Shivalik College
Dehradun, Uttarakhand

NAAC GRADE A+

TECHFRONT

Technical Magazine

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

JULY 2023- JUNE 2024

DEPARTMENT VISION, MISSION, PEOs & PSOs

VISION

To cultivate **engineers** with a worldwide employability, a strong entrepreneurial aptitude, a dedication to **research**, and a sense of **social responsibility**.

MISSION

M1. To create top IT engineers with industry-aligned education.

M2. To boost the technical skills of students as well as faculty.

M3. To inspire students to pursue higher education and launch entrepreneurial ventures.

M4. To provide exposure of latest tools and technologies in the area of Engineering and Technology.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Graduates will have the ability to be employed in industries, academia, the public sector, or work as entrepreneurs.

PEO 2: Graduates will apply tools, technologies, and research to provide innovative solutions.

PEO 3: Graduates will have capabilities in identifying, conceptualizing, designing, developing, and implementing logical solutions for real-life challenges.

PEO 4: Graduates will have good communication skills, leadership skills, ethical values, and time management.

DEPARTMENT PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO-01: Analyze and implement Web-based technology for developing projects as per social and Industry needs.

PSO-02: Ability to develop various applications using open-source software tools extensively.

ABOUT THE DEPARTMENT

The Computer Science & Engineering Department was established in the year 2008 and has graduated many qualified engineers, working at very well-known organizations in India and abroad. The Department currently offers Bachelor's Degree in Computer Engineering, Bachelor's Degree in Artificial Intelligence and Machine Learning (AIML) and Data Science. In addition to core courses, electives are provided in various Computer Science cutting-edge subjects that generate opportunities for absorption in frontier fields of Computing. Students are involved in diverse technical events and cognitive activities to explore their creativity as well as problem-solving skills. This accredited course fulfills the growing needs of the industry and would equip students with an in-depth understanding of the principles of Computer Science. The Computer Science and Engineering department at the Shivalik College possesses a unique center- the Shivalik Computation and Automation Society (SCAS). Also, it has collaboration with ICT Academy which provides real-life practical learning methodologies. A well-designed system to assess every student's performance. Value Added courses, Case Studies & Projects, Seminars, Student Development Programs, and Induction Programs delivered on cutting-edge technology impart hands-on experience and skill enhancement in students. Students are advised and assisted in their project work and Industry-relevant course material is provided.

MESSAGE BY VICE CHAIRMAN

MR. AJAY KUMAR

It gives me immense pleasure to extend my warmest congratulations to the Department of Computer Science and Engineering on the release of its technical magazine. This magazine stands as a testament to the innovation, dedication, and relentless pursuit of excellence that define our students and faculty.

In today's fast-paced digital era, platforms like this magazine play a vital role in fostering a culture of creativity, critical thinking, and collaboration. I am delighted to see the magazine encompass diverse sections such as the Student Corner, Faculty Corner, Best Project Abstracts, as well as glimpses of Tech Fests and Hackathons. These highlights not only showcase the technical prowess and accomplishments of our department but also inspire the academic community to dream bigger and reach higher.

The featured student innovations and faculty contributions reflect our institution's commitment to academic excellence and industry relevance. Such initiatives are instrumental in preparing our young minds to become future leaders in technology and innovation.

I extend my heartfelt appreciation to the editorial team, faculty mentors, and all contributors who have made this magazine a reality. May this publication continue to serve as a beacon of knowledge, creativity, and inspiration for the entire Shivalik College community.

With best wishes for continued success and innovation.

DIRECTOR'S MESSAGE

PROF. (DR.) PRAHLAD SINGH

It is a matter of immense pride to witness the release of the Technical Magazine of the Computer Science and Engineering Department. This publication is a vibrant reflection of the department's academic excellence, technical innovation, and collaborative spirit.

Featuring diverse sections such as Student Corner, Faculty Corner, Best Project Abstracts, and glimpses of Tech Fests and Hackathons, the magazine beautifully captures the intellectual energy and creative endeavors of our students and faculty.

In today's rapidly evolving technological landscape, such initiatives play a vital role in encouraging critical thinking, innovation, and knowledge sharing. This magazine serves not only as a platform to showcase talent but also as a source of inspiration for all readers.

I commend the editorial team, contributors, and faculty mentors for their dedication and vision. May this magazine continue to grow as a beacon of learning and excellence.

MESSAGE BY
COD/HOD

MR. SARTAJ KHAN

COD-CSE

It is with great pride and enthusiasm that I present to you the latest edition of the **Technical Magazine of the Department of Computer Science and Engineering.** This publication is not just a collection of articles and achievements—it is a reflection of our collective spirit, creativity, and commitment to academic and technological excellence.

The magazine captures the vibrant essence of our department through various segments such as the Student Corner, Faculty Corner, Best Project Abstracts, and glimpses of our Tech Fest and Hackathons. These sections showcase the intellectual curiosity, innovative thinking, and collaborative efforts that define our department.

In an era where technology evolves rapidly, it is essential that we continuously learn, share, and grow. This magazine serves as a platform for our students and faculty to express their ideas, demonstrate their skills, and celebrate their accomplishments. From insightful technical articles to award-winning project abstracts, this edition is a testament to the high standards and progressive mindset of our academic community.

I take this opportunity to thank all contributors—students, faculty members, and the editorial team—for their dedication and hard work in bringing this publication to life. Your efforts not only enrich the department but also motivate others to pursue excellence.

Let us continue to innovate, collaborate, and inspire. May this magazine ignite new ideas and foster a culture of learning that reaches far beyond the pages.

MESSAGE BY
EDITORIAL BOARD MEMBERS

We are delighted to present this edition of the **Technical Magazine of the Computer Science and Engineering Department**, a platform that brings together the creativity, innovation, and academic spirit of our department.

This magazine features a rich blend of content—Student Corner, Faculty Corner, Best Project Abstracts, and snapshots from Tech Fest and Hackathon events—each reflecting the vibrant and dynamic culture of CSE at Shivalik College of Engineering.

As editorial board members, it has been a rewarding journey curating the thoughts, ideas, and accomplishments of our students and faculty. We believe this magazine will not only inform but also inspire all readers to push the boundaries of knowledge and innovation.

We thank everyone who contributed and supported this effort. Let this magazine be a voice for ideas and a celebration of excellence.

CHIEF EDITOR :

Dr. Vijaylakshmi Sajwan
Assistant Professor-CSE

FACULTY COORDINATOR :

Mr. Sartaj Khan
Assistant Professor-CSE

Ms. Aakanksha Pundir
Assistant Professor-CSE

STUDENT CO-ORDINATORS :

