

An Explorative Research Analysis on Artificial Intelligence and Machine Learning - Issues, Opportunities and Challenges

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Introduction

Artificial intelligence was founded as an academic discipline in 1956. The field went through multiple cycles of optimism throughout its history. Funding and interest increased substantially after 2012, when graphics processing units (GPUs) started being used to accelerate neural networks, and deep learning outperformed previous AI techniques. This growth accelerated further after 2017 with the transformer architecture (Toews (2023)).

In the 2020s, an AI boom coincided with advances in generative AI, which became widespread and allowed for the creation and modification of media.

2. Review of Literature:

1. Shuqi Liu, Bowei He, Chen Ma, Linqi Song conducted study on Reasoning in Action: MCTS-Driven Knowledge Retrieval for Large Language Models.
2. Peter David Fagan conducted study on Toward a Physical Theory of Intelligence.
3. Luis M. Moreno-Saavedra, Silvia Jimenez-Fernandez, Antonio Portilla-Figueras, David Casillas-Perez, Sancho Salcedo-Sanz conducted study on A multi-algorithm approach for operational human resources workload balancing in a last mile urban delivery system.
4. Tiansi Dong, Henry He, Pietro Liò, Mateja Jamnik conducted study on An AI Monkey Gets Grapes for Sure -- Sphere Neural Networks for Reliable Decision-Making.

Research Methodology

Objective of the study is to examine the Artificial intelligence, Machine Language and Deep learning.

Nature and Source of data:

The study conducted with the help of secondary data base as well as primary data.

Secondary data obtained through national and international journals. Primary data obtained by conduction personal interview. Total sample size is 100.

Implications of the study:

With the help of this study it is possible to get information about the Artificial Intelligence tools ie., Chat GPT, Gemini, Copilot, Perplexity and also Open Access Sources such as Wikipedia free encyclopedia, Google Scholar, Zetero.

Limitation of the study:

In this study Artificial Intelligence tools, Machine Learning, Robotics, and Deep Learning focused. Other advanced software issues not focused, which will be area of further research.

Results and Discussion:

Artificial Intelligence is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings (B.J. Copeland). Artificial intelligence is the broad field of computer science focused on building systems that can perform tasks typically requiring human cognition -- such as understanding language, recognizing images, making decisions, and generating new content (*Alexis Dufresne*). Artificial intelligence is a family of techniques for making machines perform cognitive tasks, and in 2026 the most transformative branch is deep learning -- particularly large language models and generative AI.

Artificial intelligence (AI) is the capability of computational systems to perform tasks typically associated with human intelligence, such as learning, reasoning, problem-solving, perception, and decision-making. It is a field of research in engineering, mathematics, and computer science that develops and studies methods and software that enable machines to perceive their environment and use learning and intelligence to take actions that maximise their chances of achieving defined goals (Russell & Norvig (2021), pp. 1–4).

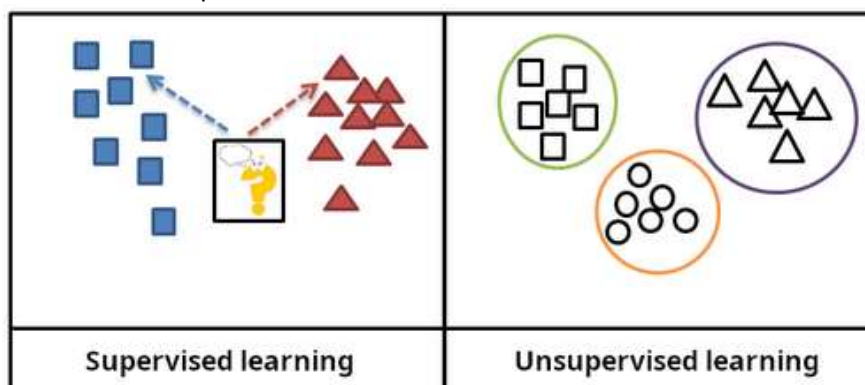
High-profile applications of AI include advanced web search engines, chatbots, virtual assistants, autonomous vehicles, play and analysis in strategy games (e.g., chess and Go), and content generation (e.g., text, images, audio, and videos).

The traditional goals of AI research include learning, reasoning, knowledge representation, planning, natural language processing, and perception, as well as support for robotics. [a] To reach these goals, AI researchers use techniques including state space search and mathematical optimisation, formal logic, artificial neural networks, and methods based on statistics, operations research, and economics. [b] AI also draws upon psychology, linguistics, philosophy, neuroscience, and other fields. [2] Some companies, such as OpenAI, Google DeepMind, and Meta, aim to create artificial general intelligence (AGI)—AI that can complete nearly any cognitive task at least as well as a human (AP News. 4 April 2024. Retrieved 20 May 2025).

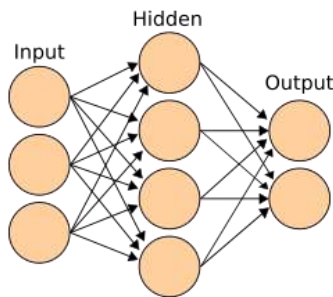
Issues of Machine Learning:

Machine learning is the study of programs that can improve their performance on a given task automatically.

