ISSUE: MAY 2021

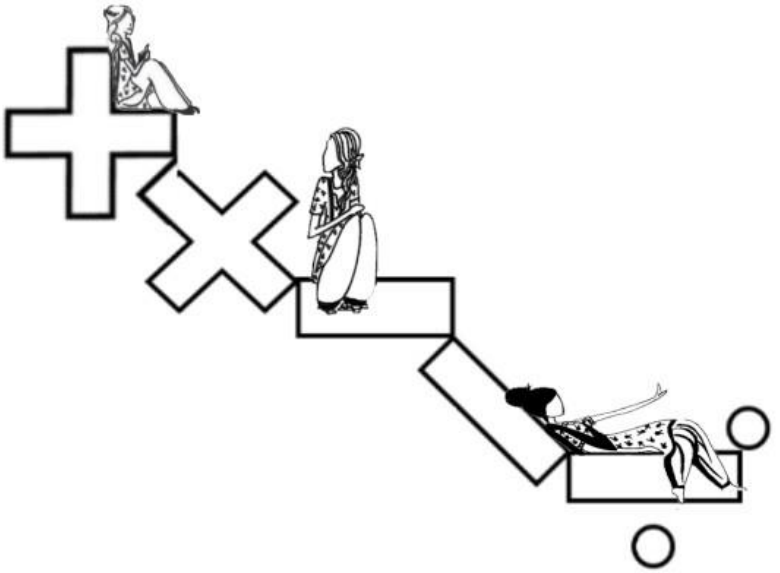
PI-RATE

WELHAM GIRLS' SCHOOL

highlight of the issue

- Geometry in Pyramids
- Shakuni's Dice
- Golden Ratio of Phi

FROM THE EDITOR'S DESK



Dear Reader,

We are delighted to present to you the first edition of Pi-rate 2021. The pandemic has resulted in a complete turn of events but it has proved to be a blessing in disguise too. We, at Welham, looked for the silver lining and were inspired to explore new opportunities. From online classes to examinations, virtual activities to competitions, everything simply moved online.

It is a common perception that Mathematics is all about formulas but in reality it is not so. It is about thinking outside the box and applying creativity through concepts. Math is an important tool to understand the world and much can be determined using various applications of math. Statistics and Probability have enabled the development of speech recognition systems and they also explain the need for social distancing! Geometry explains the science behind architecture in the world. In short, everything in the world is interconnected and in order to understand the relationship, math plays a very essential medium.

This edition of Pi-rate uncovers the mysteries behind the dice game in Mahabharata, the design of The Great Pyramid, how math is used in the colour theorem and the pattern made by prime numbers, among other exciting topics!

