NITP-AI-NLP@UrduFake-FIRE2020: Multi-layer Dense Neural Network for Fake News Detection in Urdu News Articles

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Abstract
Fake news can mislead public opinion, weaken social order, limit the legitimacy of government, and lead to a serious threat to social stability. Therefore, the early detection of fake news from the online platform is extremely important. Most of the previous literature has focused on finding fake news from resource-rich languages like English, Hindi, and Spanish. The current work utilizes the dataset of Urdu language for fake news detection. Two different models have been proposed in the paper. The first one is an ensemble-based technique and the second one is a multi-layer dense neural network. The multi-layer dense neural network-based approach performed better with character n-gram TF-IDF features to achieve a macro F_1-score of 0.8101.

Keywords
Fake news, Machine learning, Deep learning

1. Introduction

Social media and blogs have become a major source of news across the world [1, 2, 3]. Due to widespread use of a smartphone with a camera and social media apps, citizens are not only consumers of the news but they are also the producers and generators of the news items. The ease of access and freedom to share online content encourages people to select the modern way to produce or consume news [4, 5]. In recent pasts, several news was first reported on social media [6]. The benefit of modern technology is misused by some people by publishing fake news through these platforms to make fun of a person/society, create panic or make money. Fake news is verifiably inaccurate [7, 8, 6] circulated in social or mass media. Due to strong sentimental value, a piece of fake news circulates quicker than a piece of real true news. Just a tap on the forward button of the social media apps is sufficient to send it to millions of people. The widespread dissemination of fake news has serious adverse effects on individuals and society. To minimize the consequences of fake news, they need to be detected and their dissemination needs to be stopped as soon as possible.

The research community has been very active in the detection of systems for the automated fake identity of news, reviews, person, and so on [9, 10] in recent past. In the area of natural language processing, fake news detection has emerged as one of the most researched topics. The identified problem would have been simpler if the news on the web could have appeared only in a single language. But, More than 5000 plus languages are used worldwide. Developing a generalized fake news detection system that works for all languages is nearly impossible. Substantial works have been done for resource-rich languages like English, Hindi, Spanish, and so on. For example, [11] presented a system for fake news detection in English news by extracting lexical, syntactic, and semantic features. [12] proposed a model to detect fake news in Spanish using several lexical features like bag-of-words, parts of speech, and n-grams. [13, 14] proposed deep long short term memory model for fake news detection.

Despite having more than 100 million speakers worldwide, Urdu is still a resource-poor language in NLP due to the scarcity of the labelled datasets. Therefore, very few works have been reported for Urdu fake news identification. [15, 16] proposed a benchmark dataset for fake news detection in Urdu. The current paper utilizes the dataset proposed in the shared task *UrduFake-FIRE2020* [17] for fake news detection in the Urdu language. The ensemble-based model and a multi-layer dense neural network-based model are proposed. The results show that with a 0.8101 macro F1-score, the character n-gram features with a multi-layer deep neural network performed best.

The rest of the article is organized as follows: Section 2 explains the details of the proposed model along with the dataset description and feature extraction. Section 3 reports various experiments and their results. Finally, Section 4 concludes the paper by highlighting the main finding.

2. Methodology

The overall model diagram for the proposed multi-layer dense neural network can be seen in Figure 1. Along with it, an ensemble approach for identifying fake news is also proposed. The data and model description used in the current work is explained in the following subsections.

2.1. Data description

The current work utilizes the dataset shared for the *UrduFake-FIRE2020*[1] task for detecting fake news in Urdu language[17, 18]. The dataset contains news related to six different domains such as technology, education, business, sports, politics, and entertainment. The overall data statistic can be seen in Table 1.

2.2. Model description

The experimentation was performed with two different models: (i) Ensemble approach, and (ii) Multi-layer dense neural network. In both cases, one to three-gram (1-3 gram) character TF-IDF (Term-Frequency-Inverse-Document-Frequency) features were used for model training. In the

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[1]https://www.urdufake2020.cicling.org/

Table 1

The overall data statistics used to validate the proposed models

Class	Training	development	Testing
Fake	288	112	-
Real	350	150	-
Total	638	262	400

Table 2

Hyper-parameters setting for the model

Hyper-parameters	Values
Number of neurons in dense layers	2048, 512, 128, 2
Dropout rate	0.4
Batch size	16
Leaning rate	0.001
Optimizer	Adam
Loss function	Binary crossentropy
Activation Function	ReLu, Softmax
Epochs	250

case of the ensemble approach, the combination of Random forest, Decision tree, and AdaBoost classifiers were used. The predictions of each classifier were combined and performed the majority voting among them to assign a final class tag to each of the test data samples.

Like the ensemble approach, in the case of the multi-layer dense neural network, 1-3 gram character TF-IDF features were given input to the dense layer of the network, as it is shown in Figure 1. The network has four dense layers containing 2048, 512, 128, and 2-neurons at the first, second, third, and fourth layers, respectively. A regularizer Dropout with a rate of 0.4 is used in between every pair of dense layers to minimize the over-fitting. In each of the dense layers, except the output layer, *ReLu* activation function is used whereas at the output layer *Softmax* activation function is used to get the probability of being real and fake news. As the performance of deep learning-based models is very sensitive to the hyper-parameters, we performed extensive experiments with varying batch size, learning rate, dropout rate, epochs, and the number of neurons in every hidden layer. The best-suited hyper-parameters for the proposed system are listed in Table 2.

