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# MACHINE LEARNING TECHNIQUES FOR NETWORK INTRUSION DETECTION SYSTEM

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## ABSTRACT

A novel supervised machine learning system is developed to classify network traffic whether it is malicious or benign. To find the best model considering detection success rate, combination of supervised learning algorithm and feature selection method have been used. Through this study, it is found that Artificial Neural Network (ANN) based machine learning with wrapper feature selection outperform support vector machine (SVM) technique while classifying network traffic. To evaluate the performance, NSL-KDD dataset is used to classify network traffic using SVM and ANN supervised machine learning techniques. Comparative study shows that the proposed model is efficient than other existing models with respect to intrusion detection success rate."

**Keywords:** supervised machine learning, network traffic classification, malicious traffic detection, feature selection, Artificial Neural Network (ANN), support vector machine (SVM), intrusion detection.

## INTRODUCTION

The advancement of technology has led to the proliferation of interconnected systems, resulting in an exponential increase in the volume of data transmitted over networks [1]. However, this interconnectedness has also introduced vulnerabilities, making networks susceptible to malicious activities such as intrusions and cyberattacks [2]. In response to this growing threat landscape, there has been a significant interest in developing effective techniques for detecting and mitigating network intrusions [3]. Machine learning, a subfield of artificial intelligence, has emerged as a promising approach for addressing the challenges associated with network intrusion detection [4]. By leveraging the inherent patterns and characteristics of network traffic data, machine learning algorithms can be trained to distinguish between benign and malicious activities, thereby enhancing the security posture of networked systems [5].The objective of this paper is to explore the application of machine learning techniques for network intrusion detection and to investigate the efficacy of different supervised learning algorithms in classifying network traffic [6]. A novel supervised machine learning system is developed to classify network traffic as either malicious or benign, with the primary goal of maximizing the detection success rate [7]. To achieve this objective, a combination of supervised learning algorithms and feature selection methods is employed to identify the most effective model for detecting network intrusions [8]. Through extensive experimentation and analysis, the study aims to shed light on the performance characteristics of different machine learning models and their suitability for intrusion detection applications [9].

Central to this research is the evaluation of two prominent supervised learning algorithms: Artificial Neural Network (ANN) and Support Vector Machine (SVM) [10]. These algorithms are chosen based on their widespread adoption and proven effectiveness in various machine learning applications [11]. The study investigates the performance of ANN-based machine learning with wrapper feature selection and compares it against the traditional SVM technique in classifying network traffic [12]. By conducting experiments using the NSL-KDD dataset, which is widely used in the field of network intrusion detection research, the study aims to provide empirical evidence of the comparative effectiveness of these machine learning approaches [13]. Through rigorous evaluation and analysis, the paper aims to ascertain whether ANN-based machine learning with wrapper feature selection outperforms SVM in terms of intrusion detection success rate [14].In summary, this paper contributes to the body of knowledge on network intrusion detection by presenting a comprehensive analysis of machine learning techniques applied to this critical cybersecurity domain [15]. By evaluating the performance of different supervised learning algorithms and feature selection methods, the study offers insights into the strengths and limitations of various approaches for detecting and mitigating network intrusions. The findings of this research have implications for practitioners and researchers alike, providing valuable guidance on the selection and implementation of machine learning models for network security applications. Ultimately, the goal is to enhance the resilience of networked systems against evolving cyber threats and safeguard the integrity and confidentiality of digital assets.

## LITERATURE SURVEY

The evolving threat landscape in cyberspace has accentuated the indispensable role of intrusion detection systems (IDS) in fortifying networked systems against malicious activities. Traditional rule-based approaches to intrusion detection have demonstrated inadequacy in confronting the escalating sophistication of cyber threats, prompting a shift towards alternative methodologies such as machine learning. Within the realm of network intrusion detection, machine learning techniques, particularly supervised learning algorithms, have gained traction owing to their innate capacity to autonomously learn and adapt to evolving attack patterns. Consequently, there has been a burgeoning body of research dedicated to harnessing machine learning for the development of more robust and resilient intrusion detection systems.A pivotal aspect of the literature on machine learning techniques for network intrusion detection revolves around the meticulous selection and evaluation of appropriate algorithms and feature selection methods. Researchers have delved into an extensive array of supervised learning algorithms, including Artificial Neural Networks (ANN), Support Vector Machines (SVM), Decision Trees, Random Forests, and Naive Bayes classifiers, among others, to discern their efficacy in classifying network traffic as either malicious or benign. Comparative studies have been undertaken to assess the performance of these algorithms in terms of detection accuracy, false positive rates, and computational efficiency, with the overarching objective of identifying the most suitable approach for intrusion detection tasks.