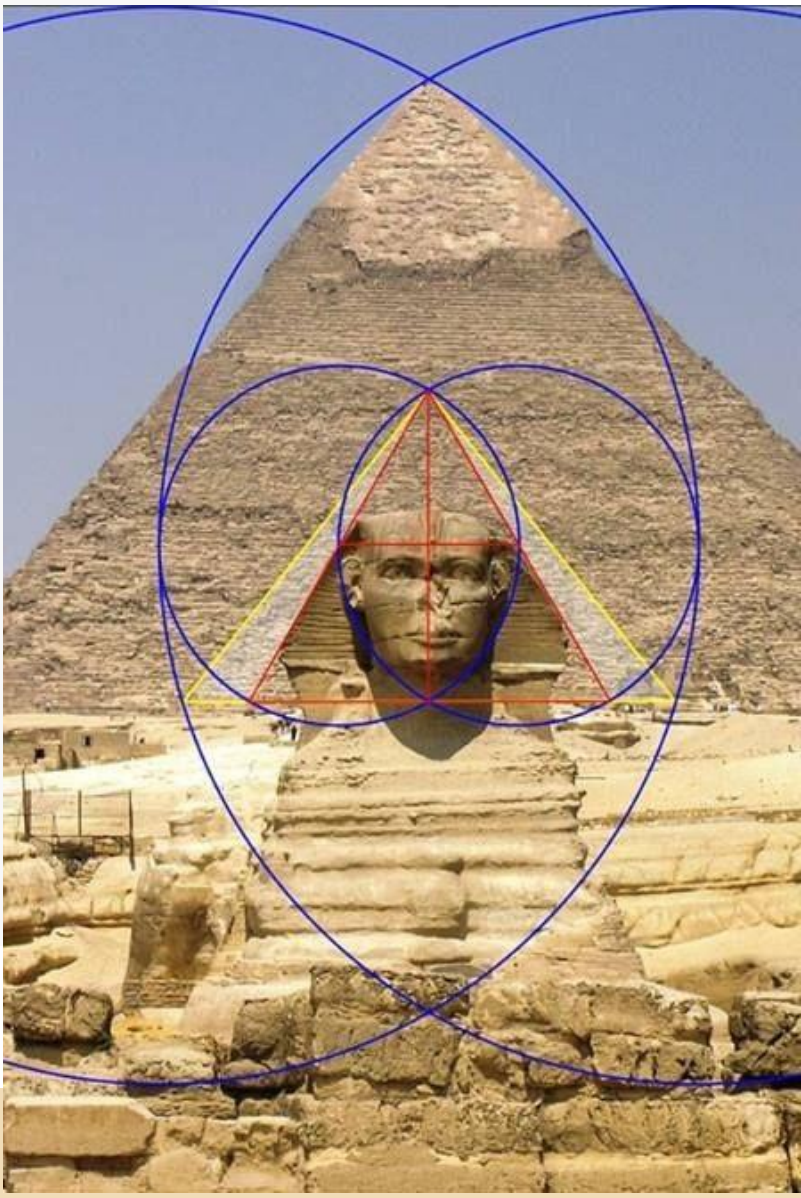
I hope this issue contributes to changing the notion about mathematics, a subject I am passionate about. It would have been impossible to compile the issue without the editorial team and our teacher, Mr. Vishal Rawat.

Stay Safe and Happy Reading!

Jiya Gupta
Editor-in-chief

GEOMETRY IN PYRAMIDS

BY DIYA DHYANI



In geometry, there are a few essential constants such as the π, square root of 2 and Φ, or the golden ratio. Pi defines the ratio between the diameter and the circumference of a circle. The golden ratio is something frequently found in nature, including the geometry of the human body.

Understanding the geometry of the Great Pyramid provides the means of finding these crucial ratios by using some rather simple geometrical principles. Although it might be quite simple to construct a shape based on these principles at a small scale, it is an amazing feat to use these values precisely for a gigantic structure like the Giza Pyramid.

So, what are the exact measurements of The Great Pyramid? Researchers generally agree that the pyramid's slope angle, which alone is enough to define the shape of the pyramid, is between 51.82° and 51.85°.

Although there is no way of knowing the exact original proportions of the pyramid, because of the erosion that has slightly shaped it, we can make a pretty good case for 440 cubits wide and 280 cubits tall. Together, with the slope angle, these figures make a lot of sense. It is obvious that the architects designed the pyramid with a sensible geometrical plan.

With these values for the height and width, the proportions are 14/22. This is an obvious hint to the value of π because the general approximation of pi is 22/7, and 22/14 is half of that. So, the ratio between the height and width is π /2. And the slope angle with these measurements is 51.84 °.

Furthermore, the ratio between the slope length and half of the base width is the golden ratio with equal precision. All this seems to indicate that the pyramid designers intentionally wanted to include the values of π and Φ into its design.

These hidden values make the Giza Pyramid the most enigmatic structure in the world.

MAHABHARATA : HOW FAIR WERE SHAKUNI'S DICE?

In the ancient epic of Mahabharata, we're all aware of the dice game between the Kauravas and Pandavas. On one side we had Duryodhana and on the other the Pandava brothers who were represented by their elder brother Yudhishthira. The game was started by the Kaurava brothers with Shakuni on their side. It is said the game was won by deceit because Shakuni had a special dice set which Pandavas did got a chance to play with. This ultimately lead Kauravas to win everything Pandavas put on stake including their wife, Draupadi.

