DEPARTMENT OF MATHEMATICS

KAMALA NEHRU COLLEGE

AXIOM'20

VOLUME 9

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We are not a team because we work together. We are a team because we respect, trust and care for each other.

~ Vala Afshar

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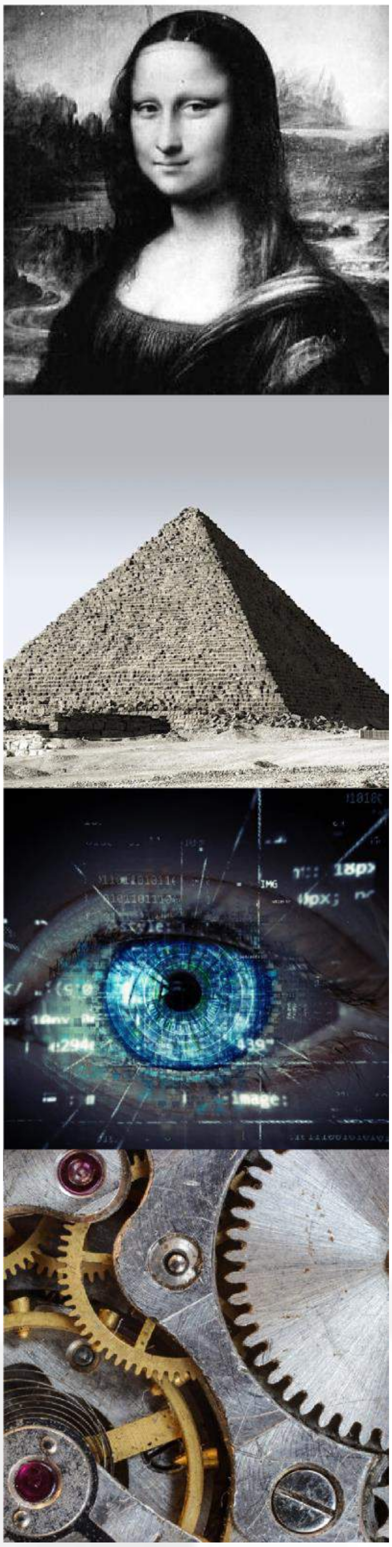


TEACHER IN-CHARGE'S DESK

Great teachers consider their student's success as a reflection of their own.

Each year, the members of the Editorial Team work together with the students to compile the Annual Newsletter-Axiom of the Department. This newsletter acts as a platform where students can share their approach and understanding towards the various aspects of the subject. It encourages the students to think out of the box for the new dimensions of the subject and enhance their knowledge.

Problems in mathematics invite students with different thought processes to approach it differently. Most paradoxes can be solved by merely crossing the language barrier, while others tend to have a mathematical enigma. Every student has a different understanding of these riddles and hence has a different course of action moving forward with it which is clearly portrayed in this year's version by our students.

I admire the perpetual endeavour of these students and also the faculty who have guided and mentored them in compiling this newsletter. Axiom'20 will showcase the broad thinking, cognition and inquisitiveness of the students for the numerous fields of the subject.

The Analytical Engine has no pretensions to originate anything. It can do whatever we know how to order it to perform.

~Lady Lovelace

Dr. Pooja

EDITOR'S DESK

Teamwork is the ability to work together toward a common vision. The ability to direct individual accomplishments toward organizational objectives. It is the fuel that allows common people to attain uncommon results.

~Andrew Carnegie

It gives me immense joy and satisfaction to present Axiom'20 - the annual newsletter of the Department of Mathematics.

This edition will take you on a journey filled with instances of the far and wide reach of mathematics and will endeavour to amaze you with the prodigious aspects of the subject. The frolic factors of the newsletter will not only delight you as you read along but glimpses of the past year will also bring back the winsome memories.

Each year, a lot of unequalled effort is put up, not only by the team members but also by the students and the teachers in compiling the newsletter and making it the gem it is. Hence, it is my solemn duty to acknowledge the endeavour of all those who have contributed towards the successful completion of the newsletter in their own way.

Foremost, I would like to sincerely thank my team members: **Geetanjali, Jaishree Garg, Muskan Arora, Aarushi Kansal** and **Soumya Gulati** for their efficient and committed hard work. Without their constant support and motivation, the newsletter would not be what it is.

I would also like to take this opportunity to sincerely acknowledge the hard work and dedication put in by the students in their ingenious pieces.

At the same time, I would like to express my profound gratitude and deep respect for our teacher coordinators**, Dr. Mohammad Mueenul Hasnain** and **Ms. Divya Saigal** for periodic extensive discussions and their valuable advice and guidance.

I would also like to extend my heartfelt gratitude to our Principal, **Dr. Kalpana Bhakuni** and our department's Teacher In-Charge, **Dr. Pooja**, for providing us with the opportunity of publishing Axiom'20.

I hope our efforts bear fruitful results and our readers have immense pleasure in reading the newsletter.

Vanshika Singhal

GRAPHICAL INTERPRETATION OF SOCIAL NETWORK

Social network is the structure that shows the relations between individuals and organizations. It indicates the ways in which they are connected through various social familiarities ranging from casual acquaintance to close familiar bonds.

These relations can be mapped using graphical methods describing how one can access the resource of other user(s). A graph is made up of vertices and edges; just like that social media is a kind of a social network, where each person or organization is represented by a vertex and the edges represent the interdependence on each other via common interests, relations, mutual friends, knowledge, common likes/dislikes etc.

On the basis of edges, graphs can be classified as:

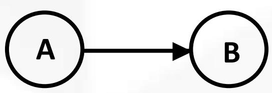
- Graph with Directed edges: Here the edges/arcs between two vertices have a particular direction; they are directed from one vertex to another. It is usually represented by an arrow.

- Graph with Undirected Edges: Here the edges do not have any particular direction from one vertex to another. It represents a both sided relation between them I. E., it is basically a bidirectional graph. There is no difference between the two vertices connected via one undirected edge. It is usually represented by a straight line.

In a graph, the degree of a vertex ‘v’, denoted by deg(v) is the number of edges incident to that vertex. Since in a graph, vertex represents a user and an edge represents a relation, a user's degree represents the number of friends the user can have or the number of pages he likes. It gives an overall idea of how many social acquaintances an individual is having.

Graph Theory in Facebook: Most of us are familiar with Facebook these days. You can click ‘like’ if you find something likeable, ‘tag’ your friends in various ‘posts’, put comments in posts and most importantly befriend someone whom you know and also someone whom you don’t know!

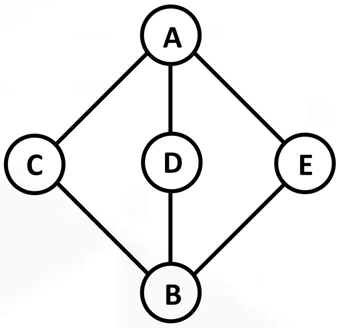
The concept of graph theory is used in Facebook with each person as a vertex and every like, share, comment, tag as an edge. When you send someone a friend request, it can be shown with a directed graph and when the person accepts your friend request you both have access to each other's data represented by an undirected graph.

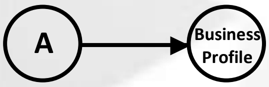


User A sends friend request to user B

User B accepts the friend request

Consider two unknown users A and B. If they have three mutual friends C, D and E who are unknown to each other then they can be represented using a complete bipartite graph K (2,3) (here) with 2 vertices sets (A, B) and (C, D, E). (In general, a complete bipartite graph is the one where every vertex of the first set of vertices is connected to every vertex of the second set but not within their own set).

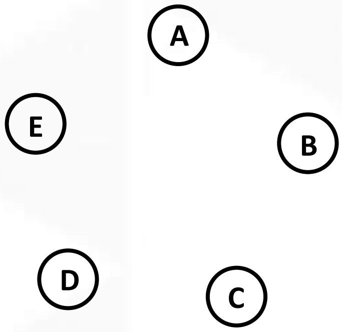


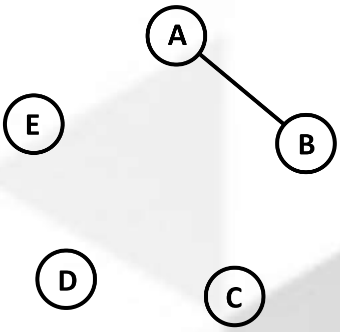


When you follow a business profile or an artist, a directed graph is formed.

