DSAA Assignment-1

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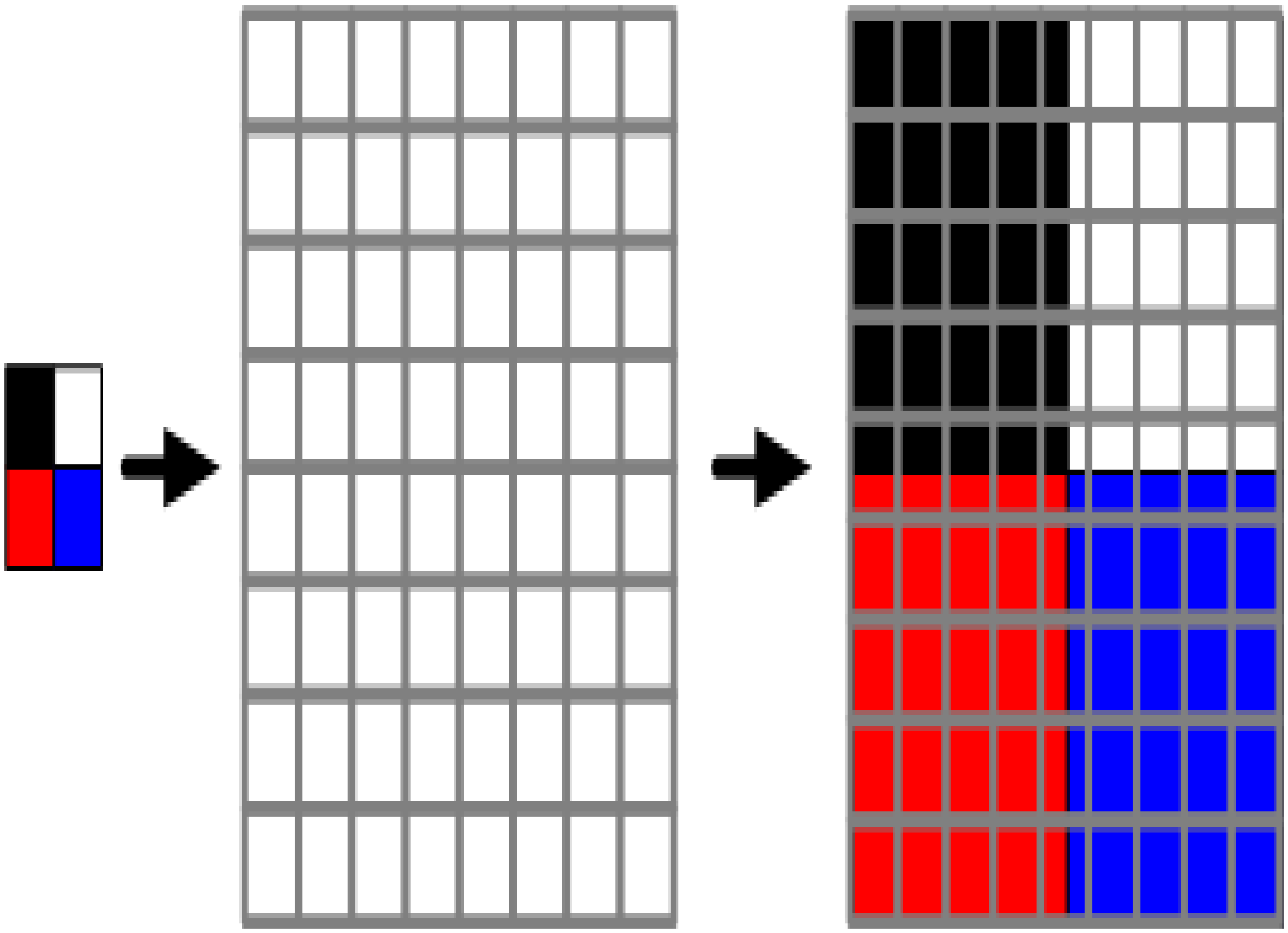
MATLAB

The PDF file contains report of all questions of assignment-1 including the algorithm, results and observations.