Naman Shrimali

Prity Kumari

Shivam Kumar

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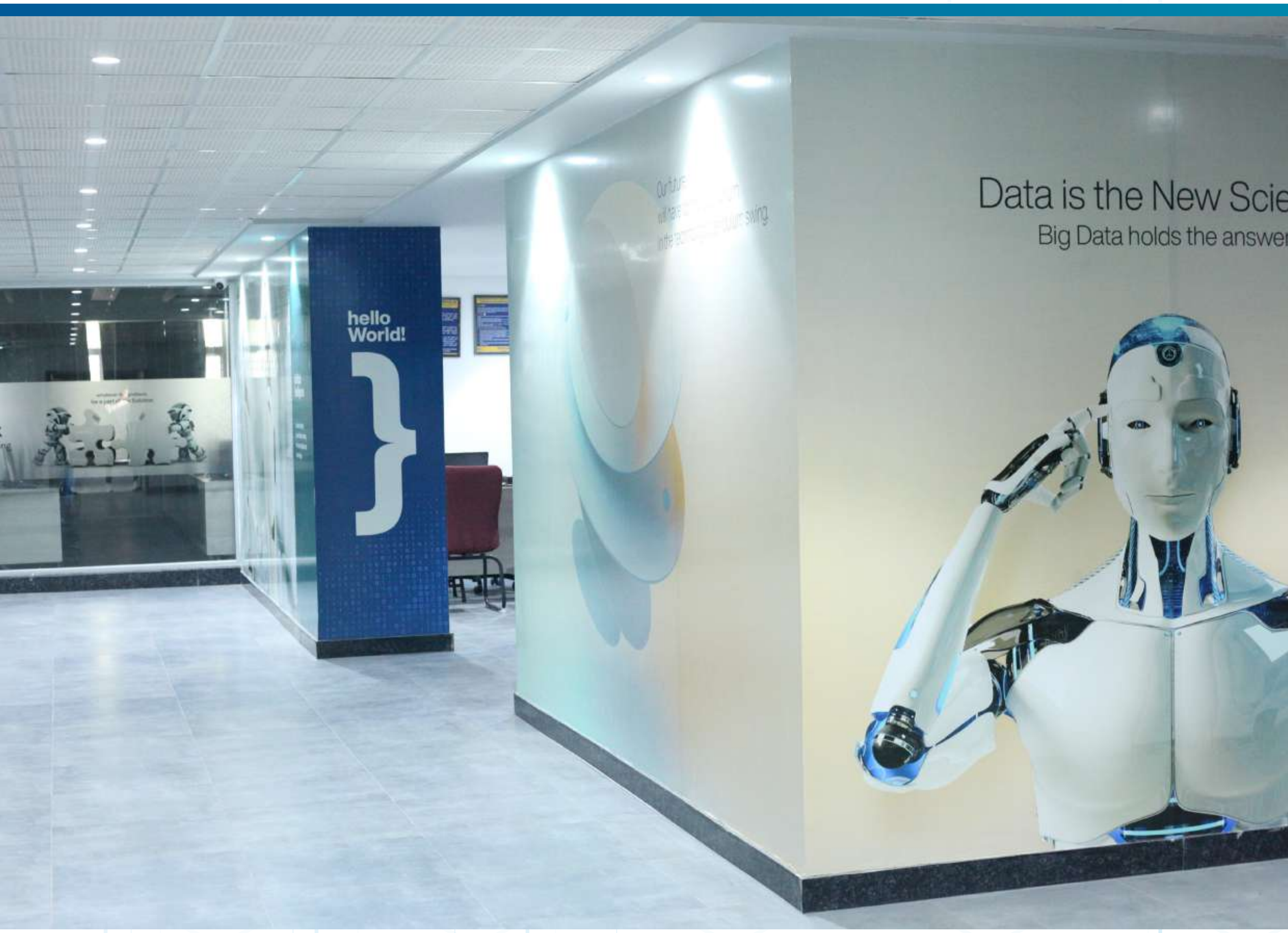


HOW PROJECT-BASED LEARNING HELPS B TECH CSE STUDENTS LEARN BETTER

Mr. Sartaj Khan
COD-CSE

In today's fast-moving world of technology, just reading books and attending lectures is not enough for Computer Science and Engineering (CSE) students. Companies now want students who can solve real problems, not just write correct answers in exams. This is why **Project-Based Learning (PBL)** has become an important teaching method in engineering colleges. In PBL, students learn by working on real or practical projects instead of only listening to lectures or studying theory.

Project-Based Learning means that students are given a task or problem, and they have to create a solution using the knowledge they are learning. For example, instead of only reading about databases, students can build an app that stores and shows user data. This kind of learning helps students understand the subject in a better way, because they apply what they learn in real situations. It also makes the learning process more interesting and useful.

For CSE students, PBL is especially helpful. Many subjects like data structures, operating systems, web development, or machine learning are difficult to understand through books alone. But when students make projects using these concepts—like building a website, creating a chatbot, or developing a simple game—they understand the topics more clearly. It connects theory with practice, which is very important in computer science.

Another big benefit of PBL is that it helps students improve their problem-solving and thinking skills. When working on a project, students often face challenges and bugs. They have to think carefully, search for solutions, test their code, and fix errors. This helps them become better at logical thinking, which is a key skill in programming and software development. PBL also teaches students how to work in teams. In most projects, students work in groups. They learn how to divide tasks, share ideas, communicate with each other, and solve conflicts. These soft skills are just as important as technical knowledge when working in the industry. Students also become more confident in presenting their work to others. One more great advantage of PBL is that students can add their projects to their resumes or online portfolios. These projects show real proof of what the student can do. It makes them stand out during job interviews and helps them get good placements.

Colleges can include PBL in teaching by giving mini-projects in core subjects and encouraging major final-year projects. They can also organize coding contests, hackathons, or allow students to work on apps that solve social problems like education, health, or the environment. However, there can be some challenges. Students may face time issues, lack of tools, or confusion about grading. These problems can be solved if teachers guide students with clear deadlines, provide access to software or labs, and use a fair marking system.

ATTENTION IS ALL YOU NEED" – THE REAL BRAIN BEHIND MODERN AI

Dr. Ekta Upadhyay
Professor- CSE

Today, we all use smart AI tools like ChatGPT, Google Translate, Alexa, and more. These tools understand what we say, reply like humans, help us write emails, solve problems, and even create poetry. But have you ever wondered — how do they understand so much? The answer lies in a research paper titled "**Attention Is All You Need**," published in 2017. This paper introduced a new AI model called the **Transformer**, which changed the world of Artificial Intelligence forever. Before Transformers, AI models used older methods like **Recurrent Neural Networks (RNNs)** and **LSTMs** to understand language. These models read words one by one, in order, like we read a sentence from left to right. But they had a major problem — they often **forgot earlier words** in long sentences. So, the longer the sentence, the more confused the model became.

Then came the **Transformer model**, and it changed everything. The most powerful idea in this model is something called "**Attention**." Just like we humans focus on the most important words in a sentence, attention allows the AI to do the same. For example, if we read, "The lion saw the zebra. It ran away," we understand that "it" refers to the zebra, not the lion. We know this because we give more attention to the important words. In the same way, AI uses attention to decide which words are most important when understanding or replying. The Transformer works in two main parts — **an Encoder** and **a Decoder**. The encoder understands the input (like your question), and the decoder generates the output (the answer). Instead of reading words one at a time, the Transformer looks at the **whole sentence at once**, and attention helps it figure out which words are most useful in understanding the meaning. This makes it **faster, smarter,** and **more accurate.**

Because of this, the Transformer model quickly became the base for many modern AI tools. OpenAI used it to build ChatGPT. Google used it in BERT and Gemini. Facebook (now Meta) used it in their LLaMA models. These tools are now used in **schools, offices, hospitals, social media, and even personal assistants.** Thanks to this model, AI can now do much more than before. It can summarize long documents, translate languages, solve maths problems, write stories, answer science questions, and even help in programming. And all of this is possible because the AI now knows where to focus — just like a good student focuses on the important part of the lesson.

WHO IS A DATA SCIENTIST AND WHY ARE THEY IN SUCH HIGH DEMAND?

Dr. Rajiv Kumar
Professor- CSE

We live in a digital world where almost everything we do generates data. Whether we shop online, scroll through social media, use health apps, book travel tickets, or watch videos on streaming platforms—data is being collected every second. But this data is only useful when someone can read it, clean it, understand it, and find meaningful patterns. This is exactly what a Data Scientist does. A data scientist is a person who takes large amounts of data, studies it, and helps companies or organizations make smart decisions. For example, when Amazon shows you product suggestions, or Netflix recommends a movie you might like, or Google Maps gives you the fastest route—all of this happens because of data science. That's why every industry today—whether it's business, healthcare, education, farming, sports, or even government—is hiring data scientists. They help in solving real-world problems using facts and information hidden in data. In short, they turn raw data into useful knowledge.

