Comparative Analysis of LSTM and Transformer Models for Emotion Detection in Text

Objective: Evaluate the effectiveness of LSTM and Transformer models in detecting emotions from textual data to enhance applications in customer feedback, mental health, and market research.

Data Description

Size: Over 839,000 annotated text entries.

Sources: Compiled from publicly available NLP datasets and supplemented by manual annotations for diversity.

Methodology

1. Data Preprocessing:
    - Tokenization: Mapping words to integers for structured model input.
    - Padding: Uniform sequence length for consistent neural network input.
2. Model Architecture:
    - LSTM: Gates-based model addressing vanishing gradients.
    - Transformer: Encoder-decoder with multi-headed self-attention.
3. Training:
    - GPU: RTX 4060.
    - LSTM: 5 epochs, ~12 min each.
    - Transformer: Total 14 min training.

Performance Metrics

Accuracy:

- LSTM: 99.2%
- Transformer: 99.8%

Precision, Recall, F1-Score:

- LSTM: Precision 99.2%, Recall 99.1%, F1 99.15%
- Transformer: Precision 99.8%, Recall 99.75%, F1 99.775%

Quantifiable Results

Data Efficiency: Transformer models outperform LSTMs in accuracy and training speed.

Project Impact

Academic Contribution: Insights into emotion detection capabilities of LSTM and Transformer models.

Commercial Application: Enhanced accuracy for customer interactions and mental health monitoring.

Technical Advancement: Sets benchmarks for future NLP research with large datasets.

Tools and Technologies Used

Python.

TensorFlow for LSTM, PyTorch for Transformer.

NVIDIA RTX 4060 GPU.