PHI

Seed the Curiosity

November 2015 - Vol 1 Issue 1

CHRIST UNIVERSITY
BENGALURU, INDIA
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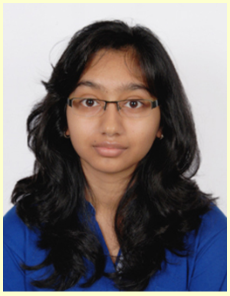
Department of Mathematics

FROM THE HOD'S DESK

According to Charles Caleb Colton, “The study of mathematics, like the Nile, begins in minuteness but ends in magnificence.” The magnificent subject has enthralled many people and has been the focus of many scientific research outcomes. The Department of Mathematics of Christ University has grown in magnitude and in research. The Post graduate course was started in the year 2005 and now consists of 80 Students in M.Sc., 18 in M.Phil and 13 faculty members including a few professor emeritus. The annual intercollegiate mathematics PG fest will see the unveiling of the magazine PHI, aiming to sow the seeds of curiosity. Over the years mathematicians have been doing the same, by exploring the unexplored-results, theories, proofs, puzzles, conjectures so on and so forth. The magazine is a showcase for students to display their prowess in the subject as well as deal to give vent to their creative side. The inaugural edition, painstakingly put together is indeed, another feather in the cap for the department. Paying tribute to great minds who have contributed their lives for the development of mankind through mathematics.

I congratulate the team and wish them the very best.

MESSAGE FROM THE EDITORS



"Mathematics seems to endow one with something like a new sense."

–Darwin, Charles"

The Da Vinci Code, a bestselling thriller by Dan Brown, would probably be most responsible for popularizing the golden ratio, mathematically denoted by the Greek letter Phi. A number appreciated as early as 490 BC, earns its lofty name due to its aesthetical value: its unobtrusive and pervading presence is seen in architecture, paintings, music and nature. Like the ubiquitous Phi, mathematics, the queen of sciences, is omnipresent, revealing itself only to the attentive observer. It is on this note that we have christened the mathematics magazine with the unassuming yet powerful name, Phi.

Our very first issue begins with an interview with an illustrious mathematics professor, Prof. C S Aravinda where he relates his thoughts about and experiences with the subject he loves. What is probably most refreshing in this issue is the attempt that young students have made to understand mathematics and how it relates to the philosophy of life. Humorous poems, tricky puzzles, entertaining stories, all from the minds of mathematics students, dot these pages, accompanied by inspiring quotes from renowned figures.

We hope that the creativity and thoughtful contemplation of mathematics contained in all our issues of this magazine is as unending as the digits of Phi.

The editors of Phi are N Soujanya, Arpitha Prasad and Ujwal P Raj from M.Sc. Mathematics along with Dr. S Pranesh, Coordinator, Department of Mathematics. Soujanya, studying in first year, has energetically worked on compiling this magazine. Arpitha, a second year student, has industriously edited, while Ujwal, also a second year student, has tirelessly designed this magazine. Dr. Pranesh has constantly guided this endeavour and paved the way for its completion.

DETERMINING THE DETERMINANT OF A 3 X3 MATRIX

Fr. Joseph Varghese, Associate Professor, Department of Mathematics

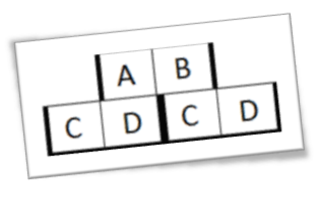
Introduction

Determinant is a unique value representing a square matrix. It is useful in determining the inverse of a matrix. The determinant of a 1x1matrix is the entry in the matrix itself whereas in the case of a 2x2 matrix, it is the upper left into lower right minus the upper right into the lower left. The determinant thus obtained is called the minor of the 2x2 matrix. Conventionally, the determinant of a higher order matrix is calculated by a recursive method with the help of the minors. Let us now see a method of rotations to find the determinant.

Let us consider the 2x2 matrix given below. Its determinant as per the rule given above is AD-BC.

A	B
C	D

However, look at the diagram given below. It can be explained as follows.



Rotation Method

Rotate left the second row to one position and then multiply the entries in the respective columns. Subtract the second column product from that of the first. This process can be extended into higher orders also. This is done by carefully completing all the rotations depending on the number of rows. Let us see the case of a 3x3 matrix.

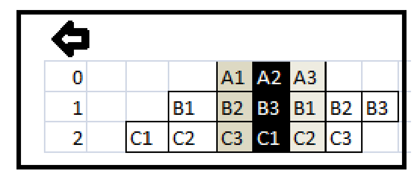
A1	A2	A3
B1	B2	B3
C1	C2	C3

At first, rotate left the second row to one position and third row to two positions. The matrix thus obtained is given on the right.

Multiply the values in each column separately and then add the three products. Thus we get

A= (A1.B2.C3)+(A2.B3.C1)

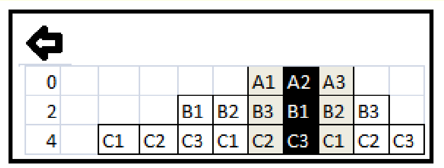
+(A3.B1.C2).



Now we rotate left the second row to one more position and the third row to two more positions. The matrix thus obtained is as follows.

