**COMPARATIVE ANALYSIS OF VARIOUS ALGORITHMS FOR FAKE NEWS DETECTION**

***Thesis submitted in partial fulfilment***

***of the requirements for the degree of***

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**In**

**Computer Science and Engineering**

**by**

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***Under the guidance of***

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**Certificate**

This is to certify that the thesis entitled ”**Comparative Analysis of various Algorithms for Fake New Detection**” is a Bonafede record of work carried out by **Prithwiraj Samanta,** under my supervision and guidance, for the partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology (Honours)** in Computer Science and Engineering at the Indian Institute of Information Technology, Ranchi. The thesis has fulfilled all the requirements as per the regulations of the institute and in my opinion reached the standard for submission.

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Abstract

The advent of the World Wide Web and the rapid adoption of social media platforms (such as Facebook and Twitter) paved the way for information dissemination that has never been witnessed in the human history before. With the current usage of social media platforms, consumers are creating and sharing more information than ever before, some of which are misleading with no relevance to reality. Automated classification of a text article as misinformation or disinformation is a challenging task. Even an expert in a particular domain has to explore multiple aspects before giving a verdict on the truthfulness of an article. In this work, we have created an analysis report of various algorithms (particularly LSTM + CNN + Transformer Models) for automated classification of news articles. Our study explores different textual properties that can be used to distinguish fake contents from real. By using those properties, we train a combination of different machine learning algorithms using various methods and evaluate their performance on real world datasets.

Content

**Acknowledgement ii**

**Abstract iii**

**List of Figures iv**

**List of Tables v**

**1 Introduction 7**

1.1 Background …………………………………………………………………………………. 7

1.2 LSTM Models …………………………………………………………………………….... 7

1.3 CNN Models …………………………………………………………………………………. 8

1.4 LSTM + CNN Models ……………………………………………………………………. 8

1.5 Transformer Models ……………………………………………………………………. 9

**2 Review of Literature 10**

2.1 LSTM + CNN Models ………………………………………………………………….. 10

2.2 Transformer Models ………………………………………………………………….. 11

**3 Implementation 11**

3.1 Data Pre-processing ………………………………………………………….……… 11

3.1 LSTM + CNN Models …………………………………………………………...…... 11

3.1 Transformer Models ……………………………………………………………….… 11

**4 Results and Discussion 11**

4.1 Result ……….…………………………………………………………………………..…… 11

4.2 Discussion …...…………………………………………………………………………..… 11

**5 Conclusion and Future Work 11**

5.1 Conclusion ….………………………………………………………………………..…… 11

5.2 Future Work ………………………………………………………………………..……. 11

**List of Abbreviation vi**

**References vii**

List of Figures

1.1 Example Figure ………………………………………………………………………… 10

List of Tables

1.1 Example Table ………………………………………………………………………… 10

**1**

Introduction

* 1. **Background**

With the advancement of technology, digital news is more widely exposed to users globally and contributes to the increment of spreading hoaxes and disinformation online. Fake news can be found through popular platforms such as social media and the Internet. There have been multiple solutions and efforts in the detection of fake news where it even works with artificial intelligence tools. However, fake news intends to convince the reader to believe false information which deems these articles difficult to perceive. The rate of producing digital news is large and quick, running daily at every second, thus it is challenging for machine learning to effectively detect fake news.

In the discourse of not being able to detect fake news, the world would no longer hold value in truth. Fake news paves the way for deceiving others and promoting ideologies. These people who produce the wrong information benefit by earning money with the number of interactions on their publications. Spreading disinformation holds various intentions, in particular, to gain favour in political elections, for business and products, done out of spite or revenge. Humans can be gullible and fake news is challenging to differentiate from the normal news. Most are easily influenced especially by the sharing of friends and family due to relations and trust. We tend to base our emotions from the news, which makes accepting not difficult when it is relevant and stance from our own beliefs. Therefore, we become satisfied with what we want to hear and fall into these traps.

* 1. **LSTM Model**

In theory, classic  RNNs can keep track of arbitrary long-term dependencies in the input sequences. The problem with vanilla RNNs is computational (or practical) in nature: when training a vanilla RNN using back-propagation, the long-term gradients which are back-propagated can "vanish" (that is, they can tend to zero) or "explode" (that is, they can tend to infinity), because of the computations involved in the process, which use finite-precision numbers. RNNs using LSTM units partially solve the vanishing gradient problem, because LSTM units allow gradients to also flow unchanged. However, LSTM networks can still suffer from the exploding gradient problem.

