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

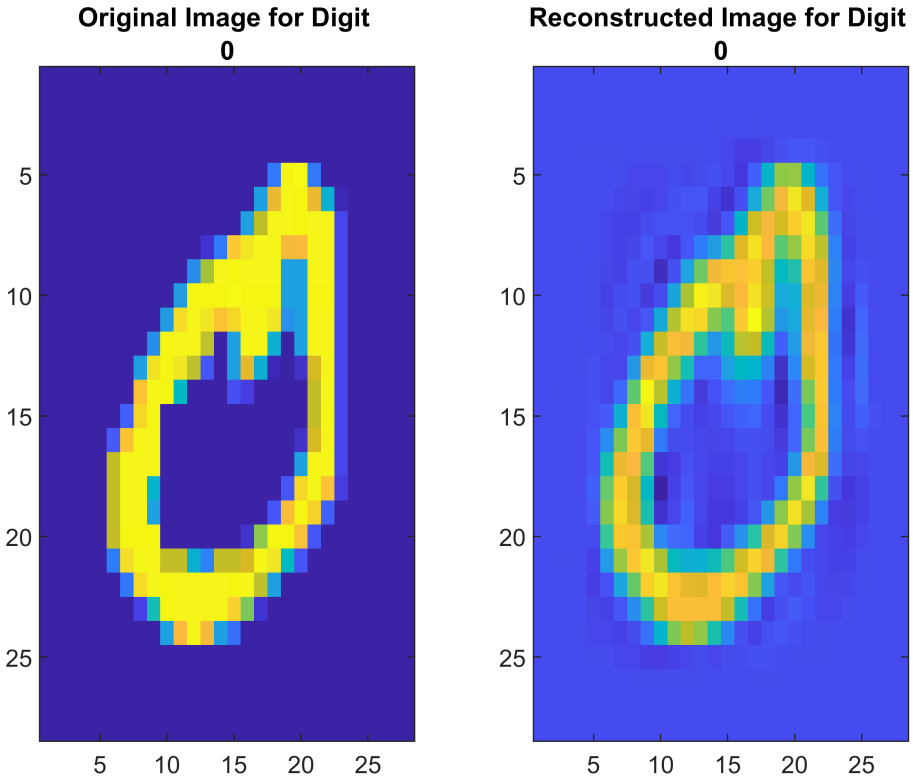
```
    reconstructed = basis*reduced_data;
    % To reconstruct we multiply by bases (explained in the report)
    % Essentially this would ensure that the jth column in reconstructed is
    % the linear combination of the bases with coefficietnts =  inner products
    % with the jth sample.
```

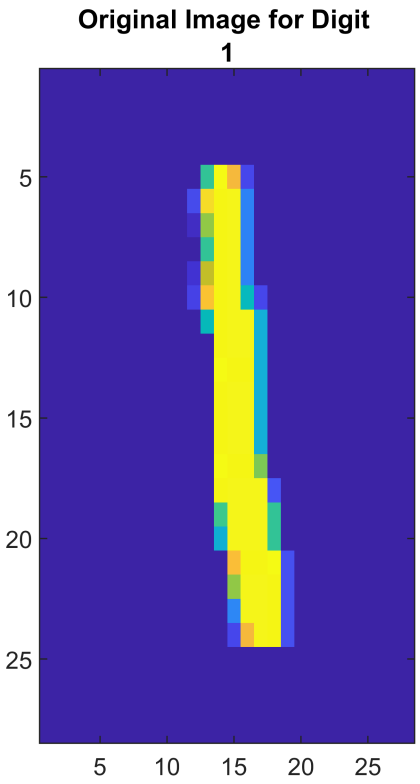
