# *Sentiment Analysis on Real and Fake News of Twitter*

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***Abstract*— This big data programming project aims to develop a convolutional neural network (CNN) model for detecting fake news and predicting the sentiment of tweets. The project will use two datasets of tweets that have been labeled with their authenticity and sentiment, respectively. The CNN model will be trained on these datasets using deep learning techniques, with the goal of applying it on a different tweet dataset, in order to gain insights about current political events. The project will also utilize big data technologies, such as Tensorflow, to efficiently process and analyze the substantial amounts of data.**

***Keywords—CNN, NLP, Tensorflow, Fake News Detection, Sentiment Analysis***

## I. INTRODUCTION

Turkey's recent earthquakes have highlighted the significance of prompt and efficient governmental response to natural disasters. The country's forthcoming presidential elections serve as yet another reminder of the need of providing the public with accurate and trustworthy information. Yet, social media sites like Twitter have developed into a fertile ground for the dissemination of misinformation and false information, which has a substantial negative impact on the public's perception and political consequences.

With the forthcoming presidential elections in mind, we offer a study on sentiment analysis and fake news identification on a Twitter dataset pertaining to the political response of the Turkish government to the recent earthquakes in this article. In order to identify false information and fake news, we assess the sentiment present in tweets about the government's response.

With this analysis, we hope to shed light on public opinion and the dissemination of false information during a pivotal juncture in the nation's political history. Policymakers and government representatives can use this study to better understand the potential effects of propaganda and false information on the future elections and to create plans to combat false information. We can gain important insights into public opinion and political outcomes during times of crisis by utilizing advanced big data programming techniques, such as sentiment analysis and fake news detection, and this will help to ensure the accuracy and reliability of information shared on social media platforms.

## II. APPROACH

In our project we aim to build a Tensorflow Keras CNN model for binary classification. The model will classify the tweets into Real and Fake news, as well as in Positive and Negative Sentiment. The dataset chosen does not include these features thus we will utilize two additional datasets. The first one will train the model to predict the legitimacy of the tweet and the second one will provide the sentiment. Our research question concerns the political response of the tweet, consequently we will filter the data accordingly using keywords such as “political”, “minister”, “president” etc.

## III. RELATED WORK

Based on the work of [1] it is important to monitor fake news and spread of false information before it becomes uncontrollable, as it can lead to a global rise of revolts and breakdown. Their research compares various machine learning methods for detecting fake information, analyzing the difference between them by comparing the accuracies and determining which one gives the best results. The focus is on tweets related to COVID-19, which is a major concern as it can be detrimental for people, businesses, industries, and many other facets of the society. The results of the proposed method can help solve some of the current global problems associated with the spread of false information. The dataset was classified into Rumors and Non-rumors, and the models used were ANN, Random Forest, KNN, SVM, and Logistic Regression. The dataset size was 10,698 tweets, with 13 content features and 5 user features. The J48 decision tree classifier and SVM returned the highest accuracy of 80%. The researchers handled smaller datasets in their work, our project however, is significantly greater by means of data size, thus the use of a Big Data Programming tool is necessary.

TensorFlow is a machine learning system that has enabled the development of increasingly sophisticated models, large datasets, and software platforms to enable the easy use of computational resources for training models on these large datasets. It is based on a unified dataflow graph to represent both the computation in an algorithm and the state of which the algorithm operates and is flexible enough to support experimentation and research into new machine learning models and system-level optimizations. TensorFlow takes hundreds of powerful servers for fast training and runs trained models for inference in production on various platforms, ranging from large, distributed clusters in a datacenter to running locally on mobile devices. TensorFlow is a programming model that allows programmers to experiment with different parallelization schemes such as offloading computation onto servers to reduce network traffic. It has been used successfully in many applications, such as image classification and language modeling, to demonstrate its extensibility and scalability [2].

Convolutional neural network (CNN) is a deep neural network consisting of an input layer, a convolutional layer, and a pooling layer. It is divided into two processes: forward and back propagation, with the former output layer outputs the prediction results and the latter performing parameter adjustment according to the difference between the prediction result and the actual value. The conceal layer is a fixed-size filter (convolution kernel) that is convoluted with the image of the previous layer to extract eigenvalues in the image.

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Pooling consists of two forms: max pooling and average pooling. The purpose of the transformation is to reduce the dimension of the feature map, without changing the number of feature maps, but to change the size, thereby reducing the parameters in the fully connected layer and speeding up the calculation. From the beginning of the input, the full connected layer calls it the "convolution block", which extracts high-dimensional data from the parent layer (convolution layer) as input in a flat form [3].

