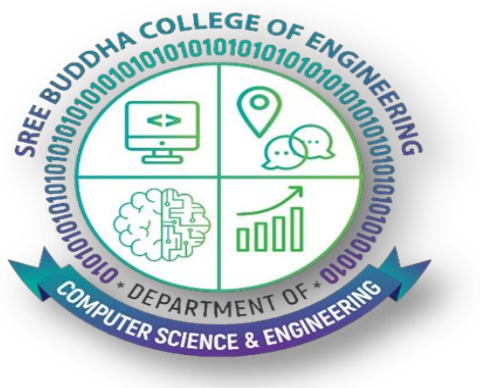

Emotion Recognition from Text Stories Using an Emotion Embedding model

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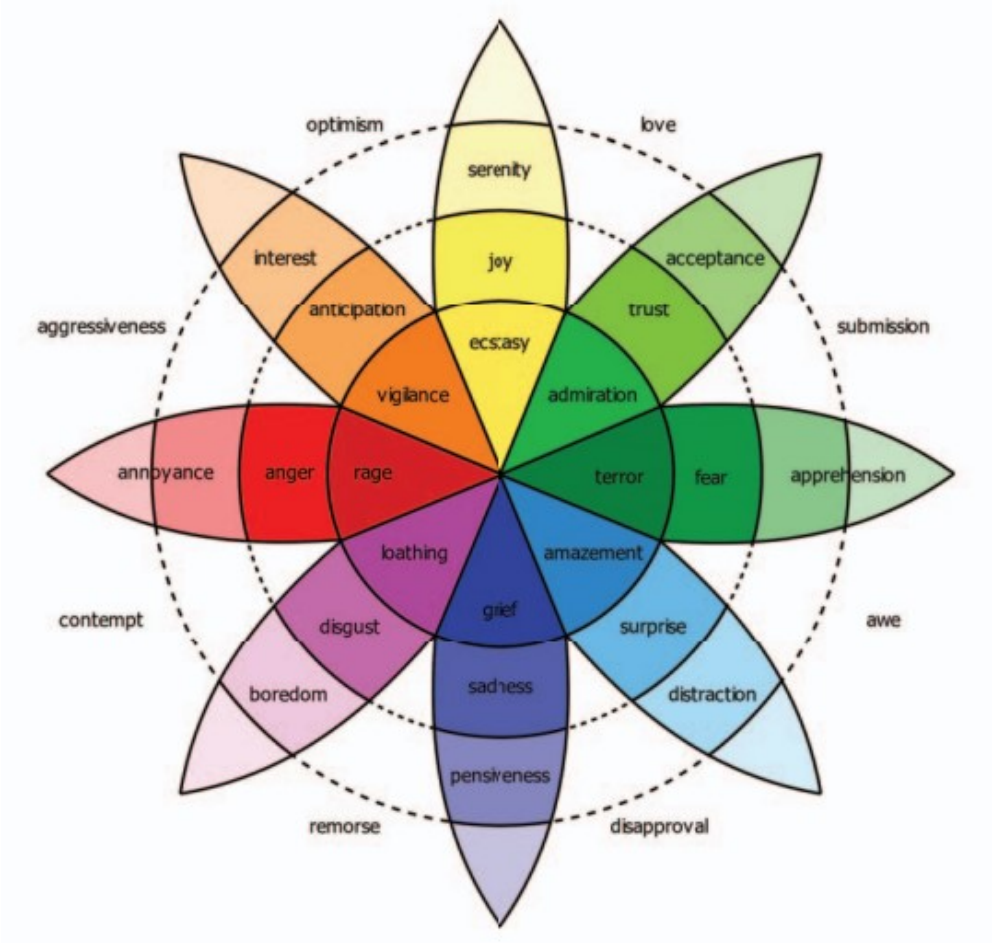
INTRODUCTION

- Emotion detection is a huge step towards making the computer respond with empathy.
- Detect joy, trust, fear, surprise, sadness, disgust, anger and anticipation.
- Research on emotion analysis is expanding from sentiment analysis of review data to emotional interactive chatbots development.

story sentence	emotional word	emotion class
she started crying in frustration	cry	sadness

Contd.

