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 RESEARCH ARTICLE

# An Intelligent Scheduling Strategy in Fog Computing System Based on Multi-Objective Deep Reinforcement Learning Algorithm

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**ABSTRACT** Fog computing (FC) has recently emerged as a promising new paradigm that provides resource-intensive Internet of Things (IoT) applications with low-latency services at the network edge. However, the limited capacity of computing resources in fog colonies poses great challenges for scheduling and allocating application tasks. In this paper, we propose an intelligent scheduling strategy algorithm in an FC system based on multi-objective deep reinforcement learning (MODRL) to select nodes for task processing (fog nodes or cloud nodes) based on three objectives: node current load, node distance, and task priority. The proposed model addresses two main problems: task allocation and task scheduling. We employ three deep reinforcement learning (DRL) agents based on a deep Q network (DQN), one for each objective. However, this is a more challenging scenario because there is a trade-off among these objectives, and eventually, each algorithm may select different processing nodes according to its own objective, which brings us to a Pareto front problem. To solve this problem, we propose using multi-objective optimization, a multi-objective evolutionary algorithm based on decomposition (MOEA/D), and a non-dominated sorting genetic algorithm (NSGA2), which are multi-objective optimization algorithms that can choose the optimal node by considering three objectives. The simulation results show that our proposed intelligent scheduling strategy could achieve better outcomes for the various employed performance, efficiency, and adaptability metrics: Task Completion Time, Makespan, Queuing Delay, Propagation Delay, Transmission Delay, Processing Delay, Computational Delay, Latency, CPU Load, and Storage Utilization, with an average value of 2.02 ms, 10 ms, 2 ms, 9.9 ms, 25 ms, 1.0 ms, 3.5 ms, 10 %, and 99 %, respectively, compared with the existing related research studies.

**INDEX TERMS** Fog computing (FC), Internet of Things (IoT), multi-objective deep reinforcement learning (MODRL), deep Q network (DQN), scheduling and allocating tasks.

## 1. INTRODUCTION

In recent years, with the increasing advancement in the

Moreover, the traditional cloud computing architecture is not compatible with IoT applications because of its inherent