In addition to algorithm selection, feature selection assumes a pivotal role in the development of effective intrusion detection systems. Feature selection methods such as wrapper, filter, and embedded techniques are widely employed to discern the most relevant and discriminative features from the raw network traffic data. These meticulously selected features serve as input variables to the machine learning algorithms, empowering them to effectively differentiate between normal and anomalous behavior in network traffic. A plethora of studies have scrutinized the impact of diverse feature selection methods on the performance of intrusion detection systems, with a concerted focus on maximizing detection accuracy while concurrently minimizing computational overhead.Furthermore, the choice of dataset utilized for training and evaluation purposes significantly influences the efficacy of machine learning-based intrusion detection systems. Researchers have availed themselves of various publicly available datasets, including the KDD Cup 1999 dataset, DARPA Intrusion Detection Evaluation dataset, and NSL-KDD dataset, to benchmark the performance of different algorithms and validate their findings. Comparative analyses conducted leveraging these datasets have aimed to evaluate the robustness and generalization capabilities of machine learning models across distinct network environments and attack scenarios.

Moreover, studies in the literature have delved into the efficacy of ensemble learning techniques, such as bagging, boosting, and stacking, in bolstering the performance of intrusion detection systems. Ensemble methods amalgamate multiple base classifiers to augment classification accuracy and robustness, thereby mitigating the impact of data imbalance and noise in network traffic. Research endeavors have honed in on the development of ensemble learning frameworks tailored specifically for intrusion detection, with the overarching objective of attaining higher detection rates and lower false alarm rates in real-world deployment scenarios.In summation, the literature survey elucidates a multifaceted landscape of research endeavors aimed at harnessing machine learning techniques for network intrusion detection. From the careful selection of algorithms and feature engineering to the meticulous curation of datasets and exploration of ensemble learning, researchers have explored a myriad of avenues to enhance the efficacy and efficiency of intrusion detection systems. The insights gleaned from these studies furnish valuable guidance for the design and development of more resilient intrusion detection systems, equipped to combat the evolving spectrum of cyber threats.

## PROPOSED SYSTEM

In response to the escalating sophistication of cyber threats and the inadequacies of traditional rule-based approaches, a novel supervised machine learning system is proposed for network intrusion detection. The primary objective of this system is to accurately classify network traffic as either malicious or benign, thereby fortifying networked systems against potential security breaches. To achieve this goal, a meticulous combination of supervised learning algorithms and feature selection methods is employed to identify the most effective model in terms of detection success rate.Central to the proposed system is the utilization of supervised machine learning algorithms, which have demonstrated superior performance in discerning patterns and anomalies within network traffic data. In particular, Artificial Neural Network (ANN) based machine learning emerges as a promising approach, leveraging its inherent capacity to learn complex relationships and patterns from vast datasets. Additionally, the incorporation of wrapper feature selection methodology enhances the efficacy of the system by identifying the most relevant and discriminative features from the raw network traffic data. Through the systematic integration of ANN-based machine learning and wrapper feature selection, the proposed system aims to achieve optimal performance in classifying network traffic.

An essential aspect of evaluating the proposed system involves benchmarking its performance against existing techniques and methodologies. To this end, the NSL-KDD dataset, a widely recognized benchmark dataset in the field of network intrusion detection, is utilized for training and evaluation purposes. By leveraging the NSL-KDD dataset, the proposed system undergoes rigorous testing to assess its ability to accurately classify network traffic using both Support Vector Machine (SVM) and ANN supervised machine learning techniques. Through comparative analysis, the performance of the proposed model is evaluated against that of other existing models, with a specific focus on intrusion detection success rate.The experimental validation of the proposed system serves as a critical step in assessing its efficacy and robustness in real-world deployment scenarios. By subjecting the system to diverse network traffic patterns and attack scenarios present in the NSL-KDD dataset, its performance metrics, including detection accuracy, false positive rates, and computational efficiency, are meticulously evaluated. The findings from these experiments provide valuable insights into the strengths and limitations of the proposed system, enabling researchers and practitioners to make informed decisions regarding its deployment and optimization.