In this article, we will put a statistical check on Shakuni's magical dice, whether they actually obeyed his command or was it just chance that led Kauravas to win the game. We will see the probability associated with the game outcomes and how possible it was for Kauravas to win.

Let us assume the pair of dice that were used in the game had one die of [1, 3, 4, 6] and another [1, 2, 5, 6]. So if Shakuni threw the dice and predicted the number 8, it will be possible if he gets 3 on Die 1 and 5 on Die 2. Another possibility is 6 on Die
1 and 2 on Die 2. We can calculate the probability of this event keeping these numbers in mind as shown below:

The probability of getting 3 on Die 1 and 5 on Die 2 is (1/4) * (1/4) = 0.0625

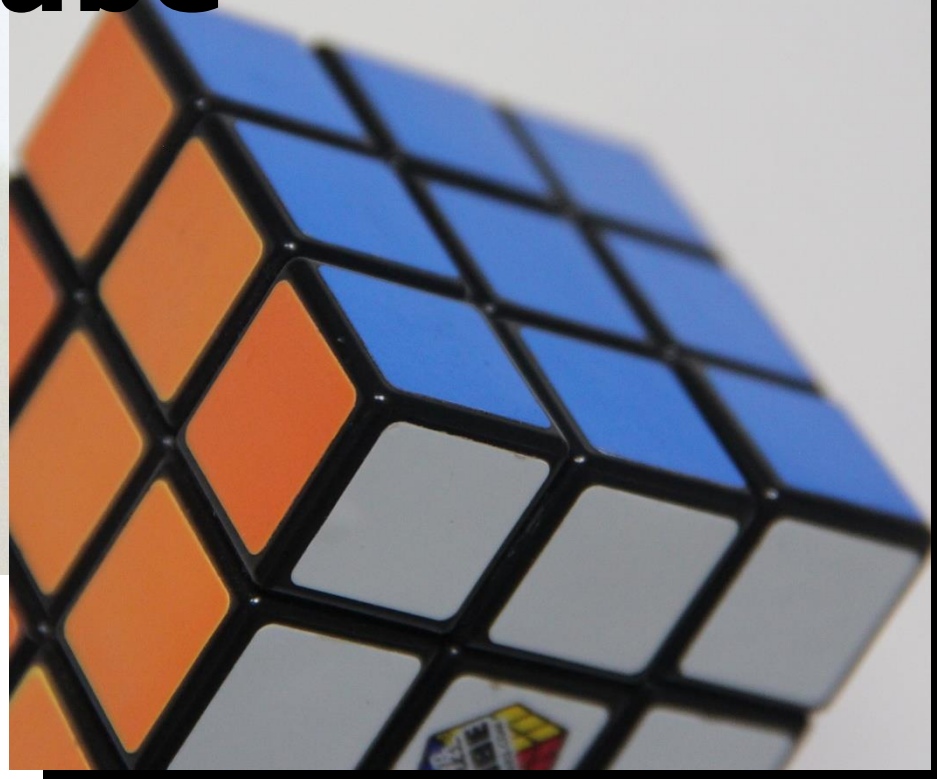
Also, the probability of getting 6 on Die 1 and 2 on Die 2 is (1/4) * (1/4) = 0.0625 Hence the probability of getting number 8 will be 0.0625 + 0.0625 = 0.125 or 12.5%

Suppose after number 8 rolls, Shakuni bets on the number 12. The probability of this event seen as separate from the first one would be 0.0625 (calculated in a similar way as that of number 8). But since these were a series of independent events (statistically speaking) the probability of getting 8 in the first throw and 12 in the 2nd would be the multiplication of two probabilities i.e. 0.125 * 0.0625 = 0.00783.

Among historians, the relation between gambling, counting, and by implication, probability theory was not known until the 14th or 15th century. So let this article leave you with thought of the mysteries behind math and its application in times when the probability theory was not even introduced!