Multiply the values in each column separately and then add the three products. Thus we get B=(A1.B3.C2)+(A2.B1.C3)

+(A3.B2.C1).



The determinant of the 3x3 matrix is then

A-B=(A1.B2.C3+A2.B3.C1

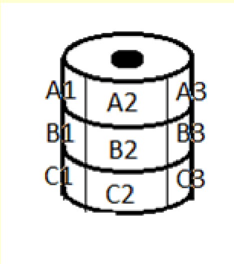
+A3.B1.C2) -

(A1.B3.C2+A2.B1.C3

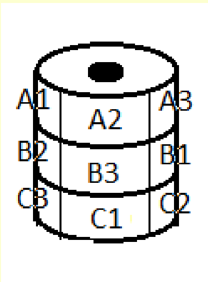
+A3.B2.C1).

Cylindrical Rotation Method

This process is better understood if we can represent the matrix cylindrically. Consider a cylinder that has three horizontal sections which can be rotated freely with respect to a central vertical axis. Entries in the matrix are given on the exterior of the cylinder.



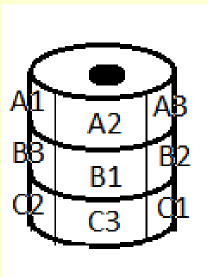
After the first set of two types of left rotations, the cylinder looks like what is below.



Multiplying the entries in the columns separately we get $A=(A1.B2.C3)+(A2.B3.C1)$

$+(A3.B1.C2)$.

After the second set of two types of left rotations, the cylinder looks like what is below.



Multiplying the entries in the columns separately we get

$B=(A1.B3.C2)+(A2.B1.C3)$

$+(A3.B2.C1)$.

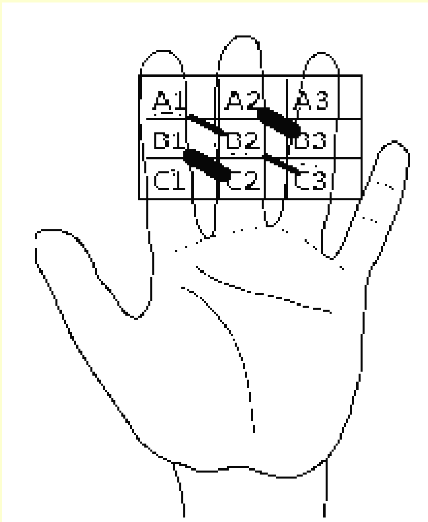
The determinant of the 3x3 matrix is then

$A-B=(A1.B2.C3+A2.B3.C1$
$+A3.B1.C2)-(A1.B3.C2$

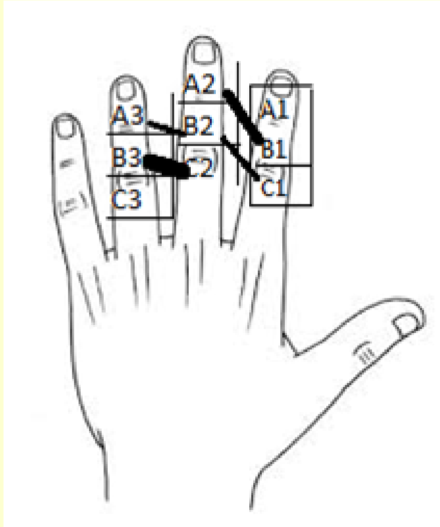
$+A2.B1.C3+A3.B2.C1)$.

Palm Method

This can be visualized in yet another way also. Let us use the three central fingers on the left palm to represent a 3x3 matrix.



Instead of the first set of rotations, multiply the entries from left as indicated by the dark lines, starting from the diagonal to get the value A. To get the value B, we can multiply the entries from right starting from the antidiagonal. This can be done also by turning the palm and then multiplying the entries from left as given below from the diagonal.



Conclusion

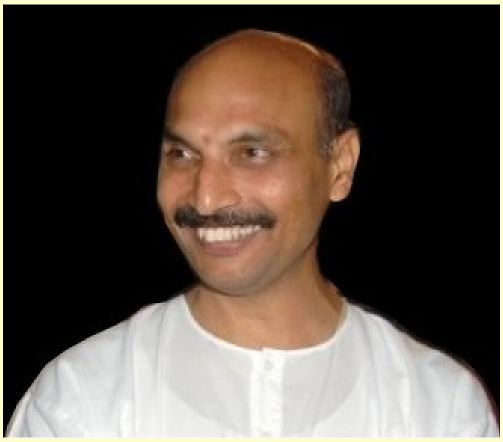
An advantage of the above mentioned process is the elimination of the repeated use of plus(+) and minus(–) which are sometimes disturbing for beginners and non-Mathematics students.

ON PRIMES

Prof. B. D. Acharya

Prime is an integer and pi is irrational,
Still, O, the beholder, they are connected!
Twenty two by seven, seven being a prime,
Is a wild but ancient approximation to pi.
'Wild'! Could there chaos safely hide?
Mathematicians have been pondering!!
Srinivasa Ramanujan, Wizard of India,
Fiendishly worked on both primes and pi.
The irrational pi and the exponential 'e',
Are closest allies as mathematicians know.
Seven dividing twenty two and similar
Approximations to pi have raked up primes!
Your pondering about the roles of these fiends,
In Astrophysics and Cosmology alike,
Have given little lessons to mathematics
On primes, pi or on the eccentricity of 'e'!
'Phireka'
(Hindi expression for 'Unity in Diversity'?!)

