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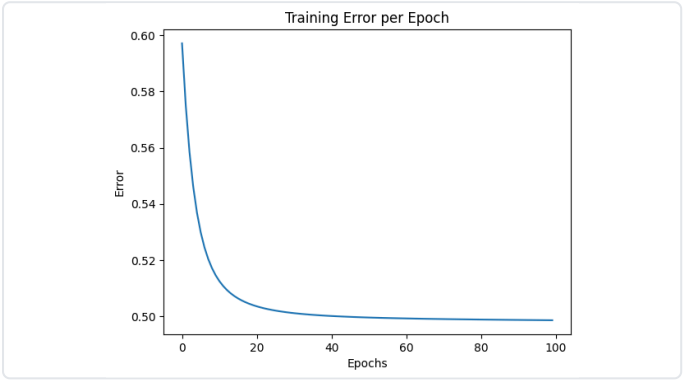
Machine Learning from Scratch

University of Toronto, ECE421 (Introduction to Machine Learning) · Course projects

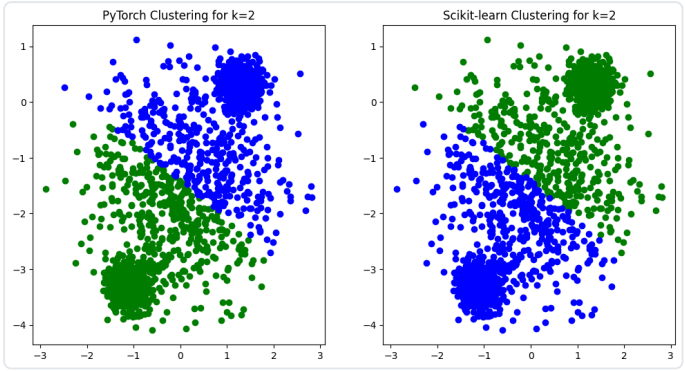
Individual implementations

Implementing core machine-learning algorithms from first principles, from the perceptron to neural networks and clustering.

A sequence of programming projects implementing machine learning from the math up: a perceptron and linear regression, a neural network built from scratch and then in PyTorch with a convolutional network, and unsupervised clustering with k-means and a Gaussian mixture model. The aim was to understand each method by coding it rather than calling a library.



Neural-network training error per epoch, from my implementation.



My k-means clustering, PyTorch against scikit-learn on the same data.

Supervised learning

Built a perceptron and linear regression by hand, then a multi-layer neural network from scratch with its forward and backward passes, and a convolutional network in PyTorch trained on an image set. Training error fell steadily per epoch.

Unsupervised learning

Implemented k-means and a Gaussian mixture model, comparing a PyTorch clustering against scikit-learn on the same dataset.

SELECTED REFERENCES

- I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.
- C. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

Engineering portfolio brief. Course and team project; contribution as noted above.