- **Textual emotion detection**:
  - Coarse-grained level
    1. Positive
    2. Negative
  - Fine-grained level
    1. Anger
    2. Anticipation
    3. Disgust
    4. Fear
    5. Joy
    6. Trust
    7. Sadness
    8. Surprise



Plutchik's Wheel of Emotions Model

Methods of emotion analysis

1. **Keyword-based method**
   - It first identifies emotional words within a text, and then detects the emotion of a sentence using pre-defined rules and vocabularies.
   - Utilise rule-based dictionaries with a large number of words and emotional information in them.
   - Employs emotional scores of each word.
   - E.g.:- NLTK VADER Sentiment analyser

NLTK VADER

- VADER stands for Valence Aware Dictionary for Sentiment Reasoning.
- Used for text sentiment analysis that is sensitive to both polarity and intensity of emotion.

```
from nltk.sentiment.vader import SentimentIntensityAnalyzer

sid = SentimentIntensityAnalyzer()
```

- SentimentIntensityAnalyser( ) takes in a string and returns a dictionary of scores in each of four categories:
  - Negative
  - Positive
  - Neutral
  - Compound(computed by normalizing the scores above)

Contd.

```
a = 'This was a good movie.'
sid.polarity_scores(a)


OUTPUT-{'neg': 0.0, 'neu': 0.508, 'pos': 0.492, 'compound': 0.4404}
```

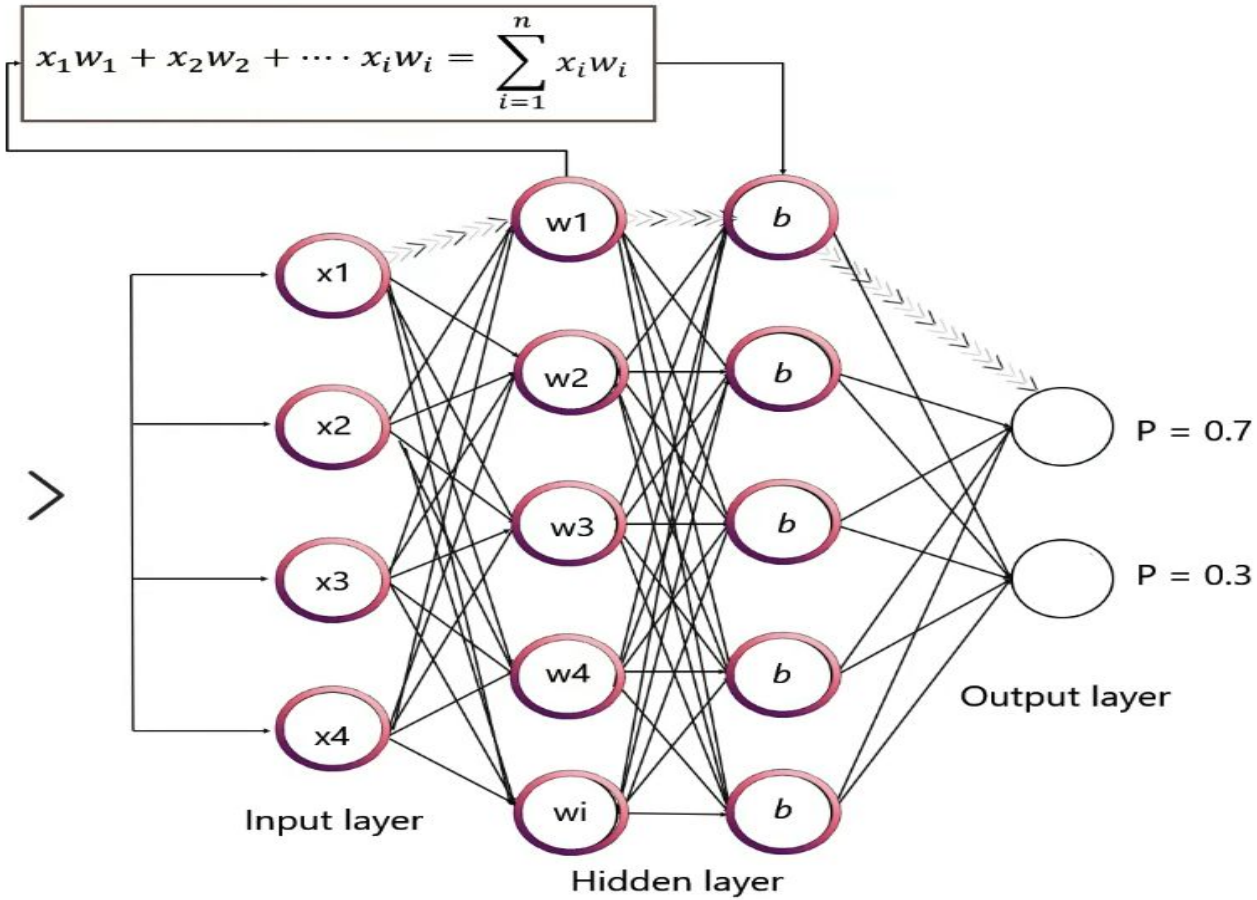
Contd.