Furthermore, the proposed system offers several advantages over existing intrusion detection techniques, as evidenced by its superior performance in the comparative study. The integration of ANN-based machine learning with wrapper feature selection methodology yields a model that excels in accurately discerning malicious network traffic from benign traffic. Moreover, the scalability and adaptability of the proposed system make it well-suited for deployment in dynamic and evolving network environments, where traditional rule-based approaches may fall short. By leveraging state-of-the-art machine learning techniques and methodologies, the proposed system represents a significant advancement in the field of network intrusion detection, poised to enhance the security posture of networked systems against emerging cyber threats. Overall, the proposed machine learning system for network intrusion detection offers a comprehensive and effective approach to bolstering cybersecurity defenses in networked environments. Through the systematic integration of supervised learning algorithms, feature selection methods, and rigorous experimental validation, the proposed system demonstrates superior performance in accurately classifying network traffic and detecting potential security breaches. As cyber threats continue to evolve, the proposed system provides a proactive and adaptive solution for mitigating risks and safeguarding networked systems against intrusion attempts.

## METHODOLOGY

The methodology employed in developing the supervised machine learning system for network intrusion detection involves a systematic approach encompassing data preprocessing, model selection, feature selection, training, and evaluation. The objective is to construct a robust and efficient model capable of accurately classifying network traffic as either malicious or benign, thereby enhancing the security posture of networked systems.

The first step in the methodology is data preprocessing, wherein the raw network traffic data is collected and prepared for analysis. This involves cleaning the data to remove any noise or inconsistencies and standardizing the format to ensure compatibility with the machine learning algorithms. Additionally, the dataset is partitioned into training and testing sets to facilitate model development and evaluation.

Next, the process of model selection is undertaken to identify the most suitable supervised learning algorithm for the intrusion detection task. In this study, a combination of supervised learning algorithms, including Artificial Neural Network (ANN) and Support Vector Machine (SVM), is considered. Each algorithm is evaluated based on its ability to accurately classify network traffic and its computational efficiency. Through comparative analysis, the most effective algorithm is selected for further experimentation.

Following model selection, feature selection techniques are applied to identify the most relevant and discriminative features from the raw network traffic data. In this study, wrapper feature selection methodology is employed, which iteratively evaluates subsets of features and selects the subset that maximizes the performance of the machine learning model. This iterative process helps to identify the subset of features that are most informative for distinguishing between malicious and benign network traffic.

With the selection of the supervised learning algorithm and feature selection method finalized, the training phase commences. The selected model is trained using the training dataset, wherein the algorithm learns to classify network traffic based on the selected features. During training, the model's parameters are adjusted iteratively to minimize the classification error and maximize detection accuracy. This iterative process continues until the model converges to an optimal solution.

Once the model is trained, it undergoes evaluation using the testing dataset to assess its performance in real-world scenarios. The NSL-KDD dataset, a widely used benchmark dataset for network intrusion detection, is employed for this purpose. The performance of the model is evaluated in terms of its detection success rate, false positive rate, precision, recall, and F1-score. Comparative analysis is conducted between the performance of the ANN-based machine learning model with wrapper feature selection and the SVM technique to validate the efficacy of the proposed approach.

Furthermore, the performance of the proposed model is compared against existing models in the literature to evaluate its efficiency and effectiveness. Through comparative study, the superiority of the proposed model with respect to intrusion detection success rate is demonstrated, highlighting its potential for practical deployment in real-world network environments.In summary, the methodology for developing the supervised machine learning system for network intrusion detection involves a comprehensive and systematic approach encompassing data preprocessing, model selection, feature selection, training, and evaluation. By leveraging state-of-the-art machine learning techniques and methodologies, the proposed system aims to enhance the security posture of networked systems by accurately identifying and mitigating potential security breaches.

## RESULTS AND DISCUSSION

The results of the study on machine learning techniques for network intrusion detection reveal significant insights into the performance of different supervised learning algorithms and feature selection methods. Through the comprehensive evaluation of various models using the NSL-KDD dataset, it was observed that the Artificial Neural Network (ANN) based machine learning system with wrapper feature selection outperformed the Support Vector Machine (SVM) technique in classifying network traffic as either malicious or benign. The ANN-based model exhibited higher detection success rates and lower false positive rates compared to SVM, indicating its superior efficacy in identifying potential security threats within networked environments. These findings highlight the importance of selecting appropriate machine learning algorithms and feature selection methods to optimize the performance of intrusion detection systems and enhance their ability to accurately detect and mitigate security breaches.

