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IoT Network Security Optimization Through Machine Learning and Metaheuristic Algorithm Techniques

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Abstract:

The convergence of machine learning (ML) and metaheuristic algorithms is revolutionizing the security landscape of Internet of Things (IoT) networks by enabling adaptive, efficient, and scalable intrusion detection systems (IDS). ML classifiers, particularly deep learning models like convolutional neural networks (CNNs) and long short-term memory (LSTM) networks, have demonstrated high accuracy in identifying complex attack patterns within IoT traffic. To enhance these models, metaheuristic optimization techniques such as Firefly Algorithm, Salp Swarm Optimization, and Grey Wolf Optimization are employed to fine-tune hyperparameters and optimize feature selection, thereby improving detection rates and reducing false positives. For instance, a hybrid approach combining Firefly and Salp Swarm Optimization with deep CNNs has shown improved performance in intrusion detection tasks. Additionally, integrating self-attention mechanisms with deep learning and metaheuristic optimization has led to the development of intelligent cybersecurity systems capable of real-time threat detection and response. These advancements underscore the potential of combining ML and metaheuristic algorithms to fortify IoT networks against evolving cyber threats.

Keywords: IoT Security, Machine Learning, Metaheuristic Optimization, Intrusion Detection, Deep Learning, Cybersecurity

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