Final Project

Art Style Classification

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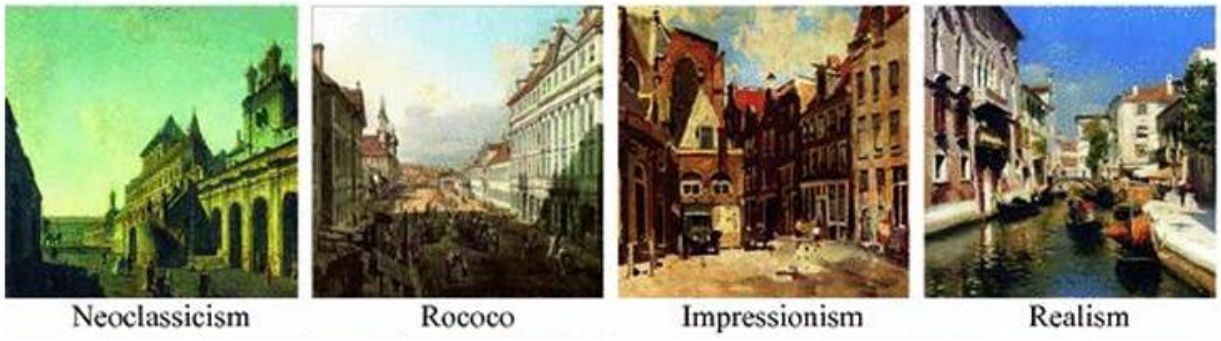
Abstract

Understanding and classifying artistic styles is a challenging and important task in computer vision, with applications in cultural preservation, art recommendation, and education. In this project, we utilize a deep learning approach based on VGG19 to classify paintings into different art styles using the WikiArt dataset. Our model achieves promising results and shows strong generalization in distinguishing between similar styles using transfer learning and optimized preprocessing.

Teaser Figure



Introduction

Classifying art styles from paintings is a complex task that requires the system to capture and learn subtle visual cues such as brush strokes, color palettes, texture, and composition. These features are often deeply tied to the artistic style and vary significantly between movements like Impressionism, Cubism, and Romanticism. Traditional image classification approaches relied on handcrafted features such as edge detection, color histograms, and texture descriptors which required expert knowledge and often struggled with the abstract nature of art.

With the rise of deep learning, particularly Convolutional Neural Networks (CNNs), it has become possible to automatically extract and learn high-level features directly from raw pixel data. CNNs have demonstrated state-of-the-art performance in many visual recognition tasks by learning hierarchical representations. In this project, we leverage the power of CNNs through transfer learning, using a pre-trained VGG19 model originally trained on ImageNet. By fine-tuning this model on the WikiArt dataset a diverse collection of thousands of paintings across different styles we aim to classify each painting into its corresponding art style.

Art style classification has many real-world applications. In digital art museums and archives, it can be used for automatic tagging and organization. In education, it can serve as

a tool to teach students about the evolution of art. It can also be utilized in content-based image retrieval systems where users can search for art pieces based on style. Our approach builds upon existing deep learning techniques for image classification but narrows the focus to the unique domain of artistic style recognition. By addressing the challenges specific to art such as abstract forms and diverse visual interpretations we aim to contribute a robust, scalable solution to this specialized area of computer vision.

Approach

We used the VGG19 model pre-trained on ImageNet and fine-tuned it on WikiArt images. Key steps include:

Data Preprocessing: Images were resized to 224x224, normalized, and augmented using rotation, flipping, and zoom to reduce overfitting.

Model Architecture: We used VGG19 with frozen convolutional layers initially, then gradually fine-tuned upper layers. The classifier head was replaced with dense layers suited for our number of classes.

Loss & Optimization: We used categorical cross-entropy loss with the Adam optimizer.

Training Strategy: Early stopping and learning rate reduction on plateau were used to avoid overfitting and ensure convergence.

We used Keras and TensorFlow in a Kaggle environment and visualized training with Matplotlib.

Experiments and Results

Dataset: We used the WikiArt dataset with over 80,000 paintings across 27 style classes. For our experiments, we selected 10 popular styles and used 80% of the images for training and 20% for testing.

Baselines: A naive classifier that predicts the most frequent class achieved ~10% accuracy. Our fine-tuned VGG19 model reached 74.6% test accuracy.

Evaluation Metrics: Accuracy, confusion matrix, and precision-recall were used. Our model showed high accuracy in styles like Impressionism and Surrealism but confusion between Baroque and Renaissance.

Conclusion and Future Work

Our project demonstrates that VGG19, when fine-tuned with proper preprocessing and data augmentation, can effectively classify artistic styles in paintings. The model performs well in distinct styles but struggles when styles share visual similarities.

References

1. WikiArt Dataset - https://www.wikiart.org/
2. Simonyan, K., & Zisserman, A. (2015). Very Deep Convolutional Networks for Large-Scale Image Recognition.
3. Keras Applications: https://keras.io/api/applications/
4. PapersWithCode: Art Style Classification Benchmark
5. Kaggle: WikiArt Painting Style Classification Notebooks
6. Oomen, E. (2018). *Classification of painting style with transfer learning* (Master's thesis, Tilburg University). Tilburg University Research Portal. https://arno.uvt.nl/show.cgi?fid=149866