Softmax Regression Comprehensive Demo Report

Multiclass classification with softmax function

Topics Covered:
- Decision boundary visualization
- Training convergence analysis
- Softmax function properties
- Temperature scaling effects
- Sklearn comparison and validation
- Real-world dataset (Iris)

SEED = 42 for reproducibility

Summary of Results

1. 3-Class Decision Boundaries
   - Training Accuracy: 100.00%
   - Final Loss: 0.004791

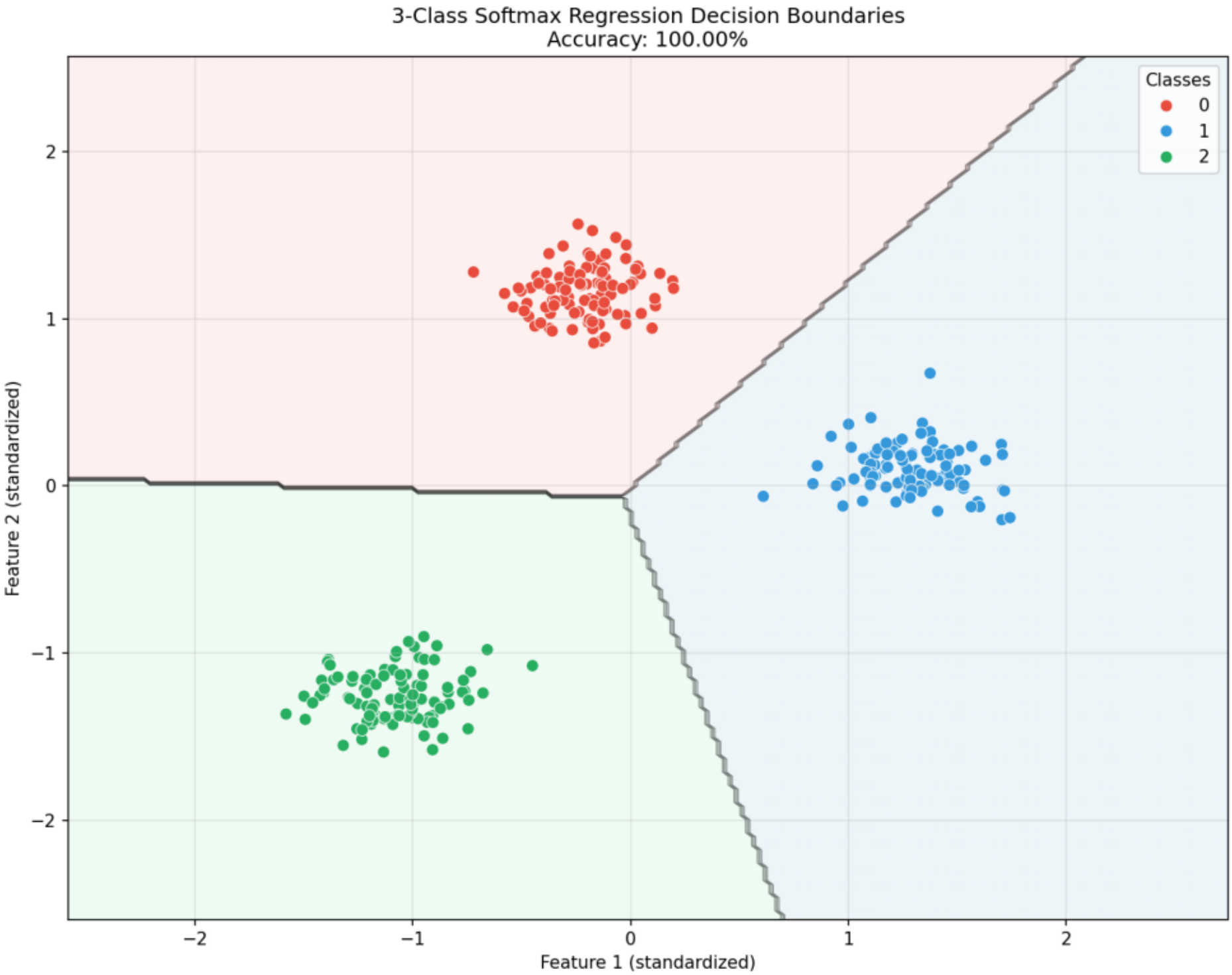
2. Convergence Analysis
   - LR=0.01: Final Loss = 0.217224
   - LR=0.1: Final Loss = 0.024547
   - LR=0.5: Final Loss = 0.005564
   - LR=1.0: Final Loss = 0.002970