Graph Theory in WhatsApp: In WhatsApp, it shows the contacts of the people who are using WhatsApp. It can be compared as the set of all vertices.

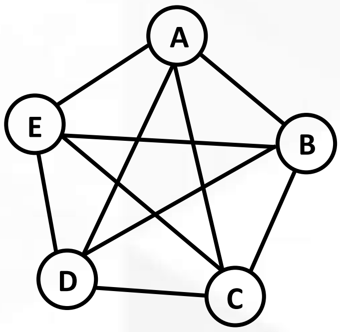
Let there are 5 people using WhatsApp represented by 5 vertices- a, b, c, d, e (say). When all persons are idle, there is no communication and thus will be represented by a null graph.





When 2 people are in chat it means they are connected i.e. there exists an edge between them.

When all 5 users are communicating in a group chat, it represents a complete graph since every pair of users in communicating i.e., there exists an edge between every pair of users.



Graph Theory in Twitter and Instagram: Here the people are considered as vertices and if one person follows another then we say there exists an edge between the two but in One Direction only i.e., a directed graph until the other person follows back.

Hence, we can study the different relations among individuals and organizations and how they are connected to the ones far away from them on social networking sites in the form of a graph.

Geetanjali
IIIrd Year

GOLDEN RATIO PHI

As we mathematicians like to say, Phi is one H of a lot cooler than Pi!

~Dan Brown

The golden ratio denoted by φ was discovered by the mathematician Hippasus in 5 B.C. Two quantities are said to be in golden ratio if their ratio is equal to the ratio of their sum to the larger of the two quantities.

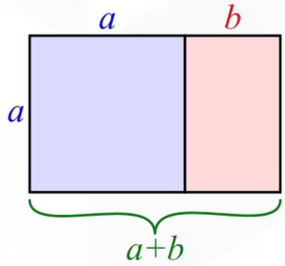
Mathematically, let the two quantities be 'a' and 'b' such that $a > b > 0$, then if

$$\frac{a+b}{a} \approx \frac{b}{a} = \varphi = \frac{1+\sqrt{5}}{2} = 1.6180339887 \ldots \qquad (1)$$

It can be seen that the value φ is an irrational number. It is the solution of the quadratic equation $x^2 - x - 1 = 0$ which can be shown as follows:

Let us consider,

$$\frac{a+b}{a} \sim 1 + \frac{b}{a} = \varphi$$

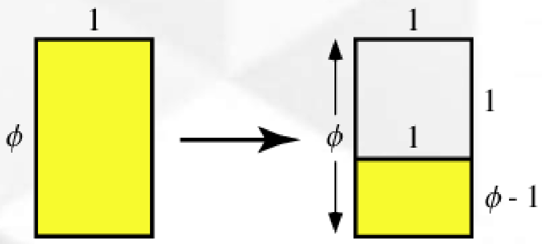


If we substitute $\frac{b}{a} = \frac{1}{\varphi}$, then

$$1 + \frac{b}{a} = 1 + \frac{1}{\varphi} \Rightarrow 1 + \frac{1}{\varphi} = \varphi.$$

The golden ratio is considered beautiful for its aesthetic sense, creating and appreciating a sense of beauty through harmony and proportion. It has been seen that our brains prefer objects and images that use the golden ratio. It is a subconscious attraction and small changes that make an image truer to the golden ratio have a large impact on our brain. The golden ratio has wide applications in the field of geometry, for example, the division of a line into extreme and mean ratios, the drawing of a pentagon, etc. The golden ratio is often depicted by a golden rectangle. If a square with side length equal to the shortest side of the rectangle is partitioned from the original rectangle then the leftover rectangle will have the same proportion as the original rectangle.

The importance of the golden ratio was deeply studied by Fibonacci. One would be astounded to learn the very famous Fibonacci sequence is true to the golden ratio. In



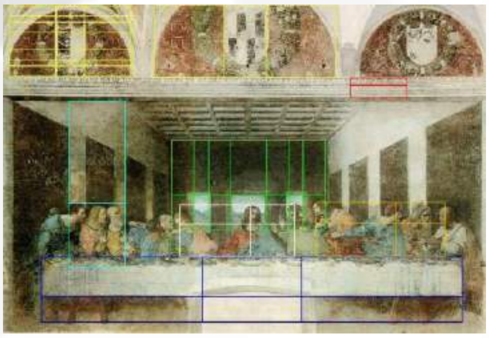
the Fibonacci sequence 1, 1, 2, 3, 5, 8, 13… each term is the sum of the previous two terms. If we divide each number by the previous number, we get

$$\frac{1}{1} = 1, \frac{2}{1} = 2, \frac{3}{2} = 1.5 , ...,$$

which results in a sequence

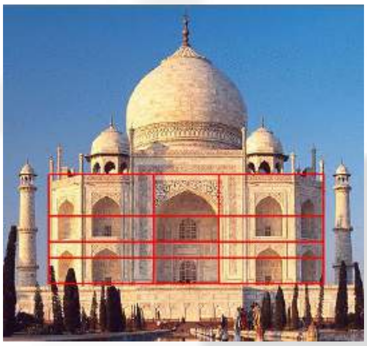
$$1,2, 1.5, 1.666, 1.6, 1.625, 1.615 \ldots, 1.619 \ldots, 1.6176 \ldots, 1.6181 \ldots, 1.6179 \ldots, \ldots$$

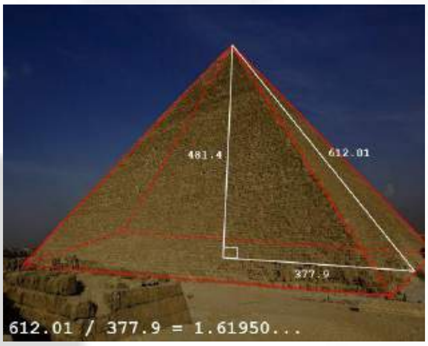
and so on.

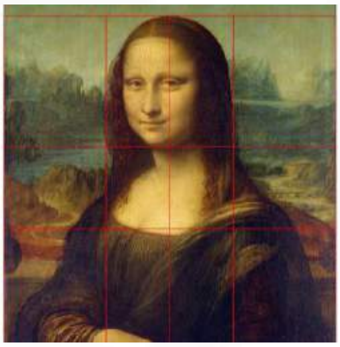


The beauty of the golden ratio has been appreciated for thousands of years. It can be used to create pleasing, organic-looking composition. The famous artist Leonardo DaVinci widely used the golden ratio. In his painting 'The Last Supper', DaVinci has positioned the disciples of Jesus using the golden ratio and the position of Jesus is plotted by arranging the golden rectangle across the canvas.

From the famous Mona Lisa, the proud Parthenon in Athens, the sky kissing pyramids of Giza, the Michelangelo's "The Creation of Adam" in Sistine Chapel, the Pepsi Logo to the simple pointy needle all are in the golden ratio.

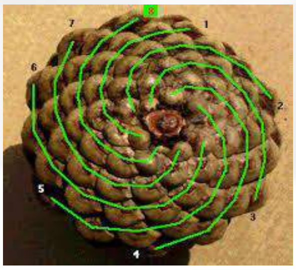


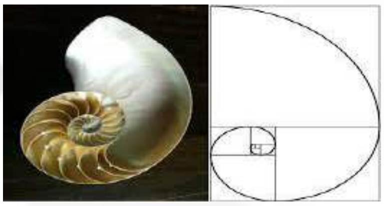




The most bewildering fact is that the Taj Mahal built by Emperor Shah Jahan is designed using the golden ratio where the rectangles that served as the outlines of the exterior of the building were in golden ratio.

