

## Exercise 5

### Machine Learning in Graphics & Vision

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#### 5.1

a) Visualization of the first 5 principal components:

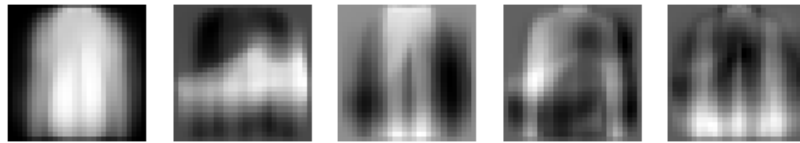


Figure 1: 5.1a, output of *compute\_pca(x)*, first 5 principal components.

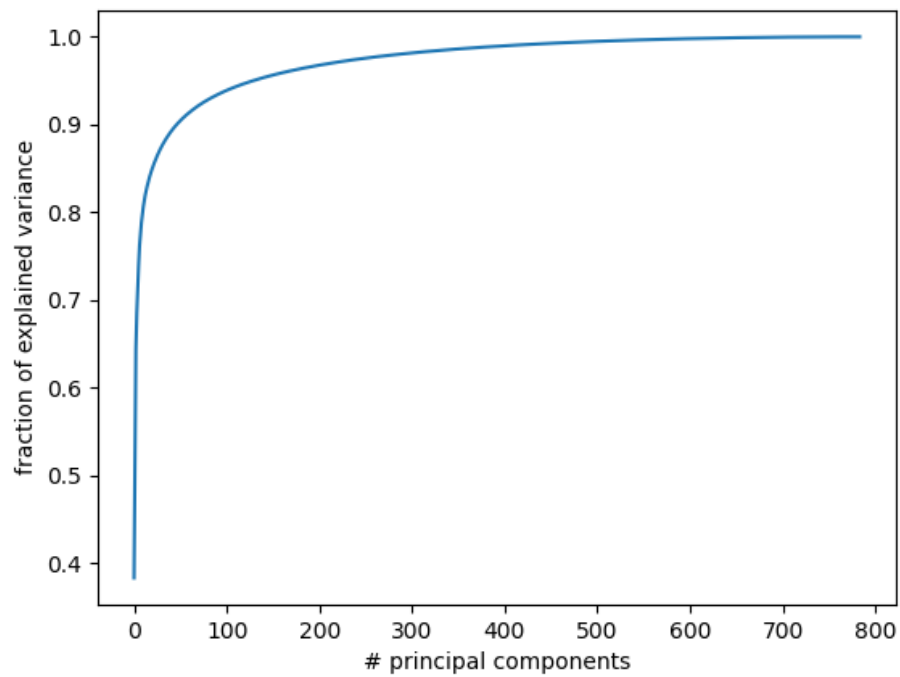


Figure 2: 5.1b, the percentage of explained variance over the number of principal components.

- (b)
- |                         |     |
|-------------------------|-----|
| Entries to achieve 50%: | 1   |
| Entries to achieve 90%: | 47  |
| Entries to achieve 95%: | 129 |
| Entries to achieve 99%: | 404 |

(c) Reconstruction:

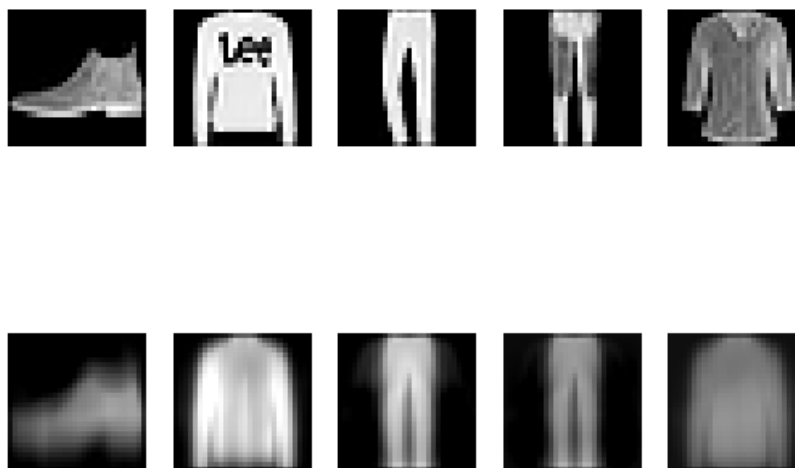


Figure 3: 5.1c, reconstruction after compression with PCA.

Mean Squared Error: 0.035497293  
Compression Ratio: 156.8

(d) Sampling from a gaussian distribution:

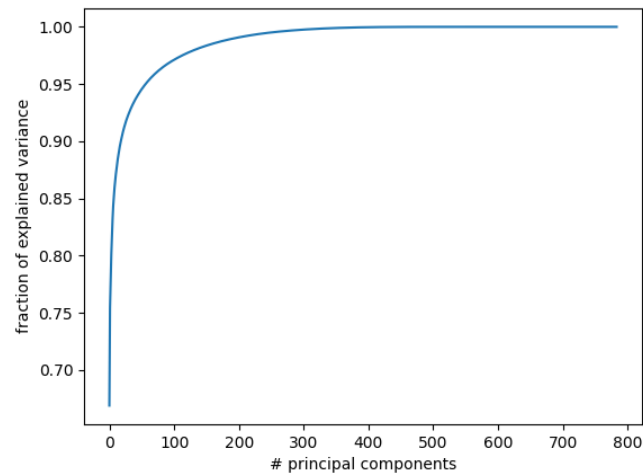


Figure 4: 5.1d, Synthetic generated samples from a Gaussian distributed model with 5 principle components.

**Do they look realistic?**

There are some recognizable contours, but they do not really look realistic.

- (e) By applying PCA only to the Sneaker-subset, we can obtain better results as shown in the following figures:



(a) cumulative distribution



(b) principal components

The other outputs like needed principal components to achieve proper variance of the data decreased and the mean squared error is lower too:

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Entries to achieve 50%: 0  
Entries to achieve 90%: 18  
Entries to achieve 95%: 56  
Entries to achieve 99%: 193  
Mean Squared Error: 0.015440599
```



(a) reconstruction



(b) synthetic samples

Figure 6: 5.1e, results after applying PCA only to the Sneaker-subset. As we obviously can recognize, the reconstruciton results and the synthetic generation of samples are better than in the tasks before.