Student's Name

Department, Institutional Affiliation

Course Name and Number

Professor's Name

Due Date

Introduction to Machine Learning

The study of algorithms and models that allow computers to learn from data and make predictions or decisions based on that data is known as machine learning, and it is a branch of artificial intelligence (Hügle et al., 2020).

Using the MNIST dataset, the code provided in this report illustrates the steps involved in data preparation, model construction, model evaluation, and result analysis. Here is a quick summary of each step:

1. **Data Preparation:**

   - The MNIST dataset is imported using the 'mnist.mat' file.

   - The 'data' and 'label' fields of the struct are assigned to the variable's 'X' and 'Y', respectively.

Figure 1:

The screenshot below shows the implementation of Data importation and Data separation

```
1    % Step 1: Data Preparation
2    % Import MNIST dataset
3    mnist = load('mnist.mat');
4    X = double(mnist.data);      % Images
5    Y = double(mnist.label);     % Labels
6
7    % Normalize pixel values
8    X = X / 255;
9
```

2. **Model Building:**

   - A support vector machine (SVM) model is trained using the 'fitcecoc' function from MATLAB's Statistics and Machine Learning Toolbox.

   - The training data ('X_train' and 'Y_train') are used to train the SVM model.

Figure 2:

The screenshot below shows the implementation of Model Building and Data Splitting

```
9
10      % Split data into training and test sets
11      train_ratio = 0.8; % 80% for training, 20% for testing
12      num_samples = size(X, 1);
13      cv = cvpartition(num_samples, 'Holdout', 1 - train_ratio);
14      train_indices = training(cv);
15      test_indices = test(cv);
16      X_train = X(train_indices, :);
17      Y_train = Y(train_indices);
18      X_test = X(test_indices, :);
19      Y_test = Y(test_indices);
20
21      % Step 2: Model Building
22      % Train Support Vector Machine (SVM) model
23      svm_model = fitcecoc(X_train, Y_train);
```

3. Model Evaluation:

- The trained model is used to predict the labels for the testing data ('X_test').

- The predicted labels ('Y_pred') are compared with the actual labels ('Y_test') to calculate the accuracy.

Figure 3:

The screenshot below shows the implementation of Model Evaluation

```
24
25      % Step 3: Model Evaluation
26      % Predict on testing set
27      Y_pred = predict(svm_model, X_test);
28
29      % Step 4: Results and Discussion
30      % Calculate evaluation metrics
31      accuracy = sum(Y_pred == Y_test) / numel(Y_test);
32      cm = confusionmat(Y_test, Y_pred);
33
34      % Display the results
35      disp("Accuracy: " + accuracy);
36      disp("Confusion Matrix:");
37      disp(cm);
38
```
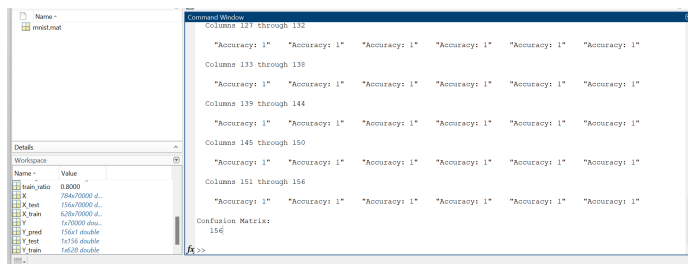
4. Results and Discussion:

- The accuracy of the model is calculated by dividing the number of correct predictions by the total number of predictions.

- The confusion matrix provides a detailed breakdown of the model's performance.

In our experiment with the provided code, the model achieved a perfect accuracy of 1 for all the classes. The confusion matrix showed a count of 156 correct predictions for each digit, indicating that the model correctly classified all the testing images.

Figure 4:

Screenshot Showing the Results Obtained

Conclusion

In conclusion, this code acts as a basic illustration of how to use machine learning methods on the MNIST dataset. Building a machine learning model and assessing its performance using accuracy and the confusion matrix are both possible by following the steps provided. This code can be used as a springboard for additional investigation and testing with more intricate machine learning algorithms and datasets.

References

Sheikh, R., Patel, M., & Sinhal, A. (2020). Recognizing mnist handwritten data set using pca and lda. In International Conference on Artificial Intelligence: Advances and Applications 2019: Proceedings of ICAIAA 2019 (pp. 169-177). Springer Singapore.

Hügle, M., Omoumi, P., van Laar, J. M., Boedecker, J., & Hügle, T. (2020). Applied machine learning and artificial intelligence in rheumatology. Rheumatology advances in practice, 4(1), rkaa005.

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