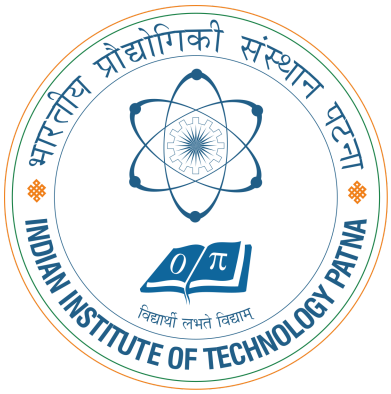
CS571: Artificial Intelligence Lab

Indian Institute of Technology Patna



ASSIGNMENT 8

Logistic Regression

Group Members

- Kartik Kailas Mouli (2001CS35)
- Rohit Ranjan (2001CS56)
- Siddhant Kumar (2001CS70)

Accuracy

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[8]  ✓ 9m 58.9s

...  Training of the model:  model_0 , to recognize the digit:  0
     Accuracy: 0.9819
     Training of the model:  model_1 , to recognize the digit:  1
     Accuracy: 0.9846
     Training of the model:  model_2 , to recognize the digit:  2
     Accuracy: 0.9576
     Training of the model:  model_3 , to recognize the digit:  3
     Accuracy: 0.9571
     Training of the model:  model_4 , to recognize the digit:  4
     Accuracy: 0.9612
     Training of the model:  model_5 , to recognize the digit:  5
     Accuracy: 0.9361
     Training of the model:  model_6 , to recognize the digit:  6
     Accuracy: 0.9737
     Training of the model:  model_7 , to recognize the digit:  7
     Accuracy: 0.9725
     Training of the model:  model_8 , to recognize the digit:  8
     Accuracy: 0.9238
     Training of the model:  model_9 , to recognize the digit:  9
     Accuracy: 0.9359
```

Final parameter values of the logistic regression model

```
Model 0 Parameters: {'weights': array([ 0.00000000e+00,  0.00000000e+00,  0.00000000e+00,  0.00000000e+00,
        0.00000000e+00,  0.00000000e+00,  0.00000000e+00,  0.00000000e+00,
        0.00000000e+00,  0.00000000e+00,  0.00000000e+00,  0.00000000e+00,
       -4.39684311e-06, -1.83244387e-05, -9.67795059e-06, -4.03247941e-07,
        0.00000000e+00,  0.00000000e+00,  0.00000000e+00,  0.00000000e+00,
        0.00000000e+00,  0.00000000e+00,  0.00000000e+00,  0.00000000e+00,
        0.00000000e+00,  0.00000000e+00,  0.00000000e+00,  0.00000000e+00,
        0.00000000e+00,  0.00000000e+00,  0.00000000e+00,  0.00000000e+00,
       -5.95808508e-07, -2.16847331e-06, -2.92853980e-05, -7.29939614e-05,
       -1.42786479e-04, -2.22283193e-04, -3.83523896e-04, -3.85171493e-04,
       -3.02530575e-04, -3.82156658e-04, -6.15459349e-04, -5.24357818e-04,
       -5.40919915e-04, -4.29503158e-04, -2.77855802e-04, -2.03152674e-04,
       -1.51377264e-04, -5.35777124e-05, -2.11601452e-05, -6.32451258e-06,
        0.00000000e+00,  0.00000000e+00,  0.00000000e+00,  0.00000000e+00,
        0.00000000e+00,  0.00000000e+00, -1.88975762e-06,  8.35868929e-06,
       -1.32097674e-05, -1.88805574e-05, -1.82039080e-04, -4.18174331e-04,
       -9.08108674e-04, -1.92400132e-03, -3.05907342e-03, -3.99540667e-03,
       -5.57369132e-03, -7.20704704e-03, -9.56986532e-03, -1.12586946e-02,
       -1.20499113e-02, -1.11196346e-02, -9.35728395e-03, -7.00671856e-03,
       -4.23816460e-03, -2.12251111e-03, -1.04091202e-03, -3.57930965e-04,
       -1.07566751e-04, -1.53946078e-05,  0.00000000e+00,  0.00000000e+00,
        0.00000000e+00,  0.00000000e+00, -4.98563143e-06,  2.84930338e-06,
       -4.31798829e-05, -2.59142970e-04, -8.19305772e-04, -1.83029884e-03,
       -3.47418857e-03, -6.86779529e-03, -1.07185344e-02, -1.42664139e-02,
       -1.83561284e-02, -2.28703629e-02, -2.85995996e-02, -3.15426769e-02,
...
       -4.04993993e-03, -2.99208275e-03, -1.39587678e-03, -1.16316634e-04,
        2.89725745e-04,  1.23658278e-04, -7.54991439e-06, -1.63758073e-05,
        0.00000000e+00,  0.00000000e+00,  0.00000000e+00,  0.00000000e+00]), 'bias': -0.2232675726875399}