Problem 1

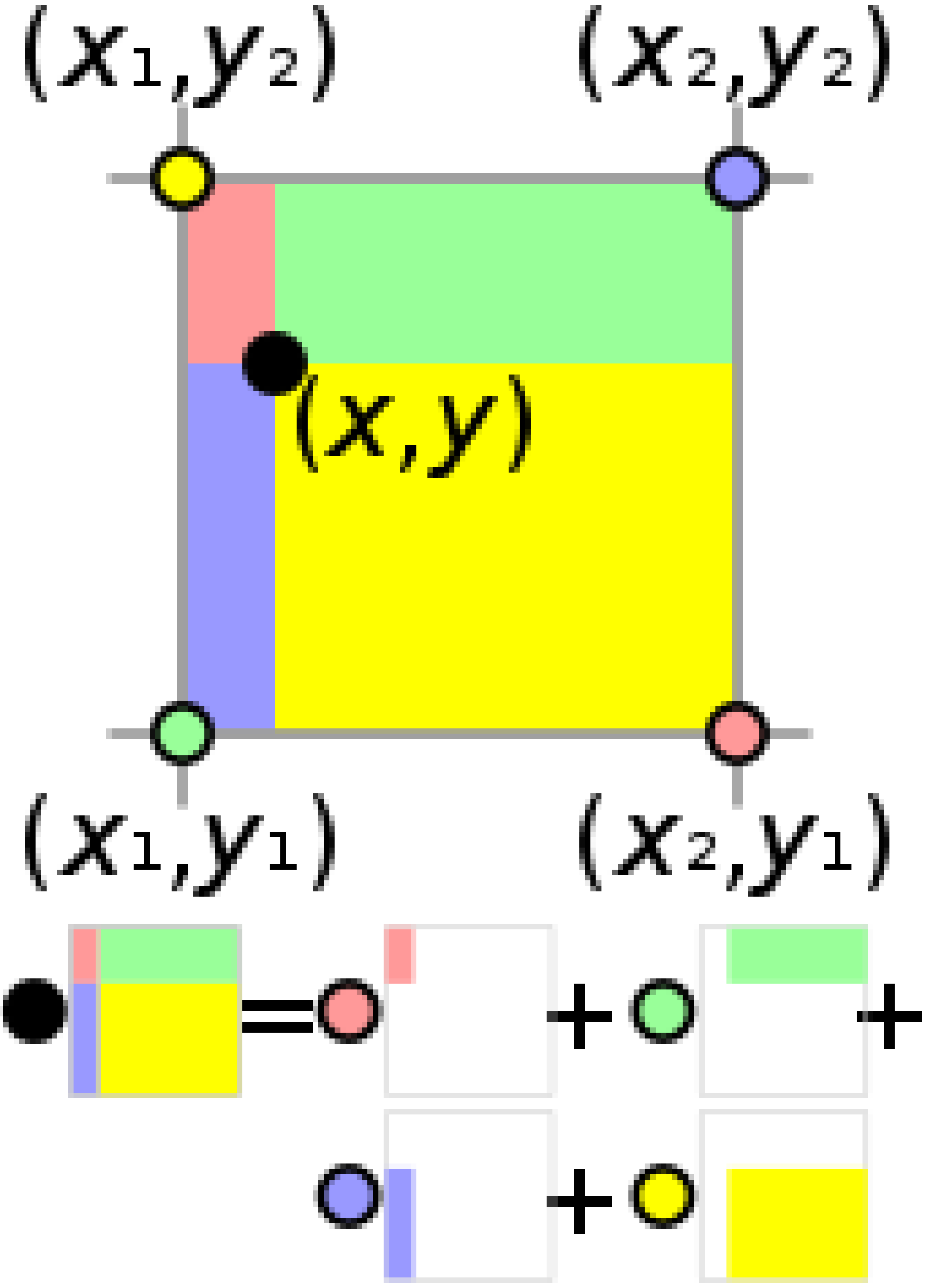
1) Nearest Neighbour interpolation

In this interpolation we take the value of the nearest known neighbour pixel. F



2) Bilinear Interpolation

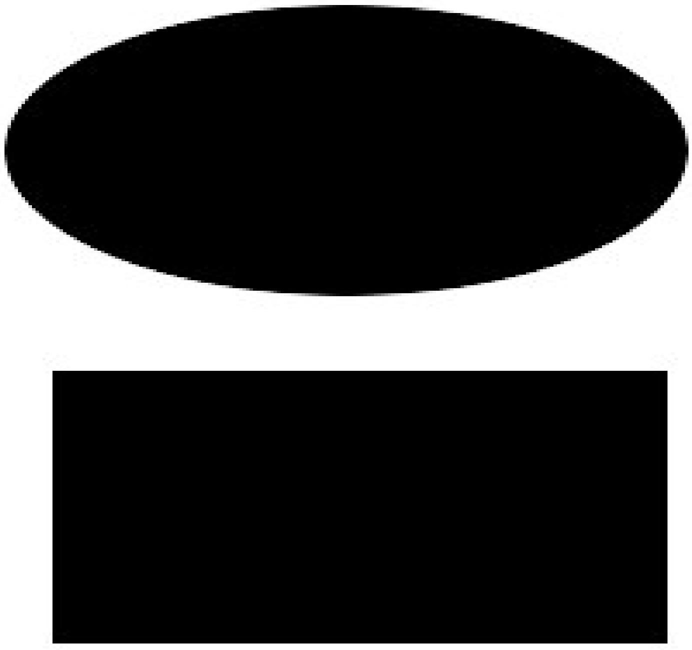
In this type of interpolation instead of just replicating the values we consider the gradation in 2-D.



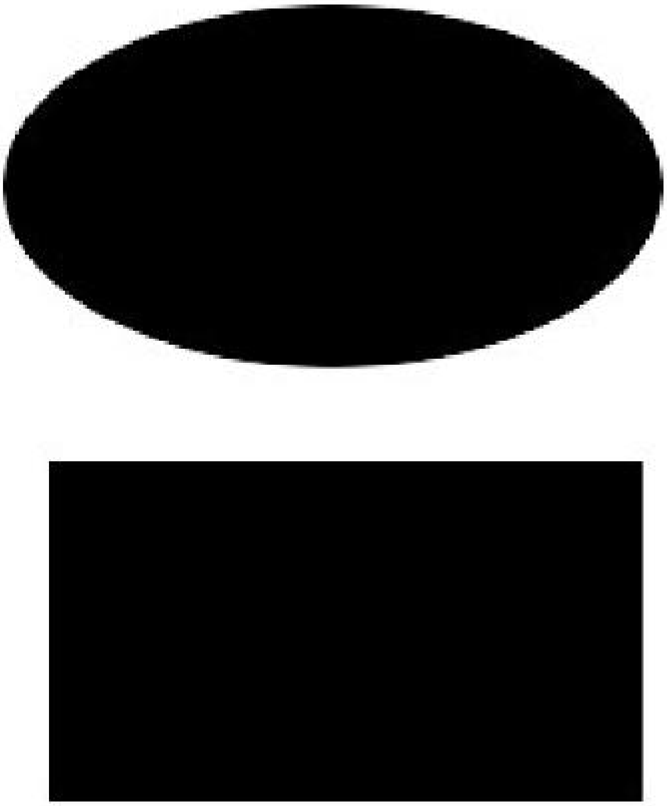
1). Algorithm

Given an image, we have to resize it to X times the original. In part a, an image of dimensions 300x300 which should contain atleast 1 ellipse and 1 polygon, as shown below, was used.
We change the pixel size to the desired X times, so that every element of size-matrix becomes X*(size of original matrix).
Now, we fill X pixels of answer matrix, with 1 pixel of original.
Bilinear Interpolation uses a weighted average of the four nearest cell centers. The closer an input cell center is to the output cell center, the higher the influence of its value is on the output cell value. Whereas, Nearest Neighbour can be used on continous data. It takes the nearest possible pixel from the original and outputs accordingly.

