Artificial Intelligence: Foundations, Advances and Perspectives

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Abstract

Artificial Intelligence (AI) has become one of the most influential scientific and technological fields of our time. Based on machine learning, neural networks and intelligent systems, it is profoundly transforming economic, scientific and social sectors. This article presents an overview of the foundations of AI, its main recent advances and future perspectives, while highlighting both opportunities and ethical challenges.

1 Introduction

Since the seminal work of McCarthy et al. (1956), AI has experienced several cycles of enthusiasm and stagnation. Today, it benefits from a favorable combination: massive data availability, increased computing power, and algorithmic advances. Applications range from image recognition to text generation, personalized medicine and robotics. The objective of this short article is to provide a concise overview of the current state of AI and its perspectives.

2 Foundations of AI

AI relies on several subfields:

- **Machine Learning (ML)**: methods that allow systems to improve with experience.

- **Deep Learning**: multi-layer architectures capable of modeling complex functions (LeCun et al., 2015).

- **Natural Language Processing (NLP)**: understanding and generating human language.

- **Multi-agent Systems and Robotics**: autonomous agents interacting in dynamic environments.

3 Recent Advances

The last years have witnessed remarkable breakthroughs:

- **Transformers and Large Language Models (LLMs)**: architectures such as GPT or BERT, revolutionizing NLP.

- **Generative AI**: image generation (GANs, diffusion) and multimodal content creation.

- **Medical Applications**: disease detection, diagnostic support, and drug design.

These advances also raise issues related to energy consumption, transparency and algorithmic biases.

4 Perspectives and Challenges

Future directions include:

- **Explainable AI (XAI)** to improve interpretability of models.

- **Sustainable AI** to reduce the ecological footprint of computation.

- **Hybrid AI** combining symbolic reasoning and statistical learning.

However, ethical challenges remain: data protection, accountability in case of errors, and large-scale disinformation (Jobin et al., 2019).

5 Conclusion

AI is both a revolutionary technology and a subject of societal debate. Its applications open major opportunities, but require critical and multidisciplinary reflection. The future of AI will depend on the balance between technological innovation, ethical regulation, and social acceptance.

References

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