CATALYST

DEANERY OF SCIENCE

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CHRIST UNIVERSITY
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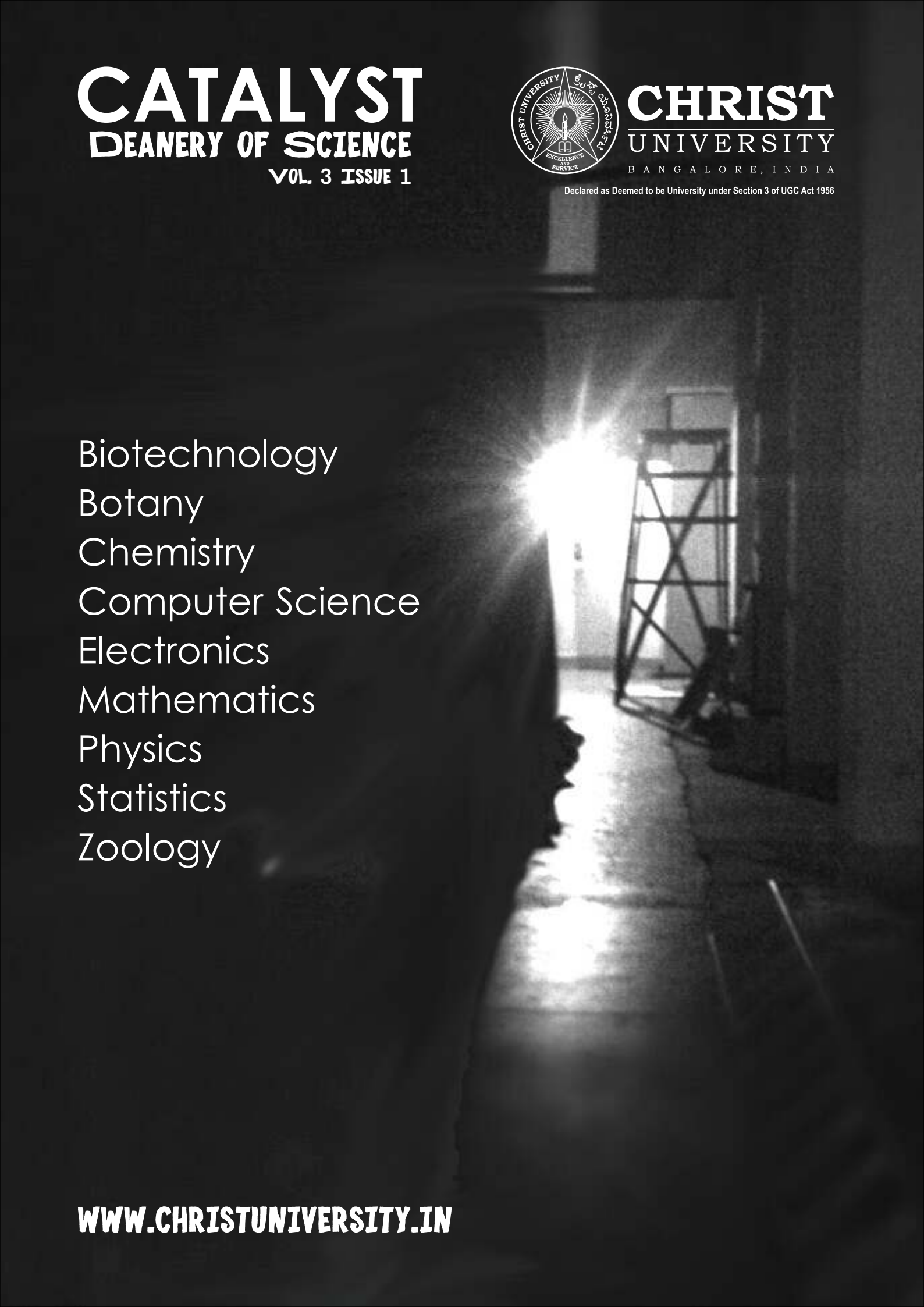

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Message from the Vice Chancellor

The Deanery of Science, comprising of nine departments, all varied and distinctive, plays a vibrant role in modeling the diverse careers of the students. They have endeavored to generate and sustain interest by conducting various events. Catalyst is an important step in this journey. The learners have showcased their competence and skills by crafting different types of articles, as well as photographs relating to science. The wide spectrum of science has been explored to bring out some exceptional gems. The deep understanding of the subject, presentations and enthusiasm of the students is apparent in the magazine.

The present issue of the magazine, with articles from students, research scholars and eminent scientists, deserves merit for its layout. Intellectual inputs have enhanced the flavor of the magazine and paved way for further research in diverse fields. The editorial team deserves kudos for their effort in arrangement, planning and editing.

I congratulate the team of Catalyst and wish them the best for the years to come.

Dr Fr Thomas C Mathew, Professor of Chemistry and Vice Chancellor, Christ University, pursued his MSc Chemistry at Mahatma Gandhi University, MS Education at Iona College NY, USA and PhD at Bangalore University. He has authored and edited several books on higher education, both on teaching-learning and administration. He has also been the recipient of several awards and recognitions at various national and international platforms.

Message from the Dean

It is an immense pleasure to note that the newsletter Connaissance, rechristened as Catalyst is in its third year of existence. The students and the teachers under the Deanery of science are striving hard to improve the quality of education to enrich their intellectual talents. The articles, photographs and related puzzles are an indication of the knowledge acquired. Various events organized in the campus also support this process of learning and research. This is evident from the status of our University in the all-India ranking of higher educational institutions by India Today-Nielsen Survey. Hearty congratulations to the editorial team!

Dr. Nanje Gowda N M, Professor and Dean of Science, has completed his MSc from Bangalore University in 1969 and PhD from Bangalore University in 1976. He joined Christ University, then Christ College, in the year 2006.

From the Editor's Desk

Science for us, today, is no more just a series of chapters that we learn in school. It is a source of inspiration and a way to look into the future. That is what science has been for as long as mankind can recall. Science has always given us a way to turn our dreams into reality. But today, science has spread its wings like never before.

Science has grown. It has moved mankind from being scared of innovation to striving for it. This movement is an outcome of generations of scientists' hard work and dedication. One among the most notable steps towards this transformation was taken by Michael Faraday. In 1825, he ignited the minds of the masses by giving Christmas lectures at the Royal Institution, London. His first lecture was on the chemistry of the candle. This initiative created a platform for the hallowed scientists of their time to interact with and educate the curious minds of the mortals. The tradition lives on in the hands of scientists like Peter Wothers, Alison Woolard, etc.

Today, when a common man talks about science, it is proof of the fact that we are much more curious to know all that we can. This has only been possible because we decided that the textbooks weren't enough. Everywhere we look, there is so much to keep our curious minds questioning. With science today, we constantly create, innovate and grow. But we're growing too fast and we need ways to keep up. And so YouTube channels have been dedicated to science, TV shows and movies, like Star Trek, House M. D. have been aired and published magazines/newsletters have forced us to think outside the box. Embracing this grand tradition, Catalyst, the Science Deanery Magazine, seeks to pick the brains of the departments to create a truly diverse knowledge source.

The Making of Catalyst

The continued passion, the eagerness and dedication of the editorial team is evident in the third issue of Connaissance, now renamed as Catalyst. A strong team, with a new crop of names as well as senior students have ensured the newsletter is infused with fresh and bright ideas while retaining the original fervor and purpose.

The constant support of the Vice Chancellor Dr. Fr. Thomas C Mathew, Pro Vice Chancellor Dr. Fr. Abraham V, Registrar Dr. Anil Pinto, Dean of Sciences Dr N M Nanjegowda , Dr. Louis George and Dr. George Thomas C along with the heads, faculty and students of the various departments of the Science deanery has been a strong motivating factor in working for the newsletter. I acknowledge the support of Centre for Concept Design in helping us improvise.

Sanketh Jain , a silent and strong gentleman, is now a veteran as he has been associated with all issues of the newsletter . He has been a "big boss", a tough task master and a rock-solid support to the entire team. Chahak Goyal and Nivedita Ramakrishnan, with their ferocious loyalty and hard work have ably supported the leader as well as inspired the young entrants.

Jai Sharma, Harsh Jaiswal , Samyak Jain, Heba Susan Roy , Shibika Bose and Tirath Nagda have proved themselves as team workers by involving themselves in every aspect of the newsletter. Siddharth Seshadri , with his ever ready smile and camera has ably supported the team.

The wonderful response from students in contributing articles, photos, puzzles and related matter, contributions from the alumni and the invited articles has enriched the content of the newsletter and encouraged the team.

A heartfelt prayer of thanks to the Almighty in helping us reach our goal and releasing the third issue of newsletter of Science deanery.

Please send in your feedback to catalyst@christuniversity.in

Sahana Prasad, Associate Professor of Statistics, completed her MSc from University of Delhi and MPhil from Bharatidasan University. She frequently pens down articles for leading periodicals like The Times of India, Deccan Herald, Readers Digest and several others.

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Sports Statistics

Numbers in sports may seem geeky to many, but they are in fact most vital—which may be surprising to many of us. Ever since its importance was realized, the sports industry has used numbers and statistics immensely to help players achievee better benchmarks.

A few centuries ago, statistics was not prominent in sports but in recent years statistics and sports have been going hand in hand.

It is useful for fans to get the statistics of their favourite player or team. They use such information to prove their point as to why their player or team is better than the others.

Furthermore, the data is used to draw inferences as to which team or player is actually better. Several measures of averages can be used to evaluate a player's performance over his career and can be compared to other players. This is one of the most important factors that decide pay scales for these players. The movie "Money Ball" tries to show how statistics help make a better team as player evaluation becomes a more accurate process.

