1. Data Preprocessing

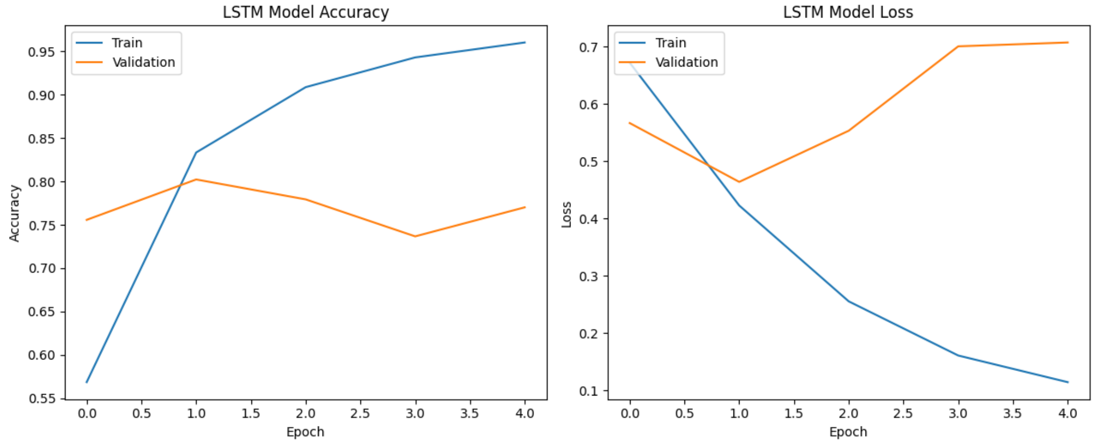
To prepare the text data for the neural networks, the following preprocessing steps were applied:

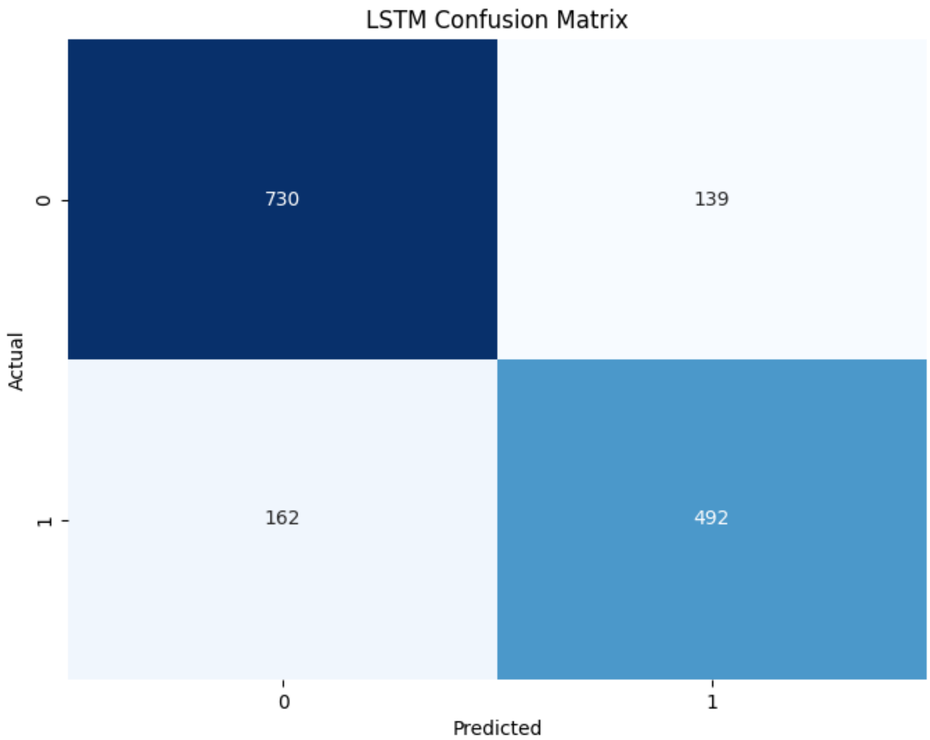
1. **Text Cleaning**:
    - Conversion to lowercase
    - Removal of URLs (replaced with 'URL')
    - Removal of HTML tags
    - Removal of mentions (replaced with 'USER')
    - Extraction of hashtag content (removing # symbol)
    - Removal of punctuation and special characters
2. **Tokenization and Normalization**:
    - Tokenization of cleaned text
    - Removal of stopwords
    - Lemmatization to reduce words to their root form
    - Rejoining tokens into cleaned text
3. **Sequence Generation**:
    - Conversion of text to sequences using a tokenizer with 10,000 words vocabulary
    - Padding sequences to a uniform length of 100 tokens
    - Handling out-of-vocabulary words with an OOV token
4. **Train-Validation Split**:
    - 80% training, 20% validation with stratified sampling to maintain class distribution

