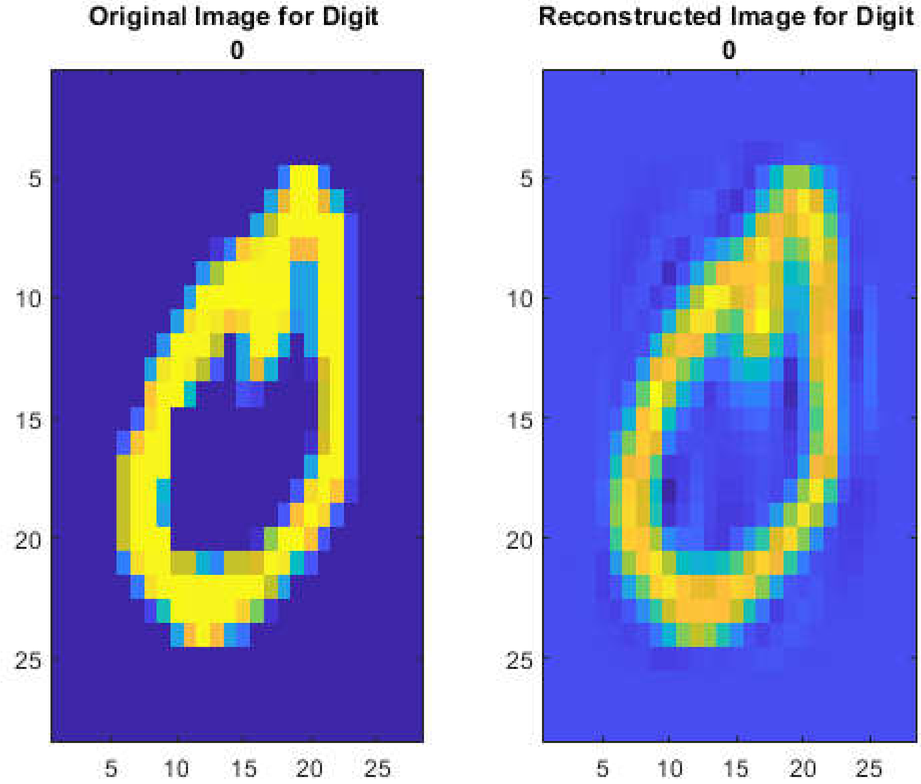
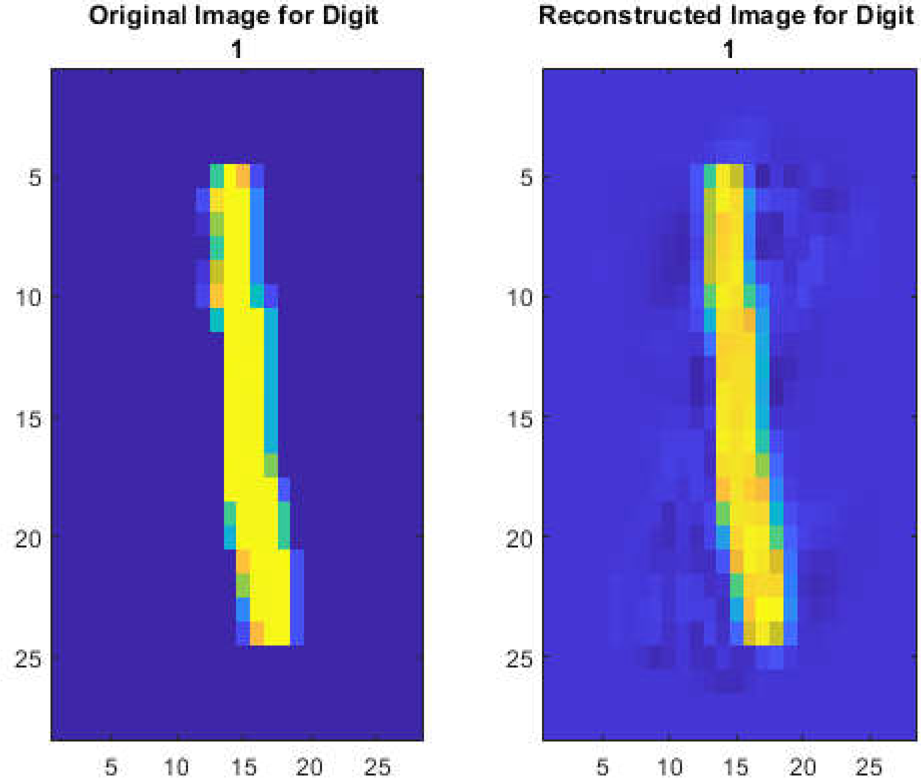
```
load("mnist.mat");

for d=0:9
   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_vector = sum(digits, 2)/size(digits, 2);
   % mean is found by summing the column vectors
   digits = digits - mean_vector;
   % mean subtraction (needed for covariance)

   [bases, diagonal] = highest_dimensions(digits, 84);
   % the function will give the 84 eigenvectors of the covariance matrix
   % that have the highest eigenvalues
   % Note that bases are column vectors which have been stacked column wise
   % in the bases matrix
   % diagonal is a diagonal matrix (84x84) whose diagonal values are the
   % corresponding eigenvalues

   reduced_data = bases'*digits; % in form of coefficients along bases
   % the above vectorised implementation gives us the compressed data.
   % This is because after multiplying as above the value of R_{ij} where R
   % is the reduced data matrix, is the inner product of the ith
   % eigenvector with the jth sample (the jth column in digits).
   % Thus in reduced data the jth column contains the 84 inner products of
   % the jth sample with the eigenvectors which is our compressed
   % represnation.

   reconstructed = bases*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 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
```