Sport statistics may help the jury in deciding which player deserves a certain award. Statistics thus helps prevent any personal bias. For example the best bowler award in cricket can be given to a bowler whose combination of wickets taken and runs given is the highest.

In the NBA, a basketball league in the US, there are a few players who are paid higher than what most other players get. In an experiment, data from various matches was studied. It was inferred that high paid players performed worse in high pressure games than low pressure games while players with an average pay performed more or less the same in all the games. Even though there is no economic reasoning behind this and it seems to defy rationality, data tells us more than what intuition does. (Racheli Barkan et al, 2010)

Each team can improve their performance based on player statistics. For example some players may perform better at some periods of the game. The team can make strategies accordingly.

Statistics can help teams make informed decisions by answering questions such as how many games they need to win to qualify or how many points they can allow the opponents

Individual players can use correlation analysis to improve their performance. This need not necessarily be in the form of empirical data but a simple and continuous observation can help a player know the relation between food habits and his performance. He can thus use this to know what kind of food he should be eating before a game and he can improve his performance.

The amount of statistical research in sports is unimaginable. For example in 2003, Ignacio Palacios-Heurta conducted a study in football where he analysed 1417 penalty kicks games in various football leagues and kept track of whether each player kicks the ball left or right - ignoring for convenience, the option of kicking straight. He analysed that if both the goalie and kicker choose left, the probability of kicker scoring is 58% and goalie saving it is 48% while if the goalie and kicker score right, the probability of kicker scoring is 70% while probability of goalie saving it is 30%.

Statutory warning: The data has been collected by experts. Do not try this at home.

Krishna Srinivasan, studying in the second year of BSc EMS, is a multi-linguist, with an interest in sports and watching movies. He trades on the stock market and runs a website called ecosquare.com that is dedicated to nuances of Economics.

A Strange and Incomprehensive Reality

Things believed to exist in reality may not really have a presence at all. Strange as it sounds, Quantum Theory is a fascinating study. This article explains more of what is 'real' and what is not.

"If you think you understand quantum theory, you don't understand quantum theory."
- Richard Feynman

This statement by Feynman is not meant as a discouragement, but rather an opportunity to self-interpret and make sense out of the most bizarre phenomena one can ever come across. For instance, if you were a doctor and received news of a cat inside a closed box and you were asked to judge whether it is alive or not, you would be helpless because you can't check its pulse to make a decision. Whereas if you were a quantum physicist like Feynman himself, the original helplessness would still persist, but you would also be entitled to add one more possibility – the cat is simultaneously both alive and dead.

So what do you do if you want to know the reason for such phenomena? In most cases, you take a few steps back and revisit your basics. At the end of the line, you may stumble upon a hard rock called quantum physics, which simply is the science of the building blocks of all matter at the most fundamental level. And one of the questions that quantum physicists pursue is about the Nature of Reality. Is reality and existence narrowed down to events that one can observe and measure? Does my mother stop existing when I am not talking to her or touching her or seeing her? Despite the blatant madness in that question, it does happen to be experimentally true, not in our everyday world (fortunately!) but at the microscopic level. Quantum physics does not care what you want to believe as the truth. Proponents of quantum physics struggled with understanding their own hypotheses, let alone us students, and some also regretted proposing such bizarrely ungraspable, supernatural (beyond intuitive comprehension) and seemingly unreal ideas. We haven't yet come across any experiment that has disproved any postulate of quantum physics, which is one scientific and intellectual reason why we haven't yet got rid of it, no matter how much we want to. And to think of it, you wouldn't have a mobile phone, this page could never have been typed, and you couldn't have thought of googling quantum physics if it were not for quantum physics.

Samip Velani, a third year student from Bsc PCM, is a trekker with an impressive academic record consisting of his appointment to the Student Council in school and a Best Student award.

Know Thyself, Know Others

Here are a few facts which can actually help you torment all your minds and sit back to think of when and how you react while meeting up with people.

1. People with low self-esteem tend to humiliate others. The matter of fact is that different kinds of people obediently believe that the negative opinions or comments they give out are honest and have no connection with them and their self-confidence. Rather, the humiliation of others helps them restore their own self-esteem.

2. Bodily sensations often affect people. Now just imagine that could we ever think of such things which would include bodily sensations. For example, rigidity and hardness make people non-flexible. I'll just give you an example of how people react when they respond to cold. When they get closer to chilly weather, they tend to feel lonely. Secondly, when people face any kind of a rough surface they sense a complexity in relationships.

3. Lying requires a lot of mental effort. A person who is lying has to keep in mind at the same time the lie – that it to say, and the truth – in order to hide it. As a result, he uses simple sentences and finds it more difficult to cope with mental tasks. It often happens to be that people while saying lies to others fumble and the most interesting part about lying to people is that you blink your eyes a lot while lying. Interesting, isn't it?

4. Attractive and honest appearances can easily be misleading. People tend to trust appearance more than sincerity. Appearance plays an important role even when voting during elections. Maturity and physical attractiveness of politicians were mostly important for voters' choice (unconsciously, of course).

5. Most people, especially the upper class society, are generally considered to be more intelligent and wise. Ego increases the desire of possession in people. People make more efforts to obtain the object that is associated with angry faces. The more complex the decision to be taken is, the more people tend to leave things as they are. If a store has too many choices and people cannot immediately find out which of the products is better, they will leave without buying.

When people feel they have no control over what is happening, they tend to see non-existent patterns in unrelated pictures and believe in conspiracy theories. People regret quick decisions, even if the results are satisfying. It is not the actual time allotted for the decision that matters, but the feeling that the time was enough.

Thus we happen to see the various connections of psychology with basic science-related facts. Psychology is a subject which brings us closer to our mainstream living. It gives us an idea of how and when we react meeting up with people. This subject has a lot of scope in explaining human relationships.

Shibika Bose, studying in the first year of BSc EMS, is a sports person, an eco-activist, and an excellent dancer. She has worked as the managerial head of her school's magazine too. Currently, she is also a part of the editorial team of Catalyst.

Nuclear or Unclear Future

With technology and science scaling new heights, expansion of the nuclear energy field isn't far behind. This article leaves a question behind on whether nuclear uses would lead us to a better future or be the reason of our destruction as this question needs to be answered soon.

"I know not with what weapons World War III will be fought, but World War IV will be fought with sticks and stones"
-Albert Einstein

In the late 1930s, a series of experiments showed that bombarding uranium with neutrons produced several new radioactive elements, with the spontaneous release of a tremendous amount of energy. The experiment brought great excitement in the minds and hearts of the people, as they thought they had discovered a nearly unlimited and clean source of energy. Nuclear fission of a single gram of enriched uranium is enough to fuel an entire city for an entire day. It's quick, controllable and causes none of the conventional pollution problems that we face today. The residue which is left can be stored away until it is no longer hazardous. Nuclear fission is extremely efficient, and provides much more energy than burning of coal, hydroelectric or any other kind of energy. And the best part is, there is a lot of plutonium available for this purpose.

Otto Hahn who was a German chemist and pioneer in the fields of radioactivity won the Nobel Prize in Chemistry for the revolutionary discovery of nuclear fission.

August 6th 1945, Japan Standard Time, an American B-29 bomber, the Enola Gay, drops the world's first atom bomb, over the city of Hiroshima. Approximately 80,000 lives are extinguished in the blink of an eye. This was the first time that nuclear power had ever been used in a war for such a destructive purpose. Then began the race for building nuclear weapons between the US and the Soviets. At the height of the Cold War, there were some 70,000 nuclear weapons. Today, there are 17,300 "known" nuclear weapons that exist, each with 100 times the destructive power of the one that was dropped in Hiroshima. This number of nuclear weapons has enough power to destroy the world 1000 times over. What mankind fails to realize that these very weapons that we built to protect ourselves will be the bringer of our doom. So the decision lies in our hands. Should we use this amazing force of nature to make this world a better place, or will history repeat itself, this time, on a global scale.

In the end I would like to quote a line said by Dr. J. Robert Oppenheimer, one of the scientists who discovered the Atom bomb, during its first testing.

"I am become death, the shatterer of worlds"

-Quoting from the 2000 year old Bhagwad Gita.

Siddharth Sheshadri, studying as a first year student in BSc CMS, is extremely talented. He has taken part in international debates and regional photography contests. He is the lead photographer for Catalyst.

Time Travel

Time travel is a solution for our dreams where we want to go back to the past and redo things, like perform better at an exam. Though it's been a hotly debated topic, the possibilities of traveling across time are revisited in this article.

This article will focus on the possibility of time travel. Thus, to go back to the start, we can recap that Einstein, in one of his studies, found out that space and time are relative to one another. Hence, the birth of 'space-time' took place. Space-time can be any mathematical model that equates space and time into a single measurement.

We know that Newton's law of universal gravitation explains gravity as "the principle that two particles attract each other with forces directly proportional to the product of their masses divided by the square of the distance between them", which implies that every mass has a gravitational force of attraction that enables it to attract another body of mass depending on the magnitude of each mass and the distance between them.

Thus, the gravity of a larger mass would be greater when compared to the same of a smaller mass; hence the apple falls on the Earth and not opposite.

Einstein opposed this by stating that gravity was nothing but the indentation in the shape of space-time caused by the mass of an object.

Hence, the greater the mass of an object, the greater is the curve caused by it in the shape of space-time.

