



# Emotion Detection: A Comparative Analysis



**Benchmarking Machine Learning and Transformer Models on the GoEmotions Dataset**

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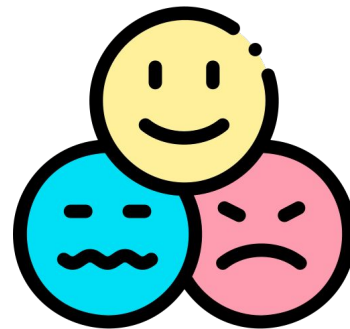
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# Introduction

## What is Emotion Detection?

- An **NLP** task to identify and classify specific human emotions from text.
- It's more detailed than **Sentiment Analysis**, moving beyond 'positive/negative' to emotions like joy, anger, and sadness.



# Motivation

## Why is it Important?



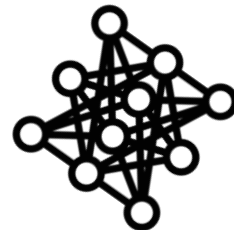
- **Customer Insights:** To understand nuanced feedback on products and services.
- **Content Moderation:** To detect harmful or distressing content online.
- **Mental Health Research:** To analyze expressions of well-being in digital text.



# Contribution



- Built and trained machine learning models and fine-tuned pre-trained deep learning transformer models to detect multi-label emotions classifications.
- Worked on class imbalance for robust emotion detection.
- The study outperforms machine learning models in detecting emotion with **RoBERTa** having the highest **recall**.





# Dataset

- Sourced from real-world Reddit comments, collected by Google.
- Contains **~58,000** comments labeled across **27 emotions + neutral**.
- **Key Challenge: Multi-label & Imbalanced.** A single comment can have multiple emotions, and some emotions are much rarer than others.



Column Name ▾	Data Type ▾	Description ▾
text	object	The actual text content of the Reddit comment.
id	object	A unique ID for each comment.
author	object	The username of the person who wrote the comment.
subreddit	object	The subreddit where the comment was posted.
created_utc	float64	The timestamp of when the comment was created.
rater_id	int64	An ID for the person who labeled the emotion.

Table No.1: Dataset Features

Column Name(s) ▾	Data Type ▾	Description ▾
admiration, amusement, anger, annoyance, approval, caring, confusion, curiosity, desire, disappointment, disapproval, disgust, embarrassment, excitement, fear, gratitude, grief, joy, love, nervousness, optimism, pride, realization, relief, remorse, sadness, surprise, neutral	int64	A binary flag (0 or 1) indicating if the text expresses this emotion.

Table No.2: Emotion Features

# Methodology

Our workflow is divided into two parts, one being classical ML models, the other being state-of-the-art DL models.