BY JIYA GUPTA

Rubik's cube



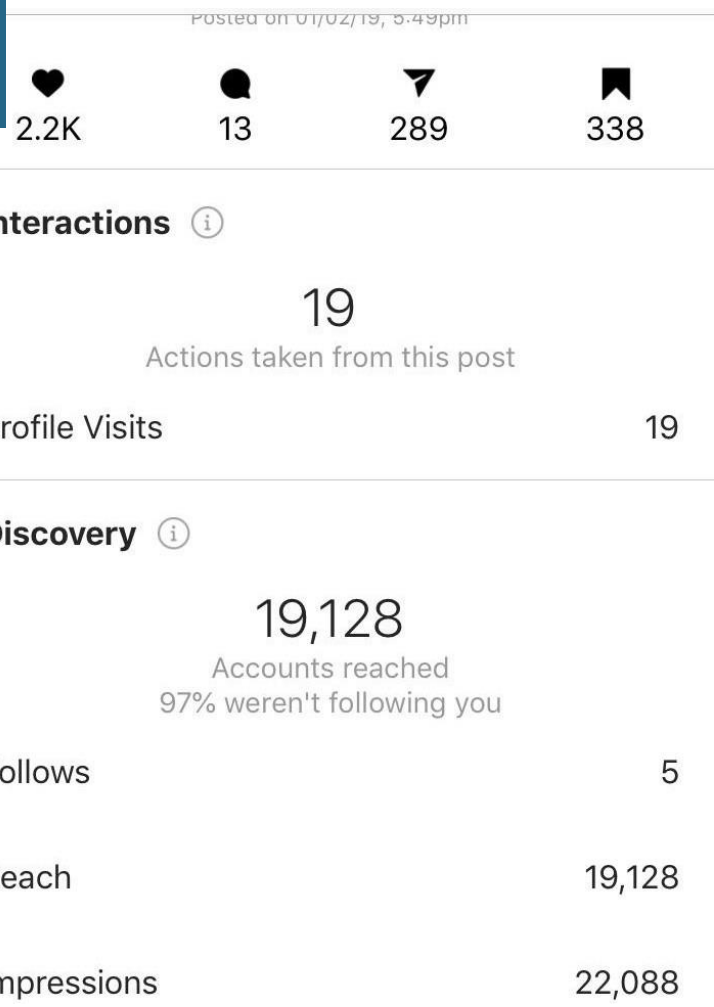
The Rubik's cube is something we've all heard of and seen- a small pocket-sized puzzle cube with six brightly-coloured faces. People use it for fun as a toy, a puzzle or even a stress reliever.
Interestingly, its discoverer, Erno Rubik initially designed it as a visual tool to teach his class about three dimensional shapes in 1974. Soon the cube became very popular with over one hundred million of them being bought in just two years and over 350 million of them bought till date.
To solve the cube you have to twist the cubes in such a way so that all sides come back to their original colours.

However, if you don't know the algorithms to solve a cube, it is very likely that you would have to go through all 43 quintillion possible colour combinations to solve it. To do this, even if you managed a different permutation every second, it would take 1.4 trillion years!

The cube also has multiple variations like a 3x3 cube, 2x2 cube, 6x6 cube, megaminx, pyraminx, etc. The Rubik's cube is a remarkable, first of its kind invention that changed the way the world perceived learning.

BY SHREYA SINGH

MATH BEHIND SOCIAL MEDIA



With the current circumstances, most of us are locked inside our homes and one of the most popular source of entertainment is social media. Surprisingly, math and social media go and hand in hand.

Some of the coolest social media apps work on algorithms .These are basically a set of rules to solve a given problem.

The goal of most algorithms is to filter higher quality information from a broader pool of information. So instead of searching the entire internet for the top 10 blogs about fashion, Technorati tries to use math to give you the list of the best blogs to comb through.

Facebook uses an algorithm called edgeRank which tells us how much interest a particular person has in a story and then it filters more stories for the same type of persons on their Facebook page. This works on three things: Affinity, Weight, and Recency. Affinity is created by the interaction between you, your friends, and the object's creator to see your likes and dislikes.