PROF. C S ARAVINDA: "MATHEMATICS IS NOT JUST ABOUT NUMBERS"



Prof. C S Aravinda

Interviewed by Ravikiran P and N Soujanya

It was an immense pleasure to interview an eminent mathematician Prof. C. S. Aravinda, Associate Professor at TIFR-CAM, Bengaluru. His distinguished research in mathematics, his down-to-earth nature and friendly approach towards students would certainly make him a role model for those who dream big in mathematics. He has held long term visiting faculty positions at ICTP, Trieste, Italy and SUNY at Binghamton, USA. His areas of interests, broadly, being Reimannian geometry, Ergodic theory and Topology, his particular area of research is manifolds of non-positive curvature, its geometric, dynamic and topologic aspects. He has written several research articles and expository articles in his area of research.

We owe him our gratitude for sharing his experiences amidst his busy schedule. His inspiring words would ignite mathematical minds.

What are some of your earliest memories of Mathematics?

Well, solving a simple puzzle in the Kannada weekly magazine '*Sudha*' when I was in class 6 is one of my earliest memories. The puzzle went like this: There are two groups of birds on a tree, one less in number than the other. The group lesser in number says to the other, "If you send one bird to our group, we'll be equal", while the other group says, "Well, if you send one bird to our group we'll be twice your number". I had found the answer and was very happy. Not only mathematics, but Sanskrit, English and Kannada literature also excited me a lot. Moreover, I loved going to school and college, the pressures to score well were perhaps less back then.

What experiences and people were influential on your mathematics education?

The first time I enjoyed doing mathematics was when I was in class 6. Perhaps, I did not study things from exam point of view. Or probably I wasn't good at answering questions the way it's asked in the class. Scoring 38/100 in mathematics in class 9 shook me.

It made me focus and score well in the SSLC public exam. A score of 88 was a good score then.

My teachers have been quite influential too. I started looking at mathematics seriously during my B.Sc. (PME). Though I was interested in physics, I scored well in maths. I got a seat in Bangalore University for M.Sc. Mathematics and a week later for M.Sc. Physics too. But a week of mathematics classes, especially Analysis, made me continue in mathematics. I have no regrets at all and I am glad to be a mathematician.

Could you comment on mathematics education in India and some other countries?

In terms of talent and potential, I think that we are as good as the best in other countries. Since India is thought of as a developing country, our society has always thought of education as a means for getting secure jobs. As a result, focus on academics by itself has taken a back seat and this attitude may have seeped into teaching. Of course, working is equally important but there has to be a balance. Another big failing of ours could be in not keeping ourselves updated about latest advances in the subject and upgrading our syllabus with time.

What attracted you to the particular problems you have studied?

It was in M.Sc. that I got hooked to mathematics. When I started looking back, I could see the seeds of it which I never realized then. In the 1st year since we didn't study much of Topology, I really liked Algebra. In the 2nd year, I chose to take Riemannian Geometry and Lie Groups as my electives. My teachers used good books. I'm really fond of my teachers Nirmala Agashe who taught Riemannian Geometry and K. E. Bakeshaswamy who taught Lie Groups. I was attracted to Measure Theory as well. When I went to TIFR, Mumbai it was really difficult in the beginning but my thesis advisor, S. G. Dani was very patient and helped me a lot. While working on the thesis problem, I got interested the area of negative curvature. Geometry and Topology have an advantage since they have a visual appeal. In India, the mind-set of a layman and school or college teachers alike,that mathematics is just about numbers, should change.

Can you describe your research in accessible terms? Does it have applications in other areas?

Abstract mathematics is not really easy relate directly to real life applications. As people say, mathematics is also an art. Unfortunately, unlike standard art forms like painting or music, it takes another practicing mathematician to fully appreciate this art. To convey some feel of what I do, I am interested in what is known as geodesic flow. Locally, geodesics are distance minimizing paths. If we want to travel from here to Chicago in a straight line, we can't go inside the earth. So we have to travel on the surface or fly close to the surface. Thus we look at Geodesics on the surface of the earth which are great circles. If you look at venation patterns in leaves and flowers, these veins basically transport water and carbohydrates through the xylem and phloem. I'm learning a bit of biology (laughs)! The efficient path for transportation has to be a geodesic and my contention is that it is the hyperbolic geometry or the geometry of negative curvature that may be relevant here. Non-Euclidean Geometry, or hyperbolic geometry arose out of an abstract thought process when looking for a geometry in which Euclid's parallel postulate did not hold. It took over 2000 years to axiomatically put the Non-Euclidean Geometry on a firm ground. In order to convey some excitement of our profession, couple of years back, we organized an exhibition at VITM called '*Mathematics of the Planet Earth*'. We had exhibits on tiling, networks and so on. They can all be related to daily life. Though you do research motivated by the intrinsic beauty of the problem or address it in an abstract setting, it's also important to see its reflection into the real life. The only thing you need to do is to 'observe' things around you.

Though you do research motivated by the intrinsic beauty of the problem or address it in an abstract setting, it's also important to see its reflection into the real life. The only thing you need to do is to 'observe' things around you.

