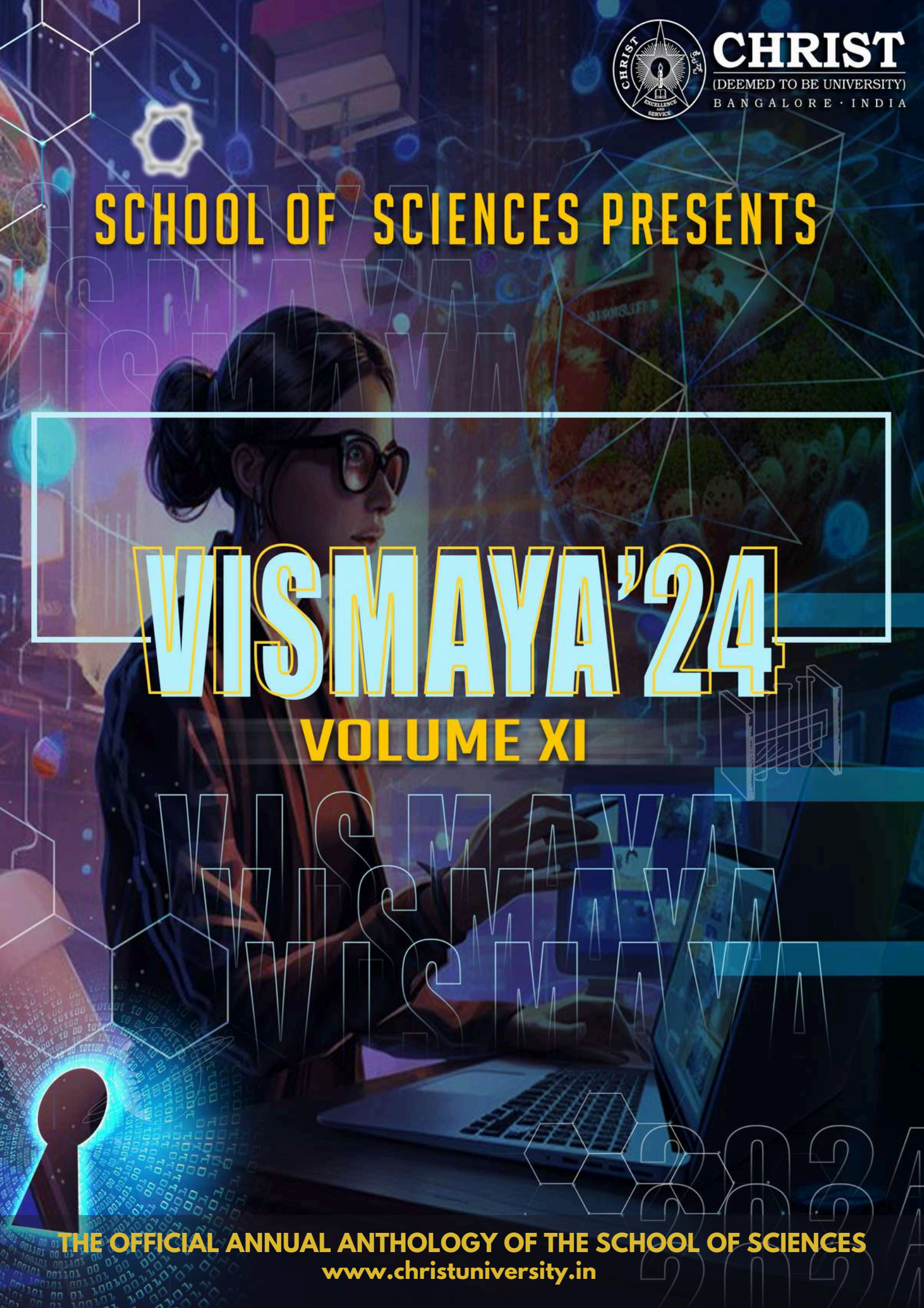
CHRIST
(DEEMED TO BE UNIVERSITY)
BANGALORE · INDIA

SCHOOL OF SCIENCES PRESENTS



VISMAYA'24

VOLUME XI

THE OFFICIAL ANNUAL ANTHOLOGY OF THE SCHOOL OF SCIENCES

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Message from the Vice Chancellor

Cultivating Critical Thinkers, Empowering Future Leaders

At CHRIST (Deemed to be University), the School of Sciences stands as a beacon of intellectual curiosity, innovation, and creativity. Our vibrant academic environment fosters an unyielding passion for scientific inquiry, encouraging collaboration between students and faculty across a multitude of disciplines. This synergy inspires our students to reach for the stars, propelling their knowledge and discoveries far beyond the walls of our institution, ready to illuminate the world with their brilliance.

The annual science magazine, VISMAYA, is a remarkable testament to this unwavering commitment. Each edition showcases thought-provoking articles and creative artwork, reflecting the dedication, expertise, and energy of its contributors. This year's VISMAYA is especially noteworthy, with an impressive number of students, researchers, and faculty coming together across the campuses to enrich its pages with their unique perspectives.

I would like to congratulate the School of Sciences for their remarkable achievements, including the successful initiation of UnderGraduate Research and the establishment of the Office of Research in Science, which fosters a culture of innovation and scientific inquiry. I also extend my heartfelt congratulations to our esteemed professors, who have been recognized among the top 2% of the most influential scientists by Stanford University, a testament to their dedication and expertise. The School's receipt of multiple funded research projects and its ongoing contributions to research and development further highlight its role in advancing knowledge and pushing the boundaries of scientific exploration.

I extend my heartfelt appreciation to the entire VISMAYA team – the writers, editors, designers, and contributors – whose tireless efforts have brought this publication to life. Your work not only informs and inspires but also nurtures the spirit of discovery at the heart of scientific pursuit.

Congratulations to everyone involved in this outstanding achievement. May VISMAYA continue to engage, enlighten, and spark curiosity in the minds of its readers for many years to come.

Dr Fr Jose CC
Vice Chancellor
CHRIST(Deemed to be University)

Message from the Dean

The School of Sciences at CHRIST (Deemed to be University) is home to forward-thinking minds, dedicated to shaping a better world through innovation and creativity. VISMAYA 2024 showcases the finest literary works from our School of Sciences, where students have utilized their creativity to transform complexity into simplicity. This magazine is a testament to the hard work and dedication of our pioneering youth, who are committed to using their talents for the betterment of society.

Our university's mission is to provide a nurturing environment for holistic development, enabling students to make meaningful contributions across a wide range of disciplines, including Physics and Electronics, Chemistry, Statistics and Data Science, Mathematics, Life Sciences and Computer Science. Each department plays a crucial role in shaping the bright minds that embody the spirit of advancement and exploration. By encouraging collaborative research, we bring together the analytical strength of Mathematics, the foundational insights of Chemistry, Physics and Electronics, the biological expertise of Life Sciences, the computational prowess of Computer Science, and the statistical rigor and data-driven approaches of Statistics and Data Science.

I extend my heartfelt congratulations to the editorial board, faculty members, and every student whose perseverance and creativity have brought VISMAYA 2024 to life. Your daily devotion is what keeps our collective mission of exploring limitless boundaries and endless frontiers alive. As you continue your journey of exploration, may wisdom guide you, and may your curiosity lead to greater discoveries. The future is bright for those who embrace the adventure of learning.

Dr T V Joseph
Dean
School of Sciences

Message from the Associate Dean

I am delighted to present Vismaya, the School of Sciences magazine, which is a unique blend of creativity, intellectual engagement, and forward-thinking content. Unlike other publications, Vismaya stands out with its distinct features such as interdisciplinary articles, student-driven, alumni and faculty content and exclusive interviews with industry experts. These features set it apart and make it a must-read for anyone interested in academic and cultural content. Vismaya sparks curiosity and provokes meaningful conversations, reflecting the University's commitment to holistic learning. It combines academic excellence with creative expression, offering a fresh perspective that captures both the academic and cultural essence of our community. I invite you not only to engage with Vismaya but also to contribute your own ideas and research. Discover how it continues to inspire and connect our community.

Our school has six dynamic departments—Mathematics, Physics and Electronics, Chemistry, Life Science, Computer Science, Statistics and Data Science. Each of these departments plays a vital role in advancing fundamental and applied research while fostering a deep sense of academic curiosity. What sets our school apart is the emphasis on interdisciplinary approaches. In an increasingly interconnected world, complex problems such as climate change, healthcare challenges, and technological advancements cannot be addressed by a single discipline alone. By encouraging collaborative research, we bring together the analytical strength of Mathematics, the fundamental understanding of Physics and Chemistry, the biological insights from Life Science, the computational power of Computer Science, the analytical power of Data Science and the statistical rigour of Statistics. Our interdisciplinary research approach allows us to prepare students for real-world applications that demand collaborative, innovative problem-solving skills.

In this spirit, Vismaya is an ideal platform to showcase these strengths. Through its pages, the magazine highlights academic achievements and emphasizes the importance of collaboration and interdisciplinary thinking. It provides students and faculty a space to present their research, share insights from cross-disciplinary projects, and reflect on the impact of their work beyond the University. In this edition, we also have insights from the science departments of other campuses of our University. By offering diverse perspectives from across our departments and campuses, Vismaya fosters a sense of community and intellectual exchange that mirrors the values of our school. The magazine thus becomes a vital tool in nurturing creativity, encouraging exploration and connecting academic rigour with broader societal relevance. Heartly Congratulations to the Vismaya team for the beautiful XI edition.

Dr Deepthi Das
Associate Dean
School of Sciences

Message from the Vismaya Faculty Team

"Science is not only a disciple of reason but also one of romance and passion."
—Stephen Hawking

Vismaya, the word itself, evokes a sense of wonder, curiosity, and boundless exploration—exactly the spirit in which this anthology is crafted. As faculty coordinators, we take immense pride in presenting the 2024 edition of *Vismaya*, The Official Annual Anthology of the School of Sciences. This magazine is a collective effort, born from the passion and creativity of our students, who, like the ever-curious scientists they aspire to be, have once again succeeded in piecing together a vibrant tapestry of scientific thought and innovation.

The past year has been marked by groundbreaking achievements that have expanded the horizons of knowledge. From advancements in quantum computing, which promise to revolutionize technology as we know it, to the awe-inspiring images captured by the James Webb Space Telescope, providing us with the most detailed glimpses of galaxies far beyond our imagination, science continues to push the boundaries of what we know about the universe. Alongside these astronomical discoveries, strides in bioengineering have brought us closer to growing human organs in the lab, offering real hope for the future of healthcare.

In keeping with this relentless pursuit of discovery, *Vismaya 2024* reaches several exciting milestones. For the first time, we are proud to feature interviews with the Heads of Departments (HODs), offering expert insights into the growing importance of interdisciplinary research and collaboration. These discussions highlight how diverse fields—Mathematics, Physics, Chemistry, Life Sciences, Data Science, and beyond—are converging to tackle some of the most complex challenges facing our world today. This deeper exploration of cross-disciplinary efforts demonstrates how science thrives when minds from different specialties come together to innovate and find solutions.

In the true spirit of collaboration, *Vismaya 2024* includes contributions not only from other CHRIST campuses but also beyond the School of Sciences, offering a richer and broader perspective. We have dedicated a special section to highlight student achievements, showcasing research projects and accolades that serve as inspiration for all. This interdisciplinary approach reflects the enthusiasm and curiosity that fuel every scientific mind.

"Vismaya 2024 serves not merely as a chronicle of achievements but as a testament to the passion and curiosity that ignite every scientific mind. We would like to thank the entire editorial, design, and core teams, as well as all contributors, for their tireless effort and dedication. Each page of Vismaya 2024 is a testament to the creativity, perseverance, and ingenuity of the students who have crafted it.

We hope you enjoy this edition as much as we enjoyed creating it. Let us continue pushing the boundaries of science, exploring the mysteries of existence, and seeking answers along the way.

Dr Jinny Ann John, Dr Sagaya P Aurelia & Dr Ditto Abraham Thadathil

~ Faculty Team Vismaya

On Behalf of the Core Committee & the Editorial Team

We are thrilled to present to you the 11th edition of “Vismaya”, the annual science magazine of the School of Sciences. This magazine stands as a testament to the boundless curiosity, creativity, and innovation that our students and faculty bring to the table year after year. It serves as a platform where science meets storytelling, where complex ideas are simplified, and where research, innovation, and discovery are celebrated.

This edition is not just a collection of articles; it is a reflection of the scientific temperament that drives our academic community. From cutting-edge research to explorations of the natural world, from technology’s latest trends to timeless philosophical questions of the universe, we’ve curated content that both informs and inspires.

A big thank you to all contributors—students, faculty, and staff—whose passion and dedication have brought this magazine to life. Your hard work and insight continue to remind us that science is more than just a subject—it’s a way of understanding the world around us and improving it for the future.

We hope you enjoy reading this edition as much as we enjoyed putting it together. Let it spark new ideas, foster creativity, and fuel your passion for science.

Happy reading!

Core Committee Members

Nithya TN	3BSc DM
Vishal Das	3BSc DM
Himangi Thakkar	3Bsc PC
Vibek Kumar	5Bsc CBZ
Sakthisivagami J	3BSc PM
Adrino Rosario	1BCA
Sakshee Priya	5BCA
Melonee Maibam	3BSC PM
Harini Sockalingam	3EMS
Adya Chauhan	5BSc BCB

~ Student Team Vismaya

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HEADWAY FROM THE HEADS

Dr Aniiha Varghese

CHEMISTRY

Hearty congratulations to team Vismaya for all their efforts and success. As the head of the chemistry department, I feel honoured to have this opportunity to share my experiences as the head of the department of chemistry and my perspective on what VISMAYA stands for.
As the head of the department, it is my responsibility to invigorate the team of faculty members at the department to work collectively for student well-being. We foster critical thinking through problem-solving activities, open-ended experiments, and science exhibitions and by emphasizing the importance of research experience. By inviting alumni and industry professionals to share their experiences, we have succeeded in effectively communicating the significance and relevance of the department's activities to the students. We also put emphasis on the need to constantly update oneself to stay relevant in the dynamic academic panorama. This approach empowers our students to become innovative problem-solvers and thinkers, ready to navigate the ever-evolving and challenging scientific landscape.

Our primary goal is to shape our students' future by sparking their curiosity and passion for science. Through engaging and hands-on learning experiences, we aim to build essential skills such as critical thinking and problem-solving. By connecting chemistry concepts to real-world applications, we assist ourstudents in understanding the relevance of their studies and encourage innovative thinking. Through these strategies, we hope to deliver the key message: to embrace curiosity and remain open to new experiences and opportunities. The students should not sleep on the fact that exploration is as much about discovering the world around them as it is about finding themselves. Remembering that challenges and setbacks in the learning process are growth opportunities, allowing change and adaptability is the most vital lesson that we hope to pass through.

VISMAYA has always served as a platform for sharing groundbreaking research that advances scientific understanding and has the potential to address real-world challenges. Articles covering a range of topics, each being unique and thought-provoking, should be included. More importantly, they should contribute to our knowledge of the ever-evolving scientific scene and spark curiosity among its readers. Additionally, VISMAYA should feature messages and testimonials from alumni to provide a comprehensive understanding of the wide range of opportunities that lie ahead of them.

I wish the very best to team VISMAYA.

Dr Ashok Immanuel

COMPUTER SCIENCE

At CHRIST (Deemed to be University), we recognize that computer science has transcended traditional boundaries and is now integral to virtually every field. With advancements in AI and machine learning, our reach has expanded even further. From everyday mobile usage to diverse professional applications, computer science plays a pivotal role.

As students of computer science, you have a significant opportunity to make a meaningful impact on society by developing technological solutions to real-world challenges. It is essential to emphasize practical implementation alongside theoretical learning to enhance both your employability and societal contributions. While academic degrees are valuable, they are not sufficient on their own. I encourage you to go beyond the standard curriculum through online courses and hands-on experience. Practical skills, continuous learning, and knowledge-sharing are crucial.

Our department's initiative, the Digital Mission, aims to broaden computer science education for all students, fostering a culture of learning and innovation. We employ a theme-based approach, focusing on emerging technologies such as AR/VR and drones, to remain at the cutting edge of innovation. This approach includes training, learning, and project development, preparing you to tackle contemporary challenges and make meaningful contributions across various fields.

Dr Pranesh S

MATHEMATICS

As the head of the Mathematics Department at CHRIST (Deemed to be University),I am excited to share with you the immense potential and impact of our discipline. Mathematics,often seen as a purely theoretical subject, is in fact a fundamental tool for understanding and addressing the complex challenges of our world.

From the intricate calculations that underpin scientific discoveries to the algorithms that drive technological advancements,mathematics provides the intellectual framework for innovation and progress. Our department is committed to fostering a culture of interdisciplinary collaboration, recognizing that the most groundbreaking solutions often emerge at the intersection of different fields.By working closely with scientists from diverse disciplines,our faculty and students are making significant contributions to addressing pressing global issues, such as climate change,healthcare, and economic inequality.

I encourage you to explore the vast potential of mathematics and to discover how it can enrich your academic journey and shape your future. Whether you are drawn to the beauty of abstract concepts or the practical applications of mathematical modeling, there is a place for you in our department. By studying mathematics, you will develop critical thinking skills, problem-solving abilities,and a deep appreciation for the power of human reason.

As you embark on your academic journey,I urge you to embrace the challenge of mathematics and to explore its limitless possibilities. Together,we can harness the power of mathematical thinking to create a brighter future for ourselves and for generations to come.

Dr Saleema J S

STATISTICS & DATA SCIENCE

The Department of Statistics and Data Science has made significant progress, establishing itself as a leader in innovation and academic excellence. Over the past year, our faculty's achievements, including securing patents, have demonstrated the innovative research within our department. We also hosted International Teaching Week, where global professors trained our students in micro-credential courses, broadening their perspectives.

We launched the Statistical Consultancy and Census Data Workstation, offering valuable research resources and practical experience. Collaborations with ministries in statistics and data science have created new opportunities for both students and faculty.

Our students excelled in national competitions such as Tilastro, OneAPI Hackathon, and the Indo-Korean Science & Technology Hacktech, highlighting the quality of our education. Many have secured positions in leading industries and government internships, underscoring the demand for our graduates.

We've shifted focus to quality publications, funded research, and consultancy services. We've expanded internships and strengthened our alumni network, creating a robust ecosystem of support. Looking ahead, we plan to raise the average CTC for students and establish labs focused on Climate Informatics and Health Analysis. StaDa, our student club, is being revamped to promote holistic student development. We're excited about upcoming international collaborations and exchange programs to expose students to global perspectives and technologies.

Vismaya, the flagship magazine from School of Sciences, reflects the commitment to fostering creativity and scientific rigor. As we look to the future, we are dedicated to preparing the next generation of leaders with the skills and vision to make meaningful contributions to both science and society.

PHYSICS & ELECTRONICS

Dr Manoj B

“Falling down is not a failure. Failure comes when you stay where you have fallen.” - Socrates

Over the years, the Department of Physics & Electronics has not only transformed but elevated the academic nurture of Christ University. From actively trying to promote the UN sustainable development goal 7 i.e affordable and clean energy by doing ground breaking research in the field of material sciences which includes solar cells, hydrogen production, and fuel cells to inaugurating the centre of excellence in astronomy and astrophysics which spearheads the progress of research with reputed institutes like IUCAA & IAA, the Department of Physics and Electronics not only encourages academia, but also exceptional application of it in real life. Having more than 16 ongoing funded projects in association with esteemed organizations like DST, ISRO, SERB etc, it can be analyzed that the gap between research and academics has narrowed down over the years. With the implementation and initiation of start and laboratories as well as incubation centres, it can be said that the Department of physics and electronics would flourish here on.

Dr Fr Jobi Xavier

LIFE SCIENCES

Greetings from the Department of Life Sciences, Christ University!

Our goal in the Department of Life Sciences is dedicated to offer advanced knowledge in the biological sciences through innovative teaching, cutting-edge research, and by assuring a commitment to academic excellence. Our mission is to provide a robust and innovative education that prepares students for careers in various fields such as research, healthcare, biotechnology, and environmental science. We offer a diverse range of undergraduate and postgraduate programs in fields of Botany, Zoology, Biotechnology, Forensic science disciplines. Our curriculum integrates cutting-edge research with hands on laboratory experience, ensuring that students are well-equipped to face real-world challenges. Our faculty members are experienced researchers and educators, committed to mentoring students and guiding them through their academic journey. We also emphasize the importance of interdisciplinary collaboration, encouraging students to engage in research projects through the UG research project scheme. Our department provides numerous opportunities for students to participate in seminars, workshops, and internships, further enriching their learning experience.

As the team of vismaya continue to inspire and engage the Christ University community through the exceptional magazine, I extend my heartfelt congratulations and best wishes to you. May Vismaya continue to flourish, bringing fresh perspectives, celebrating milestones, and fostering a deeper connection among the members of our academic community.

Wishing the team the continued success and many more inspiring issues ahead!

Feature Interview

Prof Dr SABU THOMAS
Former Vice Chancellor, Mahatma Gandhi University, Kottayam

As we begin this conversation, could you please share a brief overview of your journey in the field of Nanoscience and Nanotechnology.

My academic journey at Mahatma Gandhi University began in 1987, with a focus on Polymer Science. However, I also expanded my research into Polymer Nanoscience and Nanotechnology more than two decades ago. Recognizing the vast potential that nanoscience holds for both academia and society, we established the International and Interuniversity Centre for Nanoscience and Nanotechnology. Within 13 years, we built an excellent research centre equipped with advanced facilities such as TEM, AFM, XRD, DSC, and DMA, fostering ground breaking research in nanotechnology.

As a professor specializing in Polymer Chemistry, Nanoscience, and Nanotechnology, my research group actively explores interdisciplinary fields, including nanobiotechnology, nanomaterials for energy, water purification membranes, nanostructured polymeric blends, EMI shielding materials, strain sensors for human motion monitoring, bio-based scaffolds for wound healing, separators for batteries, and nanofillers for tyre formulations. Our work focuses extensively on the synthesis, characterization, and application of nanomaterials.

Our research has led to significant industrial collaborations. We partnered with Apollo Tyres, a leading Indian tiye company, to patent a high-performance technology for tyre inner liners. Additionally, we developed formulations for high-voltage cables in collaboration with General Cable, USA. We also had collaborations with DuPont USA

These partnerships have allowed us contribute new research that can betranslated research into practical products, such as cables and tyre components, which are now integral to daily life.

The support from these industries has been invaluable, not only in co-developing technologies but also in filing joint patents and facilitating technology transfer. These companies. are highly satisfied with the results generated in our laboratory.

Did you have a role model during your early years? If so, who inspired you the most, and how did they influence your path?

Throughout my career, I have been fortunate to have several mentors and colleagues who have profoundly impacted my development. From my school days, I was guided by excellent teachers who instilled in me a love for learning and curiosity about the world. My chemistry teacher Mrs Suma Shivadas at Devi Vilasom School was particularly influential. Their enthusiasm for the subject and dedication to teaching sparked my initial interest in chemistry and laid the groundwork for my academic journey.

During my B.Tech. studies, I had the privilege of being mentored by Dr. Rani Joseph and Dr. K.E. George Their exceptional teaching and guidance were instrumental in shaping my understanding of material sciences. Their expertise and dedication to the subject helped me develop a solid foundation in core concepts, and insightful instruction and encouragement played a key role in my life.

Among the most significant influences in my career has been Prof. S.K. Dey at the Indian Institute of Technology (IIT) Kharagpur. His mentorship was instrumental in shaping my research trajectory. Prof. Dey provided me with the opportunity to work independently, taught me valuable research skills, and encouraged me to think critically and independently. His emphasis on setting clear goals and supporting my development laid a strong foundation for my career.

Indeed, I was fortunate to have a towering figure in the field of science inspire me during my career, Professor C.N.R. Rao. His name is synonymous with excellence in solid-state chemistry and

materials science, and his contributions have been instrumental in shaping the landscape of Indian science. I recall reading his papers and books with a sense of wonder and admiration. His work on nanomaterials, in particular, was a revelation to me. Professor Rao's influence extended far beyond his scientific achievements. He was a mentor, a role model, and a source of inspiration for countless scientists in India and beyond. It was my privilege to have had the opportunity to interact with Professor Rao on several occasions. His insights, his wisdom, and his unwavering belief in the power of science have profoundly influenced my own research journey.

What initially sparked your passion for Science, and how did that shape your career trajectory?

My passion for science was ignited by the inspiring teachers who fostered a deep curiosity in me, particularly in the field of chemistry. Their enthusiasm encouraged me to explore beyond the classroom and immerse myself in scientific inquiry.As my career evolved, the influence of my research supervisors and collaborators became crucial. Their working patterns, dedication, and passion have significantly shaped my research approach. Additionally, the energy I gain from collaborating with others and the societal benefit of guiding young students have fuelled my journey. These experiences not only enrich my understanding but also help shape the direction of my career.

Why did you choose a career in academia over corporate life? What drew you to this path?

Academia provides a unique environment where I can shape brilliant minds, and mentor the next generation of scientists I chose a career in academia over corporate life because it offers the possibility of contributing not only to academic knowledge and society but also to the corporate sector in meaningful ways. My passion for research, coupled with the freedom and vast opportunities that academia provides, allows me to establish myself in a field I am truly enthusiastic about. The collaborative nature of academic research, along with the opportunity to guide and mentor young students who share a passion for science, is incredibly fulfilling.

Their curiosity constantly inspires me, further driving my contributions to the scientific community. The opportunity to interact with colleagues from diverse backgrounds, exchange ideas, and engage in critical discussions is a constant source of inspiration and growth. In a corporate setting, research is often driven by commercial goals and market trends. While this can be beneficial, it can also limit the scope of enquiry.

You've been in Science for a significant part of your career. Could you share some of the key challenges you faced during your time as a research scholar, and how you overcame them?

My policy is to work hard, always do my best, and hope for the best. Throughout my career in science, I have encountered a range of challenges, from setbacks in experiments and administrative hurdles to moments of failure. The scientific community is highly competitive, and expectations are often demanding. Overcoming this pressure required a combination of perseverance, resilience, and a willingness to embrace setbacks as opportunities for growth. However, my guiding principle has always been to remain focused on the bigger picture and hope for the best. Challenges are inevitable, but I believe in pushing forward, continuously trying, and striving to contribute to the scientific community rather than allowing personal challenges to hinder my progress, I concentrate on how my work can benefit society. By maintaining this perspective, I' have been able to overcome difficulties and stay motivated throughout my journey as a scientist.

One challenge I have encountered is the limitations imposed by funding constraints. Research can be expensive, and securing adequate funding is often a struggle. To overcome this obstacle, I have had to be creative and resourceful, exploring alternative funding sources and maximizing the resources available to me.

Furthermore, there comes technical difficulties associated with conducting research like experiments may not yield the desired results, equipment may malfunction, and unexpected challenges may arise. Overcoming these obstacles requires a systematic approach to problem-solving, a willingness to learn from mistakes, and a strong belief in the potential of my research.

Do you notice a shift in the mindset or approach of today's students compared to when you were a student? How do you view these changes?

Modern students are efficient in handling new technologies, which can significantly enhance their research and learning experiences. However, despite these advantages, the core requirement remains the same: hard work and focus. They should minimize the use of social media and utilize it for beneficial purposes only, avoiding time wastage. While technology provides powerful tools, students must integrate these tools with a strong dedication to their goals. The combination of advanced technology and a ethics of hard work can greatly enhance their success .

However, I have also observed a growing sense of anxiety and pressure among today's students. The constant stream of information and the competitive nature of the modern world can be overwhelming. It is important to recognize and address these issues, ensuring that students have the support and resources they need to cope with stress and maintain a healthy work-life balance.

Given the demands of research, would you recommend students or professionals to pursue research part-time?

While full-time research offers the opportunity for deep immersion and focused exploration, part-time research can also be a valuable and rewarding experience. Pursuing research part-time can provide several benefits. If you are passionate about research and can effectively manage your time and resources, part-time research can be a fulfilling and rewarding experience.

As the former Vice-Chancellor of Mahatma Gandhi University, how did it feel when you were appointed, and in what ways did this role impact your career?

Being appointed as the Vice-Chancellor of Mahatma Gandhi University was a moment of immense pride and responsibility. It was a culmination of years of dedication to academia and a recognition of my contributions to the field of Nanoscience and Nanotechnology. The role of Vice-Chancellor presented a unique set of challenges and opportunities.

On one hand, it provided me with a platform to influence the direction of higher education in Kerala and to promote the vision of excellence of the University.

On the other hand, it demanded a broad understanding of various academic disciplines and a keen sense of administrative acumen.

Serving as Vice-Chancellor significantly impacted my career in several ways. It broadened my perspective beyond my own research interests and gave me a deeper appreciation for the complexities of higher education management. I gained valuable experience in strategic planning, resource allocation, and policy development. Furthermore, the role allowed me to interact with government officials, industry leaders, and other stakeholders, expanding my professional network and influence.

While the responsibilities were demanding, the experience was immensely rewarding. I am grateful for the opportunity to serve as Vice-Chancellor and for the positive impact that the role has had on my career.

My tenure as Vice-Chancellor of Mahatma Gandhi University brought numerous benefits to both the university and the broader academic community:

a) **Enhanced Academic Programs:** The introduction of new academic programs such as M.Tech in Nanoscience and Nanotechnology, Integrated M.S-Ph.D. programs, and M.Tech in Polymer Science and Technology enriched the educational offerings. These programs provided students with advanced training in cutting-edge fields, better preparing them for careers in science and technology.

b) **Global Recognition and Rankings:** Under my leadership, the university achieved notable global rankings, including 713 in the world and 154 in Asia by TIMES, and 142 in the Times Higher Education Young University Rankings. These rankings enhanced the university's reputation on an international scale and attracted more students and faculty from around the world.

c) **Increased Research Funding and Infrastructure:** Through successful national and international research proposals, I contributed over INR 30 crore to the university. This funding supported the development of state-of-the-art laboratory and instrumentation facilities, which advanced research capabilities and provided better resources for students and researchers.

d) **Strengthened International Collaborations:** Signing over 115 MOUs with global universities and research institutes facilitated international student exchanges, knowledge transfer, and cultural exchange. This global network broadened the university's influence and provided students and faculty with valuable opportunities for collaboration and learning.
e) **Elevated University's Status:** Achieving The Chancellor's Award for being the best university in the state twice highlighted the university's excellence and innovation. This recognition brought additional prestige and support to the institution.
f) **Development of Kottayam as a Knowledge Hub:** Organizing international conferences and programs like the Erudite Program transformed Kottayam into a significant knowledge hub. This not only enhanced the city's cultural and academic profile but also promoted tourism and increased interactions with global scientific leaders.
g) **Mentorship and Guidance:** My experience and international exposure allowed me to mentor and support a large number of students, helping them become successful scientists and professionals. This guidance had a lasting impact on their careers and contributions to the field.