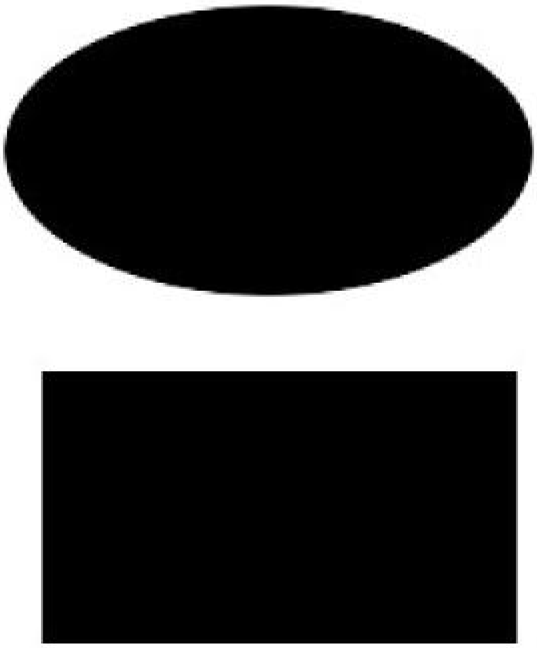
2). Result & Observations



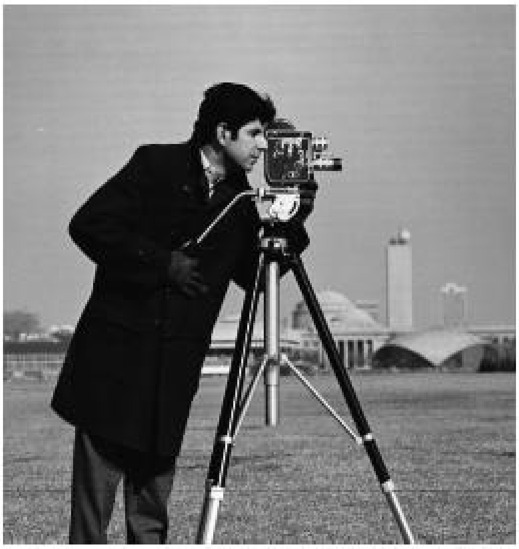
Original Image



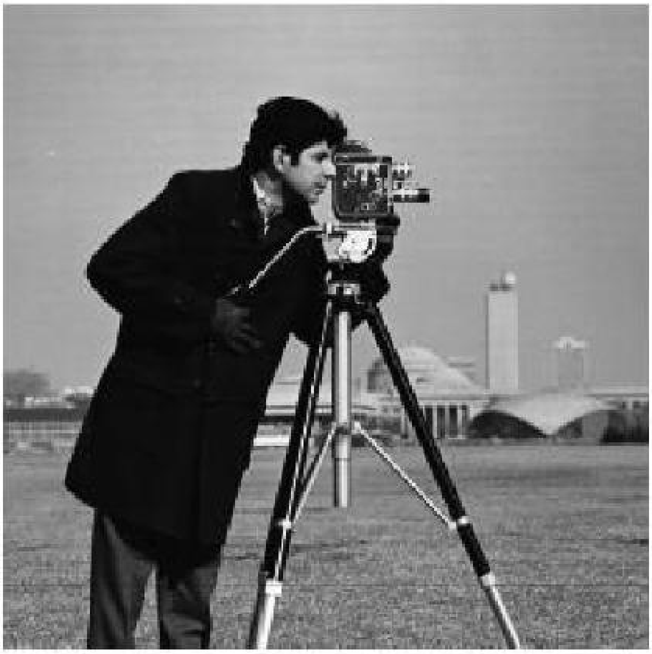
X=5 Nearest Neighbour



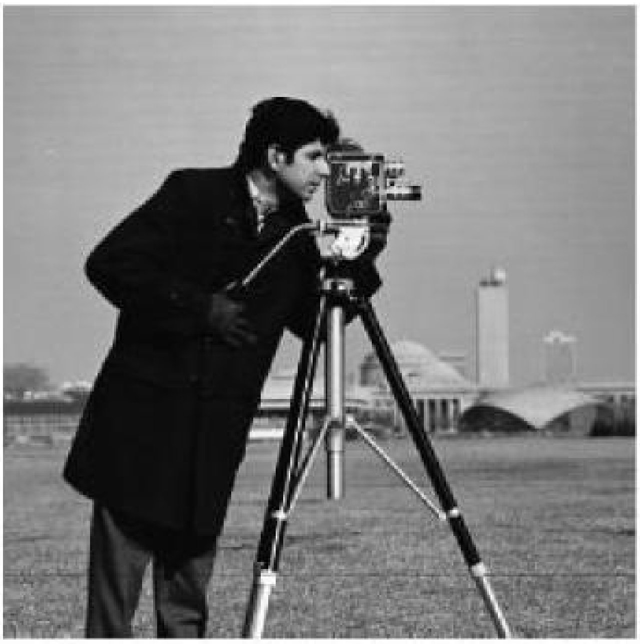
X=2 Bilenear Interpolation



Black&White Original



Black&White X=5 Nearest Neighbour



Black&White X=2
Bilenear Interpolation

Chrome Original

Chrome X=5 Nearest Neighbour

Chrome X=2 Bilenear Interpolation

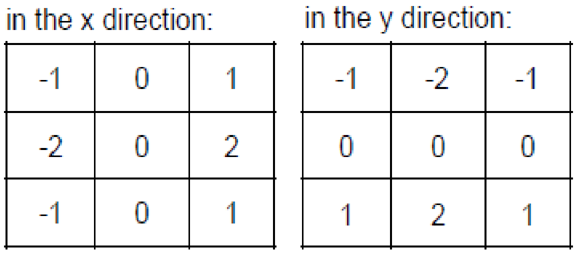
<u>Problem 2</u>

1) Algorithm

The matrix provided is known as ‘Sobel Filter’. It detects transition wherever colour change occurs and draws a white line.(This is done using conv2 function as well as for-loop).

2) Result & Observation

When we perform convolution by M, we get Horizontal lines which detects vertical transitions among colours and when we do convolution by Transpose of the matrix, we get vertical lines which detects horizontal transitions among colours.



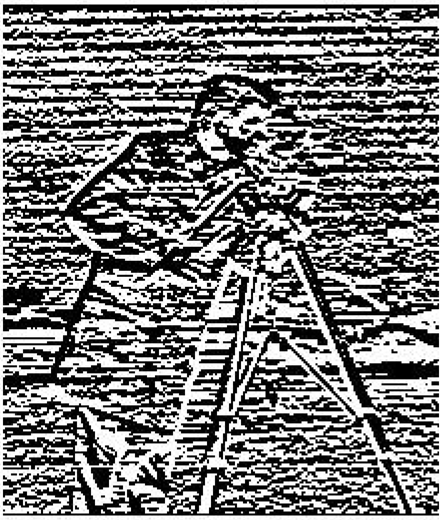
in the x direction:

-1	0	1
-2	0	2
-1	0	1

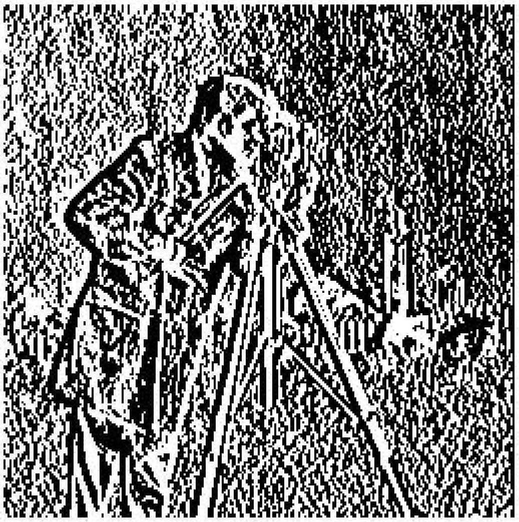
in the y direction:

-1	-2	-1
0	0	0
1	2	1

Sobel Matrices



Convolution with M



Convolution with M-Transpose

Problem 3

A) The formula for just 1 convolution will be
W = ((Width - F + 2Z) + S)/S

H = ((Height - F + 2Z) + S)/S

Where W is the Width of the output and H is the Height of the output.
But here we are doing N convolutions and so we have to keep in mind the dimensions of the previous output matrix to calculate the dimensions of the new output matrix. Suppose we are doing (i)th convolution and so we need the dimensions of the (i-1)th convolution.
Suppose the dimensions of the (i-1)th convolution are Wi-1 and Hi-1 . So the dimensions of after (i)th convolution will be

Wi = ((Wi-1 - F + 2ZT) + S)/S

Hi = ((Hi-1 - F + 2ZT) + S)/S

Z-transpose is such that when Z<= F-1, ZT will be taken as Z and when it is greater then F-1, ZT will be taken as F-1 to avoid filter from going out of range.
We do the above calculation till we get WN and Zn starting from W0 and Z0 which is the actual width and height of the image.

B) There will be F2 multiplications and F2 -1 additions for each convolution at each channel. So in total there will be
∑ Wi * Hi * F2 * Channels : i = 0 to n-1
this much number of multiplications and

∑ Wi * Hi * (F2 -1)* Channels : i = 0 to n-1
this much number of additions.

