

Load Data

```
load("mnist.mat");
```

Iterate through the digits

```
for d=0:9
```

Read the images of the digit and reshape into 1D

```
digits = digits_train(:, :, labels_train==d); % choose all images with digit d
digits = reshape(im2double(digits), [784 size(digits, 3)]);
% reshape this data into a 784xN matrix, where N is the number of images
% with digit d
% Every column is a sample digit d (that is our samples are stacked
% column wise in the matrix)
```

Mean and translation of data points

```
mean_vector = sum(digits, 2)/size(digits, 2);
% mean is found by summing the column vectors
digits = digits - mean_vector;
% mean subtraction (needed for covariance)
```

Compression of Images along 84 dimensions

```
[reduced_data, basis] = rerepresent_digits(digits, 84);
% the function rerepresent_digits(digits, d) defined in
% rerepresent_digits.m reduces the digits dataset into d dimensions
% and returns it in reduced_data
% we also want to know the directions (basis vectors) along which we reduced
% the data and this is given in the basis matrix stacked column wise
% Details of this is in the function
```

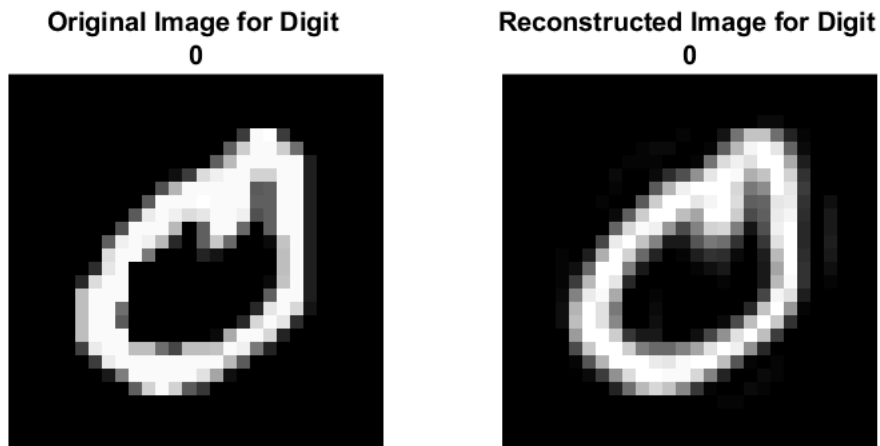
Reconstruct the image from the weights calculated earlier

```
reconstructed = basis*reduced_data;
% To reconstruct we multiply by bases (explained in the report)
% Essentially this would ensure that the jth column in reconstructed is
% the linear combination of the bases with coefficients = inner products
% with the jth sample.
```

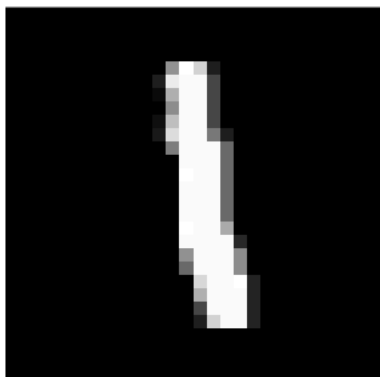
plot the images

```
% Plot below. We reshape the images after adding back the mean vector
% and then plot
```

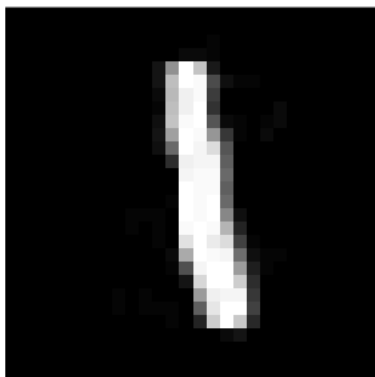
```
figure;  
axis equal;  
subplot(1, 2, 1);  
imshow(reshape(mean_vector + digits(:, 2), [28 28]));  
title(["Original Image for Digit " num2str(d)]);  
  
subplot(1, 2, 2);  
imshow(reshape(mean_vector + reconstructed(:, 2), [28 28]));  
title(["Reconstructed Image for Digit " num2str(d)]);  
end
```



