

Artificial Intelligence and Machine Learning: An Overview

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Abstract: Artificial Intelligence (AI) and Machine Learning (ML) are among the most transformative technologies of the 21st century. This paper provides an overview of AI and ML, including their definitions, historical evolution, core concepts, types, key algorithms, real-world applications, benefits, challenges, ethical concerns, and future scope. The objective is to offer a clear and concise understanding suitable for students and beginners.

Keywords: AI, ML, Algorithm.

1. Introduction

Artificial Intelligence refers to the capability of machines to perform tasks that typically require human intelligence, such as reasoning, learning, perception, and decision-making. Machine Learning is a subset of AI that enables systems to learn patterns from data and improve performance without being explicitly programmed. With the growth of big data, computational power, and advanced algorithms, AI/ML has rapidly expanded into healthcare, finance, education, transportation, manufacturing, and entertainment.

2. History and Evolution of AI and ML

The concept of AI dates back to the 1950s when Alan Turing proposed the Turing Test to measure machine intelligence. Early AI focused on rule-based systems and symbolic reasoning. In the 1980s and 1990s, expert systems gained popularity. Machine Learning emerged as data-driven approaches became feasible. In the 2000s and 2010s, advances in deep learning, neural networks, and access to large datasets led to breakthroughs in computer vision, speech recognition, and natural language processing.

3. Types of Machine Learning

Machine Learning is commonly categorized into three types: (a) Supervised Learning, where models are trained on labeled data to perform classification or regression; (b) Unsupervised Learning, where models discover patterns in unlabeled data, such as clustering and dimensionality reduction; and (c) Reinforcement Learning, where agents learn optimal actions through trial and error by interacting with an environment and receiving rewards or penalties.

4. Key Concepts and Algorithms

Important concepts in AI/ML include datasets, features, labels, training, testing, overfitting, and model evaluation. Common algorithms include Linear Regression, Logistic Regression, Decision Trees, Random Forests, Support Vector Machines, K-Nearest Neighbors, Naive Bayes, and Neural Networks. Deep Learning, a subset of ML, uses multi-layered neural networks to learn complex representations from data.

5. Applications of AI and ML

AI and ML have widespread applications across industries. In healthcare, they assist in disease diagnosis, medical imaging, drug discovery, and personalized treatment. In finance, they enable fraud detection, algorithmic trading, and credit scoring. In transportation, they power autonomous vehicles and traffic optimization. In education, they support personalized learning systems. In everyday life, virtual assistants, recommendation systems, and smart devices rely on AI/ML technologies.

6. Benefits and Impact

The benefits of AI/ML include improved efficiency, automation of repetitive tasks, enhanced accuracy in predictions, and the ability to process large volumes of data. These technologies help organizations make data-driven decisions, reduce costs, and create innovative products and services. AI/ML also has the potential to address global challenges in healthcare, climate change, and sustainable development.

7. Challenges and Ethical Considerations

Despite its advantages, AI/ML faces challenges such as data quality issues, bias in algorithms, lack of transparency, and security concerns. Ethical issues include privacy, surveillance, job displacement, and accountability of automated decisions. Responsible AI practices, fairness, explainability, and robust governance frameworks are essential to ensure that AI/ML systems are used safely and ethically.

8. Future Scope of AI and ML

The future of AI/ML is promising, with ongoing research in explainable AI, general artificial intelligence, and human-AI collaboration. Emerging areas such as generative AI, edge AI, and AI for social good are expected to shape the next decade. Continuous learning, regulatory frameworks, and interdisciplinary collaboration will play a crucial role in responsible and impactful AI adoption.

9. Conclusion

Artificial Intelligence and Machine Learning are reshaping the way we live and work. Understanding their fundamentals, applications, and implications is essential for students and professionals alike. While challenges remain, responsible development and deployment of AI/ML can unlock significant benefits for society and the global economy.

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