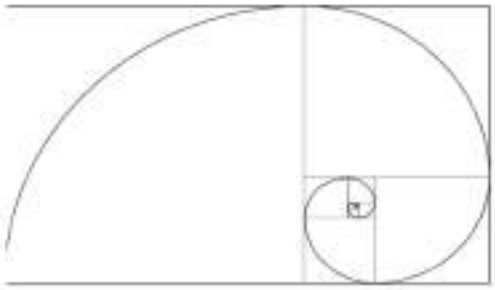
At present, much of the work in these growth areas—for example, bioinformatics, Web-based companies, financial engineering, data analytics, computational science, and engineering—is handled primarily by people who would not necessarily be labeled "mathematical scientists." But the mathematical science content of such work, even if it is not research, is considerable, and therefore it is critical for the mathematical sciences community to play a role, through education, research, and collaboration. People with mathematical science backgrounds per se can bring different perspectives that complement those of computer scientists and others, and the combination of talents can be very powerful.

MATHS IN ARTS

- Vaishali Negi and Ritu Parashar, 3rd Year

Have you ever wondered where artists find their inspiration ?
How are famous paintings such as The Mona Lisa painted to perfection ?

Well that happens because of mathematics or I'd rather say an important result of it that is The Fibonacci Sequence.



Fibonacci Sequence

An integer sequence whereby each number is the sum of the two preceding numbers 1,1,2,3,5,8,13,21,34 and so on.
Although it may not seem obvious , there is a strong connection between this mathematical sequence and the composition of artwork. By visualising each number as a square (increasing in size , in the same way as the sequence) and connecting the opposite corner of each square, you can create the fibonacci spiral.

The Fibonacci sequence is intimately connected with another mathematical construct, the golden ratio (two quantities whose ratio is the same as the sum of the total to the larger ratio).
The golden ratio is sometimes called the divine ratio Mathematicians found that it is abundant in nature such as proportion of human face , flowering of an artichoke . This principle is used in composition of picture , giving a more pleasing flow to the picture.

From the Renaissance onwards , artists have - whether purposefully or by instinct - created dramatic and attractive paintings which demonstrate Fibonacci spiral in their composition such as Mona Lisa , Robert Green-ham's Tango Final of British Championship , Blackpool.

As you can see in the image above the entire com position is perfectlyoutlined by two Fibonacci spir als , which trace the line of spotlit dance floor , the skirts in arms of the dancer and even the curve of central lady's neck and place the focus perfectly on the two foremost couples .

This complex , abstract composition makes it very to see the Fibonacci sequence at play . The most interesting aspect of Fibonacci spiral is , perhaps , the fact that it can be forced or simply found .Last year it was even observed in a journalist's photo-graph of brawling Ukrainian parliamentarians.

APPLIED MATHEMATICS ROLE IN DATA SCIENCE

- Mansi Awasthi, 3rd Year

Data Science has opportunities, challenges and potential future strategies for mathematics within it, and the added value that the mathematical sciences can bring to industry. With the ever increasing amount of data available, the role of data science becomes ever more important and the mathematical sciences are a key element for its success.

Many mathematical techniques are emerging which on paper provide numerous benefits to data science. As these methods are, however, new to the data science scene there is a limited number of applications and case studies of their use.

Topological Data Analysis (TDA) example is a new area of study aimed at having applications in areas such as data mining. TDA represents data using topological networks and uses data sampled from an idealized space or shape to infer information about it . It essentially allows algorithms to analyze sets of data to reveal the inherent patterns within rather than showing correlations between preselected variables.

In addition, there are many mathematical methods which have not been widely applied in the area of data science but could have the potential to bring considerable advantage.

These include:

- **Neural computing**
- **Tropical geometry**
- **Topological data analysis**
- **Pattern theory**
- **Algebraic statistics**

The demand for data scientists has risen dramatically in recent years and many companies are finding it hard to hire people with the relevant skills. This is partly due to the creation of new roles and skill sets in industry that did not exist before. It is uncommon to find experienced individuals who have strong sector specific skills who can also apply cutting-edge mathematical methods of data analysis. There is great value in attracting mathematicians into industrial areas to gain sector-specific knowledge or introduce sector- specific expertise to data science techniques.

The industrialists at the workshop recognized the importance of the mathematical sciences when drawing information from data, and highlighted their frustration of not having (or knowing how to have) access to mathematicians. The discussion uncovered that the implementation of tools was not a problem within industry; what they need is access to people who can provide insight. It also highlighted internal challenges within organizations, such as the need to break down silos between different teams.

For mathematicians, there are challenges of how to take the mathematical sciences to industry and what are the best mechanisms for commercialization of their knowledge.

There appears to be great demand in industry for the provision of advice on what the appropriate mathematical and statistical techniques are, and for mathematicians to engage with the domain experts to solve problems together. New collaborations can avoid non-experts taking on specialist work, and instead create and support an environment where each expert contributes from their own specialism.

TWIN PRIMES

- Sonika, 3rd Year

Everybody knows about the prime numbers. These numbers are ancient source of mathematical mystery and are infinite in numbers. Like primes does everybody know about twin primes? What are these twin primes?
And the definition comes out is-
A pair of prime numbers are twins if they differ by 2.Or we can say that the twin primes are the pairs of those primes whose difference is 2.

(3,5),(5,7),(11,13),(17,19),(29,31),(41,43),(59,61),(71,73),(101,103),(107,109)

are some examples of the twin prime pairs. The twin primes are also known as prime twins or prime pairs. The question –Are these twin primes infinitely many or not ,is a great question in number theory. And where these twin primes are used ? The twin primes are used to define one of the unusual constant Of mathematics. In 1919 , it was proved by Viggo Brun that the sum of the reciprocals of all the twin primes converged. And after this achievement of Brun ,the constant to which the sum of the reciprocals of all the twin primes converged is named as Brun's constant.

SOLVING THE SYSTEM OF LINEAR EQUATIONS USING NUMERICAL METHODS

-Anshu and Gunjan, 3rd Year

We have been taught over years on how to solve equations using various algebraic methods. These methods include substitution and the elimination method. Other algebraic methods that can be used include the quadratic formula and factorization. However, when these methods are not successful, we use the concept of numerical methods. Direct methods can solve the system in finite no. of steps and gives an accurate solution. However, there are system of equations which are very time consuming when solving with direct methods or can't be solved by direct methods. So to solve them, we resort to the numerical methods.

Numerical methods provide a technique to find an approximate but accurate solution of the system of equations.

A system of Non-linear equations:

$$F_1(x_1, x_2, \ldots, x_n) = 0,$$
$$F_2(x_1, x_2, \ldots, x_n) = 0,$$
$$\vdots$$
$$F_n(x_1, x_2, \ldots, x_n) = 0.$$

when $(x_1, x_2, \ldots, x_n) \in R^n$ & each f_i is non linear real function , $i=1,2,\ldots,n$.

Because system of non linear equations can't be solved as nicely as linear systems, we use procedure called iterative methods.

An iterative method is a procedure that is repeated over & over again to find the root of an equation or to find the solution of a system of equations.

- Numerical solution of non linear equation means a point x^* such that $f(x^*) \sim 0$
- For this, we always assume that $f(x)$ is continuously differentiable real valued function.
- Also it is assumed that roots are isolated i.e. the root of $f(x)=0$ for which there is a neighbourhood which doesn't have any other root for the equation.

Convergence :

A sequence of iterates $\{x_n\}$ is said to converge with $p \geq 1$ to a point x^* if

$$\lim_{n \to \infty} \frac{|x_{n+1} - x^*|}{|x_n - x^*|^p} = c$$

for some constant $c>0$.

x_{n+1} approximation in $(n+1)$ iterations

x^* approximate solution

Order/Rate of convergence

If $p=1$, the solution is said to converge linearly to x^* ;

if $p=2$, the sequence is said to be converge quadratically and so on.

Order of convergence measures how fast a sequence converges. Thus, higher the value of the order, more rapid is the sequence. In the case of numerical methods, the sequence of approximate solutions is converging to the root. If the convergence of an iterative method is more rapid, then a solution may be reached in less iterations in comparison to another method with a slower convergence. Thus, there is a huge importance of numerical methods in solving the problems.

GROUP THEORY AND IT'S EVOLUTION

- Himani Pokhriyal and Jyoti Deshwal, 3rd Year

In mathematics and abstract algebra, group theory studies the algebraic structures known as groups and also it involves concept of algebraic structures such as rings,fields and vector spaces endowed with additional operations and axioms. Galois is honored as the first mathematician linking group theory and field theory with the theory that is now known as Galois theory.

There are four major sources in the evolution of group theory:

· Classical algebra(J. L . LAGRANGE, 1770)
· Number Theory (C.F. GAUSS , 1801)
· Geometry (F.KLEIN , 1874)
· Analysis (S.LIE 1874; H.POINCARE AND F.KLEIN)

Lagrange established the results of olutions of a polynomial equation and the permutation of it's roots.In fact the study of permutation of the roots of an equation was Lagrange's theory of algebraic equation and it can said that germ of the group concept is present in his work.
The number theoretic strand was begun by ***Leonhard Euler*** and developed by ***Gauss's*** work on modular arithmetic and additive and multiplicative groups related to quadratic fields.

In geometry,groups first became important in projective geometry and later non-Euclidean geometry. ***F.Klein's Erlangen*** program proclaimed group Theory to be the organizing principles of geometry.
In 1874 the mathematician ***Lie*** introduced his general theory of transformation groups essentially called as Lie groups and represented by transformation.He worked further on results done by ***N.H.Abel*** and ***Galois*** doing in differential equation. Although Lie is not succeed in the actual formulation of Galois theory of differential equations but give some of his observations on transformation groups.

Three main historical sources of Group Theory:

CLASSICAL ALGEBRA -result to the theory of permutation groups

NUMBER THEORY -result to the theory of abelian groups

GEOMETRY AND ANALYSIS -result to the theory of transformation groups

As ***Lagrange,Ruffini*** and ***Abel*** initiated the study of permutation groups and solvability of equations.

Evarivste Galois coined the term 'group' in 1830s and was first to employ groups to determine the solvability of polynomial equations . Arthur Cayley and Augustin Louis Cauchy pushed these investigations further by creating the theory of permutations groups. Cauchy introduces permutation notation as well as the cyclic notation for permutation, transposition, recognises the identity permutation and etc. terms related to it. Jordan gives the study of linear group and subgroups.

Algebraic number theory arose with Fermat's hypothesis concerning equation of Gauss' theory.

Then after lie groups, Groups were at first implicity and later explicitly,used in algebraic problems. G.L.Drichlet established that the group of algebraic units is a direct product of a finite cyclic group and free abelian group of finite rank.Kronecker aimed at working out the laws of combination of "magnitudes" in the process giving an implicit definition of a finite abelian group.

As in number theory so in geometry and analysis group theoretic ideas remained implicit until the last third of 19th century, Moreover Klein explicit use of groups in geometry influenced conceptually rather than technically evolution of group theory for signified a genuine shift in the development of that theory form with permutaion groups to study groups of tranformation i.e. to study transformstion groups inspite of permutation groups.

The different scope of these early sources resulted in different notions of groups. The theory of groups was unified starting around 1880.Since, the impact of group theory ever growing giving rise to the birth of abstract algebra in the early 20th century, representation theory and many more influential. The classification of inite simple groups is a vast body of work from mid 20th centuryclassifying al the finite simple groups.

APPLICATIONS OF GROUP THEORY

1 Algebraic Topology: which associates groups to the objectsand used to describe certain invariantsof topological spaces.Grigori Perelman is a prominent application of this idea.

2 Algebraic geometry and cryptography: used in elliptic curves cryptography serves for public key cryptography, discrete logarithms, caeser's cipher etc.

3 Algebraic nymber theory: Euler's product formula syas that any integer decomposes in a unique way into primes.

4 Harmonic Analysis: Lie groups come under this and used for pattern recognition and other image processing techniques.

5 Combinatorics: often used to simplify the counting of a set of objects.

6 Music: presence of 12-periodicity in the series of circle of fifth yields applications of elementary group theory in musical set theory.

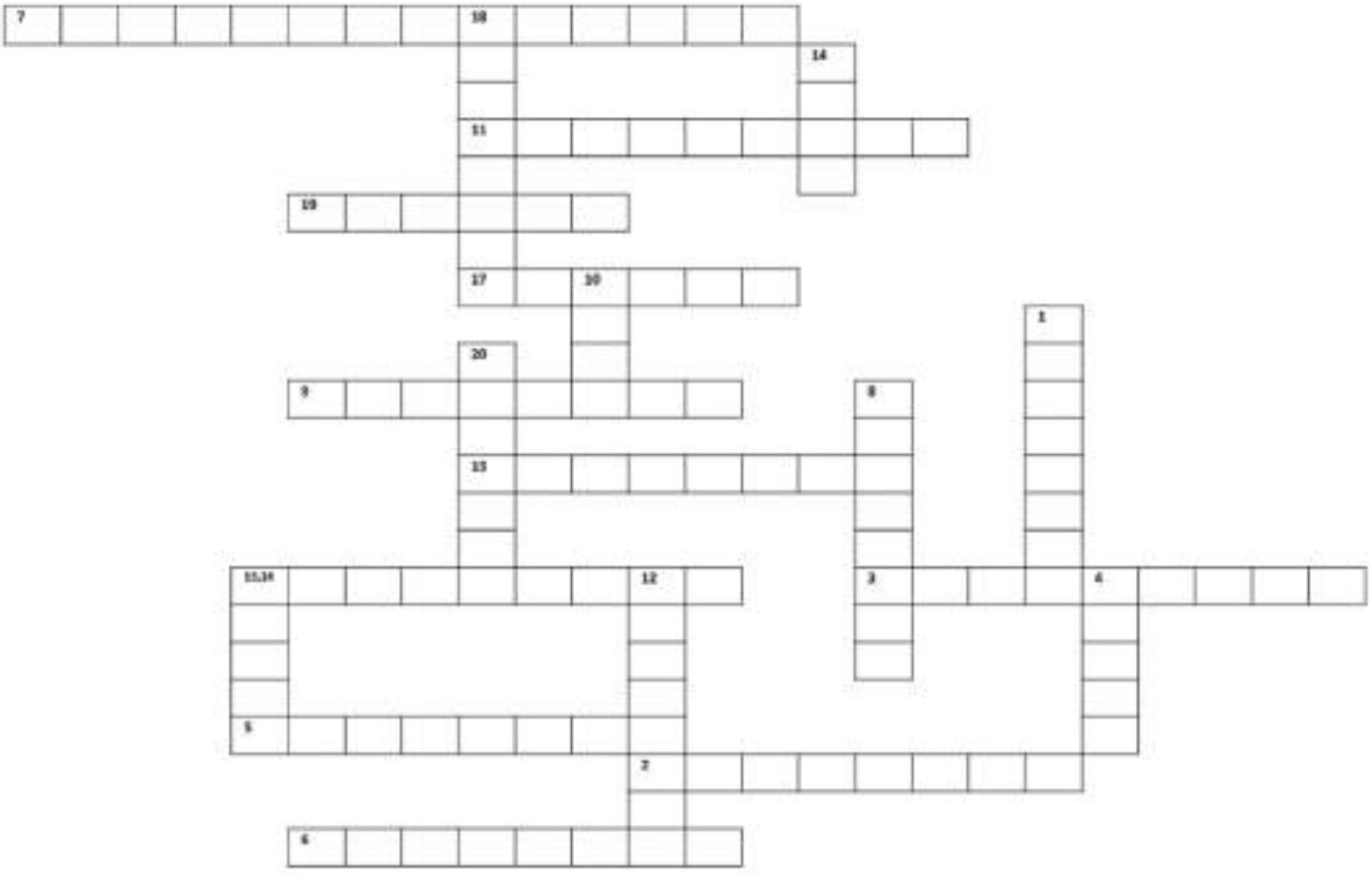
7 Physics: As they describes symmetries.It includes Standard model, gauge theory , the Lorentz group and Poincare group.

8 Chemistry and materials science: Groups used to classify crystals structures, regular polyhedra and symmetries of molecules and to determine the physical properties, spectroscopic properties and to construct molecular orbitals.

9 Stastical Mechanics: developed by Willard gibbs relating to the summing of an infinitr number of probabilities to yield a meaningful solution.

10 Puzzles/Rubik Cubes : such as the 15-puzzle and Rubik's cube.Group theory provides the conceptual framework for solving such puzzles. So you can learn an algorithm solving such puzzles.

CROSSWORD



ACROSS:-

2) A mathematical sentence that contains an equal sign.
3) Point where graph intersects an axis.
5) A relationship between sets.
6) To find the value of an expression.
7) Product.
9) The form of a linear equation Ax+By=C, with a graph that is a straight line.
11) A whole number that has no more than two factors
13) Numbers written in the form of p/q,q not equal to 0.
15) The length of the boundary around the figure.
17) The numeric values assigned to the axes of a graph.
19) A value that has magnitude but no direction.

DOWN:-

1) Symbol used to represent unknown numbers or values.
4) A comparison of two numbers by division.
8) Polynomial od degree two.
10) The inside of region of a 2-D figure measured in square units.
12) The number of times base occurs as a factor.
14) A network of evenly spaced, parallel horizontal and verticle lines.
16) A set of steps that demonstrate the truth of a given statement.
18) The branch of mathematis that deals with derivatives,integrations etc.
20) All the same or all in same manner.

ANSWERS:-

1) Variable
2) Equation
3) Intercept
4) Ratio
5) Function
6) Evaluate
7) Multiplication

Alumni

Richa Kumar
Working as a flying officer in Indian Air Force

Richa Gupta
Doing MBA(2017-19) from Narsee Monjee Institute of Management Studies (NMIMS) Mumbai

Apoorva Nambiar
Doing PhD from IIT Bombay (Dec 2018) Monash research academy Did MSc(2016-18) from International institute of population sciences Mumbai

Aarti Sharma
Doing MSc(2017-19) in Mathematics from IIT Roorkee

Kanchan Dwivedi
MSc in mathematics from IIT Jodhpur (2016-18)

Priyanka Patel
MSc in Mathematics from NIT Visvesvaraya, Nagpur(2016-18)

Vertika Shukla
MSc in Mathematics from NIT RourKela (2016-18)

Anusha Garg
M Tech in computer science from Indian Institute of Information Technology and Management, Thiruvananthapuram, Kerala (2016-18)

Parina Rattan
PO at oriental bank of commerce

Anurima Anand
She has got offer letter from Trinity College Dublin UK for masters in Financial Mathematics(2019-20)

The possibilities are infinite

Token of thanks

Arnima Chauhan
Tanisha Negi
Rabina Divya
Diksha Garg
Divya Khurana
Mohini S Jena
Vanshika Srivastava
Kriti Goma

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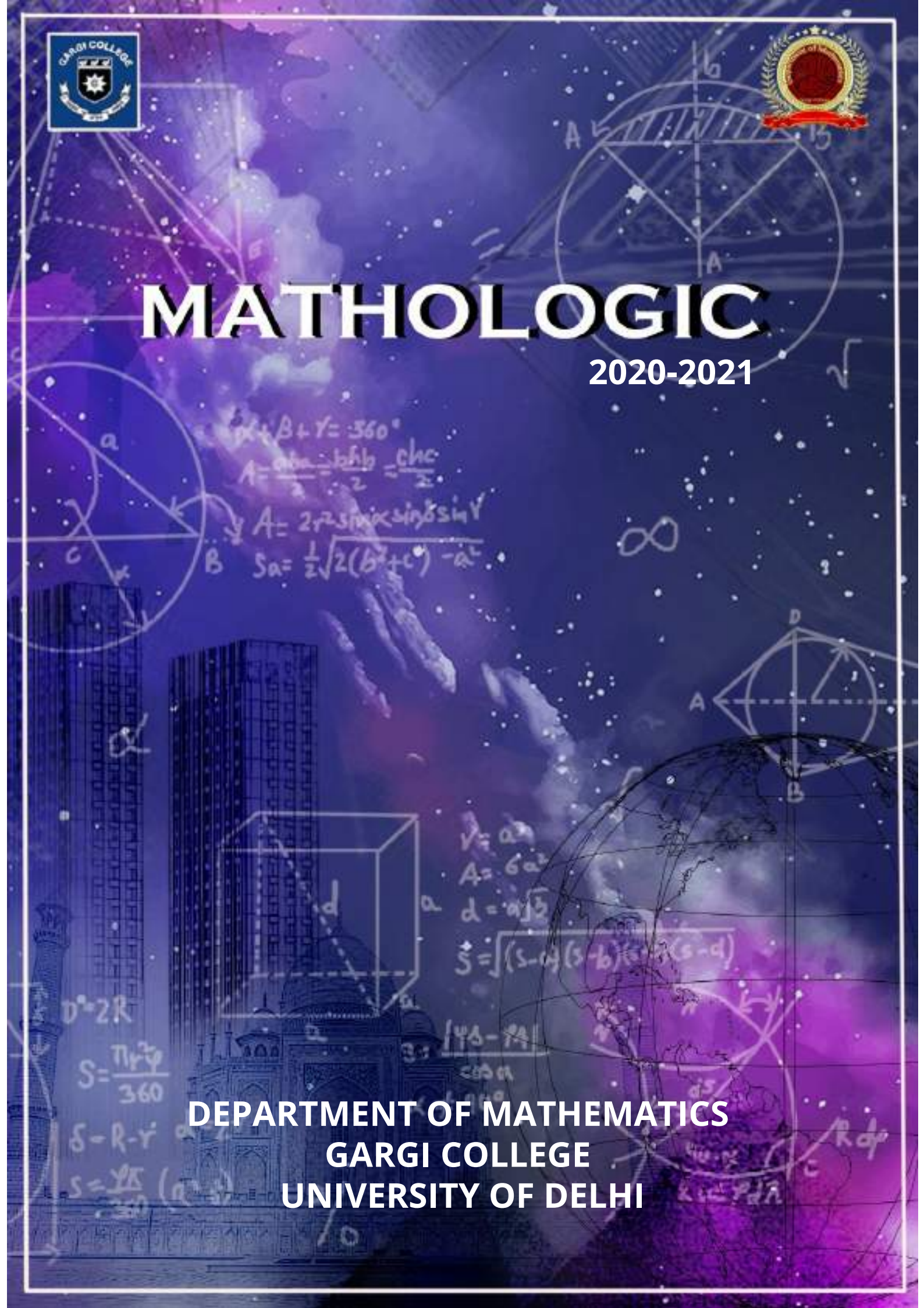

MATHOLOGIC

2020-2021

DEPARTMENT OF MATHEMATICS
GARGI COLLEGE
UNIVERSITY OF DELHI

To Our Readers,

This third edition of Mathologic brings to you the world of geometry, a well-known part of mathematics which is not just present in books. The magazine aims at bringing out the true meaning of geometry to its readers as well as highlighting geometry in those fields where you have never imagined it before.

In ancient times, people believed that God was the ultimate geometer and hence geometry was considered divine, often referred as 'sacred geometry'. Well, through this magazine we have tried to analyze some of the basic concepts of its divinity.

Many of us may have missed the vast applications of geometry in art, nature and many other things. So we hope Mathologic 2021 gives our readers the mirror to see this beauty of geometry.

The editorial board of Mathema could put together this edition despite the unfortunate circumstances faced in the year only with the whole hearted support, enthusiasm and contribution of the students of the Mathematics department, the creative team of the Union and other members of Mathema as well as the teacher advisors.

We believe we have done complete justice during the compilation of the magazine, keeping a balance to make your reading experience knowledgeable, interactive and interesting. We hope you will enjoy reading Mathologic 2021 as much as we enjoyed compiling it.

Regards

The Editorial Board

In loving memory

Mr. Narendra Kumar

Assistant professor,
department of mathematics, gargi College
(1985-2021)

The past academic year has been a tough hurdle for all students and teachers everywhere. Adding to all the difficulties, our department suffered a big loss, the untimely and sad demise of our TIC, Dr Narender Kumar.

He was a prolific mathematician, a supportive teacher and a loving colleague.He left a mark on the lives of everyone who has known him and will always be remembered by his students and his colleagues as someone who radiated knowledge and compassion. The mathematics department of Gargi college pays respect, gratitude and present this year's magazine in honour of our loved professor.

From the Principal's Desk

-Prof.(Dr.) Promila Kumar
Principal of Gargi College

We know you're a brilliant mathematician. What fascinated you to pursue your career towards mathematics?

Mathematics is a subject of logic which requires a massive brain exercise. Playing Sudoku, solving riddles and crossword puzzles has always been my favourite pastime. Such kind of brainteasers always fascinated me. This, probably is the reason that I got attracted towards Mathematics.

As per social norm, students tend to assume mathematics to be a challenging subject and they don't take it as their major subject. What are some myths that you would like to bust/break?

Yes, Mathematics has always been considered as a challenging subject because it needs concentration and 100% involvement in the subject. One can't afford to deviate from one's goal. But once you appreciate this, you will be surprised that you have started understanding the logic which makes the subject interesting and you would surely start loving it.

Being a principal of such a renowned college how has your experience been so far?

Becoming a Principal of a college of repute is a huge challenge because

- *You have to sustain the reputation of the college build by your predecessors.*
- *The college should grow further.*

If I talk about my experience, each day is a new learning. However, it has been a pleasant experience so far because of the simple reason that the faculty in Gargi is distinguished, staff is hard working and students are enthusiastic, loving and disciplined.

How has being a mathematics professor helped you in your journey as a principal?

As mentioned earlier mathematics is a subject of logic and a person with strong logic is able to handle complications conveniently and efficiently.

With E-learning becoming the new norm what were the challenges that you had to face and what positive and negative impact did it have on the students.

Yes, E-learning has become a norm in the prevailing circumstances but it will

continue like this is a big question mark. All of a sudden moving to online mode was a bit problematic but with the cooperation of the whole Gargi fraternity it was executed successfully.

Wi-fi connectivity in the campus had been enhanced, Zoom platform was purchased for a month to hold webinars and annual day. Later on Cisco WebEx platform was purchased for one year to facilitate webinars and big classes.

The negative impact is lack of physical interaction with students which is necessary for the holistic development. Moreover face to face teaching is more interactive and makes the subject interesting. Some students could not attend online classes due to certain limitations at their end and it's not convivial.

At the same time E-learning has made everyone technology savvy irrespective of age and profession. The ease of E-learning is a boon to students living in faraway places as it saves time and energy. Through e-modes it's much more convenient to organize and attend workshops, webinars etc. at inter-state as well as international level. Students could attend many online add-on courses along with their regular classes. Lastly OBE!!!! definitely it has become students favourite.

What are some career advices that you would like to give to the students of mathematics department of Gargi College.

