The Stylistic Fingerprints of Art Genres

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Abstract

- Given the wide variety of paintings throughout history, the stylistic differences between genres is highly subjective and **requires the judgement of an "expert"**
- Using the dataset *Best Artworks of All Time*, this project trains a classifier to identify a genre within Impressionism, Post-Impressionism, Renaissance and Baroque when given a painting
- Clustering is also performed to find the relationship between latent structure and genre
- A **95% accuracy** was found for one vs. all multi-class classification using Support Vector Machines
- The latent structure produces non-overlapping clusters, but the clusters produced do not coincide with genre

Data Set

Best Artworks of All Time is a Data Set found on Kaggle that contains over 8400 paintings labeled by genre.[1]

Related Work

Gatys et. al in their paper *A Neural Algorithm of Artistic Style* demonstrate that **artistic style is extractable from an image[2]**

References

1. Kaggle Data Set: https://www.kaggle.com/ikarus777/best-artworks-of-all-time
2. Gatys et.al, A Neural Algorithm for Extracting Style
3. Christian Safka, Extract a feature vector for any image with PyTorch, https://becominghuman.ai/extract-a-feature-vector-for-any-image-with-pytorch-9717561d1d4c
4. http://www.subsubroutine.com/sub-subroutine/2016/11/12/painting-like-van-gogh-with-convolutional-neural-networks

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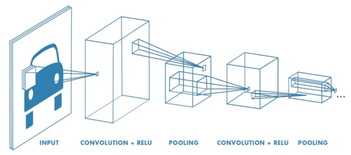
Sci-kit learn

Preprocessing

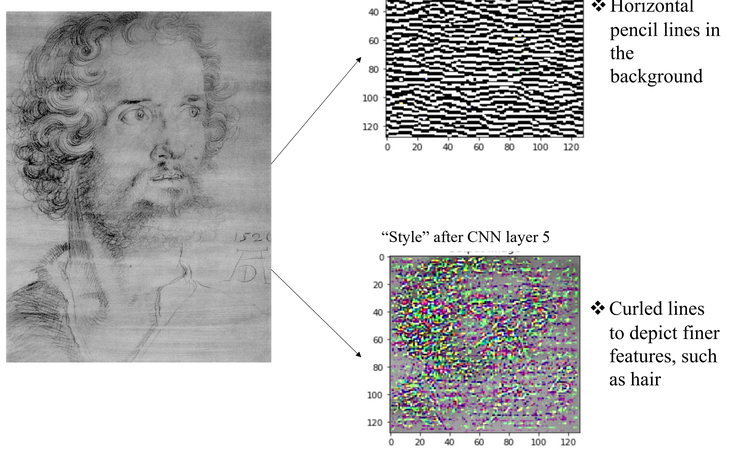
Using Convolutional Neural Networks to Extract Features

- Img2vec – extract a 512x1 Feature Vector for a given image
  - Using the pretrained convolutional neural network Resnet18[2]



- Extracting Style via Gram Matrices, as in *A Neural Algorithm of Artistic Style*
  - Using a 19 layer Visual Geometry Group (VGG) Convolutional Neural Network
  - Encodes information on similarity across the image without considering specific content thereby encoding style.[3]
  - After every layer of convolution: F_{ik} is computed. To compute the Gram Matrix F_{ik} is multiplied by its transpose

$$\text{Gram Matrix} = \sum_k F_{ik} F_{jk}$$

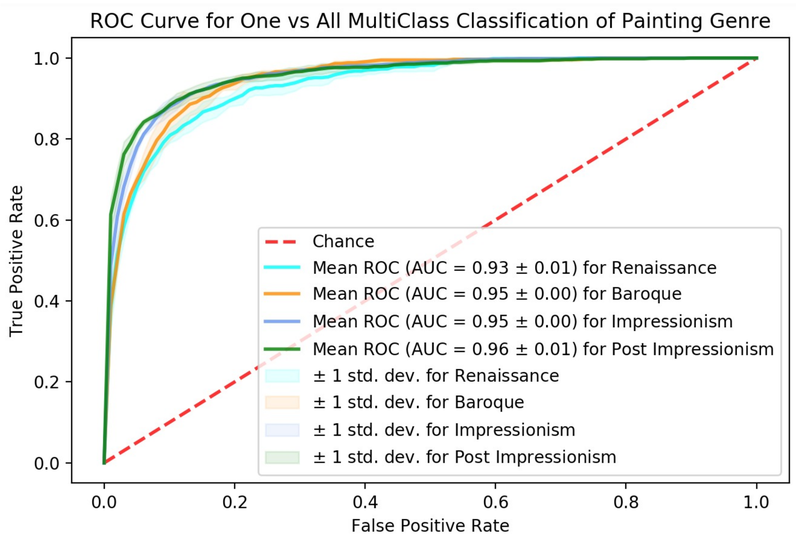


- Horizontal pencil lines in the background
- Curled lines to depict finer features, such as hair

Classification

Can quantitative methods distinguish between qualitative genres?

