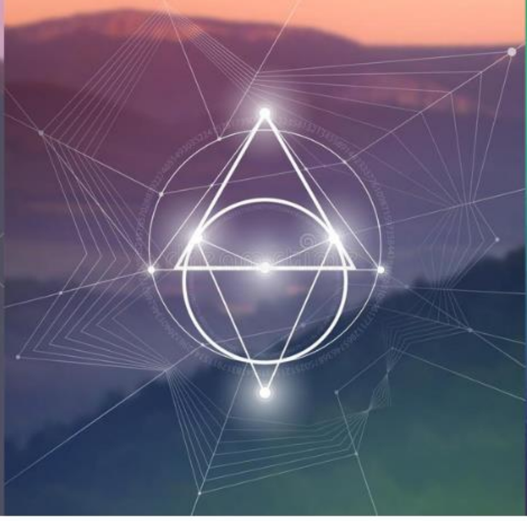
MATH LIFE

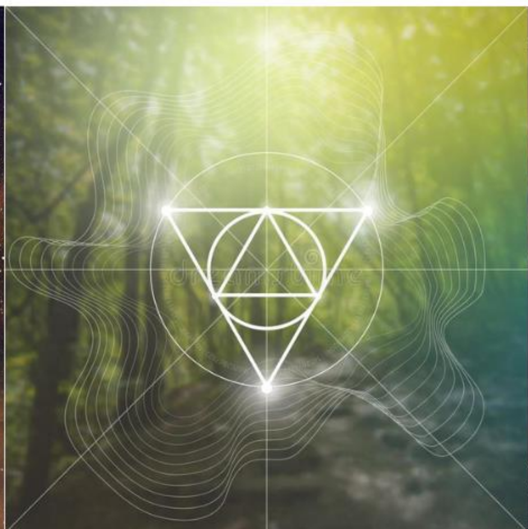
Department of Mathematics, Sri Venkateswara College, University of Delhi

Issue 8 | 2020-21


"We feel that a verse about mathematics is a verse about life in disguise.
What is life if not a set of problems for us to solve
and what is Mathematics if not a poetry of logical ideas?
You say life, we say MathLife!"

~ Prerna Dumka (II-A)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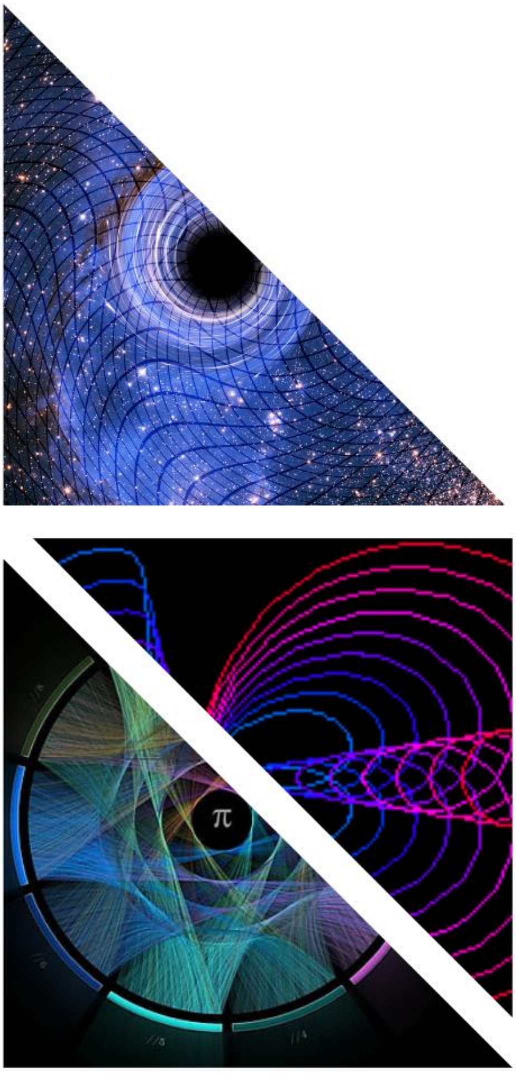

1961 - 2021

శ్రీ వేంకటేశ్వర కళాశాల
Sri Venkateswara College
(University of Delhi)
NAAC 'A' Accredited

Prof. C. Sheela Reddy
Principal

From the Principal's Desk

I extend my hearty congratulations to the Department of Mathematics on the release of the 8th edition of their annual departmental magazine 'MathLife'. The grit and immense dedication portrayed by the students and the faculty members that went into the making of this magazine is commendable.

Despite the challenges faced during the pandemic, the Department has strived hard to conduct and organise events that led to holistic development of the students. The magazine is rich in content and depicts the myriad talents of the students. I congratulate the students of the Department who used various mediums of expression to present their ideas.

I would also like to compliment the magazine team for their tremendous zeal and hard work in bringing another successful issue. I wish them best of luck in their future endeavours.

C. Sheela Reddy
PRINCIPAL

Proud History.....Promising Future

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Message
FROM THE MAGAZINE-IN-CHARGE'S DESK

Dear reader,

Welcome to The Mathlife, Issue 8, the annual magazine of the Department of Mathematics.
I am delighted to introduce you to our yearly magazine.
This, one of a kind magazine, is a platform where the students get an opportunity to showcase their talent by contributing their innovative writings, art and photography skills. The activities of the Department held throughout the year are also presented. Within the pages, the achievements of the students, be it academic or extra- curricular, are also mentioned.

This year, due to the pandemic, we all suffered our own set of problems. Some lost their dear ones, whereas some faced problem in coping up with the studies in the online mode. But the dedication with which the students have contributed to the magazine and the entire team has worked is remarkable. From finalizing the content and designs to its execution, all was online. This still did not stop us from working as hard and be out with this issue in less than 4 months.
My heart goes out to the students for their contribution and to the Magazine team for putting it all together.

I extend my gratitude to the Principal and my colleagues for being by my side always.
Hope you all enjoy the read.
Thanks.

Dr. Garima V Arora
Magazine-in-Charge

Message FROM THE EDITORS-IN-CHIEF

Dear reader,

We feel extremely ecstatic to present to you the 8th edition of the annual department magazine 'MathLife'. Acting as a platform for students to come forward, identify their talent, discover their potential and move on the path of progress, this edition garners diverse thoughts and expressions altogether thereby exploring the famous mathematical theories and conjectures by depicting the revolutionary evolution of mathematics in the 20th century and delves deeper into the applications of mathematics in diverse fields whilst representing the intricacies and the simplicity of the world of mathematics.

This digital issue also portrays the myriad talents of the students ranging from photography, poetry, art, etc. and reflects their ardent zeal in extra-curriculars as well.
We hope that the readers have as great a time flicking through the pages of this magazine as we had creating it.

We would like to express our deepest gratitude to the Magazine-in-Charge, Dr. Garima Arora for guiding us at every step during the making of this magazine and would like to thank the entire Magazine Committee for their sincere dedication and efforts to make this magazine a success.

Kind regards
Sejal Arora & Jaskaran Singh
Editors-in-Chief

सत्याना प्रमादित्तव्यम्

"Do not deviate from the truth."

Truth is powerful and it prevails. Our college envisions "Self-realisation through knowledge" emphasizing holistic, inclusive and futuristic education which is in tune with the college motto. Incepted in 1961, year 2021 marks the 60th year of our prestigious institution, whose foundation was laid by eminent Indian philosopher and statesman Dr. Sarvepalli Radhakrishnan. "Truth through self-education" has been the guiding principle in all the endeavors of our college since then.

Sri Venkateswara College, a premier part of University of Delhi, has a venerable legacy for the highest academic standards, diverse educational programmes, distinguished faculty, illustrious alumni, varied co-curricular activities and highly acclaimed sports facilities. Over the many years of its existence, SVC has been committed to growing and improving in all aspects.

Sri Venkateswara College has been ranked in India Today's top 9 colleges for science, as well as 11th in the Outlook Rating and 7th in the Education World national ranking. SVC offers more than 20 undergraduate degrees in Humanities, Commerce, and Science along with 9 post-graduate courses. Our college, which has over 4600 students and 211 dedicated teaching staff, attracts students from all over the country, and this diversity serves to enhance learning outside of the classroom through social contact, making the environment more conducive to overall development.

DEPARTMENT OF MATHEMATICS

Sri Venkateswara College

"Mathematics is, in its own way, the poetry of logical ideas".

The Department of Mathematics, Sri Venkateswara College, believes that mathematics holds an important place in the history of humanity and will always be valuable to the future of all human beings. It was initially set up by Dr. Rao in 1961 with a belief to inspire and nurture the students that numbers can be fun.

Mathematics was then offered as a subject in B.A. Program. The baton was passed by Dr. Nageshwar Rao in the hands of Mr. L.R. Gaur and Dr. Purnima Gupta in 1972. With their meticulous work and efforts, the department introduced B.S/B.Sc. (Hons.) Course in the year 1977.

The department has always believed in the mission to prepare, inspire and empower the students to accomplish and succeed in the ever-changing world. Each member of the faculty believes towards the holistic growth of the students whether academic or co-ciricular activities.

This amazing foundation along with the tremendous and successful efforts of the faculty members over the years has propelled the Department of Mathematics to lay a strong foundation for the students and to achieve greater heights ever since.

Ms. Shakuntala Wadhwa

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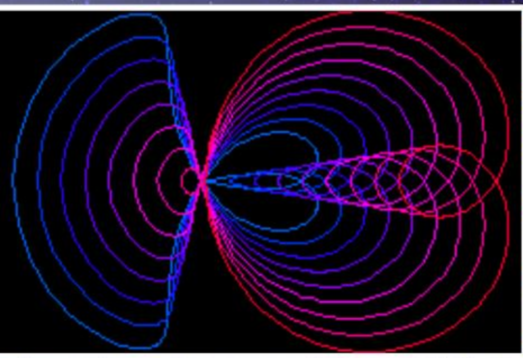
THE MATHEMATICS ASSOCIATION
SRI VENKATESWARA COLLEGE
UNIVERSITY OF DELHI

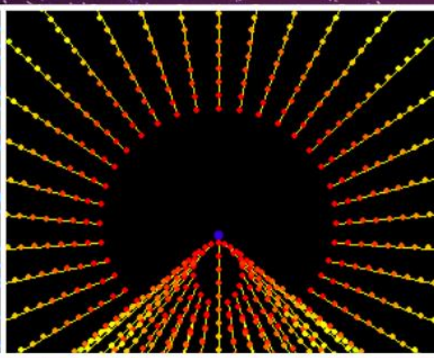
Every sail needs a skillful Captain, however, an astute and happy sail requires more than that. It needs a crew, a crew that understands the captain to the core, accurately assesses the situation and turns it into the ultimate advantage of its passengers. In the voyage across the vast mathematical ocean, Trisectrix, is the crew of our ship. The Mathematics Association- Trisectrix works to bridge the gap between mathematics and fun making the journey lively for all of us.

In geometry, a trisectrix is a curve which can be used to trisect an arbitrary angle with ruler and compass and this curve as an additional tool. The logo is inspired by 'The trisectrix of Maclaurin' which is a cubic plane curve notable for its trisectrix property. It can be defined as the locus of the point of intersection of two lines, each rotating at a uniform rate about separate points, so that the ratio of the rates of rotation is 1:3 and the lines initially coincide with the line between the two points. Impacting students' lives in a three fold way- Academics, extra curricular and sociability, Trisectrix stands true to its name!

Education is so much more than just academics and hence the association, guided by the dedicated professors, wants the students to head out of college equipped with academic, social and emotional learning. To achieve this the association organizes various events throughout the academic year, like the kite flying festival, teacher's day, fresher's party, etc., so that by participating in such activities students can develop their individual talents.

The most anticipated event of the department is its annual department fest- Exponent which epitomizes the creativity and inquisitiveness of the students.
An amalgamation of fun and learning is required in life and through healthy interactions in such group-oriented activities, Trisectrix strives to enhance the students' interpersonal, communication and management skills and be the best version of themselves.





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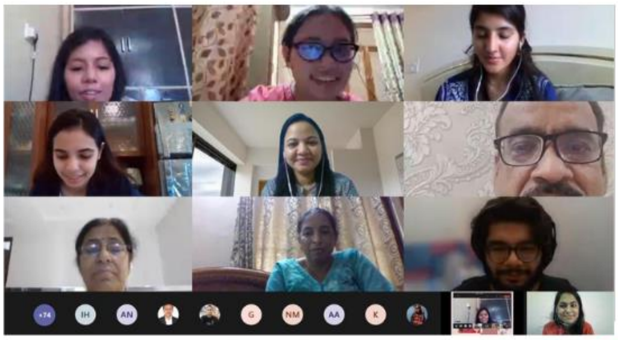
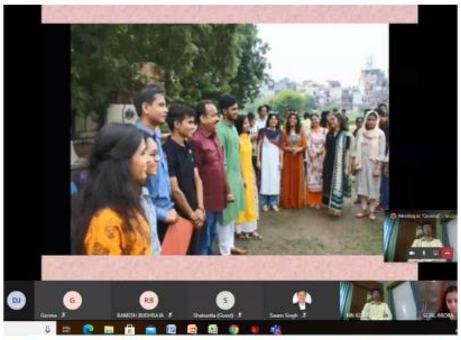
Report 2020-21

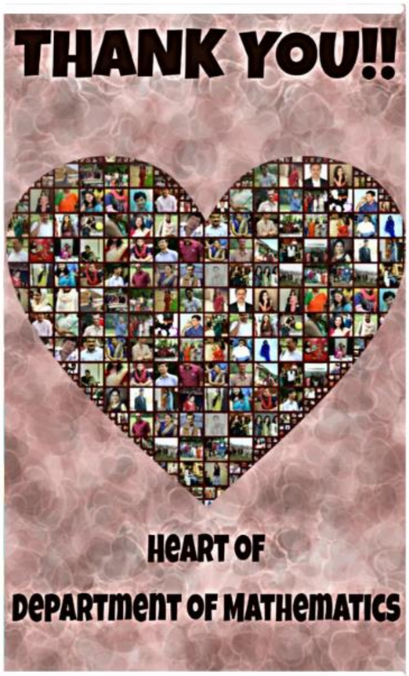
Due to the pandemic, the session 2020-21 started late. But this could in no way hamper the spirit of the Department.

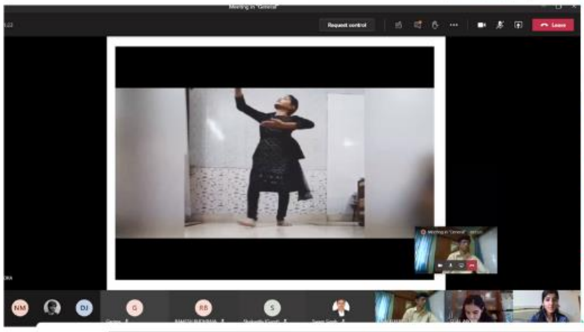
Teachers' Day

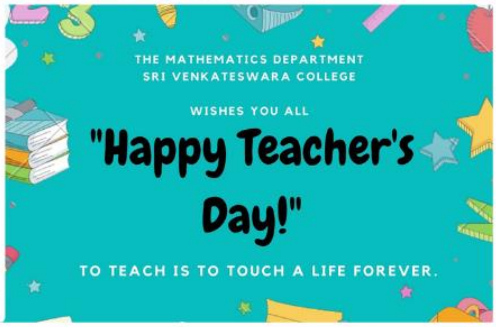
What could be a better start to the departmental activities, than by being grateful to their mentors and teachers on 5th Sept'20! Planned in a short span of time, on the digital platform, the students organized various games and fun events for the teachers to celebrate "Teacher's Day". Various titles were given to the teachers. This was a great opportunity for the Department to interact online after the longest time.