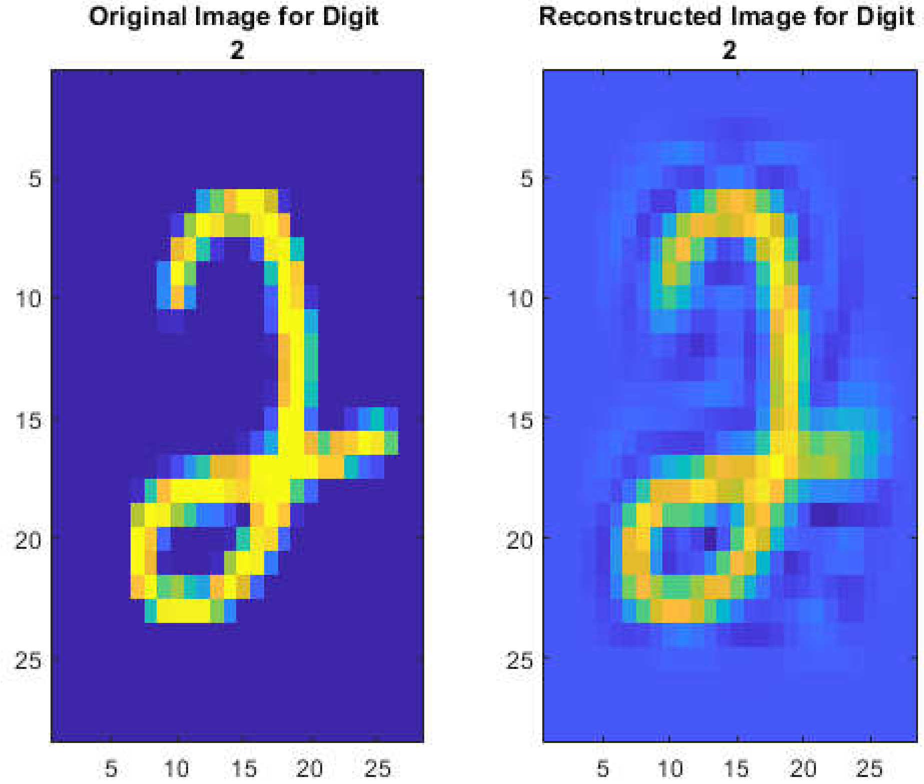
Original Image for Digit 0

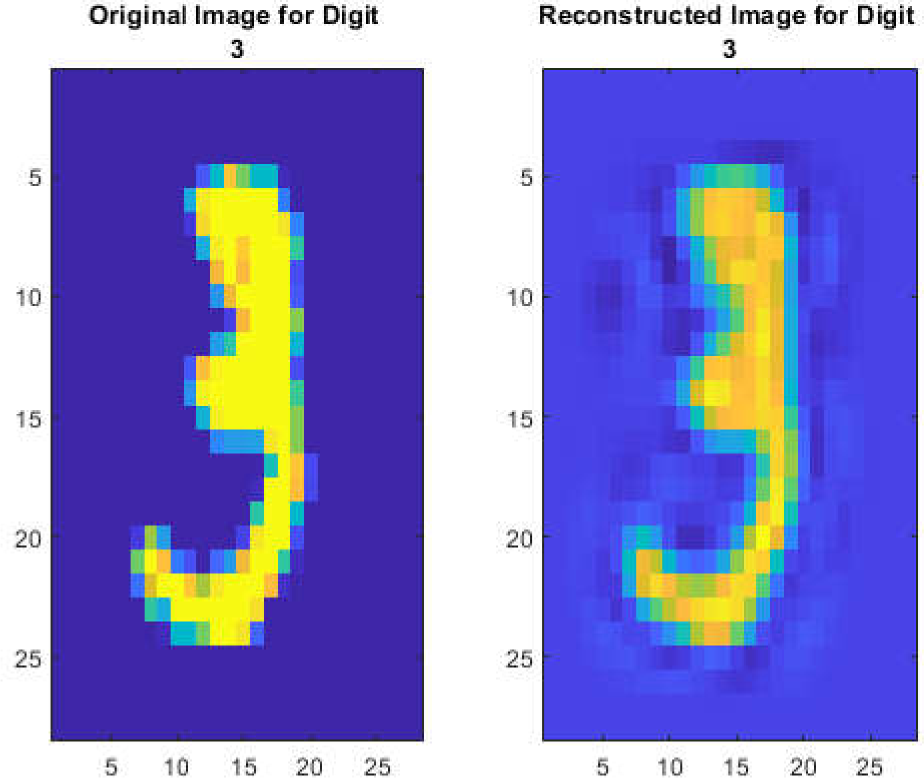
Reconstructed Image for Digit 0

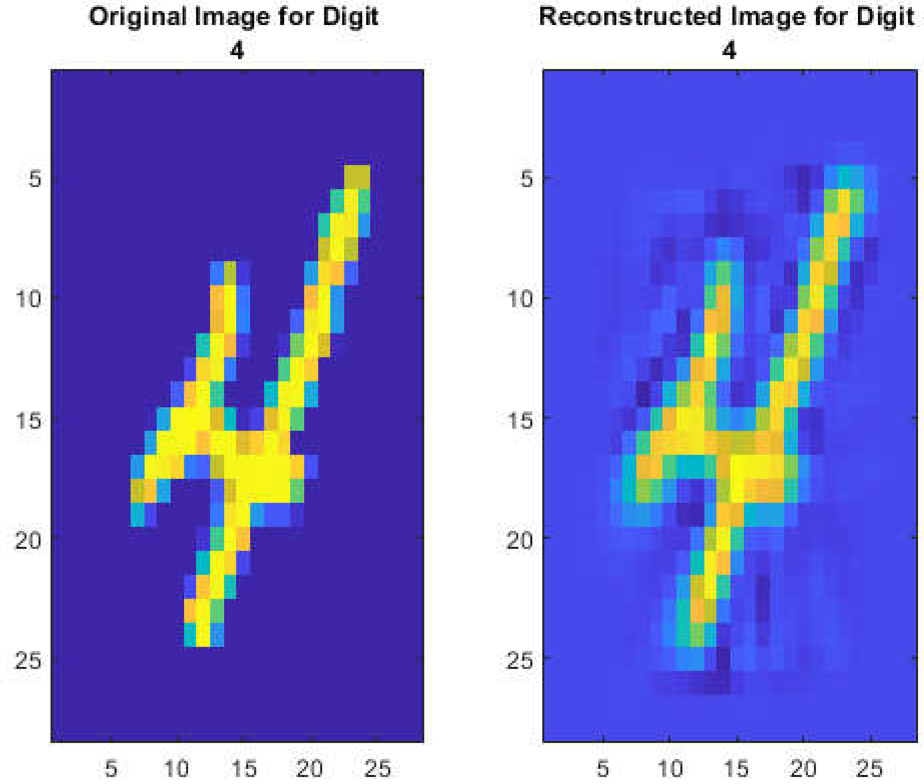


Original Image for Digit 1

Reconstructed Image for Digit 1

