Naïve Bayes Filter for Communication & Enhancing Semantic in Email

Mariyan Richard A, Prasad Naik, Suhas A, Drakshaveni G

Abstract: Due to the current pandemic of COVID-19, the world has turned into ONLINE mode and an increase in online communication thereby information exchange, sharing useful data through emails and other social media. So, addressing the security issues places a vital role in computer security and should have the priorities. We need a security check to enhance the inbox so that the important information or emails should not reach to the spam box. In this paper to improve the filtering techniques, we have adopted Naïve Bayes approach in implementation and enhancing the spam filter in the email. Bayes’s approach is efficient, accurate, and simple in implementing the proposed algorithm. Bayes algorithm is used to verify correct semantic information of the email and avoid the pass to pass approach if the incoming mail is important. The Python language is used to develop the proposed algorithm.

Keywords: Naïve Bayes, String Sematic, Spam Filtering, Python Language.

I. INTRODUCTION

Spam E-Mail is an unconstrained and unwanted messages sent in bulk. Normally, spam is sent for business and marketing purposes. It might be sent in immense volume by botnets, frameworks of polluted PCs. While a couple of individuals consider it to be corrupt, various associations despite everything use spam. The cost per E-Mail is incredibly low, and associations can pass on mass sums dependably. Spam E-Mail can moreover be a threatening undertaking to get to your PC. Botnets are an arrangement of as of late defiled PCs. Along these lines, the main spammer can be difficult to follow and stop [1]. E-Mail filtering is the process of blocking its contents based on a pre-defined set of rules. It can apply to the intercession of human knowledge, yet regularly alludes to the programmed handling of approaching messages with hostile to spam procedures - to active messages just as those being gotten. E-Mail separating programming may dismiss a thing at the underlying SMTP association stage or pass it through unaltered for conveyance to the client's letterbox - or on the other hand: divert the message for conveyance somewhere else; isolate it for additional checking; alter or 'tag' it here and there. E-mailbox service providers can incorporate dedicated lines in the transmission as a feature of the entirety of the recipients. Against infection, hostile to spam, URL sifting, and validation based dismissals are basic channel types [2-4].

Corporations frequently use channels to ensure their workers and their data innovation resources. A catch-all channel will "get all" of the messages routed to the area that doesn't exist via the post office server - this can help abstain from losing messages because of incorrect spelling. Users might have the option to introduce separate projects or arrange sifting as a feature of their E-Mail program (E-Mail customer). In E-Mail programs, clients can make individual, "manual" channels that at that point consequently channel e-mail as indicated by the picked measures. E-mail channels can work on inbound and outbound E-Mail traffic. Inbound E-Mail sifting includes checking messages from the Internet routed to clients ensured by the separating framework or for legal interference. Outbound E-Mail sifting includes the opposite - filtering E-Mail messages from nearby clients before any possibly destructive messages can be conveyed to others on the Internet [3,6]. Existing E-Mail Spam Filtering frameworks are subject to List-Based Filter procedures, for example, Blacklist, Real-Time Blackhole List, Whitelist, and Greylist. The boycott is a well-known spam-sifting strategy endeavor to stop undesirable E-Mail by filtering messages from the pre-set rundown of senders that your association's framework overseer makes [4,7,8]. Boycotts are records of E-Mail locations or Internet Protocol (IP) addresses that have been recently used to send spam. At the point when an approaching message shows up, the spam channel verifies whether it's IP or E-Mail address is on the boycott; assuming this is the case, the message is viewed as spam and dismissed. Though boycotts guarantee that realized spammers can't arrive at clients' inboxes, they can likewise misidentify authentic senders as spammers. These alleged bogus positives can result if a spammer happens to send garbage e-mail from an IP address that is additionally utilized by genuine E-Mail clients. Additionally, since numerous shrewd spammers routinely switch IP delivers and E-Mail delivers to cover their tracks, a boycott may not promptly get the most current flare-ups.

