CS-484 Computer Vision

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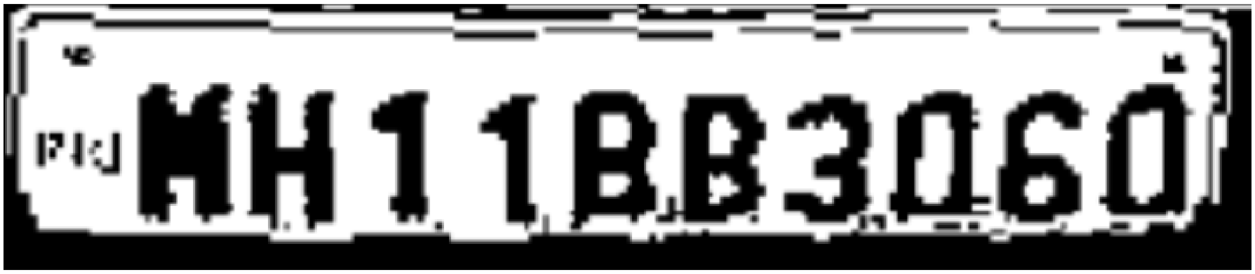
Homework 1

1) Question 1

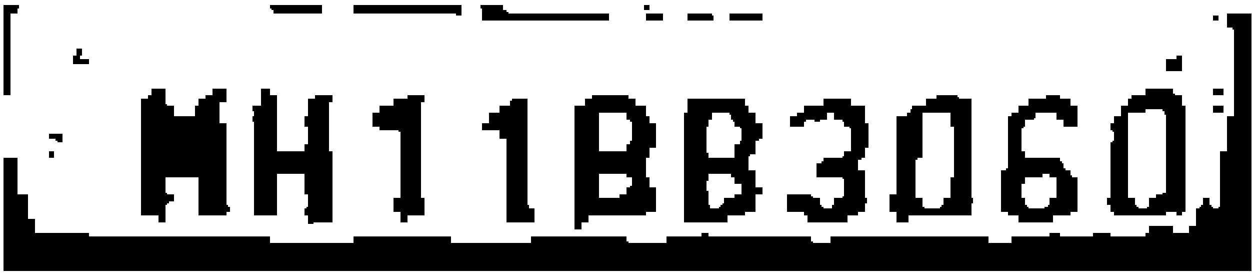
Original Image:



i) Dilation

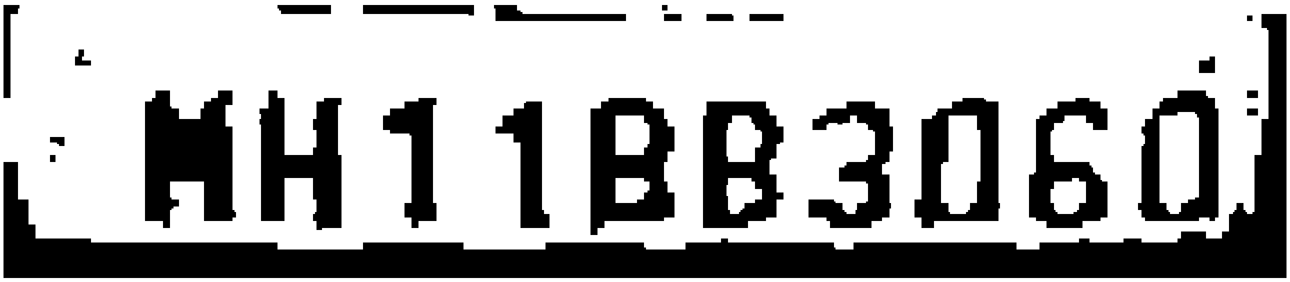
To obtain dilated images, pillow library is used to open images, NumPy library used to convert image array to NumPy array and after operations are done again NumPy array is converted to image.

a. Structure matrix is : ([1,1,1],[1,1,1],[1,1,1])



In this case, by using dilation function, which adds pixels to the boundaries of the objects in an image, white pixels, where are presented in the image are increased. This increasement is done according to structure matrix. So when a middle pixel of the structure matrix is put on the image, if the image pixel's neighbors corresponds with a structure matrix, the pixel turns to white.

b. Structure matrix is : ([0,1,0],[1,1,1],[0,1,0])