After doing Mathematics at undergraduate level many career options are available such as:

- *Teaching at School or College level*
- *Masters in Mathematics and appear for Civil services exam.*
- *Pursue MBA or MCA*
- *Actuarial Scientist*
- *Operations Research Analyst*
- *IT industry*
- *Investment Banking*
- *Learn Coding and decoding and be an official hacker.*

-Interviewed by :
Vishtha Arora

Talk with a Mathematician

As Math is indeed a very unique subject, so are Mathematicians. Lately, we got a chance to speak to one of the renowned subject expert in Delhi. Following is an abstract from this conversation.

Interview with : Dr. Tanvi Jain

Associate Professor , Theoretical Statistics and Mathematics Unit , Indian Statistical Institute, Delhi

How can young mathematicians cope up with this explosion of knowledge and come up with something new?

No one can acquire everything. Excel in whatever you like, where your interests lie. It shouldn't be like "jack of all trades, master of none", that is, you know many topics but none in depth. Your goal might change over time but whatever your goal is, give in your full attention, which will even help you to learn new things.

Many young and talented people don't consider mathematics to be an exciting subject. Why do you think math phobia is so prevalent and what as mathematicians can we do to fix it?

Not to disagree, the mathematics that is taught in school and the college mathematics are different things. Mathematics is just taught as a theoretical subject because of which students don't quite like it. It's not just the work of teachers, but the work of all students, teachers, parents, society that can help make mathematics an interesting subject. This can be done by giving challenging questions that students get intrigued by and have an interest in solving. We need to give them time to think and understand the beauty of mathematics. It is indeed very difficult to make a school child understand mathematics; it is rather easy to teach that to a college student. So I believe two things need to be catered: showing the beauty of mathematics and giving them time to understand that.

A quote by Hardy says "Mathematics is a young man's game". Do you agree with this statement?

Well to say, I'm no one to comment upon Hardy, but to a big extent yes, I do believe this statement. Young people come up with new ideas and mathematics, in fact, any field needs a fresh set of ideas. But it is also true that there is no age bar to starting something fresh. You can be in your 40's and start something new and bring out a boatload of ideas.

People have a mindset that higher-level mathematics doesn't have application in real life. How would you counter their opinion?

Mathematics plays an important role at the back front. Its direct implication might not be visible to the public. Mathematics makes you flexible. It is the base with the help of which all the applications are built. If someone is good at mathematics, it is a direct implication that that person has a certain level of intelligence and the ability to think of logic. One can see physics or economics or other subjects in real life, but one cannot see the direct application of mathematics, for example, the geometric mean of matrices is used in brain interface, medical imaging, Google needs mathematics experts or number crunchers for the smooth functions and sorting of data. Even economics or physics or computer science Ph.D. holders need to have a good command of mathematics to work upon in their fields. This is how vast the use of mathematics in the background is, so one cannot neglect its importance.

Ma'am, we see you have a long list of publications wherein you have beautifully intermixed various topics of pure mathematics. What motivated you to pursue your research in these fields?

I've always enjoyed studying mathematics; I still enjoy it a lot. Every problem is like a game to me, solving them gives me satisfaction. People have various areas of interests like singing or dancing, in the same way, mathematics is mine, the area of problems attract me. Since school mathematics has been my favorite subject, although that time I didn't know I'd be researching this field, but it has always been my source of contentment

Ma'am, what do you think is the scope of mathematics in the future?

The scope of mathematics will soar in the future. In the future mathematics would be more of an interdisciplinary subject. For example, if you'd know computer science, you'd also know mathematics and vice-versa that is knowledge of one subject would also mean you know the other subject

related to it as well. Physicists being mathematicians and statisticians as well, this thing has always been prevalent but nowadays it's getting highlighted. As far as I see the trend going, I believe one would have to excel in various fields and not just one.

According to you how does pure mathematics differ from applied mathematics and in what aspects are they interlinked?

Pure mathematics and applied mathematics go hand in hand. They can't go independently. Neither one can do applied mathematics without having good knowledge of pure mathematics, nor can one go further in pure mathematics without knowing the formulas and applications of applied mathematics. Applied mathematics and pure mathematics always complement each other.

What do you think are the hurdles a student has to face while they pursue research in the field of mathematics from India?

One of the problems is that we have fewer departments and many mathematicians working in the same department, which even though is great exposure to students and motivates them to work hard, it at the same time also creates tough competition and fewer job opportunities. We should focus on giving individual attention. We need to have good mentorship, training and institute so that it helps students choose what they want. Another problem is, for instance, students who join corporate after college, start earning whereas students who pursue research don't. This is the reason that it is necessary to motivate a student to pursue research by providing good remuneration, facilities, equipment, and scholarships but then it is also the responsibility of the students to give in their best efforts and work as hard as students in corporate do. One other problem linked with it that we can't live an ideal life, everyone needs money. Students pursue research in fields where there are chances of earning money and not where their interests lie. If we could help resolve this issue and help them pursue research in their desired area of interest, it would be for the best.

When it comes to publications, do you think you've achieved your goals or is there still a long way to go?

I don't think I'll ever believe I have achieved enough and I have reached my goal and so I should stop. You stop once you get satisfied and as we all know human beings have the virtue of not being satisfied.

Ma'am, for your incredible work you've received numerous awards and recognitions and have proven to be a role model

for all women in mathematics, but, unfortunately, there still seems to be a lack of female representation in the subject. What do you feel about mathematics being a male dominated field?

If we talk about women's representation on a lower level, there still might be some considerable participation of women but as we go up the ladder, women's participation falls rapidly. I believe this is more of a mindset. People think that women can't do mathematics as it is a difficult subject because of which it gets difficult for a girl to overcome the stigma and go beyond it and excel in some field. It is believed that the best career for girls is teaching, which makes them limited to just bachelors or masters and hence not pursuing further research. A person should pursue teaching only if they like teaching and not because society thinks it is an easy career. It is also believed that if a girl studies masters and studies further, then she is beyond her marriage age which would hinder her social position and family life. We need to bring these problems to limelight, try to resolve them and help provide a level of security to women, which unfortunately still lacks in our society and is a big problem.

People these days are coming up with new ideas to help promote women education, like Indian Association for women which organizes workshop, scholarships, awards, etc. to improve women representation at various levels. I believe that along with the change in the society and support from our families, we also need to support ourselves, be strong enough to fight, and most importantly be mentally strong to do whatever we want to.

If you could give one piece of advice to students pursuing mathematics, what would that be?

Be focused, give your 100% to whatever you do. Don't always expect a return, you give your best shot, you will receive your best.

Interviewed by :

Nishtha Arora

From the Faculty Advisors

It gives us a great delight to introduce the third issue of our magazine 'MATHOLOGIC'. As Albert Einstein once said, "pure mathematics is, in its way, the poetry of logical ideas". The magazine is published annually with collective efforts of our students and teachers. It aims to encourage and enhance student's desire to discover logics of mathematics in their daily lives.
In this publication, we bring forth a spectrum of articles addressing various aspects of geometry to engage a curious mind. The edition will encompass the highlights of this academic year. Our special gratitude to the principal, Dr. Promila Kumar, for her ceaseless support and gracious guidance.

I extend my appreciation to Ms. Muskan Yadav with her entire editorial team for their spirited efforts. We express our sincere thanks to Ms. Shruti Agarwal, our students' council president and her team for their strenuous effort.
Progress is the key of life and to make it happen we must strive for excellence in both spheres of quality and quantity. Human mind is filled with endless curiosities and we are incessantly making endeavors to expand our reach and explore beyond known. This magazine is a perfect example of vision of scale, speed and skills. It glimmers the idea that we can be the best.

We wish for every accomplishment for all the students, as they strive to master the contents of this magazine and conquer new frontiers. Let us take inspiration from today's success and dedicate ourselves to accelerate our progress with unfaltering confidence.
Thank you and best wishes.

-Ms. Pooja Gupta (Convenor)

-Mr. Ramakant Prasad (Co-Convenor)

A word with the Union President

-Ms. Shruti Agarwal

We know you've been actively involved with the union for the past two years. What changes do you see?

When I started off as an undergraduate here, I wasn't even aware of the fact that 1st year students are allowed to be a part of the union. A lot has changed since then. We have better communication among the students of different years. I have seen a growing interest amongst the students. They are extensively showing participation in department activities. We have been able to organize a number of events that focus not just on theoretical math but its application as well.

As a president what goals had you envisioned for the department?

Before I became the President of our students' council, I held the post of proctor and I still remember my interview where I was asked as to what is it that I'd do differently if I were to be a part of this union, and my two primary goals were to improve the communication amongst the students of different batches and to have more application based events that will be of interest to not just a handful of students. And this year, even with the adaptation of online learning, we witnessed a huge participation from the first years for the students' council. We also had an informal session with them where we shared our own experiences so far, things that we've learnt the hard way and tried reducing the communication gap that persists among the students of different years. We organized a bunch of activities and events that focused on all round development of the students.

How would you motivate your batch mates and your juniors to multitask?

Prioritizing and time management are crucial when talking about multitasking. One should first figure out which tasks require immediate

.

attention and work accordingly. My advice would be to list down everything that needs to be done and try not to procrastinate. I try to write as much as possible. All that I've planned for the day, any updates so far, and strike it off once completed.

According to you what is the key to developing a good team?

When every member of the team is committed to their tasks, can cooperate with each other while complementing one another and is open to communication, it is only then that we can build not only good but a great team.

What are the responsibilities that accompany the power of the students' union?

It is crucial that one does not abuse their power. One should move forward keeping in mind the interests of not just themselves but the entire department. At times, things might get personal or complicated, and keeping an unbiased opinion is a must.

What impact and legacy would you like to leave on as the president of Mathema?

I urge them to focus on establishing meaningful goals and keep on working towards new opportunities. To never be afraid of speaking their mind and to have the ability to be bold, take risks and new challenges, and make something of their own.

What have been your leadership priorities at Mathema?

I've always tried my best to value every member's ideas and suggestions, make sure that the work doesn't pile up on any one person, keep an unbiased front at all times, and cater to the needs of the department students.

What motivated you to join the union?

I have always enjoyed organizing and managing events and initially that was the driving cause for me to join the union as a proctor. But once in, I realized there was much more that could be done, given the power and authority. And that was my motivation to be the President of the students' council so that I could put my ideas and thoughts into action.

What have you gained through the multiple roles that you've played in the students' union?

There has been a lot that has changed in me ever since I first joined the union. I am a much more confident version of who I was 2 years back. I have better communication skills, multi-tasking, leadership and management skills. I have also learnt to stay calm and focused at times of conflict.

Interviewed by -

Vishtha Arora

Editor's Angle

I am exhilarated to introduce to our fellow readers to Mathologic – The annual magazine of the Department of mathematics, Gargi College.

The magazine would provide a glimpse of various events conducted in the past year. The pandemic did not stop us from organizing a series of fun activities from Career counseling session to paper presentation. We also saw a huge footfall in the Chess tournament and the Article writing competition both allowing students to showcase their talent and creativity.

All the activities organized by the mathematics department witnessed an eager participation, hence making the value of organizing events that boost our department much more memorable and delightful.

We hope this magazine brings something fascinating for every reader, as it has for each of us involved in its making
Happy reading!

Muskan Yadav

Editor of Mathologic and Editorial Head (2020-2021)

MATHEMA

The Mathematics Association

2020-2021

Faculty Advisors

Mr. Ramakant Prasad

Ms. Pooja Gupta

PRESIDENT

Shruti Agarwal

VICE-PRESIDENT

Nishtha Arora

Malavika MS

GENERAL SECRETARY

Vanshika Srivastava

Khushi Singh

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A POEM FOR GEOMETRY

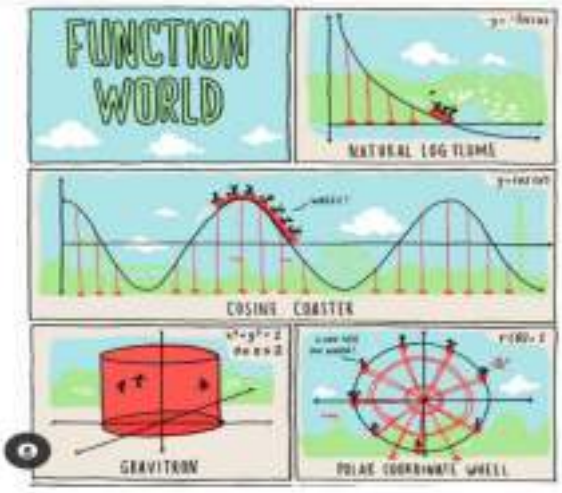
Isn't the sky and land like two parallel lines
Which never meet in real but falsely seems to entwine?
In scarlet, the silhouettes of city form different shapes
From three dimensional world, it turned into a two dimensional landscape.

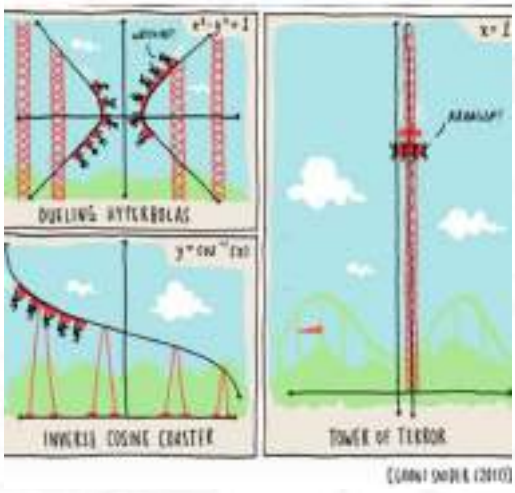
Let's prove a theorem to find the happiness hidden in x,
And here it stops unproven leaving in dilemma what to do next?
Join the dots to disappear the chaos of life
And form a path to travel sequestering the agony of strife.

Combining the length of knowledge and emotions
And the breadth of several experience and ambitions
The equation of life is completed just like the figure of geometry,
Maybe geometry is science of life puzzled like the Shakespearean poetry.

Diya Bedi

(1st Year)





MATHCRACK

GEOMETRY: THE SCIENCE OF PLANE AND SPACE

The branch of mathematics that deals with shapes, angles, dimensions and sizes of a variety of things that we notice around us is recognized as Geometry. The basic meaning of the word 'geometry' is 'the measurement of Earth', as it is derived from the ancient Greek words; ‘geo’ means Earth and ‘metron’ means measurement. Thus, its concepts help us to understand the nature of shapes based on area and volumes in day to day life.

Geometry mainly comprises of 6 different branches:-

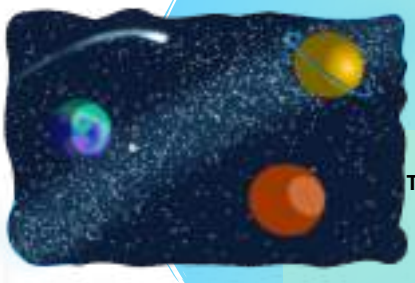
- Discrete Geometry – Deals with the relative position of simple geometric objects, like points, lines, triangles etc.
- Euclidean Geometry – Study of plane and solid figures based on axioms and theorems including angle, congruence, similarity.
- Differential Geometry– used in solving the problems of algebra and calculus.
- Algebraic Geometry – includes linear and polynomial algebraic equations that are used for solving the sets of zeros.
- Convex Geometry – uses techniques of real analysis for understanding convex shapes in Euclidean space.
- Topology – concerned with properties of space under continuous mapping.

The major applications of geometry are in the field of construction and surveying such as the construction of buildings, roads, dams and mapping. It is used in Software Industries for graphics designing, gaming and animations. Geometrical calculations between coordinates also help to chart a trajectory for a space vehicle's journey and its entry point into a planet's atmosphere. In the medical field as well, for CT scanning and MRI's, geometry concepts are used. Even, the satellite equipped with a GPS system uses it to trace the locations.

Though geometry has played a crucial role in the development of human civilization, it doesn't have any defined spot in working sectors but in last few years, the scope of geometry has been greatly expanding worldwide.

-Prerna Pranghal

(1st Year)



DO YOU KNOW ?

The Milky way

The Fibonacci pattern is found in spiral galaxies. The spiral arms of the Milky Way are description of a logarithmic spiral medsuring approximately 12 degrees. Beginning at the galaxy's center there are four major arms. Other examples are flowers, petals, DNA molecules. Geometry is hidden everywhere.

THE CHRONICLES OF THE ORIGIN OF GEOMETRY

The branch of mathematics called geometry first originated around 3000 BC in ancient Egypt. One of the main purpose for which ancient Egyptians sought help of geometry is to construct pyramids with four triangular sides and a square base.

After the Egyptians, the next known trace of geometry is Euclidean geometry in 300 BC. Euclid, the 'father of geometry', is rightfully called for he compiled a text in which he presented axiomatic format of his study in this field. The text contained the famous five postulates from which Euclid was able to derive a great portion of planar geometry.

It was in the 17th century that Rene Descartes discovered coordinate geometry. Following this discovery, calculus and physics developed to a much greater extent since coordinates and equations could be used now to illustrate proofs.

Later, Carl Friedrich Gauss, Nikolai Lobachevsky, and János Bolyai formally discovered non-Euclidean geometry in the 19th century. This geometry considers only four of the Euclid's first five postulates consistent. The last postulate that states that parallel lines do not meet was ruled out to be true. This idea of non-Euclidean geometry is one of the greatest driving forces behind elliptical and hyperbolic geometry.

Hence, the geometry as we know it today has gone through several additions, deletions and modifications. Throughout man's history, this field of subject has been of greatest significance. It will continue to remain so in the future too.

-Malavika M.S

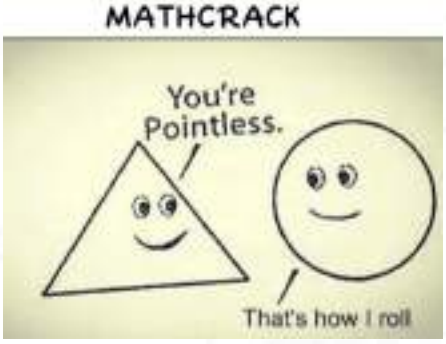
(2nd Year)

RELEVANCE OF GEOMETRY

The study of geometry starts with single points and branches out to lines and then to three dimensional shapes that are flat or solid. Squares, Circles and triangles are some of the simplest shapes in flat geometry. Cubes, cylinders, cones and spheres are simple shapes in solid geometry. The main concern of this new geometrical science is to characterize the structures and features of geometrical space in axioms and demonstration. Although it is quite clear that this revolution in geometry helped shape the scientific world such that contemporary mathematics remains incomprehensible without it, the questions of when, why and how this revolution took place, prior to this research, were still to some extent obscure.

- Pooja Kumari

(1st Year)



DID YOU KNOW?

Labyrinth

A Labyrinth is a combination of a circle and spiral to make a complicated path. The best known is in the story of the Minotaur, in Greek mythology.

GEOMETRY IN MUSICAL INSTRUMENTS

How does math sound?

Math is all around us, in everything we do. It is the building block for everything in our mundane lives, including mobile devices, architecture (ancient and modern), art, money, engineering, sports and even music. Yes, you read it right. Math has always been acknowledged as a difficult path full of hardships in the form of complex calculations revolving around numbers and thus this path is indeed tread by less people. But what people do fail to notice or, if I take the liberty to say, blatantly overlook is the fact that math is the basic component of life and is not always as complicated as one might make out it to be. As I recall Fran Lebowitz once said “In real life, I assure you, there no such thing as algebra”, and I ought to think that it summarizes the whole point.

Have you ever marveled over the fact that how does math sound? Yes, quite contrary of many onlookers’ belief, math does have a sound and why would it not have one after all it is used in the composition of musical instruments. To be more precise, geometry is the sound of math. How lovely isn’t it?

Geometry shapes the sound of music. Even through the ages, scholars have suspected that the mysterious force that shapes the melodies that catch the ear and lead the voice is none other than math. A trio of 21st-century music professors from Florida State University, Yale University and Princeton University have analyzed and categorized in brand-new ways the mathematics intrinsic to musical harmony.

Their cutting-edge collaboration has produced a powerful tool they call "geometrical music theory", which translates the language of music theory into that of contemporary geometry. Geometrical music theory represents a culminating moment in the longstanding marriage of music and math. That marriage began when Pythagoras described pleasing musical intervals with simple mathematical ratios more than 2,600 years ago and which further evolved during the Middle Ages when deep thinkers used those same ratios to model the "music of the spheres"; what many at that time believed to be the literally harmonious movements of the sun, moon and planets.

Understanding and interpreting music is a process of discarding information, which in turn is the key to discovering its underlying mathematical structure. If one might go into details, it is revealed that at each level of abstraction, musical objects are grouped into families of chords or melodies. Mathematical structure is assigned to the "families" so that they can be represented as points within complex geometrical spaces in much the same way that "x" and "y" coordinates correspond to points on a two-dimensional plane in simple high school algebra. The different families produce an exotic maze of diverse geometrical spaces such as twisted triangular donuts and pinched cones -- and even some spaces that mathematicians haven't dreamed up names for yet.

Cutting it short, it can be concluded that math is indeed the soul of everything and does synchronizes with the nature with its beautiful harmony in the form of geometry.

-Prasahnsa Mewar

(3rd Year)

The rosslynchaple

13 geometrical sounds patterns were found to match 215 "musical cubes" in the chapel's pillars and arches. By sprinkling a metal plate with saltand utilizing the vibration of sound frequency the patterns may be created. The cube pattern corresponds to musical tones of a melody.

GEOMETRY AND ART

Mathematics and art are related in a variety of ways. For instance, the theory of perspective showed that there is more to geometry than just the metric properties of figures. (Perspective is the origin of projective geometry).
Artists have long used concepts of proportion in design. Vitruvius, a famous roman poet and architect developed a complicated theory of ideal proportions for the human figure. These concepts have been used and adapted by artists from Michelangelo to modern comic book artists.
The golden ratio is a particular proportion that has had a controversial role in art. Often claimed to be the most aesthetically pleasing ratio of lengths, it is frequently stated to be incorporated into famous works of art, though the most reliable and unambiguous examples were made deliberately by artists aware of this legend.
Tilings or tessellations (covering of a plane using one or more geometric shapes called tiles, with no overlaps and no gaps. In geometry, tessellations can be generalized to higher dimensions and a variety of geometries) have been used in art throughout history. Islamic art makes frequent use of tessellations, as did the art of M.C. Escher.
Cazanne, was a French artist and Post-Impressionist painter whose work laid the foundations of the transition from the 19th-century conception of artistic endeavor to a new and radically different world of art in the 20th century. He advanced the theory that all images can be built up from the sphere, the cone and the cylinder. This is still used in art theory today, although the exact list of shapes varies from author to author.

-Monika

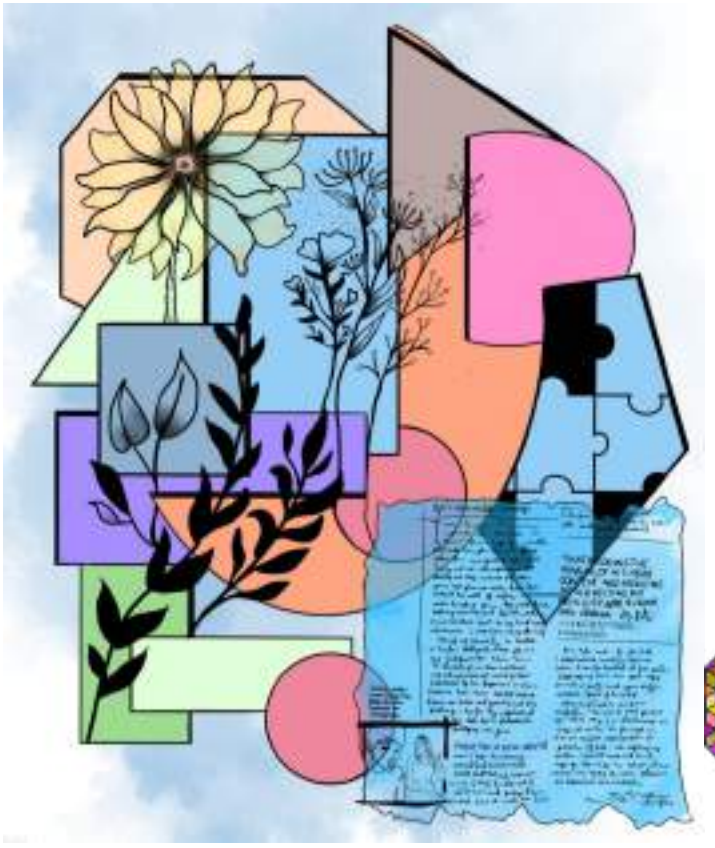
(1st Year)

DO YOU KNOW ?

Mona Lisa

Before beginning a painting, Da Vinci would lay out the sketches utilizing "DIVINE PROPORTIONS'. Sacred Geometry appears to be evident in the Mona Lisa since her face falls in line with the golden rectangle.

By creative team



GEOMETRY

AND

ART

GEOMETRY AS POEMS

Algebra was really tough
Next comes geometry
Equations to memorize
Will shape each new theory
Speaking of the shape of things
I hope my teacher cares
That I know the formulas
For trapezoids and squares
The area of circles?
I don't think I'd get by
Not knowing the radius
And the value of pi
Geometry's amazing
Do you know how to factor
All the different angles that
Are gauged with a protractor?
Get your compass out and draw
Circles that are perfect
Now get out your ruler and
Draw lines that intersect.

-Anshu Yadav
(2nd Year)

"What is a group ?"
"A symmetry of things."
"Of things from where?"
"Oh those from any place."
"But where in math?"
"In math? A Vector space."
"And what is that?"
"It's what a field brings."
"And what are fields?"
"They are the symmetries of groups."
"A group's own group?"
"Why yes, when both are one".
"So now we are back?"
"Indeed where we'd begun."
"So where to start?"
"Where you start any loop."
"And where is that?"
"From everywhere with in."
"And if you are out?"
"Then why would you begin."

-Rinku Verma
(2nd Year)

THE MATH OF KIRIGAMI

Kirigami, where Kiri stands for cut and kami for paper, is a lesser-known cousin of origami. This art form has found its way in pop-up cards, castles, books, etc., for ages. The Harvard researchers have exhibited a strong relationship between mathematics and old Japanese decorative traditions by coming up with a mathematical model that allows them to cut a kirigami sheet of paper in just such a way that it can be morphed into just about any 3D shape
For instance, consider gift-wrapping a ball or any spherical object, and you will quickly encounter the geometric abyss between paper's inherent flatness and a sphere's natural curves. As you will continue to wrap the paper around, the crinkles get bigger and bigger. Scientists have sought a systematic way of imbuing flat surfaces with curvature. Taking inspiration from tailors, how they wrap the fabric around the curves of a body by making the right cuts, the physicists put forth a basic set of rules for cutting and reattaching a piece of paper to add curvature to one point in its surface while subtracting it from another. This helps in maintaining the paper's overall flatness while forcing it to bend into the third dimension.

