MATH6380O Mini-Project 1
Image Classification with Extracted Feature

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Outline

1. Preprocessing data
2. Feature Extraction
   - Scattering Net
   - ResNet-50
3. Classification
4. Discussion

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Outline

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More Samples from Limited Paintins

Original data: 28 paintings totally, 12 genuine, 9 fake, 7 unknown.

Crop more samples from one single painting, that is, we crop 200 samples with 224*224 size.

Random cropping does not work well.

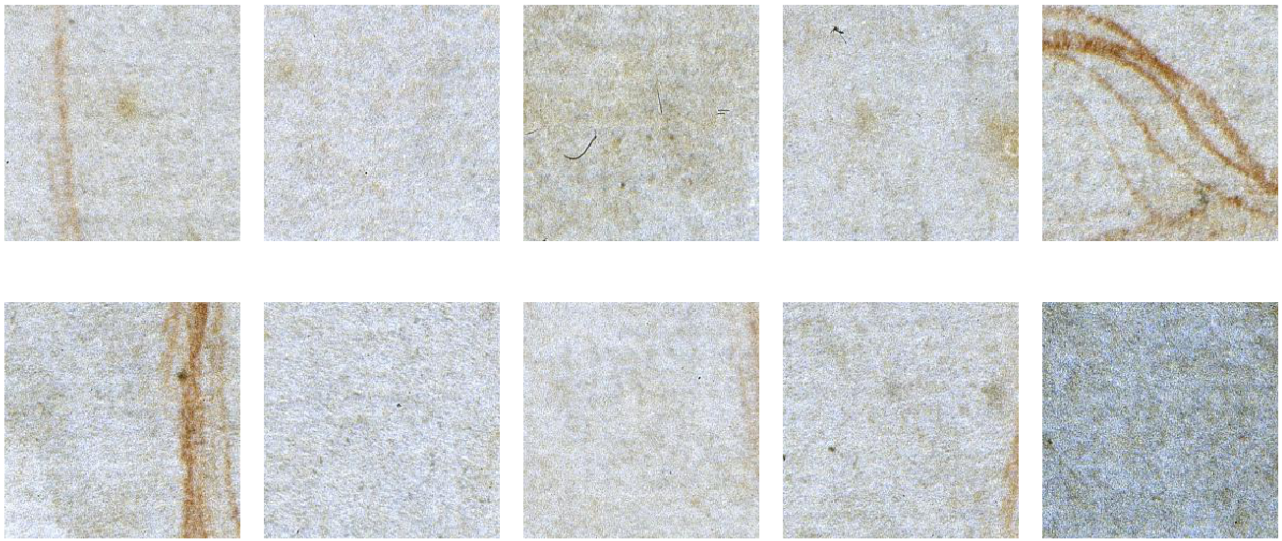

Figure: Painting No.9

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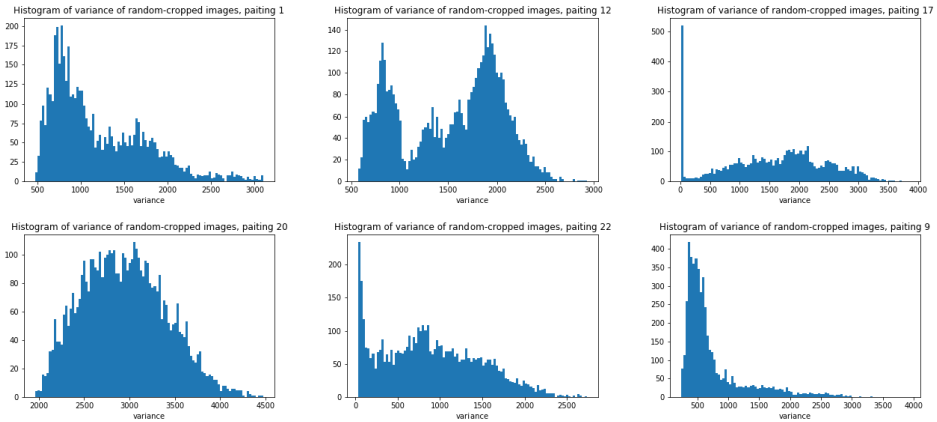
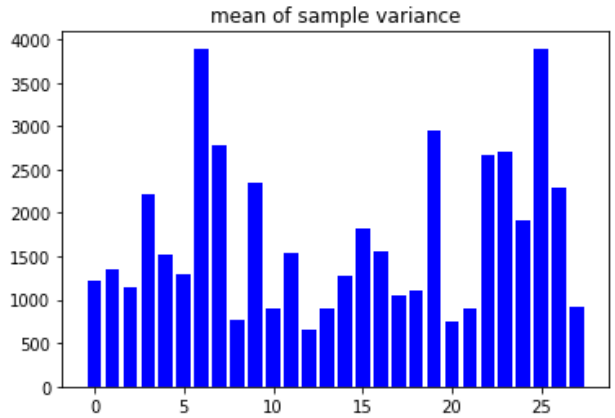
Variance Threshold

We randomly crop 5000 samples from each paintings and compute their variance, whereby we get empirical distribution of variances.





Small variance may represent empty sample. We could set a proper threshold to distinguish meaningful samples from empty ones.

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Variance Threshold

First, for every painting we set 90^{th} percentile as variance threshold to select samples cropped randomly. But it does not work well. Then we pre-crop paintings with edges like No. 18 and then crop them randomly with variance threshold.

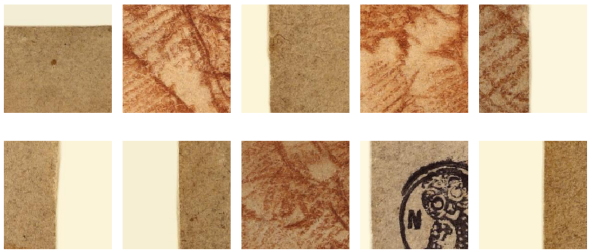


Figure: Samples from No. 18

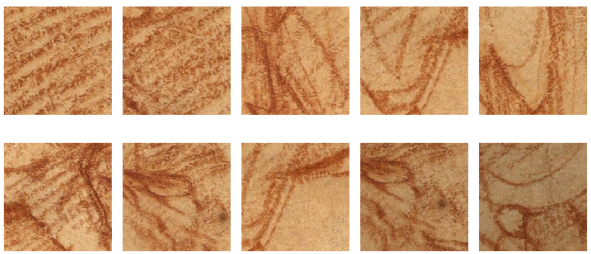
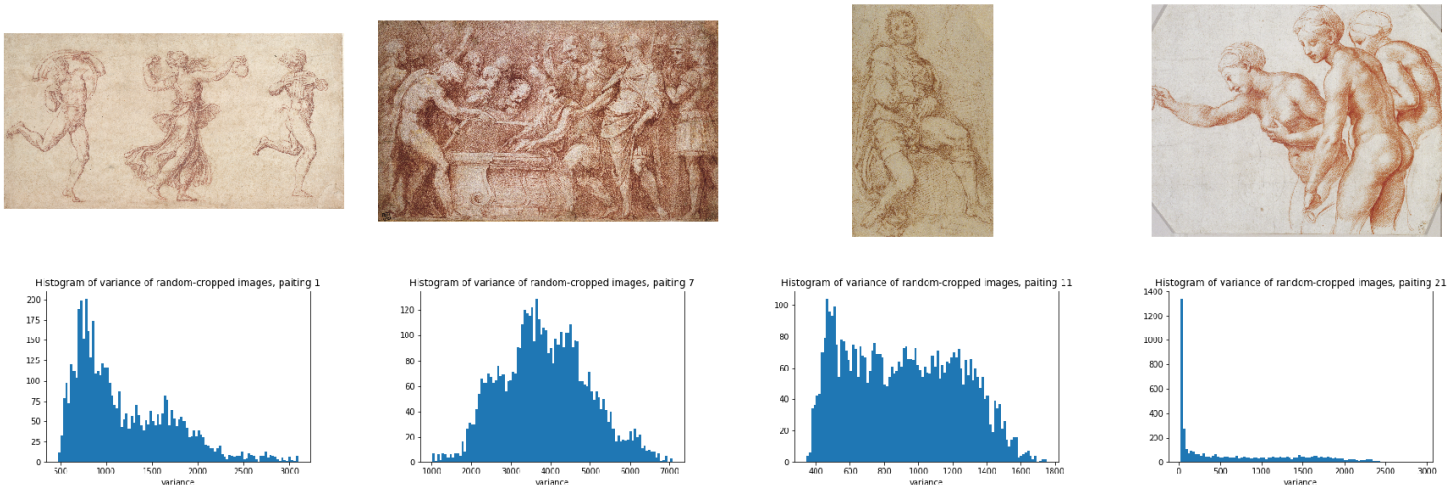


Figure: Samples from pre-cropped No. 18

Figure: Painting No. 18

Choose a Proper Variance Threshold



If we choose large variance threshold, we could only crop samples from small area. How to choose a proper variance threshold? In project, we simply choose 45^{th} percentile as variance threshold.

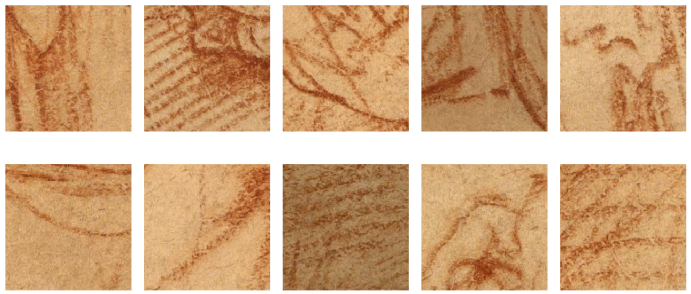


Figure: Samples with 45^{th} percentile from No. 18

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Parameters of Scattering Net

We use the package ScatNet 2.0 from ENS.

