**Features:**

Flow Duration

Flow Bytes/s

Flow Packets/s

Flow IAT Mean/Std/Max/Min

Subflow Fwd Packets/Bytes

Subflow Bwd Packets/Bytes

Active Mean/Min/Max/Std

Idle Mean/Min/Max/Std

Down/Up Ratio

Average Packet Size

Packet Length Min/Max/Mean/Std/Variance

Flag Count FIN/SYN/RST/PSH/ACK/URG/CWE/ECE

Fwd Packet Length Mean/Std/Max/Min

Fwd IAT Total/Mean/Std/Max/Min

Fwd Header Length

Fwd Packets/s

Fwd PSH/URG Flags

Avg Fwd Segment Size

Fwd Header Length.1

Fwd Avg Bytes/Bulk - Packets/Bulk - Bulk Rate

Bwd Packet Length Mean/Std/Max/Min

Bwd IAT Total/Mean/Std/Max/Min

Bwd Header Length

Avg Bwd Segment Size

Bwd Packets/s

Bwd PSH/URG Flags

Bwd Avg Bytes/Bulk - Packets/Bulk - Bulk Rate

Total Fwd/Backward Packets

Total Length of Fwd/Backward Packets

Init\_Win\_bytes\_forward/backward

act\_data\_pkt\_fwd

min\_seg\_size\_forward

**Labels:**

'BENIGN', 'Bot', 'DDoS', 'DoS GoldenEye', 'DoS Hulk',

'DoS Slowhttptest', 'DoS slowloris', 'FTP-Patator', 'Heartbleed',

'Infiltration', 'PortScan', 'SSH-Patator',

'Web Attack - Brute Force', 'Web Attack - Sql Injection',

'Web Attack - XSS'

**Level-1 Filtering**

| condition | Feature | Label (possible) |
| --- | --- | --- |
| Destination Port =[80, 443] | Destination Port | Web Attack (all)  'Web Attack - Brute Force', 'Web Attack - Sql Injection',  'Web Attack - XSS' |
| Destination Port == 22 | Destination Port | SSH-Patator |
| Destination Port == 21 | Destination Port | FTP-Patator |
| Destination Port == anything other than the above four values (80,443,22,21) | Destination Port | User Data traffic |

**Level-2 Filtering**

BENIGN: Normal traffic

if ['Destination Port'] in [80, 443] and ['Flow Duration'] < threshold:

return 'BENIGN'

if ['Fwd Packet Length Max'] > threshold and ['Flow Packets/s'] > threshold:

return 'DoS Hulk'

if ['Flow Packets/s'] > threshold and ['Total Fwd Packets'] > threshold:

return 'DDoS'

PortScan: Scanning multiple ports to find an open port.

if ['Destination Port'] > threshold and ['Fwd IAT Max'] < threshold:

return 'PortScan'

if ['Fwd Packets/s'] > threshold and ['Bwd Packet Length Max'] < threshold:

return 'DoS GoldenEye'

if ['Destination Port'] == 21 and ['Fwd Packet Length Mean'] > threshold:

return 'FTP-Patator'

if ['Fwd IAT Mean'] > threshold and ['Fwd IAT Max'] > threshold:

return 'DoS slowloris'

if ['Destination Port'] == 80 and ['Fwd IAT Mean'] > threshold:

return 'DoS Slowhttptest'

if ['Destination Port'] == 22 and ['Fwd Packet Length Mean'] > threshold:

return 'SSH-Patator'

if ['Destination Port'] in [80, 443] and ['Fwd Packet Length Max'] > threshold:

return 'Web Attack – XSS'

if ['Destination Port'] in [80, 443] and ['Fwd Packet Length Mean'] > threshold:

return 'Web Attack - Brute Force'

if ['Destination Port'] in [80, 443] and ['Fwd Packet Length Std'] > threshold:

return 'Web Attack – SQL Injection'

if ['Flow IAT Mean'] < threshold and ['Fwd Packets/s'] > threshold:

return 'Bot'

if ['Total Length of Fwd Packets'] > threshold and ['Total Length of Bwd Packets'] > threshold:

return 'Infiltration'

if ['Destination Port'] == 443 and ['Fwd Packet Length Max'] > threshold:

return 'Heartbleed'

**Flags**

Flag Count FIN/SYN/RST/PSH/ACK/URG/CWE/ECE

SYN (Synchronize) Flag:

ACK (Acknowledgment) Flag:

* Normal/ BENIGN for balanced data traffic.
* A large number is DDoS

FIN (Finish) Flag:

RST (Reset) Flag:

PSH (Push) Flag:

URG (Urgent) Flag:

* Bot Traffic

CWE (Congestion Window Reduced) Flag:

ECE (ECN-Echo) Flag:

**Counters;**

IAT (Inter-Arrival Time)

* the time between the two flows

Sample Thresholds:

These thresholds are hypothetical and need to be validated and adjusted based on the specific dataset and the nature of the traffic being analyzed.

