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Scalable energy-aware VM allocation on cloud data centers through mathematical programming models

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Mathematical programming models have traditionally been overlooked in favor of heuristics for solving the VM allocation problem, largely due to their perceived lack of scalability. However, rather than using these models to directly solve the allocation problem, we proposed a comprehensive VM allocation strategy that features two models, Micro and Macro, which serve as composable building blocks within algorithms to effectively distribute the computational workload. By employing also various scaffolds — primarily Divide et Impera — we ensured that increasing the problem input size only increases the number of instances to solve, rather than the complexity of any single instance. This approach enabled our Mini, Hybrid, Compound, and Multilayer algorithms to achieve linear scalability, significantly outperforming heuristics and metaheuristics and challenging the prevailing paradigm where these methods dominate mathematical programming in terms of solving time.

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