# UNDERSTANDING AND MITIGATING DDOS THREATS

Team 3: Rafa, Tony, Jennie

# WHAT IS DDOS?

## Distributed Denial of Service:

A DDoS attack is when hackers use thousands of computers to send too much traffic to a website or online service all at once

→ This overloads the system, making it slow or completely unavailable to real users.

# WHY IS IT IMPORTANT?

By identifying and stopping attack flows early, systems can stay online and available for legitimate users.

Minimizes Financial and Operational Loss

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**Project Objective:**
Model to predict whether a flow is part of a genuine request by a user or part of an attack.

# DATA OVERVIEW

**~13M**
Data points
(DDoS + Benign)

**~13M**
FLOWS
(forward or reverse)

**85**
Features

- Flow Summary Stats
- Traffic Volume
- Packet Stats
- Timing Features
- TCP Flags

**DDoS simulated made in a controlled environment**

- Benign requests created using B-Profile system
- DDoS attack simulated through pen testing techniques

# HOW TO DETECT DDOS ATTACK?

| Key Factors | Definition |
|---|---|
| Flow Summary Stats | Attack flow might consist of thousands of **tiny packets** sent over a very **short time** |
| Traffic Volume | **Sudden spikes in traffic**, especially targeting a single IP. |
| Packet Stats | **High packet rate,** uniform or tiny packet sizes |
| Timing Features | Traffic is often machine-generated, leading to **consistent timing patterns** |
| TCP Flags | Abuse the **TCP handshake** (e.g., SYN flood), where the attacker sends many **SYN packets** but never completes the handshake |

# DATA PREP

**01.**

**Reduced size** from 14M to 100K rows

- Random sampling 50K from benign, 50K from DDOS

**02.**

**Handled extreme values** by capping them at the 99th percentile to limit the impact of outliers and infinite values

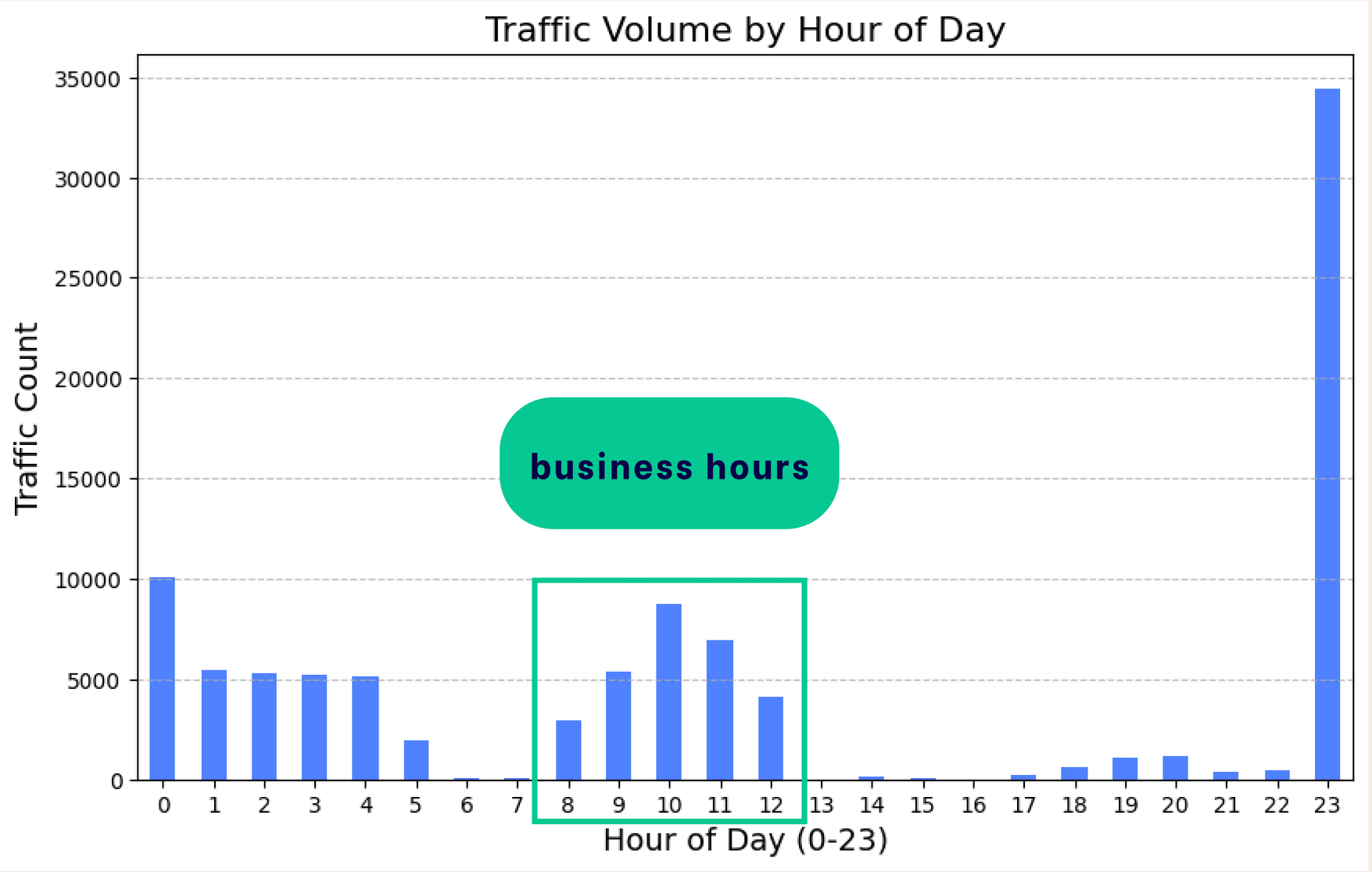
**03.**

**Dropping missing values.** Less than 0.01% of our data is missing since the flows were recreated in a controlled environment