Being a data scientist is not just about writing code. It is a combination of many skills. A good data scientist needs to understand mathematics and statistics, think clearly, and be able to use tools and software that help analyze data. They should know how to work with computers, use programming languages like Python or SQL, and create visual reports using tools like Excel, Power BI, or Tableau. They should also know how to build models using machine learning to make predictions, such as which customer might leave a service or which product might sell more next month. One of the most important skills is communication—because data scientists must explain what the data means in simple words to people who may not be technical. The good news is that anyone with curiosity, logical thinking, and a willingness to learn can start their journey in data science. You don't need a special degree to begin—there are many free and paid courses available online. You can learn step by step, build small projects, and slowly become better. Today, data is called "the oil of the 21st century" because it has so much power to bring change. So, whether you are a student, a working professional, or someone looking for a future career, data science is a great option. It doesn't just offer good salaries and job security, but also gives you a chance to solve meaningful problems and make the world smarter with the help of data.

CI/CD PIPELINES: AUTOMATING CODE DEPLOYMENT

Mr. Shiv Kumar
Assistant Professor-CSE

In today's fast-paced software development world, speed, efficiency, and reliability are key. Gone are the days when developers wrote code and waited weeks for it to be tested, integrated, and deployed manually. Thanks to CI/CD pipelines, automation has transformed the way modern applications are built and delivered.

But what exactly is a CI/CD pipeline, and why is it so essential for developers today?

CI/CD stands for Continuous Integration and Continuous Deployment (or Delivery). It is a set of practices that allows software development teams to deliver code changes more frequently and reliably.

- Continuous Integration (CI) involves automatically building and testing code every time a team member commits changes to a shared repository.
- Continuous Deployment (CD) takes it a step further by automatically deploying the code to production after passing all tests.

Together, they form a pipeline—a series of automated steps that ensure your code is always ready for deployment.

Why Do CI/CD Pipelines Matter?

1. **Speed and Efficiency:** Developers can release features or bug fixes faster without waiting for manual reviews or testing cycles.
2. **Early Detection of Bugs:** Automated testing ensures that bugs are caught early in the development process, reducing the cost of fixing them later.
3. **Improved Code Quality:** Every code change is tested and validated before deployment, resulting in a more stable and reliable application.
4. **Team Collaboration:** With CI/CD, teams can work simultaneously on multiple features without worrying about integration conflicts.
5. **Customer Satisfaction:** Faster deployment means quicker feature updates and bug resolutions, enhancing user experience.

Working

A typical CI/CD pipeline consists of the following stages:

1. **Source Code Commit**

   Developers push their code to a version control system like Git.

2. **Automated Build**

   The system compiles the code and packages it into deployable units.

3. **Automated Testing**

   Unit tests, integration tests, and functional tests are run to verify the new code doesn't break existing features.

4. **Deployment to Staging**

   If the tests pass, the application is deployed to a staging (test) environment.

5. **Deployment to Production**

   In Continuous Deployment, the changes are automatically released to production. In Continuous Delivery, manual approval may be required.

Popular CI/CD Tools

- **Jenkins** – An open-source automation server widely used for building CI/CD pipelines.
- **GitHub Actions** – Integrated into GitHub, it allows developers to automate workflows easily.
- **GitLab CI/CD** – Built into GitLab, supports full DevOps lifecycle.
- **CircleCI, Travis CI, Bamboo** – Other industry-grade CI/CD tools.

CI/CD pipelines are revolutionizing the way software is developed and delivered. For Computer Science students and aspiring developers, learning and applying CI/CD practices is no longer optional—it's essential. By adopting automation early, students not only enhance their technical skills but also prepare themselves for real-world software development practices used in companies like Google, Microsoft, and Amazon.

MODEL EVALUATION TECHNIQUES: ACCURACY, F1-SCORE, AND BEYOND

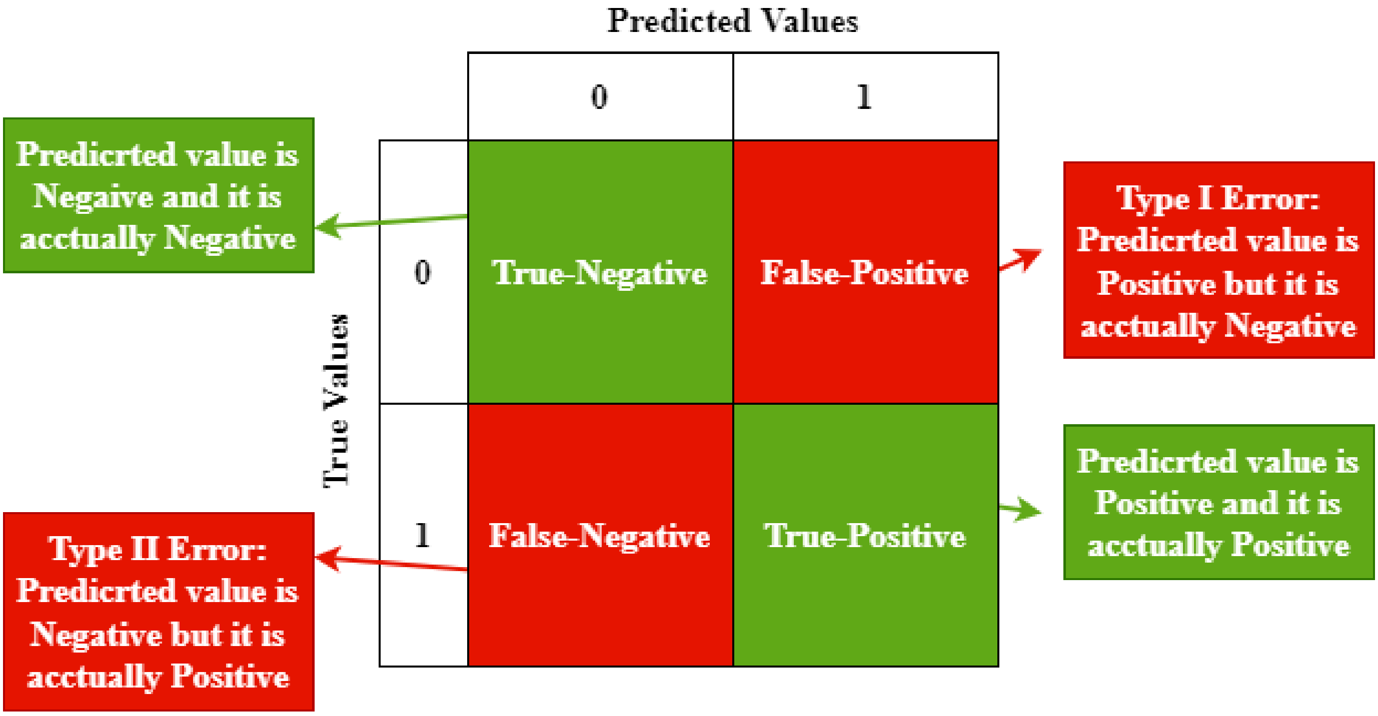
Dr. Vijaylakshmi Sajwan
Associate Professor-CSE

Introduction

In the world of machine learning and artificial intelligence, building a predictive model is only half the battle—the other half lies in evaluating its performance. A well-evaluated model helps developers understand its effectiveness and guides necessary improvements. While accuracy is the most common metric, it doesn't always tell the full story—especially with imbalanced datasets. This is where precision, recall, F1-score, ROC-AUC, and other techniques come in.

Confusion Matrix

A table summarizing prediction results by showing TP, FP, TN, and FN. It's the foundation for most evaluation metrics.



Use-Case:

Visual tool for identifying where the model gets things wrong.