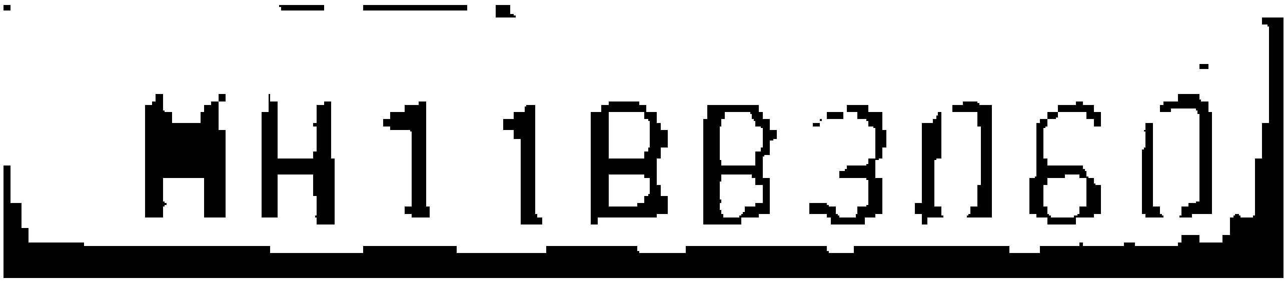


This is the same case as above, however, structure matrix is changed, therefore, tiny differences occur in the dilated image.

ii) Erosion

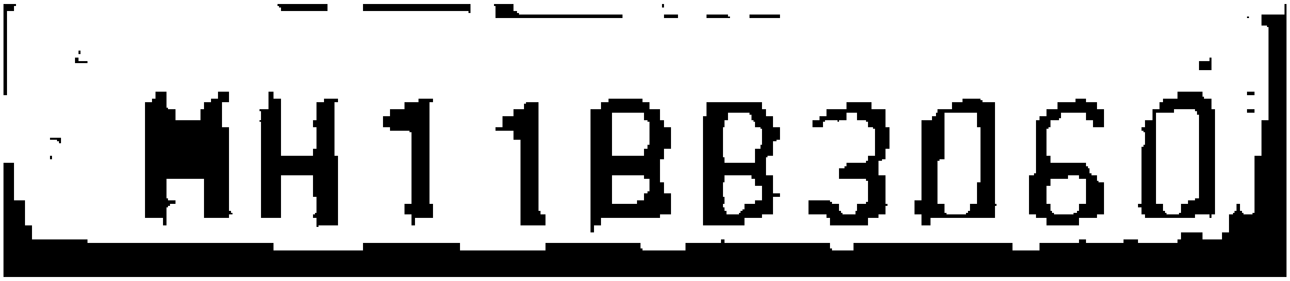
To obtain eroded images, pillow library is used to open images, NumPy library used to convert image array to NumPy array and after operations are done again NumPy array is converted to image.

a. Structure matrix is : ([1,1,1],[1,1,1],[1,1,1])



Erosion is the opposite of the dilation, in this case boundaries of the object inside of the image are removed. So black pixels in the boundary are removed. This removal operation is done according to structure matrix. If the pixel and its neighbors match with the structure matrix, the pixel is removed.

