Image Classification Project Documentation

Executive Summary

This report presents an image classification project employing Histogram of Oriented Gradients (HOG) features, Logistic Regression, and KMeans clustering. The project utilizes the Fashion MNIST dataset for training and testing, aiming to explore the performance of different approaches in image recognition.

1. Introduction

Image classification is a fundamental task in computer vision, and this project seeks to address it through two distinct methodologies: Logistic Regression and KMeans clustering. HOG features are employed as a means of representing image characteristics, providing insights into the effectiveness of each approach.

2. Installation

Before executing the project, ensure that the required dependencies are installed. Use the following command to install them:

`pip install numpy scikit-learn matplotlib scikit-image tensorflow`

3. Usage

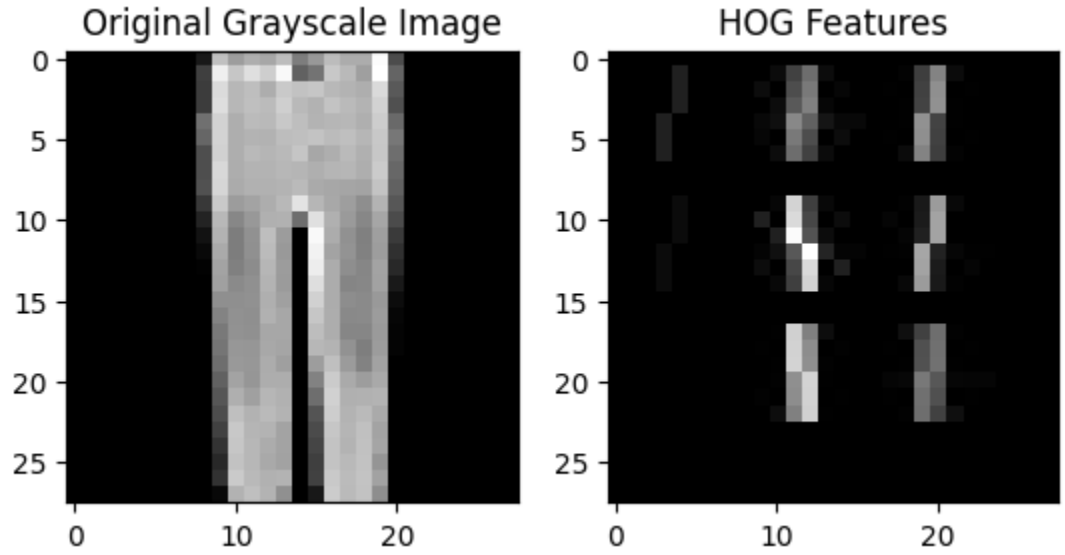
To run the image classification project, execute the provided Python script using the following command:

`python image_classification_project.py`

4. Data Loading and Preprocessing

The Fashion MNIST dataset is loaded from TensorFlow, and specific classes are selected for training and testing purposes. This step is crucial to ensure that the model is trained on relevant and specific data.

5. HOG Feature Extraction



HOG features are extracted from the images using the `skimage.feature.hog` function. This process transforms raw pixel information into a feature vector that encapsulates key aspects of the image structure. Both the training and test sets are processed to obtain HOG features.

6. Logistic Regression

A Logistic Regression model is trained using the extracted HOG features. This supervised learning approach aims to classify images into predefined classes. Predictions are made on the test set, and accuracy is evaluated to gauge the model's performance.

