

LBA Assignment

Duy Pham

CS156: Machine Learning (Professor Sterne)

Minerva Schools at KGI

April 20th, 2019

Pictures:

I took the pictures on the 9th floor of Hotel Le Petit on three days, with the time ranging from 2 pm to 7 pm each day. There are a total of 27 pictures taken by my iPhone 6s camera.

Without a tripod, the pictures are not particularly similar to each other, which explains for the unclear reconstructed images. Below are some of the original images:



Resize to 250x250 pixels

I converted the images to 250x250 pixels as the quality does not differ significantly compared the images with 512x512 pixels.

Location of the pictures in the 2D graph after PCA with 2 components

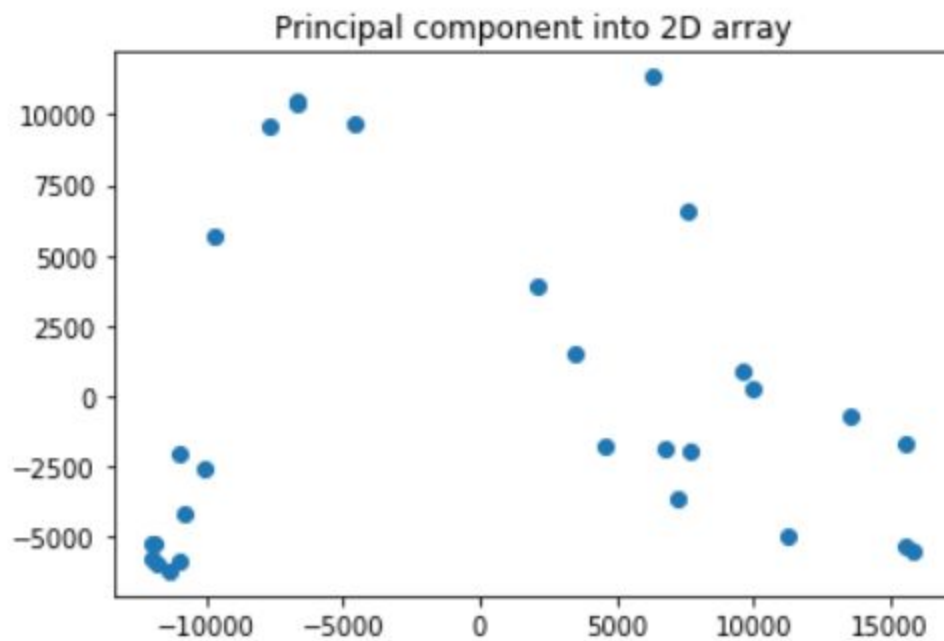


Figure 1. The space of the pictures in the 2D graph. There are a few images that combine into a cluster in the bottom left of the graph, resembling the pictures that are taken on the same day, where the angle and position of the picture do not differ significantly.

