

Assignment 3B - R

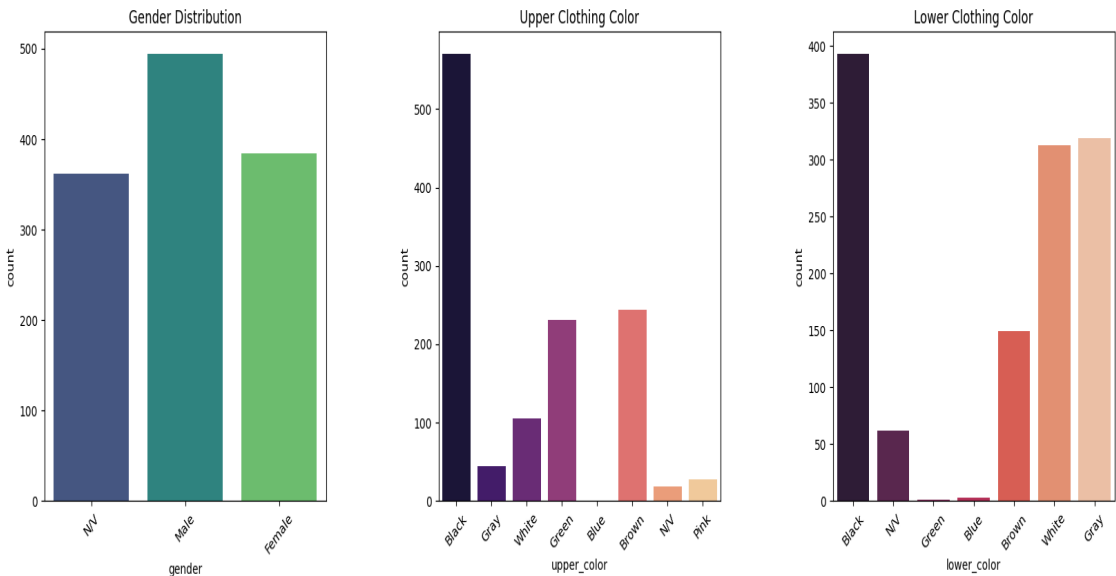
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1. Introduction

This project focuses on multi-task learning using deep neural networks to predict multiple human attributes from images. A single model is trained to simultaneously predict Gender, Upper Body Clothing Color, and Lower Body Clothing Color. This approach improves efficiency by sharing learned visual features across tasks.

2. Dataset Overview & Attribute Distribution

The dataset contains annotated images of individuals with labels extracted from a CSV file. Gender classes include Male, Female, and N/V (Not Visible). Upper and Lower clothing color classes include Black, White, Gray, Brown, Green, Blue, Pink, and N/V. The following figures show the class distribution for each attribute.



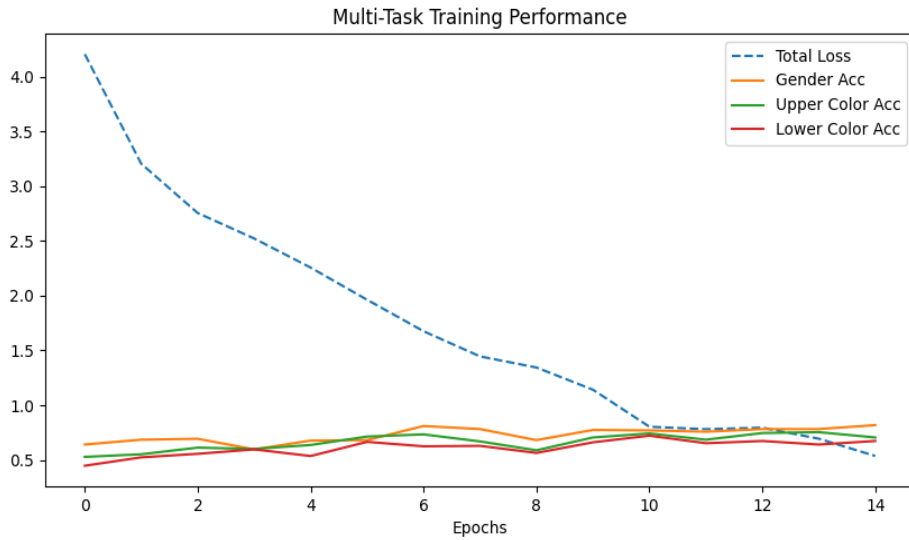
3. Model Architecture & Training Process

A ResNet-based convolutional neural network is used as the shared backbone for feature extraction. The final fully connected layer is replaced with three separate classification heads corresponding to Gender, Upper Color, and Lower Color prediction. Each task uses categorical cross-entropy loss, and the total loss is computed as the weighted sum of individual task losses. The model is optimized using the Adam optimizer with a learning rate of 0.001.

4. Training Performance

The model was trained for multiple epochs. The total training loss shows a consistent downward trend, indicating stable convergence. Accuracy trends for all three tasks demonstrate gradual

improvement, confirming effective multi-task learning.



5. Evaluation Metrics & Results

Model performance was evaluated using the Weighted Average F1-score, which accounts for class imbalance by weighting each class according to its support. The final evaluation results are summarized below:

- Gender Classification: Weighted Avg F1-Score = **0.7980**
- Upper Clothing Color: Weighted Avg F1-Score = **0.6995**
- Lower Clothing Color: Weighted Avg F1-Score = **0.6553**

6. Conclusion

The results demonstrate that the proposed multi-task learning framework is effective for simultaneous attribute prediction. Gender classification achieved the highest performance, while clothing color prediction was more challenging due to higher visual variability. Overall, the model successfully balances performance across tasks. Future improvements may include stronger data augmentation, class rebalancing techniques, and fine-tuning deeper backbone layers.