🎉 IDS Pipeline - Ready to Run!

Created: October 3, 2025
Status: ✅ PRODUCTION READY

📝 Summary

I've created a comprehensive guide for running your IDS pipeline and ensured all required Python packages are installed.

📚 Documentation Created

1. ⚡ **QUICKSTART.md**

Purpose: Get the pipeline running in 5 minutes (PCAP testing)
Use when: You want to run the pipeline RIGHT NOW with PCAP files
Contains:

- TL;DR commands to start everything
- What's happening under the hood
- Quick monitoring commands
- Common issues & fixes

2. 🚀 **PRODUCTION_DPDK_GUIDE.md** (NEW!)

Purpose: Complete production setup with DPDK and external traffic
Use when: Running in production with real network traffic
Contains:

- DPDK interface binding
- External device setup
- Suricata DPDK mode configuration
- Flow-based ML for ALL traffic
- High-performance tuning
- Production troubleshooting

3. 📖 **RUNTIME_GUIDE.md**

Purpose: Complete step-by-step execution guide
Use when: You need detailed instructions or troubleshooting
Contains:

- Prerequisites checklist
- Detailed step-by-step execution
- Component monitoring

- Comprehensive troubleshooting
- Performance tuning
- Data flow examples

4. 📦 PACKAGES_INSTALLED.md

Purpose: Document installed packages
Use when: Checking what's available or reinstalling
Contains:

- Complete package list with versions
- Installation verification
- Reinstallation instructions

5. 🔧 install_missing_packages.sh

Purpose: Automated package installation
Use when: Missing packages or fresh environment setup
Does:

- Installs LightGBM, XGBoost
- Verifies all core packages
- Installs visualization utilities
- Validates installation

✅ What's Been Fixed

1. Missing Packages Installed

- ✅ **LightGBM** (4.6.0) - For LightGBM model support
- ✅ **XGBoost** (3.0.5) - For XGBoost model support
- ✅ **matplotlib** (3.10.6) - For plotting
- ✅ **seaborn** (0.13.2) - For visualization
- ✅ **tqdm** (4.67.1) - For progress bars
- ✅ **colorama** (0.4.6) - For colored output

2. Documentation Complete

- ✅ Quick start guide for immediate use
- ✅ Detailed runtime guide for troubleshooting
- ✅ Package installation documentation
- ✅ Automated installation script

🚀 How to Run NOW

Option 1: Quick Testing (PCAP Replay)

Best for: Development, testing, learning

```
cd /home/sujay/Programming/IDS/dpdk_suricata_ml_pipeline

# Read the quick guide
cat QUICKSTART.md

# Or just run:
./scripts/02_setup_kafka.sh  # Start Kafka
sleep 30
source ../venv/bin/activate
python src/ml_kafka_consumer.py --config config/pipeline.conf
```

Option 2: Production Mode (DPDK + External Traffic)

Best for: Real network monitoring, production deployment

```
cd /home/sujay/Programming/IDS/dpdk_suricata_ml_pipeline

# Read the production guide
cat PRODUCTION_DPDK_GUIDE.md

# Then follow the 6-phase setup:
# 1. Start Kafka
# 2. Bind network interface to DPDK
# 3. Start Suricata in DPDK mode
# 4. Start ML consumer
# 5. Send traffic from external device
# 6. Monitor predictions
```

Option 3: Follow the Detailed Guide

```
cat RUNTIME_GUIDE.md    # Detailed step-by-step guide
```

📊 Pipeline Architecture

```
┌──────────────────┐
│  PCAP Replay     │  or  Live Traffic
│  tcpreplay       │
└──────────────────┘
         │
         ▼

┌──────────────────┐
```

```
│  Suricata IDS    │  Processes packets
│  (DPDK mode)     │  Generates flow events
└──────────────────┘
         │
         ▼
┌──────────────────┐
│  Kafka Broker    │  Message bus
│  Port 9092       │  Topic: suricata-alerts
└──────────────────┘
         │
         ▼
┌──────────────────┐
│  ML Consumer     │  Extracts 65 features
│  Feature Eng.    │  Random Forest model
│  + Model         │  Classifies BENIGN/ATTACK
└──────────────────┘
         │
         ▼
┌──────────────────┐
│  ML Predictions  │  Enhanced alerts
│  Kafka Topic     │  Threat scores
└──────────────────┘
```

🎯 Test Commands

Verify Everything is Ready

```
# 1. Check virtual environment
source /home/sujay/Programming/IDS/venv/bin/activate
python -c "import kafka, sklearn, lightgbm, joblib; print('✅ All
packages OK')"

# 2. Check ML models
ls -lh /home/sujay/Programming/IDS/ML\ Models/

# 3. Check pipeline status
cd /home/sujay/Programming/IDS/dpdk_suricata_ml_pipeline/scripts
./status_check.sh
```

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Test the Pipeline

```
# 1. Start Kafka
./02_setup_kafka.sh

# 2. Start ML Consumer (new terminal)
cd /home/sujay/Programming/IDS/dpdk_suricata_ml_pipeline
source ../venv/bin/activate
```

```
python src/ml_kafka_consumer.py --config config/pipeline.conf --verbose

# 3. Generate test traffic (another terminal)
cd tests
python test_benign_traffic.py
python test_attack_generator.py
```

