Regularization

L1 (Lasso), L2 (Ridge), Elastic Net & Weight Decay

Comprehensive Demo with Sklearn Comparison

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Seed: 42
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From-scratch NumPy implementation
Phase 1: Foundations

Summary of Results

Example 1: Overfitting Demonstration

- No regularization MSE: 0.0193
- Ridge (L2=0.1) MSE: 0.0715
- Lasso (L1=0.05) MSE: 0.0790

Example 2: L1 vs L2 Weight Sparsity

- Ridge near-zero weights: 1/50
- Lasso near-zero weights: 28/50

Example 3: Lambda Sweep

- Best Ridge lambda: 0.0051 (val MSE: 237.09)
- Best Lasso lambda: 0.6210 (val MSE: 221.23)

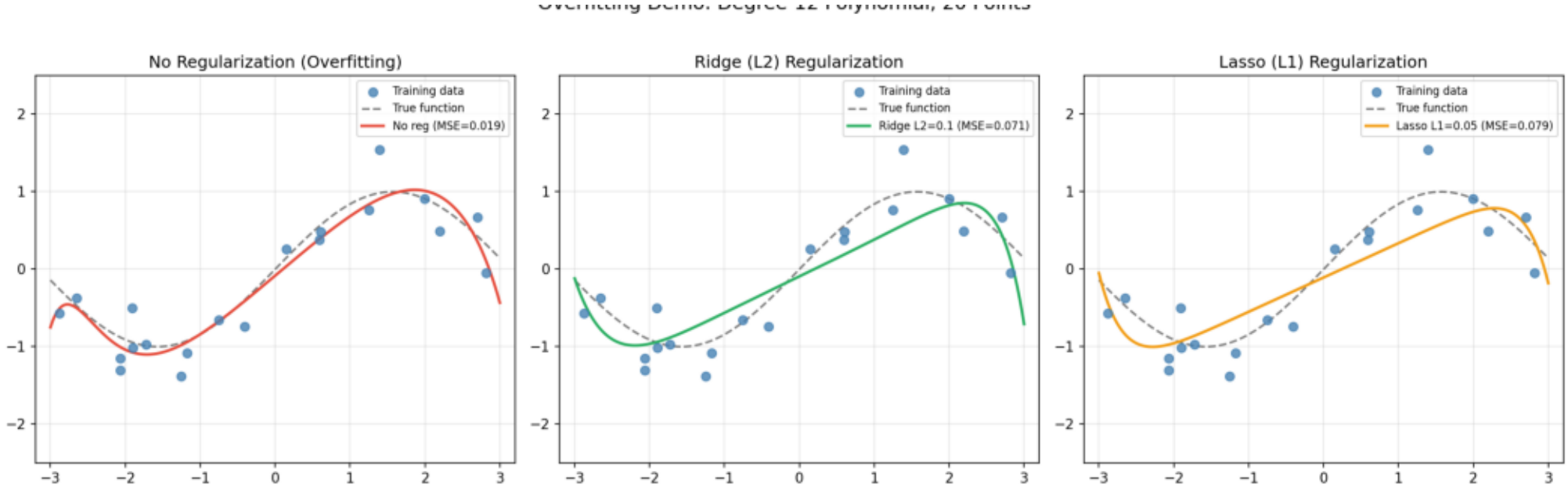
Example 5: Sklearn Comparison (Ridge)

- Max weight diff (closed-form): 5.68e-14
- Our R2: 0.731681
- Sklearn R2: 0.731681

