

# XSSGAI is the first-ever AI-powered XSS (Cross-Site Scripting) payload generator. It leverages machine learning and deep learning to create novel payloads based on patterns from real-world XSS attacks.

## Created by: AnonKryptiQuz

### Performing EDA

In [7]:

```
import tensorflow as tf

gpus = tf.config.list_physical_devices('GPU')
if gpus:
    try:
        for gpu in gpus:
            tf.config.experimental.set_memory_growth(gpu, True)
        print("GPU is available. Details:")
        print(gpus)
    except RuntimeError as e:
        print(e)
else:
    print("GPU is not available.")
```

GPU is available. Details:

[PhysicalDevice(name='/physical\_device:GPU:0', device\_type='GPU')]

In [8]:

```
!pip install tensorflow
```

Requirement already satisfied: tensorflow in /usr/local/lib/python3.11/dist-packages (2.19.0)  
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (1.4.0)  
Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (1.6.3)  
Requirement already satisfied: flatbuffers>=24.3.25 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (25.2.10)  
Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (0.6.0)  
Requirement already satisfied: google-pasta>=0.1.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (0.2.0)  
Requirement already satisfied: libclang>=13.0.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (18.1.1)  
Requirement already satisfied: opt-einsum>=2.3.2 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (3.4.0)  
Requirement already satisfied: packaging in /usr/local/lib/python3.11/dist-packages (from tensorflow) (25.0)  
Requirement already satisfied: protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<6.0.0dev,>=3.20.3 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (5.29.5)  
Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (2.32.3)  
Requirement already satisfied: setuptools in /usr/local/lib/python3.11/dist-packages (from tensorflow) (75.2.0)  
Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (1.17.0)  
Requirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (3.1.0)  
Requirement already satisfied: typing-extensions>=3.6.6 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (4.14.1)  
Requirement already satisfied: wrapt>=1.11.0 in /usr/local/lib/python3.11/dist-packages (

from tensorflow) (1.17.2)  
 Requirement already satisfied: grpcio<2.0,>=1.24.3 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (1.74.0)  
 Requirement already satisfied: tensorboard~=2.19.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (2.19.0)  
 Requirement already satisfied: keras>=3.5.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (3.10.0)  
 Requirement already satisfied: numpy<2.2.0,>=1.26.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (2.0.2)  
 Requirement already satisfied: h5py>=3.11.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (3.14.0)  
 Requirement already satisfied: ml-dtypes<1.0.0,>=0.5.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (0.5.3)  
 Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow) (0.37.1)  
 Requirement already satisfied: wheel<1.0,>=0.23.0 in /usr/local/lib/python3.11/dist-packages (from astunparse>=1.6.0->tensorflow) (0.45.1)  
 Requirement already satisfied: rich in /usr/local/lib/python3.11/dist-packages (from keras>=3.5.0->tensorflow) (13.9.4)  
 Requirement already satisfied: namex in /usr/local/lib/python3.11/dist-packages (from keras>=3.5.0->tensorflow) (0.1.0)  
 Requirement already satisfied: optree in /usr/local/lib/python3.11/dist-packages (from keras>=3.5.0->tensorflow) (0.17.0)  
 Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow) (3.4.2)  
 Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow) (3.10)  
 Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow) (2.5.0)  
 Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow) (2025.7.14)  
 Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.11/dist-packages (from tensorboard~=2.19.0->tensorflow) (3.8.2)  
 Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /usr/local/lib/python3.11/dist-packages (from tensorboard~=2.19.0->tensorflow) (0.7.2)  
 Requirement already satisfied: werkzeug>=1.0.1 in /usr/local/lib/python3.11/dist-packages (from tensorboard~=2.19.0->tensorflow) (3.1.3)  
 Requirement already satisfied: MarkupSafe>=2.1.1 in /usr/local/lib/python3.11/dist-packages (from werkzeug>=1.0.1->tensorboard~=2.19.0->tensorflow) (3.0.2)  
 Requirement already satisfied: markdown-it-py>=2.2.0 in /usr/local/lib/python3.11/dist-packages (from rich->keras>=3.5.0->tensorflow) (3.0.0)  
 Requirement already satisfied: pygments<3.0.0,>=2.13.0 in /usr/local/lib/python3.11/dist-packages (from rich->keras>=3.5.0->tensorflow) (2.19.2)  
 Requirement already satisfied: mdurl~=0.1 in /usr/local/lib/python3.11/dist-packages (from markdown-it-py>=2.2.0->rich->keras>=3.5.0->tensorflow) (0.1.2)

In [9]:

```

import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import sentencepiece as spm
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.model_selection import train_test_split
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras.layers import Input, Embedding, Bidirectional, GRU, Dense, Dropout, Attention
from tensorflow.keras.optimizers import Adam
from tensorflow.keras import backend as K
from tensorflow.keras.callbacks import EarlyStopping, ModelCheckpoint
from wordcloud import WordCloud
from collections import Counter
  
```

In [10]:

```

import pandas as pd
import requests
  
```

```
def fetch_payloads(url):
    try:
        response = requests.get(url, timeout=10)
        response.raise_for_status()
        payloads = response.text.strip().split('\n')
        return pd.DataFrame(payloads, columns=['payload'])
    except requests.exceptions.RequestException as e:
        print(f"Error fetching data from {url}: {e}")
        return pd.DataFrame(columns=['payload'])

train_url = "https://raw.githubusercontent.com/AnonKryptiQuz/XSSGAI/refs/heads/main/train_payloads.txt"
test_url = "https://raw.githubusercontent.com/AnonKryptiQuz/XSSGAI/refs/heads/main/test_payloads.txt"

train_payloads_df = fetch_payloads(train_url)
test_payloads_df = fetch_payloads(test_url)

if train_payloads_df.empty or test_payloads_df.empty:
    print("One or both datasets are empty. Please check the URLs.")
else:
    print("Datasets loaded successfully.")
```

Datasets loaded successfully.

In [11]:

```
print("Training Payloads (First 5 rows):")
print(train_payloads_df.head())

print("\nTesting Payloads (First 5 rows):")
print(test_payloads_df.head())
```

Training Payloads (First 5 rows):

```
                                payload
0  {{constructor.constructor(valueOf.name.constru...
1  <blockquote id=x tabindex=1 ondeactivate=alert...
2  <!--><svg+onload=%27top[%2fal%2f%2esource%2b%2...
3  <data onblur=alert(1) id=x tabindex=1 style=di...
4  <details onmouseup="alert(1)">AnonKryptiQuz</d...
```

Testing Payloads (First 5 rows):

```
                                payload
0  <script id=x tabindex=1 onbeforeactivate=alert...
1  <style>:target {color:red;}</style><legend id=...
2  <summary onpointerout=alert(1) style=display:b...
3  &lt;BODY BACKGROUND=&quot;javascript:alert(&ap...
4  <animate onpointerdown=alert(1) style=display:...
```

In [12]:

```
print("Training Payloads (Last 5 rows):")
print(train_payloads_df.tail())

print("\nTesting Payloads (Last 5 rows):")
print(test_payloads_df.tail())
```

Training Payloads (Last 5 rows):

```
                                payload
14432  <style>:target {color:red;}</style><mark id=x ...
14433  <style>:target {color: red;}</style><xmp id=x ...
14434  <details onpaste="alert(1)" contenteditable>An...
14435  <data onmouseover="alert(1)" style=display:blo...
14436  <tbody onbeforecopy="alert(1)" contenteditable...
```

Testing Payloads (Last 5 rows):

```
                                payload
3604                                a="\get\";
3605  <p oncopy=alert(1) value="AnonKryptiQuz" autof...
3606  <div draggable="true" contenteditable>drag me<...
3607  "'`><script>\xE2\x80\x8Ajavascript:alert(1)</s...
3608                                <div id="97"><!-- IE 5-9 -->
```

In [13]:

```
print("Training Dataset Dimensions:")
print(train_payloads_df.shape)

print("\nTesting Dataset Dimensions:")
print(test_payloads_df.shape)
```

Training Dataset Dimensions:  
(14437, 1)

Testing Dataset Dimensions:  
(3609, 1)

In [14]:

```
print("Training Dataset Info:")
print(train_payloads_df.info())

print("\nTesting Dataset Info:")
print(test_payloads_df.info())
```

Training Dataset Info:  
<class 'pandas.core.frame.DataFrame'>  
RangeIndex: 14437 entries, 0 to 14436  
Data columns (total 1 columns):  
# Column Non-Null Count Dtype  
--- ---  
0 payload 14437 non-null object  
dtypes: object(1)  
memory usage: 112.9+ KB  
None

Testing Dataset Info:  
<class 'pandas.core.frame.DataFrame'>  
RangeIndex: 3609 entries, 0 to 3608  
Data columns (total 1 columns):  
# Column Non-Null Count Dtype  
--- ---  
0 payload 3609 non-null object  
dtypes: object(1)  
memory usage: 28.3+ KB  
None

In [15]:

```
print("Training Dataset Data Types:")
print(train_payloads_df.dtypes)

print("\nTesting Dataset Data Types:")
print(test_payloads_df.dtypes)
```

Training Dataset Data Types:  
payload object  
dtype: object

Testing Dataset Data Types:  
payload object  
dtype: object

In [16]:

```
print("Missing Values in Training Dataset:")
print(train_payloads_df.isnull().sum())

print("\nMissing Values in Testing Dataset:")
print(test_payloads_df.isnull().sum())
```

Missing Values in Training Dataset:  
payload 0  
dtype: int64

Missing Values in Testing Dataset:

```
payload      0
dtype: int64
```

In [17]:

```
print("Duplicate Values in Training Dataset:")
print(train_payloads_df.duplicated().sum())

print("\nDuplicate Values in Testing Dataset:")
print(test_payloads_df.duplicated().sum())
```

Duplicate Values in Training Dataset:

0

Duplicate Values in Testing Dataset:

0

In [18]:

```
train_payloads_set = set(train_payloads_df['payload'])

duplicates_in_test = test_payloads_df[test_payloads_df['payload'].isin(train_payloads_set)]

if not duplicates_in_test.empty:
    print(f"\nFound {len(duplicates_in_test)} payloads in the test set that are also in the training set.")
    print("These will be removed from the test set to prevent data leakage.")
    test_payloads_df = test_payloads_df[~test_payloads_df['payload'].isin(train_payloads_set)]
    print(f"Testing dataset size after removing duplicates: {len(test_payloads_df)}")
else:
    print("\nNo cross-dataset duplicates found. The datasets are clean.")
```

No cross-dataset duplicates found. The datasets are clean.

