DSP Project

Fake News Detection

ISM 6251 Data Science Programming
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Abstract:

The Information and Broadcasting Industry has always been one of the essential roles in people's lives. From an early age, scientists and doctors used to discover it in isolation, and then they used to publish it in the newspapers for public display to world leaders making decisions about world banks and the environment. People always have inquisitiveness towards the person who inspires them or holds an important position in society. Today is the world of rapid dynamics where the Information and Broadcasting industry is at its best to publish news and broadcasts the moment an incident happens and people get full-fledged access to it by the means of the world wide web and social media. But every coin has two sides. In this rapid era of technology, if people enjoy fast-paced information access then it is very unfortunate to know that every news article or blog does not always contain actual incidents. Some malicious sites or companies prepare fake news so that they can defame that person or a particular incident can have people's eyes. This fake news was made with such deep intricacies and details that they look like actual ones that cannot be differentiated with normal human eyes. We need software ad technology to prevent these incidents from happening as in today's world it seems to appear more often. This fake news detection system has already fed with all the instances of fake news articles and keywords so that it maps every article word by word to detect the keywords so that it can produce the final result that either the news that has been published or about to publish is actually real or just made up story for defamation and false claims.

Background:

Fake news detection is not a new concept in today's world. It has its roots when the only means of information and broadcasting were newspapers and radios. But then was the time when its detection was quite cumbersome. In one of his articles by Prof Zhang, he mentioned that Fake news has a very negative impact on the society and mindset of an individual (Zhang, X. et al., 2019). As we all know that the internet and social media are extremely convoluted in itself hence uncovering fake news can be technically challenging.

The phrase "deceptive communication" refers to a message that is knowingly shared by the sender to serve a false thought or conclusion by the receiver, and is a message consciously shared by the sender to serve a false notion or conclusion by the receiver (Ekman and Friesen, 1969). This idea is supported by the "Interpersonal Deception Theory" (Buller et al., 1996), which explains how the deceiver critically regulates the communication attitude in response to the recipients' sentiments and distrust.

Motivation:

With the contagious spread of misinformation on socials like Twitter, WhatsApp, and Facebook, Fake news needs to be combated like the novel coronavirus. Fake news isn't a new concept in the United States. During every election, there have been cases of numerous fake news around politics and world leaders. But the wake-up call for fake news has risen ever since the election of President Trump in 2016. Freedom of thought, expression, and freedom of the press has given a free pass to post or tweet any fake news which if not addressed properly can prove disastrous.

With the boom of technology and Machine Learning platforms, our intention was to develop a program that can detect, identify and distinguish whether the given news is real or fake.

Related work:

There are some past researches done in an attempt of predicting fake news. They used the potential of Natural Language Processing, Logistic Regression, Term Frequency - Inverse Document Frequency (TF-IDF). Based on the findings, we could see that Logistic regression with the help of NLP could yield a good amount of accuracy as it is quite proven that it works well in binary classification. TF-IDF is used for text vectorization so that the input text data of fake/true news can be converted into the correct format which then can be used to fit into data and model training and testing in the development. The work done using Py-caret trains different models and gives the evaluation metrics for those and thus we can see which model fits the best.

The links to previously done work are as follows :

Fake news detection using TF-IDF

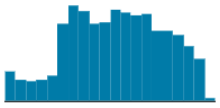
[Fake News Detection using Universal Sentence Encoder and Py-caret]

Dataset Description & Pre-processing:

Our Fake and True News Dataset consists of mainly following four columns :

Title - stores the title of the news
Text - stores the textual news
Subject - stores the type of the news like political, world news.
Date - stores the date it was posted.

The link to the dataset can be found here: [Fake and True News Dataset]

title	text	subject	date
The title of the article	The text of the article	The subject of the article	The date at which the article was posted
17903 unique values	[empty] 3% AP News The regula... 0% Other (22851) 97%	News 39% politics 29% Other (7590) 32%	 30Mar15 18Feb18
Donald Trump Sends Out Embarrassing New Year's Eve Message; This is Disturbing	Donald Trump just couldn t wish all Americans a Happy New Year and leave it at that. Instead, he had...	News	December 31, 2017

Data Sampling:

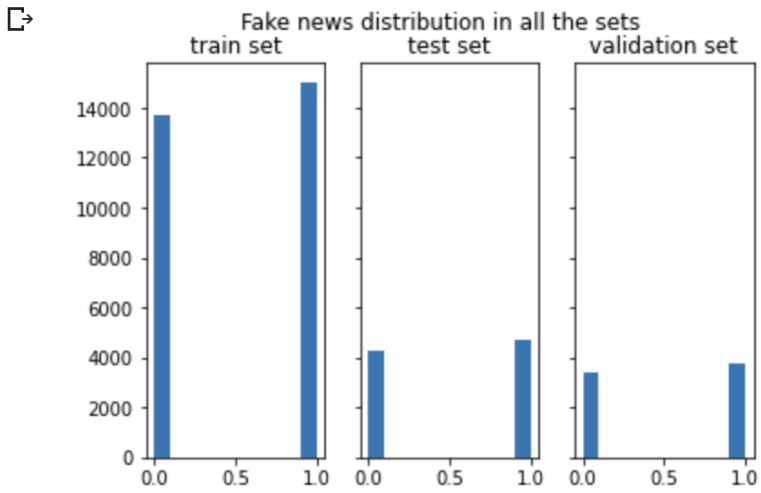
We have used stratified sampling to sample the data into train, test and validation split. Below code, splits the entire data set in the train, test, and validation split using sklearn's StratifiedShuffleSplit method :

```
[ ] from sklearn.model_selection import StratifiedShuffleSplit

split = StratifiedShuffleSplit(n_splits=1,test_size=0.2,random_state=42)
for train_index,test_index in split.split(all_news_reduced,all_news_reduced["fake"]):
    train_valid_set = all_news_reduced.loc[train_index]
    test_set = all_news_reduced.loc[test_index]

[ ] split_2 = StratifiedShuffleSplit(n_splits=1,test_size=0.1,random_state=42)
    for train_index,valid_index in split.split(train_valid_set,train_valid_set["fake"]):
        train_set = train_valid_set.iloc[train_index]
        valid_set = train_valid_set.iloc[valid_index]
```

With this approach of sampling, we were able to have the same distribution of fake news in all the samples.
Distribution of fake news:



Model/Methodology:

Our methodology consisted of mainly six steps viz.

1. Understanding the problem statement
2. Going through past related work
3. Data Collection and Preprocessing
4. Model Training
5. Model Evaluation
6. Making predictions

We started reading and thoroughly going through the related work done for predicting fake news and studied which algorithms help make better predictions.

In order to predict the credibility of the news, and thus evaluate the metrics that make for better prediction of fake news, both fake and true news, a pair of datasets were pulled from Kaggle (Fake and True News Dataset).

Then, we made and trained two models using Natural Language Processing(NLP). The models were as follows :

a. NLP with RNN
b. NLP with RNN with GRU and masking)

NLP with Deep Learning (RNN, and RNN with GRU and masking)

NLP with RNN :

First, We tried with a normal RNN sequential network with an embedding layer on top. The embedding layer is taking each word, which is a 1000x1 vector, and is converting it to a 256x1 vector. After this, we added two RNN layers with LSTM,
Each has 256 neurons. We expected it to work as two layers of 256 LSTM neurons should have been enough for an input length of 50. But to our surprise, the model didn't do well.

```
model_lstm = Sequential()
model_lstm.add(Embedding(input_dim = 1000, output_dim = 256, input_length = 50))
model_lstm.add(SpatialDropout1D(0.3))
model_lstm.add(LSTM(256, dropout = 0.3, recurrent_dropout = 0.3))
model_lstm.add(Dense(256, activation = 'relu'))
model_lstm.add(Dropout(0.3))
model_lstm.add(Dense(1, activation = 'softmax'))
model_lstm.compile(
    loss='categorical_crossentropy',
    optimizer='Adam',
    metrics=['accuracy']
)
```

NLP with RNN using GRU and masking :

For our second model, we attempted to use masking to avoid learning the padded alphabets in the words, for this, we set the masking for 0 and passed it on all the layers, we also enabled return_sequences in the first RNN layer. This model has performed

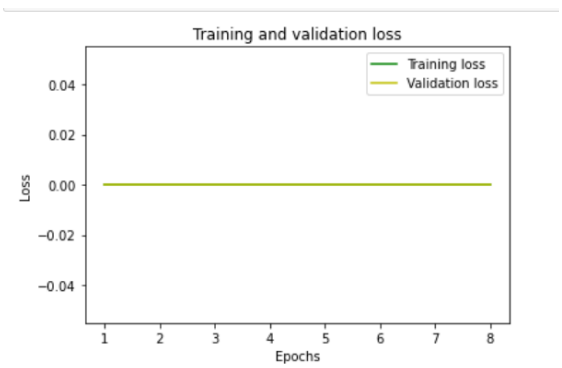
amazingly well, with an accuracy of over 97%.

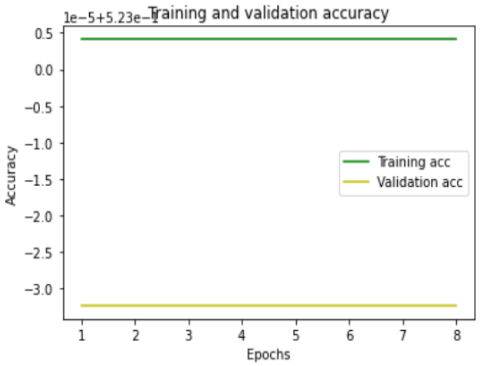
```
embed_size = 128
K = keras.backend
inputs = keras.layers.Input(shape=[None])
mask = keras.layers.Lambda(lambda inputs: K.not_equal(inputs,0))(inputs)
z= keras.layers.Embedding(max_words,embed_size)(inputs)
z= keras.layers.GRU(128,return_sequences=True)(z,mask=mask)
z= keras.layers.GRU(128)(z,mask=mask)
outputs= keras.layers.Dense(1,activation="sigmoid")(z)
model = keras.Model(inputs=[inputs],outputs=[outputs])
model.compile(loss="binary_crossentropy",optimizer="adam",metrics=["accuracy"])
```