plot the images

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

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

    subplot(1, 2, 2);
    imagesc(reshape(mean_vector + reconstructed(:, 2), [28 28]));
    title(["Reconstructed Image for Digit " num2str(d)]);
end
```




Original Image for Digit 1
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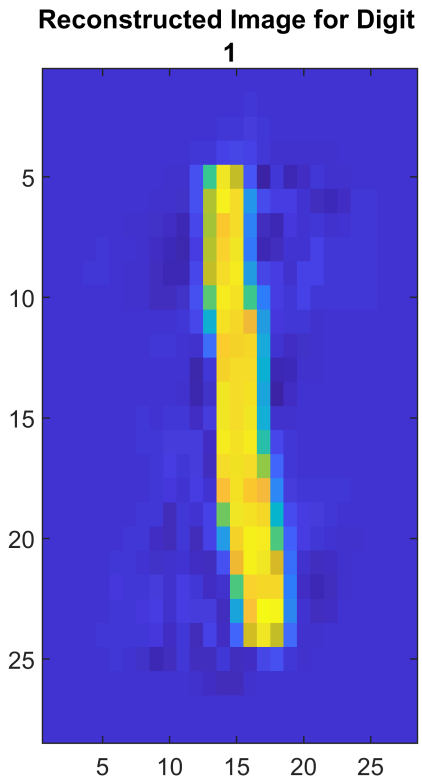
Reconstructed Image for Digit 1