As a Bangalorean, what comes to your mind when I say Bangalore and mathematics?

First thing that comes to my mind is National College, Basavanagudi where I studied PUC. There was Bangalore Science Forum, where we really heard accomplished scientists talking about their work. The second memory is from Central College where I did M.Sc. My teachers were wonderful. In Bangalore, the awareness towards maths is much better now. Earlier, serious research was done only at IISc; TIFR Centre was located inside the IISc campus back then but moved to its present location in Yalahanka New Town 8 years ago where the best research on differential equations is done. The Bangalore Centre of the Indian Statistical Institute has also come up in a big way during the past 25 years. But the gap between research institutes and universities continues to exist and perhaps may have even widened further.

What do you find most rewarding or productive?

Solving a problem or being able to answer a question satisfactorily is one such thing for me. Solving exercises, in general, is an important component of research pursuit. While doing research asking the right question gives me lot of happiness. For instance giving PhD students viable questions is important, not a hard question though. Thinking of questions which are more tractable is important.

What advice would you give to those who would like to know more about Mathematics?

Instead of talking about mathematics straight away, what I normally do is, ask what they are interested in, and then see where mathematics can enter. Start from what they like, what they can do and what they aren't afraid of. Show them the beauty of mathematics first. Whatever you do, enjoy doing it. If you want a career in mathematics as a researcher, it is a frustrating experience. Because you are always stuck with questions and no answers. But if you are prepared to really endure those moments and have belief in yourself, then that won't be a frustration anymore but could lead to an experience of pure joy.

"In mathematics the art of proposing a question must be held of higher value than solving it."

— Anonymous

WHAT IS MATHEMATICS ?

Bharath Hegde

"MATHEMATICS"! When you hear this word what comes to mind? Numbers, geometrical figures, tonnes of formulae. For number theorists, mathematics is the beauty of Hemachandra numbers (aka Fibonacci numbers) that the nature follows, for musicians it is the permutations and combinations of notes and chords to make a heart melting melody, for physicists it is the multivariant calculus that is essential to unravel the mysteries of the universe, for computer programmers it is the mathematical logic and binary system that all sorts of computers follow and for students it is merely a burden.

Mathematics plays different roles in lives of different people. From easy-peasy binary operations to complex hard-core differential geometry, everything is an excruciatingly important aspect of mathematics. And yet at the end of the day a wise man would ask, "What *is* mathematics?"

Mathematics as an expression of the human mind reflecting the active will, the contemplative reason and the desire for aesthetic perfection. It's basic elements are logic and intuition, analysis and construction, generality and individuality. Though different traditions may emphasize different aspects, it is only the interplay of these antithetic forces and the struggle for their synthesis that constitute the life, usefulness and supreme value of mathematical science. When Einstein tried to reduce the notion of "simultaneous events occurring at different places" to observable phenomena, when he unmasked as a metaphysical prejudice the belief that this concept must have a scientific meaning in itself, he had found the key to his theory of relativity. When Niels Bohr and his pupils analysed the fact that any physical observation must be accompanied by an effect of the observing instrument on the observed object, mathematics was there with them.

For more than two thousand years some familiarity with mathematics has been regarded as an indispensable part of the intellectual equipment of every cultured person. Today the traditional place of mathematics in education is in grave danger. Mathematics is like a seed in its dormant state. Sleeping in peace it awaits its explorers. The goal is genuine comprehension of mathematics as an organic whole and as a basis for scientific thinking and acting.

Image courtesy: Google images

"I'll tell you once, and I'll tell you again. There's always a prime between n and 2n."

— Paul Erdős

CROSSWORD

Arpitha Prasad

There is a town called Polygoot (weird name, I know) where the residents have formed various committees. The weather conditions and toplogy of Polygoot are so pleasing and refreshing that every committee is open minded and the members get along well with one another. Fly to Polygoot for free (in your mind) and get to know the town, its committees, residents and language to solve the crossword.

ACROSS

1. A section of Polygoot is ______ if every popular person (see clue 2 down) is a resident of that section.

4. This mathematician helped plan the town of Polygoot. He insisted that privacy was important and made sure every person had his own private neighbourhood.

5. A section of Polygoot is ______ if every popular person (see clue 2 down) is a resident of that section and if every resident of that section is popular.