Problem 4

A) Audio file is read using audioread(<file_name>,fs);

B) Let the points for which the values are known be x1 and x3 and the values being y1 and y3. Suppose
we have to find the value at some point between x1 and x3, let this be x2.

y2 = (((x2-x1)*(y3-y1))/(x3-x1)) + y1

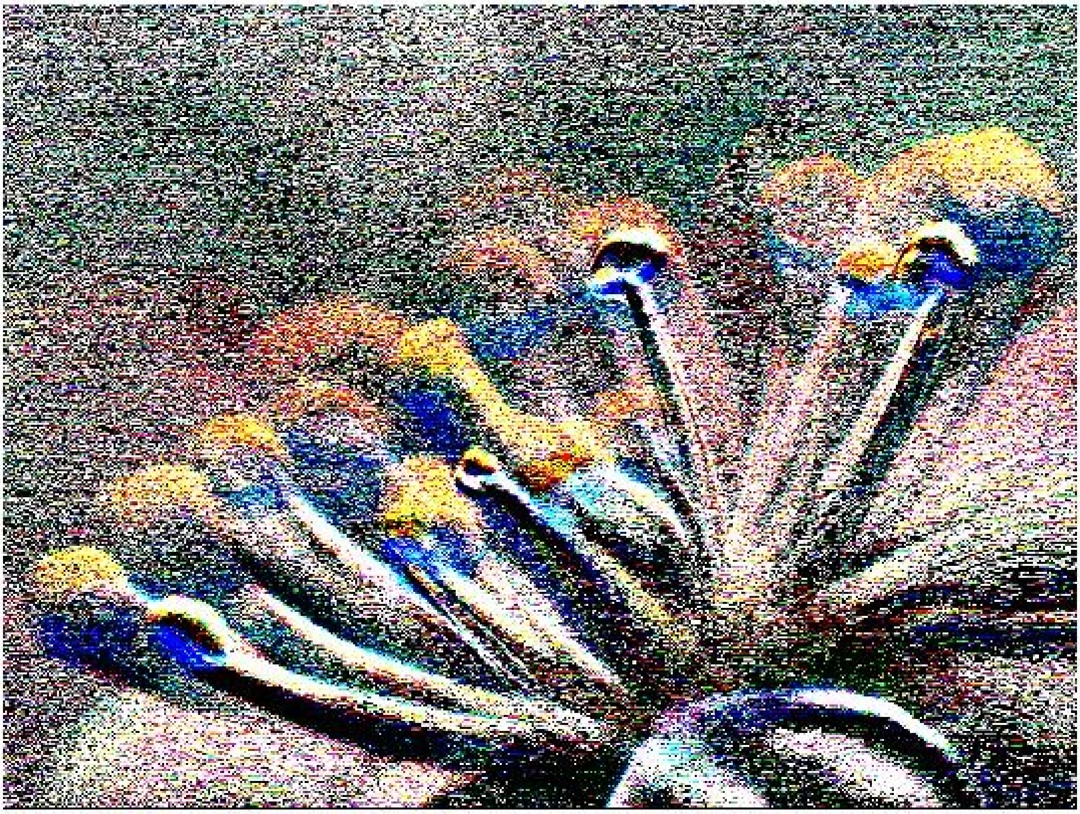
x2 = (((y2-y1)*(x3-x1))/(y3-y1)) + x1

C) Here we can convolve the sound with the impulse response captured in different environments to simulate.

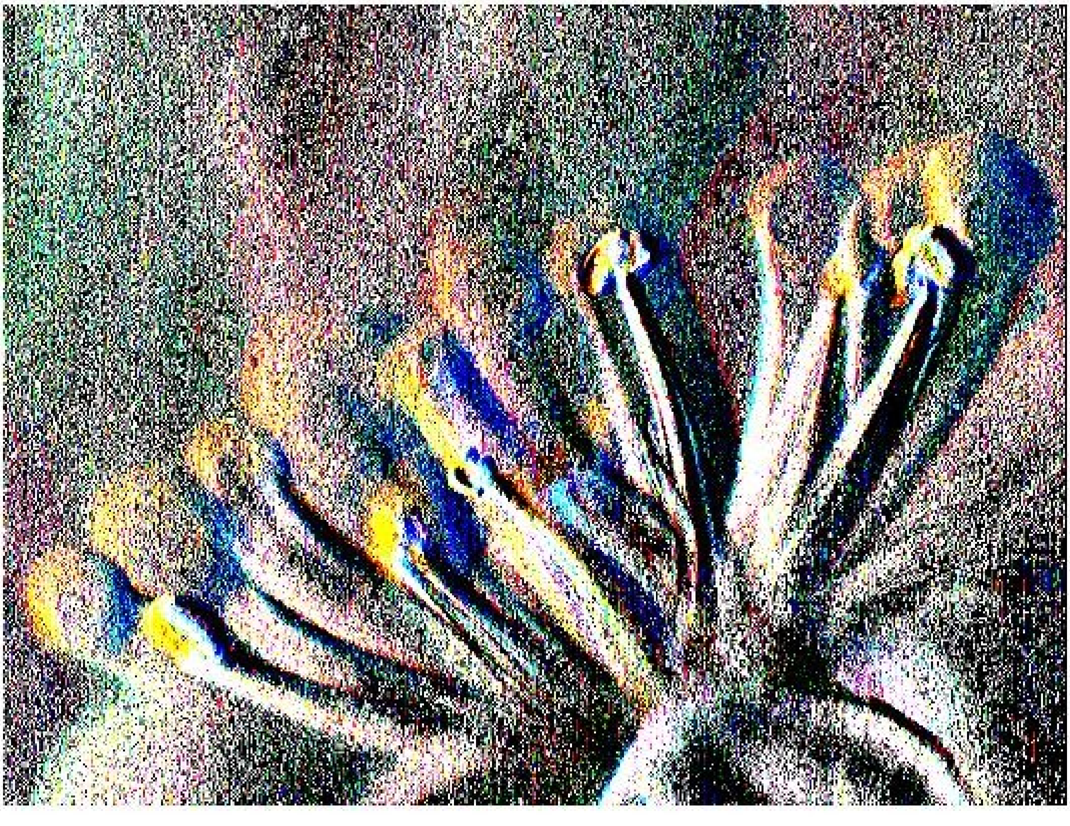
Problem 5

If the filter is used on a region with same colour it sums to zero (1+2+1-1-2-2 = 0) which makes it black. Hence, the upper and lower region in sample_imp.png, when convolved, gives black colour all over except in the middle. This is because, Transition change occurs in middle from black to white so, on convolving it results as :
3 (1+2+1) of white and -3 (-1-2-1) of black ,giving the white line.

