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# Cyberbullying Detection Using Machine Learning

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**ABSTRACT:** Cyberbullying is a type of harassment that takes place over digital devices including cell phones, laptops, computers. Cyberbullying offenses are mentioned under the laws due to the exponential increase in them. It frequently leads to physical and mental distress. In most cases, the victim avoids reaching out for help because of the fear of society and defamation. Thus, it results in the boosting confidence of criminals. The prevalence of cyberbullying can be resisted with automated detection of these offences. This paper proposes the methodology for the detection and prevention of cyberbullying which is increasing along with the growth of social media users.

**KEYWORDS:** Model, Supervised learning, Natural Language Processing, Feed forward back propagation neural network

## I. INTRODUCTION

In this era of the internet and big data, social media has become the most influential platform for the generation. This platform is an open environment for bullies with a lot of vulnerabilities. The positive side of the era allows us to use advanced technologies such as machine learning to overcome cyberbullying kind of offenses. There are several kinds of machine learning which might be helpful for resolving this issue. A random search of solutions without a deep understanding of the problem is similar to diving into the ocean for gemstones that we never heard of. The paper tries to frame the problem and the possible solution in a comprehensible way. To proceed with this paper reader must have a basic idea about supervised learning and natural language processing.

Machine learning refers to the creation of a learning framework and provision of properly formatted, relevant and clean data for the machine to learn. Model is nothing but mathematical representation. The major difference between algorithmic programming and machine learning is that machine learning is capable of generalizing and dealing with novel cases. Continuous improvement is the most differentiating feature. Supervised Learning is a type of machine learning which helps to resolve real-world problems such as classifying spam in a separate folder from your inbox. Natural Language Processing is automated manipulation of natural language like speech, text.

## II. RELATED WORK

### SUPERVISED MACHINE LEARNING AND NATURAL LANGUAGE PROCESSING

Cyberbullying is mainly in the form of text, audio and video. These forms use a common way of expression which is language. Text analytics involves sentiments, parts of speech, entities and other aspects of the text which is quite complex to process. Hence it requires some statistical techniques which further can be expressed as the model and feed to the machine. The machine applies it to other text by adopting the behavior of fed data. In supervised machine learning, a batch of text documents is tagged or annotated with examples of what the machine should look for and how it should interpret that aspect. These documents are used to “train” a statistical model, which is then given un-tagged text to analyse. Text Processing Concerns

Unlike structured data the text data is complex to process because of few concerns as below.

- Text data may have hundreds and thousands of dimensions such as words or phrases.
- Not all dimensions are used frequently.

- They exhibit polymorphism so it's difficult to classify behaviour.

### III. METHODOLOGY

#### POPULAR SUPERVISED NLP ALGORITHMS

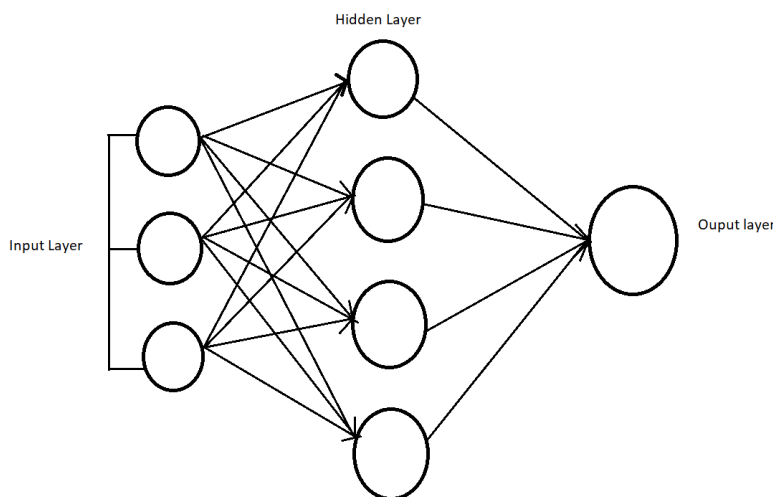
##### A. Support Vector Machines

The goal support vector machine is to find the best fit line to segregate a plane into classes. Those classes are further used in the future to plot data points. If we decide to use a support vector machine for recognition of cyberbullying then we will have to divide a n-dimensional plane into different classes such as abuse, sexual content, force, friendly abuse, etc. These classes will help to derive the best fit line which will divide the plane into the positive and negative hyperplanes. SVM uses graphical representation for visualization and decision-making.