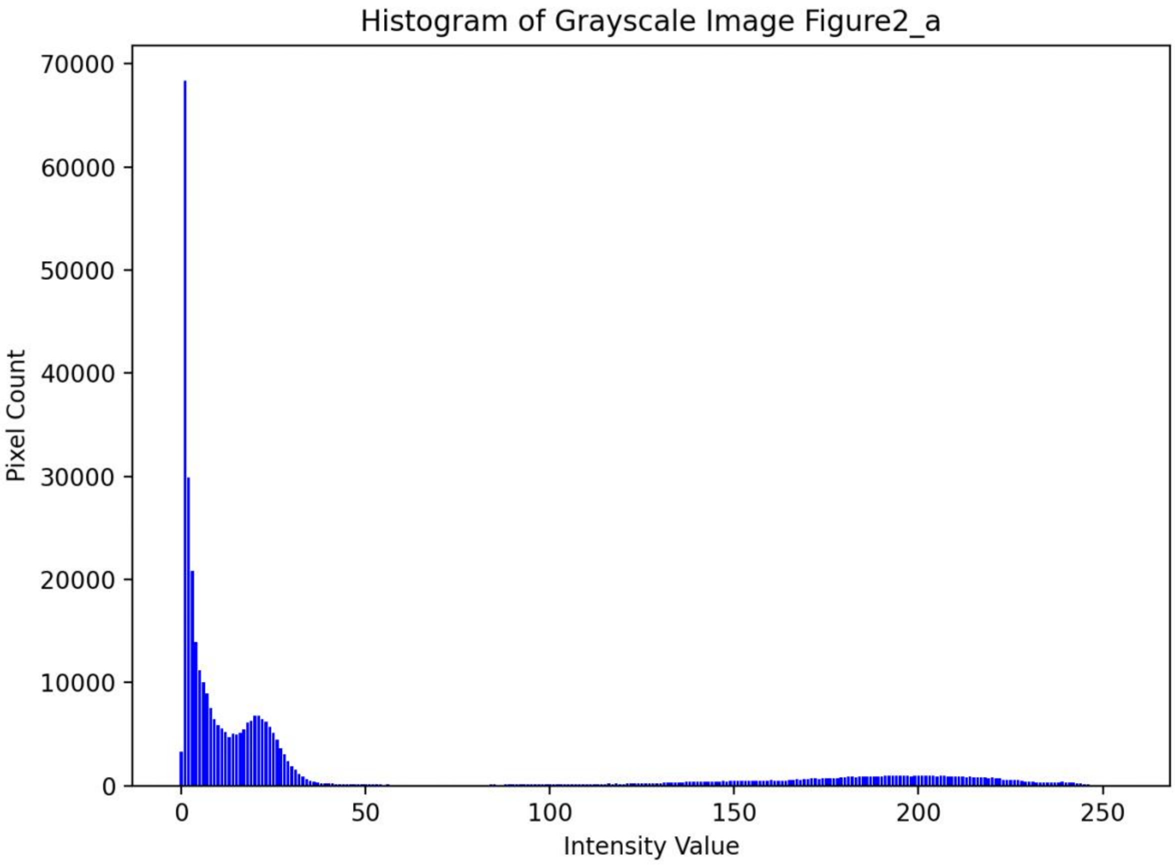
b. Structure matrix is : ([0,0,0],[0,0,1],[0,0,0])



This is the erosion with another matrix structure. In this case objects in the images can be identified better compared to first erosion operation.

2) Question 2

a. Histogram graph of Figure2_a



Images are open with cv2 library, which is a computer vision library for python programming language. While iterating through pixels of the image, 2D array is created and pixels and its values are counted. The result is plotted by using matplotlib library. As it can be seen that, Figure2_a contains black pixels a lot, which also can be seen in this graph.

