Bilkent CS 464
Homework 2 Report

Vesile İrem Aydın
21902914

Question 1.1

Proportion of variance explained (PVE) for each of the principal components and their sum for each Xi (red, green, blue)

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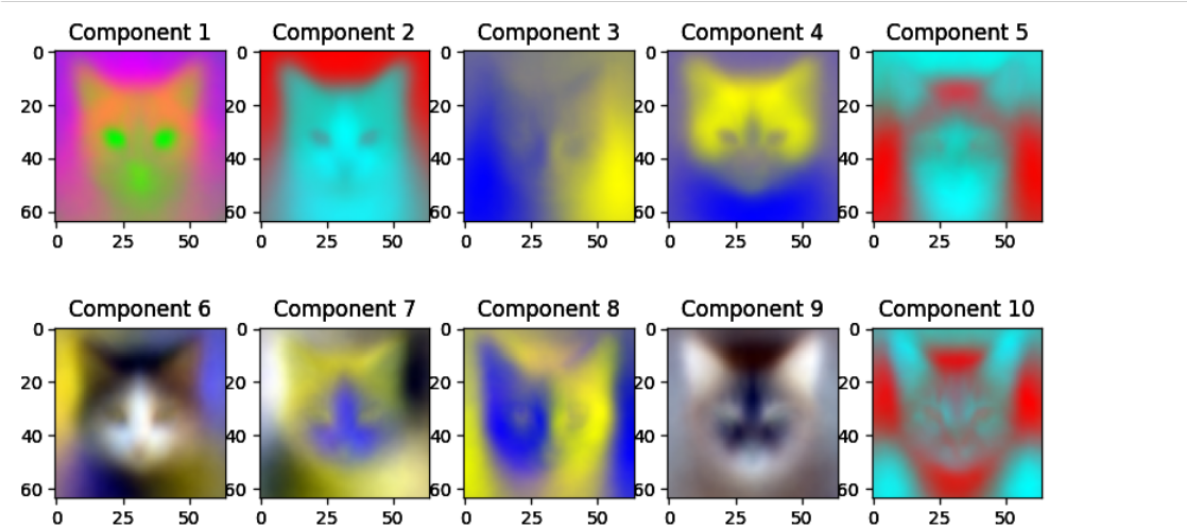
  Top 10 PVEs
  red channel
  0.2350696993627989
  0.15651115206738625
  0.0900525385704431
  0.06829954682854637
  0.03752733951106832
  0.023947539134905268
  0.02276465878006266
  0.021128209465633457
  0.017935920584406462
  0.01349360904861361
green channel
0.20873714854025469
0.15884565962402103
0.09258856862586821
0.06811111746109595
0.03798505275724365
0.024467317448625018
0.024279163413091262
0.02149052826450394
0.018870002898966124
0.014211335203650739
blue channel
```

```
blue channel
0.22859035906545555
0.1564925792534415
0.08790595575693254
0.06203548174652184
0.03740134203265636
0.024165873862426416
0.0240473339720092
0.020596134585636215
0.018458994366195053
0.014285720074286438
Minimum number of principal components that are required to obtain at least 70% PVE
for red : 12
for green 13
for blue: 13
```

Question 1.2

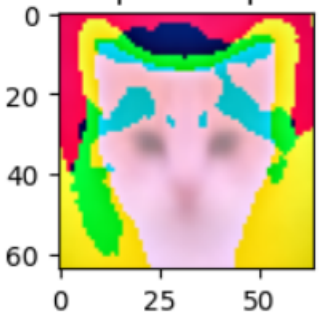
Images are different from each other since they are PCAs of different dimensions. These PCA components are the top ten components that explain the dataset.



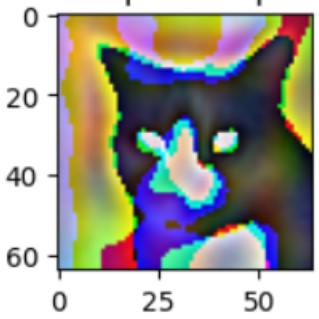
Question 1.3

The formula for the reconstruction is $X \bullet PC \bullet PC^T$ + mean. First, we dot product the centered feature matrix with principal components.Then, take the dot product of the result with the transpose of the principal components. Finally, the mean value is added to the result. Reconstructed images are resized to 64x64. Images are getting clear as k (number of principal components) is increased.

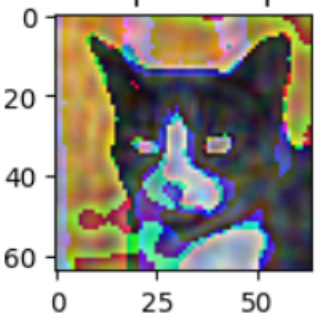
1 Principal Components



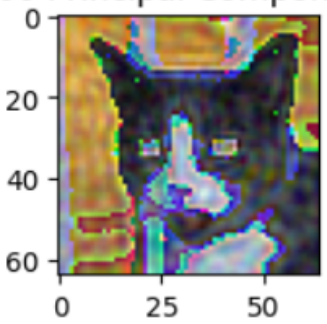
50 Principal Components



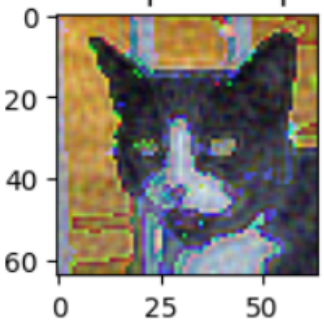
250 Principal Components



500 Principal Components



1000 Principal Components



4096 Principal Components