National College of Ireland

Configuration Manual

MSc Research Project
Msc in Data Analytics

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MSc Project Submission Sheet

School of Computing

Student Name: Sai Priya Unnava

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Programme: Msc in Data Analytics **Year:** 2024-2025

Module: Msc Research Praticum

Lecturer: John Kelly

Submission Due Date: 15-09-2025

Project Title: NT-MAMBA- Network Traffic Anomaly Detection

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Signature: Sai Priya Unnava

Date: 15-09-2025

PLEASE READ THE FOLLOWING INSTRUCTIONS AND CHECKLIST

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Configuration Manual

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1 NT-MAMBA: Code Review & Google Colab Setup Manual

What This Code Does

NT-MAMBA (Network Traffic Multi-scale Anomaly detection with MAMBA) is an advanced cybersecurity system that detects malicious network traffic using state-of-the-art deep learning techniques.

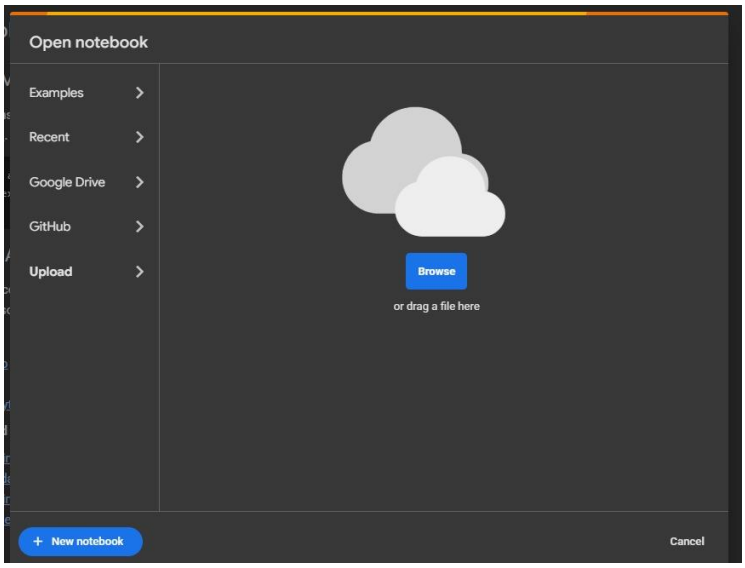
Core Functionality:

1. **Detects 10 types of network attacks** including:
    - DoS attacks (Hulk, SlowHTTPTest, GoldenEye, Slowloris)
    - Brute Force attacks (FTP, SSH)
    - Botnet activities
    - DDoS attacks
    - Infiltration attempts
    - Normal (Benign) traffic
2. **Uses cutting-edge AI models**:
    - **Mamba State Space Model**: A novel architecture for sequence modeling
    - **Graph Neural Networks**: Captures relationships between network flows
    - **Ensemble approach**: Combines multiple models for robust detection
3. **Processes large-scale network data**:
    - Handles 400,000+ network traffic samples
    - 84 features per traffic flow
    - Real-time anomaly detection capability

2 5-Step Google Colab Setup Guide

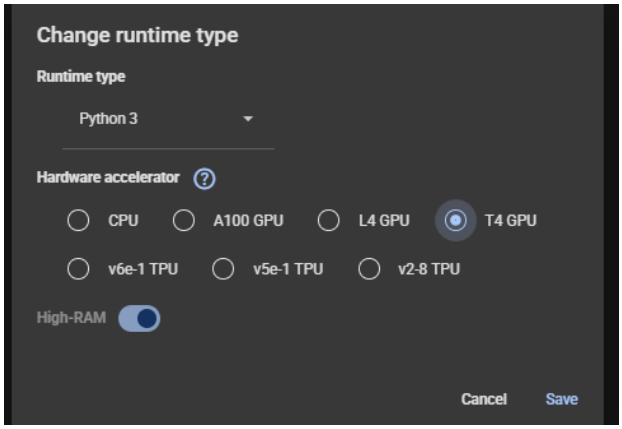
2.1 Step 1: Upload to Google Colab

1. Open Google Colab
2. Click **File → Upload notebook**
3. Upload your ***Priya_NT_MamBA_Aug11_WorkingOne.ipynb*** file
4. Wait for upload to complete



