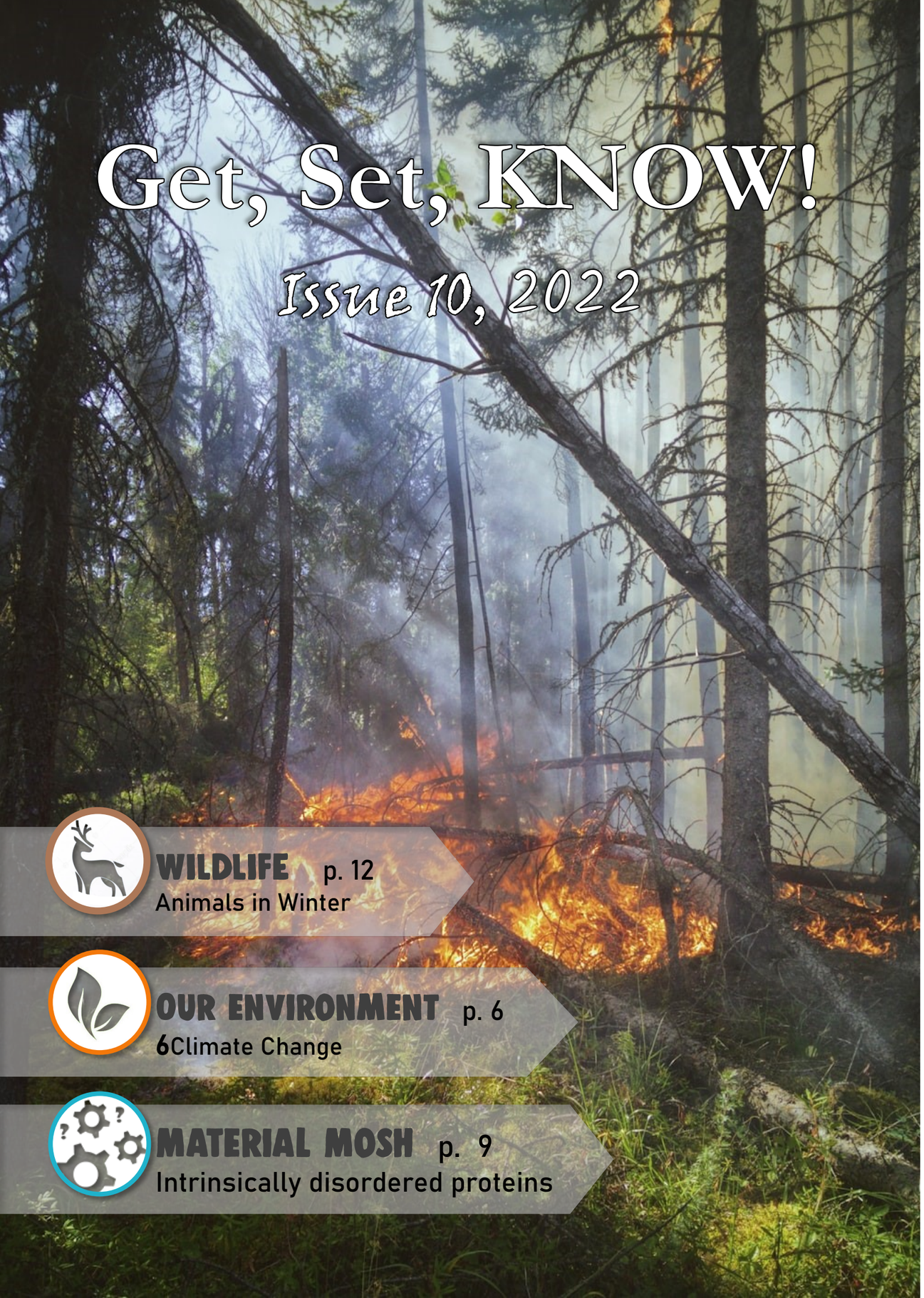

Get, Set, KNOW!

Issue 10, 2022

Get, Set, KNOW!

Issue 10, 2022

Dear Readers,

Okay, our bad. We apologize for the delay, and we share your frustration with the prolonged wait (Believe us, we've been struggling to put this issue together for what seems like ages now). Moving forward, we are excited to announce the introduction of a new way to categorise our articles (the website will reflect this change too, please hold on to our hollow promises). We grouped a bunch of similar subsections under five major sections. For this issue, we stick to the classic layout. There's one thing we're glad about – the articles we receive from researchers and college grads are a great way for our mostly high-school audience to get introduced to hot new themes in research and what their future implications might be. Some of the articles we received, we have saved up for the upcoming issue. Your patience and support has been tremendous, and we promise the next issue of GSK will indeed be released within this year.

Sincerely,
Muhammed Zaid
Associate Editor

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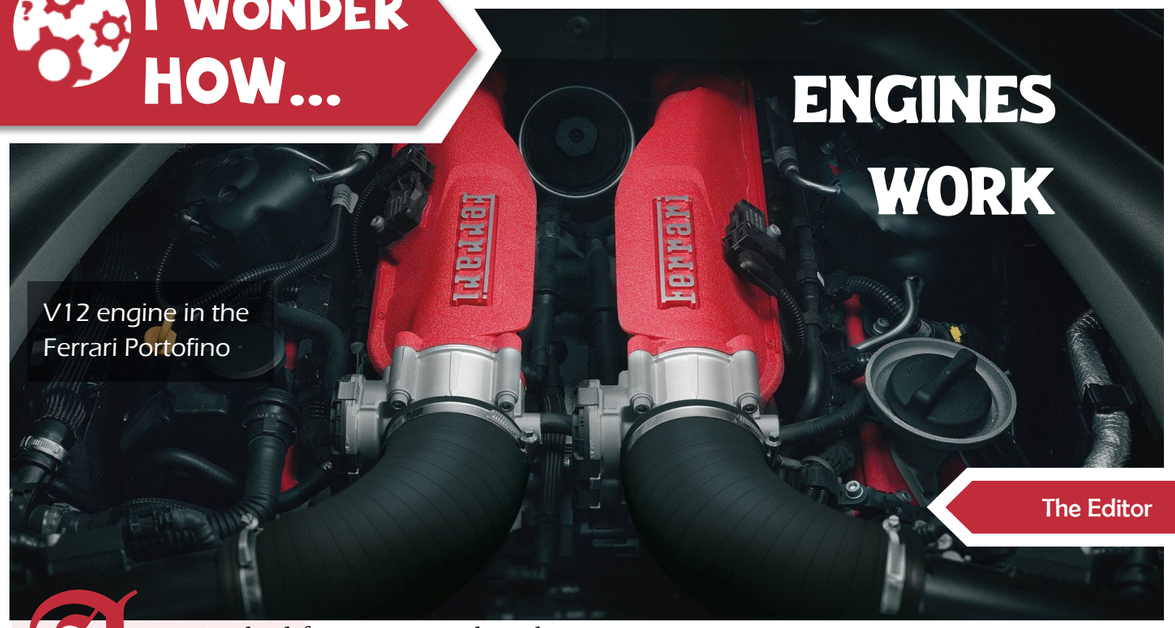
I WONDER HOW...

ENGINES WORK



V12 engine in the Ferrari Portofino

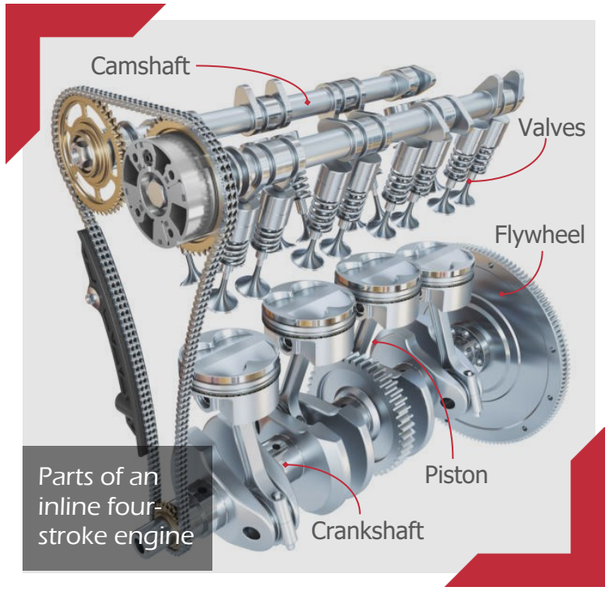
The Editor

An engine, by definition, is a machine that converts energy from a fuel into mechanical motion (often rotational). Engines find use everywhere – from large ones installed in power plants to those that power vehicles.

THE HISTORY

Simple engines which do not employ a fuel (also known as motors) have been in use since time immemorial. Use of early gearwork appears in the construction and function of temple gates, windmills, ships and waterwheels. Early steam engine designs were developed in 1712 by Newcomen and greatly improvised by James Watt. Sadi Carnot furthered the theoretical working of engines in the 1820's, establishing the groundwork of ideal heat cycles and efficiency used even today. Nicolaus Otto built the first ever working four-strole engine (based on earlier mid-19th-century models). His design was so optimal that it still drives majority of automobiles today.

