International Journal of Research Publication and Reviews

Spam Email Detection Using Machine Learning and Deep Learning Techniques

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ABSTRACT :

Now a days emails became a basic thing for communication in both personal and professional life. As time goes on, there is an increase of email users. With increase in email users there is an increase in spam emails. Spam, also known as junk, is unwanted email, often sent in bulk to a large number of recipients. Spam emails are usually commercial and driven by a financial motive. Spam emails can contain phishing scams, image spams, computer viruses, lottery scams, advertisements, commercial segments, and a lot of unwanted communications etc. Spam messes up inboxes with numerous absurd emails, posing a risk to the user. In addition to that it significantly slows down our internet speed, and most importantly, it makes it easier for spammers to take our valuable information, such as our contacts, professional information, and personal information etc. So, there is need to filter the spam mails and ham(non-spam) mails. Spam filters detect unwanted, unsolicited and virus-infected emails (called spam) and prevent them from reaching your email inbox. And among the deep learning and machine learning algorithms the algorithms that are used to detect spam emails are convolution neural network (CNN), support vector machine (SVM), naïve bayes (NB). Here the algorithms are compared based on accuracy and other metrics.

Keywords: spam email, ham email, machine learning, CNN, image spam, deep learning

INTRODUCTION

Internet plays a vital role in today's society by expanding communication and connectivity to everyone, anytime, anywhere. E-MAIL (electronic mail) is one of the most internet-based communication platforms used by civil servants, students, business people and everyone else. There is usually no cost to send an email. This vulnerability is one of the main advantages for the spammers to send spam emails. Initially, most spam emails were text-based, but with the expansion of effective text-based spam filters based on the header content, body content and some more other features. So, spammers began sending text with in images, commonly known as image spam. Even this problem is also solved to some extent by OCR technique which extracts the text from the image and then the text-based filters are applied with techniques like Naïve bayes and some other text classification techniques. Then the spammers started sending images with background, noise etc. which is filtered based on the image features. So, in this extracting the better features and identifying the spam is a big task and it done by some the models like CNN (convolution neural network), MLP (multi layer perceptron) etc.. Image spam is one of the hardest things to spot. With 30-40 e- mails received each day, with almost 50-60% of spam emails, it is difficult for users to manually filter out useful e-mails. So, machine learning techniques for distinguishing between spam and ham mail include Support Vector Machines (SVM), Naive Bayes (NB) and the deep learning techniques like convolution neural networks (CNN) and multi layer perceptron (MLP).

2.LITERATURE SURVEY

This paper deals with technical analysis about the email spam detection especially about image spam detection in this paper. Support vector machine (SVM), convolution neural networks (CNN), multilayer perceptron (MLP) are the machine learning and deep learning techniques used in this paper for detection of email spam. The algorithms are compared by using accuracy occurred while using different data sets. From the above used techniques CNN is the most efficient deep learning algorithm for the image spam detection.[1]

This paper deals with technical analysis about the email spam detection using machine learning techniques. Naive bayes (NB), support vector machine, k-nearest neighbor, decision tree are the techniques used in the above paper. This email filter is only based on body content of the email and ignoring the header content which is it's one of the limitations. From the proposed algorithms NB got best scores on every dataset.[2]

This paper works on the SVM (support vector machine) algorithm and compared to the work of others on same dataset with same algorithm and the results are improved. In this they detailly explained how the algorithm actually classifies the spam and ham emails. The algorithm is compared with other works based on accuracy where its accuracy is 94.06%. One of the drawbacks of this paper is only one algorithm is used.[3]

This paper deals with the best algorithm for detecting the email spam among the machine learning algorithms like CNN (convolution neural network), KNN (k-nearest neighbors), RF (random forest), DT(decision tree), SVM (support vector machine) and NB (naïve bayes). Comparison of these many

algorithms helps to find accurate algorithm. The comparison of algorithms is based on the accuracy rate in total and for each training split. Also, the performance and time will be considered to understand the best and well-performed classifiers that have been implemented in this work. [4]

This paper deals with LSTM (long short term memory) algorithm for filtering spam emails. The performance of LSTM algorithm is compared with many algorithm in many accepts. LSTM architecture performed fairly well on the used datasets. For LSTM algorithms they got precision=98.74%, recall=99.35%, accuracy=99.01, F1=99.24 when compared to other algorithms. From the paper they proved that the evaluation of the results shows that LSTM is able to outperform traditional machine learning methods for detection of spam with a considerable margin. [5]

3.METHODOLOGY

3.1NAÏVE BAYES:

Naïve Bayes classifier is a probabilistic machine learning model that's used for classification task. This algorithms mainly uses bayes theorem. As we know the spam detection of the email is a classification problem , and hence we can apply this algorithm to this problem. This NB(naïve bayes) algorithm is mai nl yused to detect the spam emails that are of text based.

This algorithm mainly works based on the bayes theorem.

Bayes theorem :

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Here A is the hypothesis and B is evidence.

This is the one of the best algorithm for the text classification.

