Mathema

PRESENTS

MATHOLOGIC

Department of Mathematics
GARGI COLLEGE
UNIVERSITY OF DELHI

2023-24

From Principal's Desk

Dear students,

It is with great delight and immense pride that I congratulate Team Mathematics on bringing to us their 2023-24 magazine with a yet another novel and fascinating theme -
Ganitgyaan : Journey from Galaxy to Graphical User Interface "
The intersection between technology and mathematics is vast and profound. Technology serves as a powerful tool for advancing mathematical research, education, and practical applications.

In research, especially understanding the ways of our Universe and galaxies- computational techniques and algorithms enable mathematicians to explore complex problems, simulate scenarios, and analyze large datasets that were previously unthinkable. From cryptography to machine learning, mathematics underpins many cutting-edge technologies, driving innovation and shaping the digital landscape.

In education, graphical user interface through technology enhances the teaching and learning of mathematics through interactive simulations, online courses, and adaptive learning platforms. These resources offer personalized instruction, instant feedback, and immersive experiences, making mathematical concepts more accessible and engaging for learners of all ages.
Practically, technology revolutionizes industries such as finance, engineering, and healthcare by providing mathematical models, data analysis tools, and optimisation algorithms to solve real-world problems efficiently and accurately.

I strongly believe that our students are 'Math'magicians' and will be pioneers in driving progress and pushing the boundaries of human knowledge.

My very best wishes in all the endeavour's!

Prof. (Dr.) Sangeeta Bhatia
Principal (Offg.)

Convenor's note

Dear students,

We proudly present this year's annual magazine "Mathologic" of the Department of Mathematics, Gargi College.
Our aim is to provide a platform which explores and strengthens the potential which is innate in every individual but waiting expression. This year the magazine has been designed and conceptualized by the students.

The theme of the magazine is "Ganitgyaan: Journey from Galaxy to Graphical User Interface". which explores how mathematics governs phenomenon as vast and infinite as space and as compact as a microprocessor chip. As you flip through the pages of this year's edition of Mathologic, you will be able to find how everything is interconnected, with even the most basic mathematical principles leading to infinite possibilities.

Continued progress must remain our mission. We must keep enhancing our capabilities and must expand our footprints, in terms of quality and quantity. We extend our sincere thanks to Ms. Drishti Singh our student president and her team for their strenuous effort. We would like to congratulate all the student's writers, student editorial and faculty editors for working tirelessly to bring out this edition of Mathologic.

Happy Reading everyone!

Thank You and Best Wishes.

Ms. Sapna Malhotra
TIC & Convenor

From Union President

It fills me with immense pride to witness the wonderful learning experiences we have shared as part of this MATHEMA family. The fruition of our collective efforts in organizing various events is truly satisfying. From workshops to seminars, each endeavor has contributed to our growth as individuals and professionals in the field of mathematics.

Additionally, I am pleased to highlight the significant contribution of our magazine team in compiling a diverse array of research articles and writings on theoretical mathematics and its practical applications in the real world. Their dedication and countless hours spent over the course of months have culminated in a publication that not only showcases the depth and breadth of mathematical knowledge but also inspires readers to explore the limitless possibilities of this discipline.

To our fellows I urge you to seize every opportunity and make the most out of your college life. Engage actively in extracurricular activities, pursue your passions, and never hesitate to seek guidance from mentors and seniors. Cherish every moment, for it is these experiences that will shape you into the person you aspire to be.

Lastly, I thank our teachers for their unwavering support, guidance, and dedication to our academic and personal development. Your mentorship has been instrumental in shaping our journey and fostering a love for mathematics that will endure a lifetime.

As we move forward, let us remember that the legacy we leave behind is not measured solely by our accomplishments, but by the impact we have on those who follow in our footsteps.
Together, let us continue to uphold the values of excellence, camaraderie, and service that define our Mathematics Association, MATHEMA.

Drishti Singh

From Editor's Desk

During a family discourse on the lives of people during my parents' youth, my appa and amma discussed, "The technology nowadays didn't exist at that time. Kisne socha tha ki bacho ke paas apne mobiles honge aur voh bhi touchscreens. The coming years and people's lives would be completely transformed with the new tech." Looking back to 2023, during my attempt to carry on the streak of newspaper readings, I came across many articles that supported their stand. Chandrayaan-3 landing near the moon's south pole and ISRO launching Aditya-L1 into outer space to the advent of AI in everybody's life are the major and famous examples of the same.

It was a great pleasure when the team collectively decided the magazine theme along the same lines after long and elaborate discussions. From attending late-night meetings to pitching amazing and innovative ideas, from the magazine theme reveal to designs finalising, from day 0 to day n, the team has set a great example of effective teamwork, creative and open mindset, and commitment for the next team.

The Mathologic team proudly presents to you its 6th edition "Ganitgyaan: From Space to GUI". Along with informative articles, the magazine also features interactive content like puzzles, and codes as well as the events organized by the Mathema, Mathematics Association, Gargi College.

To our readers, I hope you enjoy the journal and become part of the enjoyable wavelength of learning!

MATHEMA

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2023-2024

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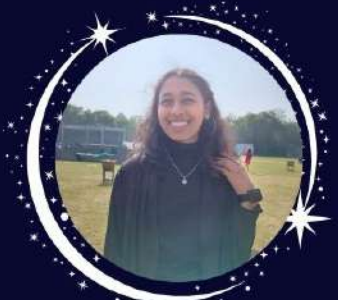

Aastha
3rd Year

Acknowledgements

Through the completion of its sixth edition, the Mathologic unveils the great expanse of application of mathematics in the infinite canvas of space and its application in the creation of the virtual world of animation. As every achievement in the universe is a result of combined efforts, the completion of the magazine owes it back to all the combined efforts of the union and other members of Mathema, students of the department, teacher advisors for their support, advice and cooperation in its whole journey.

A deep thanks to its union advisors, union members, creative team and editorial team of the Mathema for providing many needful insights during the preparation of the magazine, from deciding upon the theme to choosing details for each page of the magazine. Also, an earnest appreciation to the students of the Mathematics department for their creative works. Lastly, a genuine gratitude to our teacher advisors, convenors for all the advice and tips on every detail from the selection of theme to finally brushing up the final look of the magazine. It could not have been possible without the collective efforts and team-work, cooperation and coordination for the magazine to see the light of the day.

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"The universe is under no obligation to make sense to you."

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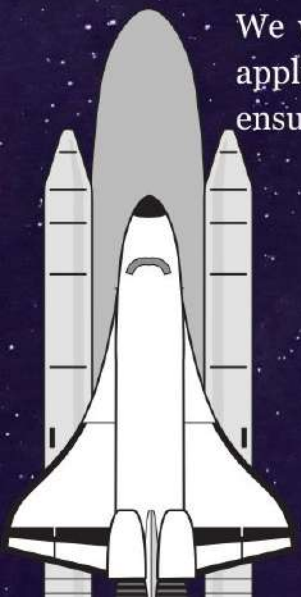
INTRODUCTION
TO THE THEME.

Galaxy to GUI is like, from the smallest of wonders to the largest of creations to exist. In mathematical terms, we could compare this with the transition from the addition of two numbers to the summation of a series. Both discoveries are equally significant for Mathematics. One comparatively smaller in physical appearance but both significantly important for their roles in mankind.

Our theme focuses on these terms. It unveils the magic of things as big as galaxies to as small and complex as GUI's with the help of mathematical phenomenons.
As the heartbeat of innovation and understanding, mathematics permeates every facet of our existence, guiding our exploration of the cosmos and shaping the digital landscapes we navigate daily.

This year, our department Mathema-The Mathematics Society of Gargi College, proudly presents a symphony of thought-provoking articles, captivating visuals, and insightful analyses, all centred around the profound significance of mathematics in our world. From unravelling the mysteries of celestial bodies to optimizing the functionality of modern technology, mathematics is the silent force driving progress and shaping our collective future.

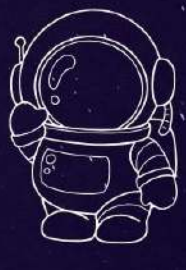
We will go into the depths of outer space and see the magic of numbers carrying magical phenomenons. How the galaxies have so much hidden within and how much we have unravelled with Mathematics? Through equations, formulas, and mathematical models, scientists and engineers, will unlock the mysteries of space, enabling advancements in space exploration, satellite technology, and our understanding of cosmic phenomena.



We will dive into GUI and see how from simple calculators to complex software applications, mathematics is employed in various aspects of GUI development to ensure functionality, responsiveness, and user-friendliness.

Join us as we embark on a journey of discovery, where the language of numbers and patterns reveals the beauty and complexity of the universe around us."

~Khushi
B.Sc. (H) Mathematics
2nd year



BEYOND AND BEHIND THE LENS: THE OUTER SPACE AND THE VIRTUAL WORLD

What do these pictures have in common? One is the infinite canvas of never ending mystery and the other the creation of human creativity and ingenuity.The thing about both of them is that the first has mathematics incorporated in its creation and the later is interpreted using mathematics.

In the most general cases, I presume that, as a child, mathematics is a subject that we have to put a bit more effort into, to grasp the logic or to get used to certain modus operandi or perfectly solve all the numericals even when we grow up. But as a mantra or as a motivational quote, my mother used to say, “Maths is everywhere, used in every subject”. And the reality is converging to proving it true. And so here I am from a small child trying to find out a subject that does not have maths to saying everything uses maths. From interpreting the blank space that stretches beyond our naked eyes and explaining the events occurring in it in the form of equations to using equations to create the world behind the screen, its domain of application covers from positive infinity to negative infinity. There are many branches of mathematics used in different aspects of life everyday. But I would like to bring the focus laser on trigonometry used in astronomy and animation specifically.

Astronomy:

Trigonometry is a branch of mathematics that deals with the relations of the sides and angles of triangles and with the relevant functions of any angles.

Trigonometry comes from the Greek word "trigonometria" - it was put together from these three words - Tri (three), gonia (angle), and metro (measure). ome attribute the advancement of Trigonometry to Astronomy as the driving force and some regard the study of astronomy as possible due to trigonometry. Well, in both cases, I think it’s safe to say that space mystery would never be unravelled if not for the space enthusiasts and the concept of trigonometry developed so far. Regiomantanus called trigonometry “Foot of the ladder to the stars”. Nevertheless, trigonometry is intended to be used for astronomy. Ancient mathematical astronomers in Greece and India in particular employed a variety of geometrical models to describe the pattern of movements within the sky, models that were further developed by the Islamic civilization. Computation with these models was a major impetus behind the development of trigonometry. The three main figures that we know of in the development of Greek trigonometry are Hipparchus, Menelaus, and Ptolomy..

Ancient mathematical astronomers in Greece and India in particular employed a variety of geometrical models to describe the pattern of movements within the sky, models that were further developed by the Islamic civilization. Computation with these models was a major impetus behind the development of trigonometry. The three main figures that we know of in the development of Greek trigonometry are Hipparchus, Menelaus, and Ptolomy. Hipparchus realised that the 2D trigonometry relating to triangles is not adequate to describe the motion of the astronomical bodies as they don't move on plane but celestial sphere. So,the need for spherical trigonometry arose. Sphaerica, the third work of Greek mathematician Menelaus, is the earliest surviving work on spherical trigonometry. Ptolemy's astronomical classic Syntaxis mathematica contains a fully realised spherical trigonometry

Coming to how it is used:
Distance- To calculate the distance of the astronomical bodies,triangulation method with parallax is used. Parallax is simply the apparent shift of position of objects viewed along two different lines of sights against the background . Looking at the tip of your finger with either eyes closed, there is a slight change in the position of the finger.By measuring this small change and the distance between the eyes, the distance to the finger-tip is calculated.

his same technique is applied in finding out the distance of distant cosmic bodies against the background of galaxies, by using the orbit of the earth around the sun as the baseline instead of the distance between our eyes.