Broadly, engines are classified as either external or internal. External engines follow a thermodynamic cycle in which the working fluid receives heat from an external source (such as the coal furnace in a steam locomotive). Engines either employ pistons to achieve back and forth 'reciprocating' motion or a triangular rotor housed in an oval shaft (the rotary engine employed in the iconic Mazda RX-7). Rotary engines generally run smoother and are more reliable due to lesser number of components, but also happen to be expensive fuel guzzlers.



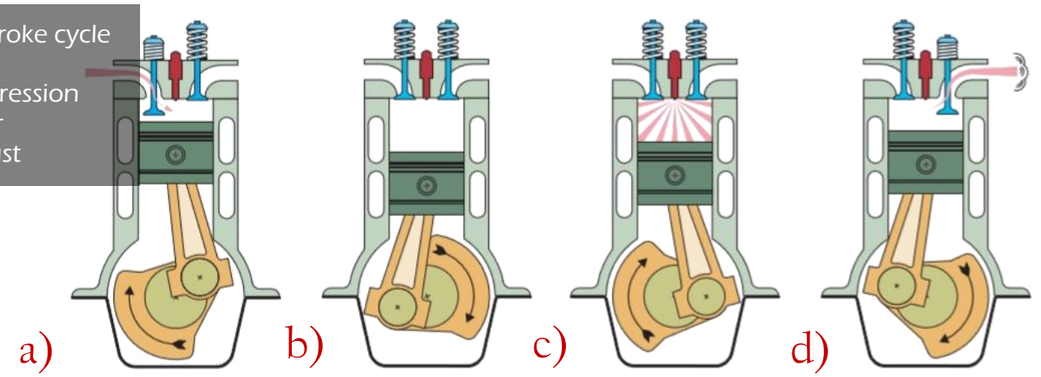
Parts of an inline four-stroke engine

THE WORKING

Typical vehicle engines consist of a series of pistons aligned over a crankshaft (the part which converts linear motion to rotation). A series of valves are attached to the top of the pistons (hence making up a 'cylinder') which regulate the intake and exhaust of fuel-air mixture. The flywheel helps stabilize the irregular movements imparted by the pistons. Each piston typically undergoes four movements or strokes to complete a full cycle.

1. In the first cycle, the intake valve opens and the air fuel mixture rushes into the cylinder.
2. The piston is pushed in as both valves close.

The Four-stroke cycle
a) Intake
b) Compression
c) Power
d) Exhaust



The air-fuel mix is ignited by a spark plug absent in diesel engines.

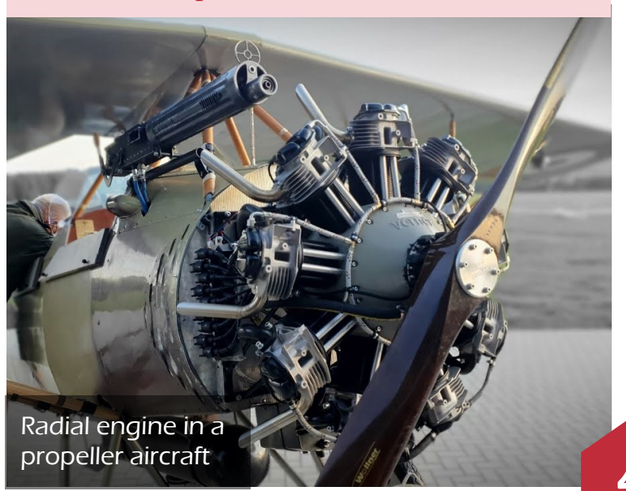
3. This is the 'power' stroke – the explosion pushes the piston out.
4. The outlet valve opens, and the exhaust is expelled.

The presence of at least four cylinders ensures that a single piston is always in power stroke at any given time. Although the four cylinders are classically arranged in a straight line, variations such as the V8, V12 models in supercars and radial arrangements in aeroplanes is also popular.

Superchargers and turbochargers are often installed to aid in the air intake of the engine (originally put in ships in WWII). 'Twin-turbo' refers to the combined us of a supercharger and a turbocharger, as was first seen in the Porsche 959. The Bugatti Bolide a new-lline hypercar, sports *four* turbochargers emloyed in a 16-cylinder W16 engine, generating over 1800 horespower.

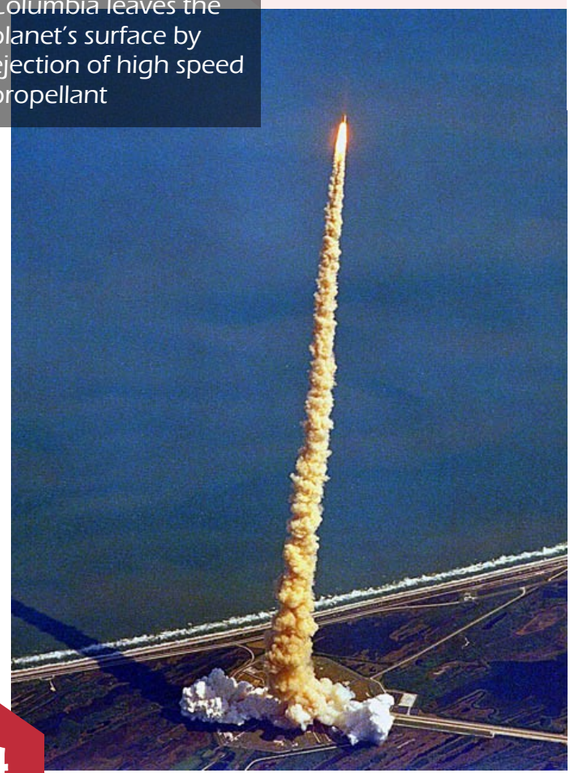
Jet engines, on the other hand, work on a much simpler basis. They force low temperature atmospheric air to create hot, high-pressure jets that propel the aircraft forward. Popular examples of iconic jets were the Concorde – the first commercial aircraft capable of supersonic speeds, and the Lockheed SR-71 Blackbird, featuring two Pratt & Whitney J58 turbojet engines which make it capable of outspeeding *missiles*. Due to the environmental implications of conventional fuel engines, electrical engines having electromagnetic motors are currently on the rise. The work similar to the miniature motors that drive household appliances and toys.

What are pulsejet, ramjet and scramjet engines? Find out and send us your answers in 350 words or more to getsetknowmagazine@gmail.com for an exclusive prize!



Radial engine in a propeller aircraft

NASA's Space Shuttle Columbia leaves the planet's surface by ejection of high speed propellant



MONEY

Freshly printed dollar notes

Syed Ali Atiq, B.Com, I Year,
Aligarh Muslim University

What is money? One would probably answer – a 'medium of exchange for goods and services that needs to be durable, portable, divisible and interchangeable'. Not exactly. The characteristics mentioned above are rather of currency. There is one more, very essential factor that differentiates currency from money.

If we go back in history, the first kind of currency used was commodity currency. Objects like axes, salt, shells, seeds etc. were used but they all had various limitations – they were not durable in the long run, and neither were they divisible or portable enough. These limitations were solved by the introduction of the first kind of real money which were nuggets of gold and silver. Out of the two, only gold did not corrode, unlike strong metals like iron and copper. They were portable, meaning one could travel with them easily, unlike other commodities like oil. And they were divisible, as it was possible to further split them into smaller units for distribution.

But they were still not currency, as they were not fungible (interchangeable). The pieces of gold were not uniform, that is their value was estimated based on guesses of their weight and size. There was no definite way of determining or assigning a correct value for them. All the limitations discussed above were overcome by paper money or 'token currency'. It shows up in various instances in history; put in place where the 'notes' indicated a 'promise to pay later'. Such notes are recorded to have been issued by early Chinese and American governments.

Cowrie Shells

With the help of modern technology, we now also have CBDCs which is a digital form of currency. They are durable, portable, divisible and interchangeable. They fulfil all the characteristics of a currency, but they are still not 'money'. Now the point is, money also needs to be a 'Store of Value', meaning it should maintain its value over a long period of time. For some time, governments and banks did possess enough gold to pay the amounts promised by the notes. But their greed led them to printing more and more money than the gold available to back it, which leads to the purchasing power going down. The currency itself holds no real value.

Modern currencies like the US Dollar (fiat currencies) are not backed by a commodity such as gold or silver. The US dollar surged from 35 marks an ounce of gold in 1971 (the year President Nixon took the dollar off the gold standard) to 1998 marks an ounce today. Modern currency is therefore, clearly not a good store of value.

No fiat currency in history has ever survived, it has a 100% failure rate. So, the chance of USD – the world's official reserve currency, to succeed after so many have come and gone is almost impossible. In my opinion it's not a question of will it survive, rather it's for how long it will survive. And we always tend to go back to gold because it has all the properties we need in money. It is fungible, because the machinery and tools available today makes it easy to mould it into small pieces and value correctly. It is also a store of value which fiat currencies are not; the value of gold a thousand years ago was the same as it is now, and its purchasing powers also stays the same. It is truly God's money as it has never lost its value since the dawn of time.