Overall, my role as Vice-Chancellor provided significant benefits by advancing the university's academic programs, enhancing its global standing, improving research infrastructure, and fostering international collaborations. These achievements contributed to the university's growth and had a positive impact on the broader academic and scientific community.

Looking back, what would you consider your breakthrough moment in academia? What achievement stands out the most to you?

Reflecting on my academic journey, it is difficult to pinpoint a single breakthrough moment. My career has been a series of incremental advancements, each building upon the foundation laid by previous achievements. However, there is one particular accomplishment that stands out as a significant milestone.I believe my breakthrough moment came when the then Vice Chancellor, Prof. U. R. Ananthamurthy, gave me the opportunity to begin my journey at Mahatma Gandhi University was at its nascent stage and I had to start from vacuum . Being appointed it opened the door to enumerable number of opportunities for me.

My life in Mahatma Gandhi University over 37 years as a Vice Chancellor, academician, administrator, and scientist, it has been a rewarding journey.

I take great pride in mentoring 130 PhD students and more than 500 M.Tech, B.Tech, M.Phil, and M.Sc project students from around the globe. It has been a privilege to support and empower these students, helping them to grow into accomplished scientists and professionals. In teaching, I have had the privilege of mentoring many students and introducing new academic programs that I hope will continue to benefit future generations. In my administrative roles, my aim has always been to support and advance our mission, of the University and I am grateful for the chance to contribute to its growth and global standing.

Additionally, introducing new academic programs at the university has been a major milestone. We launched several innovative programs, including the M.Tech in Nanoscience and Nanotechnology, Integrated M.S-Ph.D., and M.Sc-Ph.D. programs, as well as the M.Phil and M.Tech in Polymer Science and Technology. These programs have not only expanded our academic offerings but also strengthened our research capabilities and provided students with cutting-edge knowledge and skills.

In terms of administration, my roles as Vice Chancellor, Pro-Vice Chancellor, and the Director of the International and Inter University Centre for Nanoscience and Nanotechnologyand other school have been particularly noteworthy. Establishing three centres of excellence at the university and securing high international rankings reflect our commitment to advancing research and academic excellence. Additionally, my involvement in various administrative capacities, such as serving as an IQAC Coordinator and a Syndicate and Senate member at different institutions, has allowed me to contribute to the growth and development of the academic community on a broader scale.

Looking back on my academic journey, I feel deeply honored by the recognition and achievements that have come along the way. My H index of 145 and being ranked among the top 10 academicians in India are humbling acknowledgments of my work.

Being listed by Stanford University among the top 2% of scientists in India, and receiving various other rankings, reflect the collaborative effort and support from my colleagues and students. I have been fortunate to co-edit 203 books and authoredaround 1400 research papers, and to participate in numerous conferences and evaluations of Ph.D. theses. These opportunities have allowed me to contribute to the fields of polymer nanoscience and sustainable development, with some of my findings even being patented, which is truly gratifying.

Overall, It has been a rewarding journey to see our programmes and initiatives make a positive impact on students and the academic world. I view these accomplishments as a result of the collective efforts of many dedicated individuals. I am grateful for the support and collaboration I have received throughout my career, and I remain committed to advancing research and education for the betterment of society.

Science is often perceived as a challenging subject by students. How do you tailor your teaching approach to make it more accessible and engaging for them?

To make science more accessible and engaging, I focus on involving everyone in the class and inspiring them to explore more. I encourage students to share their own ideas and connect concepts to real-life examples. To keep things dynamic, I use techniques like flipping the classroom, where students review material at home and engage in interactive activities during class. I also give surprise tests to keep students on their toes and make learning more stimulating. By creating a supportive environment and incorporating these methods, I help make science more relatable and exciting for everyone.

Throughout your career, who among your peers or colleagues had the most profound impact on you, and why?

Throughout my career, I have been fortunate to have several colleagues who have profoundly impacted my development. I am also deeply grateful to my collaborators and coworkers, whose contributions have been vital in advancing my research and achieving our shared goals. Their support and collaboration have been crucial in navigating the complexities of my professional life.Overall, the combined influence of these colleagues has been invaluable in my academic journey.

What advice would you offer to students interested in pursuing a career in science or academia? What qualities do you think are essential for success in these fields?

- Science is a field that requires a deep-seated curiosity and a love for learning. Stay up-to-date with the latest developments in your area of interest, read widely, and be open to exploring new ideas.
- Research is a fundamental part of a career in science or academia. Learn how to conduct experiments, analyse data, and write effective research papers. Networking is essential for success in any field, including science and academia. Attend conferences, workshops, and seminars to meet other researchers and potential collaborators.
- Scientists and academics have a responsibility to conduct their research ethically and responsibly. Adhere to ethical guidelines and be mindful of the potential impact of your work.
- By developing these qualities and skills, you can increase your chances of success in a career in science or academia. Remember, the journey may be challenging, but the rewards are immense.

Given your international collaborations, what has been your strategy in fostering productive relationships with global academic and industrial partners, and how do you navigate the challenges of cross-border research cooperation?

My international collaborations have been instrumental in advancing my research and expanding my professional network. To foster

productive relationships with global academic and industrial partners, I have adopted several strategies. I attend international conferences, workshops, and symposia to connect with researchers from around the world. I also actively participate in online forums and social media platforms to engage with potential collaborators. I seek out opportunities to collaborate on joint research projects with international partners. These collaborations can lead to new discoveries, shared expertise, and enhanced visibility. I encourage student exchange programs to facilitate knowledge sharing and cultural exchange between my institution and international partners. This can also foster long-lasting relationships between researchers.Co-authoring research papers with international collaborators can strengthen our partnerships and increase the impact of our work. Effective communication is crucial for successful collaboration.

In your opinion, what are the key challenges facing the field of nanotechnology today, and how do you intend to address these through your current research projects?

Nanotechnology, despite its immense potential, faces several significant challenges that must be addressed for its continued growth and application. The production of nanomaterials on a large scale and at a reasonable cost remains a challenge. My research aims to develop efficient and scalable synthesis methods for various nanomaterials. We focus on using nanotechnology to support sustainable development, like reducing waste and saving energy. By tackling these issues, we hope to use nanotechnology responsibly and effectively to improve lives and support a green future.

The development of a robust regulatory framework for nanotechnology is essential to ensure the safe and responsible use of nanomaterials.
We also work with policymakers to promote the responsible and ethical use of nanotechnology. We believe that by understanding the potential risks and benefits of nanomaterials, we can harness their power to address global challenges and improve the quality of life for all.

You've had an illustrious career in both academia and research, having served as the Vice Chancellor of Mahatma Gandhi University and founding the International & Inter-University Centre for Nanoscience and Nanotechnology. What inspired you to pursue a career in nanotechnology, and how did it evolve over time?

The establishment of the International & Inter-University Centre for Nanoscience and Nanotechnology was a significant milestone in my career. This centre provided a platform for collaborative research, education, and technology development in the field of nanotechnology. It allowed me to bring together researchers from diverse backgrounds and foster a vibrant research community.

Over time, my career has evolved to encompass not only research but also academic leadership and policy-making. Serving as the Vice-Chancellor of Mahatma Gandhi University provided me with the opportunity to contribute to the development of higher education and promote the growth of nanotechnology in Kerala.
My passion for nanotechnology remains undiminished, and I am excited about the continued advancements and applications that lie ahead. I believe that nanotechnology has the potential to revolutionize various industries and address pressing global challenges, and I am committed to contributing to its development in a responsible and ethical manner.

Being awarded the prestigious Docteur Honoris Causa twice is a monumental achievement. How do these recognitions resonate with your personal and professional journey, and what significance do they hold for you?

Receiving the Docteur Honoris Causa awards twice is a deeply humbling honour. It recognizes the hard work of my research team in the field of Polymer Nanoscience and Nanotechnology. These awards validate our commitment to research and inspire us to keep pushing for new breakthroughs. They also reflect well on Mahatma Gandhi University, highlighting the quality of education and research here. Overall, these

recognitions are a meaningful encouragement for me to continue striving for excellence and to inspire future scientists. These awards serve as an encouragement to continue my research and to pursue new challenges

Your time at IIT Kharagpur was pivotal in shaping your research direction. Could you share a memorable experience from your PhD days and how it influenced your later work in nanoscience?

My professor used to come early in the morning and leave late at night. This helped me understand the importance of hard work and perseverance in research. He would organize conferences and write research proposals, which later helped me a lot in life, particularly in organizing conferences and writing proposals. My guide used to make me write a word I had misspelled 100 times to correct it. I learned from him that whatever work you do, you should do it with perfection.

How do you see the future of nanotechnology impacting industries such as healthcare, energy, or environmental sustainability?

- Nanotechnology can enable the precise delivery of drugs to specific cells or tissues, minimizing side effects and improving treatment outcomes.Nanomaterials can be used to develop highly sensitive and accurate diagnostic tools for early disease detection.

- Nanotechnology can be applied to create artificial tissues and organs, offering potential solutions for organ transplantation and regenerative medicine.
- Nanotechnology can improve the performance and cost-effectiveness of solar cells, fuel cells, and other renewable energy technologies.Nanomaterials can be used to create energy-efficient materials for buildings, transportation, and industrial processes. Nanomaterials can be used to clean up pollution, such as oil spills and heavy metal contamination. Nanotechnology can be applied to create sustainable materials with enhanced properties, such as durability, recyclability, and biodegradability. While the potential benefits of nanotechnology are immense, it is essential to address the challenges and risks associated with its development and application.

Are there any emerging trends or innovations you are particularly excited about?

Yes, there are several emerging trends and innovations in nanotechnology that I find particularly exciting. Nanotechnology is being explored to develop innovative solutions for sustainable agriculture, including improved crop yields, efficient water management, and controlled release of fertilizers and pesticides.

Materials like graphene and transition metal dichalcogenides are attracting significant attention due to their exceptional properties, such as high conductivity, mechanical strength, and optical transparency. These materials have potential applications in electronics, energy storage, and sensors.

Advances in nanotechnology are enabling the development of targeted drug delivery systems that can improve the efficacy of treatments while reducing side effects. Nanotechnology is playing a crucial role in the development of quantum computers, which have the potential to revolutionize computing power and solve complex problems that are currently intractable. These are just a few examples of the exciting developments taking place in the field of nanotechnology. As research continues to advance e, we can expect to see even more innovative and transformative applications emerging in the years to come.

You've published a significant number of papers in your field. How do you balance the demands of administrative roles, research, and the publishing process?

Effective time management is crucial for balancing multiple responsibilities. I always try to have a positive outlook in my life and I try not to waste time on failures butrather look forward to ultimate success .When I publish a peer I get excepted and this drives me further Ultimately, my passion for research and my commitment to academic excellence drive me to balance the demands of my various roles. By staying motivated and focused, I can overcome challenges and achieve my goals. It is important to find a balance that works for you and to be flexible and adaptable as your circumstances change.

What advice do you have for researchers struggling to publish their work?

- Publishing research can be a daunting task, especially for early-career researchers. I advise your researchers to read more. You should have deep learning in your area of research and select a journal that is a good fit for your research topic. Consider the journal's impact factor, scope, and acceptance rate.
- Carefully read and follow the submission guidelines of the journal you choose. Adherence to these guidelines can increase your chances of acceptance. Share your manuscript with colleagues or mentors for feedback. Their insights can help you improve the clarity and overall quality of your work.
- If your manuscript is rejected, take the time to carefully consider the reviewer comments. Address their concerns and revise your manuscript accordingly before submitting it to another journal. Rejection is a common part of the publication process. Don't get discouraged by setbacks.
- Keep submitting your work to different journals until you find the right home for your research. Building relationships with editors and reviewers can increase your chances of publication. Attend conferences, participate in online forums, and connect with other researchers in your field. Remember, publishing research takes time and effort.

STUDENT'S SPOTLIGHT

ARTICLES FROM THE STUDENTS OF THE SCHOOL OF SCIENCES

The Brain-Eating Bacteria

Ishita Lal
3 BSc BTZ

Over the years it has been seen that bacteria have a plethora of functions; some beneficial, and some not-so-beneficial. Although they come in minute, indistinguishable sizes, some of them can cause quite a lot of harm. *But bacteria that eat our brain?* It sounds like something out of a sci-fi movie, like a weird zombie apocalypse movie, even though it's absolutely true.

In the past few years, researchers have shown that a particular bacterium is capable of causing "brain-eating". *Naegleria fowleri* is a species of free-living amoebas (FLA) that are capable of infecting the human central nervous system, in other words, they cause neuroinfection. They are one among various pathogens (such as viruses, bacteria, and fungi) that can neuroinfect by implementing certain mechanisms that work at a molecular level which allow them to cross the blood-brain barrier or the blood-cerebrospinal fluid barrier, thus affecting the brain or the spinal cord.

FLAs have the ability to complete their life cycle by existing as parasites in a host, or by living freely in natural environments, thus they are known as amphizoic organisms. *Naegleria fowleri*, when present as a parasite, causes primary amoebic meningoencephalitis (PAM), a severe infection that can lead to the death of the infected patient 7-10 days after the bacteria enters the body. The disease is pretty uncommon but definitely concerning due to its lethality.

Naegleria fowleri affects susceptible individuals when contaminated water enters the body through the nose, the bacteria then cross the olfactory mucosa, the cribiform plate, reach the olfactory bulb, and then the brain. The patients often show symptoms of fever, severe headache, photophobia, nausea, vomiting, behavioural abnormalities, seizures, and altered mental status. Along with these intense symptoms, taste and olfactory abnormalities have been observed.

Although the disease is extremely rare, it has a mortality rate of 98%, and for the survival of the patients, an early diagnosis is key. For the treatment of patients, usually a combination of drugs is used to treat the disease, consisting of amphotericin, rifampin, fluconazole, miltefosine, and azithromycin. However, as a result of its low morbidity, a lack of awareness and knowledge of the pathogenesis of the PAM caused by this bacteria prevails, leading to some hindrance in developing successful and effective diagnostic tools.

The fact that such damage can be caused by these bacteria seems insane but it goes to show that even these miniscule organisms are highly developed, finding new mechanisms to evade us and our immune systems. It makes us realise that as science, technology, humans develop, so does everything else in the world; leaving us an incredible range of things to discover and learn about.

IoT, AI, Cybersecurity Transforming Airports

Jyotirmayee Sahoo
3 BSc CM

While interning at GMR Cargo, I acquired valuable knowledge about the importance and the need of IoT, AI, and Cybersecurity on airport operations.

IoT: Bridging Connections

At GMR Cargo, IoT is necessary for allowing the real-time tracking and monitoring of cargo freight. This technology ensures seamless connectivity and efficient coordination between different departments. The continuous flow of real-time data helps reduce delays and boost productivity, allowing for precise tracking and timely updates on shipment statuses.

AI: Enhancing Efficiency

Artificial Intelligence (AI) is a game-changer in optimizing airport operations. At GMR Cargo, AI predicts maintenance requirements for equipment, enabling proactive measures to ensure uninterrupted operations. Additionally, AI streamlines the customs clearance process by analyzing extensive datasets and making real-time decisions, accelerating procedures and enhancing their reliability.

Cybersecurity: Protecting the Digital Framework

In light of the increasing reliance on digital systems, cybersecurity is a pivotal key for safeguarding airport infrastructure. GMR Cargo also carries out very powerful and strong safety measures which also covers regular audits and updates, to shield the data and prevent any kind of violation or malpractice. This method certifies that the data is safe and guards against potential cyber threats.

Throughout my tenure at GMR Cargo, I observed how IoT, AI, and Cybersecurity are vital for the modernization of airport operations. During my internship, I explored how IT is inculcated in the complex system of the airport infrastructure and I feel overwhelmed to have received this opportunity.

Bacterial Cell Factories: A New Horizon for Designer Drugs

Gayathri Kunnathodi
1 BSc BTC

Metabolically engineered bacterial cell factories are revolutionizing the world of biotechnology by producing complex pharmaceuticals with unparalleled precision, efficiency, and sustainability. These innovations promise to transform drug manufacturing.

The core advancement lies in using Escherichia coli (E. coli) as a versatile platform for drug production. Traditionally, manufacturing complex drugs involves lengthy chemical syntheses or extraction from natural sources. However, constructing an advanced bio-factory with E. coli has its challenges. The process begins with designing synthetic gene circuits. Through microbial fermentation, scientists introduce key genes that enable E. coli to synthesize drugs, rewriting its genetic code to create customized metabolic pathways. For instance, engineers have engineered biosynthetic pathways in E.coli to produce valuable compounds like artemisinin, an essential anti-malarial drug, and rare antibiotics.

One of the most innovative aspects of this technology is the use of dynamic regulation systems to fine-tune drug production. Advanced genetic tools such as inducible promoters and riboswitches allow precise control over gene expression, enabling bacteria to adjust production levels based on environmental conditions. This fine-tuning enhances yield and reduces production costs.

The integration of metabolic engineering with artificial intelligence (AI) and machine learning further expands the potential of bacterial cell factories. AI algorithms analyze vast datasets to predict optimal gene and pathway combinations for metabolic engineering, accelerating the creation of new bacterial strains with improved drug production capabilities. This synergy of biology and technology makes drug design and manufacturing uniquely advanced.

Beyond pharmaceuticals, bacterial cell factories are making strides in producing biofuels, specialty chemicals, and biomaterials like spider silk proteins. With diverse microbial production possibilities, scientists are paving the way toward a more sustainable future. In essence, these microbial factories represent a fusion of synthetic biology, genetic engineering, and computational tools, heralding a new era in biotechnology.

Redefining Learning: Embracing Outcome-Based Education

Siri Muralidhar
3 BSc EMS

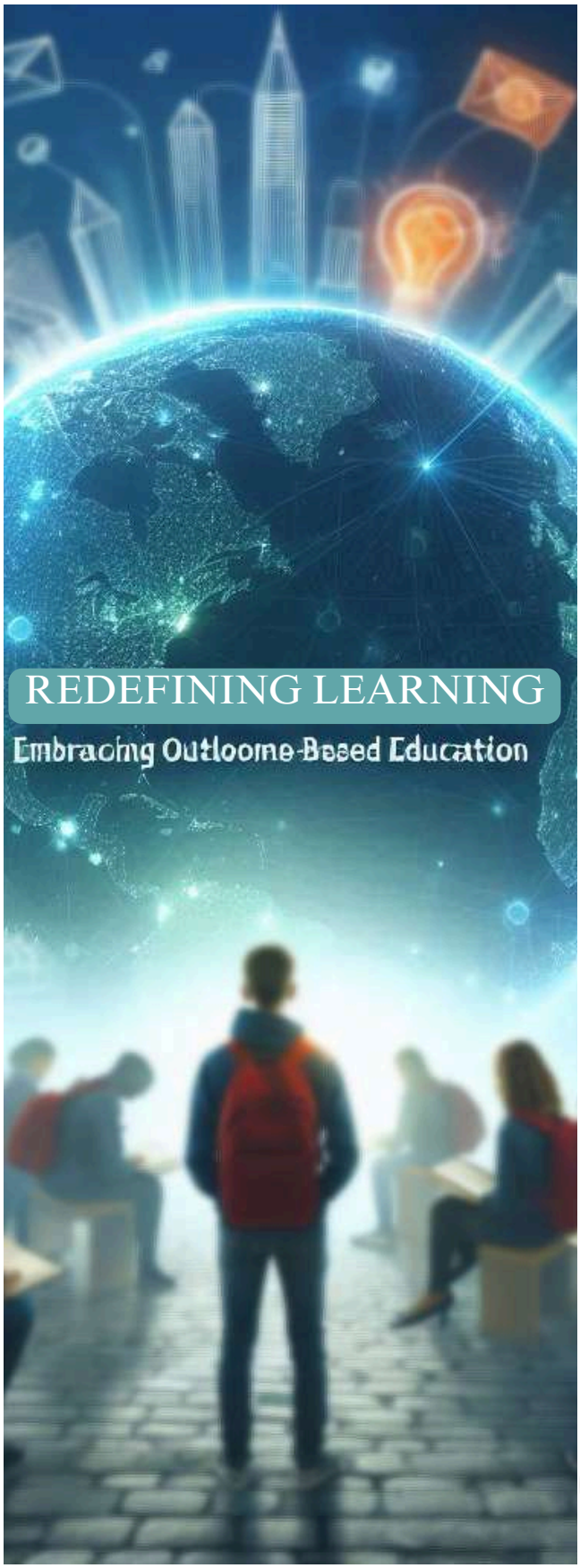
The Indian educational landscape has seen tremendous shifts over time. From time immemorial emphasis on content and processes to the Information Age's emphasis on skills and outcomes, education has constantly evolved to meet the demands of an ever-changing world. Education has seen dramatic transformations in recent decades, owing to technological advancements, globalization, and changing societal needs. Traditional methods of learning and standardized testing are losing way to innovative techniques that emphasize critical thinking, creativity, and practical abilities. Outcome-Based Education (OBE) is one such strategy that is gaining traction globally. This student-centered paradigm strives to prepare students for real-world challenges by teaching them critical 21st-century skills and competencies.

Outcome-Based Education marks a substantial transformation in the Indian education system. Historically, the Indian education system has placed a great focus on theoretical knowledge and high-stakes tests. However, with the growing understanding of the importance of holistic development and employability, there is an urgent need to transform the educational system. An attempt to transform the horizon has been made in the 2020 National Education Policy (NEP), which advocates for a more flexible and multidisciplinary approach, encourages critical thinking, and promotes experiential learning.

OBE focuses on specific learning outcomes, bridging the gap between academic knowledge and practical application. It promotes a learner-centered approach by including experiential learning activities such as projects, internships, and problem-solving assignments. This hands-on approach improves comprehension and encourages critical thinking, creativity, and teamwork which in turn encourages flexibility and customization, enabling educators to tailor instructional methodologies and evaluation approaches to individual requirements. This increases diversity and minimizes reliance on standardized testing as the sole indicator of academic achievement. In India's fast-changing employment economy and global competitiveness, OBE provides students with the skills and competencies required for success beyond the classroom. It promotes innovation, entrepreneurship, and flexibility, preparing students to face complex challenges and make effective contributions to society. Embracing OBE in India is not merely a reform of education but a step towards empowering the generations to come with knowledge along with its applicability to thrive in the competitive world that we live in!

Implementing outcome-based education in India, involves several obstacles. These include opposition to a shift from established educational techniques, a scarcity of trained educators, and inadequate infrastructure. Additionally, a strong assessment system is required to accurately measure learning outcomes. To solve these obstacles, educators must be provided with professional development opportunities both in their domain and in understanding the education system to ensure they have the skills and knowledge necessary to properly apply OBE. Infrastructure improvements, such as access to technology and educational resources, are also critical. Furthermore, building a comprehensive evaluation system, and coming up with a matrix that adheres to OBE principles can aid in correctly tracking student progress and assuring the success of the educational system.

Outcome-based education (OBE) is a change in education that emphasizes students' abilities over their education. It prioritizes output over input, skills over grades, applicability over teaching hours, and the magnitude of the chapter. Implementing OBE in India, particularly in Bangalore, has the potential to result in a more dynamic, productive, effective, and relevant education system. By addressing the issues through deliberate investments in educator training, infrastructure, and assessment frameworks, OBE can greatly improve educational outcomes. This method not only prepares students for the challenges of today's world but also develops a culture of constant improvement and innovation in education.



The Evolution of Data Analytics and Visualization: Transforming Insights into Action

Manas Khanna
5 BCA B

In our increasingly data-driven world, the capacity to analyze and visualize data is critical for businesses, researchers, and policymakers. We are producing record amounts of data, and the tools and methods used to make sense of it have changed substantially. In this article, we explore how data analytics and visualization have developed over time with a focus on their potential to transform insights into actionable strategies.

The Foundations of Data Analytics

Data analytics is the systematic computational analysis of data to reveal patterns, trends and associations. Initially, this was done using methods of descriptive analytics that summarised what had happened in the past. But overtime, analytics began to encompass many types:

- Descriptive Analytics: Describes what has happened in the past. Eg: Sales, Web Traffic etc.
- Diagnostic Analytics: Tells why something happened, based on data correlations and business logic rules to proximate causes. This will need fairly advanced statistical analysis.
- Predictive Analytics: Uses historical data to forecast future outcomes. Machine learning algorithms and statistical models are used here, for predicting the trends and behaviors.
- Prescriptive Analytics: Recommends actions based on data analysis. This kind uses optimization algorithms and complex simulations to suggest the best action.

The Rise of Advanced Analytics

The ever-increasing amounts of big data have brought about a considerable adoption in the use of advanced analytics, thanks in part to the following developments:

- Machine Learning and Artificial Intelligence: ML and AI have altered the landscape of predictive analytics and the decision-making processes by enhancing the interoperabilities and automating high level complex decision making. Deployment of algorithms such as neural networks and ensemble methods further improves pattern recognition and therefore forecasting abilities.
- Real Time Analytics: The ability to perform data analytics instantly is no longer an option in the era of IoT and other streaming data sources. With the advancement of technologies like Apache Kafka and Apache Flink, it is possible to process and analyze data as it is being produced and draw conclusions immediately.
- Natural Language Processing (NLP): Meta-analysis of large amounts of unstructured sources like social media or customer feedback text have become easier with the help of NLP tools and technology.

Data Visualization's Latest Developments

The ability of complex data to be represented in simple forms is attributed to data visualization. The development of visualization tools has been extraordinary in positive ways:

- Interactive Dashboards: Contemporary BI solutions such as Tableau, Power BI, and Qlik Sense come with dashboards that allow for interaction with the data in question. Several interactions, such as drill-downs and filters, as well as real-time updates, invoke user engagement and allow innovative insights to be made.
- Geospatial Visualization: Data analysis which involves the use of geographical information is critical, hence presenting data in the form of maps is beneficial. More advanced geospatial visualization technologies are created by combining mapping technologies like ArcGIS with Google maps, making it possible to visualize data relationships in regard to geography.
- Augmented Reality (AR) and Virtual Reality (VR): Both AR and VR technologies are becoming promising options to visualize data. These processes allow the person to deal with and view the complex data sets in an entirely different way and in a different environment, which is a 3D virtual environment. For example, in the case of VR one can represent network topology or complex modeling in a more visual context.

The Future of Data Analytics and Visualization

The future of data analytics and visualization is set to undergo a host of thrilling changes:

- Quantum Computing: The potential of applying quantum computers to the analysis of large data will be unlimited as they will be able to work on almost all data problems as compared to the current state of our technologically advanced computational tools.
- Enhanced AI Integration: While this will take time, there will be a lot of development around this line so that there is no struggle in using analytics and visualization techniques that make full use of AI. As insights provided by AI also become more complex, so do the predictive models.
- Ethical and Responsible Analytics: The collection of more and more data is directly proportional to the understanding and respect for how that data should be used. Future developments in the field of data analytics may also pay particular attention to improving the privacy, security and justice of the practice.
- User-Friendly Tools: The population of users who are actively working with any kind of data analytics from business intelligence to big data analysis will increase, thanks to the continuing democratization of data analytics, as simple yet more sophisticated tools will be made available. Eased connections and intelligent messaging will assist a wider audience to use data with ease.

Conclusion

Data analytics and visualization as a field has changed remarkably for the better due to technology and the increasing complexity of data. Looking ahead, the combination of AI, real time analytics, and newer technologies will define further evolution and very innovative exploitation of data enabling better decisions within different organizations.

Trigonalid Wasps: World's Most Bizarre Lifestyles

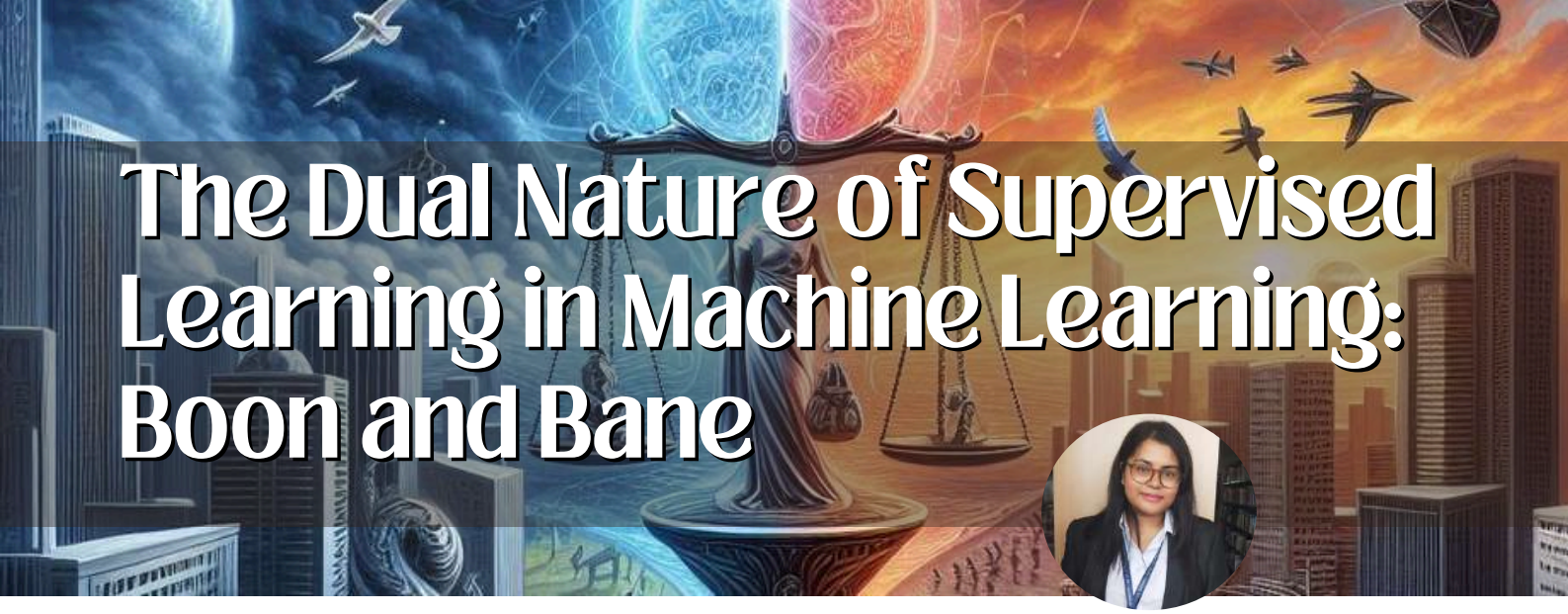
Saatvik Sridhar
3 BSc LIF

Many creatures on this planet grab our attention for their majesty or for their uniqueness, but many often go unnoticed because of their unassuming appearance. This is especially true for insects, but once we probe deeper, a whole new world is revealed hiding in plain sight.

