1928
K. N. Toosi University of Technology

In the name of God

Artificial Intelligence

Faculty of mechanical engineering

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Assignment 3

Due date: 99/02/21

1. A concrete dataset is in attachments. This dataset is about the compressive strength of different samples of concrete based on the volumes of the different ingredients that were used to make them. Ingredients include:

1. Cement
2. Blast Furnace Slag
3. Fly Ash
4. Water
5. Superplasticizer
6. Coarse Aggregate
7. Fine Aggregate

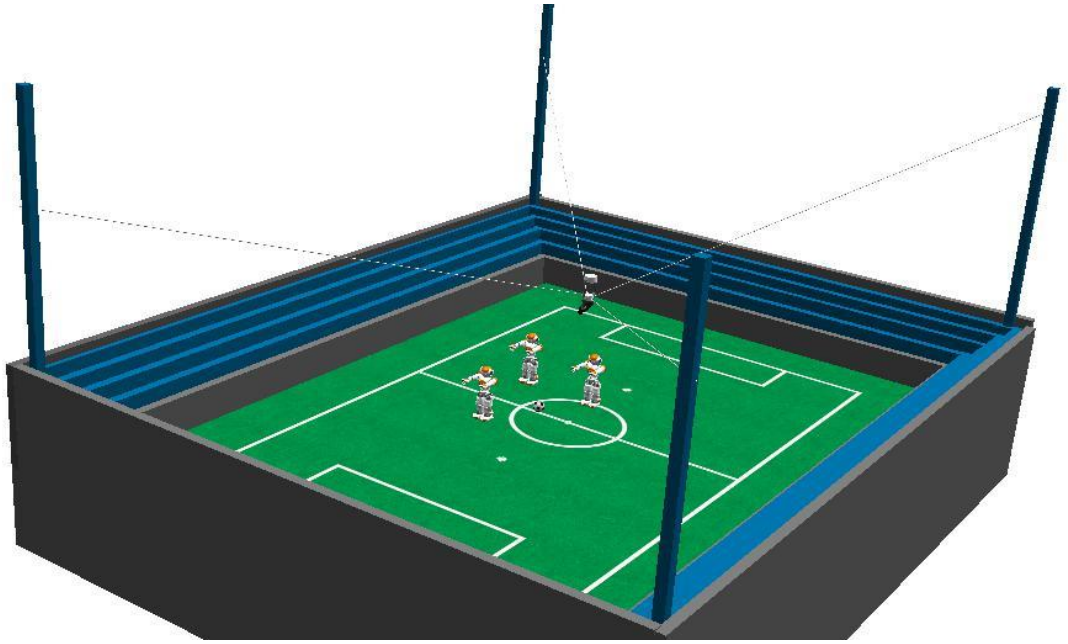
The goal of this part is to predict strength of concrete which can be used to find which combination will give more compressive strength. You should create a neural network for regression to estimate strength of concrete. Plot R2 score against epoch for validation and training data. Model parameters like loss function, number of layers and neurons and etc. are arbitrary.

2. A spider cam is designed for a stadium. This camera is attached to 4 cables. We can control position and orientation of camera by changing length of cables. In order to place camera in a suitable position and orientation, we need to know a function which maps cable lengths to orientation and position of the camera. This is done by forward kinematics of robot. But it turns out that these equations are too heavy for our hardware. So we decide to replace these equations with a neural network. A dataset is gathered which contains length of cable as L1, L2, and L4 and also target values as position_X, position_Y, position_Z, Angle_X, Angle_Y, Angle_Z. Build and train a neural network to estimate these 6 outputs simultaneously (network must have 6 outputs):

a. Use tanh as activation function, mean_absolute_error loss function, and plot R2 score against epochs.

b. Use simoid as activation function, mean_absolute_error loss function, and plot R2 score against epochs.

c. Use tanh as activation function, mean_squared_error loss function, and plot R2 score against epochs.



3. In this part we want to try another computer vision example with **fashion mnist dataset.** You can find more details about this dataset here, and here you can find how to download this dataset.

a. Train a linear classifier in **Keras** to classify **fashion mnist dataset.** Use mean squared error as loss function and plot the loss against epoch.

b. Train an MLP with 1 hidden layer with relu activation and Softmax activation at the end. Use categorical cross entropy as loss function and plot the loss against epoch.

Note1: use one-hot-encoded labels for both parts.

Note2: no non-linearity is allowed in part a.

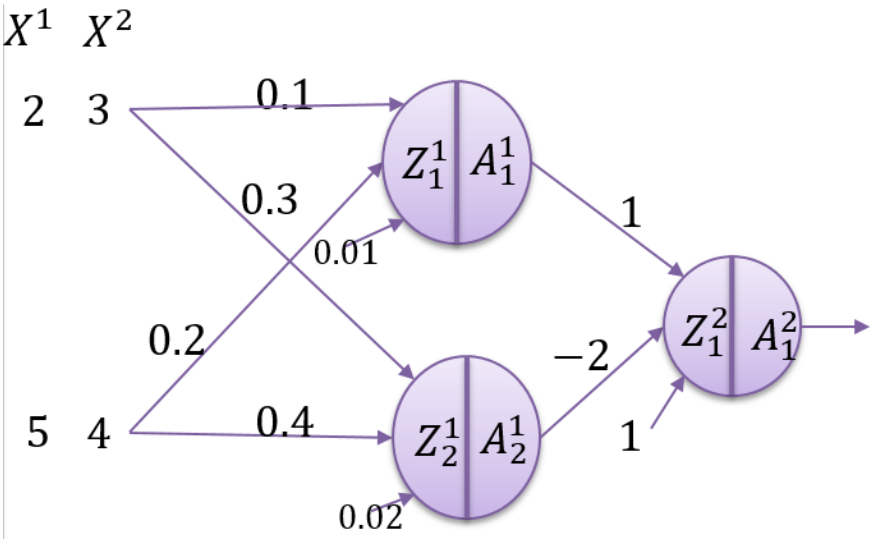
4. A neural network is shown below. Assume that all activations are tanh and loss function is mean squared error.

a. forward pass each sample to find the output, and then back propagate to find derivative of loss with respect to W^2 *and* B^2.

b. forward pass samples as batch to calculate the output and find the derivatives with respect to loss function by using batch formulization.

c. compare the results.

$$Y^1 = 1\,, Y^2 = 0$$



Good Luck