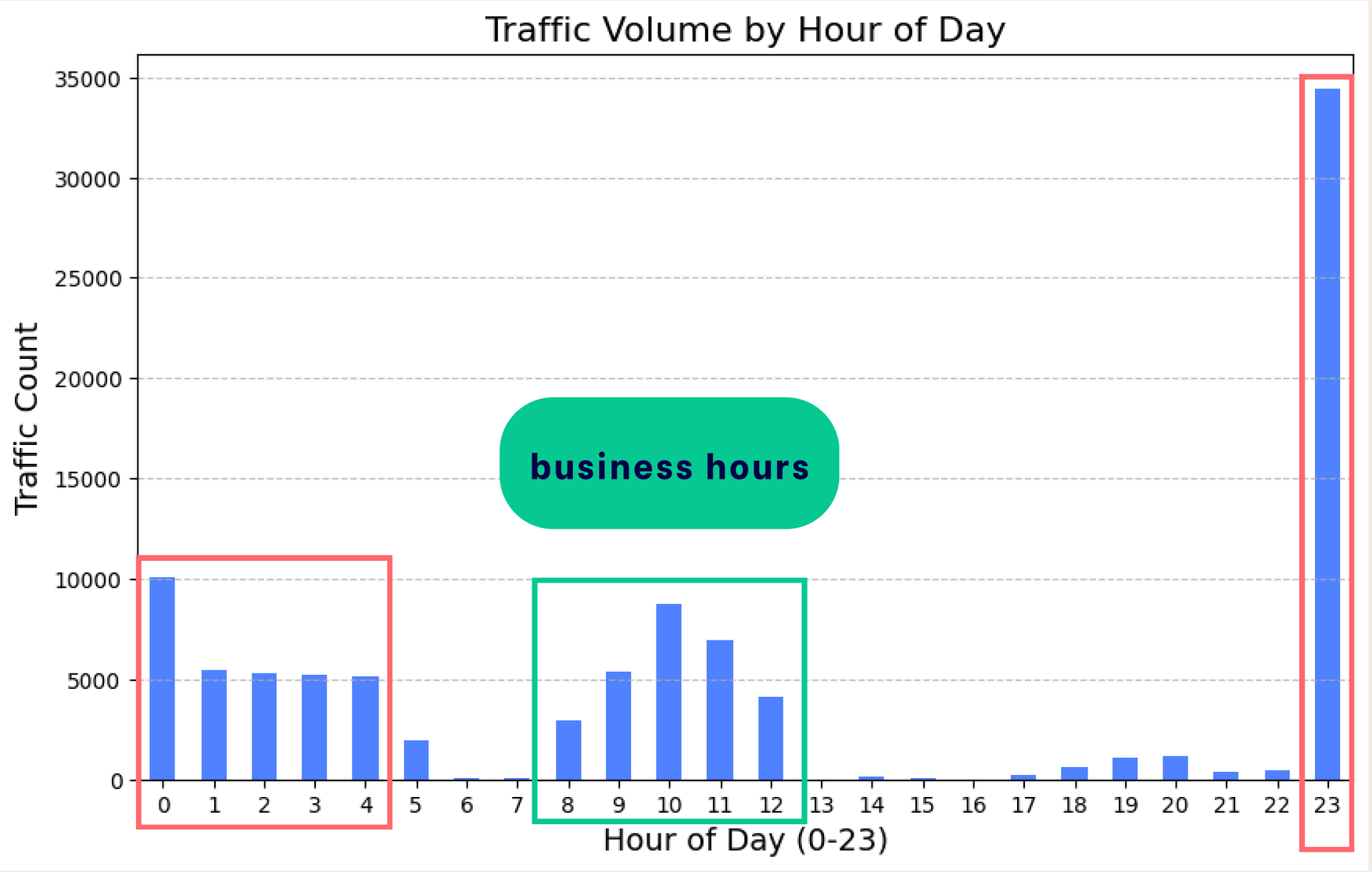
# ANALYSIS

## HOW WE APPROACH THIS PROBLEM IN REAL LIFE USING TIMING FEATURES

# TRAFFIC VOLUME BY HOUR



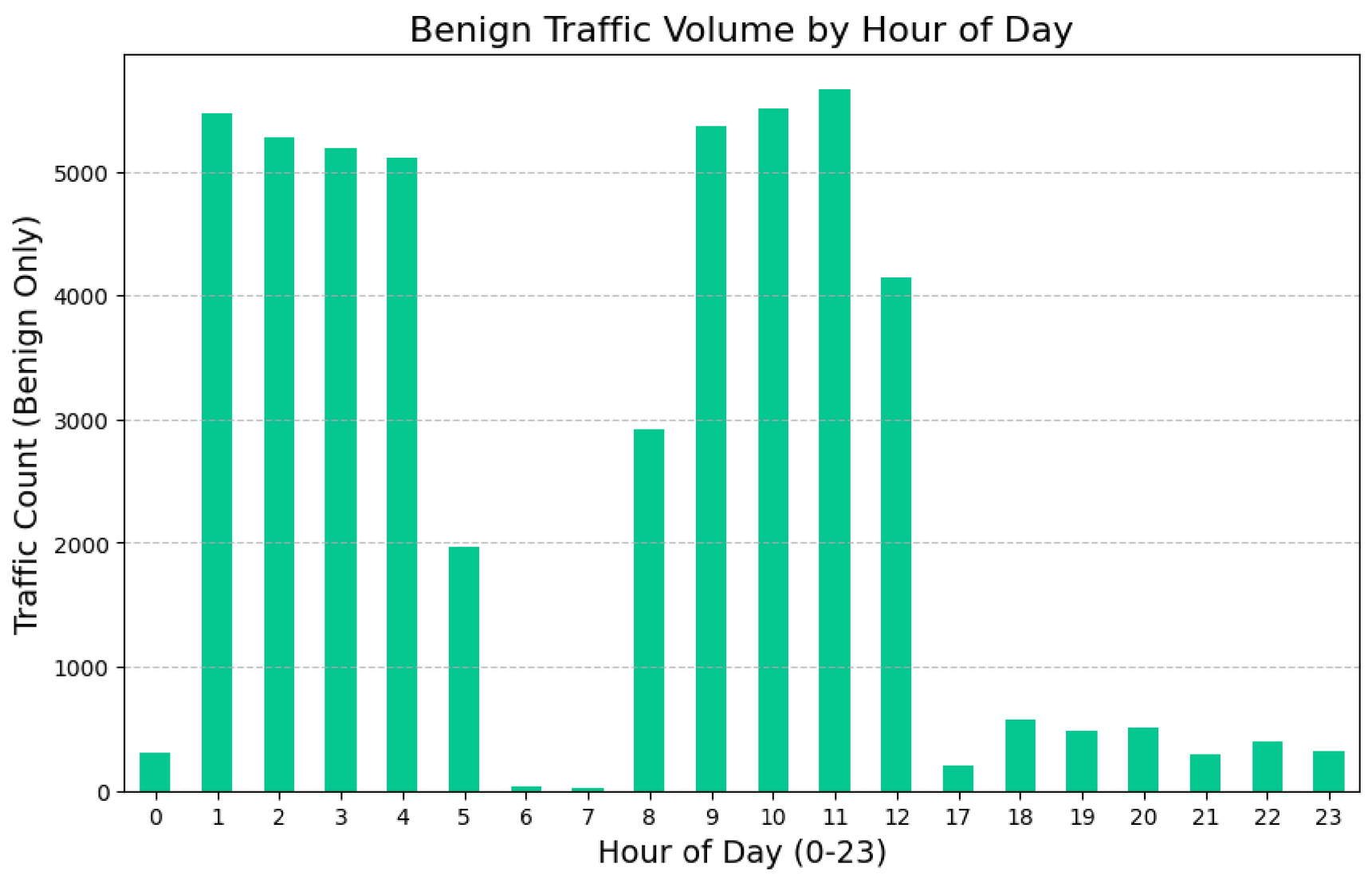
# TRAFFIC VOLUME BY HOUR




**SUSPICIOUS**

**Are these requests benign or ddos attack?**

# TRAFFIC VOLUME BY HOUR

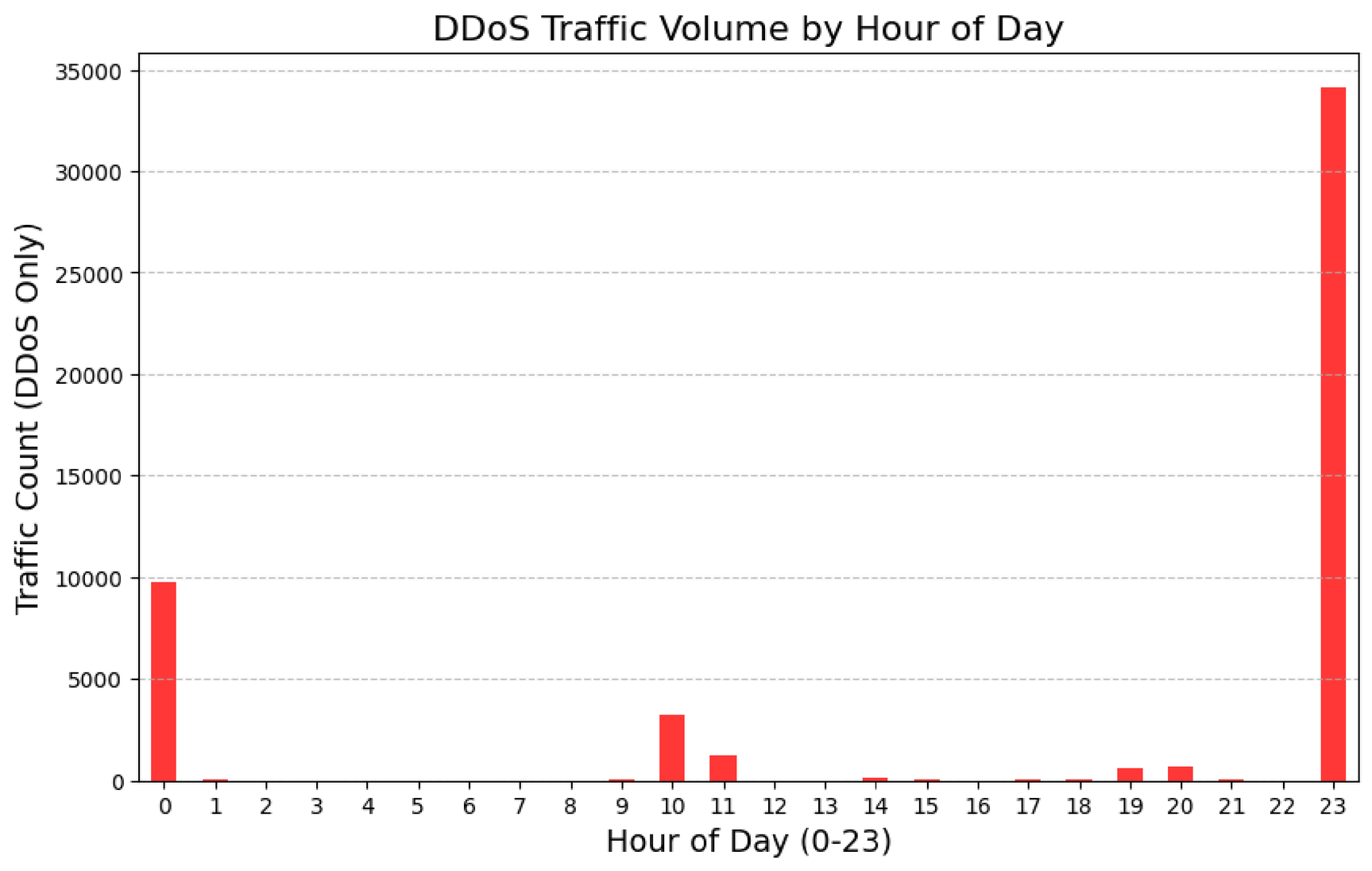



**Benign traffic:**

- **1–4 AM:** Possibly background system processes