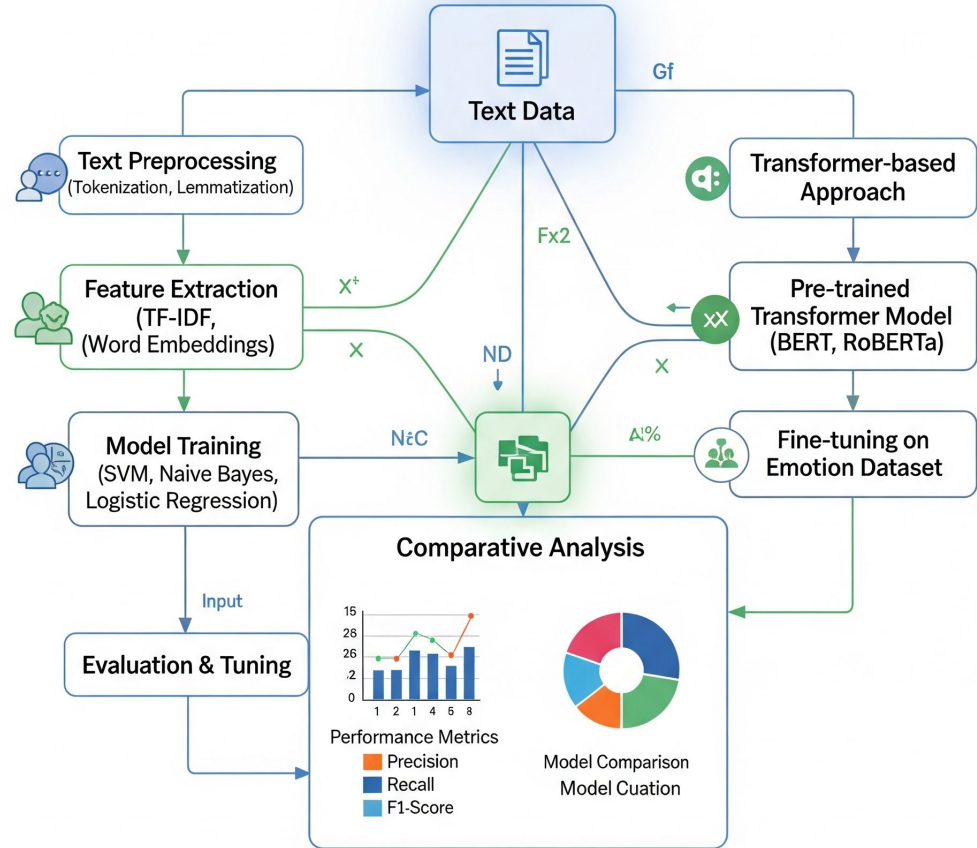
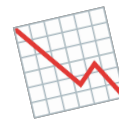
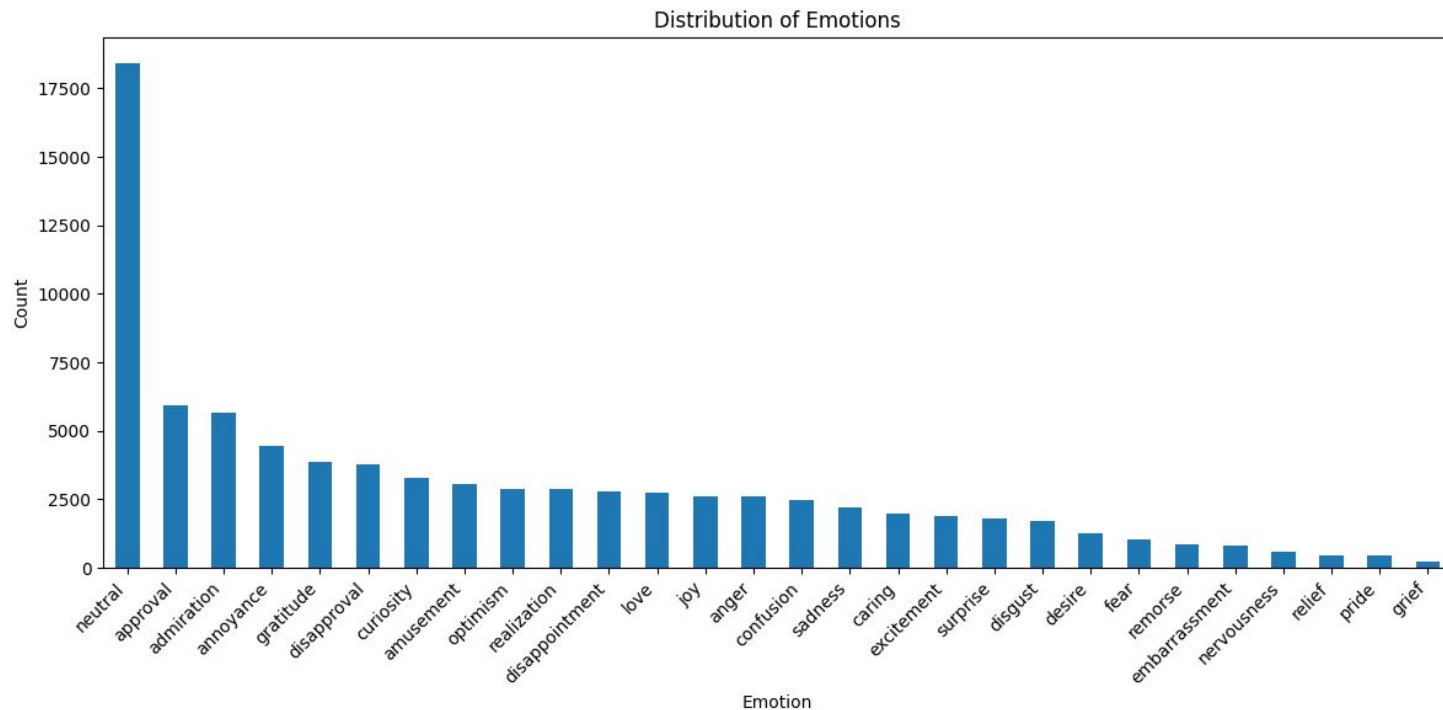