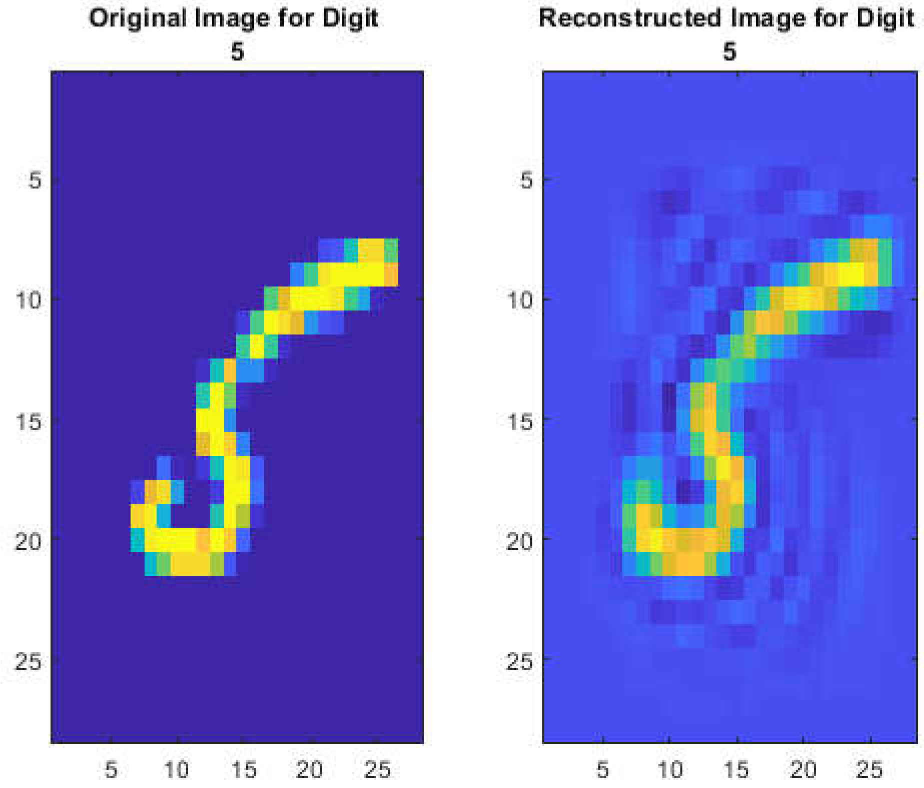

Original Image for Digit
2
Reconstructed Image for Digit
2
5
10
15
20
25
5
10
15
20
25


Original Image for Digit
3
Reconstructed Image for Digit
3
5
10
15
20
25
5
10
15
20
25