Speed- If a body appears to be moving at a particular speed in relation to an object whose distance from the body is known, then the distance of the astronaut from that body can be calculated. The process involves calculating the unknown distance in relation to the speed at which the astronauts are travelling. This can help determine how far away an object is in relation to any particular speed, and how long it would take to reach it while travelling at that speed.

Measurement: The angular size of planets are measured with a telescope, using the distance to compute the diameters by employing trigonometry.

Trigonometry is also used to find the orbit of the cosmic bodies, near the terrestrial domain, in designing and launching of rockets, trajectories of rockets and satellites.

Animation :

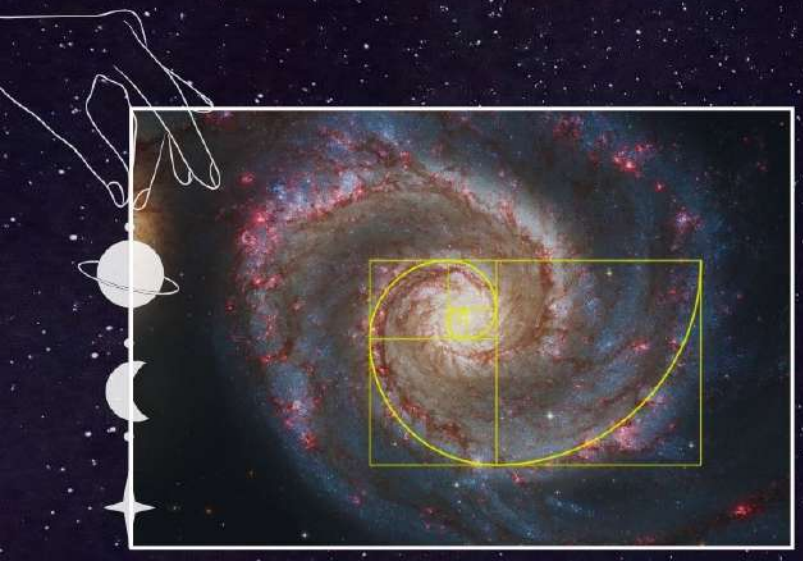
When it comes to animation, the assumed prerequisite would consist of great artistic skills. As the quality of animation keeps improving, the tack of achieving the visual effect keeps updating and so does the job of an animator. Animation, basically, is an illusion of motion, achieved through quick succession of pictures slightly different from the last. The pictures can either be traditional hand-drawings or photographs. The detailed 3D animation evolving in the 21st century, like in a waterfall composed of tiny water droplets; where the characters are quite detailed in their creation, from hair strands to wrinkles and folds to curves would be hard to achieve through traditional method of drawing every frame. And this is where the art of realistic imitation of reality is achieved through equations, equations describing disorientation of hair and clothes, deformation of skin, flow of water to achieve physically credible motions and effects of nature come in. So, when it is concerned with movement, which animation is primarily all about, trigonometry comes into play.

~Takhellambam Nirchita
B.Sc. (H) Mathematics
1st year

FIBONACCI IN SPACE

"In the vast reaches of space, mathematics may be the only way for us to truly communicate with extraterrestrial civilizations." - Clifford Pickover

Have you ever wondered why looking at the night sky is so enchanting? How do the stars seem so beautiful? And how there is a fascinating pattern to it all? Beyond these sparkling stars and swirling galaxies, there lies a mathematical harmony that connects the celestial bodies in a mesmerizing dance.



(Image Credits: Medium.com)

One such mathematical phenomenon that reveals itself in the cosmic tapestry is the Fibonacci sequence and the associated golden ratio:

Let's start with a simple question, What is Fibonacci sequence? It is a series of numbers where each number is the sum of the two preceding ones i.e.

0,1,1,2,3,5,8,13,21,34 and so on.

Another question arises what is the Golden Ratio? The Fibonacci sequence leads to an intriguing constant known as the golden ratio, approximately 1.6180339887. This ratio has fascinated artists, architects, and mathematicians for centuries due to its aesthetic appeal and prevalence in nature.

And now, we come to our last and most crucial question. Why is the Fibonacci sequence and Golden Ratio of such importance in the space and cosmos? The answer is Fibonacci's beauty may leave us 'Star-struck'.

One of the most captivating manifestations of the Fibonacci sequence in space is observed in spiral galaxies. Galaxies, vast collections of stars, gas, dust, and dark matter, often exhibit spiral arms that follow a logarithmic spiral, a form closely related to the golden ratio. The distribution of stars in these arms reflects the Fibonacci sequence, creating a visually stunning display of cosmic symmetry.

Nebulae, the birthplace of stars, also showcase the influence of Fibonacci in their intricate patterns. As new stars form within these colossal clouds of gas and dust, they often arrange themselves in a spiral pattern reminiscent of the Fibonacci sequence. The pillar-like structures within the nebula, where stars are being born, exhibit a pattern that resonates with the Fibonacci sequence, underscoring the universal prevalence of this mathematical phenomenon.

(Image Credits: Space.com)

Moving beyond the grand scale of galaxies and nebulae, the influence of Fibonacci can also be discerned in the arrangement of planets within a solar system. While the distances between planets may not precisely follow the Fibonacci sequence, their orbital ratios often exhibit remarkable numerical relationships.

As we continue to explore and comprehend the universe, the connection between mathematics and the beauty of space becomes increasingly apparent, inviting us to appreciate the sublime elegance woven into the fabric of the cosmos.

~Khushi
B.Sc. (H) Mathematics
2nd Year

INTRODUCTION TO MATHS ALGORITHMS FOR VFX

Visual effects (VFX) in movies, TV shows, and video games rely heavily on advanced mathematical algorithms to create realistic and captivating simulations. From explosive particle affects to fluid dynamics and procedural generation, these algorithms are the backbone of modern digital media.

Simulating Explosions and Particle Effects

One of the most dramatic and visually stunning VFX techniques is the simulation of explosions and particle effects. These effects rely on a deep understanding of physics, specifically the behaviour of gases, fluids, and solids under extreme conditions. By modelling
the complex interactions between pressure, temperature, and velocity, VFX artists can create explosions that look and behave realistically on screen.

1) Particle Systems:

The foundation of explosion and particle effects is the particle system, which represents individual elements like debris, smoke, and flames as discrete particles. Each particle has its own properties, such as position, velocity, and lifetime, which are continuously updated based on underlying physical simulations.

2) Fluid Dynamics:

VFX artists employ computational fluid dynamics (CFD) algorithms. These algorithms model the complex interactions between gases, liquids, and solids, allowing for the realistic simulation of expanding shockwaves, billowing smoke, and turbulent flames.

3) Rigid Body Simulations

IExplosions often involve the movement and interaction of solid objects, such as debrisand rubble. Rigid body simulations, which model the behaviour of these discrete elements, are integrated with particle systems and fluid dynamics to create a complete and convincing explosion effect.

Smoke and Fire Simulation

One of the most prominent applications of fluid dynamics in VFX is the simulation of smoke and fire. By modelling the turbulent flow of gases and the interaction with heat sources, VFX artists can create realistic and dynamic smo ke plumes, flames, and other fire-related effects.

Navier-Stokes Equations

The foundation of fluid dynamics simulations in VFX is the Navier-Stokes equations, a set of partial differential equations that describe the motion of fluids. These equations model the conservation of mass, momentum, and energy, allowing for the accurate simulation of a wide range of fluid behaviours.

$$\nabla \cdot \bar{u} = 0$$

$$\rho \frac{d\bar{u}}{dt} = -\nabla p + \mu \nabla^2 \bar{u} + \rho F$$

Liquid Simulation

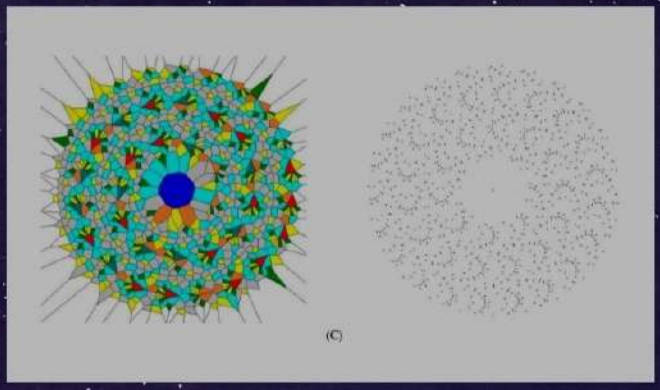
Fluid dynamics also plays a crucial role in the simulation of liquids, such as water, oil, and other fluids. VFX artists use advanced techniques like Smoothed Particle Hydrodynamics(SPH) and the Material Point Method(MPM) to capture the intricate behavior of liquids, from splashing waves to swirling whirlpools.

Procedural Generation and Noise Functions

Beyond the simulation of physical phenomena, VFX artists also rely on procedural generation and noise functions to create complex, organic-looking environments and textures. These techniques allow for the efficient generation of seemingly random, yet visually coherent, patterns and structures.

Voronoi Diagrams

Voronoi diagrams are a powerful tool for procedural generation, as they can be used to create organic, cell-like structures and patterns. VFX artists employ Voronoi diagrams to generate realistic-looking organic materials, such as reptile skin, tree bark, and rock formations.



Fractals

Fractals are self-similar patterns that repeat at different scales, creating intricate and organic-looking structures. VFX artists use fractal algorithms to generate complex, natural-looking elements like trees, plants, and rocky terrains

~Raabhya Aggarwal
B.Sc. (H) Mathematics
First Year

Trajectory and Fuel Calculations in Aerospace Engineering

We all remember the thrill of Chandrayaan 3! The victorious Lunar-exploration mission was developed by the Indian Space Research Organisation. But imagine, had there been no differential equations and calculus, how would the trajectory and fuel consumptions be calculated? How would such precise missions have been launched then? Sounds impossible, right? Indeed, it is.

In the field of aerospace engineering, trajectory and fuel consumption calculations are integral parts for the success of any space mission. The backbone of these calculations lies in the mastery of complex mathematical models as well as factors like orbital inclination and orbital insertion manoeuvres. Advanced software tools, including simulation programs and numerical integration techniques, aid engineers in modelling complex trajectories and predicting the behaviour of spacecraft with high accuracy.

The mathematical framework governing the motion of a spacecraft are Newton's Second Law of Motion, Orbital Mechanics Equations and Thrust and Propulsion equations. Newton's second law states that the force acting on an object is equal to the mass of the object multiplied by its acceleration, which is given by:

$$F = m \cdot a$$

where 'F' is the force acting on the spacecraft, 'm' is its mass and 'a' is its acceleration.

Kepler's laws of planetary motion, along with Newton's law of universal gravitation, provide the basis for Orbital-Mechanics equations.

