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Comparative study of Fake News Detection between Machine Learning & Deep Learning Approaches

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Abstract - Most of the people now-a-days prefer to read the news via social media over internet. Many websites are publishing the news and provide the source of authentication.The question is how toauthenticatethenewsand articles which are circulated among social media like WhatsApp groups, Facebook Pages, Twitter and other micro blogs & social networking sites. Itis harmfulfor thesociety tobelieveon the rumours and pretend to be a news. The need of an houristostoptherumours and focus on the correct, authenticatednewsarticles.

Aim of this project is to develop two models for detecting fake news by using Machine Learning algorithms (usingSVM) and Deep Learning algorithms (usingLSTM) respectively.

Withthe help of Machine learningand Deep Learning, it is tried to aggregate the news and later determine whether thenews isreal or fake using Support VectorMachine and Long Short-Term model. For the model, the dataset is cleaned and the data is pre-processed. Thenon the pre-processed data, feature extraction techniques are used and the model is trained using both the algorithms separately to get two different models using SVM algorithm and LSTM algorithm respectively. Confusion Matrix, Classification reports and accuracies of both the models are calculated and compared to find the best model for Fake News Detection. SVM Classifier gave99.29 %accuracy and LSTM classifier gave 99.54% accuracy. Both the algorithms gave good accuracies but LSTM gave better results compared to SVM in classifying the news articles. The major contribution of this project is to find the better fit algorithm and techniques for Fake News Detection between SVM and LSTM algorithms by comparing their accuracies. .

Keywords: SVM, LSTM, Machine Learning, Deep Learning

1. INTRODUCTION

1.1Introduction

In modern times, people utilize social media for knowledge, entertainment, education and business purposes. With a lot of information or news, the one question occurred whether the given news or information is True or Fake. Fake news is commonly distributed with an intent to mislead or make an inclination to get political or monetary benefits.

A survey found that globally percentage of internet users in July 2020 stood at 59% of the global population. Fake news aims to mislead the news users' opinion. For a conspicuous example, COVID-19 pandemic quickly spreading around the world in this period and fake information related to this disease gets created in our society. Such misinformation caused anxiety among people and even deadly consequences in health problem.

1.2 Problem Statement

Publicity through fake news on cyber space today has been adopted by States, institutions as well as individuals for various reasons and varied forms. Often sensational news are created and spread through social media to achieve intended end. On the other hand, it may also involve narration of a true fact however being deliberately exaggerated. This may also include titling the webpages with misleading title or tag-lines in order to seize attention of readers. Such misinformation may lead in committing offences, social unrest, financial frauds upon such misrepresentation, political gain, to increase number of readers, gain revenue associated with click, etc. This may also affect the affect the importance of serious news media. Further danger lies in other electronic media using this as a source for their news thereby carrying forward further spread of such news. The problem is to identify the authenticity of the news and online content. Equally important problem is to identify the bots involved in spreading false news.

1.3 Objective

- The aim of this work is to create a model that can use the data of past news reports and predict the chances of a news report being fake or not. We develop two models for detecting fake news by using Machine Learning algorithms (using SVM) and Deep Learning algorithms (usingLSTM) respectively.

- Our project aims to compare the accuracy between the two developed models i.e., SVM and LSTM approaches for fake news classification and find the most efficient model.

1.4.Scope of study

This project finds whether the news article is taken from the trusted source or not by identifying the news is true or not. We propose to use machine learning approach model and deep learning model to identify fake news. Accuracy of two models are compared to find the best fit model to classify the news into real or fake.

2. Literature Survey

Sobhani,Parinaz, Saif Mohammad, and Svetlana Kiritchenko et.al.[1] published a research paper for Fake news detection using SVM ngram, In this paper , for detecting fake news of tweets towards SemEval 2016 data , SVM ngram features were used. N-gram is a continuous sequence of items with length n. Using N-gram causes the classifiers more restrictive. This SVM model yielded a 10% lower score on the against stance compared with the flavor stance and indicated slight imbalance in classification.

