Friedrich-Alexander-Universität Erlangen-Nürnberg
CML: Control, Machine Learning, and Numerics
Assignment 3
Due Date: 6:00pm, 14 June, 2023. Assignment submission address: ycsong.math@gmail.com

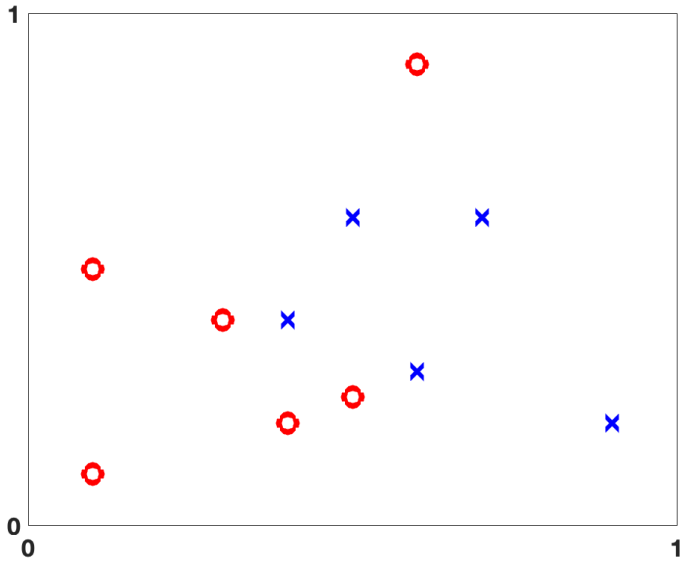
1. Consider the set of points given below and shown in Figure 1. This shows labeled data: 6 points are in category A, indicated by circles and labelled by $y = (1, 0)^T$, and the rest 5 points are in category B, indicated by crosses and labelled by $y = (0, 1)^T$. (Please note the difference from the example considered in class)

$$x_1 = [0.1, 0.3, 0.1, 0.6, 0.4, 0.5, 0.6, 0.5, 0.9, 0.4, 0.7];$$

$$x_2 = [0.1, 0.4, 0.5, 0.9, 0.2, 0.25, 0.3, 0.6, 0.2, 0.4, 0.6];$$

$$y = [ones(1, 6), zeros(1, 5); zeros(1, 6), ones(1, 5)];$$

Figure 1: aaa.



Use this data to train a neural network in order to categorize a newly unseen point in $\mathbb{R}^2$, i.e. construct a mapping that takes any point in $\mathbb{R}^2$ and returns either a circle or a cross. The settings of the neural network and training process are the same as the example introduced in class. The details can be referred to the file "classification˙NN.m". Please train the neural networks using

(i) sigmoid function as the activation function;

(ii) hyperbolic tangent function as the activation function;

(iii) different learning rates: 0.1, 0.05, 0.01 to show how the learning rate effects the training process.

For cases (i)-(iii), please report the following results:

(a) The value of the loss function versus the iteration number (see Figure 2 for an example);

(b) Visualization of output from the artificial neural network applied to the domain $(0, 1) \times (0, 1)$ (see Figure 3 for an example).

Figure 2: .

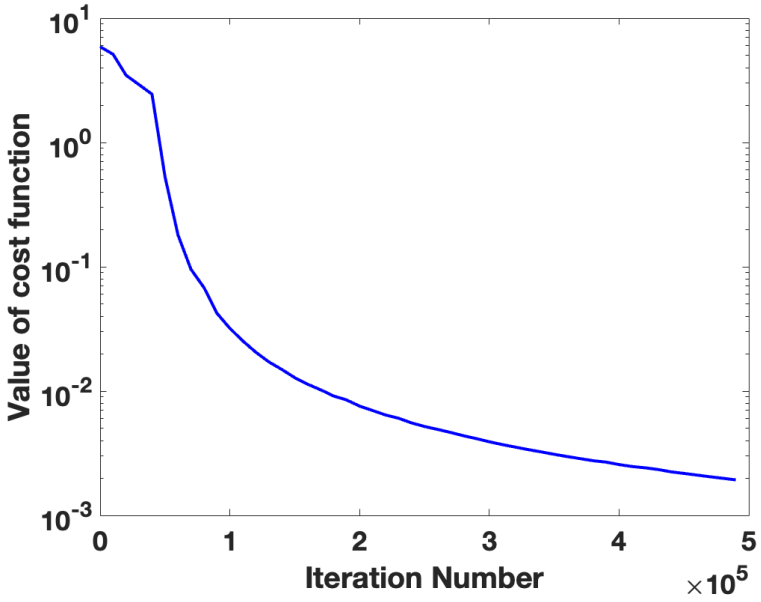


Figure 3: