K.R. Mangalam University, Gurugram

School of Engineering and Technology ***(SOET)***

Session 2025-26

Computer Science Fundamentals and Career Pathways

Assignment: 3

Explore a technology Domain & Create Pathway Report

Submitted By:
Name: Kaushal
Course: B. Tech (CSE with ai and ml)
Semester: 1
Roll No.: 2501730085
Section: B

Submitted To:
Mr. Aryan Sharma

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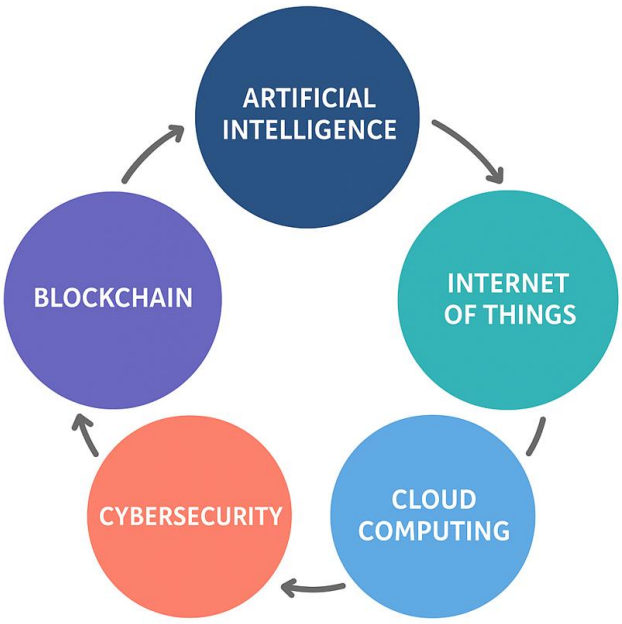
Introduction

As a computer science student, I have always been fascinated by how technology keeps changing the way we live and work. With so many emerging fields around us—like **Artificial Intelligence (AI)**, **Internet of Things (IoT)**, **Cloud Computing**, **Blockchain**, and **Cybersecurity**—it becomes important to choose one area to focus on during my college journey. I believe having a clear focus will help me build strong technical skills, work on meaningful projects, and shape a better career path.

This report is my effort to explore all five major domains, compare them based on their importance, and finally choose the one that aligns best with my passion and the future I see for myself in the tech world.

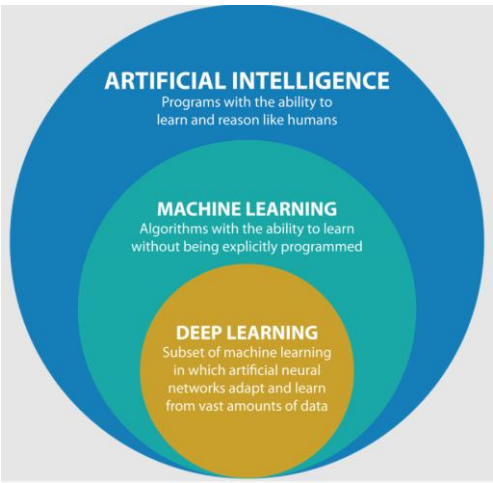


Domain: AI and ML

Introduction to AI & ML

Artificial Intelligence (AI) and Machine Learning (ML) are rapidly evolving fields at the forefront of technology, transforming the way we live, work, and interact with machines. AI focuses on creating intelligent systems that can mimic human decision-making, while ML enables these systems to learn from data and improve over time without explicit programming.

With applications ranging from self-driving cars and virtual assistants to health care and finance, AI & ML offer vast opportunities for innovation and career growth Studying this domain in depth will equip me with the skills to solve real-World problems and contribute to cutting-edge technological advancements.



Research and Analysis

Key Technologies

1.Major tools

Machine Learning Libraries

- **TensorFlow** – Deep learning library for building, training, and deploying ML models.
- **PyTorch** – Most popular framework for research and production-level deep learning.
- **Scikit-Learn** – For classical ML (regression, clustering, classification).
- **Keras** – High-level neural network API (runs on TensorFlow).
- **XGBoost / LightGBM** – High-performance gradient boosting libraries for tabular ML

Data Handling & Analysis Tools

- **NumPy & Pandas** – Data manipulation and numerical computing.
- **Matplotlib & Seaborn** – Data visualization.

Model Explainability Tools

- **Shap & Lime** – Help interpret predictions of ML models.

2.Major platforms

Cloud AI Platforms

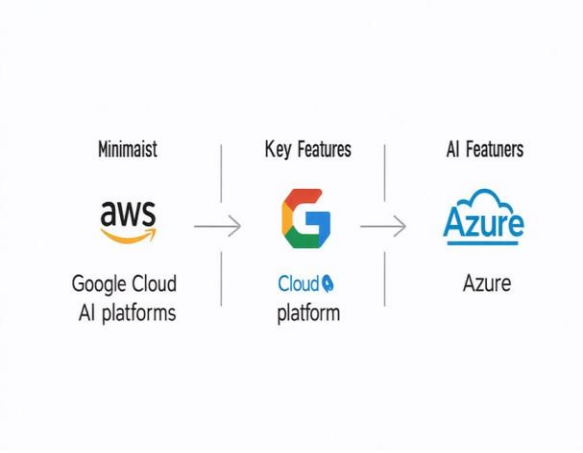
- **Google Cloud Vertex AI** – End-to-end ML lifecycle (training, deployment, monitoring).
- **AWS SageMaker –** Cloud service for building, training, and hosting models.
- **Microsoft Azure ML Studio –** Drag-and-drop ML + code-based development.

MLOps Platforms

- **MLflow –** Experiment tracking, model registry, and deployment.
- **Weights & Biases (W&B) –** Model training monitoring and experiment logging.
- **DVC (Data Version Control) –** Version control for datasets and ML pipelines.

Big Data Processing Platforms

- **Apache Spark –** Large-scale data processing engine.
- **Apache Hadoop –** Distributed storage & data processing framework.



3. Technical Concepts

Core Machine Learning Concepts

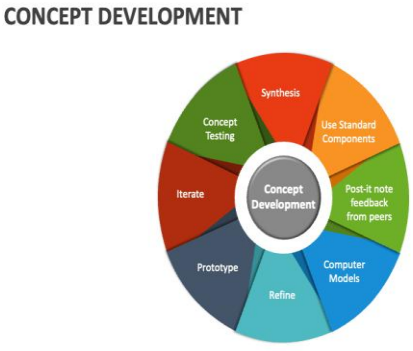
- **Supervised Learning** – Learning from labelled data (e.g., classification).
- **Unsupervised Learning** – Learning patterns from unlabeled data (clustering).
- **Reinforcement Learning** – Learning via rewards (robots, game agents).
- **Deep Learning** – Neural networks for images, text, speech, etc.

Model Development Concepts

- **Feature Engineering** – Selecting and transforming input variables.
- **Model Evaluation Metrics** – Accuracy, precision, recall, F1-score, MSE, etc.
- **Regularization** – Preventing overfitting (L1/L2, dropout).
- **Hyperparameter Tuning** – Grid search, random search, Bayesian optimization.

Neural Network Concepts

- **CNN (Convolutional Neural Networks)** – Used for image processing.
- **RNN / LSTM / GRU** – Used for sequence data like time series or text.
- **Transformers** – Advanced architecture used in LLMs like GPT, BERT.



Real-World Use Cases

a) Indian Example – Niramai Thermalytix (Healthcare AI)

Problem Addressed:
Traditional breast cancer screening (mammography) can be expensive, invasive, and not easily accessible in rural India.

AI/ML Solution:

- Niramai uses AI-based thermal imaging analysis called Thermalytix.
- A thermal camera captures heat patterns from the body, and ML models detect abnormal tissue activity.
- Uses deep learning + computer vision to identify early-stage cancer signals.