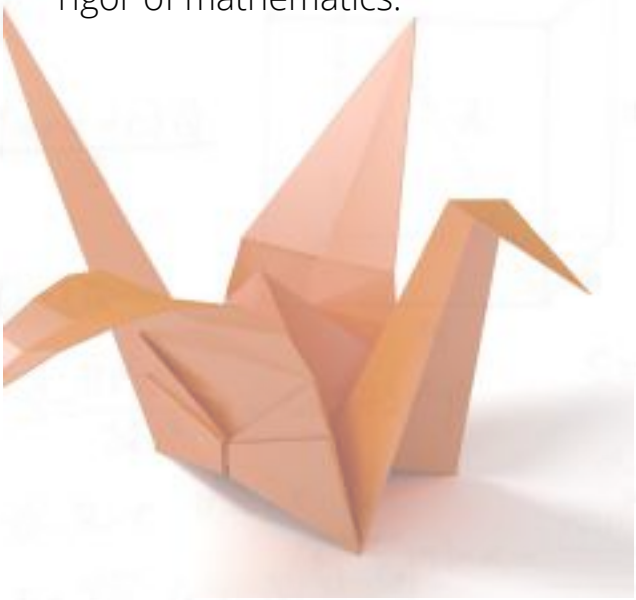
Nature has its way of doing wonders. Getting inspired by the work on sunflowers and influenced by how nature deals with the ball-wrapping problem, or the challenge of bending 2-D lattices of seeds, or leaves around curves, the Penn scientists treated their kirigami paper much like a hexagonal lattice of seeds. Over the course of hundreds of hours of cutting and folding, they discovered the rules for removing wedges from paper and gluing the holes closed to convert two hexagons into a pentagon and a heptagon, or a 5-7 pair.

To understand how this works, let's take an example of an insect crawling on a sheet of paper. Initially, the insect makes six 60-degree turns to complete an angular rotation of 360 degrees to return to its starting point, tracing out the shape of a hexagon having zero curvature. But if we remove a triangular wedge from the hexagon and paste the cut edges together, the paper is no longer flat. Now, the insect only needs to make five 60-degree turns to get back from where it started, a deficit that indicates that this pentagonal patch of the surface now has positive curvature. Nearby, the insect must make seven such turns, signifying a heptagon with an equal and opposite amount of negative curvature. Even as the paper's overall curvature remains zero, the 5-7 pair steps it up to a new plane.

The steps involved in converting a two or three-dimensional shapes into one motion are:

- Firstly, solve the problem by identifying the constraints that have to be satisfied to achieve the cut pattern.
- Determining the problem by using a numerical optimization approach.
- And lastly, experimentally verifying it. Kirigami had turned out to be a fresh and innovative approach for designing 3-D structures.

It has brought effective development in the construction of foldable shelter and housing for disaster zones, just by the closing of holes that have been pre-cut in paper or any other flat material.
The math of kirigami is nothing but inspiration taken from art, tempered by the rigor of mathematics.



-Muskan Yadav
(3rd Year)

PARADOXES

Zeno's Paradox

You will never reach point B from point A as you must always get half way there , and half of the half , and half of that half and so on.

Galelio's Paradox

Though most numbers are not squares , there are no more numbers than squares. First some numbers are squares, while others are not ; therefore, all the numbers, including both squares and non squares, must be more numerous than just the squares. And yet ,for every number there is exactly one square;hence, there cannot be more of one than of the other.

Cantor's Paradox

The set of all sets would have it's own power set as a subset, therefore it's cardinality would be at least as great as that of it's power set. But Cantor's theorem proves that power sets are strictly greater than the sets they are constructed from . Consequently, the set of all sets would contain a subset greater than itself.

Banach tarski

Cut a ball into a finite number of pieces and re-assemble the pieces to get two balls each of equal size to the first.

The Potato Paradox

If 100kg of potatoes, which (being purely mathematical potatoes) consist of 99% water , then when they'll consist of 98% water. Their weight will be 50kg.

Pigeonhole Principle

In mathematics, the pigeonhole principle states that if n items are put into m containers, with n>m, then at least one container must contain more than one item. This seemingly obvious statement can be usedto demonstrate possibly unexpected results.Given that the population of London is greater than the maximum number of hairs that can be present on a human's head, then the pigeonhole principle requires that there must be at least two people in London who have the same number of hairs on their head.

Russell's Paradox

Let R be the set of all sets that are not members of themselves.If R is not a member of itself,then it's definition dictates that it must contain itself, and if it contains itself, then it contradicts it's own definition as the set of sets that are not members of themselves.This contradiction is Russell's Paradox.

Grandi's Series

The sum of 1-1+1-1+1-1.... can be either one , zero or one -half.

THE GEOMETRY OF DANCE

Aren't dance and mathematics polar opposites? Dance is a fun activity - both to perform and observe. On the other hand, the general populace considers mathematics to be a dull and overly complicated source of constant frustration. But dance is all about changing the shape of our body to demonstrate an act, a feeling, or an idea and is it possible to talk of shapes without finding a concept of geometry hidden behind it. No! Hence the art of dancing is not only about spotlights, music, rhythms but also about geometrical concepts which we often fail to notice. Every aspect of choreography from basic moves, group formations to lifts and spins are full of concepts of shapes, angles and symmetry.

One of the most peculiar features of a beautiful choreographed dance is its symmetry, both of an individual dancer and that of the group. Including asymmetrical elements in the performance is a way to break the eye from the scene, or to demonstrate dissent within the piece. This power of symmetry is nothing but hidden geometry which is also, used in spins. While performing spins, dancers use a technique called 'spotting'. As they turn their body, they keep their head fixed for as long as possible, and then quickly rotate their neck to catch up with their body. This helps them to balance and prevent dizziness. The reason why dancers can't spin continuously, like a ball, is that the human body has no rotational symmetry, while a ball or any other spherical surface has infinite rotational symmetries. The human body has mirror symmetry which is used by choreographers to make the dance moves more attractive. In fact a choreographer, Rudolf Laban, has even created a dance, called Labanotation or as he himself described it, written dance, that manipulates body movements like a mathematical equation. His philosophy of "space harmony" is about spatial exercises linked to musical scales which flow through the structures of geometric shapes, such as the cube or an octahedron. He linked complex mathematical sequences, like the proportions of the golden ratio (phi)to movement and its relationship to human body proportions.

Modern dance also uses geometric concepts, but ballet's strict symmetry makes its commitment to geometry even more evident. The geometric shapes that comprise ballet's architecture and what they represent, is very often taken for granted. It seems there exists a sort of sacred geometry, certain principles which make these configurations penetrate in to the heart and soul of an individual. Considering the second act of Swan Lake as an example. Shortly after the swan corps enters, they form a formidable triangle, aimed like a spear towards the audience that defines the power of the flock. They then form circles around Siegfried in unity of their sisterhood. These shapes are not random formations—they embody the music's emotional and energetic charge. Thus, Geometry carries intention

The classical Indian dance known as Bharatanatyam, which is often characterized by its use of stylized, schematic body movements and sculpture-like poses also possesses a deep relation to geometry. Bharatanatyam dancers use poses and movement to convey ancient Indian stories from the Hindu epics Ramayana and Mahabharata. They often create basic geometric shapes – like the line, square, rectangle or triangle – with their bodies to tell their stories. These basic shapes have long been how we visually represent the world around us. The repetition of these shapes helps cement the elements of geometry in our minds.

Dance forms like Contemporary, Jazz, Tap Dance, Irish dance also have geometry playing a crucial role. Thus no matter what dance form it is or from what origin, geometry is always hidden in its moves. So the next time you skip a geometry class for dancing don't ever think that you're going away from it , instead you're getting closer to with each move.

-Anushka Raghav

(1st Year)

MATHEMATICAL MODELS

The reason we can talk to aliens is because of Math. Mathematics is a universal language which doesn't change anywhere in the universe.

When I heard this quote in a BBC documentary, it forced me to actually appreciate the beauty of mathematics and how universal it is in our lives. It can precisely represent every real-life situation and can be used to handle most of the complex problems. It does that with the help of mathematical modelling. The model describes our beliefs about how the world functions. We analyze this belief a real-life problem then into differential equations. Sounds interesting? I bet it does.

But how is it done? Well, it's simple. We take scientific laws or real-life world problems, analyze them and then translate them into differential equations. Let's understand this using the example of a population model. The population model gives a better understanding at how population change over time.

One of such models is exponential growth model put forward by Malthus. According to this model, "Once population size exceeds available resources, growth decreases dramatically." We analyze this statement and visualize it on a graph paper. We understand that (from the statement) population is increasing by a fixed percentage every year. We get a J-shaped curve given below for this model and this is known as exponential growth model.

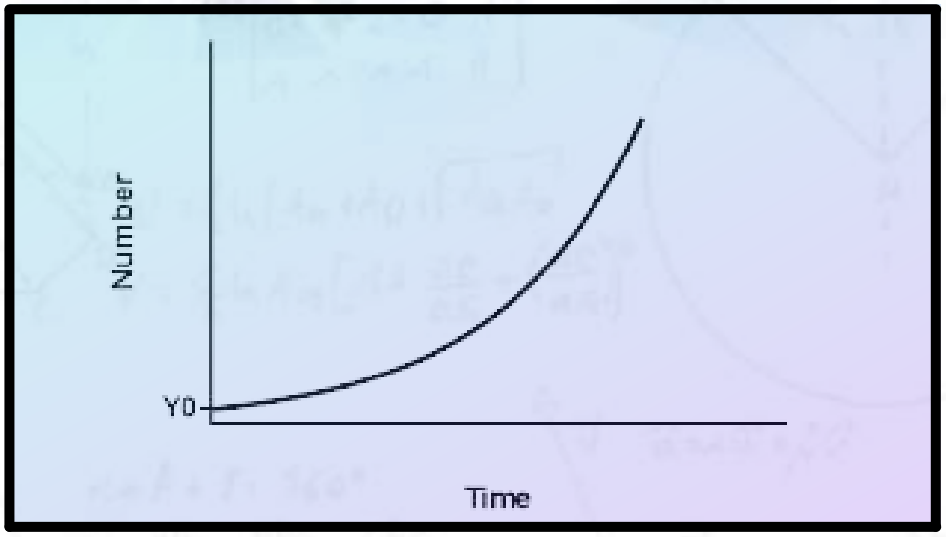


Image credit-"Exponential Growth Graph." Www.graphpad.com, 14 Apr. 2021, www.graphpad.com/guides/prism/latest/curve-fitting/reg_exponential-growth.htm.

This can be understood by the example of how population in bacteria change. Bacteria, we all know, reproduce by fission. To after every hour they'll double

i.e.,

At first hour	100 bacteria
(let)	
Second hour	200 bacteria
Third hour	400 bacteria.
.	
.	
.	And so on.

This is represented using $G=r\times N$ or $\partial N/\partial t=r\times N$
where birth and death rates are considered constant. This is known as exponential growth model.
Here, G (or $\partial N/\partial t$) is population growth rate, r per capita rate of increase and N is the population size.
That's how various mathematical models are formulated and help in understanding the dynamics of various real-life problems.

References -Population Growth Models. (2021, March 10). Retrieved April 14, 2021, from https://eng.libretexts.org/@go/page/12226

Vihanika
(1st year)

SHUFFLE THE UNSHUFFLED AND NOT GET IT SHUFFLED

Well it sound quite confusing. So let's make it a bit simpler .First of all we should understand what is shuffle(Perfect shuffle).

Take a pack of cards(ordinary deck of 52 cards) and split the pack into equal halves .Now interleave them perfectly: top card from the first pile ,top second card from the second pile, next card from the first pile ,next card from the second pile and so on. This is exact interleaving of two halves of the pack and called a perfect shuffle.

Everytime you have shuffled your cards, you must have got it in different orders. But what if after 'x' number of shuffles, we get the cards in original order ! Is it not intriguing? So let us find this 'x'.

What we are interested in here is the order of the cards in the original deck,so forget about the value of cards and label it from 0 to 51.
0,1,2,3,4,5,6,.....,50,51

A shuffle splits the cards into two halves, the top half in the first pile (0,1,2,3..... , 25) and the bottom half in the second pile(26,27,28,.....,51), and interleaves them to give the following order.

Label=position in original pack	Position in shuffled pack
0	0
1	2
2	4
...	...
25	50
26	1
...	...
50	49
51	51

The top card and bottom card with label 0 and 51 respectively remain in the same position while remaining cards are moved to 2n (mod 51) position in the shuffled pack.

Where n=label of cards in original pack.

2n mod 51=remainder when 2n is divided by 51.

Similarly ,after x shuffles, card will have moved to (2*2*2*....x times) n (mod 51) position

We are looking for x number of shuffles after which cards will return to original position i.e at position n.

$$=2^{x}n \pmod{51}$$

We are looking for x number of shuffles after which cards will return to original position i.e at position n.

$$2^{x} n \pmod{51} = n$$

$$2^{x} \pmod{51} = 1$$

So,we are looking for smallest power of 2,which when divided by 51 gives remainder 1.

$$2^{8} \pmod{51} = 1$$

$$X = 8$$

So,eight shuffles give us back the original pack.

Tareeshi

(1st year)

FRACTAL COSMOLOGY

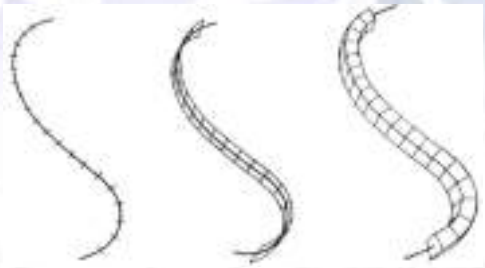
Some say it came into existence after a massive explosion. Some claim that a superior power created it. Well we cannot take any one parties side as of now because the study of how Universe came into existence ceases to end. As of now we, humans are only trying to study the structure of our mysterious but remarkable Universe with the facilities limited to our access.

Space as we know it, is boundless and infinite. Scientists all over the world are working hard to formulate the structure of the galaxies and planets in our Universe. The theory of Fractals has become an important tool in studying cosmology at a much larger scale. There are two divisions in fractal cosmology: Physical cosmology and Observational cosmology.

While observational cosmology is limited to theoretical conclusions about structure, evolution and origin of the Universe, physical cosmology is actually applied to describe practical relations.

In Physical Cosmology, fractal cosmology is a set of minority cosmological theories stating that the distribution of matter in the Universe is a fractal across a wide range of scales. Scientists use the fractal dimension of the universe or of matter distribution within it, when measured at very large or very small scales while studying about Cosmic Space. This model of including fractals in the study of cosmology was first made by Luciano Pietronero and his team in 1987. The large-scale distribution of galaxies is compared with fractal patterns as a basis to study further about the puzzling wonders of the Universe.

Added:
An important step in the understanding fractal dimensions is the introduction of the Hausdorff-Besicovitch dimension . It was first introduced by F. Hausdorff in 1919 and developed later in the 1930's by A. S. Besicovitch and his students. It revolves around the question- how do we measure the "size" of a set F of points in space? A simple manner of measuring the length of curves, the area of surfaces or the volume of objects is to divide the space into small cubes of diameter δ as shown below.



Small spheres of diameter δ could have been used instead. Then the curve can be measured by finding the number Nδ of line segments of length δ needed to cover the line. Obviously for an ordinary curve we have Nδ = L* / δ. The length of the curve is given by.

$$L = N(\delta)\delta \rightarrow_{\delta \rightarrow 0} L_* \delta^0.$$

In the limit δ approaches 0, the measure L becomes asymptotically equal to the length of the curve and is independent of δ.associating an area with the set of points defining a curve by obtaining the number of disks or squares needed to cover the curve. In the case of squares where each one has an area of δ2, the number of squares N(δ) gives an associated area

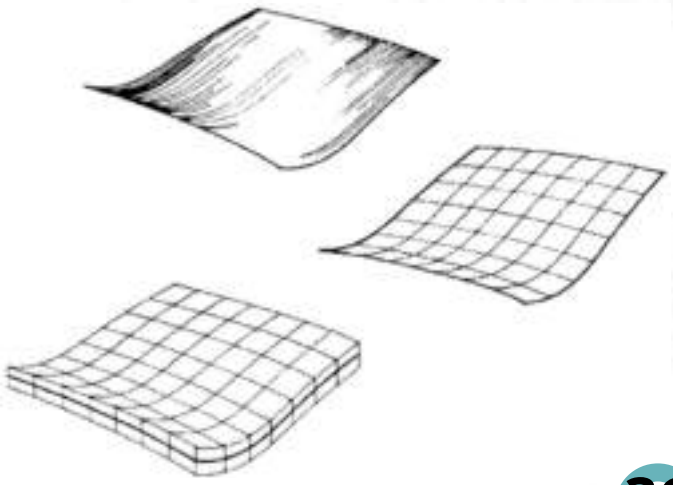
$$A = N(\delta)\delta^2 \rightarrow_{\delta \rightarrow 0} L_* \delta^1.$$

In a similar way the volume V associated with the line is given by

$$V = N(\delta)\delta^3 \rightarrow_{\delta \rightarrow 0} L_* \delta^2.$$

Now, for ordinary curves both A and V tends to zero as δ vanishes, and the only measure is the length of the curve. Now considering a set of points that define a surface as illustrated in the given figure. The normal measure is the area A, and so we have

$$A = N(\delta)\delta^2 \underset{\delta \rightarrow 0}{\rightarrow} A_* \delta^0.$$



Hence for an ordinary surface the number of squares needed to cover it is N(δ) = A*/δ2 in limit of vanishing δ, where A* is the area of the surface. Associating a volume with the surface by forming the sum of the volumes of the cubes needed to cover the surface:

$$V = N(\delta)\delta^3 \rightarrow_{\delta \rightarrow 0} A_*\delta^1.$$

This volume vanishes as δ tends to 0, as expected. Now, associating a length with a surface:

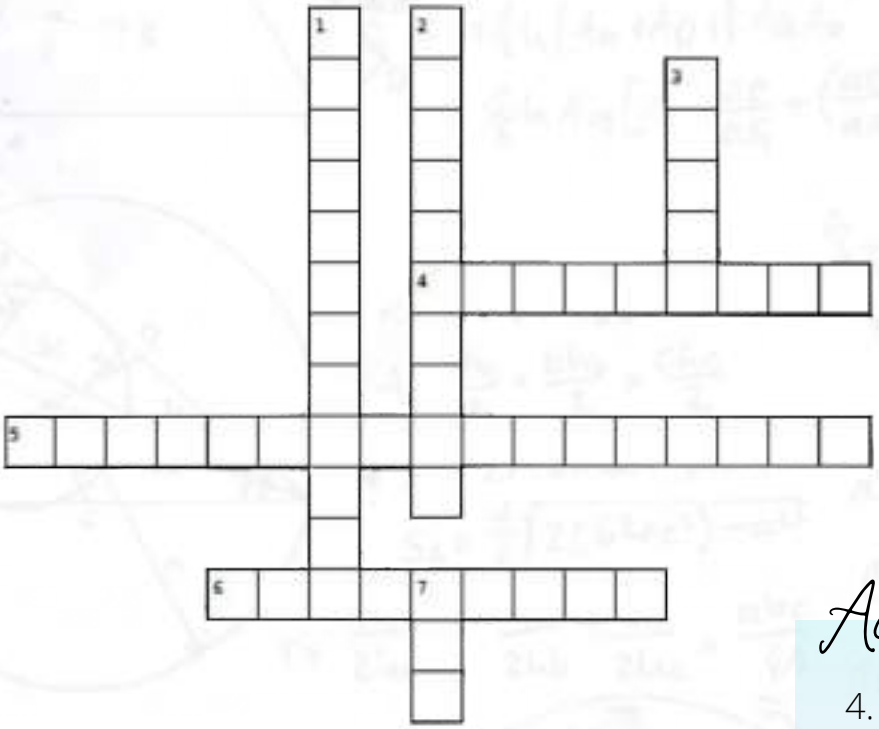
$$L = N(\delta)\delta \rightarrow A_*\delta^{-1},$$

which diverges for δ tends to 0. This is a reasonable result since it is impossible to cover a surface with a finite number of line segments. Therefore the conclusion: the only useful measure of a set of points defined by a surface in three-dimensional space is the area.

Anushka

(1st year)

MIND SCRIBBLE

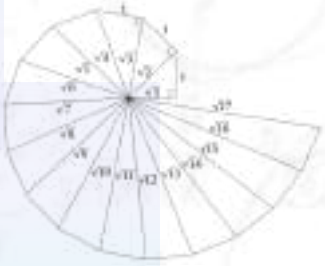


Down

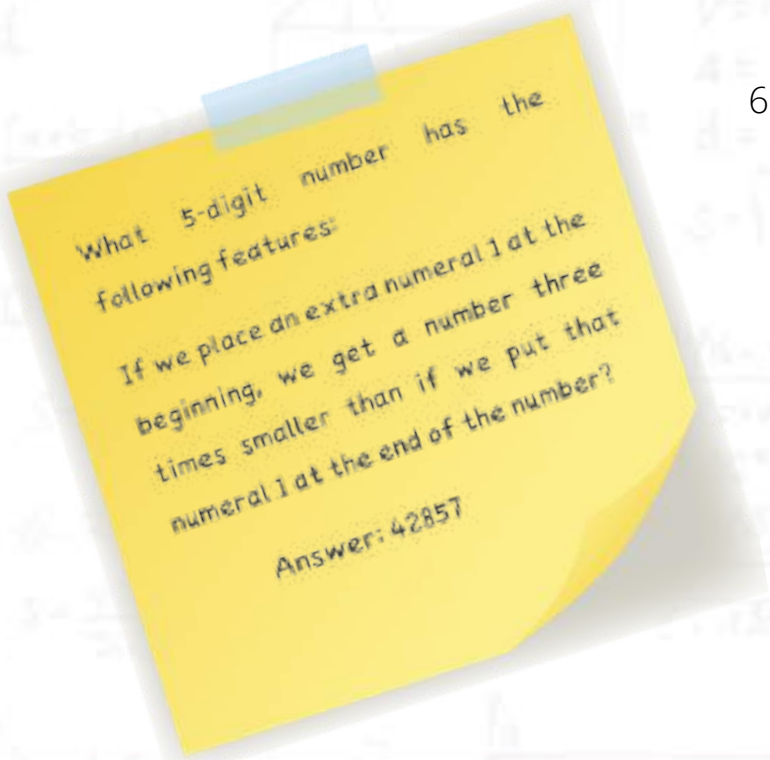
1. Mathematician who invented descriptive geometry
2. Name of the infinity symbol
3. All the internal angles in miraculous pentagram are
7. Number of parallel sides in the asymptotic triangle

Across

4. The Earth's radius gets larger by 1 meter, as a result its equator increases by_____
5. The geometrical structure depicted in the picture is called



6. During a full 24-hour day, the hands of a clock will overlap _time



When asked about his birthday, a man said, "The day before yesterday I was only 25 and next year I will turn 28." This is true only one day in a year, when was he born?

Answer: He was born on December 31st and spoke about it on January

Find a number with its letters in alphabetical order.

Answer: Forty

SOLUTION

The winning article by Rashika Pandit (B.Sc (H) Mathematics, 3rd year, Gargi College) from the Article Writing Competition hosted by the department

RELEVANCE OF STUDY OF MATHEMATICS IN OTHER SUBJECTS

यथाशखामयरूाणां, नागानांमणयोयथा।
तववेदागशााणांगणतमधूनिथतम।।

Like the crest of the peacock,
Like the gem on the head of a snake,
So is mathematics at the head of all knowledge.

Mathematics is one of the most famous subjects. It is the story of logic and reasoning which has been passed on from generations to generations, since time immemorial. The range of applications that mathematics has is: incredible. It's comparable to the range between the size of a virus and the planet, Jupiter! We use mathematics in every aspect of life: from waking up in the morning and watching the time to calculate whether we'll get late for our work - to - dividing the bill amongst our friends - to - using Google to search something or the other. Mathematics is omnipresent. Even while studying subjects other than mathematics, knowingly or unknowingly we use mathematics.

Let's try to explore some of the uses of mathematical concepts in different areas of human knowledge and appreciate the intricate intertwining of mathematics with other subjects.

Starting with Physics: If two subjects are really inseparable then it's definitely Physics and Mathematics. From the calculating speed, velocity and acceleration using simple formulae or deriving them using calculus, finding the focal length of a lens or building a telescope using the lens, finding the frequency of an oscillating pendulum or predicting the existence of a heavenly body like Neptune just by calculation! These and a lot other concepts of physics have a mathematical base.

Fine arts helps us visualize the wonders that mathematics has in it. Optimization: the concept of optimum usage comes into play for making paintings by using medium based paints like oil or water. Perfect amounts of medium and color bring out the best in the paintings and help them survive long with the artwork being still vibrant. Also, concepts of ratio, proportion, symmetry, geometry, tessellation, fractals etc. have beautifully helped the artistic world blossom to its fullest. Together art and mathematics have created the aesthetic world that we proudly live in!

In Chemistry: As per law of conservation of mass, in a chemical reaction, the mass of reactants should be equal to the mass of products. So every chemical equation must be balanced... and arithmetic (a part of mathematics) ensures this. Forming the basics, the periodic table, having more than 100 elements, that differ from each other due to number of nucleons in present them to some advanced areas like understanding behavior of solids, liquids and gases using graphs and preparing semiconductors using the idea of ratios and proportions for desired optimal result, mathematics takes care of everything.

Commerce and mathematics go hand in hand. Trade, check on GDP, formulation of economic policies, accounting, etc. without mathematics will be reduced to just theory with no practical use. Even common activities like buying and selling items will become difficult!

Mathematics in Agriculture plays a very crucial role. The idea of optimization is fully exploited in this area. Starting from deciding the best season for growing the crops and the optimal area for doing the farming, and to ploughing, sowing seeds, irrigating and harvesting them; each and every step is completely based on the concept of optimization. How many seeds should be sown in a particular area and would be irrigated at what frequency to result in bountiful harvests thus maximizing the profits!

This modern era that we live in, is due to the use of mathematics in computer science (CS). Binary math, logic, counting, probability, recurrences, graph theory and discrete math form the foundation of this subject. Computers, mobiles, security systems, robots, etc. are some invaluable products of this union of math and CS. Had it not been the use of math in CS, learning across the world, in the pandemic of 2020 would have come to a halt. Thankfully, it has not.

Mathematics in sports is omnipresent. From the technique of playing a sport like calculating the perfect angle to hit the ball to marking the perfect running track to predicting the result of a cricket match by DLS if raining interrupts it and till the final result is announced in all the other sports, math is used everywhere vividly. Chess is the most beautiful example of a mathematical sport!