3. Temperature Scaling
   - Temperatures tested: [0.5, 1.0, 2.0, 5.0]
   - Lower T -> sharper distribution
   - Higher T -> softer distribution

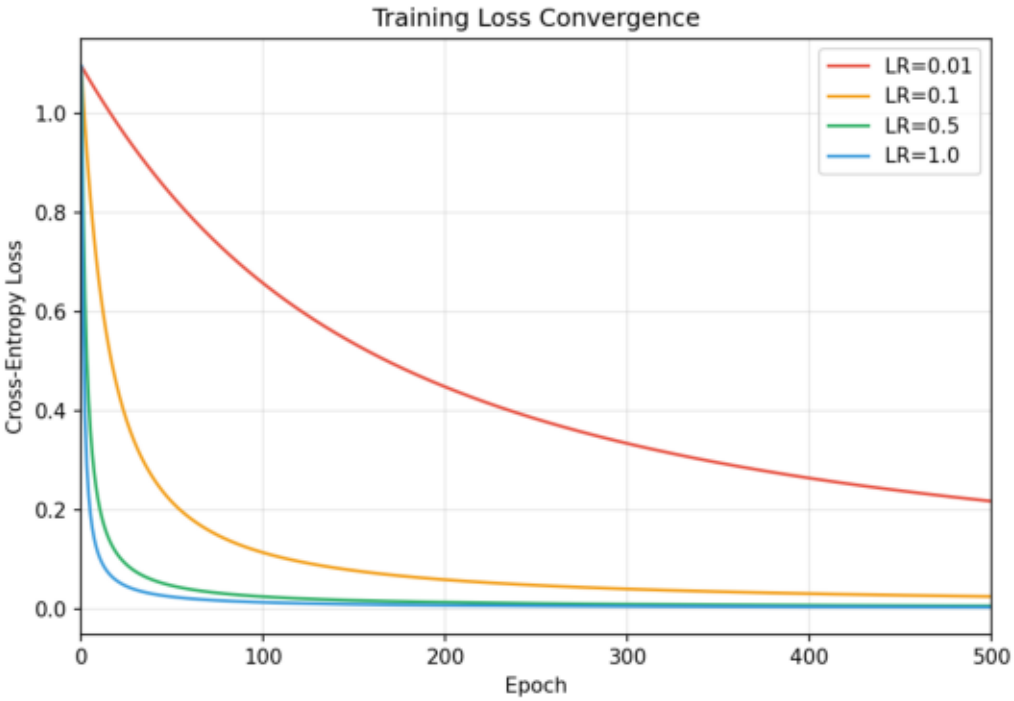
4. Sklearn Comparison
   - Our Test Accuracy: 1.0000
   - Sklearn Test Accuracy: 1.0000
   - Mean Probability Difference: 0.009506

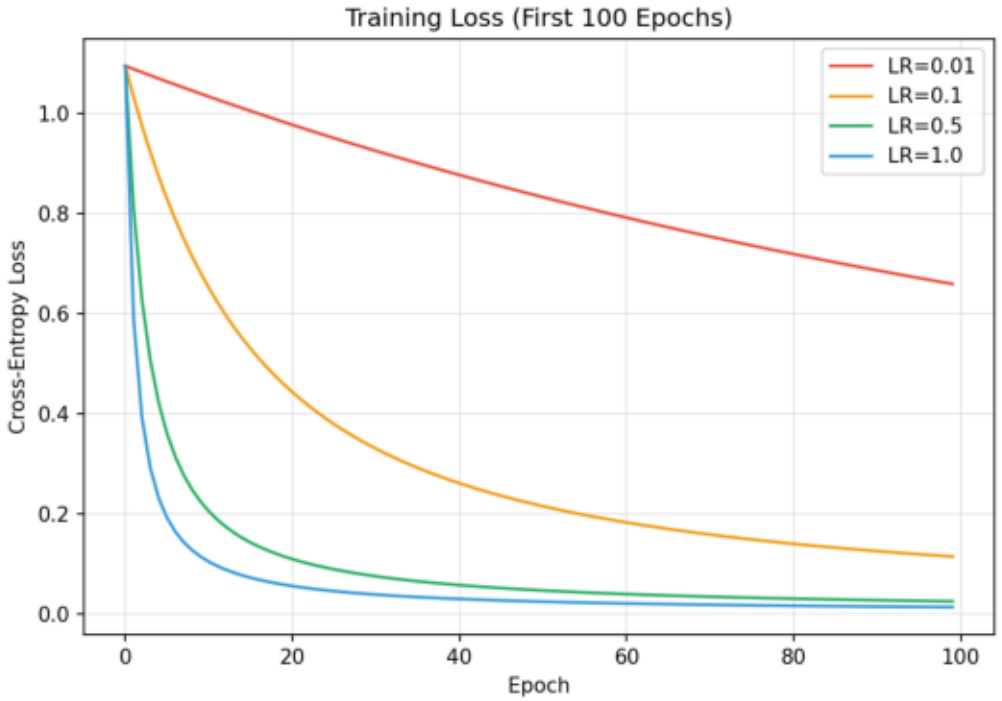
5. Iris Dataset
   - Train Accuracy: 0.9810
   - Test Accuracy: 0.9111

