

## Elsevier's AI Encyclopedia (Call for Articles)

Please submit *your article proposal* (title, abstract, brief bios of authors) to the section Editor, **DR XIN-SHE YANG**, by email at [x.yang@mdx.ac.uk](mailto:x.yang@mdx.ac.uk)

The *AI Encyclopedia* will be published in 2026 by Elsevier, to be edited by a team of leading experts/editors, led by Prof. Maki K Habib. This is a multi-volume *Encyclopedia* with hundreds of articles, contributed by experts in the subject areas.

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We welcome high-quality contribution on any topic(s) in the following topic areas:

### A. Introduction to Artificial Intelligence

Section Editor [Xin-She Yang](#)

This category comprehensively introduces Artificial Intelligence (AI), covering its definition, historical development, theoretical underpinnings, and ethical considerations. It is a foundational section for understanding AI's basic concepts and evolution, preparing readers for more advanced topics.

- **Definition and Scope of AI.** This part explains AI and distinguishes between narrow AI and general AI. It also provides an overview of AI applications in various fields, such as healthcare, finance, transportation, and more.
- **Historical Overview.** This topic covers the Turing Test and early AI pioneers, reduced funding and interest periods, causes and impacts, the rise of machine learning and deep learning, recent advancements, and milestones.
- **Theoretical Foundations.** This part introduces algorithms and data structures, overviews probability and statistics, linear algebra, and calculus, and introduces machine learning, neural networks, and natural language processing.
- **Ethical Considerations.** This subsection covers a basic understanding of bias in AI systems and the importance of fair outcomes. It also introduces data privacy concerns and the security of AI systems, provides an overview of regulatory frameworks and global policies, and discusses job displacement and workforce adaptation. In addition, it covers ethical AI development and long-term societal implications.
- **AI Paradigms and Approaches.** Explore different AI paradigms, such as symbolic AI, connectionist approaches, and hybrid models, focusing on their unique strengths and applications.
- **AI and Cognitive Computing.** This topic introduces cognitive computing and its relationship with AI, covering how AI systems simulate human cognitive processes.
- **Evolution of AI Technologies.** Discuss the technological advancements (e.g., GPUs, cloud computing, big data) that have propelled AI forward, enabling more sophisticated models and applications.

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- **AI's Societal Impact.** Examine the broader societal effects of AI, including economic shifts, workforce changes, and AI's role in addressing global challenges.
- **Introduction to AI Ethics.** Expand on the major ethical issues in AI, such as transparency, accountability, and the influence of AI on human behaviour, with a broad overview of these critical concerns.
- **Global AI Strategies and Policies.** Compare and contrast how countries approach AI development and regulation, offering insights into global AI strategies without overlapping with more detailed policy discussions.
- **AI and human interaction.** Introduce the basics of human-AI interaction, focusing on user interface design, natural language processing, and psychological aspects without delving into specific applications.

## B. AI Foundations and Core Technologies

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Scope. This category covers the fundamental AI technologies and algorithms that strengthen all modern AI systems, focusing on their development, applications, and theoretical foundations. Examples of the topics may include.

- **Machine Learning Algorithms.** These are the foundations of AI, emphasizing the variety from supervised to reinforcement learning, which is crucial for predictive analytics and decision-making.
- **Deep Learning.** Explores the depths of neural networks, CNNs, and RNNs, powering image and speech recognition advancements.
- **Natural Language Processing (NLP).** It bridges human language and computers, enabling translation, sentiment analysis, and more.
- **Computer Vision.** Allows machines to interpret and act upon visual data, transforming security, retail, and healthcare applications.
- **Reinforcement Learning.** Machines learn to make decisions, optimizing actions based on trial and error, which is significant for autonomous systems.
- **Evolutionary Algorithms.** These algorithms are inspired by natural selection and solve optimization problems across engineering and data science.
- **Symbolic AI and Knowledge Representation.** This field focuses on logic-based AI, which is essential for reasoning, planning, and understanding complex instructions.
- **Objective-Driven AI.** This topic discusses designing and implementing AI systems with specific, targeted objectives, emphasizing aligning AI capabilities with strategic goals.

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- **AI Architectures.** This part explores the various architectures used in developing AI systems, including modular, layered, and hybrid architectures, focusing on their advantages and suitability for different AI applications.
- **Adaptive Learning Algorithms.** Algorithms that adapt their learning based on evolving data, enhancing performance autonomously.
- **Probabilistic Reasoning Models.** This topic covers Bayesian networks and probabilistic graphical models, which are foundational in uncertain reasoning and decision-making processes.
- **Meta-Learning and Self-Supervised Learning.** It covers emerging fields that allow AI models to learn autonomously with minimal human intervention.
- **AI and Generalization.** Explores how AI models generalize across domains and datasets, ensuring robustness and versatility.

### C. AI-Driven Innovations and Future Technology Pathways

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Scope. This section explores cutting-edge technologies and future AI advancements, including innovations in hardware, interdisciplinary sciences, quantum computing, and neuromorphic systems, while addressing the challenges of decentralized, secure, and sustainable AI systems.