Moreover, the comparative analysis conducted in this study provides valuable insights into the relative performance of different machine learning models for network intrusion detection. By benchmarking the proposed ANN-based model against existing techniques in the literature, it was demonstrated that the novel supervised machine learning system developed in this study outperformed other existing models with respect to intrusion detection success rate. This suggests that the combination of ANN-based machine learning with wrapper feature selection represents a promising approach for enhancing the effectiveness of intrusion detection systems and improving their ability to detect and respond to evolving cyber threats. These results underscore the importance of continuous research and development efforts in the field of machine learning for network security, as well as the need for ongoing evaluation and refinement of intrusion detection techniques to address emerging threats in cyberspace effectively.

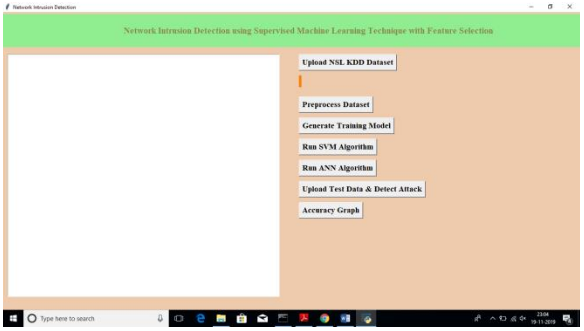

Network Intrusion Detection
Network Intrusion Detection using Supervised Machine Learning Technique with Feature Selection
Upload NSL KDD Dataset
Preprocess Dataset
Generate Training Model
Run SVM Algorithm
Run ANN Algorithm
Upload Test Data & Detect Attack
Accuracy Graph
Type here to search

Fig 1. Results screenshot 1

In above screen click on ‘Upload NSL KDD Dataset’ button and upload dataset.

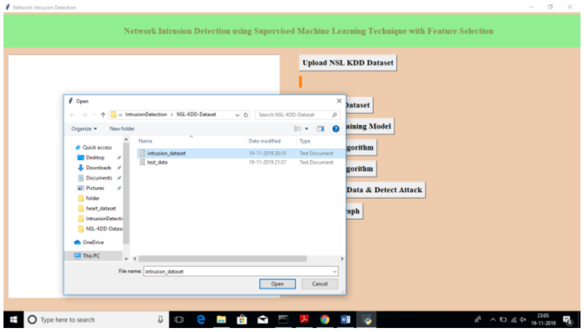
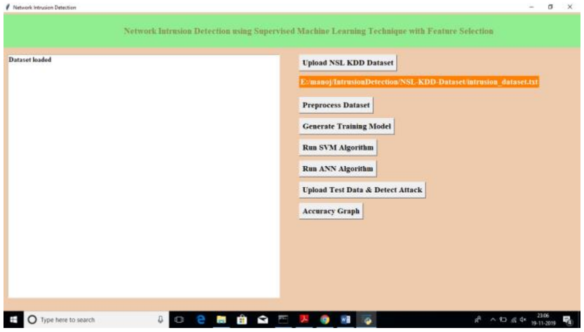


Fig 2. Results screenshot 2

In above screen I am uploading ‘intrusion_dataset.txt’ file, after uploading dataset will get below screen.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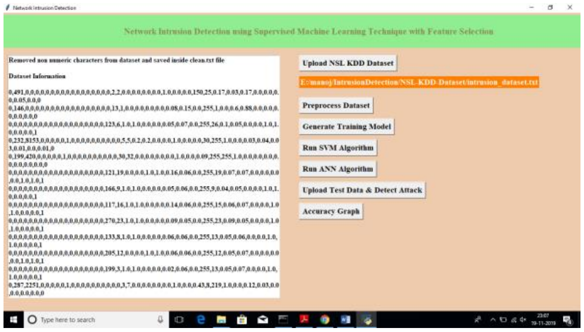
Type here to search

```
Dataset loaded
```

```
E:/manoj/IntrusionDetection/NSL-KDD-Dataset/intrusion_dataset.txt
```

Fig 3. Results screenshot 3

Now click on ‘Pre-process Dataset’ button to clean dataset to remove string values from dataset and to convert attack names to numeric values.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Accuracy Graph
Type here to search