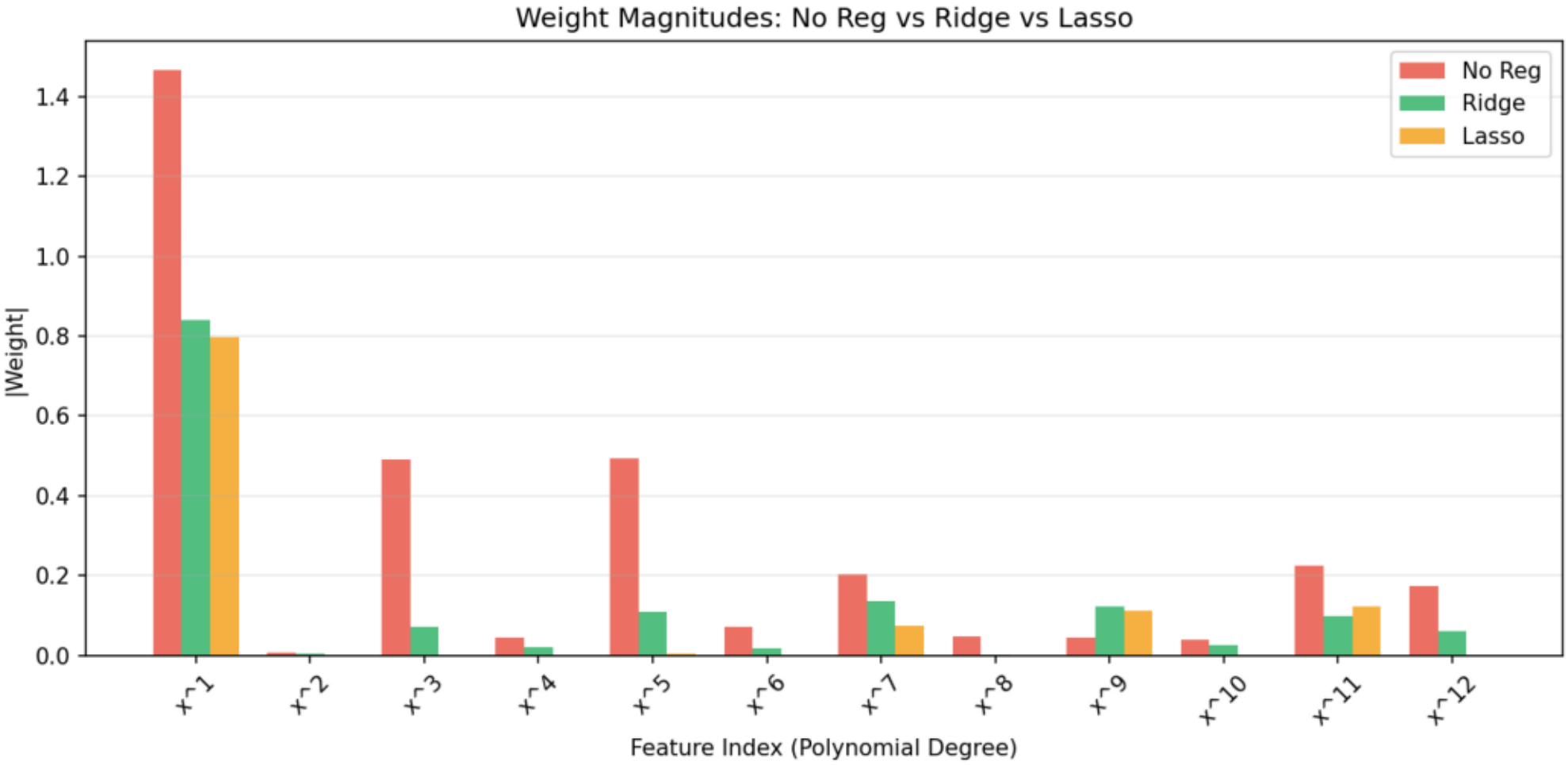
Example 7: Weight Decay vs L2 Equivalence