3-Class Decision Boundaries

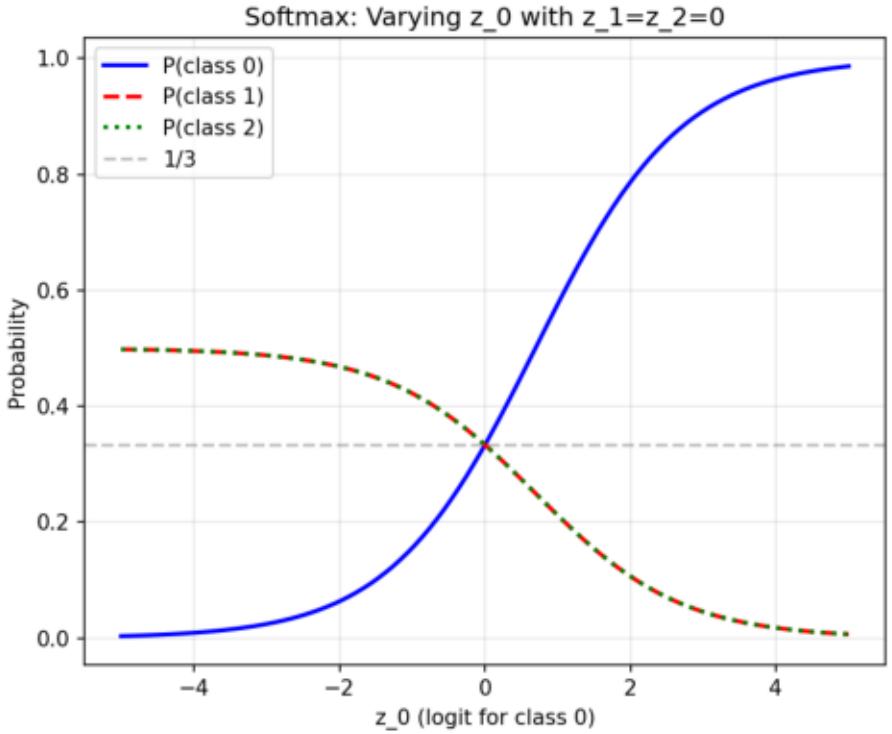


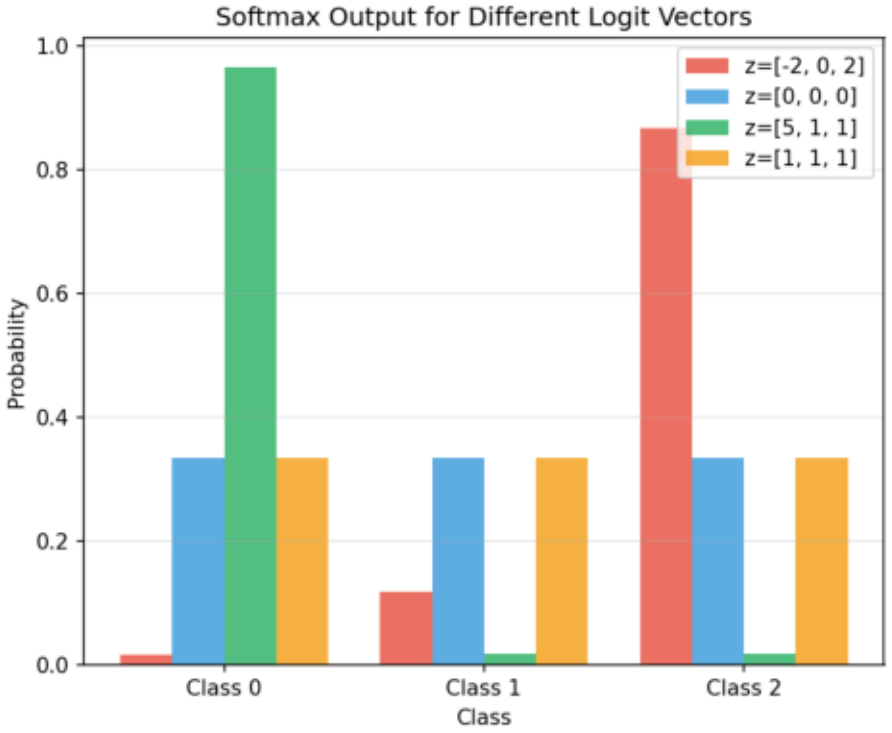