Figure 1: Overall Workflow

# EDA

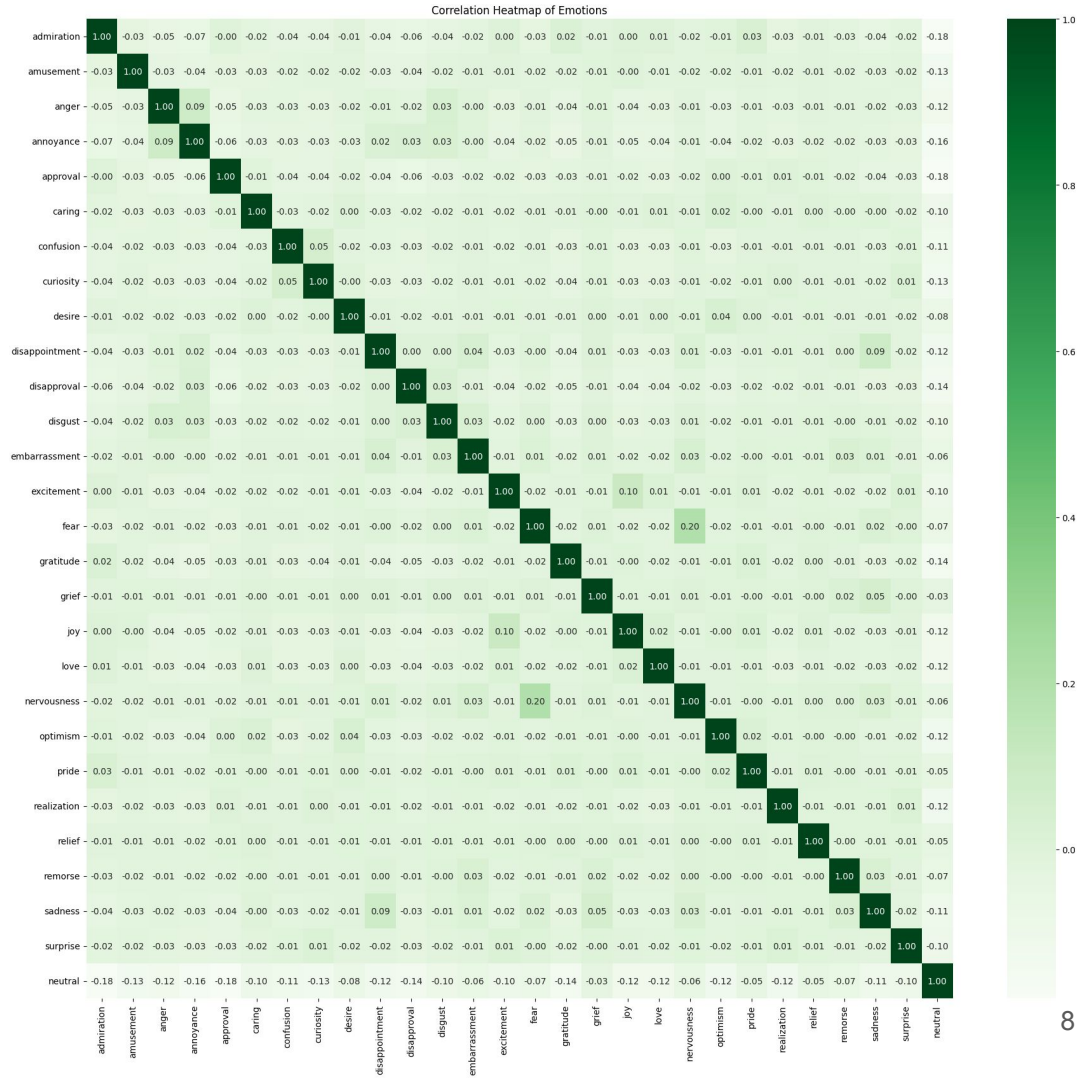
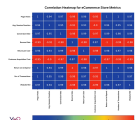


Total number of labels across the dataset.