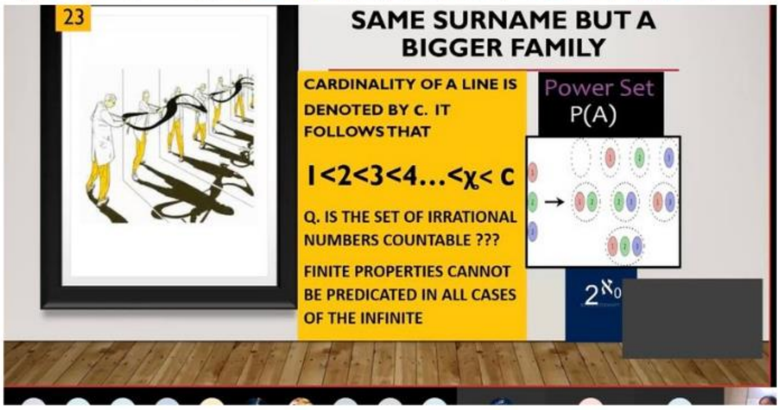


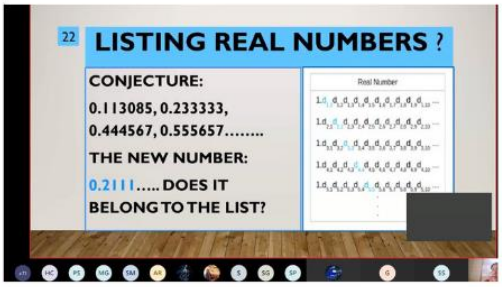


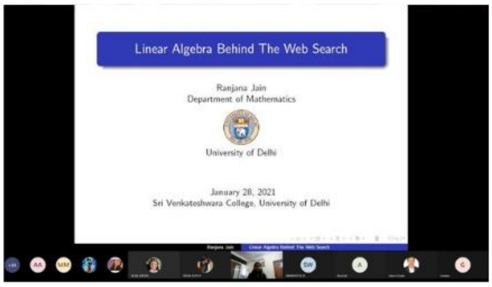


Webinars

The month of October was dedicated to imparting knowledge on "Various Aspects of Mathematics". Four webinars on different topics like Probability, Graph Theory, Optimization and Analysis were held on a weekly basis, which helped students know about the varied domains of Mathematics.







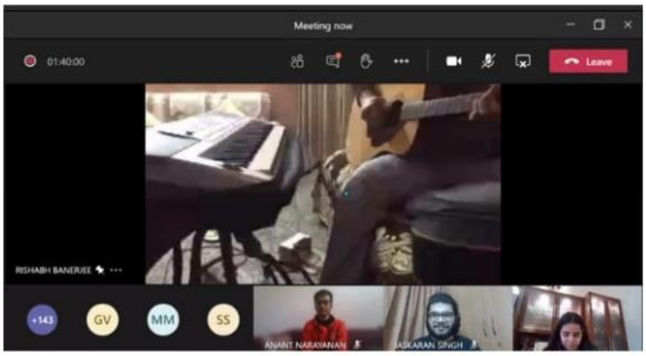
SCUDEM'20

23 Oct'20 – 14 Nov'20 was the "SCUDEM – Simiode Challenge Using Differential Equation Modeling", which was an online competition, where the teams had to prepare a model and upload a corresponding video presentation to explain its solution. Various teams participated and won prizes as well.

Freshers

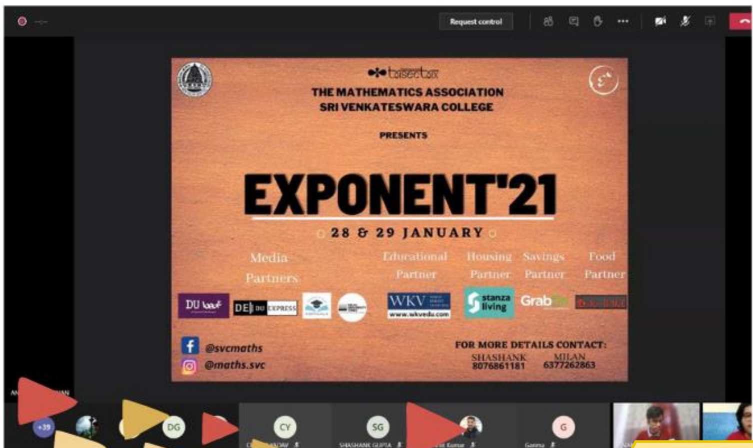
The Batch of '23 was invited for an "Orientation Programme" on 18th Nov'20, where they were made aware of the online platform they'll be using for their studies in college. They were also introduced to their course and the teachers of the Department.

The freshers were welcomed and an online "Fresher's Party" was organized on 22nd Jan'21. This gave all the new entrants an opportunity to interact with their seniors and teachers and showcase their talents. Various titles were given to them to boost their morale.



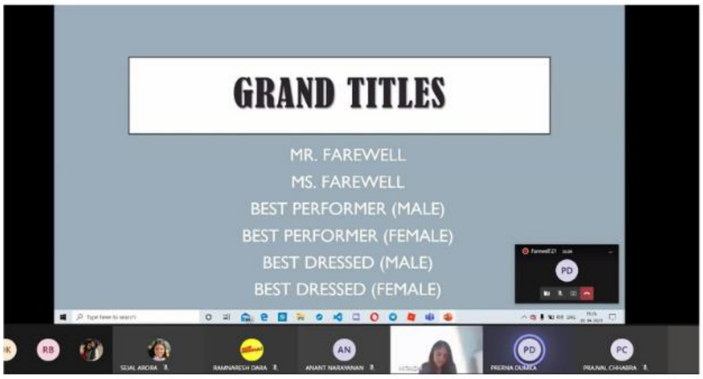
Exponent '21

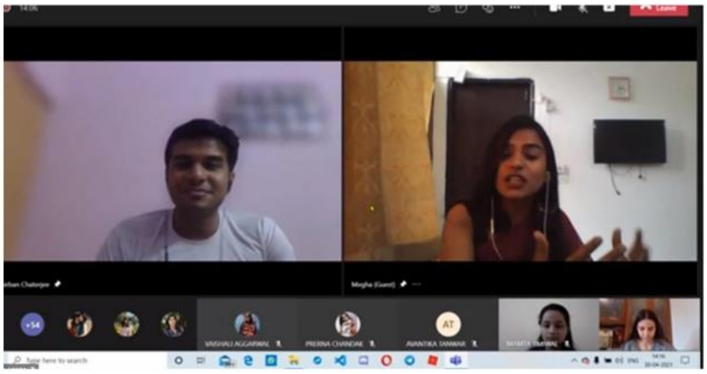
The most awaited event of the Department, its annual fest, "Exponent", held on 28 and 29 Jan'21, was in online mode this time. To increase the awareness of applications of Maths to the students, the 2-day fiesta saw two webinars from the prominent mathematicians, Dr. Sachin and Dr. Ranjana of the Department of Mathematics, University of Delhi, who talked about differential equations and linear algebra respectively. It was followed by various events like Coded Decoded, Mathematical Tambola, Mictionary, Paper presentation, Clickathon, Math-e-charades, Hunt in the House, each of which saw participation in large numbers.



Farewell

Finally, on 30 April'21, all the juniors of the Department made the 3rd year batch feel at the top and organized an online "Farewell" for them. The 3rd yearies, with high spirits, were dressed up in sarees and suits and enjoyed the event thoroughly. Various titles were presented to the passing out batch.





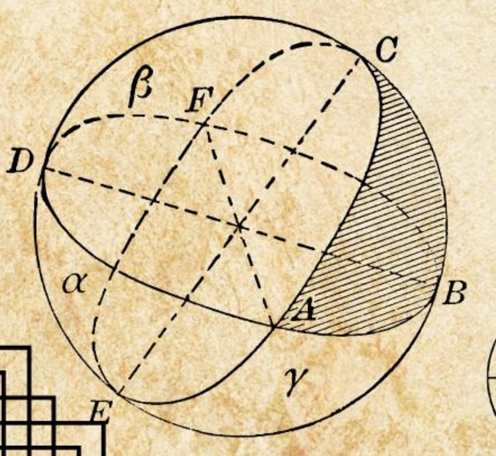
EVOLUTION OF MATHEMATICS IN THE 20TH CENTURY

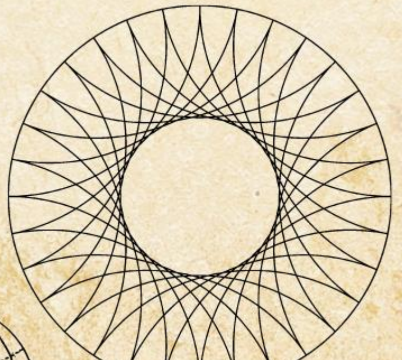
The history of mathematics is nearly as old as humanity itself. Since antiquity, mathematics has been fundamental to advances in science, engineering, and philosophy. It has evolved from simple counting, measurement and calculation, or the systematic study of the shapes, through the application of abstraction, imagination and logic, to the broad, complex and often abstract discipline we know today.

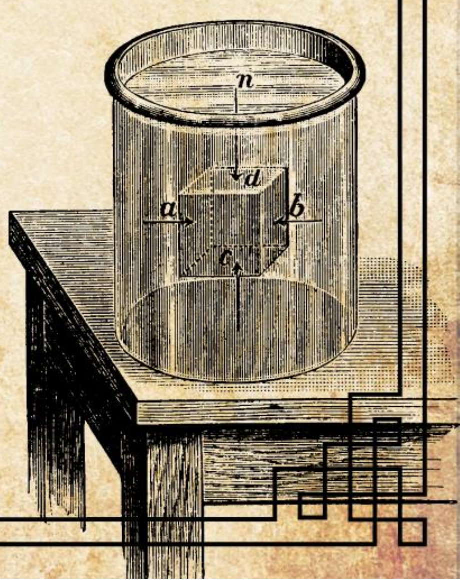
Evolution in Mathematics in the 20th century was no different, except for its unprecedented rise in the breadth and complexity of its theories, its applications in various fields or the way it was perceived.
Mathematics was now increasingly accepted as a profession, and a division was created between maths and physical sciences. This freed mathematicians to develop theories without being restricted to or relying on scientific imports for its validity. Subjects like Projective geometry, probabilistic mathematics, Non-Euclidean geometry or calculus continued to evolve, and their applications in fields like engineering, military, computer science, even more!

Through this edition, as you will read ahead, you will experience how mathematics has evolved in its entirety.

Evolution of Mathematics is nothing short of a “revolution”!



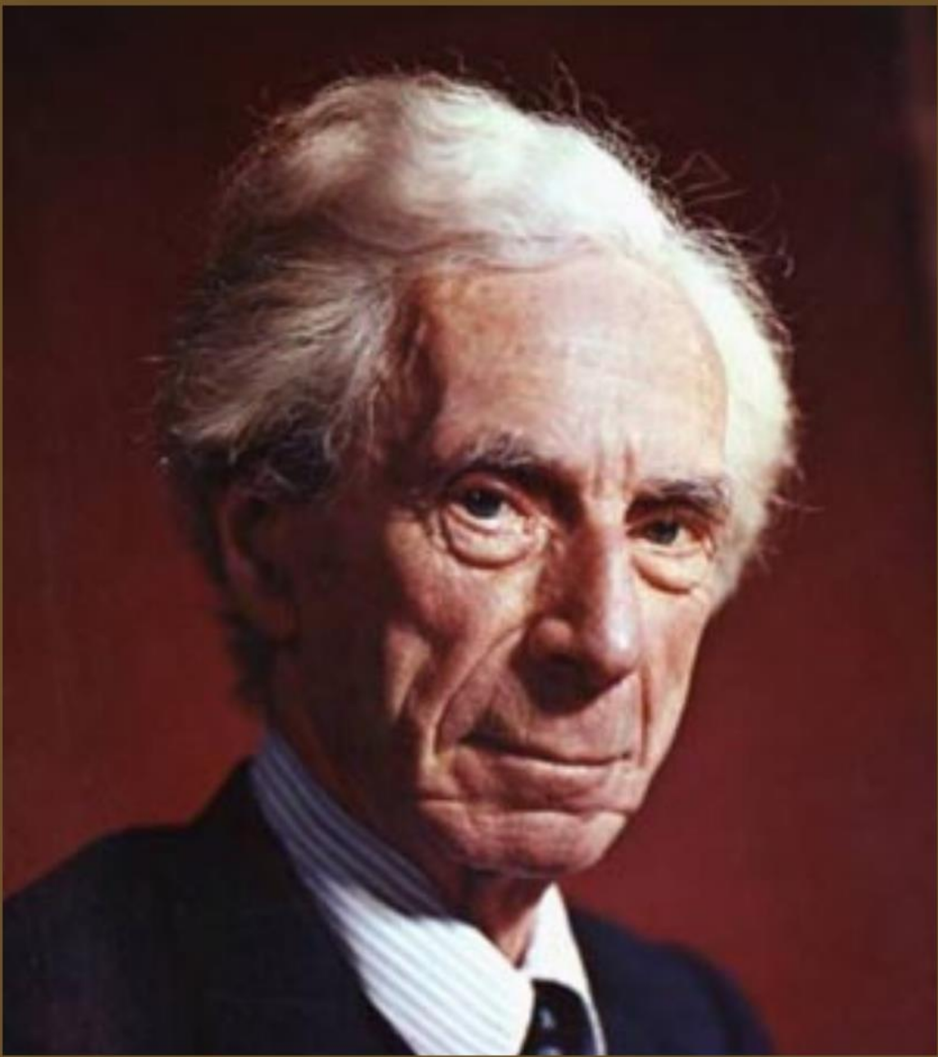




1900 1910 1920 1930 1940 1950 1960 1970 1980 1990

1901

Russell's PARADOX



"This sentence is a lie!" This is a self contradictory statement. If the sentence is true, then it is a lie, as stated. But if the sentence is a lie, how can it be true? Mathematicians, each in their unique quest, encounter strange problems. Problems so unexpected, that they are difficult to accept even though every step is valid in reasoning. Such a *"strange" problem is called a Paradox*. One can understand the paradox in Mathematics with this simple example. We know that there exist an infinite natural numbers (1, 2, 3,….) and between every natural number there are infinite decimal numbers. So if you were to walk any distance, say from point A to point B, you would never reach point B in a finite amount of time as there are an infinite number of points between A and B. This is the famous *Zeno's Paradox*.