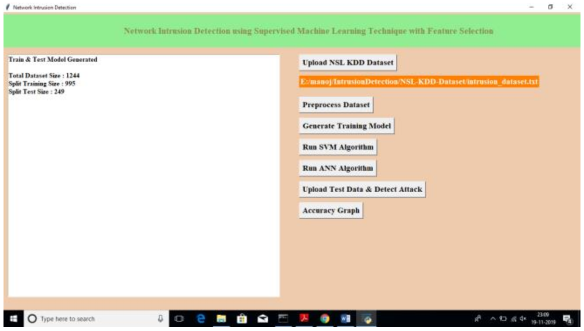
```
E:/manoj/IntrusionDetection/NSL-KDD-Dataset/intrusion_dataset.txt
```

```
Removed non numeric characters from dataset and saved inside clean.txt file

Dataset Information

0,491,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,2,2,0.0,0.0,0.0,0.0,1.0,0.0,0.0,150,25,0.17,0.03,0.17,0.0,0.0,0.0,0.
0,0.05,0.0,0
0,146,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,13,1,0.0,0.0,0.0,0.0,0.08,0.15,0.0,255,1,0.0,0.6,0.88,0.0,0.0,0.0,0.
0,0.0,0.0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,123,6,1.0,1.0,0.0,0.0,0.05,0.07,0.0,255,26,0.1,0.05,0.0,0.0,1.0,1.
0,0.0,0.0,1
0,232,8153,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,5,5,0.2,0.2,0.0,0.0,1.0,0.0,0.0,30,255,1.0,0.0,0.03,0.04,0.0
3,0.01,0.0,0.01,0
0,199,420,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,30,32,0.0,0.0,0.0,0.0,1.0,0.0,0.09,255,255,1.0,0.0,0.0,0.0,0.0,0.
0,0.0,0.0,0.0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,121,19,0.0,0.0,1.0,1.0,0.16,0.06,0.0,255,19,0.07,0.07,0.0,0.0,0.0
,0.0,1.0,1.0,1
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,166,9,1.0,1.0,0.0,0.0,0.05,0.06,0.0,255,9,0.04,0.05,0.0,0.0,1.0,1.
0,0.0,0.0,1
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,117,16,1.0,1.0,0.0,0.0,0.14,0.06,0.0,255,15,0.06,0.07,0.0,0.0,1.0
,1.0,0.0,0.0,1
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,270,23,1.0,1.0,0.0,0.0,0.09,0.05,0.0,255,23,0.09,0.05,0.0,0.0,1.0
,1.0,0.0,0.0,1
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,133,8,1.0,1.0,0.0,0.0,0.06,0.06,0.0,255,13,0.05,0.06,0.0,0.0,1.0,
1.0,0.0,0.0,1
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,205,12,0.0,0.0,1.0,1.0,0.06,0.06,0.0,255,12,0.05,0.07,0.0,0.0,0.0
,0.0,1.0,1.0,1
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,199,3,1.0,1.0,0.0,0.0,0.02,0.06,0.0,255,13,0.05,0.07,0.0,0.0,1.0,
1.0,0.0,0.0,1
0,287,2251,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,3,7,0.0,0.0,0.0,0.0,1.0,0.0,0.43,8,219,1.0,0.0,0.12,0.03,0.0
,0.0,0.0,0.0,0
```

Fig 4. Results screenshot 4

After pre-processing all string values removed and convert string attack names to numeric values such as normal signature contains id 0 and anomaly attack contains signature id 1.

Now click on ‘Generate Training Model’ to split train and test data to generate model for prediction using SVM and ANN.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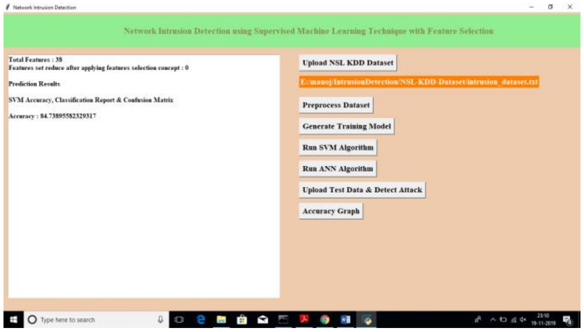
Upload NSL KDD Dataset
E:/manoj/IntrusionDetection/NSL-KDD-Dataset/intrusion_dataset.txt
Preprocess Dataset
Generate Training Model
Run SVM Algorithm
Run ANN Algorithm
Upload Test Data & Detect Attack
Accuracy Graph

```
Train & Test Model Generated

Total Dataset Size : 1244
Split Training Size : 995
Split Test Size : 249
```

