RECURRENT NEURAL NETWORK FOR SENTIMENTAL ANALYSIS

Recurrent Neural Networks(RNN) is a type of artificial neural network designed for processing sequences of data . In sentiment analysis, RNN can be highly effective because the goal is to classify the sentiments such as(positive , negative and neutral , etc.) of a given text . It involves understanding the emotional tone behind the words and Recurrent Neural network is particularly effective for handling sequential data's such as text , speech and time series data.

What is Recurrent Neural Network ?

- Recurrent Neural Network is a type of Artificial neural network.
- Designed for processing sequence of Data.
- Particularly effective for Handling sequential data with varying lengths ,such as text, speech and the time series data.
- Maintains a hidden state or memory(RNN are able to retain the memory of previous inputs in the sequence because of the connections that create cycles within the network.

What is Sentiment Analysis ?

- It is the process of determining the emotional tone or sentiment expressed in a piece of texts (such as review or social media posts..) expresses a positive , Negative or Neutral sentiment.

- The Aim of sentiment analysis is to classify text into categories that reflect the writer's feelings or opinions, typically as **positive**, **negative**, or **neutral**.

  Example:-

  Positive :- I love this necklace.

  Negative :- I hate the necklace design.

  Neutral :- The necklace design is okay ,but it could be better.

- It aims to predict the sentiment behind a text.

Common use Cases of Sentiment Analysis :-

- Product Reviews
- Social Media Monitoring
- Customer Feedback
- Political Sentiment
- Brand Monitoring

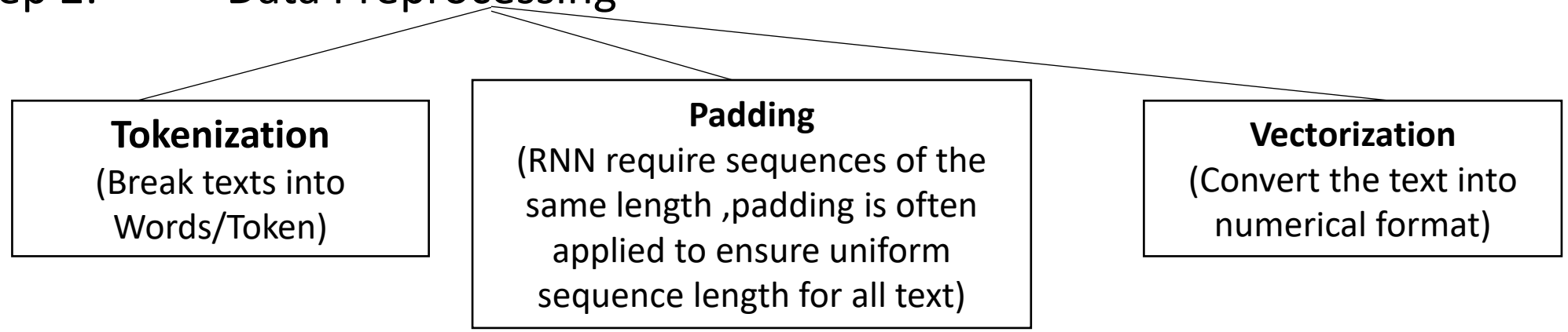
Why use RNN in sentimental Analysis?

RNN have connections that generate cycles . Which can retain memory of previous words or time steps in the sequence . This memory is crucial in recognizing the sentiment in a sentence because the sentiment might depend on how words relate to each other in context.

Steps to Implement Sentiment Analysis with RNNs :-

Step 1:- Data Collection

Step 2:- Data Preprocessing



Step 3:- Build the RNN Model(RNN model for sentimental analysis includes)

- **Embedding Layer** :- Converts words into dense vectors.
- **LSTM**(Long Short-Term Memory) - Advanced RNN architecture that uses memory cells to store information over a long periods,to process these word vectors and learn sequential dependencies.
- **GRU**(Gated Recurrent Unit) – a simplified version of LSTM , offering a balance between performance and complexity.
- **Dense layer** :- Outputs the sentiment class(Positive ,negative or neutral).

Step 4:- Train the model

- To train we use suitable loss function.
  - Binary–cross entropy for binary sentiment classification.
  - categorial cross entropy for multi-class classification.
  - Once the model is build ,we can train it using training data(x_train and y_train) for binary analysis , the labels(x_test and y_test will be 0 or1

Step 5:- Evaluation

Evaluate the model using accuracy, precision, recall and F1 score on a validation or test dataset.

Evaluation Metrics :-

Once model is trained ,we can use metrics such as,

- **Accuracy** : Percentage of correct prediction
- **Precision/Recall/F1 Score** :-Suitable for dealing imbalanced classes.
- **Confusion Matrix** : To visualize false positives and False negatives.

Tools to implement RNN for Sentimental Analysis :-

- TensorFlow - Powerful and Flexible framework for building and Training neural network.
- PyTorch - Suited for research and prototyping
- Keras - - A high-level API built on top of TensorFlow.
- etc…..