2. **Learning-based method**

- Building a model trained with large amounts of data.
- Classifying the emotions of test data based on the trained model.
- Deep learning algorithms such as CNN is applied for emotion recognition within a text.
- Text is replaced with vector.
    - E.g.:- GloVe

CNN

- Vectorized output from GloVe is fed into the input layer of CNN.
- Initial random weights is assigned to each input as it passes from input layer to hidden layer
- Input get multiplied with corresponding weights.
- Numerical value called Bias is assigned to each perceptron



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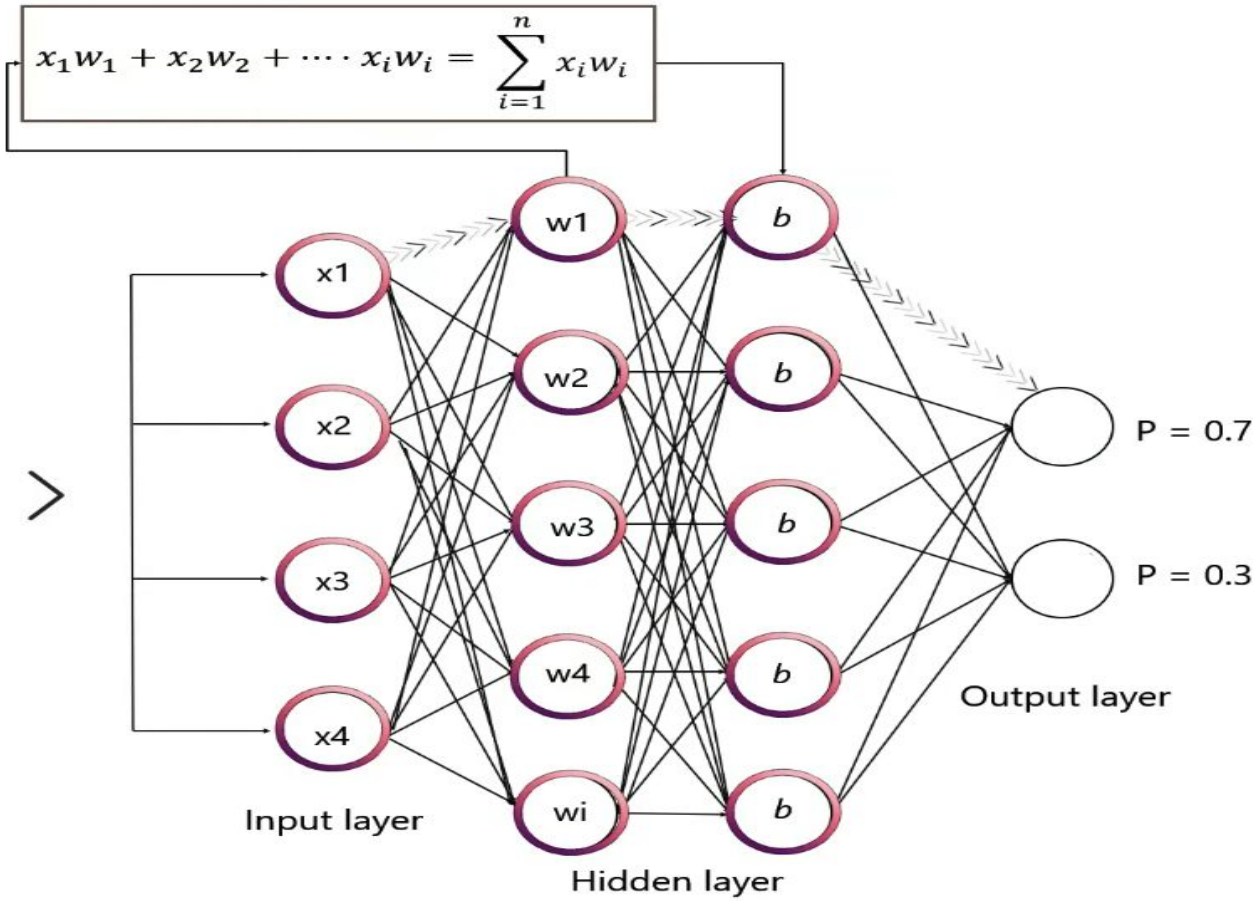
- Each perceptron is passed through activation or transformation function.
- Activated perceptron is used to transfer data to next layer.
- Similarly, data is propagated until it reach output layer.
- A probability is derived at output layer which decides the class the data belongs to.