II. LITERATURE REVIEW

WuxuPeng : Author in his paper he explained about how important is security concerning the online platform and how is Naïve Bayes algorithm has disadvantages like not properly classifying emails when they contain leetspeak or diacritics. So he explains how his proposed work improves a Novel algorithm for enhancing the accuracy of the Bayes algorithm. He used python as a programming language to implement the work and used concepts of semantic-based, keyword-based, and machine learning algorithms to increase the accuracy[15,16,17].

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Deepika Mallampati, Nagaratna P. Hegde: Authors explain about the spam emails were have alias name has non-self, unsolicited commercial emails or fraudulent emails sent to a group of people or for a company. He used Machine learning algorithms. Machine learning classifier to check whether the email received is a valid message or an unwanted message. They used Deep learning as potential tactics that can tackle the challenges of spam emails efficiently [10,11,12].

Jon Kågström: The author explains that Witten Bell is good at Turing with small performance loss comparative to simple Good Turing. He also explained Robinson’s estimate based on Bayesiam smoother showed excellent results and easy to implement and less computationally expensive than both Witten Bell and Good Turing [13,14].

III. SPAM FILTER

The proposed framework receives Content-Based Filters, which instead of upholding no matter how you look at its strategies for while sending Communication messages from any specific E-Mail or IP address, content-based channels assess words or expressions found in any individual message to decide if communication is spam or not spam [8]. The E-mail Spam filter has previously been based on fetching spam signature via supervised learning using communication messages through emails explicitly manually labeled as spam or not spam. In this paper, we study of unsupervised machine learning based spam filter for more effectively identify new spamming. Communication spam filter identifies the unsolicited, unwanted, and virus-infested email as we call them to spam emails and stop it from getting into email inboxes. Internet service providers use spam filters to make sure they aren’t distributing spam. The best spam filters currently available in the market are 1) Spam Titan(TitanHQ) it is suitable for all types of businesses 2) ZERO SPAM 3) Spambrella 4) MailChannels 5) Xeams 6) Topsec Email security 7) Symantec email security 8) MailWasher [18,19,20]. Since a Naïve Bayes channel is continually fabricating its assertion lists dependent on the messages that an individual client gets, it hypothetically turns out to be increasingly powerful the more it’s utilized. In any case, since this technique requires a preparation period before it begins functioning admirably, you should practice persistence and will presumably need to physically erase a couple of garbage messages, at any rate from the start.[21,22]

IV. METHODOLOGY

Mathematical Model for SPAM Filter

1. We have to compute the probability that the message is spam, knowing that a given string appears in the message.
2. Then we compute the probability that the message is spam, taking into consideration all of its words.
3. Then finally we give with rare string

To minimize false positives and increase the accuracy of Naïve Bayes, an addition to the existing Naïve Bayes method was created. This addition will be able to convert symbols inside words to possible letters and use a spell check function to ensure the corrected symbol is a word and then run the word through the Naïve Bayes spam filter [23,24]

A. Naïve Bayes Classifier -

Naïve Bayes algorithm is a Basic, Statistical technique for handling e-mail filtering for Naïve Bayes

B. Bayesian Classifier – Spam filtering /detection
S: Spam
!S: Ham/not Spam

C. Multinomial Naive Bayes – The multinomial Naive Bayes Classifier is suitable for classification with discrete features like word count in text classification. The multinomial distribution normally requires integer feature count, however, in practice fractional counts such as tf-idf may also work [3]. Theoretically, the best class is determined by multiplying all the probabilities that each word is spam together as shown in the equation to get an overall probability, with probabilities closer to 1 being spam. However, there are instances where the spam word does not occur at all in a message; Laplacian Smoothing may ameliorate this problem.[25]

D. Proposed Algorithm – The algorithm is implemented using python language, her in developing the code we used key-based, word-based, semantic-based in unsupervised artificial machine learning [12]

\[
P\left(\frac{S}{W}\right) = P\left(\frac{W}{S}\right)P(S)/P\left(\frac{W}{S}\right)P(S) + P\left(\frac{W}{!S}\right)P(!S)
\]

Spam Detector

100 e-mails

Spam Detector

25 Spam

75 No spam

Spam Detector

"Boy"

Spam

No spam
If an email contains the word "BUY" what is the probability that it is a SPAM?

