

PREFACE

Praise be to Allah SWT for His grace and guidance, which has enabled the author to complete this thesis entitled **”Two-Stage Semi-Supervised Co-Training for Enhanced Multi-Class Intrusion Detection”** as part of fulfilling the requirements for the Master’s degree in Electrical Engineering at Telkom University.

This thesis was motivated by the increasing need for adaptive and efficient intrusion detection systems that can perform well in multi-class classification scenarios, even with limited labeled data. To address this challenge, the proposed research introduces a two-stage co-training framework using Semi-Supervised Learning, incorporating Naive Bayes and Random Forest classifiers, as well as confidence-based pseudo-labeling through the FlexCon family of methods. Dimensionality reduction techniques such as Incremental PCA and Random Projection are also explored to enhance performance and reduce computational complexity.

Throughout the preparation of this thesis, the author encountered numerous challenges—both technical and conceptual—which have provided valuable learning experiences and helped deepen the author’s understanding of intrusion detection systems and machine learning frameworks. While this work has attempted to explore the problem in depth, the author is aware that the results and discussions may still have limitations.

Constructive feedback and suggestions from readers are warmly welcomed to improve this work further. It is the author’s sincere hope that this thesis will contribute meaningfully to the field of cybersecurity, particularly in the advancement of semi-supervised learning for network intrusion detection.

Bandung, August 12, 2025

Reynaldi Ichsanul Selamat Sembiring