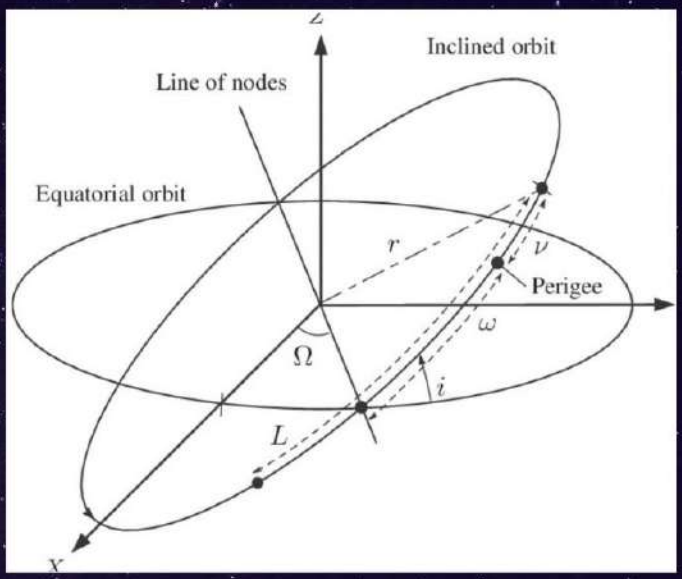


Fig1: Classical Orbital Elements

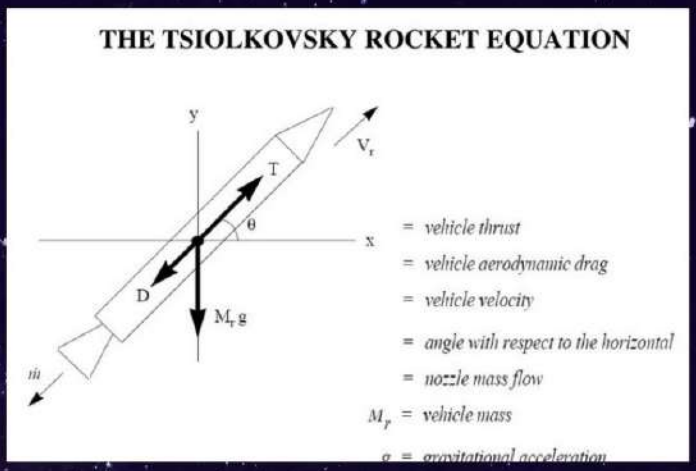
The Tsiolkovsky rocket equation is of significance in this case. It relates the change in velocity of a spacecraft to the exhaust velocity of the propulsion system and the mass ratio of the spacecraft, involving integration. This equation is fundamental in calculating the amount of propellant required to achieve a desired change in velocity.

$$\Delta v = v_e \ln \frac{m_0}{m_f}$$

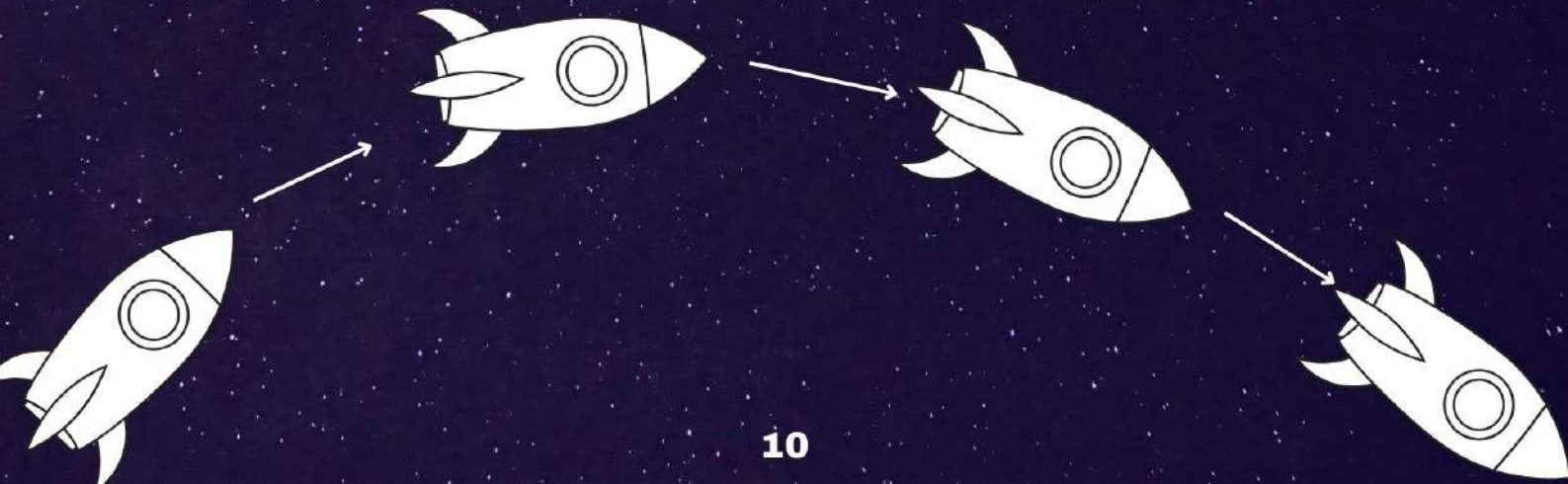
Calculus-based optimization techniques are employed to determine the most efficient trajectory for the spacecraft, taking into account factors such as gravitational assists, orbital manoeuvres, and fuel consumption constraints.

Optimization algorithms, often based on derivatives and gradients, are used to minimize the mission duration or fuel usage while satisfying mission objectives.

Thus, to model the dynamics of a spacecraft mission, mathematics plays a crucial role in ensuring the success of lunar exploration missions.



~Tanaya Trisha Bharali
B.Sc. (H) Mathematics
2nd Year



UNFOLDING

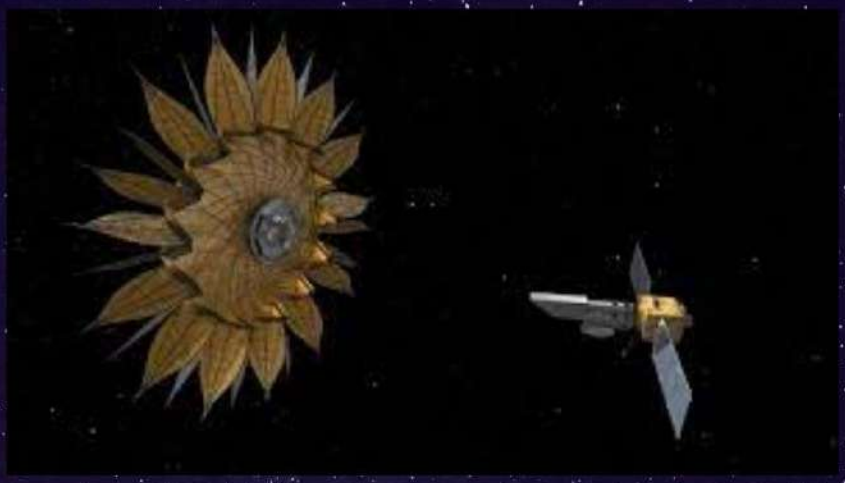
As we think of origami, we're taken back in time to squares of colourful paper as we fold away in kindergarten, or maybe to folding paper rings with the promise of love. Even though some people may feel that the closest origami comes to our daily lives, save for a hobby, is papers creasing at the corners and stingy papercuts. But I' here to tell you it sneakily crawls into almost all subjects.

NASA is working on piece of hardware called Starshade, which looks like a huge sunflower, which would be used to block light from distant stars for better imaging of the fainter exoplanets. As the agency was faced with the obstacle of fitting such huge hardware on a rocket, the iris folding pattern came to rescue as it could be folded compact enough to fit atop the rocket and unfurled to its full diameter in space. But its not just the orbit where the art of origami becomes pragmatic.

Mathematics and the art of folding intersect at various concepts. Some of them might be easier to recognize such as spatial visualization, area and volume, symmetry and perspective. As origami was studied through the application of geometric principles, Haga's Theorems came into being. These theorems aid paper folders with efficiently and accurately folding proportions, rather than the folders having to measure and calculate on both sides.

Origamists in the early 90's were not just interested in the culture, they were competitive of their understanding of the art, as oneusually is as they approach mastery over a subject. A group of Japanese artists who called themselves Origami Detectives started holding competitions and slowly as word spread, research-scientists from established universities started joining the contest. They used to compete over algorithms for paper folding problems, and now the same is known as Computational folding, which is a branch of computer science that deals with folding algorithms.

As I learnt more about this art, I realised that its more than just folding paper into intricate and aesthetically pleasing structures.The ancient art of origami, that originated from China and Japan with the development of delicate handmade paper, was passed down from generation to generation. Asians take pride in their heritage of paper folding that at the time of candles and wrapped letters conveyed more emotions than words could. The crane as a symbol of hope and healing, the Sakana fish as a symbol of strength, fulfilment, tenacity and freedom, while the owl was gifted as a wish for luck and good fortune.



The story of Sadako Sasaki, a baby girl who developed Leukemia due the radiation from the atomic bombing, and the thousand paper cranes lives in the heart of many. As Sadako and her friends learn of her condition and she's hospitalized, Chizuko tells her of the legend that if a sick person folds 1000 paper cranes, the gods grant their wish and they would recover. Sadako would fold paper cranes each day that she could in the hope of getting better but passed away having folded jut 644 of them. Her friends completed all 1000 of them and buried them with her. The paper cranes are a symbol of peace around the world.

I could probably write on and on about how the delicate art of mindful folds has found its way into almost every subject in one way or another. But I would like to end with a question, When did you last fold a paper crane?

~Yash Sabharwal
B.Sc. (H) Mathematics
3rd Year

"Alan Curtis Kay: A Tech Wizard's Journey from Sketchpad to Smalltalk"

Picture a young Alan Curtis Kay, who had a love for electronics comparable to a child in a candy store and an insatiable curiosity about the cosmos. He was born in 1940 and was a budding tech genius who was constantly experimenting and learning about the strange world of machines. However, the turn of events in his life came when he discovered Ivan Sutherland's Sketchpad system at the University of Utah. Kay experienced a sudden sense of discovery like to that of finding a magic wand – the realm of human-computer interaction unfolded before him like an abundance of opportunities. And boy, did he throw himself in!

Kay's big claim to fame? Smalltalk. Nope, not small talk like chatting about the weather – we're talking about a game-changing programming language! The first object-oriented programming language. This led to the development of operating systems with a graphical user interface, or GUI, as well as an entire genre of programming languages known as Object Oriented Programming. GUI systems were subsequently used in Apple's Macintosh operating system as well as in Microsoft Windows.

With Smalltalk, Kay made coding cool, turning it into a virtual playground where ideas bounced around like supercharged electrons. But here's the kicker: Kay didn't stop at just writing code. Oh no! He dreamed of a world where computers were more than just machines; they were like your best buddy on a quest for knowledge and fun. Enter the Dynabook – Kay's brainchild that was like a magical book filled with wonders, and Squeak, a place where learning felt more like playing your favourite video game.

What makes you care, then? Well, because Alan Curtis Kay not only altered the tech world, but made it a whole lot more awesome! He inspired all of us to dream a little bigger and explore
the world far more by transforming ordinary old computers into wonderful portals of adventure thanks to his crazy imagination and love of adventure.

~Vanshika Singh
B.Sc. (H) Mathematics
2nd Year

The Art of Curves in Animation

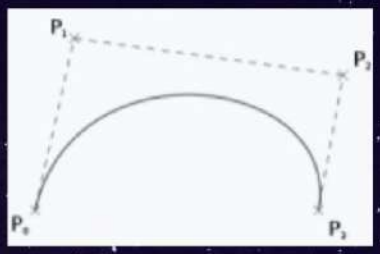
Who doesn't love 'The Toy Series' and 'Finding Nemo'? We all do, right? These two definitely come under the Greatest Animated movies of all time! But, being mathematicians, have you ever wondered the mathematics behind such classic animations? Don't worry, I shall give you an outlook!

Animation is an intricate blend of art and mathematics. One of the most pivotal components of its realism is the use of mathematical curves. These curves play a significant role in creating smooth and visually appealing characters. Ranging from simple curves like that of circles and ellipses, to complex ones like Bezier curves, these curves provide a precise way to smoothen surfaces in animation. All thanks to the mathematician Pierre Bezier for coming up with this idea of Bezier curves, wherein these are mathematically defined curves used in computer graphics and animation.