- Final max diff: 4.97e-14
- Confirms identical trajectories for vanilla SGD

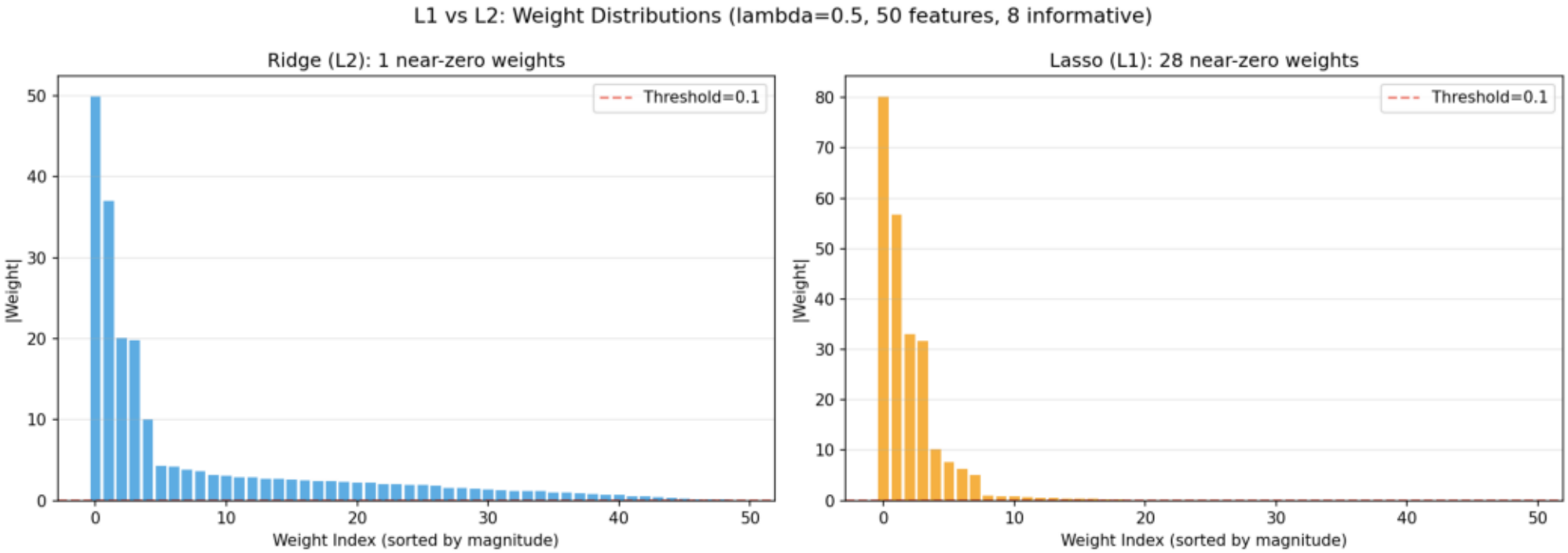
01 Overfitting Demo