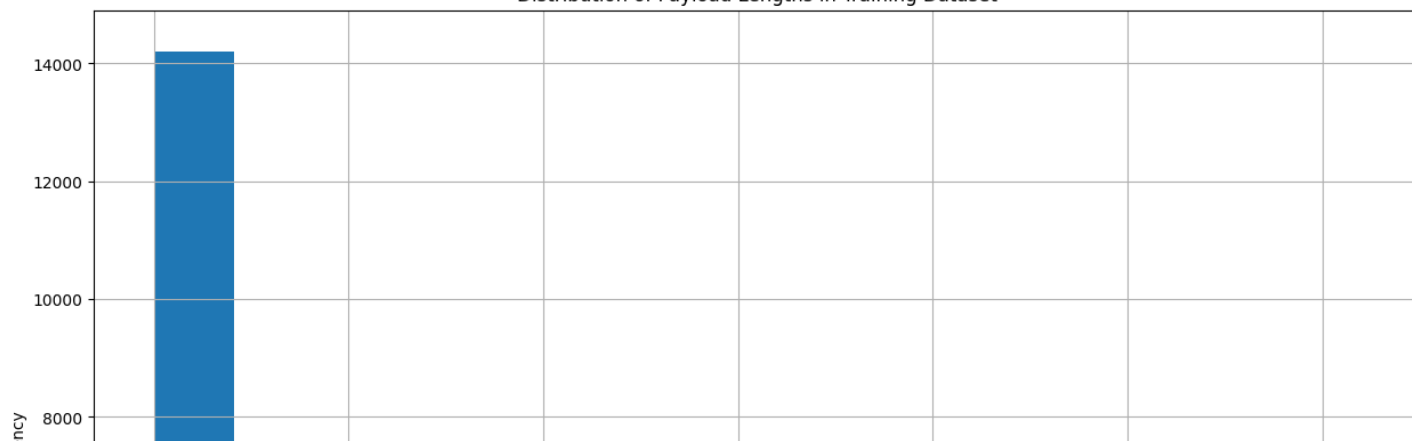
In [19]:

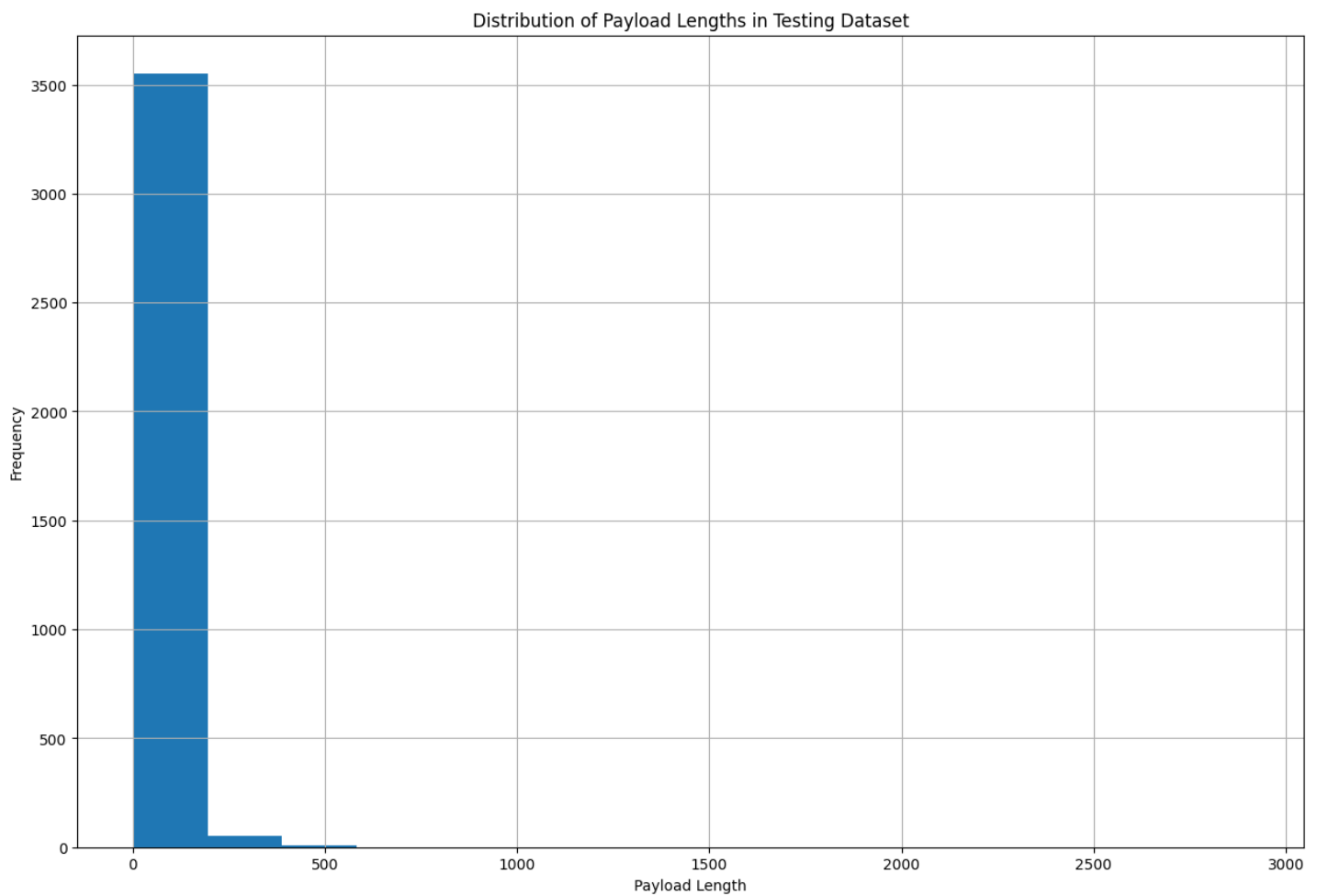
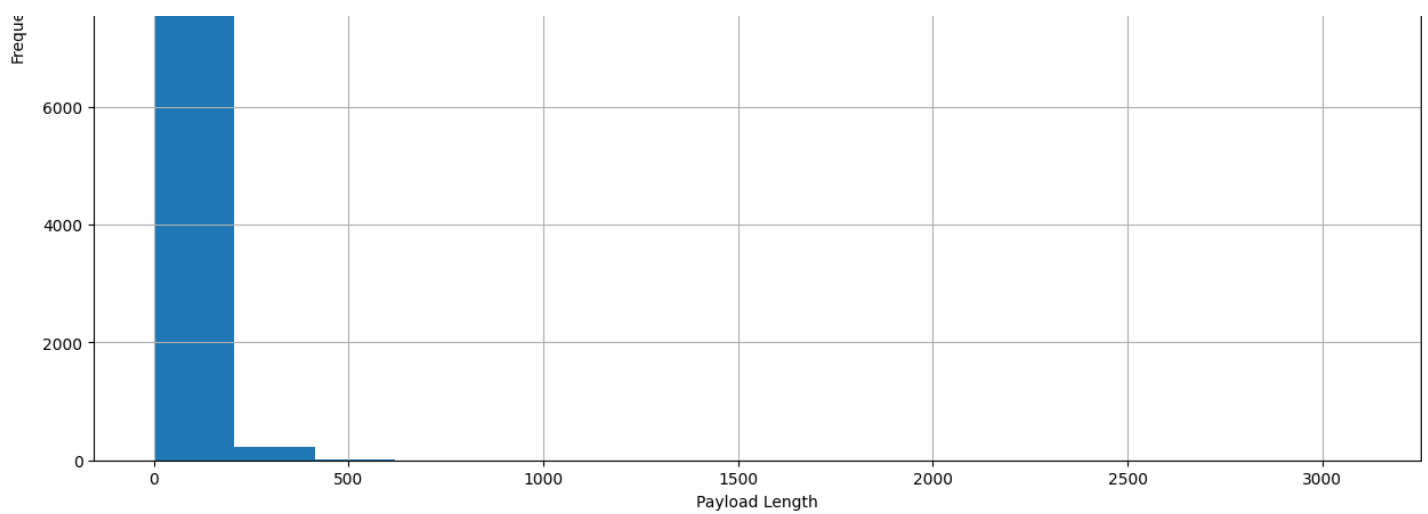
```
train_payloads_df['length'] = train_payloads_df['payload'].apply(len)
test_payloads_df['length'] = test_payloads_df['payload'].apply(len)

plt.figure(figsize=(15, 10))
train_payloads_df['length'].hist(bins=15)
plt.title("Distribution of Payload Lengths in Training Dataset")
plt.xlabel('Payload Length')
plt.ylabel('Frequency')
plt.show()

plt.figure(figsize=(15, 10))
test_payloads_df['length'].hist(bins=15)
plt.title("Distribution of Payload Lengths in Testing Dataset")
plt.xlabel('Payload Length')
plt.ylabel('Frequency')
plt.show()
```