Given distinct points P0 and P1, a linear Bezier curve is simply a line between those two points. The curve is given by

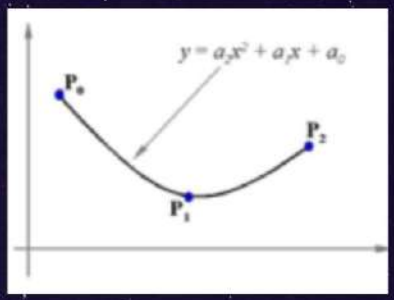
$$\mathbf{B}(t) = \mathbf{P}_0 + t(\mathbf{P}_1 - \mathbf{P}_0) = (1-t)\mathbf{P}_0 + t\mathbf{P}_1,\ 0 \le t \le 1$$

This equation is equivalent to linear interpolations. The quantity (P1 - P0) represents the displacement vector from the start point to the end point.

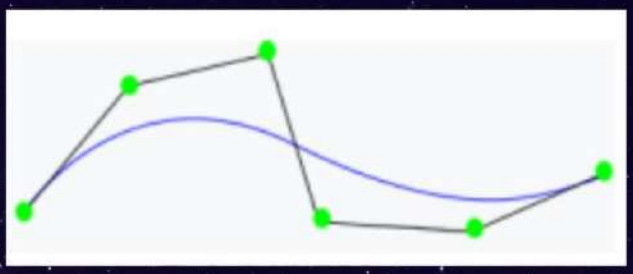


Another mathematical concept representing a smooth curve is a Spline curve. A spline is a piecewise polynomial curve. It enables the user to build an interface and allows the user to design and control the shape of complex curves and surfaces. They use a small set of control points (knots) and a function that generates a curve through those points. This allows the creation of complex smooth shapes without the need for manipulating many short line segments or polygons at the cost of a little extra computation time when the objects of a scene are being designed. Taking the equation y=f(x), we can express as a polynomial function, say:

y=a2x2+a1x+a0



Another mathematical concept, namely NURBS (Non-Uniform Rational B Splines). These complex mathematical surfaces enable animators to create smooth and detailed landscapes, thereby shaping realistic environments.



Thus, the inter-relation of mathematics and animation, more especially the use of curves, elevates the art-form to new levels of realism and aesthetic appeal. Also, with the advancement of technology, mathematical contribution in the world of animation would undoubtedly lead to more realistic realms of visually contented characters.

~Tanaya Trisha Bharali
B.Sc. (H) Mathematics
2nd Year

INFINITY THROUGH COSMOS

As the Artist's oeuvre,
Nature in words and numbers.
Words as it seems to recount the ethereal pictures,
Explicitly and picturesquely,
Numbers used to untwine her mystery,
Implicitly and precisely.

Studying how natural phenomena are unrevealed,
Maths in equations, shapes and logic
Used to decipher the code,
To express the story of creation.

Nature's boundless bounty,
Abiding the golden ratio,
In its many petals,
In varied sea-lives.

Precisely attracted on the earth,
Precisely far away from the sun,
Measured through geometry and trigonometry.

The infinity set against the galaxies,
Quantified and explained,
Through equations.

Occurrence of natural events,
Presence of a celestial body,
Predicted through statistics and probability.

Mathematics-
A language to converse with the cosmos,
To interpret the infinite canvas ,
Sequinned with stars and planets.

~Takhellambam Nirchita
B.Sc. (H) Mathematics
1st Year

MATHEMATICS IN MOTION

What were your favourite cartoons or animations as a child? Mine was Doraemon, but back then as kids, we didn't know how animations were done, or how cartoons were made. As a child, it was either the real world somewhere out of our homes, or it was a bunch of photographs that a magician inside the television was making a move.
As we grew up a little more, we got more into the technical side of animation, but we still admired it from our video games without actually knowing how it was made. But we never really knew, how mathematics was used in making stop motions, animations and our favourite cartoons.

At the heart of animation lies the concept of change i.e. how objects move, deform, and interact with their surroundings over time. Calculus provides animators with a powerful set of tools to model motion and its various attributes such as velocity, acceleration, and trajectory.
For instance, let's take the motion of a bouncing ball in an animation. Now, here by using calculus, the animators can make out the precise position of the ball after each bounce after taking into factor all the factors like acceleration due to gravity, air resistance, friction and many more.

While calculus provides the framework for analysing individual aspects of motion, it is often the interplay of multiple factors that gives rise to complex and dynamic animations.

(Image Credits: Wikipedia)

This is where differential equations come into play, by offering a systematic approach to model the relationships between different variables and how they evolve.
Differential equations allow animators to incorporate feedback mechanisms and non-linear interactions, leading to emergent behaviours that mirror those observed in the natural world. Be it the flocking behaviour of birds, the swaying of trees in the wind, or the chaotic motion of crowds, differential equations provide a mathematical framework to capture the rich complexity of motion in all its forms.

From simulating the intricate mechanics of human movement to recreating the dynamics of entire ecosystems, the marriage of mathematics and animation opens up a world of creative possibilities. As technology continues to evolve, the synergy between mathematics and animation will undoubtedly pave the way for even more immersive and captivating experiences in digital entertainment.

~Khushi
B.Sc. (H) Mathematics
2nd Year

PREDICTING CELESTIAL EVENTS

Mathematics plays a crucial role in the study and prediction of celestial events, from the movements of planets to the occurrence of eclipses and meteor showers. By applying the principles of celestial mechanics, astronomers and astrophysicists can develop sophisticated mathematical models that accurately forecast positions, trajectories of various celestial bodies, enabling us to better understand universe and prepare for upcoming astronomical phenomena.

Fundamentals of Celestial Mechanics

Celestial mechanics is the branch of astronomy that deals with the mathematical modeling of the motion of celestial bodies, such as planets, stars, and comets. This field of study relies on the principles of classical mechanics, including Newton's laws of motion and theory of gravitation. By understanding complex interactions between the gravitational forces of these celestial bodies, scientists can predict their future positions and the timing of various events, such as planetary alignments, eclipses, and the arrival of comets.

The foundation of celestial mechanics is the set of differential equations that describe the motion of celestial objects. These equations take into account factors like the masses of the bodies, their relative positions, and the forces acting upon them. Solving these equations through mathematical techniques, such as numerical integration, allows astronomers to forecast the long-term behavior of the solar system and other astrophysical systems.

Predicting Celestial Positions

The accurate prediction of positions of planets, stars, other celestial bodies is fundamental aspect of astronomy and space exploration. By applying principles of celestial mechanics, astronomers can develop mathematical models that describe motion of these objects and forecast their future locations. One of the key challenges in predicting celestial positions is accounting for the complex interactions between the gravitational forces of the various bodies in the solar system and beyond. These interactions can cause subtle changes in the orbits and trajectories of planets, moons, and other objects, which must be carefully modeled to ensure accurate predictions.

Planetary Positions

Predicting the positions of planets is crucial for understanding the dynamics of the solar system and planning space missions. Astronomers use sophisticated mathematical models to forecast the locations of the planets at specific times, taking into account factors like the planets' masses, orbital periods, and the effects of gravitational interactions.

Stellar Positions

Mapping the positions of stars is essential for navigation, both on Earth and in space. Astronomers use astrometric techniques, which involve measuring the angular positions ofstars, to create detailed star catalogues that are used to determine the locations of celestial objects and guide spacecraft.

Other Celestial Bodies

In addition to planets and stars, astronomers use mathematical models to predict positions of celestial bodies, such as comets, asteroids, exoplanets. These are crucial for understanding the dynamics of universe and preparing for potential impacts, other events that could affect life on Earth .

Forecasting Astronomical Events

The application of mathematics in astronomy extends beyond the prediction of celestial positions and into the realm of forecasting various astronomical events, such as eclipses, meteor showers, and the appearance of comets.

Eclipses

Eclipses, both solar and lunar, are predictable events that can be accurately forecasted using mathematical models. Astronomers can determine the timing, duration, and path of an eclipse by calculating the orbital motions of the Earth, Moon, and Sun, as well as the relative positions of these celestial bodies.

Meteor Showers

Meteor showers occur when the Earth passes through streams of debris left behind by comets or asteroids. Predicting the timing and intensity of meteor showers requires complex mathematical models that take into account the orbits of the debris streams and the Earth's motion through the solar system.

Comet Appearances

The appearance and behavior of comets can also be forecasted using mathematical models.By analyzing the orbital parameters and trajectories of comets, astronomers can predict when these icy bodies will be visible from Earth and how their appearance may change over time as they approach the Sun.

The Importance of Mathematical Modeling in Astronomy

The accurate prediction of celestial events and the successful exploration of space rely heavily on the development of precise mathematical models. These models, which are based on the principles of celestial mechanics and other branches of physics, allow astronomers and space scientists to forecast the motion and behavior of celestial bodies with a high degree of accuracy.

The importance of these mathematical models extends beyond just predicting the positions of planets and the timing of eclipses. They also play a crucial role in the design and navigation of spacecraft, the study of exoplanets and the search for habitable worlds, and the understanding of the evolution of the universe on a cosmic scale. As our understanding of the universe continues to grow, the need for ever-more sophisticated mathematical models will only increase, driving the advancement of astronomy and space exploration.

~Raabhya Aggarwal,
B.Sc. (H) Mathematics
1st year

NIGAR SHAZI

THE SUNNY LADY OF ISRO

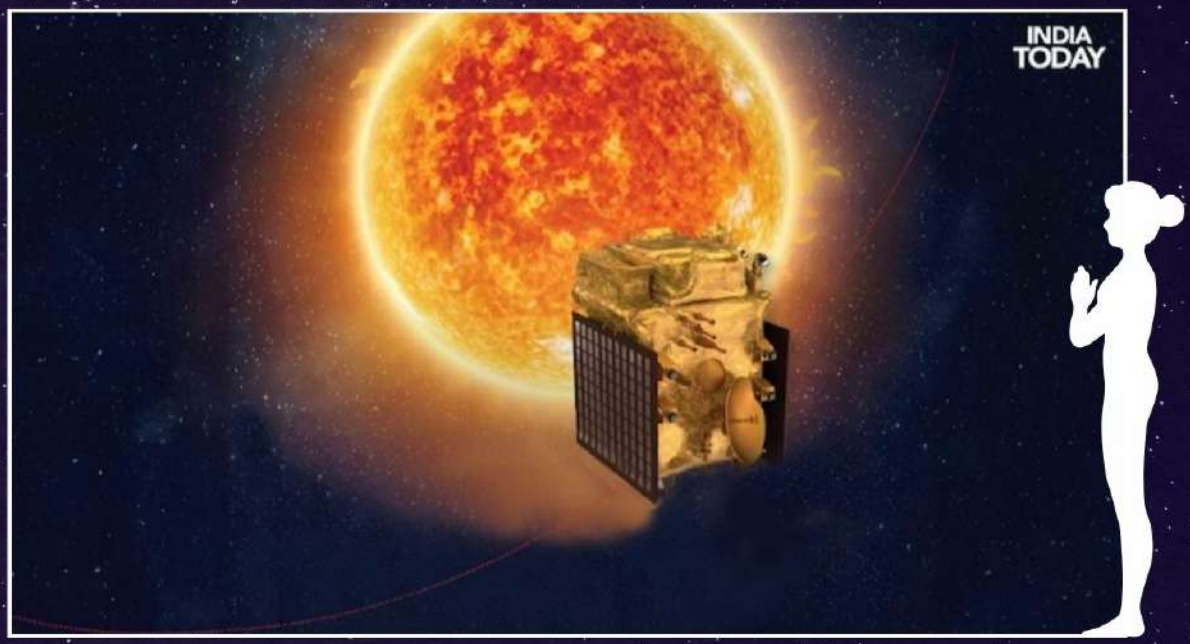
Image Credits: India Today

Leading the complex scientific mission of putting India's first solar observatory Aditya-L1 at Langrang point L1 from where the spacecraft did the 'celestial Surya Namaskar' of the Sun is ISRO's project Director Nigar Shaji, a gentle and smiling soul, who had worked tirelessly on the mission with her team for eight years to make it a success.

