Question 3

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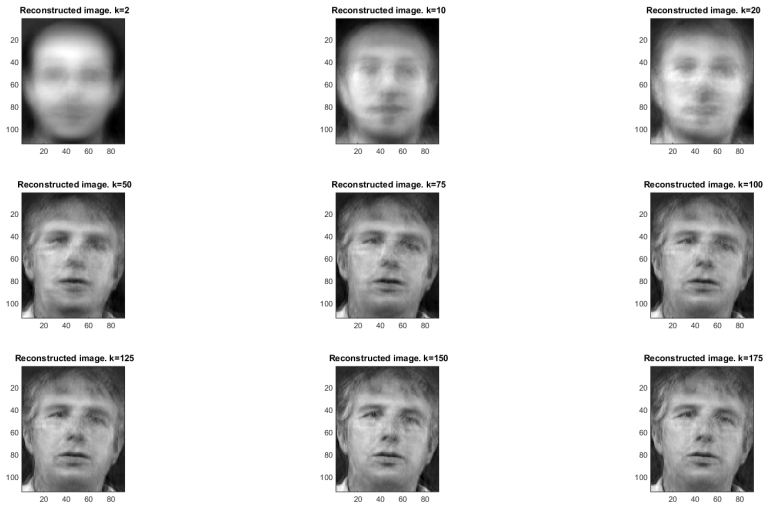
Initial Setup

```
addpath('../../common/');
image_dir = uigetdir();

% Reading all images from image_dir
X = getSet1ImagesWithSize(image_dir, 1, 40, 1, 10);

% Reading image (15, 3) from image_dir
[Y, Sa, Sb] = getSet1ImagesWithSize(image_dir, 15, 15, 3, 3);

ks = [2, 10, 20, 50, 75, 100, 125, 150, 175];
```

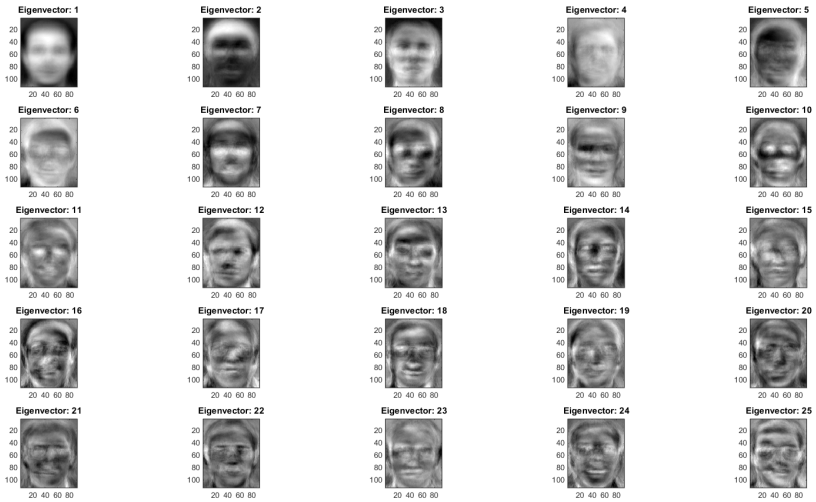
Reconstructed Image

```
figure('units','normalized','outerposition',[0 0 1 1]);
for k=1:numel(ks)
    [Vn, image] = plotEigenfaces(X, Y, 1, ks(1,k), Sa, Sb);
    subplot(3, 3, k);
    imagesc(image);
    daspect([1 1 1]);
    axis tight;
    colormap gray;
    title(sprintf(' Reconstructed image. k=%d', ks(1,k)));
end
```



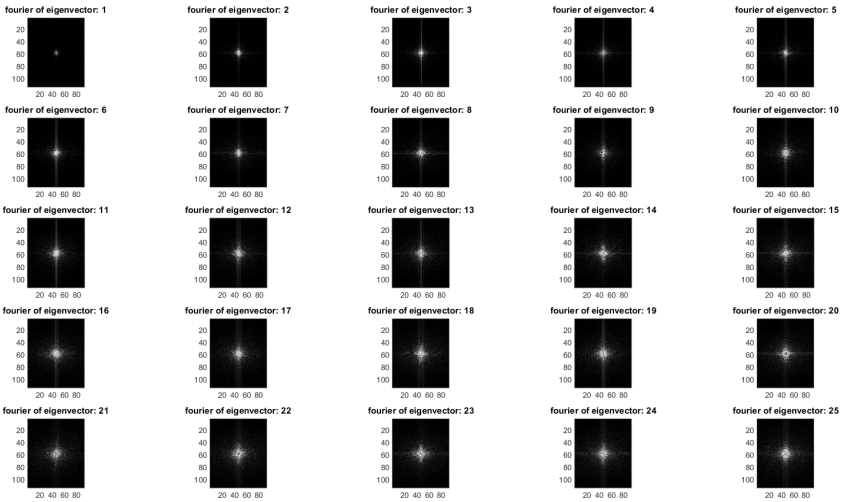
Displaying Eigenfaces corresponding to largest 25 eigenvalues

```
[Vn, image] = plotEigenfaces(X, Y, 1, 25, Sa, Sb);

figure('units','normalized','outerposition',[0 0 1 1]);
for i = 1:25
    Vn_column = Vn(:, i);
    subplot(5, 5, i);
    imagesc(reshape(Vn_column, Sa, Sb));
    daspect([1 1 1]);
    axis tight;
    colormap gray;
    title(sprintf('Eigenvector: %d', i));
end
```



Fourier of 25 eigenfaces on log scale

```
figure('units','normalized','outerposition',[0 0 1 1]);
for i=1:25
    Vn_column = Vn(:, i);
    eigenface = reshape(Vn_column, Sa, Sb);
    eigenface = fft2(eigenface);
    eigenface = fftshift(eigenface);
    eigenface = abs(eigenface);
    eigenface = log(eigenface + 1);

    subplot(5, 5, i);
    imagesc(reshape(eigenface, Sa, Sb));
    daspect([1 1 1]);
    axis tight;
    colormap gray;
    title(sprintf('fourier of eigenvector: %d', i));
end
```



Observation

Observing the reconstructed face of the person shows that only a small number of k are enough to reconstruct the image and hence we can only use a small number of k to do it. The quality of reconstruction is small initially and quickly becomes good. And after a small k, it becomes non-visible. This is also proven by the data we see in the previous question which shows the recognition rate becomes steady post a certain k

The eigen faces are a unique thing about this algorithm which is that the visualisations of the eigen vectors resembles an amalgamation of the images of the dataset. Also as the eigen value decreases we see a more noisy and eigen face with more artifacts. This is also visible in the fourier domain which shows a higher spread in the frequencies and hence indicating less of a significance towards a particular formation

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