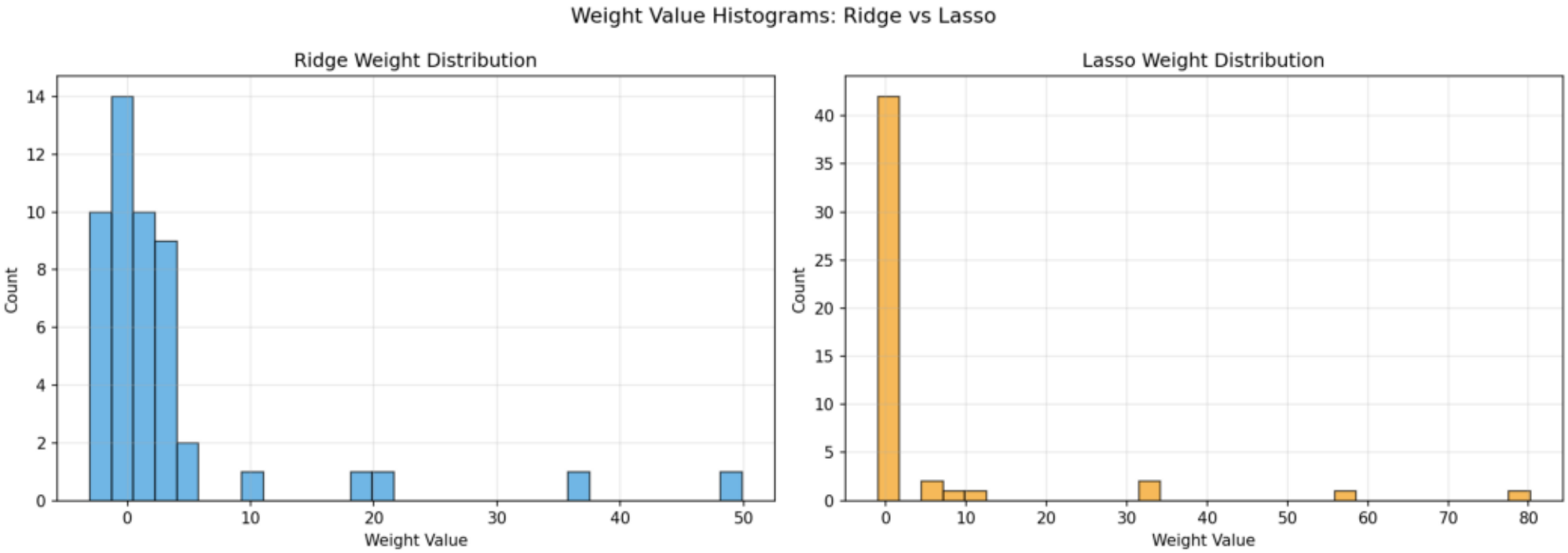
01B Weight Magnitudes



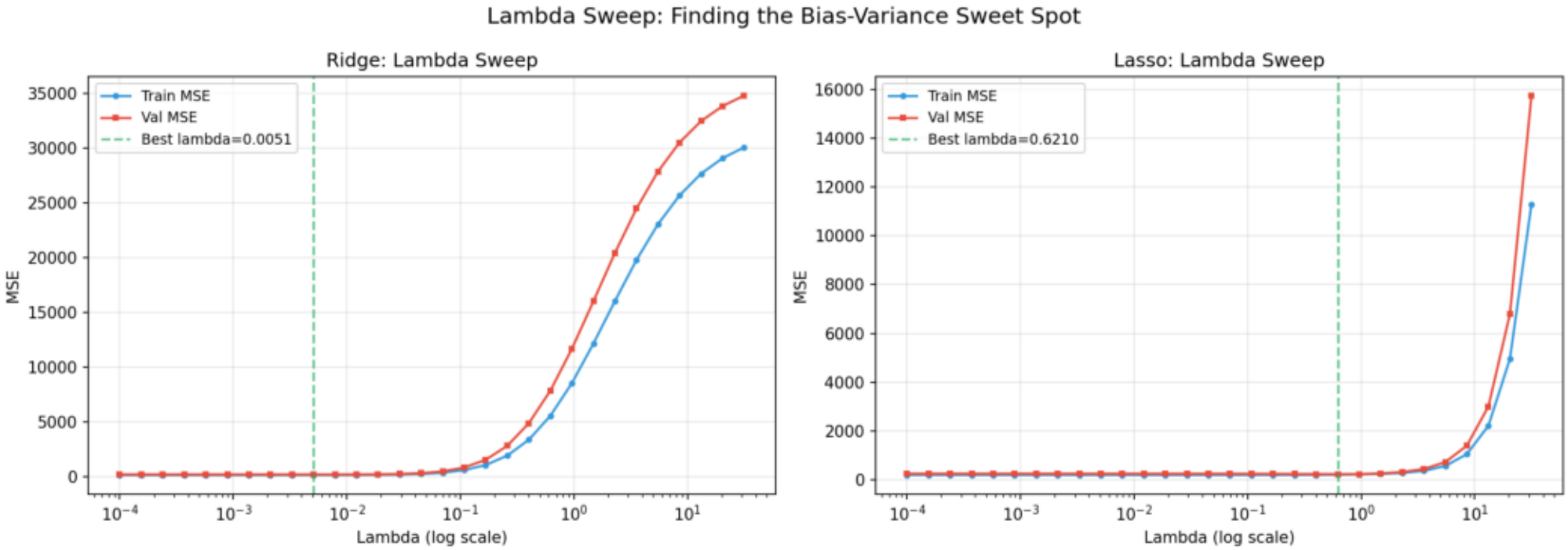
02 L1 Vs L2 Weights