As Albert Einstein was working on the theory of special relativity in 1907, he stumbled upon an off swing of his mainstream study. This was the theory of 'Gravitational Time Dilation', which "is an actual difference of elapsed time between two events as measured by observers differently situated from gravitational masses, in regions of different gravitational potential". This implies that time observed in a specific gravitational magnitude differs from the time observed from another gravitational magnitude of a different strength. Thus, he concluded by stating that clocks run slower in deeper gravitational wells.

Now, we come to black holes. Black holes are generally created out of huge dying stars that have collapsed under their own gravity. Because of the relationship between mass and gravity, we can state that they are the most compressed matter imaginable that possess massive gravity. They are black in color because not even light can escape this extreme gravity.

Thus connecting black holes to the indentation in space-time, we can rightly say that curvature of space-time around a black hole stretches till infinity.

Now, as the base for time travel we have two points:

1. Black holes have extreme gravity.

2. Clocks run slower in deeper gravitational wells.

To start off, we make a spaceship that we send with an astronaut near the black hole. The catch is that the spaceship should be as near the black hole as to be intentionally close to the immense gravitational field but not close enough as to fall into the black hole. With our second assumption we can prove that the clock inside the space ship will run slower due to the extreme gravity of the black hole. For an observer on earth with a telescope observing the spaceship, it will come to notice that the astronaut will be doing everything slowly. Because time slows down for the astronaut, all his actions, his heart rate, his rate of thoughts, everything will be slower than the person observing him from the earth. When the astronaut looks into his own telescope he will notice that every action performed by people on earth are faster than normal. This is because the gravity on earth is lesser when compared to that of the astronaut and hence the clocks on earth will run faster than the astronaut's clock.

Now, when the astronaut comes back after a time period back to earth, he would have experienced lesser time elapsed than the observer on earth because of the difference in gravity experienced by both of them.

For example, let's take a hypothetical situation where your parents go for a vacation near a black hole. For you, their time passes slower than yours. When they come back after two years of their time, fifty years of your time has actually passed. Thus, you are actually older than them now.

We learn that gravity is nothing but a curvature in space-time, the massive gravity possessed by black holes causes this curvature to stretch till infinity. We also see that time slows down in presence of gravity. Thus, time travel is theoretically possible. So in the coming times when we reach a stage of highly advanced technological growth so as to create such spaceships, our forthcoming generations will have the option and luxury of time travel.

Neellohit Datta is a student of BSc EMS. Though Neel studies Economics, Math, and Statistics, he broadens his range of knowledge by exploring other subjects. He aspires to be an Investment Banker and likes driving.

Bioinformatics

Bioinformatics is an exciting part of science showing great promises for the future. It's a wonderful innovation that seems to really make the world a better place, and this article provides an understanding of this field.

As the name suggests, bioinformatics is an interdisciplinary subject which deals with interpreting biological data using computational tools and methods.

For those who are wondering how it is possible to combine computer science and mathematics with biology, this article is going to enlighten you with an example.

We will begin by exploring a biological question: Where in the genome does DNA replication begin? This question can be answered by biologists after a series of experiments which can take several weeks or even months. Hence, the method of experimentation is not the most efficient.

In this day and age, with computers being at the forefront of all fields, we can attempt to find an algorithm that can quicken the process of finding the replication origin, thus saving time and money.

Also, the results of the experiments can better be analysed by computational methods. This is useful because gene therapy methods consist of making artificial genes which are widely used in agriculture to engineer superior quality crops like frost-resistant tomatoes or pesticide-resistant corn. It has also been successfully performed on humans, thus saving lives which could not have been saved by other methods.

The DNA string consists of a string of molecules called nucleobases which are found within nucleotides. The primary nucleobases in the DNA are Cytosine (C), Guanine (G), Adenine (A) and Thymine (T). These are arranged in a particular sequence. These sequences can be analysed to find patterns similar to how a code is decrypted. This is where we need the computer scientists. Hence, one can see the benefits of a computer scientist working alongside a biologist.

Riya Banerjee, a student in the third year of BSc CMS is from Kolkata. She has repeatedly won gold at the National Cyber Olympiad. She is a social worker, learns Japanese and aspires to pursue Computer Science at an Ivy League university.

Gaming

Gaming is one aspect of daily routine for both children and elders - but it's not just art, it's science as well. It is a fact for many non-math students that for gaming you don't need many folds in your brain. Just a little practice makes you perfect.

Before I begin, I'm a 100% sure that there are many articles and blog posts regarding the title mentioned above but this article is purely my opinion. Now, to the topic at hand! Is gaming an art or science? I think it is a combination of both. How is it possible that gaming can be both art and science? Let me begin with the artistic side with the awesome example of Minecraft. This LEGO-like, open world sandbox game lets you build magnificent structures, buildings, cities and even worlds. New York, London, Mordor and even Westeros have been re-created in Minecraft which prompted the Internet to create a new rule; Rule 34.5, "If it exists, there is a Minecraft version of it". I have played the game as well and it's really addictive. You end up creating something totally weird like a castle on the sky. But Minecraft isn't the only game that can be used to express creativity. Now, taking competitive games such as DotA and Counter-Strike, there is this saying, "A player plays the game but legends change the way it's meant to be played". I would have to agree with that point since a lot of new tricks such as "bunny-hopping" (a jump trick which allows you to move faster and out-manoeuvre your opponents) and the infamous "Russian Walking" (a crouch trick that allows you to move fast without making a sound giving you an advantage). There are always new things to come in every game. You just have to be creative and make it happen.

Now, let's move on to the scientific part of gaming.

Have you heard of Theory-crafting? Well, it is just a simple analysis of how a game works. First coined in the popular RTS game "Starcraft", Theory-crafting has become popular in other gaming genres such as FPS (First Person Shooter), RTS (Real-Time Strategy), MOBA (Multi-player Online Battle Arena) and MMORPG (Massively Multiplayer Online Role-Playing Game). I was a player of a famous MMORPG known as "World of Warcraft" and as a hardcore raider, I had to work with my guild-mates and find alternative ways to defeat the raid boss if the current mainstream strategy was difficult. By understanding how the boss worked, the spells and patterns, maximizing DPS (Damage Per Second, the amount of damage you deal in relation to real time) and the positioning of each player, it becomes a real breeze to defeat a raid boss. I'm going to be honest here. I'm really bad at Math in real life. But when I'm in-game, my mind begins a magnitude of processes where I calculate different values and variables with respect to real-time and the elements of the game. But at the same time, I could get creative and try out something new which could either benefit my team-mates or cause them failure in the midst of battle.

To me, gaming is an art as well as a science. I see it in both ways but it could different for each and every person. I've been playing games ever since I was six years old. I could be right to some and wrong to many but that's just my personal opinion on the question and with that, I conclude!

Ratul Sathish, a student in his third year of BSc CME, is a gamer who takes special interest in uploading his gameplay videos on YouTube. Born in Chennai, he enjoys watching Anime and trying various creative art tools at leisure.

Universe-ception?

The fact that the concept of radios, mathematics, frequencies, waves, astronomy, physics when combined in complex yet brilliantly reasoned proportions may lead to the idea of the existence of universes within universes.

How probable would it be to have access to multiple radio stations at the same time via the same radio? You as a sole coordinate are surrounded by many frequencies whereas your radio is tuned to a particular frequency. This is because the radio waves are in phase with that particular input frequency and hence the connection is made to that desired station. Proceeding strictly within boundaries of theoretical physics, the concept of multiverses can be understood using this relative. When two universes are in phase, they are said to be coherent. This means that for a given sinusoidal wave function, the waves of both these universes will progress with the same constant and both their positive and negative peak values will correspond. As long as these waves are in phase, they are coherent and as long as they are coherent, it is possible to move back and forth between them. Although, as time proceeds to evolve, the constant that helped them to exist in phase shifts and these waves start to disconnect and resolve. Once these waves decouple, they no longer vibrate at the same frequencies. They can no longer hinder each other. We as subject matter are essentially waves that are in authority of the Schrödinger wave function, as our composition is that of electrons which obey rules of quantum physics and function as both vibrating waves and point particles. We comprise of atoms, and atoms vibrate. The reason why we are unable to access other universes is probably because our atoms no longer vibrate in coherence with them; that our wave functions have dissociated from each other. But if there were a way by which each atom in our body was to manipulate its wave property to vibrate in unison to the frequency of the other existing universes, or a way by which the frequencies of other universes could be manipulated to exist in phase with ours, then access may be granted and we could have a scenario where we would live in a universe within a universe and so forth.

Bhavya Chawdhary is pursuing her second year of BSc CBZ.

The Long Forgotten Past

A very old adage by Montgomery goes, "Nothing is ever really lost to us as long as we remember it." But why we don't recall many happenings of our childhood though we try to is what this article talks about.

I remember the red swings in my yard, my first day in nursery, my favourite toy plane that my brother broke, my much-loved pink bicycle and a great deal more. However, I just can't remember my first trip to the US or my brother's 16th birthday when I was three years old. This universal phenomenon is referred to as Childhood Amnesia. For most people it takes place when they reach the age of 3 to 3.5 years. Until the recent past, scientists assumed that childhood memories tended to fade because brains of young people couldn't form lasting impressions of any event. In the 1980s, Bauer and his acquaintances conducted a research where they found that children of 2 years of age could very well remember the episodes in their lives even when they were 9 months old. So several years later, Bauer and his colleague taped the children of 3 years of age talking of recent events in their lives, and they were made to listen to them when they got older. It was found that among them, the 7 year old children could remember 60% percent of what had happened but those who were of 8 or 9 years could remember only 40% of the events.