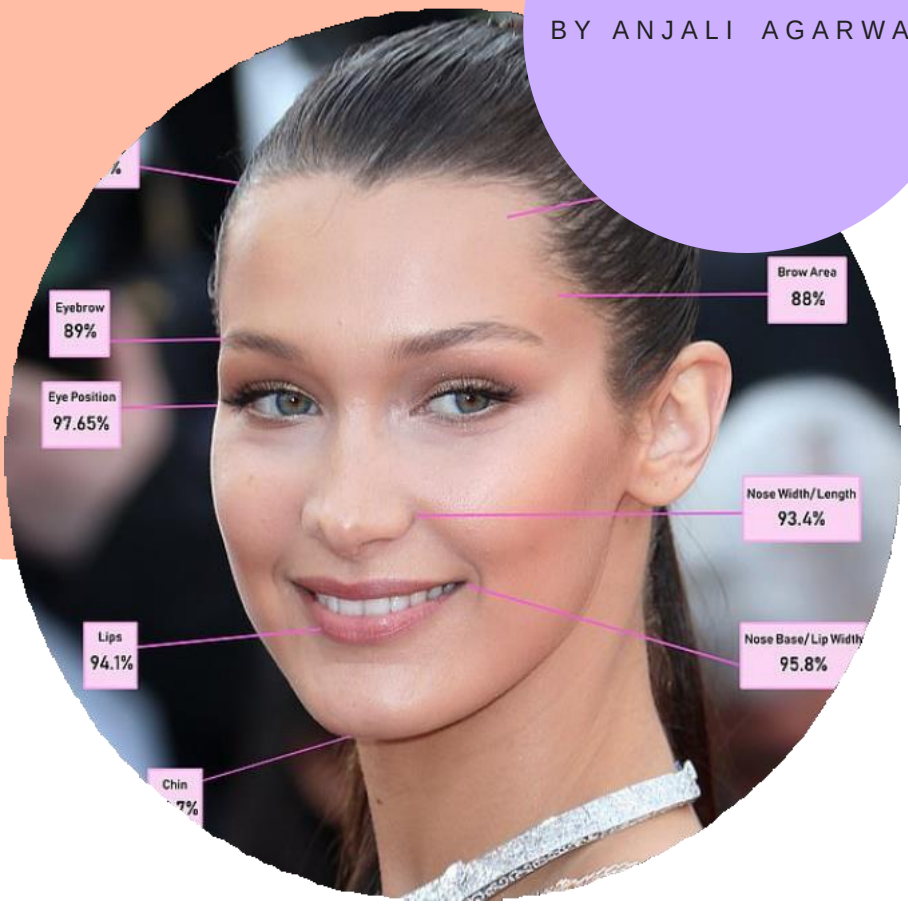
Many social media apps have promotions including Instagram and Twitter that help in marketing and improving business.

Promoted tweets are existing Twitter messages that businesses can pay Twitter to 'promote' to a larger audience for a longer time period than they would reach normally. Even Instagram has promotions both for posts and stories that depend on the number of hours they are shown for and amount that has been ranged to a type of audience and gender preferences.

BY SAAMYA MALHOTRA

The Golden Ratio of Phi

BY ANJALI AGARWAL



Although its origin remain unknown, the number 'phi' has been considered the golden ratio and actively been used since the BC era. Mathematically, two values are in golden ratio if their ratio is equal to the ratio of their sum to the larger value. It is depicted by the Greek letter '**Φ**', and its value is equal to 1+5√2 or 1.618. Why is it called the golden ratio? It is said that if any object occurs in this ratio, it will draw the eyes of the audience and is aesthetically pleasing to the viewer. You may not know this but across the globe several of the most famous monuments have been constructed on the principle of golden ratio. These include the Parthenon in Athens and the pyramids of Giza in Egypt, and the Taj Mahal. Centuries later too, Leonardo Da Vinci took inspiration from this ratio and applied it to his famous painting, the Mona Lisa. Since this ratio is derived from the Fibonacci sequence, it is also visible across nature such as in sunflowers, even pineapples and bananas.