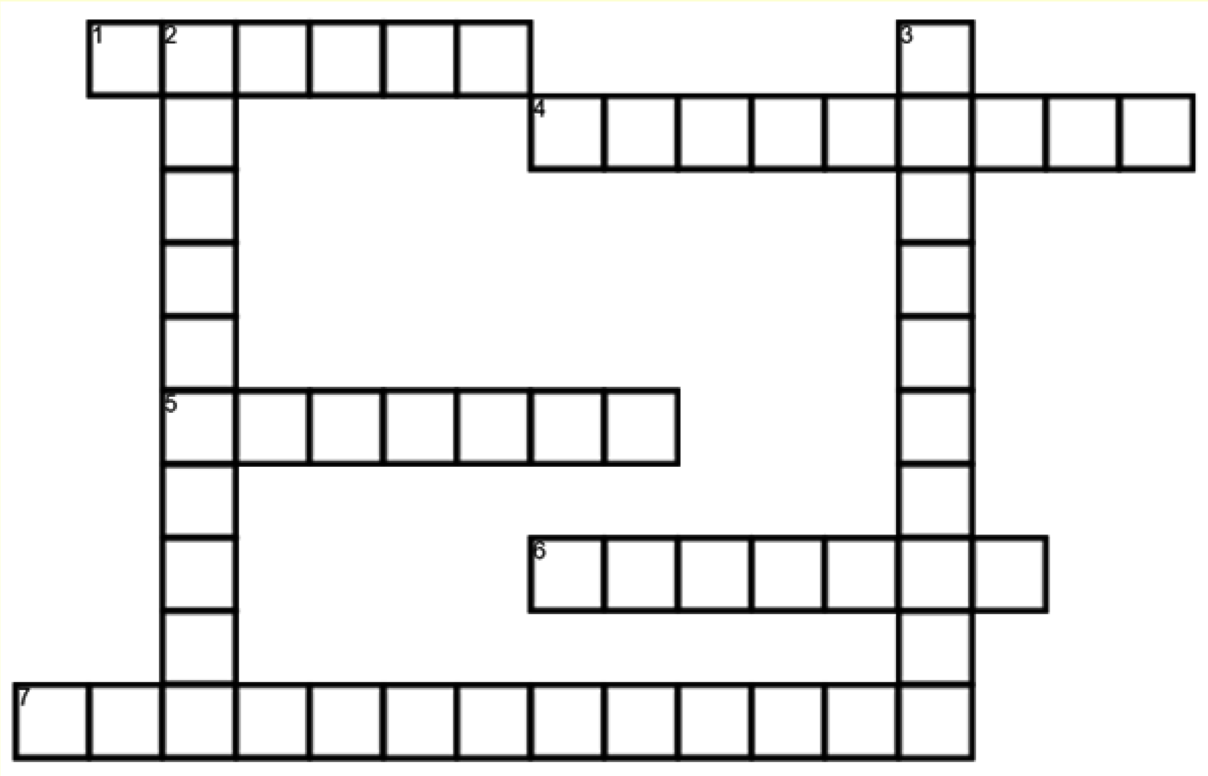
6. A section of Polygoot is ______ if the distance between any two residents is under a certain fixed number of kilometers.

7. This person is an _____ _____ of a section of Polygoot if he/she is in some community and all the members of that community are residents of that section.

DOWN

2. This person is so popular in a certain section of Polygoot that he has a friend in any neighbourhood of the town.

3. The ______ of a section of Polygoot is the rest of Polygoot.



LIFE, IN THE LINES OF REAL ANALYSIS

N Soujanya

Have you ever wondered about the integrity of mathematics with every creation of God..? Well, it's beyond our imagination. It's trivial that mathematics integrates with human beings too. No doubt!

The set of all human beings forms a 'countable set'. The life of each person is a 'sequence' of numerous events, as long as the person is a member of that set. This magnificent sequence called life is 'bounded' having birth and death as 'lower limit' and 'upper limit' respectively. Each step we take in life leads us from nothingness to non-emptiness. However, there might not be a royal road to reach heights. We encounter hardships as well as pleasant moments in our journey. This very well implies that life is not 'monotonic'. It's quite natural that sometimes it's monotonically increasing and at times decreasing. Let not the obstacle overtake the confidence. Never sit back and make the sequence 'discontinuous'. Cheer up! Give the best at each moment. May "success" be the 'point of convergence'. In the 'neighbourhood' of success, prevails passion, zeal, maturity, intellect, quest to achieve more and above all, the million-dollar word: "Happiness". This was a small glimpse of real-analysis in real-life. However, the spirit of real analysis remains eternal.

PAIN OF MATHEMAGICIANS

Priyanka Pandey

Mathematics was fun till the time,

theorems didn't come,

So there goes my poem.

Numbers with theory seems mild,

Which makes our mind go wild.

Story of statistics is fun,

Only if you know what will be the sum.

Conic section is a part of geometry,

But we never knew we would have differential geometry.

Joining lines was just a design,

Till graph theory came to our mind.

If you are happy by mastering real analysis,

Wait! You still have to learn complex analysis.

Measuring area of triangle was easy,

Measure theory will further make you go crazy.

Atleast algebra was bit humble,

But doing linear and abstract makes us fumble.

Stories in maths are uncountable containing problems,

Terminates with finding solution, chained with still many more problems.


Image courtesy: Google images

THE MATHEMATICS THAT AN ICE-CREAM LED TO

Arpitha Prasad

“Hermione, would you like an ice cream?” asked Ron, holding out a Belgium dark chocolate ice cream cone, while beginning to guzzle on one himself. Hermione Granger, looking off into space, answered rather dreamily, “Yes Ron, I would like 0.9999999... ice cream”.

Ron looked confused. He looked at Harry and said, “Er, what?” Harry looked up from his homework, peered at Hermione and said, “Are you ok Hermione?” Hermione snapped back to earth, her face shining with excitement, “Yes! Don’t you see? 0.99999..., that is to say 9 repeated infinite times, is *equal* to 1!”

Ron sat down between them, two ice creams in hand, and demanded to know what was going on. “Well Ron,” said Hermione, “I rather doubt you might understand this. You might not have studied elementary math coming from a wizarding family. We covered this in my Muggle Studies class. We were doing some simple things on decimals and I thought I’d do some extra reading, and I found out that 0.99999... is actually equal to 1! It’s *not* an approximation as most people think, but it’s actually *equal*!”Harry said slowly, “Yeah, I remember reading about terminating and non terminating decimals some long time back, and also my cousin Dudley was struggling to understand something of this sort. What’s this about?”

“Well, you know how recurring decimals can always be written as rational numbers right? For example, let’s say we want to express 0.3333... as a rational number. We know we can do this as the number is recurring. Therefore let’s assume x is equal to 0.3333...” She took out a scroll of parchment and grabbed a quill and began scribbling away.

$x = 0.333333...$

$10x = 3.333333...$

$10x - x = 3.333333... - 0.333333...$ (subtracting the

first equation from the second)
$9x = 3$
Therefore $x = 1/3$

"That seems about right," said Harry. "Well then look at this now!" said Hermione excitedly.

$x = 0.999999...$
$10x = 9.999999...$
$10x - x = 9.999999... - 0.999999...$ (subtracting the first equation from the second)
$9x = 9$
Therefore $x = 1$

"There!" Hermione said triumphantly. "Wait a minute," said Harry pushing his glasses up. "There's something wrong here. Surely you can't say x = 0.999999... and then x = 1 at the same time. There must be a mistake here." "Well then, tell me where the mistake is!" replied Hermione. Harry pulled the piece of parchment towards himself and looked closely at it. After a minute or so, "Ok, I give up. I couldn't find anything mathematically wrong with it. So tell me, what's the trick? How does it work?"

"There *is* no trick Harry! You see, you think there's something wrong just because 0.999999... looks almost equal to 1, but you feel it can't be equal to one because there is some very small difference." "Well yeah! I do think there's some very small difference. It's very, very, *very* small but the difference is there!"

"You mean to say if you add some small number to 0.999999... you would get 1 right? That is to say if you add a very, very, *very* small number, you would get 1. Well what's that number?"

"Hmmm," pondered Harry. "Well, it should be 0.000001 I think. If I add 0.000001 to 0.999999, then I'm going to get 1."

"That's good," said Hermione. "But you're forgetting one crucial fact. You took 0.999999, which *terminates*. 0.999999... has infinite 9s! Then what number do you think you should add to this number to make it equal to 1?"

"Ok in that case," said Harry slowly. "I have a number like 0.999999999999999999... and it continues, so I have to add 0.000000000000000001 to it. But I can't choose that number as 0.9 recurring has infinitely many 9s, which means that I will have infinitely many 0s before having 1, oh!" exclaimed Harry, "That means I'll *never* get to write 1 after all those 0s! Which means I'll have to add 0.0000000000000000... recurring to 0.99999999999999999... recurring to make it equal to 1. That's like saying I'm adding 0 to 0.9999999999999999.. to make it equal to 1, which means 0.9 recurring and 1 are the same thing!!!" "Exactly Harry! That's the intuitive way of looking at it! That convinces some people that 0.9 recurring is equal to 1, and not just an approximation. Bet let's also look at it this way. You agree that 1/3 = 0.333333... right? Well then." Hermione took the scroll and began writing again.

$1/3 = 0.333333...$
Let's multiply by 3 on both sides.
$3\times1/3 = 3\times0.333333...$
Therefore $1 = 0.999999...$

"That's another way of looking at it. See no matter how hard you try, you might not find something wrong with it? The mathematics looks infallible!"

"You're right," said Harry, "I'm convinced now that 0.999999... is the same thing as 1. But hey, does this mean 1.999999... is the same as 2? And 2.999999... is the same as 3?" "Well why not Harry! The same logic holds. What we need to understand is that every recurring decimal has a rational equivalent. Just like how we know that 0.333333... is 1/3, we should be able to accept that 0.999999... is 1/1 and 1.999999... is the same as 2/1 and 2.999999... is the same as 3/1, and so on. We just find it unusual but that's no reason to say it's false! Such a thing was proved as early as 1770 in Leonhard Euler's *Elements of Algebra*. There are also many proofs cited in Wikipedia."

"Wow, I hadn't thought of it that way at all. That's pretty cool!" said Harry. "It's *very* cool Harry!" beamed Hermione. "Speaking of cool, I wouldn't mind having 1 ice cream Ron! Which means to say I wouldn't mind having 0.999999... ice cream!"

"Oh, you can't," replied Ron sheepishly. "I already finished it."

THE NUMBER 26

Sharon Pinto

26 is the last two digits of my register number and I set out to explore its specialities. This number may seem a very ordinary two digit number but 'beauty lies in the eyes of the beholder'; on closely analysing the number, we understand its relevance to our everyday observations.

Apart from 26 being the number of letters in English alphabet, it may not very easily be realised that even in a deck of 52 cards, there are exactly 26 red and black cards.This becomes useful especially when we consider solving problems in probability in mathematics.

The number 26 lies between 25 and 27 .This may seem like any simple observation, but the beauty is that 25 can be expressed as 5^2 and 27 can be expressed as 3^3. This fact may not be true for all numbers considering the fact that 3 and 5 are integers.

Another interesting fact: If we subtract 10 from 26, we get 16 which is the square of 4.On adding 10 to 26 we get 36 which is the square of 6.

Considering the numbers from 2 to 6 i.e, 2 3 4 5 6, adding 2x3 and 4x5gives 26!

The number is special not only in mathematics, but is quite significant and historic in one's yearly calendar.

26th January is celebrated as India's Republic Day.

26th December is celebrated as World Boxing Day.

These may be simple facts about the number 26 but it's because of these that26 is different from other numbers!

FUN TASK: You could try this on a sheet of paper!

Write the value of **π** up to two decimal places i.e, 3.14.

Now write the mirror image of this transcendental number. What would you get??

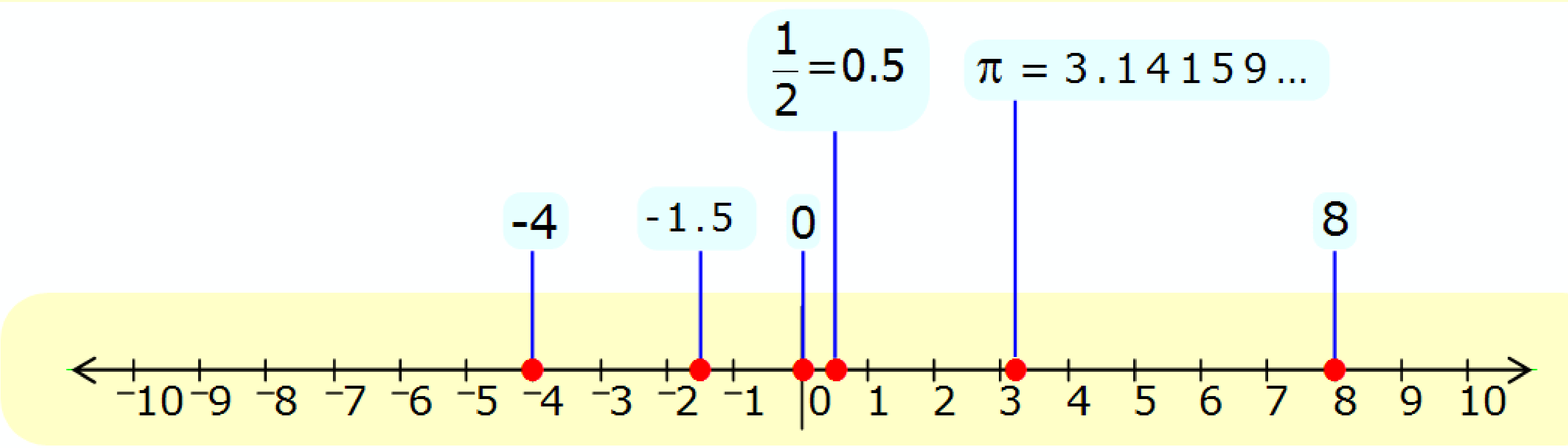
You would get a number which would look similar to the letters PI.E!!!!

This is interesting because pi and pie form an example for a pair of homophones.

Image courtesy: Google images

"Numbers are the highest degree of knowledge. It is knowledge itself."

— Plato



THE PHILOSOPHY OF REAL NUMBERS

Harshini N

After studying the concept of boundedness and unboundedness in real analysis, I realised a philosophy in life, to be happy about what we are.

As we all know, the set of all real numbers is infinite and it is neither bounded below nor above. The secret of happiness and also the idea of accepting each and every person is hidden here.

If we consider any real number arbitrarily (say 'x'), we can always find an infinite number of real numbers which are greater than 'x' and similarly an infinite number of real numbers which are lesser than 'x'. This concept can be compared to the set of all people in this world as well. Though, the population in this world is not infinite, we can still consider that the success of any person is neither bounded below nor above. If we consider a person (who is arbitrary) who has achieved 'x' amount of success in his life, we can always find a number of people who have achieved more than 'x' amount of success and also a number of people who have achieved less than 'x' amount of success. The real beauty lies here. One should learn to be happy about himself / herself and also humble, after knowing that he/she is better than a lot of people in this world. At the same time, one should get inspired and aim for the better with a positive attitude, looking at the ones who are better than him/her.

However, one should always remember to respect and accept everyone, since each person will always have something better than someone else in this world.

As we now know that success is unbounded above, no one should consider himself or herself as the ultimate. Each and everyone must understand that, there is someone who is better than him/her in this world and must learn to be humble. When a person is humble and happy about what he/she is and also ready to learn more, there is nothing in this world which is impossible.

I had heard that, all great philosophers were mathematicians, but I now see how much philosophy lies only in one branch of mathematics. We can still explore and admire the real beauty of mathematics.

MY MATH

Shraddha Ramdas Bandekar

MATH! When people hear this beautiful word, they have some perceptions about it. Some individuals think it's boring, some difficult,some very difficult and of course some think it's meant for the un-cool people,for nerds.

The question is "Do all these "some" think right?" Is "MATH" really an architect of problems and a child not getting solutions to its own problem? Is it only contradiction and assumptions, axioms and lemmas, proofs and theorems?

I say "NO". Math is much more than all these. It's only when you feel for it, when you truly understand it you actually know what math is. The entire creation of God has beauty of math in it. A lot of music is mathematics, the beautiful daisies we see around, the magnificent architecture, and our own face is all mathematics.