- **9–12 PM:** Likely actual user activity or regular business hours

**Range from 0 - 6K requests**

# TRAFFIC VOLUME BY HOUR

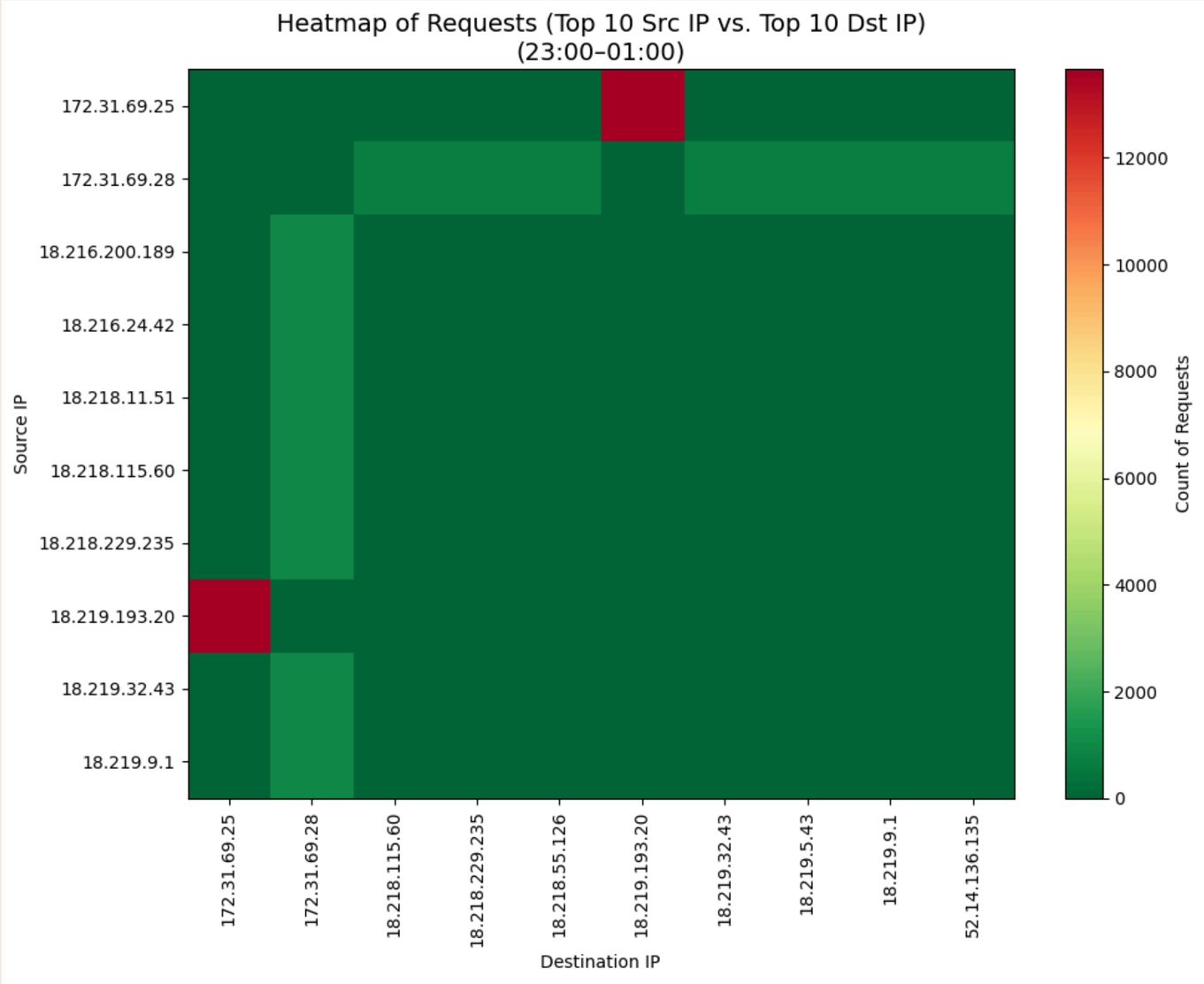



**DDoS traffic:**

- **11PM - 12AM:** Mid-night attacks

**Reach up to 35K requests per hour**

# IP-RELATED DDOS INDICATORS




## 23:00 - 1:00

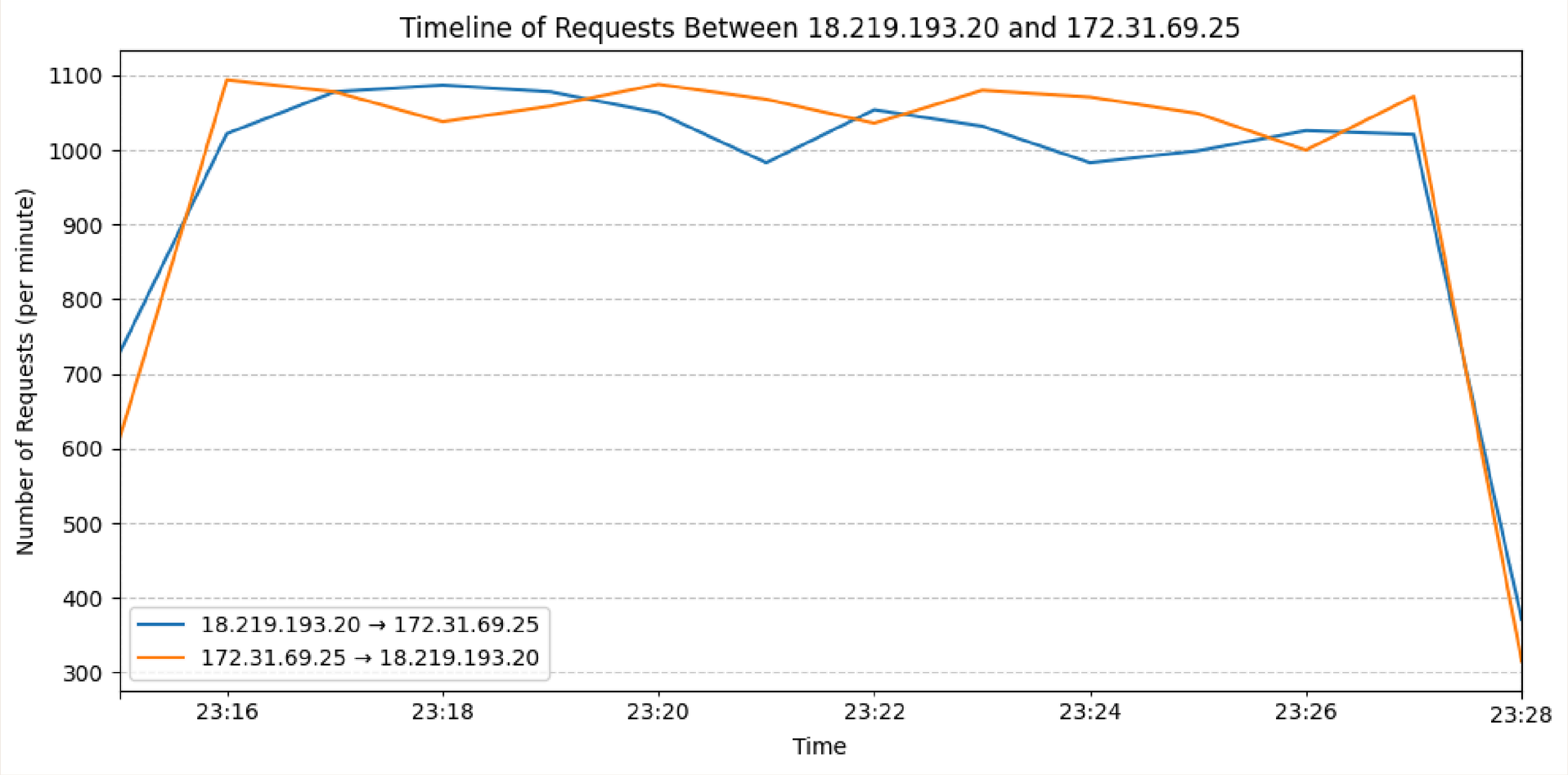
Same 2 IP address:

- 172.31.69.25
- 18.219.193.20

Volume: ~27K requests in total

# IP-RELATED DDOS INDICATORS

~1000 requests per minute



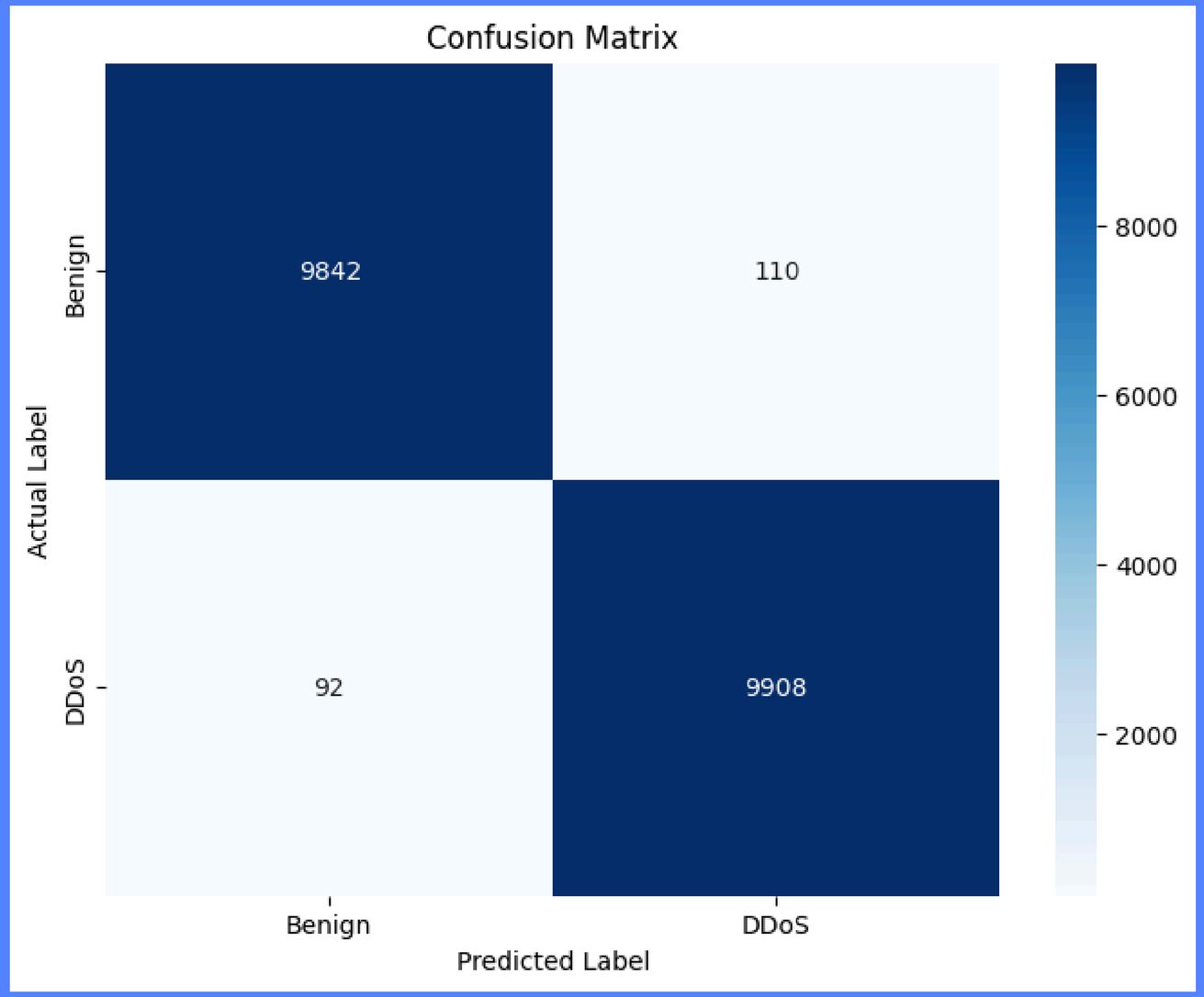

10 min

# MODELS TRAINED

1. Logistic Regression
2. Decision Tree
3. K-Nearest Neighbors
4. Gradient Boosting Classifier

- Feature Engineering
- Random GridSearchVC
- Cross Validation

# LOGISTIC REGRESSION




## METRICS:

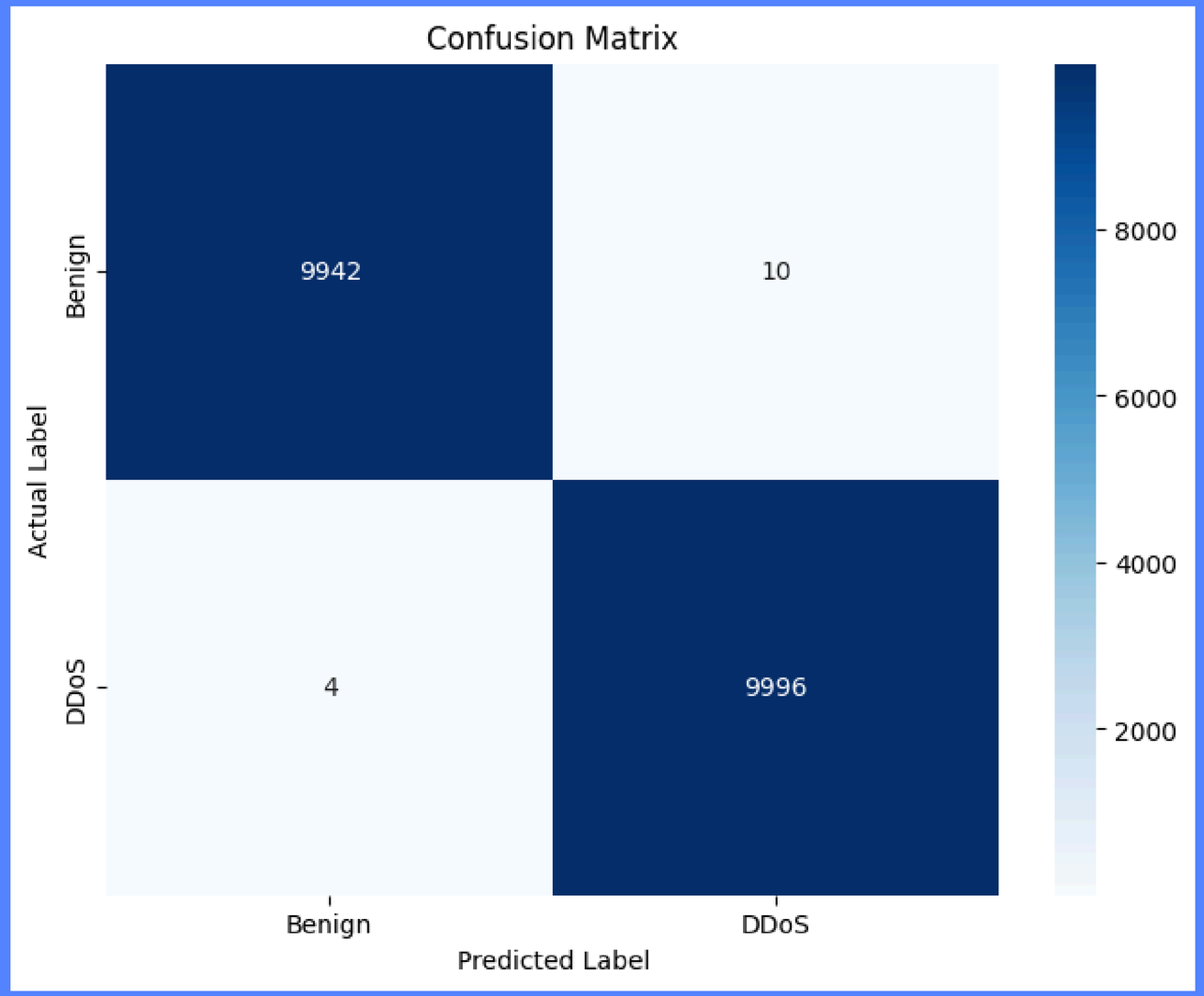
Accuracy: 98.9%

## HIGH COEFFICIENT FEATURES

L1 Penalty (LASSO):