At first, it's difficult to imagine the purpose of a subject like mathematics in language. But, when observed, words are the base of language, and syllables are the building blocks of words. And it is the perfect pattern of syllables that give poems and other literary pieces their beautiful and melodious flow, which is covered under the area of arithmetic.

Last but not the least, let us see what role mathematics plays in the subject of History. It can be clearly observed that history without dates and timelines is illusion and timelines without mathematics is confusion. Ancient, medieval and modern ages are there because math helped us to differentiate them on the basis of calculation of dates!

Thus, it can be said that those who have completely understood the various concepts of mathematics can excel at any subject because every subject contains some or the other applications of mathematics in it. If all the other subjects are bricks, then mathematics is the sand that gives them their base and helps us construct our serene world.

Mathematics is the language in which God has written the Universe.

- Galileo Galilei

GEOMETRY In NATURE

Are you one of those who are fascinated by the beauty of spirals in a pine cone or the petals of a flower? Are you too amazed by the symmetry you find in things like starfish or butterfly or snowflakes? Despite the common stereotype of Mathematics being a dull and cold subject, it also has many fascinating applications in the nature. Even with something as basic as human face, which is the most fundamental part of nature, one can find Mathematics in it. Be it the curve or the longest river of the world or the distance between those two stars one may stare every night, mathematics never fails to create miracles when it comes to nature.

We can understand the order of the universe by studying the patterns that emerge from it. Even something as seemingly random as the shape of a trees branch has an order. The main trunk of a tree will grow until it produces a branch which has two growth points and each stem branches into two. This pattern is repeated for every new stem. Many birds use celestial objects like the Sun or stars to navigate their flight path and this requires some trigonometric calculations. But it's not that they're calculating these things consciously. Animals simply do what comes naturally to them. Spider web also illustrates a beautiful geometric pattern. The spider creates this structure by performing simple and innate steps. Honeycombs show a specific regular pattern of repeating hexagons. This design is highly efficient that it uses least amount of wax to store the honey.

In fact, every natural occurrence carefully inspected reflects the beauty of geometry at its best. For example, soil erosion can cause flat rock surfaces to form that are almost perfect rectangles. This natural phenomenon is termed as ' tessellated pavement'. So it is very important to realize that geometry is one of the most interesting yet most common subject that we come across. So next time, you study co-ordinate geometry or congruence, take a glance outside your window and you might find a perfect example to understand your topic.

-Editorial Board

GEOMETRY IN MONUMENTS

Who didn't fall in love with the beauty of Taj Mahal or wasn't fascinated by the Eden project in the United Kingdom or didn't have a jaw dropping moment on seeing the pyramids of Giza. These are just three of the many excellent examples of splendid architecture around the world, from structures as old as the Parthenon in Greece to as new as the London city hall the world today is filled with architectural wonders. But, ever wondered what exactly was the secret behind building such enormously huge and beautiful structures? Is the choice of building material or their color? No, it's geometry. Geometry is a portal that allows objects to pass into the physical world from the world of drawing, making it the very base of all the architecture in the world.

Taj Mahal is not only an architectural masterpiece but also a symbol of love and one of the finest art to treat your eyes. Its structure is based on the principles of repetition and reflection. The central tomb is a cube whose corners are chopped to give it an octagonal interface. The hemispherical dome is not only the beauty factor but it helps in keeping the temperature inside the building low. The four framing minarets are made cylindrical for a strong support. These minarets are also titled outside at a certain angle so that they appear straight to the human eye while standing in frame with the central structure. Due to this these minarets don't harm the tomb in case of earthquake. Apart from all these, the monument is a great work of symmetry not only on the exterior but in the interior portion as well. Take its structure or the designing, all of it is an exact image of itself. Taj Mahal itself has a mirror image in water instead of a line image.

Another great work of symmetry and proportions depicting the brilliance of Greeks geometric principles is Parthenon. This temple of goddess Athena is a great piece of golden ratio. Another artwork of the divine proportion is the Pyramids of Giza. These three pyramids stand on a square base with equilateral triangles on lateral sides. If we cut the pyramids, obtaining the Egyptian triangle we will find the ratio of the slant height to the half of the base will result in the golden ratio. It is also said that the perimeter of the base(square) of the Great Pyramid is equal to the circumference of a circle whose radius equals to the height of the pyramid.

The spherical geodesic networks of Eden domes are just out of a fantasy world too. This structural network consists of concentric spherical networks with a radius difference forming an external and internal networks interconnected by diagonals. Talking about fantasies what can be more alluring than a room with no front or back. The City Hall of London is designed as a modified sphere which reduces the surface area of the roof causing a reduction in the exposure to the sunlight. And in winters due to less surface area, less heat escapes as compared to a cubical room of same volume. The floor plates are placed in a decreasing order with the decrease in the height forming a natural shade of the floor under it.

Early men used to live in caves, who would have thought that a shelter could be this fantasizing. Geometry is a tool to create anything and say everything. From pens to swords, rooms to manors, electric bulbs to atomic bombs all these require the study of shapes and placement and that is the importance of geometry for us to live. In fact, life is like a polygon which has infinite corners, and at every corner we grow, we learn, we live.

-Editorial Board

DO YOU KNOW ?

The Great pyramid

A lesser known fact is that the Euler number is hidden in its dimensions. It approximates the squaring of the circle. Its exact dimensions follow a formula in relations to the cubes of specific integers.

Conversation with an Alumni

-Ms. Garima Kumar

What role does Gargi play in your life, how has it shaped your personality and your professional path?

Gargi: when I hear this word, all I can think of are the millions of memories that I made in this place. It definitely holds a very important role in my life, it has shaped my personality to a great extent. Gargi has made me confident and smart that I can take any decision on my own without giving any thoughts. Not to say how supportive my friends, the environment and nonetheless the teachers of Gargi are, they've always helped me, guided me in everything, at every step. So in conclusion I'd say, Gargi would be the most important and the best decision that I've made.

What are the hurdles that you had to face while prepping for your entrances and how did you overcome them?

Start with anything, you would have your up's and down's.

While I was preparing for my entrances it was very difficult for me to manage college, entrances and travelling all together but whenever I used to have any issue, I used to go to my teachers and my friends, ask for help and like always they used to help me, guide me, provide me references. But overtime, you learn to manage things, get accustomed to it and you learn prioritizing things which I believe is one of the most important thing.

What made you chose BM as your career? Did you consider having some prior work experience?

I was more inclined towards corporate world and learn about all the domains of it and having Maths Hons. in addition as my bachelor's course made it difficult for me to get into corporate sector and pursue what I wanted so this gave me the reason to choose MBA and sit for entrances. As far as work experience is considered, had I not cleared my entrances or got into a good B-school, I would've tried for work experience wherein I could explore and learn the domains of corporate sector.

How has your experience in XLRI/BM been so far?

From bachelors to masters to job, there is a huge shift in life whatsoever you do.

Initially it was very difficult for me to manage my MBA and my final year examinations that were happening simultaneously where MBA was no less at all! So many deadlines, no extensions, summer internship, that I became sceptical of my course that I had taken up. But eventually you get accustomed to 3-4 hours of sleep, to uncertainty, and different things. Overtime you learn the things hard way.

Now that you're in XLRI, a college of repute/one of the top notch institutes, how important do you think it is to get good grades and admissions to top institutes in order to have a successful career? Are there any factors that one should keep in mind?

It is different for everyone, some have an inclination towards academics; some have towards co-curricular. The major factor is whatever you do just give in your 100%. If you're good in academics make sure that you do all the necessary groundwork that is needed and if you're in co-curricular make sure you give your best shot. If I consider myself, I've always been good in studies so I made sure to give in my best so that I could be at a position of benefit in front of others; on the other hand I also see my batch mates having not so great scores but having good co-curricular and all sitting side by side. At the end there would be no one to see your academics or your co-curricular, they would rather see what you've achieved till now, how your personality is, how you take up challenges and how wisely you manage them.

What opportunities do you see after pursuing BM in addition to your Bachelor's in Mathematics

After coming into MBA, I've learned a lot of things. I've got knowledge of plenty of domains, be it marketing, finance, operations or any other thing. I've believe I've got millions of opportunities and it depends on me what I wish to do. Even if 4-5 years down the lane I wish not to continue my job any further, I can also think of some start-up of my own, which might unfold in the upcoming years.

What are the goals and accomplishments that you are looking forward to achieve?

Presently if I talk of my short term goals, I would say I'd like to get into some good firm where I can learn different things, different areas of industry, how they function and how to make an impact in whatever domain you are in.

In my long term goal, I see myself at some top position of some top tier company wherein I can take my decisions on my own, contribute in a major way to it and align my values with it.

What other fields or activities interest you?Did you ever consider pursuing them professionally?

I've always had an inclination towards art and craft. I try devoting my extra time in art and craft or in reading books at times. But these have been my hobbies, art and craft being something where I can vent whenever I wish to, so, No, I haven't considered them taking up professionally, although one never knows about future, let's see!

What would be the one piece of advice that you would like to give to your juniors?

One thing that I'd like to say is that there would be number of challenges ahead of you, take them up. There would be times when there would be no road in front of you, try exploring new things, new paths. I know it's been a difficult time for everyone because of the pandemic but make millions of memories, do whatever you wish to, ask for help from your teachers, friends, seniors just anyone; explore your unexplored self because this is the time. But whatever you do, hang on to it and give your 100%

-Interviewed by : Vishtha Arora

Alumni

Garima Kumar - 2020, PGDM, XLRI, Jamshedpur

Himani- 2019, PO, Punjab National Bank

Vaishali Negi- 2019, M.Sc., IIT Indore

Jyoti Deshwal- 2019, M.Sc., IIT Jodhpur

Sadhavi Mehra- 2019, M.Sc., DTU

Priti-2020, Masters of Operational Reasearch, Hindu College, Delhi University

Madhurika- 2019, Actuarial Analyst at Mercer

Namrata Mongia- 2019, M.Sc., Miranda House, DU

Aanchal Agarwal- 2020, M.Sc., IIT Bhubaneshwar

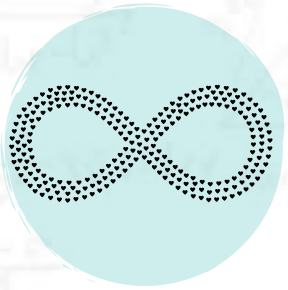
The Galleria Of Events

Despite all obstacles during the previous year, the Mathematics Department of Gargi College led by the Union 'Mathema' successfully hosted the following activities and events during the academic year 2020-21 in the digital mode.

WEBINAR ON INFINITY

25th September, 2020

The department of Mathematics of Gargi College hosted a webinar on the topic 'Infinity: a treasury of intrigue and interest' on September 25, 2020 over the Google Meet platform. The speaker of the day was Dr. Rita Malhotra, former Principal and Professor of Mathematics at Kamala Nehru College. She is also the President of Poetry Across Cultures, India. Patronized by our Principal, Dr. Promila Kumar, the webinar was attended by teachers and students from several institutions.



DEPARTMENT ORIENTATION FOR THE FRESHERS

18th November, 2020

During this online learning period, the first year students had their orientation via the digital mode itself. The session happened in the honored presence of the Principal Dr. Promila Kumar, Union teacher advisors and the department teachers. In the meeting students of first year were introduced to their course structure, class timings as well as department and college activities.

CAREER COUNSELING

15th February 2021

To make students Mathematics aware of the vast sea of opportunities after their undergraduate degree, career counseling was hosted by the department on February 15, 2021. The session was conducted for pre-final and final year students. The speakers of the day were Dr. Ravins, Assistant Professor at Jamia Milia Islamia and Mr. Ramakant Prasad, Associate Professor at Gargi College.

CHESS TOURNAMENT

10th February 2021

Mathema conducted an online chess competition to provide all chess enthusiasts a platform to brainstorm and showcase their skills in this game. The event took place on February 18, 2021 over a digital platform called lichess.org. Participants from various colleges took part in the nail-biting game of chess. While the participants showed zeal and enthusiasm competing with each other, the entire competition was monitored by strict rules. Vibhu Raj from Dr. Akhilesh Das Gupta Institute of Technology and Management emerged as the winner of the tournament.

ONLINE INTERACTIVE SESSION

with the First Year Students

24th February 2021

An informal virtual interaction session for first year students of the department was organized on February 24, 2021 by the third year students. During the session, the freshers talked about their experiences of online classes, college societies and various other experiences with their seniors. On the other hand, the third year students shared their experiences as well as cleared several doubts the freshers had in their minds.

ARTICLE WRITING COMPETITION

March

One of the most exciting events hosted by the department is the Article Writing Competition. This year, the topic for the competition was 'Relevance of Mathematics in other subjects'. Students from all departments and colleges participated. The winners were announced on March 4th via Mathema's Instagram account. First place was bagged by Rashika Pandit. While the second place was won by Shreya Agarwal and the third place was by Sarthak Pandey. Winners were awarded with certificates and cash prizes.

MACHINE LEARNING WORKSHOP

9th and 10th April 2021

A two day workshop for Machine Learning was hosted by the department on the dates, April 9 and 10. The speaker for the first day was Mr. Sanket Verma, chairperson at PYDATA. The attendees were elaborately explained Python and programming on the first day through detailed presentations. The speaker for the second day was
Mr. Utkarsh Shukla, who further conducted a very informative presentation on data analysis. He is a Date Science Engineer at ATLAN. Participants of the workshop were awarded certificates after the workshop.

PAPER PRESENTATION

5th April 2021

One of the most exciting events conducted by the Maths department of Gargi College is the paper presentation competition. This year it was conducted via online mode on April 5. The topic for this year's presentation was 'Mathematics: A poetry of logical ideas'. Three esteemed mathematicians judged the competition,

Dr. Jyoti Darbari, Assistant Professor at Lady Shri Ram College for Women; Mr. Narendra Kumar, Professor of Mathematics at Gargi College and Dr. Vandna Luthra nee Arora, Associate Professor in Physics at Gargi College. The winners were awarded with digital certificate as well as cash prizes.

Token of thanks

Muskan Yadav
Prashansa Mewar
Nishtha Arora
Malavika MS
Meenakshi
Tareeshi Mittal
Niharika Sethi
Anushka Raghav
Nikita Singla
Raima

MATHOLOGIC

2021-2022

DEPARTMENT OF MATHEMATICS

GARGI COLLEGE

UNIVERSITY OF DELHI

Mathematics is an ancient world
created out of pure intelligence

To Our Readers :

This fourth edition of Mathologic opens portals that take you back in time to the beginning of mathematics. We begin from the time of early civilizations, an era when there was no Archimedes, no theorems, no proofs, traveling through the contributions of various early civilizations and persons to this subject and we finally come back to the present, giving our readers a journey through times and phases which they never knew existed.

We are so pre-consumed by the prevailing state of mathematics and with all attempts to make its future better, very often, the rich history of a subject which is believed to be the Universe's language seems to drift away from mankind, trapped in books and scriptures. Archimedes said " Man has always learned from the past. After all, you can't learn history in reverse" ,inspired by these words Mathologic attempts to be your time machine to the past, giving you an insight of how the numbers, calculations, and theorems had come into existence and evolved over the years to make the subject look as we know it today.

The editorial board extends its gratitude to all the students of the mathematics department, the creative team, union members of Mathema, and our teacher advisors for their support, enthusiasm, and encouragement throughout the process of compiling
the annual magazine

Hence for all the math enthusiasts and for anyone who never miss a chance to run away from the subject, we have compiled something special with a lot of thought, love, and hard work in the belief that it will add precious treasures to your chest of knowledge and memories.

Love
Editorial board

Principal's desk:

I congratulate the team of students and teachers of the Department of Mathematics whose unremitting efforts has made this edition of Mathema available to us. Any such periodical gives an insight into the range and scope of the imagination and creativity of our students and faculty members collectively. As a Principal of Gargi College it gives me immense pleasure to experience the warmth of this literary tradition in resonance with the glorious past of the institution.

The past almost one year has proved that Life is not always a bed of roses but with determination, dedication and diligence you have made the unimaginable happen. We lived in a virtual world yet so meaningfully connected and you have performed every single duty whether academic or cultural so efficiently. These unprecedented circumstances have made it so evident that you are capable of handling the hurdles of life with your wisdom, skill and sophistication.

There is no doubt that this attitude will take you on a newer height in life. Grab every single opportunity that comes in your way and make your dreams come true but never forget that wisdom with which you use your knowledge, is the most precious gift. Make sure that a passion to grow in wisdom should never die because it will always guide you and show you the right path.

I congratulate the entire editorial team & contributors for the upcoming issue of Mathema and enthusiastically look forward to reading our students' perspective on various issues undertaken.

Prof. Promila Kumar

Interview With Mathematician

' Mathematics as an expression of the human mind reflects the active will, the contemplative reason, and the desire for aesthetic perfection. '

Interview with : Dr. Pooja Yadav
Assistant Professor in Kamala Nehru College, University of Delhi

What fascinates/motivates you the most about this subject?

Mathematics is a very logical and applied subject that can be found everywhere and that's why we used to consider this as a social science subject. It is very easy to visualize things and challenge yourself to do something out of the box.

Was there a moment in your career where you doubted the field you have chosen and what gave you the strength to overcome that and be the brilliant Mathematician you are today?

No, I was very clear from my school days that I will continue my studies in math only and will make a career with this only.

Which are the mathematician and theory/discovery which fascinates you the most?

The great mathematician Ramanujan and the lady calculator Sri Shakuntala Devi fascinates me the most .

What do you have to say about current situation of research in India?

A lot of research is going on in our country but since due to lack of employment and opportunities , students are moving outside for higher studies and they are doing very well.

Why do think students these days are more oriented towards applied field of mathematics than pure mathematics?

ince a majority of students are oriented towards the applied field, so what is your viewpoint on having more portion of applied in bachelor's course and pure in post-graduation?

SAs per the current scenario , students are inclined towards applied mathematics. They have vast opportunities there, But being a teacher , I would like to say that pure math is the backbone of mathematics . Students should be logically clear towards the concepts and only then they can do better in the applied part. Nowadays every semester includes applied papers such as SEC, DSE etc.

Please enlighten us with some of your research experience. How would you like to encourage the students who have entered into the field of research recently?

I did my Phd before joining the college. Then due to some family constraints , I left my personal research but being a teacher we are always involved with students . I used to give them projects so that they can have a better understanding of the concepts. Research needs free time. Students should go for higher studies in mathematics. They have the time to do so much better in research.

Mathematics is irreplaceable", what is your stand on this statement?

Yes, definitely. "Mathematics is irreplaceable ". We can't proceed further in any field from one's day to day life to interdisciplinarity research without this. In some or other way math is required everywhere. Infact, as an illiterate person you should know the basic math for daily requirements.

Has mathematics as a subject reached its peak or does the future hold as many possibilities for math enthusiasts as it holds for other fields?

Mathematics behave like an unbounded increasing function . Once we reach at some point , then we can see further aspects of the subjects as an application. We have done lots of pure math as one curriculum and must have noticed still there are problems which are unanswered. There are still or always will be lots of possibilities for math as it is applicable everywhere.

Any message for the young minds who have just started or are yet to start their journey in the world of Mathematics?

I would like to say to my young students that math is a very logical subject. You will never get bored if you have interest in this. YOu will always get new ideas that we can apply here and there. There are a lot of career opportunities as well in this field. You will never be hopeless while doing this subject.

All the best to you all.

Student Union Convenor

Student Union Co-Convenor

Student Union Advisor

We are extremely happy to bring out the fourth issue of our magazine" Mathologic ". The magazine is published annually with collective efforts of our students and teachers. For, a magazine carries the contributions reflecting ethos and aspirations of the students, and other team members of the department.

The magazine aims at bringing out the mathematics in ancient times. Through this magazine students have tried to tell, the history of mathematics has become an important study from ancient to modern times it has been fundamental to advances in sciences, engineering and philosophy.

The articles published in this magazine, which amply demonstrate the communication skills, imagination and creativity, humour and humanism, technical competence, and patriotism of the contributors.

We congratulate to the entire editorial team and thank the student union who have made untiring efforts to bring out this magazine. We wish them all success.

Ms Pooja Gupta(Convenor)

Mr Ramakant Prasad (Co-convenor)

Ms Anshika Agarwal (Advisor)

From Union President

I had begun my journey in the department union as an editorial board member in my first year. I have since then cherished every single endeavor that our union had taken up, even when we moved to an online mode of classes. Out of all the wonderful memories I have collected over these three years, two of my best ones would be the farewell that we hosted for our seniors last year as well the orientation welcoming event for our incoming first years this session.

Being instituted as the President of the academic session 2021-22 is definitely one of the proudest and happiest event of my college life. Though it came with a lot of responsibilities and challenges, I have been thoroughly enjoying my office. Also, I have got very supportive and wise office bearers in my team along with the best faculty advisors this session.

But of course, there were so many challenges in my way throughout the year. I always included my teams' opinions in decision making that affected the entire department and while hosting different competitions. When there were differences in opinion, I always tried to stay calm and think practically while taking any decision and executing it. To be able to convince and coordinate to make impartial and wise decisions without disappointing my team and the department was indeed the most difficult part of my journey as the President. Nevertheless, I have enjoyed every bit of this beautiful journey. Even though a major part of the year happened virtually, I got to learn a lot of valuable lessons from the successes and mistakes.

I have always believed that an individuals' growth also depends on co-curricular activities that help the person to horn their different life skills. This belief is what inspired me to follow the path that I took in my first year that marked the beginning of the journey to the department union President in my final year of college. Further, it is the same belief that I would like to pass on to my dear juniors.

Since my institution in the beginning of the year I have tried to be that leader who everyone can lean on for support and trust to help them. This is the impression that I hope to leave as the President of the department union of 2021-22.

Regards

President 2021-22

From Editor's Desk :

'Dark times are an opportunity to add glitters to life.'

~ Anushka Raghav

Editorial Head

We are thrilled to introduce new edition of Mathologic'22 : The annual magazine of the Departments of Mathematics , Gargi College. Along with bringing the origins of mathematics back to life , this magazine also provides a sneak peek into everything that the mathematics department did this year, together as a family. From impactful webinars , and hosting some special events, Mathema family has worked really hard to give opportunities to shine and reasons to smile to the students amid the academic pressure and covid restrictions and we only aspire to get better in our ways and ideas with each passing year.

This magazine marks the end of our year's journey, and beginning of another whose pages awaits to be filled with beautiful and enlightening lessons. We hope that every reader finds the same joy in these pages as we did while creating them.

'Life Is Made Up Of A Great Number Of Small Incidents And
A Small Number Of Great Ones.'

~ Prerna Panghal

Editorial Head

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Rise Of Mathematics In India

7000 BCE TO 3200 BCE

Rawest form of mathematics can be observed in the rough geometrical layout of scattered ruins of Mehrgarh culture that preceded Indus Valley Civilization.

[Bronze Age]

3000 BCE TO 1500 BCE

Excavations at Harappan Civilization points out the usage of standard weights and lengths which were based on binary and decimal ratios. The bricks used in construction of buildings were of the ratio 4:2:1. Highly precise workmanship in construction, with equally spaced lines suffered from only error up to 3 decimals in mm units.

[Iron Age]

1500 BCE TO 200 BCE

The Vedic Period lasting to 600 BCE saw birth of Brahmi numerals and the numbers were expressed as combinations of powers of tens.

One of the oldest written records of mathematics were The Sulba-Sutras. They contained many theorems ranging from geometry required to construct fire altars to the foetus form of Pythagoras theorem.

Pingala, a music theorist came upon what he called Meru-Prastara in his Chanda Sutra which was the premature form of Pascal Triangle of Binomial Theorem.

Jain scriptures give a detailed account on factorial and geometry basics. They were believed to be the bearers of the first documentation of permutation and combinations which were then referred to as “vikalpa”.

Chanakya tells about the administrative statistics used to record birth and death during the rule of Chandragupta Maurya.

Classical Period

300 CE TO 800 CE

Approximation of π to four decimal places, discovery of Pulveriser Method for solving linear equations and many were important contributions of Aryabhatta, the Father Indian Mathematics.

Hayashi, in his work, spoke of the emergence of Pati-Ganita (i.e. Maths of Algorithms) and Beej-Ganita (i.e. Maths of Seed) which were elements of arithmetic and algebra respectively.

Brahmagupta, a famous mathematician of the 8th century, gave formulae for the solution of quadratic equation, the area of the quadrilateral and Pell's equation.

Medieval India

900 CE TO 1300 CE

Mahavira asserted that the square root of a negative number did not exist.

Shripati in his work talked about calculating planetary longitudes, eclipses and planetary transits.

This period saw growth in the field of algebra, calculus, trigonometry and their usage in astronomy increased.

Medieval India

1400 CE TO 1800 CE

The Kerala School of mathematics and astronomy developed Taylor series expansions for the important trigonometric functions, differentiation, term by term integration, convergence tests and the theory that the area under a curve is its integral.

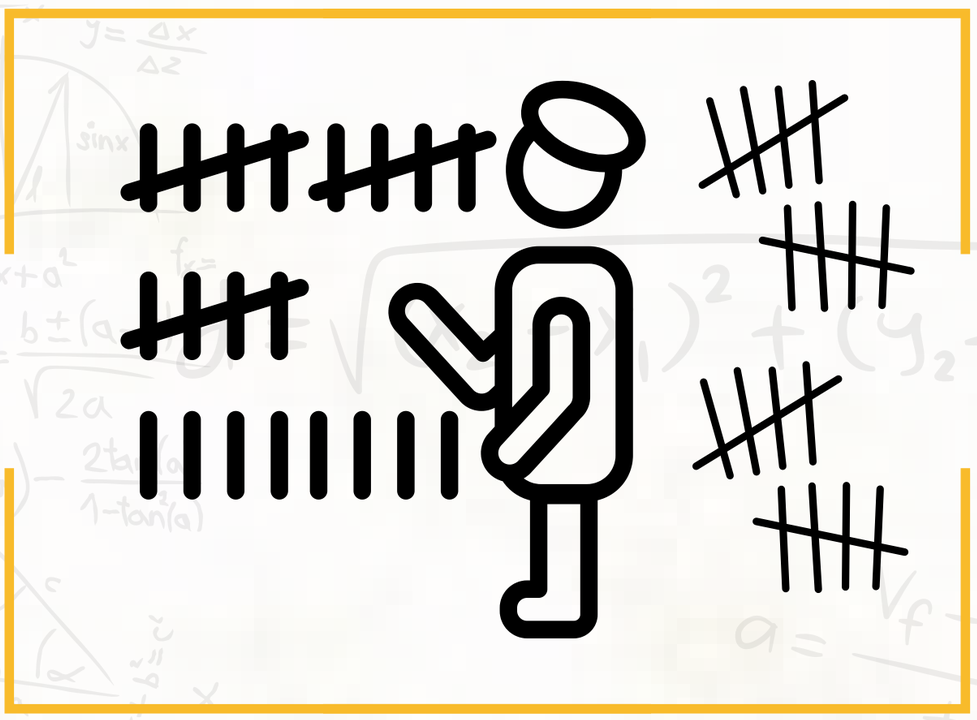
Citrabhanu was a 16th-century mathematician from Kerala who gave integer solutions to 21 types of systems of two simultaneous algebraic equations in two variables.