Sobhani,Parinaz, Saif Mohammad, and Svetlana Kiritchenko et.al.[2] during the research Sobhani founded that fake news detection accuracy is high when she included SVM multiple features and proposed this research paper. In this paper, SVM – ngram model was extended by adding two types of features , they are Sentiment features and Word embedding features. Sentiment features are extracted from NRC word-Emotion Association Lexicon which labels each word with either positive or negative sentiments. She also stated that compared to SVM model with single ngram features , this model better detected positive and negative attitudes. This model could be further improved by extraction of entity relationship features.

Davis,Richard,andChrisProctor et.al. [3] developed a research paper for Fake News Detection using BoW MLP. In this he stated that the model is developed with Bag of Word Multilayer Perceptron for fake news detection. It first converts the corpus into bag of words, vectors and then uses to SoftMax layer (one for relevance and one for attitudes) and an entropy-based cost function to make classification. The accuracy of this model is 80% by using BoW. This can be improved by using TF- IDF.

3. OVERVIEW OF THESYSTEM

3.1 Existing System

weobservedtheprevalenceoffakenewsand how technology has changed over the last years enabling us to develop tools that can be used in the fight against fake news.

Wealsoseenhowthedifferentapproachesinterlinkwitheachother,where we need to design the below noticed issues to get a better result:

3.1.1 Disadvantages of Existing System

- IncreasingtheaccuracypercentageofSVMModelagainststance classification in social media.
- Furthersentimentscanbeimprovedbyextraction ofentityrelationship features.
- Needtomakeasuccessfultrainedclassifiersforunsupervisedlearning to detect fake news.
- Fixingapermanentsolutiontoreducethenegativeimpactofsatire news on readers.
- Requiretodiscussaboutlabelleddatasetfortrainingasupervised machine learning classifier.
- Focusingonattributesthatarerepeatedlyencounteredinfakenews.
- Featurevaluescanbeimprovedbydatacleaningprocess.
- Inthefuture,wewouldliketoreplicatethekeyideas ofdifferentmodel analysis using a bigger and more robustly labelled dataset.

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3.2 Proposed System

In our proposed system two models for detecting fake news by using Machine Learning algorithms (using SVM) and Deep Learning algorithms (using LSTM) respectively are developed. The news for which we want to classify if it is real or fake is given to the proposed system. Then the proposed systems classifies the given news into Fake or Real news. The dataset has two csv files in which one has real news and the other has false news, this data is first cleaned i.e., the missing values and noisy data is cleaned from the data and then this data is pre-processed. The pre-processed data is used to extract the features by vectorizing using TF-IDF techniques. This provides the importance or summary of the data. The model is trained using SVM algorithm which is a ML approach and the other model is trained using LSTM algorithm which is a DL approach. These two models process the vectorized data to classify the given news into Real or Fake news.

3.3 Proposed System Design

In this project work, I used five modules and each module has own functions, such as:

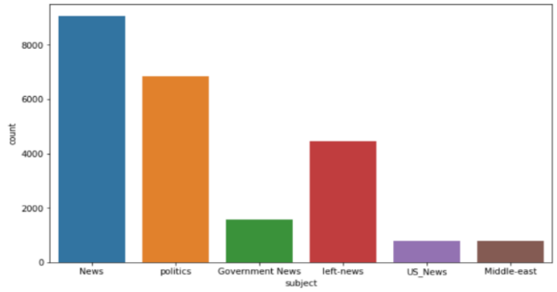
1. Dataset
2. Data Cleaning & Pre-processing text
3. Feature Extraction (using TF-IDF)
4. SVM Model Training
5. Testing
6. Classification as Fake or Real

3.3.1 Dataset

The data available for training the models consists of two CSV file datasets from Kaggle which are distinguished into real and fake news files. The dataset has various news articles to train and test the models. Dataset has 4 attributes which tells about the title, text, subject & date of news articles. Fake CSV file has fake news data and True CSV file has real news data. There are 23481 rows in fake CSV dataset and 21417 rows in real CSV dataset.

3.3.2 Proxy Server

Using this module proxy server is part of cloud service provider. Proxy server logins with valid username and password can view containers which have uploaded file of clients but divided in to 3 parts called containers. Each part size is calculated and send data to 3 cloud servers based on threshold value given for files to upload to cloud. If size of file is greater than threshold size then file is not uploaded. Proxy server can check duplicate data verification before upload to cloud.



