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## Energy - Efficient Makespan Optimized Task Scheduling and Hybrid Framework for Green Cloud Computing

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Abstract: Cloud computing has emerged as a fundamental technology in modern IT infrastructure, offering scalable and on-demand resource provisioning. However, efficient task scheduling remains a critical challenge due to fluctuating workloads, energy consumption constraints, and the need to maintain optimal Quality of Service (QoS). Traditional scheduling algorithms such as First Come First Serve (FCFS), Round Robin (RR), and Genetic Algorithm (GA) often fail to adapt dynamically to changing cloud environments, leading to inefficient resource utilization and increased power consumption .This research proposes an Enhanced Neighborhood Inspired Multi-verse Scheduler (NIMS) algorithm, which integrates hybrid optimization techniques, energy-aware scheduling, and fault tolerance mechanisms to improve cloud resource allocation. analysing the suggested NIMS technique alongside algorithms: EMVO, IMOMVO, OPSO, LJFPPSO, TSIGA, FPGWO, and MVO, using the CloudSim toolkit with diverse test scenarios for three acknowledged real-world benchmark datasets. The findings of the simulations and experiments conducted within this study demonstrates that the algorithms surpasses the other competing algorithms regarding five critical performance measures: makespan, energy consumption, throughput, load imbalance, average resource utilization.

**Keywords:** Cloud Computing, NIMS Algorithm, CloudSim, Energy-Aware Scheduling, Multi-verse Optimization, Adaptive Resource Allocation, Task Scheduling

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