- Support Vector Machine (Linear Kernel), Random Forest (500 Trees), Naïve Bayes Gaussian were used
  - SVM Performed the best with an average AUC of **0.95**:

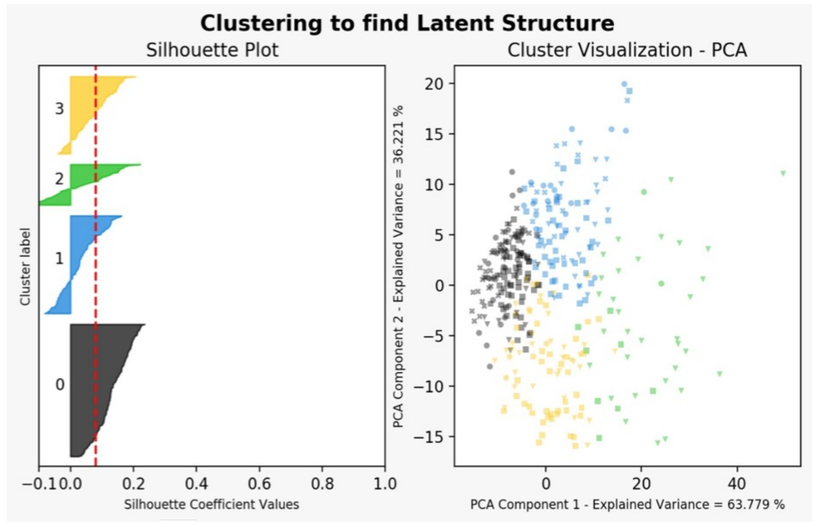


- Performed consistently well along cross validated folds indicating little over-fitting

Clustering

Does the latent structure in the paintings coincide with genre?

- KMeans and Latent Dirichlet Allocation were utilized for clustering.
  - LDA Silhouette Score is: -0.01
  - KMeans Clustering Silhouette Score is: 0.08:

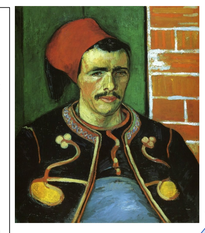


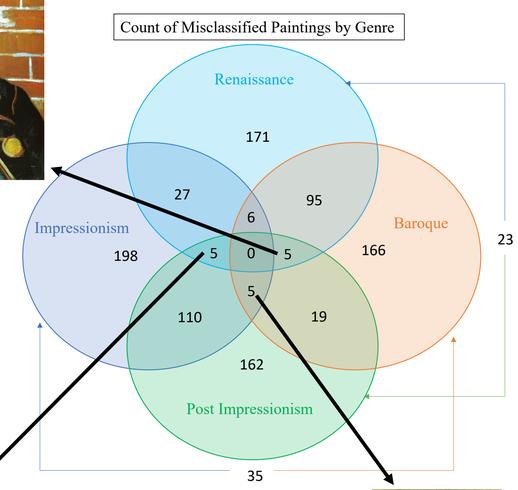
- The latent structure indicates that:
  - Post Impressionism and Impressionism are similar (Set A)
  - Baroque and Renaissance are similar (Set B)
  - Set A and Set B are differentiated more easily

Discussion

The boundaries between genres are sometimes blurry

- Correct Label: Post Impressionism
- Misclassified as Renaissance and Baroque
- Focus on facial features, characteristic of Renaissance
- Dark colors and faces as in Baroque





- Correct Label: Impressionism
- Misclassified as Renaissance and Post Impressionism
- Thicker brush strokes of post impressionism
- Biblical-like image of people as in renaissance

- Correct Label: Post Impressionism
- Misclassified as Baroque and Impressionism
- Dark colors of Baroque
- Small and thin brushstrokes, characteristic of impressionism

- Overall, genre could be successfully predicted from extracted features from paintings
- However, latent structure of clustering and some misclassified paintings suggest that there may be a different underlying categorization