Deep Learning Approach to Fake News Detection

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Abstract*—Automatically detecting and analysing fake news on the internet is a hard problem that is yet to be solved. In this project, we strive to build a tool that demonstrates how deep learning can be used to detect credible vs non-credible news sources. We experiment with different deep learning models and select features from the headline of a news article. Along-with the heading, the text of the body of the article is considered .We, thus, propose operational guidelines and a probabilistic system to tag a news headline real or fake. Major components involved in the deep learning process include techniques like Logistic Regression (LR), Long Short-term memory (LSTM), Multilayer Perceptron , Convolutional Neural Networks, bi-LSTM and certain Python modules like Tensorflow, Numpy, Scipy, Scikit-learn, Keras, and Theano.

***Keywords*—Fake News, Deep Learning, Tensorflow, Multilayer Perceptron, Logistic Regression, LSTM Numpy, Scipy, Keras .**

I. Introduction

On account of the increasing social media reach, spammers are now interested in misleading the users, with an intent to make financial or political gains or spread general chaos. As free and fair press in a democracy is bound to have large scale implications, the general public needs a more scientific and open approach of separating groundless fake news from credible, factual journalism.

Fake news has been a menace, especially in this era of unrestricted reliance on social media, leading to millions of people being misinformed all over the world. Over the years, several people have incurred loss of life and property because of false information and rumours. For instance ,recently, a circulating WhatsApp message warning against child kidnappers has caused widespread panic in Jharkhand, leading to villagers turning violent and resulting in the lynching of seven men. It was later found out that the news was fake and those seven men were innocent. Hence, in this light, we propose deep leaning based approach to automatically detect the fake news headlines.

Recently, major tech companies have begun making attempts to curb the spread of fake news on the internet. For example , Google and Facebook both have announced measures to rid the internet of the fake news.. Google plans to rectify its policy in a way that will eliminate the financial incentives to spread fake news by limiting advertisements. Facebook is planning a similar policy fix.

But both Google and Facebook's approaches to combating fake news focus on the policy reforms rather than a technical solution. The community needs an easy-to-use tool that makes use of potential machine learning to identify baseless news articles at broad band speed. We try to construct a study of fake news and implement some techniques to find it.

In this project, we plan to detect the fake news by applying deep learning models on the dataset collected from various sources such as Kaggle for fake news, Guardian API for real news. Currently, we explore detection of fake news based solely on theheadline and body text of a news article and not on any of its other descriptive characteristics (such as sourceof the news, whether it was reported online or in print)

II. Literature review

Along with gaining the technical knowledge for building the main project, it was important for us to establish a working definition of 'fake news'. We had to develop an insight into the different techniques of Deep Learning to reach the most applicable algorithm and feature combination to base our system around to correctly predict a given news headline as fake or real. Some promising existing literature is as follows:

A. *Fake News Detection: Exploring the Application of NLP Methods to Machine Identification of Misleading News Sources*

Author(s): Lauren Dyson & Alden Golab
Dataset(s) Used: Signal Media and a list of sources from *OpenSources.co*
Features Extracted: Term frequency-inverse document frequency (TF- IDF) of bi-grams
It was found that TF-IDF of bi-grams fed into a Stochastic Gradient Descent model is capable of performing quite well at identifying fake sources. Concerns about overfitting and learning topical patterns that predict the differences between the legitimate vs. fake sources as identified by OpenSources.co.

B. *Fake News Detection Using Deep Learning*

Author(s): Sameer Bajaj
Dataset(s) Used: Fake news articles from an Open Kaggle dataset. Authentic news articles from the Signal Media News dataset.

Features Extracted: Embedding Size, Learning rate, Optimizer, Dropout Epochs.

It was unsurprising to see the feedforward network per form well as a classifier. It was disappointing to see that the Convolutional network didn't perform as well, given that multiple n-grams were used as inputs to the model. It was realized that the precision numbers are high for all-models because the dataset is (deliberately) skewed, with authentic news examples (i.e., negative examples) outnumbering the fake news examples by 4 to 1.

C. *Fake News Detection on Social Media: A Data Mining Perspective*

Author(s): Kai Shu, Amy Sliva ,Suhang Wang, Jiliang Tang, and Huan Liu
Dataset(s) Used: Buzz Feed News dataset
Features Extracted: Linguistic features

It was found that they explored the fake news problem by in two phases: characterisation and detection. In the characterisation phase, they introduced the basic concepts and principles of fake news in both traditional media and social media. In the detection phase, they reviewed existing fake news detection approaches from adata mining perspective, including feature extraction and model construction.

III CLASSIFICATION TASK

Based on data collected from sources mentioned in the previous section we derived following basic features from the news headlines:
(1) Count of Unigrams
(2) Count of Bigrams
(3) Count of Trigrams
(4) Bag of words

Classification of the testing data using following deep learning models/techniques :
(1) Logistic Regression
(2) Feed Forward Neural Network
(3) LSTM
(4) CNN
(5) bi-LSTM

IV DATASET(s)

We extracted the data(headlines and body) from the following sources :

1. Kaggle fake news dataset
2. Guardian API Open Platform

V. Techniques

A. *Dataset Collection*

Generated an API Key using The Guardian Open Platform. Based on that, for headlines and content from a specific source, in our case Guardian News to obtain a JSON object

B. *Logistic Regression*

Logistic Regression is a type of classification algorithm involving a linear discriminant. Unlike actual regression, logistic regression does not try to predict the value of a numeric variable given a set of inputs. Instead, the output is a probability that the given input point belongs to a certain class (in our case, fake news or real news)

C. *Feed Forward Network*

A neural network is a made up of a number ofperceptrons connected in different ways which operates on different activation function. Input nodes extracted features from headlines. Complete network has 4 hidden layers having a single input layer and a single output layer. Layers perform computations and transfer information from input nodes to output nodes. Output layers are responsible for computations and transferring information from network to the outside world.