~ Kinjal
B.Sc. (H)Mathematics, 1st Year

Mathematics : An Unsolved Enigma

Can you estimate when was mathematics invented? Well, if that's the question then, we can indeed debate over this for very long, as it was not something that was in whole devised by us, as the innovation means something which is newly developed and which remains the same irrespective of the zone, cannot be molded. Mathematics was just there like all other things in the surroundings, say planets in the solar system and we are just exploring it. What we humans have done is that we have developed a language for mathematics, to scrutinize it, as we do for other things. And the one thing which failed is that we weren't able to provide a common language across the world to research it. We are required to decrypt it to the other terminology so that the people across the world can refer to it in the language they comprehend. For instance, the representation of numbers varies as soon as the region gets switched, say in roman we compose and express them differently, while in Hindi, we use different ways for its composing and expression.

Moreover, we weren't able to have a universal name for mathematics, say in ancient Greek, it is famous by the name of mathema, and in Latin by mathēmatica.



Why do we count till ten digit only?

Well, the point on numbers brings me to the fact that why did we have a 10 digit number system, we could have a 9 or 8 digit number system too. The answer comes from the attribute that we have only 10 fingers. Numbers are from one of the things that were developed back in ancient times. And unlike now we didn't have the advanced technology to count on, so we were strained to use very basic and oblivious things to count something or perform a task, thereupon that could be the most possible explanation for the same.

Also, it is known that The Sumerians were the first civilization to develop a counting system which is being practiced for over 4,000 years. Moreover, it is well-known by the fact that the decimal place-value system was first seen in India, which was then transmitted to the Islamic world, and eventually to Europe which is still in practice today. Indian mathematicians have been contributing to the discoveries of mathematics fields for a significantly long while.

The ancient Sumerians of Mesopotamia developed a complex system of metrology from 3000 BC. From 2600 BC onwards, the Sumerians wrote multiplication tables on clay tablets and dealt with geometrical exercises and division problems. The earliest traces of the Babylonian numerals also date back to this period.

Clay tablet, mathematical, geometric-algebraic, similar to the Pythagorean theorem. From Tell al-Dhabba'i, Iraq. 2003-1595 BCE. Iraq Museum

Clay tablet, mathematical, geometric-algebraic, similar to the Euclidean geometry. From Tell Harmal, Iraq. 2003-1595 BCE. Iraq Museum

During the era of 400CE to 1200CE influential contributions were made by the scholars like Aryabhata, Brahmagupta, Bhaskara ll, and Varahamihira.

Indian mathematicians were the foremost across the world to give in the notion of zero, infinity, negative numbers, arithmetic, algebra, and calculus, which were then transmitted to the Middle East, China, Europe. The further developments in these domains are nowadays the foundations of numerous areas of mathematics.

The beauty of mathematics is not cracked yet, because we are still exploring it. And we shall say the same thing in the near future also, as it is infinite like a real line which can only be extended to uncertainty but endpoints cannot be obtained.

~ Snehal
B.Sc. (H)Mathematics, IIIrd Year

Did you know?

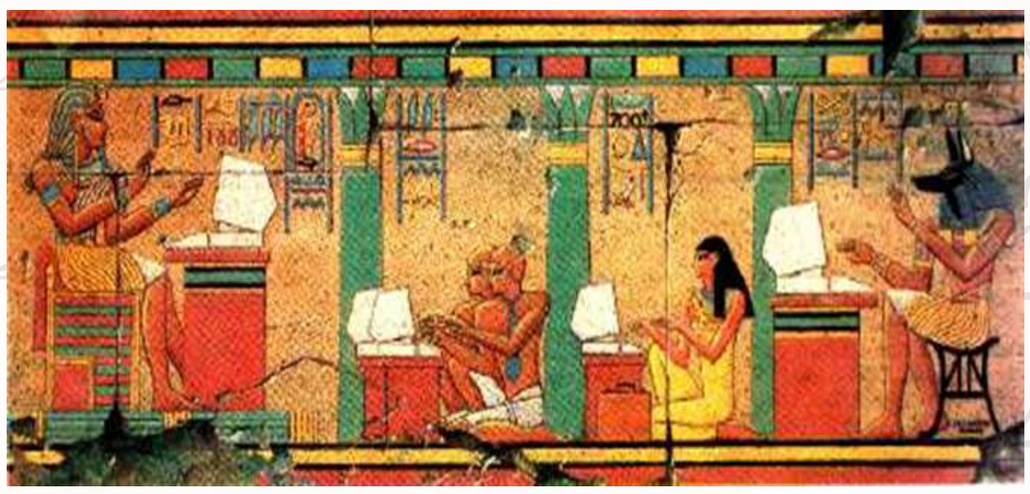
"FORTY" is the only number that is spelt with letters arranged in alphabetical order.

In The Folds Of 'GIZA'

Pharaohs to the Mummies and Pyramids to the Tombs.

Egyptian Civilization has always been a mind-twisting topic for the readers from all ages. Undoubtedly, ancient Egypt has contributed to modern-day society with its many cultural developments as well as it's blistering architects. Leaving behind thousands of unsolved mysteries challenging us every second of the day.

With no specialized tools, no thundering loud machineries to use. How come a bunch of ancient men measured using feet and hands utterly understood the concepts of surface area and volume of third dimension all together.



Scribes Learning The Application Of Mathematics In Egyption Schools.

Egyptian papyrus not only talked about architectural engineering but highlighted the theories proposed by the earlier Egypt in the field of geometry and applied arithmetic.

Even the Greeks believed that mathematics originated in Egypt then transferred to the various parts of North Africa, Colonial states and Asia.

it may be of interest to note that they themselves believed that mathematics had been given to them by the god Thoth.

Literary text written to god Thoth for getting architectural advice. (Between 26th century BC to 22nd century BC)

Mainly, to send their Pharaoh to the 'Journey Of Moon' in the afterlife. Giza's scribes state the invention of twin pillars of egyptian mathematics, that is, hieroglyphics and written tablets. Done by none other than the god of the moon, Thoth. The story goes like whenever any scribe was caught up with a mathematical problem. He used to write a letter - considered as a fictional one - to either a fellow scribe or god of wisdom for solving the same. Though it is astonishing to record that the surviving sources from the ancient texts contain the replies with the solutions. One of the well known is , a literary text written by a scribe named Hori and addressed to another scribe named Amenemope.

Revolving around the point of view of Hori calling Amenemope's work second rated and ridiculed in a satirical manner.

Taken From Catalogue Of 4th Dynasty Pàgina, representing symbols of numeral system.

To the extent that egyptian mathematics left a legacy at all, it was through its impact on the emerging mathematical tradition all over the globe. Whether it's the Greek intellectuals learning from egyptians or the decimals system followed by Russians afterwards. However, the egyptians were very practical in their approach to mathematics by which they succeeded in placing the base of the Golden Proportion, sometimes called the Divine Proportion from the beginning of creation. The harmony of this ancient proportion, built into the very structure of creation, can be unlocked with the key of cosmos. **Broadly, opening to us it's marvelous mathematical beauty.**

~Prerna Panghal
B.Sc. (H)Mathematics, IInd Year

Multiplying Ones Always Gives You Palindromic Numbers.
Hence, if multiply 111,111,111 × 111,111,111 you get 12,345,678,987,654,321 - a palindrome number that reads the same forwards or backwards. And that works all the way back down to 11 x 11 (121) or just 1 x 1 (1).

Facts

Did You Know?

Most mathematical symbols weren't invented until the 16th century. Before that, equations were written in words.

Calendars & Clocks

Five thousand years ago, Sumerians in the Tigris-Euphrates valley in today's Iraq had a calendar that divided the year into 30 day months, divided the day into 12 periods (each corresponding to 2 of our hours), and divided these periods into 30 parts (each like 4 of our minutes)

The Egyptians devised a 365 day calendar that seems to have begun around 3100 BCE, which thus seems to be one of the earliest years recorded in history.

Back to the Past !

The Ancient Egyptian obelisks, constructed about 3,500 B.C., are also among the earliest shadow clocks. The oldest known sundial is from Egypt it dates back to around 1,500 B.C

An early prototype of the alarm clock was invented by the Greeks around 250BC. The Greeks built a water clock, called a clepsydra, where the rising waters would both keep time and eventually hit a bird that triggered an alarming whistle.

Hourglasses were the first dependable, reusable, reasonably accurate and easily constructed time-measurement devices.

The very first mechanical clock that was created by I Hsing in 723 AD was also an astronomical clock.

~ Diya Bedi
B.Sc. (H)Mathematics
IInd Year

Srinivasa Ramanujan

An Intuitive Mathematical Genius

Born on 22nd December 1887 in Madras and son of Shrimati Komalatammal and Shri K. Srinivasa Iyengar ,was an Indian mathematician who lived during the British Rule in India.
At his time of birth, the priest told his father that he would not live so long. But his father wasn't disappointed.

From the very beginning of learning Ramanujan had a curious approach towards the mathematical facts. The age when children used to play with toys, he loved to play with math. He had a lot of friends even above his age. Though he was the topper in school, he failed twice in college exams. His family wasn't rich and the reason for failing is that he only studied math & math for whole days. To support his family he tried to get a job as a clerk and he did by entering into Madras Port Trust. His research papers were sent to M.C.Hill, a well known mathematician of London. But got rejected. Then they were sent to another mathematician Hardy of Cambridge, England. Even though his papers were selected, at first Ramanujan faced neglect. After waiting for long he chose to go there himself. All his doubts about ROW to live there were cleared by a friend of Hardy, being a mathematician as well. He went there via ship. And focused on solving more and more complex mathematical problems with other mathematicians in Cambridge.

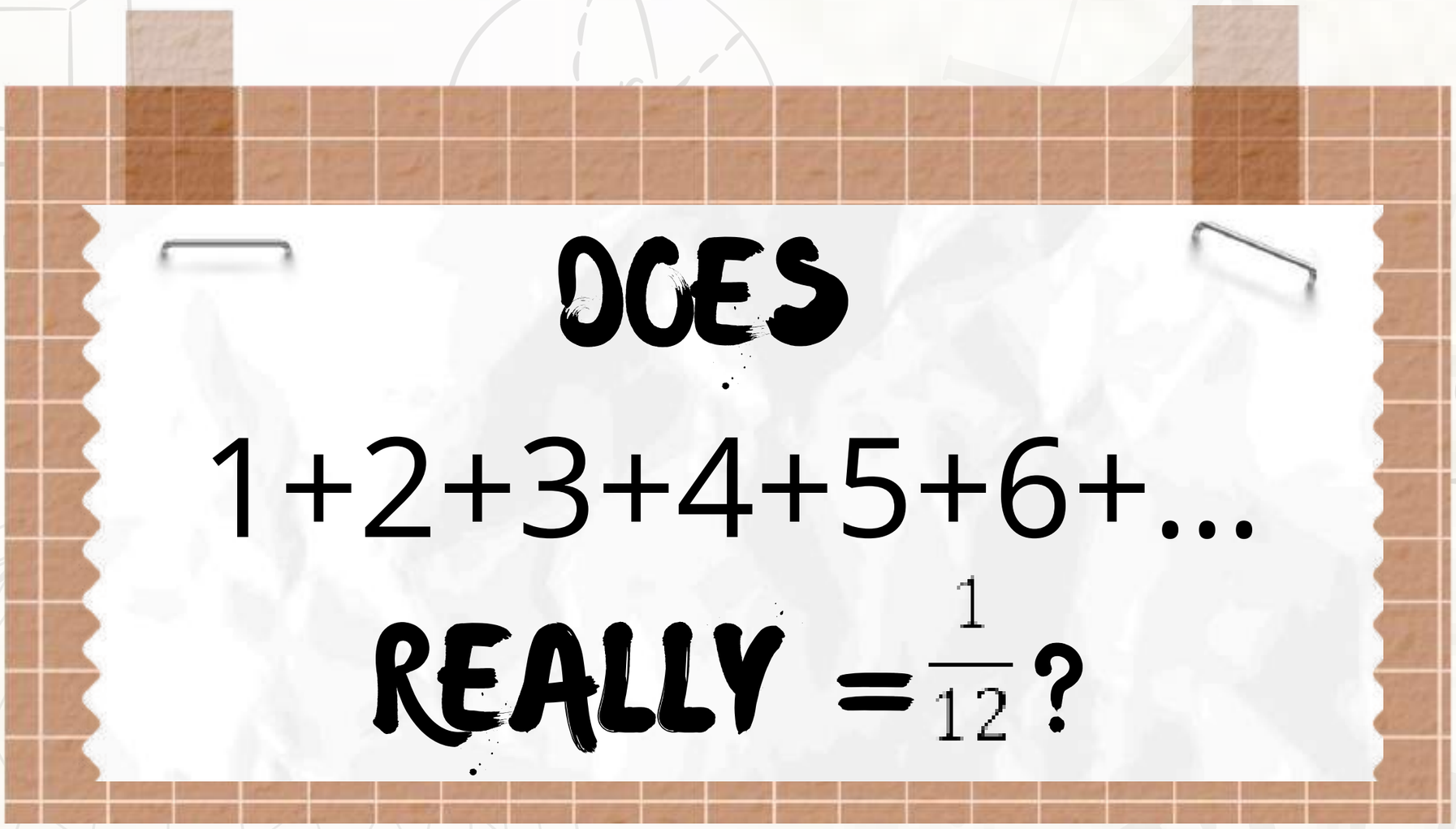
At the time, he gained his BA degree. It was a time of war and there were soldiers in and out of the country. Following his passion he completed a

PHD in the field of mathematics. He constantly wrote letters to his home town and maintained contact with his family. Suddenly he was diagnosed with Tuberculosis.
But he didn't stop and practiced his love for mathematics each day. At last he left this world in 1920 at the mere age of 32.

Some of his famed discoveries and predictions are :

- If you add all the natural numbers, that is 1, 2, 3, 4,.... and so on, all the way to infinity, you will find that it is equal to -1/12.
- He also predicted the existence of black holes.
- He discovered that 1729 is the sole number which can be expressed as the sum of the cubes of two different sets of numbers, therefore called it a magic number.

~ Ankita
B.Sc. (H)Mathematics, 1st Year



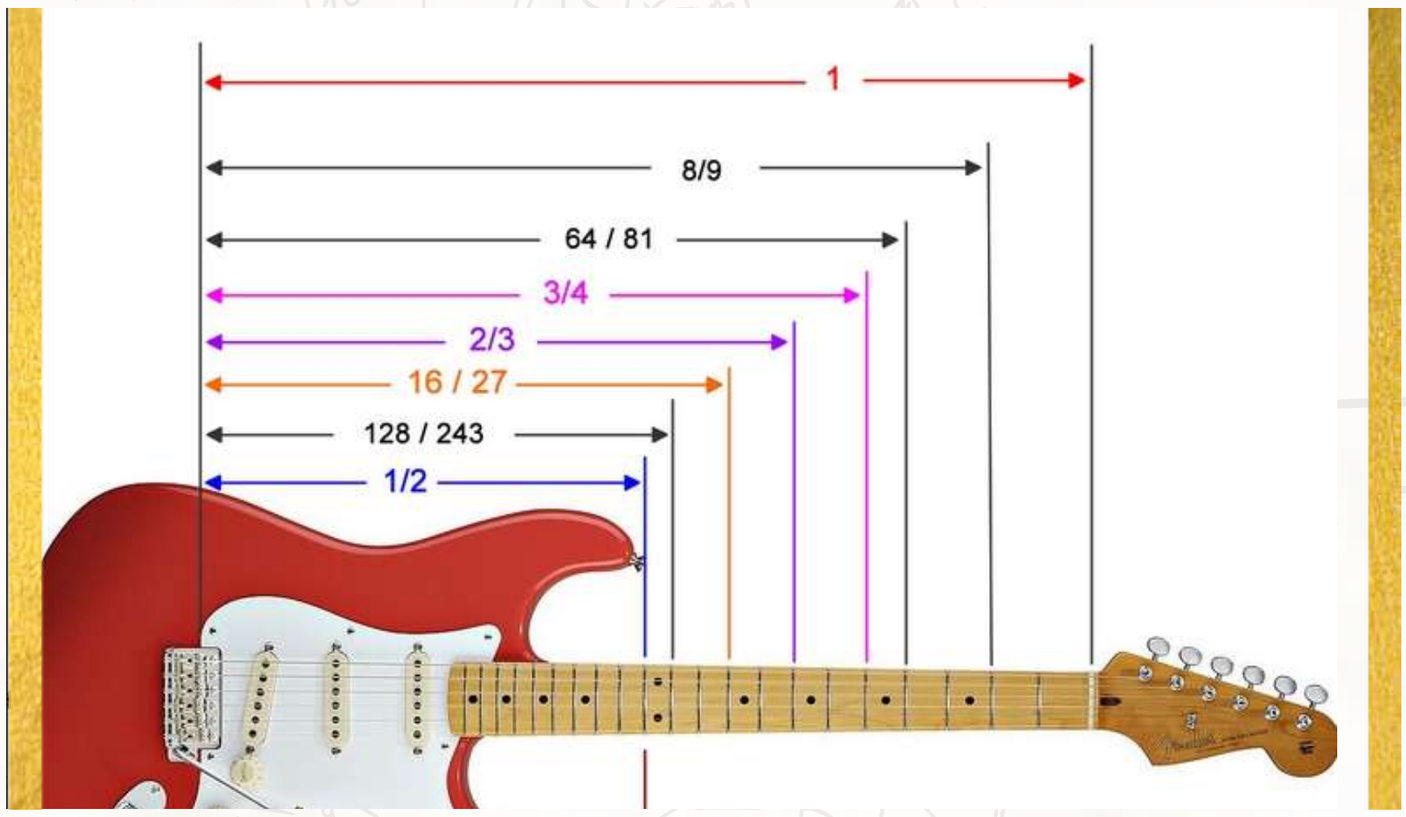
Sum of natural numbers upto infinity is negative
The infinite series and mind-blowing result.

MUSIC

A Genre Of Maths

Music and Maths are normally thought to be two different disciplines without actual overlap but they, are indeed related.

Pythagoras Ratios for Guitar Frets



Pressing down at the 12th fret makes the string half of its full length, which produces an "Octacve" or "High 8th" note.

Putting light to this concept is the Willow flute.

Norwegian folk flute

Mathematical harmonies with seljefløyte / willow flute.

Humans have long been related with producing sounds of different frequencies. The Norwegian Folk Flute is a primary example as it does not depend on finger holes to produce different pitches. Rather, it produces different pitches by varying the strength of the air blown into the flute. The answer to the different tones produced by the willow flute lies in the mathematics of sound waves .

The one dimensional wave equation

$a^2 (\partial^2u/\partial x^2) = \partial^2u/\partial t^2$

gives the behavior of the air molecules in the tube , where the symbols specify the following:

a- A positive constant

u - Pressure in the tube

x - Position along the length of the tube

t - Time

The pressure across the tube is almost constant so direction is neglected. And , the tube being open on both ends , pressure remains the same on both the ends .

So, if L is the length of the tube, $u(0, t) = 0$ and $u(L, t) = 0$.

Thus, solutions to the wave equation are sums of solutions of the form

$u(x, t) = \sin (n\pi x/L) [b \sin(an\pi t/L) + c \cos(an\pi t/L)]$

where n =1,2,3..... and b and c are constants .

The solution thus, predicts the frequencies of tones produced by the flute.

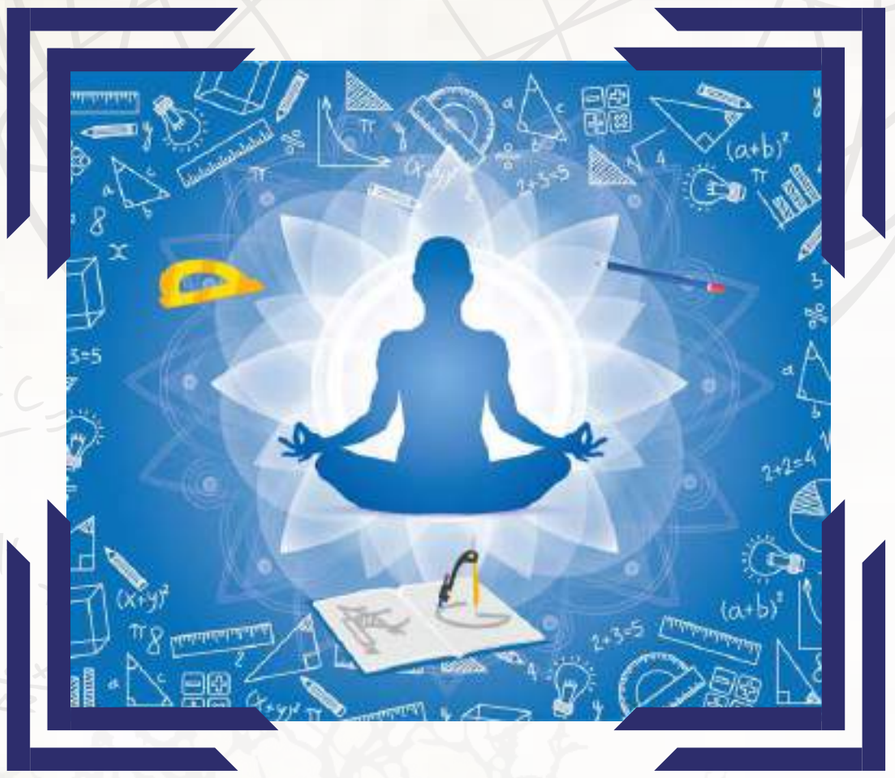
Did You Know

Mathematics is full of interesting numerals concepts. One such number is a hundred. The number 100 does not actually mean 100. It is derived from the Old Norse word "hundrath," which actually means 120.

~ Helen
B.Sc. (H)Mathematics
IInd Year

Vedic Maths :

Discovered by Indian mathematician Jagadguru Shri Bharathi Krishna Tirthaji,Vedic Mathematics is a collection of Techniques/Sutras to solve mathematical arithmetics in an easy and faster way and the origin to the concept of mental maths where the prime focus is to perform tedious calculations without pen and paper.
It consists of 16 Sutras called Formulae and 13 sub-sutras called Sub Formulae, which can be applied to the solving of problems in arithmetic, algebra, geometry, calculus, conics and all other spheres of the subject.



"Without mathematics, there's nothing you can do. Everything around you is mathematics . Everything around you is numbers."

Markings on animal bones indicate that humans have been doing maths since around 30,000BC.

It consists of 16 Sutras called Formulae and 13 sub-sutras called Sub Formulae, which can be applied to the solving of problems in arithmetic, algebra, geometry, calculus, conics and all other spheres of the subject.

SUTRAS

1. Ekadhiken Purvena
2. Nikhilam Navatacharamam Dasatah
3. Urdhva-tiryagbhyam
4. Paravartya Yojayet
5. Sunyma Samyasamuchaye
6. (Anurupye) Sunyamanyat
7. Sankalana-vyavakalamnabyam
8. Puranapuranabhyam
9. Chalana-Kalanabhyam
10. Yavadunam
11. Vyastisamastih
12. Sesanyankena Caramena
13. Sopantyadvayamantyam
14. Ekanyunena Purvena
15. Gunitasamuccayah
16. Gunakasamuccayah

Comparison : Multiplying by 11

32^{*} 11

Vedic math

Step 1: Divide 32 into 3 and 2

Step 2 : Put 3+2=5 in the middle

Step 3 : Combine the above two = 352

Normal computation

$$\begin{array}{r} 32 \\ \times 11 \\ \hline 32 \\ +320 \\ \hline =352 \end{array}$$

Multiplication number with same digit at tens place

Vedic Maths

$63^{*}67$

the multiplication becomes :

$63 \times 67 = 6 \times (6+1)/3 \times 7$

$= 6 \times 7/3 \times 7$

$= 42/21$

$= 4221$

Normal computation

$$\begin{array}{r} 67 \\ \times 63 \\ \hline 201 \\ +4020 \\ \hline =4221 \end{array}$$

3. Sqaure of a number ending with 5

$75^{*}75$

Vedic Maths

$7^{*}(7+1) = 56$

$5^{*}5 = 25$

Joining the above two : 5625

Normal computation

$$\begin{array}{r} 75 \\ \times 75 \\ \hline 375 \\ +5250 \\ \hline =5625 \end{array}$$

~ Anushka Raghav

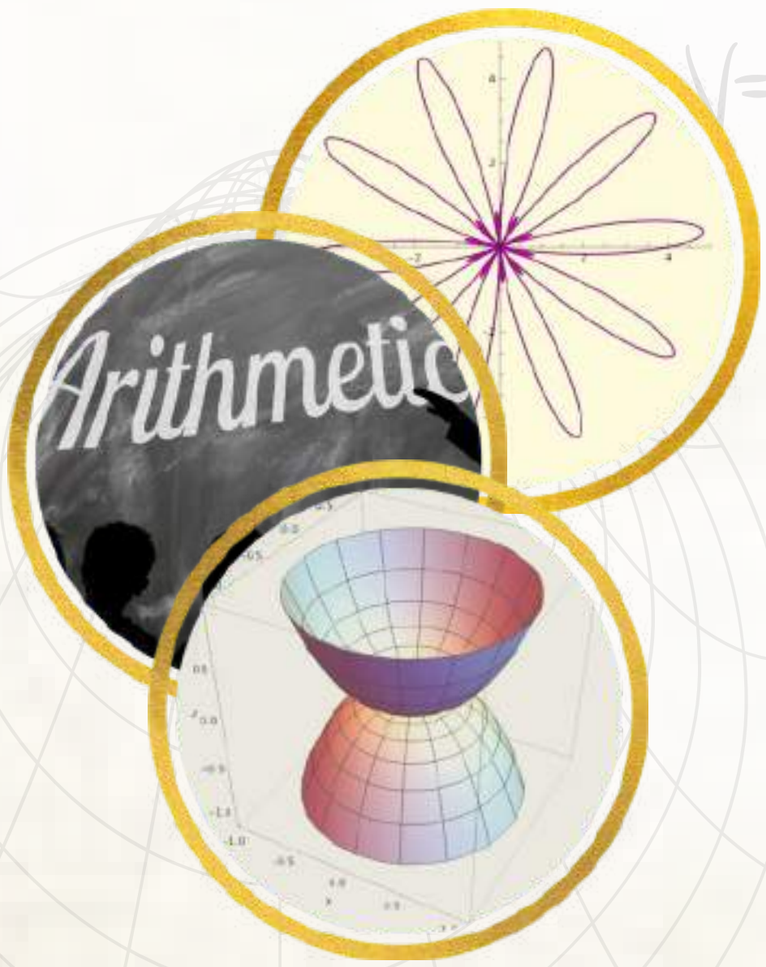
B.Sc. (H)Mathematics, IInd Year

Mathimatiki Melodies

" It all started with numbers,
and went upto infinity,
Indeed it's the glory of mathematics,
the glory of divinity.
Pythagoras, Algebra and many other
are known to us since ages,
And many other concepts
are used to find numbers or wages.
What did Aryabhatta do,
to make mathematics the thing?
He gave the value of pi,
and made circle a measurable thing.
Arithmetic and Trigonometry
are too sound since the past,
Today, everywhere, they still do cast.
Decimal system has also made it till today.
Oh mathematics, on the present
you have such a wonderful say!
What about the sum and angles that prevail,
Oh! Ancient Maths you Hail... "

~ Prerna Panghal
B.Sc. (H)Mathematics, IInd Year

Source:https://pixabay.com/photos/infinity-light-camera-1737624/
Credit: Mari Carmen Diaz



" Math is a miracle
give the way to live life.