Accuracy: Accuracy is the ratio of correctly predicted observations to the total observations:

Accuracy = (True-Positive+ True-Negative)/(True-Positive + True-Negative+False-Positive + False-Negative)

Use-Case:

Best used when the classes are balanced (e.g., equal number of positives and negatives).

Limitation:

Fails in imbalanced datasets. For instance, if 95% of patients don't have a disease, predicting "no disease" every time yields 95% accuracy—but is useless for detection.

Precision and Recall

Precision: Measures how many of the predicted positives are actually correct.

Precision= (True-Positive)/(True-Positive + False-Positive)

Recall (Sensitivity): Measures how many actual positives were correctly predicted.

Recall= (True-Positive)/(True-Positive + False-Negative)

Use-Case:

Use Precision when false positives are costly (e.g., spam detection).

Use Recall when false negatives are costly (e.g., cancer detection).

F1-Score

Harmonic mean of Precision and Recall. It balances both, especially useful for uneven class distributions.

F1-Score= 2*(Recall * Precision)/(Recall + Precision)

Use-Case:

When both false positives and false negatives carry significant costs.

ROC-AUC (Receiver Operating Characteristic - Area Under Curve)

ROC Curve: Plots true positive rate (Recall) against false positive rate.

AUC Score: Measures the entire two-dimensional area underneath the ROC curve.

Use-Case:

Helpful in binary classification. Higher AUC (closer to 1) implies better model performance across various thresholds.

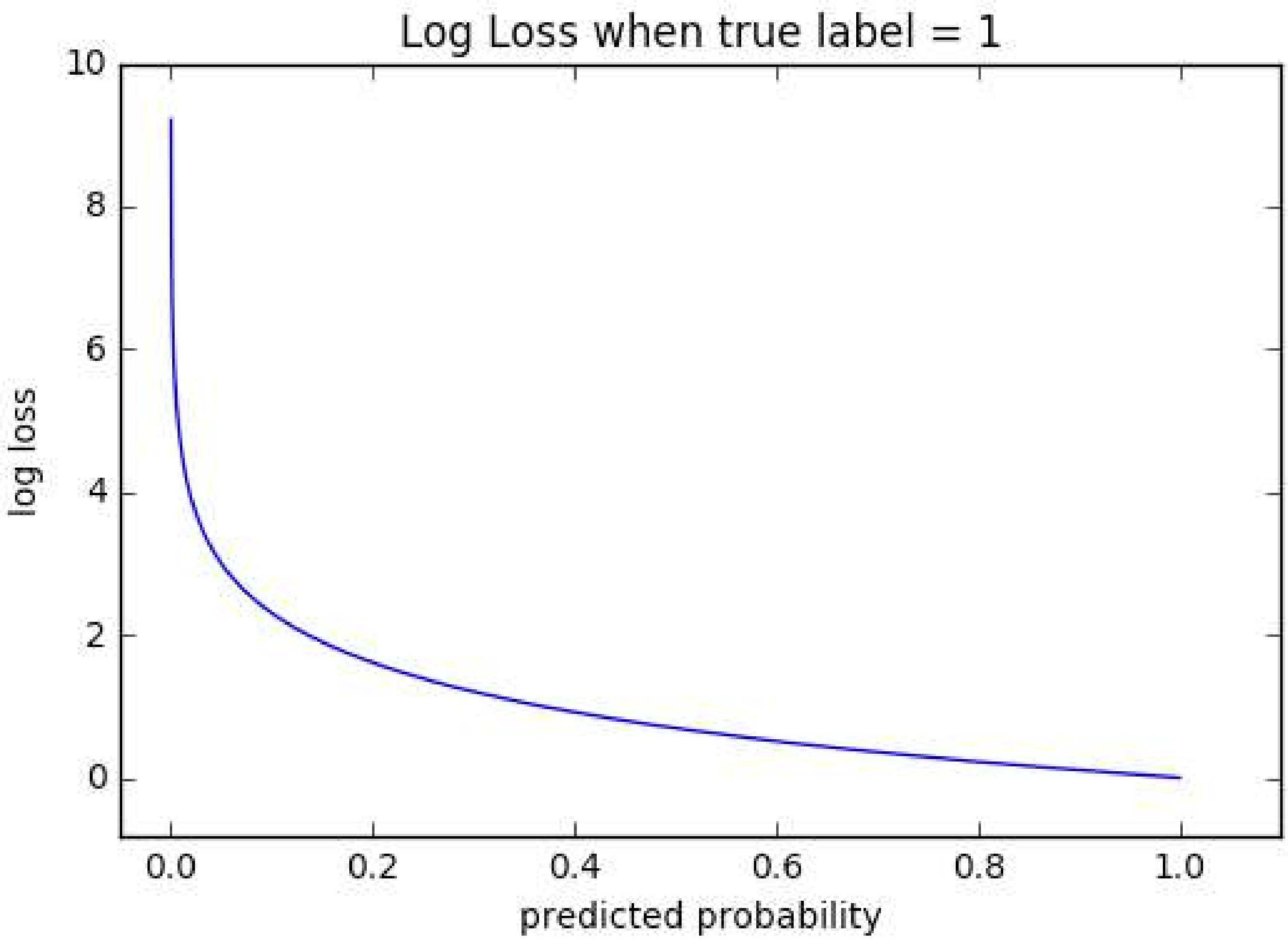
Matthews Correlation Coefficient (MCC): Considers all four confusion matrix categories; returns a value between -1 and +1.

Use-Case:

Excellent for binary classification even when data is imbalanced.

Log Loss / Cross-Entropy

Cross-entropy loss, or log loss, measures the performance of a classification model whose output is a probability value between 0 and 1. Cross-entropy loss increases as the predicted probability diverges from the actual label. So predicting a probability of .012 when the actual observation label is 1 would be bad and result in a high loss value. A perfect model would have a log loss of 0.



The graph above shows the range of possible loss values given a true observation (isDog = 1). As the predicted probability approaches 1, log loss slowly decreases. As the predicted probability decreases, however, the log loss increases rapidly. Log loss penalizes both types of errors, but especially those predictions that are confident and wrong!

Use-Case:

Used in probabilistic classifiers like Logistic Regression. Lower log loss indicates better calibrated predictions.

Conclusion

Choosing the right model evaluation technique is not a one-size-fits-all solution. While accuracy works in balanced datasets, metrics like F1-score, Precision, and Recall are better for imbalanced scenarios. For probabilistic models or critical applications, techniques like ROC-AUC, log loss, and MCC offer deeper insight. A good practice is to compare multiple metrics and visualize results to make the best-informed decisions.

