Computational Neuroscience Assignment-4
Convolutional Neural Network
BT6270

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1. Three figures (mona, ball, cat) are given in .txt format. Each figure is a 90x100 matrix.
a. Visualize the images and make sure that the black pixels are represented by -1 and white pixels are represented by +1.

Ans.

Other two were already in binary form (-1 or 1).

b. Develop a code for Hopfield network with N=9000 neurons which are fully connected

Ans. We are given three images ball, cat, and mona, each of which is 90 x 100 dimension. To develop a code for **Discrete Hopfield network** with (90 * 100) 9000 neurons, each of which is connected to all other neurons excepting itself with a particular connection weight between them.

This code contains the step:

1. Load the three images and save it as 3*9000 matrix by reshaping those (from 90 x100 to 9000) and appending those in that matrix.
2. Checked all three images are in binary format.
3. Kept those images for training the network.
4. Prepared trigger images by changing some patches of those images.

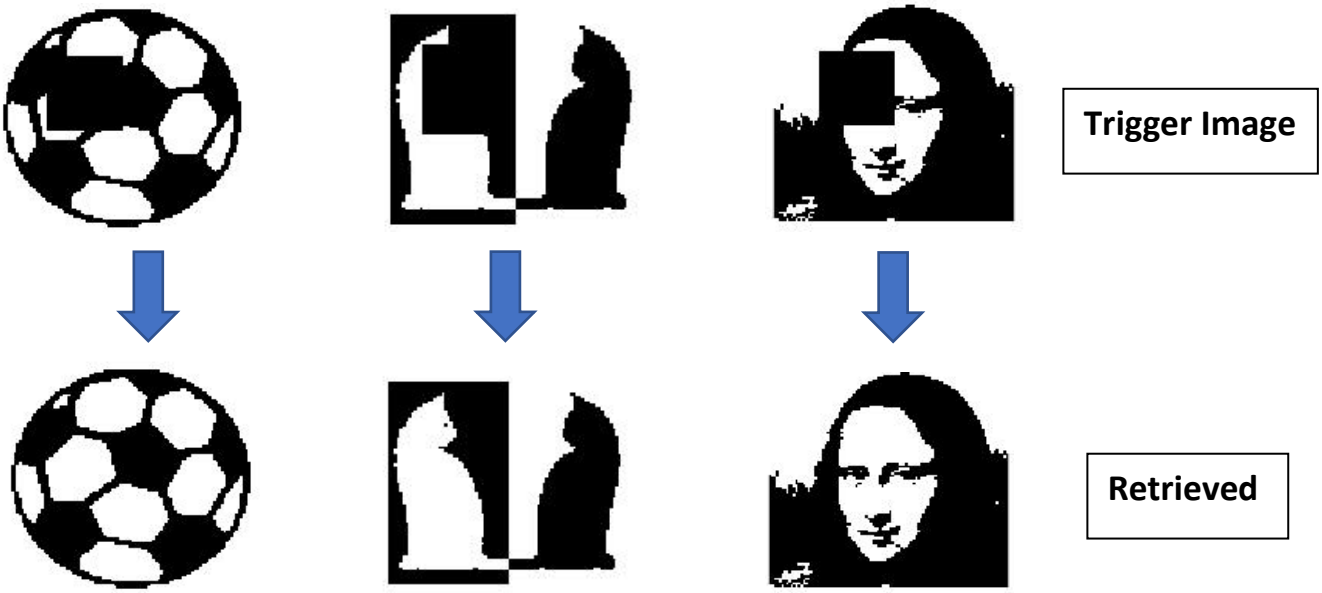
5. Calculated weight matrix from training images.

