AM 160 - SciML:

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Problem 2:

1. Perform SINDy for the noisy Lorenz 63 system.

I performed the SINDy algorithm for the lorenz system. I added noise to the derivative at each point according to the gaussian normal distribution with mean 0 and variance given by the problem set. In order to learn these coefficients, I merely used an rk4 integrator to find a trajectory and then computed the derivatives are each point along that trajectory. Then using a least squares solver, an solution for the coefficients is found. Finally, we iterate the least squares solution in order to neglect terms whose found coefficients are low (this algorithm doesn't take into account the relative weight of each column vector in the feature matrix which would be a vast improvement to the algorithm). Testing for the number of iterations used in the sindy algorithm can be seen by the plot shown in Figure 1.

2. Perform SINDy on the Lorenz 63 system using derivative schemes

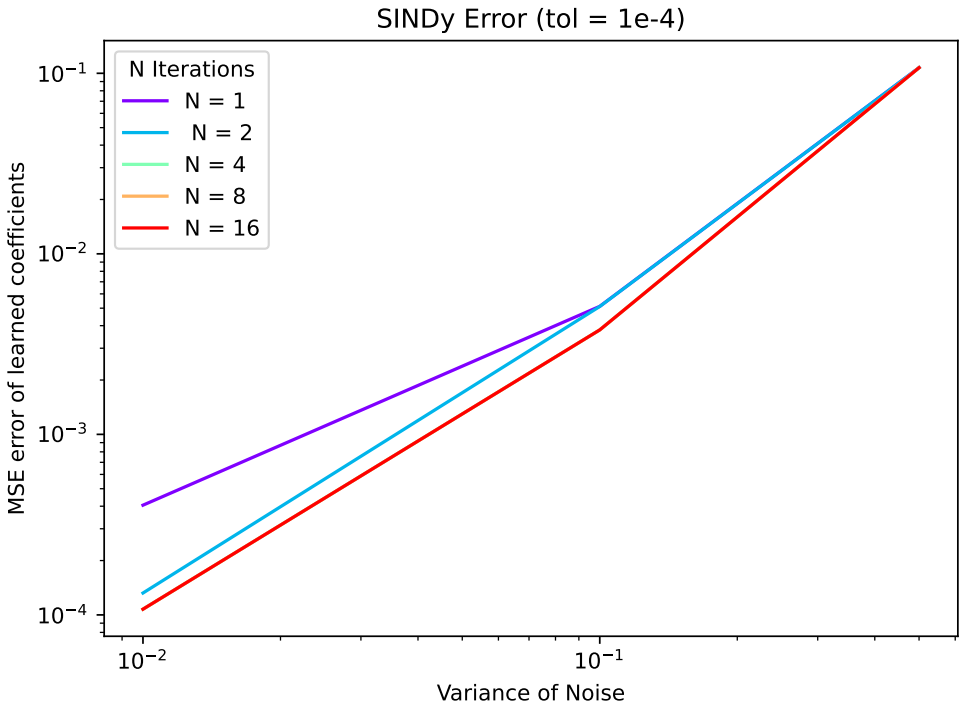

Figure 1: Plot of the MSE error for the learned coefficients ($\sqrt{(\theta_{\text{act}} - \theta_{\text{sindy}})^2}$) for the SINDy algorithm with a cutoff tolerance of 10^{-4}. A different number of iterations was used and this is depicted in color. There seems to be no distinction between the learned coefficients after about 2 iterations as $N = 4, 8, 16$ overlap exactly.