A Novel Hybrid Complex Multilayer Perceptron for Enhancing DDoS Attack Detection in Network Security

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Abstract:

Distributed Denial of Service (DDoS) attacks are potential threats to network stability, whilst network traffic for machine learning models is challenging to analyses due to its complexity. In this study, a novel Hybrid Complex Multilayer Perceptron (HCMLP) model is introduced for detecting DDoS attacks. In order to improve HCMLP's feature extraction and classification capability, we adopted multibranch structures, residual connections, dense blocks and attention mechanism. The architecture comprises three branches: while a standard MLP has been used for initial feature learning, feature reuse is implemented based on a Dense Net type structure, and the residual blocks of a ResNet type are employed to solve the vanilla gradient problem. This approach to fusion averages outputs from all branches to create a rich set of features. Further, the performance of the model has been improved via reinforcement learning with particular loss functions. CIC-IDS 2018 dataset has been used to evaluate the performance of the HCMLP. Results showed precision of 1.00, recall and F1 scores of 1.00 and accuracy of 99.96 percent. Ranking the attacks within 30 seconds, the proposed method is highly efficient and can achieve a 15.2% increase in runtime for the CIC-IDS 2018 benchmark. Feature selection is intuitively facilitated by the attention mechanism of the HCMLP, and gradient flow is improved with dense and residual connections. In this work we address class imbalance and shift in attack patterns under complex network environments to advance state of the art DDoS detection models.

Keywords:

Attack Detection, CIC-IDS 2018 dataset, Network Security, Hybrid Complex Multilayer Perceptron.