The golden ratio was called the "Divine Proportion" by Luca Pacolli. It was observed that all animate and inanimate objects in nature follow the divine proportion. To receive the maximum sunlight, the petals of the flower are arranged according to the divine proportion. The seeds in a pod, the pinecones, the spiraling patterns on pineapple and cauliflower, a volcano, the honey bee colony, the snail shell, the tree branches, and all that one can name are in the divine proportion. In fact, the proportion and measurement of the human body also follow this beautiful number including our D.N.A. molecule.






The golden ratio is a mathematical concept that makes us see the way nature provides a system of proportioning. This system organizes and symphonizes our life and makes the world more beautiful.

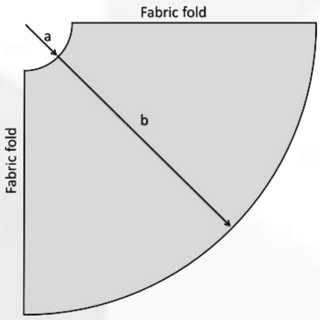
Injila Naeem
IIIrd Year

A Mathematical Approach To Designing

The world of fashion designing is a walkthrough of current trends and styles. Fashion is an art and the beauty of it lies in symmetricity of its designs! Fashion designers have an out of the box thinking but all these great minds have one thing that aligns them together- Mathematics! Yes, that's right.

People are of the perception that mathematics is self-contained and austere. But, contrary to layman thinking, mathematics is a richly enabled art that acts as an aid in understanding the deep interconnections in the world. The roots of creativity are in built in a designer's mind and through the application of simple math, it gains the potential to discover incredible beauty.

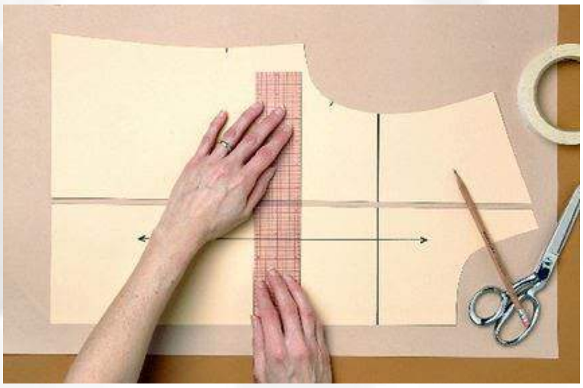
One would wonder where exactly does mathematics come into the picture?



To start with the basics, designing requires paperwork for sampling. A designer can make thousands of rough sketches before the final clothing line is launched. Designing a sketch in itself requires use of basics of mathematics-angles and shapes. Making a mathematically accurate sketch with perfect alignment is considered as intricate work. After finalizing a design, a designer has to figure out the fabric requirement that again implies the use of the concept of area per square feet.

One calculates the length of the fabric required in measuring units and here under comes the use of mensuration and imagination. In addition to this, trimming and cutting of fabric is equally technical and mathematical.

Another branch of mathematics- elementary mathematics, finds its use when one



measures the sample garment for size consistency and fitting comfort. Isn't it easier to shop by standard sizes like S, M or L rather than taking note of one's measurements and then searching for those specific sizes everywhere? Standard sizes use a scale of measurement thereby employing elementary mathematics. Not only this, knowledge of fractions also comes in use when measurements of patterns are not in an easier format of whole numbers.

Apart from this, a thorough understanding of geometry is required while mapping a two-dimensional pattern, designed to fit a three-dimensional human body. Counting the number of buttons or extra trims and stitches seems like an easy job but in the world of a designer, one miss and the dress turns out to be something they did not wish for. Any arithmetical error can lead to a huge cost overrun.

There are numerous other examples as these that collectively tell us one thing, fashion designing and mathematics walk hand in hand and that designers are hidden math geniuses!

Jaishree Garg
IIIrd Year

PORTAMENTO EFFECT AND MATHEMATICS

A musical effect, now achieved with maths framework.

~Unknown

In music, we often hear a singer or certain musical instruments gliding seamlessly from one pitch or tone to another with a smooth succession. Nearly all musicians know this as portamento, a term that has been used for hundreds of years, referring to the effect of blending a note at one pitch into a note of a lower or higher pitch. But only instruments with continuous variation in their pitch -- such as the human voice, string instruments, and trombones -- can pull off this effect. Not every instrument can achieve it, however, this continuous varying of pitch is possible only for the trained human voice, besides string and some other instruments.

An algorithm that produces a portamento effect between any two audio signals in real time has been invented to smoothen this transition. Trevor Henderson, a graduate in computer science from MIT, in an experiment showed that the algorithm flawlessly merged various audio clips such as piano notes gliding into a human voice and one song blending into another. His paper won the "best student paper" award at the recent International Conference on Digital Audio Effects for describing this algorithm.

The algorithm relies on the basic concept of "optimal transport," a geometry-based framework that determines the most efficient ways to move objects -- or data points -- between multiple origin and destination configurations. Optimal transport has been applied to formulate the study of supply chains, fluid dynamics, image alignment, 3-D modelling, computer graphics, and more.

"Optimal transport here is used to determine how to map pitches in one sound to the pitches in the other," says Henderson. According to Henderson, this is a unique technique to apply optimal transport to transform audio signals. While explaining the various uses of this algorithm, he mentioned that he has already used it to build equipment that seamlessly transitions between songs on his radio show. The algorithm, thus, is of major use to the music world. DJs could also use the equipment to transition between tracks during live performances. Other musicians might use it to blend instruments and voice on stage or in the studio.

A good way to think of optimal transport according to Henderson is finding "a lazy way to build a sand castle." In that analogy, the framework is used to calculate the way to move each grain of sand from its position in a shapeless pile into a corresponding position in a sand castle, using as little work as possible.

Applying this theory of mixing two audio clips involves some additional ideas from signal processing. Musical instruments produce sound through vibrations of components, depending on the instrument. Violins use strings, brass instruments use air inside hollow bodies, and humans use vocal cords. These vibrations can be captured as audio signals, where the frequency and amplitude (peak height) represent different pitches. The mixing of these pitches can be achieved by fading one of them and raising the other.

Conventionally, the transition between two audio signals is done with a fade, where one signal is reduced in volume while the other rises. But this old approach will soon be replaced by this new original approach by Henderson, bringing a revolution to the music industry with the help of an age long concept.

Navyaa Kapoor
IIIrd Year

There is geometry in the humming of the strings, there is music in the spacing of the spheres.

~ Pythagoras

MATHEMATICAL OPTIMIZATION IN REAL LIFE

Mathematical optimization refers to finding the optimum solution out of all feasible solutions of any optimization problem. This is done by using the techniques of mathematics to find the values of the variables required to maximize or minimize the objective under certain constraints. There are three elements in any optimization problem. First is the objective which is the function that needs to be maximized or minimized. Second is a collection of variables whose optimum values are necessary to maximize or minimize the objective. Third is a set of constraints which poses restrictions on the values that the variables can take.

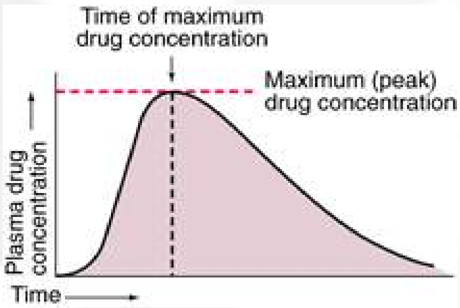
Mathematical optimization has its applications in various fields in real life:

Manufacturing: A manufacturer needs to optimize two objectives namely cost of production and price of goods.

A manufacturer's aim is to minimize the total cost of production of goods, for which he/she must have knowledge about the number of goods to be produced with the available constrained resources (raw material, labour, machinery etc.). The costs of production also include shipment costs and storage costs. When the manufacturer orders raw material then he/she must pay a fee for their shipment and then a storage fee for storing the raw material until needed. If each shipment of raw material is large then few shipments will be needed and the shipment costs will be low but the storage costs will be high as more material will be stored at a time. In contrast, if each shipment is small then the shipment costs will be high as many shipments will be needed but storage costs will be low. Therefore, a manufacturer must determine the optimum shipment size that minimizes the total cost.