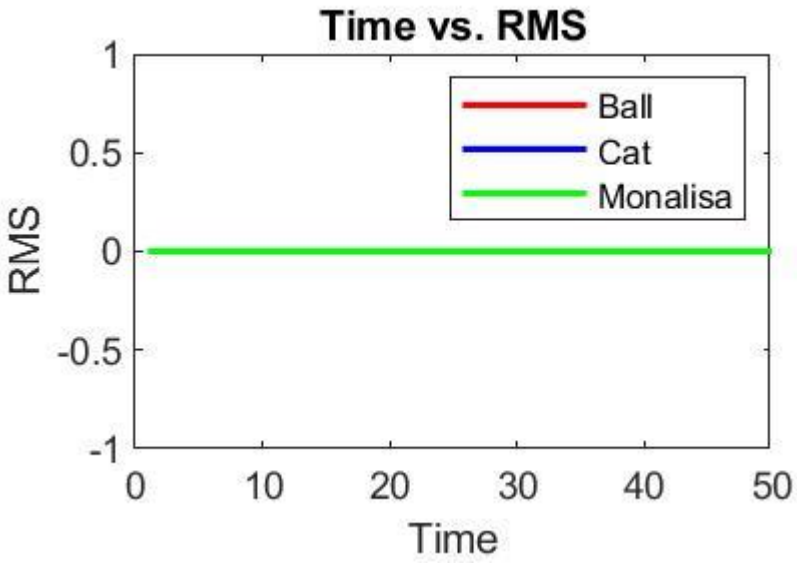
6. Updated each node using till 50 iterations:

$$V_i(t+1) = \sigma(\sum_{i=1}^{N} w_{ij} V_j(t))$$

7. Finally got the retrieved images from trigger images.

The code is attached in ‘hopf_1_2_3.m’ file.





Wrote the code Hopfield Network and run the code for the above trigger images (covered some part of the image with black patch to put the noise in the trigger images) and the retrieved images are also shown in just bellow of the trigger image.

2. Save the image of ball in the network

a. Initialize a zero matrix of the same size as that of the input image and replace a small patch with a portion of the input image as shown in figure 1. Use this (figure 1.B) as the cue for retrieving the image

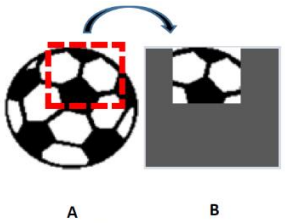
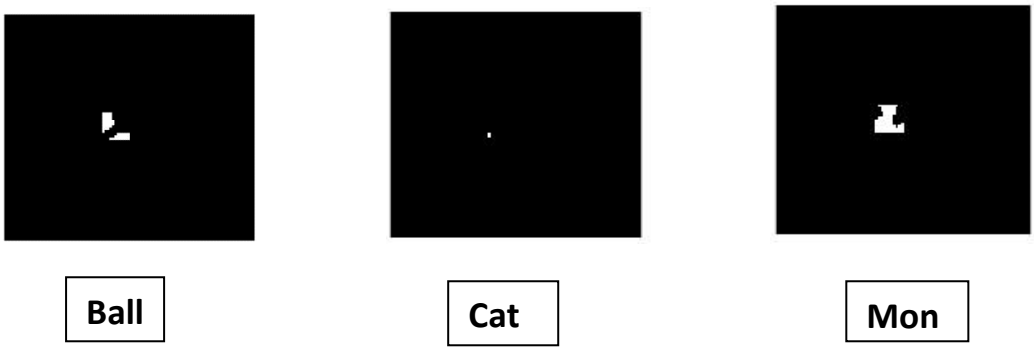


