Homework 4 - CSE 276C - Math for Robotics

Due: Tuesday, 26 November 2024

1. In robotics it is typical to have to recognize objects in the environment. We will here use the German Traffic Sign dataset for recognition of traffic signs to compute subspaces for the PCA and LDA methods. Provide illustration of the respective 1st and 2nd eigenvectors

   Compute the recognition rates for the test-set. Report

   - Correct classification
   - Incorrect classification

   Provide at least one suggestion for how you might improve performance of the system

2. Consider a predator-prey dynamics such as the simple Lotka-Volterra model

$$\begin{aligned} \mathbf{x}' &= \mathbf{f}(\mathbf{x}) \\ \mathbf{x} &= \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} \textit{Prey polution} \\ \textit{Predator population} \end{pmatrix} \\ \mathbf{f}(\mathbf{x}) &= \begin{pmatrix} (b - px_2)x_1 \\ (rx_1 - d)x_2 \end{pmatrix} \end{aligned}$$

   Without predators, the prey population increases (exponentially) without bound, whereas without prey, the predator population diminishes (exponentially) to zero. The nonlinear interaction, with predators eating prey, tends to diminish the prey population and increase the predator population. Use your Runga-Kutta to solve this system, with the values b = p = r = d = 1, $x_1(0) = 0.3$, and $x_2(0) = 0.2$.