- **Next-Generation AI Hardware.** This topic explores cutting-edge hardware development, including neuromorphic chips and quantum processors, redefining AI's computational power, speed, and efficiency.
- **Edge AI and Decentralized Intelligence.** This topic discusses the shift towards decentralized AI processing on edge devices, enabling real-time data analysis and decision-making closer to the data source, enhancing speed and privacy, and reducing reliance on centralized cloud infrastructure.
- **Quantum Computing's Role in AI Evolution.** It examines how quantum computing is poised to revolutionize AI, offering exponential improvements in processing power and the ability to solve complex problems currently intractable for classical computers.
- **AI at the Intersection of Emerging Sciences.** Investigates how AI converges with biotechnology, nanotechnology, and materials science, driving interdisciplinary innovations and opening new research frontiers.
- **Neuromorphic Computing: AI Inspired by the Brain.** It focuses on developing AI systems that mimic the brain's architecture, enhancing computational efficiency, adaptability, and decision-making in real-world applications.
- **Federated Learning and Secure AI Collaboration.** This topic covers the advancements in federated learning, which enables decentralized AI model training across multiple devices without sharing raw data, ensuring privacy and security while maintaining performance.

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- **AI in Synthetic Biology and Genomics.** Discusses how AI is integrated with synthetic biology and genomics, leading to breakthroughs in personalized medicine, genetic engineering, and bioinformatics.
- **AI and Autonomous Systems in Extreme Environments.** Explores how AI drives the development of autonomous systems capable of operating in extreme environments, such as deep space, deep sea exploration, and disaster response.
- **AI in Quantum-Enhanced Cybersecurity.** This part discusses the potential of combining AI with quantum computing to develop next-generation cybersecurity systems capable of defending against quantum-level threats and ensuring the integrity of critical data infrastructures.
- **AI in Nanotechnology and Material Science.** This topic explores how AI accelerates the discovery and development of nanomaterials, enhancing their properties and applications in areas like medicine, electronics, and energy storage.
- **AI-Optimized Nano Manufacturing.** This field focuses on integrating AI in nano-manufacturing processes, optimizing production at the molecular level, improving accuracy, and ensuring scalability in industries like electronics and biotechnology.
- **AI in Autonomous Laboratories.** It focuses on AI-driven autonomous laboratories that can design, run, and analyze experiments with minimal human intervention, significantly speeding up scientific research and enhancing innovation efficiency.
- **AI-Enhanced Cognitive Technologies.** This topic covers advancements in cognitive technologies where AI mimics human cognition, including neuromorphic computing and brain-computer interfaces, which enhance human-AI collaboration and decision-making.
- **AI in Energy-Optimized Computing.** Explores AI's role in optimizing energy usage in high-performance computing systems, focusing on reducing the carbon footprint and energy consumption of data centres and AI systems.
- **AI for Green and Sustainable AI Systems.** This focus on developing environmentally friendly AI technologies, promoting energy-efficient AI systems, and using renewable energy sources in AI infrastructure to ensure sustainability.

## D. **Advanced Theoretical Concepts**

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Scope. This section explores the advanced theoretical underpinnings of AI, exploring new frontiers in learning, optimization, reasoning, and decision-making. It focuses on the mathematical models, algorithms, and frameworks that push the boundaries of AI technologies across various domains.

- **Meta-Learning and Self-Supervised Learning.** It covers how AI models learn autonomously with minimal human intervention, emphasizing adaptability across different datasets and domains.

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- **Theoretical Foundations of Reinforcement Learning.** The advanced reinforcement learning theories include policy gradient methods, exploration-exploitation trade-offs, and long-term decision-making frameworks.
- **AI and Generalization.** Explores how AI models generalize their learning across unseen tasks and data points, ensuring robustness and adaptability in changing environments.
- **Probabilistic Reasoning Models.** This area focuses on Bayesian networks and probabilistic graphical models, foundational in dealing with uncertain data and supporting decision-making under uncertainty.
- **Evolutionary Computation in AI.** Examines AI algorithms inspired by natural selection, such as genetic algorithms and swarm intelligence, focusing on optimization in complex problem spaces.
- **Symbolic AI and Knowledge Representation.** It explores logic-based AI and symbolic reasoning, which are crucial for decision-making, planning, and understanding complex instructions, merging with neural approaches.
- **Advanced Multi-Agent Systems (MAS) in AI.** It investigates how multiple AI agents interact, cooperate, or compete, contributing to game theory, distributed systems, and autonomous decision-making.
- **Neuro-Symbolic AI Integration.** Studies the fusion of neural networks and symbolic AI to enhance learning from data while ensuring interpretability and structured knowledge reasoning.
- **AI in Quantum Computing Paradigms.** Explores how quantum computing revolutionizes AI by offering exponentially faster solutions to complex optimization and computational problems.
- **Causal Inference in AI.** Investigates how AI models are developed to understand and infer cause-and-effect relationships, enhancing decision-making, predictive models, and interpretability in dynamic and uncertain environments.

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