

# **Logistic Regression Comprehensive Demo Report**

*Binary classification via the sigmoid function.  
Transforms linear output into probabilities using sigmoid activation,  
then applies binary cross-entropy loss for training.*

*This is the building block for neural network output layers.*

Random Seed: 42

Generated with NumPy-only implementation

# Summary of Results

## Example 1: 2D Classification

- Training accuracy: 94.00%
- Successfully visualized decision boundary

## Example 2: Convergence Analysis

- Initial loss: 0.693147
- Final loss: 0.248877
- Iterations: 500

## Example 3: Learning Rate Comparison

- LR=0.01: Final accuracy 85.50%
- LR=0.1: Final accuracy 92.00%
- LR=0.5: Final accuracy 93.50%
- LR=1.0: Final accuracy 93.50%

## Example 4: Sklearn Comparison

- Our test accuracy: 80.00%
- Sklearn test accuracy: 80.00%
- Mean probability difference: 0.006120

## Example 5: Breast Cancer Dataset

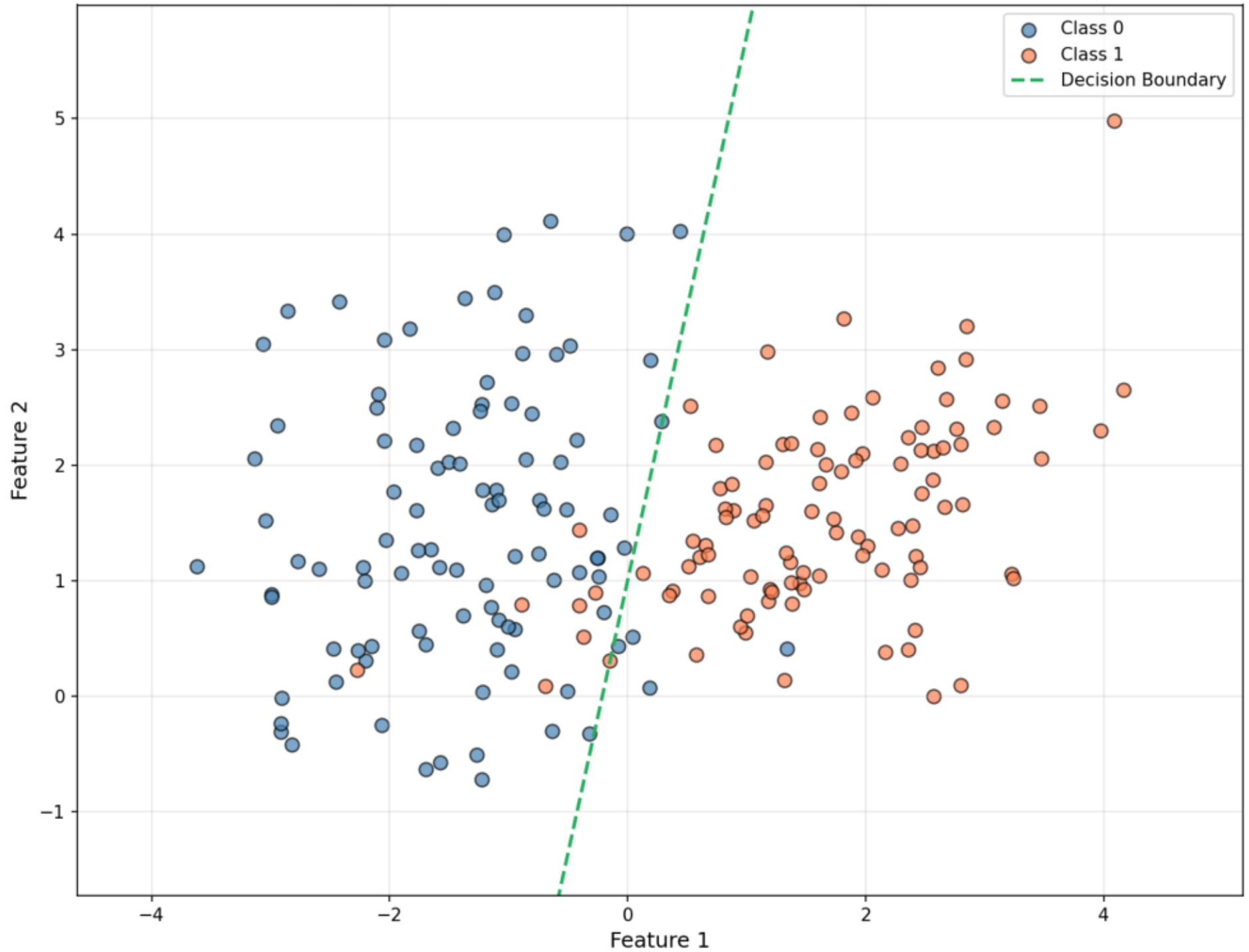
- Training accuracy: 98.99%
- Test accuracy: 98.25%
- Converged in 2000 iterations

## Example 6: Probability Calibration

- Learned weight: 0.7943 (true: 1.0)
- Learned bias: 0.1431 (true: 0.0)

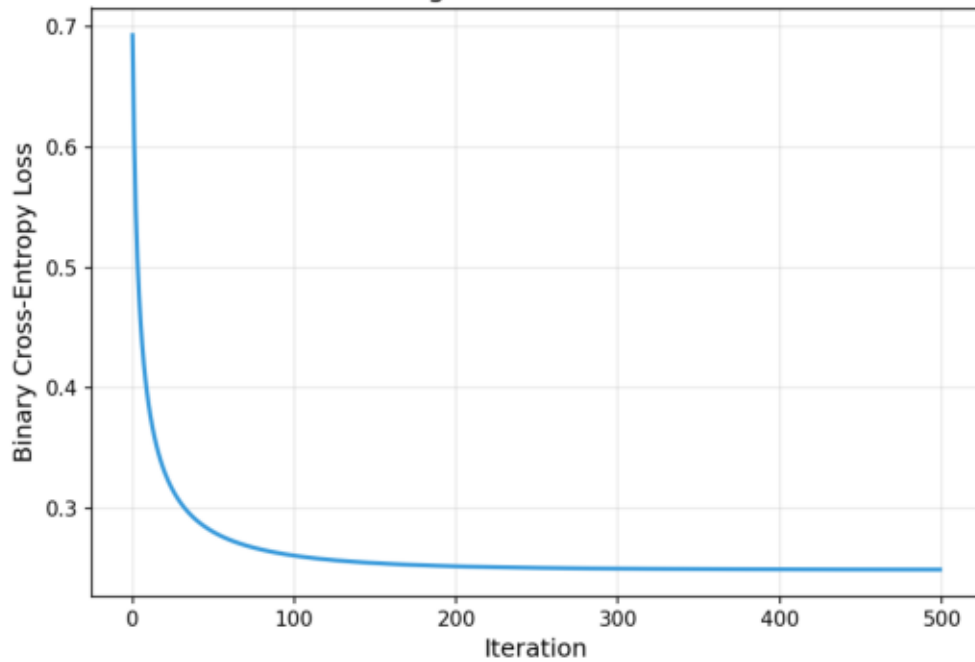
## 01 2D Classification

Logistic Regression: 2D Classification (Accuracy: 94.00%)

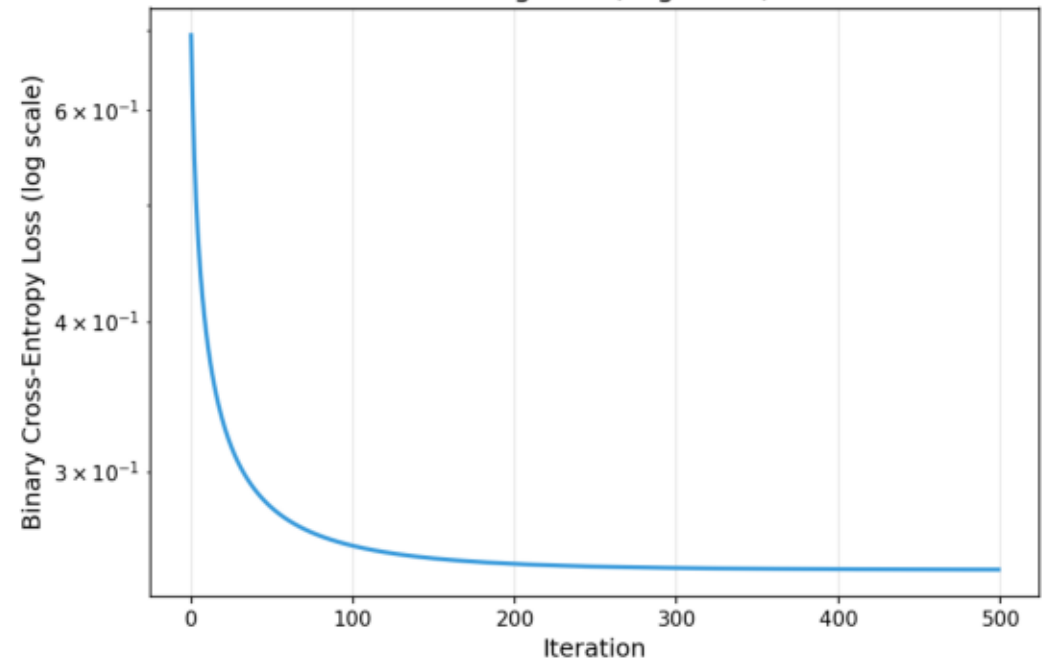


## 02 Convergence

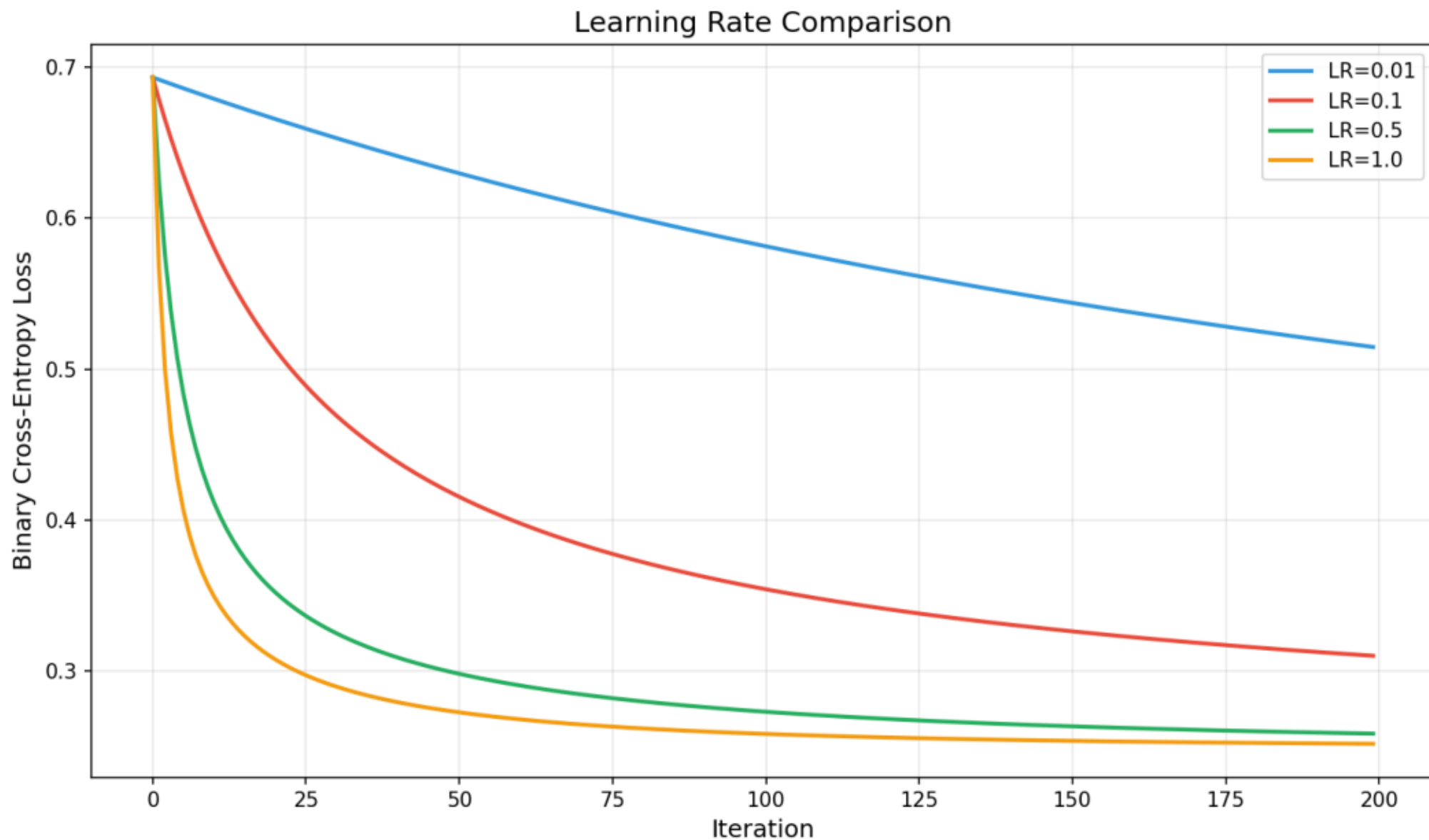
Training Loss Over Iterations



Training Loss (Log Scale)