Nevertheless, some memories do tend to persist in the mind, despite amnesia, like the first time I fell and was rushed to the hospital, and several other memories that carry a lot of emotion. These few memories don't fade away because they have so much value that they resonate within our heart. But rest assured because we can always capture these emotions with photos and videos now.

Heba Susan Roy, a student in the first year of BSc EMS, is from Kerala and Dubai. She is an avid reader, a powerful orator, as well as a marathon runner. She is a part of the editorial committee of Catalyst.

Contribution of Ancient Indians in the Field of Science

India is intellectually, politically and spiritually independent, but is still a slave to the Western thoughts and thus is limited in the field of Science. This article sheds light on the contributions of ancient Indians towards Science.

"Yojanam sahasre dve, shatadve dwecha yojana,
ekena nimeshaardhena kramamaana
namostuthe"

This is a shloka that appears in the book Rig-Veda Bhashyam written by Sayana Madhava. A Sanskrit student may look at this shloka and say that this verse is praising the Lord Sun. He is correct but this shloka says more than that. It says that we can calculate the velocity of light using this shloka. That is what Sayana Madhava did. But how?

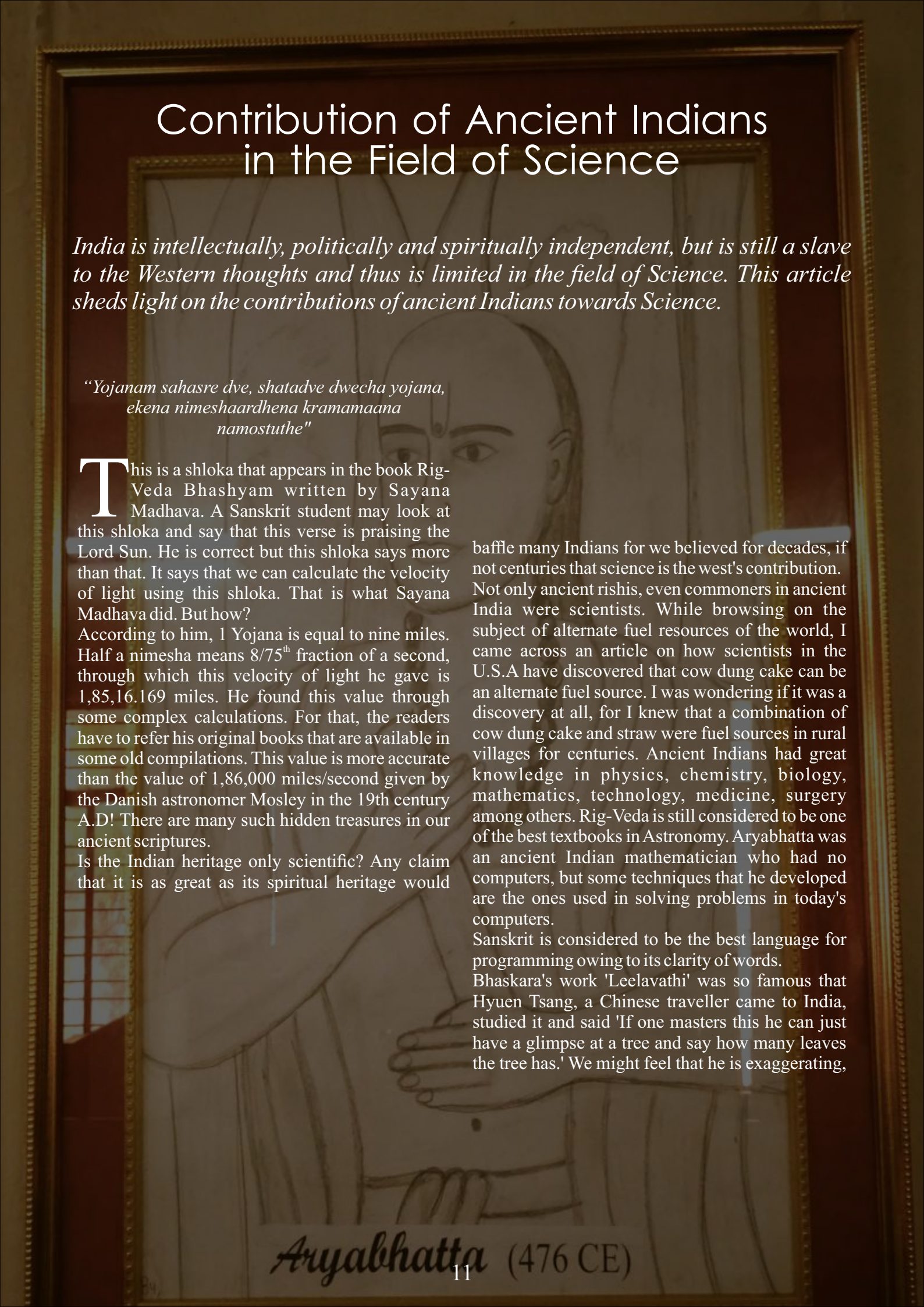
According to him, 1 Yojana is equal to nine miles. Half a nimesha means $8/75^{th}$ fraction of a second, through which this velocity of light he gave is 1,85,16.169 miles. He found this value through some complex calculations. For that, the readers have to refer his original books that are available in some old compilations. This value is more accurate than the value of 1,86,000 miles/second given by the Danish astronomer Mosley in the 19th century A.D! There are many such hidden treasures in our ancient scriptures.

Is the Indian heritage only scientific? Any claim that it is as great as its spiritual heritage would baffle many Indians for we believed for decades, if not centuries that science is the west's contribution.

Not only ancient rishis, even commoners in ancient India were scientists. While browsing on the subject of alternate fuel resources of the world, I came across an article on how scientists in the U.S.A have discovered that cow dung cake can be an alternate fuel source. I was wondering if it was a discovery at all, for I knew that a combination of cow dung cake and straw were fuel sources in rural villages for centuries. Ancient Indians had great knowledge in physics, chemistry, biology, mathematics, technology, medicine, surgery among others. Rig-Veda is still considered to be one of the best textbooks in Astronomy. Aryabhatta was an ancient Indian mathematician who had no computers, but some techniques that he developed are the ones used in solving problems in today's computers.

Sanskrit is considered to be the best language for programming owing to its clarity of words.

Bhaskara's work 'Leelavathi' was so famous that Hyuen Tsang, a Chinese traveller came to India, studied it and said 'If one masters this he can just have a glimpse at a tree and say how many leaves the tree has.' We might feel that he is exaggerating,



but we may understand by his review as to how impressed he was with the book. Below is the shloka that appears in the tenth book of Rig-Veda that gives the value of Pi up to 28 digits:

"Gopibhagya madhuvraataha shringishodaadhi sandigaha
Khalaajeevitakhaataava galahaataara sandhara"

To code to decipher this is given in the same book.

"Kaadi nava, Taadi nava, Paadi panchakam
Yaadi ashtakam kshaha shunyam"

Its simple enough for one to understand the gist as another article can be written on just deciphering this. The willingness to learn is the key. After applying the code to the first shloka we get the value of Pi as 3.14159265358979323846264338327 92. If the fastest computer available is used to program the value of Pi, one will know how difficult it is.

Who invented nuclear physics and surgery? The Indians! Pavooluri Mallana of the 12th century A.D. wrote a shloka that appears like a technical description of nature but has ideas on the nucleus inside an atom. Pakoda Katyayana wrote about atomic theory at Nalanda University. When people in the west were eating raw vegetables, we had the full-fledged Nalanda University. Maharshi Kannada of 3rd century B.C. wrote atomic theory in Vaisheshika Sutras. He says that all matter is made up of smaller indivisible particles called as 'anu' or 'kana' (Dalton's atom). Tippu used missiles and guns much before the British knew that. NASA recognises Tippu while we still deny. Acharya Bapooji Talapade flew the first aeroplane in 1495 at a Mumbai beach in the presence of Baroda's King much before the Wright brothers (recorded in the 1945 Mumbai Gazette by the British). The rust-less Iron pillar at Delhi is also a mentionable marvel.

While studying these, many questioned me, "You will not find any invention around you. When all are contributions from the west, how can you say that ancient Indians have many contributions in the field of science?"

We must always remember that ancient Indians never looked outwards to make mechanical and electrical toys. They did not believe that "necessity is the mother of invention." Today every discovery has a theory behind it. Most of those are postulated in our ancient books. They knew that where science ends, spirituality starts. Understanding this and being proud of our heritage must inspire us all to achieve.

Hailing from Mangalore, Gaurav Shetty is in his first year of BSc PME. He has won numerous laurels including the Science Lecture Contest and the Vanchanamandara Award for his literary skills. He is the current Environment Ambassador of Bangalore.

Killing the Zombie – Goldback's Conjecture and other Mathematical Weapons

Fairytales and myths aplenty on zombies exist but are never really believed. If at all their existence is taken into account and mixed up with some mathematical theories, a conclusion can be reached and that is what this article draws out.

Investigations into the nature of the mind and mental processes have culminated in diverse theories, over the course of many years. Physicalism and other associated standpoints, and their critique and dissemination, have popularly been at the focal point. In rejection of the Physicalist assertion that every complex object, experience or phenomena can be explained in purely physical terms, 'philosophical zombies' were introduced into the discourse. Zombies, in philosophy, are imaginary creatures used to vocalize certain problems about consciousness and its relation to the physical world. P-Zombies are imagined to be perfectly human in all regards except in one key aspect– they lack consciousness and all conscious experience.