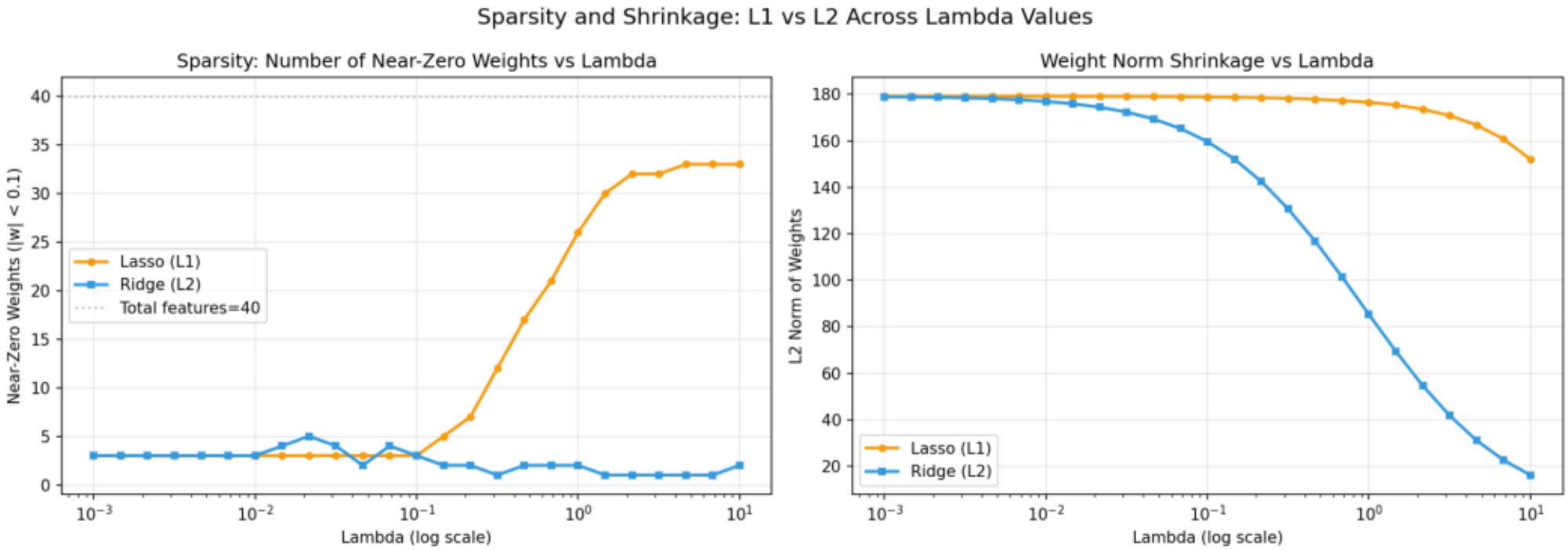
02B Weight Histograms



03 Lambda Sweep

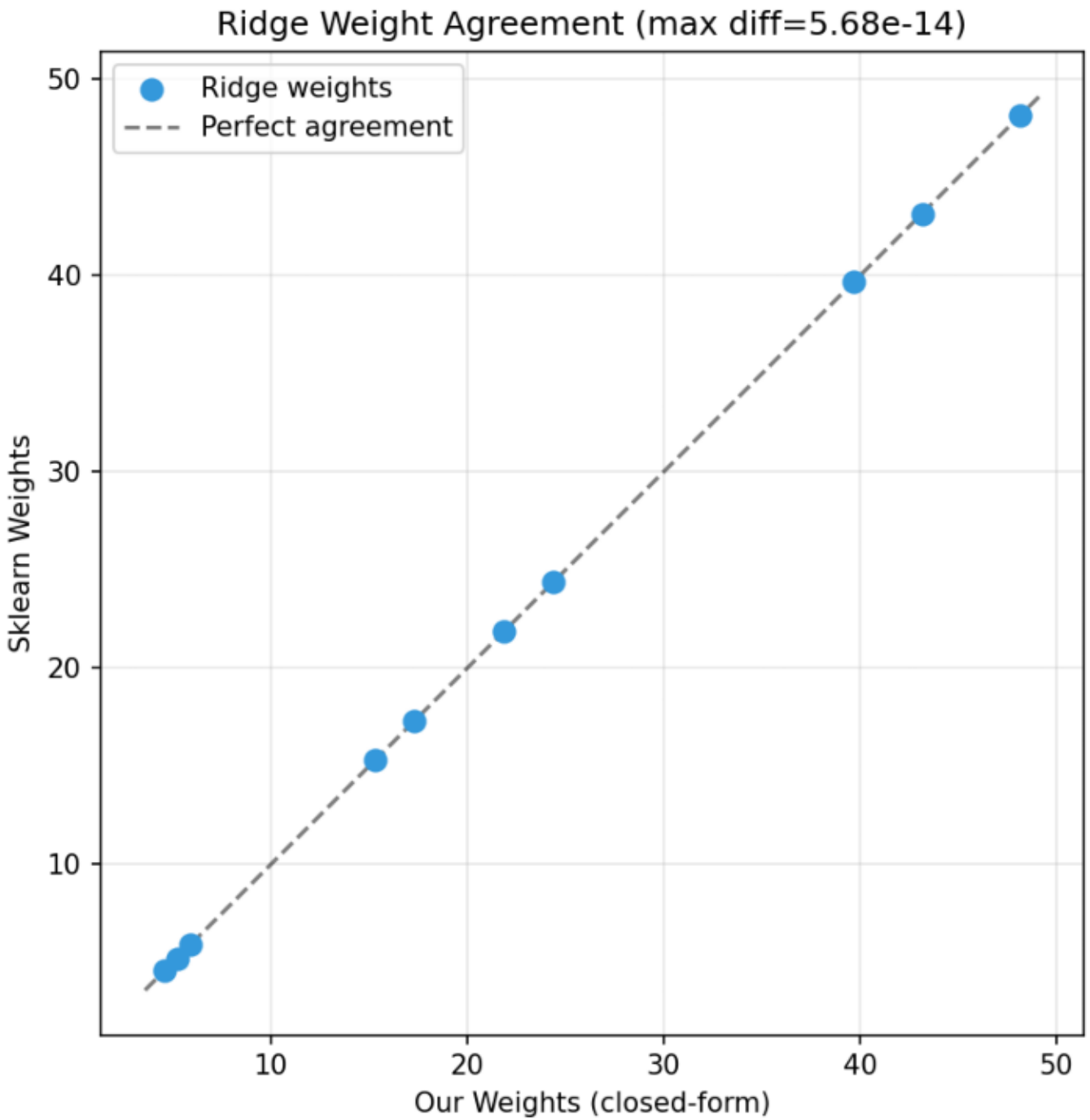


04 Sparsity Vs Lambda