Distribution of Payload Lengths in Training Dataset

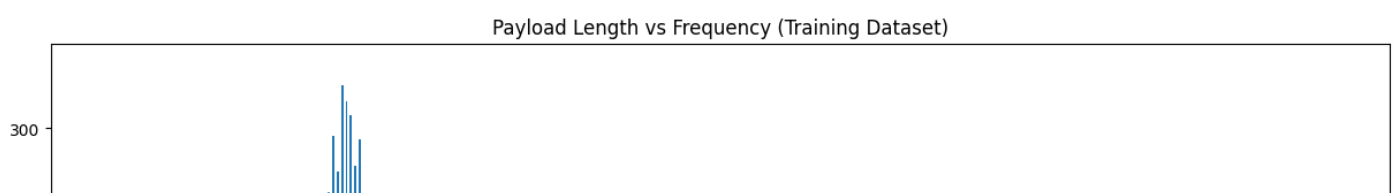


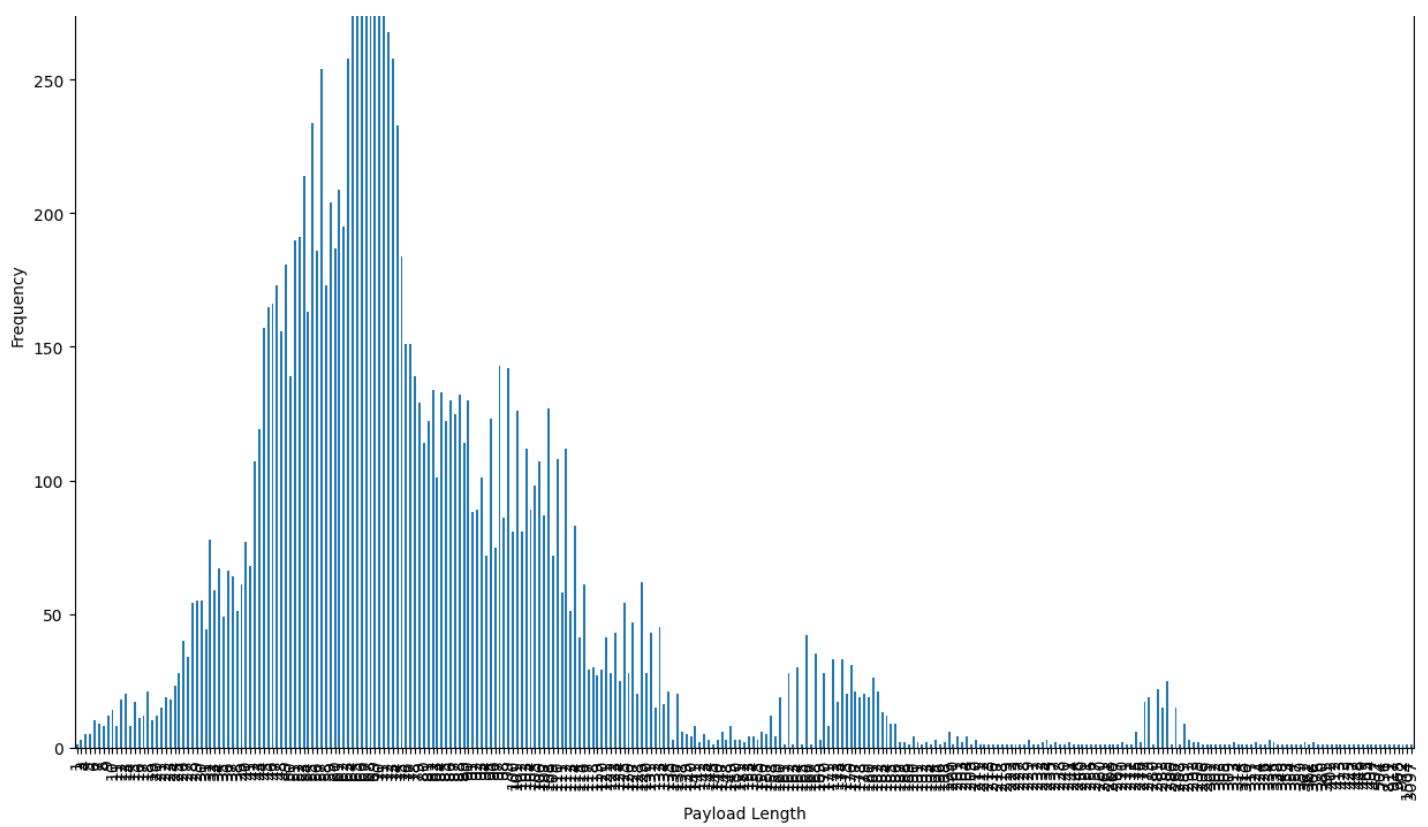


In [20]:

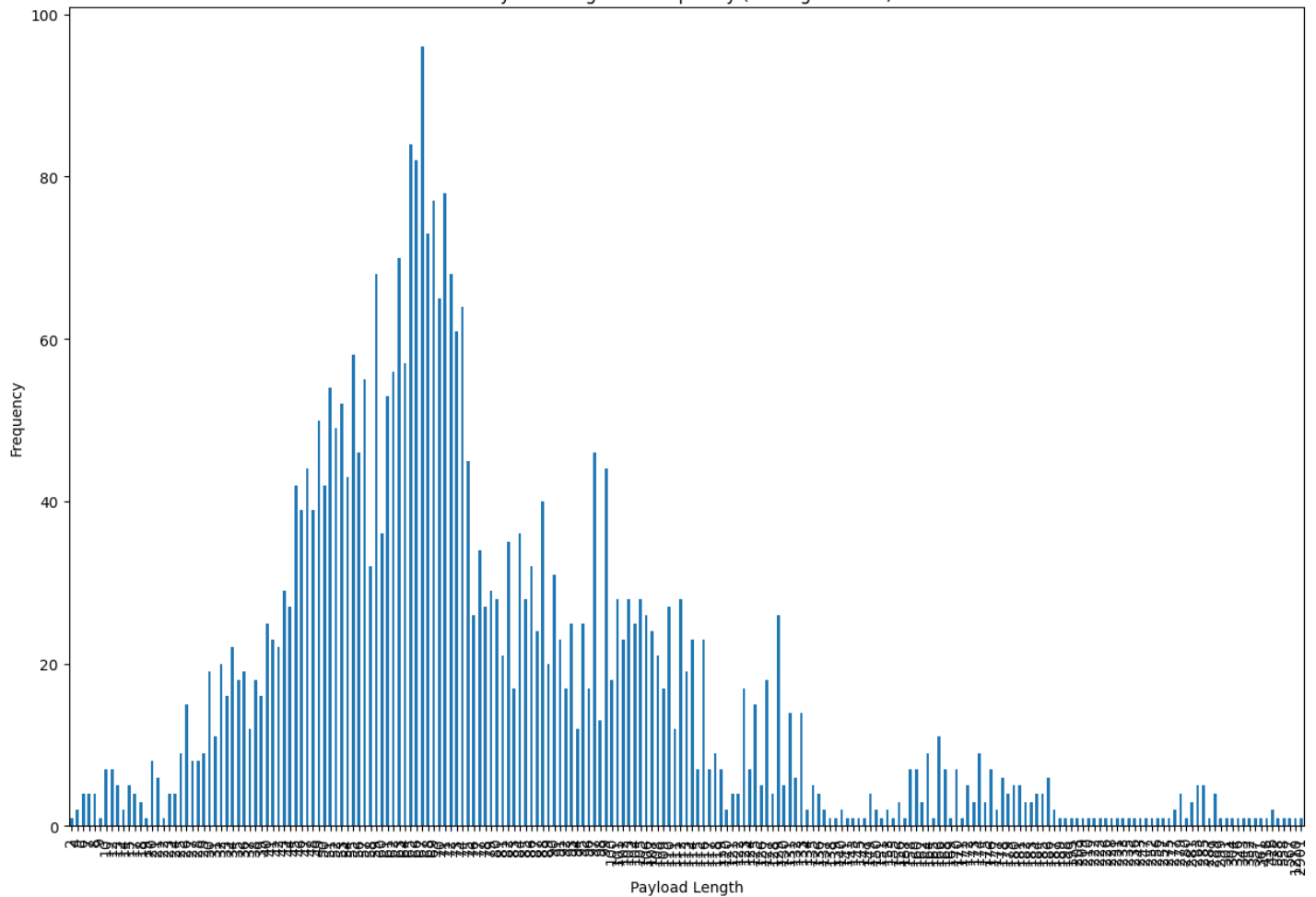
```
plt.figure(figsize=(15, 10))
train_payloads_df['length'].value_counts().sort_index().plot(kind='bar')
plt.title('Payload Length vs Frequency (Training Dataset)')
plt.xlabel('Payload Length')
plt.ylabel('Frequency')
plt.show()

plt.figure(figsize=(15, 10))
test_payloads_df['length'].value_counts().sort_index().plot(kind='bar')
plt.title('Payload Length vs Frequency (Testing Dataset)')
plt.xlabel('Payload Length')
plt.ylabel('Frequency')
plt.show()
```





Payload Length vs Frequency (Testing Dataset)