Shocking for some and for some unbelievable. But yes Math is everywhere. No one can tell you the shortest route to your destination but math does, math helps a postman to drop all letters in every lane using shortest path, neither you nor your friend can say provided they know the in depth essence of math. Study math but not for the sake of it. Mathematics is a melody of reasons. It's about imagination, to imagine the world in a much more enchanting way, to add a pinch of innovation in it. way, to add a pinch of innovation in it. Never try to get a definition for math in most logical sense that will fetch you more marks. I say see it in a most unique way, define it for yourself no matter what people think, say define it as life, love, music, nature etc. do mathematics to actually master it. Define it for you to get more interested towards it. For me math is future because it never lets u rest and keep u eager to know more hidden facts.

Let math "arrive" in the most magical way in your life and never let this "AAROHAN" to step back!!

Image courtesy: Google images

"Mathematics is the door and key to the sciences."

— Roger Bacon

THE UNIVERSE CONSTANT-A MYSTERY?

Oliver Drishila

Defined as the ratio of the circumference of circle to its diameter,
But decimals never ending forever and ever.
Its the most common constant known,
But the exact origin of discovery is unknown.
Adding first 144 digits mathematicians gave us '666',

But Satanist claimed that to be the "MARK OF THE BEAST".

Humans searching for its end for 3,500 years,
But cannot be even solved by computers.

Handiness in formulae of fields of mathematics,

Also showing up everywhere on earth, literally in our eyes.

So called the irrational and transcendental,

But mysteries it still own.
Represented by the 16th letter of the Greek alphabet,
π - The Universal Constant - A Mystery ?

(An adaptation from The Mad Mystery Of Pi by Abby Haglage)

THE SECRETIVE INHABITANTS OF OUR NUMBER SYSTEM

Aparnna Vemuganti

Edward Cullen. Count Dracula. Stefan Satvatore. These famous personalities from the pages of fiction draw a similarity: the thirst for blood – the vampire.

Mathematics is an eternal beauty of numbers. Interestingly, hidden among them, the vampires also contribute to this charm, the charm of Vampire Numbers.

A vampire number has an even number of digits, and can be expressed as a product of its ‘fangs’. The fangs are two numbers, not both with trailing zeroes such that each of them has half as many digits as the vampire number, and collectively contain all the digits within the vampire number, counting the multiplicity. 1260 = 21 x 60 is a vampire number.

There also exist sequences of infinitely many vampire numbers, such as:

1530 = 30 x 51, 150300 = 300 x 501, 15003000 = 3000 x 5001,………

Vampire numbers can have more than one pair of fangs. For example, 24959017348650 has five pairs of fangs:

24959017348650 = 2947050 × 8469153 = 2949705 × 8461530 = 4125870 × 6049395 = 4129587 × 6043950 = 4230765 × 5899410.

Pseudovampire numbers are similar to vampire numbers, except that the fangs do not need to contain an equal number of digits. For example, 126 = 6 x 21. A prime vampire number is a true vampire number whose fangs are its prime factors. A double vampire number is a vampire number whose fangs are also vampire numbers. These hidden inhabitants indeed add a spasm of charisma to our number system.

FALLACY

Ujwal Raj

A fallacy in mathematics generally results from a violation of some rule or law of mathematics. This makes these paradoxes excellent vehicles for presenting these rules, for their violation leads to some rather “curious” results, such as 1 = 2, or 1 = 0, just absurd! They are clearly entertaining since they very subtly lead the student to an impossible result. Often the student becomes frustrated by the fact that every step to this weird result seemed correct. This is quite motivating and will make the conclusion that much more impressive. Let

$S = 1 - 1 + 1 - 1 + 1 - 1 + \cdots$

$= (1 - 1) + (1 - 1) + (1 - 1) + \cdots$

$= 0 + 0 + 0 + 0 + \cdots$

$= 0$

However, if we group this differently, we would get the following:

$S = 1 - 1 + 1 - 1 + 1 - 1 + \cdots$

$= 1 - (1 - 1) - (1 - 1) - \cdots$

$= 1 - 0 - 0 - 0 - \cdots$

$= 1$

Therefore, since $S = 1$ and $S = 0$, it would follow that $1 = 0$. What’s wrong with this argument?

$S = 1 + 2 + 4 + 8 + 16 + 32 + \ldots$ ---- (1)

$2S = 2 + 4 + 8 + 16 + 32 + \cdots$ ---- (2)

Here S is clearly positive.

Consider (1),

$S - 1 = 2 + 4 + 8 + 16 + 32 + \cdots$ ---- (3)

From (2) and (3), we have,

$2S = S - 1$

$S = -1.$! ! ! ! ! ! !

Answer

The flaw here has to do with convergence. To clarify the last fallacy, you might want to compare the following *correct* form of a convergent series:

Let

$S = 1 + (1/2) + (1/4) + (1/8) + (1/16) + \ldots.$

We then have $2S = 2 + 1 + (1/2) + (1/4) + (1/8) + (1/16) + \ldots.$

Then $2S = 2 + S$, and $S = 2$, which is true. The difference lies in the notion of a convergent series, as this last one is. What we did above for a divergent series was not permissible.

ACROSS

1 Closed

4 Hausdorff

5 Perfect

6 Bounded

7 Interior point

DOWN

2 Limit Point

3 Complement

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