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Machine Learning for Anomaly Detection in Edge Clouds

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Abstract

Edge clouds have emerged as an essential architecture, revolutionizing data processing and analysis by bringing computational capabilities closer to data sources and end-users at the edge of the network. Anomaly detection is crucial in these settings to maintain the reliability and security of edge-based systems and applications despite limited computational resources. It plays a vital role in identifying unexpected patterns, which could indicate security threats or performance issues within the decentralized and real-time nature of edge cloud environments. For example, in critical edge applications like autonomous vehicles, augmented reality, and smart healthcare, anomaly detection ensures the consistent and secure operation of these systems, promptly detecting anomalies that might compromise safety, performance, or user experience. However, the adoption of anomaly detection within edge cloud environments poses numerous challenges.

This thesis aims to contribute by addressing the problem of anomaly detection in edge cloud environments. Through a comprehensive exploration of anomaly detection methods, leveraging machine learning techniques and innovative approaches, this research aims to enhance the efficiency and accuracy of detecting anomalies in edge cloud environments. The proposed methods intend to overcome the challenges posed by resource limitations, the lack of labeled data specific to edge clouds, and the need for accurate detection of anomalies. By focusing on machine learning approaches like transfer learning, knowledge distillation, reinforcement learning, deep sequential models, and deep ensemble learning, this thesis endeavors to establish efficient and accurate anomaly detection systems specific for edge cloud environments.

The results demonstrate the improvements achieved by employing machine learning methods for anomaly detection in edge clouds. Extensive testing and evaluation in real-world edge environments show how machine learning-driven anomaly detection systems improve identification of anomalies in edge clouds. The results highlight the capability of these methods to achieve a reasonable trade-off between accuracy and computational efficiency. These findings illustrate how machine learning-based anomaly detection approaches contribute to building resilient and secure edge-based systems.

Keywords
Edge Clouds, Anomaly Detection, Machine Learning

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