

# CS683: Assignment 1

## Sentiment Polarity Classification

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# Data Preparation

- Dataset: Used Cornell movie review dataset (rt-polaritydata) containing positive and negative reviews.
- File Reading & Labeling:
  - Read reviews from files using latin-1 encoding.
  - Assigned labels: Positive reviews (1), Negative reviews (0).
- Data Splitting:
  - Training Set: First 4,000 positive and 4,000 negative reviews.
  - Validation Set: Next 500 positive and 500 negative reviews.
  - Test Set: Remaining 831 positive and 831 negative reviews.
- TF-IDF Vectorization:
  - Converted reviews to numerical format using TF-IDF with 7,000 features.
  - Converted sparse matrices to dense format for model input.

# Vectorization and Transformation

- TF-IDF Vectorization:
  - Purpose: Convert text data into a numerical format for input to a neural network.
  - Method: Applied TF-IDF vectorization to convert reviews into numerical features.
  - Features Extracted: Limited to the top 7,000 most important words from the dataset.
- Dense Transformation:
  - Converted the sparse TF-IDF matrix into a dense matrix.
  - Ensured compatibility with the Keras model for training.

# Model Architecture

- Input Layer:
  - Accepts TF-IDF features of shape (7,000,).
- Hidden Layers:
  - First Dense Layer: 256 neurons with ReLU activation, L2 regularization, followed by Batch Normalization and Dropout (0.4).
  - Second Dense Layer: 128 neurons with ReLU activation, L2 regularization, followed by Batch Normalization and Dropout (0.4).
- Output Layer:
  - A single neuron with a sigmoid activation function for binary classification.
- Compilation:
  - Optimizer: Adam.
  - Loss Function: Binary Cross-Entropy.
  - Metrics: Accuracy.
- Regularization and Callbacks:
  - L2 Regularization: Helps reduce overfitting.
  - Early Stopping and Learning Rate Reduction: To stop training when validation loss stops improving and adapt the learning rate.

# Training and Testing

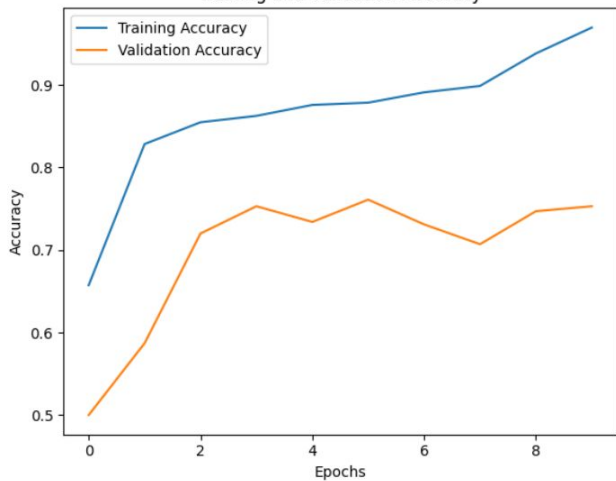
- Training:
  - Trained on 8,000 reviews (4,000 positive and 4,000 negative) for 10 epochs.
  - Batch size of 32 used for efficient mini-batch gradient descent.
  - Validation Set: Evaluated on 1,000 reviews (500 positive, 500 negative) during training.
  - Early stopping and learning rate reduction techniques were applied to prevent overfitting.
- Testing:
  - Evaluated on a separate test set consisting of 1,662 reviews (831 positive and 831 negative).
  - Model performance assessed using precision, recall, F1-score, and a confusion matrix for detailed evaluation.

# Evaluation Metrics

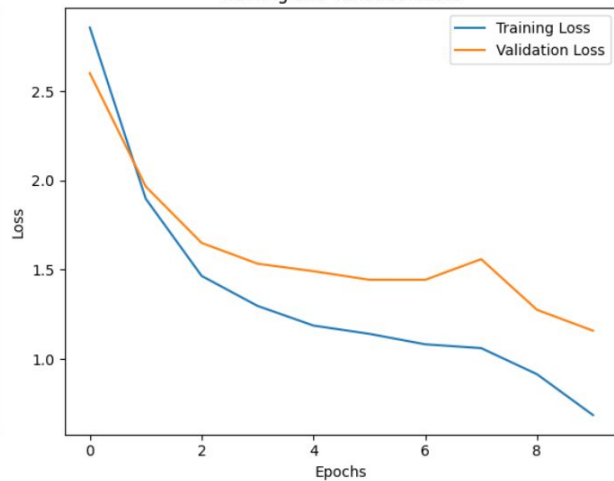
- Test Set Evaluation:
  - Confusion Matrix:
    - True Positives (TP): 617
    - True Negatives (TN): 637
    - False Positives (FP): 194
    - False Negatives (FN): 214
- Performance Metrics:
  - Precision: 76.079%
  - Recall: 74.248%
  - F1-score: 75.152%

# Graphs

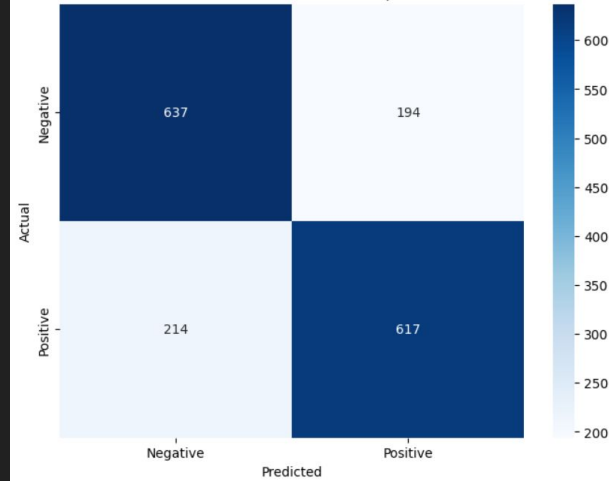
Training and Validation Accuracy



Training and Validation Loss



Confusion Matrix Heatmap



# Submission Links

- Link to Google Colab:
  - [https://colab.research.google.com/drive/11a7HmgiGs-ifIX1yHs1Bf856a0CCSrL\\_?usp=sharing](https://colab.research.google.com/drive/11a7HmgiGs-ifIX1yHs1Bf856a0CCSrL_?usp=sharing)
- Link to Github Repository:
  - [https://github.com/hrajput0322/CS683\\_NLP\\_2101081](https://github.com/hrajput0322/CS683_NLP_2101081)