Key advantages of RNN for Sentimental analysis :-

- **Contextual Understanding:** RNNs can capture the context of words within a sentence, which is crucial for sentiment analysis.

- **Handling Variable-Length Sequences:** RNN can process text sequences of varying lengths, making them flexible for real-world applications.

- **Learning Complex Patterns:** RNNs can learn complex patterns and relationships between words and phrases, and improve the accuracy of sentiment analysis.

STEPS TO CODE :-

1. Import libraries
2. Load the dataset
3. Process the text data
4. Split the data into training and testing sets.

```
# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X_pad, y, test_size=0.2, random_state=42)

# Check the shape of the data
```

5. Build the RNN model.

```
# Initialize the RNN model
model = Sequential()

# Embedding Layer: Convert the words to dense vector representations
model.add(Embedding(input_dim=10000, output_dim=128))

# LSTM Layer: Capture sequential dependencies in the data
model.add(LSTM(units=128, dropout=0.2, recurrent_dropout=0.2))

# Fully connected (Dense) layer for binary classification (0 = negative, 1 = positive)
model.add(Dense(1, activation='sigmoid'))

# Compile the model with binary crossentropy loss and Adam optimizer
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])

# Print the model summary
model.summary()
```

6. Train the model.

```
# To Train the model
history = model.fit(X_train, y_train, epochs=5, batch_size=64, validation_data=(X_test, y_test))
```

7. Evaluate the model

```
# To Evaluate the model on the test data
test_loss, test_acc = model.evaluate(X_test, y_test)
print(f"Test Accuracy: {test_acc * 100:.2f}%")
```

8. Plot the training and validation accuracy.

```
# Plot the training and validation accuracy
plt.plot(history.history['accuracy'], label='Train Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Model Accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.show()

# Plot the training and validation loss
plt.plot(history.history['loss'], label='Train Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Model Loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()
plt.show()
```

9. Make the predictions.

Link to Git hub

https://github.com/Hemabindhukrishnan/machine_learning.git

or

https://github.com/Hemabindhukrishnan/machine_learning/blob/714fe53b2760e54ab925e038989689b261bcda85/machine_lear_code.ipynb

Conclusion :-

Recurrent Neural Networks (RNNs), especially Long Short-Term Memory (LSTM) networks, are powerful tools for tasks involving sequential data, such as sentiment analysis . By capturing temporal dependencies, RNNs effectively handle complex patterns in text and numerical data. LSTMs, with their ability to overcome the vanishing gradient problem, excel in learning long-term relationships, making them ideal for applications like sentiment classification.

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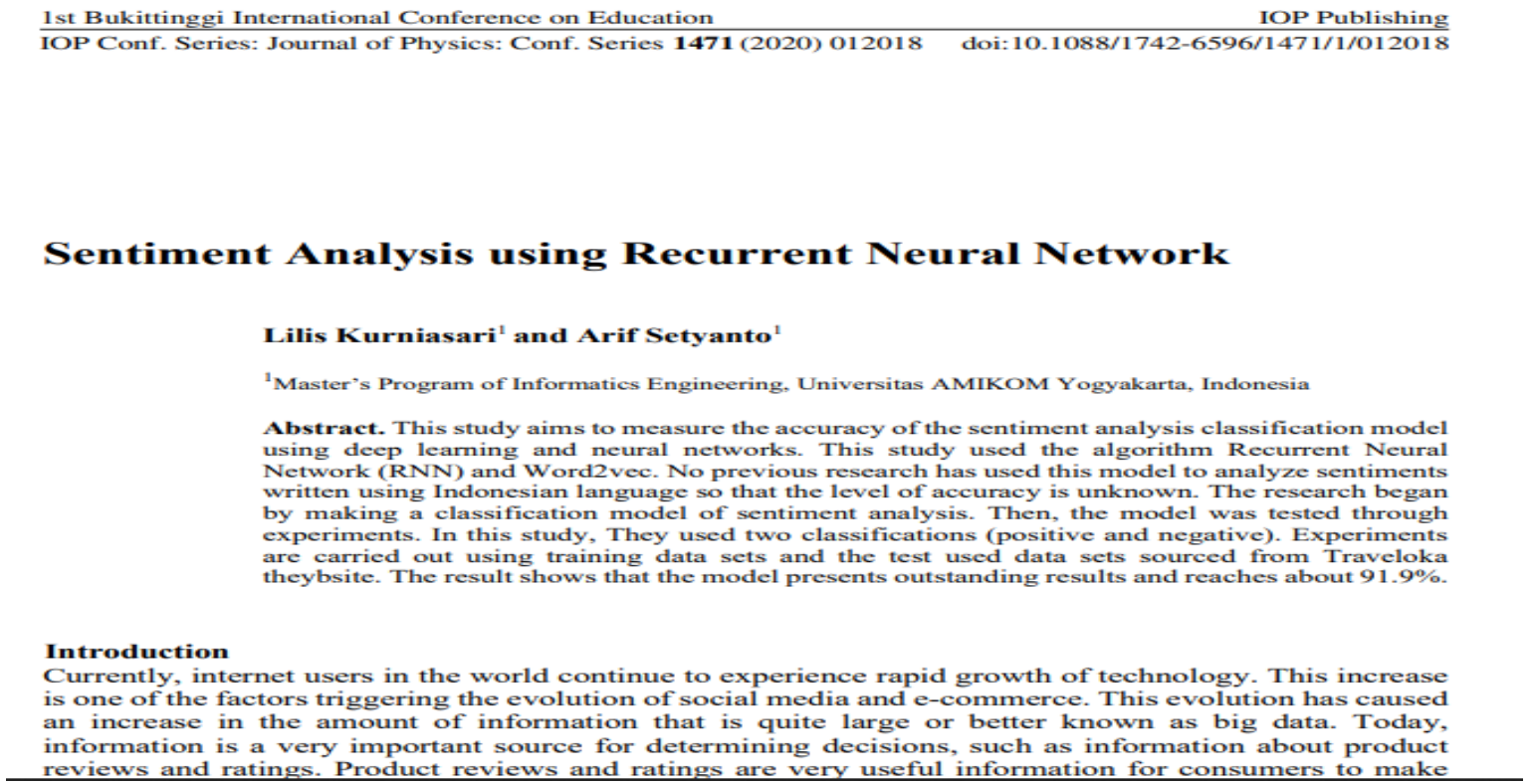