Climate Change

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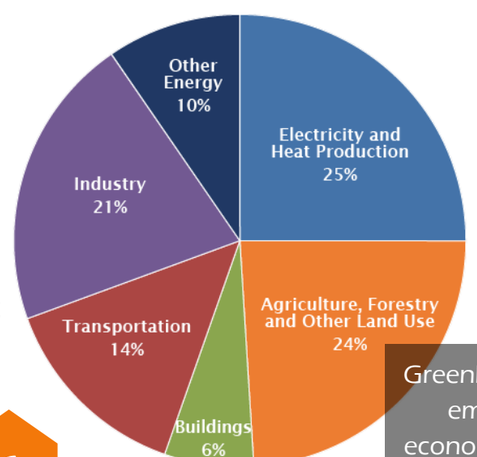
NCCR-Bioinspired Materials,
University of Fribourg, Switzerland

Climate is the term used to describe typical weather conditions prevailing over a large geographic area. Even though the weather over a place fluctuates by the day and with the passage of each season, stability in the overall climate is what sustains life. The planet has seen many drastic climate changes leading to mass-extinctions in the past, (our geologic timescale is divided on *this* very basis!) but this time the cause isn't natural - human activities such as burning fossil fuels drove up global temperatures at rates never seen before. Greenhouse emissions alone are responsible for majority of extreme weather events - melting of polar ice caps, retreating glaciers, rising sea levels, heat waves and wildfires in the tropics, followed by devastation of crops and massive habitat losses across the globe.

Extreme weather conditions affect essential infrastructure such as telecommunications and transportation. The availability of natural resources such as food and fresh water is also impacted, resulting in shortages and conflict, especially in poor and developing countries. Extreme weather conditions such as floods and droughts disrupt supply chains, resulting in financial losses and social upheaval.

A changing climate also impacts human health. Diseases like malaria and dengue fever can spread more quickly due to rising temperatures and changing weather patterns, a time when our immune system is compromised as well. Turns out, our dependence on conventional, polluting energy sources in nearly *every* sector in the pie-chart below shows how reduced reliance on fossil fuels is necessary to address the main cause of climate change. Development of alternate energy sources like solar, wind or nuclear power is hence crucial in reclaimng the future of our planet.



Greenhouse gas emissions by economic sector

MIND AND BEHAVIOUR

GESTALT

Mariam Nusrat Khan, B.A. , I Yr, Psychology,
Women's College, Aligarh Muslim University

The brain is the busiest organ in the body, but also one of the laziest. When out in the world, if our brain was to stop and focus on every single stimulus around, it would take a good while till we could move on to your actual task. We do not take note of every small component an image consists of; instead, our minds tend to perceive as a *whole*, greater than the sum of its parts. In this laziness, our brain wants to find order in chaos, and so we start to look for an overall meaning in all the stimuli around us.

To illustrate this, suppose this wasn't the case. Then right now, one would not be able to read through this article at all. If our brain wasn't being 'lazy', then we would only perceive individual letters all scattered around across different words. The fact that our eyes sense eight letters in the word 'shawarma', while the brain perceives a meaning greater than the stimuli shows how necessary this laziness is. When one flips through a flipbook or watches a film, he does not focus on every single image, because if he were to specifically look at each one, he would miss the whole movie.

The idea is that the brain sees things as a whole rather than in parts, and that this whole is something greater than the sum of parts. A direct contrast to the structuralist's view, this idea of Gestaltism is the main idea binding all that we know about human perception. We are innately driven to experience things in as good a *gestalt* (whole) as possible.

"Good"
can mean many things here, such as regular, orderly, simple, symmetrical, and so on.

You are constantly constructing gestalts, organizing and reorganizing your experience, searching for patterns and a feeling of wholeness in all the unrelated distorted objects around. Consider the following image-

In this collection of unrelated stimuli, the mind searches for a pattern, and then one might perceive a football. In reality, there is no football—only a bunch of scattered black shapes. There are laws governing these patterns, called the Gestaltian Principles. These are also the secrets behind optical illusions (false perception). This same concept is used by designers, artists, and marketers to present an object that is not actually there. We see movement on flat surfaces and our mind creates images that don't exist.

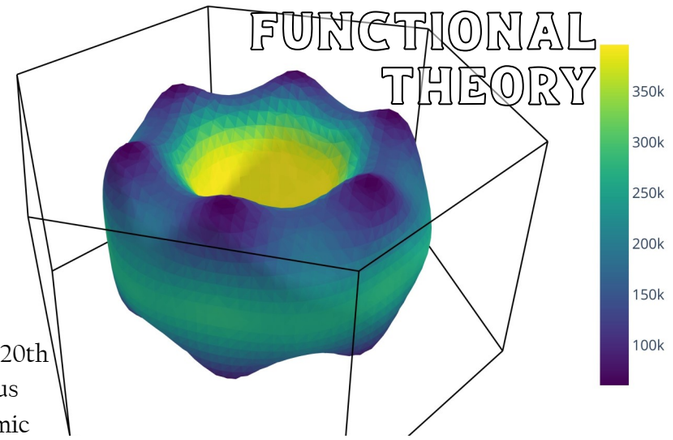
The Phi Phenomenon (φ) is the apparent motion of fixed stimuli. If there are two stimuli separated by distance, and if they are presented successively at a certain speed, then the brain perceives only one object, and this object appears to move (remember look again at the dotted loading loop). The Phi phenomenon is the optical illusion that helps you perceive movies and flipbooks.

Our minds are wired to overlook the individual elements that make up a burger and focus on its overall 'meaning' instead

These were some of the simplest examples of the phenomenon. Everything you see is gestalt. Do we see four sticks of wood and a plank just lying around? No, we see a table. This is not rhetoric. Every perception takes place in the brain, without this mental activity everything around us would just be sticks and blocks of wood and iron. Also, what we perceive at any given moment is dependent on our personal physical abilities, energy levels, bodily discomfort, and more. A lot of what one sees is subjective to genetic predispositions, past experiences, prior knowledge and notion, emotions, motives, self-interest, and cognitive distortions. It's fascinating how a piece of rope can be a deadly snake with just a little change in brightness of the room. Perception is not a physical reality, in fact it is something bigger, and it's all because our mind is a bit lazy.

PARTICLE PUDDING

DENSITY FUNCTIONAL THEORY



M. Nur Hasan, Senior Research Fellow,
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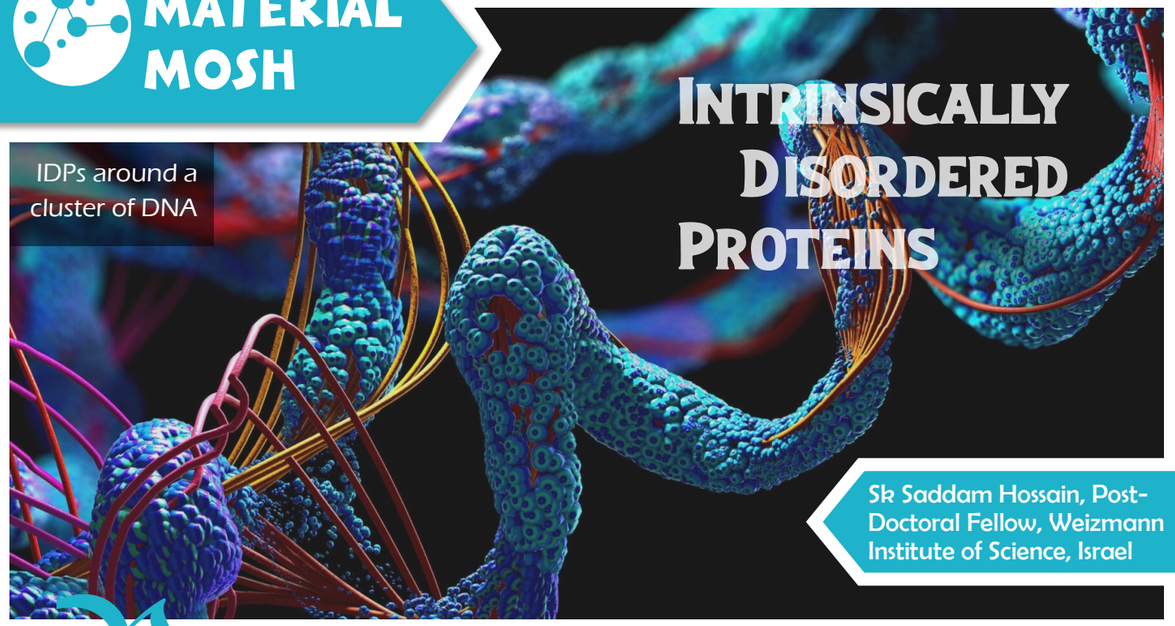
Quantum mechanics emerged in the early 20th century as the field that explained various microscopic phenomenon involving atomic and subatomic particles. Such particles do not follow laws formulated for ordinary, macroscopic objects. Interaction between a tennis ball and a racquet for instance, can be studied by Newtonian Laws, but microscopic systems with only 3 or 4 bodies exhibit far more complicated interactions (known as 'entanglement'). The water molecule has only three atomic nuclei and must thus encounter ten electrons to probe theoretically a very difficult task indeed.