The simplest version of the conceivability argument for the possibility of zombies goes:

1. Zombies are conceivable.
2. Whatever is conceivable is possible.
3. Therefore zombies are possible.

Despite the much debated veracity of the two premises and the ambiguity in the semantic understanding of 'conceivability' and metaphysical 'possibility', the zombie argument managed to raise a few Physicalist eyebrows. By Zombie Argument, therefore, if an exact physical duplicate of me that lacks conscious experiences could possibly exist, it implies that consciousness itself is not wholly physical.

The proof of Goldbach's famous conjecture, as posed to Euler in 1742, that 'Every even integer greater than 2 can be expressed as the sum of two primes.', can be cited in response. Being an open problem, the existence of both the proof and the disproof of Goldbach's conjecture can be mentally conceived; in the same ambiguous way the zombies were conceived. But being a rigorous mathematical proof, one of them is surely impossible (yet perfectly conceivable), given the other is true.

We can effectively assert analogous counter-arguments for the zombie proposal using other open problems in mathematics, like the Riemann Hypothesis. Therefore, 'conceivability' need not assert metaphysical possibility, unless we hard-line the meaning of the word. But in that case, zombies would themselves cease to be conceivable.

Hailing from Kerala, Rohit Revi is a student in his final year of BSc PCM. He has presented a research paper at the International Conference on Cognition, Emotion and Action at IIT, Gandhinagar.

It's not Rocket Science!

Science is considered as 'THE' stream. Yes, 'THE' path which leads you to a secured future with no guarantee of your present. There are some who take it because they like it, others because they have to. The question ofwhether science is rocket science or not applies to all of us.

Why science is and always will be the most intimidating thing known to a student (other than asking your significant other out)-
'Beta, tumse na ho payega', said so many parents when their little ones checked the box saying science—and very rightly so. Science is no joke. Not because it's the study of all things-living, dead, un-dead and non-living, but because of the way we learn it. I know. We all know. SCIENCE. When I took science, like you guys did, I got some incredulous looks. The whole 'Are you going to do engineering? Medicine? No? Then what's the use?' or 'But it's so difficult!' and 'Are you prepared for the course load?' got to me. And then it did- DAT COURSELOAD. Some may say I'm just unloading five years of frustration over a bad choice—I might be. But then again, when you look at the suicide stats and depression cases, do I have a valid point? Maybe. An avalanche of record work, unit tests, expectations, tuitions (No teacher would actually teach in class) when you finally made the plunge in 11th grade is really painful. So today, let an un-enlightened, lazy, powerless teenage girl make her point or attempt to show what we can do to make science un-daunting:

```
Attitudes:
if(science!=engineering || science!=medicine)
{
    student.life.quality = OKAY;
}
Course loads:
if (science.courseLoad <= student.ability)
{
    student.life.quality =
    FREAKING_FABULOUS;
}
else
{
    student.life.quality =
    (Psychiatry.ManicDepression +
    Psychiatry.StressDisorder);
}
```

Cassandra Goveas, studying in second year BCA, from Abu Dhabi, UAE has won the under-15 tennis championships in the ADCO Open. She is a motorbike and gore enthusiast with a bit of cartooning thrown in.

Disagreement Aiding to Pursuit of Knowledge in Natural and Human Sciences

Disagreements are always at every other stick's end. Though seen negatively, they can bring about positive changes in many instances is what this article says with substantial proof to back it up its message.

Humans have built and humans have destroyed, and that is how humans have grown. Similarly, we can never chalk down a plan before erasing our mistakes. Errors and mistakes are a part of life and it is these mistakes that help us progress in our lives substantially. In the same way in science, these errors and mistakes are a result of difference in opinions, and disagreements between scientists. However, the question that arises in our minds is whether these disagreements lead science to pursuit of knowledge? Is it beneficial for science and henceforth for the mankind?

A theory is proven after all the steps of induction go right. And a scientific model can be questioned if any of the steps in the process of induction contradict the logic of arguments. These disagreements are a result of an important way of knowing – perception. As said by Henry David Thoreau "It's not what you look at that matters, it's what you see." Different observations for the same scientific model lead to disagreement as different thoughts create a set of entirely different conditions. So, scientific progress needs a background of careful and immense observations. However it is not always the difference in perceptions that causes disagreements between people, difference in language and emotion can also lead to disagreements.

As said by Carl Sagan "Science is a way of thinking more than it is a body of knowledge." Scientific knowledge to a great extent depends on the way you perceive a particular aspect. The difference in perceptions for the same scientific model was greatly encouraged by Popper. Here the term falsification is noticed. Falsification for a particular theory is a type of disagreement that asks for verification to see till what level the particular

theory holds true. The different perceptions bring in various falsifications in the theory. Popper believed that the greater you try to find different observations that falsify a particular scientific model and work upon them; the faster will be the scientific progress. And hence, any theory that resists our best efforts to falsify should be provisionally accepted as the best we have for the time being. According to my perspective, we cannot claim a theory that is disapproved as an invalid theory and a theory that replaces the old one as a valid theory, as to some extent the old theory also remains true. All of its traces do not vanish. Hence rather than claiming a theory to be right or wrong, we better understand theories to be more or less inclusive. And this inclusiveness is bringing scientific knowledge closer to the truth.

According to me, different perceptions help science to grow in its own way, and prevent it from being static. Not all the theories are perceived the same way by all the scientists. Till date, we have been studying the law of conservation of mass, which states that the mass can neither be created, nor can it be destroyed, it can only be transferred from one form to another. However because of Dr. Higgs different perception for the law of conservation of energy was formed. After finding evidence for the existence of the Higgs Boson particle it can be assumed that there is a Higgs field due to which all mass is formed. Experimental results verify Dr Higgs hypothesis.

The same way, different perception of Tycho Brahe leading to different observations that were contradicting in the orbital planets helped Kepler to discover law of planetary motion. Through this example it is again evident that anomalies help in progressing science and the human knowledge.

Hailing from Gujarat, Tirath Nagda is a student of the first year BSc EMS. He takes a special interest in books, economics, mathematics and sports. He is also a part of the editorial committee of Catalyst.

Unstoppable Force vs Immovable Object – Who wins ?

The concept of immovable objects and unstoppable forces on the same platform might be confusing for it can be either possible or remain mere fantasy. This is a quizzical intake on what might happen when these two are woven together.

'What happens when an immovable object meets an unstoppable force?'
is a popular question on the internet.

According to 'relativity,' there is no such thing as an immovable object. For example, we know it is impossible to move a mountain but if we moved relative to the mountain, it would appear to move from our frame of reference. The laws of physics make no preference for a frame of reference. Hence the immovable object moves and because of relativity, an immovable object cannot exist.

But if by 'immovable' we mean that the object cannot move if a force is applied to it or in other words an 'un-acceleratable' object . Then this object can exist .According to Newton's second law of motion, we know that an object's acceleration is equal to the total force divided by the mass. Therefore, for an object to be 'immovable,' it has to have infinite mass and energy—which does not exist.

What about an 'unstoppable force'? Well, all the fundamental forces are caused by particles like protons, gluons and gravitons that interact with an object and change its momentum. The only way to not get affected by a force is not to interact with it, like how electrons don't interact with gluons. Even light is an unstoppable force. Every photon that hits your body changes your momentum a little bit (Radiation pressure). There's nothing you can do about it besides avoiding light itself by becoming transparent. So, all forces are already unstoppable. By my impression, it is that the phrase 'unstoppable force' is really meant to imply forces like magnetism, gravity. That is, an object whose velocity can't be changed which means the object cannot accelerate.

But wait! Earlier, we discussed about an immovable object and came to a conclusion that an immovable object has to be un-acceleratable. Hence an immovable object and an unstoppable force are nothing but the same.

Let's just say if an object with infinite mass and energy did exist. If the immovable object and the unstoppable force were to meet nothing would happen. A paradox would have been created.

Shuaib Khan, a student from first year BSc CMS, is a passionate footballer from Dubai. He is a part of the team Falcons that qualified for the semi-finals in the Pedagogic League.

Science – The way the Common Man sees it!

Everything in the world has two sides of views to it, and Science is no exception to this 'rule'. This article that is written from a young student's perspective has everything to offer about how Science is really perceived by a common bystander.

The evolution of mankind has always led to constructive and destructive culminations. With every passing year, the number of inventions and innovations seem to scale new heights and the fulcrum of this progress is undoubtedly Science.

Science has always been man's best friend; it helps the housewives for instance—induction cookers and latest innovative cooking techniques have helped them to ease their work. It also works out for the young toddlers in numerous ways from washing their poo-poos to help them grow into fine adults. Even in the smallest of matters, there is always science involved which gets the play going. It is like an omnipresent character without which the world might just not function. It is the Alpha and the Omega, too.

However, the cons of this fulcrum cannot be ignored. Science has been the root cause of several killings and massacres across the globe, with the use of nuclear energy. Misuses of this powerful source have raised a question as to whether this would be mankind's progress in future, or if it would be the beginning of the end. The biggest problem it imposes is on the young adults as a career path. Some take it up as they like it, others because they have to. With the educational pressure increasing rapidly it turns out to be a hindrance for several students which leads to undesired results.

Although science has greatly contributed to elevating the quality of life, especially in the areas of geology and communication, it has also negatively impacted the world through its misuse. Several questions still remain unanswered, several facts still remain hidden, but what we can be assured about is that science is sure to crack them wide open.

Jai Sharma, pursuing his first year of BSc CMS, is from Kolkata. Jai is a part of the editorial committee of Catalyst. He has bagged the Best Actor Nation Award at the British Council and at Manchester Metropolitan University.

Mermaids – Myth or Reality?

The myths of the past have been debated much over their presence in reality. The mystical mermaids, too, are a subject of this, and more of the same is covered here.