Trigonalid wasps are one such little-known species. They are extremely rare, with only around a hundred species discovered so far, and can easily be distinguished from other wasps by their multi-segmented antenna. The primary reason for their extreme rarity is their incredibly bizarre and seemingly unnecessarily complicated larval life cycle. Their life cycle being the way it is, it's astonishing that any of them even manage to survive until adulthood at all.

Trigonalid wasps are a kind of parasitoid wasp—an enormous aggregate of unrelated wasps all of which spend their larval days consuming and pupating on or inside of a living host, usually another arthropod. (Of course, this isn't a great experience for the host as they're essentially a hollow shell by the time the wasp larva emerges from its pupa.) But even within parasitoid wasps, trigonalids are an enigma. They step up parasitoidism to the next level.

Depending on the species, these wasps follow either of two main types of life cycle:
In the first type, an unexpecting caterpillar crawls along a leaf, consuming it and along with it, a trigonalid wasp egg. Once the egg enters the caterpillar, it hatches into a larva. Now, if this were a normal parasitoid wasp larva, this would be the end of the story. But not for the trigonalid—its aim is not even the caterpillar, but the larva of another parasitoid wasp from the family Ichneumonidae or Braconidae, or of a parasitoid fly from family Tachinidae, which are (hopefully for the trigonalid) also present inside the caterpillar. This is what it will attach to and consume. If a larva from any of these exact families is not present inside the caterpillar, it is game over!
In the second type, the starting is similar- an unexpecting caterpillar consumes a leaf along with a trigonalid wasp egg. But this caterpillar has to now be captured by a female wasp of the non-parasitic vespid family and taken back to its nest. Here, the vespid wasp larvae consume the caterpillar, and in doing so, one unwittingly consumes the trigonalid wasp egg, which now hatches and consumes the vespid wasp larva! Again, if this exact sequence does not play out, it's game over for the trigonalid.
So, this is one creature whose life itself is a gamble. Apparently, going by the fact that they aren't extinct, even this highly improbable life cycle is enough to guarantee the species' survival.
Being little-known, they fully deserve more study and attention along with other little-known creatures. Who knows what other bizarre lifestyles exist out there?



The Dual Nature of Supervised Learning in Machine Learning: Boon and Bane

Smriti Sinha
5 BCA B

Supervised learning, one of the foundational techniques in machine learning (ML), has revolutionized industries ranging from finance to healthcare. By using labeled data to train algorithms, supervised learning enables machines to make predictions or classify data based on input features. While its advantages are profound, this approach also has inherent limitations that can pose challenges. This article explores how supervised learning can be both a boon and a bane, shedding light on its transformative impact as well as its potential pitfalls.

The Boon: Advantages of Supervised Learning

- Predictive Accuracy: Predictive accuracy, especially with a lot of good quality labeled data being available, is one of the strengths of supervised learning. For example, supervised machine learning models in healthcare are able to predict disease outcomes using patient data and such predictions can take place with great accuracy making it possible to facilitate early diagnosis and efficient treatment regimens.
- Structured Learning Process: Supervised learning process is explicit and clearly formulated, thus learning algorithms are compared against previously known solutions. Such clear understanding of the machine learning process assists to build models that can be decoded and credibly trusted. Like linear regression, decision trees and neural networks rely upon such structure, which also enhances interpretability as well as debuggability of the models.
- Versatility Across Domains: It is also important to mention that for supervised learning, one of its truest merits is its versatility and it can be used in so many other spheres. It drives recommendation systems (as done by Netflix, Amazon and so on), natural language applications (chatbots, translation applications), and computer vision (face recognition and self-driving cars) among others.

The Bane: Limitations and Challenges Dependency on Labeled Data

- A significant drawback of supervised learning is its dependency on labeled data. It can be time-consuming, cost-intensive and in some cases practically impossible to obtain quality labeled data. This dependency can make it hard to apply supervised methods as many situations may not provide labeled data to work with.
- Overfitting Risks: It should be highlighted that supervised learning models sink into overfitting. This phenomenon means that when a model, especially a predictive model,

is fitted to the training data, it works very well on it, while performing poorly on testing or validation data. Overfitting is mostly when overgeneralization occurs where the model learns the noise or some intricate details that are present in the training set rather than the pattern. There are methods such as cross validation and regularization to control this problem of overfitting, however it is still a hurdle to overcome.

- Bias and Fairness Issues: There are several instances when supervised learning models bias the prediction because of the biases that were built on the labeled dataset during the training phase. Predominantly, the supervised learning model uses such degrees of freedom as history bias, and if the training dataset is biased, then predictive decisions made may perpetuate and/or innovatively predict bias.

Conclusion

Supervised learning provides a well-defined and structured methodology and better capability to predict the results, for which it is very effective in several fields. Nevertheless, the existing failures, including data reliance, overtraining, and prejudice, indicate the implementation's sensitive nature and further monitoring. Thus, it is possible to state that overcoming these challenges will let practitioners take the best out of supervised learning paradigm to apply it to solving innovative tasks and achieving highly significant outcomes.

Thaw and Order: The Return of Ancient Arctic Viruses

Shamith B V
5 BSc BCB

Scientists are warning of a new and unusual pandemic threat as the Earth's climate warms. Ancient viruses, long frozen in the Arctic permafrost, could be released and trigger global health crises. These "zombie viruses" have been trapped in the frozen ground for thousands of years but may soon re-emerge as temperatures rise and the ice thaws. “Zombie viruses” include Pithovirus sibericum, and Alphapithovirus, etc.

Jean-Michel Claverie, a geneticist from Aix-Marseille University, has already revived ancient viruses from Siberian permafrost. In 2014, his team successfully isolated these viruses, showing they could still infect single-celled organisms. While those viruses posed no threat to humans, Claverie warns that others, frozen deep in the permafrost, could be far more dangerous. He pointed to genomic traces of human pathogens such as poxviruses and herpesviruses, which could potentially cause illness if released.

"The Arctic is warming several times faster than the rest of the planet, and that’s melting the permafrost, which has kept these viruses trapped for millennia," Claverie said. "We need to take this threat seriously."

Virologist Marion Koopmans from the Erasmus Medical Center agrees. "There’s a real possibility that one of these ancient viruses could trigger a disease outbreak, perhaps something like an ancient form of polio," she said.

The risk is heightened by increased human activity in the Arctic, where melting sea ice opens up new industrial development areas. Mining operations, in particular, could disturb the permafrost, releasing ancient pathogens into the environment. Workers in these areas may unknowingly come into contact with these viruses.

In response, scientists are calling for an Arctic monitoring system to track the potential release of these pathogens. Claverie and his colleagues are working with UArctic, an international research network, to create regional quarantine and medical response facilities. The goal is to detect early signs of infection and contain any outbreaks before they spread.

As the world grapples with climate change, the threat of ancient diseases re-emerging from the melting permafrost is a stark reminder that the past may come back to haunt us.

The Influence of Artificial Intelligence on Human Cognitive Abilities and Skills

Sebastian Jose
3 BCA A

Artificial Intelligence (AI) has transitioned from a futuristic concept to a vital part of everyday life. AI refers to the ability of machines to perform tasks traditionally requiring human intelligence, such as learning, reasoning, and problem-solving. Today, AI is integrated into countless technologies, including virtual assistants, medical diagnostic tools, and complex algorithms that analyze large datasets. Its capabilities are changing how we interact with technology and the world around us.

Human cognition refers to the mental processes that allow individuals to acquire knowledge, think critically, and solve problems. Over centuries, human cognitive abilities have evolved significantly. In the hunter-gatherer era, early humans relied on memory, attention, and problem-solving skills for survival. These cognitive skills enabled them to hunt, gather resources, and navigate complex environments. As human societies progressed into more structured and complex civilizations, so did the sophistication of human cognition. The capacity to reason, learn, and think creatively became more developed, allowing for advances in language, technology, and culture. In the modern era, these cognitive skills remain crucial for adapting to technological advancements.

However, with the rise of AI, a significant shift is occurring in how we use our cognitive skills, leading to potential challenges and concerns.

The Adverse Effects of AI Overdependence

As AI tools become more prevalent in everyday life, from chatbots and navigation systems to automated email assistants and code generators, concerns are emerging regarding overreliance on these technologies. While these AI-driven tools undoubtedly improve convenience and efficiency, they also pose risks to human cognitive skills. One of the most concerning effects is the phenomenon of cognitive atrophy, or the gradual decline of cognitive abilities due to disuse. This issue is especially worrisome among young adults and students, who are growing up in a world where AI can perform many tasks that traditionally required active mental effort.

For instance, students often use AI to draft essays, solve complex problems, or even manage their schedules. While these tools reduce workload and save time, they also decrease the need for individuals to engage their memory, problem-solving, and critical thinking skills. This overreliance on AI can lead to a weakening of essential cognitive abilities, such as concentration, information retention, and creative thinking. Tasks that previously required careful planning and in-depth thought can now be outsourced to machines, diminishing our capacity for independent cognitive work.

In addition to academic settings, everyday life is also impacted. For example, AI-powered navigation systems, such as GPS, can cause a decline in spatial memory and directional awareness. Similarly, using automated responses for emails can result in reduced communication skills and overdependence on AI to formulate thoughts. Over time, as we delegate more cognitive tasks to AI, we risk neglecting the very mental processes that have been crucial to human development and adaptability for millennia.

Strategies to Preserve Cognitive Abilities

To address the potential decline in cognitive skills due to overreliance on AI, individuals must take proactive steps to maintain and strengthen their mental abilities. One of the most effective approaches is engaging in regular brain exercises. Activities that challenge the mind—such as puzzles, memory games, and tasks requiring strategic thinking—help maintain cognitive sharpness. Games like chess, sudoku, and other logic-based challenges can stimulate critical thinking, enhance problem-solving skills, and improve memory retention.

Furthermore, it is essential to adopt a mindset of performing tasks manually whenever possible. For instance, rather than relying on AI to write emails or reminders, take the time to do these tasks independently. Similarly, try navigating familiar areas without the use of GPS or solving math problems without turning to a calculator. By practicing these everyday tasks, individuals can reinforce their cognitive abilities and foster a greater sense of autonomy and achievement.

Another important solution lies in the education system. Schools and universities should emphasize the importance of developing core cognitive skills independent of AI. Students should be encouraged to engage in activities that require deep thinking, memory recall, and creativity, such as critical thinking exercises and hands-on problem-solving activities. By creating an environment that values these skills, educational institutions can help students develop and maintain the mental agility necessary to thrive in an AI-dominated world.

In conclusion, while AI provides tremendous benefits and advances, it is important to recognize and address the potential cognitive risks associated with overreliance on these technologies. By incorporating brain exercises into daily routines, reducing dependence on AI for routine tasks, and fostering cognitive development in educational settings, we can safeguard our cognitive abilities while continuing to embrace the opportunities that AI offers. Striking this balance will allow us to maximize the advantages of AI without sacrificing our mental faculties.

The Blueprint of Life: A Genetic Symphony

Debadrita Datta
1 BSc BTB

Amidst the whispers of the cell's library lies a remarkable book—the DNA. Each strand, an intricate manuscript, holds the delicate blueprints of life, written in the precise language of A, T, G, and C. These four letters compose the epic tale of all living beings, determining everything from the color of our eyes to our vulnerability to certain diseases. When the story reaches the chapter of protein synthesis, the DNA, too precious and fragile to risk exposure, entrusts its sacred text to RNA. As the RNA steps in as the messenger, faithfully transcribing the DNA's blueprint into a temporary draft. This transcription transforms abstract genetic codes into tangible proteins, the building blocks of life. In this way, the DNA's complex, hidden narrative unfolds, bringing to life the endless diversity and functionality of living creatures. Through this elegant dance, the blueprint of life becomes reality, a timeless story inscribed in the very essence of our being.

Decoding Sustainable Consumer Behavior: A Machine Learning Approach

Utkarsh Thakur
3 BSc CS

Introduction

In an era of growing environmental consciousness, understanding consumer behavior towards sustainable products and practices is paramount. Machine learning, with its ability to analyze vast datasets and identify complex patterns, offers a powerful tool to unravel the intricacies of this behavior.

Leveraging Machine Learning

Machine learning algorithms can be applied to a variety of consumer data, including purchase history, social media interactions, and survey responses. By analyzing these data points, researchers can gain valuable insights into:

Identifying Key Influencers: Machine learning can help pinpoint the factors that drive consumers to choose sustainable products. These factors might include price, quality, environmental benefits, social responsibility, or personal values.

Predicting Future Behavior: By analyzing historical data, machine learning models can predict future consumer trends and preferences. This information can help businesses anticipate market shifts and develop products that align with emerging sustainability demands.

Personalizing Marketing Efforts: Machine learning can be used to create highly targeted marketing campaigns that resonate with specific consumer segments.

This can increase the effectiveness of sustainability initiatives and reduce marketing costs.

Optimizing Product Design: By analyzing consumer feedback and preferences, machine learning can help businesses design products that are both sustainable and desirable. This can lead to increased market penetration and consumer satisfaction.

Case Study: A Retail Giant's Approach

A major retail chain recently implemented a machine learning-based system to analyze customer data and identify patterns related to sustainable product purchases. The system was able to:

Identify high-potential customer segments: The retailer pinpointed groups of customers who were more likely to purchase sustainable products based on their past behavior and demographics.

Optimize product placement: By understanding which products were frequently purchased together, the retailer was able to strategically place sustainable options to encourage cross-selling.

The Future of Sustainable Consumption

Machine learning has the potential to revolutionize the way businesses approach sustainability. By providing deeper insights into consumer behavior, it can help companies develop more effective strategies to promote sustainable products and practices. As technology continues to advance, we can expect to see even more innovative applications of machine learning in the field of sustainable consumption.

A Chromosome in Crisis: The Evolutionary Fate of the Y Chromosome

Y Vennela
1 MFS

Abstract:
The Y chromosome, the genetic key to male biological sex, which was once packed with over 1,400 genes, now contains only about 45. This shrinking has been happening since millions of years ago, leading to questions about its prospective disappearance. Why is the Y chromosome shrinking, Is the Y chromosome in danger of disappearing, what if the Y chromosome disappeared completely? Well, for now, men are not facing an immediate genetic crisis. Let us delve into the science behind the shrinking Y chromosome and explore its potential consequences and possibilities for scientific intervention.

Introduction:
The role, structure, and evolutionary history of the Y chromosome:
The Y chromosome, a fundamental component of male biology which has major importance in male sex determination, is gradually degrading or facing extinction. These changes might cause some traits to become extinct, while others might emerge. It carries the SRY genes, essential for male development, such as production of male hormones. As a unique genetic marker, this helps in tracing paternal ancestry. The Y chromosome is essential for men to have children. It can also be linked to certain genetic problems that affect fertility. Scientists believe that it used to be the same size as the X chromosome. Over time, through a process called "genetic decay," it shrunk significantly, due to its inability to repair itself effectively. Unlike paired chromosomes that can exchange genetic material, this is isolated, leading to mutations and gene loss. It now contains 27-45 genes compared to the X chromosomes' 1,100. While some studies predict its complete disappearance, in some rodent species, the Y chromosome is initially lost but then stabilizes, indicating that there may be mechanisms in place that could potentially prevent its complete disappearance. Perhaps similar mechanisms could function in humans as well.

Latest theories and breakthrough discoveries:
The Y chromosome is essential for male development and fertility. Some animals have managed to survive without it, including certain rodent species such as the mole vole and the Japanese spiny rat, which have completely lost their Y chromosomes but continue to produce males. Scientists have discovered that genes once found on the Y chromosome have moved to other chromosomes in these species, allowing them to survive without the Y chromosome entirely. However, humans still depend on it for essential functions. Despite its decreasing size over time, the Y chromosome hasn't disappeared. This is because its remaining genes are crucial for male development and health. Losing too much of the Y chromosome can increase the risk of certain health problems, such as infertility, cancer, and cardiovascular diseases. Therefore, while the Y chromosome may not be as essential as it once was, it is still a vital component of human biology. Its continued existence is essential for maintaining a healthy male population.

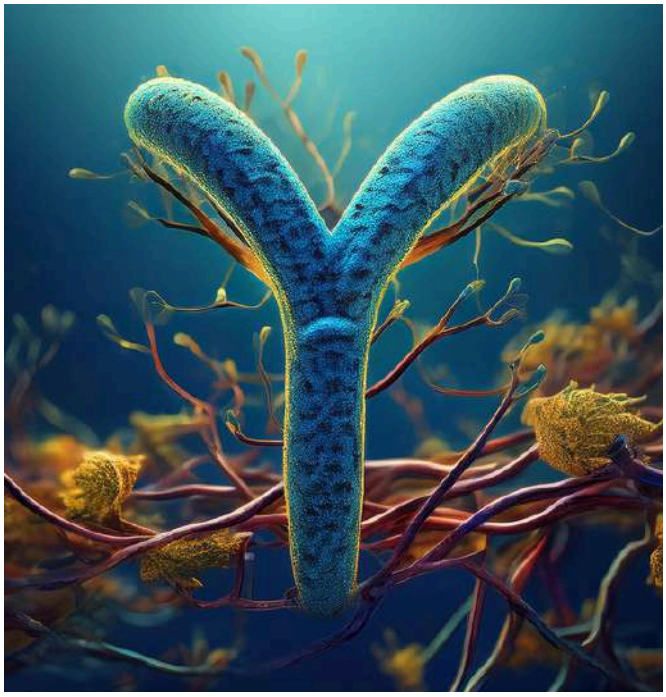
Underlying causes for degradation of Y chromosome:
The loss of Y chromosome is primarily driven by its unique evolutionary history and genetic makeup. Since the Y chromosome does not undergo recombinations during reproduction, there might be a handful of reasons for this loss:

1. **Lack of recombination:** The Y chromosome is shrinking because it cannot repair itself like other chromosomes since they are present as pairs early on while it does not have a partner to swap genes with. This means that if it gets damaged, it cannot fix itself. Over millions of years, this damage has been built up, causing the Y chromosome to lose many genes. Originally it had 1,400 genes but now only 45 remain. This shrinking is shown as a result of lack of genetic exchange.
2. **Mutation and accumulation:** The Y chromosome is getting smaller because it can't fix itself. If it gets damaged, the process of genetic decay starts. Some genes have already been lost, while others are crucial for male reproduction. The important and crucial genes are still present on the Y chromosome. However, there is a possibility that these relocated genes may have the ability to become damaged or erode completely.
3. **The Role of Selection:** Natural selection has allowed the survival of critical genes on the Y chromosome that are necessary for reproduction. However, because there is no mechanism for recombination to "refresh" the Y chromosome, any mutations affecting non-essential genes tend to be lost over generations. In some species like certain rodents, the Y chromosome has been lost entirely, yet males still exist through the evolution of alternative genetic mechanisms.

Compensatory mechanisms in nature:

Some animals have adapted to survive without a Y chromosome by moving their essential genes to other chromosomes. This shows that nature can find ways to overcome genetic challenges. Humans also have backup systems in place. One important Y chromosome gene, SRY, has a backup on the X chromosome. This means that even if the Y chromosome disappears, humans might still be able to produce males.

For example, the X chromosome contains a backup for the foremost and cardinal Y-linked gene, SRY, which has a critical and significant role in male sex determination. Additionally, advances in reproductive technologies, such as in-vitro fertilization (IVF) and gene editing, may provide future solutions to offset any problems caused by Y chromosome loss.



Future research and Ethical considerations:

The condensation of Y chromosome is a delaying process that doesn't pose an immediate threat to human reproduction. However, it is still a fascinating topic for scientists studying genetics and evolution. More investigations are necessary to acknowledge the long-term consequences of Y chromosome loss. Many empiricists are also examining and analyzing ways to preserve or replace the functions of the Y chromosome. The proposition of manipulating or replacing the Y chromosome raises certain important ethical questions. If we could do this replacement or manipulation, should we? What could be the potential consequences after these procedures? Such composite questions need contemplation. These queries will develop progressive importance as our understanding of genetics and reproductive biology deepens.

"I want AI to do my laundry and dishes so that I can do art and writing

Ananya Siriki
1 BSc CS

and not for AI to do my art and writing
so that I can do my dishes and laundry."
-Joanna Maciejewska (Author)

The debate of whether AI is a boon or a bane has long preceded its rise to prominence. Does AI simplify daily life for the common man? Or does it mitigate one's cognitive growth? Do those who feed into the database of AI companies understand the repercussions of their actions?

Perhaps, it does simplify life for students – a simple click can lead to full marks on a test! However, we know all too well that it does nothing for learning, memorizing and solving real world problems. Not only that, a large percentage of people spend their time mindlessly scrolling through the internet. Social media platforms powered by AI algorithms keep one hooked onto reels for hours at a time.

This has resulted in a decreased attention span and an altered perception of reality for an entire generation. Education has lost its essence as students are not only passing exams, but acquiring degrees through AI.

Conversely, algorithms which result in hours spent scrolling mindlessly, also help in disease diagnosis and prevention. AI-powered algorithms also serve a major role in fraud detection and document processing in the field of finance.

One thing is certain – AI continues to evolve and strengthen. As we keeping feeding our data into its expanding repository, it gains all the infinity stones to our lives. It analyses our behaviours, patterns and sentiments and might know more about our preferences than our closest comrades.

Ultimately, it all comes down to the wielder. As the famous saying goes, "Fire is a good servant but a bad Master." The same applies to AI—its utility and influence are determined by the choices of its users.

It is clear that usage of AI is a double-edged sword. While its application in menial tasks like laundry can free up time for creative pursuits, its involvement in creative fields poses potential risks. The threat of AI taking over jobs and work can be mitigated if we hold onto the thing that makes us distinctly human – our creativity.

It's similar to how our ancestors used their canines. However, over time, due to decreased usage, humans no longer have sharp canines. It's akin to the appendix in the human body: once a useful organ for our ancestors, it has become largely redundant in modern times. We must preserve our creativity and ensure it survives this era of technological advancement.

Engaging in regular brainstorming, setting aside time for deep work, limiting passive screen time and seeking feedback from peers are a few habits that can keep our standard of creativity intact.

AI offers remarkable benefits but also challenges our cognitive growth and creativity. To maximize its potential, we must use AI for routine tasks while actively nurturing our intellectual and creative skills. As with everything in life, balance is key to ensuring AI enhances rather than diminishes our humanity.

The Dance of History and Algorithm

Soham Chatterjee
4 MSc DS

Ancient scrolls—lost to the ashes of Mount Vesuvius for centuries—whisper their stories anew, not through the touch of human hands but through artificial intelligence. The wonder of the digital age is now at that juncture where algorithms meet antiquity: where AI becomes an archaeologist's best tool. The Roman Empire left behind, in addition to the structures and artistic works so characteristic, many enigmas tightly wrapped in papyrus scrolls and, as it was thought, lost to time.

Where human capabilities struggle, those of machines prevail. By 2023, AI had already managed to "read" through the tender remains of ancient Roman scrolls carbonized by volcanic ash. Researchers at the University of Kentucky, under the leadership of Dr. Brent Seales, have come up with software so sophisticated as to actually process X-ray scans of such scrolls and read hidden ink. This technology has cracked open a gateway to the past, an unparalleled fusion of history and computer science.

The carbonized and preserved scrolls of Herculaneum stand as testimony to the durability of history and human curiosity since AD 79. Discovered in the 1700s, the scrolls were much too fragile and couldn't be unrolled without crumbling. Scholars had long speculated about what knowledge was inside while being allowed only to look at their blackened surface.

Thanks to machine learning, we may now be at the threshold of another revolution: deciphering whole texts on those artefacts with no more than a glance, leaving them intact. But here is the heart of the scientific quest: an intriguing paradox at work wherein human limitations reveal themselves as machines thrive with capability. Invisible carbon-based ink becomes readable thanks to machine vision; computers identify patterns that even the sharpest of human eyes would miss.

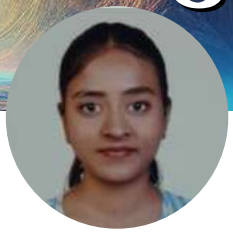
This is no ordinary feat of data science but digital wizardry with a cause.

Scanning inside rolled-up scrolls using computed tomography-CT-for peering, the AI "unwraps" these ancient texts virtually. Machines are mapping the surfaces inside 3D objects; like digital scribes, it begins translating what was once hidden. But there was one peculiar problem with the ink of Herculaneum scrolls: it was composed of carbon, just like the papyri themselves. This means conventional X-ray techniques rely on contrasting materials. Here comes AI, the invisible eye. Teaching machine learning models to trace even the faintest ink trails, the Vesuvius Challenge began a global campaign of deciphering these ancient texts. Scholars and amateurs have teamed up in an effort to outpace time and technology in the race to read as much of the Roman texts as they can.

Whereas the impression of AI is mostly that of a future, even pioneer, application, its incursion into heritage science reveals its gentler, deeper side: bringing together modern technology and ancient wisdom. With algorithms, we protect not only the past but return it to life. This is history unfolding anew, told by the pixels and code that form the contours of 21st-century advancement.

An undergraduate major in computer science opened the first physical word in Roman literature to emerge from the effort: the word "purple." Simple yet a historically weighted term, it means wealth, status, and the power of the Roman Empire. Somehow, it's poetic of how technology can breathe into the previously unreachable.

Where Science Meets the Supernatural: Unveiling the Boundaries and Challenges



Preethi Prakash Nadar
1 BSc BTB

Albert Einstein once said that everything is energy, and that is all there is to it. Match the frequency of the reality you want, and you cannot help but get that reality. It can be no other way. This is not philosophy; this is physics. Here, the physics Albert Einstein mentioned is quantum physics, the study of molecular particles, which is the exact concept we are going to explore with regard to manifestation.

Let us start by understanding which concept of quantum physics explains a better understanding of manifestation. The concept that unveils manifestation, often considered witchy and supernatural, is **quantum entanglement**. The theory states that when two particles in space are separated by infinite distance, they are still entangled. The quantum state of one particle will instantaneously affect the state of the other, even when they are separated by infinite distance.

Scientists have discovered with the help of EEG that thoughts are waves. Similar to the theory, these thoughts are connected to multiple realities in the universe. When you give energy to the thought, it jumps or tunes into different realities. This proves that manifestation is nothing but getting your thoughts to tune in with your desired reality.

Wave properties indicate that they possess frequency. According to wave-particle duality, everything that has mass can behave like waves as well as particles. So practically, the entire physical realm has frequency. As humans, we can only hear about 1% of sound wave frequency in the sound wave spectrum and can view 0.0035% of light waves in the whole spectrum with our physical senses. This leads that humans cannot observe or grasp most of the waves in these spectrums. We can say that the non-physical world cannot be measured as it does not exist in time or space according to the theory of relativity, but that doesn't imply that it doesn't exist. Rather, we as humans, just cannot understand or don't have the ability to grasp it.

Thoughts are waves, which means they have no mass. According to the relativity theory, those who have no mass are not bound by space and time, and go beyond space and time. Finding physical evidence for something means locating it in time and space. But according to Heisenberg's uncertainty principle, we cannot measure anything without mass. We know that waves have no mass and can only be measured when they interact with mass by providing energy to the mass. Likewise, when we manifest, we feed energy to our thoughts through our emotions. Our emotions have frequency, as we established previously that everything in our universe has frequency. When we feel a certain emotion towards a thought, we tune in with the frequency of our desired realities from the multiple realities in our universe. Here, the frequency of our emotion plays a crucial role. The higher your frequency, the higher the jump—similar to a quantum particle jumping to a higher-level orbital.

For example, when an electron jumps to a higher-level orbital upon giving energy, the higher the frequency, the higher the jump, and the closer you get to your desired frequency. In the quantum field theory, we are unable to understand the whereabouts of the electron when it jumps to the excited level from the lower orbital, and the gap between the lower level orbital and the higher-level orbital. This concludes that the electron cannot exist in between as per the uncertainty theory. We can only measure it going from one level to another. We can literally say that we don't know if its exists in between, but just because we cannot measure it, doesn't mean it does not exist.

Some things cannot be explained by science when they are not physical. This can also be considered a limitation of science, and we might remain hopeful that as we advance, we will understand more about our quantum world.

Gene Therapy: A Medical Revolution or Ethical Dilemma?

Neil Anthony George
3 BSc BTC

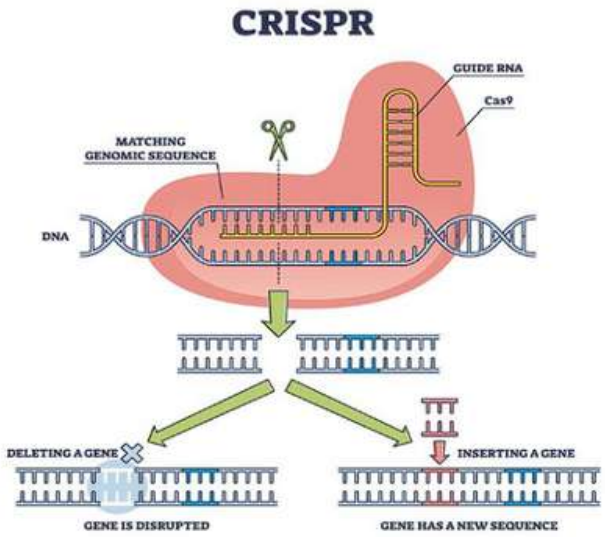
Although drug treatments are used in controlling the symptoms of genetic disorders, the ideal outcome is to cure the disease completely. This is the goal of gene therapy where therapeutic genes are delivered into a patient's cells to correct genetic diseases caused by a faulty gene or genes. The treatment of a human genetic disease by gene therapy is the ultimate application of genetic technology. However, for the past 25 years, this field has not lived up to its expectations. With the discovery of CRISPR-Cas, gene therapy is currently experiencing a fast-paced resurgence.