Many such paradoxes exist in the field of Mathematics. One of the most famous paradoxes in the history of Mathematics is the Russell's Paradox. This paradox, based on set theory, was discovered in *1901 by Bertrand Russell*, a British philosopher, mathematician and Nobel Prize winner. We will try and understand a simpler version of this paradox, which is called the *Barber paradox*.

Consider a town with one barber. He is the one who shaves all and only those who do not shave their beard. Let us observe a seemingly simple question: Does he shave his own beard? A contradiction will arise in answering this question. He cannot shave his own beard as he shaves only those who do not shave themselves. On the other hand, if the barber does not shave his beard, then he must shave it as a barber because he is in the group of people who do not shave their own beard.

Russell's Paradox is similar to this paradox. Consider a set R which is the set of all sets that are not members of themselves.

$$\mathbf{R = \{S : S \notin S\}}$$

According to Naïve Set Theory, any defined collection of objects is a set and according to the Unrestricted Comprehension Axiom, there exists a set corresponding to a given property. According to this theory, R is a set. What is the paradox? Well, does R contain itself? Suppose R contains itself. But R must be a set that is not a member of itself by the definition of R which leads to a contradiction. On the other hand, if R does not contain itself, then R is one of the sets that is not a member of itself. By the definition of R, it must be contained in itself which again, leads to a contradiction.

In both cases, neither $R \in R$ nor $R \notin R$ which is not possible in set theory.

Russell concluded that it is not possible to have a set like R. It may be possible that some defined collection of objects may not be a set. Russell's Paradox is an important milestone as it reshaped the definition of sets and redefined some Fundamental Axioms of Set Theory.

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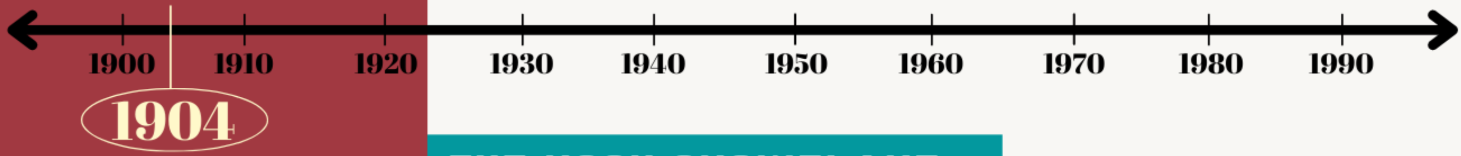
http://www.britannica.com

- Megha
(II-B)



KNOW THE MATH

KOCH SNOWFLAKE

THE KOCH SNOWFLAKE

The Koch Curve is a curve that is self-similar which means that it looks the same on any scale. The Koch Snowflake comes from this Koch Curve. Instead of using one line, it begins with an equilateral triangle and then each side of the triangle is used to make the Koch Curve continuously.

The man behind the existence of Koch Snowflake was Niels Fabian Von Koch. This Swedish Mathematician constructed one of the earliest fractals that bears his name in 1904. This mathematical curve was used to show that it is possible to have curves or figures that can be continuous everywhere but differentiable nowhere.

THE KOCH CURVE

We start with the creation of the Koch Curve first and to do that, we divide a straight line segment into three equal parts and convert the middle segment into a baseless equilateral triangle.

The first iteration curve is obtained. Now, taking each of the four line segments, firstly divide them into three equal parts and repeat the previous process to create the Koch Curve.

The first iteration curve is obtained. Now, taking each of the four line segments, firstly divide them into three equal parts and repeat the previous process to create the Koch Curve.

THE MATHEMATICS BEHIND IT

Number of sides (n)

For each iteration, the number of sides in the first stage becomes four times in the following stage and there are three sides in a triangle. According to this,

$$n = 3 \times 4^{a}, \text{ where a = number of iterations}$$

The number of sides for 0, 1, 2 and 3 iterations are 3, 12, 46 and 192 respectively.

Length of a side (k)

Let the length of a side of an equilateral triangle be 's units' at a stage. It becomes s/3 in the following stage and then 1/3 of the previous length in the further stages. So the length becomes,

$$k = 3^{-a} \times s$$

For iterations 0, 1, 2 and 3, the lengths are s, s/3, s/9 and s/27 respectively.

Perimeter (p)

Since all the sides in each iteration of the Koch Snowflake are the same, the perimeter is simply the number of sides multiplied by the length of a side.

$$p = n \times k = 3 \times 4^a \times 3^{-a} \times s = (\frac{4}{3})^a \times 3 \times s$$

For iterations 0, 1, 2 and 3, the perimeters are 3s, 4s, 16s/3 and 64s/9 respectively. If the number of iterations tends to infinity then the perimeter will increase with no bound. Due to this, we conclude that the Koch Snowflake has an infinite perimeter. It is continuous throughout because there are no breaks in the perimeter. However, it is not differentiable because of the presence of sharp corners and no smooth lines.

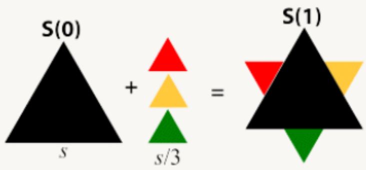
Area (A)

The length of the side of the initial triangle is given by the value of s. The area of the equilateral triangle is:

$$A_0 = \frac{\sqrt{3}}{4} s^2$$

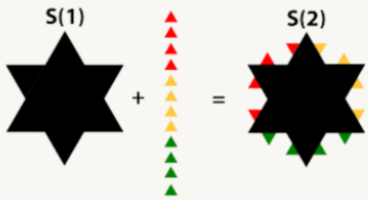
To calculate the area after the first iteration, we take the length of the side to be s/3

$$A_1 = A_0 + \frac{3\sqrt{3}}{4} \times (\frac{s}{3})^2 = \frac{\sqrt{3}}{4} s^2 + \frac{3\sqrt{3}}{4} \times (\frac{s}{3})^2 = \frac{\sqrt{3}}{4} s^2 (1 + \frac{3}{9})$$



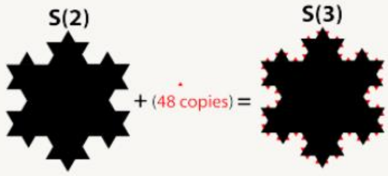
To calculate area after the second iteration, we take the length of the side to be s/9 and hence, the area becomes:

$$A_2 = A_1 + \frac{12\sqrt{3}}{4} \times (\frac{s}{9})^2 = \frac{\sqrt{3}}{4} s^2 (1 + \frac{3}{9} + \frac{3 \times 4}{9^2})$$



To calculate area after the second iteration, we take the length of the side to be s/27 and so, the area becomes:

$$A_3 = A_2 + \frac{48\sqrt{3}}{4} \times (\frac{s}{27})^2 = \frac{\sqrt{3}}{4} s^2 (1 + \frac{3}{9} + \frac{3 \times 4}{9^2} + \frac{3 \times 4^2}{9^3})$$



Can you notice a pattern? At the **ath** iteration, we add $3 \times 4^{a-1}$ additional triangles of area $\frac{\sqrt{3}}{4}(\frac{s}{3^a})^2$. This means that we add a total area of

$$3 \times 4^{a-1} \times \frac{\sqrt{3}}{4}(\frac{s}{3^a})^2 = \frac{\sqrt{3}}{4}s^2(\frac{3 \times 4^{a-1}}{9^a})$$

After n iterations, we get the area as

$$A_n = \frac{\sqrt{3}}{4}s^2(1 + \sum_{a=1}^{n} \frac{3 \times 4^{a-1}}{9^a})$$

The sum inside the parentheses is the partial sum of a geometric series with common ratio r = 4/9. Therefore, the sum converges as n → ∞. Thus, we see that the area of the Koch snowflake is

$$A = \frac{\sqrt{3}}{4}s^2(1 + \sum_{a=1}^{\infty} \frac{3 \times 4^{a-1}}{9^a}) = \frac{\sqrt{3}}{4}s^2(1 + \frac{\frac{3}{9}}{1 - \frac{4}{9}}) = \frac{2\sqrt{3}}{5}s^2$$

We have a finite area but an infinite perimeter. That's the Koch Snowflake!

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Palak Chaudhary
(II-A)

अनंत

Anant (Infinity) is perhaps one of the most beautiful discoveries of mathematics, that has intrigued the imagination of both mathematicians and philosophers, since time immemorial. Interestingly, infinity is not only limited to the two domains. Upon closer scrutiny, we find that infinity is all pervasive. It is in the flowers of spring, the leaves of autumn, in the radiant sunshine and in the turbulent human emotions. The poetry below, attempts to bring forth some instances of life through the lens of infinity.

आसमान से फूटी किरणें , छायी बसंत की रंगोली
हरी डालियाँ, मैना का गीत, और भवरों की टोली,
जा-जाकर बैठे फूलों पर, फूलों में बिख़रे रंग अनंत...

एक नन्ही चिड़िया, तिनकों के आशियाने में महफ़ूज़ रहती है
फिर धीरे-धीरे रग-रग में, उड़ान की ख्वाहिश भरती है
और एक दिन, पंखो में परवाज़ लिए, नापती है वो आसमान
अनंत...

प्रेम, घृणा, द्वंद्व, द्वेष , हर भाव का नाद बजता है
मन में अंतर्द्वंद्व का विचित्र चक्रव्यूह रचता है
उस चक्रव्यूह में पनप रहीं, अभिव्यक्तियों का ब्रह्माण्ड अनंत...

प्रताप से जलता सूरज जग से, शौर्य गाथाएँ पाता है
और निश्चल दीप उजियारा कर, जो स्वयं बुझ जाता है
उस दीप की कहानियाँ रह जाती हैं, अनकही, अनसुनी
अनंत...

पांच तत्त्व की सृष्टि है, हर साँस-साँस का सार अनंत
जीवन के इस पार अनंत, जीवन के उस पार अनंत...

- Kshitij Kumar
II A

1900 1910 1920 1930 1940 1950 1960 1970 1980 1990

1919

Ramanujan's TAXICAB NUMBER

Some say mathematics is an illusion. Its numbers and theorems are just a part of the mathematical reality created by the mathematicians. Others say mathematics exists independently in the universe. Humans did not create it, they could never. No mathematician would have the imagination to invent it, they merely discovered what already existed.

Whichever side of debate you are in, Ramanujan was in the latter camp. He believed God communicated through the language of numbers. The numbers and their relationship with the world were his clues of how this whole universe fits together. For the momentous genius, no number existed without purpose. His every breath knew numbers in close proximity. His intuitions, oriental beliefs, superstitions and isolation have produced the most elegant results in the history of mathematics in the form of theorems and numbers.

One such number is 1729. It may look fairly ordinary to many eyes but Ramanujan said it was not. The number is mystifying and so is the anecdote of legendary British mathematician G.H. Hardy. Hardy was a mentor and a life-long friend to Ramanujan. His brief collaboration with the genius Ramanujan has led to the exploration of unknown alleys and avenues of mathematics and is acclaimed as one of the most impactful collaborations of all time. However, Ramanujan's time in Cambridge was bitter-sweet. Due to the contrasting climate between India and England and the lack of vegetarian food, he became ill. Hardy who had gone to the hospital to visit Ramanujan, later told the story of the discovery of the 'Taxicab Number':

"I remember once going to see him when he was lying ill at Putney. I had ridden in Taxicab number 1729 and remarked that the number seemed to me rather a dull one, and that I hoped it was not an unfavourable omen. 'No,' he replied, 'it is a very interesting number; it is the smallest number expressible as the sum of two cubes in two different ways.' "

Ramanujan, in his ailing state, pointed out that 1729 can be written as the sum of two 'positive cubes' and that too in two different ways i.e. $1729 = 1^3 + 12^3 = 9^3 + 10^3$.

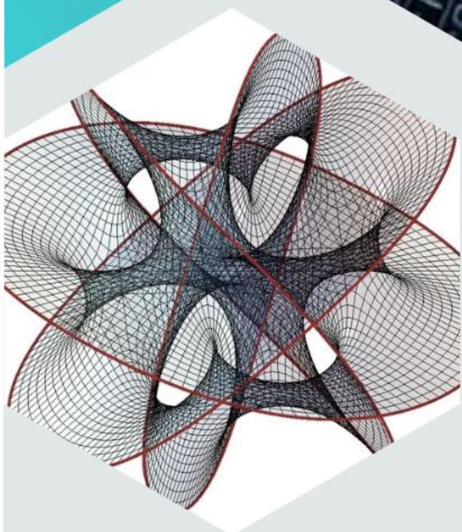
1729 is the smallest number to meet these conditions. In the honour of this conversation, the smallest integer that can be expressed as the sum of two positive integer cubes in 'n' distinct ways is named as Taxicab number. Taxicab(2) is also known as Ramanujan's Number or Hardy-Ramanujan number. In a more generalized way, parameters are used to express other taxicab numbers. For example Taxicab(j, k, n) represents the smallest number that can be expressed as a sum of a *j* number of *k* powers in *n* different ways.

After Ramanujan, other mathematicians like J.A. Dardis and David W. Wilson found other taxicab numbers. The world is familiar with 6 taxicab numbers so far.

$$Ta(1) = 2 = 1^3 + 1^3$$
$$Ta(2) = 1729 = 1^3 + 12^3 = 9^3 + 10^3$$
$$Ta(3) = 87539319 = 167^3 + 436^3 = 228^3 + 423^3 = 255^3 + 414^3$$
$$Ta(4) = 6963472309248 = 2421^3 + 19083^3 = 5436^3 + 18948^3$$
$$= 10200^3 + 18072^3 = 13322^3 + 16630^3$$
$$Ta(5) = 48988659276962496 = 38787^3 + 365757^3$$
$$= 107839^3 + 362753^3 = 205292^3 + 342952^3 = 221424^3 + 336588^3$$
$$= 231518^3 + 331954^3$$
$$Ta(6) = 24153319581254312065344 = 582162^3 + 28906206^3$$
$$= 3064173^3 + 28894803^3 = 8519281^3 + 28657487^3$$
$$= 16218068^3 + 27093208^3 = 17492496^3 + 26590452^3$$
$$= 18289922^3 + 26224366^3$$

The number 1729 and notes associated with it were also found in one of his notebooks. Recent studies have shown that many properties of this enigmatic number are yet to be unravelled. Researchers have found that Ramanujan associated the number 1729 with the study of elliptical curves and *K3* surfaces. Interestingly, it was years before *K3* surfaces were even named! A *K*3 surface is a smooth complete surface that is regular and has trivial canonical bundles which have become fundamental objects in string theory, moonshine, arithmetic geometry, and number theory. He used the number 1729 and elliptic curves to find formulas for *K3* surfaces. He had the intuition long before the world actually knew about the surfaces.

Cryptography which has use in various fields like protecting information in bank account numbers is said to be impacted by elliptical curves. Number theorists are positive that Ramanujan's formulas and notes associated with the taxi-cab number can unearth secrets of elliptic curves which will significantly affect modern mathematics as well as areas outside it.



Taxicab number may not be the greatest work of S. Ramanujan but it is a fascinating discovery. A discovery that did not originate from a discussion between revolutionary minds in a university research room but birthed out of a casual conversation. It was the magnanimity of his talents and accomplishments that we say Ramanujan knew infinity. Well, maybe he knew more than that.

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- Prerna Dumka
(II-A)

1900 1910 1920 1930 1940 1950 1960 1970 1980 1990

1965

THE MATHEMATICS OF HACKING PASSWORDS

In most cases, the password setting fails just to reject it as too weak. Have you ever wondered why we are also told to change our passwords on a regular basis? Obviously an additional security-like measure, but how accurate is it? Why do we need to set passwords that are currently resistant to hacking?

When asked to set a password for a particular length and a basic combination, the choice fits into every unique optional area that matches that rule, the "space" of possibility. If you use 5 lowercase letters, for example hgjyt, juthf, carpe, sssss, the space contains 26^5 or 11,881,376 possibilities. That is, the first character has 26 choices and the new character has 26 choices. These choices are independent and do not require the use of different characters. Therefore, the size of the password space is the product of possibilities, that is, 26 x 26 x 26 x 26 x 26 = 26^5.

Despite, 10 numerals and 10 symbols (e.g.: !, +, =, /, @, &, %, $) you are prompted for a 12 digits password that contains both uppercase and lowercase letters. Possible space sizes are close to 72^12 (19,408,409,961,765,342,806,016). This is more than 62 trillion times larger than the first space. A computer that executes all the 12-digits password options in sequence takes 62 trillion times longer. However, if the computer newly accesses the 5-character range, it will have to spend 1.5 million places to look up each of the 12-character passwords. Due to the large number of possibilities, it is impractical for a hacker to carry out an attack plan that was possible with a five-digit space.

To calculate the size of these spaces on a computer, you usually need to count the number of double-edged blades among the number of possibilities. This number N is taken from this equation 1 + an integer (log (N)). In the expression, the value of log (N) is a real number with multiple decimal places, corresponding to log (26^5) = 7.07486673985. The "integer" in the expression indicates that the fractional part of this log value has been forgotten, rounding down to a whole number- as in integer (7.07486673985).

For the above five lowercase representations, the number is 24 bits. For a more complex 12-character sample, it is 75 bits. (Mathematicians refer to spaces that may have 24-bit and 75-bit entropy separately).

The French National Cyber Security Agency (ANSSI) recommends at least 100 bits of space for passwords or private keys for cryptographic systems that must be absolutely secure. Encryption involves presenting data in a way that makes it unrecoverable unless the patron has a secret code to break the key. In fact, the agency recommends a potentially 128-bit space to ensure the security of multiple routes. 64-bits is very small (really weak). 64-80 bits is smaller. And 80-100 bits is medium (strength).

Moore's Law (computers available at a particular price double the computing power about every two years) is that weak passwords are not enough for long-term use, and brute force computers find passwords very quickly. Moore's Law seems to be slowing down, but it's wise to keep in mind the passwords that you want to keep secure for long periods of time.

A very strong password, as specified by ANSSI, requires a 16-character sequence, each consisting of a set of 200 characters. This gives 123 bits of space and will almost undo the study of words. As a result, system adopters are generally less demanding and accept low-intensity or medium-intensity words. They admit that the words are automatically generated by the system and are long only if the freaks don't have to remember them. There are other ways to protect yourself from password hacking. The simplest is known and is used by credit cards, like after three unsuccessful attempts to block access. Essential ideas have also been proposed, such as doubling the wait time for each successive unsuccessful attempt and resetting the system after a long period of time. Regardless of these strategies, these have no effect if an attacker can break into the system without being detected, or if the system cannot be configured to invalidate failed attempts.

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From Webinar of IIT BHU

- Saumya Jain & Siddhi Aggarwal (II-A)

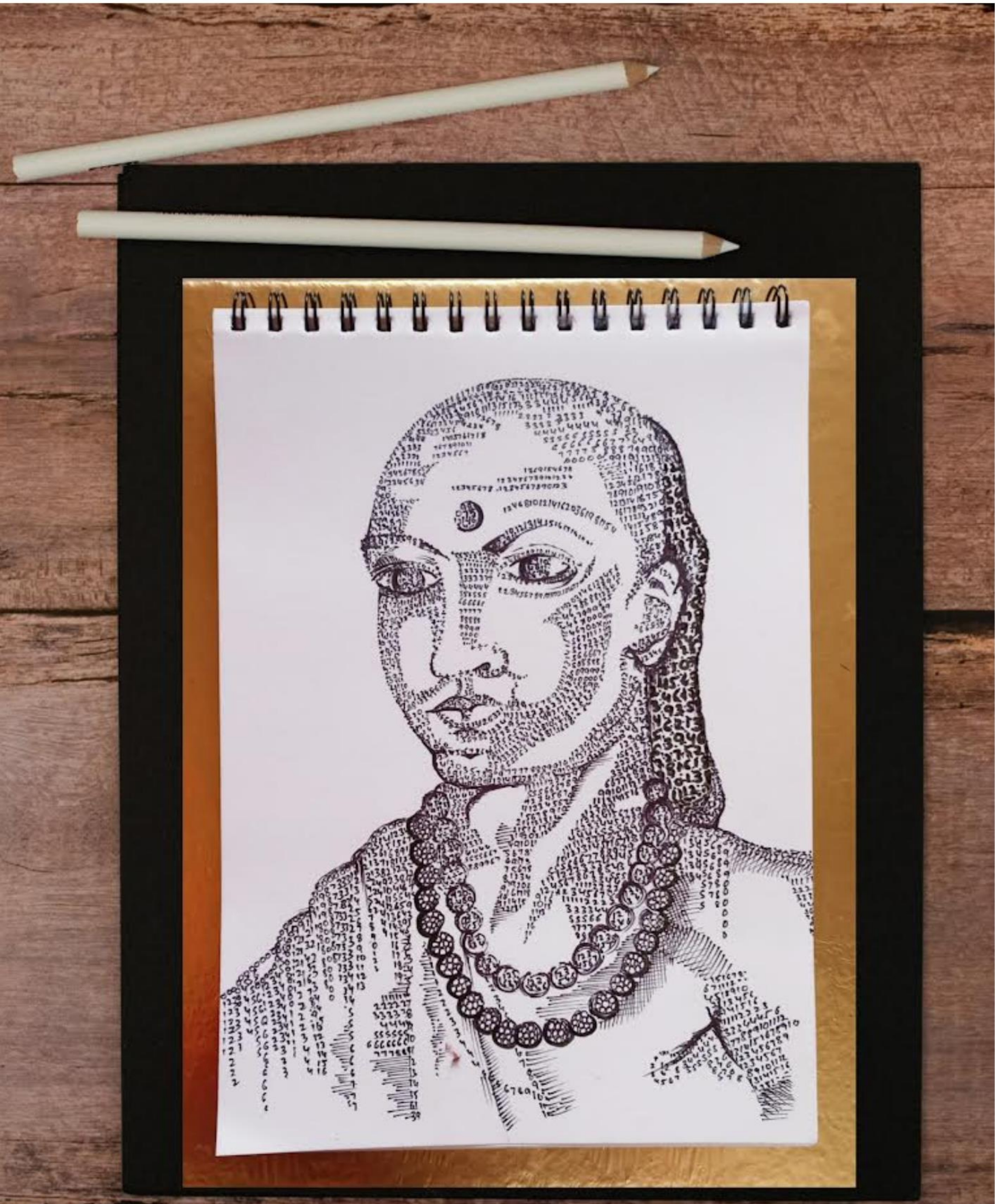
"The laws of nature are but the mathematical thoughts of God."

- Euclid

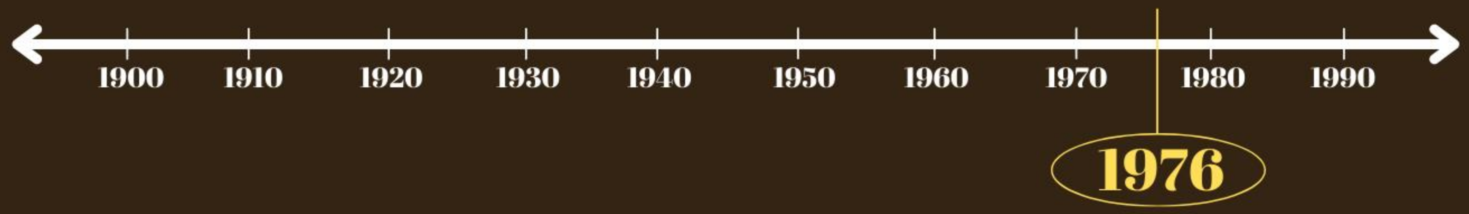
Artwork by Prerna Dumka

"He is the master who, after reaching the furthest shores and plumbing the inmost depths of the sea of ultimate knowledge of mathematics, kinematics and spherics, handed over the three sciences to the learned world."

- Aryabhatta



Artwork by Malvika Goswami



LOGISTIC MAP

The logistic map is a one-dimensional discrete-time map that, despite its formal simplicity, exhibits an unexpected degree of complexity. Historically it has been one of the most important and paradigmatic systems during the early days of research on deterministic chaos.
It is defined by the equation following equation:

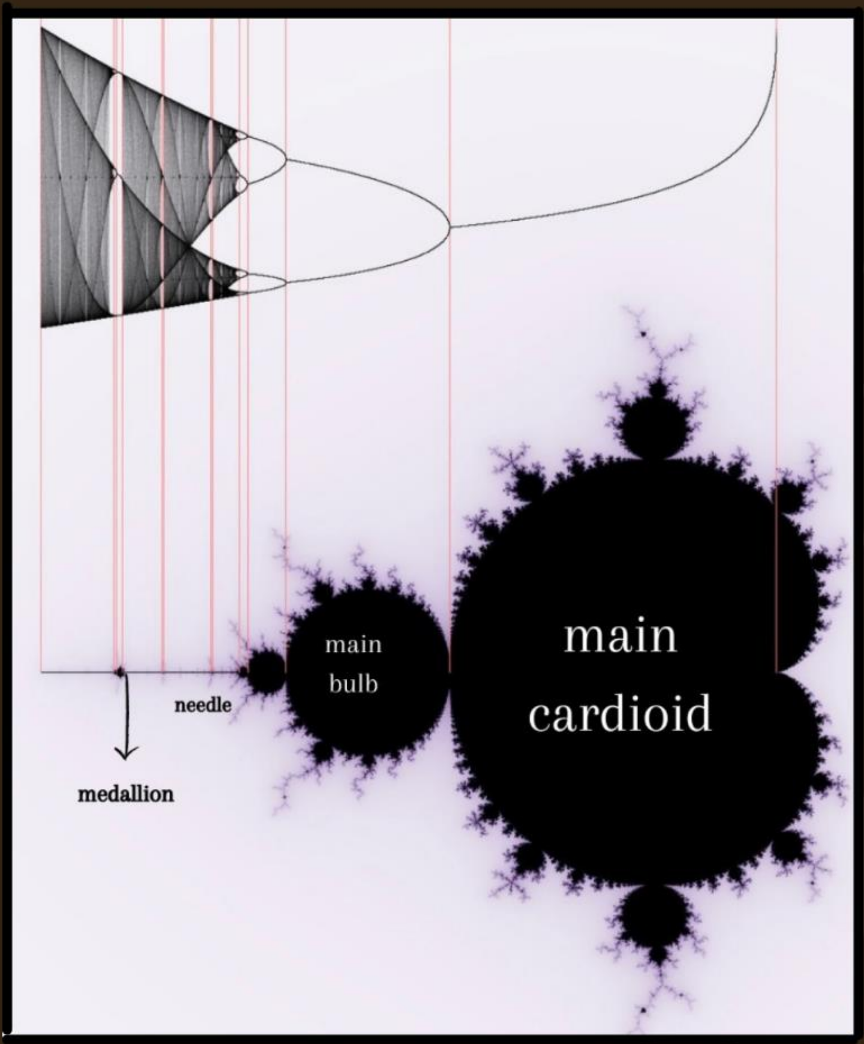
$$x_{n+1} = r\, x_n(1 - x_n)$$

This equation can be used to describe seasonally breeding populations in which generations do not overlap, where x_{n+1} denoting the population for next year, x_n denotes the present population, r denotes the growth rate and $(1\text{-}x_n)$ denotes the constraints of the environment.
When we plot the $x_{n+1}+1$ versus x_n graph we get an inverted parabola.

However, when we plot the x_n versus r graph as below, we observe that when $r<1$ the populations become extinct i.e., populations stabilize at 0 but after $r=1$ the populations stabilize at a fixed value which increases as r increases however when r crosses 3 the graph bifurcates into two i.e., the populations exhibit a cyclic behaviour. Beyond this point the initially stable period 2 points in turn become unstable, and bifurcate to give an initially stable cycle of period 4 and thence to a hierarchy of bifurcating stable cycles of periods 8,16,32, 64… and then at r = 3.57 infinite number of different orbits occur and this situation has been termed "chaotic" by Li and Yorke.

As r increases there are 'windows' of stable periodic behaviour amidst the chaos for example at $r = 3.83$ there is a stable cycle of period 3 and as r continues to increase it splits to 6,12,24 and so on before returning to chaos.

If you look closely, you'll see that the bifurcation diagram is a fractal, and that this is the Mandelbrot Set but you're only seeing one dimension of it.



All the numbers in the main cardioid of the Mandelbrot Set end up stabilizing onto a single constant value but the numbers in the main bulb end up oscillating back and forth between two values, and in the succeeding bulbs between 4,8,16… until finally on the needle of the Mandelbrot Set chaos hits. The medallion here that looks like the smaller version of the Mandelbrot Set corresponds to the windows of stability in the bifurcation plot with a period of three.

Another intriguing aspect of the logistic plot is the strange order in this chaos, that is the occurrence of the bifurcations.

Physicist Mitchell Feigenbaum discovered that when the the width of each bifurcation section was divided by the next one, the ratio closed in on the number 4.669… which is now called the Feigenbaum constant.

In fact, any single hump function if iterated would give you bifurcations that always occur in the ratio 4.669 and this is referred to as universality.

The first experimental observation of the bifurcation cascade that leads to chaos and turbulence in convective Rayleigh-Bernard systems was done by physicist Albert Libchaber. Using microbolometers engraved in the convective cell he was able to observe temperature fluctuations without perturbing the environment. In this way, he clearly observed the bifurcations that lead to chaos.

The logistic map is an archetypal example of how complex, chaotic behaviour can arise from very simple non-linear dynamical equations. To conclude this article, I would like to quote biologist Robert M. May who published a paper titled 'Simple mathematical models with very complicated dynamics' about this very equation in which he said, "Not only in research, but also in the everyday world of politics and economics, we would all be better off if more people realized that simple nonlinear systems do not necessarily possess simple dynamical properties."

