MATH HONOR SOCIETY
CALCUTTA INTERNATIONAL SCHOOL

CALCUTTA INTERNATIONAL SCHOOL
KOLKATA-107

Calcutta International School

MATH HONOR SOCIETY

2019-2020

presents

The Winter Edition

of the

The Math Newsletter

The Board

PRESIDENT- ARJUN ARORA

Our President, Arjun Arora, has been a quintessential constituent of the Math Honor Society ever since its commencement in 2018. Arjun is a rather eccentric individual with a deep-seated love for Mathematics that he has been nurturing for years, culminating in him achieving this prestigious position at our club.

Arjun's perspicacious nature has allowed him to unearth a sizable portion of Mathematics' myriads of beautiful mysteries and impart his knowledge to his peers. Although he is a man of many interests, his academic potential outshines all else, and his ambition to study Mathematics and Computer Science at university is what drives him today. He ensures his enthusiastic participation in extra-curricular activities like football, cricket, table tennis and badminton does not hamper his academic performance in the IB Diploma Programme and wishes to maintain this balance throughout his school life.

Arjun has a lot planned out for the Math Honor Society this year!

VICE- PRESIDENT- SRINJOY MAJUMDAR

Our Vice President, Srinjoy Majumdar, seeks to transform the way students percieve the Math Honour Society throughout the course of the year. Notwithstanding Srinjoy's perception on the entertaining nature of creative mathematical pursuits, but also his aim to **integrate** his excessive passion for advanced mathematics into school curriculum will hopefully give students with similiar interests a platform to express, innovate and apply their knowledge outside a controlled environment. He looks forward to creating many opportunities for doing so.

SECRETARY: ROHAN BANERJEE

Our Secretary, Rohan Banerjee, wants to change people's perspective on math as not only number that we are forced to learn but the underlying patterns that are formed due the abstractions of basic addition and logic.He is fueled by his laziness to find the easiest way out and least annoying way out(and most of the time the stupidest way).
Rohan has many interests mainly ranging STEAM subjects. He especially loves learning about the human brain and how people think. Another distinctive feature about Rohan is his inability to talk about himself positively without feeling immense pain.
Rohan wants the math honor society to help foster the interest of people on the topic of math

TEACHER-IN-CHARGE: MRS SARIKA MAIWAL

The Weird Sum

What is the sum of all positive integers? Obviously, you tell yourself it can't be anything but infinity. However, what I told you answer could, in fact, be -1/12? Yes, 1 + 2 + 3 + 4... may be an absurd negative fraction. Once you go through the reasoning and proof, it doesn't seem ridiculous at all, and yet, it most certainly is. I'm going to briefly outline one of several proofs so you can judge for yourself whether the answer is nonsense or logic.

Consider the following infinite series:

$$A = 1 - 1 + 1 - 1 + 1\ldots$$
$$B = 1 - 2 + 3 - 4 + 5\ldots$$
$$C = 1 + 2 + 3 + 4 + 5\ldots$$

Proving A = A½

Subtract A from 1:

$$1 - A = 1 - (1 - 1 + 1 - 1 + 1\ldots)$$

Simplifying, you get

$$1 - A = 1 - 1 + 1 - 1 + 1\ldots = A$$

Hence, $1 - A = A$

$$1 = 2A$$
$$A = \tfrac{1}{2}$$

Proving B = ¼

Subtract B from A:

$$A - B = (1-1) + (-1+2) + (1-3) + (-1+4)\ldots$$
$$A - B = 0 + 1 - 2 + 3 - 4\ldots = B$$

Simplifying, you get

$$A - B = B$$
$$A = 2B$$

Since $A = \tfrac{1}{2}$ (check proof above),

$$\tfrac{1}{2} = 2B$$
$$B = \tfrac{1}{4}$$

Final step

Subtract C from B:

$$B - C = (1-2+3-4+5-6\ldots) - (1+2+3+4+5+6\ldots)$$
$$B - C = (1-2+3-4+5-6\ldots) - 1-2-3-4-5-6\ldots$$
$$B - C = (1-1) + (-2-2) + (3-3) + (-4-4) + (5-5) + (-6-6)\ldots$$
$$B - C = 0 - 4 + 0 - 8 + 0 - 12\ldots$$
$$B - C = -4 - 8 - 12\ldots$$