Mythology, folklore and such facets of fiction are found abundantly around the globe, and have played a major role in defining today's civilizations for they have great influence in beliefs that surround people to shape up the foundations on which societies are built.

Talk about India and serpents, snake-charmers, spicy food, colorful things are what conjure up in a foreigner's mind, while an Indian would recall dirty politics, bad streets, racists, social views—this is an instance to remind that there's always two sides to a coin.

Fairytales are what are now proclaimed to be fiction, to be stories created long ago by jobless folks. But what if the stories of goblins, leprechauns, unicorns, witchcraft might be true after all? We've all read, heard about these in kindergarten or elementary school, but not thought about it later. A few days after watching some myth-based horror-movie, we would research it on Wikipedia, leave it there.

There are famed television series, spin-offs based on fairytales—Disney movies for example that make us feel wowed, have us believe them for the brief moment they air. Then why do we refuse to believe in those fairytale-creatures' existence when we chance upon any figment of 'proof' of their reality?

Now, do mermaids really exist?

Before answering that, knowing theories that surround them is good. There are accounts of people who've sighted them; mermaids have always been earmarked in worldwide history. Ancient Greece, the Near East, the Arabian countries, Western and Eastern Europe, the British Isles, India, Thailand, the Philippines, Africa, China, Japan and many more places have narratives of sightings or tales of mermaids. With the countries in different continents thousands of miles apart, how are the myths of mermaids present everywhere? This is perhaps not mere coincidence, but a pointer to let us know that there might be mermaids existing in the world, inhabiting the deep seas like we humans are on the land.

The talk of mermaids chronicles how they are bringers of doom who wreck ships, bring ill-luck to sailors, lure people with their irresistible voice and womanly charms. It is notable that females are portrayed in most tales, with very few mentions of mermen.

Both mythologically and scientifically speaking,

there survive theories explaining the possibility of the emergence of humans evolving from sea creatures. Very recently, the channel Animal Planet released two documentaries on mermaids in which one seemed to support this theory with computer-based graphics for viewers to understand this seemingly complex theory; it showed that our ancestors, the ancient apes, might have chosen the aquatic world to lead life, later blended with the sea to form their new habitat, developing into creatures we call mermaids. The documentary is highly appealing and is recommendable.

These two documentaries are called 'Mermaids: The Body Found,' and, 'Mermaids: The New Evidence'. Both span an hour approximately, compelling the viewer into believing. It has three scientists who worked with the NOAA of North America, said to be fired now over their annoncement of mermaid findings which the government wanted to keep hushed. They talk about their findings, and rare discoveries of the 'bloop' that's believed to be the recording of mermaids talking underwater whose frequency of sound is below that of dolphins maybe, and people on the show claim to be experts in decoding the lingo of sea mammals, that there definitely exists a society of mer-people in the waters whose intellect may be high, as their language structure is also deemed highly complicated.

There are frighteningly surprising videos showing that mermaids exist, claiming to be promising. These documentaries seem worthy though there are many ridicules hurled at Animal Planet for airing such fake documentaries; there are rude comments over the internet about it saying that the 'scientists' on the show are actors, that the show is fraudulent.

For sure, one might not know what to believe in; people after watching these documentaries, reading write-ups of mermaids in the internet may not know what to believe. There's so much proof, yet so much not to believe in which makes the mystery surrounding the mermaids even more magical, and mystifying.

Nivedita. R, a student in the second year of BCA, hailing from Bangalore is a writer, poet, blogger, violinist, bibliophile. She enjoys Japanese and Computer Science, and also likes driving. Nivedita is also the senior editor for Catalyst.

Should we Explore Oceans Rather Than The Space?

What if there was a National Oceanography and Ship Administration (NASO) that sent men underwater to explore and discover the mysteries of the deep dark, vast blue carpet of water? This article stresses why there should be a NASO.

Oceans are mysterious. These have their own hidden secrets that are wandering in depths, waiting to be explored. Studying the oceans is not as exotic or glamorous as space but the benefits outweigh every other thing.

Exploring space and not oceans is like having a car but still travelling in a bus. Finding new species or an organic substance too is becoming easier now. In the recent past, oceans have been a centre for new developments and discoveries. Lately, ocean organisms have held the promise to cures of a number of diseases. A study of an eye of a ray fish has led to advancements in combating blindness. A drug that was derived from a sea sponge led to a major breakthrough to combat breast and urinary cancer. The Earth is covered with 70% water but it is astonishing that we have explored less than 10% of it.

Almost 200 new species of fish and plants are being discovered in a calendar year. Just imagine the potential that is hiding in those unaccounted places. Maybe we can get hints to engineer a species that will eat carbon dioxide and reduce global warming. What thrills and puzzles lie in those regenerating spines or those colourful corals in the oceans! No one yet knows the hidden potential in those depths and no one will ever know if we never start. So what I say is - Stop crying for Mars and let us start with what lies in front of us!

Samyak Jain is a student in the first year of BSc EMS. Coming from Gaya, Samyak's interests lie in playing badminton and cricket. Besides, he is also a part of the editorial committee of Catalyst.

Impact of Science

Though technology is being heavily relied upon, not many are reminded of this on an everyday basis; technology is taken for granted as a naturally existent thing. Here is a little reminder focusing on how science benefits us always.

Today, everything we do is influenced by science and its applications. From morning to night, each activity is related to science in one way or the other. Apart from the pre-conceived notion that science relates to electronic gadgets, science finds its use in every places. Even in the field of commerce, there are applications of science. We have several disciplines of science like nutritional science, behavioral science, management science etc.

Science has its own beauty. Think of a simple calculator: it is pocket-sized and does any calculation within fractions of a second. Science never limits itself. It always ventures to unravel the unknown. The various laws and theories developed provides explanation to our each action—from yawning to running and more! Today, 'Google ' answers all our queries in a second, but there are still several answers to be found by the research experts. Even today, scientists have been unable to find all the elements mentioned in the periodic table. There is a vast scope in science for everything there is. Furthermore, the basic acid reactions and their cure are explained through basic chemistry. Our nutrient requirement, fat control, and such bodily actions are taken care by nutritional science.

Thus, science plays a huge impact in our life and it is something to which a boundary cannot be drawn. If we start making a list of activities where science affects us, the list will become endless. This is the magic of science.

Harsh Jaiswal is in his first year pursuing BSc CMS. Born in Kolkata, Harsh plays basketball and cricket. He is currently a part of the editorial team of Catalyst, and he enjoys helping out in fests. He aspires to be a Data Analyst.

The Fault in our 3D

This article is a good read for those who have wondered about what is behind 3D motion pictures. With the moving pictures creating illusions in the mind, 3D movies are adored by all. But this popular media form also contains a major fault.

One calm Saturday afternoon, I was rudely awakened from my nap by my cousin. He rushed me to get ready as we had planned to go for the movie Avatar by James Cameroon that hit the screens a few days back. Controlling my excitement for the animated 3D movie, I started getting ready indifferently. Shark Boy and Lava Girl was the last 3D picture I'd watched, which was way back in the calendar, and after which I was fascinated about 3D image capturing techniques. I got interested in the optical physics and I always became the most enthusiastic student in the class whenever my teacher uttered the words focal length, convex, concave and the likes.

As this passion haunted me, I kept watching 3D movies not just for the story, but also for the techniques trying to resemble the reality of physics. In due course, I came up with something serious which struck my mind as a major fault in the prevailing 3D image capturing technique. Yes, this is a 'Haven't-you-thought-of-this?' type of article.

Looking at the evolution of these moving pictures, I arranged its development in two simple steps. Firstly, man made a static two-dimensional picture. Second, when a series of these 2D pictures with slight change in each frame is seen at some speed, it resulted in the moving 2D picture. Obviously, most of us know this. These two steps are the same in the case of 3D photography and 3D videos. Before directly jumping into the moving picture, I consider a single frame from that video, as these frames constitute the entire video.

Consider a two-dimensional picture frame from a 2D video. In a two-dimensional picture, the details of the field are recorded only in the x and the y axes and one particular point in z-axis. Thus every point in these two pictures has its coordinates with respect to the x and the y axes. Clearly, if I ask you to look at a point in this picture, the picture allows you to see that particular point. The biggest difference between 2D and 3D is the presence of z-axis in the 3D pictures.

Every time we start to watch a 3D movie, our eyes strain a little during the beginning of the film. This acute strain lasts only for few minutes and it becomes alright as the movie proceeds. This is because the iris in the human eye adjusts the focal length of the lens in the eye, by compressing and expanding it from the edge of the lens.

It adjusts in such a way that we get a clear image of what we want to see. I keep this human-eye-point at pause and now let me put forth the fault which I found in 3D videos as well as in three-dimensional photography.

Like the 2D pictures, three-dimensional pictures too have only one focal point. It can acquire only the details of the distance of other unfocused objects in the field, but not capture the clear detail of each and every point in the z-axis of the field photographed because the lens can focus only one point at a time. This just gives an illusion of the reality.

So when a movie begins, the 3D picture orders the human eye to focus only the clear point which the camera recorded. Thus the human eye is in confusion whether to obey the orders of the picture or the orders of the brain. This change in the thickness of lens of the eyes takes place so fast that we may not notice it, but this is the reason for the small strain which I mentioned earlier. As the movie proceeds the eye obeys the picture and the strain vanishes.

The Fault: We are able to see any point in x-y axes in a 2D picture. But we are not able to see all points in x-y-z axes, but only the focused point in z-axis, which is not exactly what 3D means.

If we are able to produce a 3D picture, in which we can see any points in the z-axis clearly, it can resemble reality, as a window of the world. Movies become an experience. I call that the MULTI-FOCAL IMAGES (MFI). Even when a special mechanism is needed to be developed to capture as well as project an MFI, the future is with it!