3.2CONVOLUTIONAL NEURAL NETWORKS:

Deep learning algorithms train machines by learning from examples. Deep learning models make use of several

algorithms but no network is considered as perfect, some algorithms are better suited to perform specific tasks. Convolutional

Neural Networks (CNN's) is one such type of Deep Learning algorithm. CNNs are widely used in image analysis, and it is highly effective. CNNs are also called as Conv Nets which consist of multiple layers and are mainly used for image processing and object detection. There are multiple layers that process and extract features from data:

        a.Convolution layers

        b.Pooling layers

        c.Fully connected layers

The following figure (1) depicts the first convolutional layer, which is applied directly to the image, whereas subsequent convolutional layers are applied to convolutional .
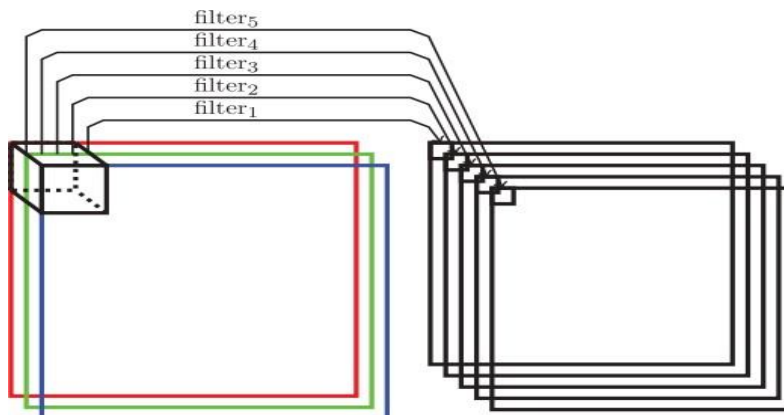
Figure(1):first convolution layer for RGB image

3.3SUPPORT VECTOR MACHINE:

SVM stands for support vector machine.This algorithm is used to detect spam emails.based on the decision boundary. The emails are classified as two sets i.e one side of boundary as spam emails and the other side as ham emails.The main objectives of SVM are separating hyperplane, Maximize the margin, Work in higher dimensions, Kernel trick.
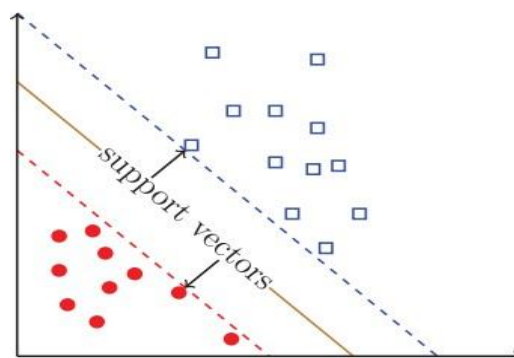
Figure2:SVM

3.4MULTI LAYER PERCEPTRON:

This MLP algorithm is used to detect the image based spam emails. The MLP stands for multi layer perceptron.The below flow diagram of MLP with two hidden layers. Each edge in an MLP graph represents a weight that is learned via training. Based on the weights occurred it decides whether the email belongs to which class.
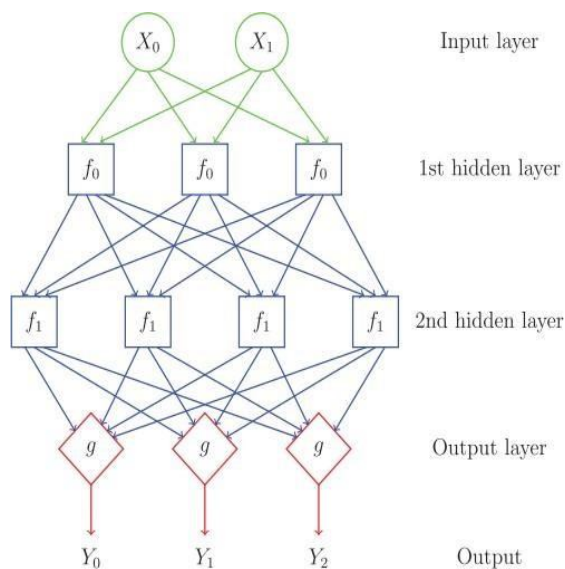
Figure3:MLP

RESULTS

Spam email is detected using many deep learning and machine learning algorithms like naïve bayes, support vector machine and convolution neural network algorithms. Among the above discussed algorithms convolution neural network algorithm is performed good on the used dataset based on image

features. Where as naïve bayes worked well for the images whose text is extracted. CNN (convolution neural network) technique got an accuracy of 99.20%.

DISCUSSION

Among the proposed papers the paper proposed by Tazmina Sharmin, Fabio Di Troia, Katerina Potika & Mark Stamp discussed about how CNN algorithm effectively worked on the proposed dataset when compared to other proposed deep learning algorithms. whereas the paper proposed by Sunday Olusanya Olatunji discussed about how effectively the SVM algorithm performed when compared to others work on the same dataset.

CONCLUSION

Spam email detection is very necessary to preserve our data. From the above discussion on the detection of spam email it is observed that when comparing to the other algorithms, CNN (convolutional neural networks) performed better with an accuracy greater than the orther techniques. CNN got an accuracy of 99.02%. and this CNN technique worked better in the all applied datasets. And this also worked better on the challenge dataset. And there is a scope to the future work on this spam email detection mainly the image spam which particularly based on image features.

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