Sentiment Analysis using Recurrent Neural Network

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Abstract. This study aims to measure the accuracy of the sentiment analysis classification model using deep learning and neural networks. This study used the algorithm Recurrent Neural Network (RNN) and Word2vec. No previous research has used this model to analyze sentiments written using Indonesian language so that the level of accuracy is unknown. The research began by making a classification model of sentiment analysis. Then, the model was tested through experiments. In this study, They used two classifications (positive and negative). Experiments are carried out using training data sets and the test used data sets sourced from Traveloka theybsite. The result shows that the model presents outstanding results and reaches about 91.9%.

Introduction

Currently, internet users in the world continue to experience rapid growth of technology. This increase is one of the factors triggering the evolution of social media and e-commerce. This evolution has caused an increase in the amount of information that is quite large or better known as big data. Today, information is a very important source for determining decisions, such as information about product reviews and ratings. Product reviews and ratings are very useful information for consumers to make

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SENTIMENT ANALYSIS USING RECURRENT NEURAL NETWORKS

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ABSTRACT: Sentimental Analysis is the process of identifying and classifying human emotions or sentiments expressed in source text. Social media nowadays is a collection of people interacting with each other, expressing multiple emotions. These emotions range anywhere between positive emotion and negative emotion. The main objective of this project is to survey public emotions and sentiments about a product or an incident. This Sentimental Analysis can be obtained by using Lexicon-based approach or by using Machine Learning/Deep Learning/Natural Language Processing algorithms. In this project, Sentimental Analysis is achieved using a Deep Learning algorithm known as Recurrent Neural Networks and a Natural Language Processing technique known as Word2Vec. Furthermore, by recording the user's audio we can analyse the sentiment of the user. Sentimental Analysis finds its application in Opinion Mining, Market Research, Brand Monitoring, Customer Feedback, Social Media Monitoring and Crowd Analysis.

General Terms

Sentiment_Analysis, Neural Networks, Sound_Sensor, Python, Tensorflow, Rnn, Raspberry, Word2vec, Pyaudio, Speechrecognition, Pickle.

Keywords

RNN, CSV, I2C, IDE, Analysis, pyaudio, Raspberry pi, tensorflow.

INTRODUCTION

In our modern world, emotions and sentiments can be or an incident. Once the text is analysed, we can identify what people think about a particular product, incident or an happening.

Sentiment Analysis

Sentiment Analysis is the contextual mining of text which identifies and extracts subjective information in source material, and helping a business to understand the social sentiment of their brand, product or service while monitoring online conversations. With the recent advances in deep learning, the ability of algorithms to analyse text has improved considerably. Creative use of advanced artificial intelligence techniques can be an effective tool for doing in-depth research. Sentiment analysis can be used in different websites such as Twitter, Facebook, Amazon, IMDb and many similar social media sites. Sentiment Analysis finds its use in social media monitoring, brand monitoring, customer feedback, opinion mining and crowd analysis.

Neural Network

A neural network is a network or circuit of neurons, or in a modern sense, an artificial neural network, composed of artificial neurons or nodes. Thus a neural network is either a biological neural network, made up of real biological neurons, or an artificial neural network, for solving artificial intelligence (AI) problems. The connections of the biological neuron are modelled as weights. A positive weight reflects an excitatory connection, while negative values mean inhibitory connections. All inputs are modified by a weight and summed. This activity is referred as a linear combination. Finally, an activation function controls the amplitude of