Suraj Maharaj, a student of first year BSc PME, from Coimbatore is an amazing blogger, newsreader, sportsman and guitarist. He has won the Division Level Table Tennis Championship, has composed music for many short films and is also a proud recipient of the Inspire Fellowship.

Desserting Mathematics

Harry Potter and his friends found out the underlying truth behind the seemingly harmless numbers over homework and some ice-cream here at Catalyst. It isn't simple to discover truth unless you are challenging, and this article challenges us to sight a truth.

"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 okay 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, grabbed a quill and began scribbling away.

$x = 0.33333$

$10x = 3.333333$

$10x - x = 3.333333 - 0.333333$ (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! This means, I'll have to add 0.00000000000000000... 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.
3×1/3 = 3×0.333333
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 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 on 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."

Every decision taken defines its significance in our life, and so did math for Arpita Prasad in her apparent choice to take up Mathematics for her Masters degree, currently in her first year. She teaches at BASE and sings professionally.

Invited Articles

To Queue or not to Queue

People are always in a hurry and have no patience to wait in long lines or queues. However, the ever-reliable technology provides a solution for this is what's explained here.

In 2012, I had the opportunity to visit Disneyland in Anaheim, California. At Walt Disney's "happiest place on earth", operations managers are addressing the psychology of queuing. In late 1999, they introduced "Fastpass", a virtual queuing system which can be used by guests to avoid long waiting lines at certain attractions. Each card has a specific time slot and guests arriving at this time slot skip the long queue to experience a ride or a live show. This way guests do not complain about long waiting as they might have only one day to visit the entire theme park. Also, Disney adopts another strategy to keep guests engaged while waiting in the line. They have placards in the line which display sojourn time informing guests that it will take "x" minutes from here to get to the ride. Disney also has photographs that explain the evolution of the rides along with costumed characters and food carts which keep guests engaged while waiting in the queue.

The reason I started with Disney's example is to introduce readers to a shift in traditional operations research i.e. to consider human behaviour while designing systems or processes. The formal approach has been the use of analytical models to design, analyze and optimize systems. Even though these modeling approaches have been successful, they assume that decisions are made by a rational decision maker, which is far from true. This drawback is addressed in behavioural operations which incorporates human behaviour as first order effects in traditional operations models. Quoting Hayes et al. from their book, Dynamic Manufacturing: Creating a Learning Organization: "Superior performance is ultimately based on the people in an organization. The right management principles, systems, and procedures play an essential role, but the capabilities that create a competitive advantage come from people—their skill, discipline, motivation, ability to solve problems, and their capacity for learning."

Readers interested in behavioural operations can refer "Toward a Theory of Behavioural Operations" written by Francesca Gino and Gary Pisano, published in a reputed operations management journal, Manufacturing & Service Operations Management.

Karthik Sankaranarayanan is an Assistant Professor of Operations Management at the University of Ontario Institute of Technology in Oshawa. He earned a PhD degree in Economics and a Master's degree in Embedded Systems from the University of Lugano.

Invited Articles

Teeth

What we would do without teeth is unimaginable. This is highlights the importance and wondrous facts of teeth.

Teeth have more uses than one knows. A human gets two sets of teeth in his lifetime. The first set is called milk teeth or deciduous teeth. It is called milk teeth since its milky white in colour. The second set is called Permanent teeth. The function of the milk teeth is three-fold.

1. To help the child in chewing food which provides nourishment to the child to aid in growth
2. For aesthetics or looks, which is of utmost importance for the healthy physiologic growth of the child and
3. Serves a most important function of maintaining space for the permanent teeth. If the milk teeth are prematurely removed, then, gross mal-alignment results.

Hence, one must not be under the impression that the milk teeth is temporarily present and it doesn't matter to lose them.

The permanent teeth start erupting from the age of 5 or 6. The last milk tooth falls off around the age of 11-12. This period is between 5-12 years is called as mixed dentition, since both milk teeth and permanent teeth are present. The last permanent teeth the wisdom teeth erupt between the ages of 18-25. They are called as wisdom teeth since they erupts around the time the person gets mentally mature or gets wisdom. Nowadays, due to the process of evolution, jaws have decreased in size. Hence, most people have their wisdom teeth stuck in their jaw bone causing pain.

The functions of the permanent teeth include

1. Aesthetics or looks
2. Chewing of food or mastication
3. Speech. A person without teeth finds it difficult to be understood by others when they talk. Teeth are most important while saying words with F, V, S and many more such letters.
4. Preservation of remaining tissues. The tooth helps stimulate the underlying bone and hence maintains the bulk of the bone. One can see sunken cheeks in people who have lost their teeth.
5. Proprioception. Greek and Latin isn't it? It basically means that one doesn't have to look at one's knee to say that it's bent or straight. The same goes for an elbow or fingers or any other joint. There are Proprioceptive nerves which send these signals to the brain. The tooth through its roots, sends the signals to the brain as to the location of the lower jaw against the upper jaw. A person who has lost all his teeth loses the feel of the lower jaw against the upper jaw.

Winding up, the human body or even any other animal for that matter is a complex creation of Nature. So much of evolution has happened over millions of years to make man as he is now.

Professor Dr. Ravindra Savadi has done his BDS and FDS degrees and has teaching experience in Dentistry. He is a recognized Ph. D guide and has held office as the President of the Indian Dental Association.

Alumnus Article

Churn the Data, Get the Delicious Info

Have you ever wondered of the sea of information that is created by you every millisecond? Your email traffic, internet search history, geotagged images you share through social media sites, your retail transactions, etc., all generate information about you.

Science says, “Every act of us leaves a carbon footprint behind”, likewise every activity of ours, leaves behind a “Big data footprint”.

Yes! This is a modern era of huge volumes of data growing exponentially! Technical advancements have aided classification and filtering of waste to a large extent, but there is still a dire need for more and more decisive abilities such as ETL.(Extract Transform Load).

Big data scientists have an exploratory career. They uncover the relationships of various variables, analyse past data with appropriate trend patterns, forecast the behavior of future data, and explain the phenomenon under relevant studies. Research and development sector is working constantly towards handling this huge data and providing optimal methods to resolve it.

Experts also say, “Everything we do is a big data problem”, so, let the data do all the talking.

An interesting application of big data is in the field of criminology. Mike Flowers, a lawyer, who used data to identify terrorist hotspots in Iraq, was picked by the mayor of New York City to help police find illegal housing where houses meant for four were being used to house much more, sometimes up to twelve people, resulting in fire hazards, rats and nuisance. Instead of relying on old methods like inspectors' hunches and tip-offs, they used big data. All property related data in New York was used and patterns were explored. It is highly interesting to note the frequency of brickwork maintenance rat sightings, fire incidents, tax payments and many others had a correlation with illegal housing. They ranked the leads so that most likely violators could be narrowed down and the success ratio increased from 13 per cent to 70 per cent.

From being an industry buzz word to one of the most prevalent technologies in modern day, big data has come a long way. So, get the delicious data and icy info before it melts!

Srishma Sunku is an ex-BSc CMS student who enjoys singing, reading novels and Grapho Analysis. Statistics is her favorite subject and she desires to apply her best in her further studies.

Facts

- Yelling for 8 years, 7 months and 6 days, produces enough sound energy to heat one cup of coffee.
- The chance of being born on Leap Day is about 684 out of a million.
- One in ten people in the world live on an island. Aren't they lucky?
- A square piece of dry paper cannot be folded in half more than 7 times.
- Because man is light enough to float on the moon, heavy weights have to be put into an astronaut's moon-walking boots!
- Milking a cow by hand or machine increases the amount of milk produced far beyond what she would have produced if she had continued nursing her calf!
- The monkey has two brains. One controls its body, the other its tail!
- The ostrich's legs are so powerful that one kick can kill a lion!
- Our eyes are always the same size from birth, but our nose and ears never stop growing.
- A single breath from a mature blue whale can inflate up to 2000 balloons.
- Hugging releases oxytocin, which helps to heal physical wounds and makes someone trust you more!
- You have no sense of smell when you're sleeping!
- The human body has enough iron in it to make a 3 inch long nail.
- While sleeping, one person out of every eight snores, and one in ten grinds his teeth.
- People generally read 25% slower from a computer screen compared to paper.
- Your brain is move active and thinks more at night than during the day.
- Do you know what is Uvula? It is the small piece of the small tissue dangling over the tongue.
- Do you know your brain is 80% water?
- No pain in the brain! Do you know our brain does not feel pain! Even though brain processes pain signals, the brain itself actually does not feel pain.
- The tips of your fingers have enough strength to support the weight of your whole body.
- The strongest bone in your body is the femur (thighbone), and it's hollow!
- A sneeze can exceed the speed of 100 miles per hour. When a sneeze leaves your body, it is at such a high speed that you should avoid suppressing it.
- Women’s hearts beat faster than men. Also women blink more than men .
- Do you know a woman has approximately 4.5 liters of blood in her body, while men have 5.6 liters?

Prakash Pandey
I BSc CME

Shreeraj Hegde
I BSc PCM

It's Normal

It's hard to write, it's hard to speak, it's more in heart, less on sheet..
Eyes are shut, air breathe in, I swear I swear, its not my sin !
From the walks we have walked, to the path we have talked,
In spite of storm, despite the norms,
We'll stand, no fail, the bond shall hale.

Head held high, then down with sigh,
the roll calls up and the seats occupied.