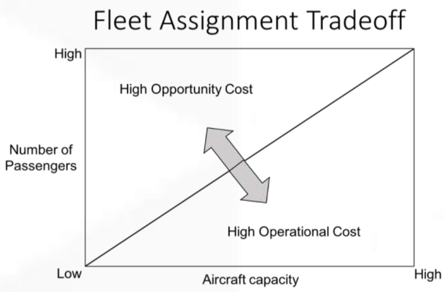
A manufacturer also desires to maximize profits from the sale of goods. The manufacturer must determine the price per unit of the good required to maximize profits. The higher the price of the good, higher is the total revenue and higher will be the profits with fixed total cost. But this price decision is also influenced by the fact that as the price of the good increases the demand for the good reduces. Therefore, for a given demand and total cost, it is necessary for a manufacturer to determine that price of the good which maximizes profits.

Medicine: Whenever a drug is given to a patient, initially the concentration of the drug in the bloodstream is zero. As the drug is metabolized, its concentration in the bloodstream increases until it reaches a maximum concentration beyond which it can no longer increase and further begins to decline until it falls below a desired effective amount. Now is the time to take another dose of the drug.



Mathematical optimization is required to determine the time period after which the maximum concentration of a drug occurs in the bloodstream. The time taken for each drug to reach its maximum concentration in the bloodstream is different and this determines how frequently a drug needs to be taken to cure a disease. So, the next time the doctor prescribes you a drug dose of 2 pills a day, one in the morning and one in the evening, you know why!

Machine Learning: Machine learning is an application of artificial intelligence in which machines are trained through examples to perform similar unseen tasks precisely without receiving explicit instructions. Mathematical optimization is used to minimize the loss function on a training set of examples concerned with any machine learning algorithm for performing a task. The loss function is the difference between the predictions of the machine being trained and the actual problem instances (which are the constraints here). Accordingly, the parameters of the algorithm are determined which minimize the loss function so that the machine is able to perform the unseen tasks more accurately.



Airlines: The airline industry uses mathematical optimization in fleet assignment. Any airline company needs to determine the optimum fleet size that minimizes the total cost. Fleet size is the number of planes of similar model and make operated by an airline company. If the company overestimates the fleet size then the assets and investments of the company will be wasted implying higher costs. On the contrary, if it underestimates the fleet size then it will not be able to accommodate some of its passengers and will lose many potential customers to other airline companies.

Apart from these applications of mathematical optimization, we as rational humans use optimization in some form in our daily lives. Each one of us needs to determine how much money to spend on every desired commodity to minimize expenditure subject to constrained income. One also needs to know how much money to invest in different financial instruments (with different rates of interest) in order to maximize the return with limited money available for investment.

So, readers put on your thinking caps and optimize your lives to maximize your happiness!

Aarushi Kansal
IInd Year

The whole of mathematics is nothing more than refinement of everyday thinking.

~Albert Einstein

SYMMETRY AND LIFE

Can a world still look that much beautiful if it no longer possesses symmetry? No, it cannot. Symmetry refers to a sense of harmonious and beautiful proportion and balance. Symmetry is a concept that not only attracts our visual sense but also gives us a sense of beauty. "Exact correspondence of form and constituent configuration on opposite sides of a dividing line or plane or about a centre or an axis." In other words, we say an object possesses a symmetry if it remains unchanged under a set of operations or transformations.

It is a mathematics concept but looking at broader context it exists everywhere just like water. It exists in nature, molecules, animals, plants, geometry, buildings, monuments etc. The central idea in the mathematical study of symmetry is a symmetry transformation. These transformations give rise to some types of symmetry such as bilateral symmetry- a symmetry due to reflection such as in butterfly, radial symmetry- a symmetry due to rotation such as in starfish, translational symmetry- a property in which translation to another location doesn't change its pattern such as in wallpapers and scaling symmetry- a property where each part is identical to the whole as seen at different magnifications such as in tree branches.

Symmetry is present in every aspect of life. It is present in reactions of different people to comedy, to sadness, to fear, to surprise, to happiness etc. It may be present in interactions with other people where we expect from others to do that is required at that situation. It is present in response to traffic rules and lights where everyone stops on seeing red light. This way of connecting symmetry helps in relating all instances of symmetry that we have already seen for example, in the commutative and associative properties of arithmetic, the positions of the numbers or parentheses change, but the answer doesn't change.

Devanshi Gupta
IInd Year

Math is the only place where truth and beauty mean the same thing.

~ Danice McKeller

THE INFLUENCE OF MATHEMATICS ON MACHINE LEARNING

Have you ever wondered how Spotify always seems to know the songs that are best tailored to your life? How its daily mix playlists not only are from the genre of music you enjoy but also how they can describe your life story? This is because Spotify uses Machine Learning to provide the best recommendations for its listeners. But the application of Machine Learning doesn't just stop there, from Alexa to Instagram filters, Machine Learning is everywhere.

In layman terms, Machine Learning is giving an algorithm the ability to learn without being explicitly programmed and make predictions based on what it has learnt. Tom Mitchell (1997) gives a more technical definition of Machine Learning below:

"A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P improves with experience E."

To improve the performance for a specific task, we need a large and diverse dataset. Even the bare minimum number of training examples needed for a half-decent algorithm goes up to tens of thousands of rows. Hence, the collection of data is an important part of Machine Learning, which can be achieved either manually or automatically. In addition, there are many online datasets ranging across different domains, such as Kaggle, UCI Machine Learning Repository.

The dataset is then scavenged, reorganized, and scaled to find the best features for the algorithm. These features are what the machine uses to learn and make predictions. But how does it decide what are the most optimal features for the best predictions? This is where Mathematics comes in handy for a Machine Learning engineer. While mathematics in Machine Learning does not involve hefty calculations, it is critical to comprehend what, why, and how the algorithms are working. This understanding plays a critical role in manipulating the models to get the desired results.

Machine Learning is heavily influenced by Linear Algebra as it is a proper and defined representation in a language that is easily understandable by the computer. Linear Algebra is essential for handling the huge datasets that the algorithm works on. By using matrix multiplication, as seen in the image on the right, Linear Algebra provides quick solutions for x and y.

$$\begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 18 \\ 27 \end{bmatrix}$$

Matrix Multiplication

Another factor for manipulating the predictions in the Machine Learning model is partial differentiation from Multivariate Calculus. Before understanding the application of partial differentiation in Machine Learning, we must know that a cost function is implemented to check the accuracy of the algorithm. The cost function is then minimized using partial differentiation to form gradient descent, which adjusts the function's direction and magnitude coefficient.

$$J = \sum_{i=1}^{n} \frac{(mX_i + c - Y_i)^2}{n}$$

The equation of the cost function

Notations: Xi is the i^{th} row's feature, Y_i is the i^{th} row's labelled output, n is number of training set, m and c are the parameters for slope and intercept respectively.

$$G_m = \frac{\partial J}{\partial m} = 2\sum_{i=1}^{n} \frac{(mX_i + c - Y_i)X_i}{n}$$

$$G_c = \frac{\partial J}{\partial c} = 2\sum_{i=1}^{n} \frac{(mX_i + c - Y_i)}{n}$$

Jacobian vector representation of partial derivatives.

The equations of the gradient descent function. G_m and G_c are derivatives of m which is treated as slope and c as intercept.

Partial differentiation is done to give the rate of change of cost function with respect to m and c individually. When represented in vector form, the partial derivatives form the Jacobian Vector. The prediction of the outputs in Machine Learning models requires elementary level probability. While often utilized in the form of distribution, like Bernoulli distributions, Gaussian distribution, probability density function and cumulative density function, the most interesting formula is the Bayes' Theorem.