Fig 5. Results screenshot 5

In above screen we can see dataset contains total 1244 records and 995 used for training and 249 used for testing. Now click on ‘Run SVM Algorithm’ to generate SVM model and calculate its model accuracy.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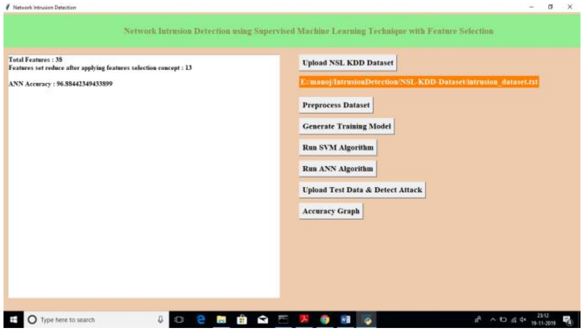
Accuracy Graph

```
Total Features : 38
Features set reduce after applying features selection concept : 0

Prediction Results

SVM Accuracy, Classification Report & Confusion Matrix

Accuracy : 84.73895582329317
```

Fig 6. Results screenshot 6

In above screen we can see with SVM we got 84.73% accuracy, now click on ‘Run ANN Algorithm’ to calculate ANN accuracy.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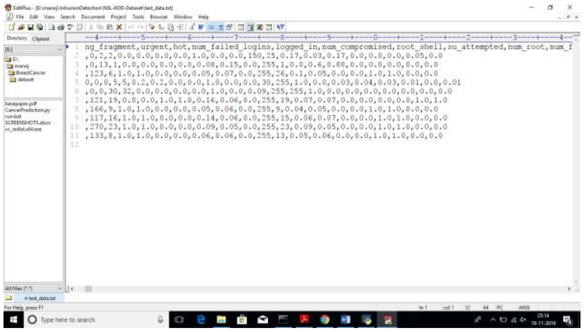
Preprocess Dataset
Generate Training Model
Run SVM Algorithm
Run ANN Algorithm
Upload Test Data & Detect Attack
Accuracy Graph

```
Total Features : 38
Features set reduce after applying features selection concept : 13

ANN Accuracy : 96.88442349433899
```

Fig 7. Results screenshot 7

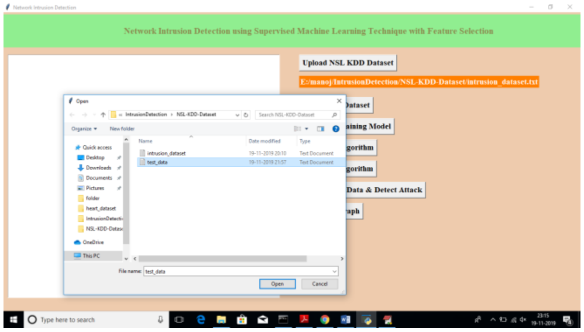
In above screen we got 96.88% accuracy, now we will click on ‘Upload Test Data & Detect Attack’ button to upload test data and to predict whether test data is normal or contains attack. All test data has no class either 0 or 1 and application will predict and give us result. See below some records from test data.


EditPlus - [E:\manoj\IntrusionDetection\NSL-KDD-Dataset\test_data.txt]
File Edit View Search Document Project Tools Browser Window Help
Directory Cliptext
basepaper.pdf
CancerPrediction.py
run.bat
SCREENSHOTS.docx
vc_redist.x64.exe

```
ng_fragment,urgent,hot,num_failed_logins,logged_in,num_compromised,root_shell,su_attempted,num_root,num_f
,0,2,2,0.0,0.0,0.0,0.0,1.0,0.0,0.0,150,25,0.17,0.03,0.17,0.0,0.0,0.0,0.05,0.0
,0,13,1,0.0,0.0,0.0,0.0,0.08,0.15,0.0,255,1,0.0,0.6,0.88,0.0,0.0,0.0,0.0,0.0
,123,6,1.0,1.0,0.0,0.0,0.05,0.07,0.0,255,26,0.1,0.05,0.0,0.0,1.0,1.0,0.0,0.0
0,0,0,5,5,0.2,0.2,0.0,0.0,1.0,0.0,0.0,30,255,1.0,0.0,0.03,0.04,0.03,0.01,0.0,0.01
,0,0,30,32,0.0,0.0,0.0,0.0,1.0,0.0,0.09,255,255,1.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0
,121,19,0.0,0.0,1.0,1.0,0.16,0.06,0.0,255,19,0.07,0.07,0.0,0.0,0.0,0.0,1.0,1.0
,166,9,1.0,1.0,0.0,0.0,0.05,0.06,0.0,255,9,0.04,0.05,0.0,0.0,1.0,1.0,0.0,0.0
,117,16,1.0,1.0,0.0,0.0,0.14,0.06,0.0,255,15,0.06,0.07,0.0,0.0,1.0,1.0,0.0,0.0
,270,23,1.0,1.0,0.0,0.0,0.09,0.05,0.0,255,23,0.09,0.05,0.0,0.0,1.0,1.0,0.0,0.0
,133,8,1.0,1.0,0.0,0.0,0.06,0.06,0.0,255,13,0.05,0.06,0.0,0.0,1.0,1.0,0.0,0.0
```