The initial prediction of density functional theory (DFT) started in the mid-1960s. In this theory, electron density has been taken as the fundamental variable rather than the attributes of any single particle. DFT followed many previous theories such as the Valence Bond and Molecular Orbital theories and reformulated the many-body problem as a comparable single-particle problem.

DFT has been the most widespread and versatile tool available in condensed matter physics, computational physics and computational chemistry since the 1970s. The Nobel Prize of 1998 was awarded to Walter Kohn for the discovery of the DFT. Over the following years, the technique developed into a powerful tool for understandings of the electronic properties of materials. The consistency of the algorithms is yet subject to the improvement of approximations used in the exchange-correlation energy functionals.

Modern DFT simulation codes are able to simulate a huge variety of structural, optical, chemical, elastic, infrared vibrational & spectroscopic properties exhibited by quantum systems. Nowadays, researchers have made it a common practice to include DFT results in research articles to justify experimental findings.

MATERIAL MOSH



Intrinsically Disordered Proteins

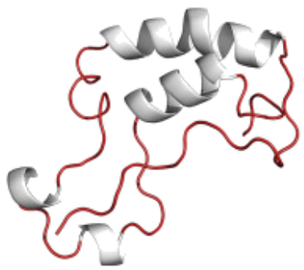
IDPs around a cluster of DNA

Sk Saddam Hossain, Post-Doctoral Fellow, Weizmann Institute of Science, Israel

Proteins are one of the most important biomolecules that play a variety of crucial roles involved in almost all biological processes occurring in any form of life. Proteins are long polymeric chains of amino acids that fold into unique three-dimensional structures under physiological conditions. The stable 3D structure of a protein is necessary for maintaining its activity and proper functioning.

Or is it? In the late 1990s, researchers observed that some proteins did not have a well-defined 3D structure. Initially, these proteins were thought to be anomalous or misfolded, but further study revealed that they were indeed a distinct class of proteins now commonly known as intrinsically disordered proteins (IDPs). The discovery of IDPs was a remarkable breakthrough in the field of bioscience, challenging the long-standing belief that all proteins had a defined structure.

intrinsically disordered protein (IDP)



intrinsically disordered regions (IDRs)

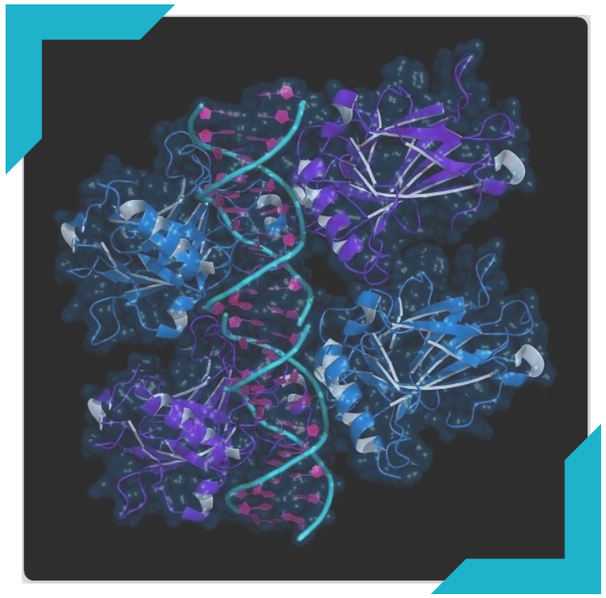
structured protein

Proteins now seemed to be highly flexible and dynamic, capable of adopting various conformations depending on their environment as well as the binding partners they interact with. These features make them a versatile candidate in the cell to perform a wide variety of functions, as they have been found in both eukaryotic and prokaryotic organisms. Approximately one-third of eukaryotic proteins contain in whole, or in part, intrinsically disorder regions (IDRs). On the contrary, less than 5% of prokaryotic proteins contain IDRs. They can interact with a wide range of binding partners simultaneously, including proteins, nucleic acids, and membranes, allowing them to regulate complex cellular pathways.

IDPs are characterized by low sequence complexity and high net charge, due to the abundance of some specific amino acids in their chain. The low sequence complexity arises due to the presence of amino acids such as glycine, serine, and proline, which promote flexibility and disorder. These amino acids tend to disrupt the formation of stable structures, like alpha helices and beta sheets, common in folded proteins. The high net charge arises due to the presence of charged amino acids, such as lysine and arginine.

Despite their lack of stable 3D structure, IDPs play significant roles in a wide range of biological processes. For example, IDPs involves in the regulation of gene expression by binding to DNA and RNA. They also participate in signaling pathways by interacting with other proteins in the cell. In addition, IDPs involves in the formation of membrane-less organelles in the cell that are dynamic in nature with no membrane boundary.

Interestingly, IDPs are often found in regions of the genome that are rich in repeats, suggesting that they may have evolved to perform specific functions in these regions. Despite their versatility, IDPs have been shown to play a role in protein aggregation. These aggregates can disrupt normal cellular processes and often leads to several diseases, including cancer and neurodegenerative disorders. For example IDP p53 is a well-known tumor suppressor that is frequently mutated in cancer. Similarly, mutations in the gene that encode Alpha-synuclein and Tau have been linked to Parkinson's and Alzheimer's disease, respectively.



However, in-depth understanding of the role of IDPs involved in these diseases is still an active area of research with the hope of developing potential treatments or therapies for these devastating conditions. Because IDPs are highly flexible and capable of adopting different shapes, they are difficult to target with common small molecule drugs. Researchers are exploring the use of peptides or other molecules that can bind to specific regions of IDPs and manipulate their function.

Overall, the discovery of IDPs has opened up new dimensions for research in biochemistry, biophysics and structural biology. Because they do not have a well-defined shape, IDPs are difficult to study experimentally. However, recent advancements of many experimental techniques, such as Nuclear Magnetic Resonance (NMR) spectroscopy and single-molecule based fluorescence microscopy, have made it possible to study them in more detail. Although significant amount of efforts has been put together to better understand various aspects of these unique class of biomolecules there is still much to learn about them. Their versatility and importance in various cellular processes made them an intriguing topic of research for scientists around the globe. The story of the IDPs are to be continued with many more discoveries and breakthroughs yet to come.

Courtsey-

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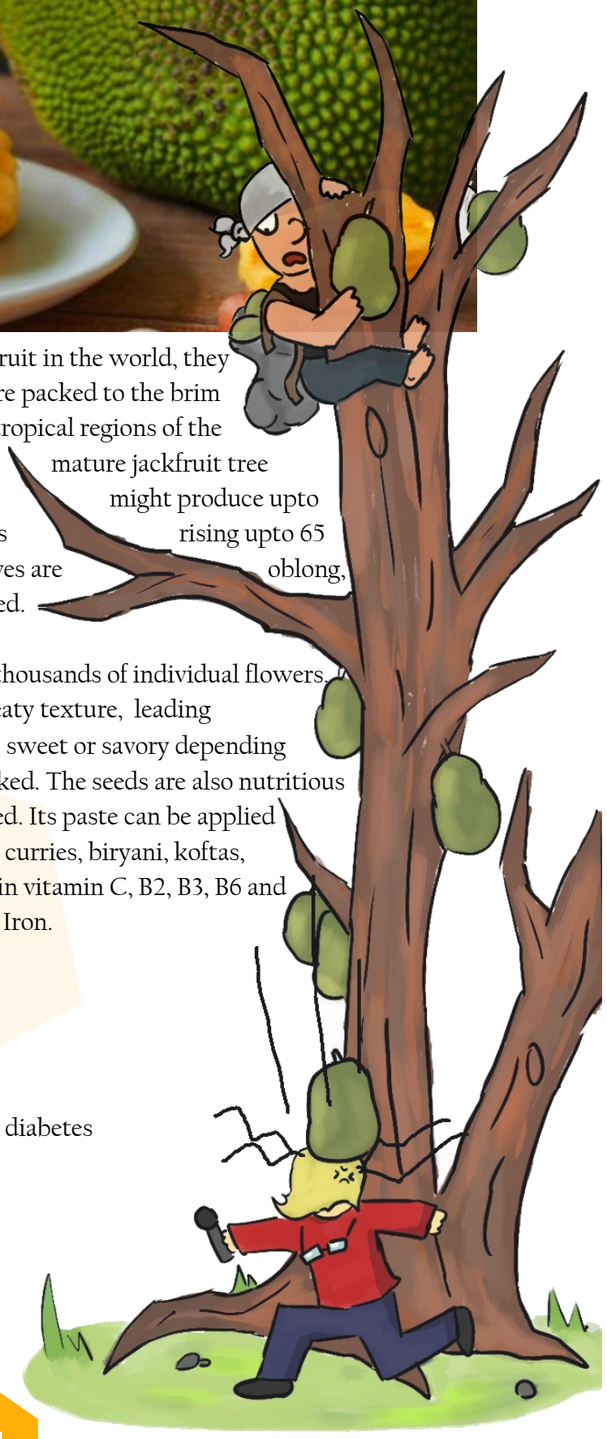
JACKFRUIT

Associate Editor



J for jumbo, J for jackfruit! As the largest tree fruit in the world, they are capable of reaching 55 kg in weight, and are packed to the brim with nutrition. It is native and best suited to tropical regions of the world— parts of Asia, Africa, and South America. A mature jackfruit tree produces aroun 100 fruits a year, whereas an older one might produce upto 500. The tree has a short trunk and large bushy treetops rising upto 65 feet. Their bark is reddish-brown and smooth. The leaves are oblong, gummy and thick, and are alternate and spirally arranged. Jackfruits are also the national fruit of Bangladesh!