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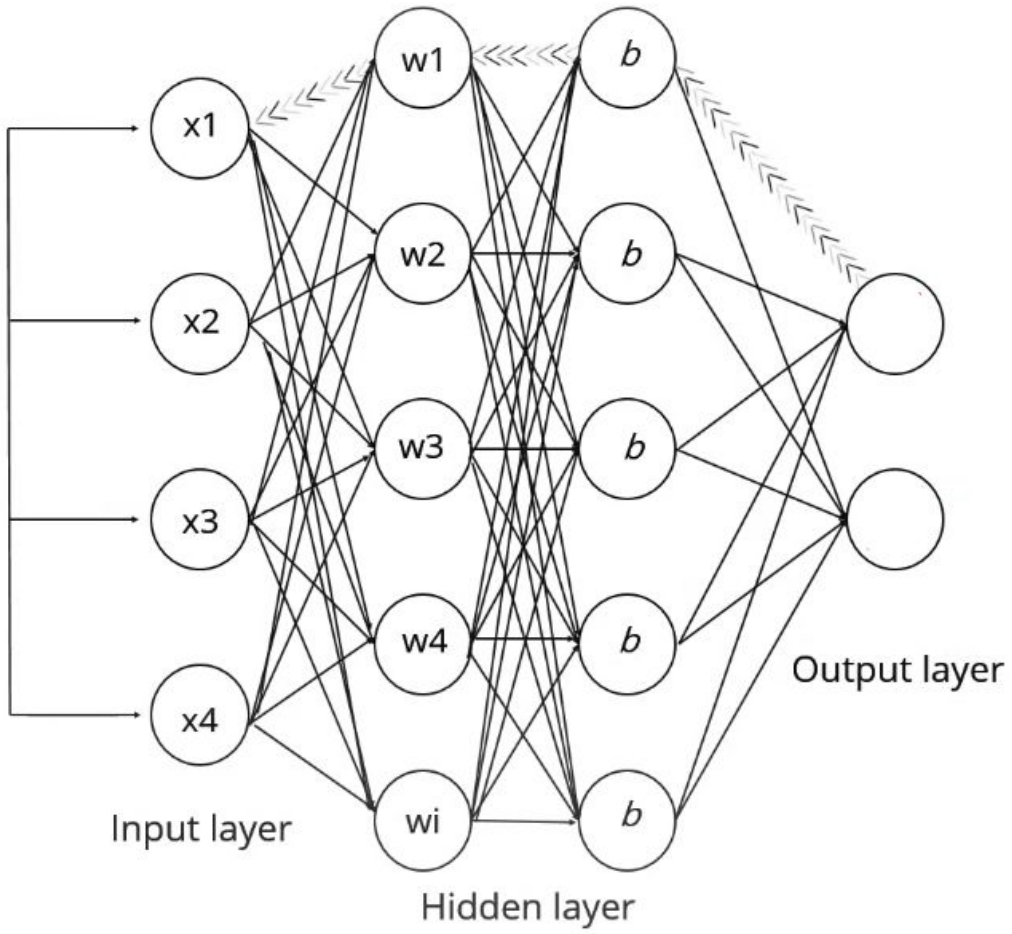
- If the predicted output is wrong**, Back propagation method** is applied.
- The initially assigned weights denote the importance of each input.
- We propagate backward in neural network and compare **actual output** to **predicted output**.



