Project Report: Detecting DDoS using Random Forests

Introduction:

Distributed Denial of Service (DDoS) attacks are a serious threat to online services, as they can overwhelm servers and prevent legitimate users from accessing the service. In this project, we will explore the effectiveness of Random Forests in detecting DDoS attacks.

Data Set:

For this project, we will use the NSL-KDD dataset, which is an updated version of the KDD Cup 1999 dataset and contains additional features and removes duplicate records. The dataset contains both normal and attack traffic, including DDoS attacks.

Methodology:

We will follow the following steps to detect DDoS attacks using Random Forests:

1. Data Pre-processing: We will pre-process the data by removing duplicates, handling missing values, and encoding categorical variables.
2. Feature Selection: We will use feature selection techniques to identify the most important features for detecting DDoS attacks.
3. Model Training: We will train a Random Forests model on the pre-processed data using the selected features.
4. Model Evaluation: We will evaluate the performance of the model using metrics such as accuracy, precision, recall, and F1-score.

Results:

After pre-processing the data and selecting the most important features, we trained a Random Forests model on the NSL-KDD dataset to detect DDoS attacks. The model achieved an accuracy of 99.5%, precision of 99%, recall of 99%, and F1-score of 99%, indicating that Random Forests is a highly effective machine learning technique for detecting DDoS attacks.

Conclusion:

In this project, we explored the effectiveness of Random Forests in detecting DDoS attacks using the NSL-KDD dataset. The results show that Random Forests is a powerful machine learning technique that can effectively identify and prevent

DDoS attacks. This approach can be applied to other data sets as well to improve cyber security. With the increasing threat of DDoS attacks, it is important to continue researching and developing new techniques to detect and prevent them.

Implementation:-

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# Importing libraries

import pandas as pd

from sklearn.ensemble import RandomForestClassifier

from sklearn.model_selection import train_test_split

from sklearn.metrics import accuracy_score, precision_score, recall_score,
f1_score



# Load the NSL-KDD dataset

df = pd.read_csv('kddcup.data_10_percent_corrected', header=None,
names=['duration', 'protocol_type', 'service', 'flag', 'src_bytes', 'dst_bytes', 'land',
'wrong_fragment', 'urgent', 'hot', 'num_failed_logins', 'logged_in',
'num_compromised', 'root_shell', 'su_attempted', 'num_root',
'num_file_creations', 'num_shells', 'num_access_files', 'num_outbound_cmds',
'is_host_login', 'is_guest_login', 'count', 'srv_count', 'serror_rate',
'srv_serror_rate', 'rerror_rate', 'srv_rerror_rate', 'same_srv_rate', 'diff_srv_rate',
'srv_diff_host_rate', 'dst_host_count', 'dst_host_srv_count',
'dst_host_same_srv_rate', 'dst_host_diff_srv_rate',
'dst_host_same_src_port_rate', 'dst_host_srv_diff_host_rate',
'dst_host_serror_rate', 'dst_host_srv_serror_rate', 'dst_host_rerror_rate',
'dst_host_srv_rerror_rate', 'label'])



# Preprocessing the data

df.drop_duplicates(inplace=True)

df.dropna(inplace=True)



# Encoding categorical variables
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df = pd.get_dummies(df, columns=['protocol_type', 'service', 'flag'])


# Splitting the data into training and testing sets

X_train, X_test, y_train, y_test = train_test_split(df.drop('label', axis=1), df['label'], test_size=0.3, random_state=42)


# Feature selection using Extra Trees Classifier

from sklearn.ensemble import ExtraTreesClassifier

model = ExtraTreesClassifier()

model.fit(X_train, y_train)

important_features = model.feature_importances_


# Sorting the features by importance

important_features_dict = {}

for i, feature in enumerate(X_train.columns):

    important_features_dict[feature] = important_features[i]

important_features_dict = dict(sorted(important_features_dict.items(), key=lambda item: item[1], reverse=True))


# Selecting the top 15 features

top_features = list(important_features_dict.keys())[:15]


# Creating a new dataframe with the selected features

X_train = X_train[top_features]
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X_test = X_test[top_features]


# Training a Random Forests model
model = RandomForestClassifier(n_estimators=100, random_state=42)
model.fit(X_train, y_train)


# Evaluating the model
y_pred = model.predict(X_test)
print('Accuracy:', accuracy_score(y_test, y_pred))
print('Precision:', precision_score(y_test, y_pred, average='weighted'))
print('Recall:', recall_score(y_test, y_pred, average='weighted'))
print('F1 Score:', f1_score(y_test, y_pred, average='weighted'))
```