It is a multiple fruit, comprising of hundreds to thousands of individual flowers. The petals of the fruit are the part eaten. The fruit a meaty texture, leading jackfruits to be known as **vegetable meat**. They taste sweet or savory depending on the ripeness, and can be consumed cooked or uncooked. The seeds are also nutritious and edible, and pack a quirky crunch on being sun-dried. Its paste can be applied on poisonous bites. It is used in a variety of dishes like curries, biryani, koftas, kebabs, momos, sabzis, fritters, etc. Jackfruits are rich in vitamin C, B2, B3, B6 and B9, Magnesium, Calcium, Phosphorous, Potassium and Iron.

These help in:-

- Wound-healing
- Curing inflammation
- Preventing constipation, ulcers, skin problems and diabetes
- Improving blood quality
- Strengthening bones
- Preventing ageing

ANIMALS IN WINTER

A hedgehog hibernating in the foliage

Aryz Nadri, Class III,
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Atlanta, Georgia , USA

Have you ever wondered how animals survive winter? They do not have comfy homes or drink hot cocoa to keep themselves warm. Everyone knows that warm-blooded animals hibernate, means they sleep throughout the winter. They eat food in late October and early November and prepare fat reserves for a long time in mid-December. They slow their body down, their body temperature, their breathing, and their heart. Rodents, hamsters and bats commonly hibernate—larger animals like bears enter only a light state of sleep called **torpor**. Similarly, insects' way of surviving the winter is called diapause. In this case, some insects pause growing and undergo **developmental arrest**, particularly in the pupae stage.

Cold blooded animals like frogs, lizards and snakes survive winter by **brumating**—they sleep but wake up sometimes to eat and gain their energy back from the long rest. Most turtles sleep in their shells close to berry or grape trees so when they are hungry, they just poke their head out of their shell and eat the food around them. The wood frog survives long and cold winters owing to a special antifreeze in its blood. **Estivation** occurs in certain animals where they sleep during heat stresses. The lungfish covers itself in a sheath of mucous that dries up and protects it as the lakes dry up.

Sometimes birds and aquatic animals tend to **migrate** away from their homeland in large numbers, journeying for miles on land, sea, or air to reach their destinations. They do so in order to find food and a "warmer spring temperature" in winter or cooler temperatures in the fall. The Great Wildebeest Migration is one of the most iconic events in which zebras, wildebeest, and antelope swarm from the Serengeti in Tanzania to the Maasai Mara National Reserve in Kenya in search of greener pastures. Equally famous are the 'March of the Emperor penguins' from the Antarctic coast, the 'Monarch Butterfly Migration' from Southern California and Mexico, the migration of Humpback Whales, and the Artic Tern which journeys over 40,000 km a year.

DATA IN THE WORLD OF AI

Md. Shoiab, Graduate, Computer Science Engineering, Narasaraopeta Engineering College (JNTU-K)

Despite the fact that artificial intelligence has been evolving for a while, it is now entering a critical phase in both its research and use. The ability to use this technology much more widely has been made possible over the past 10 years by a convergence of variables like deep learning and the expansion of data availability and computing capacity. There never seems to be a shortage of sensationalist headlines about how AI could increase human creativity, speed up human innovation, and heal diseases. One would assume that we already live in a world when AI has entered every part of civilization based solely on the headlines in the media.

A worldview known as 'AI solutionism' has emerged as a result of AI, which is indisputable in that it has created a multitude of exciting options.

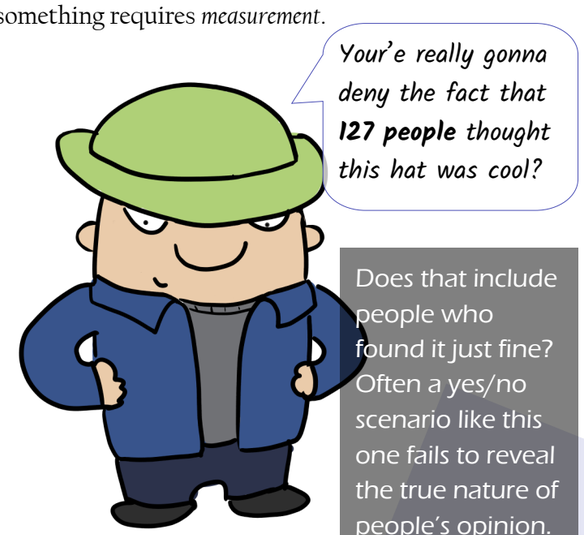
The idea behind this, is that if given enough data, machine learning algorithms can resolve *every* issue facing humanity. However, there is a serious issue with this notion. By trusting too much data and having inflated expectations about what AI can genuinely accomplish for humans, it actually *undermines* the value of machine intelligence rather than advancing it. In short, there are as many risks and errors as there are opportunities in utilizing AI for good.

Correlation detection by AI, such as finding that clouds increase the likelihood of rain, is essentially the most basic form of causal inference. This approach can produce very reliable predictions when given a wealth of information about well-known circumstances. If a computer knows how frequently hundreds or even millions of patients with the same symptoms have a particular condition, it can figure out the probability of a patient with a given set of symptoms having that disease.

This means that machines would not have to constantly learn everything from scratch. They could now apply what they had learned in one area to another *if* they could understand how certain things *relate* to other things. Furthermore, if machines were capable of using common sense, we would be able to trust them more, knowing they wouldn't make stupid mistakes. Certain things have to be get considered while dealing with data under AI-

1. METRICS CAN BE ADDICTIVE:

Mathematicians are generally regarded as trustworthy because they are known to deal in carefully considered logical arguments based on premises and axioms. We also believe in math because it is hard, is thought to be objective, and because mathematicians are known to deal in values and axioms (or statements that everyone believes to be almost true). It is ingrained in us that understanding something requires *measurement*.



Does that include people who found it just fine? Often a yes/no scenario like this one fails to reveal the true nature of people's opinion.

We're all directly or indirectly instructed to never ask stupid questions and to always project a sense of certainty and success. When we utilize mathematical models, our confidence in arthmetic has a clear effect; even if a concluion is incorrect, the very fact that the arthmaetic is involved makes it appear predictable and undeniable. For example, if you love someone, how would you measure it? How would you measure the importance of, or value of reputation in a field? The effect or power that some officials have? How can we quantify those?

Uncertainity is often key in understamding phenomenon such as the Heisenberg principle which make it *impossible* to be certain about multiple parameters at the same time. An uncertainity arises in all everyday phenomenon due to limited precison of measuring instrumentsas well. In such cases, we talk about *chances* of odds, or what *range* of value we can expect. This sometimes depends on the model we chose.

If you're supposed to measure income but instead, for instance, you're utilising census data to estimate it, then mention so. Surveying and data-polls can be a great supplement to data-driven analysis.

2. MISSING OUT THE PATTERNS:

AI modelers, in almost every case, use proxies when something is unable to be measured directly. We can monitor how many pages a user has read and how much time they spend on it(both on a whole and on an each page) but it really is impossible to evaluate the user's actual interest in a website. Generally speaking, that serves as an indicator of their interest, but there are always exceptions.

When selecting appropriate proxies, a great deal of personal influence shadows over what sort of data is relevant and what isn't. The remainnder is subsequently pushed to the margins and made invisible to the models. The strength of proxies varies generally and they can be fairly weak. A common occurrence with research, for instance, is the experiment leading to *no* conclusion. Researcher often tend to subdue such results and they rarely even get published. Seeing only the conclusive versions of an experiment might actually conceal the actual relibilty or reproducibilty of the procedures invoved.