Training Convergence

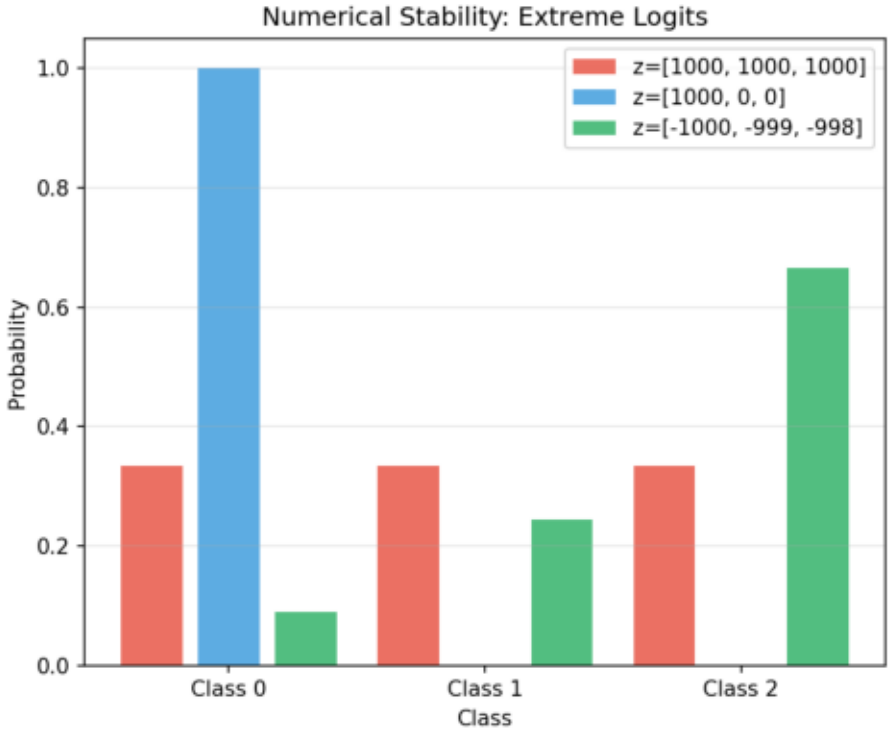


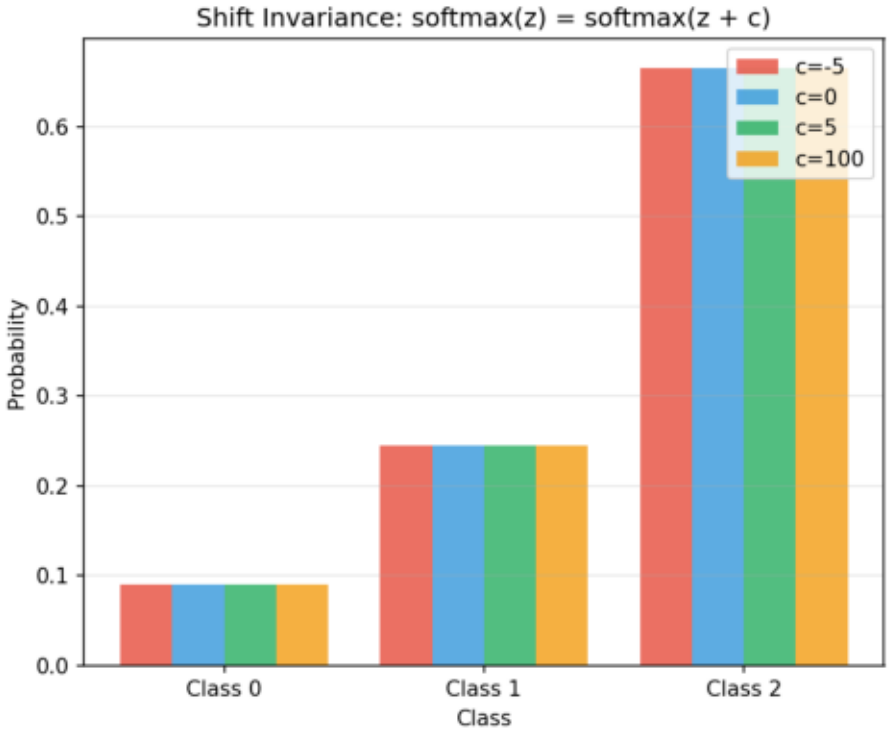