Latin or Greek, is all I wonder,
I beg to seek the past, who caused such thunder.
"Its essential, should be pure,
for the world to run, for people to endure"
"What should we call it", asked Apollo "dear Athe",
"Arithmetic! Too big, just call it Math"
Then some did doom, while some relished,
reason of change, all minds did vanquish.
The greats were born, in the brightest of forms,
created such histories, beyond lies the mysteries.
But be it Euler, or be Gauss,
There's mess, there's chaos, mistakes and flaws,
"I can't remember, it's a big concern",
"Lets work together, we'll slowly learn".
You tell me alpha, I'll tell you beta,
together we'll find, the value of theta.
Then you differentiate with x, I will with y,
That's how we'll get, dx by dy.
The last hope left, was the trust we had shared,
marks become the mark sheet, of how much we cared.
Brains on work, like electrons in wire,
in the end we put the ice on fire.
Alas! There was more, more to the core,
"Math is too less, let's put one more crest"
"The era shouldn't perish, and human shall cherish,
I am Janus, I am for them, and it's the risk that I condemn"
"They shall be the masters, there own tutors,
lets give them the power to seek into the future".
"Summation, negation, so many characteristics,
keep it simple, just call it statistics."
In this race of pie, score wasn't high,
moments and functions are all who spied.
"Chi square or t, it is such a confusion,
notations altogether, danced like illusion.

The pen went on, testified my intuition,
then she whispered in ear, "its normal! Normal distribution."

Chahak Goyal, studying in second year of Bsc EMS, is a silver medallist holder in the "International Award for Young People". Her artistic abilities are exceptional and can leave the viewer spellbound. She aspires to become an Acturian.

Pixel Perfect

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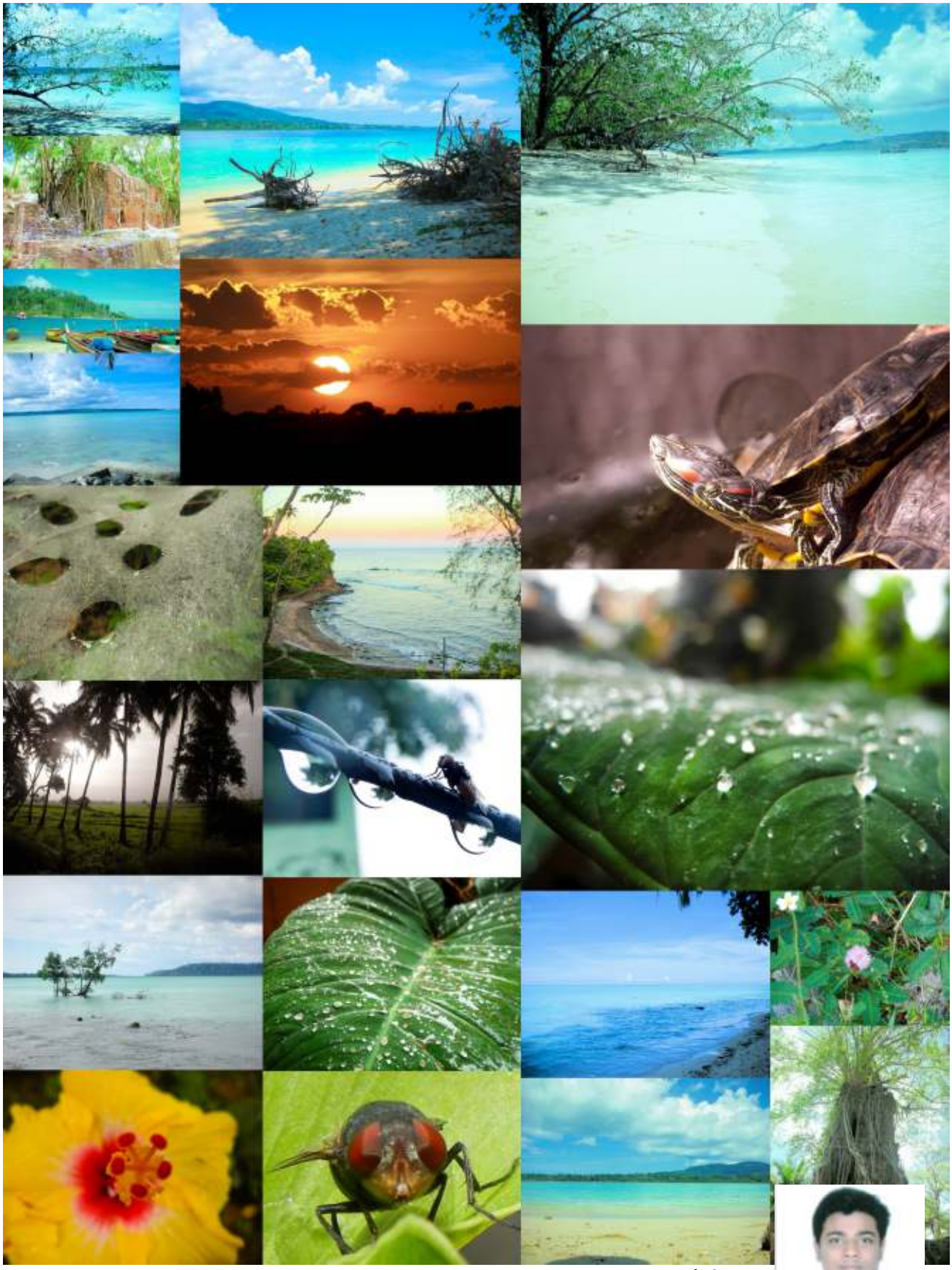

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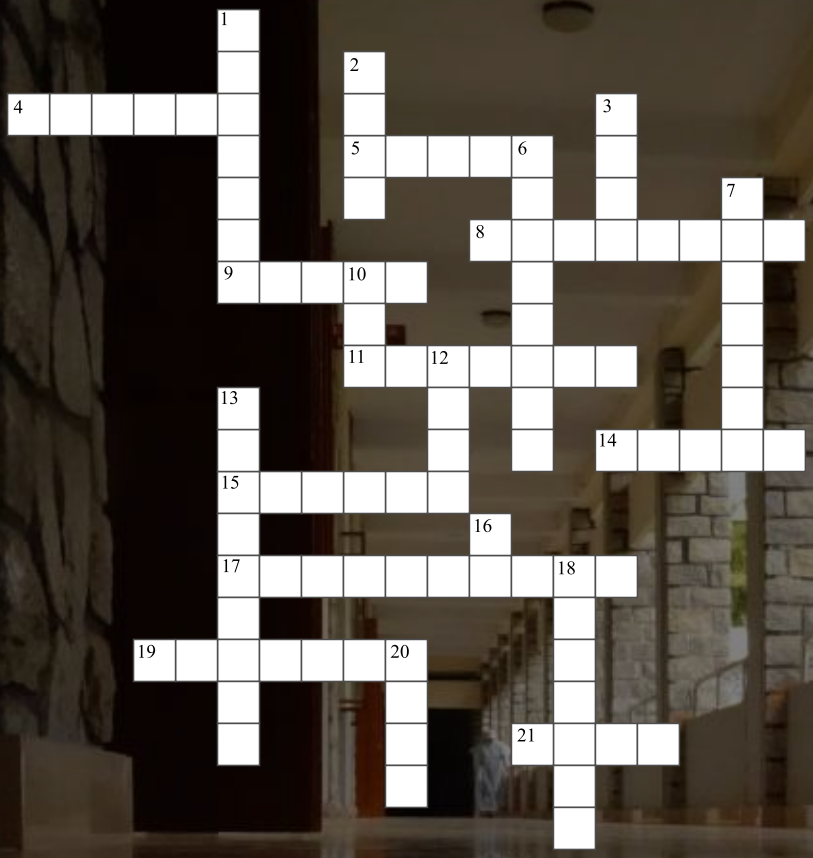
Crossword



Across:
4. A semiconductor that consists of a junction
5. A gas acts as a screen for ultraviolet rays
8. Systematic investigation to establish facts
9. The state in which a substance has no tendency to flow under moderate stress, not liquid
11. Either one of the two external openings to the nasal cavity in the nose
14. The rate of doing work
15. A gas, an element discovered by Joseph Priestly
17. A property of a substance to oppose flow of current
19. The largest planet in the solar system
21. An insect in the inactive stage of life

Down:
1. Red eruptions on the skin
2. A gas, a chemical element
3. A connective tissue in a body, takes more percentage of calcium intake
6. A base elementary particle
7. A study of Natural and physical world, Main world
10. A particle that is electrically charged
12. A tissue which covers all the body of animal, sense organ
13. A study of earth science
16. A strong wind
18. An electrical device that provides a path for current to flow
20. Drops of fresh water that fall as precipitation from clouds

Answers
1.Rashes 2.Neon 3.Bone 4.Diodes 5.Electron 6.Solid 7.Science 8.Research 9.Solid 10.Ion 11.Nostril 12.Tissue 13.Geography 14.Power 15.Oxygen 16.Gale 17.Resistance 18.Circuit 19.Jupiter 20.Rain 21.Pupa

Sai Saranya, a student in first year Bsc CME from Ananthpur, Andra Pradesh, believes in trying to make the best of her time by indulging herself in various activities. Her keen interest in dancing and utilizing her mental skills in Chess, has thus enabled her to win several school competitions.

CATALYST

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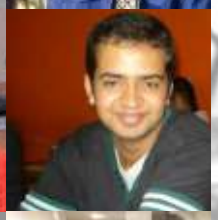


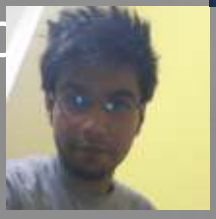


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