

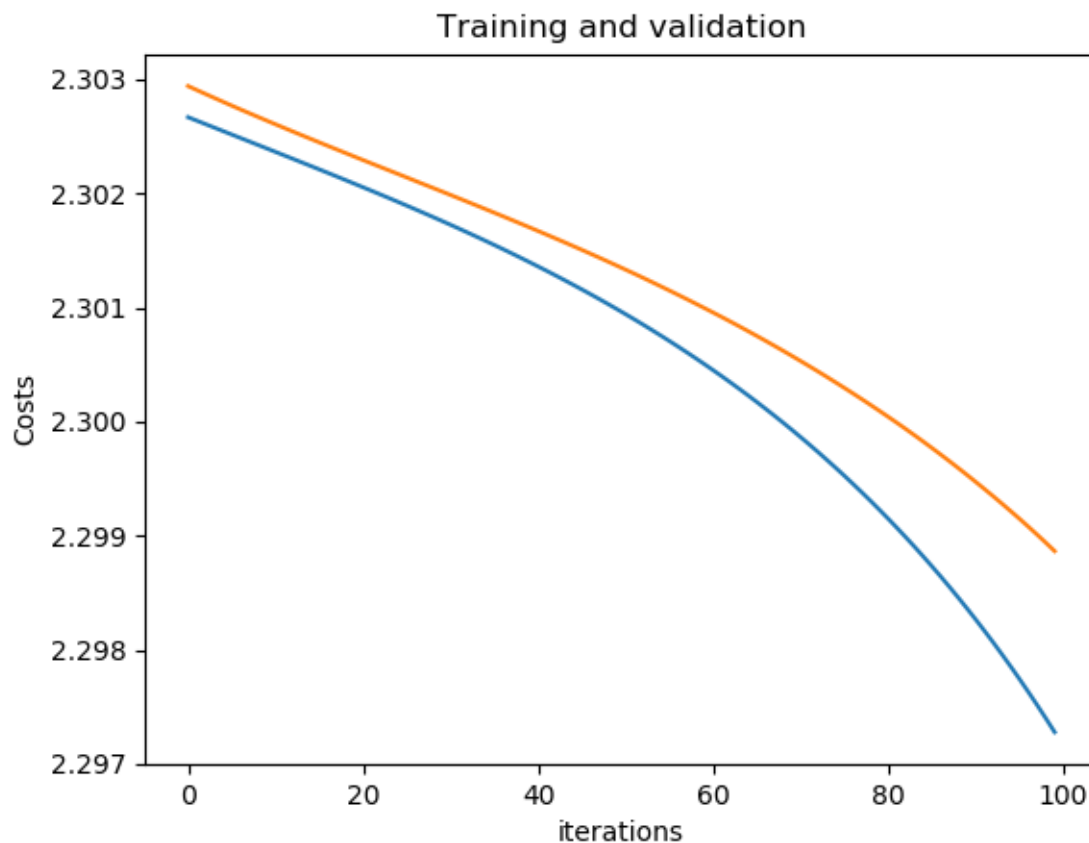
Plot of Train cost (average loss) vs iterations and validation cost vs iterations in the same figure:

Blue curve – Training

Orange curve - validation

Plot 1:

Learning rate: 0.1



CMD prompt output:

Cost at iteration 960 is: 2.29763, learning rate: 0.10000

validation error is : 1058.000000

Cost at iteration 970 is: 2.29752, learning rate: 0.10000

validation error is : 1054.000000

Cost at iteration 980 is: 2.29740, learning rate: 0.10000

validation error is : 1052.000000

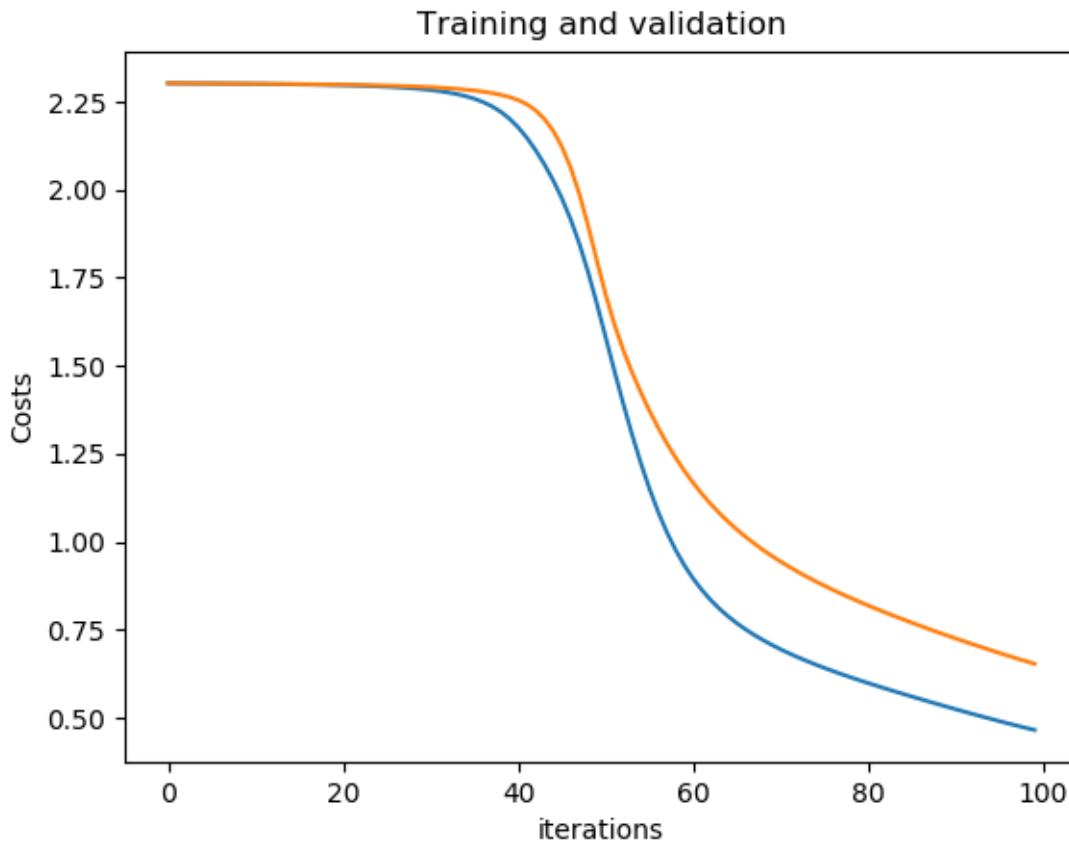
Cost at iteration 990 is: 2.29728, learning rate: 0.10000

Train error is : 5304.000000

Test error is : 916.000000

Accuracy for testing set is 8.400 %

Learning rate: 0.5



CMD Prompt output:

Cost at iteration 970 is: 0.47748, learning rate: 0.50000

validation error is : 366.000000

Cost at iteration 980 is: 0.47130, learning rate: 0.50000

validation error is : 356.000000

Cost at iteration 990 is: 0.46527, learning rate: 0.50000

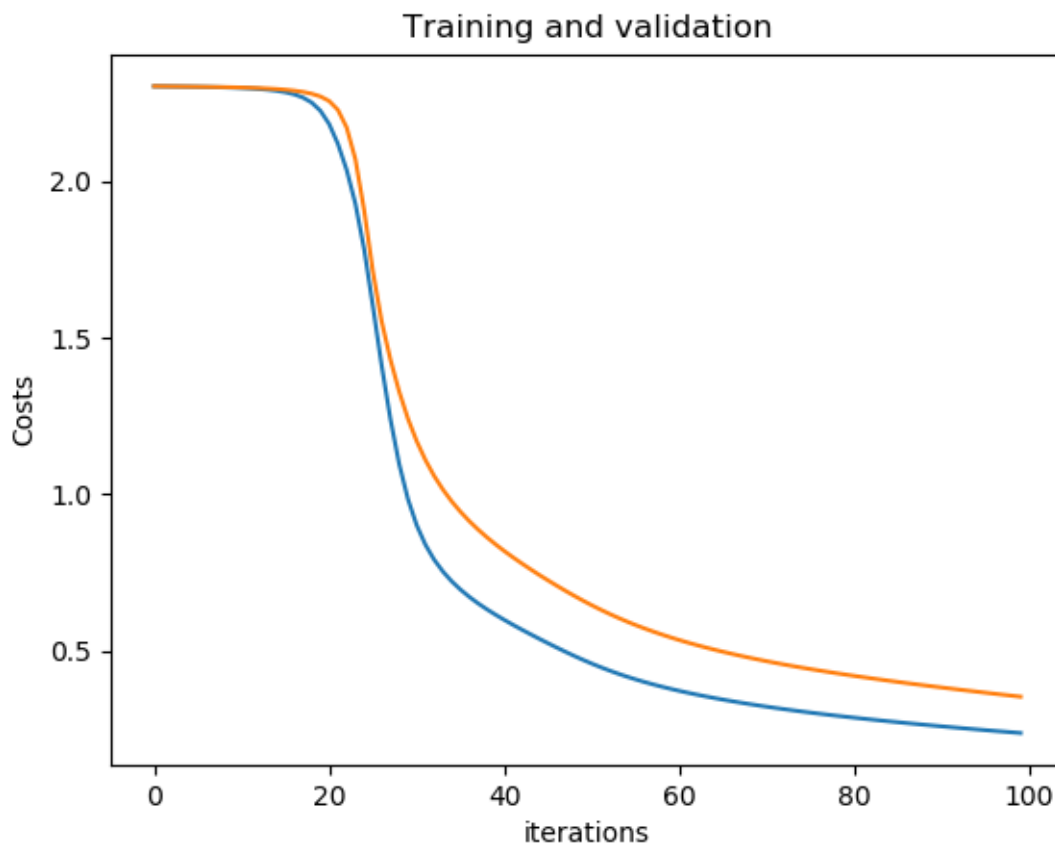
Train error is : 1538.000000

Test error is : 346.000000

Accuracy for training set is 69.240 %

Accuracy for testing set is 65.400 %

Learning rate: 1.0



CMD Prompt output:

Cost at iteration 950 is: 0.24799, learning rate: 1.00000

validation error is : 188.000000

Cost at iteration 960 is: 0.24567, learning rate: 1.00000

validation error is : 186.000000

Cost at iteration 970 is: 0.24338, learning rate: 1.00000

validation error is : 186.000000

Cost at iteration 980 is: 0.24111, learning rate: 1.00000

validation error is : 180.000000

Cost at iteration 990 is: 0.23888, learning rate: 1.00000

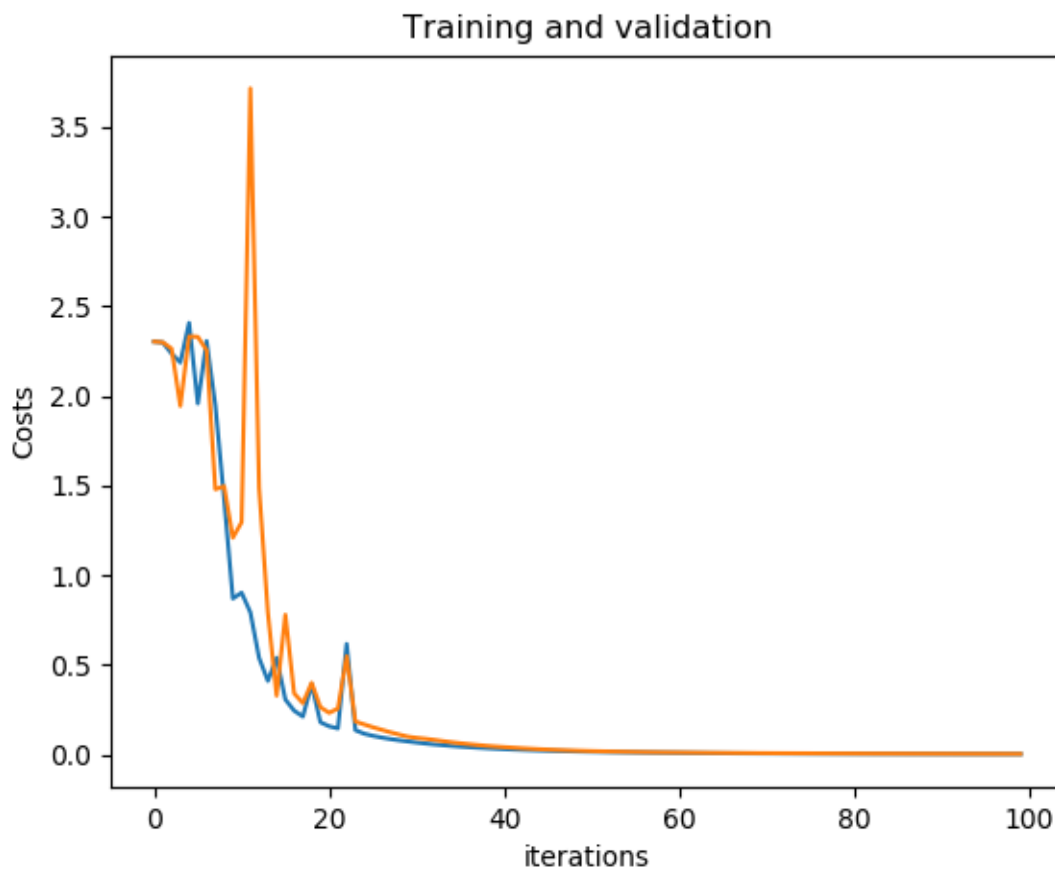
Train error is : 768.000000

Test error is : 228.000000

Accuracy for training set is 84.640 %

Accuracy for testing set is 77.200 %

Learning rate: 10.0



CMD Prompt output:

Cost at iteration 950 is: 0.00232, learning rate: 10.00000

validation error is : 0.000000

Cost at iteration 960 is: 0.00225, learning rate: 10.00000

validation error is : 0.000000

Cost at iteration 970 is: 0.00219, learning rate: 10.00000

validation error is : 0.000000

Cost at iteration 980 is: 0.00214, learning rate: 10.00000

validation error is : 0.000000

Cost at iteration 990 is: 0.00208, learning rate: 10.00000

Train error is : 0.000000

Test error is : 134.000000

Accuracy for training set is 100.000 %

Accuracy for testing set is 86.600 %

Summary :

For 1000 iterations

Learning Rate	Accuracy
0.1	8.4%
0.5	65.4%
1.0	77.2%
10.0	86.60%

As we can see from the plots as the learning rate grows the cost function converges quickly.

For 1000 iterations with learning rate 0.1 the costs did not converge to its minimum yet and it is taking lot of time hence the accuracy is less. If we increase the number of iterations for this learning rate the accuracy will improve.

For 1000 iteration with learning rate 10.0 we can see the accuracy when compared with learning rate 0.1 its lot better and this is because the cost function converging quickly to its minimum.

Also we can see for learning rate 10.0 the cost decrease and increases again during first few iterations this is because of over shooting.