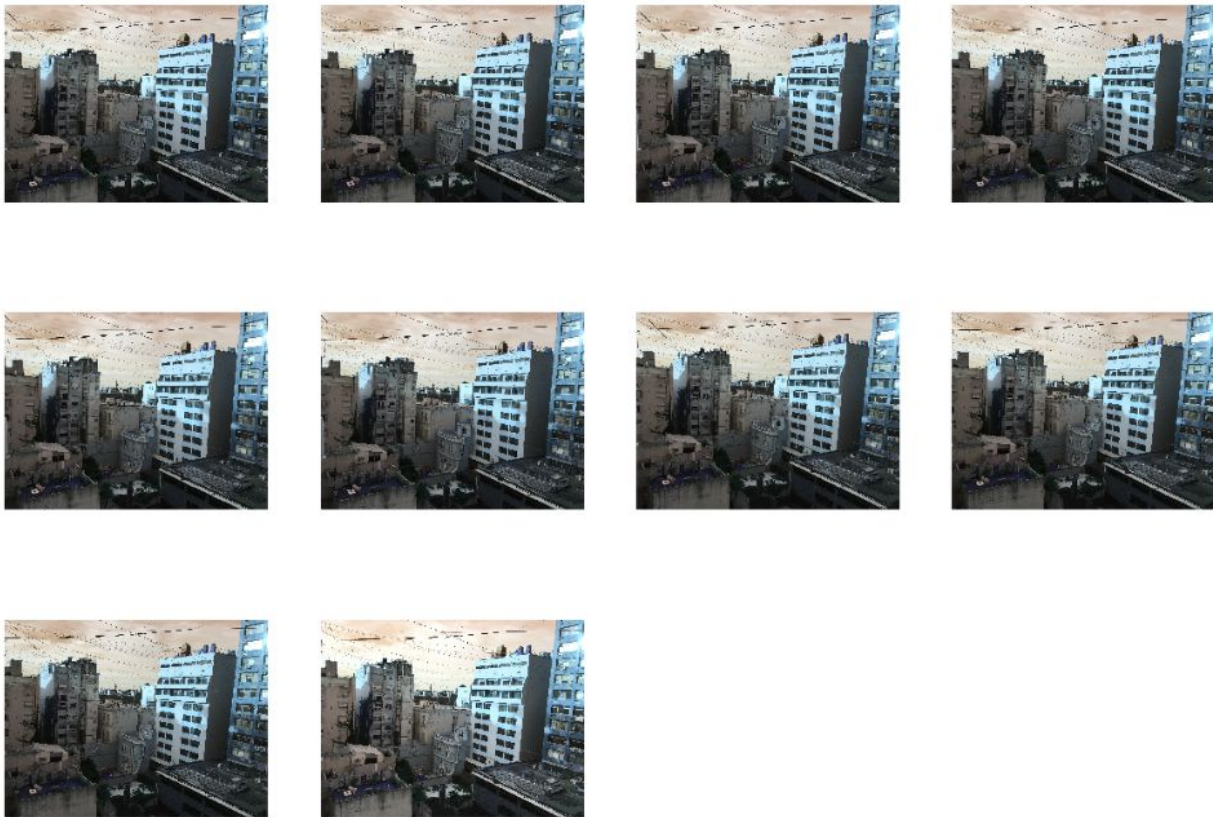
From the graph above, the PCA method does not seem to be performing well. Checking the explanatory power of the PCA method above, it can only explain 46% of the total dataset. The 1st component explains 34.7% and the 2nd component explains 11.3%. This low explanatory

power can come from the angle differences in each picture (due to the lack of tripod) and the time differences in each picture (which impacts the lighting of the pictures).