- TCP Flag

# DECISION TREE



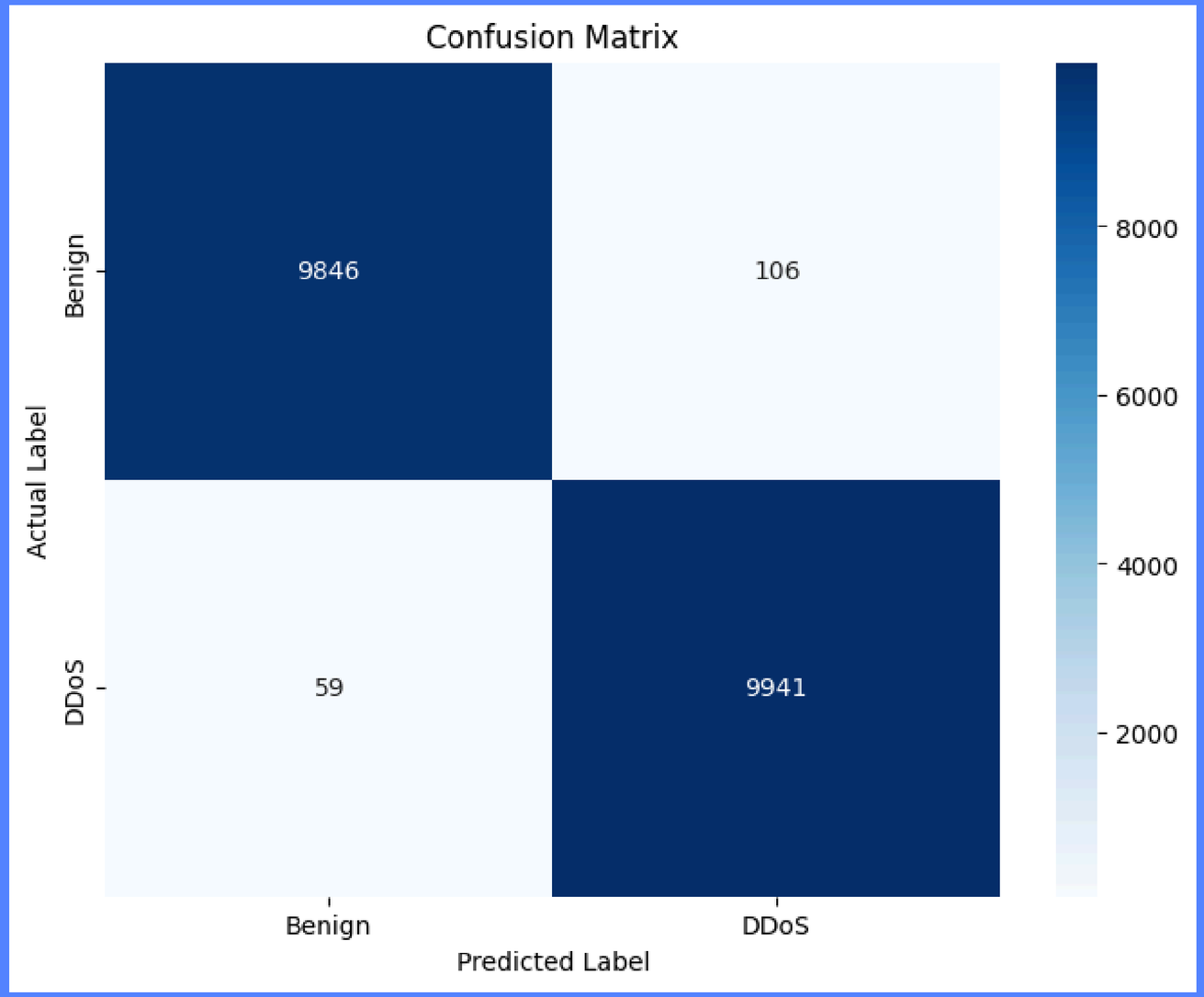

## METRICS:

Accuracy: 99.93%

## HIGH COEFFICIENT FEATURES

- Traffic Volume
- Packet Stats

# K-NEAREST NEIGHBORS



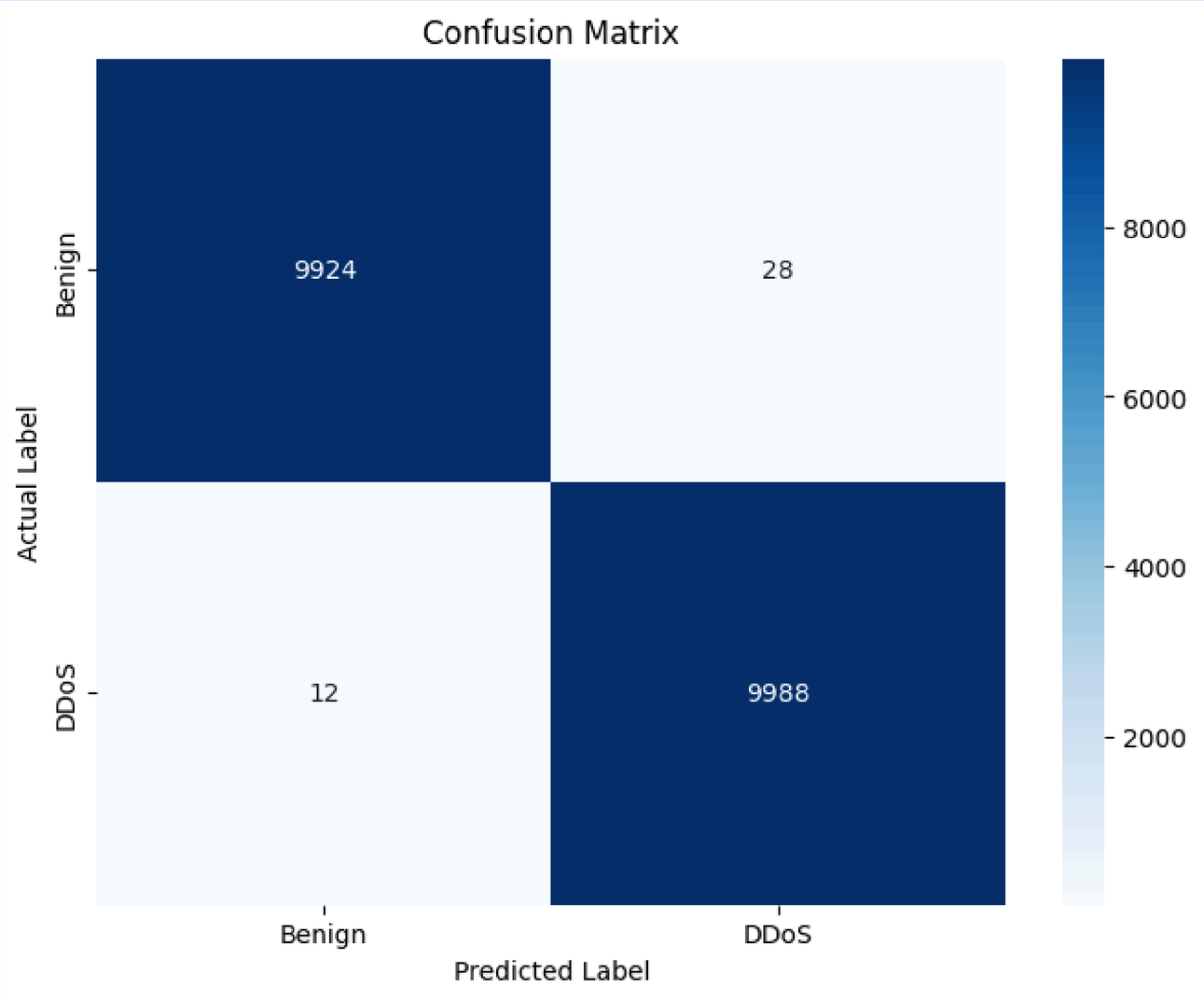

## METRICS:

Accuracy: 99.17%

## HIGH COEFFICIENT FEATURES

- Doesn’t learn explicit weights or coefficients for each feature during training

