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**Optimasi Task Scheduling di Heterogeneous Edge Computing Menggunakan Hybrid Optimization Berbasis
Multi-Objective Energi dan Latency**
Adinda Fahmawati Jais, Dr. Sahirul Alam, S.T., M.Eng.
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# INTISARI

## OPTIMASI *TASK SCHEDULING* DI *HETEROGENEOUS EDGE COMPUTING* MENGGUNAKAN *HYBRID OPTIMIZATION* BERBASIS *MULTI-OBJECTIVE* ENERGI DAN *LATENCY*

Adinda Fahmawati Jais

22/494426/SV/20816

*Task scheduling* pada *heterogeneous edge computing* menjadi tantangan karena setiap *edge node* memiliki kapasitas CPU, memori, dan karakteristik daya yang berbeda. Ketidaktepatan alokasi *task* dapat meningkatkan *latency*, konsumsi energi, serta ketidakseimbangan beban antar *node*. Proyek Akhir ini bertujuan merumuskan *Objective Function* untuk meminimalkan energi dan *latency*, serta menerapkan metode optimasi pada simulasi dan lingkungan VPS. Metode yang digunakan adalah perbandingan sembilan kombinasi optimasi, yaitu PSO, BFO, dan Tabu Search sebagai *global optimizer*, dengan None, CPM, dan Diffusion sebagai *local method*. Evaluasi simulasi dilakukan pada 9 *edge nodes* heterogen menggunakan model energi, model *latency*, konvergensi, *time-to-target*, dan CDF. Metode terbaik kemudian divalidasi pada VPS menggunakan satu *central node* dan sembilan *edge nodes*. Hasil simulasi menunjukkan bahwa Tabu + Diffusion memperoleh performa terbaik dengan *final objective* 0,498001, *latency* model 1,380130, dan peningkatan 50,20% terhadap *random baseline*. Validasi VPS menunjukkan *real average latency* turun 94,62%. Selain itu, *estimated real energy* turun 12,75%.

Kata kunci**:** *task scheduling*, *heterogeneous edge computing*, Tabu Search, Diffusion, *latency*, energi

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# *ABSTRACT*

## *TASK SCHEDULING OPTIMIZATION IN HETEROGENEOUS EDGE COMPUTING USING HYBRID OPTIMIZATION BASED ON MULTI-OBJECTIVE ENERGY AND LATENCY*

Adinda Fahmawati Jais

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*Task scheduling in heterogeneous edge computing is challenging because each edge node has different CPU capacity, memory capacity, and power characteristics. Improper task allocation can increase latency, energy consumption, and load imbalance among nodes. This Final Project aims to formulate a Objective Function to minimize energy and latency, as well as to apply optimization methods in simulation and VPS environments.,The method used in this research compares nine optimization combinations, consisting of PSO, BFO, and Tabu Search as global optimizers, combined with None, CPM, and Diffusion as local methods. The simulation evaluation was conducted using 9 heterogeneous edge nodes based on an energy model, latency model, convergence, time-to-target, and CDF. The best-performing method was then validated in a VPS environment consisting of one central node and nine edge nodes. The simulation results show that Tabu + Diffusion achieved the best performance with a final multi-objective of 0.498001, a latency model of 1.380130, and a 50.20% improvement over the random baseline. VPS validation shows that the real average latency decreased by 94.62%. In addition, the estimated real energy decreased by 12.75%.*

*Keywords: task scheduling, heterogeneous edge computing, Tabu Search, Diffusion, latency, energy.*