CS-439 mini-project

Topic: Some of the theoretical behaviors we analyzed in theory: Do they actually appear in practice or not, for convex models or deep nets?

Preparation: Review on Chapters 1-7 (GD, PGD, Proximal & subgradient, SGD, Acc GD, Newton/Quasi-Newton)

Practical problems: Convex models (find some convex problems for machine learning), deep nets (highly non-convex, so theoretical behaviors should not work well)

*Questions to test on*

1. Local minimum = global minimum for (strongly / smooth) convex problems? Examples: Linear regression, LASSO regression (prediction problem), SVM (separation) with suitable loss (eg. MSE)
2. Deep linear nets VS deep NON-LINEAR nets? For non-linear nets, can check if same initializations with different trials converge to different results (indicating non-convex may not converge to global minimum)?

*Resources*

Lab 1: Intro to Python

Lab 2: Gradient Descent (with MSE)

Lab 3: Fixed Point

Lab 4: Convergence of Random Walks

Lab 5: (Projected) Stochastic Gradient Descent (with MSE)

Lab 6: SGD with PyTorch, RBF Kernel, Neural Networks, Optimizers

Lab 7: Fixed Point with Newton

Lab 8: Matrix Completion with Projected Gradient Descent / Frank-Wolfe

Lab 9: Coordinate Descent / Stochastic Gradient Descent on Support Vector Machine

*Ideas*

Regression: MSE / ridge regression / linear + L1 regularization

Classification: MSE / SVM hinge loss (with subgradient descent) / logistic