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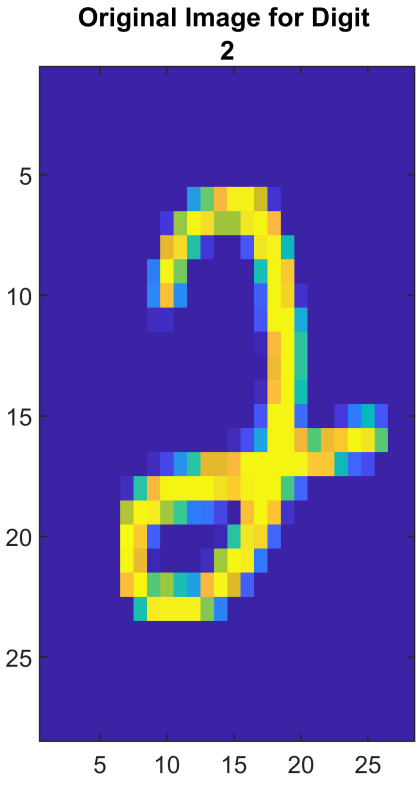
Original Image for Digit 2
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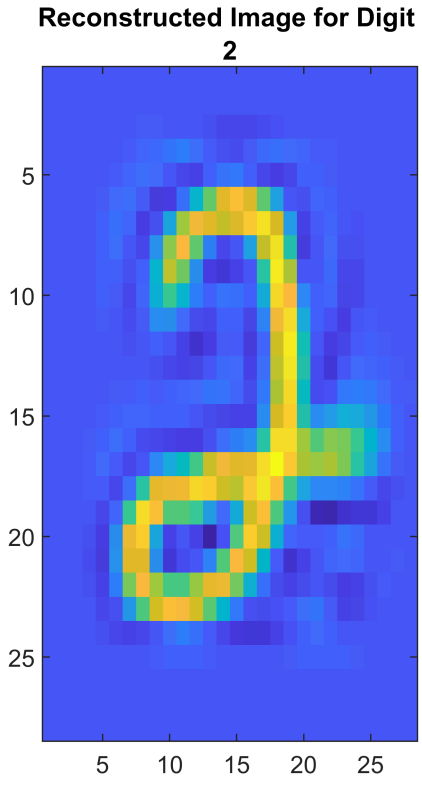
Reconstructed Image for Digit 2
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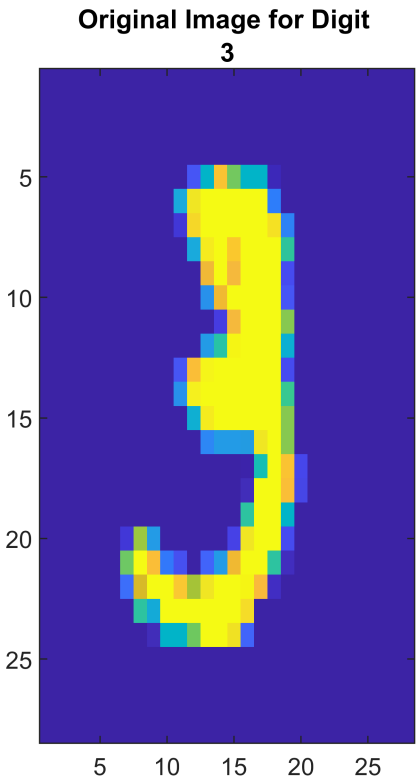
Original Image for Digit
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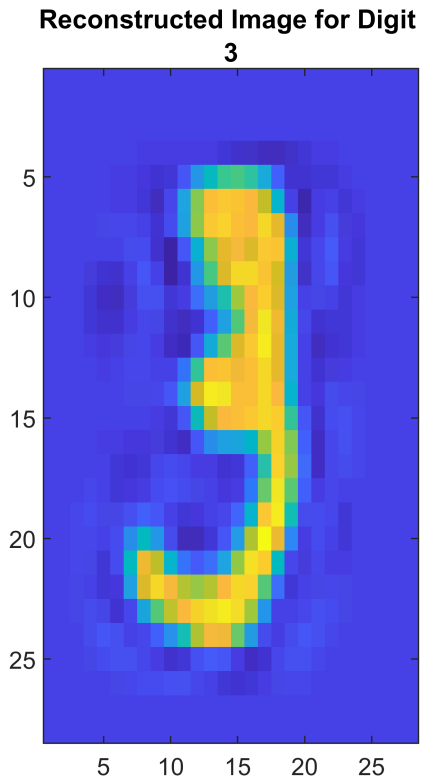