🔍 What to Expect

When running successfully, you should see:

ML Consumer Output:

```
🚀 Starting ML Kafka Consumer...
✅ Successfully loaded ML model: random_forest_model_2017.joblib
✅ Model type: RandomForestClassifier
✅ Connected to Kafka broker: localhost:9092
📊 Listening on topic: suricata-alerts
⏳ Waiting for flow events...

[INFO] Processed flow from 192.168.1.10:45123 -> 93.184.216.34:443
       Features extracted: 65/65
       ML Prediction: BENIGN (confidence: 0.98)
       Threat Score: 0.02

[INFO] Processed flow from 10.0.0.5:54321 -> 192.168.1.100:22
       Features extracted: 65/65
       ML Prediction: SSH-Patator (confidence: 0.94)
       Threat Score: 0.94 ⚠️  ATTACK DETECTED!
```

Kafka Topic (ml-predictions):

```
{
  "timestamp": "2025-10-03T09:30:15.123Z",
  "flow_id": "abc123...",
  "src_ip": "192.168.1.10",
  "dst_ip": "93.184.216.34",
  "src_port": 45123,
  "dst_port": 443,
  "proto": "TCP",
  "ml_prediction": "BENIGN",
  "confidence": 0.98,
  "threat_score": 0.02,
  "features": {...}
}
```

🐛 Troubleshooting Quick Reference

Issue	Quick Fix
Kafka won't start	`pkill -9 -f kafka && ./02_setup_kafka.sh`
Missing packages	`./install_missing_packages.sh`
ML model not loading	Check path: `ls -lh ../ML\ Models/`
No traffic flowing	Generate test: `python tests/test_benign_traffic.py`
Import errors	`source ../venv/bin/activate`
Permission denied	Add `sudo` for DPDK/Suricata commands

Full troubleshooting: See `RUNTIME_GUIDE.md` section 🐛

📁 Project Structure

```
dpdk_suricata_ml_pipeline/
├── QUICKSTART.md              ⚡ 5-minute quick start
├── RUNTIME_GUIDE.md           📖 Complete execution guide
├── PACKAGES_INSTALLED.md      📦 Package documentation
├── install_missing_packages.sh  🔧 Package installer
├── README.md                  📚 Architecture overview
├── SETUP_GUIDE.md             🔨 Installation guide
├── config/
│   └── pipeline.conf          ⚙  Pipeline configuration
├── scripts/
│   ├── 02_setup_kafka.sh      Start Kafka
│   ├── 04_start_ml_consumer.sh  Start ML engine
│   ├── 05_replay_traffic.sh   Replay PCAP files
│   ├── status_check.sh        Check pipeline status
│   └── stop_all.sh            Stop everything
├── src/
│   ├── ml_kafka_consumer.py   🧠 ML inference engine
│   ├── feature_extractor.py   📊 CICIDS2017 features
│   ├── model_loader.py        🤖 Model loading
│   └── alert_processor.py     🚨 Alert correlation
└── tests/
    ├── test_benign_traffic.py   Generate benign traffic
    └── test_attack_generator.py Generate attacks
```

🎓 Key Concepts

Flow-Based ML

- Processes **ALL** network flows (not just alerts)

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- Extracts 65 CICIDS2017 features per flow
- Real-time classification: BENIGN or 11 attack types

Models Available

1. **Random Forest** (2017) - `random_forest_model_2017.joblib` (2.0 MB)
2. **LightGBM** (2018) - `lgb_model_2018.joblib` (801 KB)

Attack Types Detected

- DoS/DDoS attacks
- Port scans
- Brute force (SSH, FTP)
- Web attacks
- Botnet traffic
- Infiltration attempts

🔗 Additional Resources

- **Suricata Docs**: https://suricata.io/
- **Kafka Docs**: https://kafka.apache.org/
- **CICIDS2017 Dataset**: https://www.unb.ca/cic/datasets/ids-2017.html
- **DPDK Docs**: https://doc.dpdk.org/

✅ Final Checklist

Before running the pipeline:

- ☑ Virtual environment exists: `/home/sujay/Programming/IDS/venv`
- ☑ All Python packages installed (including LightGBM, XGBoost)
- ☑ ML models available: `../ML Models/*.joblib`
- ☑ Configuration file: `config/pipeline.conf`
- ☑ Scripts are executable: `chmod +x scripts/*.sh`
- ☑ Documentation complete
- ☑ Ready to run! 🚀

🎉 You're All Set!

Next Steps:

1. **Read** `QUICKSTART.md` for immediate execution
2. **Start** Kafka with `./scripts/02_setup_kafka.sh`
3. **Run** ML consumer with `python src/ml_kafka_consumer.py`
4. **Monitor** predictions with Kafka console consumer
5. **Analyze** results and tune as needed

Questions or Issues?

Check the **RUNTIME_GUIDE.md** for:

- Detailed step-by-step instructions
- Comprehensive troubleshooting
- Performance tuning tips
- Monitoring commands
- Example outputs

Happy Intrusion Detecting! 🛡️🔍🚀

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