

COMPU 9TH EDITION 2324 TECH



**DEPARTMENT OF COMPUTER SCIENCE
AND ENGINEERING**



GIRIJANANDA CHOWDHURY UNIVERSITY
Hathkhowapara, Azara, Guwahati-17

CompuTECH

9th Edition, 2023-24

**Published by Department of Computer Science & Engineering
GCU, Guwahati-781017**

Editorial Board

Editor : Mrs. Mridusmita Baruah

**Student Editor : Satavisha Roy Choudhury,
Ritanjit Das**

Magazine Designer : Ritanjit Das

Vision and Mission of the University

VISION OF THE UNIVERSITY :

Girijananda Chowdhury University shall create a culture of education that will provide students a transformative experience – intellectual, ethical, cultural, and social. We envision a society where our students shall contribute with unparalleled professionalism, competence and integrity while upholding the basic human values of liberty, justice, and equality.

MISSION OF THE UNIVERSITY :

M1: Girijananda Chowdhury University embarks upon its academic plan and programs with a mission of empowering our students with knowledge and skills in their chosen domain with a strong mooring in its envisioned values.

M2: We have a mission to be contemporary in our pedagogy and to be future focused in developing courses and research trajectories considering the dynamic realities of the region, nation and the world at large.

M3: Our mission is to equip our students with the requisite knowledge, skills and values in a unique ecosystem that will enable them to avail the opportunities coming in the wake of the industry 4.0. In this mission we strive for vibrant industry - academia bonding and excellence in research and innovation.

M4: We have a mission of creating human resources critical for harnessing the unique and diverse natural resources of the northeast for a strong and vibrant economy necessary for sustainable development of the region.

M5: Girijananda Chowdhury University's mission of creating citizens who will be globally competent and competitive with skills for communication, collaboration and cooperation is embedded in all its academic programs and research.

M6: Our mission is to create a cultural continuum with our neighboring countries of Southeast Asia on the foundation of the commonalities of our tradition, culture, and common history.

M7: Our mission is to enable our students to contribute towards a society that is heterogeneous, cosmopolitan, and egalitarian.

Vision and Mission of Department of Computer Science & Engineering

VISION OF THE DEPARTMENT :

To develop competent computer science and engineering graduates who will contribute productively to local, national as well as global economies.

MISSION OF THE DEPARTMENT :

M1: To provide good quality education through state-of-the-art facilities and pedagogy in teaching.

M2: To motivate the students to develop research-based, societal projects through innovative solutions and to make them acquainted with the latest developments, traditions, and culture through seminars, workshops, expert talks, and industrial visits.

M3: To promote and nurture a conducive environment in the department so that the students ingrain professional values and ethical behaviour to contribute towards a society that is heterogeneous, cosmopolitan, and egalitarian.

PROGRAM OUTCOMES (POs)

ENGINEERING GRADUATES WILL BE ABLE TO :

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PROGRAM OUTCOMES (POs)

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

The Computer Science and Engineering graduates are able to:

PSO1: Analyze, design, develop, test and apply mathematics, science, engineering fundamentals and management principles to solve complex engineering problems.

PSO2: Develop their skills in the field of computer science and its latest trends for successful career, research, entrepreneurship and higher studies.

PSO3: Apply ethical principles and commit to professional and social responsibilities.

Program Educational Objectives (PEOs)

Graduates will be able:

PEO1: Graduates will be able to apply the mathematical, scientific and engineering fundamentals to solve a wide range of computational problems in industry, government, or other work environments.

PEO2: Graduates will be able to become entrepreneurs, employees of reputed organizations, pursue higher studies including research enhancing their skills in Computer Science and Engineering.

PEO3: Graduates will be able to exhibit professional and ethical attitude, effective communication skills and teamwork for professional development in societal and environmental contexts.

Courses Offered:

- B.Tech in Computer Science & Engineering
- M.Tech in Computer Science & Engineering
- Ph.D in Computer Science & Engineering

Message

**From the desk of
Dean of Engineering and Technology:**



The School of Engineering and Technology plays a crucial role in the education of emerging engineers and individuals with aspirations, fostering a shared ambition to create a positive impact in the world. The faculty of our school has a decade of experience in engineering education and has garnered a significant reputation as a highly sought-after educational institution among students in the surrounding area throughout the course of its existence. Our school has a comprehensive infrastructure, well-equipped laboratories, an extensive library, and a substantial faculty comprised of highly experienced individuals.

As an academic institution, our foremost objective is the continual enhancement of our endeavours. Our primary objective is to inculcate awareness and responsiveness towards the requirements of the community, while concurrently offering valuable contributions to the domains of education, knowledge, and society at large. Our primary objective is to assist students in cultivating the attributes of self-assurance, proficiency, and adaptability that are essential for achieving success in workplace and making meaningful contributions to society.

A handwritten signature in dark ink, appearing to read 'S. Robert Ravi', written in a cursive style.

With best wishes,
Prof. S. Robert Ravi
Professor and Dean,
School of Engineering and Technology,
Girijananda Chowdhury University, Assam

Message

**From the desk of
Head of Department:**



It gives me great pleasure to present this edition of “CompuTech”, the annual magazine of the Department of Computer Science & Engineering. This publication is a reflection of our students’ creativity, enthusiasm, and technical excellence. It showcases not only their academic achievements but also their innovative ideas, projects, and co-curricular accomplishments.

The department continually strives to provide a learning environment that promotes curiosity, critical thinking, and professionalism. I appreciate the sincere efforts of the editorial team, faculty coordinators, and student contributors who have made this issue possible. I hope this magazine will inspire everyone to continue exploring, learning, and innovating in the ever-evolving world of technology.

A handwritten signature in black ink, reading "Minakshi Gogoi".

With best wishes,
Prof. Minakshi Gogoi
Professor and Head of Department,
Department of Computer Science & Engineering,
Girijananda Chowdhury University, Assam

Editorial Message

Editor:

Mrs. Mridusmita Baruah



It is with immense pride that I present the 9th edition of the technical magazine “CompuTech” of the Department of Computer Science and Engineering, Girijananda Choudhury University, Assam. This magazine is not just a collection of writings, but a reflection of the creativity, passion, and innovative spirit of our students.

In today’s fast-changing world of technology, it is important for young minds to think beyond textbooks and explore new ideas. Through “CompuTech,” our students have expressed their thoughts, aspirations, and creativity, proving that learning is most meaningful when it is shared.

I extend my heartfelt gratitude to our management, our respected Head of Department Prof. Minakshi Gogoi and the faculty and staff for their encouragement and constant guidance. I would also like to acknowledge the sincere efforts of Satavisha Roy Choudhury and Ritanjit Das, student members of the editorial board, whose dedication has been instrumental in shaping this issue.

May this magazine inspire every reader to think, create, and innovate.

A handwritten signature in black ink that reads "MBaruah".

Mrs. Mridusmita Baruah

Laboratory Instructor

Department of Computer Science & Engineering

Girijananda Chowdhury University, Assam

From the Student Editorial Board



Editor: Ms. Satavisha Roy Choudhury

Dear readers,

It is with great excitement that the department of Computer Science and Engineering welcomes the readers to this edition of our magazine, a platform where ideas, creativity and innovation blend together. As a student of CSE department, it is a privilege to serve as the editor of this issue, which showcases the innovative ideas that makes our department a thriving hub of technological creativity.

The domain of Computer Science is more than just a field of coding and algorithms. It is a way of thinking, a mindset which is driven by curiosity, creativity and the yearn to solve problems. Each day, we immerse ourselves in challenges that push us to think beyond the ordinary - every idea that is curated, every project that is built, every algorithm that simplifies complexity, has the potential to impact the society.

In this edition of our magazine, we have curated content that highlights the best of what our community has to offer - whether it is the thought-provoking articles, personal reflections from students or insightful interviews with our esteemed faculty. The magazine captures a sense of a shared vision for a future shaped by creativity and innovation. Our department is a hot-spot of diverse perspectives, where every student brings something unique to the table. What makes this journey so meaningful is that we are not just bound to the concept of textbooks, but are also actively applying them to solve real-world problems.

This edition of the magazine also serves as a reminder of the broader challenges that lie ahead of us as future engineers and technologists. The rapid pace of technological development raises important questions about privacy and security. As responsible engineers, it is our duty to ensure that the technologies we create are used for the greater good, and that we are conscious of their long-term impact on humanity and the environment.

In closing, I would like to thank all the contributors, editorial team members, and faculty who made this issue possible. Your hard work and dedication have resulted in a magazine that truly reflects the spirit of innovation and collaboration that defines our department. I hope this edition inspires you to continue exploring new ideas, pushing the boundaries of what's possible, and striving for excellence in everything you do.

Happy reading, and let's continue to code, create, and collaborate!

Warm regards,

Satavisha Roy Choudhury

Student Editor, Computech 2023-24,

Department of Computer Science and Engineering

Girijananda Chowdhury University



From the Student Editorial Board



Editor: Mr. Ritanjit Das

Dear readers,

I am filled with immense pride and heartfelt gratitude to present this edition of CompuTech, the official magazine of the Department of Computer Science and Engineering, Girijananda Chowdhury University.

This magazine is not just a compilation of articles, ideas, and creativity – it is a reflection of the hard work, passion, and dedication of every individual who contributed to it. Behind every page is a team of students and mentors who devoted their time, energy, and skills to ensure that CompuTech truly represents the spirit, innovation, and intellectual vibrance of our department.

The 2023–24 edition of CompuTech carries forward our legacy of celebrating academic and creative excellence. This issue embraces a diverse range of content – from cutting-edge technological discussions and thought-provoking research insights to artistic expressions and achievements that deserve the spotlight. Every contribution mirrors the unique voice of its creator and adds value to the collective narrative of our department's progress and potential.

Bringing this magazine to life was both a challenge and a deeply enriching journey. From brainstorming and designing to editing and curating, every stage required not just commitment, but collaboration, patience, and a shared belief in the value of what we were creating. The journey tested our limits but also revealed the power of teamwork and vision. Along the way, we learned the importance of communication, leadership, and attention to detail – lessons that extend far beyond the pages of this magazine.

I wish to express my deepest appreciation to the faculty members of the Department of Computer Science and Engineering, whose guidance and constant support acted as a pillar throughout this endeavor. A heartfelt thanks also goes to all contributors whose writings, ideas, and art form the very heart of CompuTech.

To our readers, I invite you to immerse yourselves in this edition with curiosity and reflection. May these pages spark your imagination, broaden your understanding, and kindle a sense of pride in being a part of our dynamic academic community.

Let CompuTech stand as a testament to what we can achieve when we work together with passion, creativity, and purpose.

Happy Reading!

Ritanjit Das,
Student Editor, CompuTech 2023–24,
Department of Computer Science and Engineering,
Girijananda Chowdhury University



CONTENTS

TOPIC	SUBMITTED BY	PAGE NO.
How Gaming Evolved	Subrata Goswami	15 - 17
Cybersecurity in the Age of AI	Mrinmoy Pathak	18 - 22
Hackathons: A Participant's POV	Kumar Jigyas Pritam	23 - 24
The Evolution of Edge Computing	Sudeep Dutta	25 - 27
Data Science in Personalized Healthcare	Sohini Roy	28 - 30
AI in Music:	Sandilya Baruah	31 - 32
DAOs: Future of Governance?	Rojot Paul	33 - 34
Human-Computer Interaction	Sagar Choudhury	35 - 37
Emotionally Intelligent AI	Dhruman Das	38 - 39
Generative AI Beyond Text	Bhaanvee Baruah	40 - 41
Neuromorphic Computing	Nishanta Deka	42 - 43
Evolution of GPUs	Prasurjya Goswami	44 - 45
Quantum Computing Applications	Dibashree Baruah	46 - 46
Impact of 6G on Communication	Nishant Huzuri	47 - 49
Data Science in CSE	Ankita Chakraborty	50 - 51
Why are laptop prices increasing?	Ritanjit Das	52 - 53
The Rise of AI in Everyday Life	Satavisha Roy Choudhury	54 - 55



How Gaming Evolved:

A Technological Journey from Pong to Photorealism



➤ Subrata Goswami - 4th Semester, Dept. of CSE

Gaming's evolution mirrors the growth of technology itself -- starting with a simple bouncing pixel and transforming into hyper-realistic worlds powered by artificial intelligence, physics engines, and virtual reality. What once required nothing more than a television and a joystick is now a playground for cutting-edge tech that blurs the lines between reality and simulation. From blocky sprites to ray-traced reflections, the story of gaming's growth is a testament to the relentless march of innovation. Let's hit the reset button.