The golden ratio of beauty is simply the mathematical proof that your face is 'perfect' in accordance with nature. It indicates that the length of your face must be 1.5 times the width in order to be beautiful. Intricacies include that the distance between your forehead and eyeline, eyeline and nose, and nose and chin must be equal, and that the length of your nose matches the length of your ear. Till date, model Bella Hadid has come closest to match these ancient Greek standards of beauty, with a 94%match.

In modern times however, such medieval methods seem to be of little consequence. In a world that is beginning to accept beauty with all its irregularities, we must realize the era of its origin to be one that constrained the concept of beauty and that there can be no mathematical equation for your beauty.

MATHMIRTH

MAGIC SQUARE

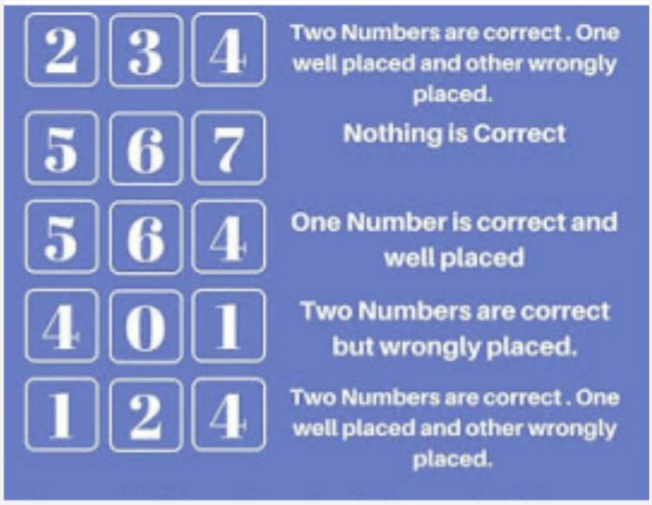
A magic square is a square grid containing numbers, arranged so that the numbers in each row, column and diagonal produce an equivalent sum. This sum is called the "magic number."

		4	
16	20		10
	12	14	
2		28	

MAGIC NUMBER= 68

CRACK THE CODE

Can you solve the code and open the lock?



RIDDLES

1. A grandmother, two mothers, and two daughters went to a baseball game together and bought one ticket each.How many tickets did they buy in total?

2. I add five to nine, and get two. The answer is correct, but how?

Solutions:

Magic Square:

26	6	4	32
16	20	22	10
24	12	14	18
2	30	28	8

Code: 314

Riddles:

1. 3 tickets (because the grandmother is also a mother and the mother is also a daughter)
2. When it is 9 AM, add 5 hours to it and you will get 2PM.

A LEGACY OF SORTS

By Shubhika Khanna

As Alan Turing joins the Hall of Fame of scientists to be featured on currency, the £50 note, (notably he is the first person belonging to the LGBTQIA+ community to do so), it only seems appropriate to reflect on his contributions to both the scientific community and war endeavour.