Parameter setting

- filt_opt.J = 5, the number of scale of wavelets (high pass filters)
- filt_opt.L = 6, the number of orientations
- scat_opt.M = 3, the maximum scattering order (layers of scatter net)

Samples are RGB small images. We implment scattering net on each channel and then concatenate transformed feature together as a single vecter.

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RestNet 50

- We use a pre-trained ResNet-50 model on Image Net trained by Tensor flow.
- Data pre-processing.
- Remove last layer and use the output as feature.

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Classification Methods

Use features extracted by CNN and Scatter Network

- Linear Regression
- SVM
- KNN

Fine tune ResNet 50

Results on extracted features

Leave one out scheme for testing

Features	Classifier	Acc on sample	Acc on painting
ResNet50	SVM	66.7%	65.8%
	KNN	71.4%	65.1%
	Logistic Regression	81.0%	71.4%
Scatter Network	SVM	77.3%	80.9%

Data splitting for ResNet 50

- Pre-select samples of 7 paintings as test set.
- Pre-select 20% in training set as validation set
  One concern is that features of samples from the same painting are similar.
- Trained on a 1080ti GPU.

Results

- Accuracy on samples: 84.28%
- Accuracy on paintings: 85.71% (6/7)
- Voting result:

Painting	#1 Not	#2 Not	#3 Yes	#4 Yes	#5 Yes	#6 Yes	#7
Voting Acc	199/200	200/200	200/200	200/200	181/200	0/200	200/200

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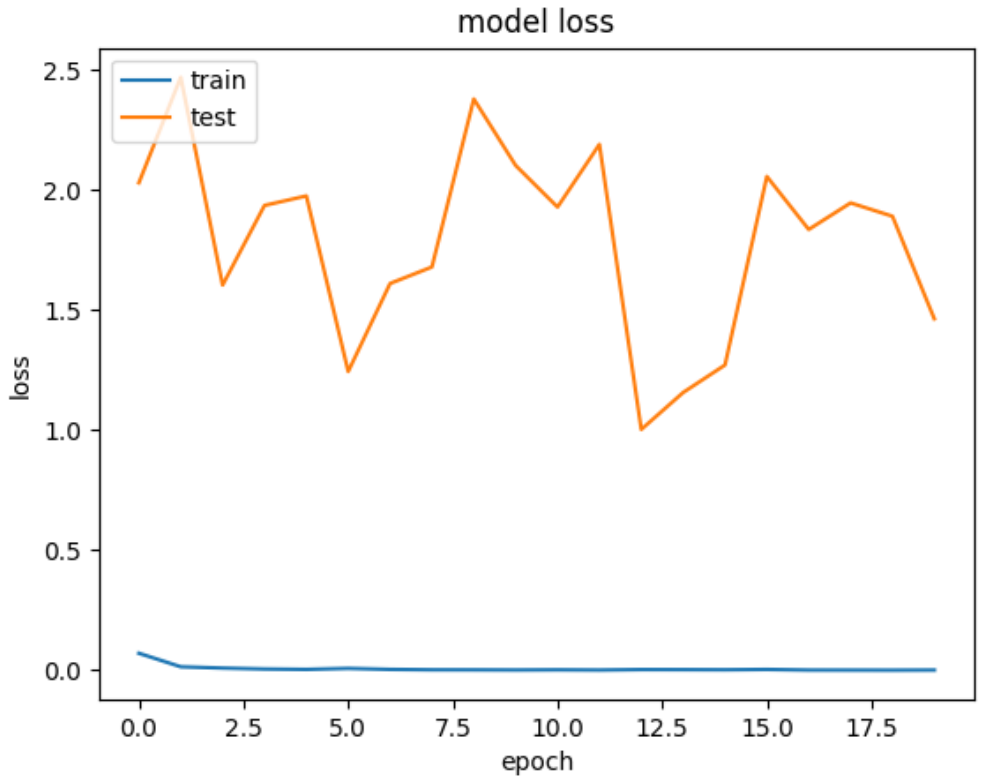
Training Losses

During the first epoch, the training acc is about 100%.



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Re-choose training and validation set

- The validation set are all non-Raphael paintings while the training set is consist of mostly Raphael paintings.
- Split the data again, and use most of the non-Raphael paintings as training data.

Result

- Accuracy on samples: 31.9%.
- Accuracy on paintings: 28.6%.
- Voting result:

Painting	#1 Not	#2 Not	#3 Yes	#4 Yes	#5 Yes	#6 Yes	#7 Yes
Voting Acc	200/200	200/200	0/200	1/200	0/200	0/200	46/200

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Conclusion

- The dominant factor is which painting the sample belongs to.
- The network draw a boundary for Rapheals paintings out, and hopefully they are close to each others. So we have many true positive cases.
- But the boundary is not accurate, so it leads to many false negative cases.

Q&A

Thank you for listening!

Q&A

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