# EDA Cont.

Correlation Heatmap showcasing every emotions relation with each emotion.

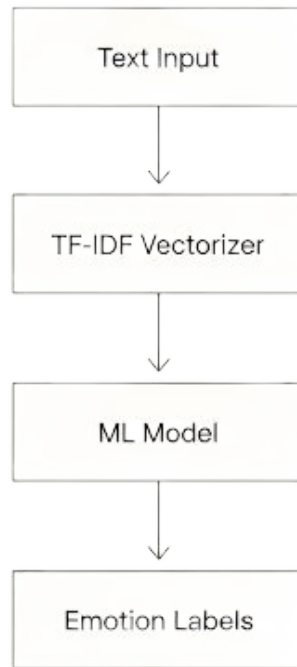




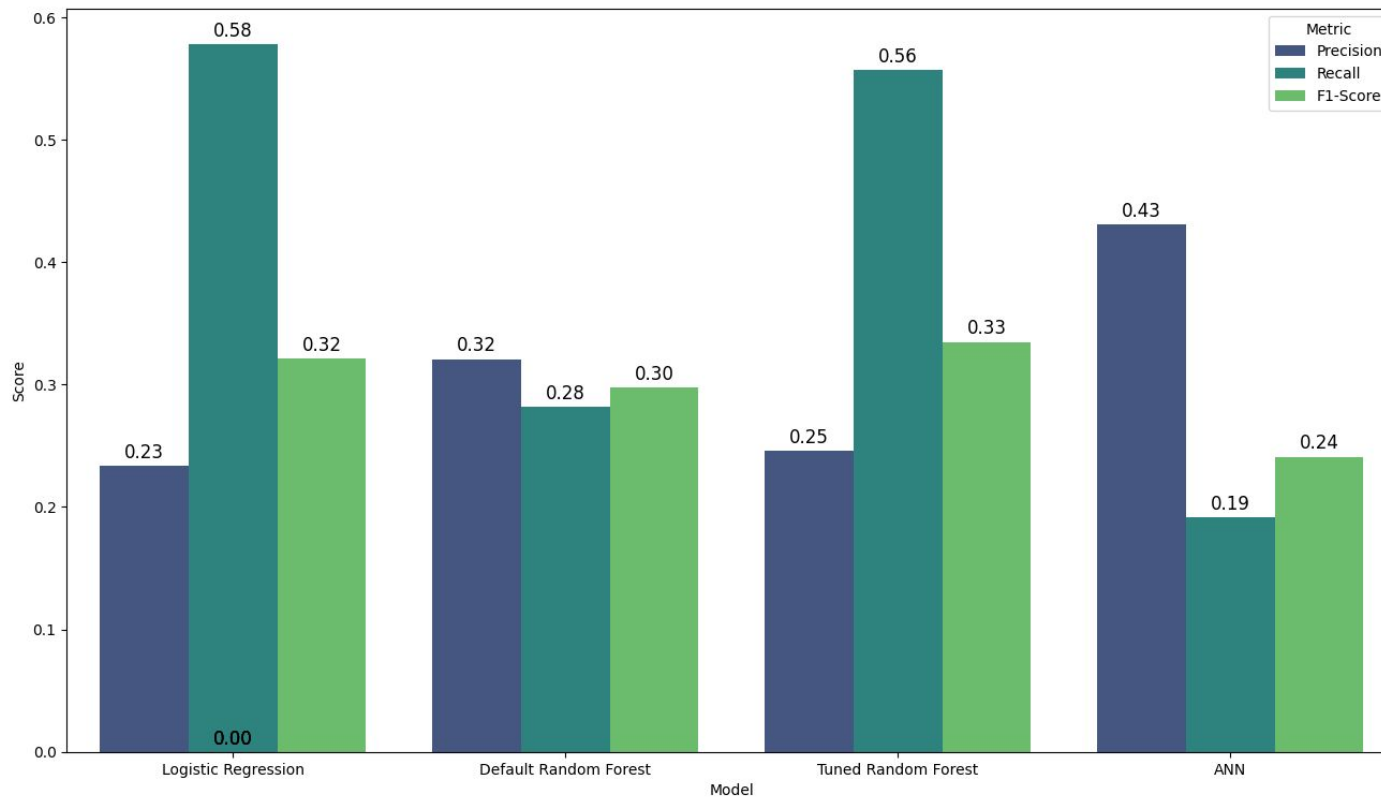


# Approach 1: The Machine Learning Baseline

- **Objective:** "To establish a baseline performance using traditional ML."
- **Method:**
  1. **Feature Extraction:** Converted text to vectors using **TF-IDF**.
  2. **Modeling:** Trained three models:
    - **Logistic Regression**
    - **Random Forest**
    - **ANN**
  3. **"Handling Multi-Label:** Used `MultiOutputClassifier` to enable the models to predict multiple emotions for each text."



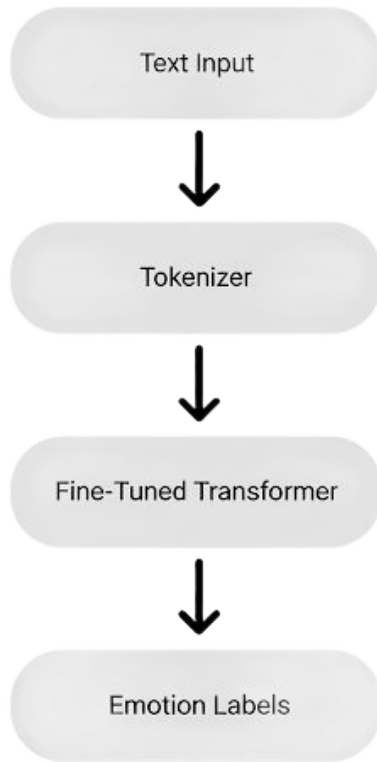
