Assignment 2

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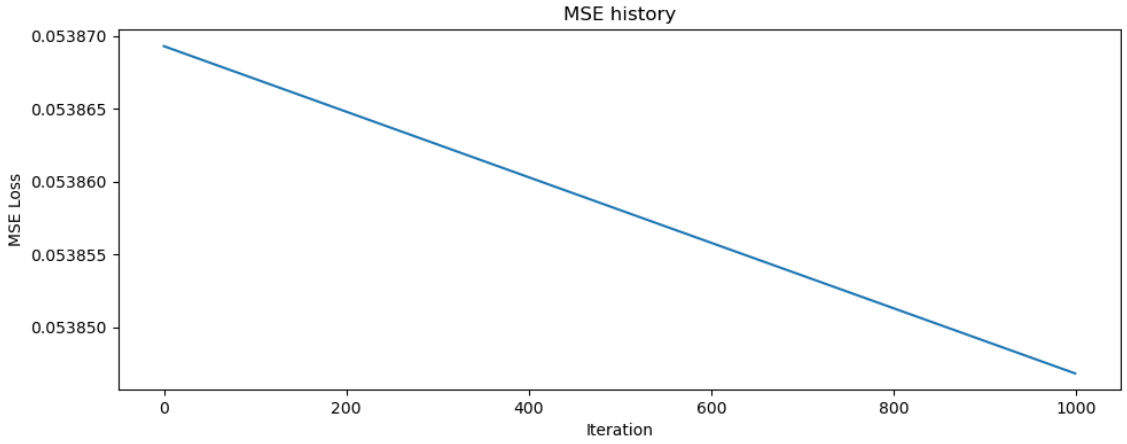
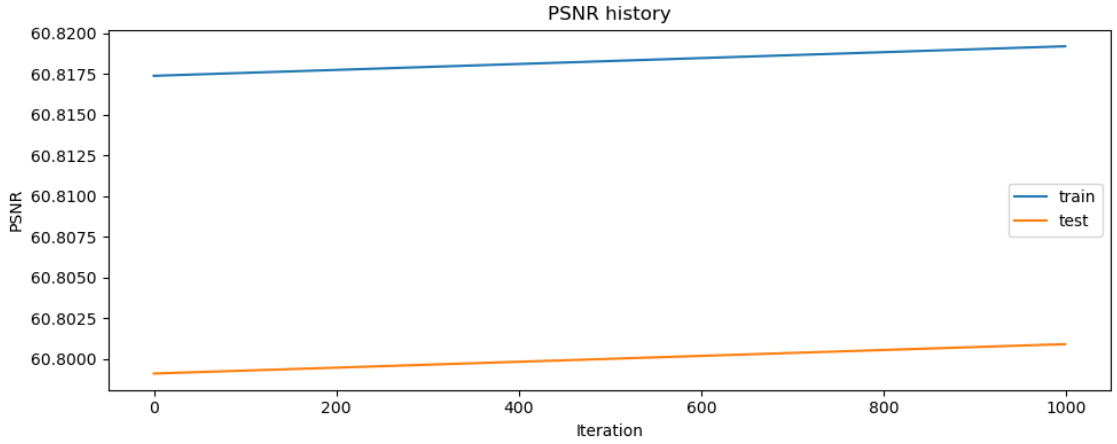
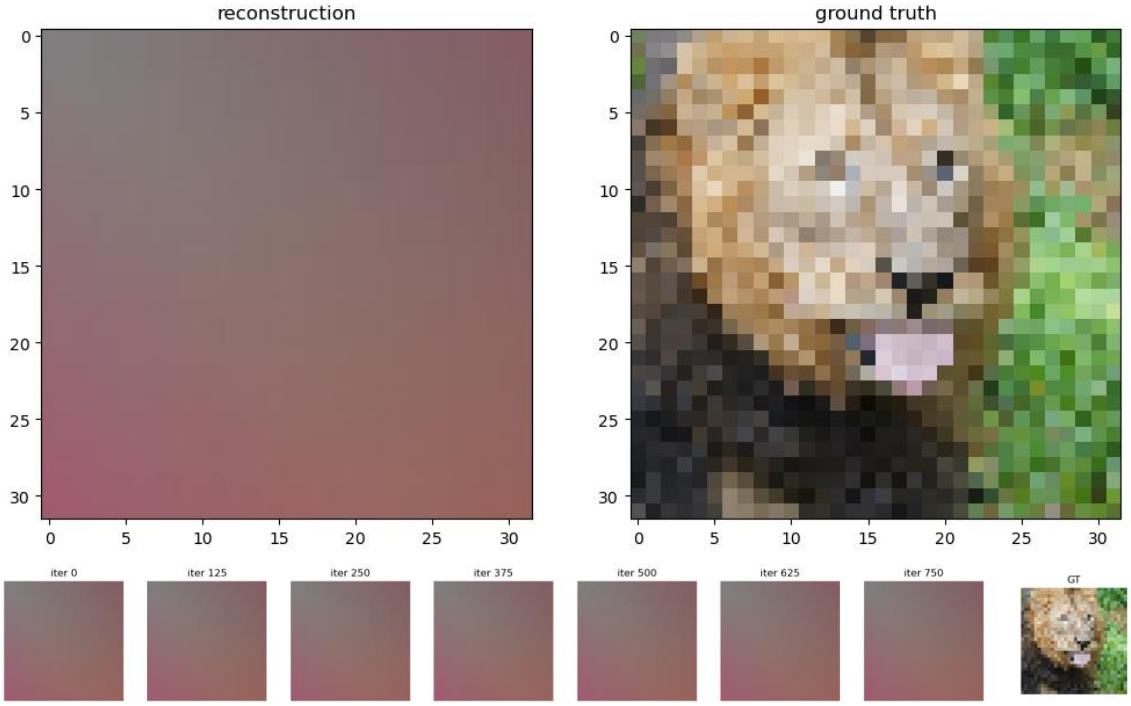
In each the following parts, you should insert the following:

- Train/test loss plots
- Qualitative outputs for GT, No encoding, Basic Positional Encoding, and Fourier Feature Encoding

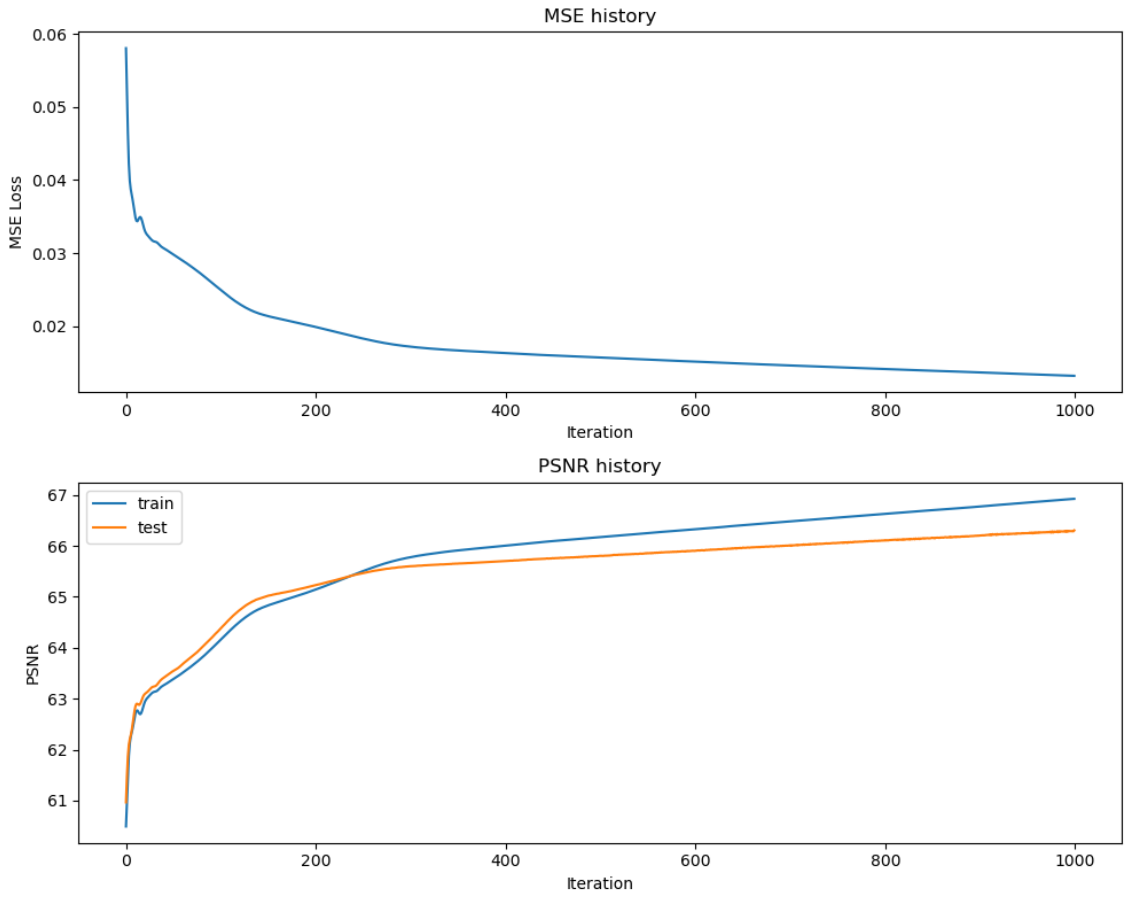
Part 1: Low resolution example - SGD

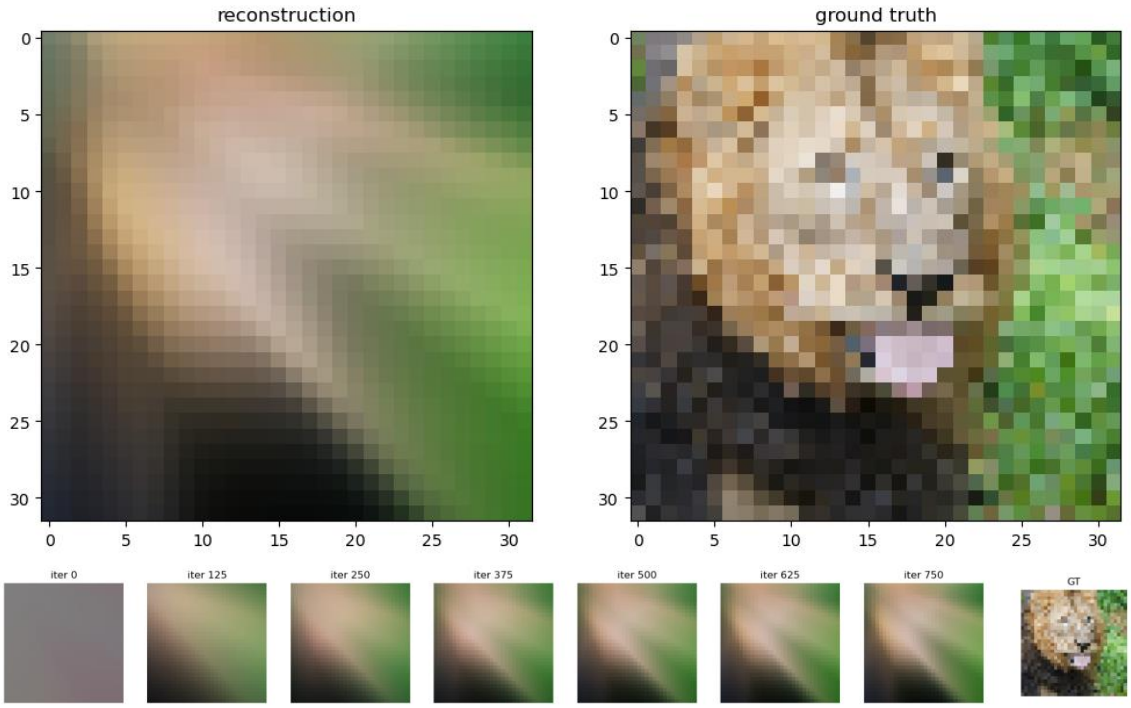




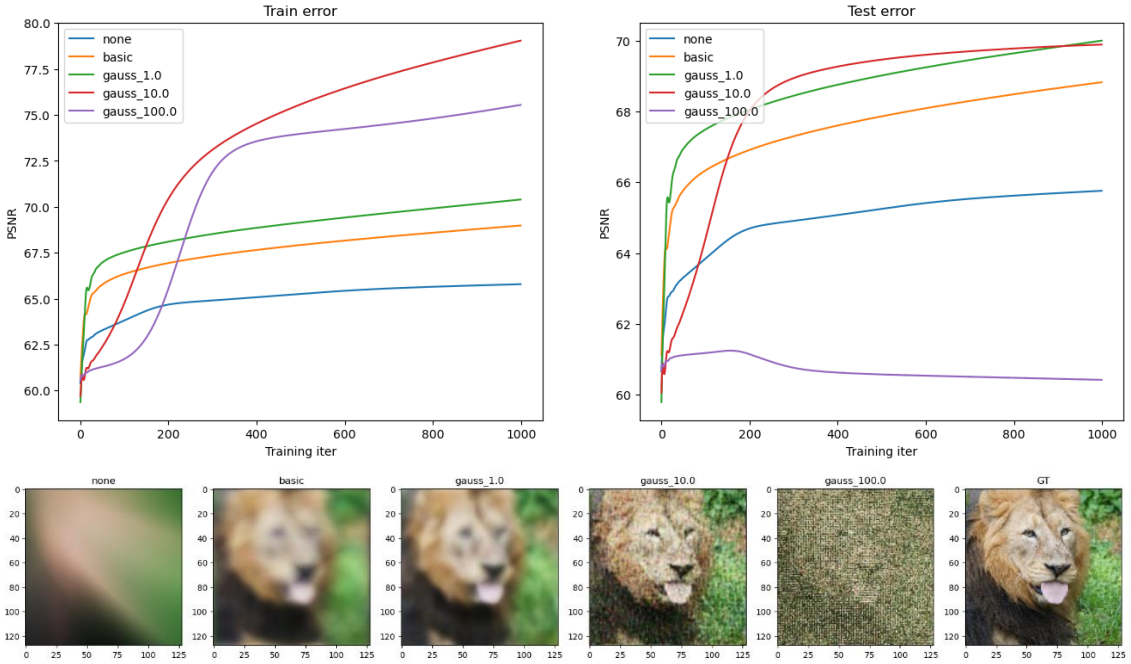


Part 2: Low resolution example - Adam



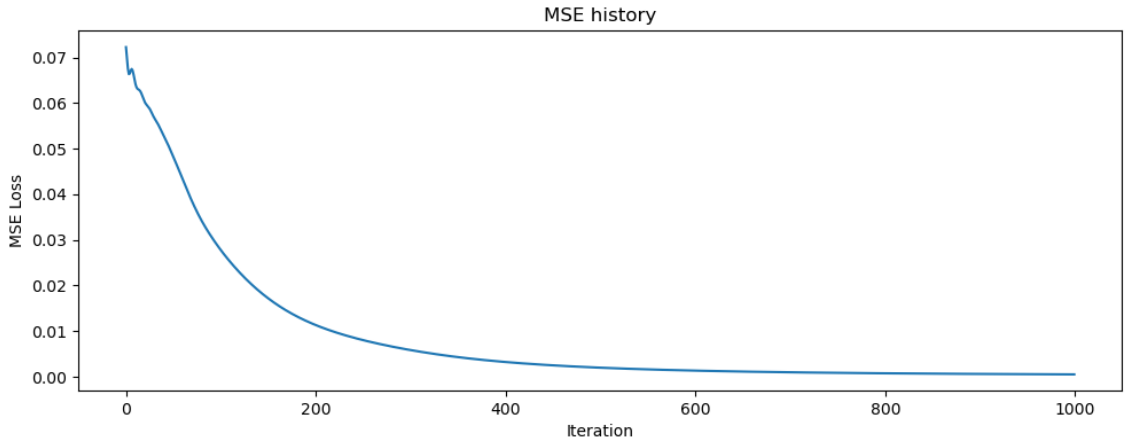


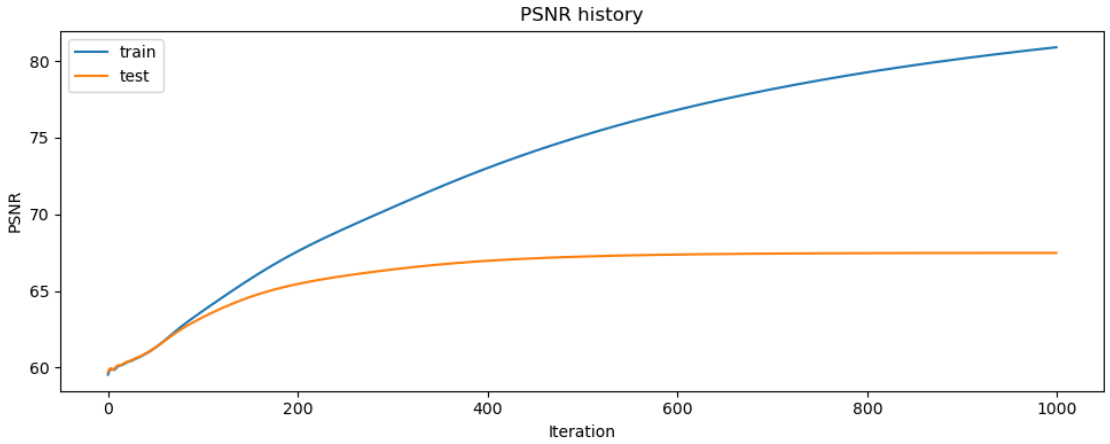
Part 3: High resolution example

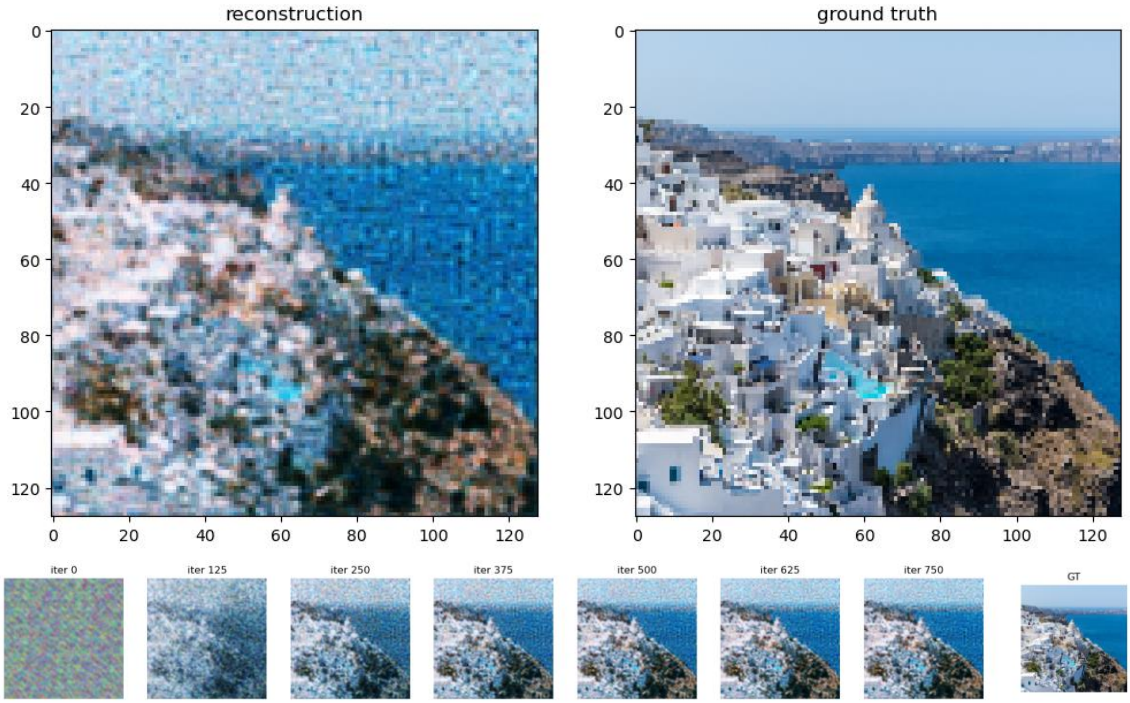


Part 4: High resolution (image of your choice)