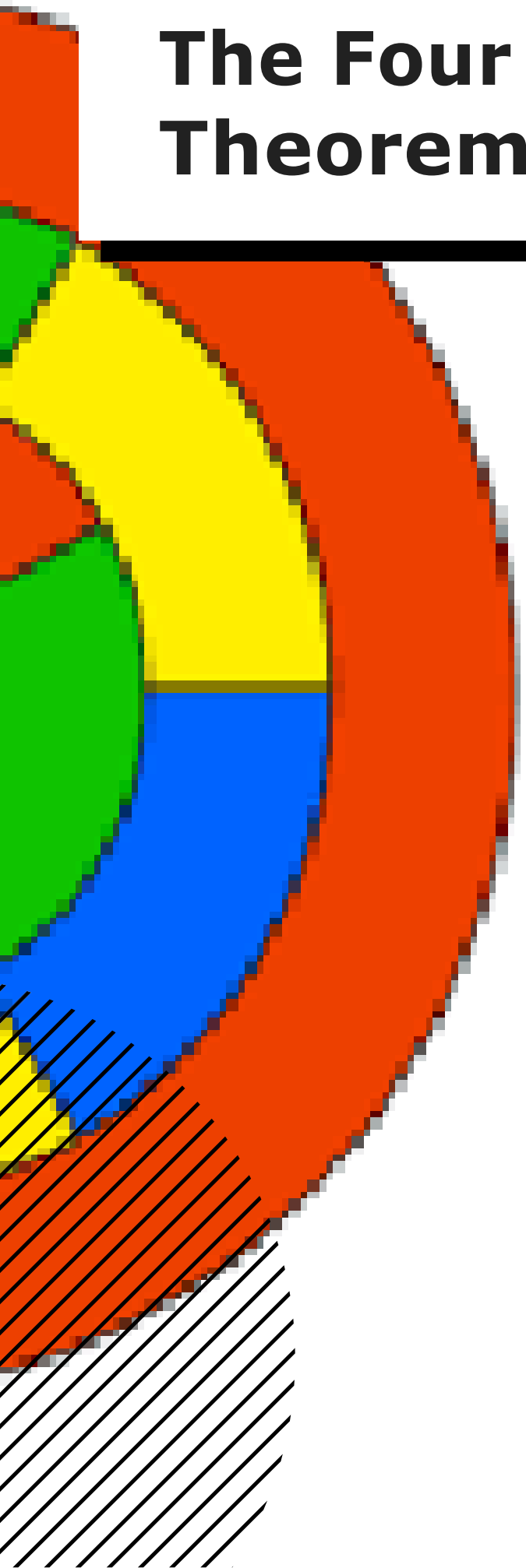
Known for cracking the enigma code - which saved approximately 2 million lives, inventing a cipher machine and theorizing about artificial intelligence, we can all agree that he was an extraordinary mathematician and cryptologist.

If you have watched 'The Imitation Game', you will know how he tragically committed suicide by ingesting cyanide when he was ordered by the court to go get chemically castrated due to the "gross indecency" of being in a homosexual relationship. He was excluded from the scientific community afterwards and only given an official pardon as recently as 2012, is perhaps a sad reflection of the biased nature of our society.

Unfortunately, Hollywood movies, in an effort to eulogize such masterminds often fail to show the more humane aspect of their personalities. Contrary to his narcissistic and detached portrayal in the movie, his friends and colleagues described him as "unfailingly generous", "thoughtful" and "kind". He used to make monopoly boards for children who couldn't afford them. Possibly, the oddest thing about him would be the stuffed bear in front of which he practised his lectures or how he chained his teamug to the radiator beside his desk to prevent it from getting stolen!

Turing was truly an inspiration and the honour bestowed on him now is a true recognition of the great man.

The Four Colour Theorem



When asked to colour a map with many regions, most people get confused and find it difficult to choose the least number of colours required to fill the distinct regions of the map. This map-colouring problem would not arise if one uses 'The Four-Color Theorem', a mathematical theorem which states that only four distinct colours are required to fill the regions of the map so that no two adjacent regions have the same colour. This theorem is famous for being simple yet incredibly hard to prove. What makes it even more remarkable is the fact that it was the first ever theorem to be proven by a computer! The Four Colour Theorem was first stated over 150 years ago, in a letter from Augustus De Morgan, the first professor of mathematics at the new University College London, to his friend William Rowan Hamilton, the famous Irish mathematician in 1852. It faced a lot of controversy and counter examples, but was finally solved in 1976 by Kenneth Appel and Wolfgang Haken after 4 years of unprecedented synthesis of computer search and theoretical reasoning. It is an outstanding example of how old ideas combine with new discoveries and techniques in different fields of mathematics to provide new approaches to a problem. This proposition looked so simple but was very difficult to prove, therefore, catching the eye of many mathematicians at that time. Beside the obvious application in cartography, the Four-Colour theorem can be applied to a number of situations. It can be used for activity scheduling, security camera placement optimization in a large building with many corners to minimize overlap, construction of a wildlife reserve (applying knowledge of food chains to see what combination of animals can live together and not completely wipe each other out), to mention a few. Be sure to use it the next time you colour a map with various regions.

