# Chapter 14
# Green Artificial Intelligence and Machine Learning: Strategies for Sustainable Development

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## ABSTRACT

*AI and Machine Learning technologies have been on the rise in the recent past, and as this happens, there have been growing concerns over the energy they consume and their carbon footprint. This paper offers a systematic literature review of Green AI and ML, which discusses approaches deployed to reduce the environmental impact of these technologies without compromising their effectiveness. We address*

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*the environmental impacts of largescale AI models and data centers categorizing energy efficient algorithms, model compression, and low power hardware as the main ways to approach the energy issue. Moreover, we discuss different aspects of AI usage for environmental protection with examples in renewable energy management, climate change tracking, and eco-friendly farming. Data management best practices including federated learning and sustainable dataset creation are also highlighted. Lastly, we discuss future research areas and trends that hold potential to improve the sustainability of AI and ML.*

# 1. INTRODUCTION

## 1.1 Overview of AI and ML's Growing Role in Various Industries

AI and ML have turned into the core components of the development of numerous industries including healthcare, finance, manufacturing, transportation, and entertainment[Nadella et al 2023]. AI is bringing changes in areas such as predictive analytics, automation, data processing, and decision-making that help industries to increase efficiencies, decrease costs and create better customer value[Mohamed et al 2023]. Of this, Machine Learning, a subfield of AI, makes these innovations possible because it enables systems to devise their operations from data without prior coding. By using AI and ML technologies, their applicability is increasing and this is helping world economy to enhance productivity[Raghunath et al 2023].

## 1.2 The Environmental Impact of AI and ML

Although AI and ML have tremendous advantages, the exponential increase in their usage has led to massive environmental impacts, especially in energy consumption and carbon footprint. The training process of big neural networks, especially deep learning ones, consumes a lot of computational resources, which in its turn, consumes a lot of energy. The computation of these models is done by data centers, physical structures that require significant power to operate and much of this power comes from carbon sources. This has raised questions of sustainability of these AI technologies particularly as more organizations get to adopt their use. The effects of AI on the environment are worsened by energy consumption of cooling systems that is required in data centers.