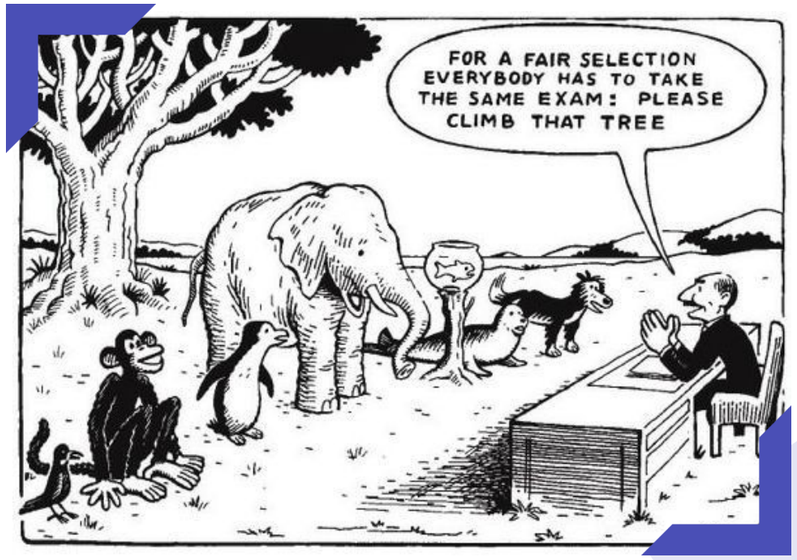
Such a cleansing impact of mathematical modelling causes us to frequently mis-interpret the findings of data-analysis as being objective when in fact they are only as objective as the underlying process and depend on the chosen proxies in opaque and complicated ways. The end result is a metric that

Sometimes the trail holds more significance than the feed itself

appears to be both powerul and objective but is fact neither. For instance, Netflix's movie recommendation system suffer from this, because their model of "all people" only includes people who have the time and interest in rating movies online. Netflix is an example of an interpretation-after-the-fact problem - we believe we have the consensus opinion when in reality

There has recently been a significant effort put into quantifying schooling. How does one evaluate something as complex and significant as teaching a subject in high school? The solution, for time being at least comes in the form of test scores. There are a plethora of proprietary models that claim to quantify the "value added" by a particular teacher based on the annual test scores of their pupils, most of which are marketed by private education consulting firms.

Note how we started off determining a teacher's effectiveness with a very poor proxy. We never get to



witness how the teachers engage with the pupils or whether they encourage them towards learning. *How effectively do these models operate? Such* models lack an evaluation metric, making it difficult to tell for sure. However, there is indirect proof that these models are rather filmsy: teachers who receive two evaluations for the same subject in the same year, for separate classes, only find a 24% correlation between their two ratings.

Sometimes enough care is to be taken about the objectivity. If you're tasked with building a model to decide who to hire, for example, most of the time, you might find yourself comparing women and men with the exact same qualifications who have been hired in the past. Then, looking into what happens next, you learn that those women have tended to leave more often, get promoted less often, and give more negative feedback on their environments compared to the men. Your model might be tempted to hire man over woman thw next time the two show up, rather than looking into the possibility that the company doesn't treat female employees well.

3. INABILITY TO FRAME THE ISSUE:

Modelling is the first step in the data science process. Such a process is not always straightforward, as a single measurement may be modelled in a variety of ways. For instance, how would one evaluate a business? By the amount it earns, the number of people it employs, or both? Do we evaluate its effects on the environment? What in this circumstance, constitutes *progress*?

Once we've made a decision, especially if it's seen as an important measurement, we frequently find ourselves optimising to that progress bar, sometimes without checking to confirm that the progress it measures actually corresponds to the definition of progress we truly want to use.

Even though the problem is quite well described, the evaluation of the solution still has to be done carefully. Selecting an inspection metric is a difficult process that, by all accounts, needs to be included in a model. For example, "Do advertisements result in sales that they otherwise wouldn't have been made?" This is what advertisers want to know. For this, they rely on indicators like "Did that individual click on the ad?" is a question that is frequently asked since the available data is so scarce. The real question to address here is, "Do these ads get people to buy

the product who would not have purchased that product anyway?"

4. REJECTION OF PERVERSE INCENTIVES BY PEOPLE:

As often observed, models, particularly high-stakes ones where participants' quality of life is at stake, beg for gaming. But for some reason, especially when they stand to gain from the gaming. we frequently observe modellers ignoring this feature of their models. However, models with poor evaluation measures can nonetheless result in negative feedback loops even when there is no direct gaming. It's crucial to remember that it's not always possible to game a model, and the degree to which it is done, depends on the kind of proxies utilised and how powerful they are.

For example, the Credit Score Model rates rather well on the gamability scale. For example, we are aware that timely bill payment will help us raise our credit score. Actually, the majority of people wouldn't even call that gaming. Another instance is a highly transparent, proxy-based, high impact model will be gamed. It must function when the persons being judged by the model are aware of how it operates; it is insufficient to demonstrate that it functioned on test data prior to implementation.

That's the reason why most of the businesses use dashboard approaches, rather than solely relying on one inaccurate metric. But that depends on the background of the game loop, utilising eithers Campbel's Law or Goodhart's law. At the sametime, being cautious is necessary as the measurement itself will affect the same item we are trying to quantify.

Let's end on a happy note with some good news - First, great tools are being developed involving AI, Machine Learning etc., that should be very beneficial in the pursuit of meaningful data communication, storytelling, and sharing. Products like the IPython Notebook, which enables data scientists to not only share code

Definition

Cambell Law: When a metric is used as a key predictor of success, its capacity to measure success effectively is usually reduced

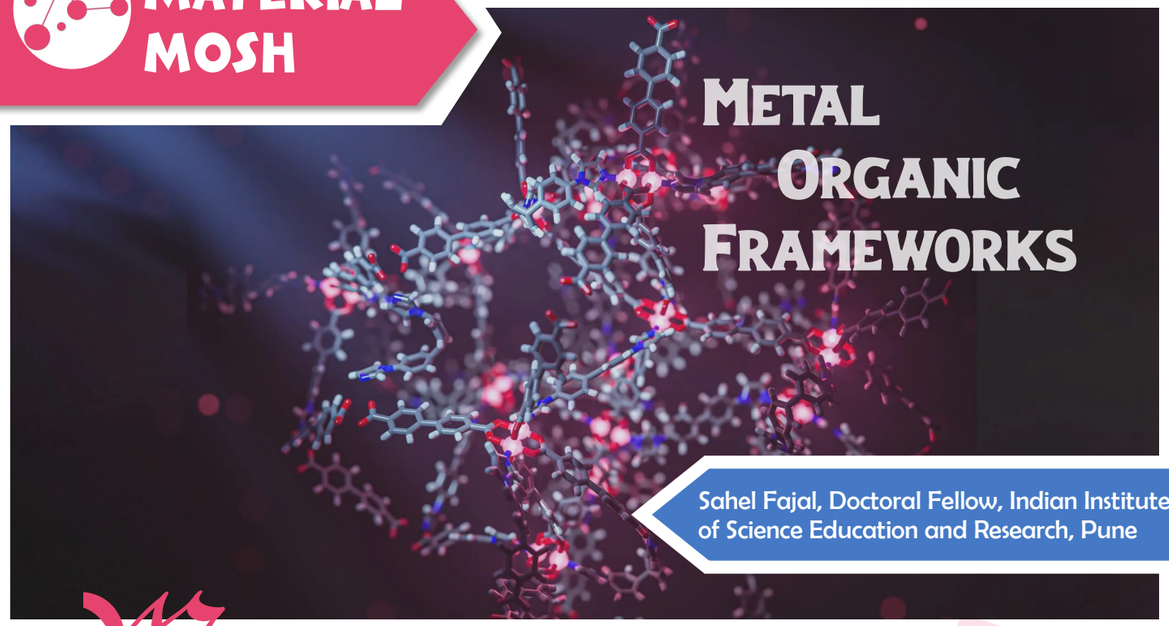
Goodhart Law: - Outcomes become less useful as soon as measures are undertaken to control them.

and results with nontechnical people but also to develop a narrative outlining their thought processes along the way, are being improved by the open source community.

Second, data used properly is a powerful force for good, despite all the harm that improperly applied data may cause. Data is a tool, and like all tools, its effectiveness depends on how it is applied. Furthermore, whether a data application is good or poor doesn't even depend on whether the data was used incorrectly; good guys can make excellent data analysis mistakes just like bad guys (and most people believe them to be good so). But if one cultivates a healthy scepticism, which is to say, a habit of mind to question and insist on understanding the reasoning behind the findings, he is more likely to utilise data successfully and comprehend how others are using it.

John McCarthy, widely known as the father of Articial Intelligence

METAL ORGANIC FRAMEWORKS



Sahel Fajal, Doctoral Fellow, Indian Institute of Science Education and Research, Pune

Metal-organic frameworks (MOFs) are crystalline porous solid materials constructed from the periodic coordination bonds between inorganic metal ions (or cluster) and organic linkers or ligands. MOFs have become an innovative class of materials with enormous potential for usage in a wide range of electrochemical and biological applications, including sensing, gas adsorption and separation, catalysis, etc. Due to their extraordinary tunable surface area and versatility in incorporating different functional groups, MOFs are particularly well-suited for use in sensing systems according to their distinctive architecture.

The extraordinary sensitivity and selectivity of MOFs as sensors is one of their main advantages. Their effective adsorption and interaction with target analytes is made possible by their porous nature. MOFs can be specifically designed to preferentially capture *specific* molecules, enabling highly accurate detection by carefully selecting metal ions, ligands, and pore diameters. This tunability includes the addition of functional groups to the MOF structure, which can boost the sensor's performance and affinity for the target analytes.

