Career Foundry Data Analytics Program

Machine Learning Specialization

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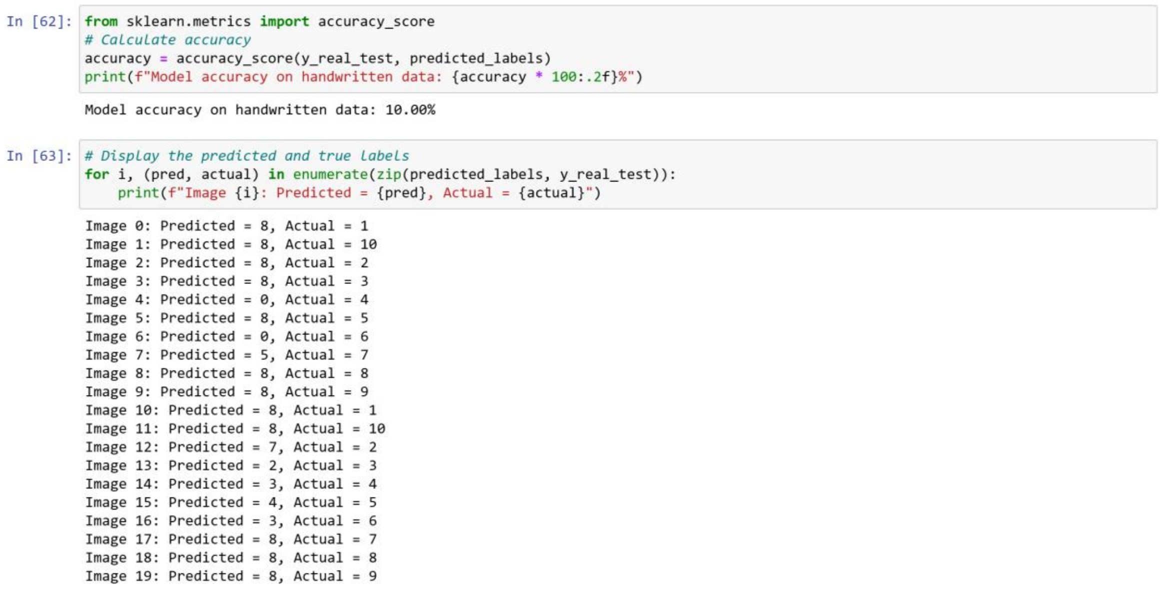
Task 2.5 Visual Applications of Machine Learning

Handwriting Recognition Task Results

Model Accuracy: 10.00%

Summary: The model was tested on a set of 20 handwritten images (10 numbers drawn twice). The accuracy of the model in predicting the handwritten digits was significantly low, achieving only 10% accuracy. This suggests that the model struggled to correctly identify the handwritten numbers from the test images.



```
In [62]: from sklearn.metrics import accuracy_score
         # Calculate accuracy
         accuracy = accuracy_score(y_real_test, predicted_labels)
         print(f"Model accuracy on handwritten data: {accuracy * 100:.2f}%")

         Model accuracy on handwritten data: 10.00%

In [63]: # Display the predicted and true labels
         for i, (pred, actual) in enumerate(zip(predicted_labels, y_real_test)):
             print(f"Image {i}: Predicted = {pred}, Actual = {actual}")

         Image 0: Predicted = 8, Actual = 1
         Image 1: Predicted = 8, Actual = 10
         Image 2: Predicted = 8, Actual = 2
         Image 3: Predicted = 8, Actual = 3
         Image 4: Predicted = 0, Actual = 4
         Image 5: Predicted = 8, Actual = 5
         Image 6: Predicted = 0, Actual = 6
         Image 7: Predicted = 5, Actual = 7
         Image 8: Predicted = 8, Actual = 8
         Image 9: Predicted = 8, Actual = 9
         Image 10: Predicted = 8, Actual = 1
         Image 11: Predicted = 8, Actual = 10
         Image 12: Predicted = 7, Actual = 2
         Image 13: Predicted = 2, Actual = 3
         Image 14: Predicted = 3, Actual = 4
         Image 15: Predicted = 4, Actual = 5
         Image 16: Predicted = 3, Actual = 6
         Image 17: Predicted = 8, Actual = 7
         Image 18: Predicted = 8, Actual = 8
         Image 19: Predicted = 8, Actual = 9
```