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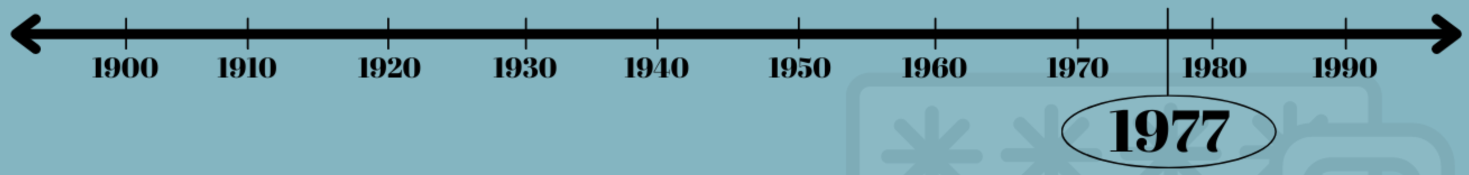
- Aarushi Jugran
(II-B)



THE MATHEMATICS OF RSA ALGORITHM

An application of the famous Number Theory

Number Theory, one of the purest of 'pure' mathematics, is devoted primarily to the study of integers and integer-valued functions. It has, since forever, fascinated both amateurs and highly-skilled mathematicians. The concepts and theorems under Number Theory can be easily understood by laypersons, however, understanding their lengthy proofs and complex reasoning requires intricate knowledge of pure mathematics.
Did you know, the 600-page proof for the profound mathematical conjecture, commonly known as the 'abc' conjecture, has been recently accepted and validated. It took nearly 8 years for the mathematician Shinichi Mochizuki to get his proof published!

Well, Number Theory is not just in theory.
Leonard Dickinson once said, "*Thank God that number theory is unsullied by any application*." Dickinson died in 1954, little did he know, concepts of Number Theory had applications well beyond the field of mathematics. Surprisingly, it has turned out to be one of the most useful when it comes to computer security.
Until the mid-twentieth century, number theory had no direct applications to the real world. The advent of digital computers and digital communications revealed that number theory could provide unexpected answers to real-world problems. The best-known application of number theory is public-key cryptography, such as the **RSA algorithm**.

Now, let's first understand the RSA algorithm!
RSA, a widely used encryption system, is short for **Rivest–Shamir–Adleman**.
Ronald Rivest, Adi Shamir, and Leonard Adleman, a group of three well-known scientists, publicly described the algorithm in **1977**.
In layperson's terms, RSA is essentially an asymmetric cryptographic algorithm, where asymmetric means that there are two keys: **a public key and a private key**. This algorithm is used in modern computers to encrypt and decrypt messages. For instance, the RSA algorithm permits users to make secure online transactions such as paying for orders online through a credit card.
In situations like the above, sensitive data exchanged between a user and a website needs to be encrypted to prevent disclosure or modification by unauthorized parties. The encryption ought to be done so that decryption is only possible with knowledge of a secret decryption key, which should only be known by authorized parties.

You must be wondering how mathematics is used in such an algorithm. Let me put your mind at ease.
The prime mathematical concept or the fact behind this discovery is that **finding the factors of a large composite number is difficult.**

The RSA Cryptosystem:

- The public key in this cryptosystem consists of the value 'n', known as the modulus, and the value 'e', called the *public exponent*.
- The private key consists of the 'modulus n' and the 'value d', the *private exponent*.

Generation of keys:

- Take 2 large, random prime numbers, say ***p*** and ***q***. These numbers should be kept discrete.
- Multiply these numbers, ***n = pq***. Here, n is the modulus for public and private keys.
- Compute the Euler Phi (or Euler totient) function of *n*

$$\phi(n) = (p - 1)(q - 1)$$

- Choose an **integer *e*** such that **1 < *e* <** ϕ(n) where ***e*** is co-prime to ϕ(n). Here, ***e*** is released as the public key exponent.
- Compute ***d*** that satisfies

$$de \equiv 1(mod\ (\phi(n))$$

Here, ***d*** is released as the private key exponent.
  - **public key** is ***(n, e)***
  - **private key** is ***(n, d)***

Encryption and Decryption:

- Let '**m**' be the message to be exchanged.
  - $c = \text{ENCRYPT}(m) = m^e \bmod n$
- The decrypted message is given as
  - $m = \text{DECRYPT}(c) = c^d \bmod n$

Working of the algorithm

Now let's try one example!
Let's assume **p as 3 and q as 7** (taking small values for convenience)
Product of p and q:
n = pq = 21

The next step is to find the Euler Phi function of n,
ϕ(n) = (3-1)(7-1) = 12

Now, we have to choose an e>1 co-prime to ϕ(n)
Let **e = 11**

Computing 'd' that satisfies the equation de≡1(mod (ϕ(n)) ⇒de = 1+k(ϕ(n)), where k is an integer.
Hence, **d = 11**

Therefore, public key is (n = 21, e = 11) and private key is (n=21, d=11)

If the message to be exchanged is, say **m = 10**, then
Encryption: c = 10^{11} mod 21 ⇒ c=19
Decryption: m = 19^{11} mod 21⇒ m=10

Hence, we get the value of *m* as 10 again!

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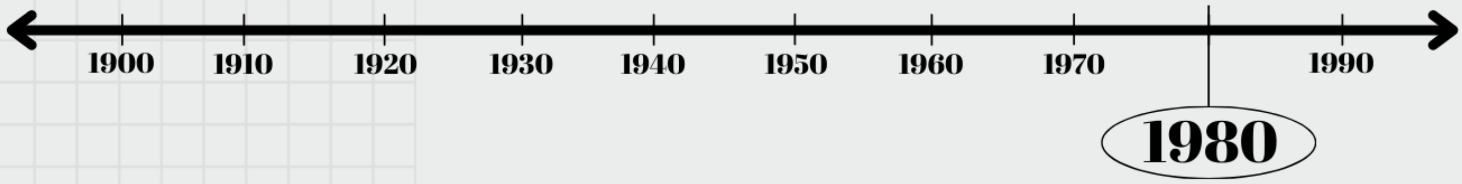
- Uditi Bajaj
(II-B)



MATH ROCK

Math and Rock music - at the very first look, these 2 terms together might seem like an oxymoron. It is known that mathematics is used in music but a whole genre named after the subject; fascinating, isn't it? When you experiment with rhythms and beats to combine it with the complexity of math, it gives you 'Math Rock'.

All kinds of music have mathematical influence when it comes to beats and time signatures, the most common time signature in songs is 4/4. This means that there are 4 quarter note beats in each measure.

4/4 time signature in sheet music

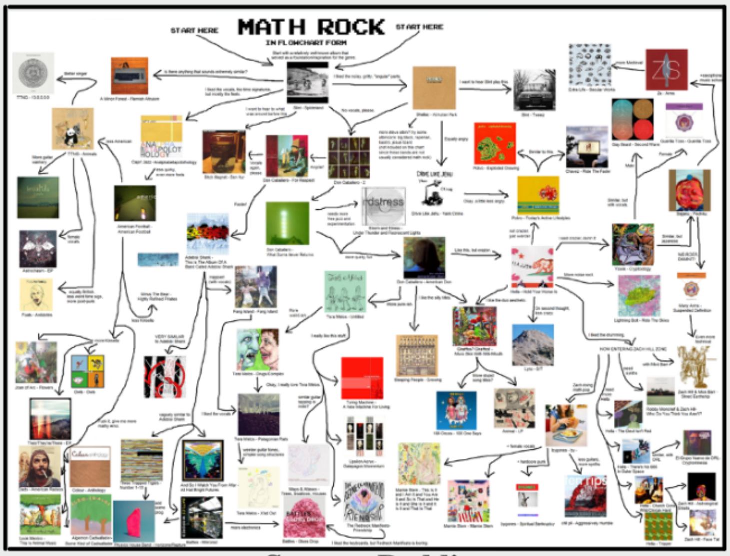
However, math rock uses unconventional time signatures, for example the structure 7/8 goes- one two three four five six seven, one two three four five six seven eight. These signatures make the beats sound irregular and unusual, different from the usual song structures. These beat measures keep changing abruptly throughout the song, thus, making the sound non-uniform and distorted. To put it in mathematical terms, there is no limit to the continuity of the rhythm.

The Origin

Having its roots in classical influences of Igor Stravinsky and Steve Reich, and keeping in mind the revolutions in Jazz in the 1960s, math rock took the developments of 70s' progressive rock and pushed them further. It started out in the early 1970s and 80s with albums such as Red and Spiderland by bands King Crimson (English Band) and Slint (American Band). Slowly, the influence spread to Asia, majorly Japan.

Initially, due to the complex sounds, the name was started as a joke by critics but later got accepted as the official name for the genre. Of course, whenever a little unconventional and complicated concept is used anywhere, it's termed as 'scientific' or 'technical' but math rock is more catchy than science rock.

Famous Artists in the Genre



Source: Reddit

There are numerous bands who are known to be associated with this genre, some of the most popular and iconic ones being Slint, American Football, Tricot, Elephant Gym and No Somos Marineros. A really captivating trait about this genre is its experimental and open-ended nature, due to which it is popular with indie bands in many regions unlike rock music, which is mostly associated with bands from the US and UK.

Math rock is really popular in Japan. If you're an anime fan, most of the songs used in anime are from this genre! Moreover, if you are into Indian indie music, bands like Jeepers Creepers from Kolkata have elements of math-rock in their otherwise dance/pop/indie style of music, and Sky Level from Shillong call themselves 'alternative psychedelic math rock'.
Even after being a lesser known and obscure genre, it gives way to diversity in music.

To sum it up, if you admire math, a career as a Rockstar is not a completely illogical option!

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- SHREYASI JHAMB
(II-A)

1985

ZERO-KNOWLEDGE PROOF AND BLOCKCHAINS

We all are aware of how proofs are important not only in mathematics but also in our everyday life. Without proof, a statement has little to no value to it. We are also aware of how proving a given statement works. We use certain aspects and parameters to prove something. But what if I ask you to show a statement without providing any other knowledge than the statement itself. Here, the concept of zero-knowledge proof comes in.

Zero-Knowledge Proof (ZKP) is a notion introduced by Goldwasser, Micali, and Rackoff by which we can prove a given statement without leaking any extra information

Let us understand this by an example.
Let us suppose that Bob and Alice got some chocolate bars for Halloween and they would like to know if they received the same amount of candy, without disclosing their number of chocolates.

Let's assume they can have exactly 10, 20, 30, or 40 chocolate bars in their trick-or-treat bags. To compare the number of chocolate bars they got without sharing the actual number, Bob gets 4 lockable boxes and puts a label in each that says 10, 20, 30, or 40 (chocolate bars). Then Bob throws away all the keys except for the key to the box that corresponds to the number of chocolate bars he's got (let's say he has 20 chocolate bars) and leaves.

Alice takes 4 small pieces of paper and writes "+" on one of them and "-" on all the others. Then, she slips the "+" piece through a slot into the box with the number that corresponds to the number of candies she's got (let's say she has 30 candy bars) and slips the pieces of paper with "-" on them into the rest of the boxes and also leaves.

Bob returns and opens the one box he still has the key to — the one that corresponds to the amount of candy he's got — and sees if it contains "+" or "-"

If it is a "+", Alice has the same number of chocolate bars in her bag. If the slip of paper says "-", it means that they have a different amount of candy.

We know that Bob's bag contains 20 chocolate bars and Alice's — 30 chocolate bars. On opening the box and finding the piece of paper with a "-" on it, Bob learns that he and Alice have a different amount of candy. But he has no way of finding out whether Alice has more or fewer chocolate bars.
Alice also returns and sees that Bob has a piece of paper with a "-" on it. So, he has a different amount of candy. But both Alice and Bob still don't know how many chocolate bars each of them has. They only know that they don't have the same amount.

Properties of Zero-Knowledge Proof

- **Completeness**: if the statement is true, the honest verifier (that is, one following the protocol properly) will be convinced of this fact by an honest prover.
- **Soundness**: if the statement is false, no cheating prover can convince the honest verifier that it is true, except with some small probability.
- **Zero-knowledge**: if the statement is true, no verifier learns anything other than the fact that the statement is true. In other words, just knowing the statement (not the secret) is sufficient to imagine a scenario showing that the prover knows the secret.

BLOCKCHAINS

A blockchain is a digital ledger of transactions that records information in a way that makes it difficult to hack or alter. The technology allows a secure way for individuals to deal directly with each other, without an intermediary like a government, bank, or other third parties. The growing list of records, called blocks, is linked together using cryptography, which is a method of storing data in a cryptic form so that only those for whom it is intended can read and process it. Cryptography not only protects data from theft or alteration but can also be used for user authentication.

ZERO-KNOWLEDGE PROOF IN BLOCKCHAINS

Messaging applications

We all are aware how end-to-end encryption has played a big part in making sure that our messages are completely private. But even for that, a person needs to prove his identity by providing additional information to the servers. With the help of ZKP, one can prove his identity without providing any personal data for example, Over 18 ZKP can be used to prove someone is over 18 without revealing their exact age.

Complex documentation

Combining ZKP and blockchain allows users to share complex documents safely. It enables users to control who can access the information while restricting others.

Transferring private blockchain transactions

The most notable concern in private blockchain transactions is numerous loopholes evident in conventional procedures. The productive integration of ZKP with private blockchain transactions can create a powerful hacker-proof process.

Data Security

Organizations that control sensitive data, such as banks and hospitals, must keep them free from third-party access. ZKPs and blockchain together can make accessing data impossible.

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- Divyanshi Rawat & Bharti Meena
(II-B)

LIFE OF SET SQUARES

Hear, hear! As we knock
The two fine triangles that
Lay inside your geometry box.

If you don’t remember us
‘Set Squares’ is what we are called.
I am 45, the smarter twin,
My brother 60-30 is rather tall.

Perpetually ignored by you,
We still behaved ourselves.
Not only completed your set but
Kept protractor company as well.

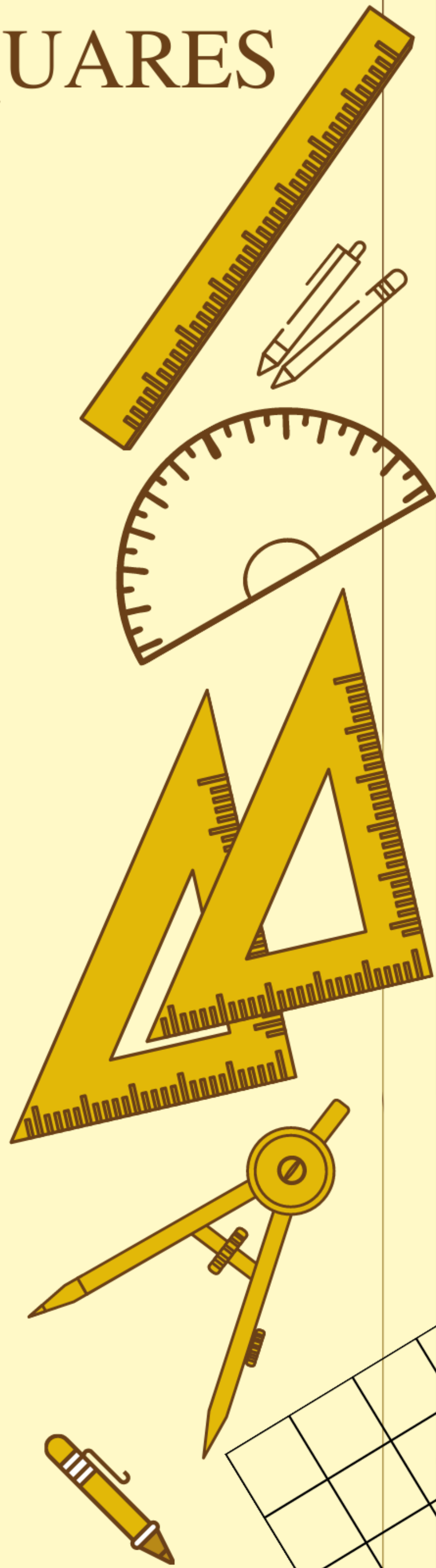
When you played with your friends,
We became your makeshift guns.
Could’ve been a lil' appreciative,
You ungrateful human!