##### B. Neural Networks/Deep Learning

This term generally leads to confusion, and we start separating the neural network from machine learning. But the basic idea of a neural network is similar to supervised learning. It was born in the 1950s with the perceptron algorithm. A perceptron is a simplified model of a human neuron that accepts an input and performs a computation on that input. The output is then fed to the activation function which decides if the neuron will fire based on the output value.

NEURAL NETWORK DIAGRAM



- The choice of number of inputs, hidden and output layers may lead to argument as there are various opinions about it. "Neural Smithing" the book written by Russell D. Reed believes that the input should not be counted as they are not active.
- Now the question arises do we need a multilayer neural network in our case. Single layer neural network is good for representing the linear separable functions that is any classification problem which can be separated by single line. In case of cyberbullying the input data is going to be highly dimensional and single layer won't be sufficient.
- There are several algorithms which can be used to implement the ideology. One of them is 'Feed Forward Back Propagation'. This algorithm has lesser complexity than our human brain because it doesn't have any recurrent loops in it.
- There are mainly seven types of artificial neural network for natural language processing.
  1. Multilayer Perceptron (MLP): It has three or more layers. It utilizes the non-linear activation function. Every node of MLP is connected to following layer making the network fully connected and mainly used in multilayer perceptron natural language for example. Speech recognition and machine translation.
  2. Convolutional Neural Network (CNN): It has multiple convolutional layers, pooling or fully connected, and uses a variation of multilayer perceptrons. It performs convolutional operation

which is mathematical combination of two functions to produce third function. This operation allows network to go deeper with fewer parameters. CNN is outstanding for the speech or image recognition. It can achieve great performance without having knowledge of words, phrases etc.

3. Recursive Neural Network (RNN): It applies same weight recursively over a structure resulting into structured or scalar prediction over variable size input structures.
4. Recurrent Neural Network (RNN): In this network, connections between neurons form a directed cycle and hence output depends on the present input as well as the previous step's state of neuron. This is generally used for nlp problems like connected handwriting recognition and speech recognition.
5. Long short-term memory (LSTM): It is a specific recurrent neural network (RNN) architecture that was designed to model temporal sequences and their long-range dependencies more accurately than conventional RNNs .
6. Sequence to sequence model: It consists of two recurrent neural networks one is encoder and decoder. It is mainly used in question answering systems like chatbots.
7. Shallow Neural Network : Besides deep neural networks, shallow models are also popular and useful tools.

#### IV. EXPERIMENTAL RESULTS

##### 1. ROLE OF SUPERVISED LEARNING IN NLP TO DETECT CYBERBULLYING

NLP isn't sufficient alone to handle language behaviour. There are different areas where behaviour varies which becomes difficult to classify.

###### 1) *Tokenization:*

This action involves breaking of text documents into pieces that a machine understands such as words. Now its quite easy to perform when we are dealing with the English. We just need to separate the document based on spaces. But it's not going to be same for all of the languages and this is where model comes into picture. We can train the model for separating the specific words and understanding the context of words.

###### 2) *Part Of Speech Tagging:*

It means identifying the part of speech of each token and tagging them as noun, adjective, adverb, etc. To achieve a great performance in sentiment recognition we need to have proper PoS tagging which is possible with trained model. In case of cyberbullying, the sentiment of message plays an important role without which we might misinterpret the message and an innocent person would be punished for that.