In probability theory and statistics, Bayes' theorem is the probability of an event, based on prior knowledge of conditions that might be related to the event. Naïve Bayes, a machine learning algorithm, works on this principle. The word naïve comes as Bayes' theorem works on the assumption that both events are independent of each other, which is a naïve approach.

$$P(A\backslash B) = \frac{P(B\backslash A)P(A)}{P(B)}$$

Bayes' Theorem

A, B are the events, $P(A|B)$ is the probability of A given B is true, $P(B|A)$ is the probability of B while A is true, and $P(A)$, $P(B)$ are independent probabilities.

Thus, Mathematics is an important facet for Machine Learning, and has multiple uses throughout a model's function. Before ending I have implemented a text generator using the sonnets of Shakespeare to form a text generator that imitates Shakespeare's writing style. I have used the Long Short-Term Memory model, a machine learning model. The text generated is below.

```
s the riper should by time decease,
his tender heir might bear his memory:
but thou, contracted to thine own bright
eyes,
feed'st thy light's flame with self-
substantial fuel,
my beept is she breat oe bath dasehr ill:
tirse do i pine and turfeit day by day,
or gluttoning on all, or all away.
```

Medhavi Darshan
IInd Year

MATHEMATICS; ARCHITECTURAL ENIGMA

Mathematics and architecture are related, as architects use mathematics for several reasons. Apart from using mathematics when engineering buildings, architects use geometry.

Like, to define the spatial arrangement of a building. An example of this is the Pythagoreans of the sixth century BC, where it was considered to create forms that were harmonious with nature, and to lay out buildings and their surroundings according to mathematical, aesthetic and sometimes religious principles and beliefs. Moreover, decorating buildings with mathematical objects and to meet environmental goals, such as minimising wind speeds around the bases of tall buildings mathematics was used. Hence, it can be observed that mathematics has a versatile use since ages. Let's find out the hidden math in some of the ancient great buildings:

The Great Pyramid of Giza, Cairo, Egypt: The pyramid's perimeter is 365.24 – which is approximately equal to the number of days in a year. Further, the pyramid's perimeter when divided by twice its height is equal to pi (3.1416).

Taj Mahal, Agra, India: When we look closer into this epitome of love we find a great example of line symmetry – with two lines, one vertical down the middle of the Taj, and one along the waterline, which shows the reflection of the prayer towers in the water making it look magnificent and no doubt a wonder of the world.

Cube Village: The Cube Village, which was built by Dutch architect Piet Blom has tilted, geometric houses — built on top of a pedestrian bridge to make it appear like an abstract forest — split into three levels. The top has windows on every facade and feels like an entirely separate structure which makes it magnificent.

Parthenon, Athens, Greece: This was constructed in 430 or 440 BC. The Parthenon was built on the Ancient Greek ideologies of harmony, demonstrated by the building's perfect proportions. The width to height ratio of 9:4 governs the vertical and horizontal proportions of the temple as well as other relationships of the building, an example is the spacing between the columns. It has also been suggested that the

Parthenon's proportions are based on the Golden Ratio, which is found in a rectangle whose sides are 1: 1.618 respectively.

Chichen Itza, Mexico: Chichen Itza was built by the Maya Civilization, who are famous as fantastic mathematicians, and also credited with inventing 'zero' within their counting system. The fifty two panels on each side of the pyramid symbolises the number of years in the Mayan cycle, the stairways dividing the eighteen tiers correspond to the Mayan calendar of eighteen months and the steps within El Castillo mirror represents the solar year, with a total of 365 steps, one step for each day of the year.

Thus, we can observe that the architects have used mathematics for several reasons, even if we leave aside the necessary use of mathematics in the engineering of buildings. Firstly, they use geometry because it defines the spatial form of a building. Secondly, they use mathematics to design forms that are considered beautiful or harmonious with the surroundings.

Mini Melkani
IInd Year

MATHEMATICS IS OMNIPRESENT

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

~ Galileo

The very first time I heard this quote was when I was a 12-year old. I never understood what it meant back then because all I knew of mathematics were mere numbers. Only now, as a 19-year old, do I finally understand the beauty and ingenuity of this line. This article endeavours to map out the omnipresent beauty of Mathematics around us while highlighting the dazzling impact it has exercised in shaping the present visage of our world.

To begin with, Mathematics is not something tangible, rather it is a collection of abstract concepts. There is a multitude of ways to express Mathematics, the most basic being the number system. The base, the symbol, the structure and the method used to express it, can be radically different. Different civilizations have different ways of expressing mathematics. Yet they can be considered the same because they represent the same basic quantification of logical concepts.

Everything that happens around us, from as minute as the movement of electrons to the grand movement of planets is governed by the fixed rules and laws of mathematics. In fact, our physical world is a giant mathematical object!

But first, let us take a look around us to understand what this means. Just look around yourself, what mathematical things can you see? Surely, you may see some numbers around you like on this magazine you are reading or the channel number on the television or the price and nutrition information on that packaged food in your hand. But these are just numbers which are a part of the social construct we live in. Even the shapes around you, squares, rectangles, circles, etc. are all a part of our social construct. But throw a stone in the air and watch the beautiful trajectory it makes!

The trajectory of anything you throw up has the same upside-down trajectory called a parabola. Similarly, humans have observed many recurring shapes and patterns in nature which form the basis of motion, magnetism, electricity, radioactivity, heat and more. These patterns have led to the invention of hundreds and thousands of devices, machines, electronics, etc. we use in our daily lives. So, it's safe to say we live, breathe and eat Mathematics no matter how unappetizing it sounds!

Mathematics has been the most important and prominent factor of the variegated stems of knowledge which has ever helped mankind in understanding the mysteries of our universe. Right from our easy-going daily life to the intriguing riddles which aim at tapping the secret of the formation of this world, Mathematics works as a pal and true mate.

We must understand that Mathematics is not something dreadful but one of the most beautiful revelations of knowledge on earth. The rules of Mathematics are not invented but discovered by the true appreciators of this subject. If we have to crack the code in which the script of this universe is written then we will have to emulate and apply the rules of maths to the brim. Like this eternal galaxy time & space, Mathematics is also eternal, universal & omnipresent. Whenever we go, we are sure to find Mathematics in each & every particle of this Universe.

Rhythm Parija
IInd Year

Good Mathematics is not about how many answers you know… it is about how you behave when you don't know.

~Unknown

A GLIMPSE OF 2019

OMICRON'19

The Annual Mathematics Day, "Omicron" held on October 31, 2019 was meticulously organized by the Department of Mathematics.

The event began with an interactive session by Mr. Ayaan Chawla, the founder and CEO of Asian Fox Developments. Mr. Ayaan Chawla apprised the students by discussing about Entrepreneurship and Success. Mrs. Geetha Venkataraman, a professor of Ambedkar University Delhi, also enlightened the students about Groups and Symmetry, its real-life applications, symmetries in finite figures, Escher's art and much more. Lots of stalls with colorful stationery items along with lip smacking delights were put up for the students.

The other informal events included Math Pi-rates, Quiz Competition and Shape Chase.

The paper presentation competition was the first event in the lineup of Omicron after the inaugural lectures. Later, Ms. Nikita Satija, the Brand Manager of PeeBuddy, briefed all the girls about menstrual hygiene, the products by PeeBuddy and its uses.

FAREWELL'19

Our seniors have always been a source of inspiration for us. With joyful tears, we bade adieu to our venerated seniors on April 27, 2019. The hardworking bunch of students of Batch 2016-2019 will be missed.

FRESHERS'19

Freshers'2019 was organized by the second and third years of the department to welcome the first years. The event acted as a bonding session for our students and teachers. From introduction to showcasing their talents to enthralling games, the event was full of fun and joy.

WHY 0! IS 1?

This expression is illogical, but when we try to understand it by considering the definition of Factorial its complexity reduces and we can analyse it in a better way.

We denote factorial with an exclamation mark! and the factorial of any non- negative number is represented as follows;

$$X! = X(X-1)(X-2)\ldots 3 \times 2 \times 1.$$

For example: $$5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$$

$$4! = 4 \times 3 \times 2 \times 1 = 24$$

and so on.

Talking of base, so how does anyone argue $0! = 1$ or you just accept it and don't think about it?