Impact:

- Non-invasive, painless, radiation-free screening.
- Affordable and accessible for rural/low-resource hospitals.
- Adopted by several Indian hospitals and public health programs.
- Helps in early cancer detection, reducing mortality.

b) Global Example – DeepMind AlphaFold (Biology & Drug Discovery)

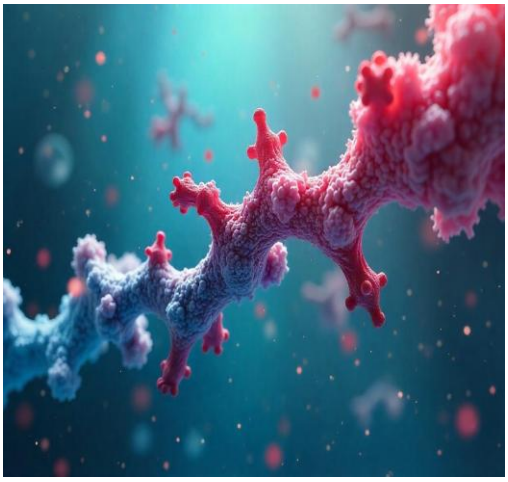
Problem Addressed:
Predicting 3D structures of proteins traditionally takes months to years and is highly costly.

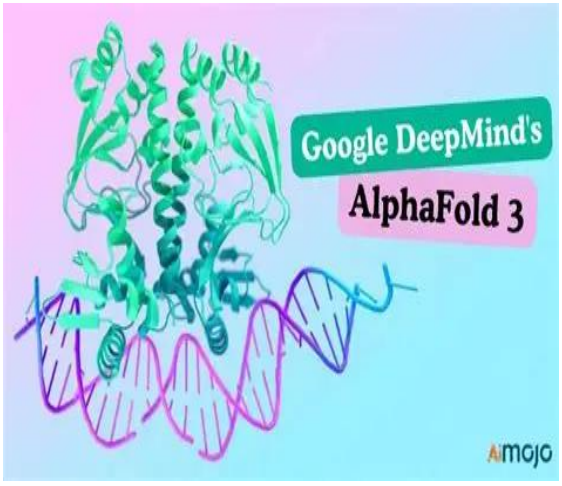
AI/ML Solution:

- AlphaFold, developed by DeepMind, uses deep learning to predict protein structures with high accuracy.
- Trained on millions of biological sequences and structures.
- Revolutionized computational biology by providing nearly complete protein databases.

Impact:

- Accelerates drug discovery, vaccine development, and genetic research.
- Saves huge time and cost in laboratory experiments.
- Used globally by scientists, pharmaceutical companies, and research labs.
- Over 200 million protein structures made publicly available.





Career Opportunities

1.Possible Job Roles

Core Technical Roles

- **Data Scientist** – Builds models, analyzes data, performs statistical modeling and visualization.
- **Machine Learning Engineer** – Develops, deploys, and optimizes ML models for real-world applications.
- **AI Engineer** – Works on building intelligent systems (chatbots, vision systems, recommendation engines).
- **Deep Learning Engineer** – Specializes in neural networks, computer vision, NLP, and LLMs.
- **MLOps Engineer** – Manages ML pipelines, automation, CI/CD, model monitoring, and deployments.

Data & Infrastructure Roles

- **Data Engineer** – Creates data pipelines, ETL systems, and maintains databases for ML use.
- **Big Data Engineer** – Works with Spark, Hadoop, and distributed data systems.

Research & Domain Roles

- **AI Research Scientist** – Develops new algorithms and models, often in labs or universities.
- **NLP Engineer / Computer Vision Engineer** – Works on text, speech, and image-based AI solutions.
- **AI Product Manager** – Bridges technical teams and stakeholders to build AI-powered products.

2. Industry Demand

- AI & ML are among the **fastest-growing tech fields in India and globally**.
- Multiple industries are adopting AI such as:
    - Healthcare
    - Finance & Banking
    - E-commerce
    - Automobile & Robotics
    - Telecom
    - Education & EdTech
    - Manufacturing & Automation
- Reports show millions of new AI-related jobs emerging worldwide by 2025–2030.
- Indian job portals (Naukri/Indeed) show high demand for ML engineers, data scientists, and MLOps professionals.