D. LSTM (Long Short Term Memory)

A LSTM unit is made up of an input gate, a cell, an output gate and a forget gate.Cells are responsible for remembering values over arbitrary time intervals. Each of the gates compute an activation function using a logistic function. Each gates has its own parameters, i.e. weights and biases. Input gate controls the extent of value of cell, the forget gate controls the extent to which a value remains in the cell and output gate controls the extent to which the value in the cell is used to compute the output activation of the LSTM unit.

E. Convolutional Neural Network

It consists of an input and output layer with some hidden layers. Hidden layers of CNN consists of convolutional layers, pooling layers, fully connected layers and normalisation layers. Convolutional layers applies convolution operation to the input, passes results to the next layer. Each convolutional neuron processes data only for its receptive field. Neurons share weights in convolutional layers, which reduces memory footprint and improves performance.

F. Bi-directional LSTM

This network performs well for long range dependencies. They are enhanced version of the LSTM in which it is trained in both forward and backward pass consecutively. It is composed of a cell, a forget gate ,an input gate,and an output gate. Cell is responsible for remembering values over random time intervals and therefore the word "memory". Each gate can themselves be thought of a neural network .

VI IMPLEMENTATION

1. Data Extraction: First we collected the fake news dataset from Kaggle and real news dataset through the Guardian API.

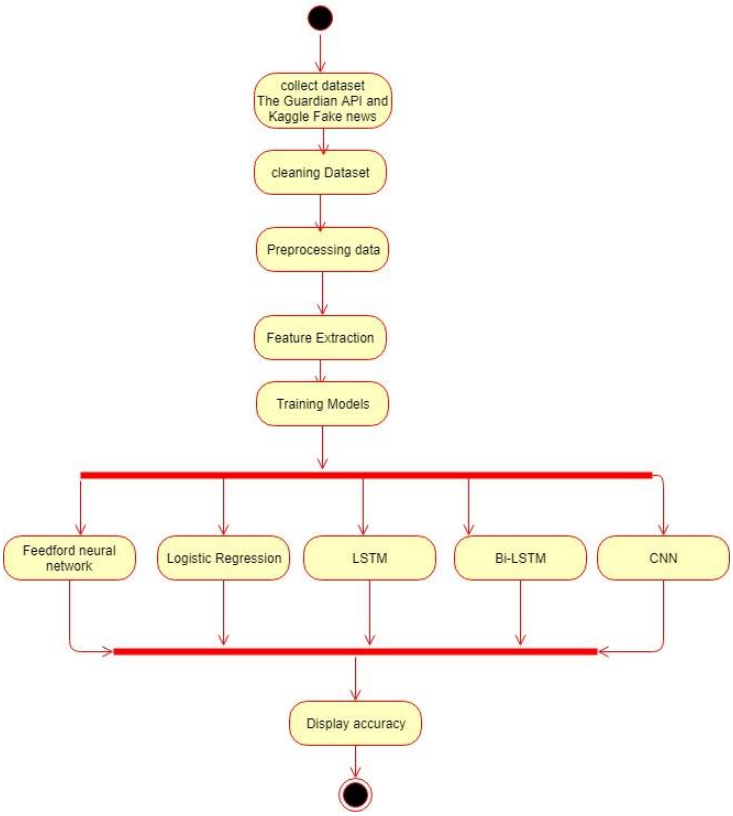
2. Data cleaning: Then we cleaned the collected dataset. Out of all the given sections of news we used only US News, Politics, World, and Business. We wrote the cleaned data to csv file.

3. Data pre-processing: we removed unwanted columns and kept only cleaned headlines, body and added an extra column of fakeness which takes 0 if news if true(i.e. collected from the guardian) and 1 if news is false(i.e. from Kaggle fake news dataset).

4. Then we split our data of headlines, body and labels into training and testing by using sklearn train test split function.80% of our data is used for training and 20% for testing.

5. Then we extract features from the news headlines and articles and use them to train models.

6. Then deep learning algorithms are applied on the training data and results are predicted on testing data. 6. We then compare our model output with the actual output and display the resultant accuracy .



. Fig.1 Activity Diagram depicting the proposed approach .

VII EXPERIMENTAL RESULTS AND ANALYSIS

The components, as mentioned, in the description were used as features for our Deep Learning Models.

In. Feed forward network, number of hidden layers is 4 and 10 neurons in each layer and for 100 epochs.

The results obtained for each model for each feature are as follows:

Features	Logistic Regres-sion	Feed-forward neural network
Unigrams+Bigrams	64.12%	62.15%
Unigrams+Trigrams	63.50%	62.40%
Unigrams+Bigrams+Trigrams	63.25%	66.01%
Linguistic	**65.31%**	**68.51%**
Linguis-tic+Unigrams+Bigrams+Trigrams	62.85%	62.34%

CNN	80.43%
LSTM	84.35%
Bi-LSTM	**86.16%**

Results on Headlines

CNN	**84.61%**
LSTM	81.56%
Bi-LSTM	83.45%

Results on Body

Table1
Comparison of the accuracy estimates of different combinations of features and classification techniques.

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