Nigar went to an English medium higher secondary school in Sengottai. "At a time when it was not very common for Muslim women to come out and study, my father ensured that all of us brothers and sisters received a good education. He believed that women should be financially independent. He himself had done his masters in maths", Shazi told the Indian Express. Shazi said she had never planned to join ISRO. It was her love for maths and physics that took her there. "I did consider becoming a doctor, like my family suggested, but I decided to go ahead with engineering because I really loved maths and science," she said. She chose Electronics and Communication Engineering for her Bachelor's degree which she completed at Tirunelveli Government Engineering College. She later completed her master's degree in Electronics and Communications from Birla Institute of Technology in Ranchi.

It was in 1987 that Shaji joined the Satish Dhawan Space Centre. At the space agency, Shaji worked in several fields like communication, satellite, design, and control systems. She was also the Associate Project Director of Resourcesat-2A, the Indian Remote Sensing Satellite for National Resource Monitoring and Management. She worked at the UR Rao Satellite Centre in Bengaluru and held several important roles. Shazi has worked on multiple satellite programmes, including serving as study director for India's proposed mission to Venus which she spoke about in 2012. She also headed the Satellite telemetry centre at ISRO, Bengaluru. She has authored several papers on image compression, system engineering among others. Talking about Aditya L-1 project, Shazi said,"I have been heading this complex project for eight years. It was a challenging project. To place the spacecraft in the halo orbit itself is a major challenge. Further the payloads were also first of its kind,"

Her contribution to India's Space Odyssey seems to be enduring as a woman scientist from the state's southern district of Tenkasi will have her tryst with destiny when Aditya-L1 satellite soared into the sky on September 02, 2023. After the launch of Aditya L-1 was successful, Shaji said, "This is like a dream come true. I am extremely happy that Aditya L-1 has been injected by PSLV. Aditya L-1 has started its 125 days of long journey. Once Aditya L-1 is commissioned, it will be an asset to the country and the global scientific fraternity. I want to thank the entire team for their support and guidance in making this mission possible". She is now a role model for not only the women who want to pursue a career in space science but also for women who want to fly high and reach heights.



~Vinita Yadav
B.Sc. (H) Mathematics
3rd Year

CHAT WITH BOT

Q. What's your take on the space industry?

A. The space industry is a fascinating and rapidly evolving sector that encompasses various fields such as satellite technology, space exploration, and commercial spaceflight. It holds immense potential for scientific discoveries, technological advancements, and economic growth, although it also faces challenges such as cost barriers and sustainability concerns.
In addition to its potential for scientific discoveries and economic growth, the space industry also plays a crucial role in global communications infrastructure through satellites, enables Earth observation for environmental monitoring and disaster management, and fosters international collaboration and peaceful cooperation in space exploration endeavors. However, it also faces issues such as space debris management, regulatory frameworks, and ensuring equitable access to space resources.

Q. How does the space industry contribute to a country's GDP?

A. The space industry contributes to a country's GDP through direct revenues from space-related activities like satellite services and space tourism, indirect impacts on related sectors, technology transfer, international collaborations, and inspiring STEM education and workforce development.
In addition, investments in space research and development often lead to spin-off technologies that benefit other industries, further boosting economic growth. Furthermore, the space sector's international collaborations foster diplomatic relations and open up new opportunities for trade and cooperation on a global scale.

Q. What's your take on GUI?

A. Graphical User Interfaces (GUIs) have revolutionized the way people interact with computers and digital devices. Here are some key points about GUIs:
1. User-Friendly Interaction
2. Enhanced Productivity
3. Visual Feedback
4. Customization and Personalization
5. Cross-Platform Compatibility
6. Challenges and Considerations

Overall, GUIs have had a profound impact on technology usability, productivity, and accessibility, and they continue to play a crucial role in shaping the user experience across various digital platforms and devices.

Q. Do you think the political state of a nation can impact its space infrastructure?

A. The political state of a nation can significantly impact its space infrastructure and activities. Political stability, government priorities, funding allocation, and international relations all play crucial roles in shaping a country's space program. A stable political environment allows for long-term planning and sustained investments in space exploration, satellite development, and related technologies. Conversely, political instability or frequent policy changes can disrupt funding streams, delay projects, and hinder progress in space initiatives. Government priorities also influence the direction of space programs, with some nations focusing on scientific research and exploration, while others prioritize commercial space ventures or national security-related activities. International relations further impact space infrastructure through collaborations, access to launch facilities, and regulatory frameworks governing space activities. Strong diplomatic ties can facilitate partnerships for joint space missions, technology exchanges, and shared use of space assets, enhancing a nation's space capabilities.

Conversely, strained relations or geopolitical tensions may restrict access to critical resources or impede cooperation in space endeavors. Therefore, the political state of a nation plays a vital role in shaping the trajectory and success of its space infrastructure and endeavors.

Q. Do you think being an animateur as a good career option?

A. Becoming an animateur can indeed be a rewarding career option for individuals passionate about creative expression, storytelling, and animation. Here are some considerations:

1. Creativity and Artistry
2. Demand for Animation
3. Job Opportunities
4. Continuous Learning and Growth
5. Collaborative Environment
6. Challenges and Competition

Overall, being an animateur can be a fulfilling career for individuals with a passion for animation and storytelling, offering opportunities for creativity, growth, and collaboration in a dynamic and evolving industry.

Q. How is quantum computing used in space missions?

A. Quantum computing has the potential to revolutionize space missions in several ways:

1. Optimization
2. Data Analysis
3. Secure Communication
4. Simulation
5. Sensor Development
6. Navigation and Timing

Overall, quantum computing has the potential to transform space missions by enabling faster computation, secure communication, advanced simulations, precise sensing, and reliable navigation. As quantum technologies continue to advance, they are expected to play an increasingly important role in the future of space exploration.

BEHIND THE SCENES: USE OF MATHEMATICS IN ANIMATING CHARACTERS

In a magical world where pirouettes and polygons waltz, a secret symphony of mathematical harmonies directs the ethereal dance of animated characters. Behind the glittering veil of creativity lies a secret kingdom of algorithms, the unknown architects of the tapestry of mesmerizing character animation. In this enchanted ballet, mathematics wears an enchanted cloak, weaving spells of movement an expression that appeal to our senses.

At its core, character animation is a delicate ballet between artistry and precision, where the magic of mathematics shapes the heartbeat of each animated character. Imagine, if you will, an abstract workplace where mathematical equations become the core of figure and movement, expression and emotion. In particular, this magical equation involves the art of rigging, the skeleton on which the characters hang their animated identities. Imagine a complex puppet theater and system where mathematical puppet languages pull and pull the virtual strings of our digital protagonists.

In rigging, the careful use of matrices, transformations, and rotations make characters adaptable to the whims of the animators, allowing them to articulate movement with a mathematical subtlety that is both fascinating and complex. Enter the confusing world of trigonometry, where sine waves and cosine functions create smoothness of motion. As the characters move across the screen, their every move is an intricate dance of angles and curves, choreographed by an invisible athematician on the wings.

The sinuous grace of figure and gait or the dramatic mood of gesture - all are painted with tricks of mathematical elegance. In this enchanting animated ballet, physics takes center stage, driving the illusion of weight, gravity and kinetic energy. Newtonian laws and principles of dynamics become the unsung masters that dictate how the characters interact with the world they inhabit. Leaping into the air, falling to the ground, every move is carefully calculated to obey the laws of the physical universe, giving the characters a tangible presence in the fantasy world. But this elusive manuscript is not complete without the magic ink of calculation. Derivatives and integrals, poets of change and accumulation, nuanced transitions of the script between frames, making the movements smooth and fluid. Animation computing hidden in the shadows ensures that the transition from frame to frame is as riveting as the frames themselves, acontinuous progression that mimics the pulsating rhythm of life.

In the mesmerizing panorama of character animations, probability and statistics appear as puppeteers of unpredictability. Every frown, every flicker of figure and eyelash is not left to chance, but to statistical chance. This statistical ballet breathes life into the digital inhabitants, imbuing them with a spontaneity that mirrors the beautiful chaos of reality. In addition to the visual brilliant charm, algebraic algorithms play the role of unprecedented composers arranging a symphony of emotions.

Emotional states, transitions, and expressions are encoded into equations that resonate with the nuanced tone of human emotion. As the characters feel, algebraic equations resonate and dictate the rise and fall of an emotional crescendo echoing through the pixels, leaving the audience mesmerized. In this field of algorithmic alchemy, machine learning is emerging as a cutting-edge artist pushing the boundaries of creativity. Neural networks trained on vast datasets of human movement and expression become digital choreographers that learn the language of animation and imbue characters with an insane sense of realism.

The combination of mathematics and machine learning creates a mesmerizing dance where characters transcend the boundaries of mere pixels and pixels, embracing real authenticity.In conclusion, the tapestry of character animations is woven with the golden threads of mathematics, and each algorithmic point contributes to the exquisite design of a digital masterpiece. Rigging, trigonometry, physics, calculus, probability, algebra and the cutting edge of amachine learning are all players in this enchanting ballet where the language of mathematics speaks louder than words. While enjoying the captivating animations that grace our screens, let's not forget the silent masters behind the curtain, the mathematicians whose precision and artistry bring the characters to life in a dance that transcends the limits of imagination.

~Jiya Assija
1st winner
Article Writing Competition
Kirori Mal College
3rd year

SPACE THEME RIDDLE

1. Riddle: What kind of music do astronauts listen to?
   Answer: Rock-et music!

2. Riddle: Why did the rocket scientist break up with their partner?
   Answer: They needed space!

3. Riddle: What did the astronaut say to the rocket ship?
   Answer: "You're out of this world!"

4. Riddle: What do you call a rocket that doesn't explode?
   Answer: A success!

5. Riddle: Why did the rocket go to school?
   Answer: To improve its launch skills!

6. Riddle: What do rockets do when they get married?
   Answer: They have a blast-off!

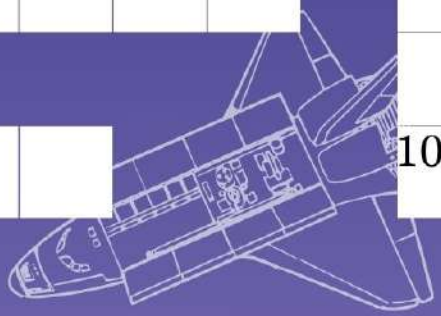
7. Riddle: What's a rocket's favorite part of a computer?
   Answer: The space bar!

8. Riddle: Why did the rocket go to the doctor?
   Answer: It had a bad case of the "blast-offs"!

9. Riddle: Why was the math book sad?
   Answer: It had too many problems.

10. Riddle: What do you call a rocket that doesn't orbit properly?
    Answer: A lost cause!

CROSSWORD



Hints:

Across

1. color model
6. smallest display unit
7. scalable graphic
8. pixel based image
9. user-friendly interface
10. grid based image

Down

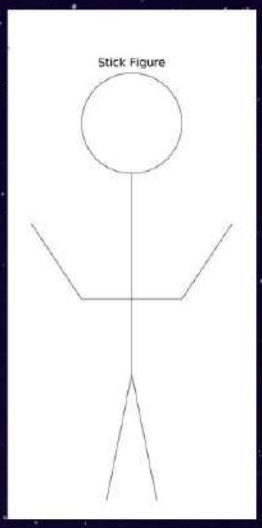
2. smooth curves
3. color selection
4. generate image from model
5. 3D graphics API

{[CODE] + [FOR]+ [YOURSELF]}

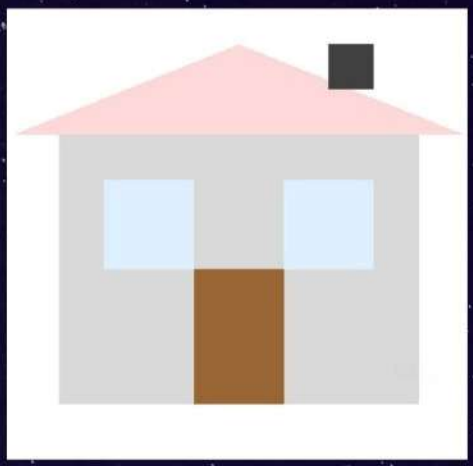
We bring you a set of codes for making beginner level graphics on Mathematica. As they say, Every Journey starts with small steps. Do try them out!