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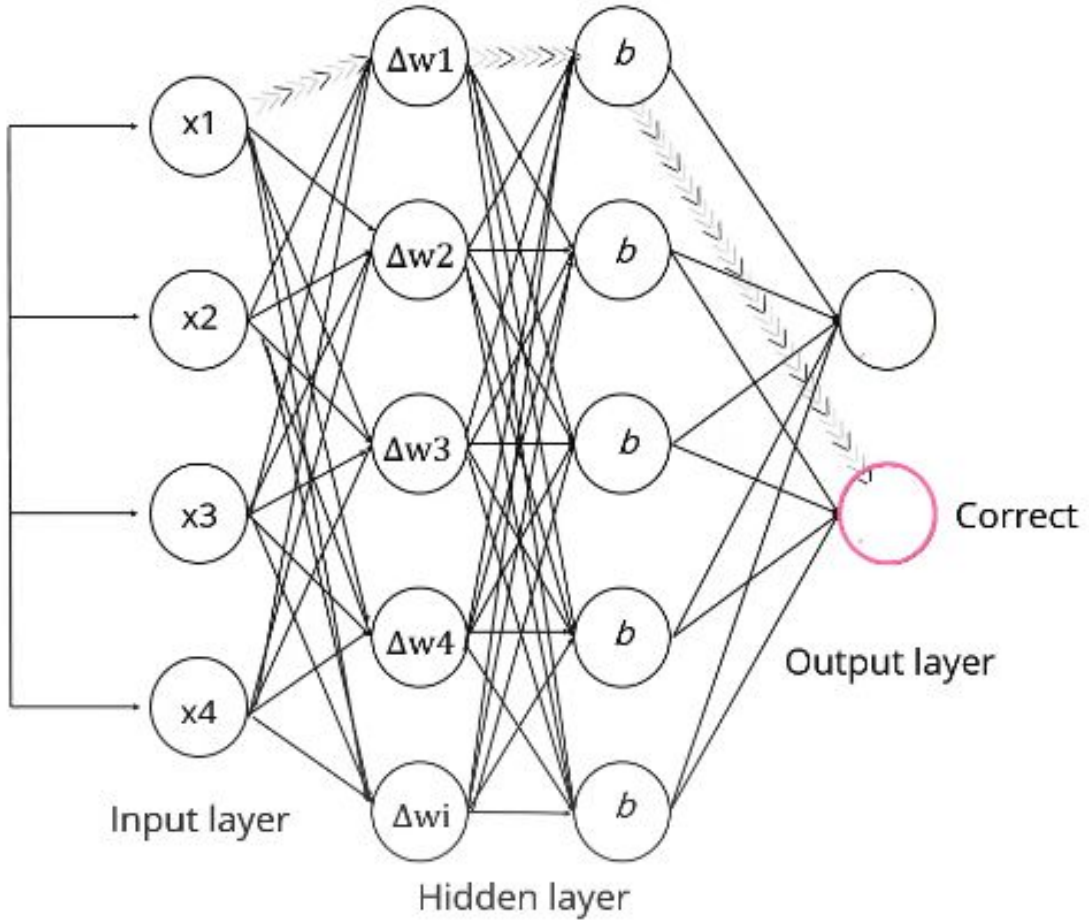
- Weights are re-adjusted for each inputs to minimize error.
- This results in more accurate output.



LITERATURE STUDY

1. **Hwa-Yeon Kim, Jinsu Lee, Na Young Yeo, Marcella Astrid, Seung-Ik Lee & Young-Kil Kim (2018*). CNN based Sentence Classification with Semantic Features using Word Clustering.IEEE 2018***

- ✔ Proposed a text classification method based on deep neural networks and word clustering.
- ✔ Combine word vectors and their cluster information for CNN-based sentence classification.
- ✔ Word embedding, word clustering and CNN-based text classification are the methods used.
- ✔ Performance improvement can be obtained by adding semantic features of each word to CNN-based sentence classification model.
- ✔ Additional experiments are needed to adjust the number of word clusters according to the number of classes for sentence classification.