In supervised learning, the training data is labelled with the expected answers, while in unsupervised learning, the model identifies patterns or structures in unlabelled data.



Deep learning is a type of machine learning that runs inputs through biologically inspired artificial neural networks for all of these types of learning.



A neural network is an interconnected group of nodes, akin to the vast network of neurons in the human brain.

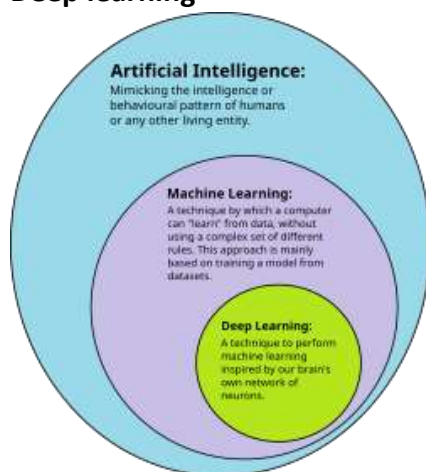
An artificial neural network is based on a collection of nodes also known as artificial neurons, which loosely model the neurons in a biological brain. It is trained to recognise patterns; once trained, it can recognise those patterns in fresh data. There is an input, at least one hidden layer of nodes and an output. Each node applies a function and once the weight crosses its specified threshold, the data is transmitted to the next layer. A network is typically called a deep neural network if it has at least 2 hidden layers (Neural networks: Russell & Norvig (2021, chpt. 21), Domingos (2015, Chapter 4).

Learning algorithms for neural networks use local search to choose the weights that will get the right output for each input during training. The most common training technique is the backpropagation algorithm (Gradient calculation in computational graphs, backpropagation, automatic differentiation).

Neural networks learn to model complex relationships between inputs and outputs and find patterns in data. In theory, a neural network can learn any function. . The term perceptron typically refers to a single-layer neural network (Perceptrons: Russell & Norvig (2021, pp. 21, 22, 683, 22) [In contrast, deep learning uses many layers (Deep learning: Russell & Norvig (2021, chpt. 21),

Long short-term memory networks (LSTMs) are recurrent neural networks that better preserve longterm dependencies and are less sensitive to the vanishing gradient problem (Recurrent neural networks: Russell & Norvig (2021, sect. 21.6). Convolutional neural networks (CNNs) use layers of kernels to more efficiently process local patterns. This local processing is especially important in image processing, where the early CNN layers typically identify simple local patterns such as edges and curves, with subsequent layers detecting more complex patterns like textures, and eventually whole objects (Convolutional neural networks: Russell & Norvig (2021, sect. 21.3).

Deep learning



Deep learning is a subset of machine learning, which is itself a subset of artificial intelligence (Sindhu V, Nivedha S, Prakash M (February 2020). "An Empirical Science Research on Bioinformatics in Machine Learning".

Deep learning uses several layers of neurons between the network's inputs and outputs (The multiple layers can progressively extract higher-level features from the raw input.

Deep learning has been used to improve the performance of programs in subfields of artificial intelligence including computer vision, speech recognition, natural language processing, image classification and others.

Deep neural networks and backpropagation had been in development since 1950

Starting in 2012, the speed of deep learning was increased one hundred-fold by switching to GPUs (Christian (2020), p. 21-22). and there were enormous amounts of data available on the internet (called at the time "big data") as well as curated datasets used for benchmark testing, such as ImageNet (Clark (2015b). Usage of deep learning increased in 2012–2015 due to these improvements (Big data, computer power and deep learning: Russell & Norvig 2021, p. 786; Hinton & Stewart 2025 Christian 2020, p. 22).

Issues on GPT:

GPT

Generative pre-trained transformers (GPTs) are large language models (LLMs) that generate text based on the semantic relationships between words in sentences. Text-based GPT models are pre-trained on a large corpus of text that can be from the Internet. The pretraining consists of predicting the next token (a token being usually a word, subword, or punctuation). Throughout this pretraining, GPT models accumulate knowledge about the world and can then generate human-like text by repeatedly predicting the next token. Typically, a subsequent training phase makes the model more truthful, useful, and harmless, usually with a technique called reinforcement learning from human feedback (RLHF). Current GPT models are prone to generating falsehoods called "hallucinations". These can be reduced with RLHF and quality data, but the problem has been getting worse for reasoning systems (Metz, Cade; Weise, Karen (5 May 2025).

Thus Current models and services include ChatGPT, Claude, Gemini, Copilot, and Meta AI ("AI Writing and Content Creation Tools".

Multimodal GPT models can process different types of data (modalities) such as images, videos, sound, and text (Marmouyet (2023).

Conclusion:

Thus welknown AI tools used by technical persons are Symphony by Wix, ChatGPT, Claude, Gemini, Zapier AI ,Salesforce Agentforce Notion AI ,ClickUp Brain, Canva AI ,Grammarly ,Fireflies.ai.

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