# GRADIENT BOOSTING CLASSIFIER




## METRICS:

Accuracy: 99.80%

## HIGH COEFFICIENT FEATURES

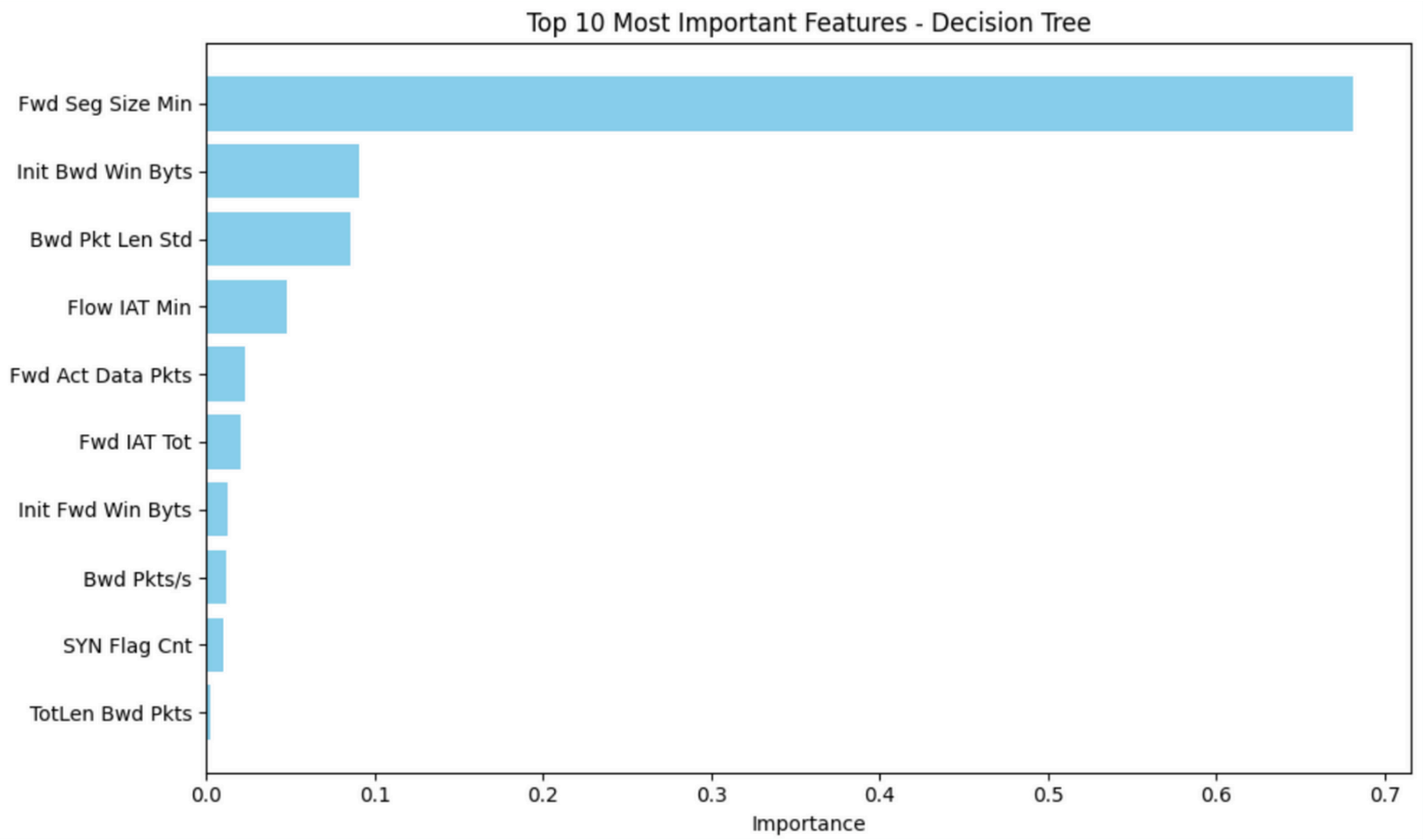
- Traffic Volume
- Packet Stats

# MODELS OVERVIEW

| | | | |
|---|---|---|---|
| Logistic Regression | KNN | Gradient Boosting Classifier | Decision Tree Classifier |

## PERFORMANCE

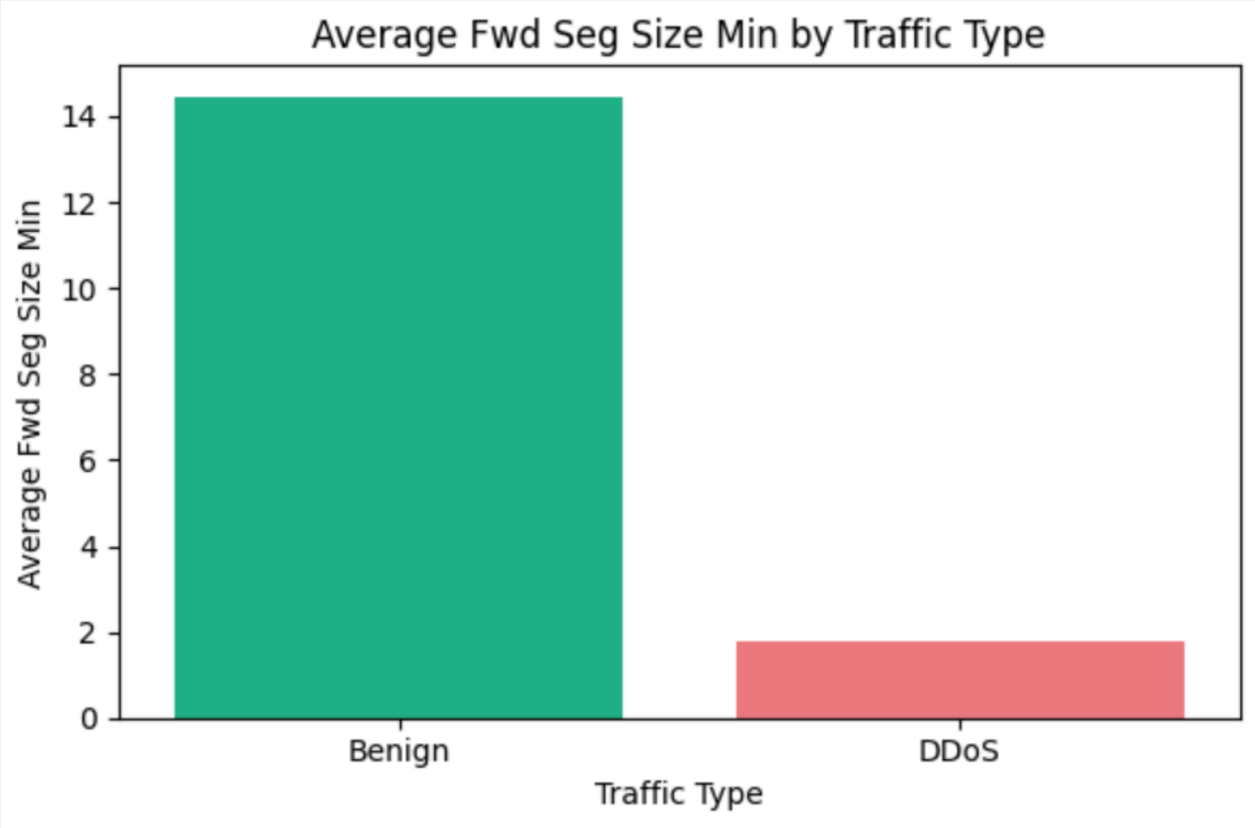
# WHY IS DECISION TREE SO GOOD?