6.1 Classification Report

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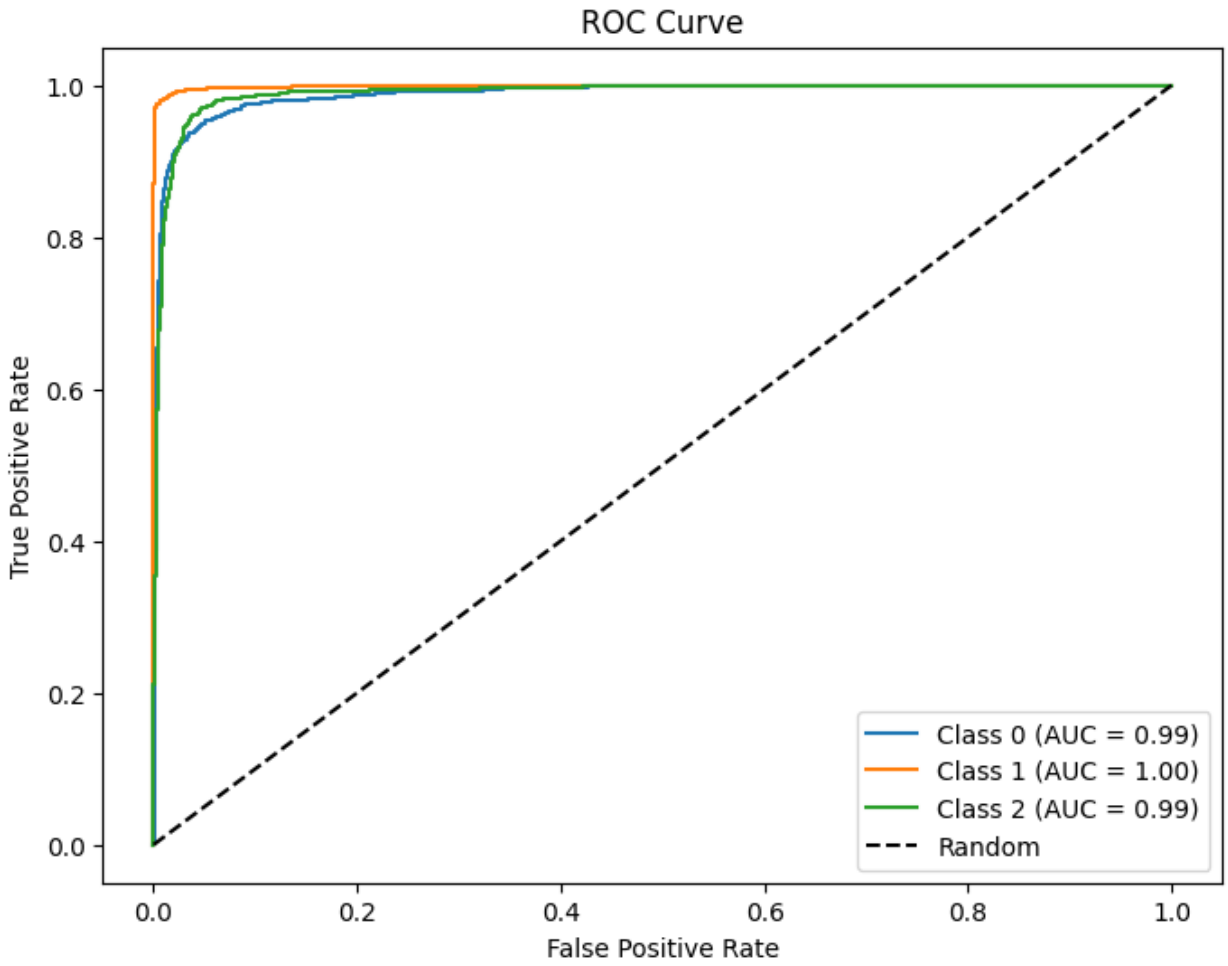
The LogisticRegression accuracy: 87.98

              precision    recall  f1-score   support

           0       0.95      0.92      0.94      1433
           1       0.98      0.98      0.98      1410
           2       0.92      0.95      0.94      1357