Softmax Function Visualization

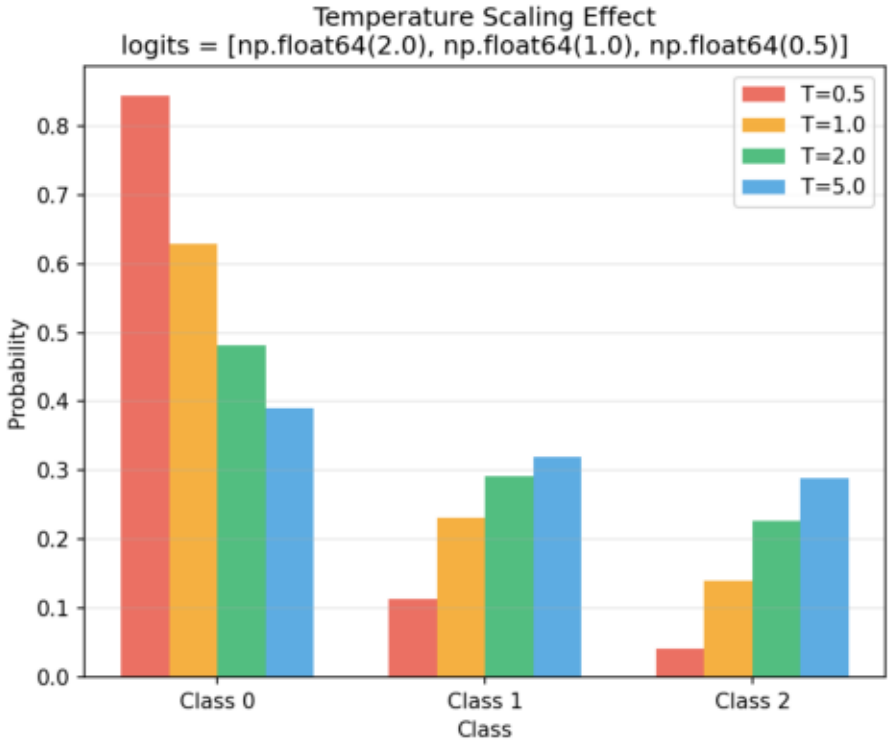


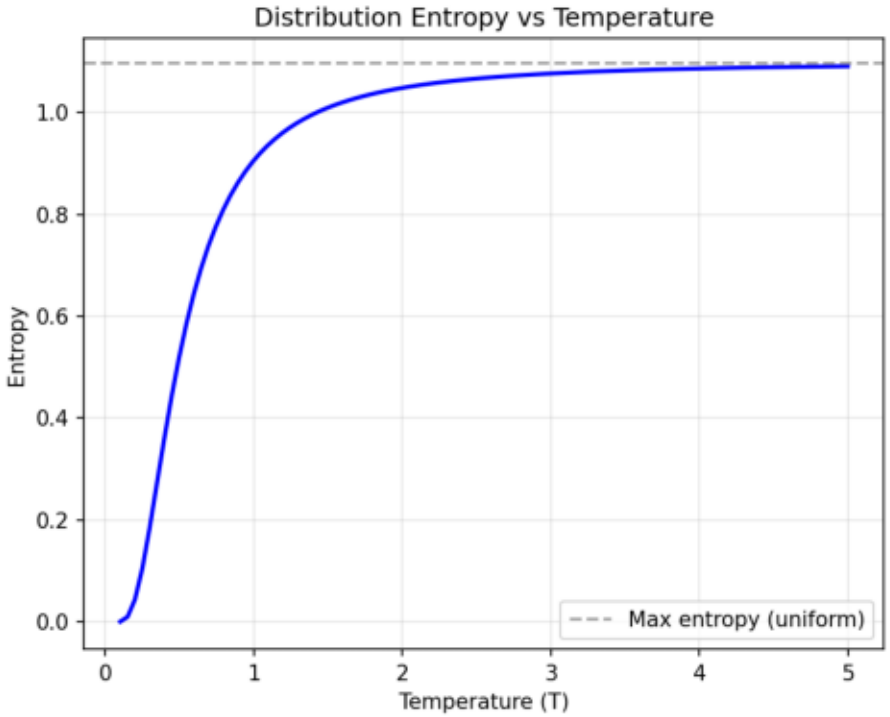