3. Results

Three different predictions for the testing dataset were submitted for the evaluation at the workshop. We submitted two different runs from the ensemble approach and one run from the multi-layer dense neural network models. The results for each of the runs are listed in Table 3. For the ensemble approach, the best results were achieved for the second run (Run-2) with the precision of 0.9387, recall of 0.3066 for the fake class whereas the precision of 0.7037, recall of 0.9880 for the real class. In terms of macro F_1-score and accuracy, the ensemble approach
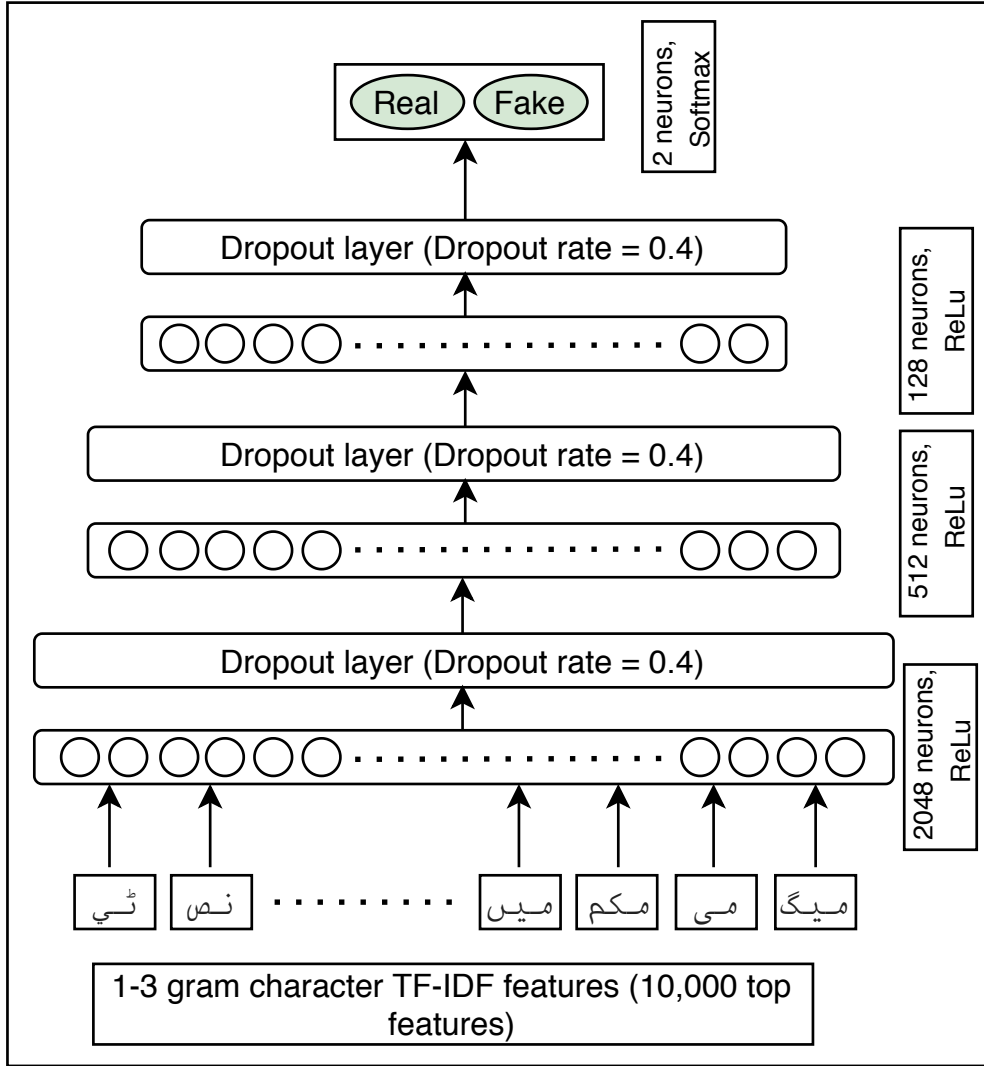
Figure 1: Proposed model diagram for the fake news detection

achieved a macro F_1-score of 0.6870 and an accuracy of 0.7325, as can be seen from Table 3.

The proposed multi-layer dense neural network achieved the best performance among all the three submitted predictions. The multi-layer dense neural network achieved the precision of 0.8900, recall of 0.5933 for fake class, and precision of 0.7966 and recall of 0.9560 for real class. In terms of macro F_1-score and accuracy, the multi-layer dense neural network achieved a macro F_1-score of 0.8101 and an accuracy of 0.8200, as can be seen from Table 3.

Table 3
Results for the proposed models

Model	Class	Precision	Recall	F_1-score	Accuracy
Ensemble approach (Run-1)	Fake	0.9361	0.2933	0.6329	0.7275
	Real	0.6997	0.9880	0.6329	
	F_1 (Macro Avg.)	-	-	0.6795	
Ensemble approach (Run-2)	Fake	0.9387	0.3066	0.6421	0.7325
	Real	0.7037	0.9880	0.6421	
	F_1 (Macro Avg.)	-	-	0.6870	
Multi-layer Dense Neural Network	Fake	0.8900	0.5933	0.7905	0.8200
	Real	0.7966	0.9560	0.7905	
	F_1 (Macro Avg.)	-	-	0.8101	

4. Conclusion

The widespread dissemination of misleading information has significantly affected individuals and society. In this work, we have proposed an ensemble approach and a multi-layer dense neural network for the detection of fake news written in the Urdu language. The proposed multi-layer dense neural network performed best with the character n-gram TF-IDF features and achieved a macro F_1-score of 0.8101.

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