In [21]:

```
max_train_payload_length = train_payloads_df['length'].max()
max_test_payload_length = test_payloads_df['length'].max()

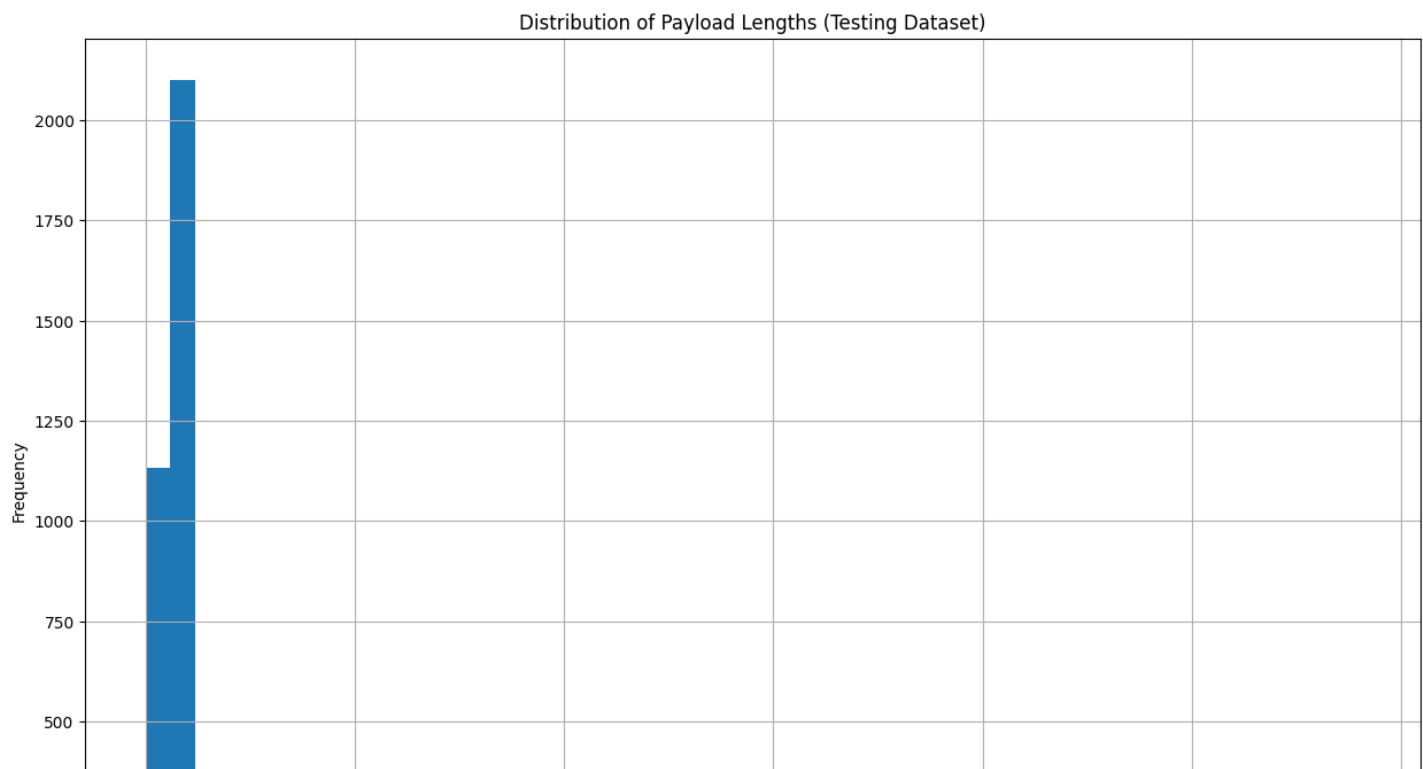
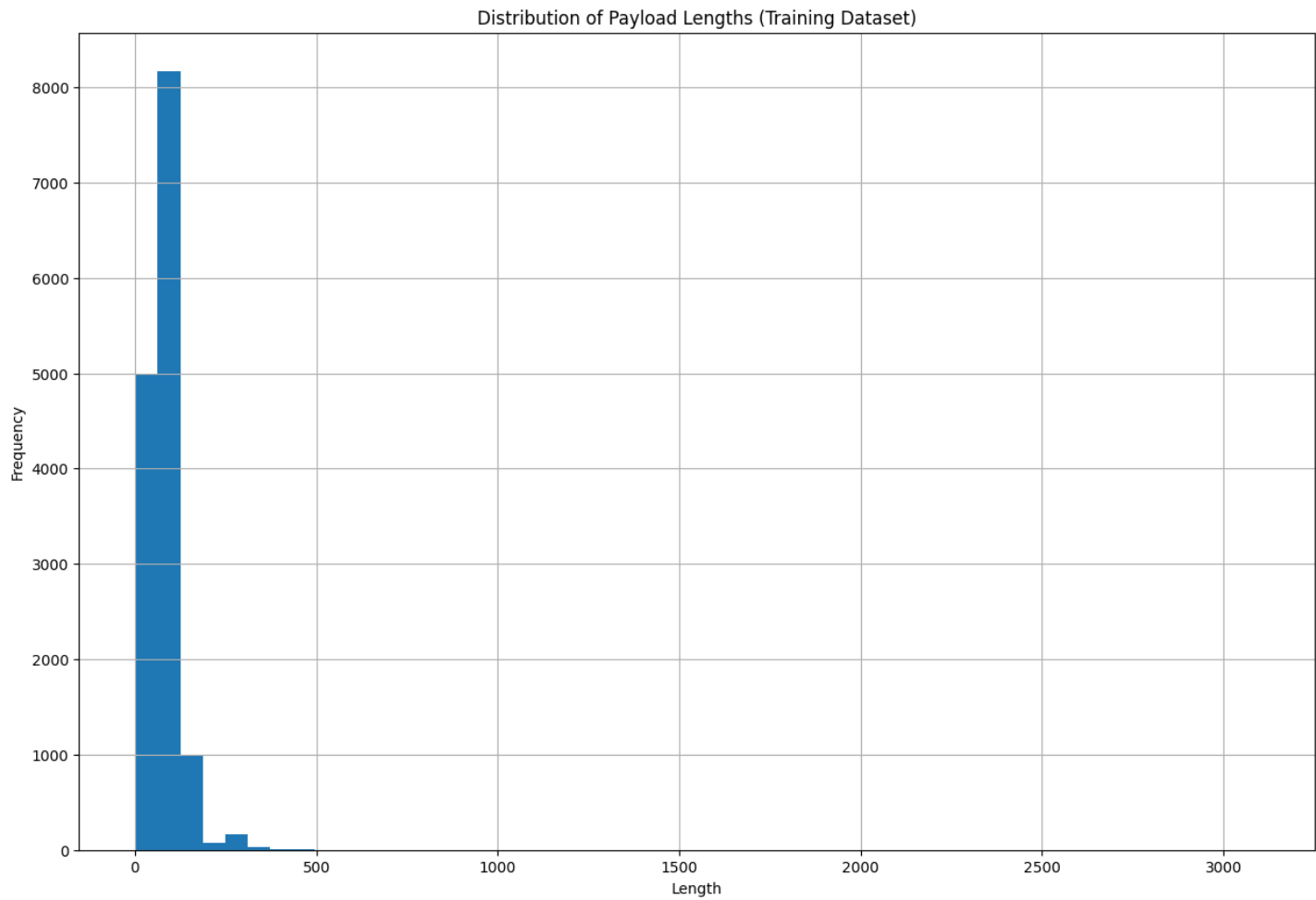
print("Maximum payload length in Training Dataset:", max_train_payload_length)
print("Maximum payload length in Testing Dataset:", max_test_payload_length)

plt.figure(figsize=(15, 10))
train_payloads_df['length'].hist(bins=50)
```

```
plt.title("Distribution of Payload Lengths (Training Dataset)")
plt.xlabel('Length')
plt.ylabel('Frequency')
plt.show()

plt.figure(figsize=(15, 10))
test_payloads_df['length'].hist(bins=50)
plt.title("Distribution of Payload Lengths (Testing Dataset)")
plt.xlabel('Length')
plt.ylabel('Frequency')
plt.show()
```

Maximum payload length in Training Dataset: 3097  
Maximum payload length in Testing Dataset: 2901

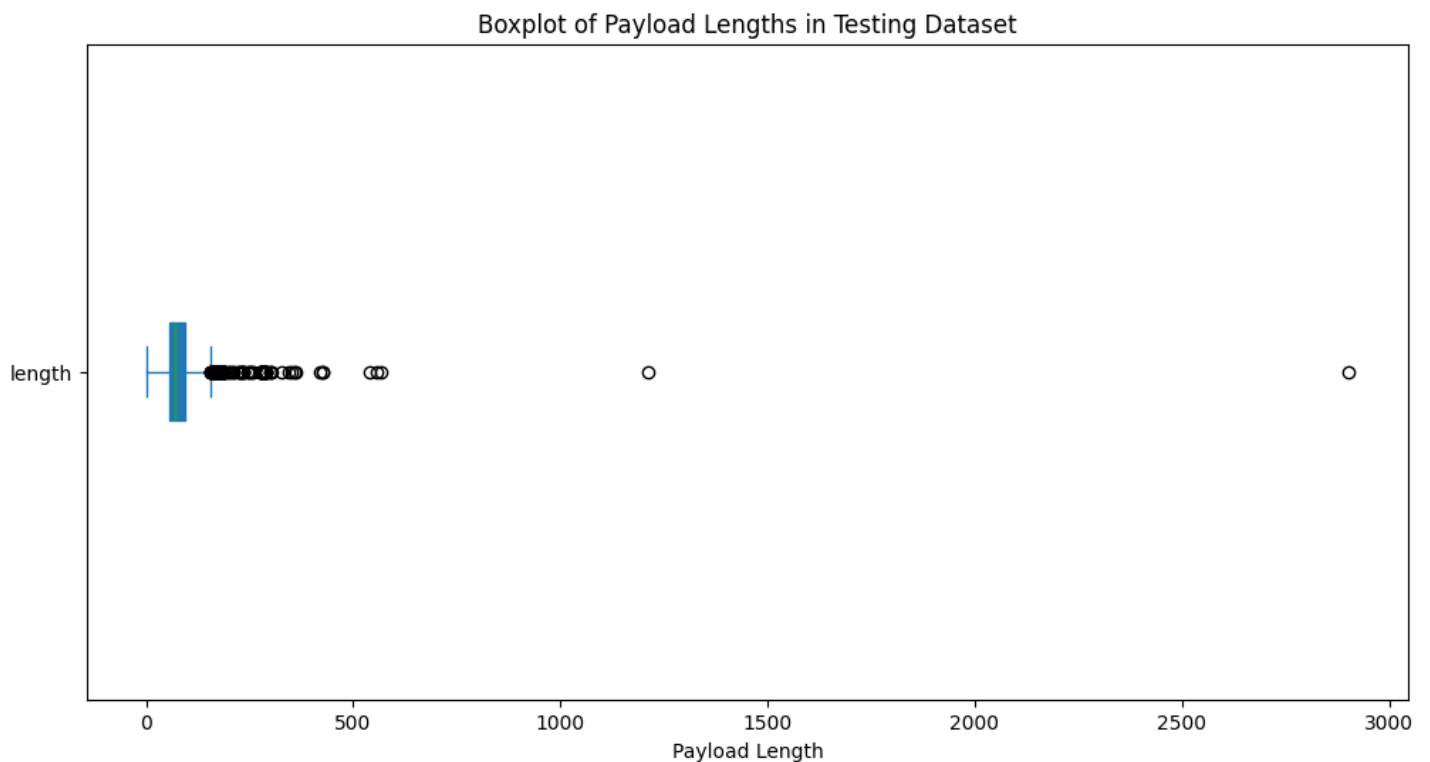
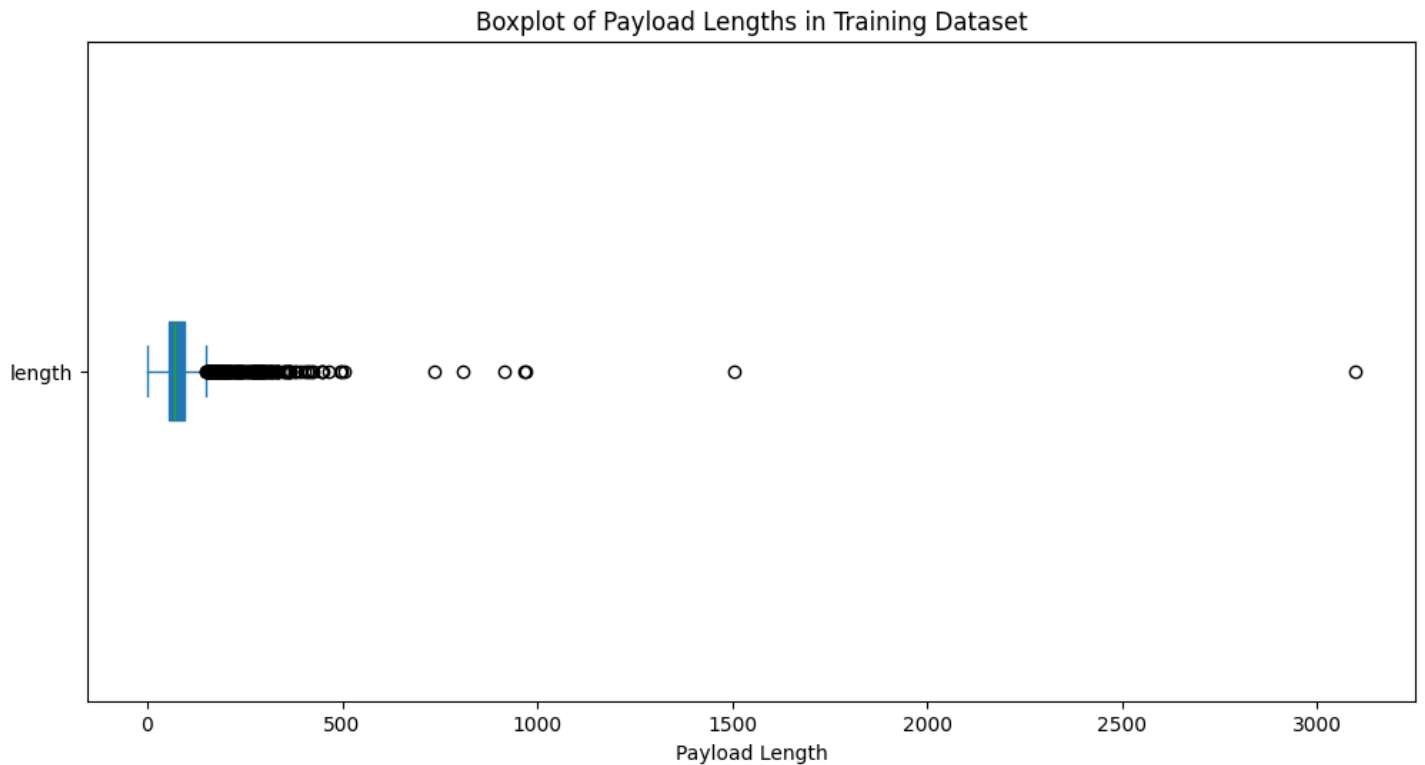








```
plt.title('Boxplot of Payload Lengths in Testing Dataset')
plt.xlabel('Payload Length')
plt.show()
```