3. Required Skills

Technical Skills

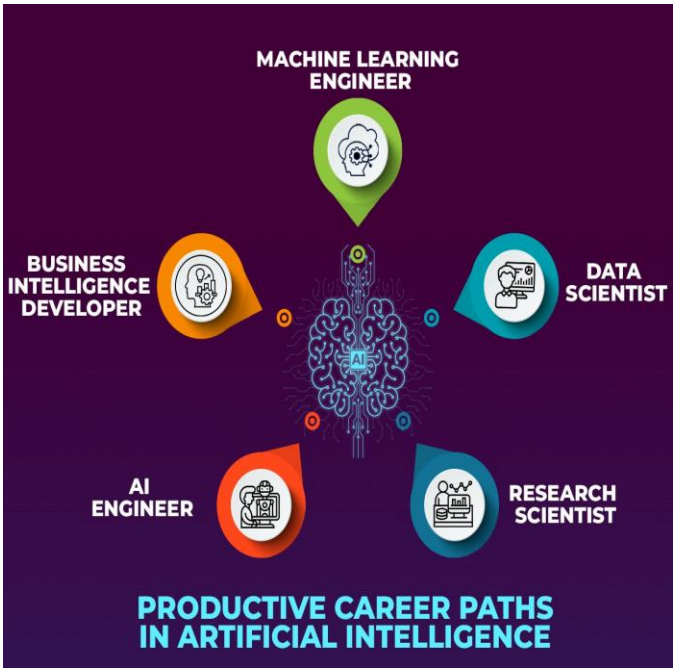
- **Programming:** Python, R, SQL
- **ML Frameworks:** TensorFlow, PyTorch, scikit-learn
- **Data Skills:** Pandas, NumPy, data cleaning, data visualization
- **Deep Learning:** CNNs, RNNs, LSTMs, Transformers
- **MLOps Tools:** MLflow, Docker, Kubernetes, Git
- **Cloud Platforms:** AWS, Azure, Google Cloud

Soft Skills

- Problem-solving and analytical thinking
- Communication and presentation skills
- Team collaboration
- Understanding business requirements

4. How Students Can Prepare

- Learn Python & ML basics through online courses.
- Build real-world projects and publish them on GitHub.
- Do Kaggle competitions and internships.
- Learn at least one deep learning framework (PyTorch/TensorFlow).
- Gain hands-on experience with MLOps tools.
- Stay updated with AI trends like LLMs, Generative AI, and edge AI.



Reflection Writing

1. How this Domain Aligns with My Academic Interests or Career Goals?

The field of Artificial Intelligence and Machine Learning aligns strongly with my long-term academic and career ambitions. I am deeply interested in how intelligent systems work and how technology can automate processes, improve decision-making, and solve complex real-world problems. AI & ML represent some of the fastest-growing technologies globally, and learning them opens doors to careers in research, data science, software development, and innovation-driven industries. Since I want to build a career in the tech sector, this domain perfectly matches my desire to work with advanced tools, cutting-edge algorithms, and future-oriented applications**.**

2. Skills I Already Have That Are Relevant to This Domain

I already possess several foundational skills that support my journey into AI & ML. I have a basic understanding of programming concepts and familiarity with languages like Python or JavaScript. Along with that, I have good logical reasoning, mathematical understanding, and problem-solving abilities—skills that are essential for analyzing data and understanding ML algorithms. My curiosity, consistency, and willingness to learn also help me stay motivated in this rapidly evolving field.

3. Skills I Aim to Develop to Work in This Field

To pursue a professional career in AI & ML, I aim to develop deeper technical expertise. I want to strengthen my Python programming, learn important ML libraries (NumPy, Pandas, Scikit-Learn, TensorFlow), and understand core concepts such as model training, evaluation, and deployment. I also want to build skills in data analysis, visualization, and MLOps so I can work on complete end-to-end projects. Additionally, I hope to improve my soft skills like communication, teamwork, and critical thinking to collaborate effectively in real-world AI environments.

Conclusion

I have chosen Artificial Intelligence and Machine Learning as my focus because I see immense potential in this field for growth and innovation. I am excited about learning in-demand skills and working with cutting-edge technologies. I believe focusing on AI and ML will give me strong career prospects and the chance to contribute to shaping the future of technology.

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