VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE

AI&DS Insights

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Dreams don't work unless you do—every small step forward brings you closer to greatness

Diwali

The faculty members from the Artificial Intelligence and Data Science department came together to celebrate the vibrant festival of Diwali with enthusiasm and creativity. Dressed in elegant traditional attire, they illuminated the department with the spirit of the festival. A grand diya-lighting ceremony was held, symbolizing the triumph of light over darkness and knowledge over ignorance. The faculty also decorated the department with colorful rangoli designs, glowing lamps, and festive decorations that added to the festive charm. This celebration not only honored the rich cultural heritage of Diwali but also fostered unity and joy among the faculty. The cheerful occasion was shared across social media and received heartwarming appreciation, making it a truly unforgettable event for everyone involved.

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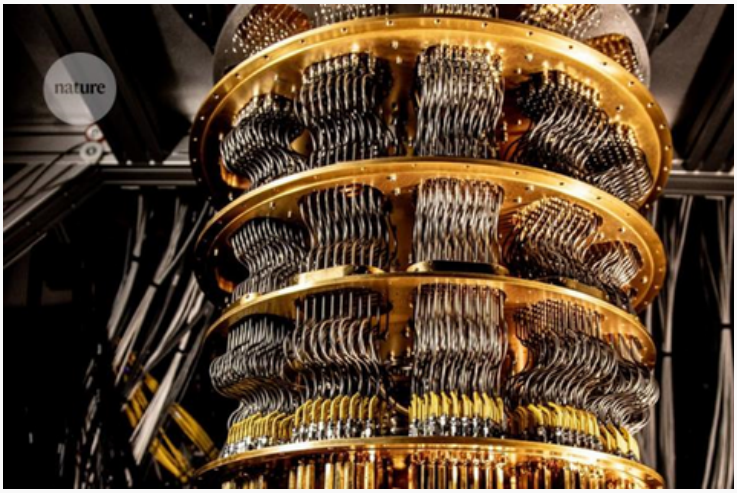
Faculty Article

The Quantum Leap: How Quantum Computing is Redefining the Limits of Computation



Introduction

Quantum computing represents a paradigm shift in the way we approach complex problems, pushing the boundaries far beyond the capabilities of classical computers. Quantum Computers are poised to revolutionize computing by tackling problems that are intractable for even the most powerful classical computers. Quantum computing leverages phenomena like superposition and entanglement to process information in fundamentally different ways.

Why Quantum Computing Outperforms Classical Computing

Classical computers, powered by CPUs and GPUs, process information in binary bits, which represent either a 0 or a 1. Quantum computers, on the other hand, use qubits that can exist in multiple states simultaneously, thanks to superposition. This unique property enables quantum computers to evaluate multiple possibilities at once, dramatically increasing their computational power for certain types of problems.

One of the most striking examples of quantum superiority is the problem-solving demonstrated by Google's quantum processor, Sycamore, in 2019. Sycamore completed a specific computation in 200 seconds that would have taken the world's most powerful supercomputer approximately 10,000 years. More recently, Google unveiled Willow, a quantum chip capable of solving computations in minutes that would otherwise require billions of years on a classical machine.

Breakthroughs in Quantum Computing

Quantum computing has seen a series of breakthroughs that illustrate its transformative potential:

1. Google's Willow Chip: Willow integrates 105 qubits with advanced error correction, enabling computations previously deemed impossible. This innovation addresses the critical challenge of qubit instability and error rates, paving the way for more reliable quantum systems.
2. IBM's Quantum Systems: IBM continues to develop scalable quantum architectures. Their "Eagle" processor marked a milestone by surpassing 100 operational qubits, demonstrating significant strides toward practical quantum applications.
3. China's Jiuzhang Quantum Computer: This photonic quantum computer achieved quantum supremacy by performing Gaussian boson sampling, a complex mathematical problem, exponentially faster than any classical supercomputer could.

When to Use Quantum Computing:

- Problems with Exponential Complexity: Problems like factoring large numbers (crucial for cryptography) and simulating quantum systems can be solved exponentially faster on quantum computers.
- Optimization Problems: Quantum computing can offer advantages in solving complex optimization problems, such as logistics and financial modeling.

Future Challenges and Opportunities

Despite its promise, quantum computing faces challenges, including qubit instability, error correction, and scalability. Innovations like Google's Willow chip and IBM's scalable systems show progress, but practical, large-scale quantum computing is still in development.

As quantum computing evolves, its integration with classical systems, such as CPUs and GPUs, will likely become more seamless, creating hybrid computational architectures. These systems could leverage the strengths of both quantum and classical computing, unlocking unprecedented potential for problem-solving across industries.