We said, “It’s alright”
After you called us names.
Being the bigger person, we
Thought ignorance is to blame.

But you didn’t stop here and
Committed the last sin.
The day you’ll use us on paper,
We thought our new life will begin.

Compass danced in arcs,
Protector sang in full degree.
Elated and excited,
We anticipated what would it be?

Standard measured angles or
Lines parallel or perpendicular?
But you drew some margins and said
“Set squares serve as an excellent ruler.”

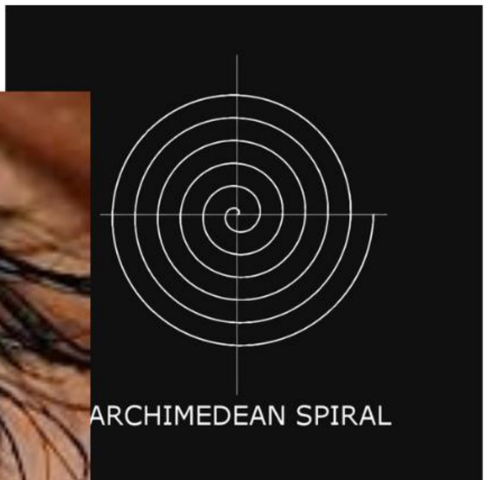


Prerna Dumka
2nd year

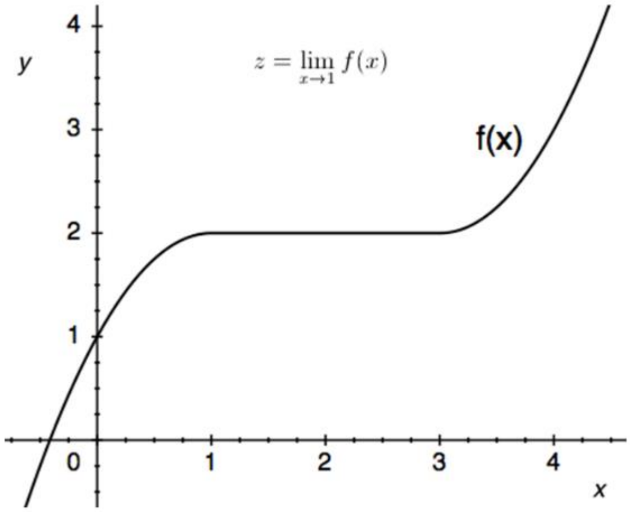
LIFE THROUGH THE EYES OF A MATHEMATICIAN

Mathematics is everywhere and yet we may not recognize it. Mathematics is in every aspect of our lives; from a mother-child relationship to a person's everyday needs. The emotional distance between a mother and her child can be minimized by supposing that there exists a delta > 0 for which we have epsilon > 0. A mother always tends to a child, who is the limit for her.

Every person has a desire to fulfill, despite knowing the fact that it is not a real number. Human beings generally behave like a modulus function as they react positively or negatively according to the circumstances or people around them; whenever a person is looking forward to a positive outcome from a situation he/she takes the positive value, otherwise, he/she chooses to remain indifferent by taking the negative values. Friends are like limitless functions separately, but together they become a constant function. College students resemble the 'unlike terms' of algebra, that is, until the lunch break. The cafeteria then becomes their exists to a lot of enjoyment at lot of points, in that interval of time. A group of friends is like an integral domain because of the absence of zero divisors which implies that there exists two friends such that (1st friend * 2nd friend) = 0 as their love for each other makes them an identity together.

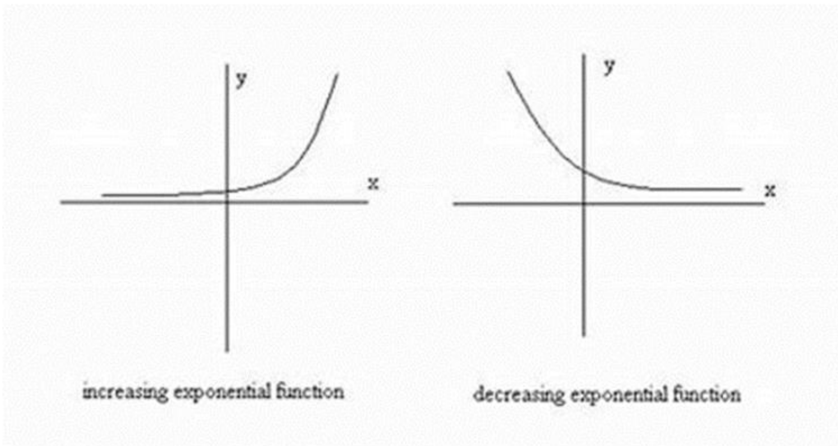


Teachers are synonymous with integration as they increase the capabilities of a constant student with their knowledge and magnify a student's capabilities. We think of them as a definite integral and they can increase our potential to a definite point in accordance with upper limit and lower limit but in reality they are indefinite integrals, their upper limit is infinity as their morals and values remain with us for the lifetime.



Our success is a function of our efforts. We should try it to be an increasing function rather than a decreasing one. The way others treat us is a function of how we behave towards them.

The most important lesson mathematics gives us is that we must have the will to never give up as every problem has a solution.



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https://studymoose.com/maths-in-everyday-life-essay

- Muskan Jindal
(II-A)

Unwinding the rationality of THE IRRATIONAL e

In the world of mathematics, certain letters and symbols hold a special meaning. These symbols are of extraordinary significance to mathematics as we know it today. Perhaps, one of these symbols is e, commonly known as the Euler's number.

Let's first walk down the history of this versatile mathematical constant. In 1683, while trying to compute a question on compound interest, Jacob Bernoulli discovered this constant. Initially represented as the letter "b", Leonhard Euler first rolled out the letter "e" as a base for natural logarithms. He proved its irrationality by expanding it into a convergent infinite series of factorials and later started using the letter "e" itself for this very constant. Henceforth, the representation of this magical constant as "e" eventually became standard. Hence, it is after Leonhard Euler that e got its name.

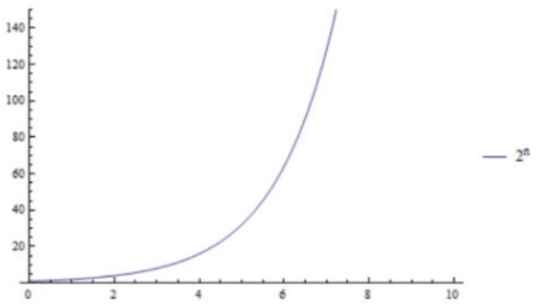
But What is e? How did Euler's number get its value?

Why $\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e$ ***?***

Why is exponential growth the maximum growth?

Let us assume, you have $1.00 with you at the start of a year and you decide to deposit this $1 in a bank at a certain compound interest expecting the maximum return by the end of the year.
The bank assures you to double your principal sum by the end of each year, that is, compounding your initial sum of money at 100% interest rate credited once at the end of each year.

So, compounding the principal sum annually at a 100% interest rate, credited only once at the end of each year, will give us $2 at the end of the 1st year, $4 at the end of the 2nd year, $8 at the end of the 3rd year and so on. Hence, the total amount in our hand at the end of n years would be 2n.



Graph of 2^n

Calculating it mathematically using the formula of compound interest, that is, -

$$A = P\left(1 + \frac{r}{100}\right)^n$$

where, P = principal amount,
r = rate of interest
n = number of cycles

Computing the values of P and r in the given equation, where,
P (Principal sum) = $1,
r (rate of interest) = 100%, we get,

$$A = 1\left(1 + \frac{100}{100}\right)^n$$

But is this the maximum growth we can get by the end of a year?

To understand this, let us have a look at various scenarios-

COMPOUNDED	FINAL AMOUNT AFTER A YEAR	
Annually (n=1)	$A = \left(1 + \frac{100}{100}\right)^1$	$2
Half Yearly (n=2) (at 100% interest yearly, that is, 50% interest half yearly)	$A = \left(1 + \frac{50}{100}\right)^2 = \left(1 + \frac{1}{2}\right)^2$	$2.25
Quarterly (n=4) (at 100% interest yearly, that is, 25% interest quarterly)	$A = \left(1 + \frac{25}{100}\right)^4 = \left(1 + \frac{1}{4}\right)^4$	$2.44
Monthly (n=12)	$A = \left(1 + \frac{1}{12}\right)^{12}$	$2.613
Daily (n=12*30)	$A = \left(1 + \frac{1}{12*30}\right)^{12*30}$	$2.7146
Hourly (n=12*30*24)	$A = \left(1 + \frac{1}{12*30*24}\right)^{12*30*24}$	$2.7181
Every second (n=12*30*24*3600)	$A = \left(1 + \frac{1}{12*30*24*3600}\right)^{12*30*24*3600}$	$2.71828
n=10,00,00,000	$A = \left(1 + \frac{1}{100000000}\right)^{100000000}$	$2.718281

Hence, we see that if we keep increasing the value of n, our final value nearly approaches the constant 2.71828…..

01

And as Leonhard Euler said, "For the sake of brevity, we will always represent this number 2.718281828459…….. by the letter e."
Therefore, this is how e got its value as 2.718281828459……..

02

Therefore, e can be defined as the maximum growth, after continual compounding at 100% growth rate

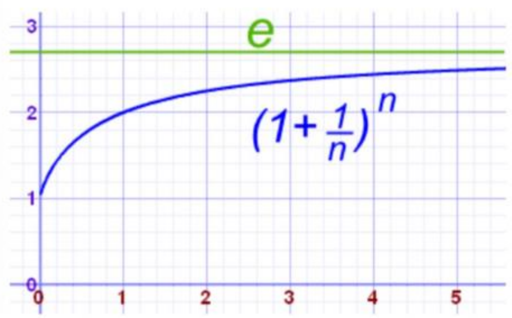
As, on increasing the value of n, it is approaching 2.71828, viz, e, therefore we get that,

03

$$\lim_{n \to \infty} \left(1 + \frac{1}{n}\right)^n = e$$

This growth is the maximum growth and is called as Exponential growth

04



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- Jahnvi Agarwal
(II-A)

The search for lines

How do I tell you what these endless lines convey?
I close my eyes and find myself in a world with these parallel running lines,
They run long till infinity,
Without intersecting,
Unheard and unseen,
With a fathom of peace,

I ponder what these lines could verse me,
Lifeless and pale lines for you and me,
But, I feel there is a beautiful and fragile story blooming on the other side,
Which is always hard to see,

How you travel those difficult roads,
To an endless journey,
No matter what the conclusion is,
There is a lot to learn,
You keep achieving sanity,
The patience,
The willpower,
Is what it preach,

What do I tell you these lines are so inspiring,
Asymmetry of life which is numb and quiet yet eternal,

You may see a void between these lines,
A space that is empty,
But you may never know a plethora of emotions you may find there,

Soaking the positivity,
It goes on till the vague,
Endless and endless,
Till the infinity....

Divyum Goel
II-B

Achievements

Academics

Rajat Kumar, currently in 3rd year, worked on a project named "Ordinary differential equations" during June - July 2021 under the direction of Dr. Jagmohan Tyagi Indian Institute of Technology, Gandhinagar, and obtained a certificate for successfully completing the Summer Research Fellowship. The Summer Research Fellowship Programme was jointly sponsored by IASc (Bengaluru), INSA (New Delhi), and NASI (Prayagraj).

Siddhi Agarwal and Soumya Jain, currently in 2nd-year secured, won 2nd position in Paper Presentation Competition organized by Mathematics Department of P.G.D.A.V. College, University of Delhi. They researched and made a presentation on a mathematical topic and presented it in front of the jury of professors. They also secured 2nd position in this national level competition organized by the Economics Association of Daulat Ram College, University of Delhi. The team members were given a situation based on Economics, and had to make the economic policy from scratch by showcasing their views in the form of a presentation and presenting them to the judges.

Yash Goel, currently in 3rd year, got selected as a machine learning engineer intern in a startup named voxel (based in San Francisco Bay Area) that recently raised a funding of $3M. He also got selected as a software engineer intern in a startup named ReachTheTop (based in Ireland).

Extra Curriculars

Ankita Goyal, currently in 2nd year, won first prize in folk dance competition organized by SRCC called "Natra Nritya" which was organized in February-March 2021.

Akanksha Singh, currently in 2nd-year, secured 2nd position in Digital Poster Making Competition, Amplifier 2021 organized by Department of Electronics, Sri Venkateswara College.

Uditi Bajaj, currently in 2nd year, held various awareness sessions on menstruation in multiple government schools in Punjab, under Project Crimson in collaboration with District Administration, Rupnagar. Also participated in Pad Distribution drive at Sanjay Camp, with Adira Foundation.

Clubs & Societies

Rishika Panwar, currently 2nd Year, became the General Secretary of Boolean Society and facilitated Bool-Guides that had 7 speakers on 6 themes, 149 cumulative attendees, and was rated 4.75/5 in its first season. She also assisted students in receiving guidance and mentorship from college alumni. She facilitated the Bool-Pedia that has connected about 150 students with 100+ quality internships and other tech-related opportunities to help students build themselves inside-out.

Uditi Bajaj, currently in 2nd Year, got promoted to Project Head of Project Gulzar at Enactus. Through this project, we aim to solve floral and paper waste generation by turning them into different products. We are also providing employment to a group of women who work as a house help. The project's ideation started out last year and it's finally launching under her tenure!

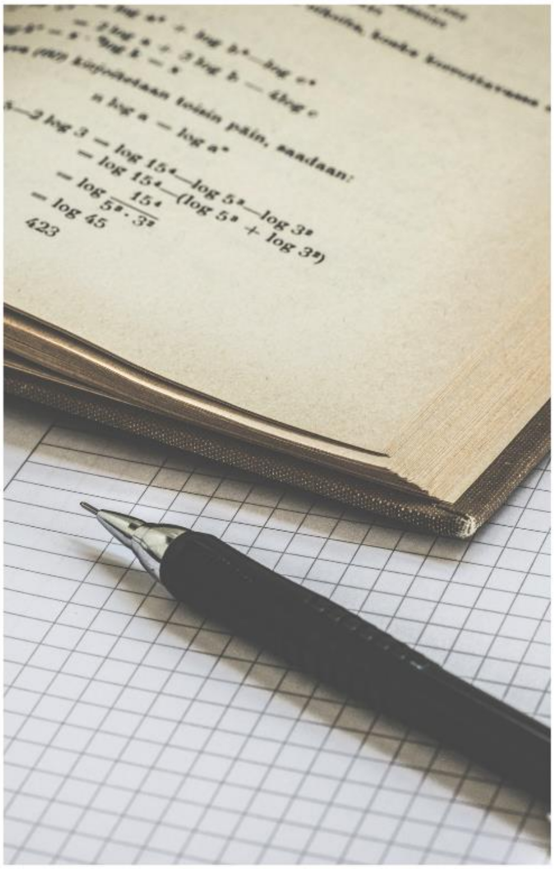
Kritika , currently in 2nd year, became a part of Anubhuti, the Dramatics Society of the college and was promoted to the post of General Secretary.