# Results: ML Models





# Approach 2: The Transformer Models

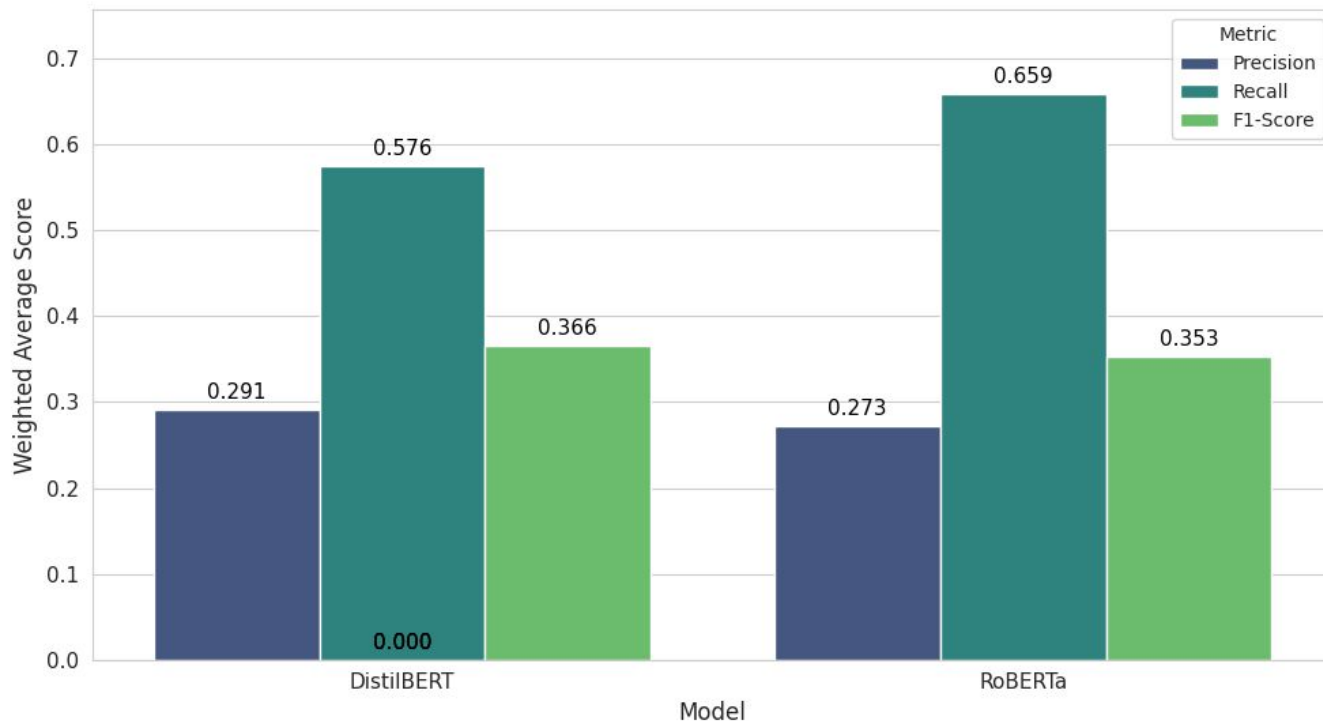
- **Objective:** "To leverage state-of-the-art architectures for improved performance."
- **What are Transformers?**
  - Models pre-trained on vast internet text, giving them a deep understanding of language context and nuance.
- **Our Models:**
  - **DistilBERT:** A smaller, faster, and lighter version of BERT.
  - **RoBERTa:** A more robustly trained version of BERT, often leading to better performance.
- **Process: Fine-Tuning** - We specialized these pre-trained models for our specific emotion detection task.