Factor out the -4, and you get

$$B - C = -4(1+2+3\ldots)$$
$$B - C = -4C$$
$$B = -3C$$

Since $B = \tfrac{1}{4}$

$$\tfrac{1}{4} = -3C$$
$$C = -1/12$$

Made complete sense, did it not? Sadly, the entire proof can collapse with just one simple assertion: divergent infinite sums cannot be treated as finite sums.
Consider the sequence $x = 1 + 1 + 1 + 1\ldots$
Adding 1 to it, you get
$1 + x = 1 + (1 + 1 + 1\ldots) = x$
$x + 1 = x$
$1 = 0$
As soon as you see this, you know something went horribly wrong. That happened because a divergent infinite sum was treated as a finite one.Â

That said, renowned summation methods like the Ramanujan Summation and Zeta function regularisation, which assign a finite value to a divergent infinite series, define the sum of all natural numbers to be -1/12. However, any method that assigns a finite value to the sum $1 + 2 + 3\ldots$ is said to be unstable, since it can be used to prove contradictions like the one shown above.Â

Despite many criticisms of this contentious result, $1 + 2 + 3\ldots = -1/12$ has been used to derive equations in string theory and quantum field theory (both of which are famous theories in physics) since it supposedly provides more accurate results (yeah, I don't know how).

All this simply goes to show that mathematics is an ever-intriguing field in which extremely counterintuitive and mind-blowing results can, in fact, make sense.

-Kiron Deb

All Math is Useful

Even the most avid mathematicians and admirers of the subject have, at some point, found themselves trapped at a point deep in its web where they've asked themselves the question: sure, but so what? Sure, let's say the time coordinate is getting multiplied by some constant, but what difference does that make?

As we delve deeper into the more abstract and complicated aspects of advanced mathematics, it becomes extremely easy to lose touch with what it actually entails in the real world. However, to a large extent, math is always useful.True mathematicians work for the math and not the applications but they also somewhere know for a fact that their work has major applications.For example, when initially thought up, the Schrodinger Equations were developed purely to feed curiosity with regard to the theoretical matter underlying wave functions. However, the applications for the same discovered much later are insanely widespread.

The idea that all math is useful works at all levels. Even the six remaining millennium problems -the most difficult mathematical questions asked by man that remain unsolved till date - have extremely significant implications to the real world. For example, one of the millennium problems is better known as P vs NP. The question this asks is “if we can (quickly) verify the solution to any given problem, can we also solve it (quickly)”. The name comes from the idea that class P covers problems that an algorithm can quickly give an answer to and that class NP covers those which can be quickly verified using some algorithm and effectively proving P = NP or P ≠ NP is the real challenge. Widely accepted as one of the most advanced problems mathematics has to offer, this is also the problem with the most abundant implications.

As a matter of fact, math, no matter how advanced, is the most useful tool we have. It is the only completely rational and logical way to interpret the universe. In fact, even physicists use math to predict and prove outcomes before they can logically explain why they happen. For instance, something known as the Barn Problem is a very well known issue at the juxtaposition of length contraction and time dilation in particle physics and the solution to this problem was purely mathematical. Understanding this solution gave physicists useful insight into very key concepts in special relativity spacetime fluctuations and the consistency of events through inertial rest frames in the same.

(you can read more about p vs np on
http://www.claymath.org/millennium-problems/p-vs-np-problem
and the barn problem on
http://www.math.ucr.edu/home/baez/physics/Relativity/SR/barn_pole.html)

-Yashvardhan Pansari

Fibonacci

On 6th September, Prof. Asok Mallik came to our school to give a talk on the Fibonacci sequence: what makes it so special, and its occurrences in nature. I will attempt to summarise and simplify its contents in this article.

You all have probably heard of the Fibonacci sequence, or the Fibonacci numbers. The Fibonacci sequence is basically a set of numbers where the sum of two consecutive terms is the next term. The sequence starts with 0 and 1. So the third term is:0+1=1; and the fourth term is 1+1=2. And so on..

These are the first ten terms of the sequence:0,1,1,2,3,5,8,13,21,34,56.

Now, something really cool about this sequence is that the ratio of consecutive terms seems to converge to a single number. Here's a demonstration:
1/1=1

2/1=2

3/2=1.5

5/3=1.67

8/5=1.6

If you keep going you will find that at infinity the number becomes a constant; an irrational number known as φ (pronounced 'phi'). Its value is approximately 1.6180339... This value can also be derived algebraically.

Two special properties of φ are: ($\Phi^2 = \Phi + 1$)

$$(1 / \Phi = \Phi - 1)$$

These relationships are derived from dividing a line at its golden section point, the point at which the ratio of the line (A) to the larger section (B) is the same as the ratio of the larger section (B) to the smaller section (C).