Reconstructed Image for Digit
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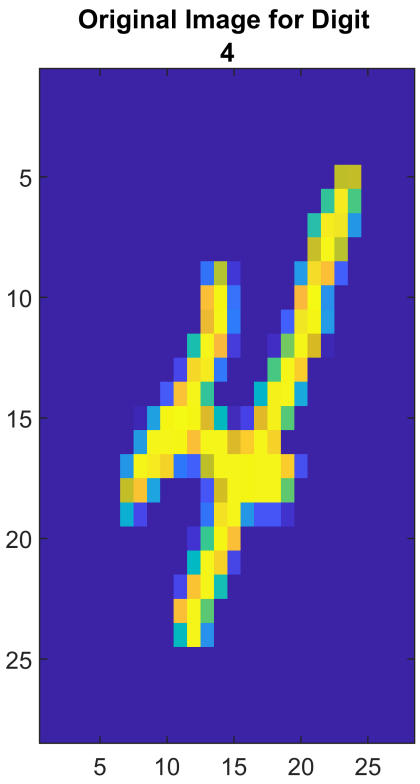
Original Image for Digit
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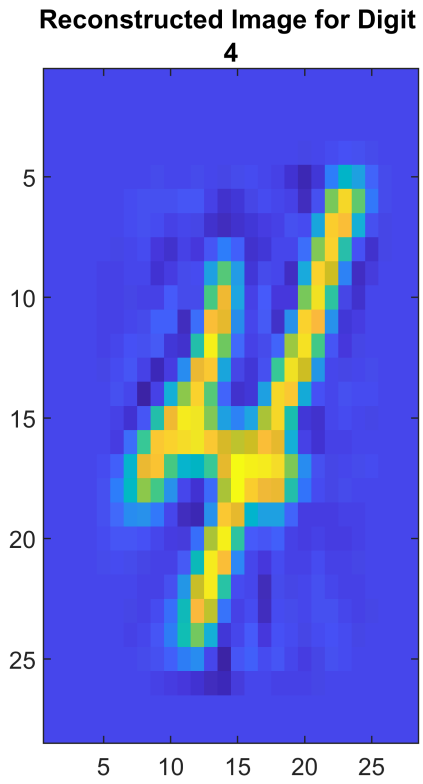
Reconstructed Image for Digit
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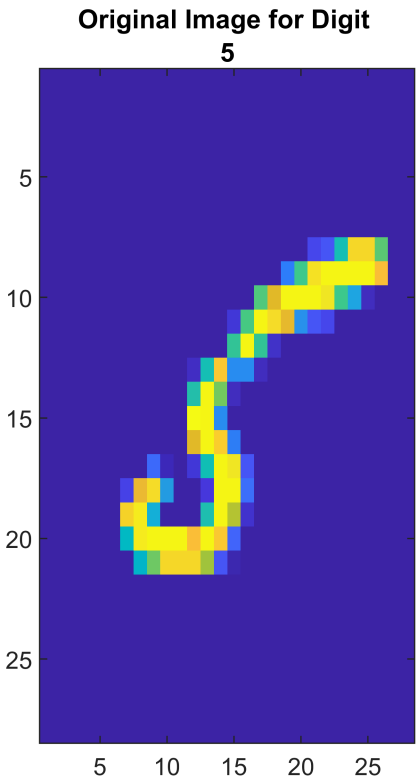
Original Image for Digit
