Recognizing Chinese Calligraphy Styles: A Cage Fight

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Introduction

- Our goal is to recognize different Chinese Calligraphy script styles using machine learning models.
- Support Vector Machine (SVM), Softmax classification, k-Nearest Neighbors (kNN), Random Forests (RF), and Convolutional Neural Network (CNN) with different feature extraction techniques are compared in this classification problem.

Data

Figure 1: Five different Chinese calligraphy styles

Style	Train Set	Test Set
Regular	1500	505
Clerical	1500	500
Seal	1500	500
Running	1500	514
Cursive	1500	500

Table 1: Description of dataset

Methodology

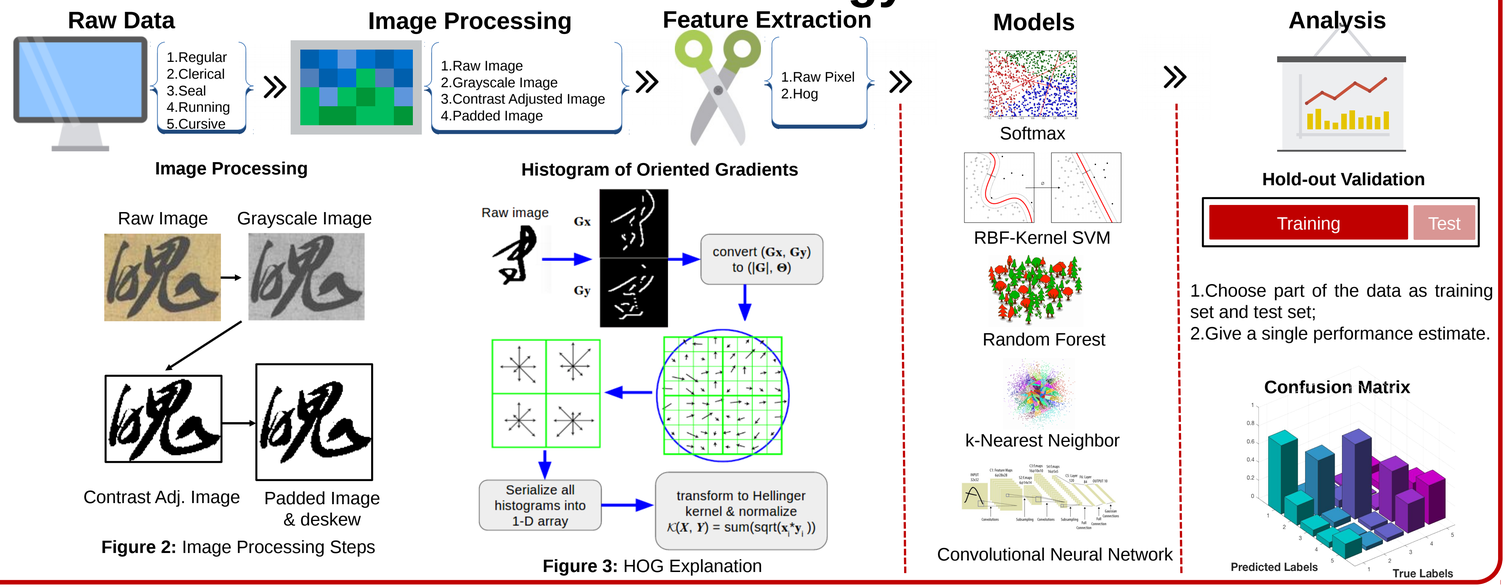


Figure 2: Image Processing Steps

Figure 3: HOG Explanation

Experimental Results and Analysis

- Confusion Matrix for Each Model

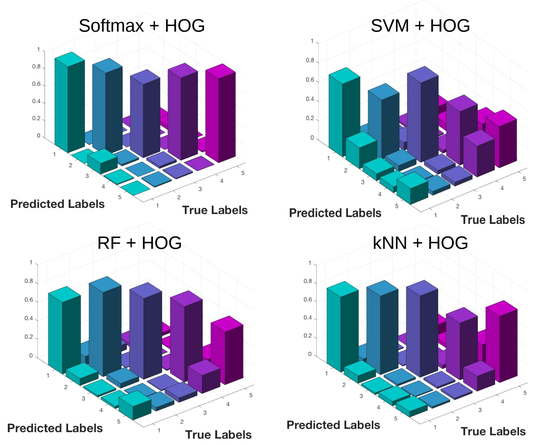
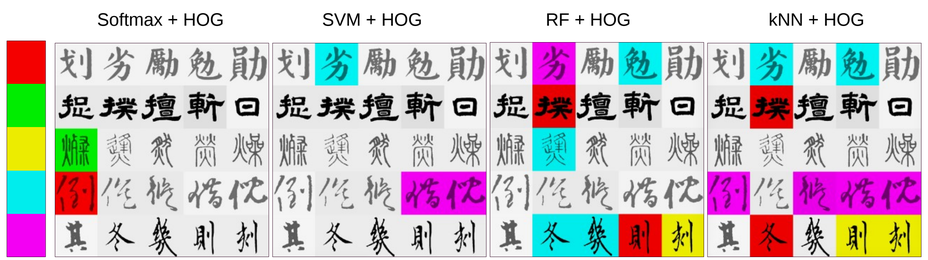


Figure 4: Confusion Matrix for 4 Different Models
the order of labels is Regular(1), Clerical(2), Seal(3), Cursive(4), Running(5)

Rank	Algorithm	Training Accu.	Testing Accu.	Confusion Covar.
1	Softmax Classification + HOG	96.80%	95.55%	0.9415
2	CNN (11 Layers) *	90.11%	88.64%	*
3	Support Vector Machine + HOG	86.37%	78.76%	0.6104
4	Random Forest + HOG	90.11%	78.52%	0.7356
5	Softmax Classification	85.31%	71.89%	0.6123
6	K-Nearest Neighbor + HOG	79.93%	63.51%	0.7681

Table 2: Ranking Board: Who is fittest for the job?



1. CNN (11 Layers) * is the result cited from Boqi Li, " Convolution Neural Network for Traditional Chinese Calligraphy Recognition", CS 231N Final Project.

Conclusion

- For this classification problem, Softmax classifier with HOG descriptor outperforms all other ML algorithms, including CNN and SVM.
- Softmax with HOG can even beat human judgment with respect to running and cursive styles.
- Traditional ML with relevant features can be more accurate and efficient than CNN, while CNN can do excellent jobs without designing features (domain knowledge)
- Feature extraction is the key factor to this problem.

Future Works

- Train our models to classify Calligraphers' styles. (maybe new feature is needed).
- Build a more complex CNN configuration to complete the more sophisticated tasks.