Digit Recognition

By

Akshay Rajput

Question:- Digit recognition

This Project has four parts.

Part a:- Write a script to show the digits in the data.

The script is included in the attachment and shown is given below.

Part b:- Train neural network to recognise 3 and 8.

There will be 785 inputs 784 of 28X28 images and 1 is constant. The data is normalised by dividing input by 255. There are 100 hidden units, so dimension of theta between input and hidden layer is 785X100 and the dimension of theta between hidden and output layer is 2X100.
First the weights are assigned normally and closed to zero and the input is passed to it. After that the output is subtracted from original output (i.e 1 for the correct number and 0 for others) and weights are recalculated using back propagation.

Back propagation for θ_2 :-
$\delta_k = (-1 * (y - o_2) * o_2 * (1 - o_2)$
$\theta_2 = \theta_2 - \eta * \delta_k$

Back propagation for θ_1 :-
$\delta_j = (\delta_k * \theta_2) * o_1 * (1 - o_1)$
$\theta_1 = \theta_1 - eta * (\delta_j * x)$
where η is learning rate and
$\eta = \frac{1}{sqrt\tau}$
τ = number of iterations

Part c:-
Stochastic gradient descent is used and error is sum of errors over all training example.

$\epsilon = 0.1$
accuracy for classifying 3 = 98.9109%
accuracy for classifying 8 = 98.8706%
time = 4643 secs

$\epsilon = 1$
Accuracy for classifying three = 95.7426%
Accuracy for classifying eight = 98.7680%
Elapsed time is 343.923031 seconds.

$\epsilon = 5$
Accuracy for classifying three = 96.3366%
Accuracy for classifying eight = 98.0493%
Elapsed time is 53.793139 seconds.

Part d (Extra credit):-

The network was trained similarly as in previous question but now there are 10 outputs(0-9) instead of 2(3,8).

$\epsilon = 30$

Accuracy for classifying zero = 0.986735
Accuracy for classifying one = 0.976211
Accuracy for classifying two = 0.904070
Accuracy for classifying three = 0.914851
Accuracy for classifying four = 0.918534
Accuracy for classifying five = 0.846413
Accuracy for classifying six = 0.950939
Accuracy for classifying seven = 0.913424
Accuracy for classifying eight = 0.941478
Accuracy for classifying nine = 0.919722
Elapsed time is 594.545480 seconds.