cs-logistic-regression

May 20, 2023

1 Linear Regression

[7]:
```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, precision_score, recall_score,␣
 ↪f1_score, confusion_matrix, classification_report
import matplotlib.pyplot as plt

# Load the dataset
df = pd.read_csv('preprocessed_dataset.csv')

# Map label values to corresponding attack names
label_mapping = {
    0: 'BENIGN',
    1: 'Brute Force',
    2: 'SQL Injection',
    3: 'XSS'
}
df['Label'] = df['Label'].map(label_mapping)

# Split the dataset into features (X) and labels (y)
X = df.iloc[:, :-1]  # All columns except the last one
y = df.iloc[:, -1]   # Last column (labels)

# Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)

# Create and train the Logistic Regression model
model = LogisticRegression()
model.fit(X_train, y_train)

# Predict the test set
y_pred = model.predict(X_test)
```

```
# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
precision = precision_score(y_test, y_pred, average='weighted')
recall = recall_score(y_test, y_pred, average='weighted')
f1 = f1_score(y_test, y_pred, average='weighted')
confusion_matrix_4x4 = confusion_matrix(y_test, y_pred)
confusion_matrix_2x2 = np.zeros((2, 2))

# Calculate values for the 2x2 confusion matrix
confusion_matrix_2x2[0, 0] = confusion_matrix_4x4[0, 0]  # True Negatives (0, 0)
confusion_matrix_2x2[1, 0] = np.sum(confusion_matrix_4x4[1:, 0])  # False␣
 ↪Negatives (1, 0)
confusion_matrix_2x2[0, 1] = np.sum(confusion_matrix_4x4[0, 1:])  # False␣
 ↪Positives (0, 1)
confusion_matrix_2x2[1, 1] = np.sum(confusion_matrix_4x4[1:, 1:])  # True␣
 ↪Positives (1, 1)

classification = classification_report(y_test, y_pred)

# Plot the confusion matrix 4x4
plt.figure(figsize=(6, 4))
plt.imshow(confusion_matrix_4x4, cmap='Blues', interpolation='nearest')
plt.title('Confusion Matrix (4x4)')
plt.colorbar()
tick_marks = np.arange(len(np.unique(y)))
plt.xticks(tick_marks, np.unique(y), rotation=45)
plt.yticks(tick_marks, np.unique(y))
plt.xlabel('Predicted')
plt.ylabel('True')
for i in range(len(np.unique(y))):
    for j in range(len(np.unique(y))):
        plt.text(j, i, str(confusion_matrix_4x4[i, j]),␣
 ↪horizontalalignment='center', verticalalignment='center')
plt.show()

# Plot the confusion matrix 2x2
plt.figure(figsize=(6, 4))
plt.imshow(confusion_matrix_2x2, cmap='Blues', interpolation='nearest')
plt.title('Confusion Matrix (2x2)')
plt.colorbar()
tick_marks = np.arange(2)
plt.xticks(tick_marks, ['0', '1'], rotation=45)
plt.yticks(tick_marks, ['0', '1'])
plt.xlabel('Predicted')
plt.ylabel('True')
for i in range(2):
    for j in range(2):
```

```
        plt.text(j, i, str(confusion_matrix_2x2[i, j]),␣
 ↪horizontalalignment='center', verticalalignment='center')
plt.show()

# Print the model's evaluation results
print('======= Logistic Regression Model  ============')
print()
print("Model Accuracy:\n", accuracy)
print("Model Precision:\n", precision)
print("Model Recall:\n", recall)
print("Model F1-score:\n", f1)
print()
print("Confusion matrix 4*4:\n", confusion_matrix_4x4)
print()
print("Confusion matrix 2*2:\n", confusion_matrix_2x2)
print()
print("Classification report:\n", classification)
print()
print("Distribution of Attacks:")
df['Label'].value_counts().plot(kind='bar')
plt.xticks(np.arange(4), ['BENIGN', 'Brute Force', 'SQL Injection', 'XSS'],␣
 ↪rotation=0)
plt.show()
```

```
C:\Users\pappu\anaconda3\lib\site-
packages\sklearn\linear_model\_logistic.py:814: ConvergenceWarning: lbfgs failed
to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  n_iter_i = _check_optimize_result(
C:\Users\pappu\anaconda3\lib\site-
packages\sklearn\metrics\_classification.py:1318: UndefinedMetricWarning:
Precision is ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\pappu\anaconda3\lib\site-
packages\sklearn\metrics\_classification.py:1318: UndefinedMetricWarning:
Precision and F-score are ill-defined and being set to 0.0 in labels with no
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C:\Users\pappu\anaconda3\lib\site-
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```