Fake news value counts

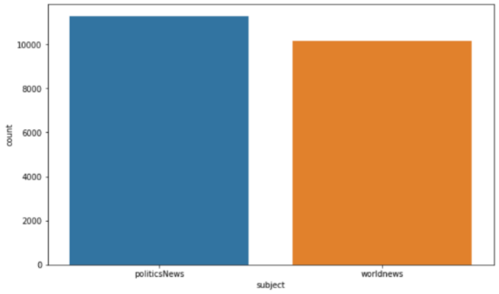


Fig: Real news value counts

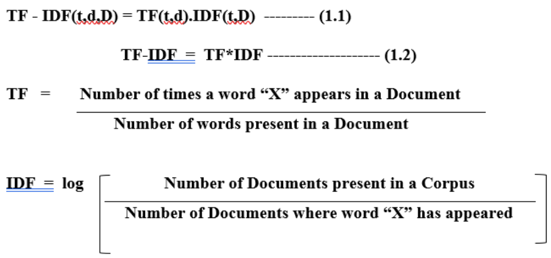
3.3.3 *Data Cleaning and Preprocessing*

Data Cleaning is removing Noisy data with null values or missing values in a file. It is to be done before pre-processing the data. Data pre-processing phase is very important step in any data science lifecycle, as pre-processed data will make that the data is reliable and consistent in building machine learning models. Social media news is unstructured, big and noisy. Thus, these data need to be pre-processed.In data pre-processing step, we have first dropped duplicate rows and missing values from the dataset. After that, we have removed punctuations, numbers, alphanumeric texts, non-English words and stop words from the news articles. These values can cause the model over fitting the data and these are not added any real values to the actual news content.

3.3.4 *Feature Extraction:*

Machine learning model can deal with numeric values only. Therefore, we need to transform the text input data into numeric vector form for applying classification methods. The process of converting text data into numerical representation is called vectorization. There are many word vectorization techniques in text processing. Among them, our model uses frequency-based method (TF-IDF) and pre-trained word embedding methods.

TF-IDF : TF-IDF is sparse vector representation and it evaluates how relevant a word in a collection of documents or corpus . TF-IDF techniques use all the tokens in the sentence as vocabulary. TF means term frequency which can use to measure how frequently a term in one document. IDF measures the important of a term in document. The value of TF-IDF weight can be obtained as a way of normalization in Equation (1), where TF is term frequency, d is a document, IDF is inverse document frequency and D is corpus or documents in the dataset.



$$\text{TF - IDF}(t,d,D) = \text{TF}(t,d).\text{IDF}(t,D) \text{ --------- } (1.1)$$

$$\text{TF-IDF} = \text{TF*IDF} \text{ -------------------- } (1.2)$$

$$\text{TF} = \frac{\text{Number of times a word “X” appears in a Document}}{\text{Number of words present in a Document}}$$

$$\text{IDF} = \log \left[\frac{\text{Number of Documents present in a Corpus}}{\text{Number of Documents where word “X” has appeared}} \right]$$

Word Embedding:

Word embedding is a learned representation for text where words that have the same meaning have a similar representation. It helps transform raw data (characters in text documents) to a meaningful alignment of word vectors in the embedding space that the model can work with more effectively. It is this approach to representing words and documents that may be considered one of the key breakthroughs of deep learning on challenging natural language processing problems.

Model Training:

SVM Model:A support vector machine (SVM) isasupervised learningalgorithm. SVMs work by being trained withspecific dataalready organizedintotwodifferentcategories.Hence, the modelisconstructedafterithasalreadybeentrained. Furthermore, the goal of the SVM method is to distinguish which category any new data falls under, in addition, it mustalsomaximizethemargin betweenthetwo classes.The optimalgoalis thattheSVM willfinda hyperplane that divides the dataset into two groups.

The objective of a Linear SVC (Support Vector Classifier) is to fit to the data you provide, returning a "best fit" hyperplane that divides, or categorizes, your data. From there, after getting the hyperplane, you can then feed some features to your classifier to see what the "predicted" class is.