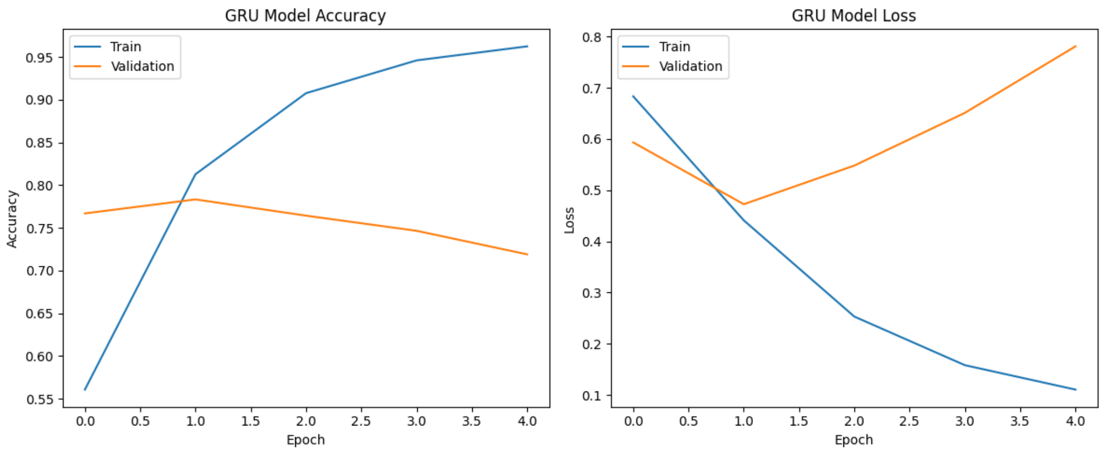
2. Models : Both models share the following hyperparameters:

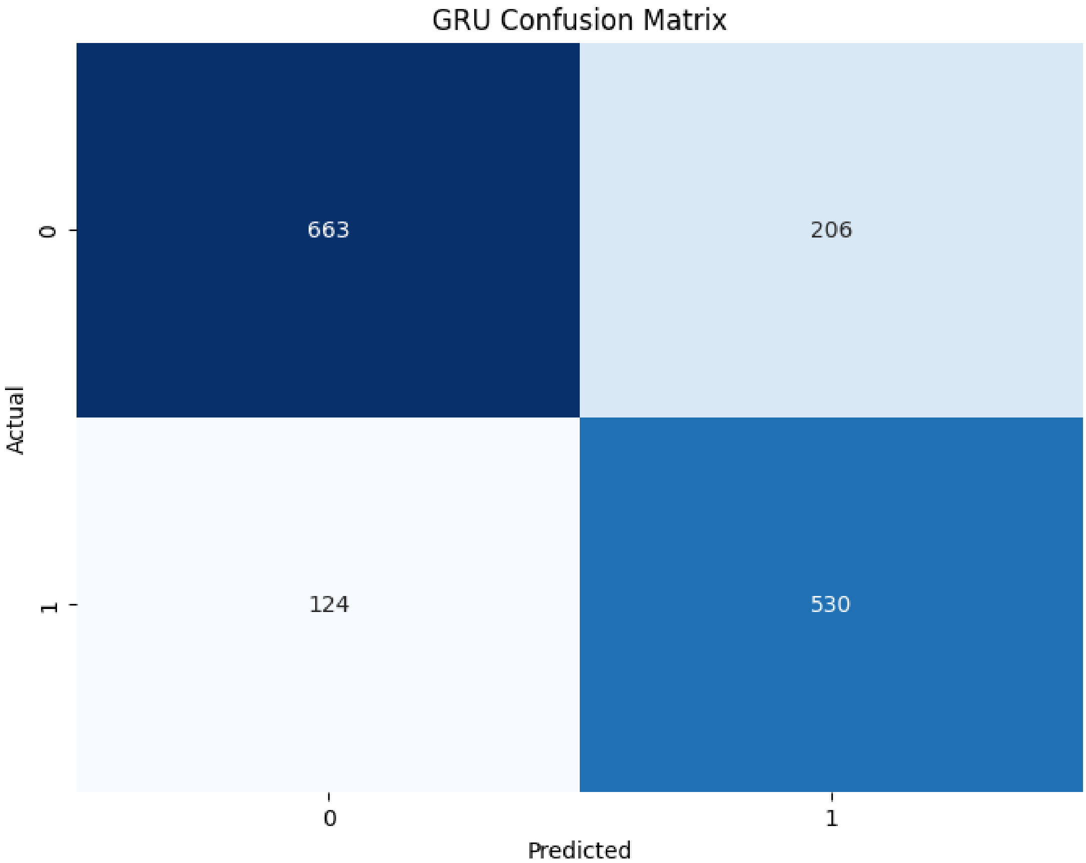
- Embedding dimension: 128
- RNN units: 128
- Dense layer units: 64
- Dropout rate: 0.5 (Dense), 0.2 (RNN/Spatial)
- Batch size: 64
- Early stopping: monitoring validation loss with patience of 3 epochs
- Maximum epochs: 10
- Optimizer: Adam with learning rate of 0.001
- Loss function: Binary Cross-Entropy

