MES COLLEGE OF ARTS, COMMERCE AND SCIENCE

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NAAC ACCREDITED WITH 'A' GRADE'

Volume 2 | Issue 1 | July 2024

# Mathemirum

A BI YEARLY NEWSLETTER BY THE DEPARTMENT OF MATHEMATICS

# Mathemirum

## Message from the department

We are happy to bring out the latest edition of **Mathemirum** Magazine at MES College, showcasing the incredible talent and dedication of our Mathematics community. This issue highlights innovative and fun articles by our students. We hope you enjoy reading and find it as stimulating as we did in putting it together.

- Prof. Devika Rani Shetty
Head of Department,
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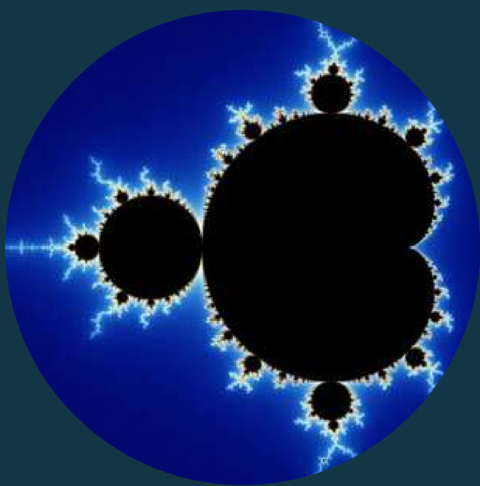
## THE FOREWORD

*BY THE EDITORIAL DESK*

Welcome to **MatheMirum!**
The Bi-yearly magazine of the Department of Mathematics.
One of our prime objectives is to challenge the notion that math is a difficult subject. Within these pages, you'll discover the beauty, creativity, and accessibility of mathematics. Join us in reshaping perceptions and embracing the joy of mathematical exploration!
Enjoy the journey!



## CONJECTURE

In mathematics, a conjecture is a statement that appears to be true but has not been formally proven. A conjecture can be thought of as a mathematician's way of saying "I believe that this is true, but I have no proof yet".
Conjectures are formed when a person notices a pattern in mathematics. For example, the intersections of the perpendicular bisectors of a parallelogram create a new parallelogram with the same angle measures as the original.
Conjectures can be proven to be true or false. To prove that a conjecture is false, a counter-example must be found.
Some conjectures, such as the Riemann hypothesis or Fermat's Last Theorem, have shaped much of mathematical history.
Formal mathematics is based on provable truth. In mathematics, any number of cases supporting a universally quantified conjecture, no matter how large, is insufficient for establishing the conjecture's veracity, since a single counter-example could immediately bring down the conjecture. Mathematical journals sometimes publish the minor results of research teams having extended the search for a counterexample farther than previously done. For instance, the Collatz conjecture, which concerns whether or not certain sequences of integers terminate, has been tested for all integers up to 1.2 × 1012 (over a trillion). However, the failure to find a counterexample after extensive search does not constitute a proof that the conjecture is true—because the conjecture might be false but with a very large minimal counterexample.
Nevertheless, mathematicians often regard a conjecture as strongly supported by evidence even though not yet proved. That evidence may be of various kinds, such as verification of consequences of it or strong interconnections with known results.A conjecture is considered proven only when it has been shown that it is logically impossible for it to be false.

- Shrikari Sharvani M S

# CONVERSATION BETWEEN TWO MATHEMATICIANS

Have you ever wondered how mathematicians talk to each other?
Here's a glimpse for you.
Characters:
**M1** : Mathematician 1
**M2** : Mathematician 2
Plot: M1 and M2 have fought for some reason and the following conversation is the way they express their anger.
**M1** : You're mean.
**M2** : You're median.
**M1** : You're mode.
**M2** : You're the numbers that are put after 3.14.
**M1** : You're the +C of indefinite integration.
**M2** : You're the ₹1 given on spending ₹2,999.
**M1** : You're the zeroes after decimal point.
**M2** : You're sin0 and cos(π/2).
**M1** : You're the derivative of eX .
**M2** : You're very √(-1).
**M1** : You're the negative which people forget to write while solving $x^2$-$a^2$=0.
**M2** : You're the lim x->0 (1/x).