Confusion matrix for a model with masking:

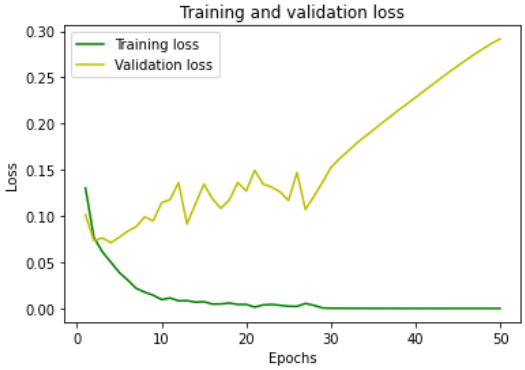
```
array([[4193,   91],
       [ 139, 4557]])
```

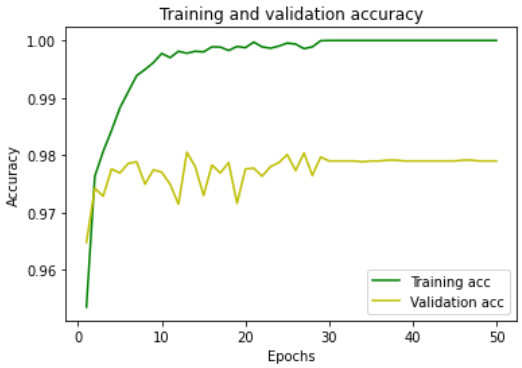
NLP with RNN graphs :



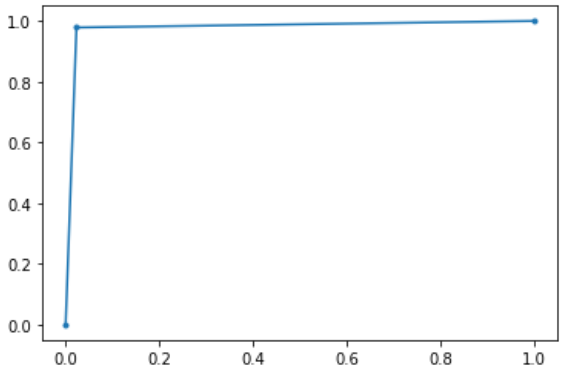


NLP with RNN using GRU and masking :





ROC curve:



We also tested our model on fake news that wasn't in our data and was spread for real. And our model accurately classified it as fake.

Testing our model on a fake news

```
In [36]: fake_news = "Elon Musk reportedly dead at 49 following Tesla Battery Malfunction"

In [41]: fake_news= clean_text(fake_news)
         fake_news = process_text([[fake_news]],tokenizer)

In [42]: prediction = model.predict(fake_news)

In [43]:  np.round(prediction).astype(int)
Out[43]: array([[1]])
```

Model Comparison based on the Accuracy Results:

Model	Accuracy
NLP with RNN	47.70%
NLP with RNN using GRU and masking	97.76%

Future scope and Application:

To avoid the dangers and negative impact of faux news, we can alert the users with the help of an automated system that has our model embedded in that whether the news is fake or real with the help of some labels or indicators beforehand. Using our model we can implement the following in the future :

- Making the system commercially available.
- State-of-art predictions.
- Plug-in or extension in a browser.
- Use to give ratings beforehand for the credibility of the news and help ban the authors of the fake news.

Conclusion:

Our model could give an accuracy of 97.45%. Thus, we can predict the fake news with this accuracy using our model. The spread of fake news can be certainly solved by harnessing the power of data science models to predict news to be fake or not. This will thus help people be more aware of the news they read which have labels associated with it to warn the readers beforehand with the help of an automated system with a detection model embedded into it. In addition, this system certainly needs to be tested on a variety of models and thus, has a large scope of improvement.

References :

1. Fake and Real news dataset, Kaggle :
   Link to the dataset
2. Fake news detection: https://www.oxfordlearnersdictionaries.com/us/definition/english/fake-news
3. Ahmed H, Traore I, Saad S. “Detecting opinion spams and fake news using text classification”, Journal of Security and Privacy, Volume 1, Issue 1, Wiley, January/February 2018.
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5. Previous work done used for reference :
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   Fake News Detection using Universal Sentence Encoder and Py-caret
6. Pérez-Rosas, V., Kleinberg, B., Lefevre, A., & Mihalcea, R. (2017, August 23). Automatic detection of fake news. arXiv.org. Retrieved November 9, 2021, from https://arxiv.org/abs/1708.07104.
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8. Chen, Y., Conroy, N. J., & Rubin, V. L. (2015, November). Misleading online content: recognizing clickbait as" false news". In Proceedings of the 2015 ACM on workshop on multimodal deception detection (pp. 15-19) https://dl.acm.org/doi/10.1145/2823465.2823467
9. Zhang, J., Cui, L., Fu, Y., & Gouza, F. B. (2018). Fake news detection with deep diffusive network model https://arxiv.org/abs/1805.08751