CAREER PROSPECTS

AFTER B.SC. (HONS.) MATHEMATICS

Mathematics is one of the most studied and diversified subjects in and around the world. This subject opens up doors leading to a plethora of career options in the future for the students.

In both private as well as government sectors, there are a plethora of career options after B.Sc. (Hons) Mathematics. The degree is an extensive course taught over a period of three years at an undergraduate level. Here is a career roadmap that can help students choose and pursue their careers after completing B.Sc. (Hons) Mathematics.



1

GOVERNMENT JOBS

Students willing to establish their careers in the government sector can sit for various government entrance examinations after completing B.Sc. (Hons) Mathematics. There are many competitive examinations at the state as well as National levels (UPSC, Indian Defense, SSC, etc.). Many students sit for the UPSC examination after completing this degree every year. Other established government career options are:

- Village Officer
- Government Teacher
- Government Professor
- Central Government Jobs
- Public Sector Banking Jobs
- Jobs in Indian Railways
- Defense Research and Development Organization (DRDO)
- Indian Space Research Organization (ISRO)
- IFS officer

2

MBA (MASTERS OF BUSINESS ADMINISTRATION)

Students who are willing to pursue and make their careers in the fields of management and business prepare for an MBA. MBA courses have huge demand in the world. Students can start preparing for entrance examinations like CAT and GMAT for MBA. To apply for the CAT or GMAT entrance test, they must have completed their graduation from a recognized university with 50% of marks and if they are belonging to SC and ST, then 45% of marks are enough. There is no age limit. CAT is a common entrance test to be conducted by IIMs to get admissions into their management programs. This is an online test and it is a national wide entrance test, where they should write the entrance test online. Almost all the business schools in India are accepting CAT scores.

3

TEACHING

Teaching as a career has limitless opportunities in the field of mathematics. Students after completing bachelors in mathematics can pursue teaching. The various opportunities in this field are:

- Lecturer
- Professor
- Associate professor
- Assistant professor

4

ACTUARIAL SCIENCE

This discipline is interdisciplinary and incorporates mathematics, computer science, finance, economics, and statistics. This makes it one of the lucrative career options after B.Sc. (Hons.) Maths. The professionals assess financial risks (anticipating the future scenarios) in the corporate world. The field also handles the production of life tables, mortality analysis, and the application of compound interest. The various opportunities in this field are:-

- Financial Analyst
- Financial Consultant
- Actuary

5

OPERATIONAL RESEARCH

It deals with the application of various methods in order to make better decisions. Also, it is a method of solving various problems of a business firm and organization.

The main motive is to achieve the best performance and protect firms from an uncertain future. Hence, they play a huge role in a firm by providing their services to solve multiplex problems which will help them to improve efficiency. It is a great opportunity and helps an individual to act as an asset for the organization and is a really good career option in the business.

6

DATA SCIENCE

From small startups to MNCs, each organisation nowadays generates, on a regular basis, vast amounts of data. The professionals working in the field of data science make sense of this data and this in turn helps the companies make their future plans. The services include data mining, data modelling, interpretation, developing prototypes, predictive models and custom analytics, etc.

According to studies by LinkedIn, since 2012, there has been an increase of 650% in data science jobs. The U.S. Bureau of Labor Statistics estimates that there will be about 11.5 million new jobs by 2026. Let us take a look at some of the best career options after bsc maths.

7

ECONOMICS

There is a broad scope of economics as it not only studies its subject matter. But it also studies various other things such as its scientific nature, ability to pass value judgments, and suggest solutions to real-world issues. The study of economics opens up a broad range of opportunities to gain an edge in today's globalised world. Since the growth of any business relies on economic policies, a career in this field can be very rewarding. After gaining proper skills and training, you can not only find employment opportunities at the national, but also at the international level. Economics is the foundation for every industry and organisation, hence it has incredible scope and prospects to supply.

Alumni Section

We believe that each graduate's story is unique and powerful and as we conclude another successful academic year, let's have a look at some successful stories of the visionaries of Mathematics graduates who have gone forth from Sri Venkateswara College and have carved their post-college paths.

Mahima Negi: Mahima Negi, also a former Vice President of The Mathematics Association, is currently studying Computer Applications from Jamia Millia Islamia. Mahima is well-versed in the German language and has earned a Diploma in the same from St. Stephen's college. Even during her Master's, she is quite active in her co-curricular activities, being in multiple societies and interning at Aon.

Tejas Chimwal: Currently working as a Sales Manager at Zomato and interned as a Business Risk Analyst at EY, Tejas is skilled in C++, Public Speaking, R, Microsoft Office, and LaTeX.

Aditya Vashist Sharma: Currently working as a consultant at Deloitte. Aditya started off his Deloitte journey as a risk analyst. He was also an executive member of Trisectrix along with being the President of FAA.

Tanush Taneja: Soon after graduating from Sri Venkateswara College, Tanush joined IISER Kolkata as a Research Scholar

Astha Jain: Aastha has cleared 5 actuarial exams from the Institute and Faculty of Actuaries and is currently working as a Senior Actuarial Analyst at AXA. She also worked at Zomato as a sales intern.

Aayushi Goyal: Aayushi Goyal, a 2016 alumni, is an upcoming talented Actuarial Analyst. After finishing her Bachelor's, she went on to pursue MBA from a well-reputed university. She has, so far, cleared 9 CT Actuarial exams. She has worked at Metlife as Senior Actuarial Analyst, and she is currently employed as Actuarial Analyst at Deloitte.

Garima Hans: Garima Hans having pursued her Master's in Mathematics from our college, has created a successful career for herself in Actuarial Science. She has cleared 9 CT Actuarial exams and CM2 exam. Quality Council of India (QCI) and Xceedance are some esteemed companies she has worked in. Currently, she is working as an Actuarial Executive at KPMG.

Shivangi Sardana: An alumni of the 2019 batch, Shivangi is currently employed as an Associate at ZS, a management consulting company. She is also the Founder and President of 'Delhi Hub', a city wing of Impact Consulting Global, where she has created a network of aspiring and professional consultants for social impact organizations.

SRI-VIPRA 2020

"Research is to see what everybody else has seen, and to think what nobody else has thought."
- Albert Szent-Gyorgyi.

Sri Venkateswara Internship Program for Research in Academics (SRI-VIPRA) is an undergraduate summer research internship programme organized by Sri Venkateswara College to develop independent critical thinking skills in the students along with oral and written communication skills. In this programme the students execute small research projects in a particular discipline of their choice under the guidance of the mentors.

The Department of Mathematics believes that research experiences enable greater understanding and retention of mathematical skills in the students as they learn to apply the theoretical knowledge to analyse data and derive at coherent conclusions.

This year even the pandemic did not deter this spirit as the students participated in 3 projects with full zeal under the guidance of the professors of the department.

S.No.	Mentor	Project Title	Students Involved
1.	Mr. Sudhakar Yadav	Prey-Predator Model of Real-Life Problem and Dynamical Behaviour	Sanskriti Khemka, Himani Bhatia, Aastha Arora, Megha, Shruti Sharma, Ankit Kumar Goyal and Shubhi Gupta
2.	Dr. Swarn Singh	Differential Equations and Mathematical Modelling	
		1. Application of Computational Fluid Dynamics in the detection of Glaucoma	Anant Narayanan and Prassanna Nand Jha
		2. The Corona Curve	Anant Narayanan, Prashasti Sharma, Prassanna Nand Jha, Rajat Kumar and Vanshika Bansal
		3. Partial Differential Equations in Oil Reservoirs	Prashasti Sharma, Dolly Goyal and Shriya Koul
		4. Infectious Diseases Modelling	Bhavini Malhotra
		5. SIR(D) Model + SIR(DV) Structure: Predictive Mathematical Modelling	Kashish, Dolly Goyal and Shriya Koul
3.	Dr. Deepti Jain	Graph Theory:Problems and Applications	
		1. Fingerprint Analysis using Graph Theory	Sejal Arora
		2. Graph Theory in Video Games	Yash Goel
		3. Genome Sequencing using Graph Theory	M.S Laxman