C is a hypermeter which is set before the training model and used to control error and Gamma is also a hypermeter which is set before the training model and used to give curvature weight of the decision boundary.Intuitively, the gamma parameter defines how far the influence of a single training example reaches, with low values meaning 'far' and high values meaning 'close'. The gamma parameters can be seen as the inverse of the radius of influence of samples selected by the model as support vectors.

Kernel Function is a method used to take data as input and transform it into the required form of processing data. The kernel used in this application is Linear Kernel which is used when the data is Linearly separable, that is, it can be separated using a single Line. It is one of the most common kernels to be used. It is mostly used when there are a Large number of Features in a particular Data Set.

LSTM Model: It is a special type of recurrent neural network that process the sequential data and time series data. It is more suitable for text classification rather than machine learning algorithms because LSTM can capture long-term dependencies between word sequences and it composed of three gates. A cell state helps the data to flow through the cell units without being changed by allowing only a few linear interactions. The input gate in LSTM controls the new values flow into the cells, the forget gate control the extent to which a value remains in the cell and the output gate use to compute the activation output of the LSTM cell. In the proposed model, we applied sigmoid activation function and Adam optimization function to classify news.

4 Architecture

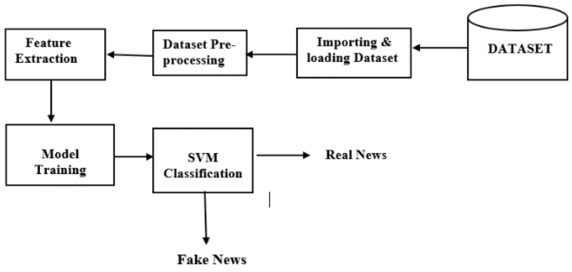


Fig 1: Frame work of

Using Deep Learning approach:

- Data Cleaning & Pre-processing text
- Feature Extraction (Word embedding)
- LSTM Model Training
- Classification as Fake or Real

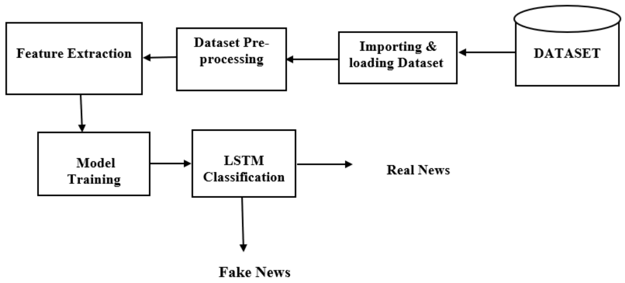
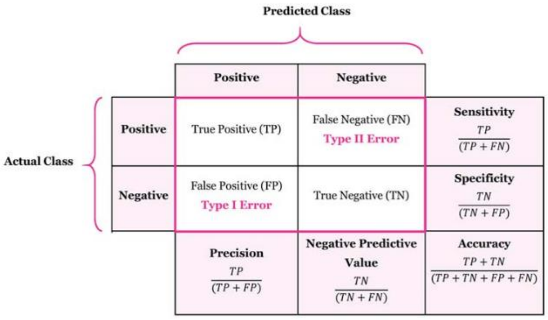


Fig : LSTM Model Flowchart

5 RESULTSANALYSIS

Confusion Matrix:

A confusion matrix is a table that is often used to describe the performance of a classification model (or "classifier") on a set of test data for which the true values are known



		Predicted Class		
		Positive	Negative	
Actual Class	Positive	True Positive (TP)	False Negative (FN) Type II Error	Sensitivity $\frac{TP}{(TP+FN)}$
	Negative	False Positive (FP) Type I Error	True Negative (TN)	Specificity $\frac{TN}{(TN+FP)}$
		Precision $\frac{TP}{(TP+FP)}$	Negative Predictive Value $\frac{TN}{(TN+FN)}$	Accuracy $\frac{TP+TN}{(TP+TN+FP+FN)}$

Fig : 5.1. Confusion Matrix

Recall: Recall is the ability of a classifier to find all positive instances. For each class it is defined as the ratio of true positives to the sum of true positives and false negatives.