AI-POWERED ROBOTICS: MERGING INTELLIGENCE WITH AUTOMATION

Kushpreet Singh
Assistant Professor- CSE

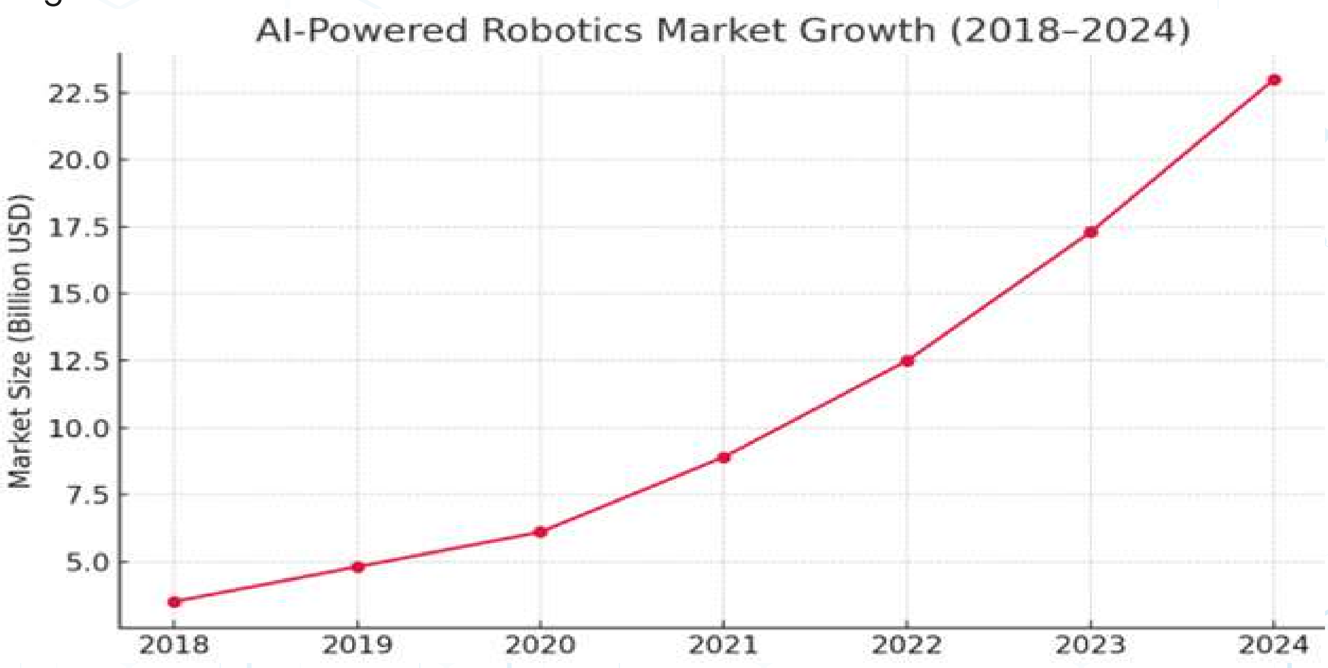
Introduction

Artificial Intelligence (AI) is revolutionizing the field of robotics by enabling machines to think, learn, and adapt. While traditional robots follow predefined instructions, AI-powered robots leverage data, sensors, and algorithms to perceive their environment, make decisions, and improve their performance over time. This convergence of robotics and AI is not only transforming industries but also redefining the boundaries of what machines can do—making them more autonomous, collaborative, and intelligent.

Market Growth Trajectory

The market for AI-powered robotics has grown rapidly. In 2018, it was valued at approximately $3.5 billion, reaching $12.5 billion in 2022 and projected to hit $23 billion by the end of 2024.

The chart above highlights this remarkable growth—driven by the adoption of smart robots in manufacturing, healthcare, logistics, and service sectors, as well as innovations in computer vision, deep learning, and natural language processing.



Key Applications Across Industries:

Industry	Use Cases of AI Robotics
Manufacturing	Smart assembly lines, quality inspection, warehouse automation
Healthcare	Surgical robots, elderly care assistants, AI diagnostic robots
Agriculture	Crop monitoring drones, autonomous tractors, precision spraying
Retail & Hospitality	Customer service robots, inventory management, cleaning robots
Logistics & Delivery	Autonomous delivery robots, AI-driven sorting in fulfillment centers
Defense & Security	Surveillance drones, bomb-disposal robots, border patrolling units

For example, Amazon's robotic fulfillment centers use AI to optimize routes and reduce human walking time by 40%. Similarly, Da Vinci surgical robots use AI-assisted vision for minimally invasive procedures.

Core Technologies Enabling AI Robotics

• Computer Vision: Enables robots to interpret and understand visual data from cameras or sensors.

• Reinforcement Learning: Allows robots to learn optimal actions through trial and error in dynamic environments.

• Natural Language Processing (NLP): Empowers robots to understand and interact with humans using speech or text.

• SLAM (Simultaneous Localization and Mapping): Enables mobile robots to build a map of their surroundings and locate themselves within it.

• Edge AI: Processes AI computations locally on the robot, reducing dependency on cloud-based inference and improving real-time responsiveness.

Challenges and Limitations:

1. High Cost of Implementation

AI-powered robots often require significant investment in hardware, software, and integration.

2. Complexity in Real-world Environments

Unlike controlled lab conditions, real-world scenarios are unpredictable and require extensive training and adaptability.

3. Ethical and Safety Concerns

Autonomous robots in healthcare or defense raise concerns about accountability, job displacement, and human-machine trust.

4. Data Requirements and Security

AI systems need large datasets to learn, and these datasets can raise concerns about privacy and cybersecurity.

5. Regulation and Standardization

The legal framework for autonomous machines is still evolving, especially in sectors like healthcare and transportation.

Future Outlook

AI robotics is moving toward greater collaborative intelligence, where robots work side-by-side with humans (cobots), learn from them, and adapt to human intentions. Key future trends include:

• Humanoid robots for household and caregiving roles.

• AI-driven swarms of drones or bots for coordinated actions.

• Emotion-aware robots capable of responding to human moods and social cues.

• Robotics-as-a-Service (RaaS) for scalable, subscription-based robotic deployments.

Conclusion

AI-powered robotics represents the ultimate fusion of intelligence and automation. As robots become smarter and more autonomous, they are poised to transform every aspect of industry and daily life. With strong market growth and accelerating technological innovation, the age of intelligent machines is no longer a vision of the future—it is rapidly becoming our present. But for this transformation to be inclusive, ethical, and sustainable, we must navigate its challenges with foresight and responsibility.

STUDENT WRITE-UP

THE FUTURE OF DATA SCIENCE: TRENDS, TOOLS, AND CAREER PATHS

Ayush Panwar
B.Tech CSE II-Year

In the contemporary digital landscape, Data Science has emerged as an indispensable discipline, underpinning strategic decision-making, business intelligence, and technological innovation across multiple domains. As organizations grapple with unprecedented volumes of structured and unstructured data, the role of Data Science in extracting actionable insights and driving operational efficiencies has become increasingly prominent. This paper offers a comprehensive exploration of the future of Data Science, emphasizing key trends, cutting-edge tools, and evolving career trajectories that are poised to redefine the field.

The study begins by analyzing major trends shaping the discipline, including the accelerated adoption of Artificial Intelligence (AI) and Machine Learning (ML) techniques, the proliferation of automated analytics and no-code platforms, the growing focus on explainable AI (XAI), and the heightened importance of ethical data governance in response to privacy concerns and regulatory frameworks. Furthermore, the paper discusses the convergence of Data Science with emerging fields such as edge computing, the Internet of Things (IoT), and augmented analytics, which collectively broaden the scope and application areas of data-driven methodologies. In addition to trends, the paper examines the evolution of tools and technologies that are transforming the Data Science workflow. Next-generation platforms supporting cloud-based data management, scalable machine learning operations (MLOps), and interactive data visualization are enabling faster, more collaborative, and reproducible data science practices. Special attention is given to open-source frameworks, cloud-native services, and automated machine learning (AutoML) systems that are democratizing access to advanced analytics capabilities.

Finally, the paper addresses the dynamic and expanding career landscape within Data Science. Traditional roles such as data analysts, data engineers, and machine learning engineers are being complemented by emerging positions including AI ethicists, data translators, data privacy officers, and AI product managers. The study highlights the essential technical, analytical, and ethical competencies required to thrive in this evolving ecosystem, offering guidance for aspiring professionals and academic institutions aiming to align curricula with industry needs. By integrating insights from industry reports, academic research, and practical case studies, this work provides a forward-looking perspective on how Data Science will continue to evolve as a transformative discipline. It underscores the need for continuous learning, interdisciplinary collaboration, and responsible innovation to harness the full potential of data-driven decision-making in the years ahead.