BENIGN:

threshold = 10000 (e.g., Flow Duration)

DoS Hulk:

threshold = 500 (e.g., Fwd Packet Length Max)

DDoS:

threshold = 1000 (e.g., Flow Packets/s)

PortScan:

threshold = 1024 (e.g., Destination Port)

DoS GoldenEye:

threshold = 200 (e.g., Fwd Packets/s)

FTP-Patator:

threshold = 150 (e.g., Fwd Packet Length Mean)

DoS slowloris:

threshold = 10000 (e.g., Fwd IAT Mean)

DoS Slowhttptest:

threshold = 5000 (e.g., Fwd IAT Mean)

SSH-Patator:

threshold = 100 (e.g., Fwd Packet Length Mean)

Web Attack – XSS:

threshold = 300 (e.g., Fwd Packet Length Max)

Web Attack - Brute Force:

threshold = 200 (e.g., Fwd Packet Length Mean)

Web Attack – SQL Injection:

threshold = 150 (e.g., Fwd Packet Length Std)

Bot:

threshold = 50 (e.g., Flow IAT Mean)

Infiltration:

threshold = 1000 (e.g., Total Length of Fwd Packets)

Heartbleed:

threshold = 200 (e.g., Fwd Packet Length Max)

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**Findings**

Dataset: Training ULAK-Data-Set/Train\_ULAK.csv'

| Metric | Baseline  Model | Model  Customization  (ML model with less complexity) | Accuracy >90% | Recall >90% | Precision >90% | False Positive value  <10% |
| --- | --- | --- | --- | --- | --- | --- |
| BENIGN | Random Forest |  |  |  |  |  |
| DoS Hulk | Random Forest |  |  |  |  |  |
| DDoS | Random Forest |  |  |  |  |  |
| DoS GoldenEye | Random Forest |  |  |  |  |  |
| DoS slowloris | Random Forest |  |  |  |  |  |
| DoS Slowhttptest | Random Forest |  |  |  |  |  |
| FTP-Patator | Random Forest |  |  |  |  |  |
| SSH-Patator | Random Forest |  |  |  |  |  |
| PortScan | Random Forest |  |  |  |  |  |
| Bot | Random Forest |  |  |  |  |  |
| Infiltration | Random Forest |  |  |  |  |  |
| Heartbleed | Random Forest |  |  |  |  |  |
| Web Attack – XSS | Random Forest |  |  |  |  |  |
| Web Attack - Brute Force | Random Forest |  |  |  |  |  |
| Web Attack – Sql Injection | Random Forest |  |  |  |  |  |

Dataset: Test ULAK-Data-Set/Test\_ULAK.csv'

| Metric | Baseline  Model | Model  Customization  (ML model with less complexity) | Accuracy >90% | Recall >90% | Precision >90% | False Positive value  <10% |
| --- | --- | --- | --- | --- | --- | --- |
| BENIGN |  |  |  |  |  |  |
| DoS Hulk |  |  |  |  |  |  |
| DDoS |  |  |  |  |  |  |
| DoS GoldenEye |  |  |  |  |  |  |
| DoS slowloris |  |  |  |  |  |  |
| DoS Slowhttptest |  |  |  |  |  |  |
| FTP-Patator |  |  |  |  |  |  |
| SSH-Patator |  |  |  |  |  |  |
| PortScan |  |  |  |  |  |  |
| Bot |  |  |  |  |  |  |
| Infiltration |  |  |  |  |  |  |
| Heartbleed |  |  |  |  |  |  |
| Web Attack – XSS |  |  |  |  |  |  |
| Web Attack - Brute Force |  |  |  |  |  |  |
| Web Attack – Sql Injection |  |  |  |  |  |  |