Chapter 1
Machine Learning and Deep Learning Algorithms for Green Computing

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ABSTRACT

Green computing is an innovative approach to making computer systems environmentally friendly, energy-efficient, and low in carbon emissions. It uses advanced techniques from machine learning and deep learning to optimize real-time resource allocation, reducing energy consumption. This approach enhances workload patterns and uses methods like convolutional and recurrent neural networks to enhance architectural efficiency. The integration of ML and DL techniques allows for accurate temperature forecasting and alternative cooling strategies. Despite challenges, the synergistic fusion of ML and DL algorithmic software with green computing holds great promise for reducing energy consumption and enhancing environmental sustainability.

1. INTRODUCTION

Green computing, sometimes referred to as ecological computing, is a method that makes use of semiconductors, computer systems, and software to maximize energy efficiency. It's a sustainable approach that minimizes negative environmental effects by minimizing the need for more computers. This approach extends across the supply chain, from the raw materials used to recycling systems. Green computers must give the greatest work for the least energy, commonly measured by performance per watt. Optimizing the energy efficiency of hardware and minimizing system temperature is also enhanced by DL approaches such as compression neural networks or recurrent neural networks.

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For millennia, intelligent people have contemplated building a device capable of reproducing the functions of the human brain. Originally postulated by Aristotle in 300 B.C., "associationism" is where deep learning originated. Because it is essential that scientists understand how effectively human recognition systems work, this hypothesis served as the impetus for people to become more interested in learning about the brain. The McCulloch-Pitts model, which is commonly referred to as the origin of artificial neural models, was initially proposed in 1943, marking the beginning of the current deep learning era. They designed a computer model based on neural networks that functionally replicate the neocortex in human brains. Reduced energy use, electrical waste reduction, and decreased operating expenses are only a few advantages of green computing Deep compression (Han. S et al, 2015). Data centres, networks, hardware, software, and other components of computer systems are all included in the domain of "green computing." Green computing techniques include improving software efficiency, virtualizing servers, lowering power usage, using renewable energy sources, and managing e-waste.

2. ENERGY-EFFICIENT COMPUTING USING MACHINE LEARNING

Using the scheduling mechanism, the power consumed can be decreased in the software approach. The scheduling approach allocates service requests from clients to virtual machines (VMs) that can fulfil them within the parameters of the service level agreement (SLA). The scheduling approach chooses virtual machines (VMs) running on physical machines (servers) that have the potential to use less power in order to meet the goal of lowering the consumption level of power. Numerous suggested techniques rely on the scheduling or software approach (A. Hameed et al, 2016). Energy efficiency is highly valued in modern cloud computing since it reduces operating costs and adheres to green computing ideals. Resource management in the cloud encompasses many different aspects, such as workload consolidation, job scheduling, virtual machine deployment, and more. Researchers work to establish the best policies for this management. In these attempts, machine learning is essential. In this research, we conduct a comprehensive assessment of the literature on machine learning (ML) in recent works to provide recommendations for energy conservation in cloud computing systems. Large-scale data centres are outfitted with mechanical and electrical gear and sensors that throw millions of data points a day. A machine learning method called "neural network framework" analyses these data points to assess how effectively energy is used. The strategy was tested in Google's data centre. Results indicated that it could result in energy savings (Hatzivasilis, G et al., 2008) (Hassan, M. B et al., 2022). The most important greenhouse gas is carbon dioxide (CO2). According to recent research, five automobiles' worth of on release of carbon dioxide. over course of a Natural Language Processing (NLP) model's development utilising deep neural networks "Deep Learning" (Ning, Z et al., 2019) (Bharany, S et al., 2022) (Luo, T et al., 2023). The mathematical model's initially unknowable parameters are estimated using machine learning. Specifically, we need to ascertain the task performance level. Predict a priori utilisation of resources (e.g., CPU consumption) by different activities under existing workloads and agreements (e.g., reaction periods) given burden characteristics, host features, and competition between jobs on the same host (Raja, S. P., 2021) (Gholipour, N et al., 2021). When paired with precise or approximate schedulers, algorithms based on machine learning can precisely predict system behaviour and assign jobs to hosts in a way that balances power consumption, income, and service quality (Yu, P et al., 2020).