OVERFITTING AND UNDERFITTING: THE BALANCING ACT IN MACHINE LEARNING

Harshit Shrivastava
B.Tech CSE III-Year

Machine learning thrives on patterns. Feed an algorithm enough examples and it will discover relationships that let it recognize faces, recommend movies, or predict equipment failures. Yet those same patterns can betray us if we fail to strike the right balance between memorizing data too closely and capturing it too loosely—a dilemma famously known as overfitting and underfitting. Understanding this tug-of-war is essential for anyone in computer science and engineering who hopes to build models that perform reliably in the real world.

When a model overfits, it clings to every nuance of its training data—noise, outliers, and all. Imagine cramming for an exam by memorizing last year's paper word for word: you might ace identical questions but stumble on even slightly different ones. Overfit models behave the same way; they show sparkling accuracy on the data they have seen but falter disastrously on fresh inputs. This occurs when a model is overly complex relative to the amount—or diversity—of data available, such as a deep neural network trained on a small dataset or a high-degree polynomial forced through scattered points.

At the opposite extreme lies underfitting, where a model is so simple—or so constrained—that it fails to grasp the underlying structure of the data. Picture using only a straight line to capture the twists of a winding mountain road. The resulting predictions are consistently off-base, yielding high error on both training and unseen data. Common causes include overly aggressive regularization, insufficient training time, or choosing an inherently weak model for a complex task.

For practitioners, the art is to navigate between these two hazards. One proven strategy is to divide the dataset into three parts: training (to fit the model), validation (to tune hyperparameters), and test (to gauge final performance). Monitoring validation error while training helps signal whether the model is starting to overfit—validation error will plateau or rise even as training error keeps dropping. Techniques like early stopping cut training short at this inflection point, preserving a model that generalizes better.

Regularization provides another safeguard by subtly penalizing complexity in the loss function. L1 regularization promotes sparsity, effectively pruning less important features, while L2 discourages large weights that can make models overly sensitive to specific examples. For decision trees and ensembles, methods such as limiting depth or using random feature subsets (as in Random Forests) prevent any single tree from becoming a brittle memorizer.

Data itself is a powerful antidote. Augmentation—perturbing images with rotations or adding noise to numerical inputs—expands the effective size of a dataset, exposing the model to a richer variety of scenarios. When genuine new data can be collected, even better; broader coverage reduces the temptation to latch onto spurious quirks. Cross-validation further strengthens robustness by ensuring every data point gets a turn in validation, smoothing out the risk that one lucky split hides overfitting.

Meanwhile, diagnosing underfitting often points to the need for more expressive power. Adding layers to a neural network, increasing the number of trees in a gradient-boosted model, or simply relaxing regularization parameters can free a model to learn subtler relationships. Feature engineering—deriving additional informative variables—may also give the algorithm the vocabulary it lacked to describe the data faithfully.

In practice, few projects remain static. Concept drift—where data distributions shift over time—means that yesterday's balanced model can slip into underfitting as patterns evolve, or overfitting if the training set no longer represents current reality. Continuous monitoring and periodic retraining keep performance aligned with real-world conditions.

Ultimately, the balancing act between overfitting and underfitting reflects a deeper truth: models are mirrors of the data and assumptions we provide. A disciplined workflow that emphasizes validation, appropriate complexity, and quality data transforms this delicate equilibrium from a stumbling block into a stepping stone. For students and faculty in the Department of Computer Science and Engineering, mastering this balance equips us to deploy machine-learning solutions that are not just impressive in theory but trustworthy in the dynamic environments they are meant to serve.

BLOCKCHAIN FOR DIGITAL IDENTITY VERIFICATION

Abdul Wahid
B.tech CSE II-Year

Blockchain technology offers a secure, decentralized, and tamper-resistant way to manage digital identity verification.

Here's how it works and why it's valuable:

How Blockchain Enhances Digital Identity Verification

1. Decentralization:

- Eliminates the need for a central authority, reducing risks of a single point of failure.
- Users have more control over their identity data.

2. Immutability & Security:

- Once stored, data on the blockchain cannot be altered, reducing fraud risks.
- Cryptographic techniques ensure privacy and integrity.

3. Self-Sovereign Identity (SSI):

- Users own and manage their digital identities without relying on third-party intermediaries.
- They can selectively share specific credentials (e.g., age verification without revealing full identity).

4. Verifiable Credentials:

- Organizations can issue credentials (e.g., government IDs, diplomas) on the blockchain.
- Third parties can verify credentials without needing to contact the issuing authority.

5. Interoperability:

- Enables cross-border identity verification without redundant paperwork.
- Supports seamless integration with different identity systems.

How it works:

Identity Registration:

Users would initially register their identity details (like government-issued ID, biometric data) on the blockchain, which would be encrypted and stored as a unique digital record.

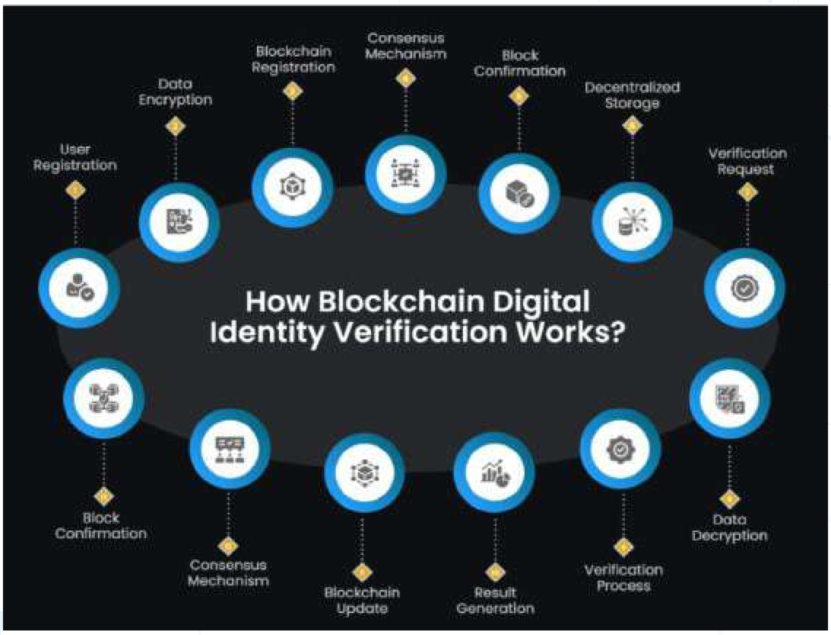
Digital Signature:

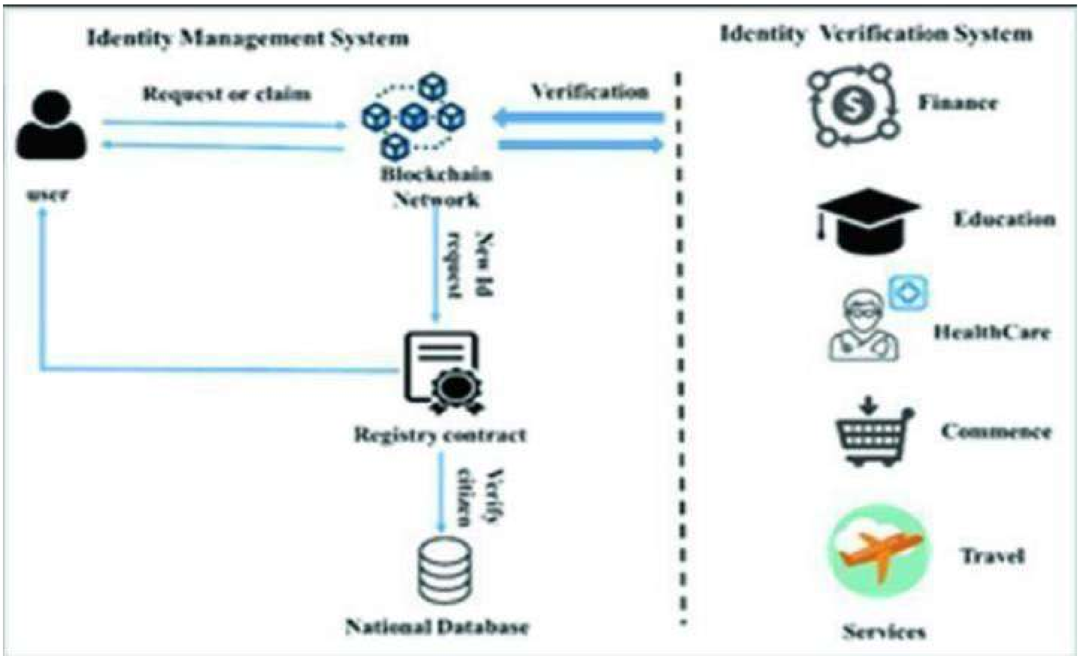
Each user receives a cryptographic key pair, allowing them to digitally sign their identity data, further ensuring authenticity.