BY SHAMBHAVI CHANDRA

AESTHETICS OF CALCULATIONS

"After a certain high level of technical skill is achieved, science and art tend to coalesce aesthetics, plasticity, and form. The greatest scientists are artists as well". ~Albert Einstein

Math and art are often viewed as completely different subjects. Art is associated with the right brain which is mastered by creativity and imagination while math is associated with the left brain which is ruled by analysis and practicality. People often see themselves as either 'a math person' or 'an art person' believing that they can't possibly be both. Math can also be creative; art can also be analytical, and both can influence our imagination!

Many core skills of art and math are closely inter-related as spatial reasoning skills and the ability to recognize patterns is a requisite for both the disciplines. Proportion and symmetry are used by most mathematicians and artists. There is always a hidden mathematical logic even behind the most abstract piece of art. Many educators have even shifted their focus from STEM to STEAM.

Leonardo da Vinci, a great painter and mathematician has used the concept of The Golden Ratio also known as Divine Proportion in his famous painting, the Mona Lisa which led to aesthetic results. Pablo Picasso has been found to use regular and irregular polygons in his work to depict people or scenes. M.C. Escher created mathematically-challenging artwork by producing polytypes which were a combination of two and three-dimensional images into a single print. They looked possible by perception but cannot be constructed in the real world as they were mathematically impossible.

BY ANVI MITTAL

RECOMMENDATIONS

Travelling Salesman is an intellectual thriller film about four mathematicians solving the P versus NP problem, one of the most challenging mathematical problems in history. The title refers to the Travelling salesman problem, an optimization problem that acts like a key to solving other mathematical problems that are thought to be hard. It has been proven that a quick travelling salesman algorithm, if one exists, could be converted into quick algorithms for many other difficult tasks, such as factoring large numbers.

The Wild Numbers is a mathematical fiction in the form of a short novel by Philibert Schogt, a Dutch philosopher and mathematician. It was first published in Dutch in 1998 and an English translation appeared in 2000.Through this book, the author is trying to provide insights to the workings of a mathematics-obsessed mind. It is the story of a mathematics professor who believes he has solved one of the great problems of mathematics- Beauregard's Wild Number Problem. In the imaginary settings of the novel, the problem is presented as a real mathematical problem seeking a solution and not as a delusion of the protagonist. But in the real mathematical world, there is no such problem; it is a fictitious problem created by the author of the book.

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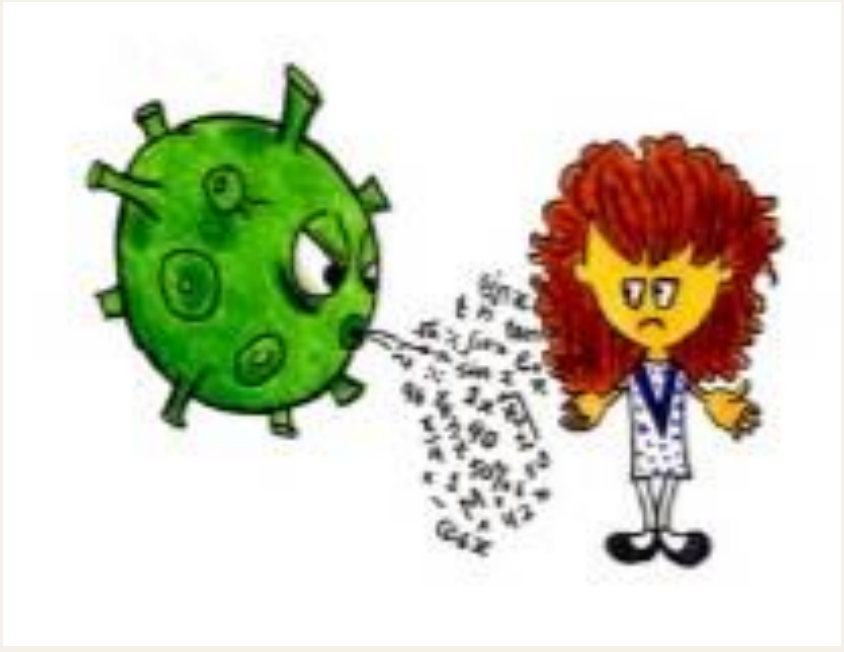

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