Math is a black hole of knowledge
never let you go back.
Math is like life
a little thing make big difference
& choosing one wrong way
lead to wrong proof.

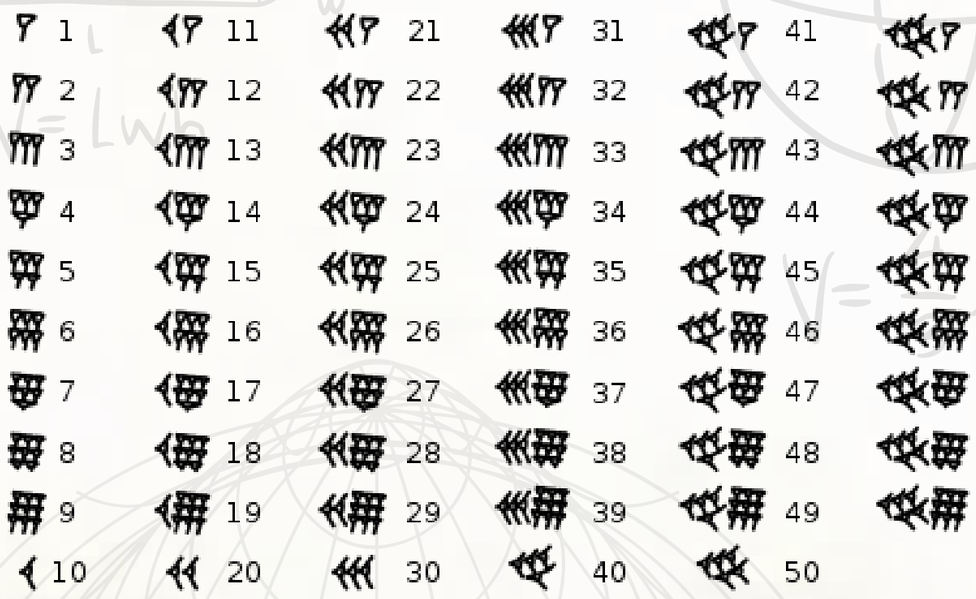
Having infinity like our thoughts
Math can be anything
but can never be nothing

~ Sumiti
B.Sc. (H)Mathematics, Ist Year

Astronomy & Mathematics

The contemporary field of astronomy has expanded 'exponentially' after the development in science and technology. But, this was not the scenario thousands of years ago. Nevertheless, we observe major growth and achievements in astronomy all over the globe during every period of human history. This was all possible with the help of mathematical theories, principles and models.

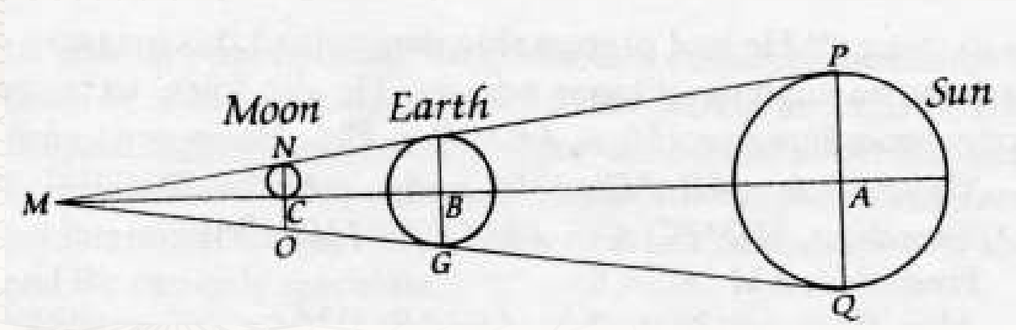
Mesopotamia, one of the cradles of civilization, is believed to have the earliest documentation of the celestial occurrences. Coordinate systems were known to be used in locating the heavenly bodies like moon sun and the constellations.



Sexagesimal Number System

FOUR is the only number in the English language that is spelt with the same number of letters as the number itself.

They also used a sexagesimal number system, which simplified the task of recording very large and very small numbers. Scholars talk about Chaldeans, the priests-scribes who were responsible for developing new mathematical principles to calculate the movements of the celestial bodies. Nabu-Rimmanni, the moon god priest, devised a group of ephemerides, giving the positions of the Moon, Sun, and planets at any given moment. His system was superseded about a century later by Kidinnu's System, a refined mathematical method for finding celestial positions more accurately. George Sarton in his work points out that the arithmetical and empirical nature of planetary models which were different to that of geometrical or philosophical nature of Hellenistic model. One of the unearthed cuneiform tablets holds the calculations regarding the movements of Jupiter while another one records Venus movements. Later stages in astronomy witnessed that astronomers who used previous written text to predict phenomenon had now developed mathematical models that allowed them to predict with computation itself.



Aristarchus's 3rd century BC calculations on the relative sizes of the Sun, Earth and Moon

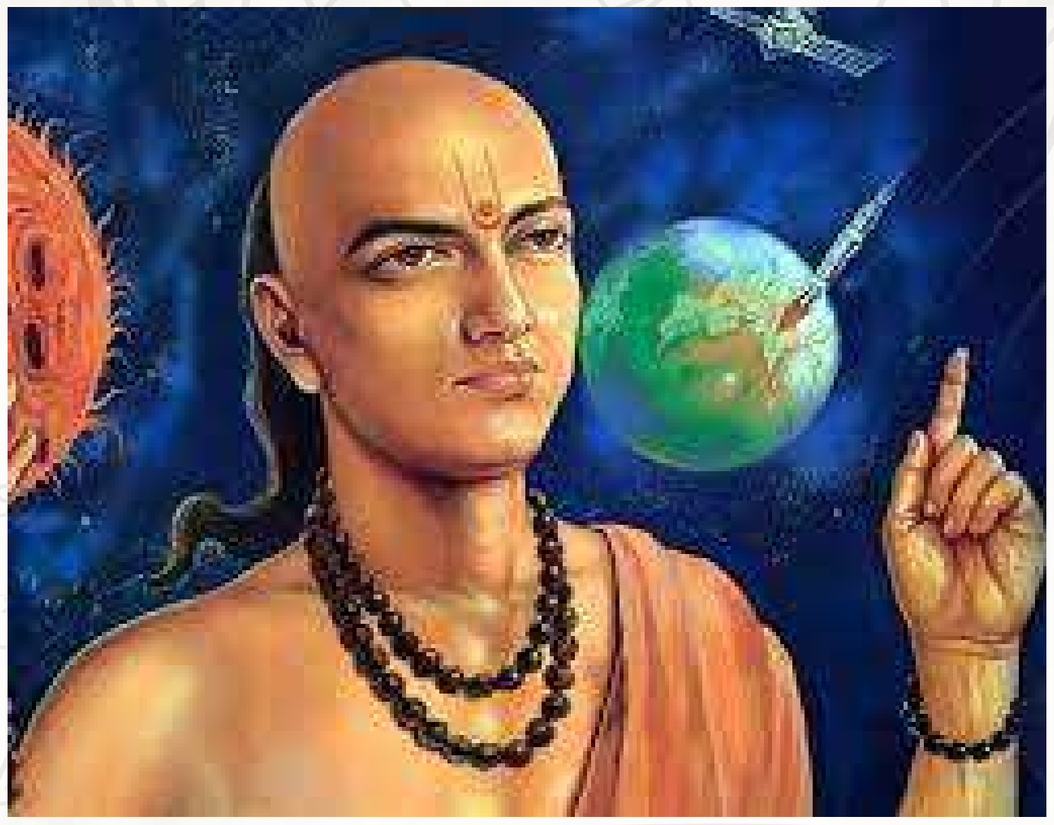
On the foundation laid by the Mesopotamian priests, the Greek erected a whole new set of constructions with help of geometry. Geometrical models were encouraged in 'the classical Greece' to mimic the planetary motions. The famous scholars like Eudoxus of Cnidus and Plato were the flag bearers of classical astronomy. Eudoxus gave the very first model depicting the heavenly system in concentric spheres followed by Plato who claimed the earth to be the center of the solar system. Mathematical scholars gave the 'eccentric model' and the epicycle on a different model which described the planetary motion around the earth. Famous scholars like Ptolemy and Aristotle constructed their models on the same concept of geocentrism. In the 3rd century BCE, Aristarchus proposed the heliocentric model of the solar system. He also calculated the distance between the sun, the moon and the earth.

The solar system was only the primary puzzle of knowledge unraveled by humankind. The above paragraphs only mention the Mesopotamian and Greek contributions to astronomy achieved with the aid of mathematics. However, we can never ignore the contributions of the ancient Mayan, Chinese and Indian scholars just because they were never documented as extensively as their western counterparts. We have come a long way from the time where our ancestors determined the movements of the planets by only giving out theories and models. Advancements in calculus and physics as well as invention of precise instruments and technology have allowed us to discover the vast universe and its constituents. We, as a whole species, wield the capacity to unravel the mysteries the universe hold and the key lies in mathematics" the mother of all sciences".

~ Kinjal
B.Sc. (H)Mathematics
1st Year

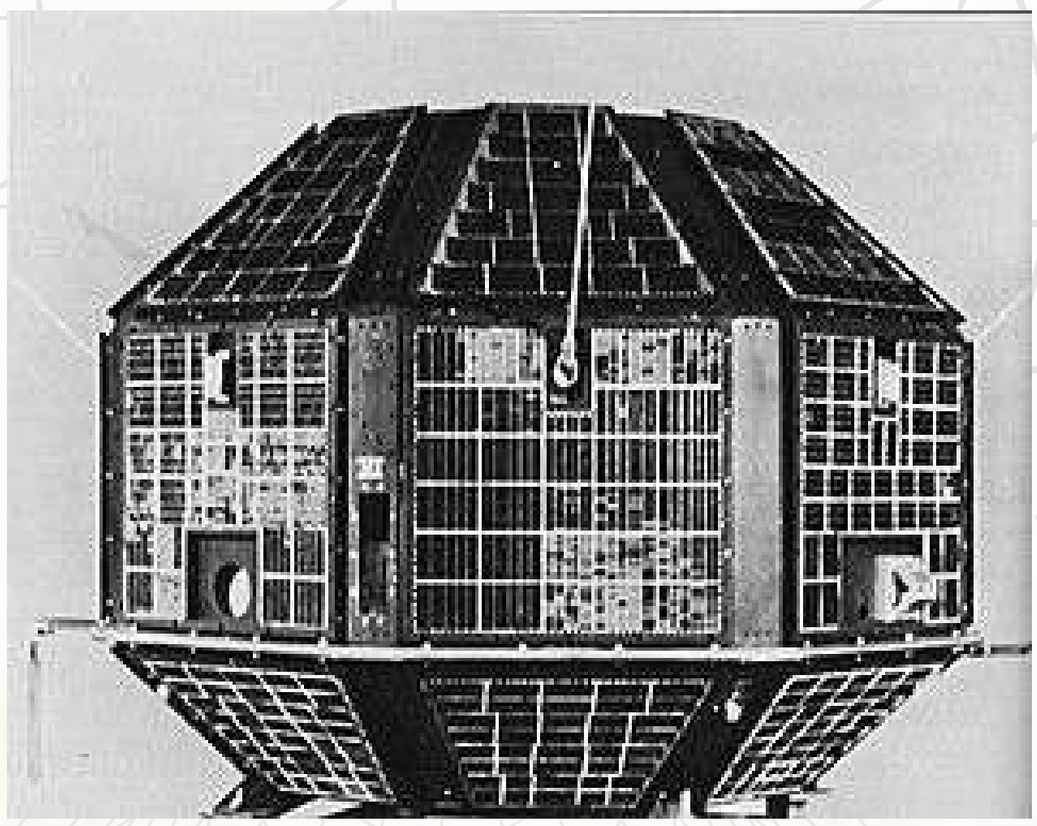
Aryabhata

Aryabhata was also known as Aryabhata I or Aryabhata the Elder to distinguish him from the mathematician with the same name. He was born in 479. Though there is widespread debate on his birthplace with theories ranging from South all the way to the North-East, he at some point in his life settled in Kusumapura near Pataliputra which was then the capital ,during Gupta Dynasty. It was in Kusumapura where he published his magnum opus is his reatise in mathematical and astronomical observation, named Aryabhatiya and his now lost work Aryabhatasiddhanta.



Aryabhata

Source:
https://wonderthatwasindia.blogspot.com/2018/06/the-great-mathematician-astronomer.html

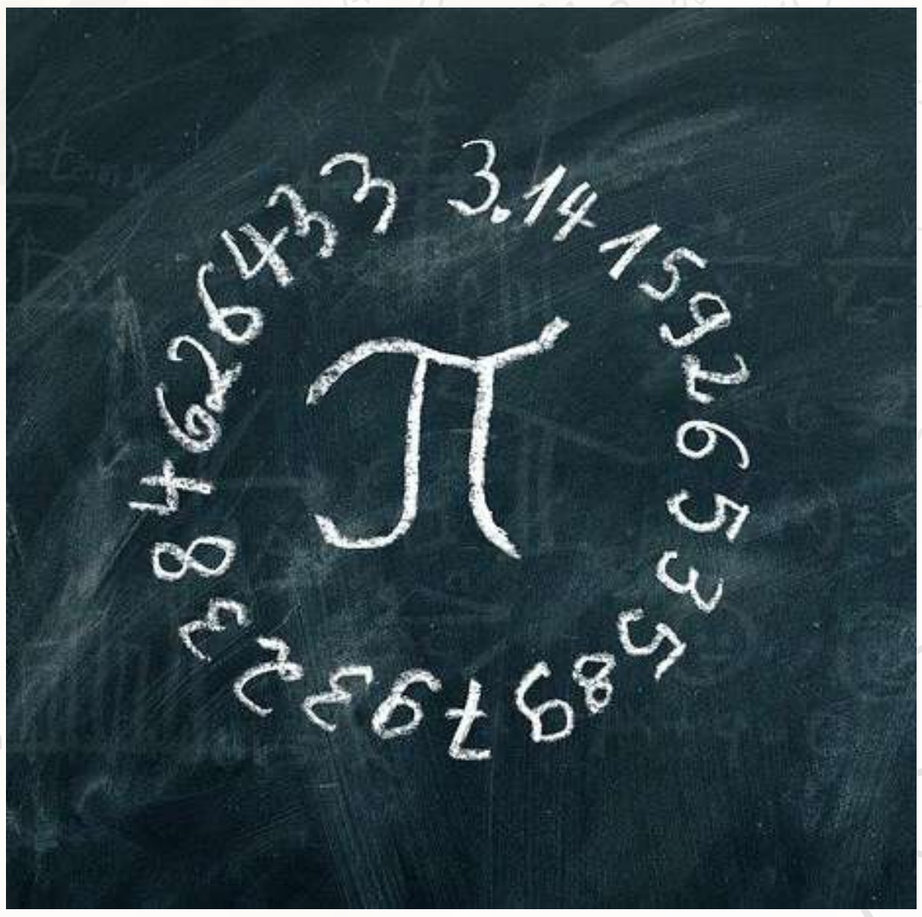


First satellite of India named after genius mathematician

Source: Wikipedia

His first surviving work Aryabhatiya was particularly popular in South India. Several mathematicians wrote numerous commentaries over the ensuing millennium. It was written in verse couplets and dealt with mathematics and astronomy. It followed an introduction that contained astronomical tables and Aryabhata's system of phonemic number notation in which numbers were represented by a consonant-vowel monosyllable, the work is divided into three sections: Ganita ("Mathematics"), Kala-kriya ("TimeCalculations"), and Gola ("Sphere").

His second work Aryabhatasiddhanta circulated mainly in the northwest of India and, through the Sāsānian dynasty (224–651) of Iran.It profoundly influenced the development of Islamic astronomy. It is one of the earliest astronomical works to assign the start of each day to midnight. His work spread westwards where he was known as Arjabad to the Arabic Muslim Scholars and to the Europeans in the middle ages as Ardubarius.



The value of pi as calculated by the genius which was 3.146 was accurate upto 3 decimal digits.

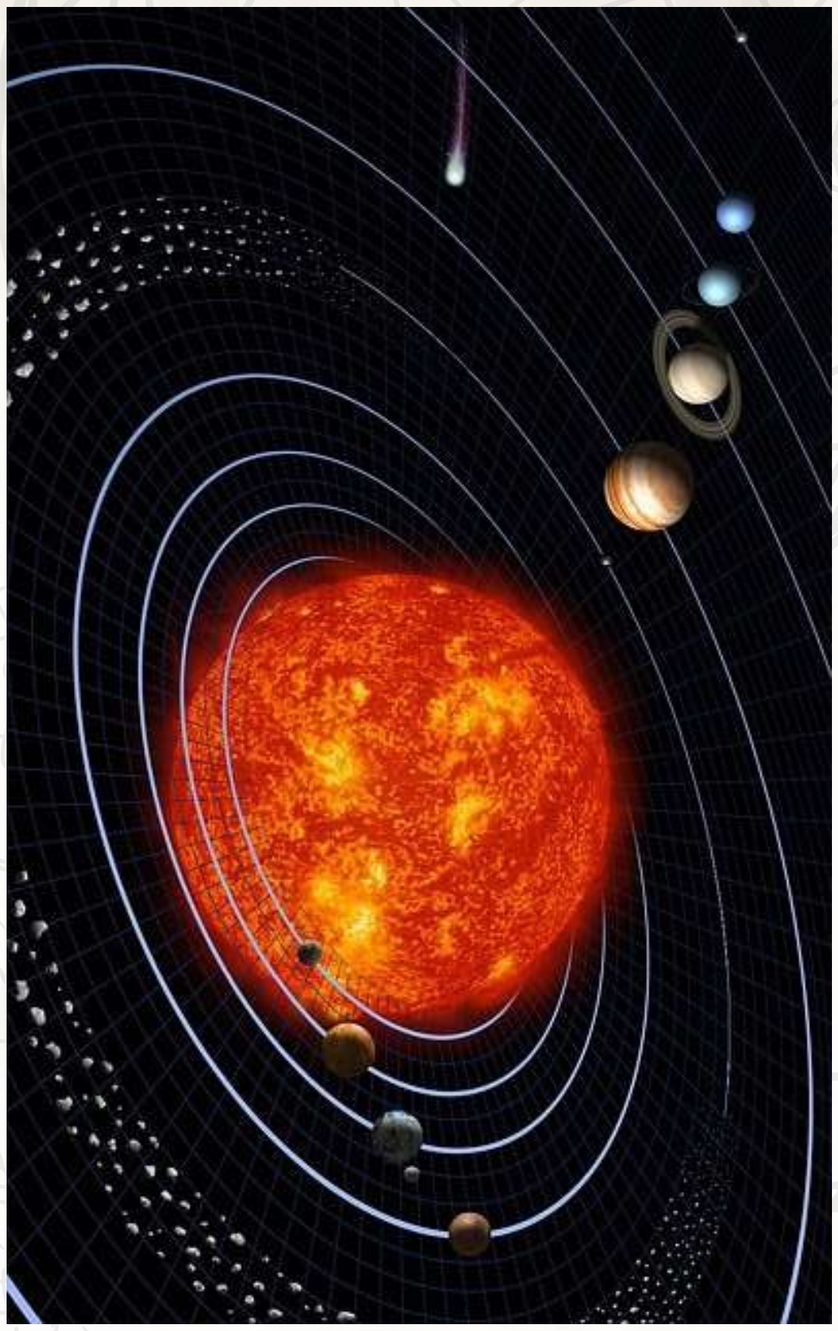
Turning to astronomy with Kalakriya he treated planetary motion along the ecliptic. The topics included definitions of various units of time, eccentric and epicyclic models of planetary motion, planetary longitude corrections for different terrestrial locations,and a theory of “lords of the hours and days” .

Aryabhata used the word 'Shuniya' for zero when representation of numbers change from Sanskrit word to Brahmi numerals.

Insights from his surviving work shows how his findings were revolutionary for his time. Ganita, the first part of his surviving work gives algorithms to obtain square and cubic roots using the decimal number system by naming the first 10 decimals. Geometric measurements—employing 62,832/20,000 (=3.1416) for π, very close to the actual value 3.14159—and develops properties of similar right-angled triangles and of two intersecting circles. He obtained one of the two methods for constructing his table of sines using the Pythagorean Theorem which brought him to the realization that second-order sine difference is proportional to sine.Arithmetic and algebraic topics included.

Back in a jiffy? You’d better be fast! A “jiffy” is an actual length of time, equal to about 1/100th of a second.

Aryabhatiya ends with spherical astronomy in Gola, where application of plane trigonometry to spherical geometry by projecting points and lines on the surface of a sphere onto appropriate planes is witnessed . Further, he also explained solar and lunar eclipses scientifically rather than mythologically instead of the prevailing cosmology in which eclipses were caused by the dieties 'Rahu' and 'Ketu' .He also made an explicit statement that the apparent westward motion of the stars is due to the spherical Earth's rotation about its axis. He ascribed the luminosity of the moon and planets to reflected sunlight.



Aryabhata's calculations on astronomy may have been constructed upon the model of helicentrism.

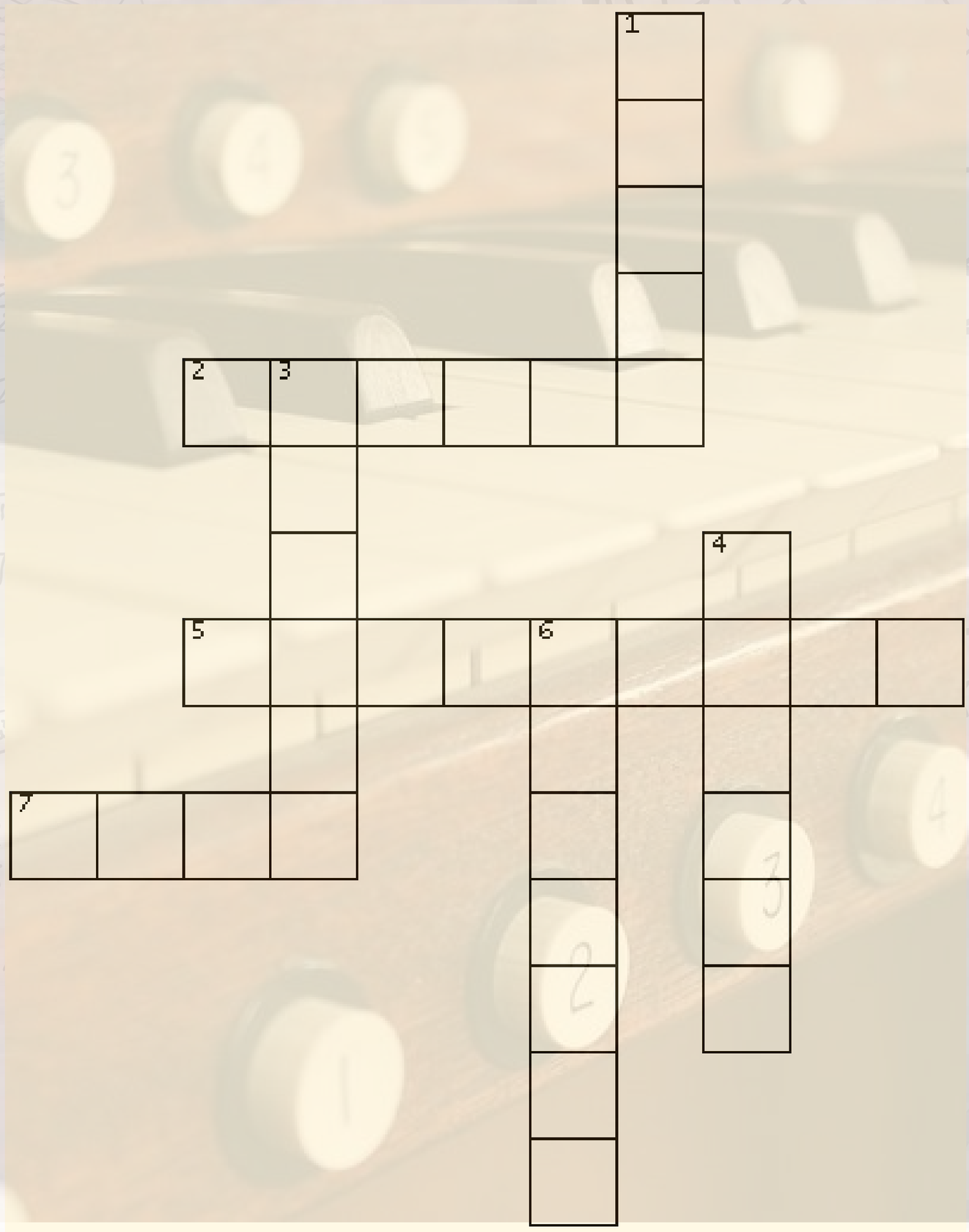
Although his genius in the field were recognised,there are controversies surrounding them even during his lifetime and subsequent centuries. Despite the criticisms ,Aryabhata has not been forgotten due to the ensuing school of mathematical thought in southern India and the Arabic translations. To honour Aryabhata's role as the subcontinent's most influential astronomer, the first Indian satellite was named after him.

If you count up the number of letters in the 13 different kinds of playing cards (ace, two, three, four, five, six, seven, eight, nine, ten, jack, queen, king) you will find that there are 52 letters, exactly the number of playing cards in a deck (excluding jokers).

अधिकाग्रभागहारं छिन्द्यादूनाग्रभागहारेण ।
शेष परस्परभक्तं मतिगुणमग्रान्तरे क्षिप्तं ॥
अधउपरिगुणितमन्त्ययुगूनाग्रच्छेदभाजिते शेष ।
मधिकाग्रच्छेदगुणं द्विच्छेदाग्रमधिकाग्रयुतम् ॥

A verse in Aryabhatiya Explaining kuttak

Word Play With Music



ACROSS :

2. An interval that is five semitones apart
5. This instrument originally came from West - Bengal with zebra skin like striped keys equally distributed in number on the playing board.
7. A squared plus B squared equals C squared, is ofcourse the Pythagorean theorem from basic geometry. But Pythagoras was intrigued by this musical instrument and his method of understanding the musical scale eerily foreshadowed the sequence of steps leading to the development of Quantum Mechanics and modern physics.