It all began humbly enough. In 1958, a physicist named William Higginbotham created *Tennis for Two* — a rudimentary game displayed on an oscilloscope. It was more science project than entertainment, but it lit a spark. By the early 60s, *Spacewar!* was born at MIT, offering one of the earliest digital gaming experiences. Yet, these experiments were restricted to massive university computers, far beyond the reach of the average person. That all changed when Atari's *Pong* hit the scene. Simple, addictive, and utterly groundbreaking, *Pong* brought gaming into arcades and forever embedded itself in pop culture.



But something was still missing—accessibility. Arcades were stationary; gamers wanted to bring the fun home. In the 1980s, gaming took over living rooms with the rise of home consoles. The Nintendo Entertainment System (NES) and Sega Genesis introduced an era of unforgettable classics like *Super Mario Bros.*, *The Legend of Zelda*, and *Pokémon*. These games were more than just entertainment—they laid the groundwork for genres we still love today. For the first time, players could explore virtual worlds, battle enemies, and piece together stories without ever leaving their couch.



Then came the real “game-changer” -- 3D graphics. In the mid-90s, gaming transitioned from side-scrolling adventures to fully immersive three-dimensional experiences. *Super Mario 64* led the charge, offering fluid character movement and open, explorable worlds. *Tomb Raider* followed, bringing players on cinematic adventures through treacherous landscapes. Meanwhile, *Quake* introduced real-time 3D rendering and dynamic lighting, revolutionizing the shooter genre, that we today know as first-person shooters. Any FPS players reading? Huh, what a silly question! Back to the topic, suddenly, gaming was no longer just about reflexes — it became a fully immersive experience. Storytelling became richer, environments grew more complex, and games like *Final Fantasy VII* and *Grand Theft Auto III* pushed the boundaries of what players could expect from their virtual playgrounds.

By the early 2000s, gaming had gone mainstream. Broadband internet made it possible for players to connect, compete, and cooperate across the world. *World of Warcraft* became a global phenomenon, letting millions explore a shared virtual universe. Console games embraced online multiplayer with *Halo 2* and *Call of Duty*, transforming gaming into a social experience. Suddenly, you weren’t just playing against the computer—you were facing off against real people, trash talk included.

While online play redefined gaming culture, graphics took a quantum leap forward. The arrival of high-definition gaming on the PlayStation 3 and Xbox 360 raised the bar for visual fidelity. Real-time shadows, detailed textures, and breathtaking cinematic sequences became the norm. Games like *Crysis* pushed hardware to its absolute limits, sparking the now-legendary question- “*But can it run Crysis?*”



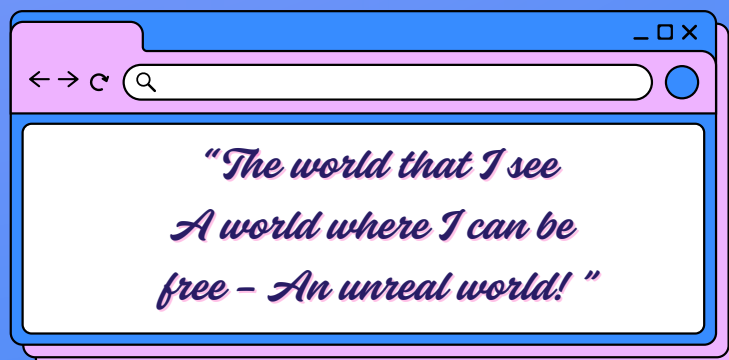
Of course, gaming wasn't just about looking better—it was about feeling real. AI grew smarter, giving us enemies that could adapt to our strategies and NPCs that felt more alive than ever. Physics engines became more sophisticated, simulating destructible environments, realistic collisions, and fluid movements. No longer were cars bouncing off invisible walls; instead, entire buildings could crumble realistically under fire, as seen in the *Battlefield* series. Open-world games grew in size and complexity (right now it seems a mess!), offering dynamic weather systems, wildlife interactions, and emergent gameplay. *The Witcher 3* and *Red Dead Redemption 2* set new standards for what open worlds could be, creating experiences so rich and immersive that they felt more like alternate realities than video games.

Then there's the dream of every sci-fi fan: virtual reality. For decades, VR was the holy grail of gaming, but the technology wasn't quite ready. Early attempts like Nintendo's Virtual Boy flopped hard. But modern innovations changed everything. With the Oculus Rift and PlayStation VR, players could step into entirely new worlds. Meanwhile, augmented reality made its own splash with *Pokémon GO*, blending gaming with the real world and turning city streets into virtual playgrounds. I still haven't got a chance to catch that Bulbasaur!

And if that wasn't enough, cloud gaming is shaking things up once again. Imagine playing the latest blockbuster game without owning a console or high-end PC. With services like Xbox Cloud Gaming and NVIDIA GeForce Now, that's already possible. Games can now be streamed directly to your device, just like Netflix, offering high-quality experiences on almost any screen. Sure, there are challenges—latency and bandwidth limitations still hold it back—but the potential is enormous. It's not a stretch to imagine a world where consoles as we know them become obsolete, replaced by seamless streaming experiences.

From a bouncing pixel to immersive virtual realities, the evolution of gaming is nothing short of astonishing. And the best part? It's far from over. The next decade promises AI-generated content, where entire worlds could be created on the fly based on player behaviour. Virtual reality will become more lifelike, perhaps incorporating touch, temperature, and even scent. Brain-computer interfaces—once the stuff of science fiction—might become gaming's next big leap, allowing players to control games with their thoughts.

One thing is certain -- gaming will continue to push technological boundaries, just as it has for the past five decades. Now, if you'll excuse me, I've got some side quests to complete! In the mean time, enjoy and ponder this little haiku that I've wrote –



The Cybersecurity Landscape in the Age of AI:

An Evolving Battlefield of Intelligent Threats and Defenses with Global Perspectives and India's Strategic Approach



➤ Mrinmoy Pathak - 6th Semester, Dept. of CSE

The integration of artificial intelligence into cybersecurity has fundamentally transformed digital defense mechanisms, creating an ongoing technological arms race between cyber attackers and defenders. This paradigm shift has propelled the global AI cybersecurity market from 17.4 billion in 2022 to a projected 102.78 billion by 2032, reflecting the critical role these technologies now play in safeguarding digital infrastructure. The current landscape presents an increasingly sophisticated array of AI-powered threats that challenge traditional security models while simultaneously offering powerful new defensive capabilities.

Modern cyber threats leveraging artificial intelligence demonstrate unprecedented levels of sophistication and adaptability. Deepfake technology has evolved beyond simple voice cloning to create fully synthetic audiovisual impersonations, as demonstrated in a 2023 incident where a Hong Kong bank manager transferred \$35 million after interacting with AI-generated deepfakes of his company's executives. Natural language generation systems can now produce thousands of hyper-personalized phishing emails per hour, tailored to individual recipients with 98% linguistic accuracy. Malware has become significantly more dangerous through AI augmentation, with threats like the "BlackMamba" worm using onboard machine learning to rewrite its code in real-time, evading 93% of signature-based detection systems. Autonomous botnets like "DarkAI" demonstrate frightening capabilities, having compromised over 150,000 IoT devices in a single quarter through completely automated reconnaissance and attack processes. Adversarial machine learning techniques present additional challenges, with attackers using generative adversarial networks (GANs) to create "fooling images" that bypass facial recognition systems 87% of the time, while data poisoning attacks against corporate machine learning models increased by 300% in 2022 according to Microsoft reports.

In response to these evolving threats, cybersecurity teams are deploying equally sophisticated AI-powered defensive systems. Behavioral analytics platforms now monitor over 5,000 parameters per user, detecting anomalies with 99.5% accuracy through advanced machine learning algorithms. Palo Alto's Cortex XDR exemplifies this approach, using ensemble learning techniques to correlate security events across endpoints, networks, and cloud environments while reducing false positives by 70%.



Predictive threat intelligence systems like Darktrace's Antigena employ Bayesian networks to anticipate attack pathways before they're exploited, preventing an average of 150,000 threats weekly. IBM's Watson for Cybersecurity demonstrates the power of natural language processing in security applications, analyzing 10,000 research papers daily to identify emerging threat patterns. Automated response systems have dramatically improved incident response times, with Sentinel One's Ranger platform reducing average threat dwell time from 21 days to just 24 minutes through AI-driven threat hunting. Perhaps most intriguing are next-generation deception technologies like AI-powered honeypot networks that actively study attacker behavior while containing threats, using reinforcement learning to continuously improve defensive strategies.

The rapid adoption of AI in cybersecurity presents complex ethical and regulatory challenges that the industry continues to grapple with. The persistent "black box" problem leaves 78% of security professionals unable to adequately explain their AI systems' decisions, creating compliance challenges with emerging regulations like the EU's AI Act that mandate algorithmic explainability. Privacy concerns escalate as behavioral monitoring systems analyze increasingly personal data points including keystroke dynamics, mouse movements, and biometric patterns, raising difficult questions about GDPR compliance and user consent. The proliferation of autonomous cyberweapons adds another layer of complexity, with the UN identifying 43 nation-states now possessing AI-driven offensive capabilities, prompting international efforts like the 2023 "AI Cyber Stability Framework" to establish norms for government cyber operations.

Different industry sectors face unique challenges and opportunities in implementing AI cybersecurity solutions. Financial institutions like JPMorgan process 6 trillion in daily transactions through AI fraud detection systems that have reduced false positives by 3520 billion annually. Healthcare organizations employ federated learning techniques to secure medical devices while protecting patient privacy, though attacks on AI-driven drug discovery platforms in 2023 demonstrated the sector's vulnerability, delaying 17 critical clinical trials. Critical infrastructure operators now monitor 15 million data points daily through AI-based anomaly detection systems, with incidents like the Colonial Pipeline attack underscoring both the stakes and potential of AI cybersecurity when properly implemented.

Emerging technologies promise to further reshape the cybersecurity landscape in coming years. Quantum machine learning presents a double-edged sword, offering potential breakthroughs in both breaking current encryption standards and creating theoretically unhackable systems. Neuromorphic computing chips like Intel's Loihi hint at a future of ultra-efficient, brain-inspired security systems capable of real-time anomaly detection at the network edge. However, new vulnerabilities emerge through AI supply chain risks, with over 60% of organizations now relying on third-party AI models of unknown security provenance, while model inversion attacks demonstrate the ability to extract sensitive training data from deployed machine learning systems.



Organizations seeking to navigate this complex landscape should consider several strategic approaches. Implementing defense-in-depth AI architectures that combine supervised learning for known threats with unsupervised techniques for zero-day detection creates more resilient systems. Continuous adversarial testing of security models helps identify vulnerabilities before attackers can exploit them. Building dedicated AI Security Operations Centers (AI-SOCs) staffed with cross-disciplinary teams of data scientists and security experts represents a growing trend, with Gartner predicting 75% of enterprises will adopt this model by 2025. Participation in collective defense initiatives like the AI Cyber Threat Alliance and open-source security projects helps raise overall ecosystem resilience while providing access to shared threat intelligence.

India's Cybersecurity Preparedness and AI Integration :

India has emerged as a key player in the global cybersecurity landscape, with its Computer Emergency Response Team (CERT-In) reporting a 53% increase in ransomware attacks in 2022 alone. Recognizing the strategic importance of AI in cybersecurity, the Indian government has launched several initiatives through its National Cyber Security Strategy 2020 and the National AI Portal. The Ministry of Electronics and Information Technology (MeitY) has established four Centers of Excellence in AI, with cybersecurity being a key focus area. Indian tech giants like Tata Consultancy Services and Wipro have developed advanced AI-based threat detection platforms that are being deployed both domestically and globally. The Reserve Bank of India has mandated AI-powered fraud detection systems for all major financial institutions, resulting in a 37% reduction in digital payment frauds in 2023.

Advanced Threat Landscape and India's Response :

Modern cyber threats leveraging artificial intelligence demonstrate unprecedented levels of sophistication, with Indian organizations facing increasingly complex attacks. The Indian Computer Emergency Response Team (CERT-In) reported that AI-powered phishing attacks targeting Indian businesses increased by 270% between 2021 and 2023. Deepfake technology has been particularly concerning, with several high-profile cases of synthetic media being used for financial fraud and misinformation campaigns. In response, Indian cybersecurity firms like Sequaretek and Securonix have developed advanced behavioural analytics systems that monitor over 8,000 parameters per user, specifically tuned to Indian usage patterns and threat vectors.