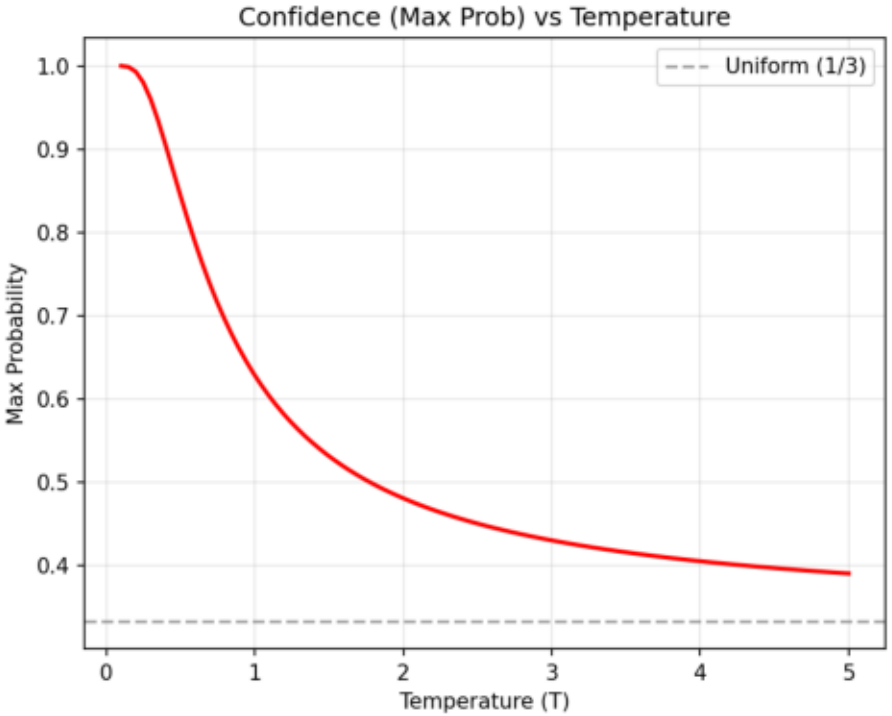


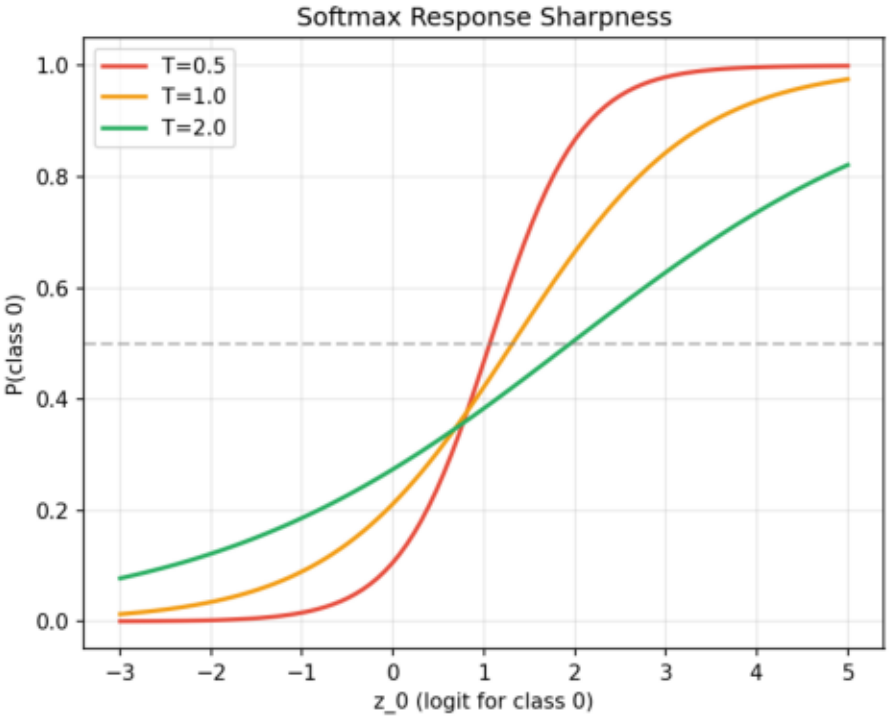


Temperature Scaling