(For this part, you can select an image of your choosing and show the performance of your model with the best hyperparameter settings and mapping functions from Part 3. You do not need to show results for all of the mapping functions.)







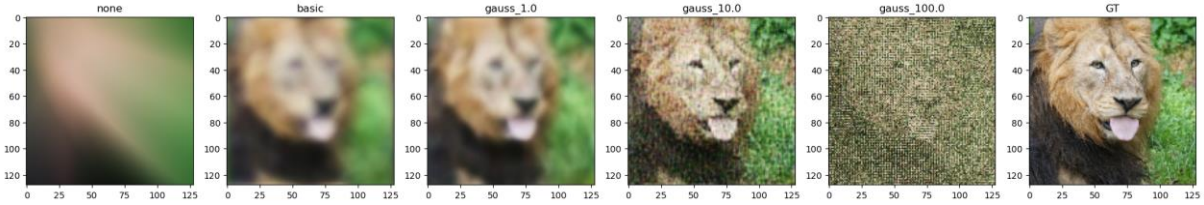
Part 5: Discussion

Briefly describe the hyperparameter settings you tried and any interesting implementation choices you made.
Number of layers = 4
Hidden layer size = 256
Epochs = 1000
Learning rate =1e-4
Optimizer = Adam
Mapping = Gaussian with size 10

How did the performance of SGD and Adam compare?
The performance of Adam is better than SGD in low resolution reconstruction.

	MSE	PSNR
SGD	0.0541	60.8009
Adam	0.0152	66.3041

How did the different choices for coordinate mappings functions compare?
Among all feature mapping strategies, the reconstructed image of Gaussian distribution with size 10 is the best, as shown in the figure below.



Do you make any interesting observations from the train and test plots?
As the iterations increase, the PSNR of the training data is higher (better) than the testing data. In addition, the PSNR of the testing data increases more and more slowly. This means that our model is overfitting the training data set. Therefore, our further improvement would be to reduce the number of layers or hidden layer size of the model.

What insights did you gain from your own image example (Part 4)?
From our own image, we found that Fourier Features Let Networks is good at learning the high frequency details of the image (the boundaries of the sky, ocean, and the buildings), but is bad at learning low frequency parts (details in the large area of the sky and the sea).

Part 6: Extra Credit

Explain what you experimented with in detail and provide output images.