The Indian government has taken proactive measures against AI-powered threats, with the Cyber Swachhta Kendra (Botnet Cleaning and Malware Analysis Centre) deploying AI-based solutions to detect and prevent malware infections across millions of Indian devices. The Indian Cyber Crime Coordination Centre (I4C) has established a dedicated AI research wing focused on developing countermeasures against emerging threats like polymorphic malware and adversarial machine learning attacks. These efforts have been particularly crucial in protecting India's rapidly growing digital payment infrastructure, which processes over 10 billion transactions monthly.



India's Defensive Capabilities and Innovation Ecosystem :

India's cybersecurity defense capabilities have seen remarkable growth through public-private partnerships and academic collaborations. The Indian Institute of Technology (IIT) network has established specialized labs for AI cybersecurity research, with IIT Delhi's AI-based intrusion detection system showing 98.7% accuracy in identifying zero-day attacks. The Defense Research and Development Organization (DRDO) has developed the "Chakravyuh" AI-powered cyber defense system, which uses machine learning to predict and prevent cyber-attacks on critical infrastructure.

Indian startups are making significant contributions to the global AI cybersecurity landscape. Bangalore-based startup "Asteria Aerospace" has developed AI-powered drones for cybersecurity surveillance of critical infrastructure. "Silent Eight," another Indian-origin company, provides AI solutions that help financial institutions combat money laundering and terrorist financing. The government's "Startup India" initiative has funded over 150 AI cybersecurity startups since 2020, creating a vibrant innovation ecosystem.

Regulatory Framework and Capacity Building :

India has been actively developing a comprehensive regulatory framework for AI in cybersecurity. The Personal Data Protection Bill includes provisions for AI governance, while the National Cybersecurity Policy 2023 emphasizes the need for "Responsible AI" in security applications. The government has established the National AI Center under NASSCOM to develop ethical guidelines for AI deployment in cybersecurity.

Capacity building remains a key focus area, with the Ministry of Skill Development launching specialized courses in AI cybersecurity through the National Skill Development Corporation. Over 50,000 professionals have been trained through these programs since 2021. The government has also partnered with leading tech companies to establish Cybersecurity Centers of Excellence in major cities, fostering research and development in AI-powered security solutions.

Future Outlook and Strategic Initiatives :

Looking ahead, India is positioning itself as a global leader in AI cybersecurity solutions. The National Supercomputing Mission includes dedicated resources for cybersecurity research, while the proposed National Cybersecurity Strategy 2024-2030 envisions India as a "Global Hub for AI Cybersecurity Solutions." Key projects in development include:

1. BharatNet AI Shield: Protecting India's rural broadband infrastructure with AI-powered threat detection
2. Digital India AI Sentinel: A national-level AI system for monitoring critical digital infrastructure
3. AI-based Cyber Swachhta Kendra 2.0: Next-gen malware analysis and botnet prevention

India is also actively participating in global cybersecurity collaborations, joining initiatives like the Christchurch Call to combat online extremism and the Global Partnership on Artificial Intelligence (GPAI). These international partnerships are helping shape India's approach to balancing innovation with security in the AI era.



India's Strategic Position in the AI Cybersecurity Landscape :

As the cybersecurity landscape continues to evolve, India's comprehensive approach — combining robust policy frameworks, strong domestic capabilities, and international cooperation — positions it well to address both current and emerging AI-powered threats. The country's vast talent pool, thriving startup ecosystem, and government support create a unique environment for developing innovative AI cybersecurity solutions tailored to both domestic needs and global challenges.

The next decade will be critical as India works to secure its digital transformation while contributing to global cybersecurity standards. With AI expected to play an increasingly central role in both cyber-attacks and defense, India's investments in research, education, and infrastructure will determine its ability to protect its growing digital economy while establishing itself as a leader in the global AI cybersecurity market. The nation's approach serves as a model for developing countries seeking to harness AI's potential for cybersecurity while navigating the complex ethical and regulatory challenges it presents.

Conclusion :

This ongoing technological arms race exemplifies what experts term the "Red Queen Effect" in cybersecurity, where constant innovation is required simply to maintain existing defensive positions. As the field approaches the theoretical limits of classical computing defences, organizations must prepare for coming paradigm shifts including post-quantum cryptography and biologically-inspired security architectures.

The next decade will likely see cybersecurity evolve from a technical challenge to an existential imperative for digital societies, with artificial intelligence serving simultaneously as both our greatest vulnerability and most powerful defensive tool. Success in this new era will demand unprecedented collaboration between governments, private enterprises, and the research community to develop frameworks and standards that can keep pace with technological evolution while protecting fundamental digital rights and freedoms.

The stakes have never been higher, as the security of our increasingly interconnected digital future depends on getting this balance right.



Hackathons:

From a participant's point of view



➡ **KumarJigyasPritam - 4th Semester, Dept. of CSE**

Hackathons have a way of pushing you beyond what you think you're capable of. When I first participated in the Smart India Hackathon (SIH) in 2023, I had no idea how transformative the experience would be. And when I returned for SIH 2024, this time with a deeper understanding of the process, I realized just how much I had grown—not just as a programmer but as a team leader, a problem solver, and a learner.

From the very beginning, the constant urge to learn more kicked in. The experience was intense—brainstorming ideas, designing solutions, writing code, learning new things all under tight deadlines.

Before participating in hackathons, I was way too lost in the field of coding. Where to start, how to start, should I learn from hours long YouTube videos or shall I directly try to implement something and try making projects. Participating in SIH gave me the clarity and confidence I needed.

One of the most valuable lessons I learned was the power of teamwork. Every idea had to be refined through discussions, every challenge had to be tackled collectively, and every success felt like a shared victory. There were moments of intense debates, frustrating moments that seemed like the end of our journey of even participating in a hackathon. Yet, through all of this, I realized how much more effective problem-solving can be when multiple minds work together. It taught me patience, adaptability, and the importance of clear communication.

What stood out the most was how much we learned in such a short time. In a regular academic setting, understanding a new technology or concept might take weeks or even months. But in a hackathon, you don't have that luxury. You have to pick up new frameworks, troubleshoot errors, and implement solutions on the go. It was exhilarating to see how quickly we adapted and improved. The pace was intense, but it also made me realize that sometimes, the best way to learn is to throw yourself into the deep end.

Beyond the technical aspects, SIH gave me hands-on experience in bringing an idea to life. From conceptualizing the project to designing the architecture and finally building a working prototype, every step was a lesson in real-world problem-solving. Unlike classroom projects, where the focus is often theoretical, hackathons demand that you think practically—about scalability, usability, and impact. This hands-on approach made me appreciate the process of creation in a way I hadn't before.

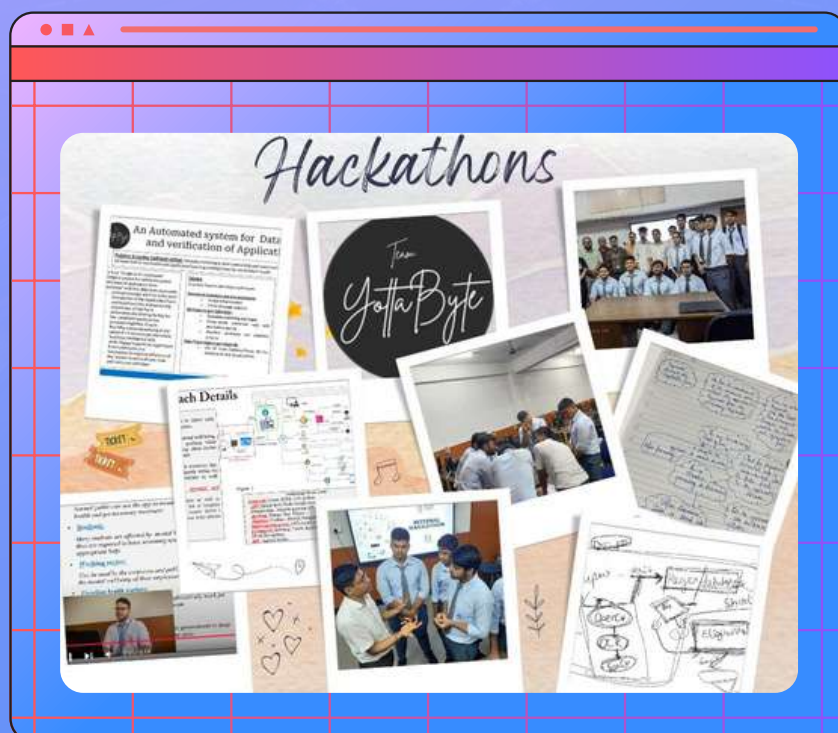


Another invaluable takeaway from these hackathons was the connections I built. Interacting with faculty mentors and seniors was eye-opening—their insights and encouragement greatly shaped our approach. Networking wasn't just about exchanging ideas; it was about understanding perspectives, learning from experienced minds, and realizing that the tech community thrives on collaboration and knowledge-sharing.

Perhaps the most surprising lesson was discovering how much we could push ourselves. The long hours, pressure, and cycle of trial and error were exhausting but revealed a capacity I didn't know I had. It was empowering to realize that passion and purpose drive us beyond limits.

Of course, we faced challenges. We struggled with procrastination, limited imagination at times, and lacked a systematic approach. But recognizing and addressing these flaws was crucial. SIH helped us break bad habits and develop a more proactive, solution-driven mindset.

Looking back, these hackathons were transformative learning experiences. They showed that no challenge is too big with the right mindset and a strong team. Though we didn't win, the skills, experiences, and confidence we gained are victories that will stay with us forever.



The Evolution of Edge Computing and IoT Integration:

A Transformative Paradigm Shift



➤ Sudeep Dutta - 6th Semester, Dept. of CSE

The rapid proliferation of Internet of Things (IoT) devices across industries has created an unprecedented data deluge, with current estimates suggesting over 75 billion connected devices will be in operation by 2025. This exponential growth has exposed the limitations of traditional cloud-centric architectures, giving rise to edge computing as a revolutionary approach that redistributes computational power to the network periphery. This fundamental shift is transforming how we process, analyze, and act upon data in real-time across countless applications.

Technical Foundations and Architectural Revolution:

At its core, edge computing represents a complete reimagining of network topology. Unlike conventional models where raw data travels long distances to centralized cloud servers, edge computing establishes a distributed framework of localized processing nodes. These edge devices range from industrial-grade micro data centers to sophisticated AI-enabled gateways, all capable of performing significant computational tasks. The Open Edge Computing Initiative has standardized key architectures that enable this distributed processing, including fog computing models that create hierarchical layers of computation between devices and the cloud.

Modern edge systems leverage several critical technologies:

- Lightweight containerization (Docker, Kubernetes) for application deployment
- TinyML frameworks for running machine learning on resource-constrained devices
- Time-Sensitive Networking (TSN) for deterministic low-latency communication
- Secure enclave technologies like Intel SGX for protected execution environments

Latency-Critical Applications Redefined:

The latency advantages of edge computing are revolutionizing industries where milliseconds matter. In autonomous vehicles, edge processing enables real-time sensor fusion, combining LiDAR, radar, and camera inputs at the source to make instantaneous navigation decisions. Tesla's latest autonomous systems perform up to 36 trillion operations per second (TOPS) locally in each vehicle, eliminating cloud dependency for critical driving functions.

Industrial automation has seen perhaps the most dramatic transformation. Modern smart factories deploy edge computing for:

- Real-time predictive maintenance using vibration and thermal analysis.
- Machine vision quality inspection at production line speeds.
- Closed-loop control systems with sub-millisecond response times.



Siemens reports that their edge implementations in manufacturing have reduced equipment downtime by up to 50% while improving production quality metrics by 30%.

Bandwidth Optimization and Cost Efficiency:

The bandwidth conservation benefits of edge computing have become increasingly valuable as IoT deployments scale. A single smart city camera generating HD video can produce over 2TB of data daily. Edge processing reduces this to mere kilobytes of meaningful metadata (license plate recognition, object detection alerts). AT&T estimates their edge networks save over 40% in backhaul costs by processing video analytics at the edge.

5G networks are being architected with edge computing as a fundamental component through Multi-access Edge Computing (MEC). This allows carriers to offer ultra-low latency services while maintaining efficient spectrum utilization. Verizon's edge deployments for enterprise customers have demonstrated 60% reductions in bandwidth requirements for IoT applications.