Two essential criteria for gene therapy are that the genes involved in causing that disease have been identified and that the gene can be cloned or synthesized in the laboratory. The cells affected by the genetic condition must be easily accessible for treatment. For example, blood disorders like leukemia and hemophilia can easily be treated since it is relatively easier to manipulate blood cells and return them to the body than treating cells in the brain, heart, or spinal cord. A majority of the recently approved clinical trials are for cancer treatment and to date, there are 5000 gene therapy trials that have occurred or recently been initiated. The two broad approaches for the delivery of therapeutic genes could be either ex vivo or in vivo gene therapy.

In ex vivo therapy, cells from the person with the genetic disorder are removed and treated in the laboratory either by adding normal copies of the gene or a DNA or RNA sequence that will inhibit the expression of a defective gene, which is then transplanted back to the person. Whereas in in vivo therapy, the therapeutic DNA is directly introduced into the affected cells of the body. For both approaches, it is crucial to have a delivery system capable of transferring the genes into a patient's cells. Viral vectors such as adenoviruses and lentiviruses can be used by removing the disease-causing genes

and replacing them with a therapeutic gene. The first human gene therapy trial conducted in 1990, utilized retroviral vector carrying an inserted copy of the normal ADA gene in an attempt to cure a heritable disorder known as ADA-SCID. However, the problem with this approach is that it can cause random insertional mutations that could inactivate gene regulatory regions such as a promoter sequence. Non-viral methods include chemically assisted transfer of genes, nanoparticle delivery, and fusion of cells with artificial lipid vesicles called liposomes.

One method that has renewed faith in this field is the gene editing technique known as CRISPR-Cas (Clustered Regularly Interspaced Short Palindrome Repeats). It is based on the delivery of a sgRNA that is complementary to the target sequence in the genome and attached to an endonuclease, primarily Cas9 (which acts as the molecular scissor). CRISPR-Cas is much easier to use as compared to other techniques such as ZFNs and TALENs since it can be done in a living, adult organism accurately and efficiently.



Despite its success in both the conventional (treating retinal blindness and Hemophilia B) as well as gene editing approaches (ZFNs, TALENs, CRISPR), there have been many ethical concerns surrounding gene therapy. Germ line therapy is one form of gene editing wherein the entire future generation will be affected even without their consent since the germ cells are being targeted. Enhancement gene therapy, also known as gene doping, is another such malpractice that is extremely controversial and subject to intense debate.

Overall, gene therapy holds the promise of a medical revolution, offering life-changing treatments for genetic disorders, but its ethical implications, ranging from safety concerns to the potential for genetic enhancement, make it a complex and debated frontier in modern medicine. Thus, it is up to us as budding scientists to decide the fate of gene therapy.

Data for a Sustainable Future: How Data Science Can Help Combat Climate Change

Geshna Garga
3 BSc DS

Climate change is one of the most critical challenges facing the world today. From rising sea levels to severe heatwaves, its impacts are widespread, and the need for action is urgent. While traditional solutions focus on policy shifts, renewable energy, and carbon reduction, an emerging force is gaining momentum in the fight against climate change: data science. Through its advanced analytical capabilities, data science is helping us better understand, predict, and mitigate climate-related issues, paving the way for a sustainable future.

At the heart of climate science lies vast amounts of data. Every day, data is collected from sources like satellite images, ocean temperature readings, and atmospheric CO2 measurements. The challenge, however, is not just gathering this data but interpreting it effectively. This is where data science comes into play.

Machine learning (ML) and predictive modelling are transforming how we analyse climate data. By processing massive datasets, scientists can create climate models to predict future scenarios, such as temperature rises and extreme weather events. These simulations allow policymakers to assess the potential impacts of various actions, guiding decisions that aim to reduce emissions and protect ecosystems.

One of the most promising applications of data science in climate action is optimizing renewable energy sources. Wind, solar, and hydropower are vital in reducing our dependence on fossil fuels, but their outputs are highly variable. Data science helps predict energy production by analysing weather patterns, enabling energy companies to forecast renewable output and ensure a stable supply. Countries like Germany and Denmark have already leveraged data-driven strategies to integrate renewables into their power grids, significantly cutting carbon emissions.

Data science is also improving energy efficiency. By analysing consumption data from households and businesses, data-driven tools can identify ways to reduce energy usage, contributing to smaller carbon footprints and more sustainable habits. This optimization extends to urban planning, where data analysis can guide the development of climate-resilient cities, including renewable energy investments and green infrastructure.

Forests, which act as carbon sinks, are another critical component of the climate equation. Deforestation reduces this natural CO2 absorption, and data science is helping combat this issue by monitoring forest cover through satellite imagery. Using ML algorithms, satellite data can detect illegal logging activities and track reforestation efforts. This real-time monitoring informs policy decisions and supports conservation efforts globally.

Lastly, data science plays a pivotal role in climate policymaking. Countries involved in international agreements like the Paris Accord rely on data science to track emissions and measure the effectiveness of their strategies. By using data to generate transparent reports, nations can cooperate and hold each other accountable, fostering global efforts toward climate action.

It is clear that data science is not only essential to understanding the complexities of climate change but also in driving innovative solutions. By harnessing the power of data, we can tackle one of the world's most urgent challenges and move toward a sustainable future.

FOLLOWED MY BRAIN NOT MY HEART

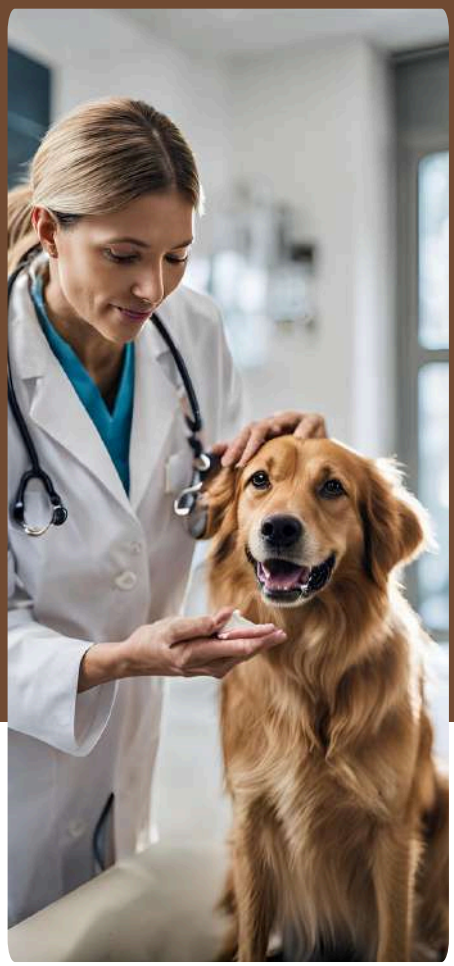
Kangan Gulati
1 BSc BTF

Neuroscience, also known as Neural Science, is the study of how the nervous system develops, its structure, and what it does. According to it, the brain is a complex organ that controls thought, memory, emotion, motor skills, vision, breathing, temperature, hunger and every process that regulates our body. So when it came to making life altering decisions how could i not follow what my brain said. People tell you to follow your heart, do what feels right and go with the flow but how can one follow a path that your most integral organ does not agree with? So I always followed what the complexly beautiful organ told me to do. Science was my space and ironically my escape too. It fascinated me how all so different looking individuals could have the same functioning structure and yet carry unique especially designed characteristics that no one could match. Constantly trying to acquire more and more about the world above and beyond I still found my brain experiencing ease when it stayed home with my parents but it's a brain we are talking about so you never know what it wants next and what it wanted I discovered was change and challenge. And in search of it I took this leap of faith and travelled across states so I could study about and with my brain. Sailors say one can never can never explore the actual depth of seas and me as a sailor of science agrees with this. No matter how many sails we take to uncover the depths of the working beauty that is our brain there will always be more to find and parts to discover.

Always remember my sailors and followers of the brain world might say Curiosity killed the cat but the full saying ends with the remark “but satisfaction brought it back”.

Animal Testing: Why We Need to Find a Better Way

Kaushikee Pandey
1 BSc BTB



Animal testing is when scientists use animals to check if new medicines and products are safe. This has been a common practice for a long time, but it's important to rethink if it's still the best choice.

THE PROBLEM :

First, using animals in experiments often causes them pain and suffering. Animals in labs may live in small cages and go through painful tests without any way to say no. Many people believe it's wrong to hurt animals for our benefit. Animals, like us, can feel pain and stress, and they don't have a say in what happens to them.

Second, animal testing doesn't always give reliable results. Medicines that work well in animals might not work the same way in humans. Sometimes, what seems safe for animals can turn out to be harmful to people. This mismatch can lead to wasted time and money, and sometimes even dangerous outcomes for humans.

BETTER METHODS:

Luckily, there are newer, better ways to test products that don't involve animals. Scientists can use human cells in the lab to see how substances might affect people. Computer models and simulations can predict how new drugs will work. There are also advanced technologies like "organ-on-a-chip," which mimic human organs and systems. These methods are often more accurate and don't harm animals. Switching to these new methods can help us make safer and more accurate products without causing suffering. Banning animal testing isn't about stopping progress but about finding better, kinder ways to do science. It's time to use technology that respects animals and provides better results for humans.

GUARDIAN'S CORNER

ARTICLES FROM THE PARENTS OF THE STUDENTS OF THE SCHOOL OF SCIENCES

NAVIGATING HAIR HEALTH: COMMON ISSUES FACED BY YOUNG ADULTS

Dr. Shaiil Gupta.
MBBS, MD (Dermatology)
Satya Skin, Hair & Laser Clinic
Parent of Arnav Gupta,
3 BSc DM
Department of Statistics and Data Science

Starting a new chapter in life, such as moving to a new city for college, is an exciting yet challenging time for many young adults. As a dermatologist and a parent, I understand the various hurdles that come with this newfound independence. One issue that is often overlooked until it becomes a significant concern is hair health. While hair might seem less critical compared to other aspects of health, it's a visible indicator of our overall well-being. I want to emphasise here the importance of maintaining good habits before facing irreversible damage, including permanent hair loss.

Common Causes of Hair Issues in Young Adults

1. Androgenetic Alopecia:
This is one of the most common causes of hair loss in young adults & is also known as male or female pattern baldness. This genetic condition may start as early as the late teens or early twenties and is characterised by a gradual thinning of hair on the scalp. Unlike temporary hair shedding, androgenetic alopecia is progressive and can lead to permanent hair loss if not addressed early. Hormonal changes, stress, and poor lifestyle choices can accelerate its onset and progression, making it essential to be mindful of one's habits and health.

2. Poor Nutrition:
Young adults often find themselves living away from home, leading to dietary choices that are convenient but nutritionally inadequate. A diet lacking in essential nutrients such as proteins, iron, and vitamins can lead to weak, brittle hair that is more prone to falling out. Hair is made primarily of keratin, a protein, so insufficient protein intake directly affects hair strength and growth.

3. Irregular Sleep Patterns:
Late nights are common, whether spent studying or socialising. However, chronic sleep deprivation disrupts the body's natural repair mechanisms, including those that keep hair healthy. Hair follicles need adequate rest periods to grow properly, and insufficient sleep can push more hair follicles into the shedding phase prematurely. Over time, this can lead to noticeable hair thinning and loss.

4. Stress and Its Impact:
Stress is an unavoidable part of life, but its impact on hair health is often underestimated. Conditions like Telogen Effluvium, where hair enters the shedding phase too early, are frequently triggered by stress. Stress can also exacerbate genetic conditions like androgenetic alopecia. Hair loss itself can be a big stress & it eventually leads to more hair loss.

5. Role of Water, Especially Hard Water in Bengaluru, in Hair Loss:
Water quality plays a significant role in hair health, and in Bengaluru, hard water is a common issue. Hard water contains high levels of minerals such as calcium and magnesium, which can accumulate on the scalp and hair. This buildup can make hair brittle, dry, and prone to breakage, leading to hair thinning and loss over time. The minerals can also interfere with the effectiveness of shampoos and conditioners, making it difficult to maintain clean, healthy hair.

6. Smoking:
Smoking poses several health risks, and hair health is no exception. Nicotine and other chemicals in cigarettes can damage hair follicles and reduce blood flow to the scalp, impairing hair growth. Smoking increases oxidative stress in the body, accelerating hair ageing and making it more brittle and prone to thinning.

Prevention and Treatment:
1. Early Intervention for Androgenetic Alopecia:
If you notice early signs of thinning or receding hair, it's essential to consult a dermatologist. There are treatments available which can help slow down or even stop the progression of androgenetic alopecia. Early intervention is key, as these treatments are most effective when started before significant hair loss occurs.

2. Nutritional Balance:
Maintaining a balanced diet rich in proteins, vitamins, and minerals is vital for hair health. Incorporating foods like lean meats, fish, eggs, nuts, seeds, and leafy green vegetables can provide the necessary nutrients to support healthy hair growth. If you are unable to meet these nutritional needs through diet alone, supplements can be helpful, but it's important to consult a doctor before starting any supplementation.

3. Prioritise Sleep:
Establishing a regular sleep routine can significantly benefit hair health. Aim for 7-8 hours of sleep per night to allow the body to undergo its natural repair processes. Good sleep hygiene practices, such as reducing screen time before bed and creating a calming bedtime routine, can help improve sleep quality.

4. Stress Management:
Developing effective stress management strategies is crucial. Practices like yoga, meditation, and regular physical exercise can help reduce stress levels. Open communication with friends, family, or a mental health professional can provide support and help manage stress more effectively. Recognizing and addressing stress is not just about mental well-being; it's also about preventing physical manifestations like hair loss.

6. Avoid Smoking:
For those who smoke, quitting is one of the best steps you can take for your overall health, including your hair. Smoking cessation has numerous benefits, including improved circulation, reduced oxidative stress, and better overall hair health.
As a parent and a dermatologist, my message to young adults is simple: be proactive about your hair health. The habits you form now will have lasting effects. Don't wait until the damage is irreversible. By taking steps to improve nutrition, manage stress, get enough sleep, and avoid harmful habits like smoking, you can maintain not just healthy hair but also a healthy body and mind.

THE RISE AND FALL OF THE HIMALAYAS

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We all know about the chain of majestic and lofty mountain ranges that borders the northern part of India. It is the largest mountain belt on the surface of the Earth and is often called the Earth's third pole.

For several decades scientists have been studying this mountain belt. Some important research questions that intrigue a scientific mind are: Why did it form? When did it form? How is the mountain changing over time? How did it change the environment?

Let us first talk about the formation of this mountain belt.

The Rise

When I was young, I used to trek in the Himalayas. Once I was trekking at a high altitude in the Nepal Himalayas. I was walking for a long time and was tired. I decided to take a break and sat down on a boulder. Then I noticed that the rock whereon I was sitting was full of marine fossils – fossilized shells of sea organisms. I thought, "Oh My God, I am looking at a limestone that formed under the sea! How can a rock formed at the bottom of a sea sit at the top of a mountain?" (You will find these marine limestones at the top of Mount Everest and in the countries of eastern Europe.)

Then I remembered what I read in my Geology textbook. A long time ago, there was a sea called Tethys. It was lying between the landmasses of the Tibetan and Indian plates. About 50 million years ago, the Tibetan landmass in the north and the Indian landmass in the south moved towards each other and closed the Tethys Sea. The edges of the two lithospheric plates buckled and the rocks were uplifted towards the sky.

Due to that collision, the upper and the lower layers of the Indian plate became detached from each other. It is like the sole of your shoe coming off when you stumble upon some hard obstacle. The lower layer was pushed inward below the Tibetan plate, and the upper layer was broken into large slabs. The slabs were stacked one upon another, each inclined towards north. I hate to say it, but it is like those horrible highway crashes, where the cars pile up on each other.

Though we talk about the Himalayas being Young Fold Mountain, the large-scale organization is more like a stack of slabs. There are innumerable folds and faults within the slabs.

So, what do we get as a result of this big collision? We get:

1) The Himalayas.

2) A plateau on the northern side – the Tibetan Plateau – A vast flat area lying at an average altitude of 5000 meters (16500 ft) - above the snow line.

3) About 200 km (125 miles) wide south-facing slope on the southern side. The Ganga-Brahmaputra plains occur at the foot of this slope.

Has the construction ended?

Oh no. Not at all. The GPS data shows that the plates are still converging. It would mean that the mountain is becoming higher and higher every day.

Can it grow indefinitely?

No, not necessarily. Because it is also falling.

The Fall

What goes up, also comes down - eventually.

Question: You are piling up rock slabs one atop another; how high can you make the pile?

Just consider:

Mount Everest is more than 8000 meters above sea level. So, at least an 8-kilometer-thick pile of rocks is pressing down on those at the base of Mount Everest. Rocks are heavy. Just imagine the amount of pressure they are exerting on the base.

What amount of pressure can the base rocks withstand before melting?

There must be a vertical limit: If you make a mountain higher than that, the rocks will melt at the base and flow. The mountain will sink. The most interesting aspect that came out recently is that the processes that build the mountain and the ones that bring it down are closely interlinked.

As per the law of geomorphology, if you make any land surface higher than the sea level, it will be eroded down by the surface processes, like those of rivers and glaciers. The higher you elevate the land the more intense the erosion will become. The huge river valleys that crosscut this mountain belt bear testimony of the action of these surface processes.

Again, when you erode it, you are removing material from it. It will become lighter, i.e., less dense. It will be much easier for the tectonic forces to uplift it further. So, if we erode it more, we can expect more earthquakes.

The Consequence

There are many consequences of the rise and fall of the Himalayas. For example, from many studies, we now know that before the rise of the Himalayas, there was no atmospheric circulation similar to the Summer Monsoon. The presence of this big topographic barrier initiated the summer monsoon.

Again, most rocks are made of silicate minerals and silicate weathering requires Carbon Dioxide. Therefore, the extensive weathering of the Himalayas must have caused a huge drawdown of atmospheric CO2. This draw-down of greenhouse gases might have caused the last Ice Age.

You might ask, how do we know all these?

It is all written in the rock records.

Many geologists are constantly trying to decipher these scripts. Maybe you are one of them.

THE FUTURE OF AI IN INDIA: WHY TECHIES NEED TO ADAPT NOW

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An August 20th 2024 Article in Times on India had a headline screaming "Arm Indian techies with AI skills on war footing". This was an article published from a Nasscom – Deloitte report. This got me interested to probe a little deeper on why the word "war footing".

Let's try to understand what is going on with this fast pace of AI adoption and how it will impact the tech community. AI is all about creating systems that perform tasks that usually require human intelligence, like…

- Helping doctors in early diagnosis of diseases, personalized treatment plans.
- Providing investment advice, and automating trading.
- Chatbots handling customer inquiries etc.

There is steady adoption of AI on almost all areas of our day to day lives. We get that, but why the rush on a "war footing"? Let's get some numbers to understand the market trend in AI.

- By 2027 the global AI market is expected to reach $500 Billion from the current $120 Billion
- India could easily be a $40 Billion market by then. It could even head onwards $100 Billion by 2030 (most of you will still be in your 20's)
- Current AI talent in India is just about 5lakhs. We need a talent pool of more than 12lakh by 2027 to keep up with this demand.

All of you are going to witness the next big leap in the IT industry powered by AI adoption. This is happening right now and will continue through 2027 and beyond. Now the big question on all your minds are...

1. How can we be a part of this AI revolution
2. What skills do I need to play an active role.
3. What kind of jobs will be in demand.

I have attempted to answer this based on the trends in the industry and my experience.

1. Look out for problems, however silly it may be. Research, Network, try to solve for it. Look out for internships / work on projects that involve AI.
2. There is a slew of skills needed to build AI solutions, both Technical & Soft skills. Good programming skills will be sort after. Java Script, Python, R, MERN Stack, Dart, ARM, flutter etc. You will need application to interface with AI models.If you love maths especially statistics, linear algebra, calculus etc., these are great skills to have to create models and explore data.There is going to be good demand for someone who is good at critical thinking, communications and loves to collaborate. Analyzing problems, explaining concepts to stakeholders are much needed skills to take an AI solution from 0 to 100.
3. Full stack & backend developers, Business analysts, AI/ML engineers, Data analyst, Data scientists. All these jobs are going to be in great demand.
4. The AI revolution is dynamic and evolving. Stay engaged, stay curious, explore. You all are in the brink of the next big leap this industry is currently experiencing. Be brave, explore and stay extremely curious and positive.

TOYOTA: DRIVING THE FUTURE OF MOBILITY

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One of the most influential players in the automobile industry is Toyota. From revolutionizing hybrid technology with the Prius to pioneering efforts in hydrogen power and autonomous vehicles, Toyota is not just a carmaker; it's a global leader in innovation. This issue will take you through Toyota's current achievements, its roadmap for the future, and how the company plans to stay ahead in an evolving automotive landscape. With a strong commitment to sustainability, electrification, and autonomous technology, Toyota is truly driving the future of mobility. Toyota's strength lies in its ability to adapt to changing market conditions, focusing on fuel efficiency, reliability, and innovative technology across its product range. Toyota is one of the largest and most profitable automakers, with a production footprint spanning five continents. In 2023, Toyota sold over 10 million vehicles globally, with flagship models like the Toyota Corolla, RAV4, and Camry leading in sales.

Toyota is credited with pioneering the hybrid vehicle revolution. The launch of the Prius in 1997 marked the beginning of a new era in fuel efficiency and reduced emissions. Since then, Toyota has sold over 20 million hybrid vehicles worldwide. Models like the Camry Hybrid, Highlander Hybrid, and the newly redesigned Prius continue to attract eco-conscious consumers looking for a reliable and sustainable driving experience.

Impact on the Market: Toyota's hybrid vehicles have set the standard for fuel efficiency while maintaining performance. The company's ability to offer hybrid technology across multiple vehicle segments, from compact sedans to large SUVs, has further cemented its leadership in this space.

Sustainability Initiatives: Toyota's Environmental Vision: Road to Carbon Neutrality,

Carbon Footprint Reduction: Toyota aims to reduce CO2 emissions from new vehicles by 90% compared to 2010 levels. Its lineup of hybrids, plug-in hybrids, and fully electric vehicles is key to this strategy.

Hydrogen Technology: Toyota is betting big on hydrogen as a clean fuel source. The Toyota Mirai, one of the world's first mass-produced hydrogen fuel cell vehicles, is a testament to this commitment.

Global Partnerships: Toyota is collaborating with governments and cities worldwide to create sustainable mobility solutions, such as the development of hydrogen-powered public transportation systems and eco-friendly urban designs.

The Future of EVs: Toyota has committed to launching 30 electric models globally by 2030. Toyota set a target to sell 3.5 million electric vehicles per annum. This includes a mix of battery-electric vehicles (BEVs), hybrids, and hydrogen-powered models, tailored for different regions and markets.

Investment in Battery Technology: To support its electrification goals, Toyota invests heavily in advanced battery technology, including solid-state batteries, which promise faster charging times,

longer ranges, and improved safety compared to current lithium-ion batteries. Toyota is one of the few automakers investing heavily in hydrogen fuel cell technology. The Toyota Mirai, first launched in 2014, remains one of the few hydrogen-powered vehicles available to consumers. Hydrogen fuel cells offer several advantages over battery-electric vehicles, including faster refueling times and longer ranges, making them ideal for long-distance travel and heavy-duty vehicles.

Challenges and Opportunities:

Despite its potential, hydrogen technology faces significant challenges, particularly in terms of infrastructure. Toyota is working closely with governments and industry partners to develop hydrogen refueling stations and promote the adoption of hydrogen-powered vehicles, particularly for commercial use in buses and trucks.

One of Toyota's most ambitious projects is Woven City, a fully sustainable, AI-driven smart city being constructed at the base of Mount Fuji, Japan. Woven City will serve as a testing ground for autonomous vehicles, AI-powered infrastructure, and hydrogen-based energy systems. It is designed to be a living laboratory where Toyota can experiment with future technologies in real-world conditions.

Collaborative Research:

Toyota invests over $10 billion annually in research and development, focusing on areas such as electrification, autonomous driving, artificial intelligence, and robotics. Toyota's R&D centers in Japan, the U.S., and Europe are at the forefront of automotive innovation.

Toyota collaborates with universities and research institutions worldwide to accelerate technological breakthroughs, especially in fields like battery development, AI, and next-generation materials.

Looking ahead, Toyota is focused on achieving its long-term goals, which include:

- Selling over 3.5 million EVs annually by 2030.
- Expanding its hydrogen fuel cell vehicle lineup.
- Achieving full carbon neutrality by 2050 across its entire value chain, from manufacturing to vehicle emissions.

2030 Vision:

Toyota's future roadmap revolves around creating a more sustainable and interconnected world, with innovations in autonomous technology, electrification, and urban mobility leading the way. With a focus on reducing emissions, improving safety, and enhancing the driving experience, Toyota is well-positioned to remain a global leader in the automotive industry.

IMMUNITY: ITS KEY ROLE IN LIFE

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Since COVID-19, immunity has been a common term associated with disease. An immune system is a vast network of organs comprising proteins, chemicals, and WBCs, which work together to protect our bodies from germs and other harmful pathogens. The immune system of an individual has been present since birth in various forms, such as skin, mucus, acids, and enzymes. It does not stop there; it develops throughout everyone's lives. It happens when the body is exposed to different pathogens or diseases. The B cells produce antibodies that engulf the antigen, destroying it in the process. A third category of immunity can be obtained from sources other than that of the individual, like the vaccines administered for diverse diseases. Remarkably, the immune system has a special memory, retaining information about every bacteria or virus it has ever fought off. This allows it to swiftly eliminate these pathogens, reducing their chances of survival and keeping the body healthy.

However, the immune system is considerably dependent on nutrients, which often goes unnoticed by many individuals. Since no one pays attention to nutrient intake and related diets, they are susceptible to diseases that would otherwise be non-existent in an average, healthy human. Lack of awareness and negligence causes the immune system to become vulnerable. The body sends multiple signals when the immune system is weakened through infections, aches, fatigue, and other unexplainable concerns. Such individuals would have gut issues, respiratory complaints, and recurring infections. Also, the wounds would take longer to heal than usual, making them feel tired in spite of not doing heavy work. This would make them look weary and worn out and may result in a loss of weight. An individual with a weak immune system is susceptible to frequent illness that takes a long time to recover. Moreover, they tend to be stressed about anything and everything, the slightest incident being the trigger factor. If the symptoms are frequent, prolonged, and unusually harsh, there are possibilities that infection may develop, which might result in cancer and autoimmune disorders. Sometimes, the immune system may overreact by attacking and, hence, cause unintentional damage to healthy tissues, which can lead to severe conditions of autoimmune disorder.

The most convenient and easiest way to improve immunity is to keep a balanced diet consisting of nutritious food incorporating carbohydrates, vitamins, minerals, probiotics, fats, and so on. There is a high relation between nutrition and immunity function. Several diseases arise when there is no adequate nutrition available. However, depending upon the dietary restriction, the effects and functions of the T-cell and B-cells vary. Not only can the significant elements of nutrients have an impact, but a single element like zinc can also affect immunity. Clinical studies have shown the link between zinc and immunodeficiency disease, which could be regulated through dietary habits. In addition, one should take 3 liters of water a day at the least. Water should be sipped slowly instead of gulping all at once, giving the body time to absorb the essential nutrients from that one sip. Good sleep can boost the immune system as well. The body repairs itself during this time, which is why it is necessary, but sleep and its relations to health are often ignored. Exercising for a minimum of 150 minutes a week is highly recommended for maintaining a healthy immune system. The simple act of moving improves blood circulation, which means that more nutrients and oxygen supply reach every part of the body. This keeps all the organs healthy and ready to fight in case of an invasion of germs. Regular exercise also stimulates the production of immune cells and enhances their function, thereby boosting the body's ability to fight off infections. Under every circumstance, one should have a positive mindset to let the immune system know that the body it works for is worth all the effort.

Alumni Reflections

ARTICLES FROM THE ALUMNI OF THE SCHOOL OF SCIENCES

THE IMMUNITY PARADOX: UNVEILING THE DARKSIDE OF THE IMMUNE SYSTEM

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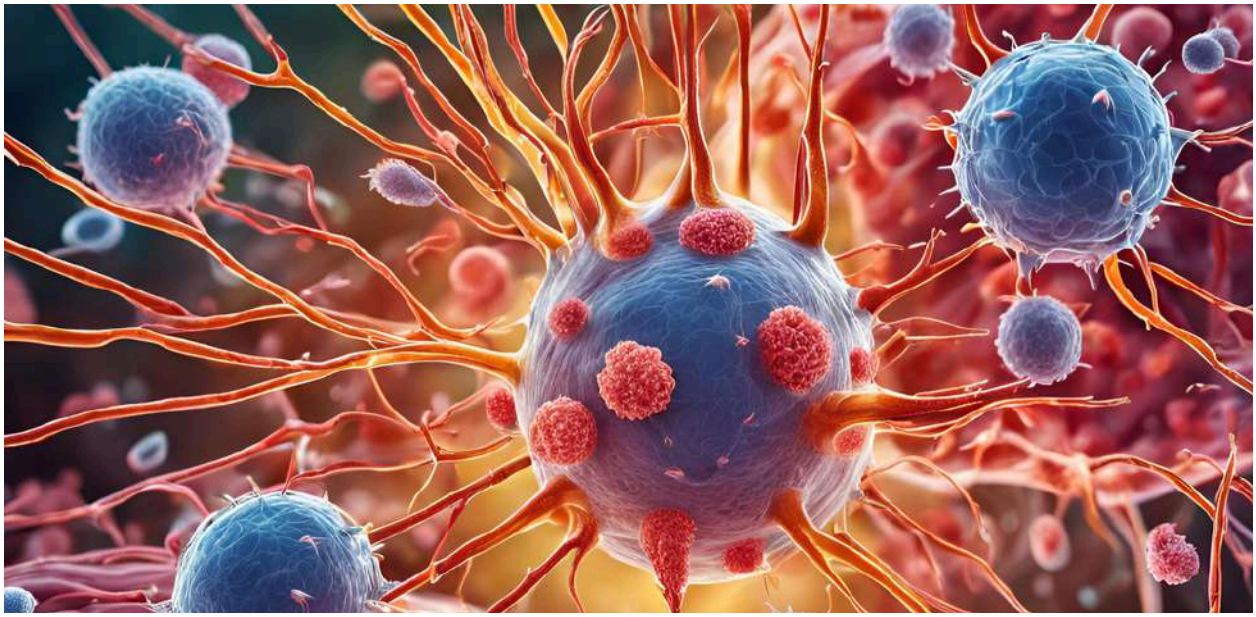
The immune system is a complex defense system of the body. The two subsystems: innate and adaptive system works together to protect the body. Antibodies are a part of the immune system conventionally known to eliminate pathogens and be classified as neutralizing (nAb) and non-neutralizing antibodies (non-nAb). nAbs directly eliminate pathogens while non-nAbs recruit other innate cells to initiate cellular cytotoxic processes, like Antibody-dependent Cellular Cytotoxicity (ADCC) .