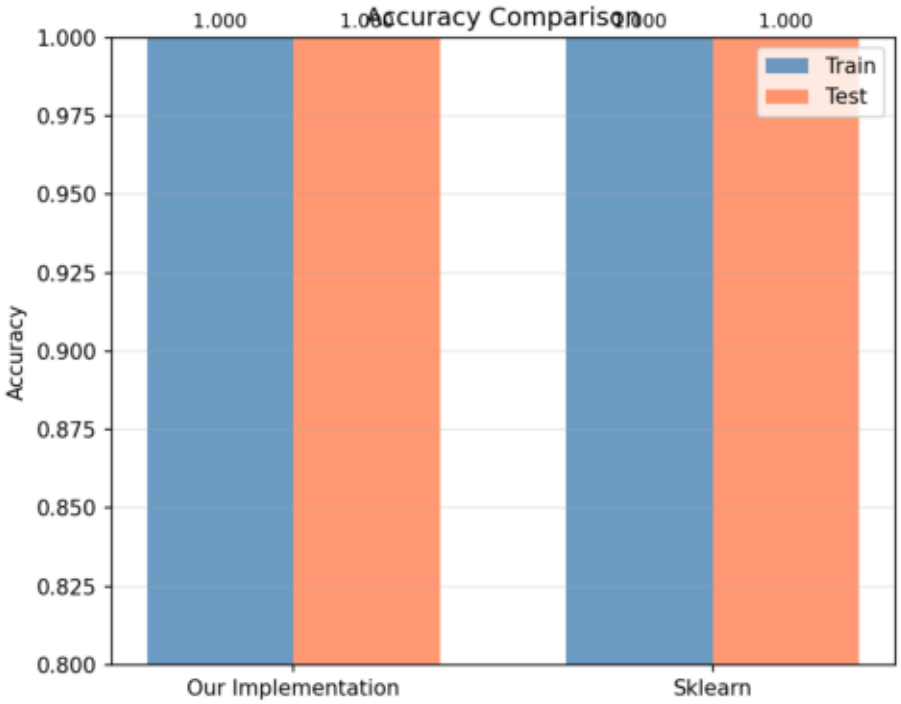


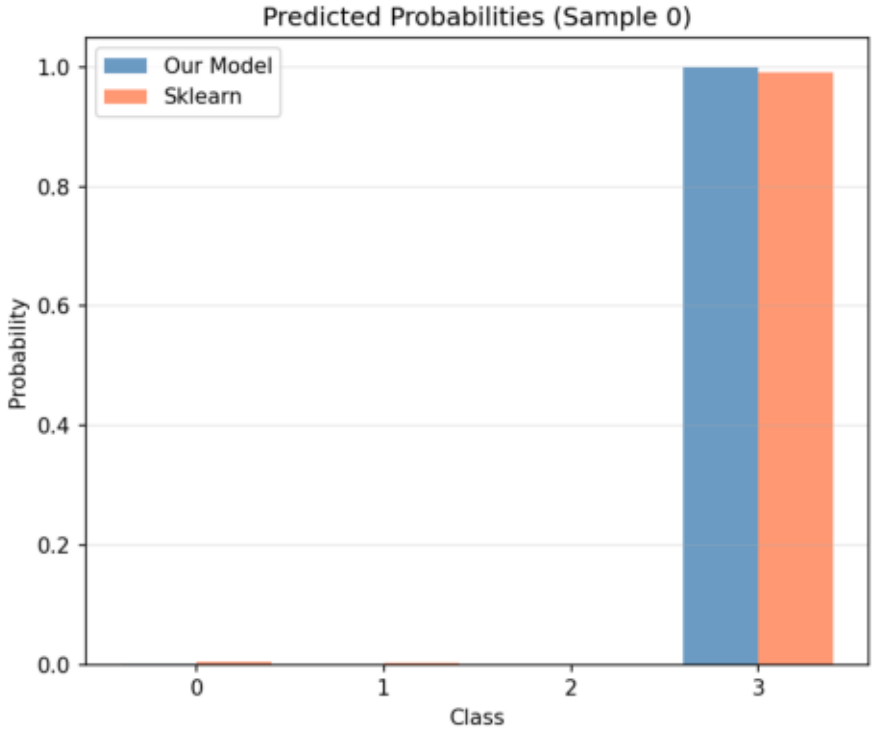