Enhanced Security Paradigms:

Edge computing introduces a security model fundamentally different from traditional cloud approaches. By implementing:

- Distributed trust architectures
- Hardware-based root of trust in edge nodes
- Federated learning models that never export raw data
- Blockchain-based device authentication

Recent implementations in healthcare demonstrate the security advantages. Philips' edge-based patient monitoring systems process sensitive medical data locally in hospitals, achieving HIPAA compliance while enabling real-time analytics that would be impossible with cloud-only approaches.

Smart City Transformations:

Urban deployments showcase the full potential of edge-IoT integration:

- In Barcelona, edge nodes process data from 19,500 smart meters, 6,500 waste sensors, and 1,100 irrigation sensors, reducing water usage by 25% and generating €42 million in annual savings
- Singapore's Intelligent Transport System uses edge computing to analyze traffic patterns across 10,000 intersections, adjusting signals in real-time to reduce congestion by 15%
- Tokyo's earthquake early warning system processes seismic data at edge locations, providing life-saving alerts 30 seconds faster than cloud-based alternatives



Industrial IoT and the Fourth Industrial Revolution:

Edge computing is the backbone of Industry 4.0 implementations:

- Oil rigs now deploy edge systems that analyze 50,000 sensor points locally, detecting equipment failures 8 hours before they occur
- Agricultural IoT combines edge processing with drone imagery to optimize irrigation and fertilization, boosting yields by 20%
- Walmart's edge-based inventory systems track 3 billion product movements daily with 99.9% accuracy

Future Directions and Emerging Innovations:

The next evolution of edge computing includes:

- Edge-native AI models that continuously learn from local data
- Self-organizing edge networks that dynamically reconfigure based on demand
- Quantum-resistant cryptography for edge security
- Holographic edge computing for AR/VR applications

Research from IDC predicts that by 2026, 75% of enterprise data will be processed at the edge, driving a \$274 billion edge computing market. As 6G networks emerge, they will integrate edge computing at a fundamental level, enabling use cases we can scarcely imagine today.

Challenges and Considerations:

Despite its promise, edge computing faces hurdles:

- Standardization across vendors and platforms
- Managing software updates across millions of edge devices
- Balancing local processing with necessary cloud integration
- Developing edge-specific security frameworks

Companies like Dell, HPE, and Cisco are addressing these through open edge computing initiatives and new hardware platforms designed specifically for edge workloads.

Conclusion: The Edge-Centric Future

The integration of edge computing with IoT represents more than just a technical evolution — it's a complete rethinking of how we build and interact with connected systems. As this synergy deepens, we'll see the emergence of truly autonomous systems capable of intelligent, real-time decision-making at unprecedented scales. The edge isn't just complementing cloud computing; it's creating an entirely new paradigm for the digital age that will underpin technological progress for decades to come.



The Role of Data Science in Personalized Healthcare



➤ Sohini Roy - 6th Semester, Dept. of CSE

The healthcare industry stands at the precipice of a revolutionary transformation as it shifts from generalized treatment protocols to precision medicine powered by advanced data science. This paradigm change represents more than just technological progress—it's fundamentally redefining our approach to diagnosis, treatment, and prevention by leveraging the unique biological and lifestyle characteristics of each individual patient. The convergence of massive computing power, sophisticated machine learning algorithms, and unprecedented volumes of health data has created the perfect conditions for this medical revolution to take root and flourish across global healthcare systems.

At the core of this transformation lies predictive diagnostics, where machine learning models analyze complex datasets to identify health risks long before clinical symptoms manifest. Modern systems process everything from high-resolution MRI scans to complete genomic sequences and comprehensive electronic health records, detecting subtle patterns invisible to human practitioners. Google's DeepMind achieved a breakthrough in diabetic retinopathy screening, demonstrating how AI can match or exceed specialist accuracy while operating at scale. Similar systems now show promise in early detection of conditions ranging from Alzheimer's disease to various cancers, potentially adding years of healthy life through timely intervention.

The drug discovery process has been similarly revolutionized by data science approaches. Traditional pharmaceutical development often followed a trial-and-error approach spanning decades and costing billions, with high failure rates. Contemporary AI platforms like Atomwise and BenevolentAI employ deep learning to simulate molecular interactions, screening millions of potential drug candidates in days rather than years. The COVID-19 pandemic provided a dramatic demonstration of this capability when AI systems helped design the Moderna vaccine's mRNA sequence in just two days—a process that might have taken months using conventional methods. These technologies are now being applied to everything from rare diseases to antibiotic resistance, dramatically accelerating the therapeutic pipeline.

Perhaps the most profound impact of data science appears in personalized treatment planning, where algorithms synthesize diverse data streams to recommend optimized therapies.



IBM Watson for Oncology exemplifies this approach, analyzing tumor genetics alongside thousands of similar cases to suggest treatment options tailored to an individual patient's cancer profile. Wearable technology adds another dimension, with devices like the Apple Watch providing continuous physiological monitoring that enables dynamic medication adjustments in real time. This represents a radical departure from the static dosing schedules of traditional medicine, moving toward truly responsive, patient-specific care protocols.

However, the path to data-driven healthcare faces significant obstacles that must be addressed. Data silos remain a persistent challenge, as patient information often remains locked in incompatible hospital systems due to privacy concerns and proprietary formats. The issue of algorithmic bias presents another critical concern, as many medical AI systems trained primarily on Caucasian male datasets demonstrate reduced accuracy for women and minority populations. Regulatory frameworks struggle to keep pace with technological advances, leaving healthcare providers navigating uncharted territory when implementing novel AI diagnostics and treatments. These challenges underscore the need for thoughtful governance and continued refinement as the field matures.

Looking toward the future, the potential applications of data science in healthcare border on the revolutionary. Imagine AI systems that integrate genomic data with real-time microbiome analysis and dietary tracking to predict and prevent disease before onset. Envision nanotechnology-enabled biosensors providing continuous health monitoring, alerting physicians to emerging issues while they remain easily treatable. Picture clinical decision support systems that assimilate the latest research findings instantaneously, ensuring every patient benefits from cutting-edge medical knowledge. These scenarios represent not science fiction, but the logical progression of current technological trajectories.

This transformation doesn't render physicians obsolete—rather, it elevates their capabilities. Data science serves as a powerful augmentation tool, handling pattern recognition and data synthesis at superhuman scales while leaving complex judgment calls and human interactions to medical professionals. The physician of 2030 may spend less time on routine diagnostics and more time interpreting AI insights, communicating with patients, and developing comprehensive care strategies. This collaborative model promises to enhance both the efficiency and humanity of medical practice.

The implications extend beyond individual patient care to population health management. Aggregated, anonymized health data can reveal community-level health trends, predict disease outbreaks, and optimize resource allocation across healthcare systems. Public health officials might one day intervene in emerging epidemics before the first case presents at a hospital, or identify environmental health risks through subtle patterns in population-wide biometric data.



Ethical considerations remain paramount as healthcare becomes increasingly data-driven. Patient privacy must be balanced against the benefits of data sharing, requiring robust anonymization techniques and secure infrastructure. Algorithmic transparency becomes crucial when lives hang in the balance—healthcare AI must be explainable, auditable, and free from hidden biases. The medical profession will need to develop new standards and protocols for integrating these technologies responsibly into clinical practice.

As we stand at this inflection point in medical history, it's clear that data science will play an ever-expanding role in healthcare delivery. The transition to truly personalized, predictive, and preventive medicine represents one of the most significant applications of artificial intelligence and big data analytics. While challenges remain in implementation, governance, and adoption, the potential benefits to human health and longevity make this one of the most important technological frontiers of our time. The coming decade will likely see these technologies move from cutting-edge research to standard practice, fundamentally transforming how we understand, maintain, and restore human health.



AI in Music:

Algorithms Creating Songs and Mixing Tracks



➤ Sandilya Baruah - 4th Semester, Dept. of CSE

The fusion of *Artificial Intelligence (AI) and music* is revolutionizing how songs are composed, mixed, and mastered. From generating melodies to fine-tuning audio tracks, AI is playing an increasingly vital role in the music industry.

Whether it's AI-powered *music composition software, auto-mixing tools, or deep-learning-based sound enhancement*, algorithms are reshaping the creative process of making music.

AI-generated music is created using *machine learning models trained on vast datasets* of musical compositions. These models analyze patterns in rhythm, melody, harmony, and lyrics to generate unique compositions.

Key Technologies Behind AI Music Creation:

1. Neural Networks & Deep Learning – AI models like *OpenAI's Jukebox* and *Google's Magenta* use deep learning to generate compositions based on existing music styles.
2. Markov Chains & LSTM (Long Short-Term Memory) Models – These help AI predict and generate sequences of musical notes, creating new melodies.
3. Generative Adversarial Networks (GANs) – AI generates new music by learning from different genres and styles.

Example: *AIVA (Artificial Intelligence Virtual Artist)* is an AI that composes orchestral music and has been used in films and games.



AI in Mixing and Mastering Music:

Beyond composition, AI is enhancing music production by automating mixing and mastering tasks.

How AI Helps in Mixing & Mastering :

- AI-Powered Mixing – AI software like *LANDR* and *Izotope Neutron* can automatically adjust sound levels, equalization, and reverb to achieve professional-grade mixes.
- Auto-Mastering Tools – AI mastering tools analyse audio waveforms and optimize dynamics, loudness, and frequency balance.
- Stem Separation – AI tools like *Spleeter* can separate vocals, bass, and instrumental tracks from a song, allowing producers to remix tracks efficiently.



Example: *Endel* is an AI app that generates personalized ambient music based on real-time data like weather and heart rate.



The Impact of AI on the Music Industry:

- Empowering Independent Artists – AI allows independent musicians to create professional-quality tracks without expensive studio equipment.
- Enhancing Creativity – AI acts as a co-creator, helping musicians explore new ideas and styles.
- Challenges & Ethical Concerns – AI-generated music raises questions about authorship, originality, and copyright laws.

AI in music is no longer science fiction—it's a rapidly evolving field that is changing how we create and experience sound. While AI may not replace human musicians, it is becoming an essential tool for creativity and production. As technology advances, AI-driven music will continue to push the boundaries of sound design, composition, and mixing, making the future of music more innovative than ever.



The first AI-generated album, *Hello World* by the AI group **SKYGGE**, was released in **2018**, showcasing AI's potential in music composition.



Decentralized Autonomous Organizations (DAOs) :

Are DAOs The Future of Governance?



➡ Rojot Paul - 6th Semester, Dept. of CSE

The DAO Revolution - Redefining Organizational Structures:

Decentralized Autonomous Organizations represent one of the most radical innovations to emerge from blockchain technology, fundamentally challenging centuries-old concepts of corporate governance and organizational management. Unlike traditional hierarchical structures, DAOs operate as flat, code-governed entities where decision-making authority is distributed among token-holding members rather than concentrated in boards or executives. This paradigm shift is enabled by smart contracts - self-executing programs deployed on blockchains like Ethereum that automatically enforce organizational rules and execute decisions when predefined conditions are met.

The first notable DAO, "The DAO" launched in 2016, raised over 150 million in ETH before its infamous hack. Despite this rocky start, the concept has evolved tremendously, with current estimates showing over 4,000 active DAOs managing more than 10 billion in assets collectively. The growth reflects increasing recognition that blockchain-enabled governance models can create more transparent, efficient, and globally accessible organizational structures.

Core Mechanisms - How DAOs Actually Work:

Modern DAOs rely on several interlocking technological components:

- **Smart Contract Frameworks:** Most DAOs use modular platforms like Aragon, DAOstack, or Colony that provide templates for governance, treasury management, and membership systems.
- **Token-Based Voting:** Governance tokens (like MakerDAO's MKR) confer voting rights proportional to holdings. Advanced systems use quadratic voting or conviction voting to mitigate whale dominance.
- **Decentralized Treasuries:** Funds are held in multi-signature wallets or smart contracts requiring member approval for expenditures. Gnosis Safe has become the standard for DAO treasuries.
- **Reputation Systems:** Some DAOs like SourceCred implement non-transferable reputation points to recognize contributions beyond capital investment.

Real-World Implementation - Case Studies:

- **MakerDAO:** The most mature DAO, governing the \$5 billion DAI stablecoin system. MKR holders vote on critical parameters like stability fees and collateral types through continuous approval voting.



- Uniswap: The decentralized exchange's DAO controls protocol fees and development funds. A 2022 proposal to create a \$74 million "Uniswap Foundation" passed with 99% approval.
- CityDAO: An ambitious experiment in decentralized land ownership that purchased 40 acres of Wyoming real estate governed entirely by NFT holders.
- KlimaDAO: A climate-focused DAO that has retired over 17 million carbon credits through decentralized governance mechanisms.