There's a pindrop silence all of a sudden!The reason is that M1 and M2 were assigned to Research on Fermat's last theorem **(Fermat's conjecture)** !

And a small bit of conversation goes like this.
**M1** : You're infinite, I'm proud to be your friend.
**M2** : You're tan(π/2).

- Shrikari Sharvani M S

# DIGITAL MUSIC - A CONSEQUENCE OF FOURIER

The Fourier transform is a fundamental mathematical tool that has revolutionized the field of digital music. At the heart of digital music is the concept of pulse-code modulation (PCM), where sound waves are sampled at regular intervals and converted into a sequence of numerical values. This discrete-time representation of the audio signal can then be transformed into the frequency domain using the Discrete Fourier Transform (DFT) . Discrete Fourier Transform (DFT) is given by

The *discrete Fourier transform* transforms a sequence of $N$ complex numbers $\{\mathbf{x}_n\} := x_0, x_1, \ldots, x_{N-1}$ into another sequence of complex numbers, $\{\mathbf{X}_k\} := X_0, X_1, \ldots, X_{N-1}$, which is defined by:

Discrete Fourier transform

$$X_k = \sum_{n=0}^{N-1} x_n \cdot e^{-i2\pi \frac{k}{N} n} \quad \text{(Eq.1)}$$

One key application of the DFT in digital music is the creation of the chromagram - a visual representation of the pitch content of an audio signal over time . By applying the DFT, we can identify the prominent frequencies (i.e. pitches) present at each moment, allowing us to analyze the harmonic structure of a musical piece.

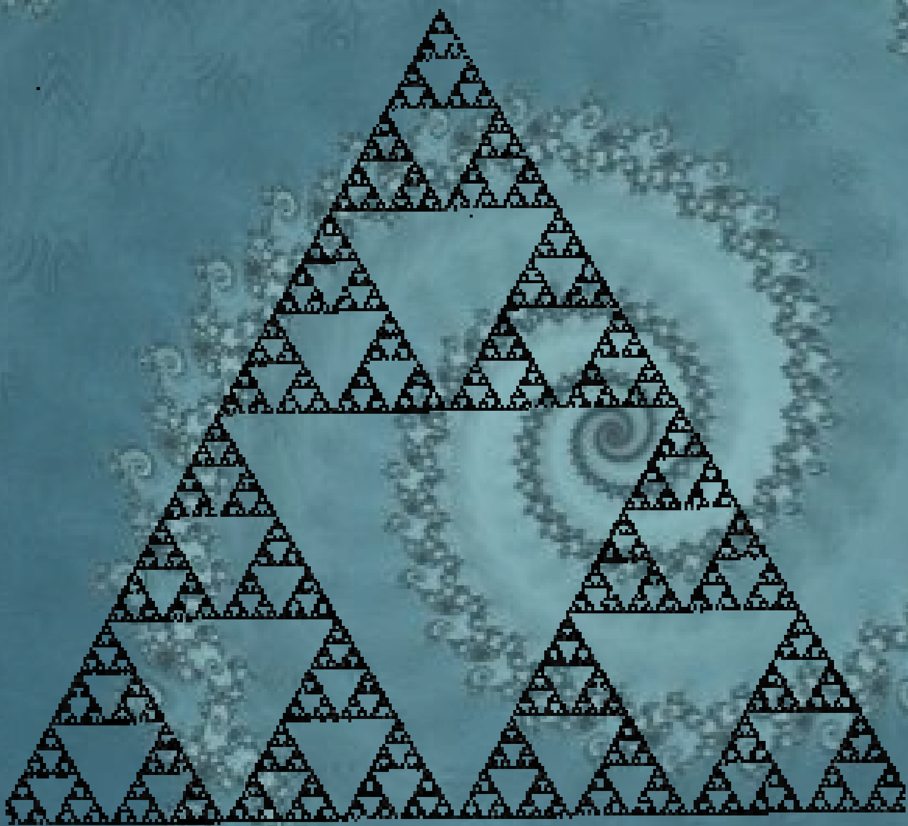
# CAN SOMETHING HAVE FRACTIONAL DIMENSIONS?

## *EXPLORING THE WORLD OF FRACTALS*

***- G N CHARAN REDDY (III BSC PM)***

In classical geometry, shapes have integer dimensions. A point has a dimension of 0 , a line has a dimension of 1 , an area has a dimension of 2 and volume has a dimension of 3 . From these elements--points, lines, areas and volume--we derive the basic shapes of traditional geometry: triangles, squares, circles, cones, cubes and spheres .

The Hausdorff-Besicovitch dimension, introduced by Felix Hausdorff and Abram Besicovitch, revolutionized mathematics by introducing non-integer dimensions. These dimensions, which are related to the varying information content of curves, provide a "in-between" dimension, allowing for more complex shapes with varying dimensions.



**This is a picture of a Sierpinski Triangle**

# CAN SOMETHING HAVE FRACTIONAL DIMENSIONS?

## *EXPLORING THE WORLD OF FRACTALS*

***- G N CHARAN REDDY (III BSC PM)***

This is a picture of a Sierpinsky Triangle: To generate it, we begin with an equilateral triangle. Draw the lines connecting the midpoints of the three sides and remove the center triangle. Note that our new triangle contains 3 “miniature” triangles. Each side = ½ the length of a side of the original triangle., and each “miniature” triangle looks exactly like the original triangle when magnified by a factor of 2. Notice the second triangle is composed of 3 miniature triangles exactly like the original. The smaller triangles could be scaled by 2 to produce the entire triangle (S = 2). The resulting figures consists of 3 separate identical miniature pieces. (N = 3).So, its dimension(D) is given by:

Code to find the dimension

$$
\begin{aligned}
S^D &= N \\
2^D &= 3 \\
\log(2^D) &= \log(3) \\
D*\log(2) &= \log(3) \\
D &= \log(3)/\log(2) \\
D &= 1.585 \ (\textit{not an integer!})
\end{aligned}
$$

# CAN SOMETHING HAVE FRACTIONAL DIMENSIONS?

## *EXPLORING THE WORLD OF FRACTALS*

***- G N CHARAN REDDY (III BSC PM)***

Fractals are found all over nature, spanning a huge range of scales. We find the same patterns again and again, from the tiny branching of our blood vessels to the branching of trees, lightning bolts, and river networks. Regardless of scale, these patterns are all formed by repeating a simple branching process. A fractal is a picture that tells the story of the process that created it.

**Fractals In Nature**
**fig 1 : A river delta from space**
**fig 2 : Lightning bolt**
**fig 3 : Snowflake**
**fig 4 : Tree and it's branches**

# GROUPS IN THE WORLD OF SYMMETRY

*- PRAKRUTHI S. (I BSc MS)*

Symmetry is one of the words we often hear to when we talk about mathematics in Nature. Yes, not only nature, the whole universe is symmetrical. For example a tree, a leaf, a flower, human body, animals, insects, heavenly bodies like planets and stars and the list is countless. To understand these symmetries and structures of various mathematical and scientific disciplines, we need something to help us with. And here comes the mighty "Group Theory" to help us comprehend symmetries and structures. What is a 'group' in the first place? A group consists of elements and is bounded by some axioms. But the mathematical definition of group states that a group is an essentially a set of elements along with a binary operation that satisfies specific properties like associativity, law of indentity, law of inverse and closure law. So, group theory is the study of these group. How did this evolve?

# GROUPS IN THE WORLD OF SYMMETRY

*- PRAKRUTHI S. (I BSc MS)*

The rise of group theory wasn't a single Eureka moment but rather the culmination of ideas from various mathematical areas in the 18th and 19th centuries. In the 18th century, the seeds of group theory were sown in Number Theory by Euler, Geometry by various mathematicians and the study of Permutation in solving Algebraic equations by Lagrange, Ruffini, Abel et.al. Building on these ideas, by 19th century, mathematicians like Augustin Louis Cauchy and Evariste Galois laid the groundwork for group theory as a distinct discipline. Galois, coined the term "group." How does this theory help us? Where do we see them around us!?