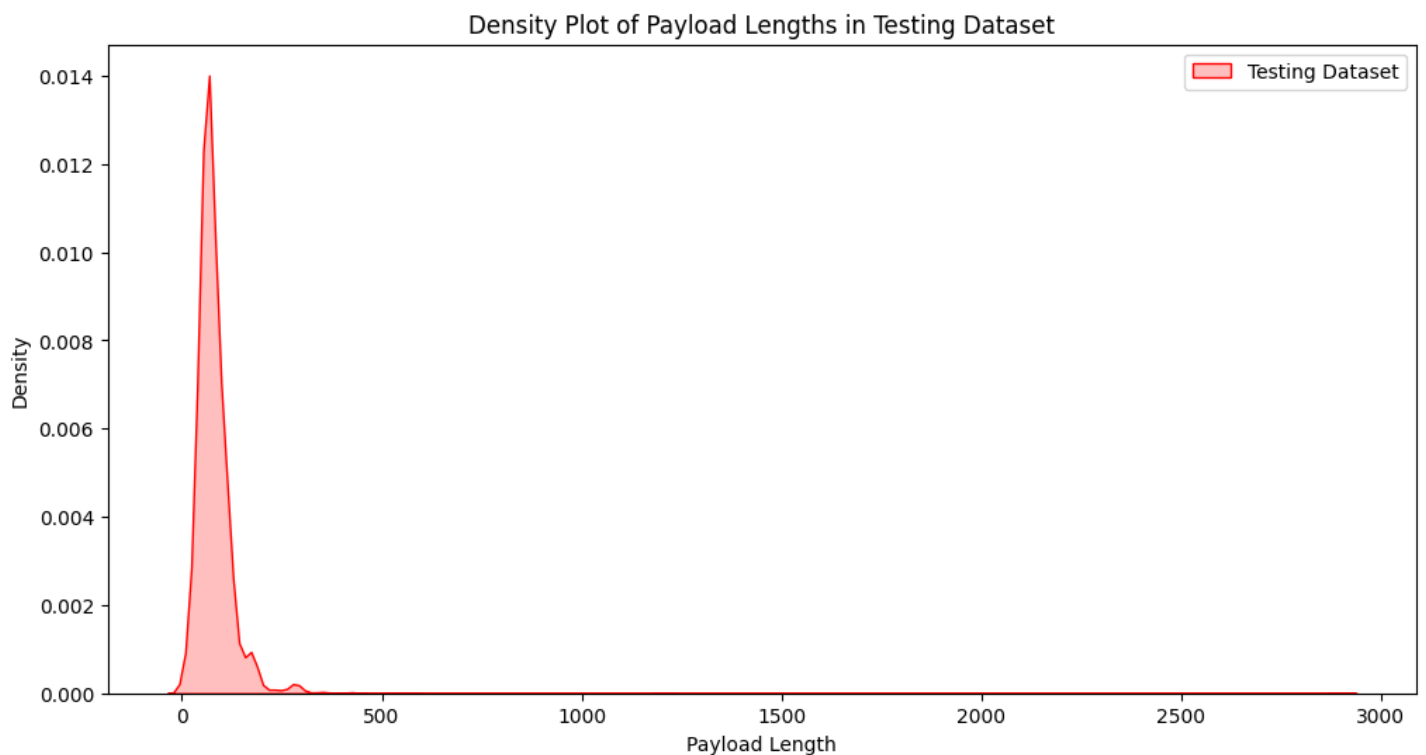
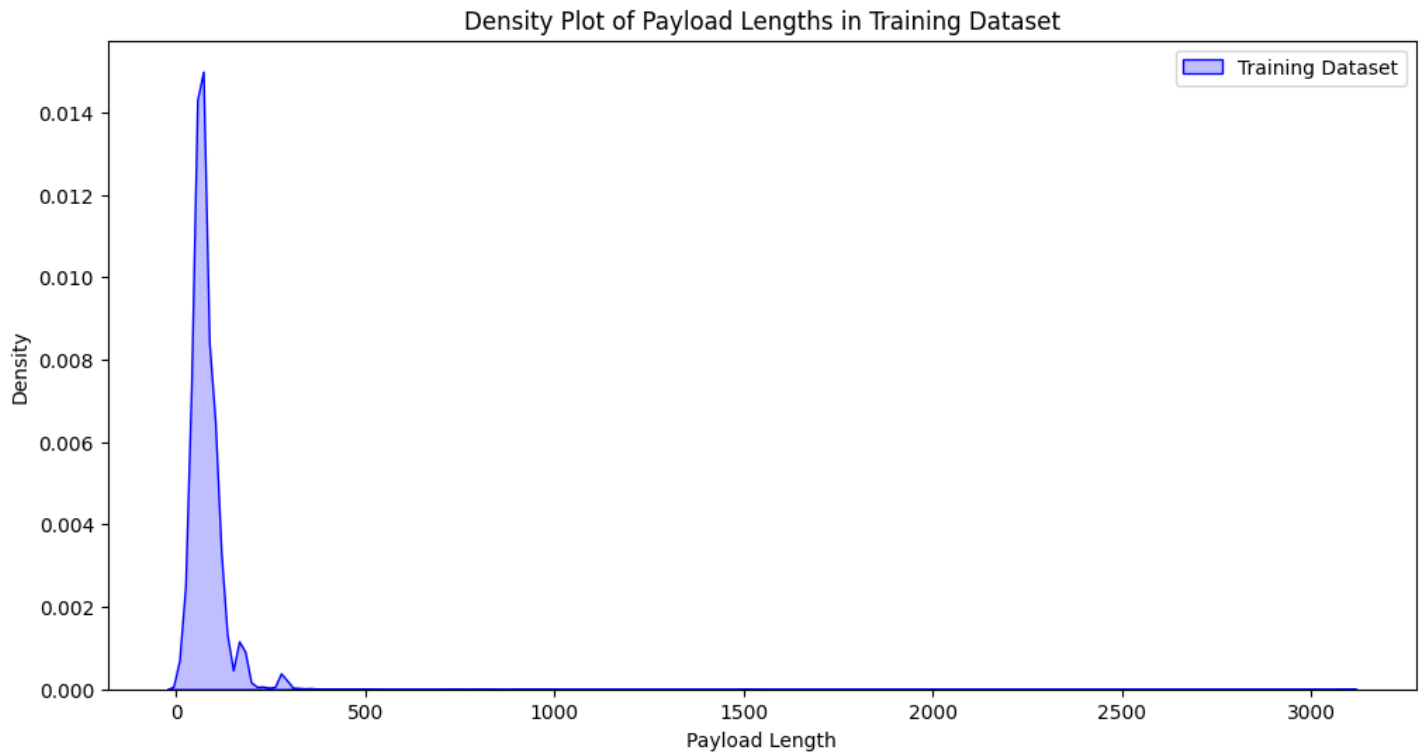


In [26]:

```
plt.figure(figsize=(12, 6))
sns.kdeplot(train_payloads_df['length'], fill=True, color='blue', label='Training Dataset')
plt.title('Density Plot of Payload Lengths in Training Dataset')
plt.xlabel('Payload Length')
plt.ylabel('Density')
plt.legend()
plt.show()

plt.figure(figsize=(12, 6))
sns.kdeplot(test_payloads_df['length'], fill=True, color='red', label='Testing Dataset')
plt.title('Density Plot of Payload Lengths in Testing Dataset')
plt.xlabel('Payload Length')
```

```
plt.ylabel('Density')
plt.legend()
plt.show()
```