Analysis:

1. **Recurrent Prediction of 8:** The model predicted the number 8 for a majority of the images, indicating potential overfitting or insufficient training.
2. **Accuracy Breakdown:** Out of 20 images:
   - Only **2 images** were correctly identified (Image 8 and Image 18 where the actual number was 8).
   - The rest of the predictions were incorrect, with some numbers repeatedly misclassified as 8 or other unrelated digits.
3. **Challenge with Handwritten Data:** The low accuracy may stem from:

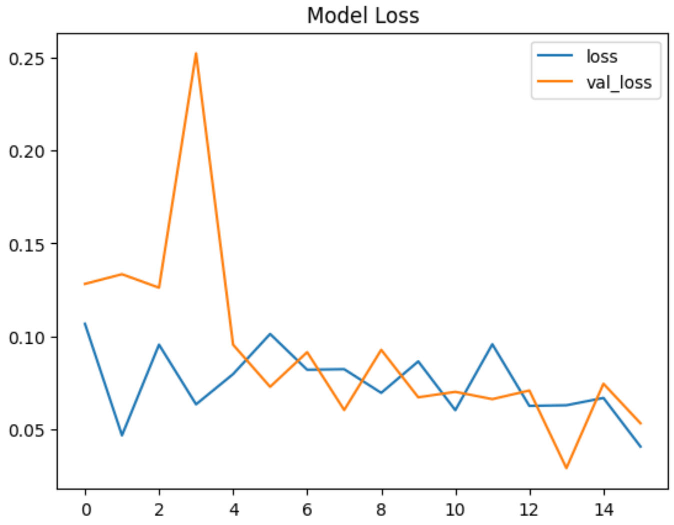
- Differences in handwriting styles not represented in the training dataset.
- Issues with preprocessing (e.g., quality of image conversion to grayscale and negative).
- Potential undertraining or inadequate model complexity.

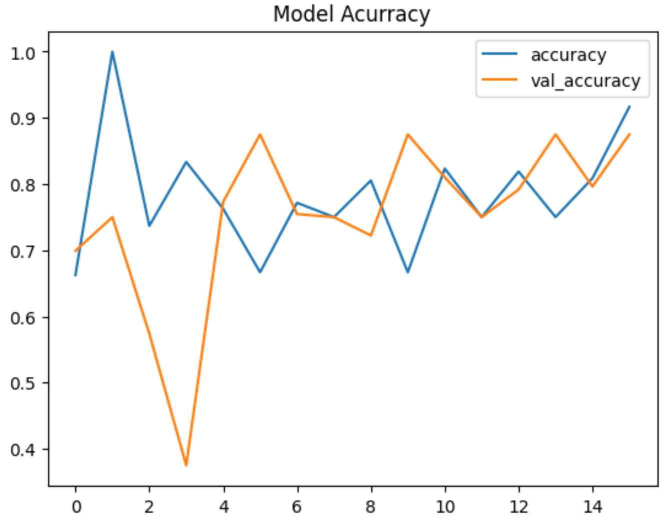
Conclusion: The current model struggles to handle real-world handwritten data. Addressing preprocessing issues, augmenting the dataset, and optimizing the model are critical steps to enhance its performance and real-life applicability.