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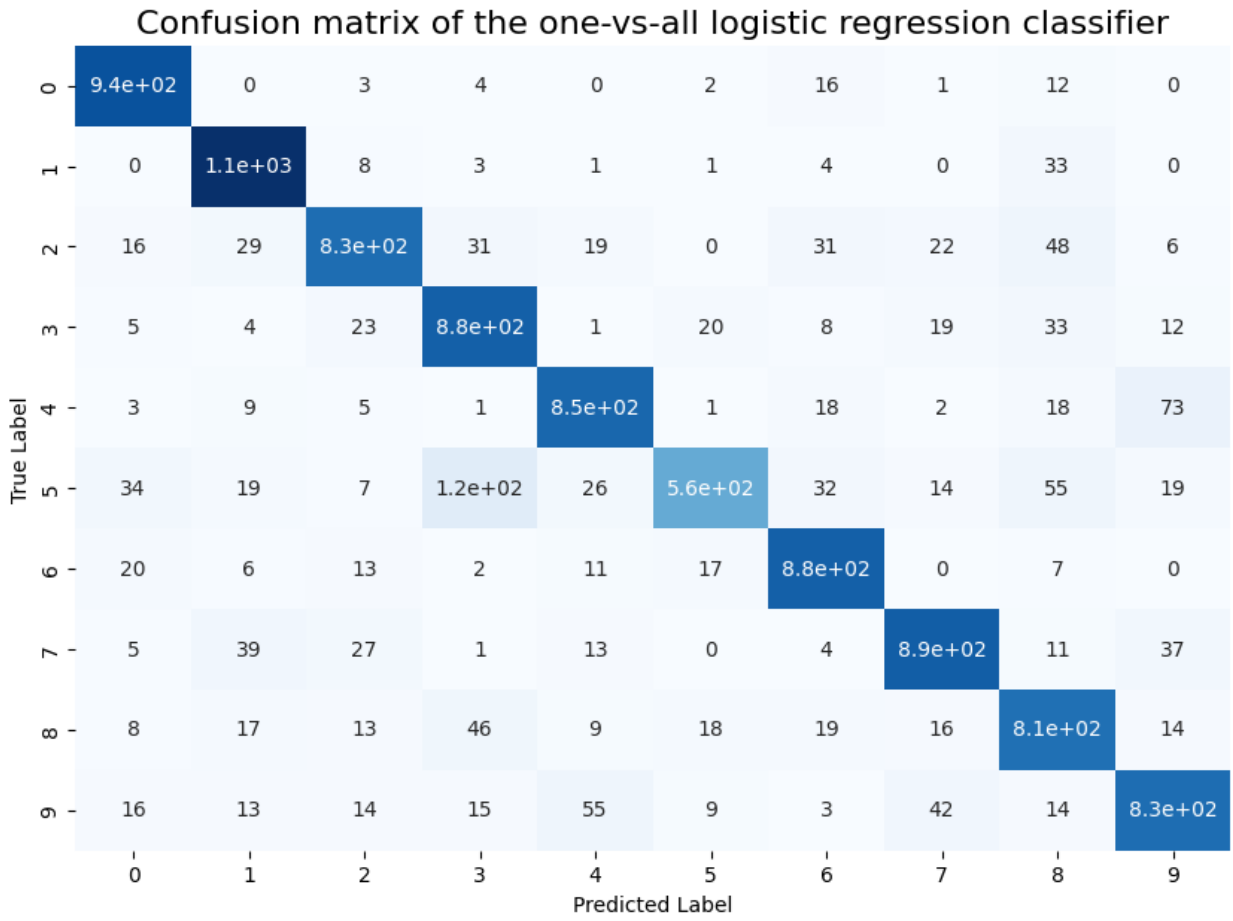
The accuracy of the One-Vs-All model is: 0.9584400000000001

Confusion Matrix



Conclusion

In the context of the MNIST dataset, a logistic regression classifier employing the One-Vs-All approach was used to classify handwritten digits into one of the 10 possible classes (0 to 9). The model achieved a remarkable accuracy score of 0.9819, indicating a high level of accuracy in correctly classifying the digits. The One-Vs-All approach involved training 10 separate binary logistic regression models, each designed to distinguish one digit class from the rest. The overall accuracy of the One-Vs-All model was 0.9584, demonstrating strong performance in multi-class digit classification.

In conclusion, the logistic regression model, with carefully tuned parameters and One-Vs-All strategy, demonstrated significant success in accurately recognizing handwritten digits. Further optimization and exploration of alternative algorithms may lead to potential accuracy improvements, but the achieved accuracy of 0.9819 is already quite impressive in this context.