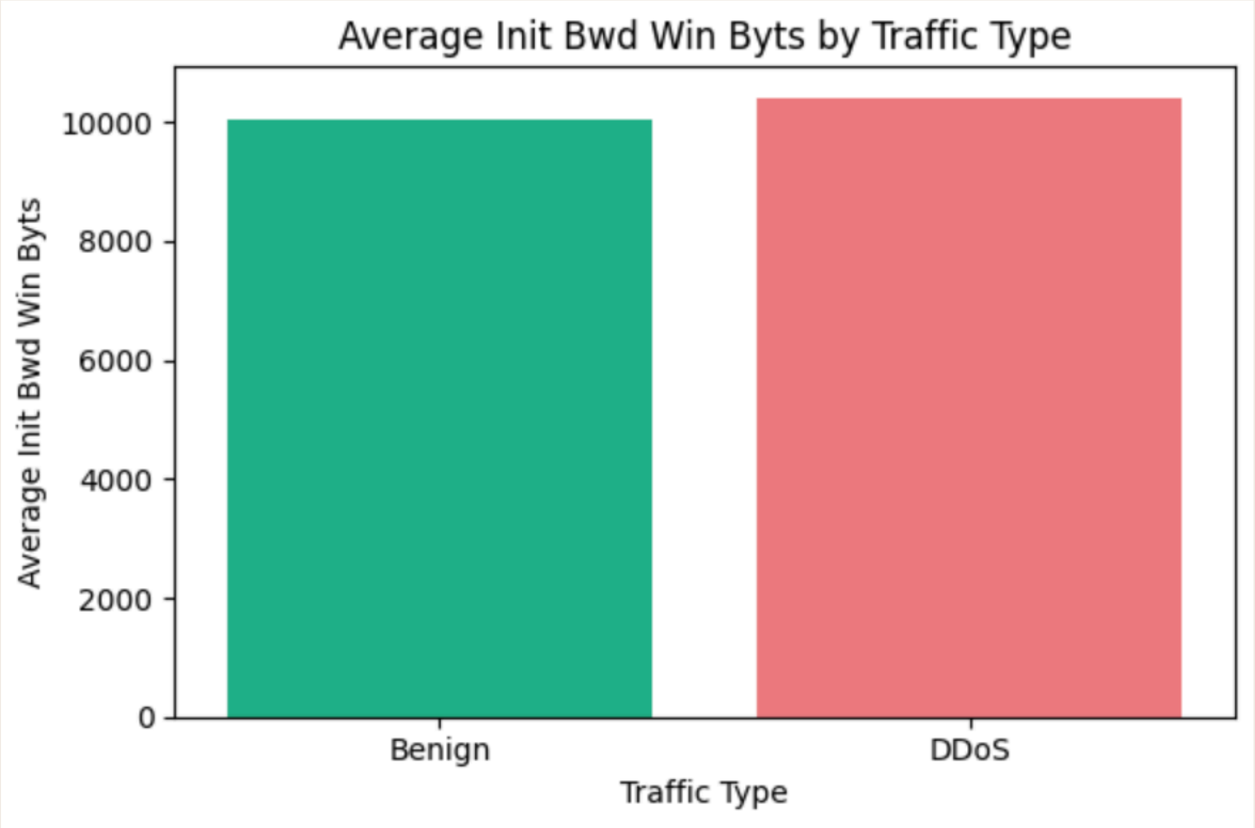

8/10 features belong to packet stats/size

dt__min_samples_split': 2
dt__min_samples_leaf': 1
dt__max_depth': None

# FORWARD SEGMENT SIZE

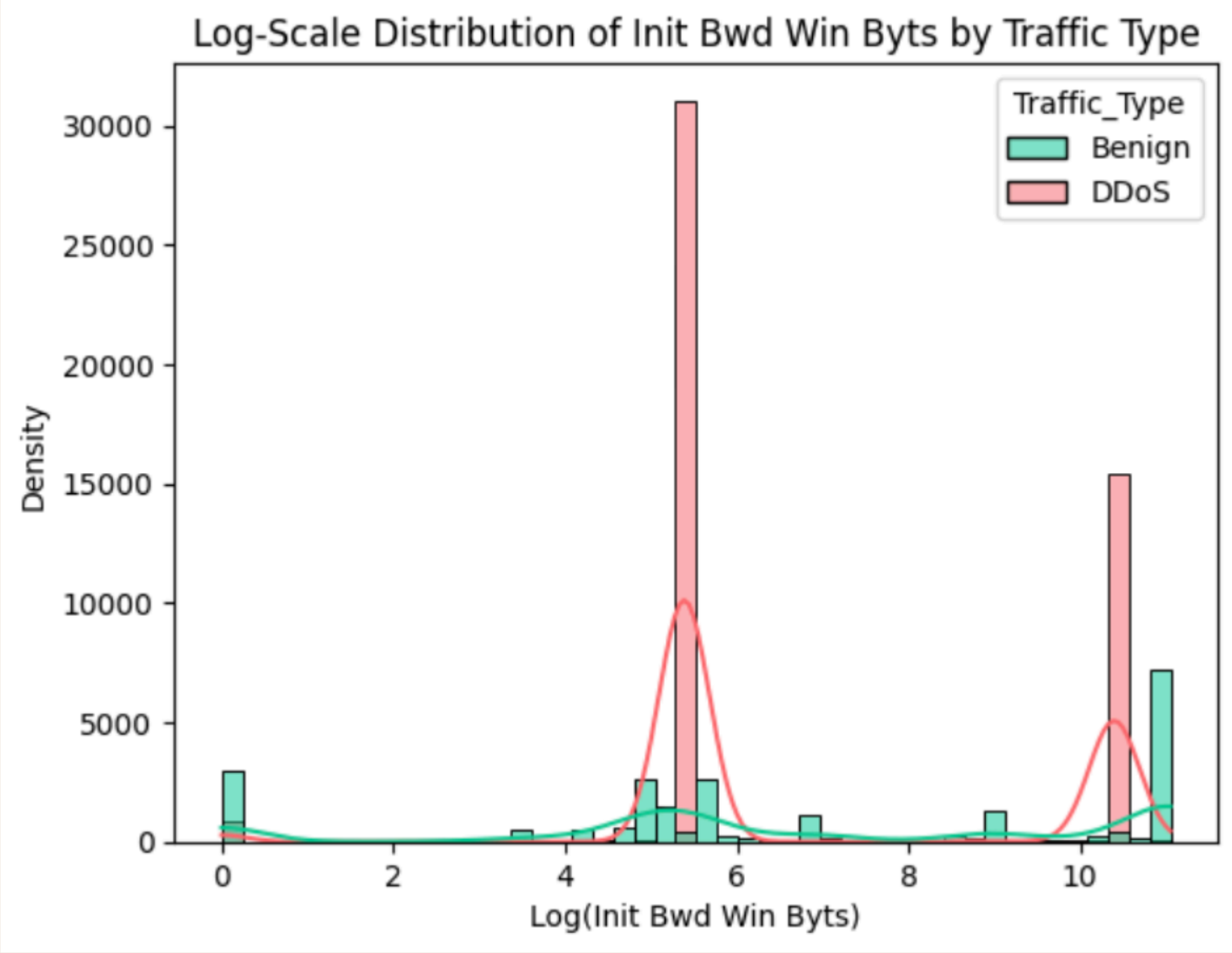



# INITIAL FORWARD BYTES

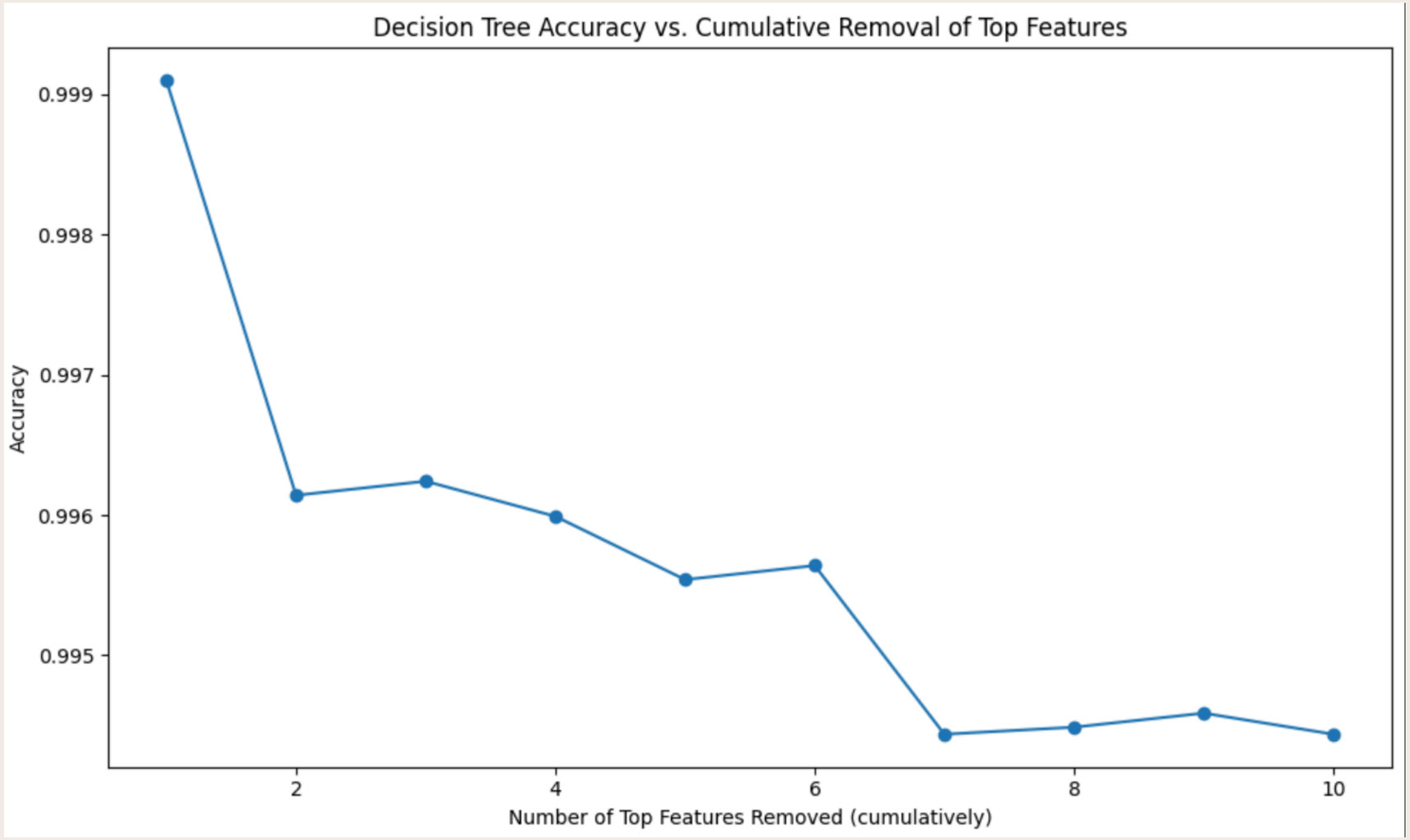



Forward Segment Size clearly separates normal traffic from DDoS attacks, making it a useful feature for detecting DDoS

# INITIAL FORWARD BYTES



# REMOVING FEATURES




Final drop after **8+ removals** but Accuracy only drops from 0.999 to 0.995

# ONE FEATURE TRAINING

## Features giving 80%+

- Packet Stats - 8
- Traffic Volume - 6
- Flow Summary - 5

## Features giving 90%+

- Fwd Seg Size Min