Radar Recognition Task Results

Summary of Results:

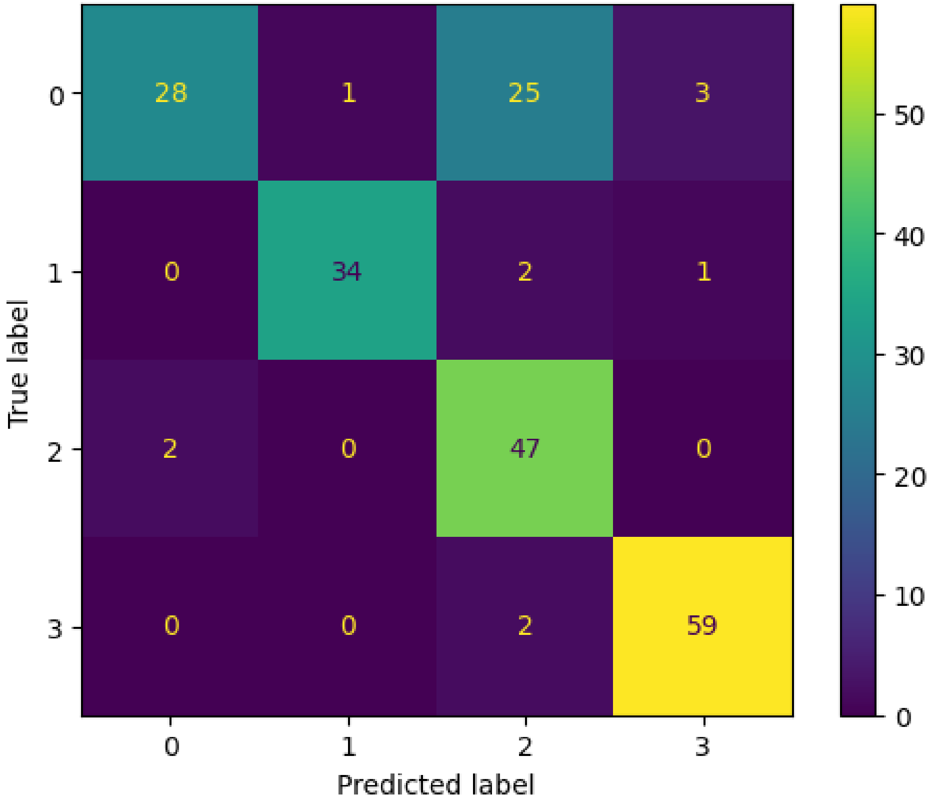
1. **Model Accuracy and Loss:**
   - Training Accuracy: 91.67%
   - Validation Accuracy: 87.50%
   - Training Loss: 0.041
   - Validation Loss: 0.053