There is a phenomenon known as Antibody-Dependent Enhancement (ADE) which can be seen in different viral infections including Dengue, Zika, Japanese Encephalitis, SARS-CoV, HIV, RSV, etc.. When an individual gets infected with the different viruses mentioned, the first stage can be called the 'sensitizing stage' and the body will produce antibodies to fight against the infections. Post this initial stage, ADE can occur due to any of the following reasons:

1. Naturally infection with the same allotype virus (Dengue/Flaviviridae family).
2. Viral infection from an antigenic diverse family (LDV).
3. Antibodies from vaccines that do not provide any protection.

Antibody-dependent enhancement (ADE) in humans involves Fc receptors (FcRs) on the surface of immune cells. These receptors bind to the Fc region of antibodies, which can activate immune cells and influence immune responses. Among the different FcRs, Fc gamma receptors (FcγRs) are essential in ADE.. Antibody-dependent enhancement (ADE) primarily occurs in mononuclear macrophages, including monocytes, tissue macrophages, and dendritic cells.

Non-nAbs facilitate viral entry into target cells, leading to enhanced infection. The interaction between these antibodies and structural proteins or epitopes on the virus plays a key role in mediating ADE. When antibodies bind to these viral components, they can sometimes aid rather than inhibit infection, especially when they cannot neutralize the virus effectively. This phenomenon can suppress antiviral responses in target cells or antigen-presenting cells (APCs), weakening the immune defense. In vitro studies reveal that ADE is particularly promoted in human monocytes, activated macrophages, and mature dendritic cells, while immature dendritic cells are less susceptible. The structural variability of certain viral proteins can mask neutralizing epitopes, leading to the production of non-NAbs that contribute to ADE.



Cross-reactive antibodies can mediate ADE across viruses within the same genus, such as Flavivirus and Coronavirus. This occurs when antibodies from a prior infection with one virus enhance the infection of a related virus. For instance, SARS-CoV-2 ADE could be influenced by previous coronavirus infections that produce non-neutralizing antibodies.

Similarly, in the Flavivirus genus, antibodies against viruses like DENV, JEV, and ZIKV can enhance each other's infections in Fc receptor-expressing cells.

Antibody-dependent enhancement (ADE) complicates antiviral development by increasing the risk that non-nAbs might enhance viral infection instead of preventing it. This challenge is particularly significant when designing vaccines, as antibodies from previous infections or vaccinations can aggravate the disease. Therefore, understanding and mitigating ADE is crucial for developing safe and effective antivirals.

Nature's Canvas

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Always stand tall, but stay grounded.

Scholarly Pursuits

ARTICLES FROM THE RESEARCH SCHOLARS OF THE SCHOOL OF SCIENCES

CHOICE

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In the breezy mornings when you take a sip of hot tea or coffee from Nandhini, the flavors just hit your soul. Stop! Look at the cup from which you are drinking. Is it popularly called a paper for a cup? Let's think logically for a minute now, can paper hold a liquid without it tearing apart and causing spillage? The answer is no. There is a fine layer of a mystery element that holds up the cup, keeping it all sturdy enough to hold a hot liquid. And, that fine element dear people, is PLASTIC. Paper cups are lined with a plastic lining to make them waterproof. In compostable cups they are lined with polylactic acid plastic lining. So why are we discussing about a paper cup and its construction, you might wonder. In one-of-a-kind research conducted in IIT Kharagpur, by Dr. Sudha Goel and her research team, it was found that a cup containing a hot liquid starts leaching microplastics. As Prof. Sudha Goel puts it, "According to our study, 25,000 micron-sized (10 µm to 1000 µm) micro-plastic particles are released into 100 ml of hot liquid (85 – 90°C) residing in the paper cups for 15 mins. Thus, an average person drinking three regular cups of tea or coffee daily, in a paper cup, would be ingesting 75,000 tiny micro-plastic particles which are invisible to the human eyes". Woah! Looks like we are ingesting more microplastics than the beverage. Microplastics are tiny plastic particles that are less than 5 mm in size. They have quirmed their way into all walks of our life. They are found in air, water, and soil. Inside the human body, various research work done have found that microplastics are present in the blood, heart, breastmilk, and even the brain. Phew! Scary isn't it. We have been consuming microplastics for decades, even without being aware of it. A youtuber read how a plastic chopping board generates hundreds of microplastic particles every time. Lot of microplastics are found in cosmetics and toiletries. They are advertised as microbeads which can act as a great scrub, but are they really worth it, considering the damage and threat they pose to the environment? The National Institute of Health's research team examined the microplastics and nanoplastics in three popular bottled water brands. The researchers discovered that approximately 2,40,000 microscopic bits of plastic were present in a litre of bottled water on average. Nanoplastics made up about 90% of these plastic fragments. So, these tiny particles are trickling down further into nanoplastics.

amount of plastic waste would end up in our landfills and oceans. A suitable and sustainable solution would be to make minor changes in our lifestyle. Carry a shopping bag wherever you go, bring your own water bottle. The next time you buy crockery or home needs, buy sustainable and eco-friendly materials. Replace your plastic water bottles with metal bottles, and instead of plastic microwave boxes prefer glass, as microwaving plastic containers leach microplastics and harmful chemicals into out food. It's good to see certain zero waste stores and recycling units opening up in different parts of the city. Find out a nearby recycling unit, make sure you segregate your waste properly. Even certain prominent brands are taking back their used bottles and containers, and offer discount on products. So read up, make yourself aware, educate yourself on sustainable techniques. If all these seem too much, let's start small. Carry a cup/mug for your coffee/tea break. I assure you, at the least save the usage of 7 cups per week and for a year that's 365 cups. That's a pretty drastic change you can make for the environment. The CHOICE is yours!

LAPLACE AND FOURIER APPROACHES TO FRACTIONAL CALCULUS

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1 Introduction

Fractional calculus is a generalization of classical integer order derivatives and integrations to any fractional order. This concept was first introduced in the 17th century when, in 1695, M de L'Hˆopital posed a question to G W Leibniz about the meaning of Leibniz's notation for derivatives, $\frac{\mathrm{d}^n y}{\mathrm{d}x^n}$ specifically asking, "what if n =1/2?" This inquiry into the derivative of non-integer order laid the groundwork for fractional calculus. Around 1819, S.F. Lacroix introduced a definition of a fractional derivative for a power function, followed by Fourier in 1822, who defined derivatives of arbitrary order using what we now refer to as the Fourier transform. After that many mathematicians have defined the fractional derivative of a function in their own ways. But the most popular definitions of fractional derivative are Riemann-Liouville fractional derivative and Caputo fractional derivative.

In recent decades, fractional calculus has gained significant attention due to its wide-ranging applications in fields such as physics, engineering, biology, climate and finance. In this article, we provide the basics of Laplace and Fourier transforms in the context of fractional derivatives and integrals to offer foundational insights into their applications, which include solving differential equations, signal processing, control theory and modeling complex systems with memory and hereditary properties.

2 Integral Transforms of Fractional Operators

2.1 Laplace Transform

The Laplace transform of a piecewise-continuous function f(t) is a new function F(s) = L{f(t)} defined by

$$F(s) = \int_0^\infty e^{-st} f(t) dt. \qquad (1)$$

2.1.1 Laplace Transform of Riemann-Liouville Fractional Integral

We know that the fractional integral of a function y(t) of order v is given by

$$D^{-v}y(t) = \frac{1}{\Gamma(v)}\int_0^t (t-z)^{v-1}y(z)dz, v > 0.$$

Clearly $\int_0^t y(z)(t-z)^{v-1}dz$ is a convolution integral.

So taking Laplace transform on both sides, we get

$$\begin{aligned}\mathcal{L}\{D^{-v}y(t)\} &= \frac{1}{\Gamma(v)}\mathcal{L}\{y(t)\}\mathcal{L}\{t^{v-1}\}\\ &= \frac{1}{\Gamma(v)}\frac{\Gamma(v)}{s^v}Y(s)\\ &= s^{-v}Y(s), v > 0.\end{aligned}$$

So we get

$$\mathcal{L}\{D^{-v}y(t)\} = s^{-v}Y(s), v > 0.$$

2.1.2 Laplace Transform of Riemann-Liouville Fractional Derivative

We recall that in the integer order operations, the Laplace transform of $y^n(t)$ is given by

$$\begin{aligned}\mathcal{L}\{y^n(t)\} &= s^n\mathcal{L}\{y(t)\} - s^{n-1}y(0) - ... - y^{(n-1)}(0)\\ &= s^nY(s) - \sum_{k=0}^{n-1} s^{n-1-k}y^k(0).\end{aligned}$$

We also know that the fractional derivative of y(t) of order μ is

$$D^\mu y(t) = D^m[D^{-v}y(t)], \mu > 0, t > 0,$$

where m is the smallest integer that is greater than or equal to μ and v = m − μ > 0. So

$$D^\mu y(t) = D^m[D^{-(m-\mu)}y(t)], \mu > 0, t > 0,$$

Assuming that the Laplace transform of y(t) exists, we get

$$\begin{aligned}\{D^\mu y(t)\} &= \mathcal{L}\{D^m[D^{-(m-\mu)}y(t)]\}\\ &= s^m\mathcal{L}\{D^{-(m-\mu)}y(t)\} - \sum_{k=0}^{m-1} s^{m-1-k}D^k[D^{-(m-\mu)}y(t)]_{t=}\\ &= s^m[s^{-(m-\mu)}Y(s)] - \sum_{k=0}^{m-1} s^{m-k-1}D^{k-m+\mu}y(0)\\ &= s^\mu Y(s) - \sum_{k=0}^{m-1} s^{m-k-1}D^{k-m+\mu}y(0).\end{aligned}$$

So, we get

$$\mathcal{L}\{D^\mu y(t)\} = s^\mu Y(s) - \sum_{k=0}^{m-1} s^{m-k-1}D^{k-m+\mu}y(0). \quad (4)$$

The equation gives us the formal definition of the Laplace transform of fractional derivative in the Riemann-Liouville sense.

2.1.3 Laplace Transform of Caputo Fractional Derivative

The Laplace transform of Caputo fractional derivative of y(t) of order μ is given by

$$\mathcal{L}\{D_*^\mu y(t)\} = s^\mu Y(s) - \sum_{k=0}^{m-1} s^{\mu-k-1}y^k(0),$$

where m is the smallest integer that is greater than or equal to μ.

2.2 Fourier Transform

The Fourier transform of a complex-valued Lebesgue integrable function $h(x) \in L^1(\mathbb{R})$ is defined by

$$\hat{h}(\omega) = (\mathcal{F}(h(x)))(\omega) = \int_{-\infty}^{\infty} h(x)e^{i\omega x}dx, \quad \forall\omega \in \mathbb{R}.$$

And the associated inverse Fourier transform to get the original function h(x) back from its Fourier transform $\hat{h}(\omega)$ is given by

$$h(x) = (\mathcal{F}^{-1}(\hat{h}(\omega)))(x) = \frac{1}{2\pi}\int_{-\infty}^{\infty} \hat{h}(\omega)e^{-i\omega x}d\omega, \quad \forall x \in \mathbb{R}.$$

2.2.1 Fourier Transform of Fractional Integral

The Fourier transform of the Riemann-Liouville fractional integral of y(t) of order v with the lower terminal a = −∞ is given by

$$\begin{aligned}\mathcal{F}\{D_t^{-v}y(t)\} &= \mathcal{F}\{\frac{1}{\Gamma(v)}\int_{-\infty}^{t}(t-\tau)^{v-1}f(\tau)d\tau\}\\ &= (-i\omega)^{-v}Y(\omega),\end{aligned}$$

where $Y(\omega) = \mathcal{F}\{y(t)\}$ and $0 < v < 1$.

2.2.2 Fourier Transform of Fractional Derivative

The Fourier transform of the Riemann-Liouville fractional derivative of y(t) of order μ with the lower terminal a = −∞ is given by

$$\mathcal{F}\{D_t^\mu y(t)\} = (-i\omega)^\mu Y(\omega),$$

where $Y(\omega) = \mathcal{F}\{y(t)\}$.

It is to be noted that the Fourier transform of the Caputo fractional derivative of a function is the same as the Fourier transform of the Riemann-Liouville fractional derivative of that function.

3. Conclusion

The basics of Laplace and Fourier transforms outlined in this paper can be applied in solving fractional differential equations, demonstrating their applicability in addressing complex problems across various fields.

MXENES:

PIONEERING THE FUTURE OF ADVANCED MATERIALS FOR NEXT-GENERATION APPLICATIONS

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In the last few years, MXenes have garnered immense recognition from the scientific fraternity since $Ti_3C_2T_x$ nanosheets were successfully synthesized at Drexel University via a selective etching method. Till now, the literature review reports successful synthesis and analysis of >150 types of MAX phases resulting in more than 30 MXenes. The MXene is characterized with a general formula $M_{n+1}X_nT_x$ (n ¼ 1, 2, 3, or 4), where M signifies early transition metal X represents C and N, and Tx is the terminal group. The MXenes result from the selective etching of MAX phases defined as layered ternary carbides with a general formula $M_{n+1}AX_n$, where A represents elements from groups 13 and 14 of the periodic table. Even though the term MAX phases were first established in the late 1990s, most were discovered 40 years ago. Their heightened dispersibility is a result of a strong mixed metallic-covalent M X bond. Therefore, 2D MXene nano-sheets are utilized towards the construction of nanostructures in the case of various applications including lithium (Li)-ion batteries, Li-sulfur (S) batteries, and sensors based on $Ti_3C_2T_x$, along with photodetectors based on Mo_2CT_x. The word "ene" is added at the end of the "MXene" to denote the 2D nature of the material. MXene consists of multiple elements, which improve their performance during heterogeneous catalytic reactions as they have varied affinities toward different target analytes. MXene also has evident supremacy over other 2D materials, including Graphene, in terms of electrical conductivity and surface chemistry. Such varied nature surface terminations leads to the prospect of surface functionalization utilizing various molecules while maintaining the electrical conductivity intact. This kind of feature is mostly absent in the case of graphene and other 2D nanomaterials as they are devoid of high electrical conductivity, which further denies any chances of surface functionalization. MXenes are highly utilized in analytical chemistry-based applications as they exhibit a plethora of properties, including superior surface area, ease in surface functionalization, and varying surface functionalization via various methods, including thermal treatments and alkylation. In addition to these properties, they also showcase high hydrophilicity, encompassing high chemical stability and great conductivity, qualifying MXenes as an ideal candidate as the substrate material for next-generation applications.

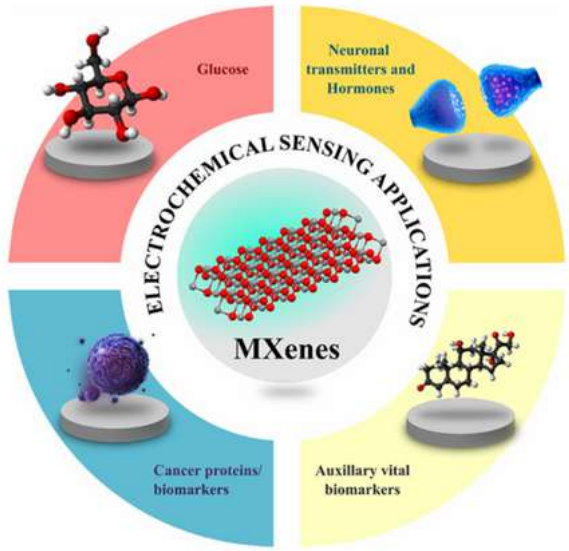

Fig: Electrochemical sensing applications of MXenes for detection of biomarkers related to chronic disorders.

CHANDRAYAAN MISSIONS: A BEGINNING OF A NEW ERA IN INDIA'S LUNAR AND PLANETARY EXPLORATION

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Figure 1: The left panel shows the PSLV-C11 carrying Chandrayaan-1. The middle panel depicts Chandrayaan-2 being launched by the GSLV-Mk III. The right panel shows the LVM3-M4 launching Chandrayaan-3.

India's Chandrayaan missions mark significant milestones in our country's space exploration journey. The Indian Space Research Organisation (ISRO) launched these lunar missions aiming to understand the Moon's surface, mineralogy, and atmosphere. Chandrayaan-1, launched in 2008, made the groundbreaking detection of water on the lunar surface in molecular form. Chandrayaan-2, in 2019, focused on exploring the Moon's south pole with a lander and rover and the orbiter to prepare high-resolution global maps of the Moon. The orbiter continues its path around the Moon, sending valuable scientific data, even though the lander and rover were lost while attempting our first soft landing. Chandrayaan-3, in 2023, successfully achieved a soft landing, advancing India's role in lunar exploration. All the launches are shown in Figure 1. ISRO has plans for future Chandrayaan missions, even aiming to build human settlements on the Moon by 2040, deepening our contributions to space exploration.

Chandrayaan-1: Pioneering Lunar Exploration

Chandrayaan-1 began its historic journey on October 22, 2008 onboard the PSLV-C11. This mission marked a significant milestone in the country's space exploration efforts and represented ISRO's first mission beyond Earth's orbit, showcasing a remarkable technological achievement. The spacecraft was equipped with 11 advanced scientific instruments, each meticulously designed to investigate the Moon's surface, topography, and mineral composition.

One of the mission's most remarkable achievements was discovering water on the Moon. This breakthrough was facilitated by the Moon Impact Probe (MIP), the Imaging IR Spectrometer (IIRS) and the Moon Mineralogy Mapper (M3) onboard Chandrayaan-1, which detected water in the form of hydroxyl (OH) and water (H2O) molecules distributed across the lunar surface (R. Sridharan et al. 2010, S. Bhattacharya et al. 2015). The discovery was made by analyzing the reflectance spectra of the Moon's surface, which revealed the presence of water-bearing minerals. The data indicated that water is present not only in the polar regions but also in the equatorial areas of the Moon, suggesting that lunar soil contains bound water. This detection further led to many theories on how water transport could occur in the extreme conditions on the Moon.

Another significant instrument was the Chandrayaan-1 X-ray Spectrometer (C1XS), which made the first direct detection of sodium on the lunar surface through remote sensing (P. S. Athiray et al. 2014). This instrument provided insights into the

Moon's elemental composition. The Chandrayaan-1 Energetic Neutral Analyzer (CENA) also achieved the first direct measurement of neutral oxygen in the lunar exosphere (A. Vorburger et al. 2014), further enhancing our understanding of the Moon's atmospheric composition. The findings from Chandrayaan-1 brought a new understanding of the Moon, highlighting the potential for water as a resource and other elements for future lunar missions and exploration.

Chandrayaan-2: Advancing Lunar Exploration

Chandrayaan-2 built on the successes of its predecessor, Chandrayaan-1, with an ambitious mission to explore the Moon's south polar region and gain a comprehensive global understanding of the Moon. Launched on July 22, 2019, the mission comprised three components: an orbiter, a lander named Vikram, and a rover named Pragyan.

The orbiter continues to function successfully and has eight scientific instruments designed to study the Moon's surface and exosphere. Its objectives include mapping the lunar surface in high resolution and providing detailed images and data on surface features, mineral composition, and temperature variations. Notable instruments include the Terrain Mapping Camera-2 (TMC-2), Chandrayaan-2 Large Area Soft X-ray Spectrometer (CLASS), Imaging IR Spectrometer (IIRS), and Dual-Frequency Synthetic Aperture Radar (DF-SAR). These tools were used for understanding the Moon's surface composition and identifying potential water ice deposits.

The Vikram lander, carrying the Pragyan rover, was intended for a soft landing on the Moon's south pole. However, during its descent on September 06, 2019, the lander lost communication with mission control and hard-landed on the lunar surface. Despite this setback, the orbiter's continued operation has been highly successful, providing invaluable data.

Among its significant achievements, the Chandrayaan-2 orbiter identified water ice deposits in the lunar polar regions using the DF-SAR (S. Kumar et al. 2022). CLASS mapped the distribution of major lunar rock-forming elements (S. Narendranath et al. 2024) and produced the first global map of sodium on the Moon (S. Narendranath et al. 2022). Meanwhile, the Terrain Mapping Camera-2 (TMC-2) captured high-resolution images of the Moon's surface, achieving the highest-resolution maps ever made, with a resolution of the maps reaching approximately 30x30 cm of the Lunar surface
(A. R. Chowdhury et al. 2020).

Chandrayaan-2 has helped understand the Moon's surface and resources, paving the way for future lunar exploration.

Chandrayaan-3: A Historic Soft Landing

Chandrayaan-3 embarked on its mission on July 14, 2023, marking a significant advancement in India's lunar exploration efforts. Building on the partial success of Chandrayaan-2, this mission aimed to achieve a successful soft landing on the Moon and showcase advanced landing technologies. The mission included a lander named Vikram and a rover named Pragyan. Unlike its predecessor, Chandrayaan-3 did not carry an orbiter, as the Chandrayaan-2 orbiter continues to provide valuable data. Instead, a propulsion module transported the lander and rover from Earth to lunar orbit.

On August 23, 2023, Chandrayaan-3 achieved a historic soft landing on the Moon's south pole, becoming the first spacecraft to land in this challenging region. This landmark achievement demonstrated advanced landing capabilities and precision. The Pragyan rover, deployed from the lander, explored approximately 100 meters above the lunar surface. The rover was equipped with scientific instruments, experiments were conducted, and data on soil samples and surface composition were collected. The images of Vikram and Pragyan on the Lunar surface are shown in Figure 2.

Figure 2: The left panel shows the Vikram lander at the lunar south pole, as captured by the onboard camera of the Pragyan rover. The right panel depicts the Pragyan rover making history by descending onto the lunar surface.

Key discoveries include the confirmation of water molecules on the lunar surface and the detection of sulfur and other elements, which provide insights into the Moon's geological history (S. V. Vadawale et al. 2024). The rover utilized an Alpha Particle X-ray Spectrometer (APXS) to derive the chemical composition and a laser-induced breakdown spectroscopy (LIBS) to determine the elemental composition of lunar soil and rocks. Chandrayaan-3 was designed to operate for one lunar daylight period or about 14 Earth days, as its electronics were not built to withstand the extreme nighttime temperatures of -120 °C (-184 °F). By September 22, the lander and rover missed their wake-up calls, and by September 28, neither had responded, limiting further surface operations.

The successful landing of Chandrayaan-3 has provided new insights into the Moon's south

polar region and improved our understanding of its composition, including the presence of water, ice and mineral resources. These accomplishments represent a significant milestone for India's space program, highlighting ISRO's technological advancements and contributing to our knowledge of lunar exploration.

India's Chandrayaan missions have profoundly impacted lunar exploration, showcasing our country's growing capabilities in space science. From the groundbreaking water discovery of Chandrayaan-1 to the successful soft landing of Chandrayaan-3, each mission has significantly improved our understanding of the Moon. The Physics and Electronics department at CHRIST also hosts Chandrayaan-2 AO projects, which utilize data from Chandrayaan missions to study the surface composition of the Moon and its connection to the Lunar exosphere.

As ISRO continues to build on these achievements, the forthcoming Chandrayaan-4 mission promises to push the boundaries of lunar exploration further. This ambitious endeavour will enhance our knowledge of the Moon's surface and resources and ignite the imaginations of young minds across India. By engaging with such pioneering projects, the next generation of scientists and engineers will have the opportunity to contribute to and shape the future of space exploration. The Chandrayaan missions serve as a beacon of inspiration, demonstrating that remarkable achievements are within reach with dedication and innovation, and they pave the way for future leaders in science and technology.

THE EVOLUTION OF GENAI - A TRANSFORMATIVE ADVANCEMENT IN HEALTH CARE

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Health Care is an inclusive field of regulating health checkups, diagnosis of various disorders, treatment plans, monitoring recovery or drug effects, and medical imaging. The landscape can be defined from diagnostics to treatment plans and refined by the evolution of innovations and advanced techniques. One of the most advanced models – Generative AI (GenAI), revolutionized various sectors, including education, business, market, research, and health care. The evolution of GenAI in health care has had a significant impact on the availability of medical services in remote areas, the availability of online medical advice, the automated interpretation of medical images, and the generation of reports for diagnosis. Some of the applications of GenAI models are discussed in detail:

1. **Enhancing Medical Image Quality** – An enhanced version of low-quality images can be achieved by implementing AI techniques such as denoising, resolution enhancement, and artifact removal. Super-resolution imaging is crucial to fetch finer details, clear visualization of anatomical structures, and regions of interest for small regions.

2. **Radiology** – GenAI evolution in radiology tremendously impacts automatic tissue segmentation, image interpretation, and generating detailed information on each region of interest. Additionally, the diagnosis speed, reduced human errors, higher accuracy, and personalized reports by cross-referencing the patient history are significant results.

3. **Early Disease Detection** – Identifying the disorders with heterogeneous patterns and symptoms by visual observation requires trained medical experts. GenAI excels in disease

diagnosis in multiple critical patterns such as early-stage tumors, microbleeds, or plaque build-up in arteries long before the physical appearance using multiple AI algorithms and analysis. Early detection of conditions such as cancers, cardiovascular diseases, and neurological conditions can significantly improve treatment, training sessions, and health outcomes.

4. **Predicting Disease Progression** - Predicting disease progression by recording historical data and medical images, such as developing neurodegenerative diseases like Alzheimer's, tracking brain atrophy patterns, or predicting tumor growth using tumor shape and size over longitudinal scans.

5. **Surgical Planning** - GenAI can create 3D models of organs or anatomical structures to help surgeons plan brain surgery or tumor resections with higher precision and less risk. GenAI can simulate the outcomes to predict the impact of removing the tumor to the surrounding structure and organs. It also helps predict disease recurrence where the chances of returning the infectious tissues are high.

Technology enhancement has a revolutionary impact; simultaneously, the limitations must be considered when applying it to real-time problems. To enhance the efficiency and accuracy of the outcomes, some considerations are required to be noticed-

- Data privacy and security are ethical issues when maintaining the use of patient data. The security and confidentiality of the data need to be ensured.
- Bias and fairness are other issues with the AI model. The models reflect the results of the data used to train and hence can produce bias analysis or prediction.

- Lack of accountability and transparency due to the black-box nature of algorithms, making it difficult for clinicians to understand the
- decision-making process and parametric measures accountable for analysis.
- Informed Consent needs a separate session to explain the use of data.
  Regulation and Oversight
- Autonomy and Human Oversight

The ethical principle of maintaining human inaccuracy is essential to ensure AI is a supporting tool rather than a tool for human decision-making. A robust regulatory framework is essential to enhance transparency and ensure human oversight.

GenAI models for Medical Imaging – Multiple modalities of medical images are available for the diagnosis of various disorders. Some scans are low-quality, and some are high-quality, generating a huge amount of data. The high-resolution images need medical experts to study and prepare reports. However, the availability of medical experts is limited. GenAI models learn from the available datasets and generate automatic reports with many insightful details about multiple dimensions of disease.

Some of the tools for image analysis are discussed here:

1. Automated image segmentation algorithms such as U-Net and UNet transformers (UNETR) apply to all the data modalities and 2D and 3D datasets for accurate and faster segmentation.
2. Disease Detection models can diagnose diabetes with 90% accuracy and Alzheimer's with 95% accuracy. Multiple models for various disorders can be trained with real-time data for decision-making.
3. Image Synthesis is recommended for research purposes to address the scarcity of data. AI models such as Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) are widely used for generating high-quality, realistic images to enhance the generalizability of the models.
4. VQGAN (Vector Quantized Generative Adversarial Network) designed for high-resolution image synthesis. It combines the strengths of convolutional neural networks (CNNs) and transformers to produce detailed images from lower-dimensional representations.
5. MONAI (Medical Open Network for AI) is an open-source framework that provides a comprehensive set of tools and libraries to develop, train, and deploy the deep learning model in medical imaging. It supports various tasks like image segmentation, registration, and classification.

VQGAN is used for generating high-quality images using GenAI techniques, and MONIA provides the required infrastructure, tools, and libraries to apply the GenAI model in the medical imaging field.

GenAI plays a significant role in health care. Some of the broad advantages of GenAI models are – enhanced learning support, efficiency in research, and accessibility. On the other hand, challenges such as reliability and accuracy, plagiarism and academic integrity, impact on personal development, and ethical considerations need to be addressed.

BEWARE OF STATISTICULATION

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1. WHAT IS STATISTICULATION

Statisticulation is a word coined by Darrel Huff in his book entitled "How to lie with statistics". Statisticulation is the articulation of "manipulation of statistics" to mislead people. Some of the more common ways of statisticulation include:

(i) Use of inappropriate statistics like average, percentages etc.
(ii) Providing Incomplete or magnified Statistics
(iii) Ill-conceived sample and preposterous methods
(iv) Tweaking the context
(v) Through data visualization

2. USE OF INAPPROPRIATE STATISTICS

Average is one of the most used statistics. Average generally is taken as the mean, which is the sum of all observations divided by the number of observations. However, there are other two averages too: the median - middle value in a ranked series, and the mode - most frequent value in a series. If the series is not normal, using mean becomes questionable. Median is generally the appropriate one. Sometimes, to amaze or to persuade mean is used in such cases instead of median. **Beware of Statisticulation.**

When the profit of a company increases from say 1% to 2%, it is an increase of 1 percentage point. However, it is common to say that the company had an increase of 1%. Some may also say that the company had an increase of 100%, since the profit has doubled. In saying 1% increase, the base is the total sales, while in the 100% increase, the base is the profit itself.