Verification Process:

When a user needs to verify their identity, they can provide their digital signature to a verifying entity who can then use the public key to validate the identity data on the blockchain.

Blockchain technology can be used for digital identity verification applications by storing an individual's identity data securely on a decentralized ledger, allowing for tamper-proof verification of their identity across different platforms while giving users greater control over their personal information, significantly reducing the risk of fraud and identity theft; essentially enabling a "self-sovereign identity" concept where users manage their own digital identities without relying on a central authority.





Use Cases of Blockchain for Digital Identity

- Financial Services: KYC/AML compliance with tamper-proof identity records.
- Healthcare: Secure storage of medical records linked to a patient's digital identity.
- Voting Systems: Secure and transparent digital voter identities.
- Travel & Immigration: Digital passports and borderless identity verification.
- E-Governance: Secure access to government services.

Challenges & Considerations

- Scalability: Some blockchains face high transaction costs and slow processing times.
- Privacy Concerns: Public blockchains can expose metadata;solutions like Zero-Knowledge Proofs (ZKPs) can help.
- Regulatory Compliance: Governments need to create frameworks to integrate blockchain with existing identity systems.
- Adoption Barriers: Institutions and users need awareness and trust in the technology.

Potential Applications:

KYC (Know Your Customer) in Banking:

Banks can use blockchain to securely verify customer identities during account opening, reducing the risk of fraudulent activities.

Government Services:

Citizens can use their blockchain-based digital identity to access government services online, simplifying the verification process.

Healthcare:

Patient records could be stored securely on a blockchain, allowing authorized healthcare providers to access necessary information while maintaining patient privacy.

Supply Chain Management:

Blockchain can be used to track the provenance of goods by assigning unique digital identities to products, preventing counterfeiting

WHY CONTRIBUTION TO OPEN-SOURCE MATTERS

Sunil Sisodia
B.Tech CSE II-Year

In the ever-evolving world of technology, collaboration stands at the heart of innovation. One of the most powerful forms of this collaboration is the open-source movement—a global effort where developers contribute their time, skills, and creativity to build software that is freely available for anyone to use, modify, and distribute. For students and professionals in computer science and engineering, contributing to open-source projects is more than just a noble cause—it's a practical, career-building, and intellectually rewarding experience.

Open-source software (OSS) powers much of the digital world. From operating systems like Linux and Android to frameworks like TensorFlow and React, these tools are built by communities of developers who voluntarily share their code with the world. By contributing to open-source projects, individuals become part of these communities, helping to develop tools that are used by millions globally. This exposure offers a unique opportunity to work on real-world problems, understand large codebases, and learn industry-level practices that go far beyond classroom assignments.

One of the most compelling reasons to contribute to open source is learning and skill development. It allows students to apply programming languages, version control systems (like Git), debugging techniques, and testing frameworks in practical scenarios. Contributors often gain firsthand experience with collaborative development models, code reviews, and software documentation—all of which are highly valued in the software industry. Unlike isolated academic projects, open-source work mimics real-world software development, making contributors more job-ready.

Building a strong portfolio is another major benefit. Recruiters and hiring managers often look for candidates who have practical experience in addition to academic credentials. An active GitHub profile showcasing meaningful contributions can serve as a digital resume. It reflects not just technical proficiency, but also qualities like initiative, communication, problem-solving, and community engagement—skills essential for any tech role.

Open-source contribution also fosters a sense of community and global impact. It breaks down geographical and institutional barriers, allowing individuals from different backgrounds to collaborate on meaningful projects. Whether you fix a bug, add a new feature, write documentation, or help triage issues, every contribution adds value. Contributors often receive guidance and mentorship from experienced developers, creating a cycle of continuous learning and growth. Moreover, the software you help improve could be used by students, researchers, or even entire companies—amplifying your impact on a global scale.

Importantly, contributing to open source also reinforces the values of openness, sharing, and ethical responsibility. In an age where proprietary software dominates many sectors, open source serves as a reminder that innovation doesn't always require secrecy or competition. It nurtures a culture where knowledge is shared, creativity is encouraged, and solutions are built for the common good. For computer science students, it instills a mindset of responsible development and collaborative progress.

Getting started with open-source contribution has never been easier. Platforms like GitHub and GitLab host thousands of projects that welcome new contributors. Beginner-friendly labels such as “good first issue” or “help wanted” make it easy to find tasks that match your skill level. Initiatives like Hacktoberfest and Google Summer of Code further encourage student participation and offer structured opportunities to contribute and learn.

Contributing to open-source projects is not just about writing code—it's about becoming a part of something larger than yourself. It's a chance to learn, grow, connect, and make a lasting impact in the tech world. For students in the Department of Computer Science and Engineering, engaging in open-source contribution is a gateway to real-world experience, community involvement, and a fulfilling career in technology. As the saying goes, "If you want to go fast, go alone. If you want to go far, go together." In open source, we go far—together.

THE ROLE OF HACKATHONS IN SKILL DEVELOPMENT

Manaswee Chauhan
B.Tech CSE II-Year

In the rapidly evolving landscape of computer science and technology, conventional learning is no longer sufficient. To stay relevant and job-ready, students need hands-on experiences that challenge their creativity, technical knowledge, teamwork, and problem-solving abilities. One such powerful platform that fosters holistic skill development is a hackathon.

What is a Hackathon?

A hackathon is an intense, time-bound event—usually ranging from 24 to 72 hours—where developers, designers, and innovators come together to build working prototypes of solutions addressing real-world problems. The term "hack" here refers not to hacking in the security sense, but rather to building or crafting a quick, clever solution.

How Hackathons Foster Skill Development

Technical Proficiency

Hackathons push participants to go beyond textbook knowledge. They get to apply programming, web development, machine learning, database management, or app development skills in real-time. Working with APIs, debugging, and using version control systems like Git are common during hackathons.

Teamwork and Collaboration

Most hackathons require participants to work in teams. This environment enhances communication, encourages brainstorming, and fosters a spirit of collaboration. It also reflects real industry scenarios where cross-functional teams must work together under deadlines.

Problem-Solving Mindset

Each team faces a unique problem statement, often from domains like healthcare, finance, education, or sustainability. Analyzing the problem, identifying user needs, and crafting a viable solution sharpens the participant's problem-solving and critical thinking abilities.

Time Management and Pressure Handling

With strict deadlines, hackathons simulate high-pressure environments. Participants learn to manage time efficiently, prioritize tasks, and deliver minimum viable products (MVPs) quickly—an essential skill in agile software development.

Creativity and Innovation

Hackathons reward innovation. Participants are encouraged to think differently, explore emerging technologies, and build something novel. Whether it's using blockchain for voting or AI for sign language detection, creativity often makes the difference.