Figure 1

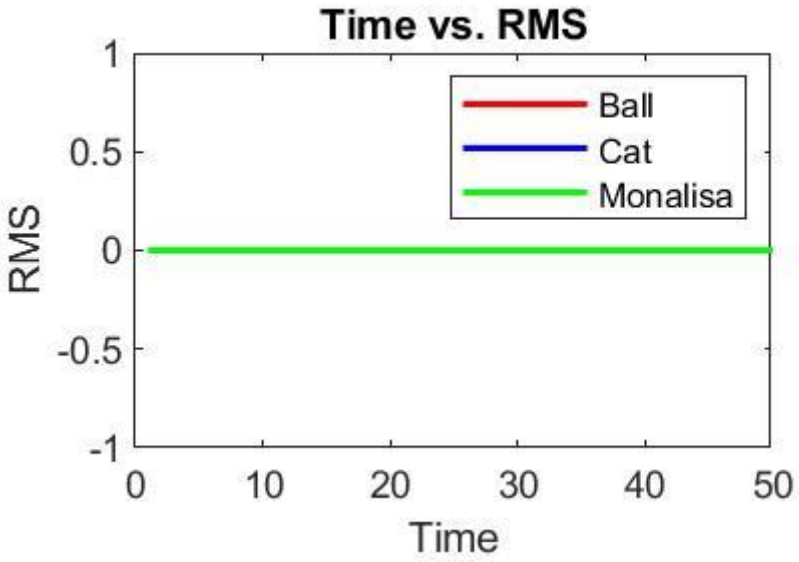
b. Plot the patch which is given as the input trigger

Ans. These are the patches of size (11 x 11) which are given as input trigger for all three images



c. Plot the Root Mean Squared (RMS) error with time

Ans. This plot is shown for the above patches as trigger images with no noise in weights



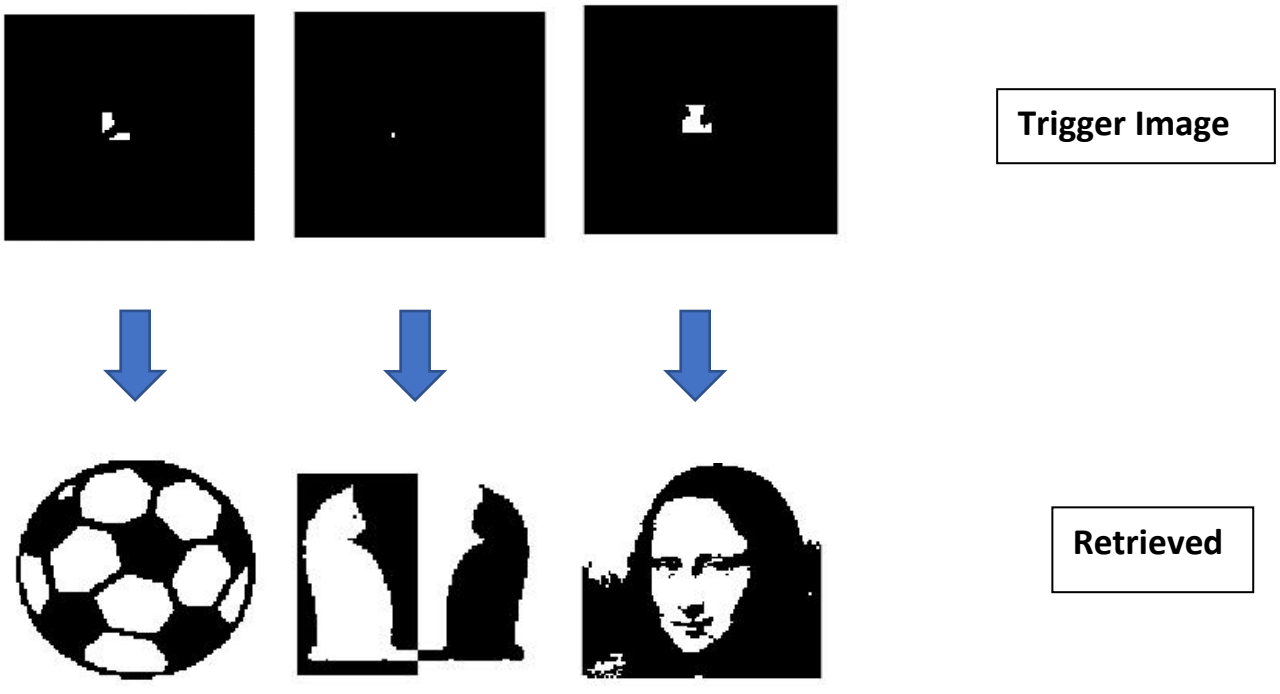
3. Save all three images (mona, ball and cat) in the network
a. Give small patches of each image to retrieve the corresponding saved image.

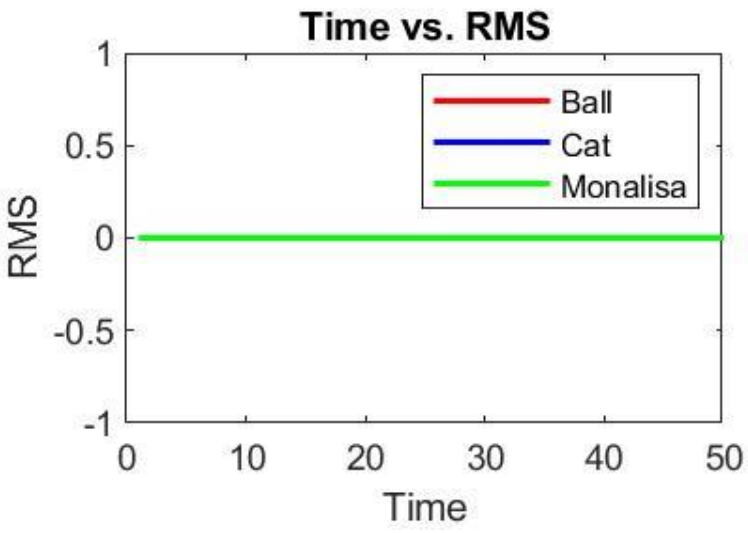
Ans. These are the patches of size (11 x 11) which are given as input trigger for all three images

Ball | Cat | Mona

b. Plot the RMS error with time and the final retrieved image for all three inputs.

Ans. This plot is shown for the above patches as trigger images with no noise in weights



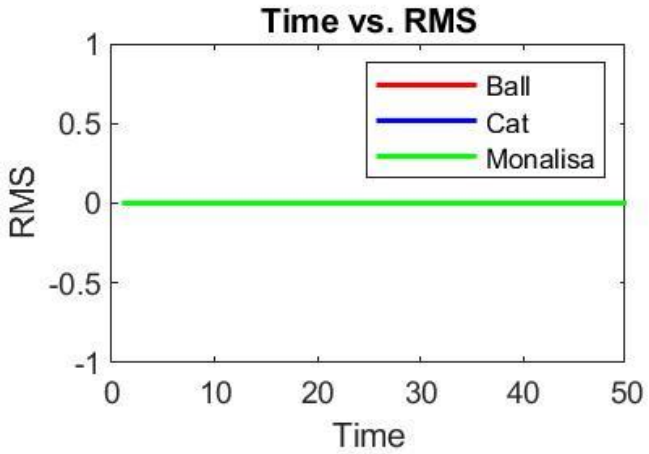


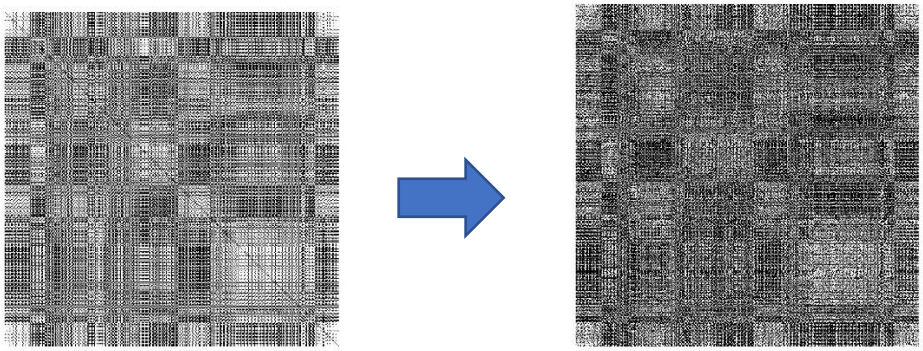
c. Make X% of weights to be zero and repeat questions 3.a and 3.b for X=25%, X=50% and X=80%

(i). Plot the RMS error with time for each case

Ans. Weight matrix is symmetric

X=25%

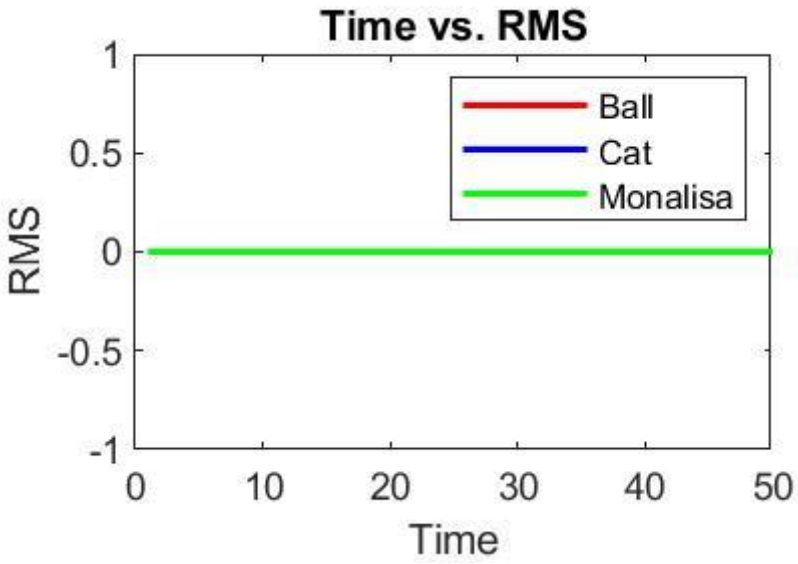


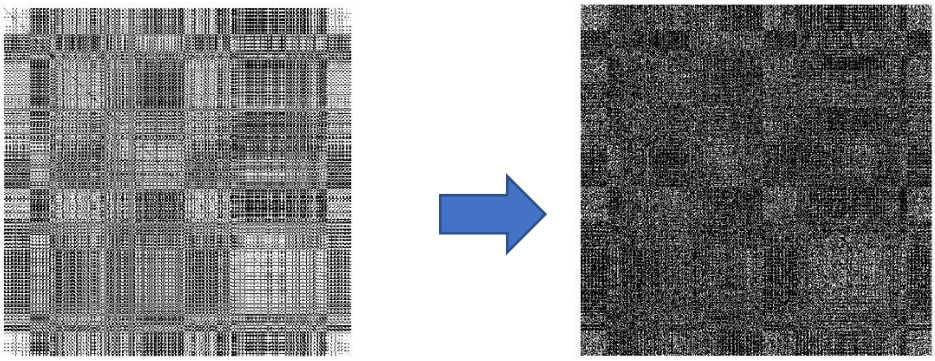


Weights Before

Weights After

X=50%

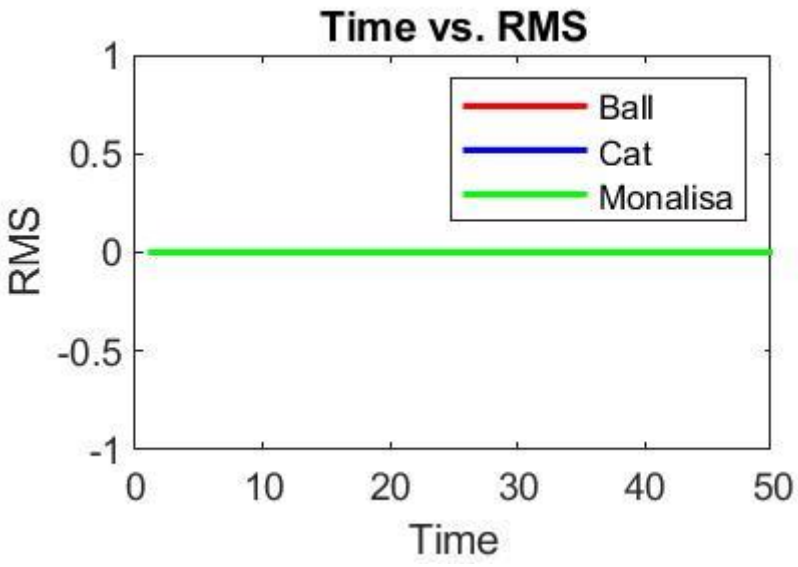


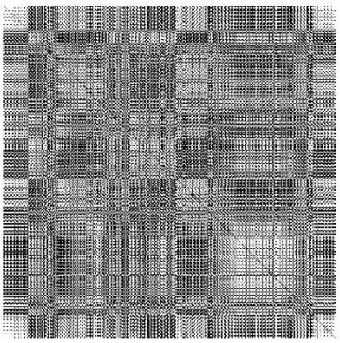


Weights Before