Let's just consider a basic example to address this basic yet intriguing question.

As we know,

$$A^0 = 1$$
$$A^2 = A \times A$$
$$A^3 = A \times A \times A, \forall A \in R$$

…and so on.

So how does anyone explain $A^0 = 1$? or again, do you just go with the flow and accept it to be the really simple 1?

To find the reason behind this take a value of A (say $A = 2$). Then

$$2^0 = 1$$

$$2^1 = 1$$

$$2^2 = 4$$

$$2^3 = 8$$

…and so on.

Here, we can see as we increase the power of 2 by one unit the result is twice the preceding term, i.e., $2^2 = 4$ and $2^3 = 4 \times 2 = 2^2 \times 2$.

Similarly, if we proceed in a reverse order, we can get the preceding term by dividing the succeeding term by 2.

that is,

$$\frac{16}{2} = 8$$

$$\frac{8}{2} = 4$$

$$\frac{4}{2} = 2.$$

Seeing the above pattern, as we reach a point where 2 needs to be divided by 2 to get 2^0or 1; we do not have any reason to change our pattern at this point.

$$\Rightarrow \frac{2}{2} = 2^0 = 1.$$

Furthermore,

$$\frac{1}{2} = 2^{-1}$$

…and so on.

The reason behind $0! = 1$ is analogus to our above process in a manner which is logical and leads us to its desired result of familiarity.

Proceeding in a following manner, we get

$$1! = 1$$
$$2! = 2 \times 1 = 2$$

$$3! = 3 \times 2 \times 1 = 6$$

$$4! = 4 \times 3 \times 2 \times 1 = 24$$

$$5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$$

…so on.

Here, as we can see that the factorial of every succeeding number is obtained by multiplying the succeeding number with the factorial of the preceding number. That is,

$$1! = 1$$

$$2! = 2 \times 1!$$

$$3! = 3 \times 2!$$

$$4! = 4 \times 3!$$

$$5! = 5 \times 4!$$

Similarly, if we proceed in a reverse order, we can get the factorial of the preceding term by dividing the factorial of the succeeding term with succeeding term itself. That is,

$$\frac{4!}{4} = 3!$$

$$\frac{3!}{3} = 2!$$

$$\frac{2!}{2} = 1!$$

Following the above pattern, as we reach at a point where 1! needs to be divided by 1 itself to give 0! or 1; we do not have any reason to breach the pattern at this point.

$$\Rightarrow \frac{1!}{1} = 0!$$

$$\Rightarrow 0! = 1.$$

The required result can be obtained by the following formula as well,

In general;

$$X! = X(X - 1)(X - 2)\ldots 3 \times 2 \times 1$$

$$\Rightarrow X! = X(X-1)!$$

$$(X-1)! = \frac{X!}{X}.$$

For example: Take X=1, then

$$(1-1)! = \frac{1!}{1}$$

$$\Rightarrow 0! = 1.$$

Samicha Dwivedi
IInd Year

FERMAT'S LAST THEOREM

We have seen many unsolved or difficult proofs in mathematics whether it was proof of modularity theorem or of algebraic number theory. But the most notable theorem in the history of mathematics is 'Fermat's Last Theorem' which has been recorded as the most difficult mathematical problem in the Guinness Book Of World Records because this theorem has the largest number of unsuccessful proofs.

The 17th century mathematician Pierre de Fermat created the last theorem while studying Arithmetica, an ancient Greek text written by Diophantus of Alexandria. Fermat's last theorem states that $x^n + y^n = z^n$ has no non-zero integer solution for x, y, z when n>2 To back up his theorem he had developed an argument and follows first marginal note described below:

"I have a truly marvellous demonstration of this proposition which this margin is too narrow to contain."

Fermat admitted that he could prove his stated theorem but he never demonstrated his proof to paper. And we had lost our hope of proof with the death of Fermat but many mathematicians some from Europe, Germany tested to rediscover the proof. Throughout the 18th and 19th centuries no mathematician could find a counterexample; a set of numbers that fitted Fermat's equation. One of the reasons why Fermat's Last Theorem is that it applies to an infinite number of equations, $x^n + y^n = z^n$ where n is any number greater than 2. Many mathematicians tried to prove this theorem. Among them some of the names are Euler, Sophie Germain Lame, Liouville etc. Sophie German's step towards the proof was somehow appreciable but couldn't get the desired proof of Fermat's last theorem. A special case says that if n and $2n + 1$


Arithmeticorum Liber II. 51

QVÆSTIO VIII.

OBSERVATIO DOMINI PETRI DE FERMAT.

QVÆSTIO IX.

[1670 Edition of Diophantus's Arithmetica]

[Pierre Di Fermat]

are primes, then $x^n + y^n = z^n$ implies that one of x, y, z is divisible by n hence Fermat's Last Theorem splits into two cases.

CASE 1: None of x, y, z is divisible by n
CASE 2: One and only one of x, y, z is divisible by n

Sophie Germain proved Case 1 of Fermat's last theorem for all n less than 100 and Legendre, another mathematician took a step forward and proved the Case 1 up to numbers less than 197. At that time Case 2 had not been proved for even $n = 5$. Case 2 was proved by Dirichlet and presented to the Paris Academie des Science in July 1825. But he was also not able to prove it completely. In the journey of the proof of Fermat's last theorem many mathematicians came with their proofs but all were lost in the deepness of difficulty of Fermat's Last Theorem.

Sangeeta Beniwal
IInd Year

Every problem has a solution but we should choose the right formula.

~ John Rose

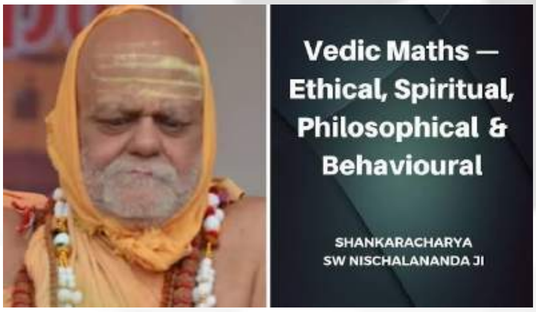
WHAT HAS CHANDRAYAAN – 2 GOT TO DO WITH VEDIC MATHEMATICS?

Chandrayaan – 2 is the India's second lunar mission that took off to its destination on 22 July 2019. And with that it took a billion of dreams to the space. India is the fourth country to have landed on moon and most notably the first country to have ever ventured in the lunar pole region in the world. The mission was operated by the best minds of Indian Space Research Organization (ISRO).

It consisted of a lunar orbiter, The Vikram Lander and The Pragyaan Lunar Rover, all of which were developed in India itself.

The main objective of the mission was to study the lunar topography, mineralogy, elemental abundance and to check the traces of lunar water nor water ice. The orbiter was supposed to help in preparing 3D maps of the lunar surface. ISRO wanted to demonstrate the ability of soft landing on the lunar surface and operate a robotic rover on the surface.

But to our surprise, when people are busy on concentrating more on the modern technology and inventions, ISRO scientists didn't want to rely only on them so they referred to the ancient Indian Vedic Mathematics.



ISRO consulted a reputed Vedic mathematician and scholar, Swami Shankaracharya, to help and dispel some of the doubts they had at the time of the launch. He is the crowned head of the Govardhan Matha Hindu Monastery since 1992. He implemented the calculations enumerated in Puranas and The Bhagwad Gita to achieve the success of the mission, as India is pioneer in mathematics, astronomy and missile technology. As per Bhishma Parva or the book of Bhishma, the sixth book in the epic

Mahabharata, the diameter of Moon is 11,000 yojana (1 yojana = 12.2 km approximately) and its circumference is 33,000 yojana.

This measure was used by the scientists to calculate the exact distance between the earth and moon using the trigonometric method. The arc that runs through the moon's diameter has an angle of 0.56 degrees. So, using the formula,

$$\frac{0.56}{180} = \frac{\theta^R}{\pi}$$

$$\theta^R = \frac{0.56\pi}{180} \approx 0.00977$$

Putting the values in the arc length formula, where $s = 11000$ yojana.

$$s = \theta^R . r$$

We get the distance as 31,508.1 yojana.