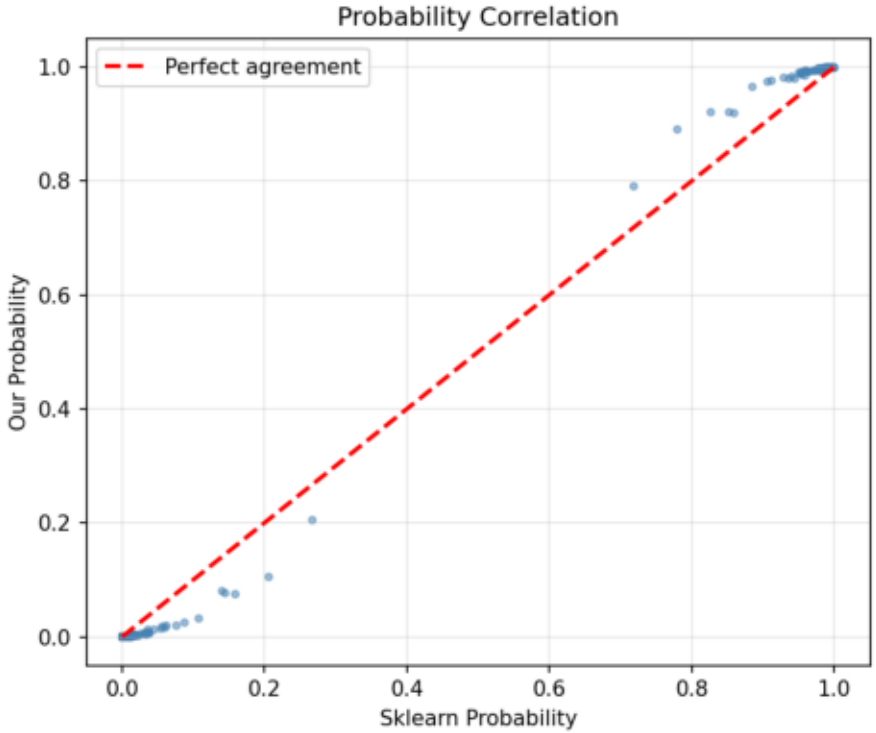


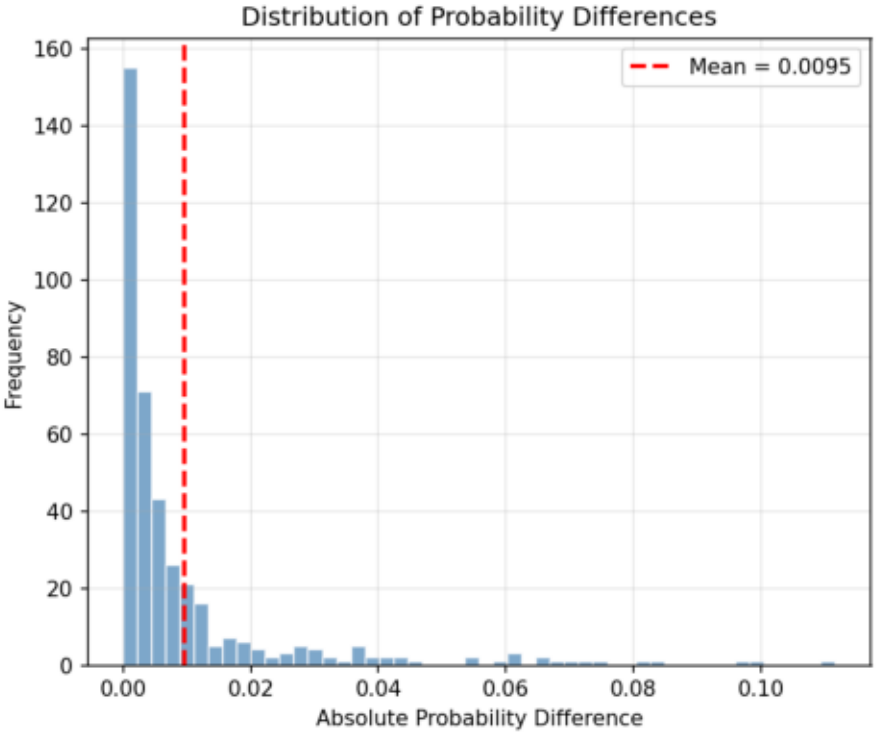


Sklearn Comparison









Iris Dataset