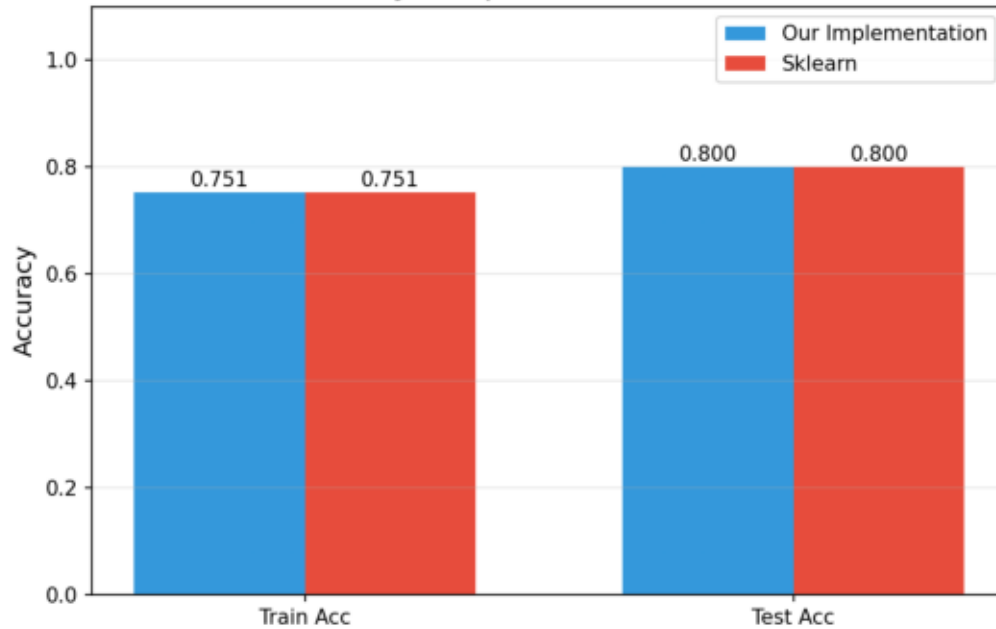


### 03 Learning Rate Comparison

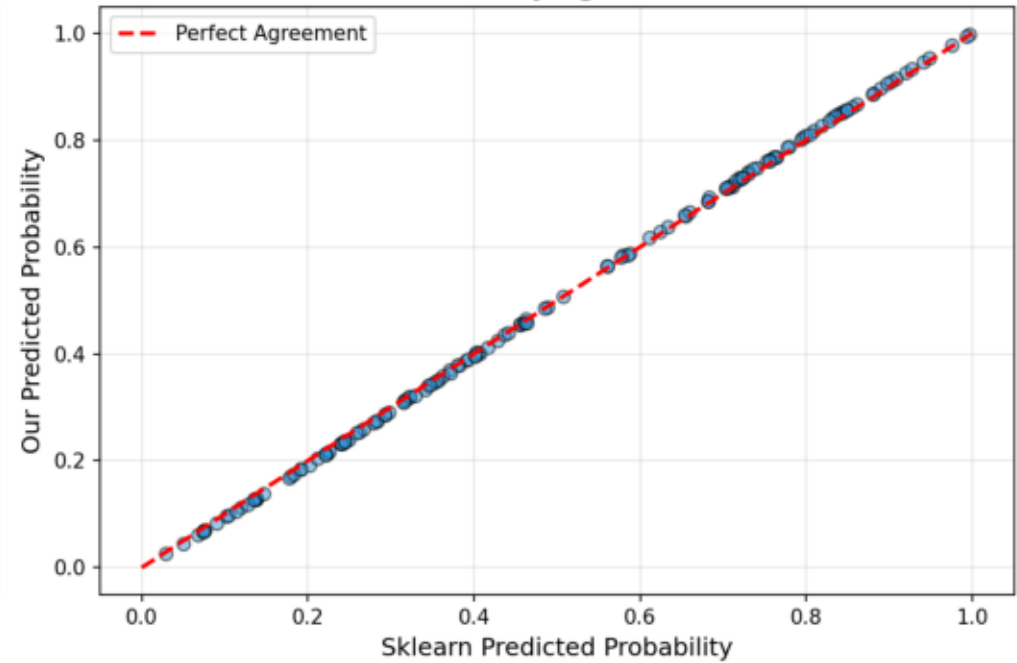


## 04 Sklearn Comparison

Accuracy Comparison: Our vs Sklearn