Definition

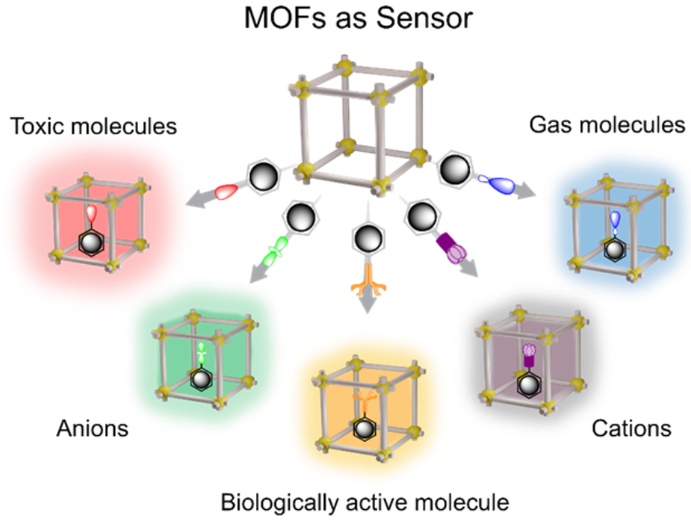
Adsorption: Process of adhesion of molecules to the surface of a solid

Transduction: Introduction of foreign genetic material to a cell

Additionally, the large surface area to volume ratio of MOF is essential to their capacity as sensors. Increased sensitivity results from the numerous analyte adsorption sites provided by the high surface area. Additionally, this increased surface area enables better signal transduction, which is necessary for sensor response. Fluorescence, electrochemistry, and optical changes are just a few of the transduction mechanisms that can be used with MOFs to transform analyte interactions into quantifiable signals.

MOFs have proven to be incredibly versatile when it comes to detecting a variety of analytes. They have been effectively applied to the field of gas sensing, where MOF-based sensors were shown to be highly sensitive and selective for gases like carbon dioxide, methane, and volatile organic compounds (VOCs). In addition, MOFs have been investigated for the detection of heavy metals, which are quite concerning because to their effects on the environment.

Some advantages of MOF sensors are quick detection, low detection limits, and the capacity to differentiate between various metal ions. The application of MOFs in biological sensing has enormous potential. They can be functionalized with certain biomolecules to enable the detection of infections, poisons, and disease indicators. For example, MOFs have been used for the highly sensitive and selective detection of cancer biomarkers like



proteins or nucleic acids. This creates possibilities for personalized medication and early disease diagnosis.

The potential for real-time, on-site monitoring offered by MOF-based sensors is yet another exciting feature. MOFs can be incorporated into flexible films or wearable devices, enabling continuous monitoring in a variety of settings. For environmental monitoring such as the detection of air pollutants or water toxins, this capability is especially beneficial. MOFs are dependable for prolonged sensing applications because they may be manufactured to have long-term stability and reusability.

The widespread use of MOFs as sensors faces obstacles despite notable developments. MOFs with specific attributes might be difficult to create and take a long time. To ensure MOFs' long-term performance, it is also necessary to address their stability in a variety of environments, including temperature and humidity. Although, MOF-based sensors have the ability to completely change industries like security systems, healthcare diagnostics, and environmental monitoring, unlocking the full potential of MOFs as sensors will surely come about as a result of further research and development in this field, providing creative answers to problems faced in the real world.

POEM COUNTER

Adrika Das, 10th standard,
St. Kabir Indian international school,
Vadodara, Gujarat.

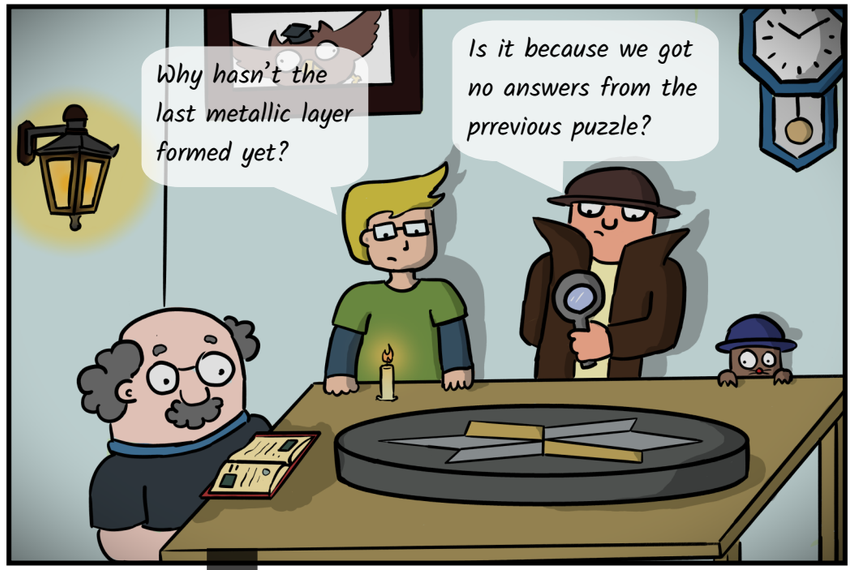
As the breeze flew past the autumn leaves
The birds chirped their melodious glee
Them syncing in absolute harmony
The silence of the morning needs no armory
To be blended into this soothing tune.
The birds giving a start to a day that might be ruined.

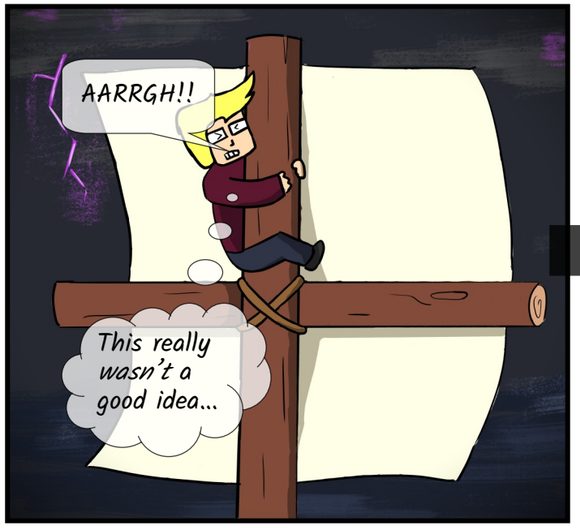
Faraway in a distant land
Jamming to her favorite band
A girl plugs in her airpods to her ears
As music washed her over, to a fantasy she peered
Driving her straight to delicacy of euphoria
Away from the worldly pressure and hysteria.
'Music' entitled as a hobby for one, an escape for the other,
To our emotions, it provides resistance
Some attack us in a way,
We smile, we cry, we shudder.
Be it in its most natural form or a human made lyrics clutter.
A true gift to human existence in either forms.

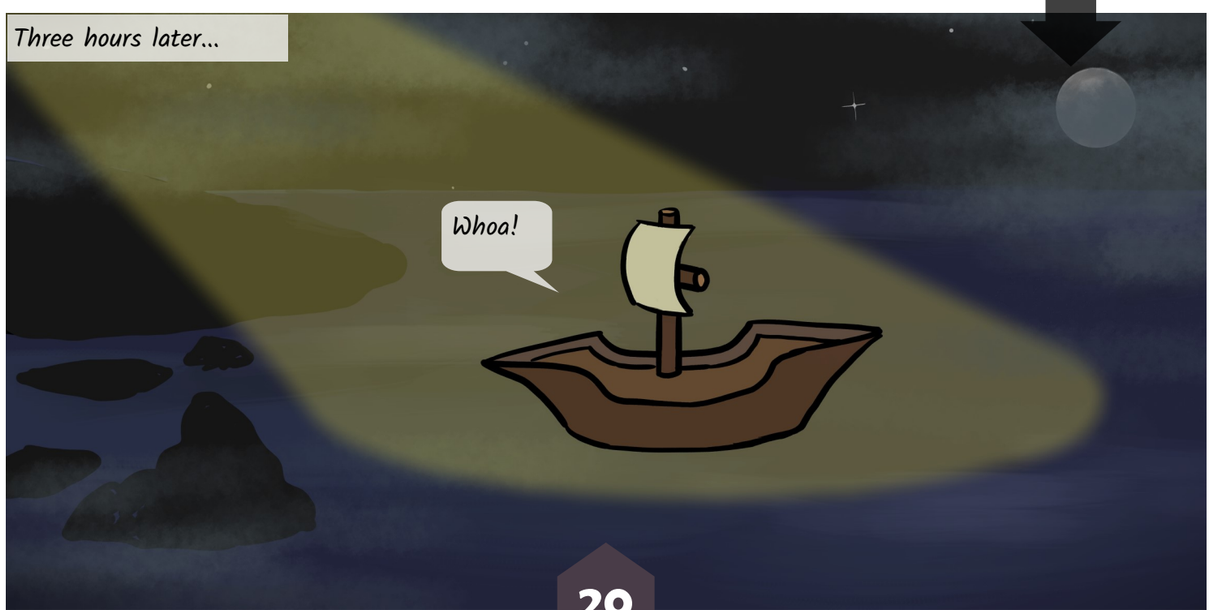
MONUMENTAL PUZZLES

Prevoiusly...