The first equation can be rewritten as:
$(\varphi^2) - \varphi - 1 = 0$
the solution to this is found with the quadratic formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Using this we find that the value of φ is $(1 + \sqrt{5}) / 2$.
φ also frequently occurs in nature. Your mouth and nose are each positioned at golden sections of the distance between the eyes and the bottom of the chin.

And if you think this is because you're special or something, you're not. φ is found in proportions of spiral galaxies, flower petals; the list is basically endless! Even the sides of the rectangle of the logo of national geographic are in the ratio of 1:1.618.

The fundamental fact of life is - Mathematics pervades all branches of your life, and φ is just one of the examples. If you found this article on φ interesting, be sure to research more about it online! There's a lot more to φ than what is mentioned in this article, and I can promise you, you will not be bored.

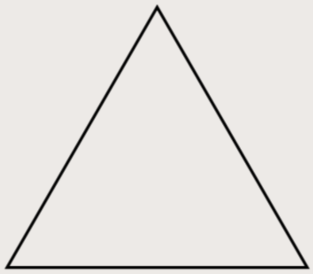
- Arjun Sen

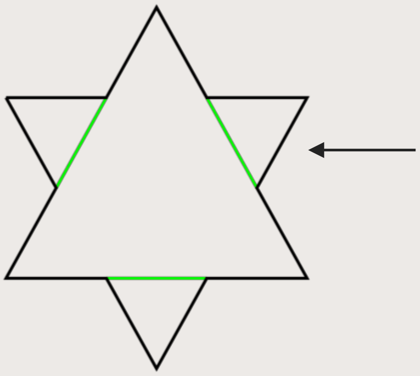
Fractals

What's common between a smart phone and a snowflake? The answer is never ending patterns known as fractals.

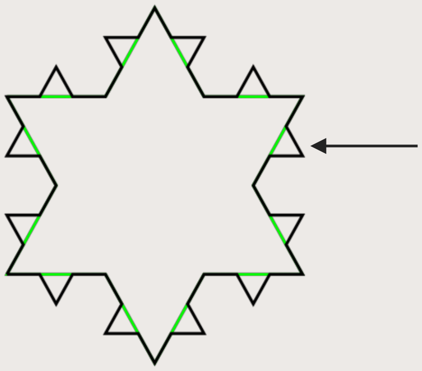
Now, what are fractals you might ask?

Fractals are repeating patterns that continue infinitely. For example, let us try drawing a snowflake by first drawing an equilateral triangle. We will call this stage 0.

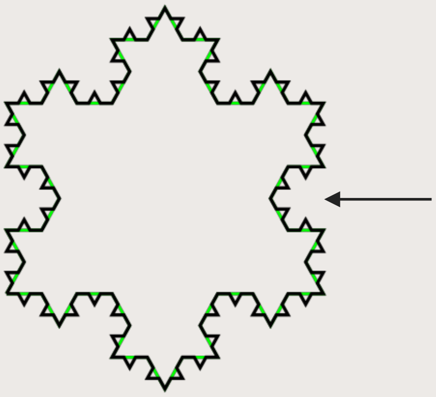




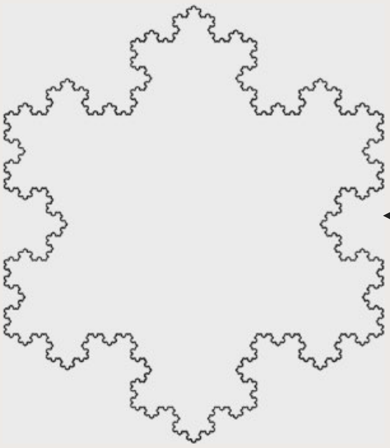
Then to move onto stage 1, we draw another equilateral triangle at the midpoint of each side, to get this



And for stage 2 we repeat again, by drawing another equilateral triangle in the midpoint of each of the 12 sides to get this:



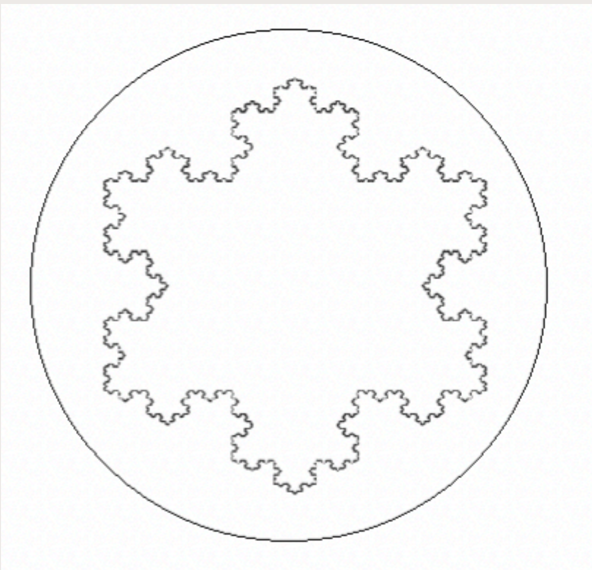
Repeat the process yet again and we get stage 3



After infinitely repeating this, our final result will look like this

Beyond a certain point, it is indiscernible to the naked eye, but as you keep zooming in you will be able to see the exact same pattern no matter how much you zoom in. These patterns are called fractals.