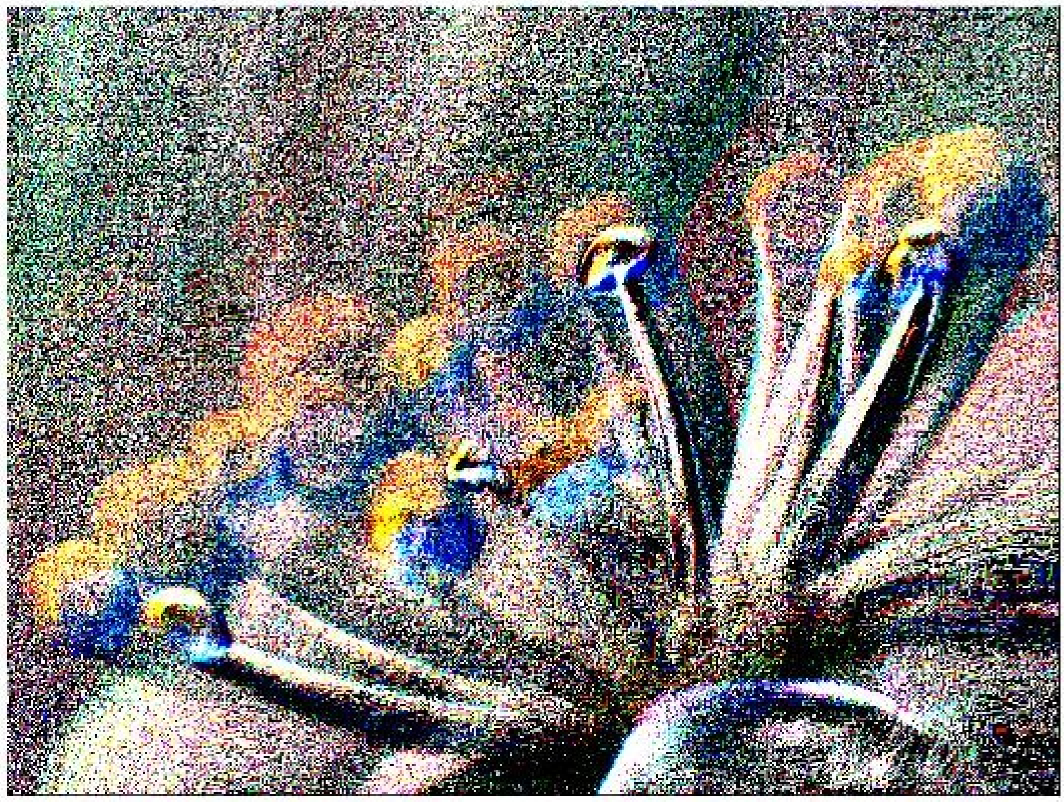
5A) Convolved with M (Horizontal Stripes)



5B) Convolved with M-transpose (Verticle Stripes)

