**Facial Recognition Using CNNs for Age, Gender, and Race Prediction**

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**Introduction**

In our project, we selected Convolutional Neural Networks (CNNs) for facial recognition due to their exceptional capabilities in image processing. CNNs excel at identifying patterns in visual data, making them a powerful choice for accurately predicting demographic attributes such as age, gender, and race. This project harnesses CNN’s strengths in feature extraction, image clarity enhancement, and complex pattern recognition, demonstrating how these models contribute to accurate demographic classification.

**Advantages and Challenges**

CNNs are recognized for their effectiveness in handling high-dimensional data, particularly images, by leveraging multiple convolution layers to identify intricate patterns. They offer significant benefits for demographic classification, including automated feature extraction and scalability for large datasets. However, implementing CNNs involves computational intensity and potential overfitting, especially when training on limited or unbalanced data. Another challenge in this project was ensuring balanced training across diverse demographic categories, particularly for race and age.

**Project Overview and Sample Work**

The core functionality of this facial recognition project lies in receiving a facial image and accurately predicting the individual’s age, gender, and race. We built four model types to explore classification accuracy: Support Vector Machine (SVM), Random Forest, and both optimized and unoptimized CNN models. Each model was tested for prediction quality, with CNN ultimately showing superior results in terms of accuracy and generalization.

**Conclusion**

This project underscores the potential of CNN-driven facial recognition for diverse applications, from social media to retail analytics. By continuously refining our approach, including data balancing and hyperparameter tuning, we achieved significant improvements in demographic classification accuracy. This exploration highlights CNNs as a promising technology, though future improvements in data quality and further model refinement could enhance the model’s performance even further.