```
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```
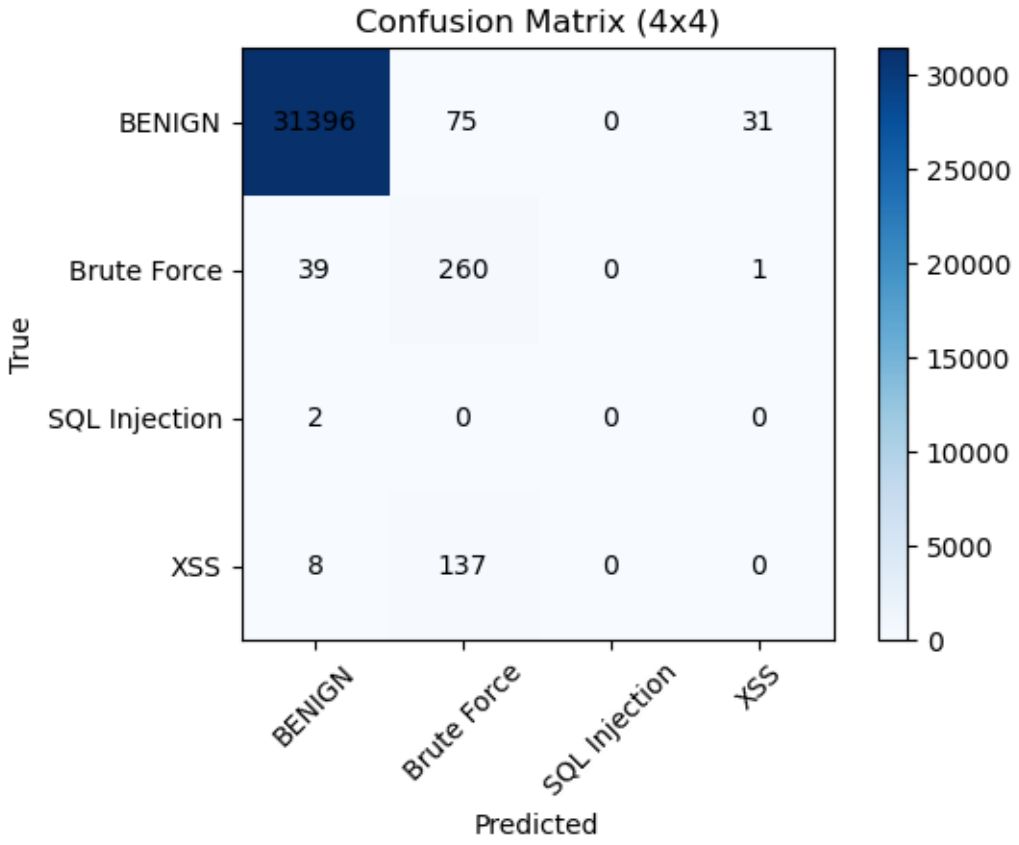
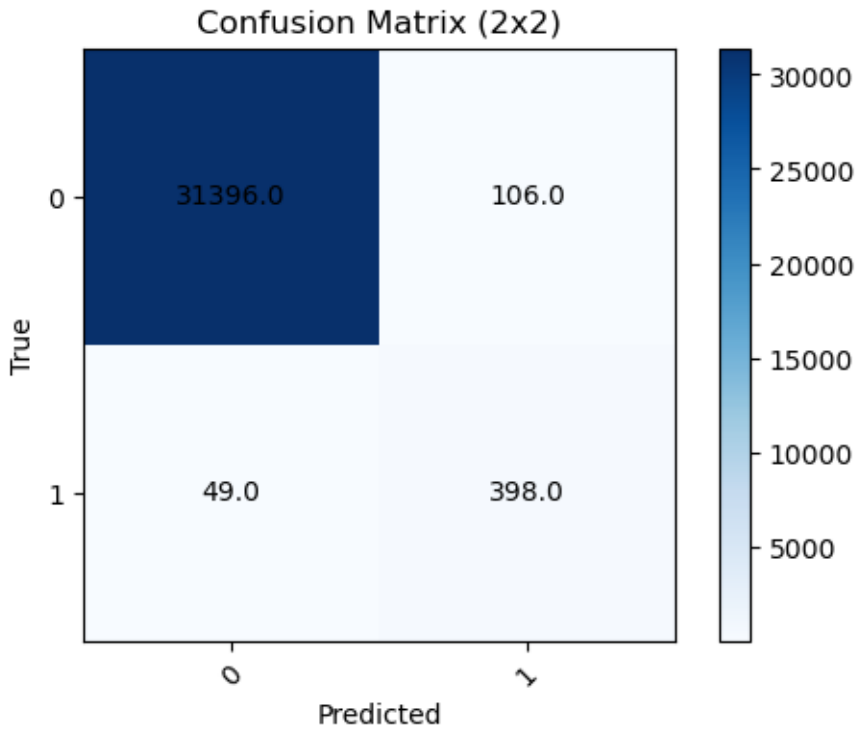
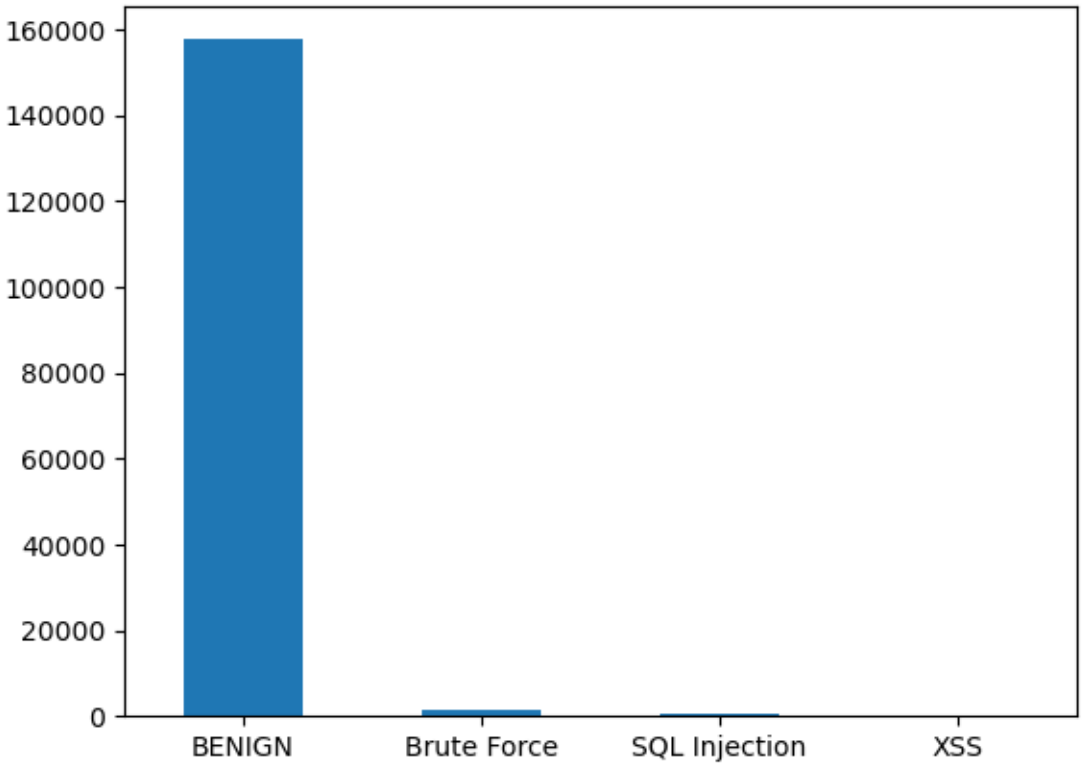






```
======= Logistic Regression Model  ============

Model Accuracy:
 0.9908291339322044
Model Precision:
 0.9896449158200842
Model Recall:
 0.9908291339322044
Model F1-score:
 0.9899058612405326

Confusion matrix 4*4:
 [[31396    75     0    31]
 [   39   260     0     1]
 [    2     0     0     0]
 [    8   137     0     0]]

Confusion matrix 2*2:
 [[31396.   106.]
 [   49.   398.]]

Classification report:
               precision    recall  f1-score   support
```

```
              BENIGN       1.00      1.00      1.00     31502
        Brute Force        0.55      0.87      0.67       300
      SQL Injection        0.00      0.00      0.00         2
                XSS        0.00      0.00      0.00       145

           accuracy                           0.99     31949
          macro avg       0.39      0.47      0.42     31949
       weighted avg       0.99      0.99      0.99     31949
```

Distribution of Attacks:



[10]:
```python
# Create a DataFrame to store the evaluation metrics
evaluation_data = pd.DataFrame({
    'Model': ['Logistic Regression'],
    'Accuracy': [accuracy],
    'Precision': [precision],
    'Recall': [recall],
    'F1-score': [f1]
})
```

```
# Save the evaluation metrics to a CSV file
evaluation_data.to_csv('evaluation_results_LR.csv', index=False)
```

[11]:
```
print(evaluation_data)
```

```
                 Model  Accuracy  Precision    Recall  F1-score
0  Logistic Regression  0.990829   0.989645  0.990829  0.989906
```

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