

From Data to Duty: A Simulation Framework for Sustainable Distributed Computing

Tuesday 29 July 2025 11:00 (30 minutes)

As scientific experiments in basic research of universe & matter continue to generate vast volumes of data, the need for scalable, efficient, and sustainable computing becomes increasingly critical, not only to match the future requirements for data storage and processing but also to align with the responsibility imposed on the scientific community towards a more sustainable future.

This contribution presents the simulation framework DCSim —developed and maintained by an international and interdisciplinary collaboration —designed to model the execution of computing workflows on large-scale heterogeneous distributed computing infrastructures. By simulating detailed aspects of workflow execution—including data movement, job scheduling, resource allocation, and workload execution—the model provides reliable insights into system performance and resource utilization.

A notable feature is its extensibility for energy consumption prediction, enabling users to evaluate and optimize computing workflows not only for efficiency and throughput but also for their environmental impact. This predictive capability supports evidence-based decision-making towards greener computing strategies, aligning with broader ethical imperatives and sustainability goals. The tool is intended to serve both as a planning aid for future infrastructure design and as a guiding basis for developing and promoting responsible digital research strategies and practices.

Sustainability

Sustainable ErUM research centres of the future

Ethics

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Session Classification: Sustainability