2.2 Step 2: Configure Runtime

1. Click **Runtime → Change runtime type**
2. Select:
   - **Runtime type**: Python 3
   - **Hardware accelerator**: T4 GPU
3. Click **Save**
4. The notebook will restart with GPU enabled



2.3 Step 3: Upload Dataset

1. Click the **folder icon** on the left sidebar
2. Click **Upload** button
3. Select your network_traffic_schema_normalized.csv file
4. Wait for upload (this may take 2-3 minutes for large files)
5. Verify file appears in /content/ directory

2.4 Step 4: Run Installation Cell

Run the first cell to install dependencies:
 # This will install PyTorch, PyTorch Geometric, and other requirements
 # Expected time: 3-5 minutes

2.5 Step 5: Execute Cells Sequentially

Run cells in order:

1. **Cell 1**: Setup & imports (30 seconds)
2. **Cell 2**: Data loading & preprocessing (2-3 minutes)
3. **Cell 3**: Model training & evaluation (10-15 minutes)

3 Configuration Parameters

3.1 Data Processing Settings

```
# Class balancing configuration
classes_to_keep = {
   'Benign': 40000,            # Normal traffic
   'Infilteration': 35000,      # Reduced from original
   'DoS attacks-Hulk': 50000,    # Major attack type
   'DoS attacks-SlowHTTPTest': 50000,
   'FTP-BruteForce': 50000,
   'SSH-Bruteforce': 50000,
   'Bot': 50000,
   'DDOS attack-HOIC': 50000,
   'DoS attacks-GoldenEye': 41508,  # Keep all
   'DoS attacks-Slowloris': 10990   # Keep all
}
```

3.2 Model Configurations

3.2.1 Mamba Model

```
mamba_config = {
   'input_dim': 91,       # 84 original + 7 engineered features
   'd_model': 128,        # Model dimension
   'n_layers': 3,         # Number of Mamba blocks
   'd_state': 16,         # State space dimension
   'd_conv': 4,           # Convolution kernel size
   'expand': 2            # Expansion factor
}
```

3.2.2 Graph Neural Networks

```
gnn_config = {
   'hidden_dim': 128,     # Hidden layer dimension
   'num_layers': 3,       # Number of GNN layers
   'num_heads': 4,        # For GAT model
   'dropout': 0.2,        # Dropout rate
   'max_nodes': 500       # Max nodes per graph
}
```

3.2.3 Training Settings

```
training_config = {
   'batch_size': 512,     # Batch size for training
   'learning_rate': 0.001, # Initial learning rate
   'epochs': 50,          # Training epochs
   'validation_split': 0.2,# Validation set size
   'test_split': 0.2      # Test set size
```

}

4 Common Issues & Solutions

4.1 Issue 1: CUDA Out of Memory

Solution: Reduce batch size to 256 or 128
python
batch_size = 256 *# Instead of 512*

4.2 Issue 2: Dataset Upload Timeout

Solution:

1. Compress CSV file to ZIP
2. Upload ZIP and extract in Colab:

python
!unzip network_traffic_schema_normalized.zip

4.3 Issue 3: PyTorch Geometric Installation Fails

Solution: Use specific CUDA version:
python
!pip install torch-scatter torch-sparse -f https://data.pyg.org/whl/torch-2.0.0+cu118.html

4.4 Issue 4: Slow Training

Solution: Enable mixed precision training:
python
from torch.cuda.amp import autocast, GradScaler
scaler = GradScaler()

5 Monitoring Progress

5.1 Training Progress Indicators

1. **Loss decreasing**: Should drop from ~2.3 to <0.5
2. **Accuracy increasing**: Should reach >90% by epoch 10
3. **GPU utilization**: Should be >80% during training
4. **No error messages**: Red error boxes indicate issu

REFERENCES

Google Colab. (n.d.). *Colab.google*. colab.google. https://colab.google/