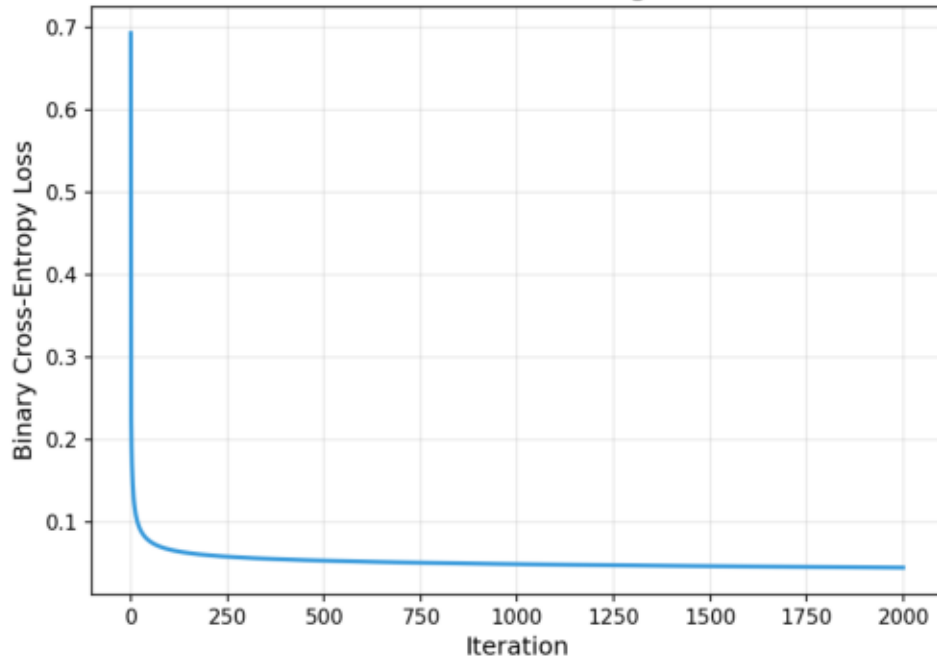


Probability Agreement

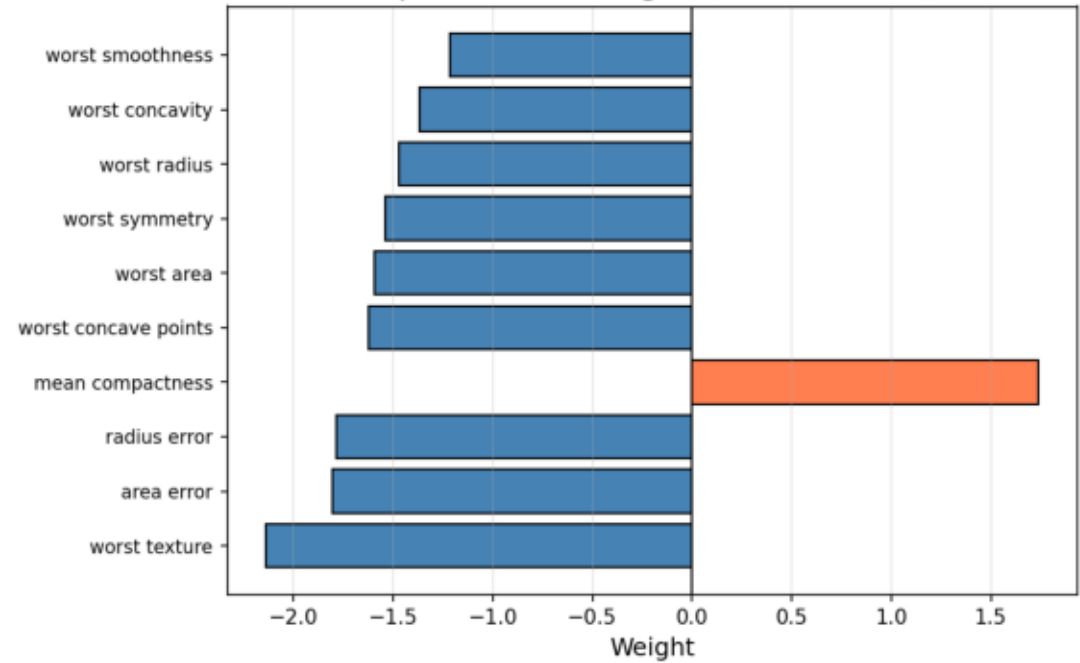


## 05 Breast Cancer

Breast Cancer: Training Loss