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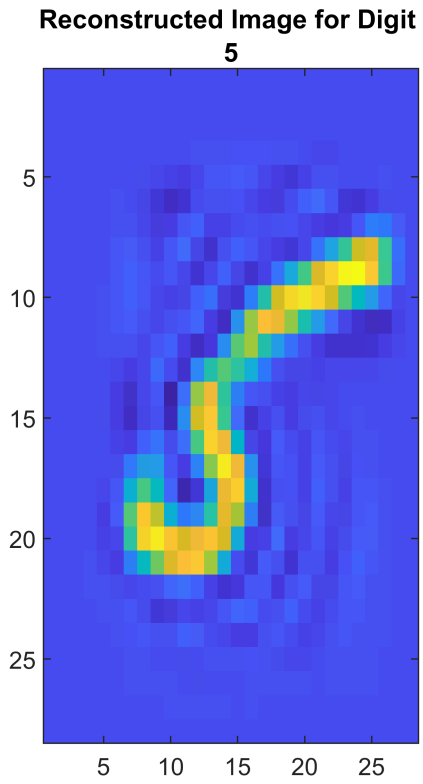
Reconstructed Image for Digit
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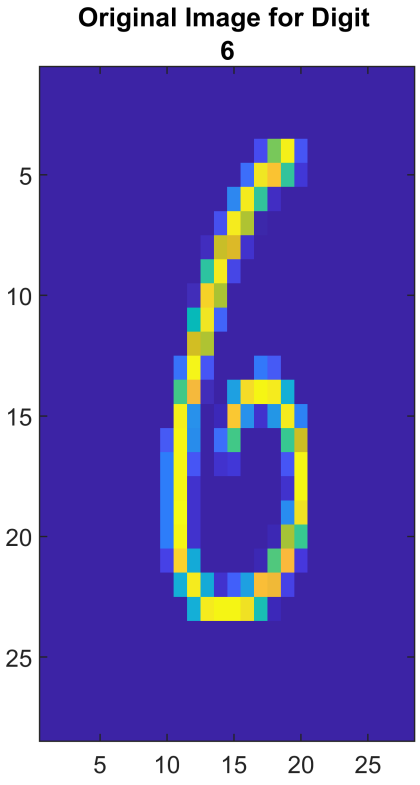
Original Image for Digit
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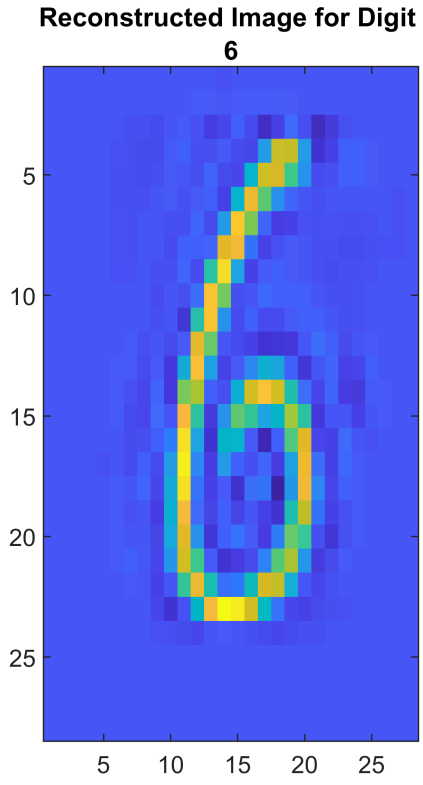
Reconstructed Image for Digit
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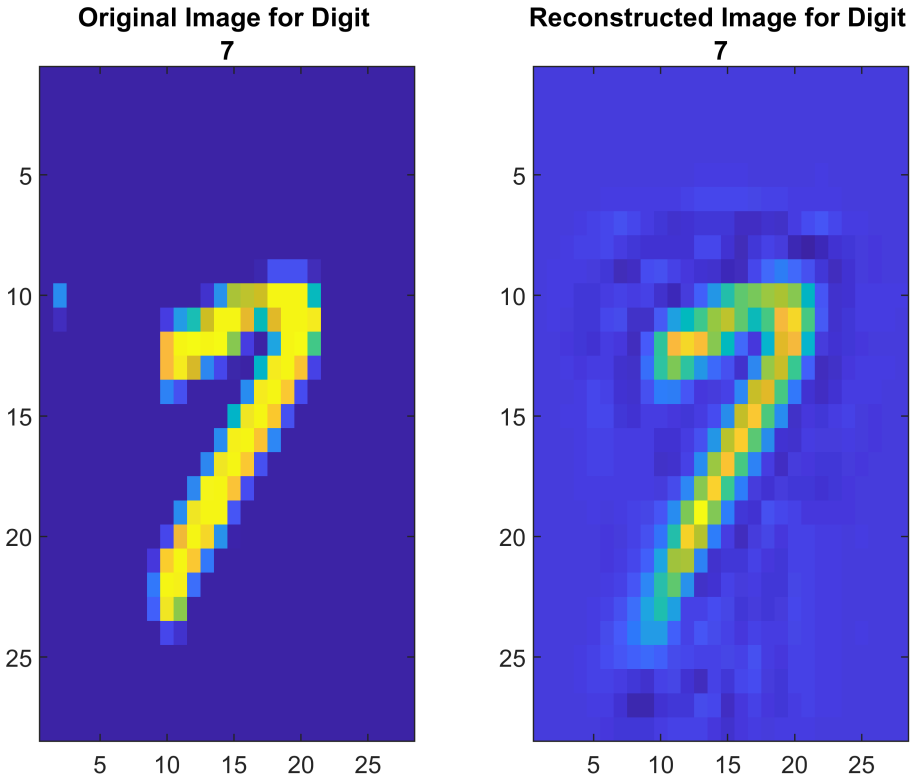
