P15: Sentiment Classification of IMDb Movie Reviews

CS485 – Project Presentation

Zervos Spiridon Chrisovalantis (csd4878)
Drakakis Rafail (csd5310)

University of Crete

Project Objectives

- Build a sentiment classification pipeline for IMDb reviews
- Apply classical and deep learning models
- Evaluate performance: accuracy, speed, and confusion matrices
- Analyze model behavior and limitations

Dataset Overview

- **Name:** IMDb Large Movie Review Dataset
- **Size:** 25k train / 25k test reviews
- **Labels:** Binary – Positive (1), Negative (0)
- **Source:**
  `https://ai.stanford.edu/~amaas/data/sentiment/`

Text Preprocessing

- Lowercasing, tokenization using NLTK
- Removing punctuation, numbers, stopwords
- For deep learning:
  - Vocabulary built (min frequency $= 2$, max size $= 20{,}000$)
  - Sequences padded/truncated to 200 tokens

Feature Engineering

- **Classical ML:** TF–IDF vectorization (unigrams, top 5,000 features)
- **Deep Learning:** Trainable embeddings (dimension $= 100$)

Classical Model Configurations

- **Logistic Regression:** L2 regularization, $C = 1.0$
- **Naïve Bayes:** Multinomial, $\alpha = 1.0$
- **Linear SVM:** $C = 1.0$

Deep Learning Architectures

LSTM:

- Single layer, 128 hidden units
- Uses final hidden state

CNN:

- Filters: sizes [3, 4, 5], 100 each
- Max pooling and FC layer

Training Setup

- Optimizer: Adam, learning rate $= 1e^{-3}$
- Epochs: 5, Batch size: 64
- Implemented in PyTorch
- Inference script: `predict.py` (Can be used to predict new reviews)

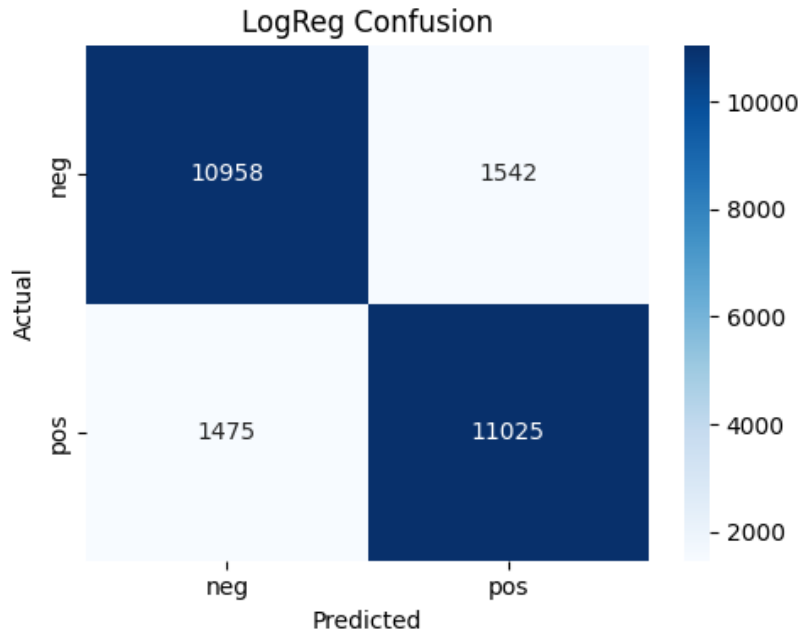
Classical Model Results

Model	Accuracy	Time (ms/sample)
Logistic Regression	0.880	0.47
Naïve Bayes	0.840	0.13
Linear SVM	0.863	0.65

TF–IDF features, evaluated on 25k test samples

Logistic Regression Report

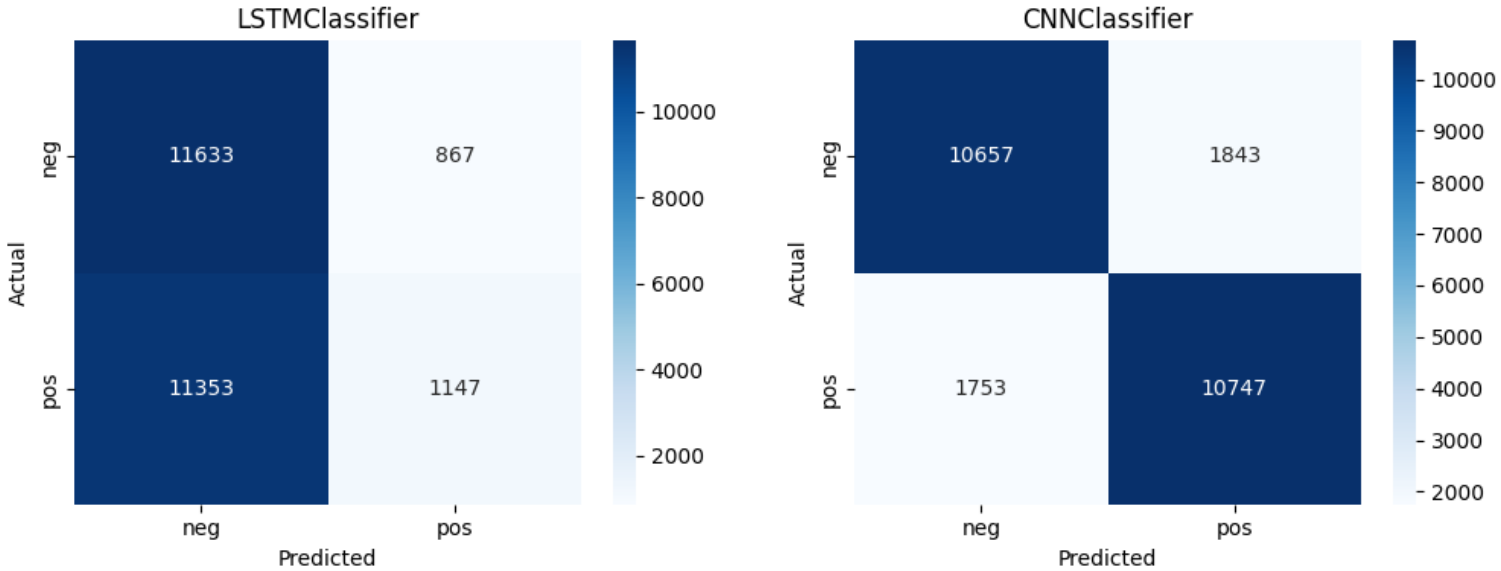
- Precision, Recall, F1-score: 0.88 for both classes
- Balanced performance across sentiment labels
- Fast inference: 0.47 ms/sample



Confusion Matrix: Logistic Regression

Deep Learning Results

Model	Accuracy	Notes
LSTM	0.511	Underfitting, unstable learning
CNN	0.856	Competitive, robust features



Confusion Matrices: LSTM (left), CNN (right)

Model Comparison

- **Best Accuracy:** Logistic Regression (0.88)
- **Best DL Model:** CNN (0.856)
- **Fastest Inference:** Naïve Bayes (0.13 ms/sample)
- **Underperformer:** LSTM (0.511), due to lack of tuning and pretraining

Error Analysis

- **LSTM:** Poor generalization without pretrained embeddings
- **CNN:** Stronger with local patterns (n-grams)
- **All Models:**
  - Misclassify short or sarcastic reviews
  - Struggle with implicit sentiment

Conclusion

- Classical methods remain strong
- CNNs show promise with competitive accuracy
- LSTM requires optimization: embeddings, attention, deeper networks

Questions?