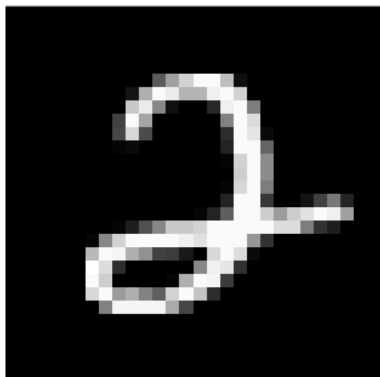
Original Image for Digit
1



Reconstructed Image for Digit
1



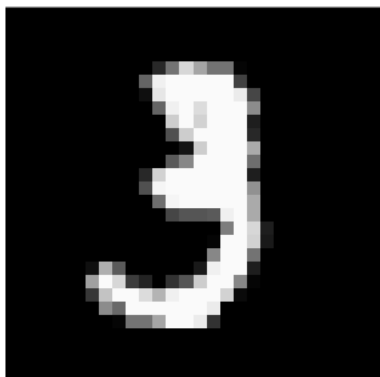
Original Image for Digit
2



Reconstructed Image for Digit
2



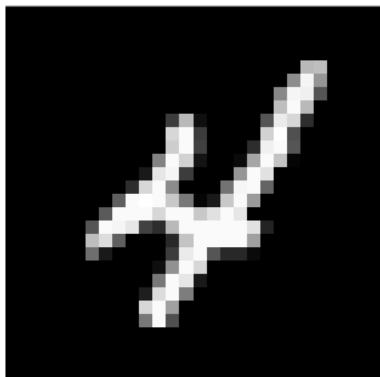
Original Image for Digit
3



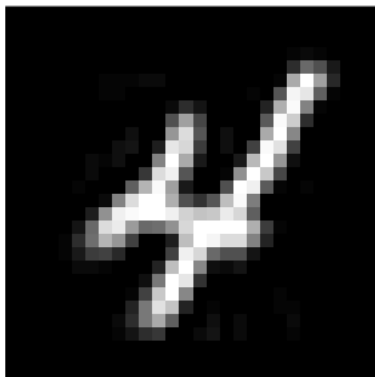
Reconstructed Image for Digit
3



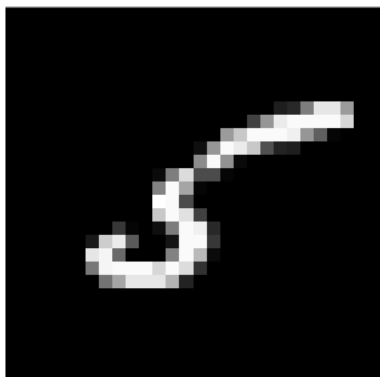
Original Image for Digit
4



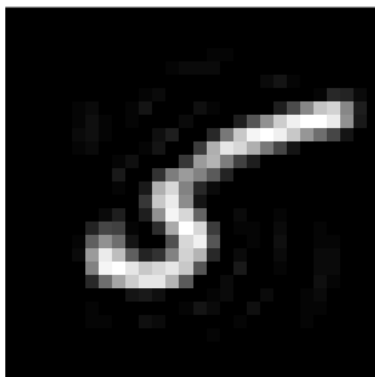
Reconstructed Image for Digit
4



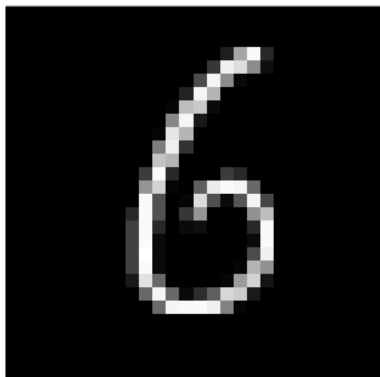
Original Image for Digit
5



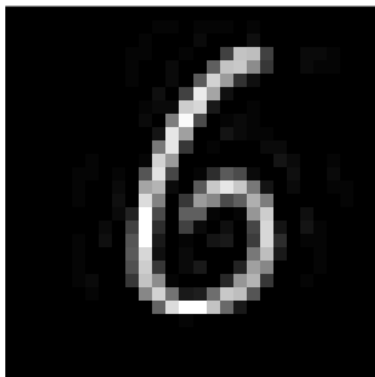
Reconstructed Image for Digit
5



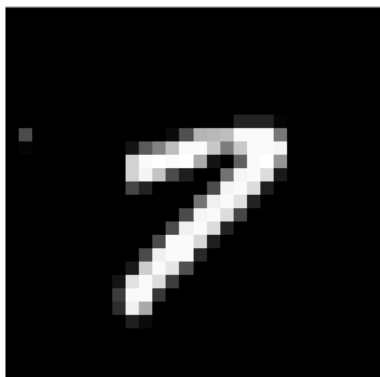
Original Image for Digit
6



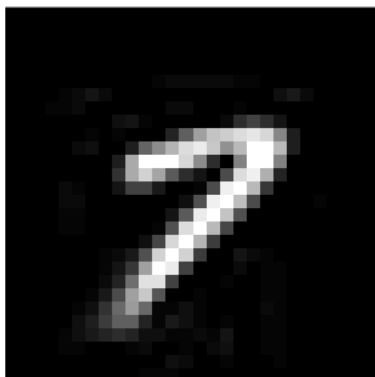
Reconstructed Image for Digit
6



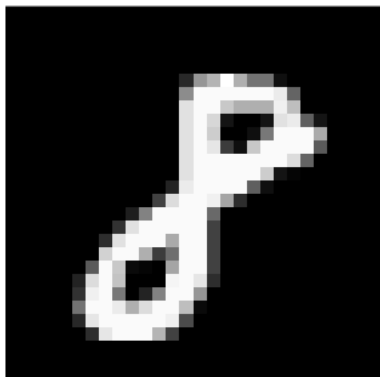
Original Image for Digit
7



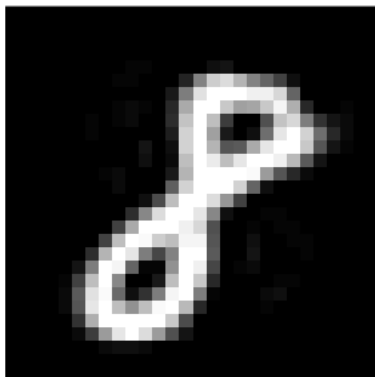
Reconstructed Image for Digit
7



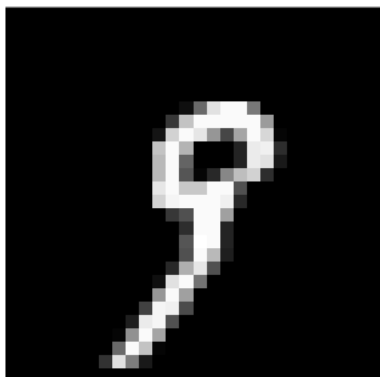
Original Image for Digit
8



Reconstructed Image for Digit
8



Original Image for Digit
9



Reconstructed Image for Digit
9