Quantum Computing vs. Classical Computing: CPU and GPU

Quantum computers and classical computing systems, such as CPUs (Central Processing Units) and GPUs (Graphics Processing Units), are fundamentally different in their approach to solving problems. While quantum computers are not designed to replace CPUs or GPUs, they complement classical systems by excelling in specific tasks that classical architectures find challenging or inefficient.

Here's a brief comparison of how they differ and where they shine:

Feature	CPU	GPU	Quantum Computer
Core Functionality	Sequential processing of tasks	Parallel processing of tasks	Explores multiple states simultaneously
Primary Use Cases	General-purpose computing	Graphics rendering, AI, and ML	Optimization, cryptography, and simulations
Processing Units	Few cores (up to dozens)	Thousands of smaller cores	Qubits
Data Representation	Binary (0 or 1)	Binary (0 or 1)	Superposition (0, 1, or both)
Speed	High for serial tasks	High for parallel tasks	Exponentially faster for specific problems
Error Sensitivity	Low	Low	High, requiring error correction techniques
Scalability	Mature and scalable	Highly scalable	Currently limited but improving

-**Dr Viomesh Singh**

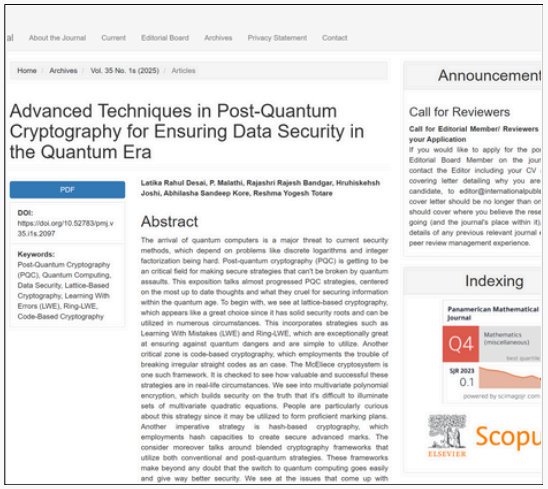
Faculty Publications

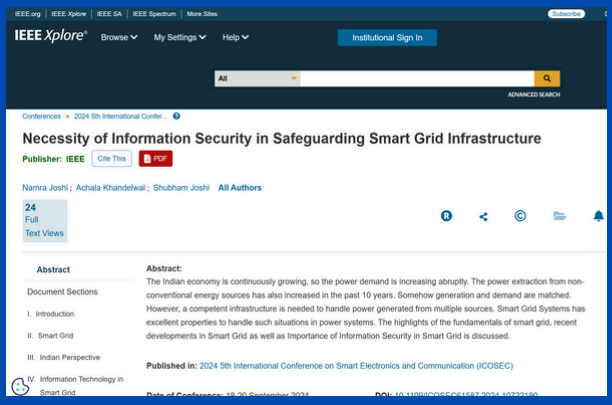
1. BITOSA Pune

At the **BITOSA Pune** event titled **"Engineering a Digital Future – The Role of Digital and Cyber Security," Professor Surabhi Kakde** shared her insightful perspective on the evolving landscape of technology and its intersection with cybersecurity. Her talk delved into the critical role digital advancements play in shaping the future, emphasizing the need for robust cyber defenses to protect this rapidly expanding digital ecosystem. The event served as an important platform to highlight strategies, innovations, and challenges in engineering a secure and sustainable digital future.

2. PanAmerican Mathematical Journal

A research paper titled **"Advanced Techniques in Post-Quantum Cryptography for Ensuring Data Security in the Quantum Era"** has been published by **Professor Dr. Hrushikesh Joshi** and **Professor Surabhi Kakad** in the **PanAmerican Mathematical Journal, a Scopus-indexed international journal.** The paper addresses the emerging threat posed by quantum computers to current security methods, which rely on the difficulty of problems such as discrete logarithms and integer factorization. As quantum computing advances, post-quantum cryptography (PQC) is becoming a critical field for developing secure strategies that remain unbreakable against quantum attacks. This paper explores advanced PQC techniques, focusing on the latest innovations and their implications for safeguarding data in the quantum age.





3. ICOSEC 2024

Professor Dr. Shubham Joshi presented a paper titled **"Necessity of Information Security in Safeguarding Smart Grid Infrastructure"** at the **5th International Conference on Smart Electronics and Communication (ICOSEC 2024).** The paper, which has been published in the conference proceedings and is indexed in Scopus, emphasizes the critical need for robust information security to protect smart grid infrastructures. The paper is available online for reference via the following link: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=10722190.

