ABSTRACT

Thesis title: Deep Neural Network Based on Graph-Level representation learning for Graph Aware application

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In recent years, graph-based deep learning has emerged as a crucial research direction, particularly with the development of graph convolutional networks (GCNs). These models enable the extraction of structural information from non-Euclidean data, extending the capabilities of deep neural networks (DNNs) to fields such as cybersecurity, computer vision, and social network analysis. However, most exist- ing studies primarily focus on node-level representations while underutilizing global graph structures.

This study proposes a DNN model based on graph-level representation learning to enhance the performance of graph-aware applications. Instead of relying solely on node features, this approach captures structural information across the entire graph, improving generalization and model performance.

The objective of this research is to optimize deep learning model for graph-structured data, enabling effective processing of complex datasets. To evaluate the proposed ap- proach, we applied it to two critical tasks:

• SQL Injection detection, where SQL queries are represented as graphs, allowing GCNs to extract deeper features.

• Hand gesture recognition using skeletal data, integrating GCNs with attention mechanisms and spatiotemporal features to enhance accuracy.

The methodology involves extended GCN architectures, combined with self-attention mechanisms to improve graph-level representation learning. Experimental

results demonstrate that the proposed approach achieves SOTA performance in SQL Injec- tion detection with an accuracy of 99%, while also attaining 99.53% accuracy in hand gesture recognition, outperforming traditional methods.

These findings highlight the potential of deep learning on graph representations in improving AI system performance across various domains. However, this study also identifies key challenges, such as the complex preprocessing required for graph data and the dependence on labeled datasets. Future research will focus on unsupervised learning for graphs and extending models to dynamic graphs.