Every percentage is a percentage of something, which is the base. When there is a percentage value, there should always be a base. Without that the percentage becomes meaningless or perpetrated. **Beware of Statisticulation.**

3 PROVIDING INCOMPLETE OR MAGNIFIED STATISTICS

In one of the blogs, I read, "Cancer is a leading health concern in India. Over the past decade, the

records of its incidence have been continuously increasing and have been projected to rise further in the upcoming years. It is estimated that every ninth person in the country is likely to develop cancer at some point in their life. The number of annual cancer cases in India doubled between the years 1990 and 2013. In 2020, India reported an estimated 1.39 million cases of cancer which rose to 1.42 million and 1.46 million in the years 2021 and 2022, respectively." This gives a very scary picture making us to worry of cancer coming to us. Actually, if you work out the percent of cancer cases to the population during 2020 to 2022, it is only about 0.1%, which obviously not that scary. **Beware of Statisticulation.**

The same blog also says, "Studies have estimated a 12.8% increase in the number of annual cancer cases by the year 2025, which would be around 1.57 million." This statement doesn't say from which year the increase is calculated. Has it been made to scare the people and to invite them to check for cancer? I do not know. However, the point is statistics quoted does not give full truth. **Beware of Statisticulation.**

4. ILL-CONCEIVED SAMPLE AND PREPOSTEROUS METHODS

To understand the impact of the Swatch Bharat Mission, (SBM) a researcher decided to collect data by sending questionnaires through email to a good number people. He thought that he did not put influence on the people and hence considered the sample random. Do the email users only are the population? Are they only the beneficiaries of the SBM? Think of the results that would be published. A river cannot rise above its source. However, if a pumping station is concealed, it can. Same is true with statistics produced by a sample. The sample result cannot be better than the sample. Therefore, the knowledge of the sample is essential to have clear understanding of the results declared. **Beware of Statisticulation.**

Does early discovery of cancer save lives? The answer is probably, YES. But, how this answer is arrived at? It is through records of the registration of tumour in a certain region or a town. To know the figures of survival, one may get more or less accurate figures for the current year. But what about the figures for the previous, say, five years? They can be made only through trace back. If the patients had left the region or city, it would be quite often not possible to know if they had died or lived. If the "not known" is included in the survival list, then the survival rate would be quite impressive and can make headlines. Thus, it is not only the ill-conceived sample, but also the preposterous methods of data collection that play a major roll in statisticulation.

5 TWEAKING THE CONTEXT

Politicians play with percentages and the total figures. If the electricity consumption charge is raised from Rs 3 to Rs 4, it is an increase of just one rupee per unit per connection or a 33.3% increase. The number one uses depends on the position one takes. **Beware of Statisticulation.**

If a survey is conducted by some person and it is found from the sample that the number of deaths occurred in hospitals is more than at home. Based on this, a headline "More deaths in hospitals than at home" has been made in a newspaper. Yes, it is a fact and the sample has revealed that. This will make a normal reader to conclude that more persons die in hospitals than at home due to lack of proper treatment and care. In spite of the fact that the statement is true, what it doesn't consider is the fact that only people with serious illness are hospitalized and therefore deaths are bound to be more. **Beware of Statisticulation.**

6 THROUGH DATA VISUALIZATION

6.1 Truncated bar chart

Two graphs have been made of the same data on population of India from 2019-2029 (Figure 1). However, the the first one does not visually show much increase in the population, while thesecond one depicts a huge increase. In spite of the same data, the two figures look so differently. It is because of the scale used for Y-axis in the two figures. In the first one, it starts from zero, while in the second, it starts from 1350. So by changing the scale there can be statisticulation. **Beware of Statisticulation.**

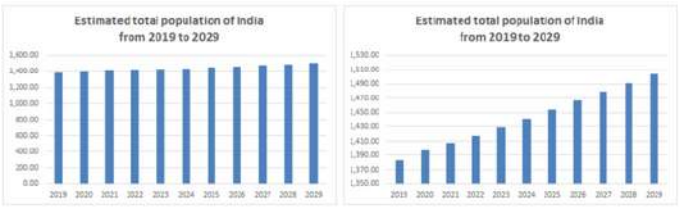


Figure 1: Truncated bar chart

6.2 Changing bar width

Figure 2 shows histograms for the same data with three different bin-widths. The horizontal scales are aligned and the total area of each display is the same. But different frequency scales are used for the vertical axis. The use and interpretation of the three histograms depends on the researcher. **Beware of Statisticulation.**

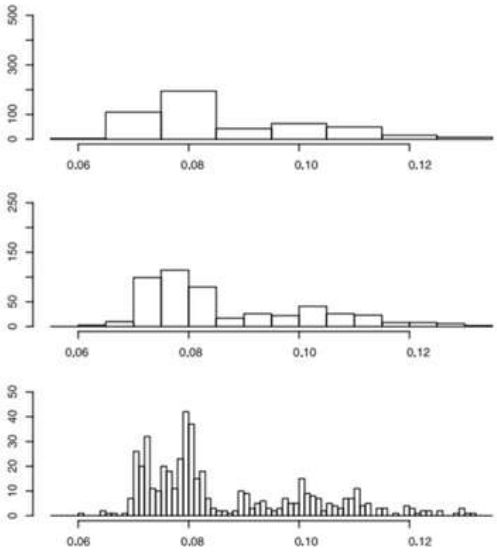


Figure 2: Changing bar width

6.3 Changing X-axis scale

In figure 3, both the graphs show an identical exponential function of f(x) = 2x. The graph on the left uses a linear scale, showing clearly an exponential trend. The graph on the right, however, uses a logarithmic scale, which generates a straight line. If the viewer of the graph was not aware of this, the graph would appear to show a linear trend. **Beware of Statisticulation.**

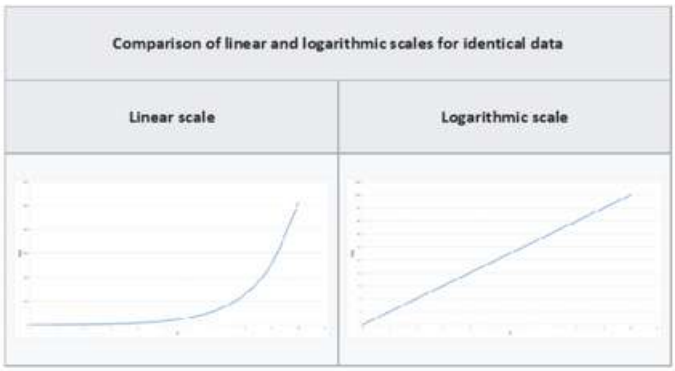


Figure 3: Linear and logarithmic scales

6.4 Changing aspect ratio

Aspect ratios have a surprisingly strong effect on the perception of graphics. This is especially true of time series. If we want to show gradual change, grow the horizontal axis and shrink the vertical axis. The opposite actions will demonstrate dramatic change. In figure 4, the effect of changing the aspect ratio is demonstrated. Which graph to use, depends on the researcher and his mind set.

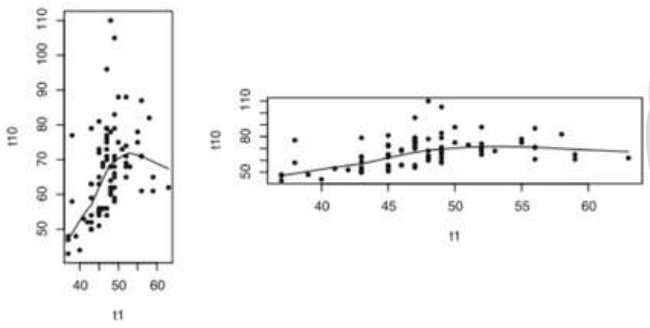
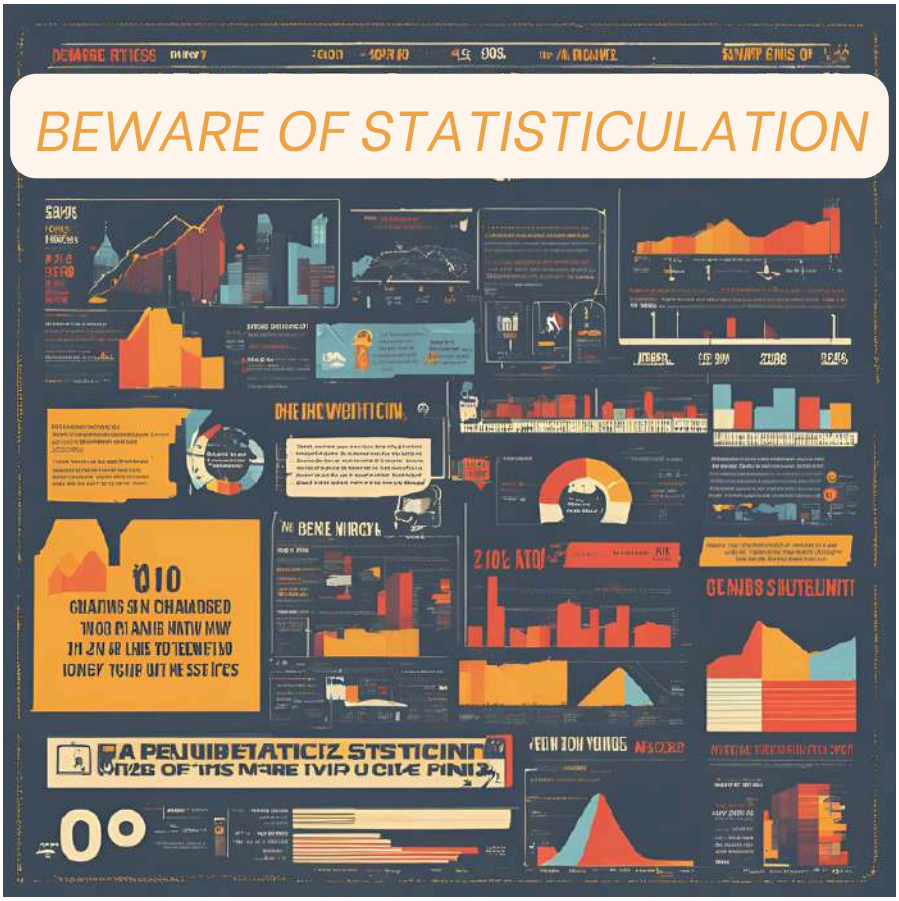


Figure 4: Changing Aspect Ratio



Good Presentation should be susceptible to only one interpretation (see Graphic presentation by Willard Cope Brinton, 1939). Looking at a graph without proper understanding is like the four blind man understanding of an elephant.

Statistical literacy - the habit of reading or listening critically when people are quoting numbers – is the one thing you need, if you don't already have it.

"Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write!" - HG Wells

MENTOR'S MUSINGS

ARTICLES FROM THE FACULTY OF THE SCHOOL OF SCIENCES

Should we be scared of emerging and re-emerging viruses?

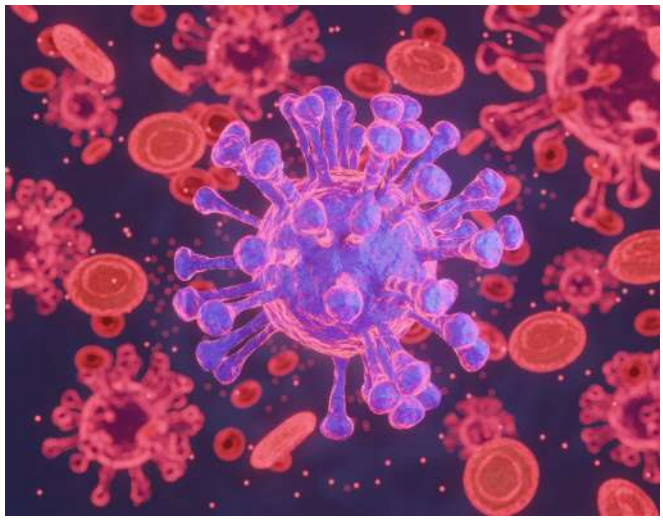
With the revolutionary discoveries in medicine and healthcare, humans believed that the centuries old battle between viruses and humankind is over and we have emerged as winners. But the current statistics on the incidence of many viral diseases shows clearly that it is a false notion. Of late, there have been many instances of emerging and re-emerging viral diseases. The United States Centre for Disease Control (CDC), has defined emerging viral diseases (EVD) as those, whose incidence has seen an upward trend in humans in the past two decades, which in turn has resulted in increased public health problems either globally or locally. Re-emerging viral diseases (REVD) are defined as the ones which were once major health problems and then declined dramatically but are recently reoccurring, leading to major health complications. Many factors have contributed to the emergence of these viruses.

Nipah virus, SARS-CoV-1 and 2, Monkeypox virus, Hendra virus, Hantavirus, MERS CoV and some of the strains of Influenza virus like H5N1, H7N9 etc include some of the dangerous EVDs, whereas Ebola, Dengue, Zika, Lassa, West Nile and Marburg viruses remain the etiologic agents of some serious REVDs. The latest EVD of concern is monkeypox, a disease which has symptoms resembling smallpox, albeit to a less severe extent. Smallpox was eradicated from the world by 1980, whereas monkeypox was found to occur sporadically in few Central and West African countries. But ever since May 2022, monkeypox has emerged in countries without previously documented cases. More than 120 countries have reported the disease till August 2024 with more than one lakh confirmed cases and over 220 deaths. WHO has renamed it as mpox and has declared it as a public health emergency of international concern (PHEIC). A disease outbreak is given the PHEIC status by WHO when it starts spreading in new or unusual ways, and is aimed at pooling international funding and cooperation to control an outbreak.

Let's try to understand what contributes to the flareup of such diseases in recent times. A plethora of factors, including climate change, international travel, human behavior, microbial adaptation, globalization, ecological disturbances etc. have played roles in this. Climate change has led to melting of many glaciers and even permafrost especially in the Arctic region. This has a dangerous consequence of resurfacing and reactivation of deadly viruses which were buried in the permafrost of the polar regions for thousands of years. Some such instances were reported in the last few years from places like Siberia.

Many of the EVDs and REVDs are zoonotic diseases, i.e. infectious diseases transmitted to humans from animals. Rabies is one such deadly zoonotic disease, which is considered very fatal, as there is no cure once the virus gets into the nervous system. Urbanization and the destruction of natural habitats have increased the risk of zoonotic diseases by increasing contact between humans and wild animals. Equally important is the increased rates of global tourism and encroachment into forest areas. These will disrupt the previously undisturbed niches of many wild animals which could be reservoir hosts of many viruses. One such important species which harbors many viruses is bats.

The extreme longevity of bats, gregarious roosting behavior, ability to fly for long distances etc. may help to harbor and transmit many viruses to other vertebrate hosts. Bats have evolved early in the evolutionary scale and have changed very less when compared to mammals. For a virus to enter into host cells for multiplication, it needs to recognize and bind to a receptor protein on the cell membrane. Many viruses have been found to coevolve with bats and have learnt to use cell surface receptors and biochemical pathways which are conserved in mammals that evolved later. Since bats have not undergone much evolutionary changes, these



conserved cell surface receptor proteins would have enhanced the ability of bat species to harbor many viruses.

One has to be cautious of such EVDs and REVDs as they pose a significant threat to human health due to their increased potential to adapt to new hosts, to switch between different host species to allow more spread and to evolve strategies to escape antiviral tactics by the hosts. A totally new host of a virus is more susceptible to succumbing to the virus as its immune system is naive to the virus. This is in stark contrast with some of the viruses which have made some species as hosts since a relatively long time in evolutionary history. These latter types of hosts have more chances of survival as they have coevolved with the viruses and hence would have adapted many strategies for coexistence too, without showcasing severe symptoms. In the light of these facts, there has to be more awareness among the general public regarding the factors contributing to such outbreaks and the need to prevent or control them. One has to learn from the severe consequences of the Covid19 pandemic, which has affected almost all walks of lives of people all over the globe and devise strategies to prevent such viral outbreaks in future.

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Quantum Horizons: The Next Generation of Computing Power

In the modern technology world, quantum computing stands out as a revolutionary force with the latent to transform industries, solve complex problems, and redefine the future of computing. Quantum computers use quantum bits, or qubits, which can exist in multiple states simultaneously, in contrast with the binary digits (bits) using 0 and 1. This unique capability enables quantum computers to tackle problems that are currently impossible for classical computers to solve efficiently.

What Makes Quantum Computing Different?

The core of quantum computing fabrications in two fundamental quantum mechanical principles: superposition and entanglement.

- **Superposition** allows qubits to exist in a combination of states, rather than being restricted to a single binary state. This means that a quantum computer with multiple qubits can handle large number of statistics at once, exponentially more than a classical computer can handle.
- **Entanglement** is a spectacle where pairs or groups of qubits become interconnected in a way that the state of one qubit directly influences the state of another,

no staple the distance between them. This entanglement enables quantum computers to perform complex calculations with extraordinary speed and accuracy.

Real-World Applications

The probable claims of quantum computing are vast and varied, with the power to disrupt industries and create new possibilities in fields such as cryptography, drug discovery, material science, and artificial intelligence.

1. **Cryptography**: Quantum computers are likely to break the widely-used encryption methods, such as RSA, by efficiently factoring large integers using algorithms like Shor's algorithm. This capability has spurred the development of quantum-resistant cryptographic techniques, ensuring data security in a quantum-powered world.

2. **Drug Discovery:** Simulating complex molecular interactions is computationally intensive for classical computers. These computers can model these interactions more accurately and efficiently, leading to faster and more effective drug discovery processes.

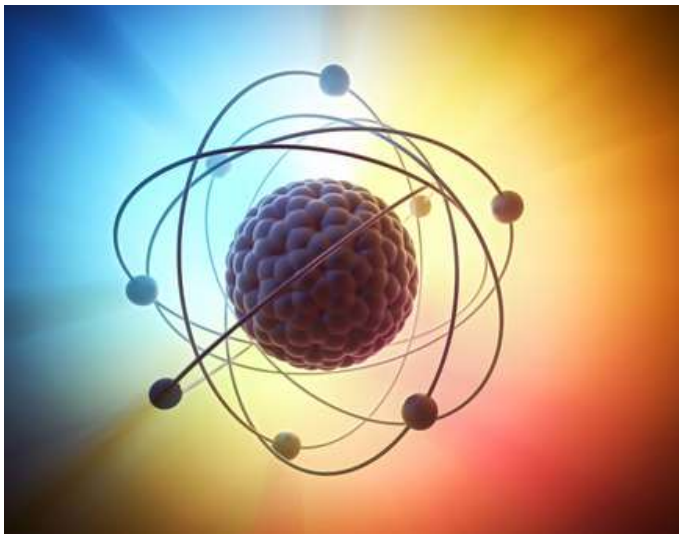
3. **Material Science:** Quantum computing can help plan new materials by simulating atomic structures and behaviors, which is outside the capabilities of classical computers. This can pave the way to the development of more efficient batteries, superconductors, and other advanced materials.

4. **Artificial Intelligence:** Machine learning models and AI algorithms can be significantly enhanced by quantum computing, allowing for faster processing of large datasets, improved pattern recognition, and more efficient optimization processes.

Challenges and the Road Ahead

While the potential of quantum computing is immense, the field is tranquil in its early stages. Building a practical, large-scale quantum computer requires overcoming significant technical challenges, including maintaining qubit coherence, error correction, and scaling up the number of qubits. The current generation of quantum computers, often referred to as Noisy Intermediate-Scale Quantum (NISQ) devices, are limited in their capabilities and are primarily used for research and experimentation.

Despite these challenges, progress in quantum computing is accelerating. Governments, academic institutions, and tech giants like IBM, Google, and Microsoft are investing profoundly in quantum research, aiming to bring quantum computing into the mainstream. As these challenges are addressed, quantum computing is expected to unlock new levels of computational power, transforming industries and solving some of the world's most complex problems.



Conclusion

Quantum computing characterizes a paradigm shift in how we approach computation. By harnessing the power of the quantum world, it promises to crack problems that are currently intractable for classical computers, opening up new potentials in science, technology, and beyond. While we are still in the early days of quantum computing, the future is bright, and the budding impact of this technology is limitless.

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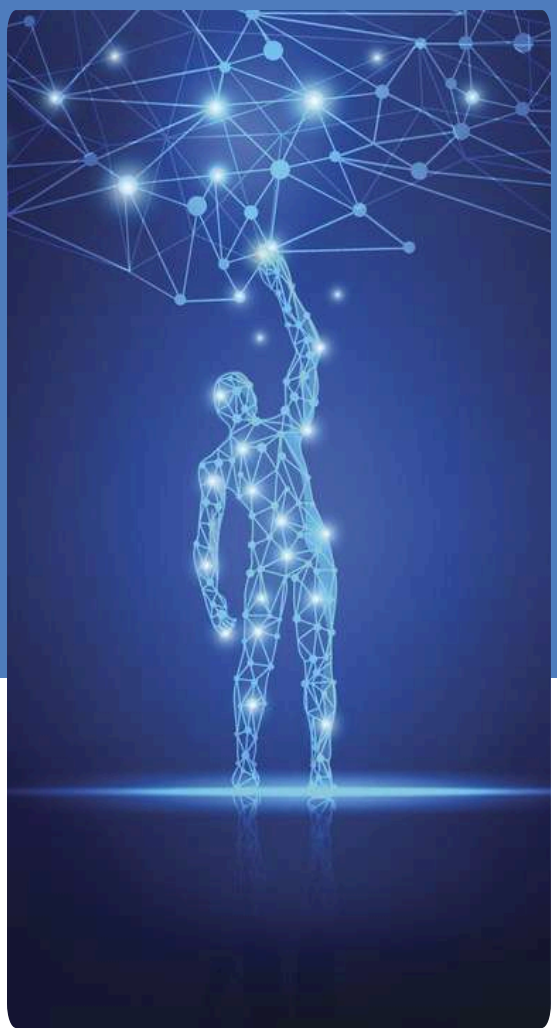
Explainable Artificial Intelligence



In today's modern world where Machine Learning has reached its highest pinnacle it is difficult for an individual to understand how exactly the AI model works. The models that provide high accuracy but lack explainability are called black-box models. Examples of some black-box models are Transformers, Neural Networks, Support Vector Machines, Curve Fitting Models etc.

Explainable AI (XAI) deals with such black-box models. XAI is defined as "the collection of principles, processes, techniques, and methods that help in understanding the results obtained from the complex machine learning models in a better way." In other words, XAI provides explainability and transparency to address the working of black-box models.

The XAI models are required so that an explanation about the workings of the black-box models can be provided in such a way that it is easy for humans to understand, interpret, and assess the results of the model. This helps the decision-makers to make a proper decision without compromising the trust, accountability, and reliability factors of AI applications. Figure 1 provides the workflow of an XAI model.

There are five main factors associated with XAI, and they can be easily remembered by the acronym JATTI.

Key Features of Explainable AI

1. **Justifiability:** It refers to the acceptable reasoning/logic behind the execution of certain tasks by the black-box model.
2. **Accountability:** There are certain sensitive areas where accountability plays a vital role. For instance, in domains like healthcare, finance, and robotics, the developers who develop the AI applications should be held responsible for any mishap that happens on their side. To make this happen, the model should be explained well and assessed based on the reliability factor. XAI provides both. So, if anything goes wrong, it is easier to identify where exactly the things might have wrongly deviated, and the person/system/company may be held responsible.

3. **Transparency:** For simple machine learning models like decision trees or regression, transparency towards the result obtained is quite clear and straightforward. However, advanced models like deep neural models and other black-box models lack transparency. XAI offers transparency so that how the deep neural models make decisions is clear.

4. **Trust:** XAI helps to build trust among the users and AI developers as it offers logical reasoning behind its actions with clear explanations. It also helps to identify any biases or errors in the model.

5. **Interpretability:** It is the act of explaining how a model arrived at a particular decision. Models with high interpretability are more acceptable and trusted.

Techniques in Explainable AI

There are various techniques used in XAI some of the major techniques are as follows:

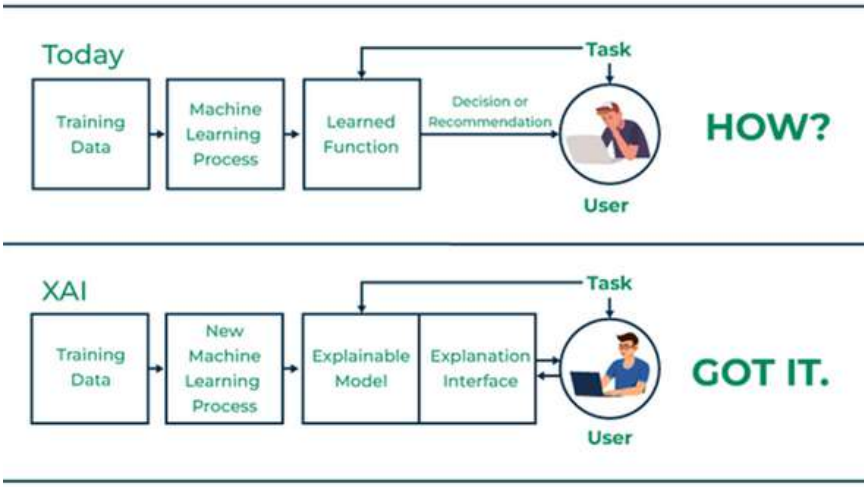
1. **Feature Importance:** Feature importance techniques help to identify the important features contributing to the high performance of the model. LIME (Local Interpretable Model-agnostic Explanations) and SHAP (Shapley Additive Explanations) are the most sought methods used to identify the features involved in the decision-making process of the black box model.

2. **Surrogate Modeling:** In XAI, a surrogate model is a simple interpretable model that can mimic the complex behavior of a black-box model. Surrogate modeling is a technique in XAI that helps to understand the workings of the black box without affecting its performance. E.g., LIME, Krigging, Polynomial response surfaces, Bayesian Approaches etc.

3. **Counterfactual Explanations:** These techniques provide the narrative of how a decision can change with a change in certain inputs. For example, in robotics, if a robot misses the target, a counterfactual explanation might give the details of how the target would be met if the robot hit at a certain angle with a certain speed.

Challenges and Limitations of Explainable AI

1. **Trade-off Between Accuracy and Interpretability:** Achieving the balance between accuracy and interpretation is the major challenge in XAI. Models with high accuracy might not provide effective interpretability, and models with good interpretability may not yield good results, which is an open area of research.
2. **Over-Simplification:** In some cases, misleading information can be interpreted when the model is over-simplified. This may lead to less authentic analysis. For example, a surrogate model might not capture all the distinctions of the original complex model.



3. Bias in Explanations: If the model built is biased, then the explanation provided will also be biased. Thus, there is no guarantee that the explainability provided by XAI is flawless.

4. **Different Stakeholder Needs:** As there might be multiple end users (stakeholders) of one application, catering to the needs of all the stakeholders is difficult. The explanation useful for one stakeholder might not be of interest to another stakeholder. For example, the technical team might be interested in a technical explanation of the model, the marketing team might be interested in a feature-related explanation, and the end user might be interested only in recommendations.

Applications of Explainable AI

1. **Healthcare:** In order to make effective decision-making medical experts make use of XAI in healthcare. E.g.: AI-based predictions in healthcare, Pattern recognition in medical images, deploying AI systems that are understandable to human users, etc.
2. **Finance:** Risk factor analysis, Anomaly detection in financial data, fraud detection, building automated loan approval systems, etc. are the applications of XAI in the finance domain.
3. **Legal Systems:** Automated systems in the legal domain require high standards of accountability, transparency, and explainability, which an XAI can provide. Eg, recommending sentencing or parole decisions.

4. **Autonomous Vehicles:** For self-driving cars, explainability is of prime importance as the system should provide the proper understanding of the dynamic scenario to make a decision in split seconds. Thus, XAI helps to provide feature understanding, background understanding and understanding of real-time dynamics to facilitate the right decision.
5. **Robotics:** Human-robot collaboration, Fault identification, robotic surgery, etc. are the fields where XAI is highly crucial.

In summary, Explainable Artificial Intelligence is the mechanism that provides light for understanding the workings of a black-box model. XAI provides explainability and interpretability for the models. Whenever any system requires transparency, trust, and accountability, then XAI is for rescue. XAI is most apt for high-risk applications and/or applications where decision-making is involved. XAI exhibits strong characteristics that make the AI application reliable and acceptable to the end-users.

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Perfect Play with PowerBI

Data is everything, can be disaster or development at the end
Data Access, Data Read, Data Analysis
Each role is crucial for new born data
It makes wonders in Businesses and Profit margins

In Data world PowerBI stands tall
Visualization into Insights Analysis Accomplishment
Dashboards and Colourful charts with playful colours
Complex data into Clean and Correct data

PowerBI amalgamates excel sheets to SQL's all varieties
Everything comes under deep learning deep well into so well
You just click and drag, nice story ready with multiple characters
Market Trend Pattern analysis to Perfect Profit making

Go-to-tool for analysts scientists and data miners
Variety of applications with velocity and veracity
Raw data into world transforming information, All datatypes
Individually collectively dance helping Businesses to Boost

Dr K Saravanakumar
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Department of Computer Science

BEYOND THE BORDERS

ARTICLES FROM THE OTHER CHRIST CAMPUSES

The Use of AI Tools in the Metaverse: Shaping the Future of Digital Interaction

The metaverse concept is rapidly evolving with technology giants, startups, and industries worldwide investing in this digital frontier. The metaverse promises a virtual world where users can interact, work and play in immersive, three-dimensional environments. Artificial intelligence (AI) is playing a crucial role in creating the experience of the growing next generation of the internet. It enables higher degrees of personalization, automation and engagement. This article examines the convergence of artificial intelligence (AI) and the metaverse, providing a comprehensive analysis of how AI technologies are employed to actualize this digital paradise.

1. AI-Powered Avatars

Within the metaverse, individuals exhibit their identity by means of digital avatars. AI power systems have the ability to analyse speech and facial expressions in real time in order to adjust avatars emotional reactions, resulting in a more realistic and immersive experience.

For example, models of Natural Language Processing NLP allow avatars to participate in significant conversations, providing construction and even acquiring knowledge from exchange. As time goes on AI aids in the personalisation of avatars by employing algorithms that analyse user preferences, body language, and speech patterns to create distinct digital personalities.

2. Content Generation and World Building

Users can explore large, dynamic worlds in the metaverse, which is captivating. AI is being used to create landscapes, architecture, and even cities on the fly. Developers may efficiently create diverse and dynamic environments using AI-powered procedural generation methods. These AI systems can create virtual terrains, accurate weather patterns, and simulate ecosystem growth, making each user experience unique and developing.

