

Chapter 9

Achieving Green Sustainability in Computing Devices in Machine Learning and Deep Learning Techniques

S. Sharanya

Data Science and Business Systems, SRM Institute of Science and Technology, India

V. Vijayalakshmi

Data Science and Business Systems, SRM Institute of Science and Technology, India

R. Radha

Data Science and Business Systems, SRM Institute of Science and Technology, India

ABSTRACT

The accelerated growth in artificial intelligence, internet of devices, machine learning (ML), and deep learning at breakneck speed has attracted the attention of researchers in developing novel green solutions for reclaiming the green society. The intersection of these technologies with green sustainability will greatly impact the deployment of cutting-edge technologies with green solutions. Leveraging ML technologies to improve engineering techniques to reduce the toxins released in the environment in various forms is discussed in this work. The predominant area of focus is applying is developing green AI-based solutions with sustainability measures and metric in mind. The primary contribution of this work is the holistic analysis of the employment of green ML and deep learning techniques in fostering a sustainable environment. The potential scope of this research is to benefit the research community in developing novel ML and deep learning technologies for improving green sustainability.

1. GREEN COMPUTING AND SUSTAINABILITY

Green Computing (GC) or sustainable computing is gaining more popularity due to the detrimental effects of modern day Information and Communication Technologies (ICT). Through the term green computing was coined in early 1990s, it has received global acclamation just before a decade in almost all the sectors of engineering like manufacturing, automobiles and information technology (Murugesan, 2008). GC encompasses design, development, implementation and proper disposal of computing devices in sustainable fashion (Sarkar et al., 2021). The primary motor behind the initiatives of GC is to mitigate the carbon footprint of the computing devices by ensuring optimal usage. This deals with focusing on environment friendly aspects of cutting edge technologies by deploying techniques for efficient resource utilization at reduced computing cost (Jayalath et al., 2019). The canopy of GC extends to almost all computing resources like software, hardware, networks, data centres and other ICT tools. The recommendable GC practices extend from optimised hardware design, low power consumption, using renewable power sources, efficient software, using virtual servers till e waste management (Rautela et al., 2021). These measures have significantly mitigated the energy consumption, decreased the device operational cost without compromising environmental sustainability. However the dark side of GC demands added investments on developing and deploying energy efficient hardware and tapping renewable energy power sources. Augmenting to this, the implementation of proper e-waste management requires tremendous effort from all sectors of the corporates which hinder its widespread usage.

The 4 main pillars of accomplishing GC is shown in Fig 1 (Wong et al., 2020). Practices of green usage focus on reducing the energy consumption of computing devices in an environmental friendly manner. This will greatly reduce the carbon footprint. The next pillar focuses on proper disposal of e waste by encouraging the practice of using or refurbishing old computing devices. At a much higher level green design sheds light on designing environment friendly products without compromising the efficiency of the devices. Green manufacturing relies on producing energy efficient electronic components computing devices and other accessories which has mitigated negative impact on the environment.

Though the above taxonomy is very generic and suitable to almost all engineering disciplines, it has delineated green path for IT sector. From the perspective of computing technologies, GC has extended its hands in three major domains namely sustainability at data centres, leveraging distributed computing and other ICT focused sustainable measures. The role of GC at data centers should never be undermined because they serve as the major contributor of carbon footprint among the computing sector. The measures such as using renewable energy sources, leveraging power management software at the servers, installing IT energy indicators, virtualization of servers, localised HVAC systems, implementing outsourcing and colocation services, usage of solid state devices and optimised storage capacity can greatly reduce the carbon footprints at data centers. Harnessing GC through distributed computing focuses on initiatives suggest virtualization at the client side, enabling thin clients, enhanced power management and improved network efficiency. There is an exhaustive list of measures that are equipped at other ICT based sustainable development. Some major activities include leveraging cloud / edge/ fog computing, disposal and recycling of e waste, paper free environment, management of application energy portfolios, design and development of best practices for efficient and optimised resource management, unified communication, conferencing collaboration telepresence and teleworking regulatory bodies with green procurement policies. Fig 2. Shows the carbon footprint of various computing devices.

13 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/achieving-green-sustainability-in-computing-devices-in-machine-learning-and-deep-learning-techniques/340527

Related Content

Multi-Cloud Adoption Challenges for the Cloud-Native Era: Best Practices and Solution Approaches

Pethuru Raj Chelliah and Chellammal Surianarayanan (2021). *International Journal of Cloud Applications and Computing* (pp. 67-96).

www.irma-international.org/article/multi-cloud-adoption-challenges-for-the-cloud-native-era/274339

Anomaly Detection in Cloud Environments

Angelos K. Marnerides (2019). *Cloud Security: Concepts, Methodologies, Tools, and Applications* (pp. 140-164).

www.irma-international.org/chapter/anomaly-detection-in-cloud-environments/224570

Leveraging Cloud Technology for Rural Healthcare in India

Girish Suryanarayana, Roshan Joseph, Sabishaw Bhaskaran and Amarnath Basu (2014). *Security, Trust, and Regulatory Aspects of Cloud Computing in Business Environments* (pp. 215-233).

www.irma-international.org/chapter/leveraging-cloud-technology-for-rural-healthcare-in-india/100849

The Enabling Technologies for Cloud Computing

(2014). *Pervasive Cloud Computing Technologies: Future Outlooks and Interdisciplinary Perspectives* (pp. 29-48).

www.irma-international.org/chapter/the-enabling-technologies-for-cloud-computing/99398

Improving Virtual Machine Migration Effects in Cloud Computing Environments Using Depth First Inspired Opportunity Exploration

Kamal Kumar and Jyoti Thaman (2022). *International Journal of Cloud Applications and Computing* (pp. 1-22).

www.irma-international.org/article/improving-virtual-machine-migration-effects-in-cloud-computing-environments-using-depth-first-inspired-opportunity-exploration/314209