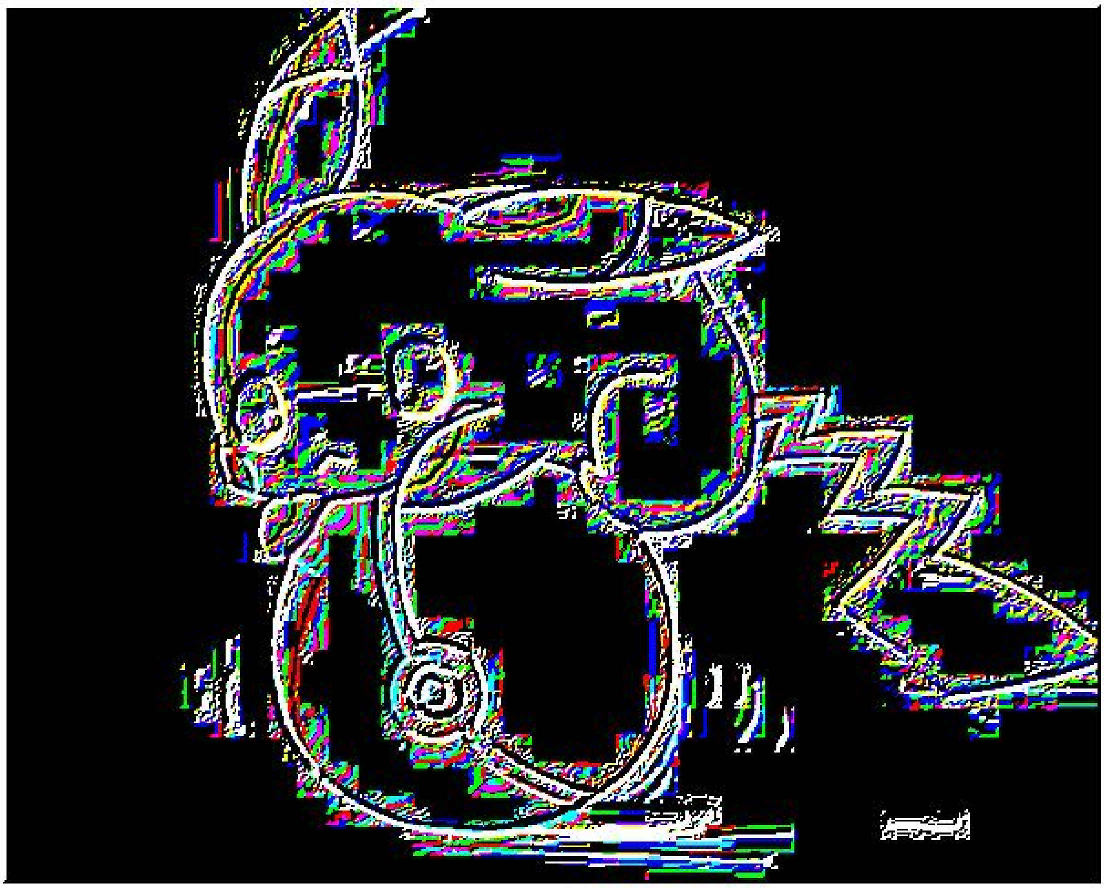


5C) Convolving with M and M-transpose

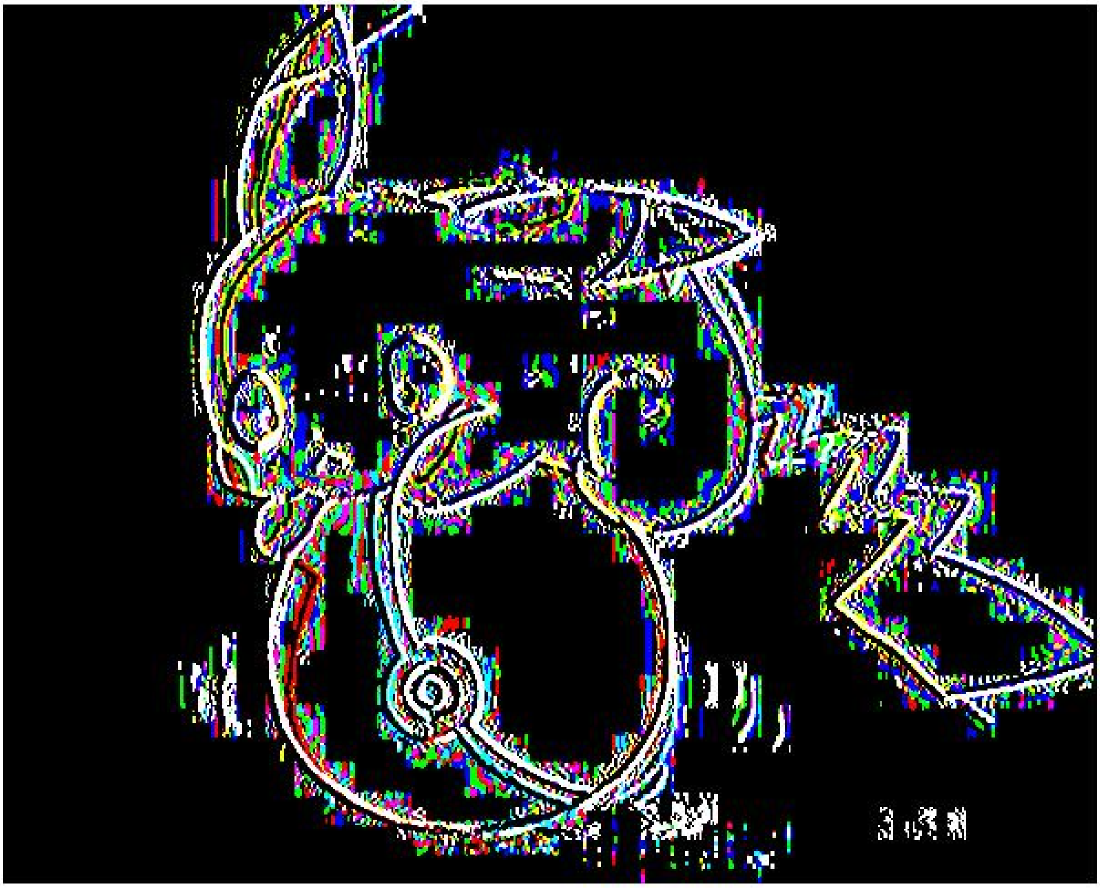


5D) With other 3 images:

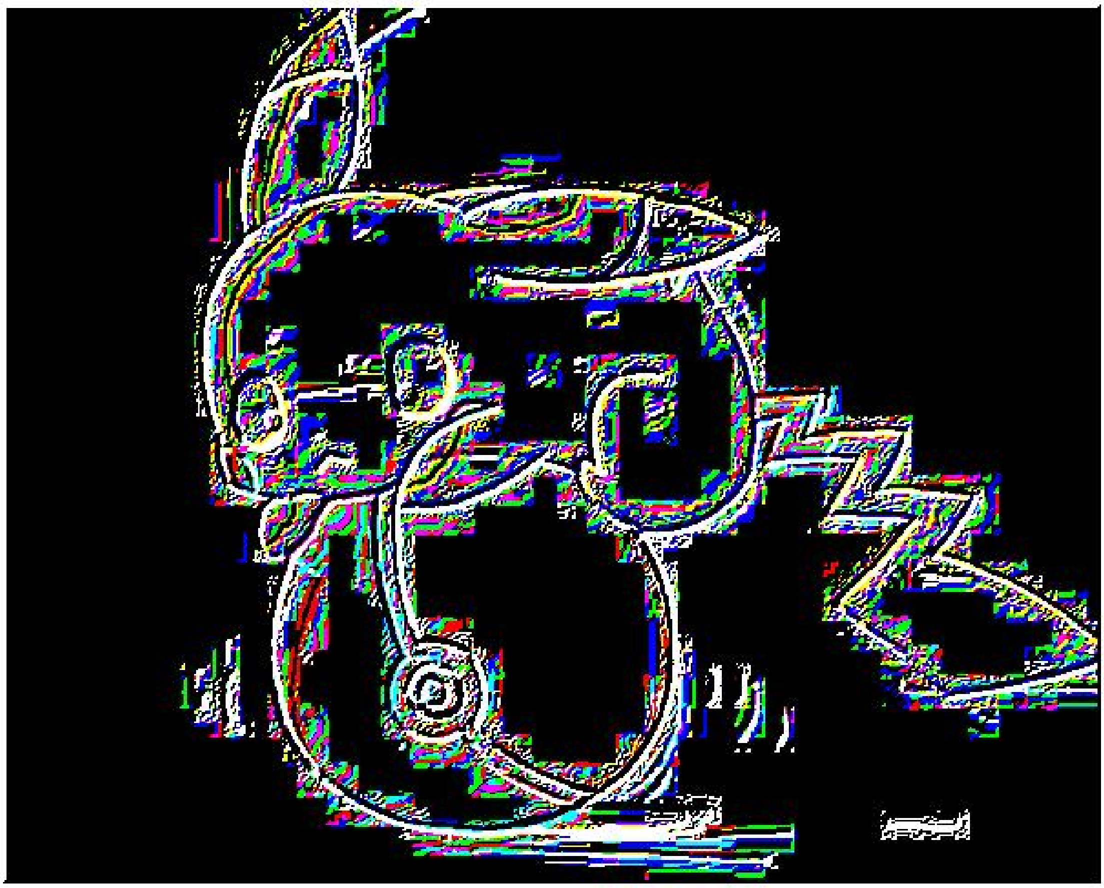
i) Convolved with M (Horizontal Stripes)



ii) Convolved with M-transpose (Verticle Stripes)



iii) Convolving with M and M-transpose

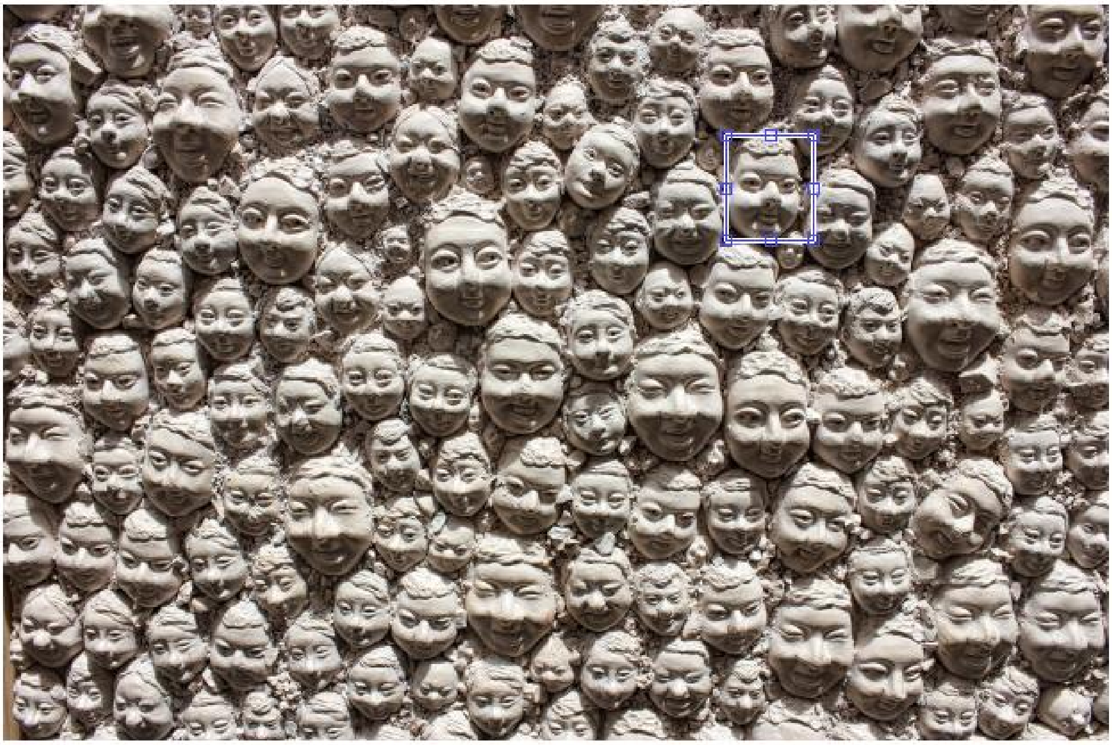


Other 2 images are vegeta.jpg and a18,jpg, and their results can be seen by replacing the file name in the codes.

Problem 6

Algorithm

Iterating the F1.jpg over the Faces.jpg and calculating the absolute difference of both matrices' values, the minimum among whome will be the closest possible result.



Problem 7

Algorithm

Here, we exacly need to calculate the impulse function, given the input and output when convolved over by impulse function.

So we are given input=X, output=Y and let impulse fxn be M matrix.

So **X * M = Y**

M = X^-1 * Y

Result & Observation

Answer Matrix M = [1 -3 -3 4 4 5]