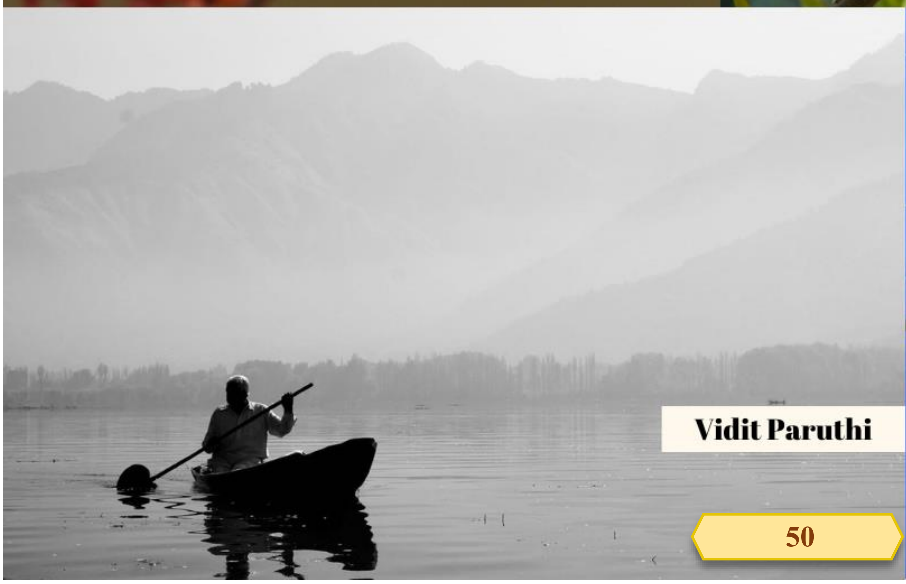
Quintessential Photography

Uditi Bajaj

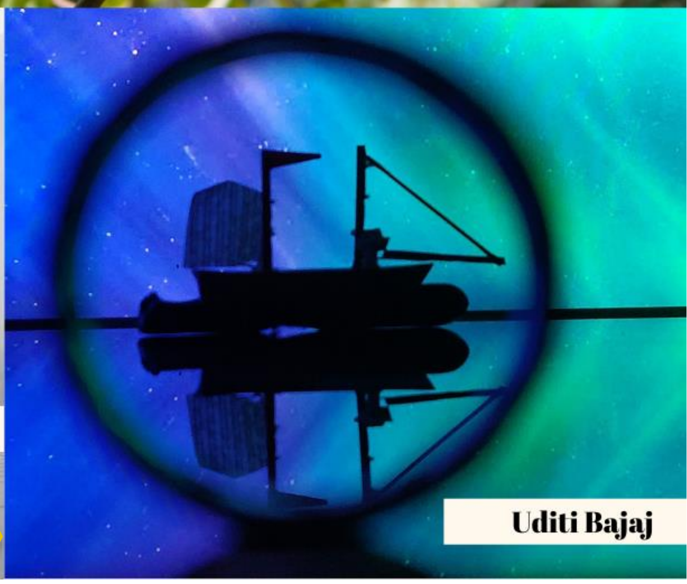
Jaskaran Singh

Jaskaran Singh

Jaskaran Singh



Vidit Paruthi

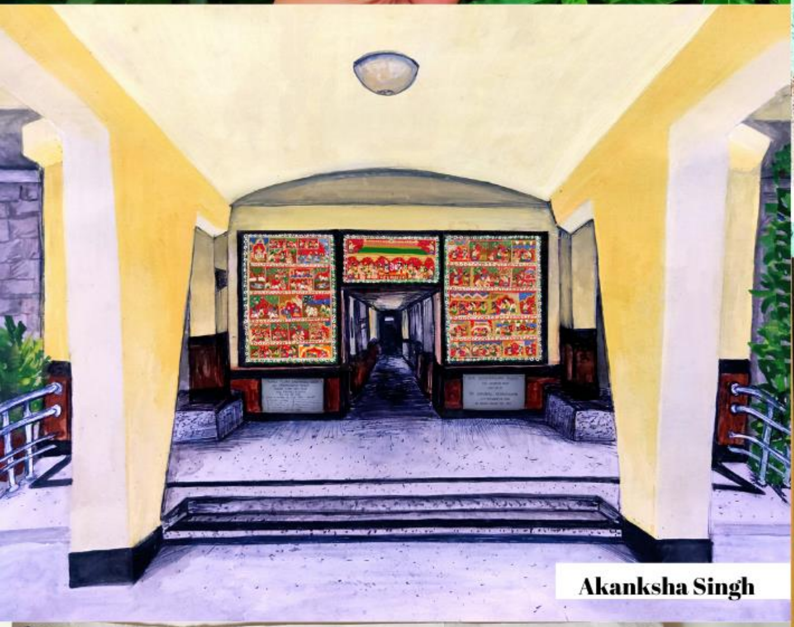


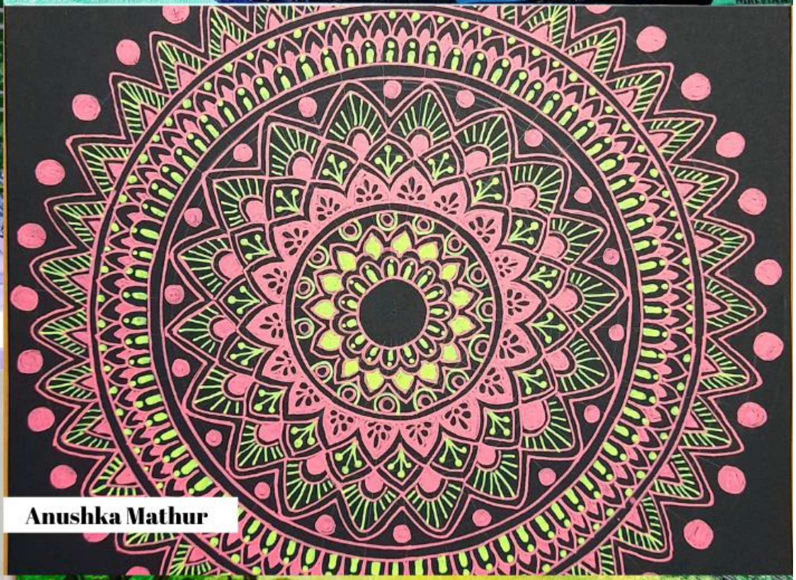
Uditi Bajaj

Avante-Garde Art

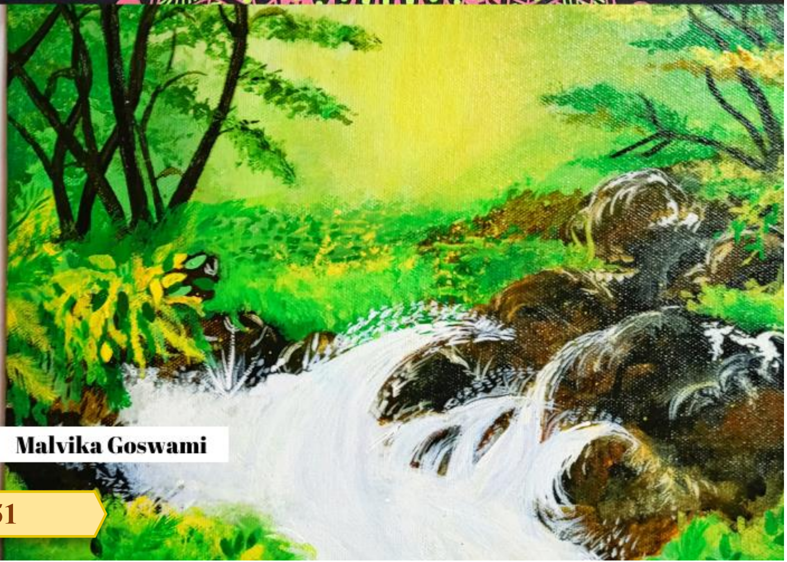
Akanksha Singh

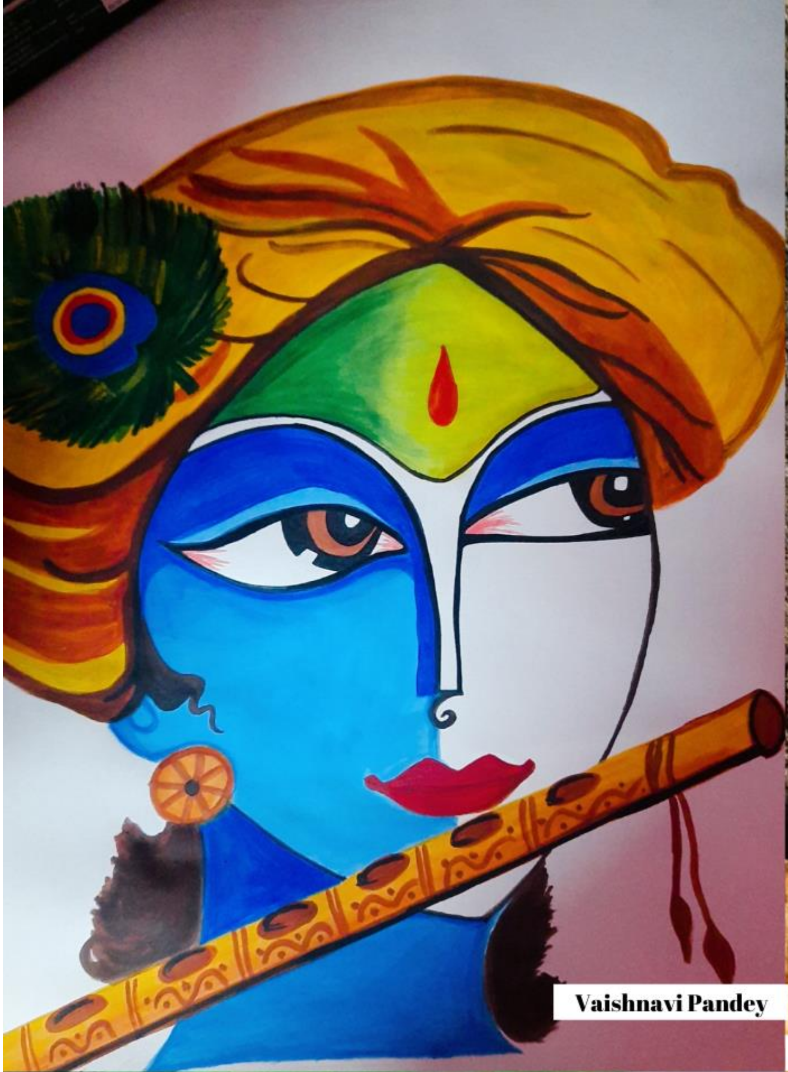

Malvika Goswami


Akanksha Singh


Anushka Mathur


Akanksha Singh


Malvika Goswami



Vaishnavi Pandey

Malvika Goswami

Rishika Panwar

Akanksha Singh

RIDDLES

1

If a hen and a half lay an egg and a half in a day and a half, how many eggs will half a dozen hens lay in half a dozen days?

2 dozen

2

I invited 10 couples to a party at my house. I asked everyone present, including my wife, how many people they shook hands with. It turns out that everyone questioned (I didn't question myself, of course) shook hands with a different number of people. If we assume that no one shook hands with his or her partner, how many people did my wife shake hands with?

In this case, my wife has shaken 10 hands, the same number as I have.

3

Tom was asked to paint the number of plates on 100 apartments which means he will have to paint numbers 1 through 100. Can you figure out the number of times he will have to paint the number 8?

20 (8, 18, 28, 38, 48, 58, 68, 78, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 98)

4

How can you add 3 with 3 and get 8?

Turn one of the threes around and put them together to make an 8.

5

You pick up a meter stick with 100 ants on it. Each ant walks 1 cm/s toward an end of the stick, and it reverses direction any time it encounters another ant. What's the longest amount of time you'd have to wait for all ants to fall off of the end of the stick?

If each ant carries a flag, and each time it meets another ant it trades flags with it, the flags will move continuously across the meter stick until it reaches the edge. Every flag falls off within 100 seconds, so every ant does too.

6

A group of students were standing in the blazing sun facing due west on a march past event. The leader shouted at them: Right turn! About turn! Left turn! At the end of these commands, in which direction are the students facing now?

East

7

What single digit appears most frequently between and including the numbers 1 and 1,000?

The digit 1
Hint: Look for a pattern!

8

My twin lives at the reverse of my house number. The difference between our house numbers ends in two. What are the lowest possible numbers of our house numbers?

The lowest possible numbers for the houses are 19 and 91. The difference is 72.

Will anyone notice him?

He woke up
In the middle of the night
Because he thought that,
He just heard some voice.

He was shivering
And the stars were shimmering
But none was merciful
Upon his quivering.

So he just went
Near a door mat.
Trembling all through
Cause he was feeling so blue.

He shrivelled himself up
On the crooked mat.
Cause maybe he believed
That it was tit for tat.

For he must have done,
Some kind of sin.
That's why he was suffering
With his broken limb.

And then he tried
To close his eyes
But the night was cold
And so he cried.

But no one saw his tears
Cause all were asleep.
And even if they weren't
They would've thought he's a freak.

And then came the sun
With 'no hopes' for him
Cause all of his agony
Wasn't going to be dim.

Lately he saw
That people has started to walk
So he got up
But was moved with a shock

When he was hit by a car
Barely visible due to smog.
But no one seemed to care,
Cause he was just a street dog
Just a street dog.

- SAUMYA SHARMA
II-A

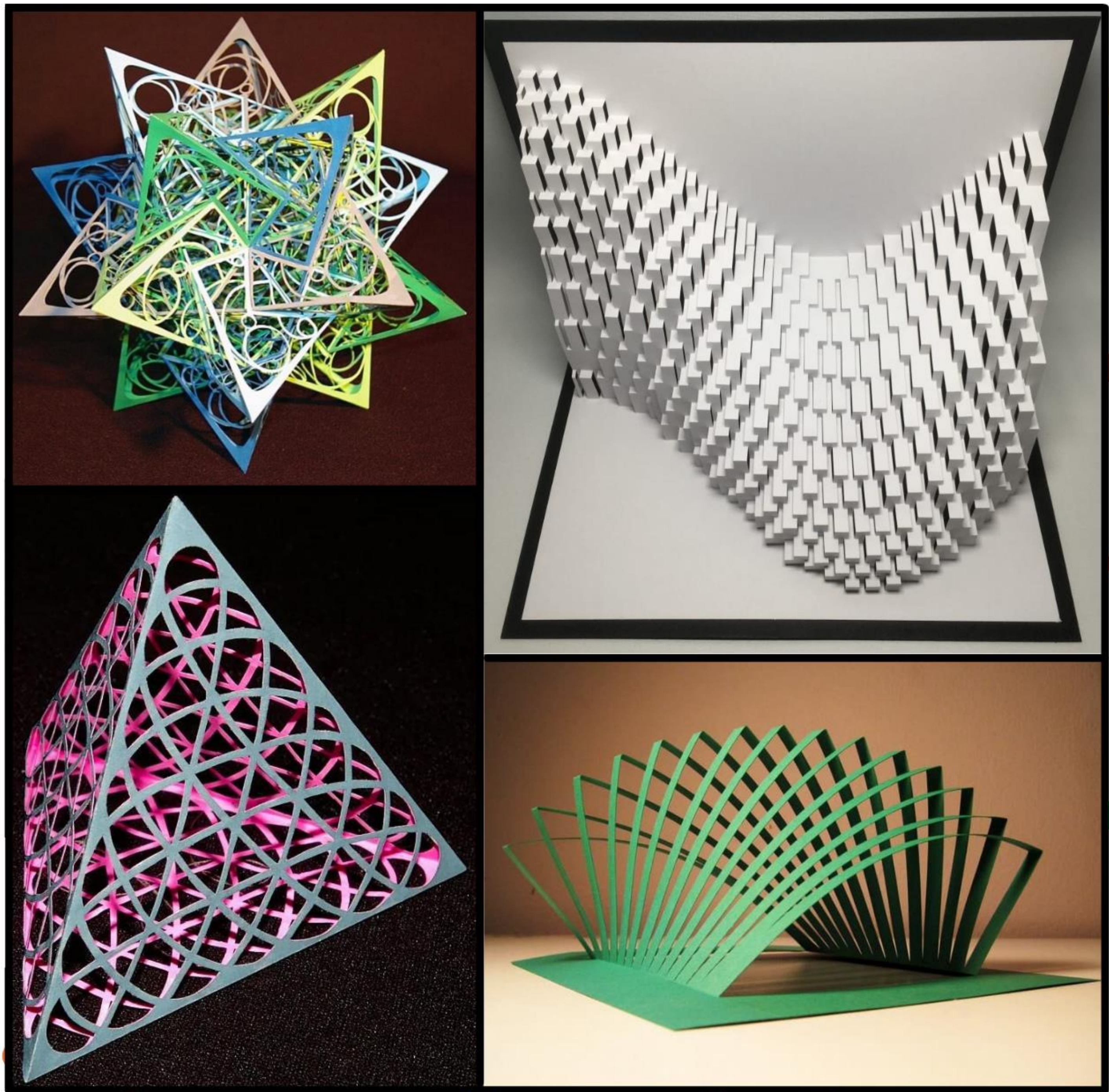
AMAZING FACT

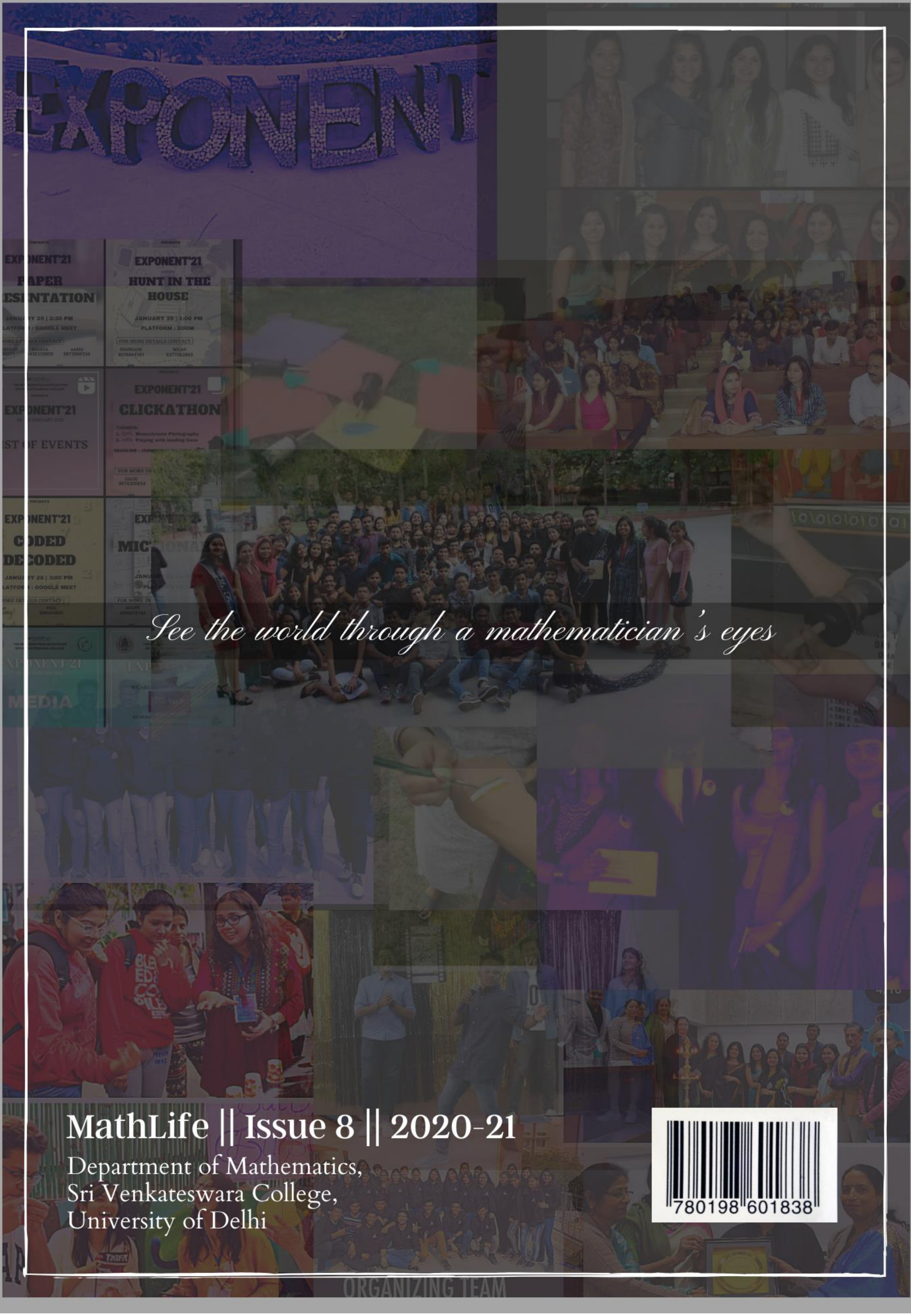
Kirigami, is a variation of origami, the Japanese art of folding paper, in which the paper is cut in addition to being folded, resulting in a three-dimensional design that stands away from the page.

In a culmination of mathematics and old Japanese decorative traditions, it has been revealed that Harvard researchers have come up with a mathematical model that creates algorithms that allows them to cut a kirigami sheet of paper in just such a way that it can be moulded into just about any 3D shape.

Applicants for Mathematics, as well as those applying for Engineering might reflect on how such a peculiar link, between the topics of art, design, and mathematical principles, might be beneficial for future innovative applications.

L. Mahadevan, the senior author on this paper believes that this research "is just the beginning of a class of new ways to engineer shape in the digital age using geometry, topology and computation."





See the world through a mathematician's eyes

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