1. (* Define the coordinates for the stick figure *)

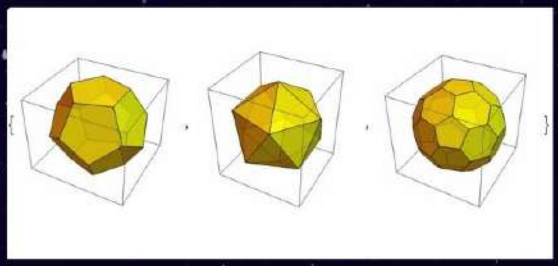
```
Head = Circle[{0, 0}, 0.2];
Body = Line[{{0, - 0.2}, {0, - 1}}];
Arms = Line[{{-0.2, - 0.7}, {0.2, -0.7}}], Line[{{-0.4, - 0.4}, {-0.2, - 1}}],
Line[{{0.4, -0.4}, {0.2, -0.7}}];
 Legs = Line[{{-0.1, - 1.5}, {0, - 1}}], Line[{{0.1, - 1.5},{ 0, - 1}}];

(* Plot the stick figure *)
Graphics[{Head, Body, Arms, Legs}, PlotRange → All,
AspectRatio → Automatic, Axes → False, PlotLabel →
"Stick Figure"]
```



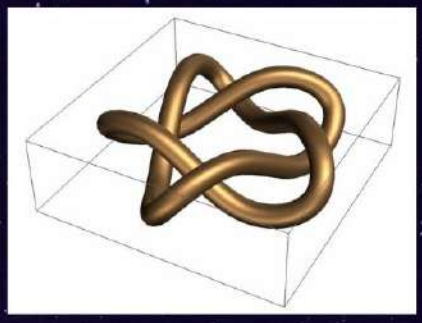
2. Graphics[{
(* House *)
LightGray, Rectangle[{0, 0}, {4, 3}],
(* Roof *)
LightRed, Polygon[{{- 0.5, 3}, {4.5, 3}, {2, 4}}],
(* Door *)
Brown, Rectangle[{1.5, 0}, {2.5, 1.5}}],
(* Windows *)
LightBlue, Rectangle[{{0.5, 1.5}, {1.5, 2.5}}],
LightBlue, Rectangle[{{2.5, 1.5}, {3.5, 2.5}}],
(* Chimney *)
Darker[Gray, 0.5], Rectangle[{3, 3.5}, {3.5, 4}]
}, PlotRange → All, AspectRatio → Automatic]



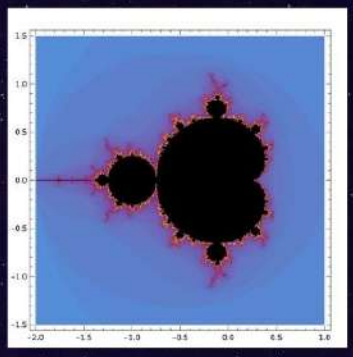
3. Table[Graphics3D[{Yellow, Opacity[.8], PolyhedronData[p, "GraphicsComplex"]}], {p, {"Dodecahedron", "Icosahedron", "TruncatedIcosahedron"}}]



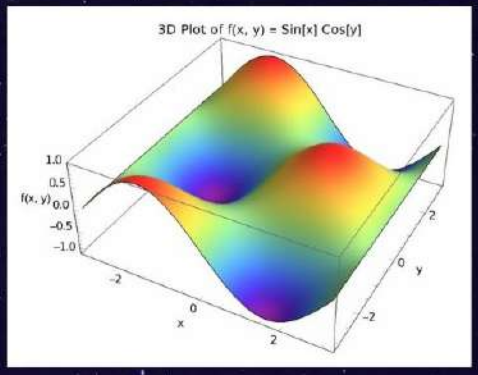
4. Graphics3D[{MaterialShading["Bronze"], KnotData["SolomonSeal", "ImageData"]}, Lighting → "ThreePoint"]



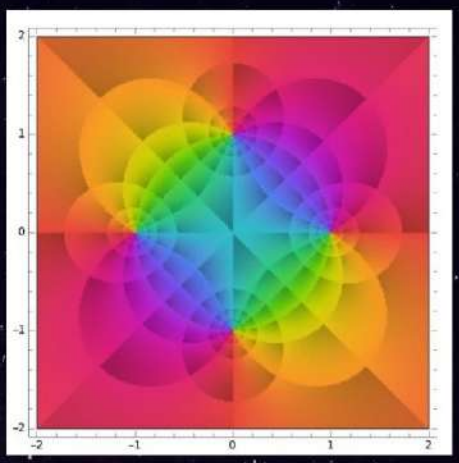
5. MandelbrotSetPlot[{- 2 - 1.5 I, 1 + 1.5 I}, ImageSize → Medium]



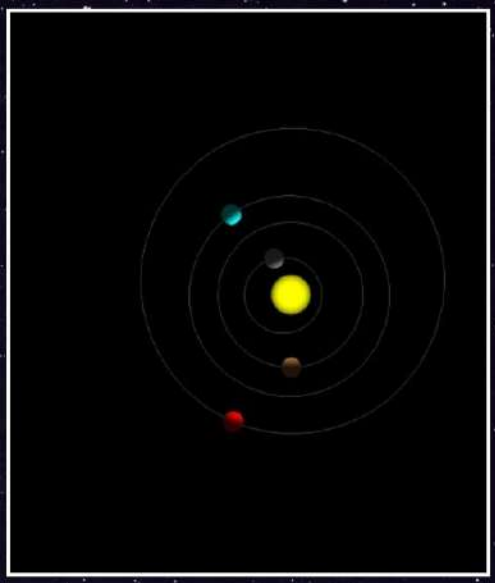
6. (* Define a function *)
fx_, y_ := Sin[x] Cos[y]
(* Plot the function in 3D *)
Plot3D[f[x, y], {x, - Pi, Pi}, {y, - Pi, Pi}, PlotRange → All, PlotPoints → 50, ColorFunction → "Rainbow", Mesh → None, AxesLabel → {"x", "y", "f(x, y)"}, PlotLabel → "3D Plot of f(x, y) = Sin[x] Cos[y]"]



7. ComplexPlot[(z^2 + 1)/ (z^2 - 1), {z, -2 - 2 I, 2 + 2 I}, ColorFunction → "CyclicLogAbsArg"]



8. ResourceFunction["SolarSystemPlot3D"][{Cyan, Sphere[Entity["Planet", "Earth"], .1], Brown, Sphere[Entity["Planet", "Venus"], .1], Gray, Sphere[Entity["Planet", "Mercury"], .1],Red, Sphere[Entity["Planet", "Mars"], .1]}, "SunStyle" -> {Yellow, Lighting -> {{"Ambient", GrayLevel[.2]}, {"Directional", White, ImageScaled[{0, 0, 1}]}}, Sphere[{0, 0, 0}, .2]}, PlotRange -> 1.7, Boxed -> False, Background -> Black, "OrbitStyle" -> Gray, Lighting -> {{"Ambient", GrayLevel[.2]}, {"Point", White, {0, 0, 0}}},"IncludeReferenceObjects"->False]



INTERACTION WITH THE SPEAKERS

INTERVIEW WITH DR. NITEESH SAHNI

Dr. Niteesh Sahni
Associate Professor

Dr. Niteesh Sahni is an Associate Professor at Shiv Nadar University. He has carried out research in collaborating mathematics with topics from various streams.

Q. What becomes the best source of motivation for a mathematician in research?

A. A lot of internal play is taking place between graph theory and machine learning. Topological data analysis is another important element. And when it comes to having a number of applications which deep learning has rather than generative AI is something which is really a hot topic right now. And chat GPT happens to be one of the examples of that. The mathematical foundations of generative AI rests on one important aspect of the topic. Functional analysis is an interplay between functional analysis, probability and statistics and many other things. And wherever you have applications involving deep learning, they all make generous use of another fundamental mathematical topic. Measure theory, functional analysis together with lots of topological data and statistics. So you can easily say that generative AI is also a mathematical model.

Q. The topics you listed like functional analysis , measure theory be offered in the higher studies - Masters or Ph.D.?

A. Anyone can pivot after your graduation because these things require just a very sound foundation in real analysis and in your education, and of course, maths basisically focus on it. So if you have a very good foundation in analysis, linear algebra, calculus, some probability theory etc. and you are basically very good to go.

Q. In your opinion what are the emerging trends or advancement in data science that mathematicians should be aware of?

A. I think there is collaboration between mathematics, humanities and liberal arts.
Okay, so the digital humanity is computational humanity that's going to be maybe something which we'll explore. There is an interlink between psychology and mathematics. Psychographic parameters are also used in machine learning.

Q. What do you see as the most significant challenges and opportunities at the intersection of data science and mathematics?

A. Data science is reduced to executing python which is wrong. The challenge is going back to basics and making people of non-tech background. We aren't motivated enough to match the syllabus with the requirements.

INTERVIEW WITH PROF. MALAY BANERJEE

Prof. Malay Banerjee
IIT Kanpur

Prof. Malay Banerjee is an influential figure, Professor at IIT Kanpur. He ranks 1 in Applied Mathematics and Natural Sciences in IIT Kanpur and is among the top 3% scientists in the world. He researches in Mathematical Ecology and in Nonlinear Dynamical systems.

Q. What motivated you to choose mathematical ecology as your subject?

A. When I was in class 2 level, I found both mathematics and biology very interesting but mathematics was my first preference. When I joined Calcutta University in the program of Applied Mathematics, as luck would have it, I was allotted the paper Mathematical Biology.

We got a couple of good teachers and they gave examples, illustrations and future directions which motivated me to work in the area of mathematical ecology. The subject is an emerging area in the present world and has a lot of prospects. It is regrettable to talk about the lack of mathematicians in this field.

Q. Please elaborate on the research and experiences during Covid Times.

A. Let's start with examples of medicines for minor coughs and colds. A particular medicine whose dosage was previously 3 tablets is now being prescribed at 5 units. Why this dosing policy changed, how it was changed, these questions lead to mathematical investigations regarding optimal dosing policy. Now, these dosing patterns are again subject to each individual physical constitution.People are familiar with epidemical terminology such as SIR model, basic reproduction number, maximum size of epidemi, what will be the peak of epidemic etc. One of the aims of our study during those times was, if we consider time varying recovery rate, time varying period an individual is under hospitalization, the number of days one individual is under ventilation, after that, how many of them survived and how many of them were unfortunate, the death toll etc, if we incorporate all these things in a mathematical model, it will produce a complicated integral equation. The task was to work on how to solve that equation from that particular equation. Now, how can I calculate or how can we derive the practical epidemiologically important factor like an effective reproduction number, maximum number of infected on a day, peak of an epidemic, size of an epidemic and so on was another detail to be furnished.

Again, if we look at the then state-wise data, the peak of the epidemic arrived on different dates in different states, and these dates are not coincident with that of India's. And that is why there was no smooth growing curve but rather a curve with ups and downs. This led to the need of a new model and we tried to research the same. Another endeavor included incorporating the effects of new strains of covid, if any in the equations, researching on vaccines effects, antibodies levels and community level of immunity.

Q. Ecology is not a mainstream subject so what is the most important or interesting aspect of the combination of ecology and mathematics?

