Machine Learning Homework2

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I. Introduction

This is the second homework in the Machine Learning class. The title in this session is Signal Representation Using Sparse Prior. There are 3 claim for this assignment. First is learn two dictionaries respectively for the data in each folder. Second is learn two convolutional dictionaries respectively for the data in each folder. Third is show the sparse approximations of each image using the learned dictionaries. But I have only completed the first goal.

II. Experimental and result

In the first question, our goals are as follows. we want to reconstruct images with a sparse representation and a dictionary. The target picture is as follows.(fig.1)

Fig. 1. target images

A. Claim 1

In the first claim, We have to first create a dictionary(D) and an alpha(a) so that I can get my original image by $D * a$. In order to achieve our goal, we must create two graphs in the program, one for updating D and the other for updating a. First, I resize my input image into (256 * 256), then cut the size of each (16 * 16) into a patch. Each patch will be flattened and became my target image(y). Then we start our training step. In the process, a and D will be interactively trained 10,000 times. After the training, I tried to multiply the trained a and D to check if I could get the same image as the original image. The result image is below.(fig.3)

I also tried to reduce the image to (64*64), change the size of the patch to (8*8) and see the result of his restoration.(fig.4)

From the results, we can clearly see that when the image size is large and the number of patches is relatively large, our dictionary accesses more details, so the restored image will be clearer.

B. Claim 2

In the claim 2, we have to learn a convolutional dictionary respectively for the data. In this question, I have not thought of any way to solve this problem at present.

Fig. 2. target image

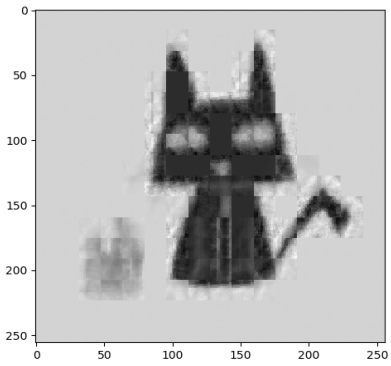

Fig. 3. result image 1

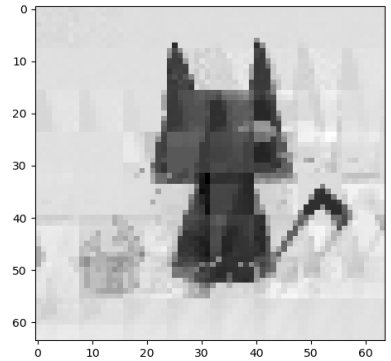

Fig. 4. result image 2

C. Claim 3

In the Claim 3, we need to find a sparse approximations of each image. In this question, I used the dictionary I trained in claim 1. Then retrain my a and add a limit after each training. When the value in my a is less than 1e-8, change it to 0 to achieve the sparse effect. But because the program is still executing, the result graph cannot be presented here.