###### 3) *Named Entity Recognition:*

This rely on accurate PoS tagging. Named entities are nothing but the people, things, places as well as hashtags, mailing addresses, phone numbers etc. We can train our model on huge number of named entities. It will be helpful to identify if victim is being asked to come to unsafe area or forced to contact anyone for sexual activities. The model can also help to recognize non-standard entities.

##### C. *Sentiment Analysis*

This process refers to determine whether a piece of writing is positive, negative or neutral. Take an example of a friend saying I'll kill you to another friend in a friendly context which might mislead the model and result into negative side of analysis. Our model should be able to determine this efficiently and assign weighted sentiment score to each entity. One cannot create NLP rules to calculate sentiment score for every possible word in every possible context. Each language will require its own sentiment classification model.



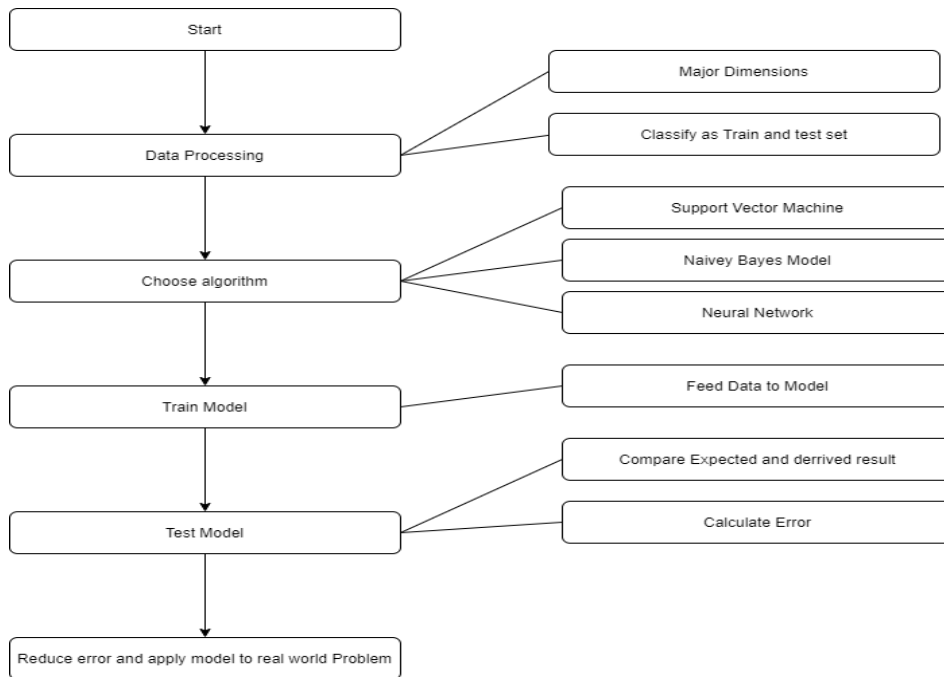


Fig. 2 Standard flow

The above figure shows the standard flow of the model. Which can be modified as per the need since there's no standard methodology which will be readily available to solve such complex problems. Supervised learning provides a great set of algorithms which can be combined with other methodology in order to detect cyberbullying.

### V. CONCLUSIONS

Cyberbullying is the problem faced across the world. Millions of terabytes of data are generated daily which is difficult to process. Hence there might be several techniques to deal with it. This paper tries to portray advantages and drawbacks of supervised learning which can be improved with the use of NLP and vice versa. They are not sufficient alone to handle the issue effectively. Different people may have different opinions but here we would like to suggest few best techniques.

Neural Networks with feed forward back propagation is one of the best methodology to deal with cyberbullying. Some of the social media platforms are using cyberbullying detection mechanisms which are limited to the bullying occurring in the form of text. But for the high dimensional data such as images and videos we can rely on neural network.

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