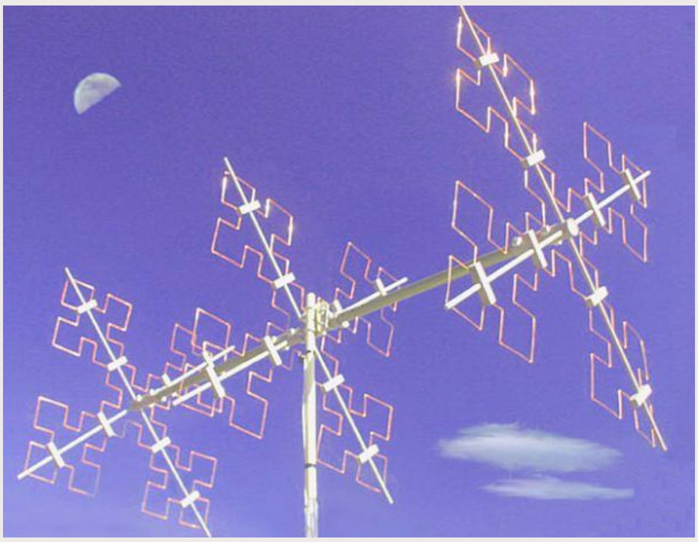
This snowflake we drew has a special name called the Koch Snowflake. As we move onto the next stage, each single side becomes 4 sides, so at stage 1 we will have 3*4 sides. Now after each stage, the number of sides will become 4 times as many, so we can say for stage n, we will have 3*(4**n) sides. Now after an infinite number of repetitions, we will have 3*(4**infinite) sides, which adds up to infinite. Since there are an infinite number of sides, the perimeter of the snowflake will be infinite, but their area will be finite. We can prove this by drawing a circle around the Koch Snowflake. We will be able to see that the snowflake will never cross the circle, so it must have an area that is smaller than the area of the circle.



Now you're probably wondering what the uses of these fractals are. There are many uses of fractals, starting with art. Images created by fractals appear complex, yet striking. Some artists consider fractal art to be true art. Artists such as Jackson Pollock and Max Ernst have created pieces that appear chaotic, yet defined.

Jackson Pollock's Autumn Rhythm (Number 30)

Aside from art, fractals are used in computer graphics, especially in the use of landscapes. When creating the image of a mountain, artists would start with a tetrahedron, and repeatedly split it into three to four smaller tetrahedrons and add them onto the original tetrahedron. This follows process similar to the construction of the Koch Snowflake except in three dimensions.



Fractals are also used in antennas. Normally, an antenna must be a multiple of the wavelength of the electromagnetic wave that it is receiving, and can therefore only receive one wavelength of EM waves. However using fractals, antenna can receive multiple different wavelengths. The more the repeated patterns, the more wavelengths it can receive.

-Ethan Hugh

The Math Honor Society Event

We hosted Profesor Asok Kumar Mallik on 6th September who gave us a talk titled ‘From Natural numbers to numbers and curves in nature’. Sir has taught at IIT Delhi, IIT Kanpur and IIEST Shibpur. He was a Commonwealth scholar at The Institute of Sound and Vibration Research at Southampton, England and an Alexander von Humboldt Fellow at TH Aachen and TU Darmstadt, Germany. He is a recipient of the Distinguished Teacher Award of IIT Kanpur, Indian National Science Academy Teacher Award. He is an elected Fellow of the Indian National Academy of Engineering (FNAE), National Academy of Sciences, Allahabad, (FNASc), Indian Academy of Sciences, Bangalore (FASc) and the Indian National Science Academy, New Delhi (FNA). Besides contributing a couple of book-chapters, he has authored/coauthored 9 books and more than 85 research papers in International Journals. He has written articles and books on Mathematics and Physics at a popular level.

MERRY CHRISTMAS

&

HAPPY NEW YEAR

Edited,Designed and Compiled by-
Varenya Jalan