DOWN :

1. A music interval that is seven semitones apart.
3. A prominent musical interval which Pythagoras observed, that highlights the universality of his findings in the musical scale.
4. A string instrument which follows the Helmholtz motion creating a sinusoidal frequency of $y=A\sin[B(x-c)]+D$.
6. A musical instrument named after a Greek God, who is a renowned theatrical critic.

ANSWERS

1. Fifth
2. Fourth
3. Octave
4. Violin
5. Harmonium
6. Orpheus
7. Lyre

~ Helen
B.Sc. (H) Mathematics, IIst Year

Singing Note
On Indian Place Value System

Like the crest of the peacocks,
the gems on the hoods of the cobras,
mathematics is at the top of the Vedanga Sastras.

The above verse from Vedanga Jyotisha shows the importance given to mathematics in earlier Indian society.

The globe is aware of the fact that the place value system originated in the ancient streets of India. Aryabhatta of the 5th Century once said :

एकं च दशं च शतं च सहस्रमयुतं तथा प्रयुतम् /
कोटयर्बुदं च वृन्दं स्थानात् स्थान दशगुण स्यात् //

which interpreted as
Numerals are as follows 1,10,100, 1000..... starting from 1, each number obtained by multiplication by 10.

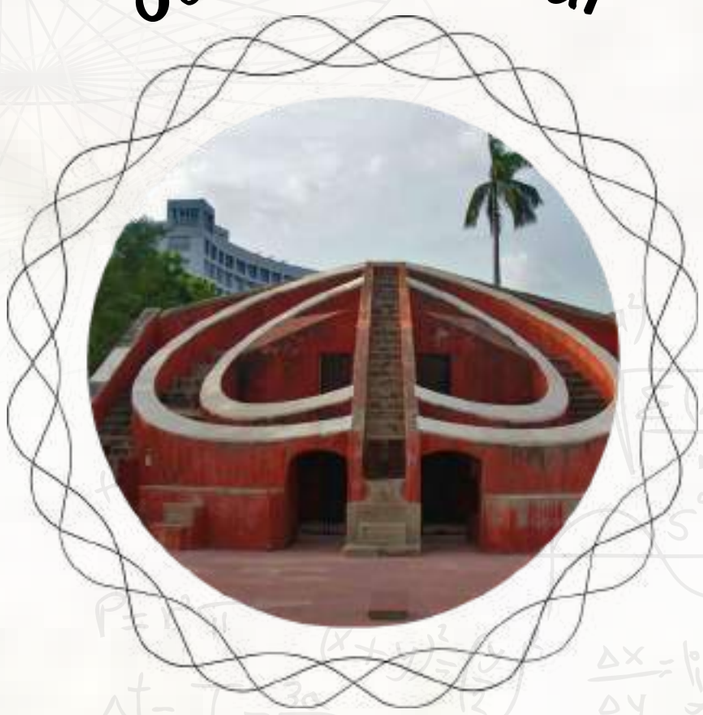
Fact

Indian Mathematicians invented place value system much before zero "0" as they used Sanskrit letters instead of Brahmi numerals to write the numbers.

~ Anjali Choudhary
B.Sc. (H)Mathematics
1st Year

Wonders Of Mathematics

Jantar Mantar



It represents the revolutionary step to shorten the bridge to the mysteries of space.

Maharaja Jai Singh II of Jaipur had five Jantar Mantars constructed between the years of 1724 and 1735 in places like New Delhi, Jaipur, Ujjain, Mathura and Varanasi.

It's filled with ancient instruments like Chakra Yantras, Digamsha Yantra Rama Yantra and many more.

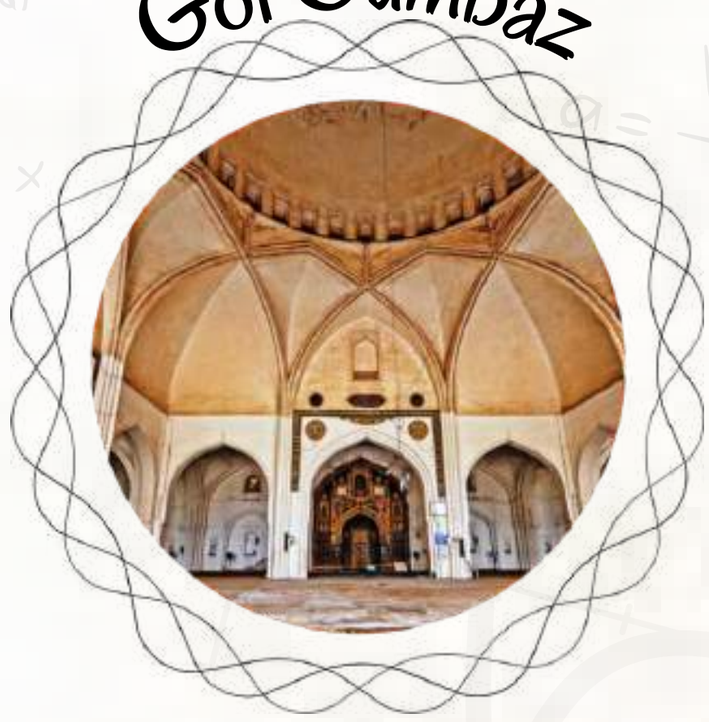
Fact

The power of exponential growth is shocking. You can actually reach the moon by folding a paper of 0.01mm 45 times.

Did You Know?

From 0 to 1000, the only number that has the letter "a" in it is "one thousand". And every odd number has an "e" in it.

Gol Gumbaz

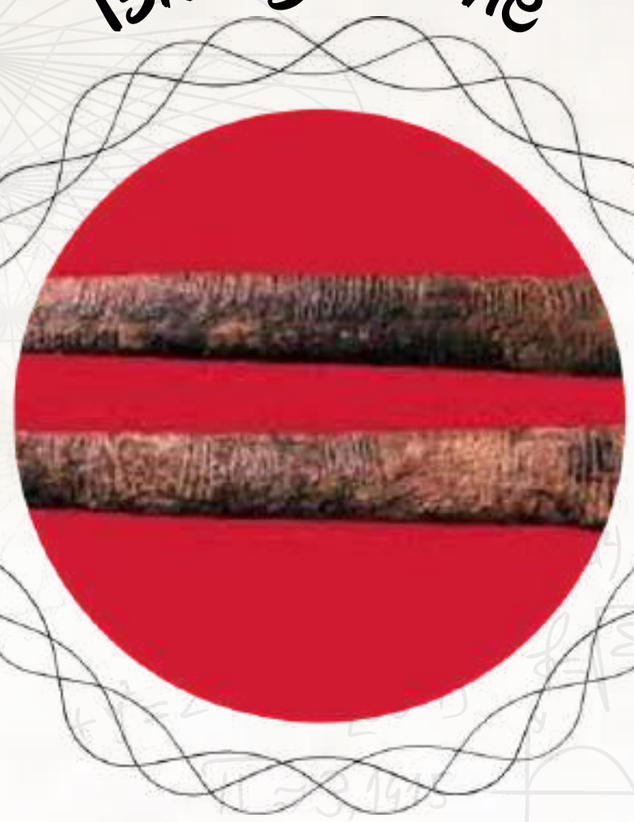


Does innovate and distinctive architecture interests you? Visit the second largest dome of the world and form on its no pillar construction

Completely constructed in the year of 1656 in the city of Bijapur,Karnataka,Gol Gumbad is one of the biggest chamber spaces of the world.

Tthe whispering gallery of the tomb amplifies and echoes back even the smallest sound 7 to 10 times.

Ishango Bone



Engraving in Ishango Bone may describe on bases of 12 and simple arithmetic calculations, was first estimated to have originated between 9,000BC and 6,500BC

Speculation by Scholars says that a woman may have craved the lunar calendar in relation to her menstrual cycle

Mesopotamian Lyre

Different points on a string will produce a different sound. It's all the play of mathematical frequencies. Sing to that!

It's sound producing component were the strings and the resonating soundbox.

They were tuned on basis of certain procedures operating system of 7 scales, originated around 3200 BCE.

Did You Know?

Have ever noticed that there is no representation of ZERO in Roman numerals.

Quipus

Quipus originated in 2500 BCE, from Inca empire contains knots that stores data as numerical codes.

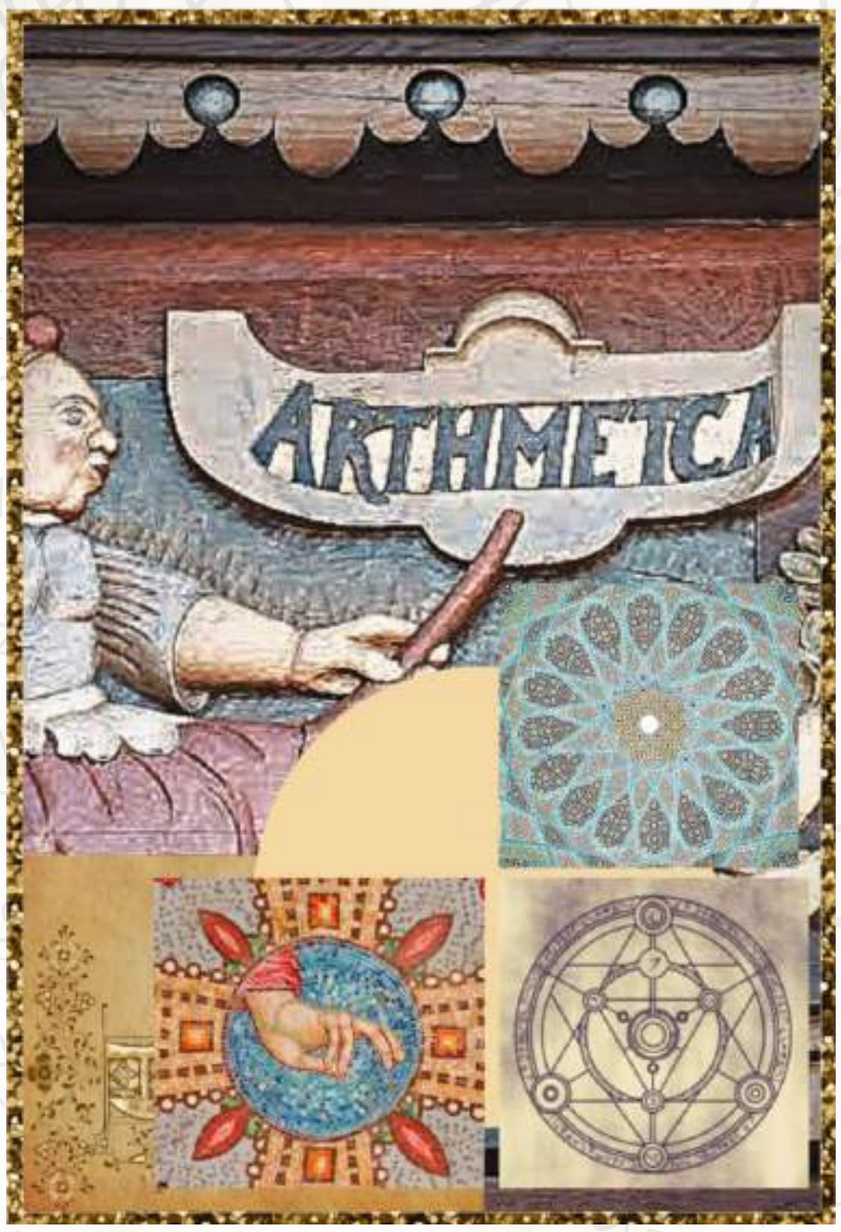
these numeric code for encoding and menu four types of notes:
simple overhand knots, long notes finger eight knots, and a finger-eight knot with an extra twist.

According to Scholars, even the colours may have some significant by conveying different informations

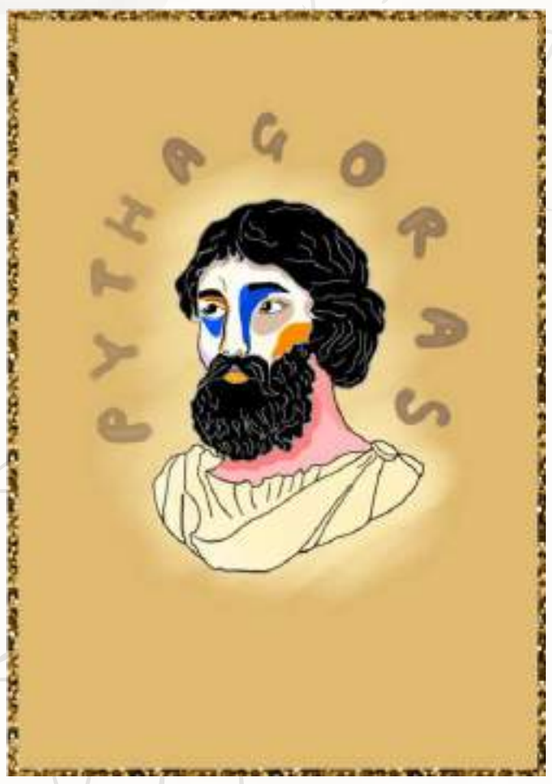
~ Kinjal
B.Sc. (H)Mathematics
1st Year

Creative Arena

Ruchita Ray, B.Sc. (H) Mathematics, Ist Year



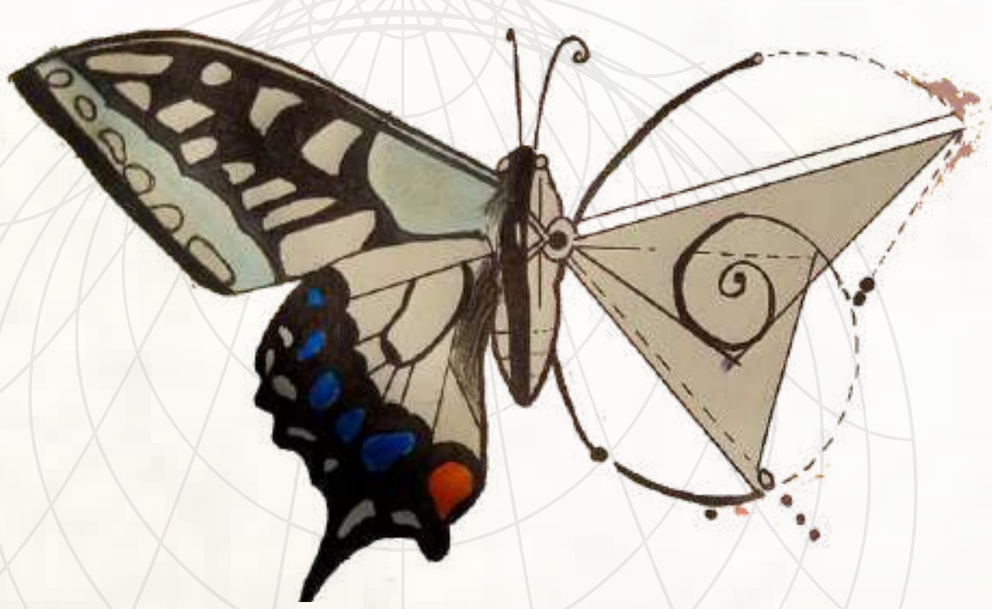
Gargi Bisht, B.Sc. (H) Mathematics, Ist Year



Palden Dolma Bhutia, B.Sc. (H) Mathematics, Ist Year

Sofia, B.Sc. (H)Mathematics, IInd Year

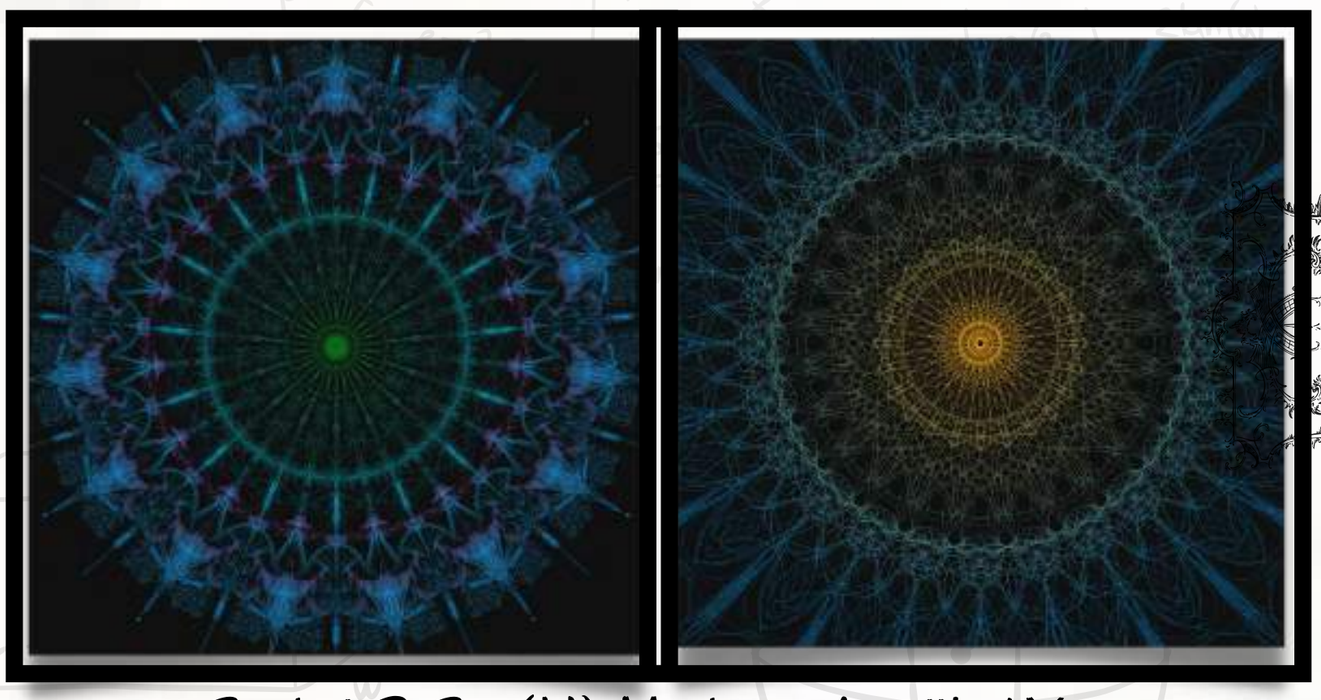
Ishita Soni, B.Sc. (H) Mathematics, Ist Year



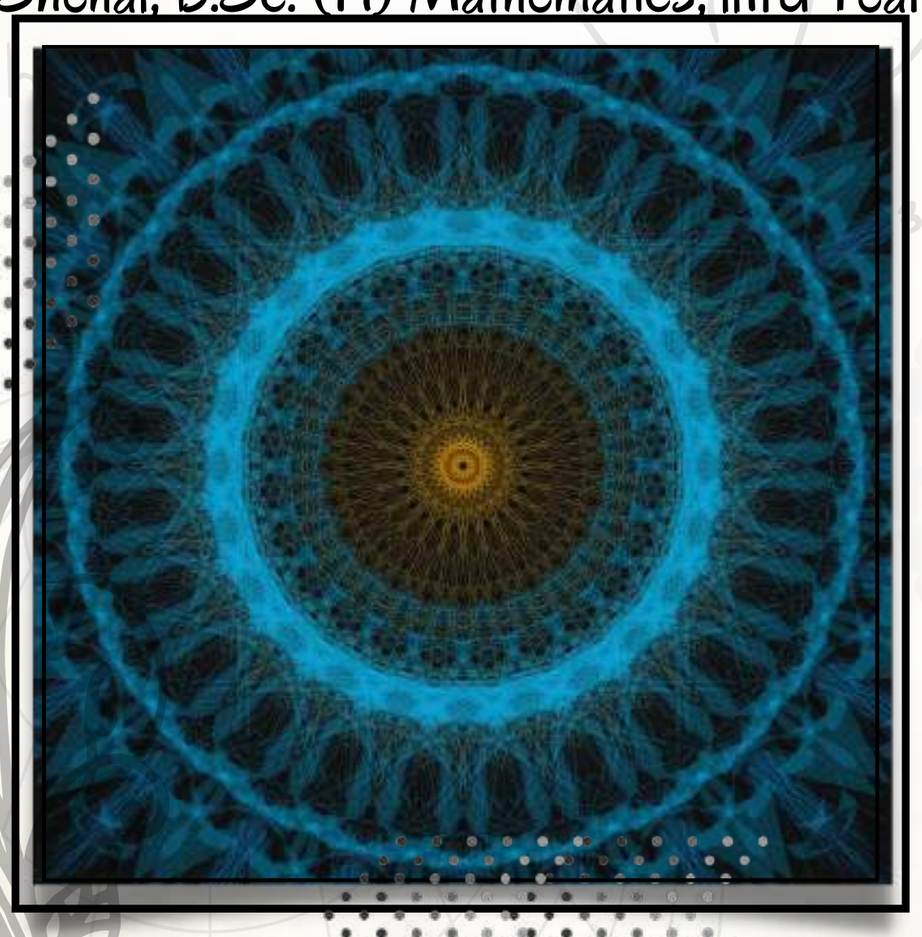
Deepanshi Yadav, B.Sc. (H) Mathematics, Ist Year

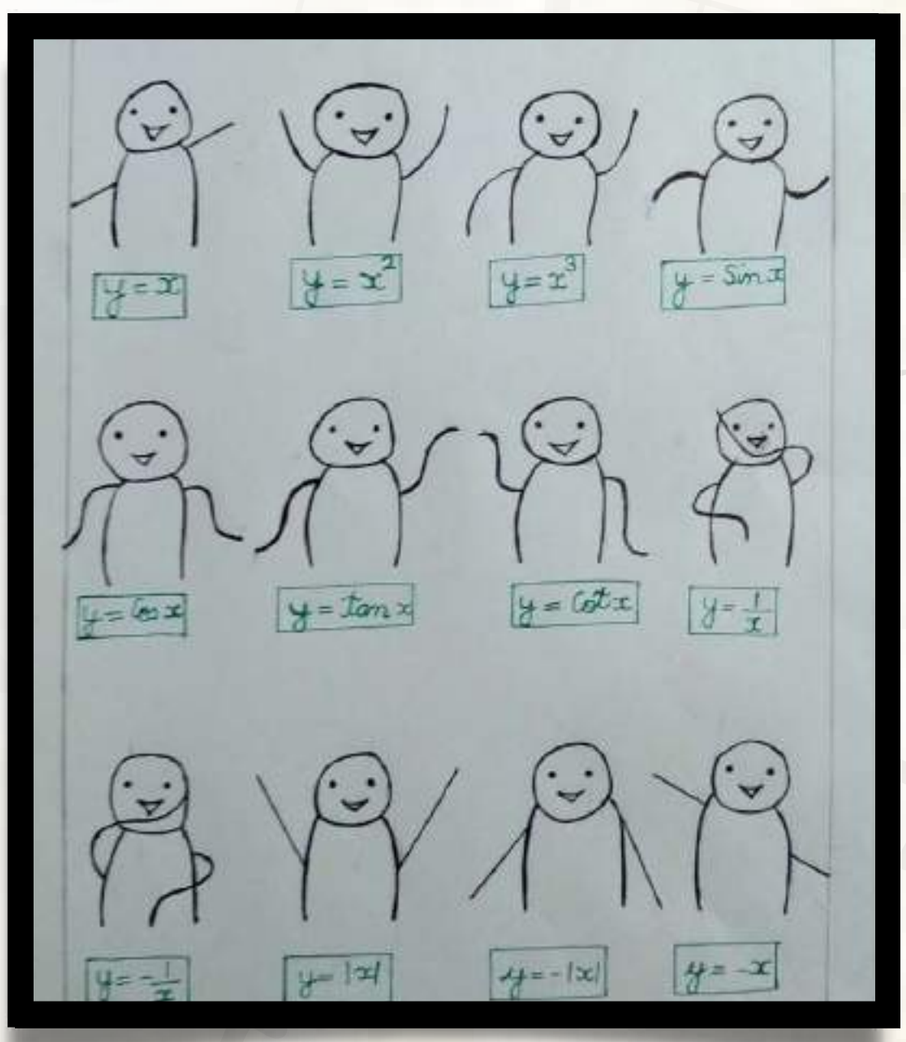
Aastha Jha, B.Sc. (H) Mathematics, Ist Year

Swati Yadav,
B.Sc. (H) Mathematics, IInd Year



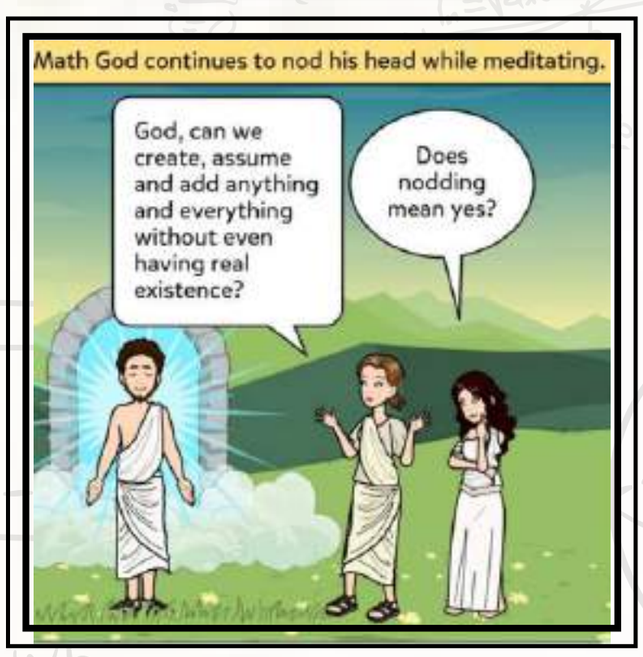
Snehal, B.Sc. (H) Mathematics, IIIrd Year

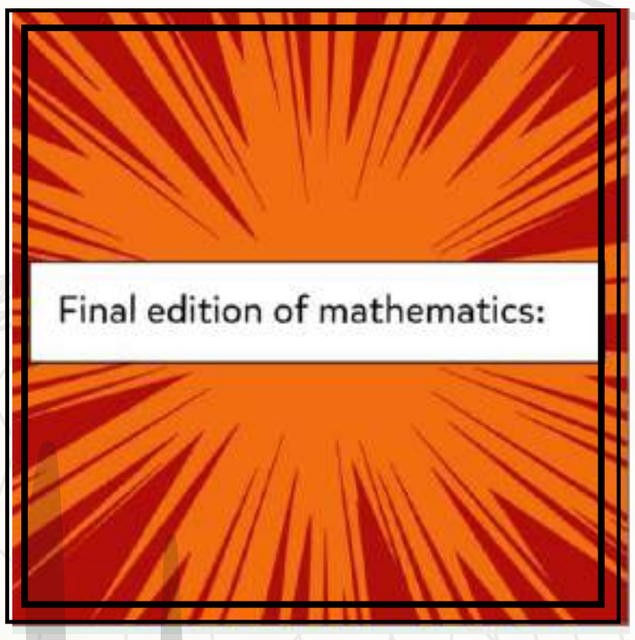




Preeti Hooda, B.Sc. (H) Mathematics, Ist Year

"Let" it be true!