Contd.

2. **Shadi Shaheen, Wassim El-Hajj, Hazem Hajj & Shady Elbassuoni (2014*). Emotion Recognition from Text Based on Automatically Generated Rules. 2014 IEEE International Conference on Data Mining Workshop***

- ✔ Proposed a framework for emotion classification in English sentences where emotions are treated as generalized concepts extracted from the sentences.
- ✔ Approach for classifying emotions from textual data based on a fine-grained level.
- ✔ WordNet and ConceptNet are used for finding word similarity.
- ✔ Able to classifying any number of emotions by providing a reasonably-sized training set that covers the required emotions.
- ✔ Outperformed the state-of-the-art method in emotion classification from text.

Contd.

3. **Edward Chao-Chun Kao, Ting-Hao Yang, Chang-Tai Hsieh, Von-Wun Soo (2009).** ***Towards Text-based Emotion Detection: A Survey and Possible Improvements. 2009 International Conference on Information Management and Engineering.***

- ✔ Presents an overview of the emerging field of emotion detection from text and describes the current generation of detection methods.
- ✔ Keyword-based, Learning-based and Hybrid methods are discussed.
- ✔ Possible solutions are suggested to improve emotion detection capabilities in practical systems, which emphasize on human-computer interactions.
- ✔ Describes a proposal of integrated system architecture.

PROPOSED METHOD

- Building a hybrid detection model as an emotion embedding model for emotion detection from text.
- Emotions are detected by using a combination of emotional keywords and learning patterns collected from training datasets.
- Overall procedure:
    1. **Collecting Tweet data.**
    2. **Building an Emotion Embedding Model.**
    3. **Extracting emotional words from text stories.**
    4. **Textual Story Emotion Recognition Using an Emotion Embedding Model.**

Contd.

1. **Collecting Tweet data**

   - Large number of tweets having emotional hashtags are collected.
   - E.g.:-

Tweetdata	
Emotion	Count
Anger	44488
Anticipation	8089
Disgust	8678
Fear	20012
Joy	22489
Trust	10697
Sadness	20462
Surprise	9786
Total	144701

Contd.

2. Building an Emotion Embedding Model

- A text emotion classification of Tweet data using the CNN learning algorithm is done.
- CNN learning algorithm trains the Tweet data corresponding to 8 emotions and validates the model performance by classifying emotions of the test data.
- GloVe is employed as the initial embedding model to vectorize text.
- Through the backpropagation process, values of neural network layers are adjusted for emotion classification.
- The embedding layer is extracted when the best classification performance is reached and it is used as the Emotion Embedding layer.

Contd.

3. **Extracting emotional words from text stories.**

   - ROCStories dataset, which include 52,666 stories is employed.
   - NLTK VADER Sentiment Analyzer is applied for detecting emotional words in the story sentences.
   - E.g.:-