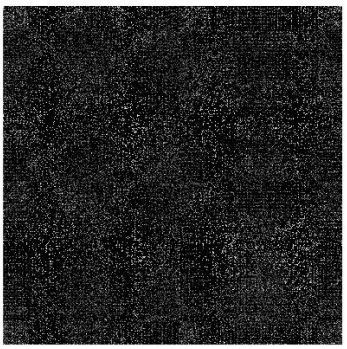
Weights After

X=80%





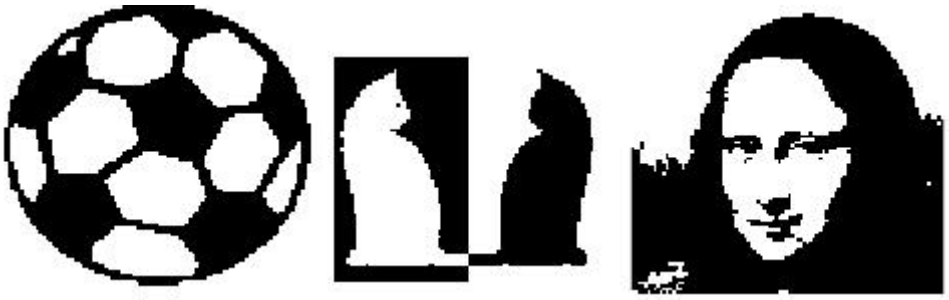
Weights Before



Weights After

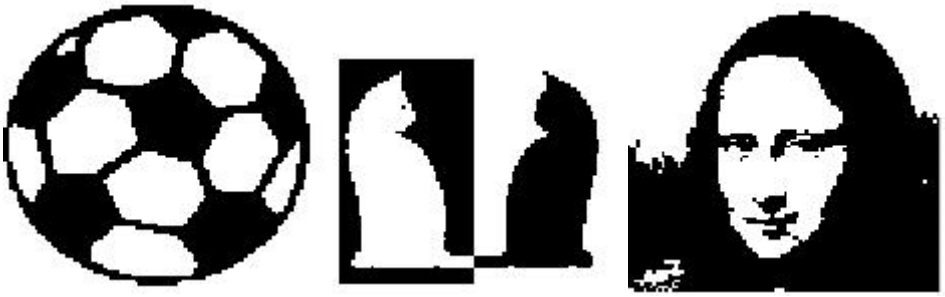
ii. Plot the final retrieved image for each case
Ans.

X=25%



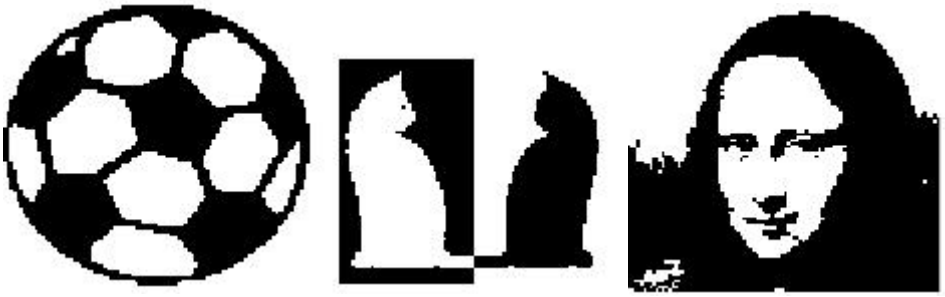
Retrieved

X=50%



Retrieved

X=80%



Retrieved