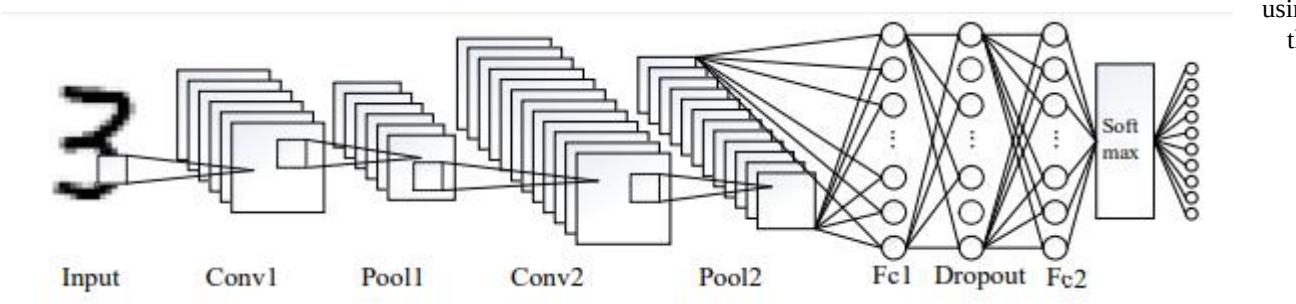


*Figure 1. CNN model structure*

Convolutional neural networks are used for classification and are composed of two layers, a convolution layer which is used for transformation (activation function) and further decisions (prediction and classification). The convolution block is a feature extractor and the loss function is a reflection of the degree of model fitting. The Adam algorithm is used to backpropagate the error and parameter values of the layers of the convolutional network are updated layer by layer. The principle of the simplified version of the model is shown in Figure 1. CNN model structure, which includes an input layer, a two-convolutional -layers, a two pooling-layers, a fully connected layer, from a Dropout layer to a Softmax and an output layer. In the pooling layer, the feature map is equal to the upper layer's feature map, while the dropout layer is necessary for overfitting and improvements in generalization. The data is classified by the Softmax regression model [3]. Considering the above application of CNN on image classification and our need for a tool that offers speed in calculations and deep learning algorithms we construct a CNN model for text classification making use of the Keras library in Tensorflow.

## *IV. SENTIMENT ANALYSIS*

Sentiment Analysis (SA) or Opinion Mining (OM) is the comparative study of people's opinions, attitudes, and emotions towards an entity. It is used to find opinions, identify the sentiments they express, and then classify their polarity. There are three main levels in SA: document-level., sentence-level, and aspect-level SA. Post-report, opinion Mining extracts and analyzes people's opinion about an entity while Sentiment Analysis identifies the sentiment expressed in a text then analyzes it. The goal of each level is to identify the sentiment and their aspects, and to determine whether the sentence expresses positive or negative opinions [4].[5] have pointed out that sentiment expressions are not necessarily subjective in nature. SA is used to predict election results and provide data sources. The authors have identified fifty-four articles which have been published in the last few years and categorized according to the target of the articular illustrating the algorithms and data used in their work. These include Feature Selection (FS) techniques, Sentiment Classification (SC) Techniques, Emotion Detection (ED), Building Resources (BR) and Transfer Learning (TL). Emotion detection aims to extract and analyze emotions, while Transfer Learning or Cross-Domain classification is concerned with analyzing data from one domain and then using the results in a target domain. Building Resources aims to create a corpora in which opinion expressions are annotated according to their polarity.

## V. DATA COLLECTION

As described in the previous sections, our goal is to create a model in which detects whether tweets are Legitimate or Fake. Moreover, we then apply sentiment analysis on those tweets to look for insights and political responses in the recent catastrophic earthquake. To reach our research goal, we aim to utilize 3 datasets that are fake news tweets, sentiment analysis tweets and Turkey earthquake related tweets. Among these datasets which are collected from Kaggle, sentiment analysis dataset has the largest size (1,600,000 records) ( https://www.kaggle.com/datasets/kazanova/sentiment140 ) compared to earthquake (approximately 190,000 records) ( https://www.kaggle.com/datasets/swaptr/turkey-earthquake-tweets ) and fake news detection (approximately 11,000 records) ( https://www.kaggle.com/competitions/nlp-getting-started/data ). In this project, we only used 20% of the sentiment analysis dataset for training and testing to ensure performance of the model satisfied our purposes and the availability we have on resources.

## VI. DATA PREPROCESSING

This problem can be considered as binary classification in natural language processing (NLP) intuitively hence our approach in the pre-processing step was to find and fill null values and apply cleaning techniques such as remove stopwords, stemming, normalizing. To deal with text classification (fake/legitimate news) and sentiment analysis (positive/negative) we used Word2Vec as feature engineering since it captures the semantic and syntactic relationship between words. Finally, Tokenizer from Keras library in Tensorflow was applied to break down text into individual words or tokens to be fed into machine learning model. The priority of this research is to predict the trustworthiness and sentiment of tweets thus after the classification in both categories we will focus on the those tweets that concern political response.

## VII. CNNs MODEL

CNNs are well-known for its effectiveness in capturing local patterns in the input text by using convolutional filters. In comparison to other traditional methods like n-gram

models of feature-based model, sequential dependencies and unseen data can be captured better with CNNs. Moreover, the model is computationally efficient as it can be trained on large dataset. A CNNs model contains series of convolutional layers, followed by pooling layer, and finally fully connected layers.

The input of the CNNs model is a vector representation of each word in the vocabulary which was generated in the pre-processing step. Thus, in the first layer we applied embedding layer that converts integer-encoded vocabulary indices into dense vectors of fixed size. This layer takes in the vocabulary length, embedding dimensions, embedding matrix, and input length as argument. To capture complex relationships between words of the input, we applied two bidirectional layers in which use Long Short-Term Memory (LSTM) units for sequence processing. Using multiple layers can expose overfitting whilst drop out was used in both bidirectional layers to help prevent that risk. Two bidirectional layers are followed by 1D convolutional (ConV1D) layer with 5 filters and Rectified Linear Unit (ReLU) activation function. This layer is capable of capturing both local and global patterns in the input data to produce a feature map hence it would improve performance of our model as we will use it to train on both fake news detection and sentiment analysis. The dimensionality of the feature map was reduced in the pooling layer by GlobalMaxPool1D because of its efficient operation that taking the maximum value of each feature map along with the temporal dimension thus ensuring the most important information is retained. Output layers of this model are two fully connected dense layers in which applied ReLU in the first layer and Sigmoid activation function in the last layer. Our desire output are fake/authentic news detection and sentiment analysis (positive/negative) and Sigmoid is a popular activation function used in binary classification tasks, with the outcome being a decimal between 0 and 1 which denotes probability.

## VIII. RESULT

The model trained in detecting Fake News reaches an accuracy level of 76%. The precision is 77% for Fake news and 74% for Real News, while the F1-score is 80% for Fake and 70% for Real news, respectively. The above could indicate that the model is slightly biased on predicting Fake news, which rises an issue on balance that could be addressed in future work. The confusion matrix for the model is shown below in Figure 2. Fake News Trained CNN CM.

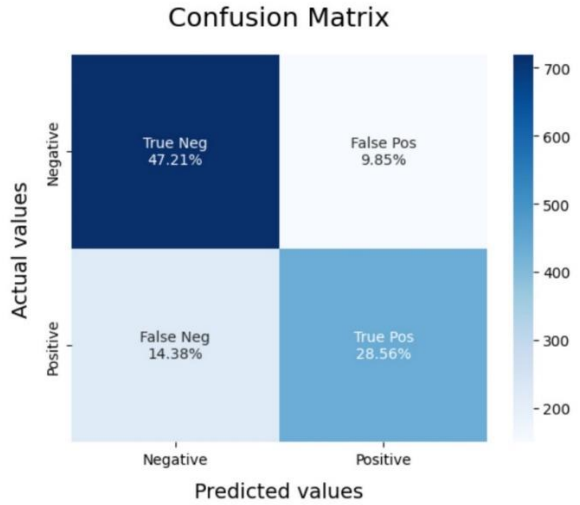


*Figure 2. Fake News Trained CNN CM*

The model then is retrained on Sentiment Analysis data. The model in this occasion appears to be more balanced with a precision of 75% for Negative Sentiment and 74% for Positive Sentiment, alongside an F1-score of 74% for Negative Sentiment and 75% for Positive Sentiment, and an overall accuracy score of 75%. The Confusion Matrix for the Sentiment Analysis model is shown below in Figure 3. SA Trained CNN CM

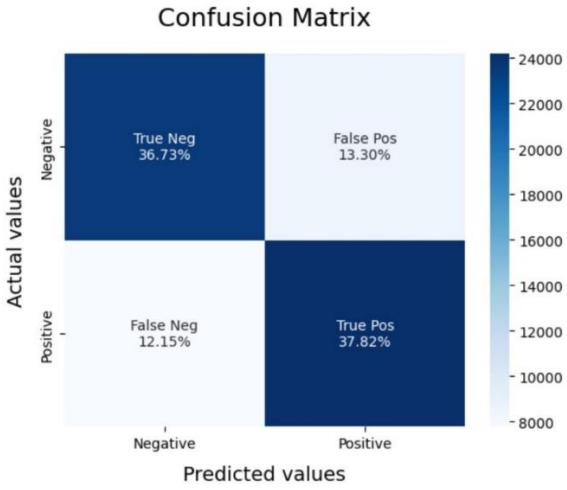


*Figure 3. SA Trained CNN CM*

As for the results of the Project we refer to Figure 4. Project Result. Overall, the Sentiment of the tweets towards the Political Climate in Turkey seem to be overwhelmingly Negative. Given the recent developments after 7.8 magnitude earthquakes struck the country and the allegations of poor constructions being responsible for the high death toll [6], a negative sentiment is to be expected. However, the interesting part is when we review the sentiment specifically on Fake and Real news. The classified Real news follow the overwhelmingly Negative Sentiment as before, on the Fake news on the other hand the Positive Sentiment tweets are 50% more than the Negative ones. The results require a political analyst, in order to draw in depth insights.

## IX. FUTURE WORK

The model proposed, achieved an adequate score for the purposes of this project and the resources available. There are however some ways that one could improve both the accuracy of the model and the overall approach of the topic.

First and foremost, given resources to further address the scalability issue, one could use the full size of the sentiment analysis dataset, thus significantly improving the training process of the model. Similarly, the first dataset concerning fake news detection could be replaced with larger one, thus increasing the accuracy and dealing with the slight bias issue that the prediction seems to have towards Fake news. With the help of a more experienced Data Scientist, especially in the field of text mining, the hyperparameters of the model could be fine-tuned, its architecture could be improved and more efficient preprocessing techniques could be applied.

Furthermore, an interesting research would be for one to incorporate more than sentiment analysis into a model that predicts the outcome of elections based on the general sentiment of the public and other features of the political climate. The model could take into account a wider spectrum

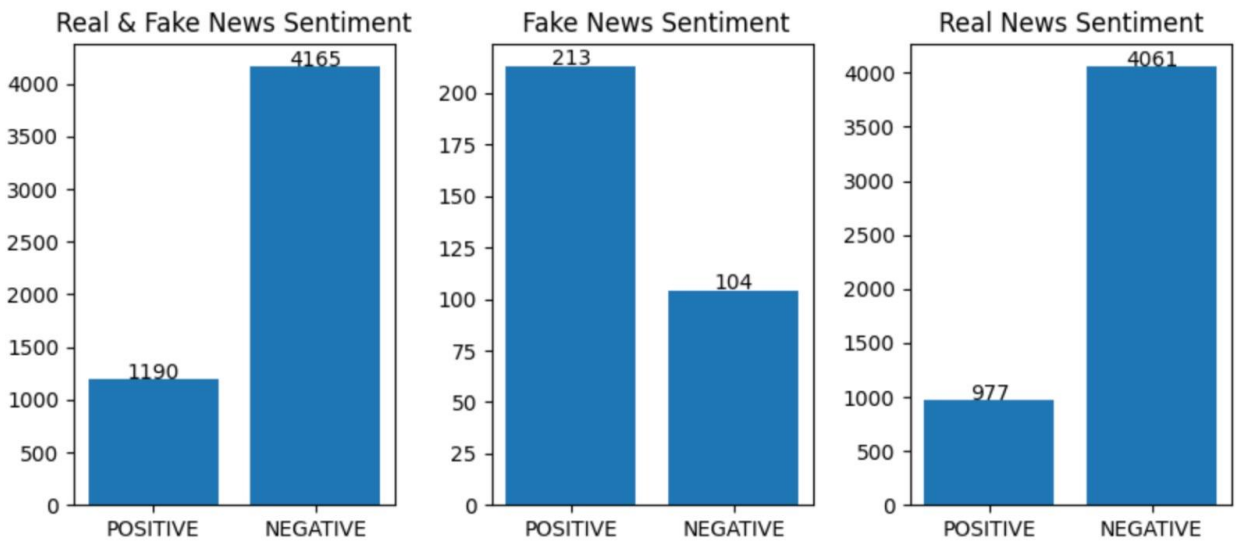


*Figure 4. Project Result*

of tweets, articles, and news, as well as the poles which is one of the most important factor when it comes to predict the outcome of an election.

Moreover, one could explore the different applications of the model. The work done covers political sentiment in a specific country for a specific event. With that in mind, one could try applying the model into different political events, in various countries. Additionally, the model can be applied into a sector beyond politics, such as marketing, customer support etc.

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