Craig and Nigel were fussing about the GSK 'garden', after which their conversation strayed to one of the sections of the anomaly. However, they did not receive any answers from the readers, therefore the sectore remained grey. Lets see what happens today...







It seems that the GSK toons has stumbled upon anther building vaguelly resembling one of the sections of the anomaly. Before the toons stood a collosal tower from the past, not much of of which lasts today. Here is an excerpt from Nicola's later explaination of the monument-

"The (1 - name of the monument) was one of the seven greatest wonders of the ancient world. A lot of records believe it to have been roughly 110 metres (350 feet) tall. It was damaged by three different earthquakes between 950 - 1300 AD. After the original place was reduced to rubble, the Sultan of Egypt turned it into a medieval fort around 1480. It is said to have been built by (2 - name) of Cnidus, commisioned by Ptolemy I Soter of the of (3 - country of origin).

This monument was located on the island of (4 - island name) in the harbour of (5 - place). For many centuries, it was the tallest man-made structure, second only to the Great Pyramids of Giza. This monument consisted of three stages with decreasing size: the lowest being cuboidal, the middle being octagonal, and the highest bein cylindrical. A broad spiral ramp led to the top, where a fire burned at night. The fire was brightened by burnished bronze mirrors. A lot of ancient records describe a statue of either Zeus or Ptolemy I Soter in the form of the sun god Helios.

It took 12 years to complete, and was made with blocks of limestone and granite." The team listened in silence, as they passed by the great loomin monument, its fire burinng bright. The fog spread, concealing , lost in the depths of time.


The monument, as its ruins rest today

Can you identify the monument that Nicola was taliking about? Find out and send us what comes im he blanks to getsetknowmagazine.com, for a guaranteed prize!

PEROVSKITE BASED PHOTOCATALYSTS

Md. Samim Hassan, Post Doctoral Fellow,
City University of Hong Kong

The demand of global energy is continuously increasing per year at the rate of 1.5% and estimated to increase up to 48% by 2040. Nowadays fossil fuels have been serving as the most reliable energy source to fulfil the needs of the global energies. The high consumption of these non-renewable energy sources cause for the depletion of reservoir of fossil fuel, environmental pollution, and global warming. These problems open up research interest towards developing methods to convert and store energy through renewable and sustainable sources.

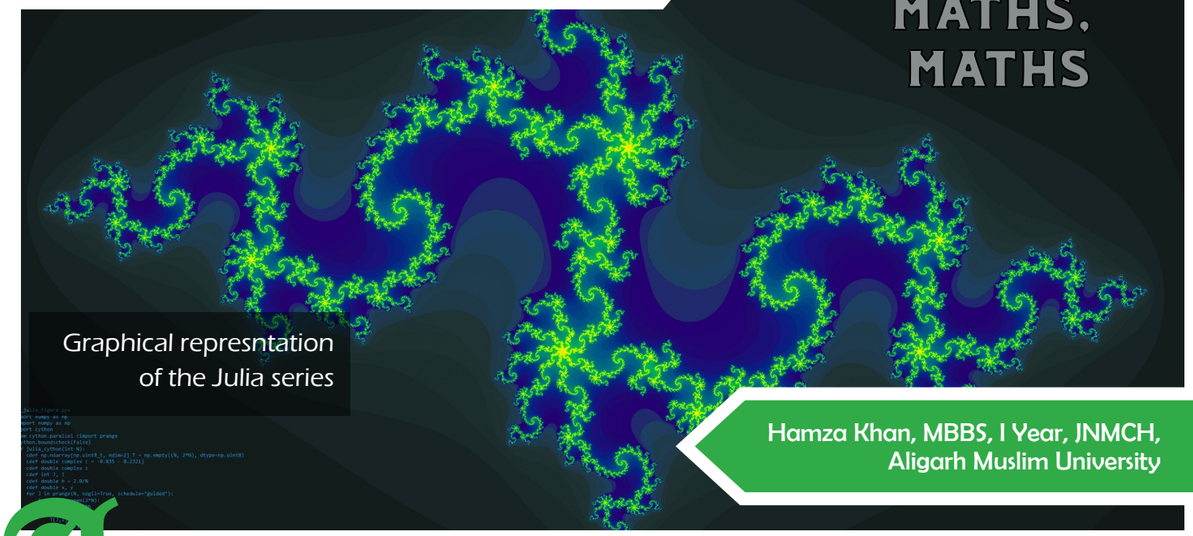
Among many available renewable energy resources, solar energy is considered to be the cleanest and most abundant resource. New routes to convert solar energy into electricity and other useful fuels are being extensively developed. In this context, photocatalysis has been considered as an attractive area of research since long time, as it directly uses solar energy to produce valuable fuels (e.g., hydrogen and hydrocarbon) as well as degrade pollutants (CO_2 reduction to useful products).

For an efficient photocatalytic process, it is required to develop materials which can harvest more energy from sunlight and carry out redox processes. An efficient photocatalyst possess large absorption coefficients, fast charge carrier separation, high charge carrier mobility, and low charge carrier recombination rate. In the past few decades, metal oxides (TiO_2, ZnO) and metal chalcogenides (CdS, CdSe, $CuInS_2$) have been widely used as photocatalysts. But, these materials suffer from rapid charge carrier recombination, lower absorption of sunlight, and limited redox processes. In this context, recently halide perovskites triggered much attention in the field of photovoltaic as well as photocatalysis owing to their interesting optical and catalytic properties, i.e, high extinction coefficient, long charge carrier diffusion length, low trapping-state density, and long charge carrier lifetime.

In very short span of time, halide perovskites show their great potential in the field of solar cells, light-emitting devices, and photodetectors. Recently, perovskites have also been used to generate hydrogen gase (considered as the most clean energy sources). Perovskites also show very promising results to convert CO_2 into useful fuels such as CO, CH_3OH, CH_4, C_2H_4 etc. through efficient photocatalytic processes.

One of the advantages of perovskites is their tunability of band gap, useful for the selective generation of fuels. However, one of the biggest concern of employing perovskites as photocatalysts for real life application is their limited stability in aqueous environment and polar solvents. In this point of view, combination of perovskites with conventional semiconductors through the making of nano-hetero-structures or core-shell structures or encapsulation with polymers show sthe path to significantly improve the stability as well as photocatalytic performances. With continuous progress, stability as well as efficiency of perovskites based photocatalysts is expected to be further improved, enabling their real life applications.

MATHS. MATHS. MATHS



Graphical represntation of the Julia series

Hamza Khan, MBBS, I Year, JNMCH, Aligarh Muslim University

"An Equation means nothing to me unless it expresses a thought of God."

-S. Ramanujan

This quote really troubled me because I could never wrap my head around how Ramanujan was feeling this. Students in my times thought about giving up on life, after ten minutes of solving an equation.

Mathematics, to the Egyptians included simple arithmetic, algebra and geometry that was used for astronomy and the construction of pointy-yellow tombs. The oldest mathematical texts from Mesopotamia and Egypt are from around 2000 BC. Around the sixth Century BC, Pythagoreans started to take things seriously and vastly developed the field of geometry - literally "measurement of land".

Euclid of Alexandria dropped "The Elements" around 300 BC, which quickly climbed the charts of theoretical Geometry, but was challenged by Archimedes of Syracuse, who developed formulas for calculating surface area and volume of solids and the area under the arc of a parabola. Such relations were important in the construction of anythnng from statues to siege machines. Later on, many noteworthy contributions were made by Indian and Islamic scholars over the course of the first millennium.

The transition to the modern period, began with groundbreaking developments made in the Western World. Regarded as the first modern philosopher, René Descartes kept mathematics central to his method of inquiry and gave birth to analytical geometry. Euler wrote books of formulas; Kurt Gödel completed the incompleteness theorem. Isaac Newton and Gottfried Leibniz independently developed the highly useful branch of calculus.

Contributions to modern mathematics are being made till this day, and will continue to happen even when you and I will both be gone. It's evident that humans have discovered, studied and implemented the knowledge of maths extensively over the course of their stay on earth. Yet our understanding is infinitesimally small compared to what actually exists.

We may yet not know how to solve The Riemann Hypothesis or The Twin Prime Conjecture but the solutions have every possibility to exist. I believe, if something can be imagined, it exists. if it exists, it has a purpose. At the end, my realization is that maths is similar to the concept of God. It encompasses everything around us, latent to the human minds, governing entirety. Maths, in a sense, is the software of Life.

WORD SHRED

The blank slots below spell a message out of which only a few fragments could be uncovered. The only clue Nicola and the team have is that the three words of each row come from rearranging all the letters of three set of letters given below. All of the uncovered letters are from the respective set only. Uncover the message and mail it to us at getsetknowmagazine.com, and the first three shall recieve a guaranteed prize!

_ _ _ E _ _ _ _ _ _ _ _

_ R _ R _ _ E _ _ L _ _ _

_ A _ T _ _ _ _ P _ _ _

N C E

J O S

I T T

H B E

Rearrange these letters to form three distinct words fot the second line of the message!

G I M R U

O E R L R

A I R E R

P H E A N T E

H P T A A R Y