Original Image for Digit 7
Reconstructed Image for Digit 7
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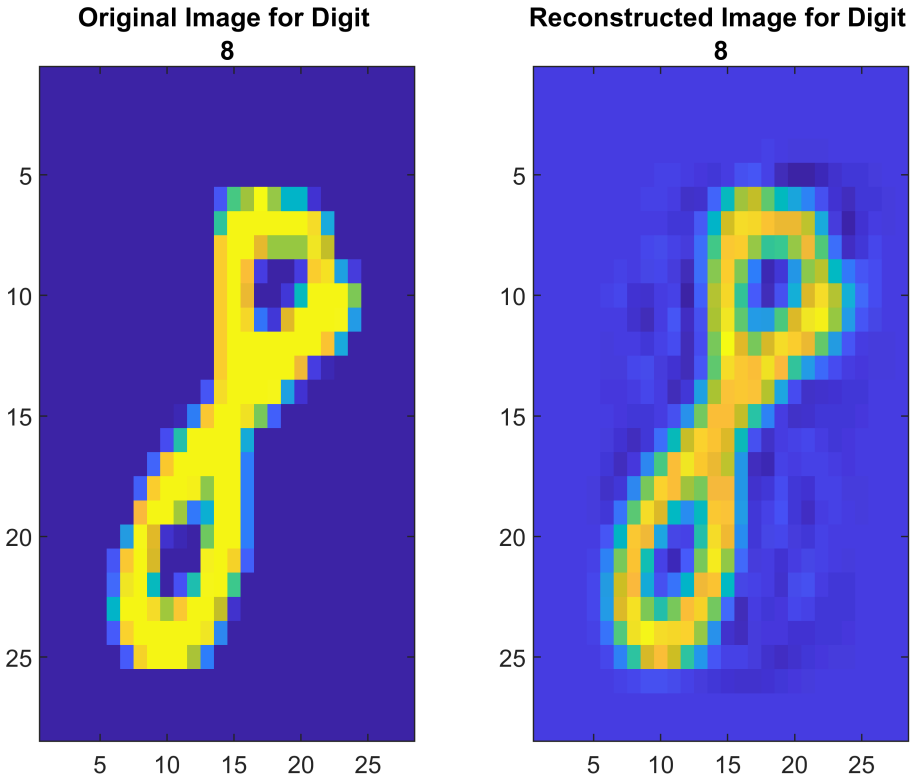
Original Image for Digit 8
Reconstructed Image for Digit 8
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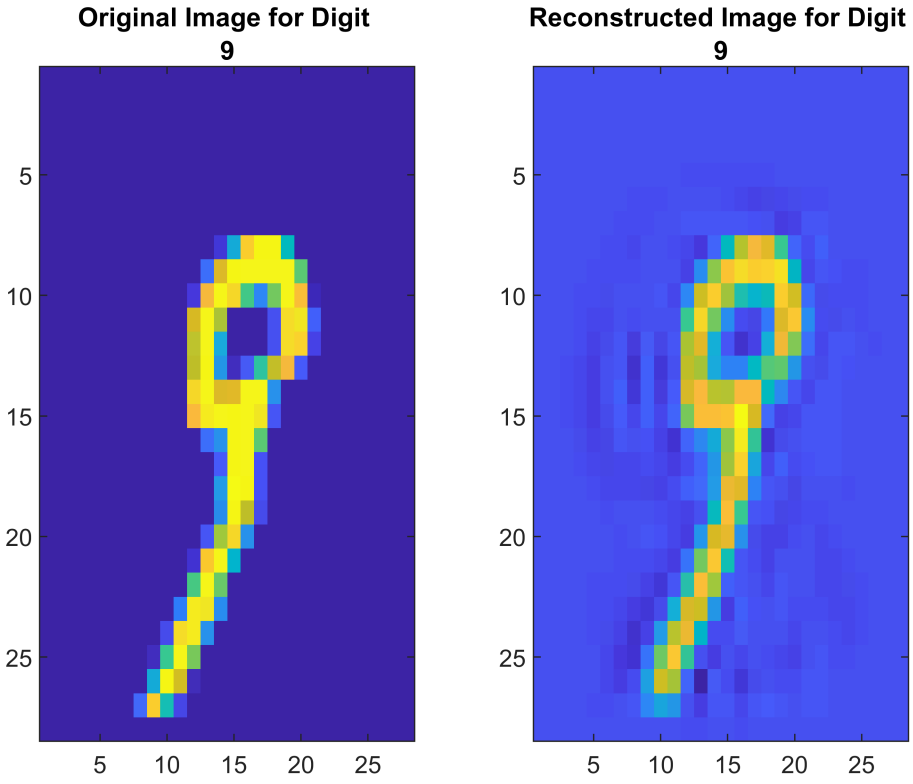
Original Image for Digit 9
Reconstructed Image for Digit 9
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