Exposure to Industry Tools and Mentorship

Many hackathons are sponsored or judged by industry professionals. Students get to network with tech mentors, understand current market needs, and receive feedback on their projects. This exposure bridges the gap between academia and industry.

Why Should Students Participate

For Computer Science students, hackathons serve as a mini-launchpad for careers. Participation in these events can:

- Strengthen resumes and LinkedIn profiles
- Open doors to internships or job offers
- Help discover personal strengths and interests
- Build confidence to participate in larger tech events like Smart India Hackathon or Google Solution Challenge

Hackathons are more than just competitions—they are learning accelerators. They simulate real-world software development challenges and foster an ecosystem of continuous learning, collaboration, and innovation. For CSE students looking to upgrade their skills, network with industry experts, and showcase their talent, hackathons are an opportunity not to be missed.

Let's code, collaborate, and create—because the next big tech innovation could start at a hackathon!

BEST PROJECT ABSTRACT

Shelf Life Prediction of Fruits and Vegetables Using Arrhenius and CNNs

Prinshu Kumar, Kamal Kumar Singh, Rahul Pal, Sandeep Panwar
Computer Science & Engineering

The accurate prediction of shelf life for perishable fruits and vegetables is a critical com ponent of modern food supply chain management. It plays a vital role in minimizing post-harvest losses, maintaining nutritional value, and ensuring the timely delivery of fresh produce to consumers. However, traditional methods for assessing freshness are often manual, subjective, or dependent on costly sensors, making them less practical for scalabile, real-time applications This study introduces a hybrid AI-based framework that integrates image-based classification with thermodynamic modeling to provide a reliable, data-driven solution for shelf life prediction.
A Convolutional Neural Network (CNN) is employed to automatically classify fruits and vegetables by analyzing visual features, categorizing the samples into three freshness levels Fresh, Moderately Fresh, and Spoiled. This computer vision model enables rapid and non-invasive quality assessment with high accuracy. To complement this visual inspection, a quantitative estimation of shelf life is performed using the Arrhenius equation, a well-established model in food kinetics. The model utilizes activation energy (Ea) and pre-exponential factor (A) parameters derived from empirical data at standard reference temperatures (0°C and 25°C), allowing the estimation of degradation rates under varying ambient temperature conditions.
By fusing deep learning-based classification with real-time temperature-dependent kinetic modeling, the system delivers a dynamic and context-aware prediction of remaining shelf life This novel integration enhances decision-making capabilities in post-harvest handling, storage, transportation, and retail operations. The proposed approach demonstrates strong potential for deployment in smart agricultural systems and cold chain monitoring solutions, contributing to reduced food wastage, optimized logistics, and improved consumer satisfaction.

Zoolens: Ai-Powered Animal Insight

Rahul Bhatt, Naman Shrimali
Computer Science & Engineering

Zoolens is an AI-powered, non-lethal system designed to mitigate human-wildlife conflict by detecting, monitoring, and deterring wild animals in real time. It combines edge AI with embedded platforms like Arduino Uno R3 and Raspberry Pi for species recognition using deep learning models such as YOLOV3 and Tiny-YOLOV3. The system draws from intelligent animal repelling frameworks and leverages motion detection, object recognition, and behaviour-specific analysis to accurately identify and respond to intrusions. Once a wild animal is detected, the system activates species-specific ultrasonic deterrents and transmits cal-time alerts and visual evidence through Telegram messaging, enabling remote situational Wareness and rapid response. Unlike conventional methods such as physical barriers or lethal traps, Zoolens adopts a humane, data-driven approach that prioritizes ecological balance and animal welfare. The system operates autonomously on low-power edge devices, making it ideal for rural and forest-adjacent areas with limited infrastructure. With integrated geospatial mapping and lightweight communication protocols like MQTT, Zoolens supports scalable deployments and adaptive learning through model retraining with field data. This project exemplifies how modern technologies-machine learning, IOT, and embedded computing can converge to create ethical, efficient, and sustainable solutions for wildlife conservation and community protection. The architecture is modular, field-tested, and designed for continual improvement, positioning Zoolens as a next-generation tool in environmental and agricultural defense systems.

Rainfall Prediction using ML

Salim Akhter Ansari, Prince Kumar Raj, Sonu Kumar, KM Shaijal
Computer Science & Engineering

India is an agricultural country and its economy is largely based upon srop productivity and ramfall For analyzing the crop productivity, rainfall prediction is require mo necessary to all farmers. Rainfall Prediction is the application of science and technology to predict the state of the atmosphere. It is important to exactly determine the rainfall for effective use of water resources, crop productivity and pre planning of water structures Using different data muing techniques it can predict rainfall. Data mining techniques are used to estimate the rainfall numerically. This paper focuses some of the popular data mining algorithms for rainfall prediction. Naive Bayes, K-Nearest Neighbor algorithm, Decision Tree, Neural Network and fuzzy logic are some of the algorithms compared in this paper. From that comparison, it can analyze which method gives better accuracy for rainfall prediction

TEDUXCELL Empowering Online Learning Through Interactive Course Delivery

Gaurav Saini, Gaurav Singh, Vijay Singh Saud, Suraj Singh
Computer Science & Engineering

The Ed-Tech sector is witnessing a profound transformation driven by digital innovation and the imperative for accessible remote education solutions. This study delves into the nuanced intricacies of developing robust online education applications, meticulously examining trends, growth drivers, challenges, and potential strategies within this dynamic ecosystem. Our exploration encompasses a wide array of cutting-edge trends shaping Ed-Tech, from immersive gamified learning experiences to AI-driven personalized content delivery. These emerging trends are not only reshaping the landscape of online education platforms but also setting new benchmarks for student engagement and learning outcomes. Key drivers propelling the growth of the Ed-Tech sector include the ubiquity of smartphones, the democratization of high-speed internet access, and proactive government initiatives supporting digital learning endeavors. These factors collectively create a fertile ground for innovation and expansion within the sector.

Nevertheless, amid the opportunities lie significant challenges that demand adept navigation. Bridging the digital divide to ensure equitable access to technology and internet connectivity, enhancing teacher capacity through targeted training programs, addressing data privacy concerns, and navigating complex regulatory frameworks are among the critical challenges faced by stakeholders in the Ed-Tech domain. By providing actionable insights gleaned from in-depth analysis and best practices, this research aims to empower developers and stakeholders to craft successful online education platforms. Our ultimate goal is to contribute to the democratization of quality education, ensuring that every learner, irrespective of geographical location or socioeconomic background, has access to transformative educational experiences. By leveraging technology intelligently and addressing challenges effectively, we aspire to contribute to the realization of a future where quality education is accessible to all—transcending geographical boundaries and empowering learners to reach their full potential in the digital age.

HACKATHONS GLIMPSE

The Computer Science & Engineering department and **the Institution Innovation Council** had organized an institute-level internal hackathon to shortlist the teams to be registered for Smart India Hackathon-2023 on 25 – 26th Sep, ground floor at Academic Block C building of the institute. Total 69 teams 327 students (252 male and 75 female) have participated in this event. As per the guidelines of Smart India Hackathon – 2023, and to encourage female participation in innovative projects, most of the teams consist of at least one female student as a member.

SHIVA TECH FEST GLIMPSE

Department of Computer Science & Engineering has organized different activities in the Shiva-Tech Fest, like code-Hunt, Cyber Hack Challenge, and LAN gaming on 3rd Nov 2023. Different department students participated in these activities.

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P.O. Sherpur, Shimla Road, Dehradun (Uttarakhand) India - 248197

tel: 0135 -2693401/02/07 Helpline: +91-9997155111, +91-7088311122

Email : info@sce.org.in, admission@sce.org.in

www.shivalikcollege.edu.in