In [27]:

```
all_train_payloads = ''.join(train_payloads_df['payload'])
all_test_payloads = ''.join(test_payloads_df['payload'])

train_char_freq = Counter(all_train_payloads)
test_char_freq = Counter(all_test_payloads)

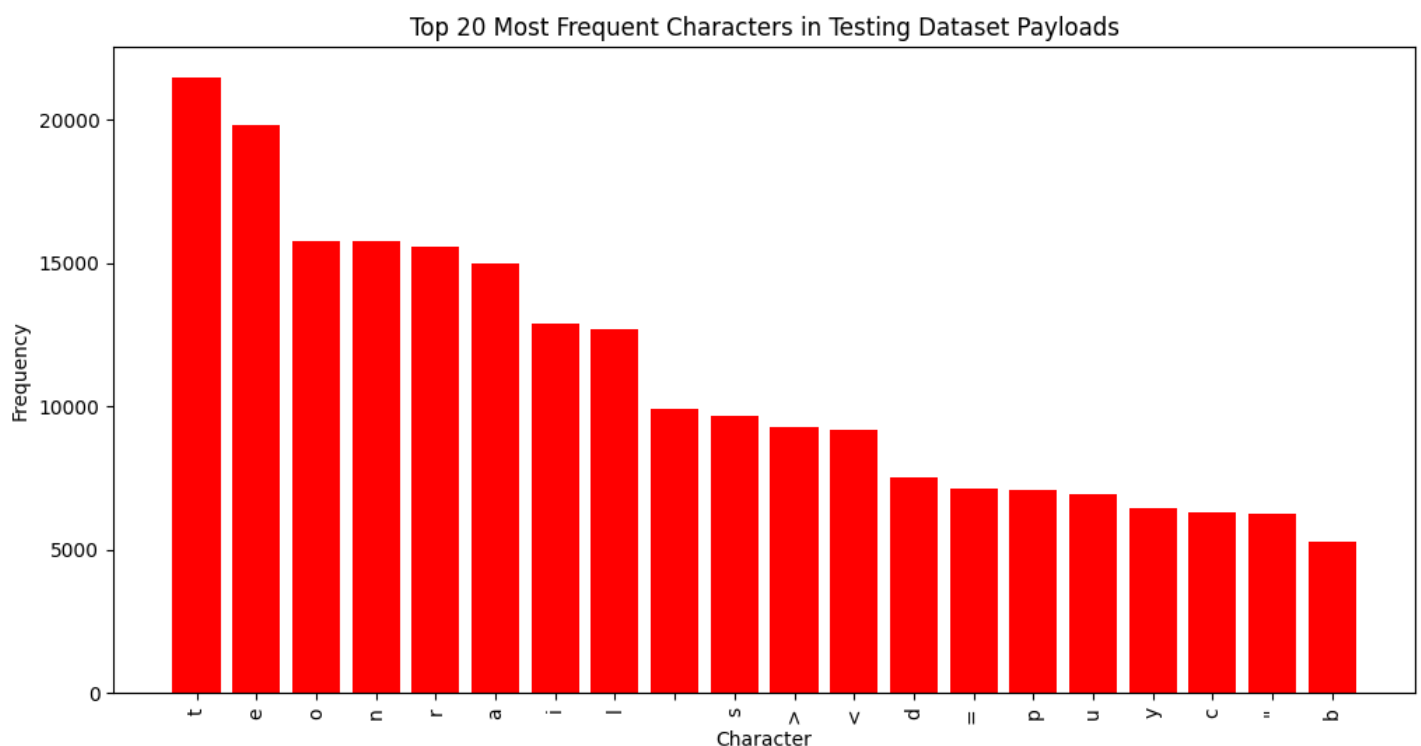
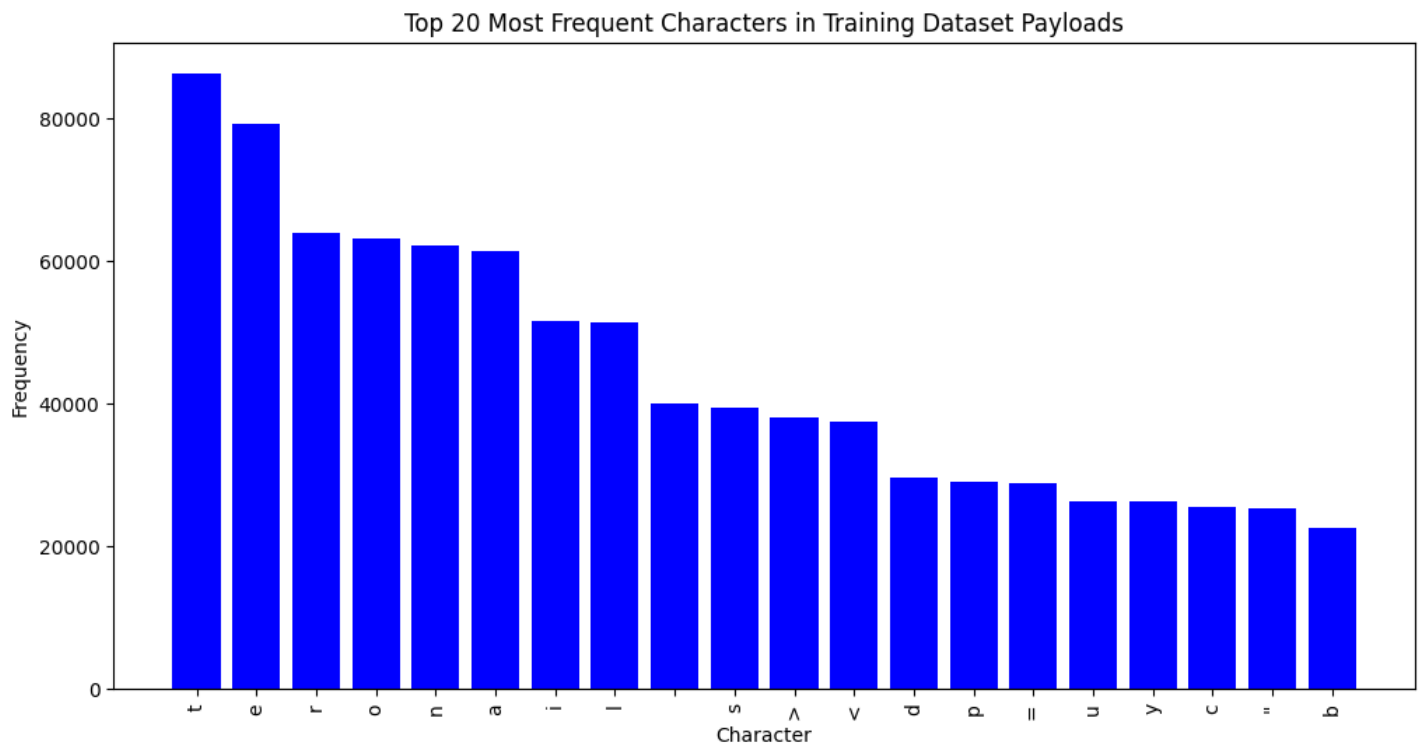
train_char_freq_df = pd.DataFrame(train_char_freq.items(), columns=['Character', 'Frequency'])
train_char_freq_df = train_char_freq_df.sort_values(by='Frequency', ascending=False).head(20)

test_char_freq_df = pd.DataFrame(test_char_freq.items(), columns=['Character', 'Frequency'])
test_char_freq_df = test_char_freq_df.sort_values(by='Frequency', ascending=False).head(
```

20)

```
plt.figure(figsize=(12, 6))
plt.bar(train_char_freq_df['Character'], train_char_freq_df['Frequency'], color='blue')
plt.title('Top 20 Most Frequent Characters in Training Dataset Payloads')
plt.xlabel('Character')
plt.ylabel('Frequency')
plt.xticks(rotation=90)
plt.show()

plt.figure(figsize=(12, 6))
plt.bar(test_char_freq_df['Character'], test_char_freq_df['Frequency'], color='red')
plt.title('Top 20 Most Frequent Characters in Testing Dataset Payloads')
plt.xlabel('Character')
plt.ylabel('Frequency')
plt.xticks(rotation=90)
plt.show()
```



In [28]:

```
vectorizer = CountVectorizer(stop_words='english', max_features=20)
```

```

train_word_counts = vectorizer.fit_transform(train_payloads_df['payload'])
test_word_counts = vectorizer.transform(test_payloads_df['payload'])

train_word_freq_df = pd.DataFrame(train_word_counts.toarray(), columns=vectorizer.get_feature_names_out())
test_word_freq_df = pd.DataFrame(test_word_counts.toarray(), columns=vectorizer.get_feature_names_out())

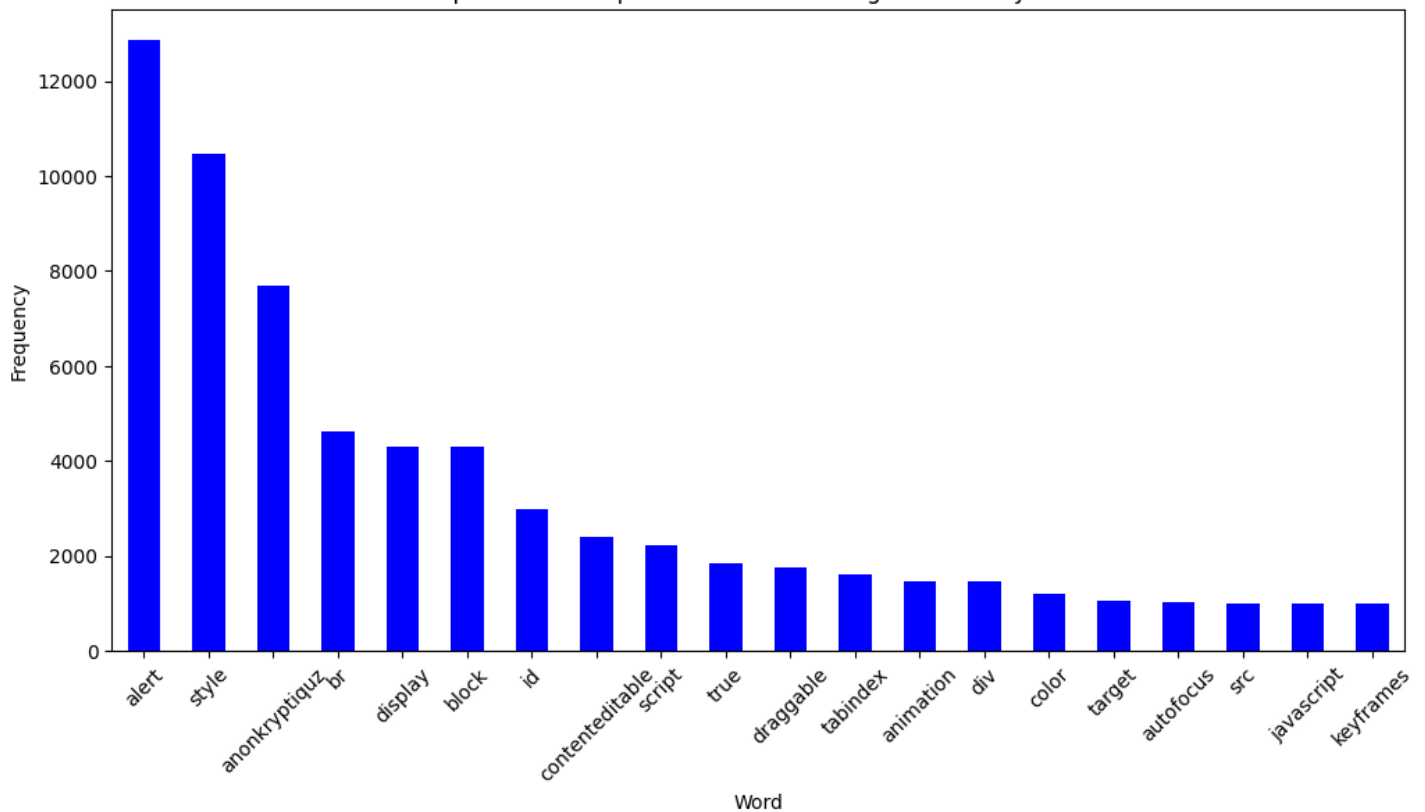
train_word_freq = train_word_freq_df.sum().sort_values(ascending=False)
test_word_freq = test_word_freq_df.sum().sort_values(ascending=False)

plt.figure(figsize=(12, 6))
train_word_freq.head(20).plot(kind='bar', color='blue')
plt.title('Top 20 Most Frequent Words in Training Dataset Payloads')
plt.xlabel('Word')
plt.ylabel('Frequency')
plt.xticks(rotation=45)
plt.show()

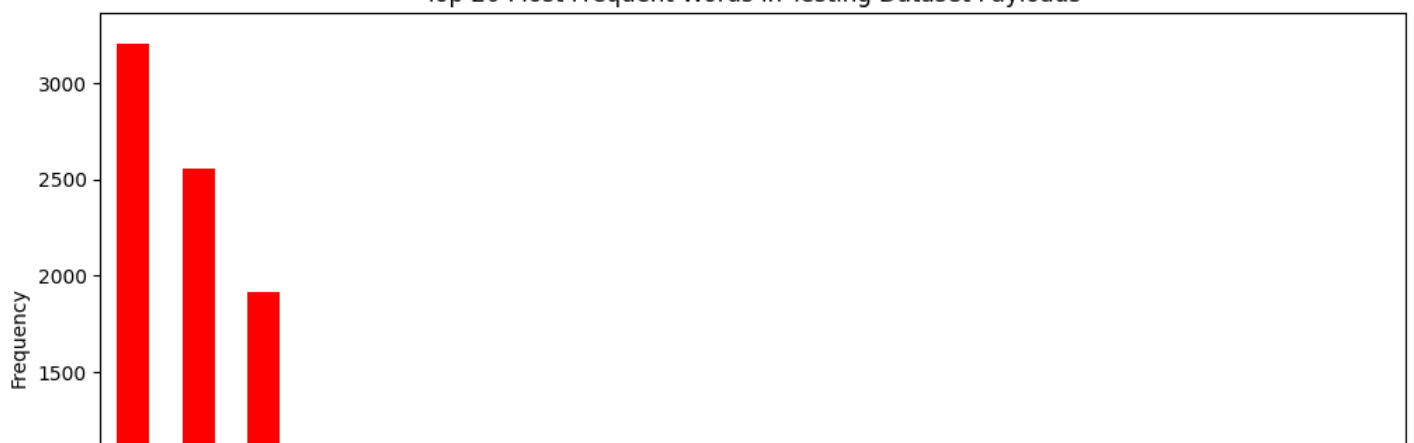
plt.figure(figsize=(12, 6))
test_word_freq.head(20).plot(kind='bar', color='red')
plt.title('Top 20 Most Frequent Words in Testing Dataset Payloads')
plt.xlabel('Word')
plt.ylabel('Frequency')
plt.xticks(rotation=45)
plt.show()

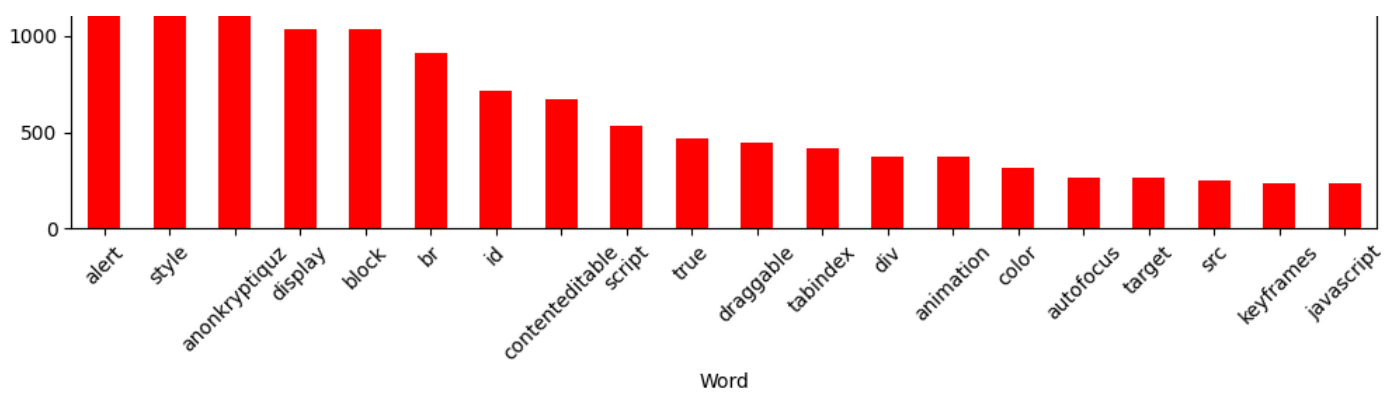
```