Crystals are fascinating examples of natural order, characterized by their repeating patterns of atoms in three-dimensional space. Group theory proves to be a powerful tool for classifying these crystal structures based on their inherent symmetries. Imagine a cube of salt (sodium chloride). It exhibits a specific arrangement of sodium and chlorine ions. Now, consider all the possible rotations, reflections, and translations that leave this basic structural unit, unchanged. These symmetry operations, when combined, satisfy the properties of a group under group theory. By understanding the symmetry group of a crystal, scientists can predict various properties, including Crystal stability (The structure's ability to resist external forces), Conductivity (How well the crystal conducts heat or electricity) etc.

# GROUPS IN THE WORLD OF SYMMETRY

*- PRAKRUTHI S. (I BSc MS)*

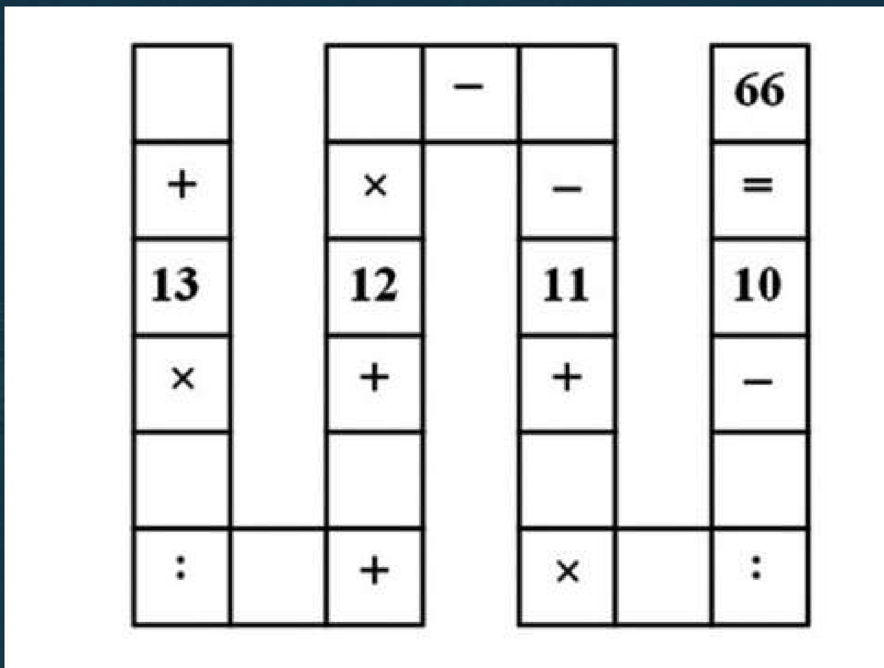
Let us consider another example of a Rubik's cube. The set of all possible moves on a Rubik's Cube can be considered a group. Each move is an element in the group, and combining two moves (like a right turn followed by a left turn) is analogous to the group operation. Group theory helps analyze the properties of these moves and their combinations, providing a framework for understanding how to solve the cube efficiently.

The mathematical examples of Group theory can be the study of integers under addition, non-zero real numbers under multiplication etc.

To conclude, Group theory's applications reach far beyond the realm of abstract mathematics. From physics and chemistry to coding and cryptography, the ability to understand and manipulate groups empowers us to solve complex problems and unlock new discoveries. So, how can you delve deeper? Explore applications in a specific field that interests you, or tackle group theory exercises to solidify your understanding. The world of symmetry and structure awaits!

# PUZZLE MANIA

*ccording to VNEXPRESS,*
*This puzzle is meant for third graders/year 3 students (8 year olds) in Vietnam!*




*All you have to do is use the digit 1 to 9 once to fill in the boxes to make the entire equation equal to 66. The expression should be read from left to right.*

*Sounds easy? Not quite.*

*the boxes containing colon represents division.*

## FOR FURTHER QUERIES , CONTACT US AT: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