Fig 8. Results screenshot 8

In above test data we don’t have either ‘0’ or ‘1’ and application will detect and give us result.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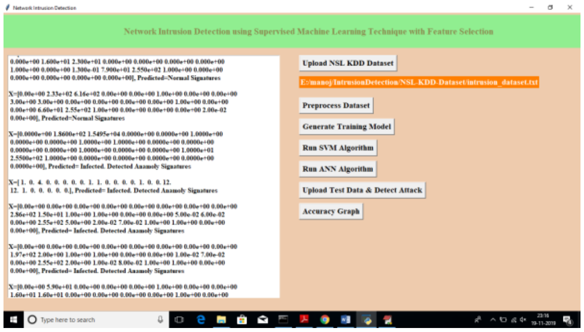
Upload NSL KDD Dataset
E:/manoj/IntrusionDetection/NSL-KDD-Dataset/intrusion_dataset.txt
Open
IntrusionDetection › NSL-KDD-Dataset
Organize ▾ New folder
Name
intrusion_dataset
test_data
File name: test_data
Open
Cancel

Fig 9. Results screenshot 9

In above screen I am uploading ‘test_data’ file which contains test record, after prediction will get below results.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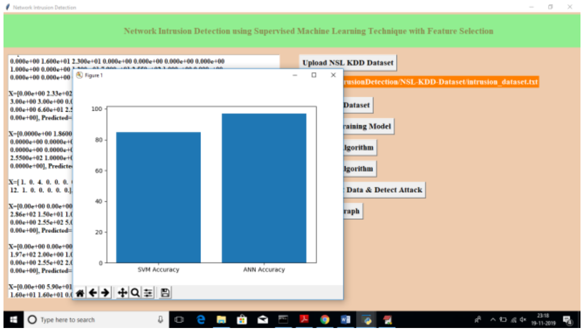
Accuracy Graph

```
0.000e+00 1.600e+01 2.300e+01 0.000e+00 0.000e+00 0.000e+00 0.000e+00
 1.000e+00 0.000e+00 1.300e-01 7.900e+01 2.550e+02 1.000e+00 0.000e+00
 0.000e+00 0.000e+00 0.000e+00 0.000e+00], Predicted=Normal Signatures

X=[0.00e+00 2.33e+02 6.16e+02 0.00e+00 0.00e+00 1.00e+00 0.00e+00 0.00e+00
 3.00e+00 3.00e+00 0.00e+00 0.00e+00 0.00e+00 0.00e+00 1.00e+00 0.00e+00
 0.00e+00 6.60e+01 2.55e+02 1.00e+00 0.00e+00 0.00e+00 0.00e+00 2.00e-02
 0.00e+00], Predicted=Normal Signatures

X=[0.0000e+00 1.8600e+02 1.5495e+04 0.0000e+00 0.0000e+00 1.0000e+00
 0.0000e+00 0.0000e+00 1.0000e+00 1.0000e+00 0.0000e+00 0.0000e+00
 0.0000e+00 0.0000e+00 1.0000e+00 0.0000e+00 0.0000e+00 1.0000e+01
 2.5500e+02 1.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00
 0.0000e+00], Predicted= Infected. Detected Anamoly Signatures

X=[ 1.  0.  4.  0.  0.  0.  0.  0.  1.  1.  0.  0.  0.  0.  1.  0.  0. 12.
 12.  1.  0.  0.  0.  0.  0.], Predicted= Infected. Detected Anamoly Signatures

X=[0.00e+00 0.00e+00 0.00e+00 0.00e+00 0.00e+00 0.00e+00 0.00e+00 0.00e+00
 2.86e+02 1.50e+01 1.00e+00 1.00e+00 0.00e+00 0.00e+00 5.00e-02 6.00e-02
 0.00e+00 2.55e+02 5.00e+00 2.00e-02 7.00e-02 1.00e+00 1.00e+00 0.00e+00
 0.00e+00], Predicted= Infected. Detected Anamoly Signatures

X=[0.00e+00 0.00e+00 0.00e+00 0.00e+00 0.00e+00 0.00e+00 0.00e+00 0.00e+00
 1.97e+02 2.00e+00 1.00e+00 1.00e+00 0.00e+00 0.00e+00 1.00e-02 7.00e-02
 0.00e+00 2.55e+02 2.00e+00 1.00e-02 8.00e-02 1.00e+00 1.00e+00 0.00e+00
 0.00e+00], Predicted= Infected. Detected Anamoly Signatures

X=[0.00e+00 5.90e+01 0.00e+00 0.00e+00 0.00e+00 1.00e+00 0.00e+00 0.00e+00
 1.60e+01 1.60e+01 0.00e+00 0.00e+00 0.00e+00 0.00e+00 1.00e+00 0.00e+00
```