Top 20 Most Frequent Words in Training Dataset Payloads



Top 20 Most Frequent Words in Testing Dataset Payloads





## Pre-processing

In [29]:

```
max_sequence_length = new_max_sequence_length = 100

vocab_size = vocab_size_SET = 175

learning_rate_SET = 0.001
epochs_SET = 10
patience_SET = 5
Dropout_SET = 0.2
batch_size_SET = 64
seq_length_SET = 70
GRU_SET = 64
output_dim_SET = 64
train_inputs_SET = 200000

max_length_SET = 70
max_repeats_SET = 3
temperature_SET = 0.3

model_name = "best_model.keras"
```

In [32]:

```
all_payloads = train_payloads_df['payload'].tolist() + test_payloads_df['payload'].tolist()

with open("payloads.txt", "w", encoding="utf-8") as f:
    for payload in all_payloads:
        f.write(payload + "\n")

spm.SentencePieceTrainer.train(
    input="payloads.txt",
    model_prefix="xss_tokenizer",
    vocab_size=vocab_size_SET,
    model_type="bpe"
)

sp = spm.SentencePieceProcessor()
sp.load("xss_tokenizer.model")

train_sequences = [sp.encode_as_ids(payload) for payload in train_payloads_df['payload'].tolist()]
test_sequences = [sp.encode_as_ids(payload) for payload in test_payloads_df['payload'].tolist()]

print("Total unique tokens in the dataset:", sp.get_piece_size())
print("Example payload:", train_payloads_df['payload'].tolist()[0])
print("Tokenized sequence:", train_sequences[0])
```

Total unique tokens in the dataset: 175

Example payload: {{constructor.constructor(valueOf.name.constructor.fromCharCode(97,108,101,114,116,40,49,41,10))()}}

Tokenized sequence: [89, 126, 126, 67, 11, 85, 98, 100, 83, 86, 85, 131, 67, 11, 85, 98, 100, 83, 86, 85, 107, 73, 91, 74, 164, 113, 131, 87, 88, 39, 131, 67, 11, 85, 98, 100, 83, 86, 85, 131, 113, 64, 104, 133, 120, 88, 85, 133, 86, 52, 107, 146, 144, 148, 105, 110]



```
, 88, 89, 131, 119, 84, 104, 133, 120, 88, 89, 133, 88, 92, 107, 140, 144, 140, 105, 119, 134, 148, 105, 119, 105, 148, 105, 105, 141, 148, 105, 105, 137, 148, 141, 119, 148, 141, 146, 148, 141, 105, 148, 105, 119, 106, 106, 107, 106, 125, 125]
```

In [33]:

```
max_train_length = max(len(seq) for seq in train_sequences)
max_test_length = max(len(seq) for seq in test_sequences)
max_length = max(max_train_length, max_test_length)

train_padded = pad_sequences(train_sequences, maxlen=new_max_sequence_length, padding='pre')
test_padded = pad_sequences(test_sequences, maxlen=new_max_sequence_length, padding='pre')

print("Maximum length of payloads:", max_length)
print("Shape of training data after padding:", train_padded.shape)
print("Shape of testing data after padding:", test_padded.shape)
print("Example padded sequence:", train_padded[0])
```

```
Maximum length of payloads: 2418
Shape of training data after padding: (14437, 100)
Shape of testing data after padding: (3609, 100)
Example padded sequence: [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  89 126 12
 6  67 11
 85  98 100  83  86  85 131  67 11  85  98 100  83  86  85 107  73  91
 74 164 113 131  87  88  39 131  67 11  85  98 100  83  86  85 131 113
 64 104 133 120  88  85 133  86  52 107 146 144 148 105 119 134 148 105
119 105 148 105 105 141 148 105 105 137 148 141 119 148 141 146 148 141
105 148 105 119 106 106 107 106 125 125]
```

In [34]:

```
train_data, val_data = train_test_split(train_padded, test_size=0.2, random_state=42)

print("Training Data Shape:", train_data.shape)
print("Validation Data Shape:", val_data.shape)
```

```
Training Data Shape: (11549, 100)
Validation Data Shape: (2888, 100)
```

## Model building

In [38]:

```
inputs = Input(shape=(max_sequence_length,))
x = Embedding(input_dim=vocab_size, output_dim=output_dim_SET)(inputs)

x = Bidirectional(GRU(GRU_SET, return_sequences=True))(x)
x = Dropout(Dropout_SET)(x)

x = Bidirectional(GRU(GRU_SET))(x)
x = Dropout(Dropout_SET)(x)

outputs = Dense(vocab_size, activation='softmax')(x)

model = Model(inputs=inputs, outputs=outputs)

def f1_score(y_true, y_pred):
    y_pred = K.argmax(y_pred, axis=-1)
    y_true = K.cast(y_true, 'int32')

    tp = K.sum(K.cast((y_true == y_pred) & (y_true > 0), 'float32'))
    fp = K.sum(K.cast((y_true != y_pred) & (y_pred > 0), 'float32'))
    fn = K.sum(K.cast((y_true != y_pred) & (y_true > 0), 'float32'))

    precision = tp / (tp + fp + K.epsilon())
    recall = tp / (tp + fn + K.epsilon())

    return 2 * ((precision * recall) / (precision + recall + K.epsilon()))
```



```
model.compile(
    loss='sparse_categorical_crossentropy',
    optimizer=Adam(learning_rate=learning_rate_SET),
    metrics=['accuracy', f1_score]
)

model.summary()
```

Model: "functional\_1"

Layer (type)	Output Shape	Param #
input_layer_1 (InputLayer)	(None, 100)	0
embedding_1 (Embedding)	(None, 100, 64)	11,200
bidirectional_2 (Bidirectional)	(None, 100, 128)	49,920
dropout_2 (Dropout)	(None, 100, 128)	0
bidirectional_3 (Bidirectional)	(None, 128)	74,496
dropout_3 (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 175)	22,575

Total params: 158,191 (617.93 KB)

Trainable params: 158,191 (617.93 KB)

Non-trainable params: 0 (0.00 B)

In [36]:

```
final_seq_length = new_max_sequence_length

train_data_truncated = train_data[:, :final_seq_length]
val_data_truncated = val_data[:, :final_seq_length]

print("Truncated Training Data Shape:", train_data_truncated.shape)
print("Truncated Validation Data Shape:", val_data_truncated.shape)
```

Truncated Training Data Shape: (11549, 100)

Truncated Validation Data Shape: (2888, 100)