3. Enhanced User Experiences through Personalization

AI shapes the metaverse through personalisation. AI-driven systems personalise user experiences by promoting events, new locales, and virtual environments. Machine learning algorithms can track users' behaviour and learn their game, social, and virtual experience preferences. This data is utilised to personalise content, experiences, and advertising in a virtual world.

4. AI in Virtual Economies

Growth in the metaverse boosts economic opportunities. Users trade commodities, services, and real estate in virtual worlds. Economic systems that support these activities depend on AI techniques. Real-time virtual asset trading is enabled by automated trading systems, dynamic pricing models, and AI-powered markets. Additionally, AI is being utilised to produce virtual goods and services for sale. AI-powered bots can create virtual art, apparel, and real estate for sale in the metaverse market.

5. AI for Security and Moderation

Safe and secure metaverse environments are essential as its complexity and user population grow. AI tools are used to detect fraud, secure IP, and track user behaviour to keep the internet safe. AI can swiftly identify and flag problematic behaviour using machine learning and pattern recognition, making the user experience safer and more welcoming.

6. AI and Cross-Platform Integration

The metaverse should seamlessly integrate platforms, devices, and apps. AI synchronises data among VR and AR headsets to provide consistent user experiences. AI allows metaverse platforms to share digital assets and avatars, improving interoperability.

Conclusion

In the metaverse, the lines between the real and the virtual will blur in the future of online communication. Artificial intelligence (AI) technologies are crucial to this shift because they provide the way for the development of safe, tailored, and ever-changing virtual worlds. Artificial intelligence (AI) will play a pivotal part in the metaverse's future development, opening us exciting new opportunities for our online lives. Metaverse consumers can expect a more intelligent, adaptive, and immersive experience as a result of AI's influence on virtual economies, personalised avatars, and world-building.

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Bridging the Gap: Reclaiming the Role of Theoretical Knowledge in Practical Domains

In today's fast-paced world, the emphasis on ' practical knowledge' and 'hands-on experience' has become dominant, often overshadowing the importance of theoretical understanding. Theoretical knowledge forms the bedrock of practical skills, providing the principles, frameworks, and critical thinking tools that drive innovation and problem-solving. However, this foundational aspect is frequently neglected, leading to challenges in both educational settings and professional environments.

Theoretical knowledge is not just about memorizing facts or formulas; it is about understanding the 'why' behind the 'how.' It enables individuals to grasp complex concepts, predict outcomes, and develop a deeper comprehension of the subject matter. Without this grounding, practical skills can become superficial and narrowly focused, limiting the ability to adapt to new challenges and think creatively when confronted with unexpected situations.

The consequences of ignoring theoretical knowledge are evident across various domains. In education, students often excel at replicating procedures without truly understanding the underlying concepts, resulting in a shallow learning experience. In the workplace, professionals may become proficient in executing tasks but struggle with innovation or problem-solving when conditions change. This lack of depth can hinder personal growth and limit the potential for progress within industries.

Examples from history and modern times highlight the crucial role of theoretical knowledge. From the scientific breakthroughs that changed the course of history to the technological innovations driving today's digital age, theoretical insights have been the catalysts for practical achievements. Even in fields like engineering, medicine, and finance, the ability to apply theoretical principles to real-world problems is what separates competent professionals from true innovators.

It is time to recognize that theoretical knowledge and practical skills are not mutually exclusive but complementary. A balanced approach that values both aspects can create a more adaptive and resilient workforce capable of meeting the challenges of the future. Educators, employers, and professionals must work together to foster environments where theoretical learning is not just an afterthought but an integral part of skill development.

In conclusion, the undervaluation of theoretical knowledge poses a significant barrier to deeper learning, innovation, and adaptability. By reclaiming the importance of theory in practical domains, we can bridge the gap and build a culture that values comprehensive understanding and fosters growth in all aspects of life.

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ROLE OF DEEP LEARNING ALGORITHMS FOR SMART FARMING

The Internet of Things (IoT), an emerging paradigm, is revolutionizing traditional agricultural practices by enabling more precision-based methods. IoT is relevant to various sectors, including healthcare, smart environments, smart devices, and livestock management. In India, which ranks second globally in agriculture and livestock production, this technology is driving advancements in smart agriculture through the use of IoT-enabled devices. Much of the existing farming data remains statistical, which has led to the development of tools for image-based crop monitoring and precision agriculture. By leveraging machine learning and deep learning algorithms, combined with image data, precision in farming practices can be significantly enhanced.

India is the land of agriculture, where 50-60 % of the overall population directly or indirectly involves as stakeholders and contributes about 18% of the country's GDP. A substantial ratio of the rural population is significantly contributing to the farming, farm related trading, transportation and Agri-processing sector. In connection with this about 85% of these stakeholders are small and marginal farmers with minimal acres of land, who plays crucial role in precision agriculture and manufacture in India. The deep learning algorithm, are utilized for better smart farming and crop monitoring to prevent from diseases by its extensive and sub-optimal prediction algorithm. Deep learning comprises of various optimization algorithms for the smart farming, varied methodologies used for the data collection, algorithms deployed for the data prediction and use case applications. The article brings out the importance of the IoT involvement in the agriculture environment and its impact on the crop monitoring and consequent increase in the crop yield.

Recently, deep learning algorithms integrated with IoT have shown promising results in crop disease prediction, particularly using models like convolutional neural networks (CNNs), VGG-16, and XGBoost. The data used for these predictions are gathered from various sources, including spatial and temporal data. The accuracy of the predictions largely depends on the quality and type of data used for analysis.

Deep learning algorithm a subset of the ML algorithms works well for the analysis and prediction of the complex dataset that comprises of multilevel data processing. Data from varied sources such as image dataset. Temperature sensor dataset, numerical data, spatial data, temporal data, both in controlled and independent environment can be analysed with the deep learning techniques for optimal crop monitoring & crop yield prediction. Some of the popular algorithms for the Deep learning includes Convolutional Neural Networks (CNN), Generative Adversial Networks (GANs), Recurrent Neural Network (RNN), Long-short term memory network (LSTM), 3D- CNN, autoencoders etc. The Deep Learning algorithms are highly effective for complex data processing since it allows to store and analyse the time-series data. The algorithms are working in a way such it automatically extracts the potential information from the given dataset and also performs the feature extraction in case of the image data. These factors play a vital role in crop growth monitoring, disease detection in the leaves, yield prediction based on the given conditions.

By integrating the deep learning models the stakeholders can considerably enhance the productivity and thus reduce the financial loss. The integration of IoT with the mobile application paves way for the real time crop monitoring, actuators and sensors for monitoring the soil, moisture, temperature helps the farmers to considerably reduce the crop loss. The accuracy of the classification algorithms, disease detection algorithms work well for any of the stressed environment. As IoT evolves, its applications will expand, driving a new era of sustainable farming.

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TechieTunes

Blooming Buddies ablaze, with code as their guide,
Live in a Tech world, where dreams abide...

Dancing fingers on Tech gadgets, so the fleet,
Playing with creations so sweet.....

Their connection to the tech world through apps, enthrall,
Their talents are unlimited uninterrupted infinity, standing so tall.....

Strong stable minds make them bold
Techie Buddies minds are story untold.....

All their mind is right,
For every code they write...

Techie Buddies are seen as prefect,
for the future digital World to be perfect...

Vigilance in Digital World

In digital space threats reside,
Protect and Back up data with cautious stride.....

Strong passwords shield of light,
Be strong to alert both day and night.....

Update software and keen,
To happily be in a safety scene.....

Aware and click the links to avoid the bait,
All cyber threats are harmful fate.....

Be wise in your digital trace,
Cybersecurity, a constant race.....

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"Enhancing Mechatronic Bio-Arms with IoT: A Technological Leap for Smart Prosthetics"

The fusion of IoT (Internet of Things) with mechatronic bio-arms has revolutionized the world of prosthetics, offering new levels of precision, functionality, and user interactivity. These bio-arms, which are essentially mechanical limbs controlled by electrical signals, have become a symbol of technological advancement. When combined with IoT, these devices transcend their original capabilities, making them smarter, more responsive, and capable of enhancing the user experience in unprecedented ways.

The Mechatronic Bio-Arm: An Overview

A mechatronic bio-arm integrates mechanical systems with electronic control to mimic the movement of a human arm. Sensors, actuators, and microprocessors work together to interpret the electrical signals from the user's muscles or brain, converting them into movement. The goal is to provide a prosthetic that can closely replicate natural limb function, enabling the user to perform everyday tasks with ease.

The Role of IoT in Prosthetics

The Internet of Things has the potential to bring about a significant transformation in how bio-arms operate. IoT is a network of interconnected devices that collect and exchange data over the internet. By embedding IoT technology into bio-arms, it opens up a whole new dimension of functionality, including remote monitoring, data analysis, and real-time adjustments.

1. Real-time Data Monitoring and Feedback

IoT-enabled bio-arms can gather data on usage patterns, pressure points, and the forces applied during movement. This data can be sent to healthcare professionals or technicians in real time, allowing them to monitor the condition of the bio-arm and the user's comfort. If there is an issue, such as a malfunction or discomfort for the user, adjustments can be made remotely without requiring a visit to the clinic.

2. Personalized Movement Calibration

One of the most critical roles of IoT in bio-arms is personalization. Every user's muscle signals and movement capabilities are unique, and IoT technology enables bio-arms to learn and adapt to individual users over time. Sensors embedded in the bio-arm collect data on the user's movement, and the system uses this data to adjust and fine-tune the prosthetic's responses. With IoT, bio-arms can continuously learn and update their movements for better performance and comfort.

3. Remote Diagnostics and Predictive Maintenance
IoT devices can detect small changes in the mechanical or electrical parts of the bio-arm. Over time, wear and tear are inevitable, but IoT helps diagnose potential problems before they become major issues. Predictive maintenance alerts users when a component may need replacement or repair, ensuring that the bio-arm remains functional and reduces downtime.

4. Improved Connectivity and Control
IoT allows bio-arms to connect seamlessly with other devices. For example, users can connect their prosthetics to smartphones or computers, enabling them to control their arm's sensitivity, speed, or grip strength via an app. Furthermore,
IoT opens up possibilities for hands-free control of smart home devices, making everyday tasks easier for users with limited mobility. A Future of Smart Prosthetics With IoT, the future of mechatronic bio-arms is filled with possibilities. From improved accuracy and customization to predictive maintenance, IoT ensures that bio-arms are not only functional but adaptive and intelligent. As technology continues to evolve, the synergy between IoT and bio-arms will push the boundaries of what prosthetics can achieve, offering greater independence and quality of life to users.

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Nature 2 tech

Nature2tech Quantum Computing

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Inter-Disciplinary Insights

ARTICLES FROM THE OTHER DEANERIES

Science: The Catalyst for Business Innovation and Growth

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Science is an imperative cornerstone in the business industry in today's fast-moving world, for innovative development, growth, and sustainability. Scientific advancements throughout industries enable businesses to develop new products, enhance their processes, and make informed data-driven decisions, enabling them to stay competitive in an evolving market.

The impact of science on business remains most profound in the case of technology and innovation. From biotechnology, artificial intelligence, to material sciences, most firms do rely on scientific development as a means of offering new solutions. For example, the pharmaceutical industry depends on scientific research for the development of drugs that cure life and save lives, while technology firms capitalize on developments in AI to create better user experiences and automate processes.
Data science has modified the way companies do business, from improvements in consumer behaviour research based on available abundant data to improving the supply chains with intelligent decisions. Major retailers like Amazon use algorithms that create a personal shopping experience, making customers very happy and increasing sales.

There is also a lot of focus on sustainability whereby, through environmental science, businesses are informed on greener ways of carrying on their businesses. Companies are incorporating eco-friendly technologies to reduce their carbon footprint and appeal to environmentally conscious consumers. Brands like Patagonia build their reputation on being green, proving that businesses can thrive while protecting the planet.

Another domain in which companies benefit from scientific insights is behavioural science. In a position to understand consumer psychology, companies will be in a position to develop marketing strategies that appeal to customers, hence commanding loyalty and increasing sales.

Besides, science significantly enhances business processes. Scientific-based methods like Lean Six Sigma assist companies in waste reduction, improvement of quality, and enhancement of efficiency, hence assuring profitability in the long term.

The bottom line is that science lies at the heart of business success, from technological innovations through sustainability and consumer insight, fuelling growth and allowing companies to respond to an increasingly complex global environment. As industries continue to evolve, this synergy between science and business will only deepen and shape the future of commerce.

Fusion of Minds: The Symbiosis of Art and Science in the 21st Century

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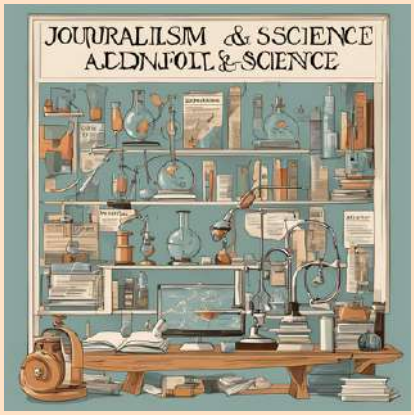
The relationship between science and art has indeed brought forth a new approach towards creative aspects and art deanery. They once appeared as different spheres of industries, however art and science now complement each other, allowing expansion in ways to make and appreciate art. Science improves the equipment that artists have, while on the other hand, art explains science, and makes everything easier to understand.

In the past, the changes that happened in the field of science changed the style and the appreciation of the visual arts. Photography, for example, is a good example of when Art was once changed by science. Another alternative is the soviet progressive science, today it is science-perfected digital technologies such as 3D modeling, virtual reality, and artificial intelligence. Due to this shift conquering art, artists do not have any restrictions of working in conventional way anymore. Instead, it gives options of approaching art in different ways and explores the use of cross-culture technology.

There is also the dimension of arts combined with sciences that relates to the 21st century. The color, shape and motion as in design, composition and animations are largely governed by the brain, especially the study of it. The artists have looked and even explored these two areas and launched new kinds of complexes that are events that attract all sense of the audience members.

This is a global shift that art deaneries are acknowledging, and one which they promote through interdisciplinary methods relying on the consistent drive for rational scientific exploration with the emotional well of artistic expression. There are a growing number of exhibitions and academic programs that look to group projects in which artists work together with scientists on themes related to thought experimentalism, social critique.



In the end, it is an inspiring commonality of art and science. Science expands the boundaries for art through its analytical reasoning, and contrariwise, art creates emotions from facts in our world so sterile of scientific discovery. Both combine together to allow visionary fascination, through their nature of looking at and understanding the world.

Poetry Unfolds

Blossoming the Name of Christ:

AMIDST THE WORLD WITH WAR

In the tapestry of life the story unfolds,
In the world with war everything withholds.
In the name of Christ we all stand,
With the token of Christ in our hand.

In the deepest darkness the war will run,
Through redeemers grace we all turn.
Amidst the tremor of war we stand with hope,
With his blossoming name we all cope.

With conflicts among nations everything burns,
Through Christ the Prudent's mind turns.
Standing in the gap of destruction we pray,
Blossoming Christ’s name everyday.

By enduring and preaching we all are grown,
Through his unfailing love our sins are thrown.
With faith in Christ we are clever,
By blossoming Christ’s name we live forever.

NANCY JASMINE A
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STARDUST

We are but stardust,
Born of cosmic flame,
Atoms forged in ancient stars,
Whispering our name.

Across the vast and endless skies,
Matter bends and swirls,
And in the heart of everything,
A universe unfurls.

From galaxies in distant flight
To the cells that form our skin,
We carry in our fleeting lives
The stars' eternal kin.

In every beat, in every breath,
A cosmic story flows,
A dance of science, life, and death
In mysteries that grow.

Vidhi Modi
1 BSc BTZ

Life Is A Bicycle Ride

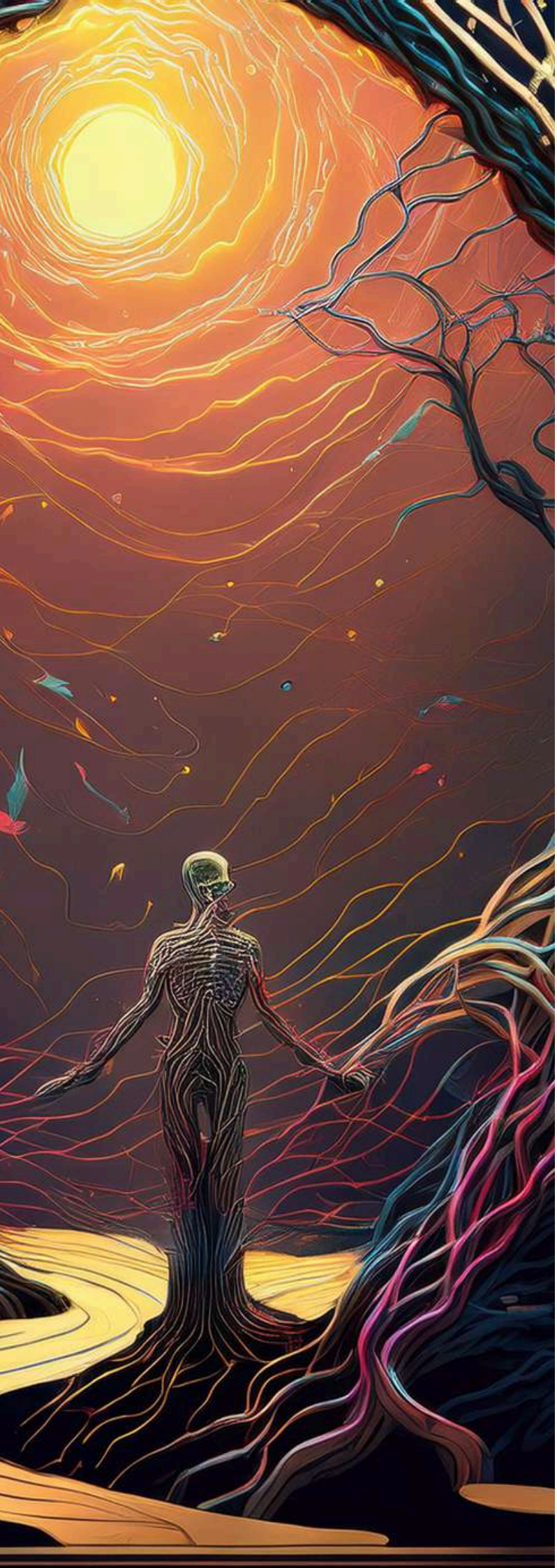
Life is a bicycle ride
Where the road of challenges is laid long and wide.
The bicycle of life stands on the wheels of grit and knowledge
When you fall and then rise on your feet again,
It reflects your mettle to face the challenge
That from facing, others might have refrained.

You may fall a few times
Facing the challenges coming your way
But one little scratch is not the end,
That is what you must comprehend.
There is a long way ahead
Where you might come across obstacles
Along with the difficulties they pose,
What matters here is your spirit
And your iron will to deal with those.

There will be times
When the breeze of happiness tickles your face,
To lighten your mood and bring a wide smile on your face.
But there would even be times,
when the road becomes very slippery,
Don't fear to move ahead, thinking you would stumble
Be confident in your wheels,
For any such challenges, the wheels are there to deal.

People can only guide you
The journey is of your own,
They can only show you the way
It is on you how you ride on the path that is shown.
There is a road of challenges laid long and wide
On which everyone travels
Life is just like an exciting bicycle ride

Yatharth Atin Jain
1 BSc EA



Epistemology Of Failure

Life is an interesting affair,
Where the almighty sends together
Failure and success in a pair.
The former tastes bitter, while latter tastes sweet,
I wonder why we beings
Expect to taste success always
And get disheartened over one bitter defeat.

Failure does not demean
Your potential and the efforts you put in,
If success is what you think
You would always achieve,
Wake up to reality,
Life is not as ideal as what you perceive.

Failures are hurtful
Surely tough to face,
But it is an unavoidable phase
Which willingly or unwillingly
Everyone has to embrace.

Epistemology of failure is the art
Of acceptance and recovery
From the debacle you may face,
Dip moments just come and go
How many times will you lament on your woes?
Have an iron will and just go with the flow.

Yatharth Atin Jain
1 BSc EA

Numbers: The Unseen Force Behind Every Action

Numbers Numbers Numbers,
Ruling the world in a system of computation.
Garbled and tweaked like lumbers,
Silhouetted against the limelight of the nation.

As Monotonous as they may be,
Eventually dispensing the upshot.
With triumph as big as the sea,
Stunned on the spot.

They're a customary part of being,
All over the map.
An inevitable aspect of living,
In every quarter and gap.

Mansi Bharat Fonseca
1 MMAT

The Morphed Link

An unattached bond affecting the
hinged core,
Off the darkness into the moonlit snow.
A blanket of tiny dew droplets
A garnish onto the petals of shiuli
The stems tell a story of paleness
The fruitful roots of a ripe bond.

The withering heat of pain,
Consumed in pastels of harmony
The vine serving the diamond cuts
Sulking on the scorching stagnancy.

The regimes and promises of fidelity
A fodder calming agitated nerves
Colliding themes of power
Cementing deflection angles of certitude
curves.

Devanshi Tuwani
3 BSc EMS

: The Most Beautiful Relationship

Friendship is a treasure, which when sought,
Gives the wealth of joy, warmth and comfort when things look distraught.
It is an ocean of elation, contentment in which you go deeper and deeper,
To strengthen your relations and make it sweeter.

Friendship is a wonder and nothing but love and care,
Where people lovingly say "I am there".
You call them your friend or mate,
They will always show up,
No matter what's your state.
A true friend or an angel is gold,
Whenever you are down, the angel will be there to hold.

Friends are lovely, soothing and kind,
They are the loveliest people one can find.
Friends are like roses who fill fragrance in your heart,
They are the ones with whom, never even in a dream you would like to part.

People may say that friends come and go,
But you know, true friends would never do so.
They would always be there for you,
No matter where you go.

Yatharth Atin Jain
1 BSc EA

Between Numbers and Dreams: The Poetry of Logic

i wish to be a poet, weaving dreams in silken threads, tracing love in stardust and in all the words unsaid.

but i'm a mathematician, charting paths where numbers tread, in spaces filled with logic, where the restless mind is led.

each problem holds a story, like the verses that i crave, a melody of reason, though my heart would misbehave. yet somehow, in their union, i find the art i save,

a symphony of order, where the wildest thoughts are brave.

i dance between the lines of theory and of rhyme, for in the math, there's music-its own rhythm, its own time. and so i blend the two, a balance so sublime, crafting both in harmony, no longer bound by line.

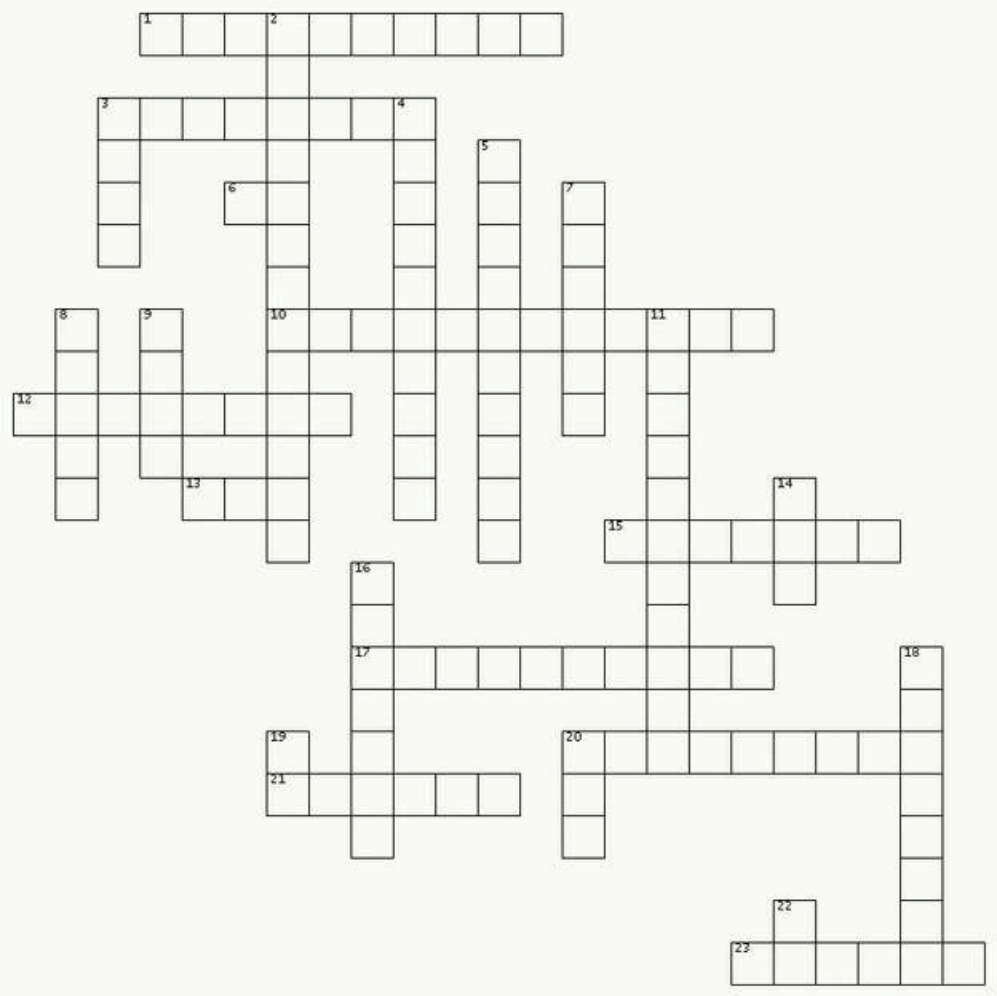
for i will not decide between the beauty of each art, i'll let them both entangle, as they've done within my heart. numbers, words, equations-all playing their own part, in a world where reason sings, and poetry is smart.

Sweta Patel
3 MMAT

BRAIN TEASERS

PUZZLES AND GAMES

Computer Science Crossword



ACROSS

1. A secure, digital transaction ledger
3. Organized collection of information
6. A computer-made world you can explore
10. The science of making and breaking codes
12. Building and maintaining software
13. Devices connected and talking over the internet
15. Learning Learning from data without being told
17. Machines doing tasks automatically
20. A recipe for solving problems
21. Code The original, human-readable code
23. The language of 0s and 1s

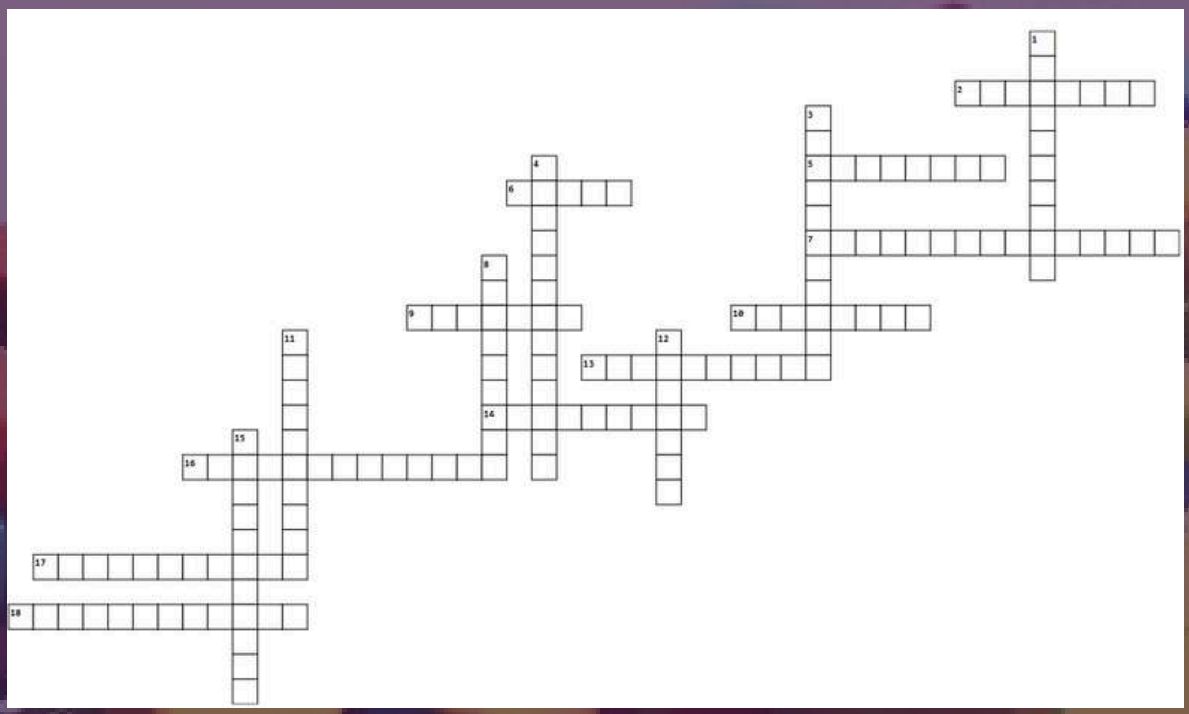
DOWN

2. Defense against digital attacks
3. Mining Finding hidden gems in huge data
4. Turning readable info into a secret code
5. Connecting computers to share data
7. Networks Brain-inspired systems for AI tasks
8. Storing and accessing data online
9. Structure How data is organized and stored
11. Writing instructions for machines
14. Data Huge sets of information, revealing patterns
16. Using qubits for superfast calculations
18. Converts code into a language the computer understands
19. The software that runs your computer
20. How apps talk to each other
22. When machines think like humans

Avisha Gupta
3 BCA A

Anushmita Pal
3 BCA A

General Science Crossword



Across

2. The smallest amount of any physical entity involved in an interaction.
5. A flow of electric charge, measured in amperes.
6. The value that appears most frequently in a data set.
7. The process by which green plants convert sunlight into chemical energy.
9. A quantity having direction as well as magnitude.
10. A statement that has been proven based on previously established statements.
13. Organized collections of structured information, often stored electronically.
14. A passive electrical component that implements electrical resistance.
16. A process that uses electricity to break down a compound into its components.
17. The set of life-sustaining chemical reactions in organisms to maintain life.
18. The process by which a cell takes in material by engulfing it with its membrane

Down

1. The maximum data transfer rate of a network or internet connection.
3. The process of converting information into a secure format to prevent unauthorized access.
4. The ability of a solid material to exist in more than one form or crystal structure.
8. Data points that differ significantly from other observations in a dataset.
11. The process in which a substance loses electrons, often associated with gaining oxygen.
12. A rectangular array of numbers arranged in rows and columns.
15. A statistical method for estimating the relationships among variables.