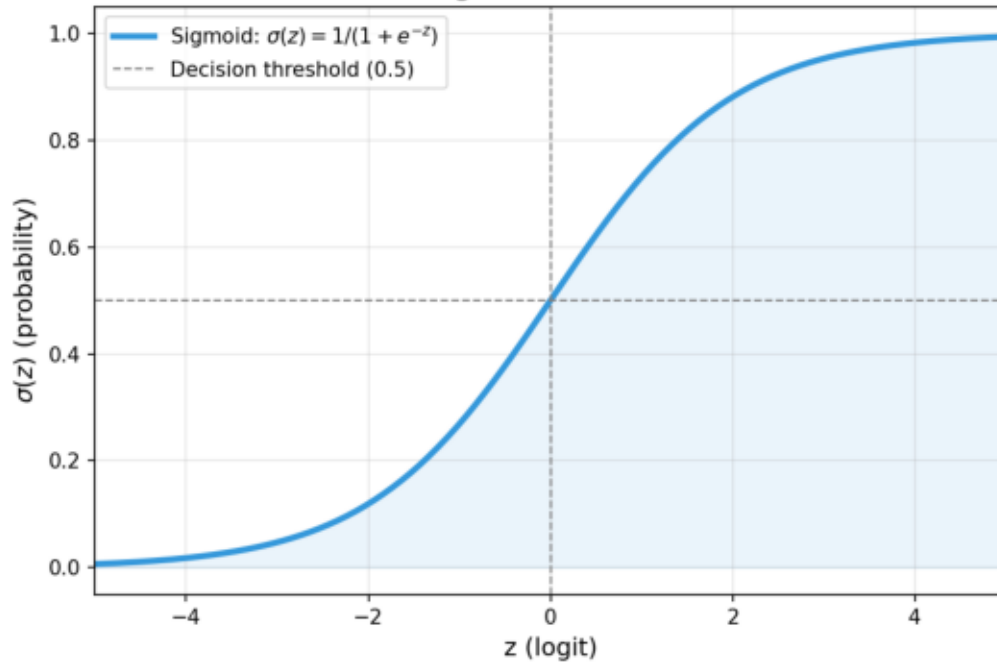


Top 10 Feature Weights (Breast Cancer)



## 06 Probability Calibration

Sigmoid Function



Probability Calibration: Data Points + Sigmoid Fit