In [37]:

```
def create_input_output_pairs(data, seq_length):
    inputs = []
    targets = []
    for payload in data:
        for i in range(1, len(payload)):
            input_seq = payload[:i]
            inputs.append(input_seq)
            targets.append(payload[i])

    inputs_padded = pad_sequences(inputs, maxlen=seq_length, padding='pre')
    return np.array(inputs_padded), np.array(targets)

train_inputs, train_targets = create_input_output_pairs(train_data_truncated, final_seq_length)
val_inputs, val_targets = create_input_output_pairs(val_data_truncated, final_seq_length)

print("Training Inputs Shape:", train_inputs.shape)
print("Training Targets Shape:", train_targets.shape)
print("Validation Inputs Shape:", val_inputs.shape)
print("Validation Targets Shape:", val_targets.shape)
```

Training Inputs Shape: (1143351, 100)  
Training Targets Shape: (1143351,)  
Validation Inputs Shape: (285912, 100)  
Validation Targets Shape: (285912,)

## Model Training

In [39]:

```
import numpy as np
import tensorflow as tf
from tensorflow.keras.models import Model, load_model
from tensorflow.keras.layers import Input, Embedding, Bidirectional, GRU, Dense, Dropout,
Attention
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.callbacks import EarlyStopping, ModelCheckpoint
import matplotlib.pyplot as plt
from tensorflow.keras import backend as K
import os
import sentencepiece as spm

def f1_score(y_true, y_pred):
    y_pred = K.argmax(y_pred, axis=-1)
    y_true = K.cast(y_true, dtype='int64')

    tp = K.sum(K.cast(K.equal(y_true, y_pred) & K.greater(y_true, 0), 'float32'))
    fp = K.sum(K.cast(K.not_equal(y_true, y_pred) & K.greater(y_pred, 0), 'float32'))
    fn = K.sum(K.cast(K.not_equal(y_true, y_pred) & K.greater(y_true, 0), 'float32'))

    precision = tp / (tp + fp + K.epsilon())
    recall = tp / (tp + fn + K.epsilon())

    return 2 * ((precision * recall) / (precision + recall + K.epsilon()))

model_name = "best_model.keras"

if os.path.exists(model_name):
    print("Found 'best_model.keras'. Loading existing model...")
    model = load_model(model_name, custom_objects={'f1_score': f1_score})
else:
    print("No 'best_model.keras' found. Training a new model...")

    final_seq_length = new_max_sequence_length

    inputs = Input(shape=(final_seq_length,))
    x = Embedding(input_dim=vocab_size_SET, output_dim=output_dim_SET)(inputs)

    x = Bidirectional(GRU(GRU_SET, return_sequences=True))(x)
    x = Dropout(Dropout_SET)(x)

    x = Attention()([x, x])

    x = Bidirectional(GRU(GRU_SET))(x)
    x = Dropout(Dropout_SET)(x)

    outputs = Dense(vocab_size_SET, activation='softmax')(x)

    model = Model(inputs=inputs, outputs=outputs)

    model.compile(
        loss='sparse_categorical_crossentropy',
        optimizer=Adam(learning_rate=learning_rate_SET),
        metrics=['accuracy', f1_score]
    )

    early_stopping = EarlyStopping(
        monitor='val_loss',
        patience=patience_SET,
        restore_best_weights=True
    )
```

```

checkpoint = ModelCheckpoint(
    model_name,
    monitor="val_loss",
    save_best_only=True,
    mode="min"
)

history = model.fit(
    train_inputs,
    train_targets,
    validation_data=(val_inputs, val_targets),
    batch_size=batch_size_SET,
    epochs=epochs_SET,
    callbacks=[early_stopping, checkpoint]
)

plt.figure(figsize=(12, 6))
plt.plot(history.history['loss'], label='Training Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Training and Validation Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
plt.show()

```

Found 'best\_model.keras'. Loading existing model...

## Model Evaluation

In [40]:

```

results = model.evaluate(val_inputs, val_targets, batch_size=batch_size_SET)
val_loss, val_accuracy, val_f1_score = results

```

```

print(f"Validation Loss: {val_loss:.4f}")
print(f"Validation Accuracy: {val_accuracy:.4f}")
print(f"Validation F1 Score: {val_f1_score:.4f}")

```

4468/4468 ————— 46s 10ms/step - accuracy: 0.9133 - f1\_score: 0.7274 - loss : 0.3547

Validation Loss: 0.3509

Validation Accuracy: 0.9142

Validation F1 Score: 0.7296

## Model Inference

In [41]:

```

import numpy as np
from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras.models import load_model
from tensorflow.keras import backend as K

def f1_score(y_true, y_pred):
    y_pred = K.argmax(y_pred, axis=-1)
    y_true = K.cast(y_true, dtype='int64')

    tp = K.sum(K.cast(K.equal(y_true, y_pred) & K.greater(y_true, 0), 'float32'))
    fp = K.sum(K.cast(K.not_equal(y_true, y_pred) & K.greater(y_pred, 0), 'float32'))
    fn = K.sum(K.cast(K.not_equal(y_true, y_pred) & K.greater(y_true, 0), 'float32'))

    precision = tp / (tp + fp + K.epsilon())
    recall = tp / (tp + fn + K.epsilon())

    return 2 * ((precision * recall) / (precision + recall + K.epsilon()))

model = load_model(
    "best_model.keras",
    custom_objects={'f1_score': f1_score}
)

```

```

def generate_payload(model, sp, seed_text, max_length=100, temperature=0.3, max_repeats=
3):
    generated_payload = seed_text
    last_chars = []

    for _ in range(max_length - len(seed_text)):
        tokenized_payload = sp.encode_as_ids(generated_payload)
        padded_payload = pad_sequences([tokenized_payload], maxlen=max_length, padding='
pre')
        predictions = model.predict(padded_payload, verbose=0)[0]
        predictions = np.asarray(predictions).astype('float64')
        predictions = np.log(predictions + 1e-7) / temperature
        exp_preds = np.exp(predictions)
        predictions = exp_preds / np.sum(exp_preds)
        predicted_token = np.random.choice(len(predictions), p=predictions)

        if predicted_token == 0:
            print(f"Predicted Token: {predicted_token}, Predicted Character: '', stoppin
g generation.")
            break
        if predicted_token == 1:
            continue

        predicted_char = sp.id_to_piece(predicted_token)
        last_chars.append(predicted_char)
        if len(last_chars) > max_repeats and len(set(last_chars[-max_repeats:])) == 1:
            continue

        generated_payload += predicted_char

        print(f"Predicted Token: {predicted_token}, Predicted Character: '{predicted_cha
r}' -> Current Payload: {generated_payload}")

    return generated_payload

print("\n--- Method 1 ---")
seed_text = "<script>alert(\"AnonKryptiQuz\")"
temperatures = [0.1, 0.3, 0.5, 1.0]
payloads_method1 = []

for temp in temperatures:
    print(f"\n--- Method 1, Running for Temperature: {temp} ---")
    generated_payload = generate_payload(
        model, sp, seed_text, max_length=100, temperature=temp
    )
    payloads_method1.append((temp, generated_payload))
    print(f"\nFINAL PAYLOAD (Method 1): {generated_payload}")

print("\n--- Method 2 ---")
payloads_method2 = []

for temp in temperatures:
    print(f"\n--- Method 2, Running for Temperature: {temp} ---")
    generated_payload = generate_payload(
        model, sp, seed_text, max_length=100, temperature=temp
    )
    payloads_method2.append((temp, generated_payload))
    print(f"\nFINAL PAYLOAD (Method 2): {generated_payload}")

```

--- Method 1 ---

--- Method 1, Running for Temperature: 0.1 ---

```

Predicted Token: 6, Predicted Character: '</' -> Current Payload: <script>alert("AnonKryp
tiQuz")</
Predicted Token: 63, Predicted Character: 'script' -> Current Payload: <script>alert("Ano
nKryptiQuz")</script>
Predicted Token: 93, Predicted Character: '>' -> Current Payload: <script>alert("AnonKryp
tiQuz")</script>
Predicted Token: 9, Predicted Character: 'alert' -> Current Payload: <script>alert("AnonK
ryptiQuz")</script>alert
Predicted Token: 107, Predicted Character: '(' -> Current Payload: <script>alert("AnonKry

```

[illegible]

[illegible]

```
Predicted Token: 6, Predicted Character: '</' -> Current Payload: <script>alert("AnonKryp
tiQuz")</
Predicted Token: 63, Predicted Character: 'script' -> Current Payload: <script>alert("Ano
nKryptiQuz")</script
Predicted Token: 93, Predicted Character: '>' -> Current Payload: <script>alert("AnonKryp
tiQuz")</script>
Predicted Token: 9, Predicted Character: 'alert' -> Current Payload: <script>alert("AnonK
ryptiQuz")</script>alert
Predicted Token: 107, Predicted Character: '(' -> Current Payload: <script>alert("AnonKry
ptiQuz")</script>alert(
Predicted Token: 106, Predicted Character: ') ' -> Current Payload: <script>alert("AnonKry
ptiQuz")</script>alert()
Predicted Token: 6, Predicted Character: '</' -> Current Payload: <script>alert("AnonKryp
tiQuz")</script>alert()</
Predicted Token: 63, Predicted Character: 'script' -> Current Payload: <script>alert("Ano
nKryptiQuz")</script>alert()</script
Predicted Token: 93, Predicted Character: '>' -> Current Payload: <script>alert("AnonKryp
tiQuz")</script>alert()</script>
Predicted Token: 9, Predicted Character: 'alert' -> Current Payload: <script>alert("AnonK
ryptiQuz")</script>alert()</script>alert
Predicted Token: 15, Predicted Character: '(1)' -> Current Payload: <script>alert("AnonKr
yptiQuz")</script>alert()</script>alert(1)
Predicted Token: 6, Predicted Character: '</' -> Current Payload: <script>alert("AnonKryp
tiQuz")</script>alert()</script>alert(1)</
Predicted Token: 63, Predicted Character: 'script' -> Current Payload: <script>alert("Ano
nKryptiQuz")</script>alert()</script>alert(1)</script
Predicted Token: 93, Predicted Character: '>' -> Current Payload: <script>alert("AnonKryp
tiQuz")</script>alert()</script>alert(1)</script>
Predicted Token: 6, Predicted Character: '</' -> Current Payload: <script>alert("AnonKryp
tiQuz")</script>alert()</script>alert(1)</script></
Predicted Token: 63, Predicted Character: 'script' -> Current Payload: <script>alert("Ano
nKryptiQuz")</script>alert()</script>alert(1)</script></script
Predicted Token: 93, Predicted Character: '>' -> Current Payload: <script>alert("AnonKryp
tiQuz")</script>alert()</script>alert(1)</script></script>
Predicted Token: 6, Predicted Character: '</' -> Current Payload: <script>alert("AnonKryp
```

[illegible]



[illegible]

[illegible]

[illegible]

[illegible]

```
--- Method 1, Running for Temperature: 1.0 ---
```

[illegible]



[illegible]

[illegible]





[illegible]

[illegible]



[illegible]

[illegible]

[illegible]

[illegible]