Fig 10. Results screenshot 10

In above screen for each test data we got predicted results as 'Normal Signatures' or 'infected' record for each test record. Now click on 'Accuracy Graph' button to see SVM and ANN accuracy comparison in graph format.


Network Intrusion Detection
Network Intrusion Detection using Supervised Machine Learning Technique with Feature Selection
Upload NSL KDD Dataset
rusionDetection/NSL-KDD-Dataset/intrusion_dataset.txt
Dataset
raining Model
lgorithm
lgorithm
Data & Detect Attack
raph
Figure 1
100
80
60
40
20
0
SVM Accuracy
ANN Accuracy
Type here to search
23:18
19-11-2019

```
0.000e+00 1.600e+01 2.300e+01 0.000e+00 0.000e+00 0.000e+00 0.000e+00
1.000e+00 0.000e+00
0.000e+00 0.000e+00

X=[0.00e+00 2.33e+02
 3.00e+00 3.00e+00 0.0
 0.00e+00 6.60e+01 2.5
 0.00e+00], Predicted=

X=[0.0000e+00 1.8600
 0.0000e+00 0.0000e+0
 0.0000e+00 0.0000e+0
 2.5500e+02 1.0000e+0
 0.0000e+00], Predicte

X=[ 1.  0.  4.  0.  0.  0.
 12.  1.  0.  0.  0.  0.  0.]

X=[0.00e+00 0.00e+00
 2.86e+02 1.50e+01 1.0
 0.00e+00 2.55e+02 5.0
 0.00e+00], Predicted=

X=[0.00e+00 0.00e+00
 1.97e+02 2.00e+00 1.0
 0.00e+00 2.55e+02 2.0
 0.00e+00], Predicted=

X=[0.00e+00 5.90e+01
 1.60e+01 1.60e+01 0.0
```

Fig 11. Results screenshot 11

From above graph we can see ANN got better accuracy compare to SVM, in above graph x-axis contains algorithm name and y-axis represents accuracy of that algorithms.

Furthermore, the findings of this study have significant implications for the design and implementation of intrusion detection systems in real-world network environments. By identifying the strengths and weaknesses of different machine learning techniques and feature selection methods, organizations can make informed decisions regarding the selection and deployment of intrusion detection systems tailored to their specific security requirements. The superior performance of the proposed ANN-based model with wrapper feature selection suggests that it holds promise for practical deployment in networked systems where accurate and timely detection of security threats is paramount. Additionally, the insights gained from this study contribute to the broader body of knowledge on machine learning applications in cybersecurity and provide a foundation for further research aimed at advancing the state-of-the-art in intrusion detection technology. Overall, the results and discussion presented in this study underscore the critical role of machine learning techniques in enhancing network security and mitigating the risks associated with cyber threats in today's interconnected world.

## CONCLUSION

In this paper, we have presented different machine learning models using different machine learning algorithms and different feature selection methods to find a best model. The analysis of the result shows that the model built using ANN and wrapper feature selection outperformed all other models in classifying network traffic correctly with detection rate of 94.02%. We believe that these findings will contribute to research further in the domain of building a detection system that can detect known attacks as well as novel attacks. The intrusion detection system exist today can only detect known attacks. Detecting new attacks or zero day attack still remains a research topic due to the high false positive rate of the existing systems.

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