The Legal Landscape - Recognition and Challenges:

The legal status of DAOs remains complex:

- Wyoming became the first U.S. state to legally recognize DAOs as LLCs in 2021
- Marshall Islands passed comprehensive DAO legislation in 2022
- EU is developing the Markets in Crypto-Assets (MiCA) framework covering DAOs
- Taxation: IRS guidance treats DAO tokens as property, creating complex tax obligations

Notable legal cases include the 2022 class action against bZx DAO, which tested the concept of "code is law" versus traditional liability frameworks.

Governance Innovations and Challenges:

Current research focuses on improving DAO governance models:

- Liquid Democracy: Delegable voting systems as implemented by Gitcoin
- Futarchy: Prediction market-based governance proposed by Augur
- DAO-to-DAO Collaboration: Frameworks for inter-DAO cooperation like those developed by PrimeDAO

Persistent challenges include:

- Voter apathy (many DAOs see <10% participation)
- Proposal spam and governance attacks
- The "1 token = 1 vote" plutocracy problem
- Legal uncertainty in cross-border operations

The Future of DAOs - Predictions and Possibilities:

Industry experts predict several key developments:

- Hybrid Organizations: Traditional corporations adopting DAO elements for shareholder governance
- DePIN DAOs: Community-owned physical infrastructure networks
- AI-Augmented Governance: Machine learning systems analyzing proposal impacts
- Vertical-Specific DAOs: Specialized frameworks for healthcare, science, and municipal governance

The World Economic Forum estimates that by 2027, 10% of global GDP could be managed through DAO-like structures. As the technology matures, DAOs may evolve from experimental crypto-native organizations to mainstream tools for collective decision-making across industries, governments, and civil society - potentially redefining how humans organize at scale in the digital age.



The Evolution of Human-Computer Interaction:

From Interfaces to Experiences



✉ Sagar Choudhury - 6th Semester, Dept. of CSE

The field of Human-Computer Interaction (HCI) has undergone a remarkable transformation since its inception, evolving from primitive punch card systems to today's sophisticated multimodal interfaces. This journey reflects not just technological advancement but a fundamental shift in how humans conceptualize their relationship with machines.

Where early interactions required users to adapt to rigid, machine-centric paradigms, modern HCI increasingly focuses on creating natural, intuitive experiences that adapt to human behaviors and cognitive patterns. This evolution mirrors the broader trajectory of computing technology from specialized tools to ubiquitous companions embedded in nearly every aspect of daily life.

The first major transition in HCI came with the move from batch processing to interactive computing in the 1960s, introducing concepts like graphical user interfaces and the mouse. These innovations established foundational interaction metaphors—windows, icons, menus, pointers—that dominated computing for decades. However, the past fifteen years have witnessed an acceleration in interface innovation driven by mobile computing, touch technologies, and artificial intelligence.

Today's HCI landscape encompasses an expanding array of interaction modalities including voice, gesture, gaze tracking, and even direct neural interfaces, each offering new possibilities for how humans communicate with and through technology.

Gesture and motion control represent one of the most visible advances in contemporary HCI. Systems like Leap Motion and Microsoft's Kinect demonstrated that computers could interpret human movements with sufficient accuracy for practical applications. Current implementations go far beyond gaming, enabling surgeons to manipulate 3D medical imagery during procedures without breaking sterility, or allowing industrial designers to sculpt virtual prototypes with natural hand motions.

Emerging technologies like ultra haptics, which create tactile feedback in mid-air using focused ultrasound, promise to make gestural interfaces even more intuitive by adding the missing sense of touch.



Voice interfaces have progressed from simple command recognition to sophisticated conversational agents capable of handling complex, multi-turn interactions. The latest generation of virtual assistants leverages large language models and contextual awareness to provide more natural dialogue, while advances in speech synthesis have made computer-generated voices nearly indistinguishable from human speech.

Perhaps more significantly, we're seeing the emergence of affective computing systems that analyze vocal patterns to detect user emotions, enabling interfaces that can adapt their responses based on whether a user sounds frustrated, confused, or hurried. This emotional intelligence layer represents a crucial step toward more humane, user-centric interfaces.

Brain-computer interfaces (BCIs) stand at the cutting edge of HCI research, promising the most direct communication channel between human and machine yet developed. Medical applications have led the way, with systems like Synchron's Stentrode allowing paralyzed patients to control computers and prosthetics through thought alone. Consumer-grade BCIs are progressing rapidly as well, with non-invasive headbands already enabling basic mind-controlled applications and gaming experiences.

The long-term potential extends far beyond accessibility uses—imagine artists composing music by imagining melodies, or workers manipulating complex 3D datasets through pure mental imagery. However, these systems also raise profound questions about cognitive privacy and the ethics of accessing neural data.

Haptic technology has evolved beyond simple vibration alerts to sophisticated tactile feedback systems that can simulate textures, resistances, and even thermal properties. Apple's Taptic Engine creates remarkably precise vibrations that mimic physical button clicks, while research projects like Facebook's ReSkin are developing thin, flexible materials that can reproduce the feel of different surfaces.

In automotive interfaces, haptic feedback enables drivers to operate touchscreen controls without taking their eyes off the road. The next frontier involves full-hand haptics that could let users feel virtual objects with realistic weight and texture, revolutionizing fields from e-commerce to surgical training.

The applications of these advanced HCI technologies span nearly every industry sector. In healthcare, BCIs are restoring communication capabilities to locked-in patients, while AR interfaces guide surgeons through complex procedures. Education benefits from immersive VR environments where students can interact with historical events or molecular structures as physical presences. Retail experiences are being transformed by AR fitting rooms and virtual product visualization. Even industrial settings are adopting gaze-controlled interfaces for hands-free operation in hazardous environments.



However, these technological advances bring significant ethical challenges that society must address. BCIs in particular raise concerns about mental privacy—how do we protect users' innermost thoughts when they become interface inputs? The potential for emotional manipulation through affective computing systems presents another area requiring careful consideration. There are also important questions about accessibility and the digital divide—as interfaces become more sophisticated, we must ensure they don't inadvertently exclude populations who may struggle with new interaction paradigms.

Looking ahead, HCI is moving toward what researchers call "invisible interfaces"—systems so seamlessly integrated into our environment and behaviors that we stop perceiving them as separate technology. This doesn't mean interfaces will disappear, but rather that they'll become more contextual, adaptive, and anticipatory. Future systems might combine multiple modalities—responding to voice commands while monitoring facial expressions for confusion, or interpreting gestures while sensing physiological stress indicators. The ultimate goal is to create interactions that feel as natural as human-to-human communication, removing the cognitive load traditionally associated with computer use.

The implications of this evolution extend far beyond convenience or productivity gains. As interfaces become more natural and immersive, they reshape how we think, how we learn, and how we relate to information. They change the nature of creativity by providing artists with new expressive tools. They transform education by making abstract concepts tangible. And they redefine accessibility by providing alternative interaction pathways for people with disabilities. In many ways, the history of HCI mirrors humanity's ongoing quest to extend its capabilities through technology—not by adapting ourselves to machines, but by shaping machines to work the way we do.

This progression shows no signs of slowing. Emerging technologies like quantum interfaces, molecular computing, and direct neural integration promise to push HCI into realms we can scarcely imagine today. What remains constant is the fundamental goal: to create technological systems that understand us as well as we understand them, enabling collaborations that amplify human potential while respecting human values. The future of HCI lies not in any single technology, but in the thoughtful integration of multiple modalities to support richer, more meaningful interactions between humans and the digital world they've created.



The Future Of Emotionally Intelligent AI :

Can Machines Truly Empathize ?



➤ Dhruvan Das - 2nd Semester, Dept. of CSE

Imagine a world where your devices do not just follow your commands but also understand how you are feeling. Picture a virtual assistant that senses your frustration and offers comforting words or a healthcare robot that recognizes loneliness in an elderly person and strikes up a conversation to cheer them up. This is not just science fiction—it is the direction artificial intelligence (AI) is heading. But here is the big question: can machines truly empathize, or are they just imitating human emotions?

Emotional intelligence in AI is about enabling machines to recognize, interpret, and respond to human emotions. They do this by analysing cues like tone of voice, facial expressions, and even heart rate.

For instance, if you are stressed while using a customer service chatbot, it might offer more supportive and patient responses. However, as impressive as this sounds, there's one fundamental difference: AI doesn't feel. While humans empathize because of shared experiences and emotions, machines simply process data and act according to their programming.

So, can we really call it empathy? That is debatable. Some argue that if a machine's response makes you feel understood or comforted, it does not matter whether it is "real" empathy or just a simulation. After all, isn't the outcome what is important? But others worry this could blur the line between human and machine interactions. If we start relying on AI for emotional support, could it lead to a society where genuine human connections are sidelined?

There is also the question of ethics. Emotionally intelligent AI has immense potential in fields like healthcare, education, and customer service. Imagine therapy bots offering mental health support or AI teachers adapting lessons based on a student's mood. These advancements could revolutionize industries and make life easier for many people. But they also come with risks. Could companies use emotionally intelligent AI to manipulate customers into buying products? Could governments exploit it for political propaganda?

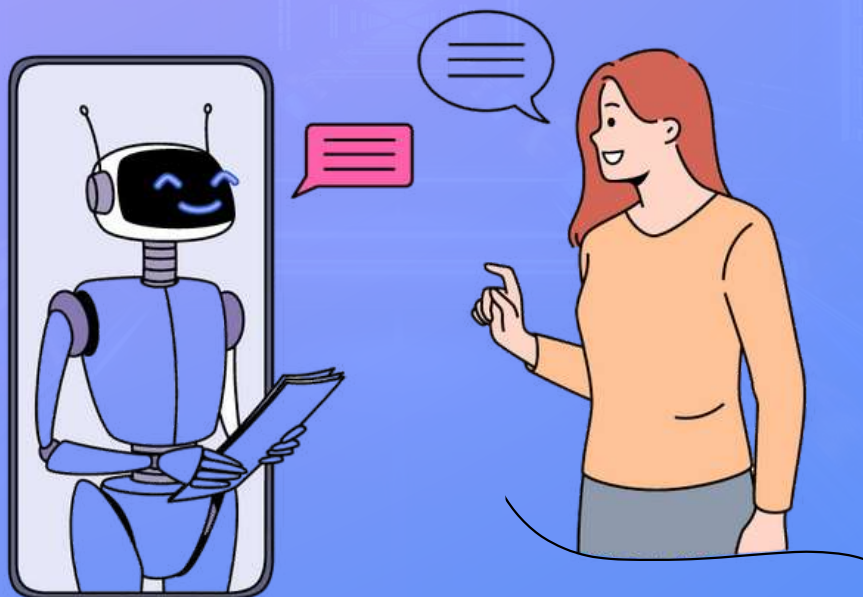
At its core, emotionally intelligent AI is still a tool—it can only do what we program it to do. While it might replicate empathy, it cannot replace the depth of human emotion. Machines do not have memories, life experiences, or values. They cannot share in your joy, grief, or excitement. What they can do is complement human interaction.



For instance, AI could help detect emotional distress in someone who might otherwise go unnoticed or provide support in situations where human help is not immediately available.

The future of emotionally intelligent AI is both exciting and uncertain. It has the potential to enhance our lives, but it also raises complex questions about ethics, trust, and the role of technology in our emotional lives. One thing is clear: no matter how advanced AI becomes; it will never replace the human touch. What makes us truly human—our ability to connect on a deeply emotional level—will always set us apart.

As we move forward, the challenge is not just about building smarter machines but about using them responsibly. We need to ensure that emotionally intelligent AI remains a tool to enhance our connections, not replace them. After all, technology might evolve, but the need for genuine human empathy will always remain timeless.



The Rise of Generative AI

Beyond Text :

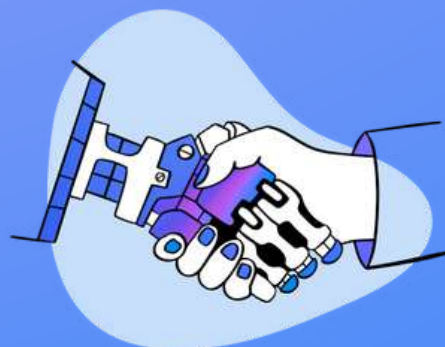


➤ Bhaanvee Baruah - 6th Semester, Dept. of CSE

Generative AI has rapidly evolved from producing simple text outputs to creating highly sophisticated media, including photorealistic images, immersive videos, lifelike audio, and intricate 3D models. This transformation is not merely technological but cultural, as it redefines creativity, entertainment, and even scientific research. The implications are vast, spanning industries from advertising to healthcare, where AI-generated content is now used for everything from marketing campaigns to synthetic medical imaging for training purposes.