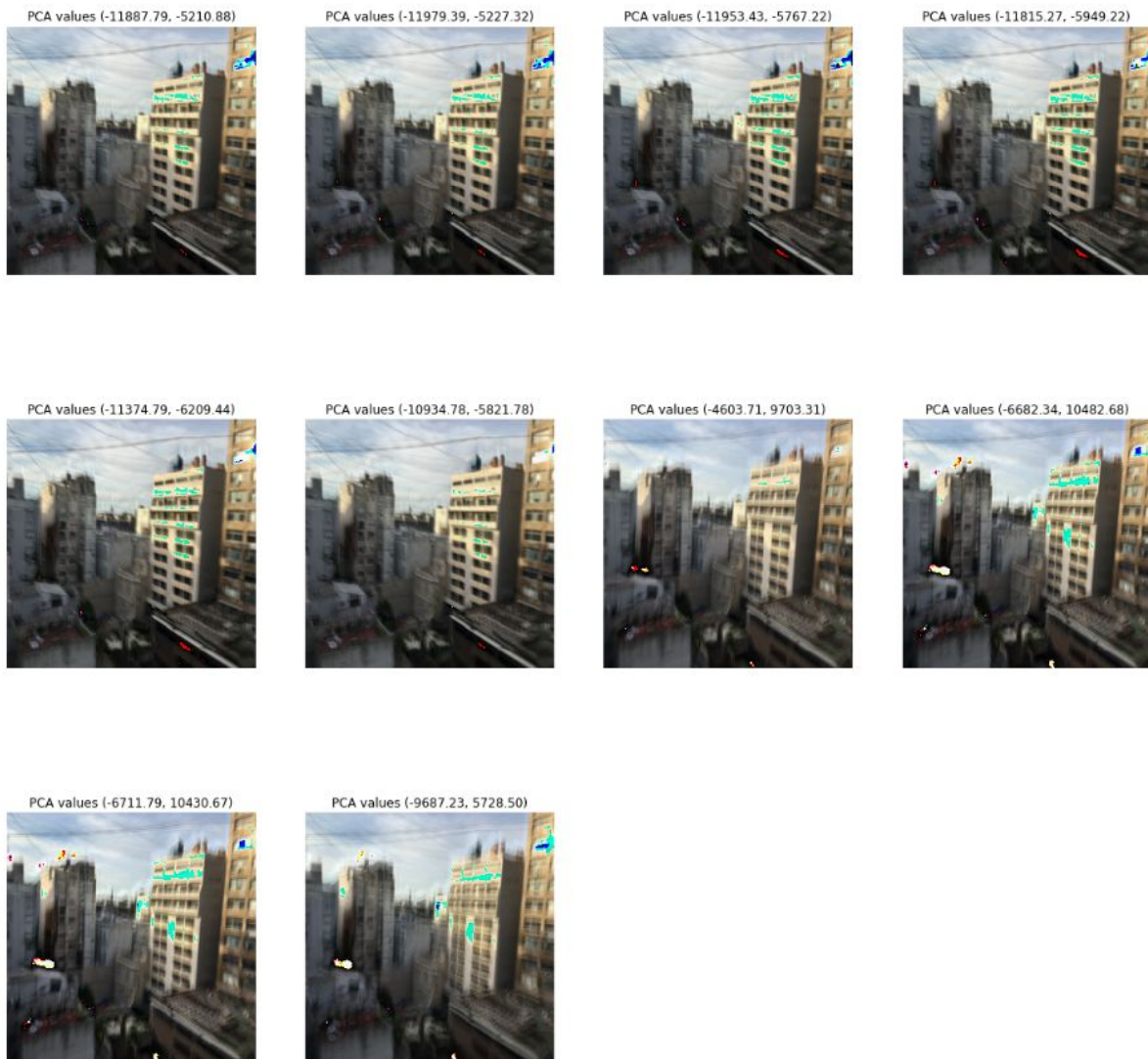
Reconstruct the images

I reverse-transformed the 2D array into an array that can represent a picture. From that array, the images are as follows:

Original images:



Picture 1. The first 10 original images

Reconstructed images:

Picture 2. The first 10 reconstructed images

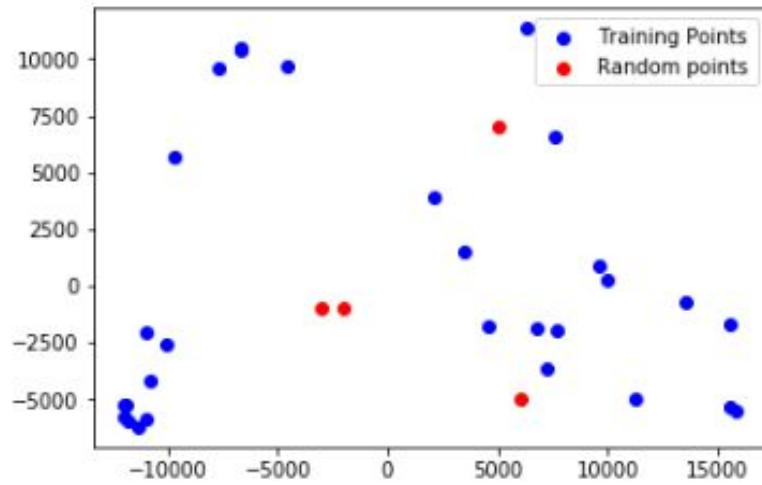
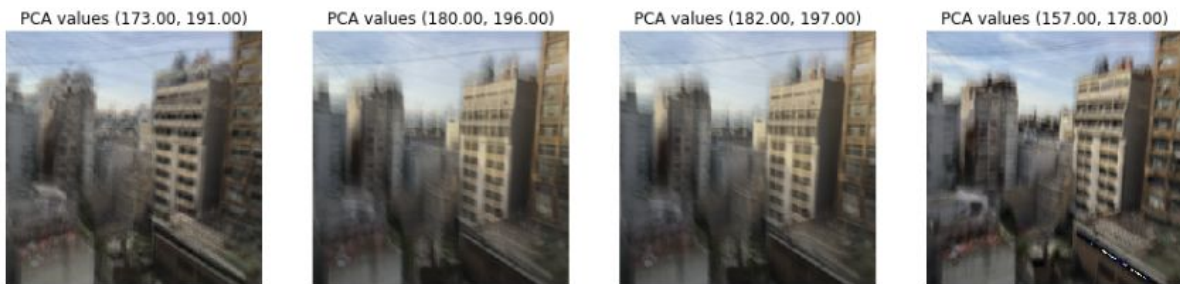
Reconstructed images from random points:

Figure 3. Generated points plotted in a 2D graph



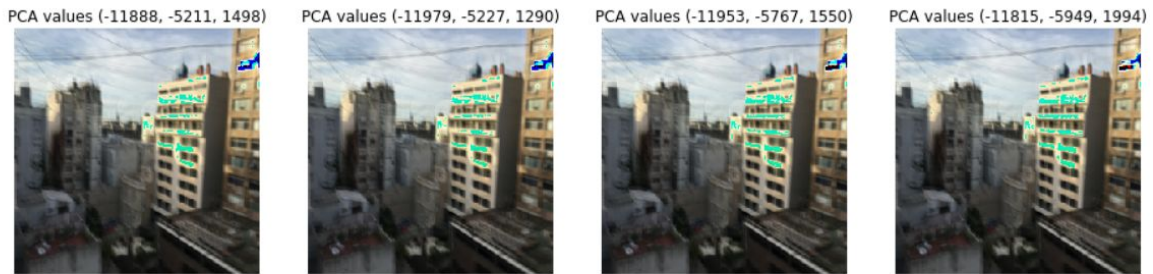
Picture 4. Reconstructed images from random points

Transform the images using PCA with 3 components

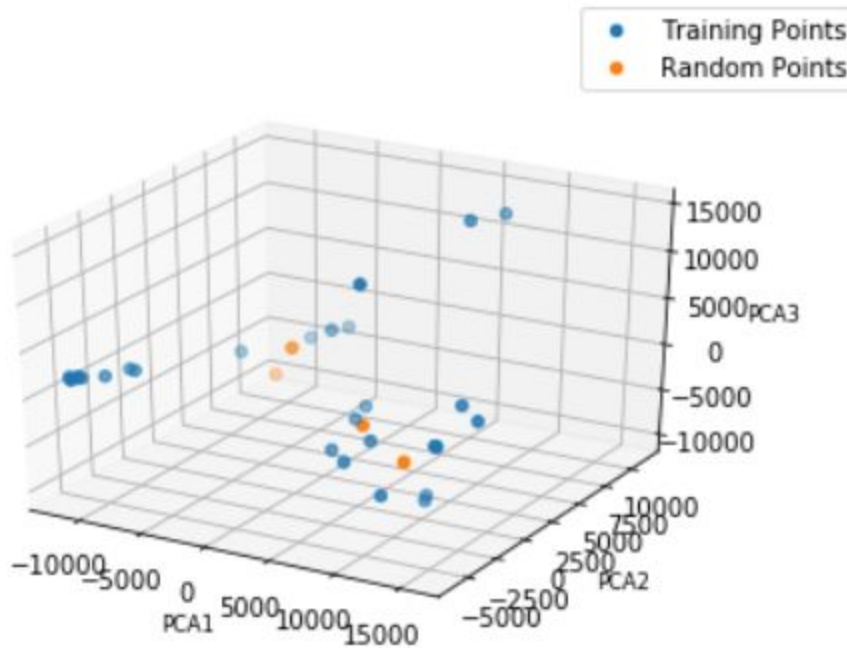
Original images



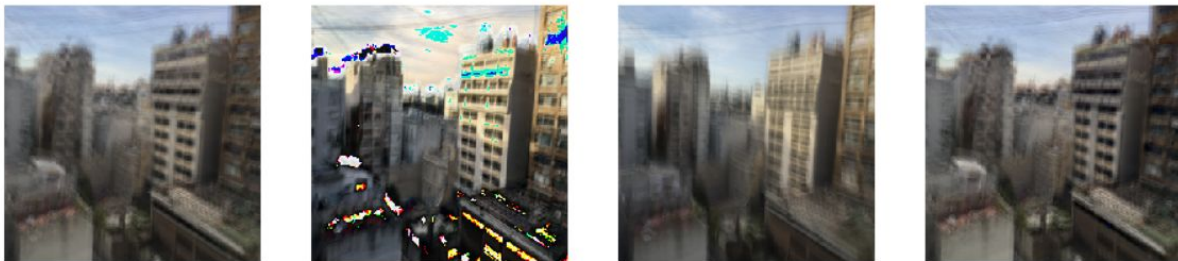
Reconstructed images



Picture 5. Reconstruct the images after using PCA 3 components. The reconstructed images this time are better, as the PCA can explain 57% of the dataset, compared to 46% of the dataset in the PCA 2 components.



Picture 6. Choosing four random points within the 3D space, then reconstruct the images from these points



Picture 7. The reconstruction of four images from four random points.

The higher explanatory power of PCA (3) (57% compared to 46% of PCA (2)) is valuable only when we attempt to reconstruct the original images. If we attempt to reconstruct images from a random point in a high dimensional space, the high explanatory should not be considered, unless

the random point is close to one of the original data. For that reason, the reconstruction of random points after PCA 2 components and PCA 3 components have somewhat similar quality.