40%, 60%, 80%, 100%

| Total | BUY | Cheap |
|-------|-----|-------|
| Data set 1: | 100 | 5 | 10 |
| Data set 2: | 25 | 10 | 15 |
| Data set 3: | 75 | 5 | 10 |

\[
P(B|S) = \frac{P(B|S)P(S)}{P(B)} + P(B|\overline{S})P(\overline{S})
\]

\[
P(\text{spam if BUY}) = \frac{20}{25} \cdot \frac{25}{100} + \frac{0}{75} \cdot \frac{75}{100}
\]

\[
P(\text{spam if BUY&'Cheap'}) = \frac{(20 \cdot 15 + 25 \cdot 5 + 0 \cdot 10)}{75} = 0.7377
\]

= 94.737%
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Fig. 1. Making predictions with supervised learning.

Consider the data sets

| Data sets | String                              | Filter |
|-----------|-------------------------------------|--------|
| 1         | I Loved the Movie                   | Ham    |
| 2         | I hated the Movie                   | Spam   |
| 3         | A Great Movie, Good Movie           | Ham    |
| 4         | Poor acting                         | Spam   |
| 5         | Great Acting, A Good Movie          | Ham    |

There are 10 unique words in this data set

They are

I, Loved, the, Movie, hated, a, Great, Poor, Acting, Good

\[
P(\text{ham}) = \frac{3}{5} = 0.6;
\]

\[
P(I) = \frac{1}{14 + 10} = 0.0833
\]

\[
P(\text{loved}) = \frac{1}{14 + 10} = 0.0833
\]

\[
P(\text{the}) = \frac{1}{14 + 10} = 0.0833
\]

\[
P(\text{movie}) = \frac{1}{14 + 10} = 0.0833
\]

\[
P(a) = \frac{2}{1 + 1} = 0.125
\]

\[
P(\text{great}) = \frac{2}{14 + 10} = 0.125
\]

\[
P(\text{acting}) = \frac{1}{14 + 10} = 0.0833
\]

\[
P(\text{good}) = \frac{2}{14 + 10} = 0.125
\]

\[
P(hated) = \frac{0}{14 + 10} = 0.0417
\]

\[
P(\text{poor}) = \frac{0}{14 + 10} = 0.0417
\]

Fig. 2. Proposed algorithm flow.

P(\text{ham}) = \frac{3}{5} = 0.6;
"I hated the poor acting"
If $V_j = \text{ham}$:
$$P(\text{ham})P(I/\text{ham})P(\text{hated}/\text{ham})P(\text{the}/\text{ham})P(\text{poor}/\text{ham})P(\text{acting}/\text{ham})$$
$$= 1.22 \times 10^{-5}$$
If $V_j = \text{spam}$:
$$P(\text{spam})P(I/\text{spam})P(\text{hated}/\text{spam})P(\text{the}/\text{spam})P(\text{poor}/\text{spam})P(\text{acting}/\text{spam})$$
$$= 2.5 \times 10^{-7}$$

$$P\left(\frac{\text{the}}{\text{ham}}\right) = \frac{1 + 1}{14 + 10} = 0.0833$$

| $P(\text{spam})$ | 0.4 |
|------------------|-----|

V. RESULTS

|              | Spam | Not Spam |
|--------------|------|----------|
| Total        | 25   | 75       |
| BUY          | 20   | 4/5      | 5        | 1/15     |
| Cheap        | 15   | 3/5      | 10       | 2/15     |
| Buy & Cheap  | 12   | 12/25    | 2/3      | 2/225    |

$$\frac{12}{12 + \frac{2}{5}} = \frac{36}{30} = 94.734\%$$

VI. CONCLUSION

Today’s generation everyone is using online mode for communication, and started using smart phones, laptops and store/exchange lot of information via emails. We get gigabits of messages every day and partitioning them with spam or not is very difficult talk in hand. So we have come up with new idea of Naïve Bayes spam filter algorithm.

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