AMATH 563 Spring Quarter 2020

Homework 4: Neural Networks for Dynamical Systems
DUE: Wednesday, June 10, 2020

Download the accompanying ZIP file which includes MATLAB code for solving (i) A reaction-diffusion system of equations, and (ii) The Kuramoto-Sivashinsky (KS) equation.

1. Train a NN that can advance the solution from t to $t + \Delta t$ for the KS equation
2. Compare your evolution trajectories for your NN against using the ODE time-stepper provided with different initial conditions
3. For the reaction-diffusion system, first project to a low-dimensional subspace via the SVD and see how forecasting works in the low-rank variables.

For the Lorenz equations (code given out previously in class emails), consider the following.

1. Train a NN to advance the solution from t to $t + \Delta t$ for $\rho = 10, 28$ and 40. Now see how well your NN works for future state prediction for $\rho = 17$ and $\rho = 35$.
2. See if you can train your NN to identify (for $\rho = 28$) when a transition from one lobe to another is imminent. Determine how far in advance you can make this prediction. (NOTE: you will have to label the transitions in a test set in order to do this task)