- Initial fwd bytes

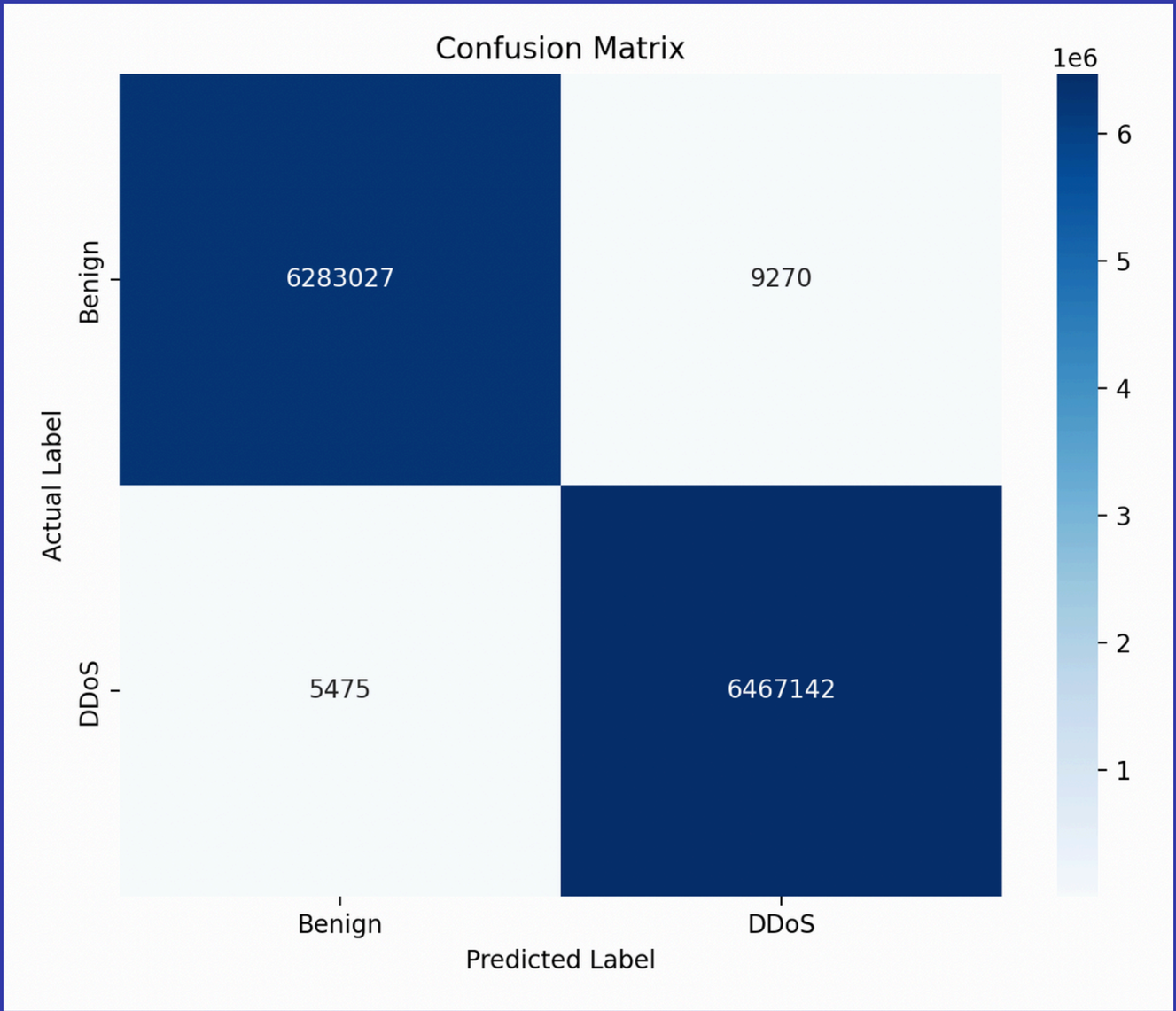
(the top two features)

# SANITY CHECKS

**Cross validation average: 99%**

**Accuracy after label shuffling: 50%**

# DECISION TREE




## METRICS:

Accuracy: 99.88%

*still better than all the other models!*

**Complete dataset**
***(13M rows)***

# CONCLUSION

**Hard** to work with DDoS attacks replicated in a controlled env
→ Not taking into account human factor

**Size** and **Info Distribution** are the most useful features for identifying a DDoS attack

**DDoS** and **Benign flows** have distinct characteristics, yet, it’s difficult to stop in real time

# THANK YOU VERY MUCH!

THOUGHTS, COMMENTS, CONCERNS?