The breakthrough in generative AI can be attributed to advancements in deep learning architectures, particularly **Generative Adversarial Networks (GANs)** and **diffusion models**. GANs, introduced by Ian Goodfellow in 2014, operate through a duel between two neural networks—the generator, which creates synthetic data, and the discriminator, which evaluates its authenticity. This adversarial process results in increasingly refined outputs, capable of fooling even expert observers. Diffusion models, on the other hand, work by gradually adding noise to data and then learning to reverse the process, producing high-quality images and audio. These models have been popularized by tools like **DALL-E**, **Stable Diffusion**, and **MidJourney**, which allow users to generate art from simple text prompts.

In the creative sector, generative AI is both a collaborator and a disruptor. Artists like **Refik Anadol** use AI to create large-scale digital installations that blend human creativity with machine intelligence. In filmmaking, AI-generated backgrounds and characters reduce production costs—Disney's **AI-assisted de-aging technology** in movies like *The Mandalorian* showcases this potential. The music industry is also embracing AI, with platforms like **Boomy** enabling users to compose original tracks in seconds, while startups like **Endel** generate personalized soundscapes for relaxation and focus.



However, the rise of generative AI raises significant ethical and legal questions. **Deepfakes**—hyper-realistic but fabricated videos—have been used for misinformation, political manipulation, and non-consensual pornography. The 2023 viral deepfake of Ukrainian President **Volodymyr Zelensky** supposedly surrendering to Russia highlighted the dangers of AI-generated disinformation. Intellectual property is another battleground; when an AI creates a song mimicking **Drake** or **The Weeknd**, who owns the copyright? Courts and policymakers are scrambling to address these issues, with the **EU's AI Act** proposing strict labeling for AI-generated content.

Looking ahead, generative AI will continue to blur the line between human and machine creativity. Future applications could include **AI-generated virtual worlds** for the metaverse, **personalized educational content** tailored to individual learning styles, and even **synthetic data** for training other AI systems. However, ensuring ethical use will require robust regulations, watermarking for AI content, and public awareness campaigns to combat misuse.



Neuromorphic Computing:

Towards Brain-Inspired Hardware



➤ **Nishanta Deka** - 6th Semester, Dept. of CSE

The limitations of traditional computing architectures have become increasingly apparent as we push the boundaries of artificial intelligence. Conventional systems, built on rigid binary logic and the decades-old von Neumann architecture, struggle to match the human brain's remarkable capabilities in real-time learning, adaptive pattern recognition, and energy-efficient processing. Neuromorphic computing has emerged as a revolutionary alternative, drawing direct inspiration from biological neural systems to create hardware that processes information in fundamentally different ways than traditional silicon chips.

At the heart of neuromorphic systems are specialized processors that emulate the brain's neural structure through spiking neural networks (SNNs). Unlike conventional artificial neural networks that process data in continuous cycles, SNNs communicate through discrete "spikes" of activity, closely mimicking how biological neurons transmit information. This event-driven approach means the chips only consume significant power when processing actual data spikes, rather than maintaining constant voltage across the entire network. Intel's Loihi and IBM's TrueNorth represent pioneering examples of this technology, demonstrating orders-of-magnitude improvements in energy efficiency compared to traditional AI accelerators.

The advantages of neuromorphic computing extend far beyond just power savings. These brain-inspired systems excel at processing temporal data and making real-time decisions, capabilities that are critical for applications like autonomous navigation and sensor processing. Their inherent ability to learn continuously from new data without requiring complete retraining makes them uniquely suited for dynamic, real-world environments where conditions change constantly. This adaptability comes from their physical architecture, which implements learning rules like spike-timing-dependent plasticity directly in hardware, allowing the systems to modify their own neural connections in response to incoming data.

Practical applications of neuromorphic technology are already emerging across multiple industries. In autonomous vehicles, these chips can process streams of sensor data with microsecond latency, enabling split-second decisions without relying on cloud connectivity. Healthcare applications include ultra-low-power wearable devices that can monitor vital signs continuously for weeks on a single charge while detecting anomalies in real time. Edge computing systems benefit from neuromorphic processors' ability to analyze video feeds locally, preserving privacy while reducing bandwidth requirements. Industrial IoT implementations use these chips for predictive maintenance, where they can detect subtle vibration patterns indicating impending equipment failures.



Looking toward the future, neuromorphic computing holds even greater promise. Researchers speculate that continued development could lead to systems approaching artificial general intelligence, capable of flexible reasoning and learning across multiple domains. The technology's energy efficiency makes it particularly attractive for space applications, where radiation-hardened neuromorphic chips could enable autonomous decision-making on distant planetary probes. Cognitive computing applications may eventually use these systems to create more natural human-machine interfaces that understand context and nuance more like human conversation partners.

However, significant challenges remain before neuromorphic computing can reach its full potential. Current implementations struggle with scalability, as the specialized architectures don't easily map to conventional programming models. The software ecosystem needs substantial development to make these systems accessible to mainstream developers. Manufacturing processes must advance to support the three-dimensional interconnectivity that true brain-like computation requires. There are also fundamental questions about how to best train and configure these systems, as traditional deep learning techniques don't translate directly to spiking neural networks.

Despite these hurdles, investment in neuromorphic technology continues to grow. Governments recognize its strategic importance, with initiatives like the European Union's Human Brain Project and the U.S. BRAIN Initiative supporting fundamental research. Tech giants and startups alike are exploring commercial applications, from always-on voice interfaces to real-time video analytics. As the technology matures, we may see hybrid systems that combine traditional processors with neuromorphic accelerators, blending the strengths of both approaches.

The coming decade will likely see neuromorphic computing move from research labs into practical applications, initially in specialized domains where its unique advantages outweigh the development challenges. As the technology proves itself in these niche applications and the supporting tools mature, we may witness a gradual shift in computing paradigms, much like the transition from vacuum tubes to transistors. This shift could ultimately lead to intelligent systems that process information more like biological brains, enabling new capabilities in robotics, scientific research, and human-computer interaction that we can scarcely imagine today. The full realization of neuromorphic computing's potential may represent one of the most significant technological advancements of the 21st century, fundamentally changing our relationship with machines and opening new frontiers in artificial intelligence.



The Evolution of GPUs:

From Simple Graphics to AI Acceleration



➤ **Prasurjya Goswami** - 4th Semester, Dept. of CSE

The graphics processing unit (GPU) has become an indispensable component in modern computing, but its journey has been far from straightforward. Initially designed to enhance graphical output in video games and applications, the GPU has evolved into a powerful engine driving advancements in artificial intelligence (AI), machine learning, and high-performance computing.

In the early days of computing, the central processing unit (CPU) handled all processing tasks, including graphics rendering. As graphical interfaces and video games became more complex, the need for dedicated hardware to accelerate graphics processing became apparent.

This led to the development of the first GPUs in the late 1990s. These early GPUs, like the NVIDIA GeForce 256, were primarily focused on improving 3D graphics rendering, enabling smoother gameplay and more visually appealing graphics.

The key to the GPU's power lies in its parallel processing architecture. Unlike CPUs, which are designed for serial processing, GPUs can perform multiple computations simultaneously. This makes them incredibly efficient at handling the complex mathematical operations involved in graphics rendering. As GPUs became more sophisticated, they began to be used for other computationally intensive tasks beyond graphics, such as scientific simulations and financial modeling.

The rise of AI and machine learning in the 21st century has further accelerated the evolution of GPUs. The massive datasets and complex algorithms used in AI training require immense computational power, and GPUs are perfectly suited for this task. Their parallel processing capabilities enable them to train neural networks much faster than CPUs, making them essential tools for AI researchers and developers.

Today, GPUs are found in a wide range of devices, from personal computers and gaming consoles to smartphones and data centers. They power everything from stunning visual effects in movies and video games to complex AI algorithms that drive self-driving cars and personalized recommendations. The demand for GPUs continues to grow as technology advances and new applications emerge.



The future of GPUs looks bright, with ongoing research and development focused on improving their performance, efficiency, and versatility. As AI and machine learning continue to evolve, GPUs will play an increasingly important role in driving innovation across various industries. We can expect to see even more powerful and specialized GPUs in the future, designed to tackle the most challenging computational tasks.

In conclusion, the GPU has come a long way from its humble beginnings as a graphics accelerator. Its evolution has been driven by the increasing demands of graphical applications, scientific computing, and, most recently, the AI revolution. As technology continues to advance, GPUs will undoubtedly remain at the forefront of innovation, powering the next generation of computing experiences.



Quantum Computing's Near-Term Applications



➡ Dibashree Baruah - 6th Semester, Dept. of CSE

Quantum computing, once confined to theoretical physics labs, is now entering the realm of practical applications, thanks to **Noisy Intermediate-Scale Quantum (NISQ)** devices. These machines, though imperfect, are demonstrating tangible advantages over classical computers in optimization, cryptography, and material science. Companies like **IBM**, **Google**, and **Rigetti** are leading the charge, offering cloud-based quantum processors that researchers and businesses can experiment with today.

One of the most promising near-term applications is **drug discovery**. Traditional methods for simulating molecular interactions require massive computational resources and often yield approximate results. Quantum computers, however, can model quantum-mechanical systems natively, enabling precise simulations of molecular behavior. In 2023, **Roche** partnered with **Cambridge Quantum Computing** to explore quantum algorithms for designing new drugs, potentially cutting development timelines from years to months.

Another breakthrough area is **financial modeling**. Quantum algorithms can optimize portfolios, price derivatives, and detect fraud patterns far more efficiently than classical systems. **JPMorgan Chase** and **Goldman Sachs** are actively investing in quantum research, with some predicting that quantum-powered trading strategies could dominate markets by 2030.

Despite these advances, **NISQ-era** quantum computers face significant hurdles. **Qubit decoherence**—where quantum states degrade due to environmental noise—limits computation time. Error correction techniques like **surface codes** are being developed, but they require thousands of physical qubits to create a single stable "logical qubit," a milestone not yet achieved.

Governments are also recognizing quantum's strategic importance. China's **Jiuzhang** photonic quantum computer and the **U.S. National Quantum Initiative** reflect a global race for supremacy. The first "quantum advantage" in real-world applications may emerge in **logistics**, where companies like **Volkswagen** are testing quantum routing algorithms to optimize delivery networks.

In the next decade, hybrid quantum-classical systems will likely bridge the gap until fault-tolerant quantum computers arrive. Industries that adopt quantum early—pharma, finance, and energy—stand to gain a competitive edge in the post-Moore's Law era.



The Impact of 6G on Wireless Communication and Beyond



➤ **Nishant Huzuri** - 6th Semester, Dept. of CSE

While 5G networks continue their global deployment, the telecommunications industry has already turned its attention to the next revolutionary leap - 6G wireless technology. This next-generation network promises to deliver unprecedented capabilities that will fundamentally transform how we interact with technology and each other. Researchers estimate that 6G could achieve speeds up to 1 terabit per second (Tbps), which is nearly 100 times faster than the maximum 5G speeds available today. Such extraordinary bandwidth will enable applications that currently exist only in the realm of science fiction, while near-zero latency measured in microseconds will make real-time interactions seamless across vast distances.

The foundation of 6G's remarkable performance lies in its use of terahertz (THz) frequencies, operating in the 100 GHz to 3 THz spectrum range. These ultra-high frequencies offer exponentially greater bandwidth than current 5G millimeter wave technology, allowing for massive data throughput that could support uncompressed 16K video streaming and real-time holographic communications. However, these high-frequency signals present unique engineering challenges, including shorter propagation distances and greater susceptibility to environmental interference from obstacles like walls or even rain. Researchers are developing innovative solutions such as intelligent reflecting surfaces and ultra-dense antenna arrays to overcome these limitations.

What truly sets 6G apart from previous generations is its native integration of artificial intelligence throughout the network architecture. Unlike 5G networks where AI functions as an additional layer, 6G will have machine learning algorithms embedded at its core. These AI systems will enable networks to self-optimize in real-time, predict user demand patterns, dynamically allocate resources, and even self-heal from disruptions. This intelligent infrastructure will create networks that are not just faster, but fundamentally smarter and more responsive to user needs.