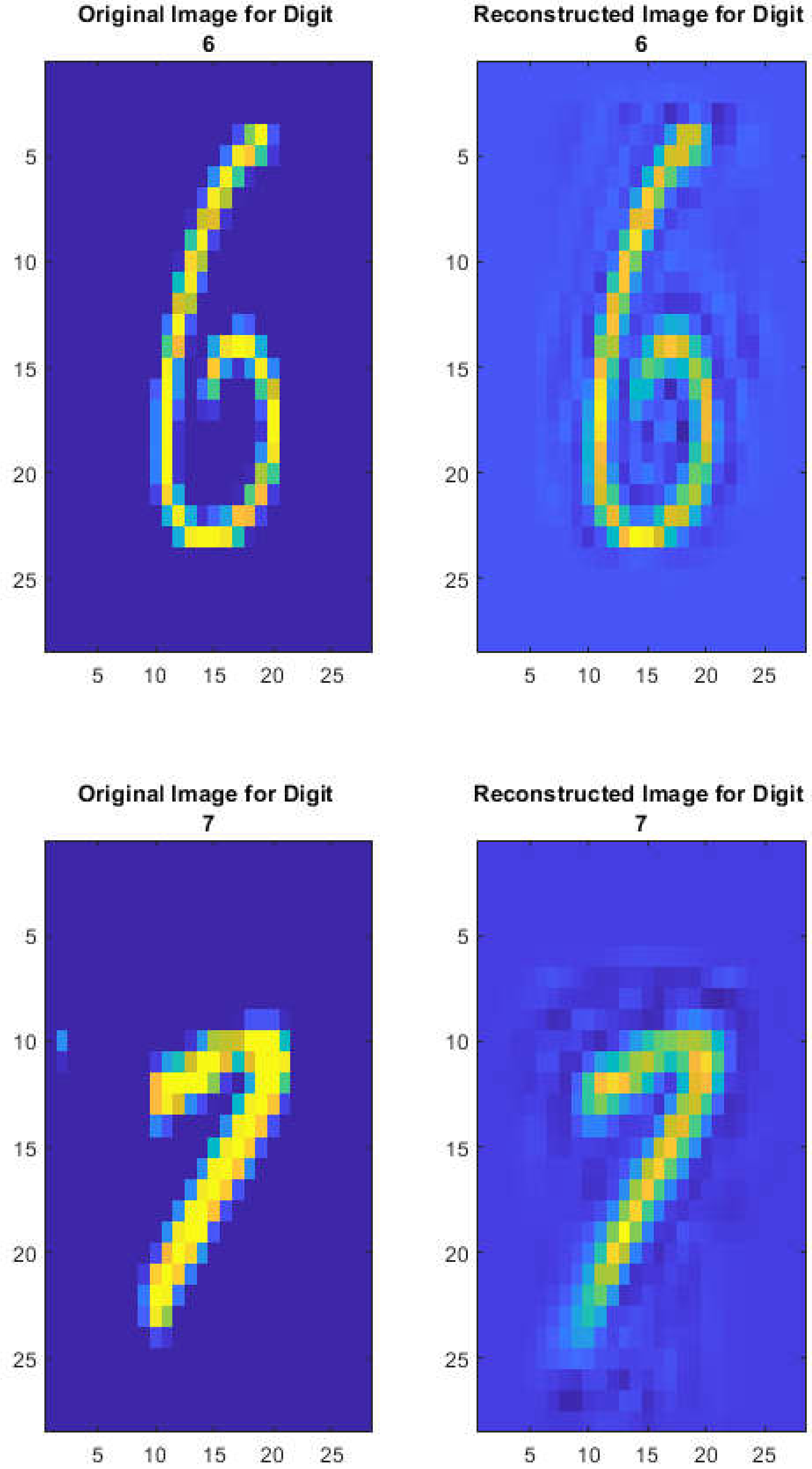
Original Image for Digit 4

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
5
10
15
20
25
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15
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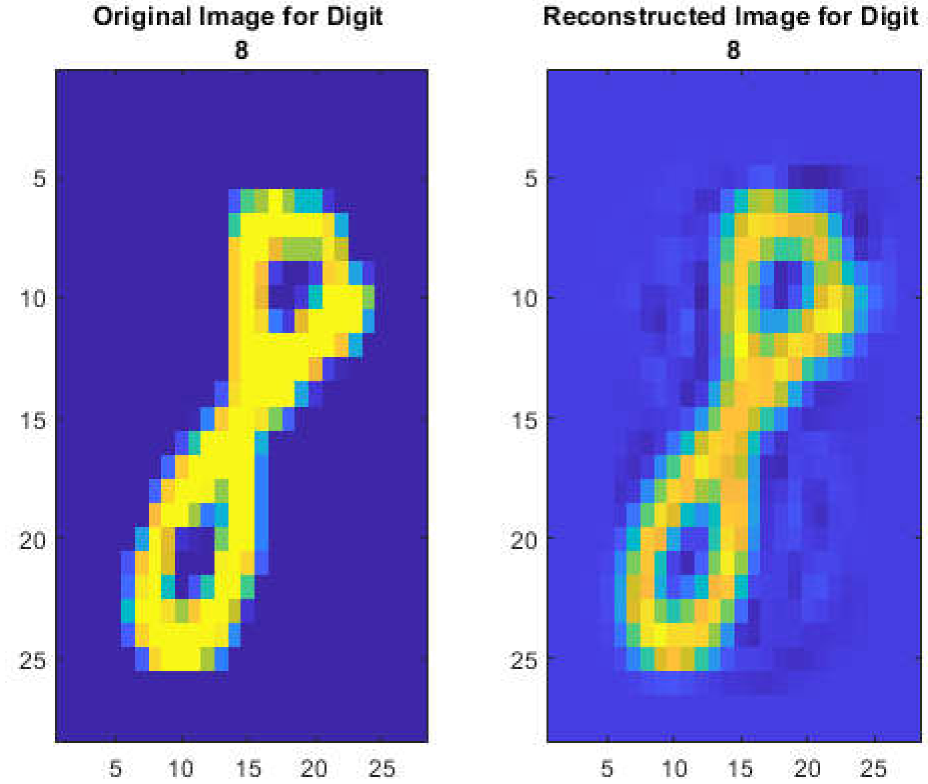
