

Machine Learning et Techniques d'Optimisation pour Améliorer l'Efficacité Energétique des Centres de Données

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Abstract

Data centers, as infrastructures hosting thousands of devices and performing intensive computations, play a key role in large-scale data processing and storage. To ensure a reliable and sustainable service, it is essential to properly manage their resources and understand the correlation between the service provided and energy consumption. Energy is indeed a crucial factor, directly related to operating costs. This correlation makes energy management of data centers a current research topic and of major importance for optimizing the performance and profitability of these infrastructures. Our work focuses on studying the correlation between data center resource utilization and energy consumption. Servers, which are the core of these infrastructures and are among the largest consumers of energy, will be at the center of our analysis. By focusing on the specific elements of the servers that consume the most, we seek to identify the key factors and components influencing energy demand. This analysis will allow us to better understand how each component contributes to overall consumption. Then, a fundamental aspect of this research is to develop Machine Learning models capable of accurately predicting energy consumption. These models will help data center managers anticipate energy needs, efficiently plan resource allocation, and predict workload variations. Accurate load forecasting is of crucial importance, as it directly influences server performance and, consequently, overall energy efficiency. In parallel, proactive load management contributes not only to energy cost optimization but also to data center sustainability by limiting the risks of server overload or underutilization. Finally, another key focus of our work is the optimal placement of virtual machines within physical servers. An optimal placement strategy reduces energy consumption, improves energy efficiency, and maintains improved quality of service, which directly contributes to the profitability and sustainability of data centers.