A common LSTM unit is composed of a cell, an input gate, an output gate and a forget gate. The cell remembers values over arbitrary time intervals and the three gates regulate the flow of information into and out of the cell. LSTM networks are well-suited to classifying, processing and [making predictions](https://en.wikipedia.org/wiki/Predict) based on time series data, since there can be lags of unknown duration between important events in a time series.

* 1. **CNN Model**

CNNs are [regularized](https://en.wikipedia.org/wiki/Regularization_(mathematics)) versions of [multilayer perceptron](https://en.wikipedia.org/wiki/Multilayer_perceptron). Multilayer perceptron usually mean fully connected networks, that is, each neuron in one [layer](https://en.wikipedia.org/wiki/Layer_(deep_learning)) is connected to all neurons in the next [layer](https://en.wikipedia.org/wiki/Layer_(deep_learning)). The "full connectivity" of these networks makes them prone to [overfitting](https://en.wikipedia.org/wiki/Overfitting) data. Typical ways of regularization, or preventing overfitting, include: penalizing parameters during training (such as weight decay) or trimming connectivity (skipped connections, dropout, etc.) CNNs take a different approach towards regularization: they take advantage of the hierarchical pattern in data and assemble patterns of increasing complexity using smaller and simpler patterns embossed in their filters. Therefore, on a scale of connectivity and complexity, CNNs are on the lower extreme.

A convolutional neural network consists of an input layer, [hidden layers](https://en.wikipedia.org/wiki/Multilayer_perceptron#Layers) and an output layer. In any feed-forward neural network, any middle layers are called hidden because their inputs and outputs are masked by the activation function and final [convolution](https://en.wikipedia.org/wiki/Convolution). In a convolutional neural network, the hidden layers include layers that perform convolutions. Typically, this includes a layer that performs a [dot product](https://en.wikipedia.org/wiki/Dot_product) of the convolution kernel with the layer's input matrix. This product is usually the [Frobenius inner product](https://en.wikipedia.org/wiki/Frobenius_inner_product), and its activation function is commonly [ReLU](https://en.wikipedia.org/wiki/Rectifier_(neural_networks)). As the convolution kernel slides along the input matrix for the layer, the convolution operation generates a feature map, which in turn contributes to the input of the next layer. This is followed by other layers such as pooling layers, fully connected layers, and normalization layers.

* 1. **LSTM + CNN Models**

This involves using Convolutional Neural Network (CNN) layers for feature extraction on input data combined with LSTMs to support sequence prediction.

CNN LSTMs were developed for visual time series prediction problems and the application of generating textual descriptions from sequences of images or sequence of text document.

This architecture is appropriate for problems that:

* Have spatial structure in their input such as the 2D structure or pixels in an image or the 1D structure of words in a sentence, paragraph, or document.
* Have a temporal structure in their input such as the order of images in a video or words in text, or require the generation of output with temporal structure such as words in a textual description.
  1. **Transformer Models**

Attention mechanisms let a model draw from the state at any preceding point along the sequence. The attention layer can access all previous states and weights them according to a learned measure of relevancy, providing relevant information about far-away tokens.

A clear example of the value of attention is in [language translation](https://en.wikipedia.org/wiki/Language_translation), where context is essential to assigning the meaning of a word in a sentence. In an English-to-French translation system, the first word of the French output most probably depends heavily on the first few words of the English input. However, in a classic LSTM model, in order to produce the first word of the French output, the model is given only the state vector of the last English word. Theoretically, this vector can encode information about the whole English sentence, giving the model all necessary knowledge. In practice this information is often poorly preserved by the LSTM. An attention mechanism can be added to address this problem: the decoder is given access to the state vectors of every English input word, not just the last, and can learn attention weights that dictate how much to attend to each English input state vector.

When added to RNNs, attention mechanisms increase performance. The development of the Transformer architecture revealed that attention mechanisms were powerful in themselves, and that sequential recurrent processing of data was not necessary to achieve the performance gains of RNNs with attention. Transformers use an attention mechanism without an RNN, processing all tokens at the same time and calculating attention weights between them in successive layers.

**2**

Review of Literature

* 1. **LSTM + CNN Models**

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* 1. **Transformer Models**

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**3**

Implementation

* 1. **Data Pre-processing**

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* 1. **LSTM + CNN Models**

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* 1. **Transformer Models**

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**4**

Results and Discussion

* 1. **Result**

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* 1. **Discussion**

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**5**

Conclusion and Future Work

* 1. **Conclusion**

this opportunity to express my sincere and profound gratitude to him.

* 1. **Future Work**

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List of Abbreviations

**NN** Neural Network

**LSTM** Long Short-Term Memory

**GRU** Gated Recurrent Unit

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