Recall:- Fraction of positives that were correctly identified.

Recall = TP/(TP+FN)

F1 score: The F1 score is a weighted harmonic mean of precision and recall such that the best score is 1.0 and the worst is 0.0. F1 scores are lower than accuracy measures as they embed precision and recall into their computation. As a rule of thumb, the weighted average of F1 should be used to compare classifier models, not global accuracy.
F1 Score = 2*(Recall * Precision) / (Recall + Precision)

Support: Support is the number of actual occurrences of the class in the specified dataset. Imbalanced support in the training data may indicate structural weaknesses in the reported scores of the classifier and could indicate the need for stratified sampling or rebalancing. Support doesn't change between models but instead diagnoses the evaluation process.

Performance analysis:

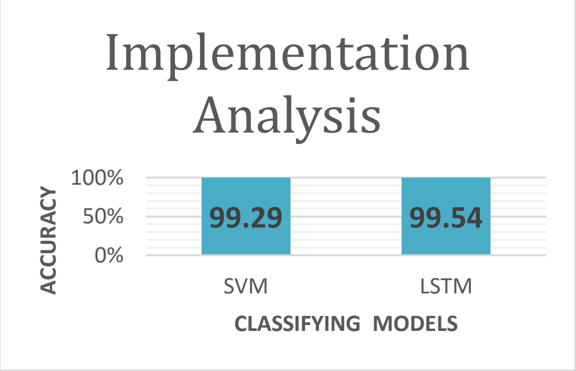
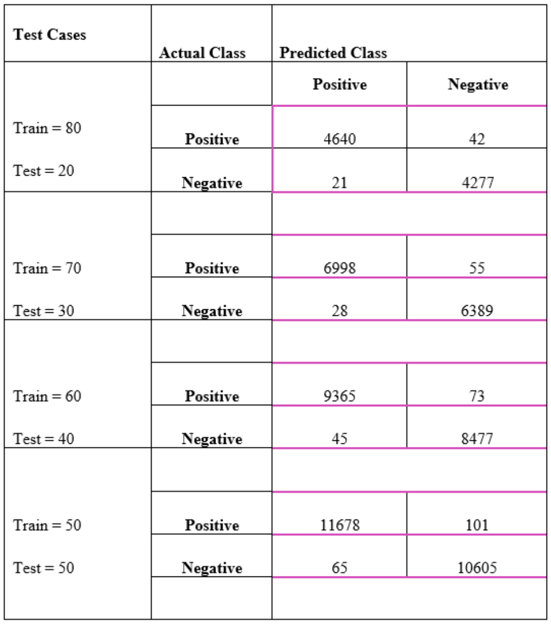


Fig: Implementation Analysis

ACCURACY COMPARISON:



Test Cases	Actual Class	Predicted Class	
		Positive	Negative

Train = 80
Test = 20
	Positive	4640	42

	Negative	21	4277

Train = 70
Test = 30
	Positive	6998	55

	Negative	28	6389

Train = 60
Test = 40
	Positive	9365	73

	Negative	45	8477

Train = 50
Test = 50
	Positive	11678	101

	Negative	65	10605

6. CONCLUSION

Our proposed system classifies the given article into real or fake news based upon the information given in that article using SVM approach (ML) and LSTM approach (DL). This helps people to know if the information present in various social media sites and on internet is real or misleading news.

Accuracy of SVM classifier is 99.29 % and accuracy of LSTM classifier is 99.54%. Both the algorithms give good accuracy but LSTM gives better results compared to SVM in classifying the news articles.

From our comparative study, we conclude that the LSTM model gave more accuracy than the SVM model for different test cases. The classification reports of LSTM model gave better precision values than SVM model. Classifying the given articles into fake or real news by LSTM model gave accurate results than SVM model. Thus, LSTM model is better for Fake news detection than SVM model.

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Future Enhancement

Fake news detection can be improved in future by making models to detect fake news from image data, video data and audio data. Accuracy of different Fake news detection models using other algorithms can be compared for developing efficient models.

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