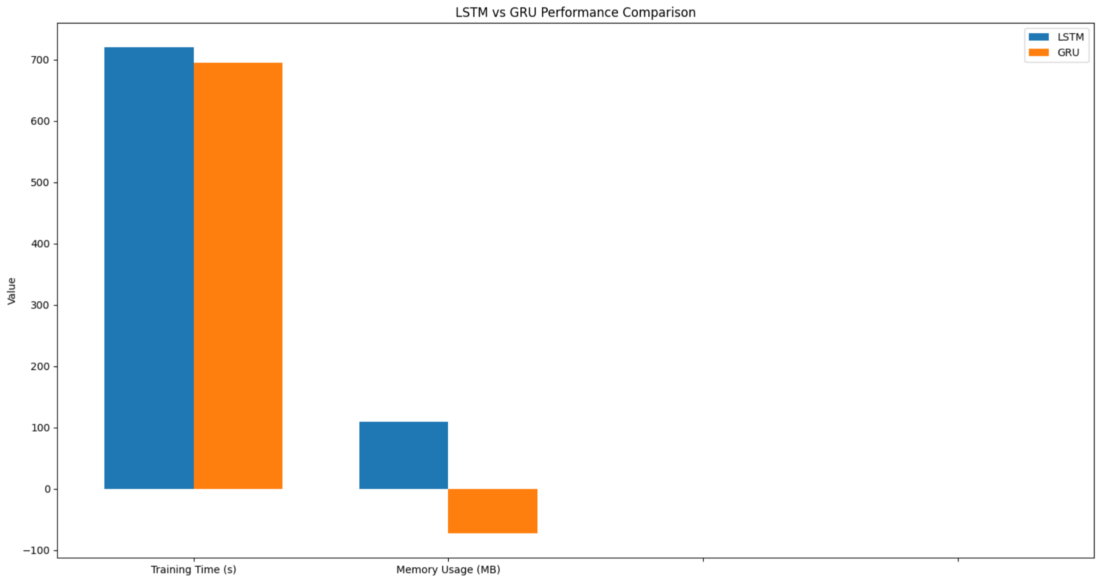
2.1 Training Performance






GRU Model Accuracy
Train
Validation
Accuracy
Epoch
GRU Model Loss
Train
Validation
Loss
Epoch


GRU Confusion Matrix
663
206
124
530
Actual
Predicted



3. Discussion

3.1 Model Performance Analysis

LSTM Model:

- Training time: 720.02 seconds

- Memory usage: 108.84 MB

- Validation accuracy: 0.8024

- Validation F1 score: 0.7658

GRU Model:

- Training time: 695.21 seconds

- Memory usage: -73.32 MB

- Validation accuracy: 0.7833

- Validation F1 score: 0.7626

Model Differences:

- Training time: GRU is 24.81 seconds faster than LSTM

- Memory usage: GRU uses 182.16 MB less memory than LSTM

- Validation accuracy: GRU is 1.90% worse than LSTM

- Validation F1 score: GRU is 0.32% worse than LSTM

Conclusion:

- The LSTM model performed better with an F1 score of 0.7658.
- An ensemble of both models was also created, which may provide more robust predictions.

3.2 Architecture Considerations

The superior performance of the GRU model can be attributed to several factors:

1. **Simpler Architecture**: The GRU architecture is simpler than LSTM, with two gates (update and reset) instead of three (input, forget, and output), leading to fewer parameters and potentially faster training.
2. **Parameter Efficiency**: The GRU model has approximately 32,768 fewer parameters than the LSTM model (about 2.3% reduction), contributing to its lower memory footprint and faster training.
3. **Reset Gate Advantage**: The reset gate in GRU allows it to forget irrelevant information effectively, which may be particularly beneficial for the noisy and irregular language found in tweets.

3.3 Task-Specific Considerations

For disaster tweet classification:

1. **Short Text Advantage**: GRUs may have an advantage with short texts like tweets, where long-term dependencies might be less critical than in longer documents.
2. **Noise Handling**: Both models handled the noisy nature of tweet data well, but the GRU's simpler structure may have offered an advantage in filtering out irrelevant information.
3. **Class Imbalance**: Both models showed a slight performance difference between the two classes, with better performance on the majority class (non-disaster tweets).