6G technology will also achieve truly ubiquitous connectivity through the seamless integration of terrestrial, aerial, and space-based networks. By combining ground-based cells with high-altitude platform stations (HAPS) and low Earth orbit (LEO) satellites, 6G will provide continuous coverage across the entire planet - from dense urban centers to remote rural areas, from ocean vessels to airborne aircraft. This global connectivity web will eliminate coverage gaps and ensure reliable service regardless of location, enabling new applications for maritime, aviation, and remote industrial operations.



The applications enabled by 6G technology will revolutionize numerous industries. Holographic telepresence will allow for lifelike 3D projections of people in real-time, transforming business communications, education, and social interactions. In healthcare, the combination of sub-millisecond latency and ultra-reliable connections will make remote robotic surgery a practical reality, allowing specialist surgeons to operate on patients thousands of miles away with precision matching in-person procedures. Smart cities will leverage 6G to create comprehensive digital twins - real-time virtual replicas of entire urban environments that can simulate and optimize traffic flows, energy distribution, and emergency response scenarios.

The development path to 6G faces significant technical hurdles that must be overcome. The high-frequency signals require entirely new antenna technologies and network architectures. Energy efficiency becomes a critical concern as data rates increase exponentially. Security presents another major challenge, as the hyper-connectivity of 6G networks expands the potential attack surface for cyber threats. Researchers are exploring quantum encryption and blockchain-based security protocols to protect these future networks. Additionally, the massive infrastructure requirements - including millions of tiny antennas and sophisticated edge computing nodes - will require substantial investment and coordination across industries and governments.

The global race for 6G leadership is already underway, with major economic powers recognizing its strategic importance. China has made 6G development a national priority, with significant government funding and coordinated research efforts among tech giants like Huawei and ZTE. The United States has formed the NextG Alliance, bringing together industry leaders to establish technical standards and accelerate development. The European Union is pursuing its Hexa-X project, focusing on AI integration and sustainability. Japan and South Korea are collaborating on advanced research, aiming to demonstrate early 6G capabilities at high-profile events like the 2025 Osaka Expo.

Industry projections suggest we may see initial 6G deployments around 2030, with widespread availability following in subsequent years. The transition will require careful coordination with existing 5G infrastructure, as 6G will likely operate in conjunction with rather than as a complete replacement for previous generations. Standardization bodies like the ITU and 3GPP are already beginning work on defining 6G specifications, with the first official standards expected around 2027-2028.

The societal impact of 6G will extend far beyond faster smartphones. This technology will enable entirely new economic sectors and transform existing ones. The manufacturing industry could see the rise of "virtual factories" where physical production is perfectly synchronized with digital simulations. Education could become truly borderless, with immersive holographic classrooms accessible from anywhere. Emergency response systems could leverage real-time sensor networks and AI analysis to predict and prevent disasters. The environmental benefits could be significant as well, with smart grids and precision agriculture reducing resource consumption.



As we look toward this 6G future, it's clear that this represents more than just another generational upgrade in wireless technology. The convergence of ultra-high-speed connectivity, pervasive AI, and ubiquitous coverage will fundamentally alter our relationship with technology and with each other. While challenges remain in making this vision a reality, the potential benefits to global connectivity, economic growth, and quality of life make the pursuit of 6G one of the most important technological endeavours of our time. The foundations being laid today will shape the digital landscape for decades to come, creating a world where physical and digital realities blend seamlessly in ways we are only beginning to imagine.



Data Science in Computer Science Engineering:

Bridging the Gap Between Data and Decision-Making

➤ Ankita Chakraborty - 2nd Semester, Dept. of CSE



In the digital age, data has become one of the most valuable assets for organizations across various sectors. Data science is a multidisciplinary field that involves extracting insights and knowledge from structured and unstructured data.

The Role of Data Science in CSE:

Data science plays a pivotal role in CSE by providing the tools and methodologies necessary to extract meaningful insights from vast amounts of data. It encompasses various processes, including data collection, data cleaning, data analysis, and data visualization.

Key Components of Data Science:

- **Data Collection:** The first step in data science involves gathering data from various sources. This can include structured data from databases, unstructured data from social media, and semi-structured data from web APIs.
- **Data Cleaning:** Raw data is often messy and incomplete. Data cleaning involves preprocessing the data to remove inconsistencies, handle missing values, and ensure that the data is suitable for analysis.
- **Data Analysis:** This phase involves applying statistical methods and algorithms to analyze the data. Techniques such as regression analysis, clustering, and classification are commonly used to uncover patterns and relationships within the data.
- **Data Visualization:** Presenting data in a visual format is crucial for effective communication. Data visualization tools and techniques help in creating graphs, charts, and dashboards that make complex data more understandable.
- **Machine Learning:** A subset of data science, machine learning involves training algorithms to learn from data and make predictions or decisions without being explicitly programmed. This is particularly useful in applications such as recommendation systems, fraud detection, and predictive analytics.

Applications of Data Science in CSE:

Data science has a wide range of applications across various industries, including:

1. **Healthcare:** Data science is used to analyze patient data, predict disease outbreaks, and improve treatment outcomes. Machine learning algorithms can help in diagnosing diseases based on medical imaging and patient history.
2. **Finance:** In the financial sector, data science is employed for risk assessment, fraud detection, and algorithmic trading. By analyzing historical data, financial institutions can make better investment decisions and manage risks effectively.



3. E-commerce: Online retailers use data science to analyze customer behavior, optimize pricing strategies, and enhance user experience. Recommendation systems powered by machine learning algorithms suggest products to users based on their browsing history and preferences.

4. Transportation: Data science plays a crucial role in optimizing logistics and supply chain management. Companies like Uber and Lyft use data analytics to improve route efficiency and reduce wait times for customers.

5. Social Media: Platforms like Facebook and Twitter leverage data science to analyze user interactions, target advertisements, and enhance user engagement. Sentiment analysis, a technique used to gauge public opinion, is also a significant application in this domain.

Skills Required for Data Science in CSE:

To thrive in the field of data science, aspiring professionals in CSE should develop a diverse skill set that includes:

- **Programming Languages:** Proficiency in programming languages such as Python, R, and SQL is essential for data manipulation and analysis.
- **Statistical Knowledge:** A strong foundation in statistics is crucial for understanding data distributions, hypothesis testing, and inferential statistics.
- **Machine Learning:** Familiarity with machine learning algorithms and frameworks (e.g., TensorFlow, Scikit-learn) is important for building predictive models.
- **Data Visualization:** Skills in data visualization tools like Tableau, Power BI, or Matplotlib help in presenting data insights effectively.
- **Domain Knowledge:** Understanding the specific industry or domain in which one is working can significantly enhance the relevance and impact of data analysis.

Conclusion:

Data science is an integral part of Computer Science Engineering, providing the necessary tools and techniques to harness the power of data. As organizations continue to recognize the value of data-driven decision-making, the demand for skilled data scientists is expected to grow. By equipping themselves with the right skills and knowledge, students and professionals in CSE can position themselves at the forefront of this exciting and rapidly evolving field. Embracing data science not only enhances career prospects but also contributes to solving some of the most pressing challenges faced by society today.



Why are laptop prices increasing with the rise of advanced GPU chips?

An In-dept Analysis of the Current Laptop Market

✉ Ritanjit Das - 4th Semester, Dept. of CSE



The short version: modern laptop GPUs cost more because making, cooling, and selling high-performance graphics in a portable package is expensive, and demand has outpaced supply for several years. If you want the long version, read on. Below I break down the main forces pushing prices up, why they may stay high, and practical ways to avoid paying top dollar.

Rising Sticker Prices: What Happened ?

Between 2020 and 2023 the average street price for desktop GPUs roughly doubled. That shift rippled into the laptop market. Manufacturers must license and buy the newest high-end chips, redesign thermal systems, and use premium components to extract that power in thin enclosures. All of these add to the final price. At the same time, demand from gamers, creators, and new AI workloads has climbed, which keeps vendors from discounting aggressively.

Why Laptop GPUs Cost So Much ?

- 1. The silicon itself is expensive:** Cutting-edge GPUs require advanced semiconductor processes and long, costly development cycles. When supplies tighten whether because of factory capacity, yield issues, or larger industry shortages, the cost per unit rises. Laptop builders don't make the chips themselves. They buy them at market prices and pass that cost on to buyers.
- 2. Packaging and cooling are hard problems:** A powerful GPU in a desktop sits in a roomy case with big fans. Putting similar performance into a laptop forces engineers to add heat pipes, bigger fans, reinforced chassis, and higher-grade power delivery parts. Those design choices drive up manufacturing costs and testing time. In short, getting desktop-like performance into a slim laptop is an engineering challenge and an expensive one.
- 3. Features that buyers expect:** High-refresh panels, higher-capacity batteries, faster RAM, and amplified audio are common on gaming and creator laptops today. Each premium feature increases the bill of materials. Two laptops using the same GPU can ship with very different price tags depending on screen, storage, and build quality.
- 4. Demand has widened (not just gamers anymore):** Gamers were the original core market, but creators, data scientists, and even hobbyist programmers now want capable GPUs in portable machines. More buyers chasing the same parts means less price pressure downward.
- 5. Market power and competition:** For much of the 2010s Nvidia dominated the market, allowing them to set higher prices. And with Nvidia still holding the performance crown, it keeps prices elevated.



Will Prices Fall and When?

Short answer: maybe, but probably not to the sub ₹50k high end cards we saw several years ago. A few things could lower prices:

- Bigger inventories and better yields at chip fabs.
- More effective competition that forces aggressive pricing.
- A cooling in demand from speculative buyers or miners.
- New architectures that shift performance-per-unit-cost.

But Several Counterforces Exist: cutting-edge design costs don't vanish, supply chains remain sensitive to shocks, and demand for hardware that accelerates AI and content creation is likely to stay healthy. Expect gradual easing in some segments (older chips, mainstream GPUs) and stubbornly high prices at the top end.

How to Shop Smarter (Practical Tips)

If you're in the market for a GPU laptop, you don't have to accept list price as destiny. Try these tactics:

- Consider last-generation chips. They offer most of the performance at lower cost.
- Target sales windows: Back-to-school, Festivals and clearance sales often bring great discounts.
- Look at thin and light laptops with mid-range GPUs if portability matters more than maximum frame rates.
- Buy desktop GPUs if you need raw power and can live without portability. They sometimes offer better price-to-performance ratio.
- If you only need occasional GPU power, try cloud GPU services as you pay less upfront.

Final Thought

Technology keeps advancing, and that's a win for features and capability. But progress has a cost. Pushing more performance into a laptop requires better silicon, smarter cooling, and premium parts. Until production scales and competition shifts the economics, high-end laptop GPUs will likely remain a premium purchase. But that doesn't mean you can't find value. It means shopping with an eye for trade offs will save you money.



RTX 5060
₹1.24 Lakhs



RTX 4060
₹1.00 Lakhs



RTX 3060
₹85.5 k



The Rise of Artificial Intelligence in Everyday Life:

From Voice Assistants to Personalized Medicine

✦ Satavisha Roy Choudhury - 4th Semester, Dept. of CSE



The short version: Artificial Intelligence (AI) has rapidly transitioned from a futuristic concept to a crucial part of everyday life, powering daily applications from voice assistants to streaming recommendations. Its ability to analyze massive data, detect patterns, and make fast decisions is its most remarkable strength. If you want the long version, read on. Below is the break down of the main areas where AI has made an impact, the ethical challenges it presents, and what the future holds.

AI's Impact: Where is it Now?

AI powers applications we use daily, from voice assistants like Siri and Alexa to recommendation algorithms on platforms such as Netflix, YouTube, and Amazon. Its seamless integration often makes its presence invisible, but its influence on our daily decisions and interactions is profound.

Key Applications of Artificial Intelligence

1. Revolutionizing Healthcare: One of the most notable areas where AI has made a significant impact is healthcare. AI-driven systems can assist doctors in diagnosing complex diseases, predicting patient outcomes, and recommending personalized treatments. For instance, machine learning algorithms can analyze medical images to detect early signs of cancer or other abnormalities, often more accurately than humans. In addition, AI chatbots and virtual health assistants provide preliminary medical advice, improving accessibility for patients in remote areas.

2. Transforming Mobility and Homes: AI also plays a transformative role in transportation and smart homes. Autonomous vehicles, developed by companies like Tesla and Waymo, are being tested to navigate roads without human intervention, potentially reducing accidents caused by human error. At home, smart devices such as thermostats, security cameras, and lighting systems learn user behavior and adjust automatically, offering convenience and energy efficiency.

Ethical Concerns and Roadblocks

Despite its benefits, AI raises important ethical concerns. Job displacement due to automation, privacy issues from data collection, and potential algorithmic bias are ongoing challenges. Policymakers, technologists, and society must work together to ensure AI is used responsibly.

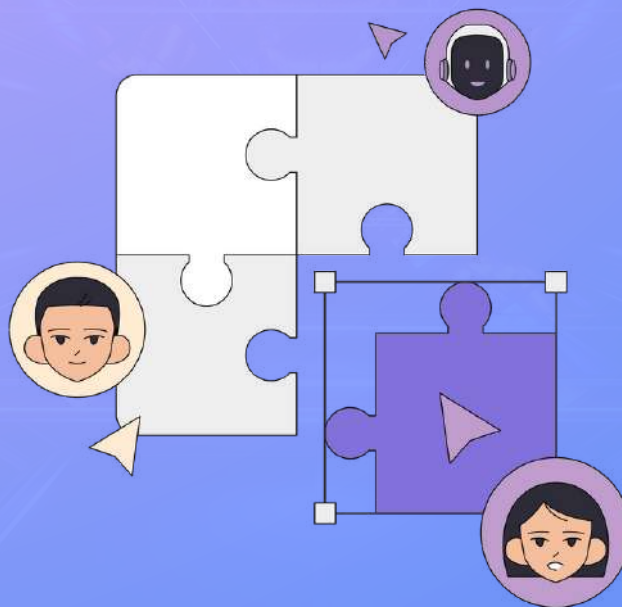


The Future Trajectory of AI

Looking ahead, AI is expected to influence even more areas of daily life, including education, entertainment, and environmental management. Adaptive learning platforms can personalize education for students, while AI in climate modeling can help predict natural disasters and optimize resource use. The integration of AI into society will require careful consideration, but its potential to improve human life and create new opportunities is enormous

Final Thought

Technology keeps advancing, and that's a win for features and capability. But progress has a cost, especially concerning privacy and job security. Understanding and leveraging AI effectively will become increasingly essential for individuals and industries alike, ensuring its power is harnessed for the betterment of society.



Key Events & Activities

Talk on Artificial Intelligence and Machine Learning :



A talk on “*Artificial Intelligence and Machine Learning in Smart Healthcare Solution: A sustainable Approach*” is organised by Department of Computer Science and Engineering, Girijananda Chowdhury University on **16th November, 2023**. Eminent **Prof. Dhruba Kumar Bhattacharyya**, Department of Computer Science and Engineering, Tezpur University acted as the resource person in the talk.

Corporate Training on Office Automation and Data Handling:



In a significant stride towards enhancing the proficiency of civilian staff within the Indian Air Force, the Computer Centre at GCU conducted a comprehensive Corporate Training on “*Office Automation and Data Handling*” which was held from **4th to 15th December 2023**. The training took place at Computer Lab III, Department of Computer Science and Engineering (CSE)



Key Events & Activities

PTM at Department of Computer Science & Engineering:



The Department of Computer Science and Engineering (CSE) has organized a **PTM** on **February 24th, 2024**, encompassing all semesters. Led by **Prof. Minakshi Gogoi**, Head of the Department. **Dr. Th. Santa Kumar**, Associate Professor, efficiently coordinated the program, along with all faculty members of the department fostering an environment of open dialogue and mutual understanding.

Workshop on Fundamentals of Cybersecurity:



With an initiative to implement cybersecurity best practices within the society, Department of Computer Science and Engineering, Girijananda Chowdhury University organized a workshop on '*CyberShiksha: Fundamentals*' in collaboration with **India Future Foundation** on **21st March 2024**.



Key Events & Activities

Workshop on 3D Printing:



With an intent to foster creativity and to socialize the education sector, Department of Computer Science and Engineering, in collaboration with **AMTRON**, took an initiative to organize a workshop on '*3D Printing: Technologies and Applications*' on **12th March 2024**.



Industry Visits & Outreach

Industry Visit to AMTRON:



Industrial Visit to AMTRON, Education & Training Center, Mirza, Bongara, Assam on **25th April May 2024** for B.Tech Pre-final year students of Computer Science and Engineering department.



Student Achievements



Debasish Bachyas and **Bidip Talukdar**, students of B.Tech 1st Semester, Department of CSE, Girijananda Chowdhury University have Secured **1st position** in the **QUIZ** competition organized by **Airports Authority of India** which was held on **1st November 2023** at Girijananda Chowdhury University.

Hangsita Shivam, **Parismita Chaliha**, and **Himakshi Sarania**, students of B.Tech 4th Semester, Department of CSE, Girijananda Chowdhury University, and members of **Team Suryoday** have Secured **1st Runner Up** position in the **Short Film Making Competition** held as part of **Pyrokinesis 2024** at **Assam Engineering College**.

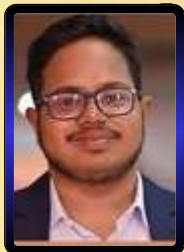


Debasish Bachyas and **Bidip Talukdar**, students of B.Tech 2nd Semester, Department of CSE, Girijananda Chowdhury University have won the **3rd prize** in the **QUIZ** competition organized by **Pub Kamrup College, Baihata Chariali** to celebrated **Pi Day** in collaboration with **Department of Mathematics, GCU, ASSAM** on **14th March 2024**.

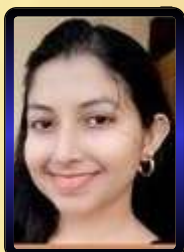
Sohini Roy, a students of B.Tech 6th Semester, CSE has won the **Best classical (kathak) dancer** in the cultural event organised during **Assam Book Fair 2023-24** which was held from **December 29 to January 9, 2024** at **Guwahati's Chandmari Engineering field**.



Student Placement



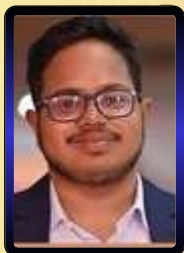
Bikash Sharma, a student of 8th semester CSE has been placed in the campus drive of **Ion Exchange (India) Limited**.



Nitismita Das, a student of 8th semester CSE has been placed in the campus drive of **Ion Exchange (India) Limited**.



Akash Bora, a student of 8th semester CSE has been placed in the virtual campus drive of **Rinex Technologies**.



Bikash Sharma, a student of 8th semester CSE has been placed in the virtual campus drive of **Rinex Technologies**.



Dhiraj Sarma, a student of 8th semester CSE has been placed in the campus drive of **Teachnook**.



Hiyangana Choudhury, a student of 8th semester CSE has been placed in the campus drive of **Teachnook**.

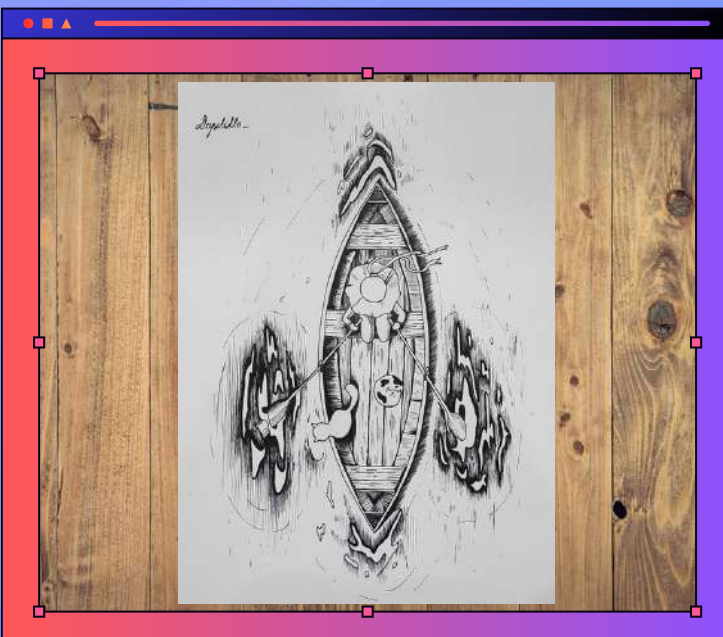
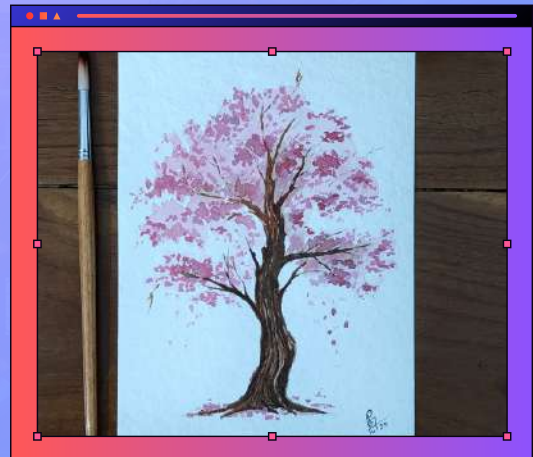
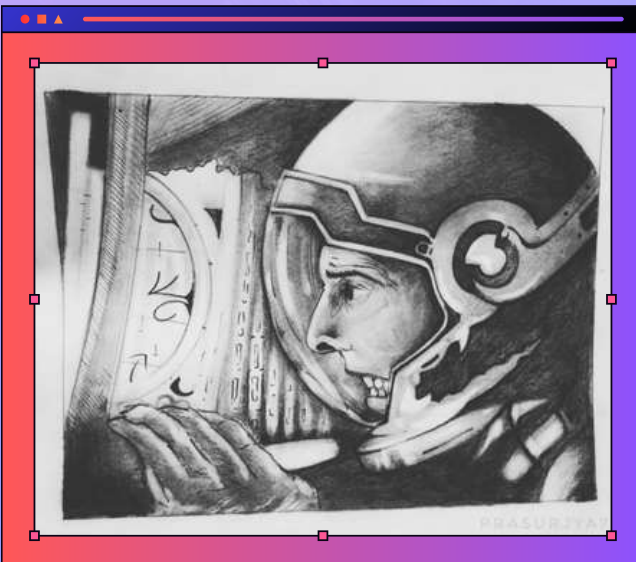


Creative Corner



Worlds Beyond: Dreams of Nature, Tradition & the Cosmos

✍ Prasurjya Goswami - 4th Semester



Whispers of the River: A Journey Beyond Still Waters

✍ Deepshikha Das - 4th Semester



Creative Corner



Life In Different Rhythms

📷 Subhrajyoti Goswami - 4th Semester



Nomad's Tale

📷 Kumar Jigyas Pritam - 4th Semester

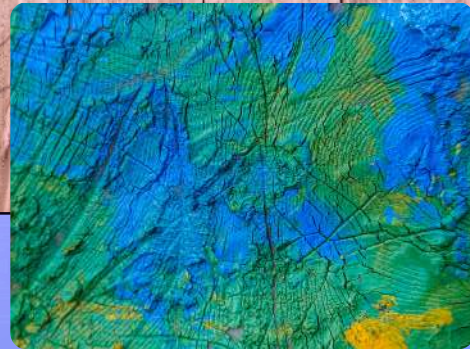


Creative Corner



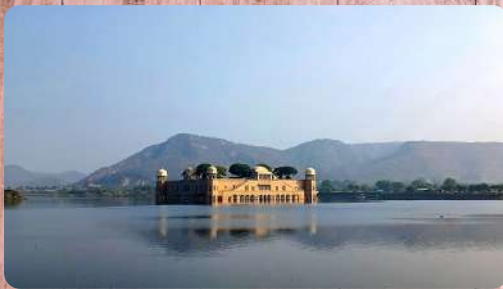
Textures Of Life

📷 Prasurjya Goswami - 4th Semester



Echoes of Majesty

📷 Sandilya Baruah - 4th Semester



Department of Computer Science and Engineering , GCU , Guwahati



Faculty and Staff Members :

Sitting from left to right:

Ms. Shrabani Medhi, Ms. Manjula Kalita, Prof. Minakshi Gogoi, Mr. Dipjyoti Deka, Dr. Th. Shanta Kumar

Standing from left to right:

Mrs. Mridusmita Baruah, Mrs. Rubi Kalita, Ms. Dharitri Sarkar, Mrs. Gitanjali Devi, Mr. Adarsh Pradhan, Dr. Monisha Devi, Ms. Ritushree Dutta, Ms. Mala Ahmed

Absentee:

Mr. Amariyoti Pathak, Mr. Arindam Saha, Mrs. Pinky Saikia Dutta



**Cover Page Designer,
Ritanjit Das,
Dept. of CSE, 4th Sem**