However, the lander deviated from its trajectory starting at 2.1 km altitude and lost the communication with the organization. Initial reports suggested a crash due to hard landing but the failure analysis committee concluded that the crash was caused by a software glitch.

But ISRO members haven't lost their hopes yet. And they are planning to re-attempt another landing by November 2020 with Chandrayaan 3.

The spectacular launch of Chandrayaan 2 will be forever etched in all our memories.

Soumya Gulati
IInd Year

GENIUS OF THE 21ST CENTURY

The potential of mathematics is incredible. I learnt so much just to realize that one lifespan is not enough.

~ Dr. Neena Gupta

In her school days, Neena Gupta would walk past the high walls of the Indian Statistical Institute (ISI), Kolkata without any idea that one day she would be teaching and doing marvellous research at this prestigious institute. Her journey is just like herself, full of yen and passion for mathematics and stands as a rigor proof that through hard work, dedication and determination one can achieve the most successful version of their goals.

The achievements of Dr. Gupta are countless. She has been awarded the prestigious Shanti Swarup Bhatnagar Prize, the highest honour in India in the field of science and technology. She is not only the youngest but also the only third woman to win this award till date. In one of her interviews, Dr. Gupta mentioned how she feels that there is a greater need for an aware society that encourages higher education for the girl child. Dr. Gupta's field of research is Commutative Algebra and Affine Algebraic Geometry. She is known for cracking the seven-decade-old problem called the Zariski Cancellation Conjecture, that many distinguished mathematicians have found hard to solve. This particular problem had remained open for about 70 years, before Dr. Gupta finally provided a complete solution to it in positive characteristic, in 2014. She got the Indian National Science Academy award (INSA) for the same. The researchers in INSA appreciated her mathematical solution and declared it as one of the best solutions ever. She has also earned Birla Science Prize in Mathematics, Ramanujan Prize, Saraswathi Cowsik Medal by TIFR and many more accolades. She has many inspiringly stimulating publications in her name as well.

In one of her interviews with Research Matters, Dr. Neena attributes her success to her conceptually strong mathematical foundation, her teachers and her family. She said,

"Behind a successful person, there are many people, not just one. You need support from the whole system. My parents were very keen on getting me higher education. My Ph.D. supervisor, Prof Amartya Kumar Dutta, has been very encouraging. Also, I am fortunate to have a very supportive husband and in-laws".

Neena Gupta is a remarkable example of a self-made woman. She is an inspiration to many female mathematicians out there, encouraging them not to give up and to pursue their passion for the subject.

Maths is for somebody who can solve the problems on their own. The pleasure which I get in solving problems in mathematics is much more than any award.

~Dr. Neena Gupta

Urva Garg
IInd Year

ILLEGAL NUMBERS

Welcome to the dark side of Mathematics. Here, by "the dark side" I do not mean the anxiety and self-loathing that comes with this subject (for some of you, obviously, cause for us, the Mathematicians, the subject is nothing less than the Holy Bible (Hahaha)) but the illegality of certain aspects of the subject like illegal geometry, illegal cryptography, and illegal numbers.

A number that represents information that is forbidden by law for one to possess or distribute, is said to be illegal. So basically it means that if you are some crazy "in-love-with” passionate mathematician or some ignorant chap who believes that 0/0 is 0, every time you write down a list of numbers, you could be using an illegal one and companies can sue you for it!

So, what, how and when can a number become illegal? When you think about it, Mathematics is a language and that too a special one because it can do what regular languages can’t. It can encode data. In the modern world, numbers are used as keys to encrypt secret information. Therefore, if you, intentionally or unintentionally, distribute those secret keys (numbers) it can lead to some serious problems, that is, it becomes illegal to distribute those numbers and the numbers themselves become illegal.

Understand this by first trying to digest the fact that anything in this vast unending multi-universe can be converted into a string of numbers. There is a number for you, for me, for the great painting Mona Lisa, for a company’s trademarked name, for the recipe of that tea you are sipping while reading this article and even for this article!

All the information can be encrypted in the form of a binary code (a two-digit code comprising of 0’s and 1’s). The ASCII values for A-Z are 065-090 and for a-z are 097-122 and they can further be converted to binary digits. For example, suppose the trademarked name for your YouTube channel is “hope”. This word can be thus converted into a binary code as described below:

Characters:	**h**	**O**	**p**	**e**
ASCII Values:	104	111	112	101
Binary Values:	01101000	01101111	01110000	01100101
Bits:	8	8	8	8

Thus, the word “hope” written as a number is 104-111-112-101 and if anyone is found distributing this list of numbers, intentionally or unintentionally, they are subject to a charge of copyright infringement or infringement of your trademark. Now, numbers can be converted into hexadecimal and hexadecimal defines colour as well so they become illegal colours! For example, for the above ASCII values and binary code, the hexadecimal that would represent the word “hope” is 68-6f-70-65 and it is the colour “this shade of grey represents the number of the word “hope” +70” where 70 is the extra bit. (Hex colour code is #RRGGBB).

Thus, if someone starts posting this around on the internet, they will be again infringing your trademark and you can sue them for the same. The Mona Lisa, for instance, can be converted into a binary code. The code starts as 11000110110101011011001010111 110 and continues for about 5-6 million digits!

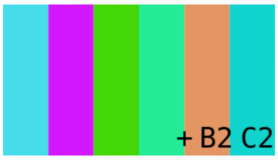
Thus, some numbers are banned because

- Of what they represent. For example, governments have prohibited the display of numbers that have a symbolic meaning, such as, the date of a revolution or connections to opposition political parties.

- Of the information they carry. Possessing or publishing these numbers can be treated as a criminal offense.

Illegal Numbers in the NEWS:

- Sony sued George Hotz and members of fail0verflow in 2011 and part of their lawsuit involved a complaint that they had distributed and published PS3 keys.



[The PlayStation3 edition of the free speech flag.]

- An AACS encryption key (09 F9 11 02 9D 74 E3 5B D8 41 56 C5 63 56 88 C0) that came to prominence in May 2007 is an example of a number claimed to be a secret, and whose publication or inappropriate possession is claimed to be illegal in the United States.

- The numbers 89, 6 and 4 each were banned from the search engines in China because of the date (1989-06-04) of the June Fourth Massacre in Tiananmen Square.

- In 2012, a school district in Colorado banned the wearing of jerseys with numbers 18,14 or 13 (or the reverse 81,41 or 31) because of the association of these numbers with gangs.

- In 2017, Slovak politician Marian Kotleba was criminally charged for donating 1,488 euros to a charity. The number is a reference to a white supremacist slogan (Fourteen Words, 14, or 14/88, is a reference to the fourteen-word slogan "We must secure the existence of our people and a future for white children").

- The use of number 49 was banned by Matteo Salvini, Deputy Prime Minister of Italy and Italian Minister of the Interior from his Facebook profile to prevent any association with the corruption scandal about party subsidies in his party Lega Nord which amounted to 49 million euros.

The concept of illegal numbers may sound absurd but it is not a hypothetical concept. It is crazy how there are so many ways you could be breaking the law, but it should be kept in mind that today's world is governed by algorithms, numbers, and patterns solely. Written numbers express information and concepts and largely, shape our realities. Hence, in a world where "the pen is mightier than the sword", the mathematician's pencil grows stronger by the day.

Vanshika Singhal
IInd Year

NATURE WALK WITH MATHEMATICS

Like the crest of the peacock, like the gem on the head of a snake, so is Mathematics at the head of all knowledge.

~Vedanga Jyotisha

Let's go on a nature walk with Mathematics today.
From flower petals to scales on animal's skin,
the subject has got its application in the attractive nature display.
Thinking deep and finding Mathematics even in fish's fin.

The flower petals, sunflower seeds, and DNA arranged in the Fibonacci sequence of 0,1,1,2,3…
the beautiful lilies and daisies are placed for best possible exposure to sunlight,
The Golden Angle (137.5°) and the Golden Ratio (1.618..) arrangement attracting the bee.
Symmetrical are the Zebra patterns of black and white.