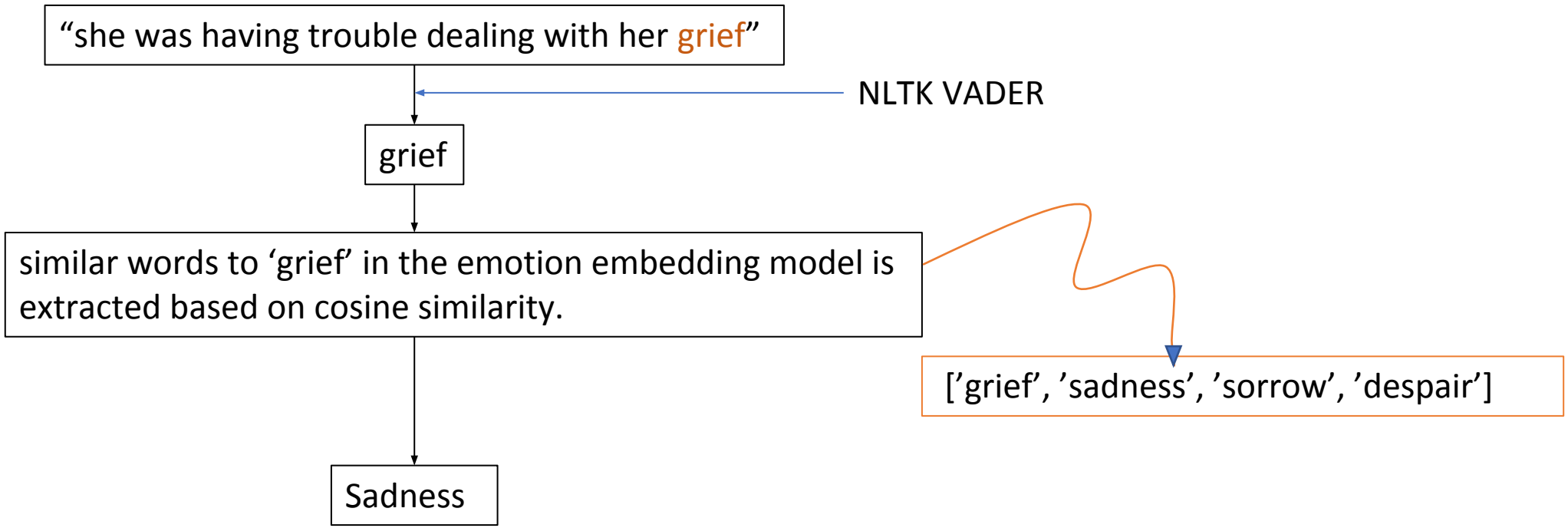
one day a guest made him very angry

➔ [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0. 121, -0.5106]

Contd.

4. Textual Story Emotion Recognition Using an Emotion Embedding Model

- Cosine similarity between the selected emotional words using the NLTK VADER and emotional hashtags for emotion annotation in Tweet data is computed.
- E.g.:-



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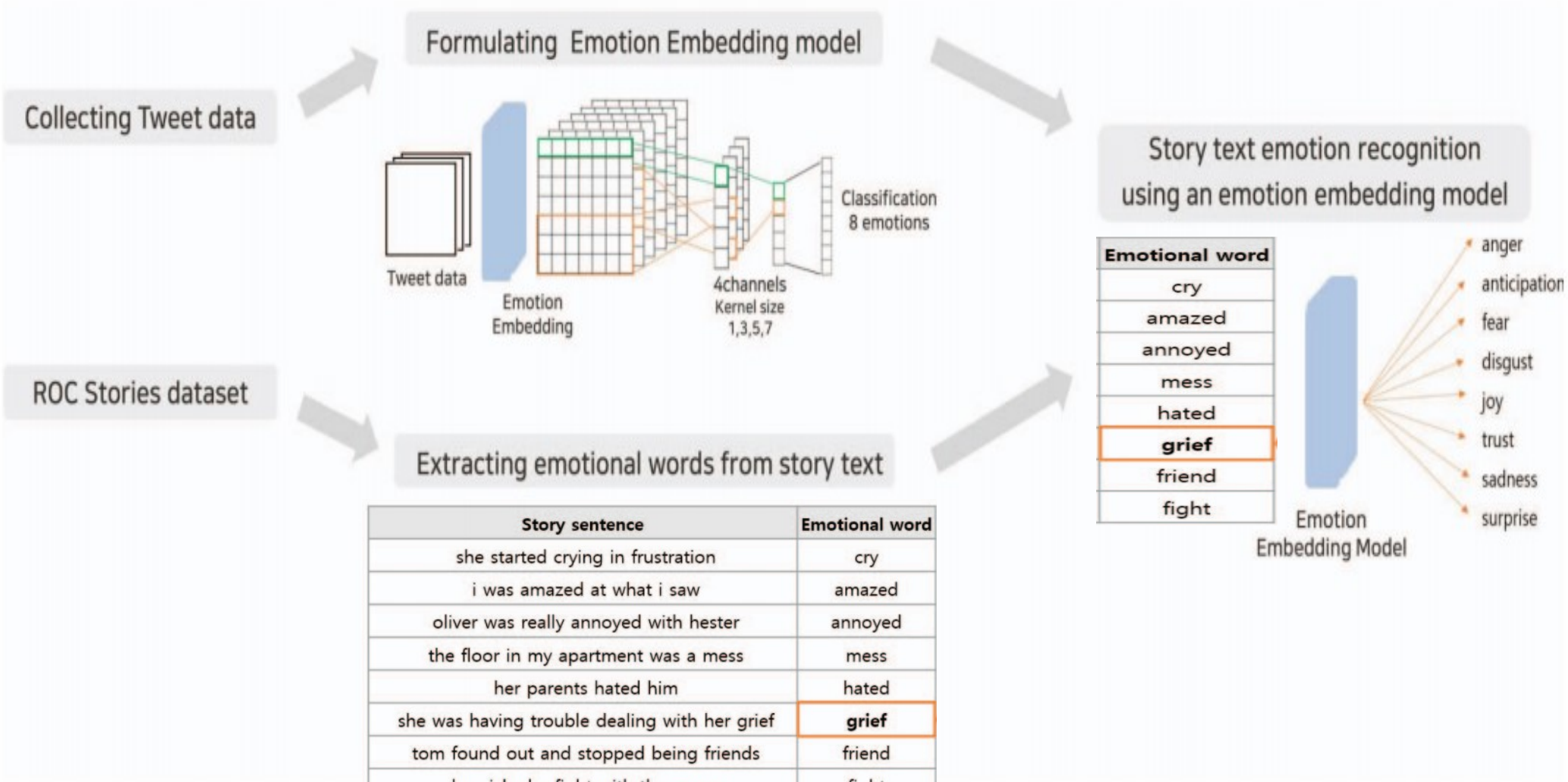