Mishika Mittal
3 BSc DM

ANSWERS

General Science

DOWN

1. Bandwidth
3. Encryption
4. Polymorphism
8. Outliners
11. Oxidation
12. Matrix
15. Regression

ACROSS

2. Quantum
5. Current
6.Mode
7. Photosynthesis
9. Vector
10. Theorem
13. Databases
14.Resistor
16. Electrolysis
17. Metabolism
18. Endocytosis

Computer Science

DOWN

2. Cybersecurity
3.Data
4. Encryption
5. Networking
7.Neural
8. Cloud
9. Data
11. Programming
14.Big
16.Quantum
18. Compiler
19. OS
20. API
22. AI

Across

1. Blockchain
3. Database
6. VR
10. Cryptography
12. Software
13.IOT
15. Machine
17. Automation
20. Algorithm

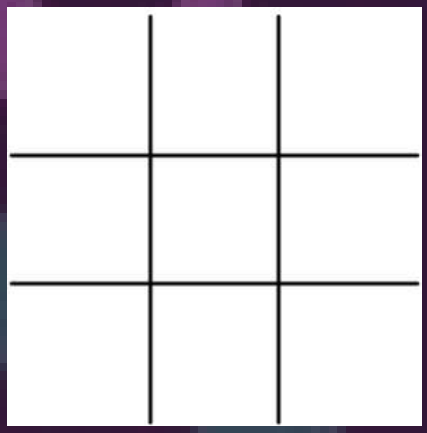
The Greater Tic-Tac-Toe

What it is: A much more strategic version of tic-tac-toe I learned from Math with Bad Drawings.

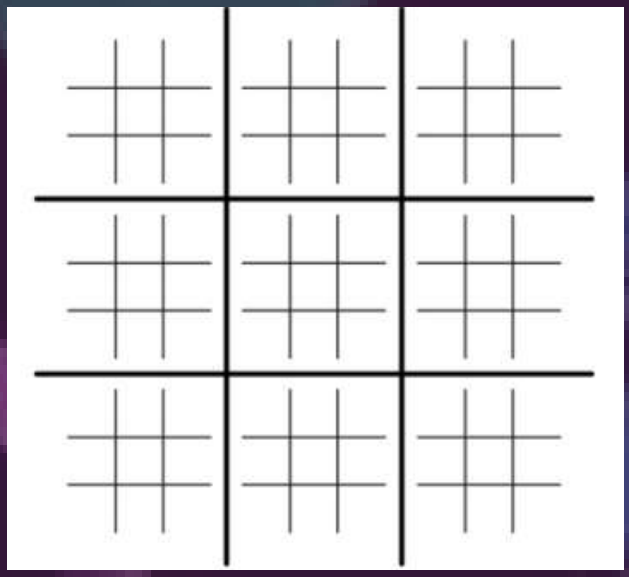
Best for: Two players
What you need:

- Paper
- Something to write with

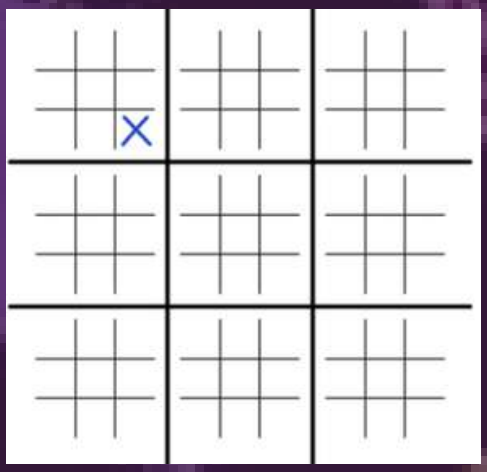
How to play: OK, so we're all familiar with tic-tac-toe, right? The normal 9-square grid?



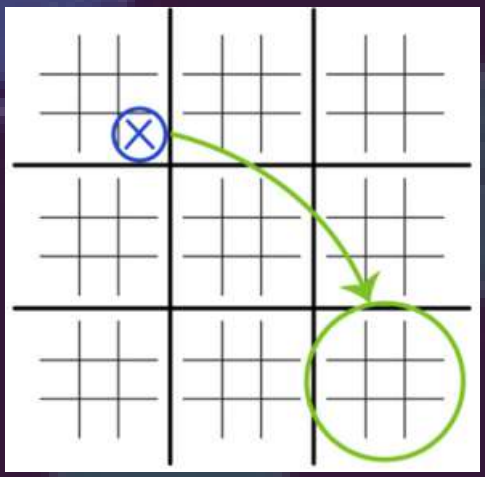
Well, in ultimate tic-tac-toe, you've got a smaller grid within each of those 9 squares:



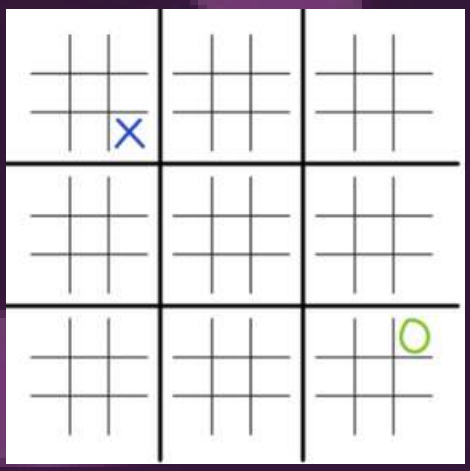
To win the game, you have to win three of the larger squares in a row, and to win a large square, you have to win three in a row in the smaller grid inside it.Here's how it works. Say X goes first:



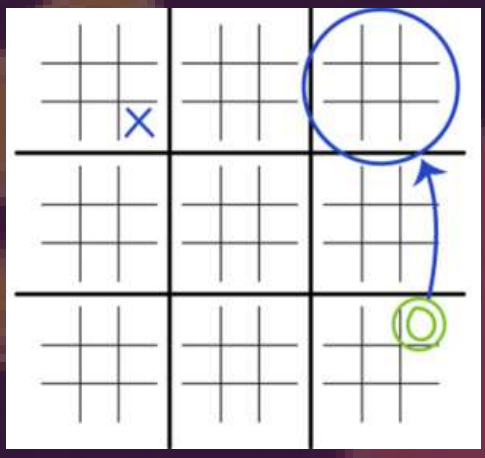
Now, just like in normal tic-tac-toe, O gets to go. But O can't just go anywhere. The smaller grid O must play in is determined by X's move. So since X went in the bottom right corner within his small grid, O must go in the bottom right corner of the large grid:



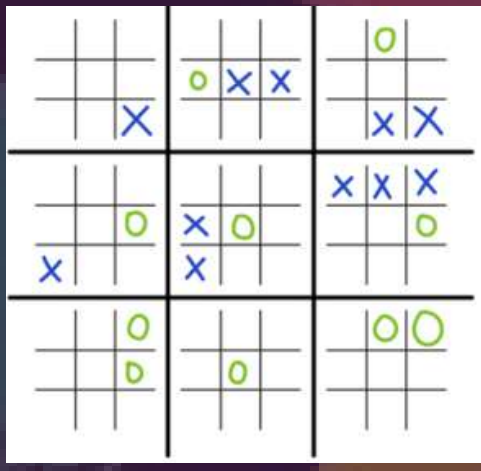
So O goes, anywhere in this small grid he wants to:



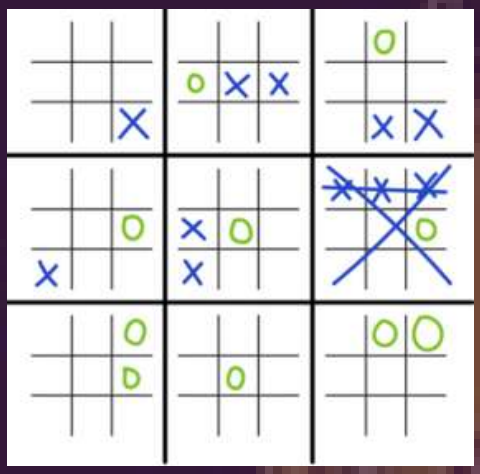
Now you know where X has to go, right??



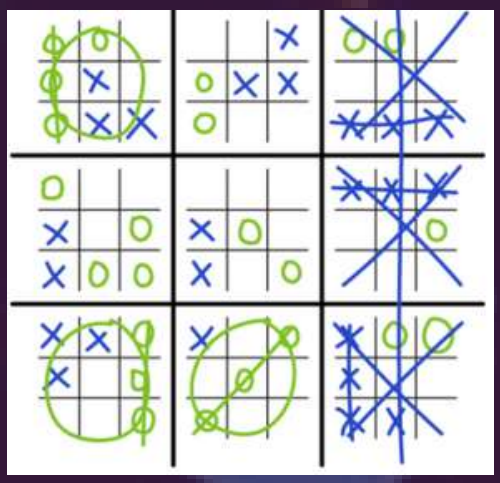
A few moves down, the game might look like this:



See what just happened in the far right middle square? X got three in a row! That means X wins that small grid, thus claiming that square in the large grid:



Then it's O's turn again (O is still sent to the small grid determined by X's last move). Eventually someone will claim three small grids in a row, thus winning the whole game:



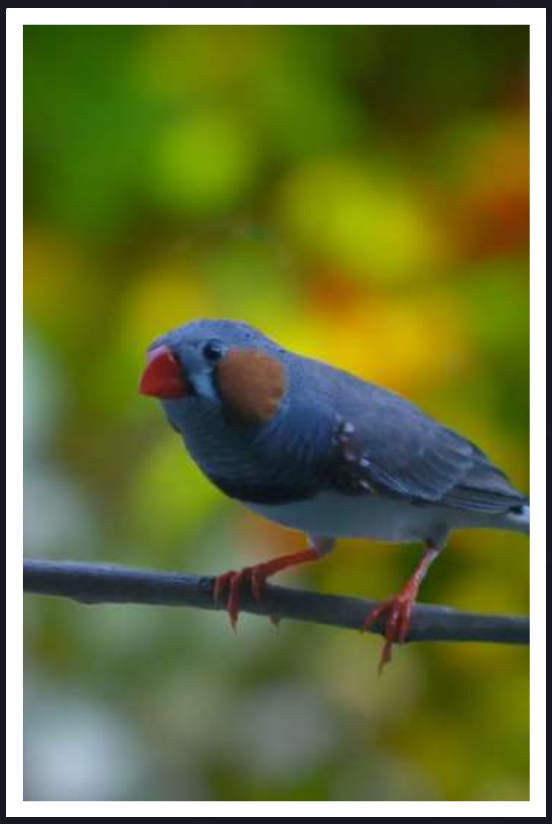
As you can imagine, there's a lot of strategy involved. You've got to keep in mind where you're sending your opponent, thinking several moves ahead.

One rule: If the player before you sends you to a grid that's already been won, you get to go wherever you want. (So try not to send your opponent to an already-won grid!) Another rule you'll need to decide on your own will be what to do with smaller grids that result in a tie. You could either count them for 1) neither X nor O or 2) both X and O. Try both ways

Soham Chatterjee
4 MSc DS

Lens and Life

PHOTOGRAPHS
FROM STUDENTS



Devadarshan VP
1 BSc BTZ

Soham Chatterjee
4 MSc DS

S Khushal
1 BCA A

Devanshi Randeria
3 BSc BTZ

Rhythm Bhatia
5 BCB

Shreeyanshu Panigrahi
1 MZoo

Samarth N Kedilaya
4 CBZ

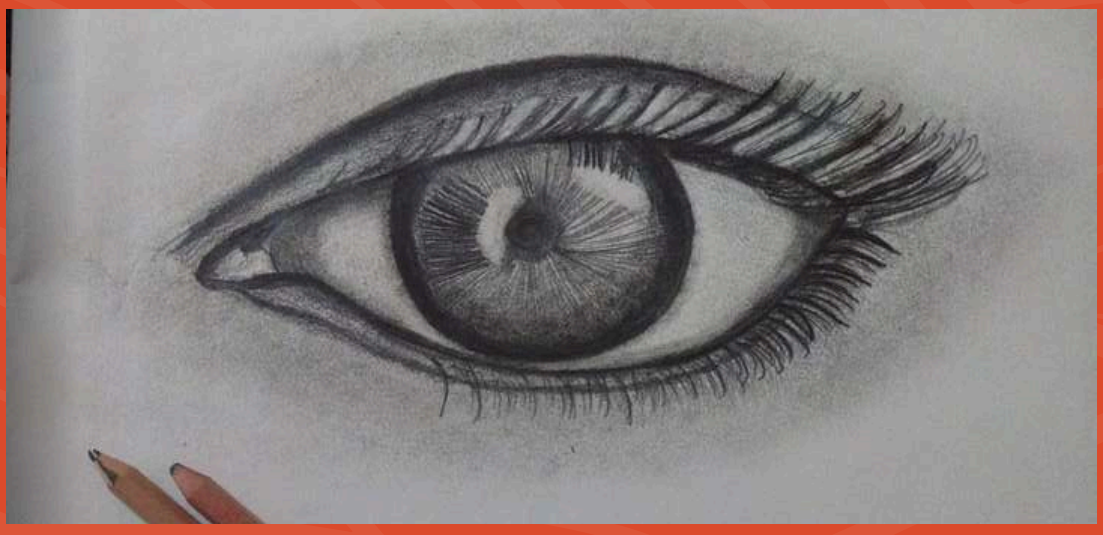
Rhythm Bhatia
5 BCB

Vishal Das
3 BSc DM

ARTISTIC ALLEY WHERE WORDS ARE UNABLE TO EXPLAIN

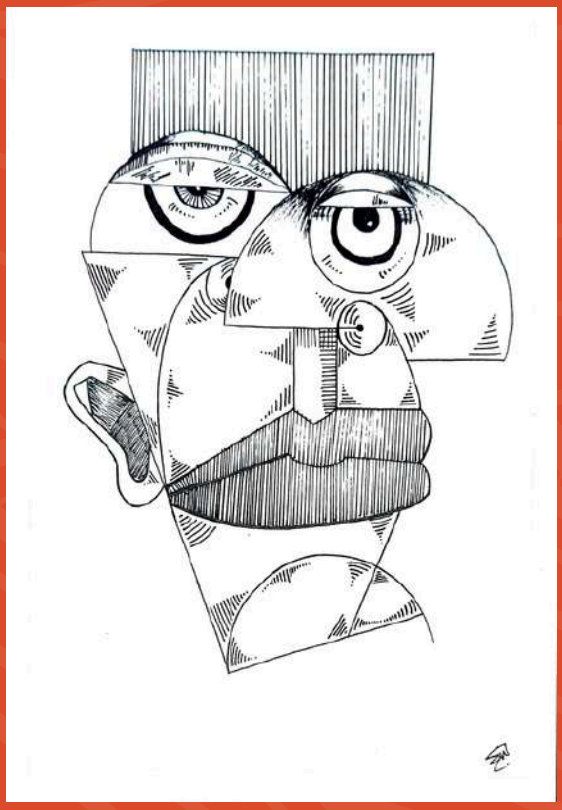
ARTWORKS FROM STUDENTS

Mary Jestina C
5 PCM



Munivel S
5 BCA A

Munivel S
5 BCA A

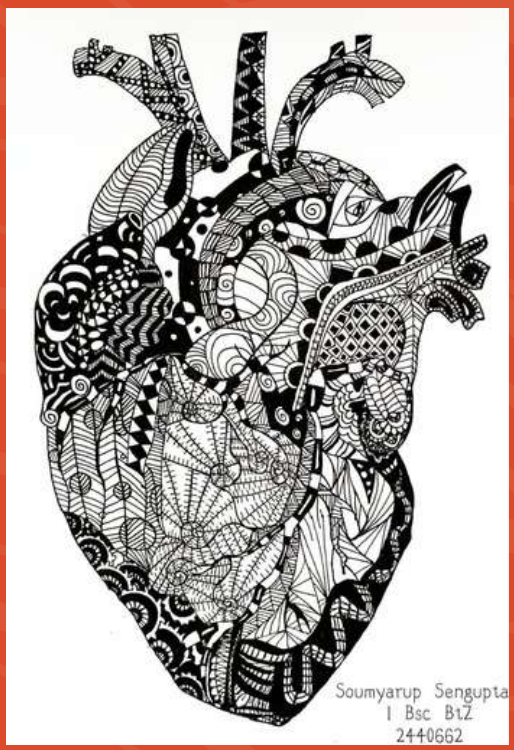


Shraddha Mukhopadhyay
1 BSc DS

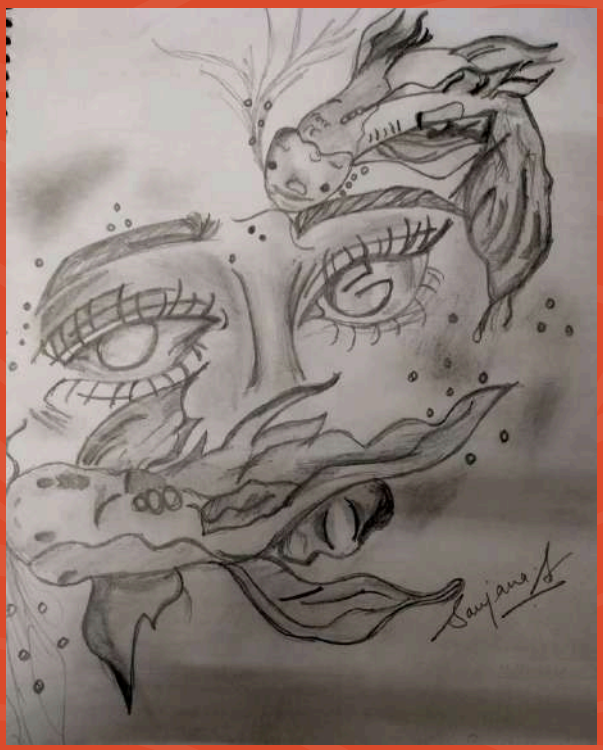
Ashraff Unnissa
1 BSc CS

Nupur Behra
3 BSc LIF

Soumyarup Sengupta
1 BSc BTZ

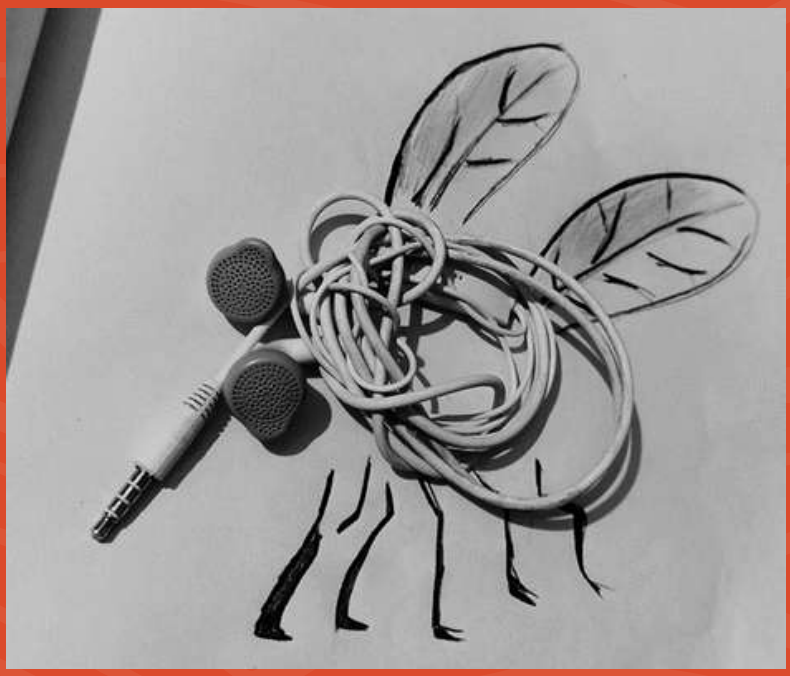


Shivani Goyal
1 BSc BTB



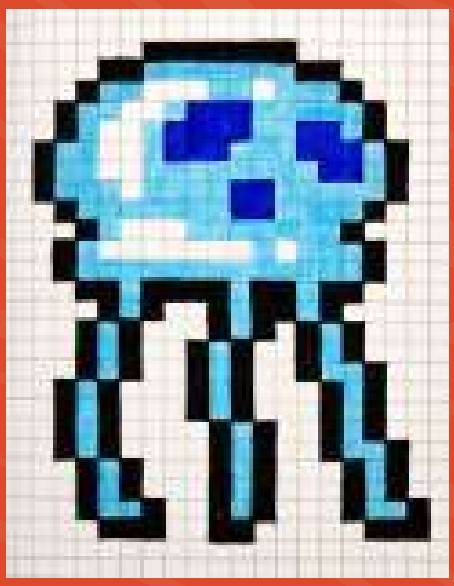
Sanjana S
1 BSc DS

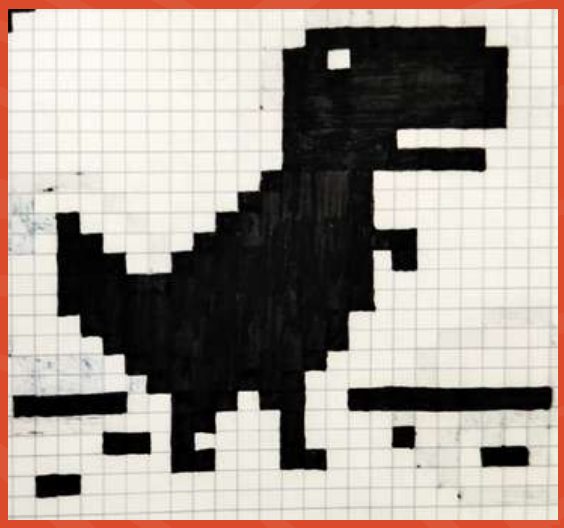
Soham Chatterjee
4 MSc DS

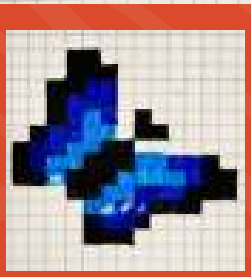


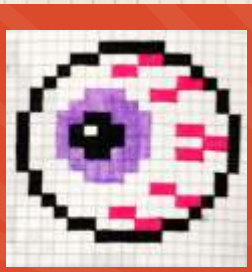
Melonee Maibam
3 BSc PM

Varanya Kashyap
1 BSc BTZ





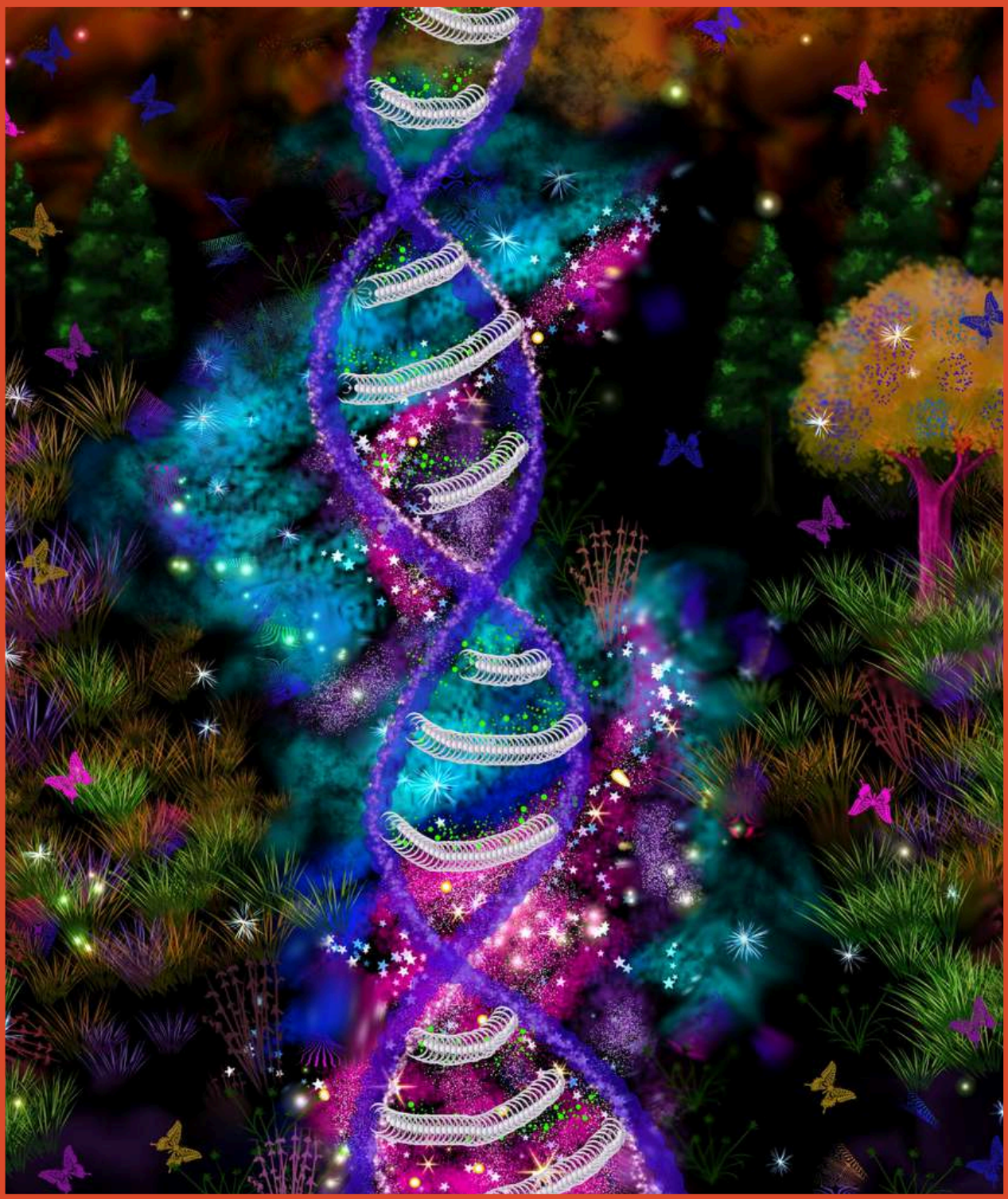




Nethan Noel Lobo
1 BSc DM

*These pixel illustrations were drawn in the university diary.

DIGITAL ART



Sivapriya S
1 BSc BTZ

STUDENT ACHIEVEMENTS

SUCCESS DEFINED

DEPARTMENT OF CHEMISTRY

ALUMNI ACHIEVEMENT

ALEENA ELIZABETH MATHEW

MSc General Chemistry
Batch of 2023
University First Rank Holder

Received a scholarship worth Rs 1.8 Crore jointly awarded by the University of Surrey, UK and a Netherlands based company to conduct research in Polymer Chemistry

STUDENT ACHIEVEMENTS

MIGHILA RIXON

BSc Biotechnology, Chemistry, Zoology

Was offered a scholarship of £2000 from Nottingham Trent University, UK to pursue MSc Chemistry (Professional Practice)

NIKITA DURGI

Research Scholar

Has been invited to the Functional Materials Lab at Tunghai University, Taichung, Taiwan, through the NSTC International Internship Pilot Programme

DEPARTMENT OF LIFE SCIENCES

Millennium Fellowship for Student Leadership

Two students actively involved in Soil and Water Analysis Cell's (SWAC's) water analysis and community outreach activities have been awarded the prestigious Millennium Fellowship (www.millenniumfellows.org). This recognition highlights their commitment to societal impact and aligns with SWAC's mission of improving water quality and raising awareness about sustainable water management. Their achievement serves as an inspiration to fellow students and strengthens SWAC's role in addressing critical environmental challenges.

TIANA DENNY
5 BCZ

KEITH GIBIN
5 BCZ

DEPARTMENT OF MATHEMATICS

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

DHANUSHUYA V S

MSc Mathematics

Mathematics Training & Talent Search Programme (MTTS) Organized by MTTS Trust and Funded by NBHM

ABHAY R KASHYAP

BSc PCM

Summer Workout in Mathematics (SWIM) - Level-2 organised by Jawaharlal Nehru Planetarium, Bangalore Association for Science Education.

NIKHILESH V

BSc PM

Summer Workout in Mathematics (SWIM) - Level-2 organised by Jawaharlal Nehru Planetarium, Bangalore Association for Science Education.

DEV GAMBHIR

BSc CME

Passed the Joint Admission Test for Masters (JAM 2024)

$$y = mx + b$$

KAVYA DUBE
BSc EMS

Passed the Actuarial Examinations CB1 and CB2 (IFoA)

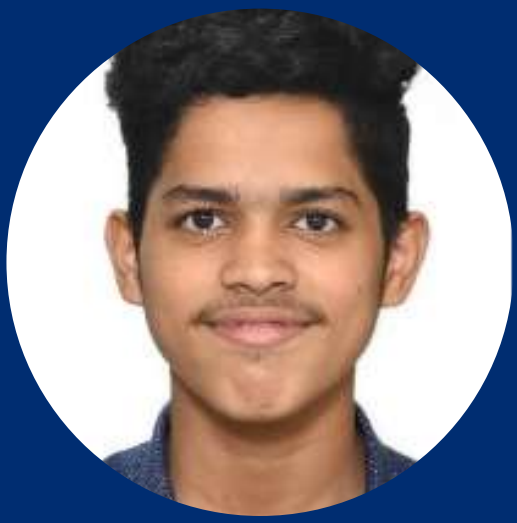
ADIEL AJAI DAVIS
BSc EMS

MARIA RENNY
BSc EMS

Got placed in NATWEST (National Westminster Bank Plc, trading as NatWest)

$$V = \frac{4}{3}\pi r^3$$

Got placed in Stripe, Inc.



AJSAL ASHRAF

BSc EMS

KURIAN PAULOSE

BSc EMS

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S KHUSHAL - EDITOR, DESIGNER

VISHAL DAS - EDITOR

ISHWAAK SARAOGI - EDITOR

SAKTHISIVAGAMI J - EDITOR

MUSENGE WA MUSENGE - DESIGNER

UNAT KAUR PANNU - EDITOR, DESIGNER

MELONEE MAIBAM - EDITOR

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CHRIST
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BANGALORE · INDIA

VISMAYA'24

VOL XI

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