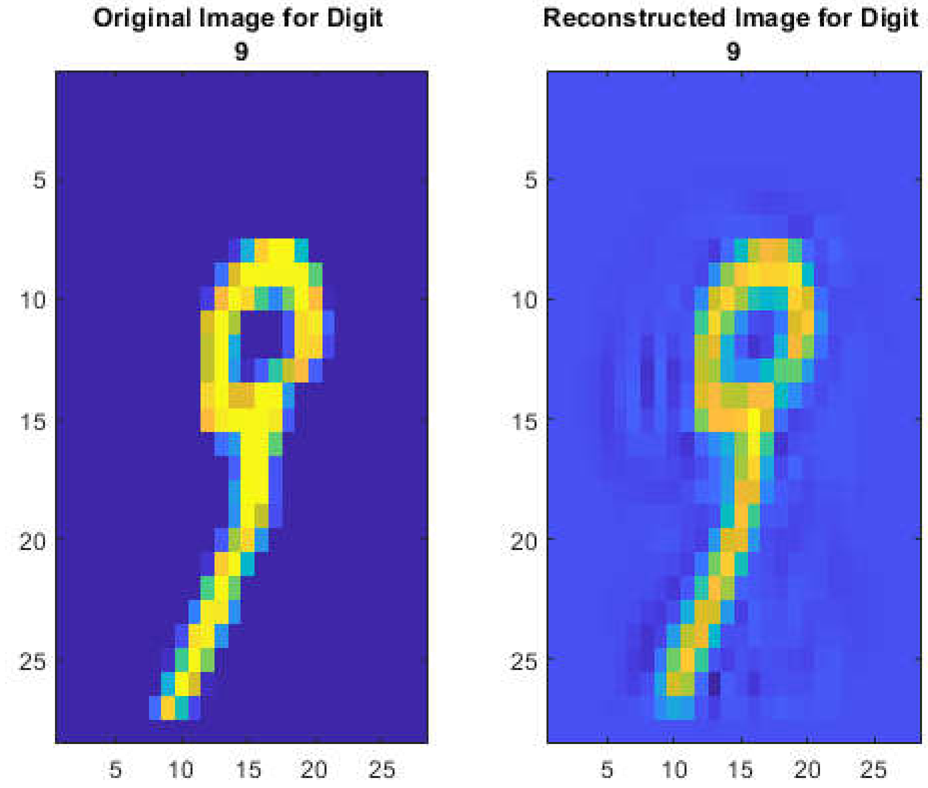
25



Original Image for Digit 8

Reconstructed Image for Digit 8



Original Image for Digit 9

Reconstructed Image for Digit 9

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