Story sentence	Emotional word
she started crying in frustration	cry
i was amazed at what i saw	amazed
oliver was really annoyed with hester	annoyed
the floor in my apartment was a mess	mess
her parents hated him	hated
she was having trouble dealing with her grief	**grief**
tom found out and stopped being friends	friend
he picked a fight with the excon	fight

RESULT

- Joy(22%), Sadness(19.88%), Fear(16.4%) and Anger(14.4%) are the top 4 emotions, occupying a majority of 73.55% of the total counts.
- Examples for some inputs given and outputs generated:-
  - “I was amazed at what I saw” → Surprise
  - “Oliver was really annoyed with Hester” → Anger

Result		
Emotion	Count	Percent
Anger	19711	14.4
Anticipation	13024	9.5
Disgust	3251	2.37
Fear	22480	16.4
Joy	31371	22.89
Trust	6769	4.94
Sadness	27245	19.88
Surprise	13201	9.63

Contd.

- Inputs with negative expressions generated false outputs.

story sentence	emotional word	emotion class
she started crying in frustration	cry	sadness
i was amazed at what i saw	amazed	surprise
oliver was really annoyed with hester	annoyed	anger
the floor in my apartment was a mess	mess	disgust
her parents hated him	hated	disgust
she was having trouble dealing with her grief	grief	sadness
tom found out and stopped being friends	friend	sadness
he picked a fight with the excon	fight	anger
she felt prepared	prepared	trust
he decided to play but knew he had to study at night	**play**	**joy**
he was not happy about having to go to school	**happy**	**joy**

Performance Evaluation

- 120 sentences of the story sentences were randomly selected.
- Four human raters evaluated the emotions of the sample sentences.
- The raters determined the sentiment polarity of the given sentences and the emotion it belongs to.
- Based on the evaluation of human raters, we calculated the accuracy of each emotion.
- Joy emotion-highest accuracy
- Anger emotion-lowest accuracy
    - Anger labelled sentences often accompanied other negative emotions such as Sadness and Fear.

CONCLUSION

- A method to extract the emotion of a sentence using an emotion embedding model is presented.
- Conducted experiments and the results show that proposed method is promising.
- Emotions from story texts is analysed based on the emotional words representing each story sentence.
    - Therefore, the approach does not take into account the contextual information that can span multiple sentences.
- It also does not handle expressions negating the sentence such as ‘no’, ‘little’, or ‘not’.

Thank you