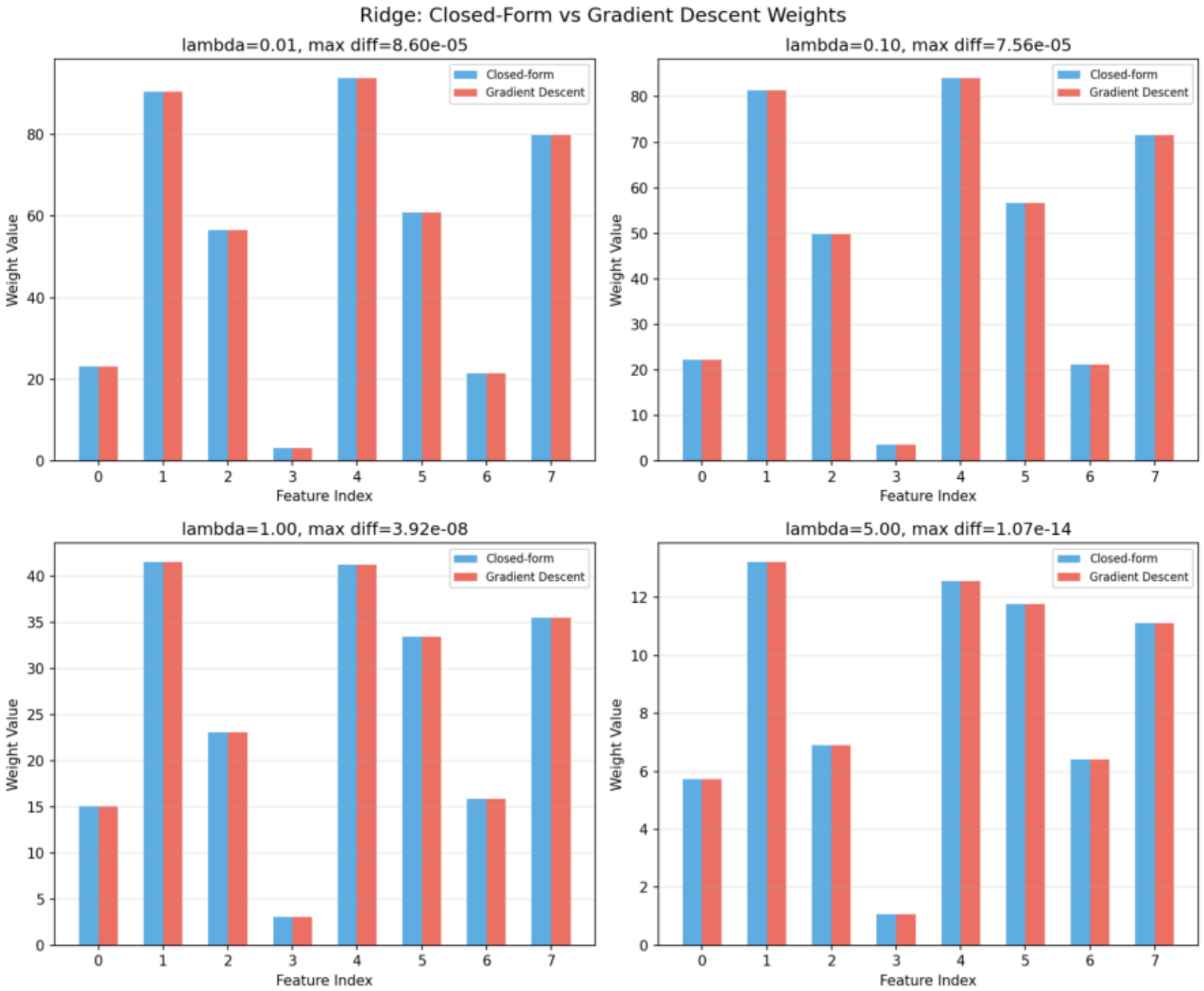


05 Sklearn Comparison

05B Ridge Weight Agreement



06 Closed Form Vs Gd



07 Weight Decay Equivalence