From the sky falls a snowflake
Special in its six-fold hexagonal symmetry
with no cracks and breaks, this fact is not fake
'No two flakes are alike' is a mystery.

Symmetry is everywhere in the Universe,
Bilateral Symmetry in Butterflies, Human Faces, Peacocks forms a mirror-image.
Beautifully carved is every creature,
Radial Symmetry of jelly-fish and star-fish keeps the audience engaged.

The strong connection between Honey-bees and Mathematics is incredible,
the hexagonal tessellation of constructing their honeycomb without knowing the theories.
Honeybees build the hives which are most economical,
with using least amount of wax and maximum honey it carries.

From Logarithmic spirals in spider-webs, Nautilus shell
trees, leaves, storms, rose petals;
to Fractal Symmetry in Romanesco Broccoli and cauliflower.
Even estimating turtles' age through markings on its shell.
This is how beautifully the nature and mathematics interact.

Ishika Arora
Ist Year

TRICK- FINDING THE DAY FOR A GIVEN DATE

We use the concept of odd days (the number of days more than the complete week) to find the day.

Number of Odd Days in a Non-Leap year: 365 days = (52 weeks + 1 day) Therefore, 1 ordinary year has 1 odd day.	Number of Odd Days in a Leap year: 366 days = (52 weeks + 2 days) Therefore, 1 leap year has 2 odd days.

100 years = 76 ordinary years + 24 leap years
Number of odd days in 100 years = 5
Number of odd days in 200 years = $(5 \times 2) = 3$ odd days.
Number of odd days in 300 years = $(5 \times 3) = 1$ odd day.
Number of odd days in 400 years = $(5 \times 4 + 1) = 0$ odd day.
Similarly, each one of 800 years, 1200 years, 1600 years, 2000 years has 0 odd day.

Day of the week related to odd days:

Number of odd days	0	1	2	3	4	5	6
Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

Example: Given date

16th July, 1776 = (1775 years + Period from 1.1.1776 to 16.7.1776).

Firstly, we will find out the number of days.
Counting of odd days:
Number of odd days in 1600 years = 0 and number of odd days in 100 years = 5
75 years = 18 leap years + 57 ordinary years
$= (18 \times 2 + 57 \times 1)$ odd days
$= 93$ odd days
$= (13$ weeks $+ 2$ days$)$
$= 2$ odd days

Therefore, 1775 years have $(0 + 5 + 2)$ odd days = 7 odd days = 0 odd day.

Jan.	Feb.	March	April	May	June	July
(31 +	29 +	31 +	30 +	31 +	30 +	16)

$= 198$ days

198 days = (28 weeks + 2 days) = 2 odd days.

Total number of odd days $= (0 + 2) = 2$.
Hence, the required day is Tuesday.

Sandhya
IInd Year

BRAIN TEASERS

1. Arrange the ten digits (0 to 9) in three arithmetic sums, using three of the four operations of addition, subtraction, multiplication, and division, and using no signs except the ordinary ones implying those operations. Here is an example to make it quite clear:

$$3 + 4 = 7; \quad 9 - 8 = 1; \quad 30 \div 6 = 5$$

But this is incorrect, because 2 is omitted, and 3 is repeated.

2. Given eight numbered cards, as shown here, rearrange them in any way, moving as few as possible, so that the two columns should add up alike.

1	**3**
2	**4**
7	**5**
9	**8**

3. Can you show that four added to six will make eleven?

4. Can you write 31 using only digit 3 five times?

5. Multiplying 10 feet by 10 feet equals 100 square feet. How much is 10-rupee times 10 rupee?

Nutan Verma
IInd Year

KAKURO PUZZLE

RULES

- Fill the empty white squares using digits 1 to 9.
- The sum of each horizontal block must equal the clue on its left.
- The sum of each vertical block must equal the clue above it.
- Each digit must be used only once in each horizontal or vertical block.

			17	19			7	44	
	3	37 \ 17				10			23
20					6	3 \ 15			
5			3 \ 25						
	8			3			10 \ 15		
	13 \ 3			7	5	17			
9			10 \ 3			16 \ 6			11
38							3 \ 17		
7					12				
	4				3				

Aarushi Kansal
IInd Year

Answers to Brain Teaser:

1. $7 + 1 = 8$; $9 - 6 = 3$; $4 \div 5 = 20$
2. First turning the 9 clockwise so as to change it to a 6 and then changing the place of 8 and 9. Each column will add up to 18.
3. Add IV turned upside down below VI and you get XI.
4. $33 - 3 + 3/3$
5. Rupee cannot be multiplied; they can only be added or subtracted

STUDENT ACHIEVERS OF 2019

Geetanjali

- Secured 1st position in quilling competition at Ullas'19 in Kamala Nehru College.
- Secured 2nd position in ICC poster making at Kamala Nehru College.
- Secured 3rd position in brushless painting in SGTB Khalsa College, quilling competition at Lady Irwin College, graffiti at Acharya Narendra Dev College.

Jaishree Garg

- Represented Kamala Nehru College at Enactus Nationals 2019 held at IIT Delhi.

Muskan Arora

- Secured 2nd position in quilling competition at Ullas'19 in Kamala Nehru College.
- Secured 3rd position in brushless painting in SGTB Khalsa College.

Soumya Bhardwaj

- Secured 1st position in dance competition Spandan, Cultural Fest of New Delhi Institute of Management.
- Secured 2nd position in western dance competition at Cult, the annual cultural fest of World University of Design.

Mini Melkani

- Won Consolation Prize in Inter College poem recitation competition by EOC Cell of Kamala Nehru College.
- Represented Kamala Nehru College at Enactus Nationals 2019 held at IIT Delhi.

Aastha Mutreja

- Secured 1st position in NSS event of Nukkad Natak at Daulat Ram College, street play competition organised by NSS society of Shaheed Bhagat Singh College.
- Secured 2nd position at Consumidor, street play competition organised by Consumer Club of Kamala Nehru College.
- Secured 3rd position in ICC poster making at Kamala Nehru College.

Rhythm Parija

- Secured 3rd position in creative writing competition in Kamala Nehru College.

Nutan Verma

- Secured 2nd position in Treasure Hunt Competition in Daulat Ram College.
- Secured 2nd position in long jump held in Kamala Nehru College

Shivangi

- Secured 2nd position in intercollege cricket match 2020.

Somya Gupta

- Secured 1st position in NSS event of Nukkad Natak at Daulat Ram College, street play competition organised by NSS society of Shaheed Bhagat Singh College.
- Secured 2nd position at Consumidor, street play competition organised by Consumer Club of Kamala Nehru College.

STUDENTS' UNION 2019-20

MS. DEVYANSHI

VICE PRESIDENT

MS. JAISHREE

PRESIDENT

MS. MUSKAN

GENERAL SECRETARY

MS. BHAWANA

MEDIA COORDINATOR

MS. URVA

TREASURER

MS. NUTAN

MEDIA COORDINATOR

The strength of the team is each individual member. The strength of each individual member is the team.

~ Phil Jackson

BATCH OF 2017-2020

First Row (L to R): Dr. Shailendra Kumar Bharati, Ms. Swapnil Verma, Ms. Divya Saigal, Dr. Pooja, Dr. Pragati Gautam, Ms. Saroj Gupta, Mr. Pushpendra Kumar Vashishtha, Dr. Mohammad Mueenul Hasnain
Second Row (L to R): Injila, Bhawana, Nancy, Manisha, Jaishree, Soumya, Navyaa, Geetanjali, Devanshi, Muskan
Third Row (L to R): Astha, Garima, Shivangi, Nancy, Kamna, Anjali, Shreya
Fourth Row (L to R): Vandana, Neelam, Mamta, Tanya, Chetna, Nisha

“The mathematician does not study pure mathematics because it is useful; he studies it because he delights in it and he delights in it because it is beautiful”

~ Georg Cantor

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