COMICTRIP

~ Diya Bedi

B.Sc. (H)Mathematics, IInd Year

Winning Article of Arcticle Writing Competition

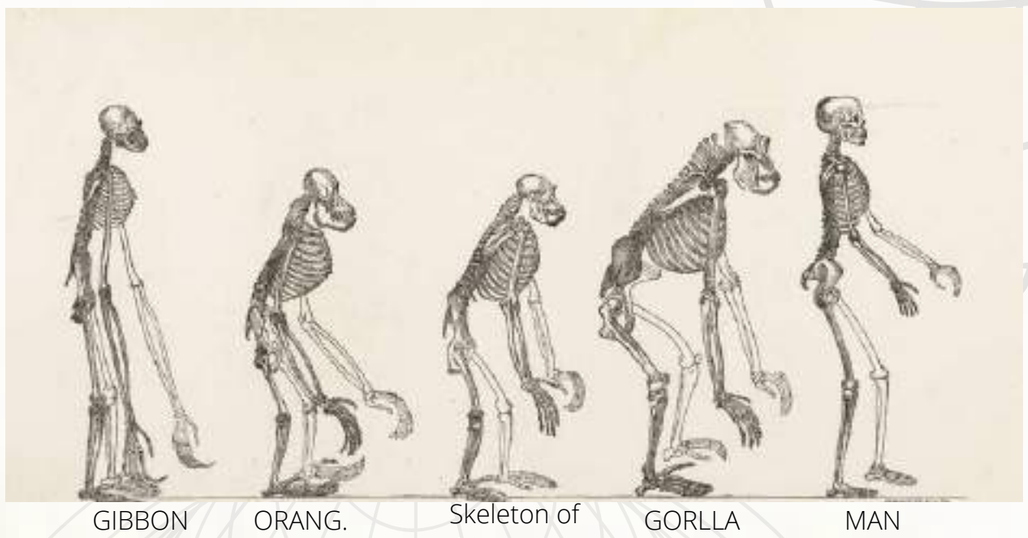
The topic of the competition was "Role of Mathematics in Evolution "

Mathematics :

An Invisible Pillar Of Evolution

Stephen Hawking rightly stated, "There is no need of invoking God, as long as we have mathematics."

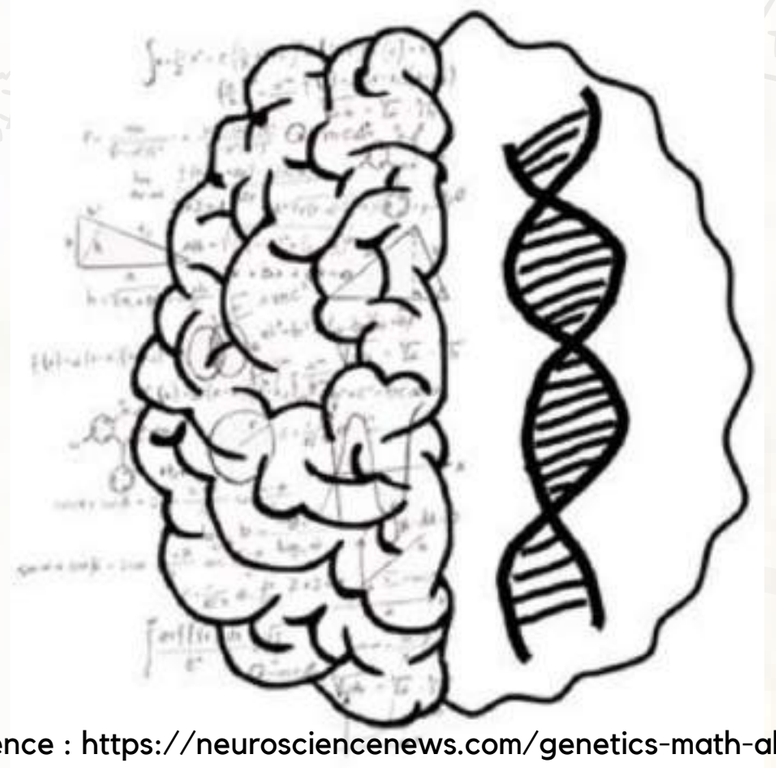
It might have all started with a zero for humankind, but Mathematics had a hand in our evolution from the start. A naked eye might miss the patterns of numbers on which nature works, but keen observation has highlighted that we humans need a structure to evolve, grow and develop, a structure provided by Mathematics. Evolution might be all about getting the equations right.



Photographically reduced from Diagram of the natural size (except that of the Gibbon, which was twice as large as nature), drawn by Mr. Waterhouse Hawkins from specimens in the Museum of the Royal College of Surgeons.

Reference : https://www.sciencehistory.org/distillations/a-world-without-darwin

Most of us are familiar with Charles Darwin's survival of the fittest theory. The concept is based on the phenomenon of natural selection, replication and variation, which in its basic form means reduction, multiplication and creation of small quantitative differences in ratios, respectively. His theory of evolution add a mathematical foundation and thus, showcases the the role of mathematics in our evolution.



Reference : https://neurosciencenews.com/genetics-math-ability-17207/

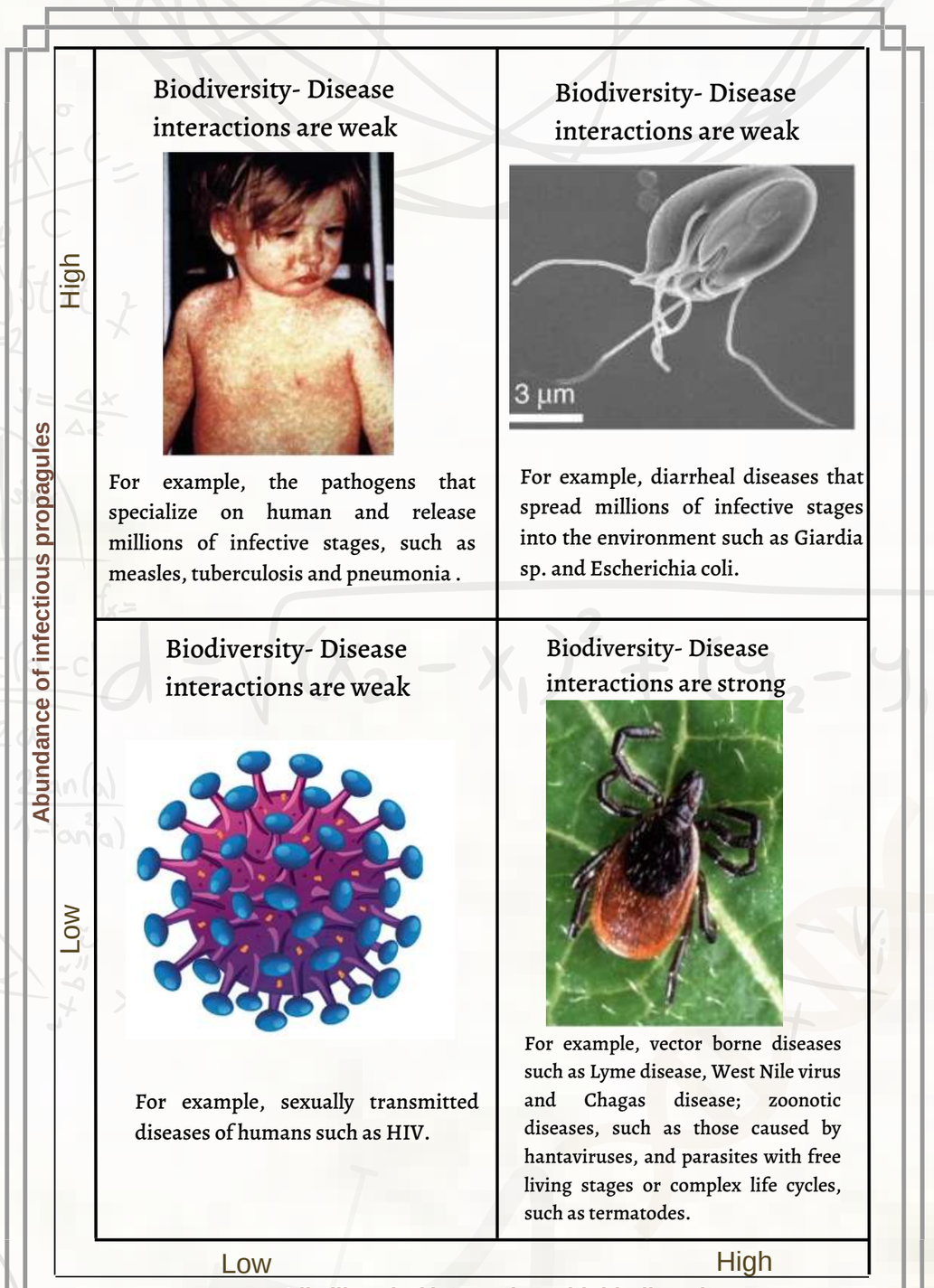
Various mathematical models of evolution are created to provide generalized descriptions of biological changes such as genotype and phenotype variations in large populations over a period of time. Mathematics converts theory into equations and numbers and gives humankind a system on which biology

seems to work on. Mathematics is used to explain how an animal might develop anatomically and how hereditary information is passed from generation to generation. With time, from biological fitness, humans shifted to social fitness and made it the criteria for natural selection. Humans are information carriers, and through the process of reproduction, this information is passed on. Hence, in an evolving population, replication is the process through which knowledge is gained.

Any mistake in this process results in variation. Selection is then made for the ones who manage to survive are to be the fittest.

Humans are social beings, and our evolving social populations are influenced by the basic concepts of mathematics. These models provide the basis for existing cultural differences. For instance, the IQ-intelligence quotient of an individual is a product of both nature and nurture.

Mathematics connects the two in a dynamic system where both of their influences are considered. Diseases are a threat to our evolution resulting in undesired evolutionary processes. Cancer may be seen as a replication of malignant cells as a result of mutation.



Making use of graphs and probabilities, a model of attacking selection is put forth, showcasing populations as mathematical abstractions and how they may be able to overpower or reinforce the effects of natural selection. Let us consider the current pandemic; COVID-19. One might wonder on what basis the authorities in power make decisions about when to initiate lockdowns, give estimates of likely

infected the percentage of the population and come to make predictions about how long a disease would last.

Mathematics is a vital component of the answers to all these questions. Through charts, graphs ho and comparative tables, a mathematical model of the disease is formed, which gives insights into the functioning of a disease. This model is then utilized to make predictions about the workings of a disease, thus, prompting the authorities to initiate timely, wise decisions that are in the welfare of the population. The hospitals receive an idea about the approach they should employ while forming their budgets as these models help in predicting the required medical equipment from ICU beds to medicines. We are a part of an ecosystem. What affects nature seems to concern our kind equally. Our lives need to be in sync with the dynamics of nature for our survival. Nature works on patterns of numbers. From the branches of a tree to the petals of flowers to the reproduction of rabbits and bees to the spirals of galaxies, numbers are all around us.

The cosmos speaks the language of mathematics. Through mathematics, we get a glimpse into the world of stars and gain knowledge about the inner workings of the universe, which is passed on to the next generations through replication, and the process of evolution continues. Mathematics has become a way of communication. No matter the domain, you belong to, you will find that equations form the foundation of your niche.

Mathematics is the essence of evolution, and though few of us might be able to recognize its contributions, no one can deny that Mathematics is an invisible pillar of evolution.

~ Shivangi Dhiman
B.A. (H) Applied Psychology
1st Year

Fact

The spiral shapes of sunflowers, snails and shells follow the Fibonacci sequence, where the two previous numbers are added together to get the next. (1, 2, 3, 5, 8, 13, 21, 34...)

Events Galleria

Plans are nothing, However Planning is everything.

A ravishing glimpse of productive
activities and events conducted by the Mathematics Association of
Gargi College, 'Mathema' during the academic year 2021-22.

Teacher's Day Celebration

5th September 2021

For the day, an online event was conducted where the complete department was gathered. The event began with the President welcoming the gathering. A beautiful video compiled by the third year students warmed every heart in the meeting and rejuvenated the energy. ! The title ceremony, in which students bestowed math-related titles on all of their professors, was the highlight of the afternoon.

Department Orientation

22nd November 2021

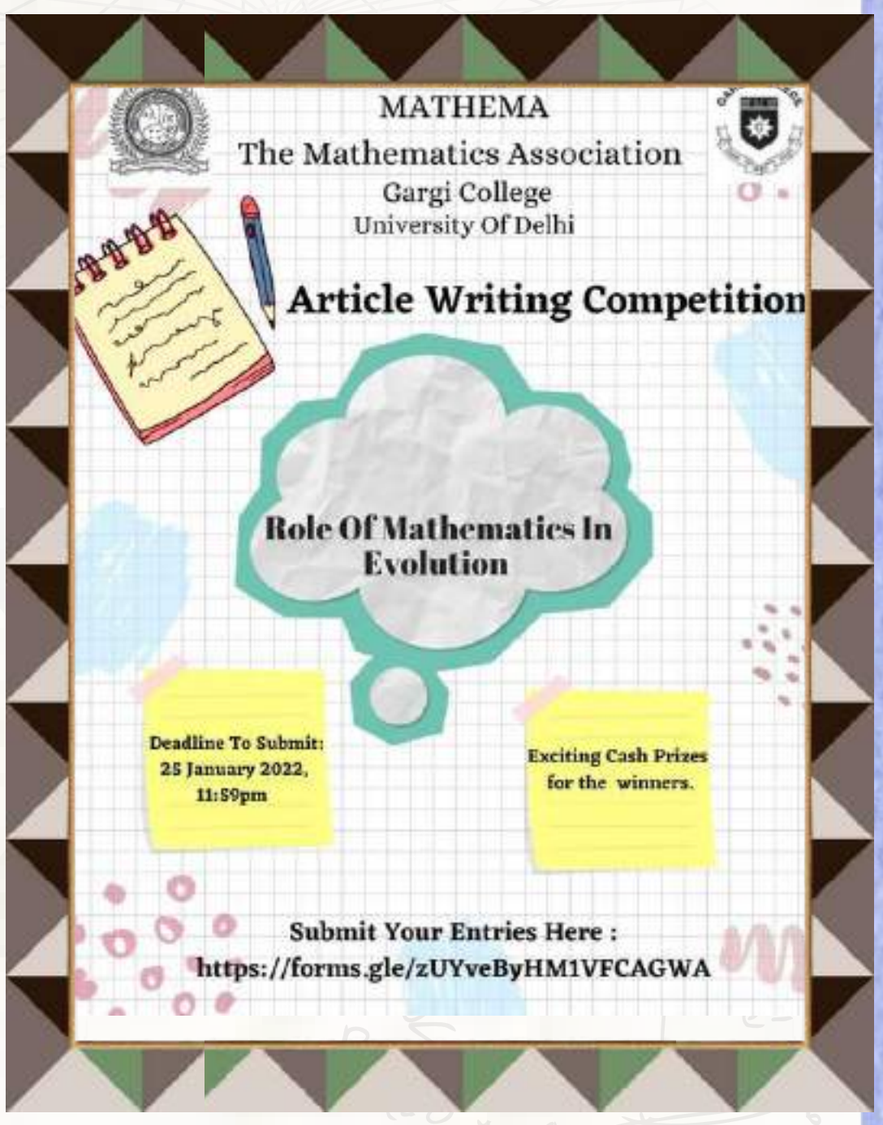
- For The Freshers, 22nd November 2021 Following the legacy of online mode during pandemic, the year as well the Department Orientation forthe first year students took place digitally. To enhance the piousness of the session Principal Prof. Promila Kumar addressed the gathering and motivated the students for their new journey. All the department teachers wre present too. Through the orientation program first year students were informed about their course structure, weekly time table followed by department and college activities

Webinar : The Tales Of The Constant e

27th January 2022

- Mathema, The Mathematics Association organized a webinar on "The tales of the constant e" underthe aegis of IQAC Dr. Tanvi Jain, associate professor, Indian Statistical Institute, Delhi. It was impressively a successful event in which students across the colleges and the faculty joined the webinar. It was a great learning opportunity and the webinar was quite insightful. There were open questions in the end that made the session more lively and interesting

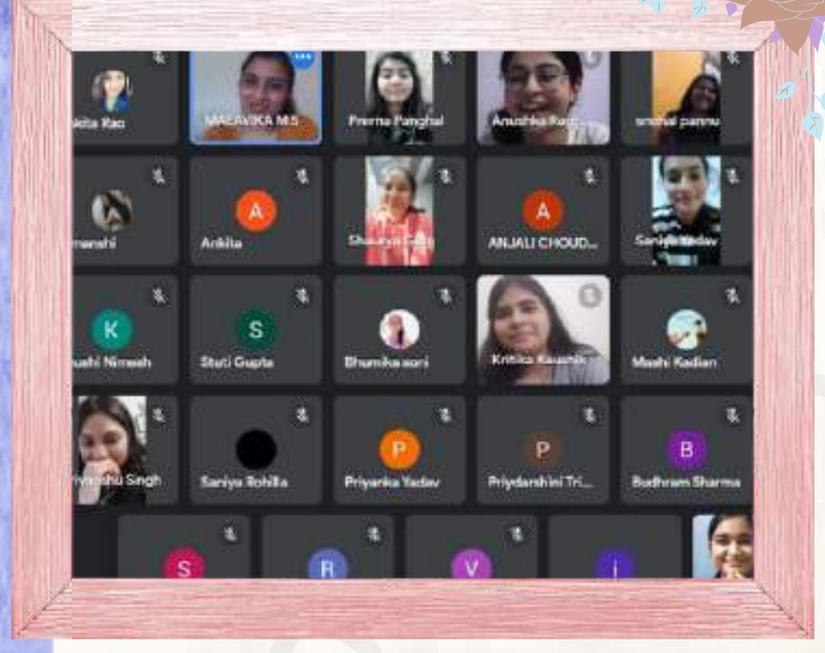
Article Writing Competition



- Keeping in mind the inexhaustibility of magic that words have , the department organized an article writing competition on the topic “role of mathematics in evolution”. The enthusiastic participation of students across departments and colleges , made choosing a winner challenging. Shivangi Dhiman of Gargi College was the writer of the winning article, while articles by Malavika MS and Rushda won the second and third position respectively. Winners were awarded by cash prizes and e certificates.

Interactive sessions

- Leadership is not about titles, positions or flowcharts, it is about communication and teamwork.
- Keeping in mind the same fact, the core team of mathematics department decided to conduct an interactive session for the department students. The main objective of the session was "to feel connected with each other and to include all students and their viewpoints for the issues of the office".

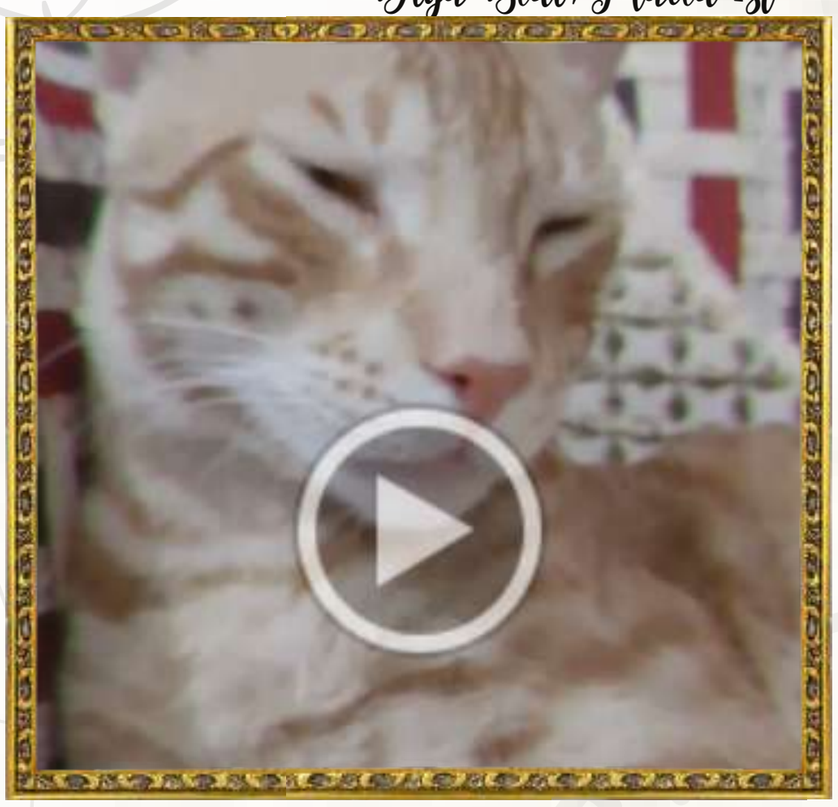


Reelmatics : Reel Making Competition

The monotonousness of the month of September was broken by the rhythms, tunes, music and laughter brought by REELMATICS-the reel making competition organised by Mathema. The topics given to participants were what people think mathematics students do VS what they actually do and a day in the life of a Mathematics student. The ideas and creativity of the participants indeed surprised everyone , all reels were hilarious and at the same time relatable to all mathematics undergraduates and this made the task of choosing the winners a difficult one for the judges.

Diya Bedi, Placed 1st

Shivangi Thapliyal, Placed 3rd



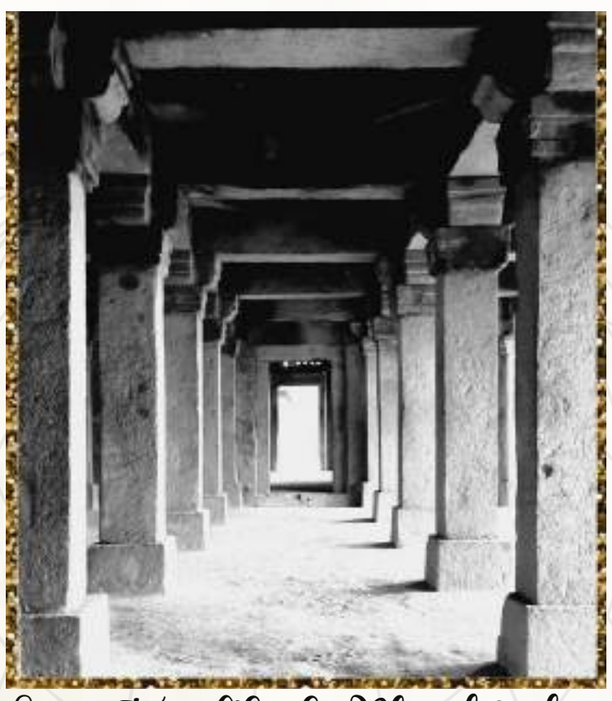
Pallavi Raj, Placed 2nd

Photography Competition

Where our eyes can't go, our lenses can. CLICK! What can be better than a visual expression of subjects that defied verbal articulation. Mathema conducted a competition for all our photography enthusiasts and the theme for the competition was "Geometrography", which was open to interpretation. The participants had to capture a picture accordingly and give their own interpretation as well.

Tisha Mondal, Placed 1st

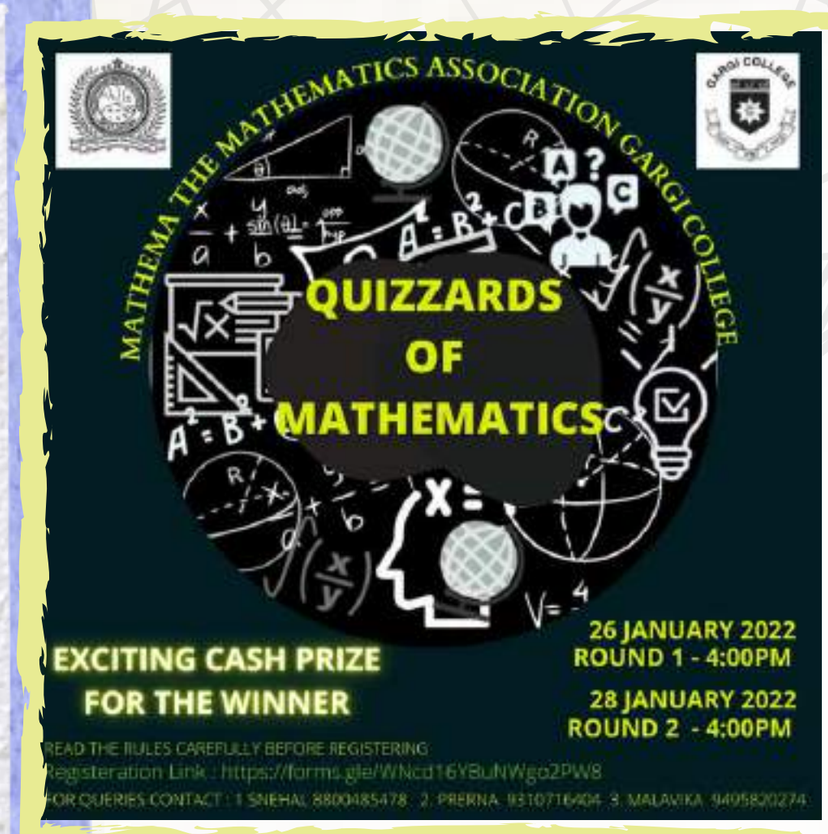
Anjali Kumar, Placed 2nd



Sayantani Ghosh, Placed 3rd

Quizzards Of Mathematics

- MATHEMA conducted an online quiz competition, hence provided a platform to all quizmasters to test their knowledge and win exciting prizes. The competition took place into two segments namely round 1 and round 2. The event experienced a huge number of enthusiastic participants. Who not only exhibited their rugged zeal to win but practiced a healthy competition among themselves. Manish Chauhan from Motilal Nehru College, University Of Delhi transpired as the winner of the quiz.



Career Counseling

- Our path to success is molded by the guidance of our mentors and in order to provide the students of mathematics department enriching guidance which will help them to choose a career path and the way to walk on it a two day career counseling session was also conducted. The guest speakers were Mr. Siddharth Rathore, Assistant Professor, Department of Economics, Gargi College and Ms. Madhu Meena, CDGA . The session revolved around government jobs and not only introduced many job opportunities which were new to the students but also provided a strategy for beginning the preparation.

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