    accuracy                           0.95      4200
   macro avg       0.95      0.95      0.95      4200
weighted avg       0.95      0.95      0.95      4200
```

7. Confusion Matrix and ROC Curve

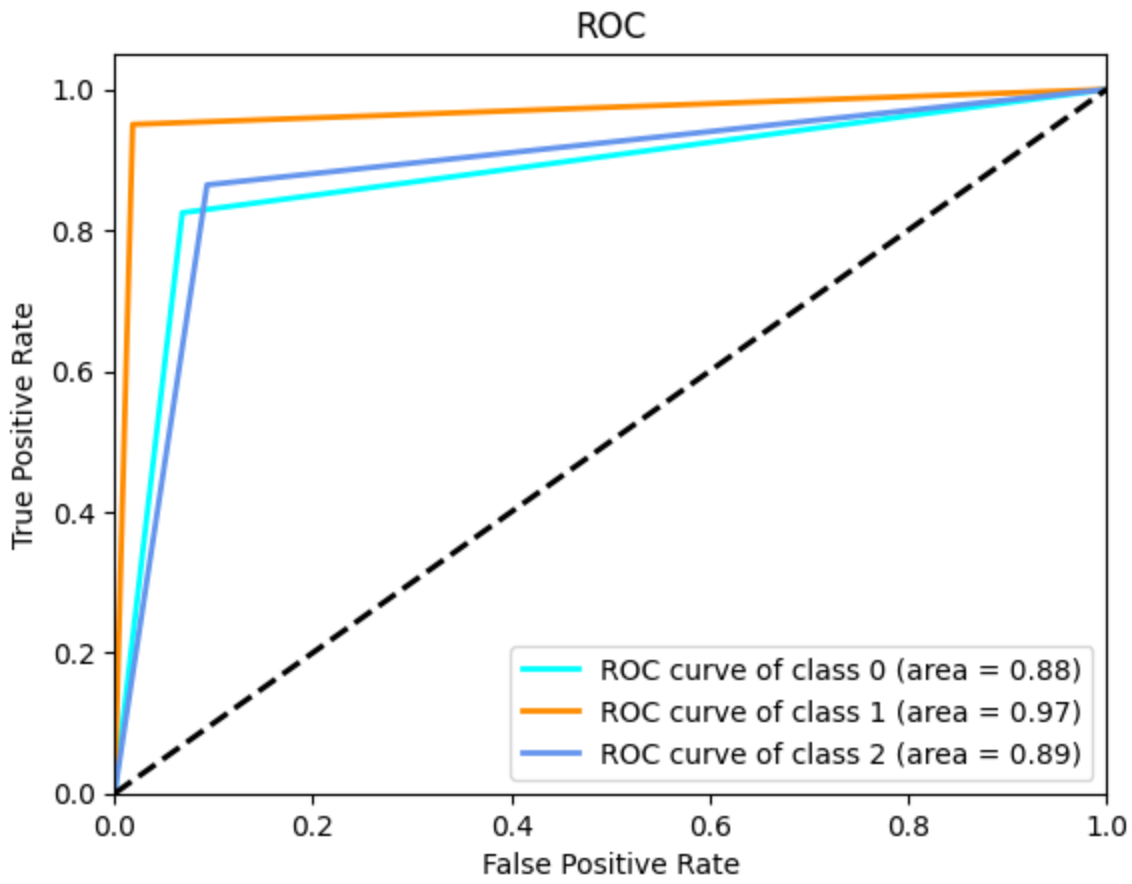


To gain a deeper understanding of the Logistic Regression model's performance, a confusion matrix is generated, illustrating the model's ability to correctly classify instances. Additionally, a Receiver Operating Characteristic (ROC) curve is plotted, providing insights into the trade-off between true positive and false positive rates.

8. KMeans Clustering

KMeans clustering is applied to the HOG features, grouping images into clusters based on feature similarity. This unsupervised learning approach explores patterns within the data without predefined class labels.

9. ROC Curve for KMeans



Similar to the Logistic Regression approach, an ROC curve is plotted for each class in the case of KMeans clustering. This analysis helps assess the clustering model's ability to distinguish between different classes.

10. Classification Report

A classification report is presented for the KMeans predictions, offering a comprehensive evaluation of precision, recall, and F1-score for each class.

	precision	recall	f1-score	support
0	0.86	0.82	0.84	1433
1	0.96	0.95	0.96	1410
2	0.82	0.86	0.84	1357
accuracy			0.88	4200
macro avg	0.88	0.88	0.88	4200
weighted avg	0.88	0.88	0.88	4200

11. **Conclusion**

This project provides valuable insights into the performance of image classification using different methodologies. The combination of supervised learning with Logistic Regression and unsupervised learning with KMeans clustering offers a holistic perspective on image recognition. Further refinements and explorations can be made to enhance the models and extend the analysis to different datasets.