A. Most important aspect would be how to mathematically model complicated ecological frameworks. In the case of simple mathematical Ecology, we consider some sort of differential equation, may be ordinary or partial or Stochastic. For example, take a grazing model or a growth model which we want to describe in terms of mathematical function. Whatever rule we are setting up in a room, they might not follow the same rule. Some sort of newly emerging area is called evolutionary mathematical biology. For example, we were supposed to use mosquito repellent incense like ABC. Now we have ABC liquid and ABC advance. The way the chemical replacement is newly designed is based on mosquito evolution. How to model that mathematically is the challenge question.

Q. Academic and industrial environment in India is dominated by few mainstream subjects like AI, data science, Quantum mathematics. What could be the scope of mathematical ecology in future?

A. The scope will vary according to different levels and places. In the future, whether it will be applied and accessible to common people or not will depend upon policy effects. For example, a key person gained appreciation and recognition abroad for his work to make an attempt to generate an MRI report based on the X-ray report of an individual and that mathematical application is called Medical Image Processing which is practically called mathematical topography.
Mental setup also requires to be changed. Applied Mathematics have lot to contribute. For example, in medical designing, optimal track designing policy, administration of chemotherapy, neural networks specifically Alzheimer's and other diseases, what is the optimal dosing policy for these diseases.

Q. What advice would you like to give to students?

A. I would like to advise the student to look for new opportunities overseas. In India, interdisciplinary approach is not appreciated as of now. In many reputable international universities, there is a clear cut balance between Mathematics and Biology. Researchers at top level tackle challenges by systems and seek mathematical methods to handle the situation. There are many emerging areas and prospects abroad.

INTERVIEW WITH MR. UTSAV SHUKLA

Mr. Utsav Shukla

Mr. Utsav Shukla, Founder of Team Builders India is a public speaker and expertises in personality development. He believes in two way communications and small interactive activities to create an aura of enthusiasm.

Q. In the ever-evolving landscape of personal and professional relationships, what is your advice in adapting personalities to navigate different environments successfully?

A. I like to believe that you lead your lives in a 5 year period.So your personality also keeps changing.
According to me, depending upon the situation and context that you are in and where you're working, your personality needs to get shaped because multiple factors come in.
I think the whole of a person, of who he is, always remains the same. I have met CEOs that they would be a certain way with their teams but they're all college students, they will suddenly have a different personality that would come out.
So there are layers that keep coming over your personality but the Core remains the same , you have to choose who you are. That is who YOU are! But if you choose the layers of the personality, depending upon your context that you keep adding.

Q. How do you stay attuned to the evolving needs and interests of your audience to ensure your messages remain relevant and impactful?

A. I have different personalities that I access depending upon the audience that I am targeting. Agar, if I am training the CEOs or the leadership teams of a company, I will be very poised, I will be calm, I won't be jumping around.
But, if I am in a college, I will have to be very energetic, right? So, depending upon the audience, if there is a lot of learning and deep content required from me, I am going to access that personality.
So, I have those different personalities attuned inside me. I am different and that comes with experience.I didn't know this before. I have learned this. I have developed this art and that helps me a lot.

Q. What are some common challenges individuals face in their journey towards enhancing their personality, and how do you guide them through overcoming these obstacles?

A. Number one is distractions. Number two is instant gratification. Everybody wants things now and right now, right? People haven't operated in a decade. They operate six months to a year. But any kind of real success that you receive is a ten -year period.
It's a 10- year game. Which is very difficult to achieve, Right? So, what can the distractions do? So if you have a distraction, you immediately pass it. You immediately succeed. Not realising that, it's a slow compounding effect.
So, some of the distractions, number two, impatience, number three, instant gratification, number four, wrong environment. That is going to determine what is wrong.

Q. Any message for our readers?

A. Be ambitious, don't be afraid to work hard and it's important to keep failing. Whatever you have got, whatever you've inherited from your parents, be sure, be mindful that you need to increase it rather than bringing it down and never complain, the less you get the better it is . Because you have something to achieve and a journey to pursue.

Event Log

ORIENTATION

16/08/2023

The orientation program at Gargi College aimed to warmly welcome first year students and provide them with essential information for their academic journey. They were made **aware about the curriculum structure**.

26/09/2023

MEET AND GREET

After the formal introduction, we warmly embraced our first years into the Gargi family. An informal meet-and-greet, encompassing all years, was organized, with Bollywood attire adding to the excitement. Icebreaker games were thoughtfully arranged to facilitate interactions. Juniors engaged with seniors, exchanging insights about the challenges ahead and strategies for navigating the degree smoothly. It was a **memorable occasion where bonds were forged.**

SEMINAR

10/10/2023

We organised a seminar on the topic **"Mathematical Framework of some popular Technologies". Dr. Niteesh Sahni, Associate Professor at Shiv Nadar University** was the guest speaker. He efficiently explained how mathematics is a foundation for python, machine learning and artificial intelligence. He further explained how a simple concept of a matrix can be instrumental in making biometric systems. The session was very interactive and enlightening.

16/10/2023 NATIONAL WEBINAR

An insightful national webinar on the topic **'Period Doubling Route to Chaos- A Brief Introduction' . Professor Malay Banerjee from IIT Kanpur** was the guest speaker for the event. He introduced the concepts of period doubling and chaos theory, using elementary examples and graphs. More than **200 participants** including students, research scholars and faculties from various universities joined the webinar.

ARTICLE WRITING COMPETITION 08/12/2023

Providing an opportunity to the writers and the mathematicians within ,we organised an online article writing competition on the topics “Cosmic Geometry -Exploring the Mathematical Patterns in Universe" and "Behind the Scenes -Use of Mathematics in Animating Characters". We experienced an amazing collaboration of mathematics and creative writing. The winners for the competition were **Jiya Assija**, Kirori Mal College, **Neeraj Sharma**, Sri Venkateshwara College, **Uday Jadaoun**, Sri Venkateshwara College.

20/12/2023 POEM WRITING COMPETITION

Weaving a poem with the mathematical yarn is not an easy task, but on the occasion of **National Mathematics Day**, we boldly took on the challenge by organizing a poetry competition. The unique twist? Participants were required to infuse their **verses with elements of mathematics**, creating a fusion of art and logic. After meticulous evaluation, we proudly recognize the triumphant poets: **Avishkaar Pawar** from Acharya Narendra Dev College, **Katyayeni Singh** from Gargi College, and **Prabha Jha** from Mata Sundri College for Women.

FILM MAKING COMPETITION

01/02/2023

With a touch of cinematic flair, **"Celestial Cinematics - Where Space Meets Mathematics",** illuminated the creative prowess of maths enthusiasts. Witnessing the fusion of filmmaking and mathematics was awe-inspiring, showcasing how these seemingly disparate domains harmonise beautifully. Amongst the stellar entries, **Simar Bagga** from Atma Ram Sanatan Dharm College emerged as the victor, captivating audiences with a masterpiece that seamlessly blended the allure of space with the precision of mathematics.

PERSONALITY DEVEOPMENT WORKSHOP

08/02/2024

Shifting our focus from academic to personality, we organised a **Personality Development workshop.** The speaker for the session was **Mr. Utsav Shukla, the founder of Team Builders India**. Through small activities, he infused the room with an aura of energy. Mr. Shukla provided insights into three key aspects: Public Speaking, the Art of First Impression, and Leadership and Teamwork. The workshop helped the participants understand how to present themselves in the real world and how they should progress towards their goals.

CERTIFICATE COURSE

16/02/2024

A certificate course of 100 hours on **Cyber Security** sponsored by Honeywell was organised in collaboration with the **ICT Academy of Gargi College.** The course aimed to train students as how to avoid cyber-attacks and implement security measures to prevent cyber threats. A strength of 52 students from **B.Sc. (Hons.) Mathematics, 3rd year** enrolled and successfully completed this course .

24/02/2023 **CELEBRATING 5 YEARS OF MATHEMATICS HONS.**

We organized commemoration of the **five-year milestone of the B.Sc. (Hons.) Mathematics.** With a heartfelt invitation extended to esteemed alumni, the event unfolded as a testament to the enduring legacy of mathematical excellence. The gathering served as invaluable opportunity for current students to forge connections with alumnus. The alumni, enveloped in waves of nostalgia. The event had a lot cultural programs and games. Entire department stood united, celebrating not only five years of academic achievement.

PARTICIPATION IN ANNUAL SPORTS DAY **12/03/2024**

Showing **our unity and sportsmanship** in us, the mathematics department took part in the March past organised on account of Annual Sports Day of Gargi College. The students practised tirelessly for the event and showcased their strength. Mathematics department was awarded **consolation prize.**

17/03/2024 **ADD ON COURSE**

The Department of Mathematics, Gargi College, under the aegis of RDC and IQAC, launched the **certificate course on Mathematical Data Science** in an online mode. The instructors for the course are **Dr. Niteesh Sahni**, Associate Professor, Mathematics, Shiv Nadar University and **Dr. Utsav Pandey,** Associate Professor, Decision Sciences, IIM Lucknow.

ACHIEVEMENTS

ACADEMIC *

Name of the student with year	Position with CGPA
Diya Bedi (3rd Year)	First, 9.541
Mukta Gaur (3rd Year)	First, 9.541
Rimjhim Kharwal (3rd Year)	First, 9.541
Garvita (3rd Year)	Second, 9.432
Anshu (3rd Year)	Third, 9.324
Manvi Sharma (2nd Year)	First, 9.46
Richa (2nd Year)	Second, 9.36
Saniya Yadav (2nd Year)	Third, 9.25
Twinkle Sharma (1st Year)	First, 9.09
Siddhi Gupta (1st Year)	Second, 8.86
Priyanshi (1st Year)	Third, 8.55

* Session 2022-23

ACHIEVEMENTS

NON-ACADEMIC*

Name of the student participated	Name of the event/activity
Gargi Bisht (2nd Year)	Scintillations'23 - Department of Zoology 2nd position
Himanshi (2nd Year)	Matharon - Department Of Mathematics, Gargi College 3rd position
Mansi Pant (2nd Year)	Scintillations'23 - Identity Dress Making Competition 3rd position
Saniya Yadav (2nd Year)	Creative Writing Competition - Gandhi Study Circle 2nd posirtion
Saumya Solanki (2nd Year)	Puzzle Palooza - Department of Mathematics and Statistics at Mata Sundri College for Women 1st position
	Scintillations'23 - Dress Making Competition 3rd position
	Scintillations'23 - Millenia Quiz Competition 3rd position

* Session 2022-23

Soumya Solanki (2nd Year)	Sevarth - Inter NSS Competition - PGDAV College 1st position
	Anti Tobacco Competition - Venkateshwar College
	Samarth Enabling Unit Volunteer
Kanishka (1st Year)	Yoga Competition - Lady Shri Ram College 1st position
Nandini Shah (1st Year)	Photography competition - Mathema (Mathematics association of Gargi College) 1st position
	Quiz Winner - NCC, Gargi College on theme G-20
	Photography Competition - Mathema (Mathematics association of Gargi College)
Siddhi Gupta (1st Year)	Participated in about 15 Mathematics and Entrepreneurship related competitions - SRCC, Hindu College, LSR Collge etc. Reached the semi final round - SRCC's 'Casespresso Competition' and the final round of E- Confluence - E-Cell, Hindu College
Pritha Aswal (1st year)	Chaired Kothari International School MUN'23 Participated in Filmmaking Competition - Shaheed Bhagat Singh College, Maitreyi College,Ramanujan College, Sri Venkateshwara College

ACHIEVEMENTS

NON-ACADEMIC*

Name of the student participated	Name of the event/activity
Drishti Singh (2nd year)	Article Writing Competition (Ramanujan college, 2nd position)
Neeraj (2nd year)	Poster Making Competition (Phy. Ed. department, 3rd position)
Vaishnavi Goswami (1st Year)	Science charades (Physics department, 1st position)
Shubhangi Gupta (1st Year)	1. Open Mic(standup comedy) (Deshbandhu maths fest) 2. Open Mic (standup comedy) (NSS gargi ECA) 3. Gargi Premier league SPIN'24 (Cricket) 3rd position
Anu Devi (1st Year)	1. Rhythmic yoga competition (LSR College, 2nd position) 2. Rhythmic yoga competition (Kalindi College, 2nd position) 3. Rhythmic yoga competition (Khalsa College, 1st position) 4. Rhythmic yoga competition (Miranda House, 2nd position) 5. Team Yogasana Competition (Institute of Home Economics, 2nd position) 6. Team Yoga competition (Shri Ram College for Women, 2nd position) 7. District Yogasana competition (Aryabhatta College, 5th position)

* Session 2023-24

ACHIEVEMENTS

INTERNSHIPS*

List of students undertaking project work/field work/internship	Name of Internship
Ankita (3rd Year)	Sales and Marketing
Chanchal Rani (3rd Year)	Children Wise
Mitali Goel (3rd Year)	Muskurahat Foundation - Crowd funding
Mukta Gaur (3rd Year)	Digipplus (subject matter expert) and Urwa Foundation (fund raiser)
Nikita (3rd Year)	1. Subject matter expert at Rancike Learning 2. Social media marketing at IGNOU
Pallavi Raj (3rd Year)	Chairperson of Indo-Pacific QUAD Council at Global Youth India
Gargi Bisht (2nd Year)	YAH-India (Youth Action Hub) and Festamarketing
Mansi Pant (2nd Year)	1. Campus Representative in Guby Rogers 2. Social Media Intern in Sinchan Education and Rural Entrepreneurship Foundation
Monika (2nd Year)	NMMS Teaching (NGO Side)
Priydarshini (2nd Year)	Guby Rogers (Campus Ambassador)

* Session 2022-23

Vinita Yadav (2nd Year)	Internship at Guby Roger as Campus Representative
Yashswini Sharma (2nd Year)	Internship in Blood connect foundation
Aastha Setia (1st Year)	Content writer
Ananya Garg (1st Year)	Content Creator intern at beyond meds foundation
Khushi (1st Year)	Content Writing at Spotlight Scouts and Orion Hostels. Member of India new Zealand Youth Forum.
Neeraj (1st Year)	1. Business development intern in Brain Enrichment Academy 2. Corporate ambassador at iFortis worldwide. 3. Brand associate at younity. 4. Content writer fellowship at pixstory 5. Senior HoD (HR) at ADM Education and Welfare Society 6. HR at Green Bhumi 7. Graphic Designer at Aam Aadmi Party 8. SME at Mavy Edusolutions
Stuti Singhal (1st Year)	Creative Content writer in Beyond Meds Foundation
Siddhi Gupta (Ist Year)	Associate Analyst for Summer internship at Accenture
Twinkle Sharma (2nd Year) **	1. HR Member at Youth Action Hub (YAH),an initiative of United Nations Conference on Trade and Development (UNCTAD) 2. Vice Chancellor Internship at Department of Statistics, University of Delhi

** Session 2023-24

BATCH OF 2021-24

Best Wishes to all the students for their future endeavours

Student's Union 2023-24

During my tenure as the president of Mathema, I have been immensely gratified by the strides we've made in fostering a vibrant mathematical community. My relationship with our members has been deeply fulfilling and rewarding. Through countless discussions, collaborations, and shared experiences, we've not only achieved our organizational objectives but also formed friendships that will endure for forever. It's been a privilege to lead such a dynamic and passionate group, and I'm grateful for the opportunity to contribute to the advancement of mathematics during this remarkable journey.

Drishti Singh, President

It is with great honor and gratitude to reflect on my journey and experiences as Vice President of this remarkable team mathema. I always have complete confidence in our collective ability to rise to the occasion and continue making a meaningful impact. Throughout my journey, I've been privileged to work alongside some of the most dedicated and enthusiastic individuals I've met with. One of the most rewarding and cherishing aspects of serving as Vice President has been the opportunity to witness the incredible growth and development of our team.

Gargi Bisht, Vice President

From being the part of Mathema in first year and finding my place in its heart to finally making my way to be the heart of it, this journey has been quite special to me . This year, I got a chance to lead and host various events as well as learn a lot from my dear coworkers. Overall, it was a great work environment where members were open-minded and ready to take on any task. The memories we have made are the ones I'll cherish forever.

Tashu Panwar, General Secretary

My experience as a IT head of Mathema was incredibly rewarding and taught me valuable lessons that I continue to apply in various aspects of my life . It helped me develop important skills such as communication, organization, problem-solving, and teamwork. It was a privilege to work with a talented and dedicated team to make a positive impact on our college community.

Manisha Kumari, IT Head

As the Gen Sec of mathema, my role involved coordinating tasks, planning events, seminars, alumni meet and building a vibrant mathematical community. Mathema helped me to hone leadership, communication and problem-solving skills. Ending my tenure with memories and friendships to cherish forever!

Siddhi, Dep. General Secretary

As the IT Co-head, my journey was nothing short of transformative.It not only deepened my appreciation for elegance of mathematics through organizing seminars, webinars and workshop but also taught me that teamwork is crucial for success.I learned that connecting with people is important, whether they are peers, teachers or professionals. Overal, it was an awesome experience for me!

Twinkle Sharma, IT Co-Head

As the PR head of Mathema, my experience in the union has been immensely rewarding. Engaging in vibrant discussions, organizing academic events, and fostering a sense of community among math enthusiasts has been a fulfilling journey. This role allowed me to refine my communication, strategic thinking, and crisis management skills while cultivating lasting connections within the community. It's been a fulfilling journey, leaving me with invaluable experiences and relationships.

Aditi Ahuja, Co-PR Head

It's been a wonderful year. Being in Mathema have broadened my horizons as I was exposed to myriads of characters and situations. I cherish the memories of our meetings where we discussed everything that happened under the roofs of Gargi College. New bonds and new people added more colour as well as more drama(which I welcomed with open arms) to my life. My time here has given a very important lesson i.e. to tone down the overthinking and give people as well as situations more time to blossom into what they are capable of. I hope that the next union takes as much fun and lessons and more from their tenure here.

Kinjal , Editorial Head

As the co-editorial head, my journey was a mix of stress and fulfillment. This role provided a platform for a dynamic exchange of ideas within the team, deepening my understanding of creative writing. With responsibility came the burden of accountability, and I learned the art of juggling deadlines while maintaining the quality standards set by both the union and our team. The process of crafting this magazine stands out as a defining moment of my tenure, showcasing our collective efforts and creativity. Working alongside each member of the union was an invaluable experience, contributing to both personal growth and the successful completion of this tenure.

Stuti Singhal, Co-Editorial Head

My experience as the Creative Head of Mathema, the Mathematics Association of Gargi College, was a transformative journey. Through this role, I acquired new skills, collaborated with inspiring individuals, and discovered a newfound confidence. It was more than just a position; it became a journey of self-discovery and healing. From battling self-doubt to embracing my capabilities, I found myself on a path of personal and professional growth, opening doors to exciting opportunities and experiences.

Anjali Joshi, Creative Head

As the creative head of mathema, I orchestrated innovative events, fostering a vibrant culture of expression. From conceptualizing themed events to designing captivating posters and digital content, I empowered fellow students to unleash their creativity. Collaborating with diverse talents, I curated unforgettable experiences that left a lasting impact on our campus community, sparking inspiration and fostering a sense of belonging among peers.

Neeraj, Co- Creative Head

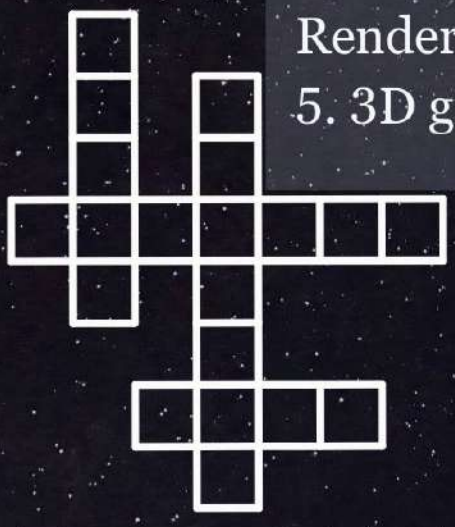
As the Cultural Secretary of Mathema, I've been blessed with a myriad of enriching experiences that have left an indelible mark on my journey. Curating events has been a profound opportunity to cultivate creativity, foster connections, and ignite passion within our vibrant community. As I reflect on my tenure, I'm filled with gratitude for the trust bestowed upon me and the countless memories shared with fellow enthusiasts. I'm excited to see the seeds we've planted continue to flourish in the years to come.

Yash Sabharwal, Cultural Secretary

ANSWERS
FOR CROSSWORD

Across
1. Color model: RGB
6. Smallest display unit : Pixel
7. Scalable graphic: Vector
8. Pixel based image: Bitmap
9. User friendly interface: GUI
10. Grid based image: Raster

Down
2. Smooth curves: Bezier
3. Color selection: Palette
4. Generate image from mod: Render
5. 3D graphics API: OpenGL



BIBLIOGRAPHY

1. Fibonacci in space:
- https://fibonacci.com/universe-geography/
- Medium.com
- Space.com
- Nasa.gov
- wikipedia

2. Mathematics in Motion:
- Medium.com
- Wikipedia

3. The Art of Curves in Animation:
- Wikipedia: Animation
- Bézier Curve as a Generalization of the Easing Function in Computer Animation, Łukasz Izdebski, Ryszard Kopiecki & Dariusz Sawicki.
- B'ezier curve, Arsalan Hasanvand, Department of Applied Mathematics, University of Tehran
- Optimization of Animation Curve Generation Based on Hermite Spline Interpolation, Liang Chen and Lutao Li,
- Modelling and animation of human expressions using NURBS curves based on facial anatomy, Ding Huang and Hong Yan

4. Trajectory and Fuel Calculations in Aerospace Engineering:
- The Tsiolkovsky Rocket Equation: A Parallel Derivation, Atholl Hay
- Orbital Mechanics, Third Edition, Edited by Vladimir A. Chobotov
- Kepler's Laws of Planetary Motion: 1609–1666
- Alan Curtis Kay:
- https://lemelson.mit.edu/resources/alan-kay
- https://chat.openai.com/
- Introduction to Maths Algorithms for VFX
- wikipedia.com
- https://link.springer.com/chapter/10.1007/978-3-642-19315-6_15
- https://www.aim-group.org.uk/

5. Predicting Celestial Events
- https://chat.openai.com/
- Nigar Shazi
- Outlookindia
- Times of India
- Indian Express
- Economic Times
- wikipedia

6. Beyond and behind the lens: the outer space and the virtual world
- https://www.mathematicshub.edu.au/students/student-resources/why-do-i-need-to-know-this/maths-in-animation-and-design
- https://www.ideasanimation.net/top-5-ways-animators-use-math/
- https://pubs.aip.org/physicstoday/article/70/12/70/904108/Trigonometry-for-the-heavensThe-stars-and-planets
- https://maa.org/book/export/html/117240#:~:text=In%20the%20ancient%20model%2C%20known,calculate%20parameters%20and%20planetary%20positions.
- https://allabouttrig.wordpress.com/art/
- https://sites.math.rutgers.edu/~cherlin/History/Papers2000/hunt.html

Vote of thanks

¬ A Special vote of thanks to the Editorial and Creative Team ·

Kinjal
Anjali Joshi
Neeraj
Stuti Singhal
Aastha Gupta
Stuti Kasera
Tanisha Shrama
Khushi Sorout
Tanaya Trisha Bharali
Raabhya Aggarwal
Takhellambam Nirchita

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