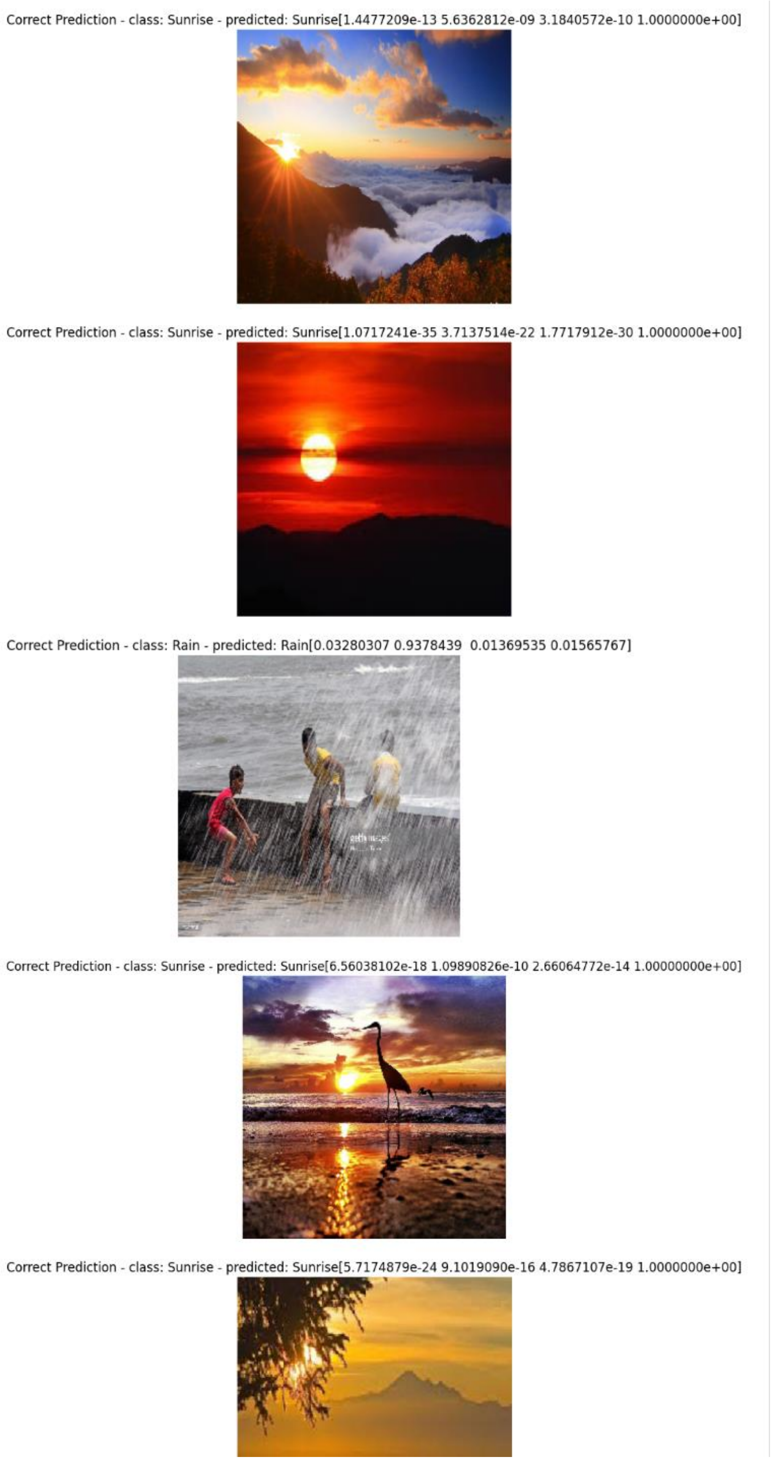
2. **Confusion Matrix:**

    - The confusion matrix indicates the model's performance in predicting each class (Cloudy, Rain, Shine, Sunrise).
    - The diagonal values represent correct predictions, while off-diagonal values indicate misclassifications.
    - Notable observations include consistent accuracy in predicting "Sunrise" and occasional misclassifications between "Cloudy" and "Shine."



3. **Image Predictions:**

    - Images and predictions showcase the model's ability to correctly classify weather types in most cases.
    - High confidence scores demonstrate the model's reliability for certain categories like "Sunrise."



```
Correct Prediction - class: Sunrise - predicted: Sunrise[1.4477209e-13 5.6362812e-09 3.1840572e-10 1.0000000e+00]
Correct Prediction - class: Sunrise - predicted: Sunrise[1.0717241e-35 3.7137514e-22 1.7717912e-30 1.0000000e+00]
Correct Prediction - class: Rain - predicted: Rain[0.03280307 0.9378439  0.01369535 0.01565767]
Correct Prediction - class: Sunrise - predicted: Sunrise[6.56038102e-18 1.09890826e-10 2.66064772e-14 1.00000000e+00]
Correct Prediction - class: Sunrise - predicted: Sunrise[5.7174879e-24 9.1019090e-16 4.7867107e-19 1.0000000e+00]
```

Recommendations:

1. **Potential Improvements:**
    - Add more data or augment existing data to address underrepresented or challenging categories.
    - Fine-tune the model's hyperparameters to further reduce validation loss and improve accuracy.
2. **GAN Applications for Weather Prediction:**
    - **Data Augmentation:** Use GANs to generate synthetic images for underrepresented weather conditions, improving model robustness.
    - **Weather Forecast Visualization:** GANs could create realistic animations or images based on meteorological data for clearer forecasts.
    - **Anomaly Detection:** Utilize GANs to identify unusual patterns in weather data, aiding in early warnings for extreme weather events.