Topic of the Month

Biohacking the Future: How Technology is Shaping Human Performance and Health

Biohacking combines biology and technology to push the limits of human potential, revolutionizing how we approach performance, longevity, and well-being. This growing field integrates wearables, genetic engineering, and data analytics to optimize health in groundbreaking ways.

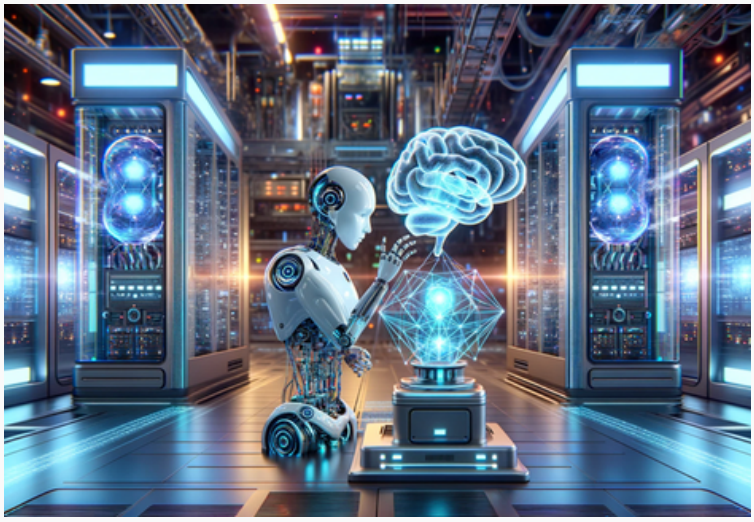
1. Wearable Technology for Real-Time Monitoring
- Smart Devices: Wearables like smartwatches and fitness bands track vital signs like heart rate, sleep patterns, and oxygen levels, providing actionable insights into daily habits.
- Example: WHOOP tracks recovery and strain, empowering athletes to fine-tune their training for peak performance.
- Future Potential: Advanced sensors could monitor glucose levels non-invasively, detect early signs of illness, and offer real-time alerts for critical health issues.

2. Personalized Nutrition and Fitness
- DNA-Based Diets: Genetic testing services like 23andMe analyze your DNA to suggest personalized diet plans and workout routines.
- Example: Athletes use genetic insights to adjust macronutrient intake, maximizing energy and recovery based on their unique biology.
- Microbiome Optimization: Advanced gut testing tools offer food and supplement recommendations to enhance gut health and overall wellness.

3. Neurohacking and Cognitive Enhancement
- Brain-Boosting Wearables: Devices like Muse or Halo Sport stimulate brain activity, enhancing focus, learning, and memory.
- Example: Professionals use transcranial stimulation to achieve deep focus during high-pressure tasks.
- Nootropics: Smart drugs and supplements are being refined to improve cognitive function and reduce mental fatigue.

4. Genetic Biohacking
- CRISPR Technology: Gene-editing tools like CRISPR-Cas9 allow scientists to modify genes, offering possibilities for curing genetic disorders and enhancing physical attributes.
- Example: Clinical trials for CRISPR-based therapies aim to tackle diseases like sickle cell anemia and muscular dystrophy.
- DIY Genetic Engineering: Hobbyists are experimenting with gene editing at home, though ethical concerns and safety issues remain critical challenges.

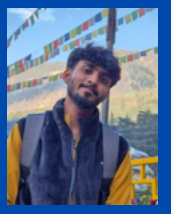
5. Sleep Optimization
- Data-Driven Sleep Habits: Devices like Oura Ring track sleep stages and offer recommendations for better rest.
- Example: Biohackers use blue-light-blocking glasses, melatonin supplements, and controlled bedroom environments to maximize deep sleep
- Future Innovations: Smart mattresses and AI-driven sleep coaches could revolutionize how we approach rest and recovery.



6. Longevity and Anti-Aging Research
- Senescence Reversal: Researchers are exploring ways to slow down aging by targeting senescent cells and boosting cell regeneration.
- Example: Companies like Altos Labs are developing therapies to extend human lifespan using cellular reprogramming.
- Supplements and Interventions: NAD+ boosters, intermittent fasting, and cold exposure are trending in biohacking circles for their potential to improve longevity.

7. Ethical and Social Implications
- Accessibility: While biohacking promises to improve lives, the cost of advanced technologies may widen the gap between socioeconomic groups.
- Privacy: With wearables and genetic data, privacy concerns arise regarding how personal health information is stored and shared.
- Regulation: Governments and organizations face the challenge of creating ethical guidelines to govern the rapid growth of biohacking technologies.

Biohacking offers exciting opportunities to reimagine human health and performance, but it also raises important questions about ethics, accessibility, and safety. The future of biohacking will depend on how we balance innovation with responsibility.



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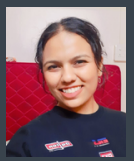

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