# Results: Transformers



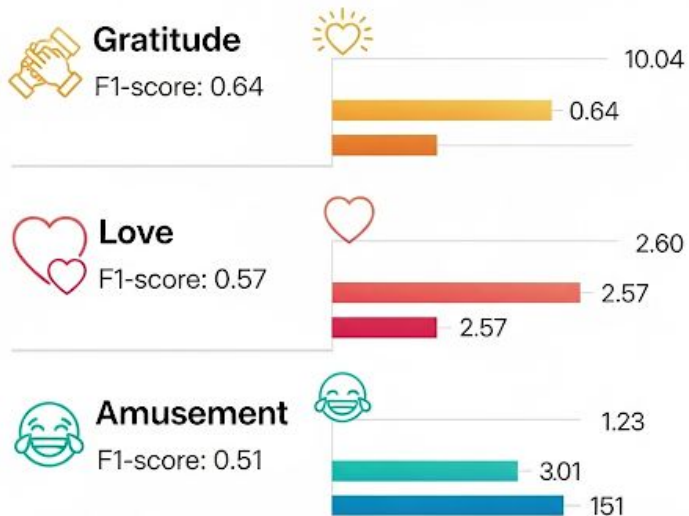
DistilBERT vs. RoBERTa: Model Performance Comparison





# Results: A Deeper Look at RoBERTa's Performance

## Top 3 Highest-Performing Emotions from Text Analysis



## LOWEST PERFORMING EMOTIONS IN TEXT ANALYSIS





## Predicted Emotions

Enter a sentence to analyze: Khulud Ma'am was nice and kind throughout the whole semester.

Analyzing your text: 'Khulud Ma'am was nice and kind throughout the whole semester.'

▶ Predicted Emotions: ['admiration 🥰', 'gratitude 🙏']

Enter a sentence to analyze: Tanjila has been working since morning. I think she will excel today's presentation.

Analyzing your text: 'Tanjila has been working since morning. I think she will excel today's presentation.'

▶ Predicted Emotions: ['admiration 🤩', 'approval 👍', 'neutral 😐']

Enter a sentence to analyze: I think Sufian was being sarcastic that day.

Analyzing your text: 'I think Sufian was being sarcastic that day.'

▶ Predicted Emotions: ['amusement 😂', 'approval 👍', 'realization 💡', 'neutral 😐']

Enter a sentence to analyze: The computer is located on the desk.

Analyzing your text: 'The computer is located on the desk.'

▶ Predicted Emotions: ['approval 👍', 'neutral 😐']



# Conclusion and Future Work

- **Summary of Work:**
  - We successfully benchmarked four models on the challenging GoEmotions dataset.
  - Our results prove the effectiveness of fine-tuning transformer models like RoBERTa for nuanced emotion detection.
- **Key Challenges Identified:**
  - **Class Imbalance** is the single biggest factor limiting performance on rare emotions.
- **Future Directions:**
  - Applying these techniques to **Bengali or code-switched text**.
  - Exploring methods like **data augmentation** to improve results for rare classes.



# Thank You



## Questions?

Scan this for surprise