b. Histogram graph of Figure2_b

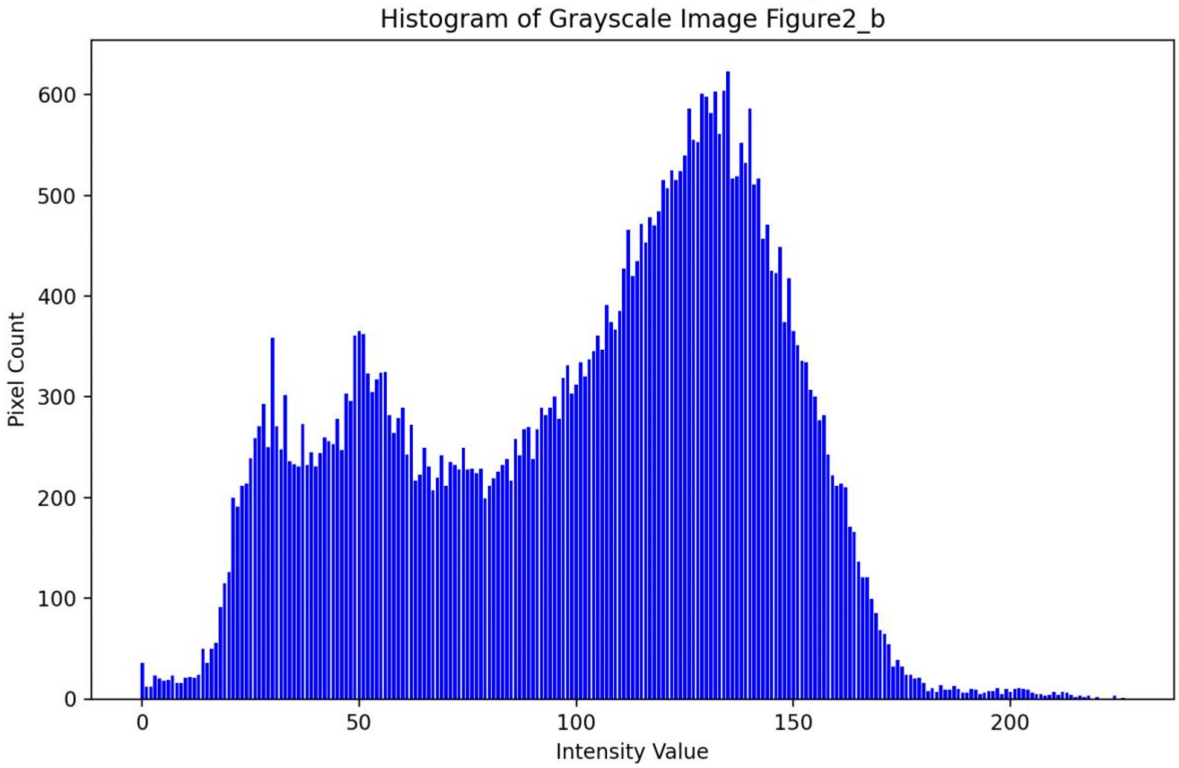
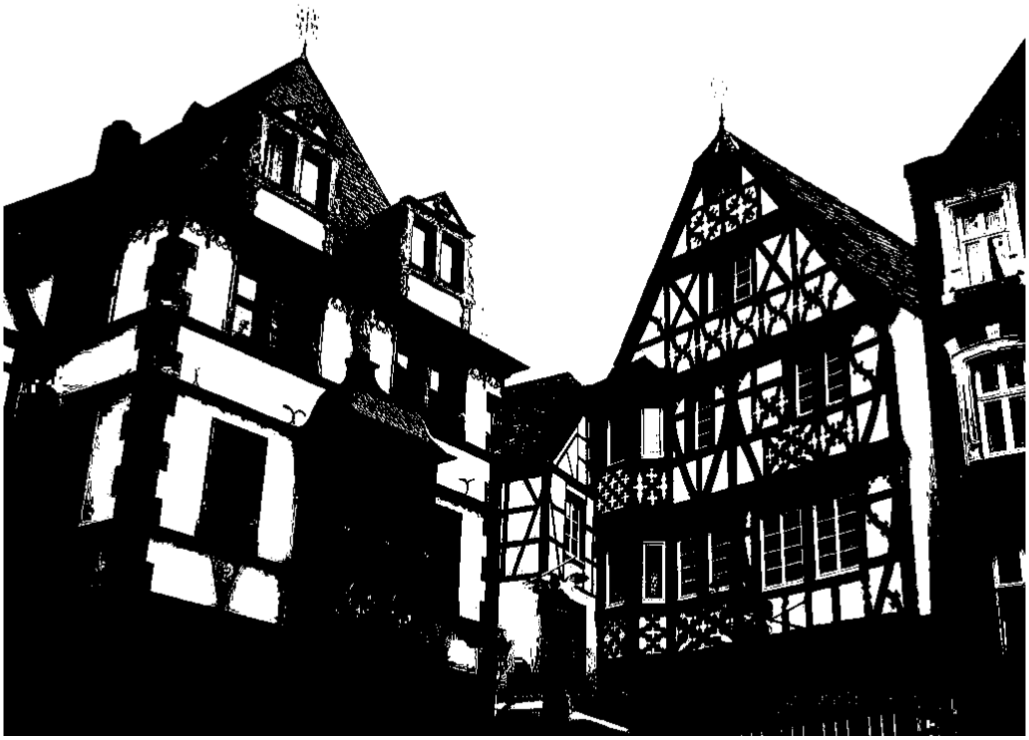


Image is open with cv2 library, which is a computer vision library for python programming language. While iterating through pixels of the image, 2D array is created and pixels and its values are counted. The result is plotted by using matplotlib library. As it can be seen that, Figure2_b contains variety of pixels and intensity is distributed among almost all pixels, which also can be seen in this graph.

3) Question 3

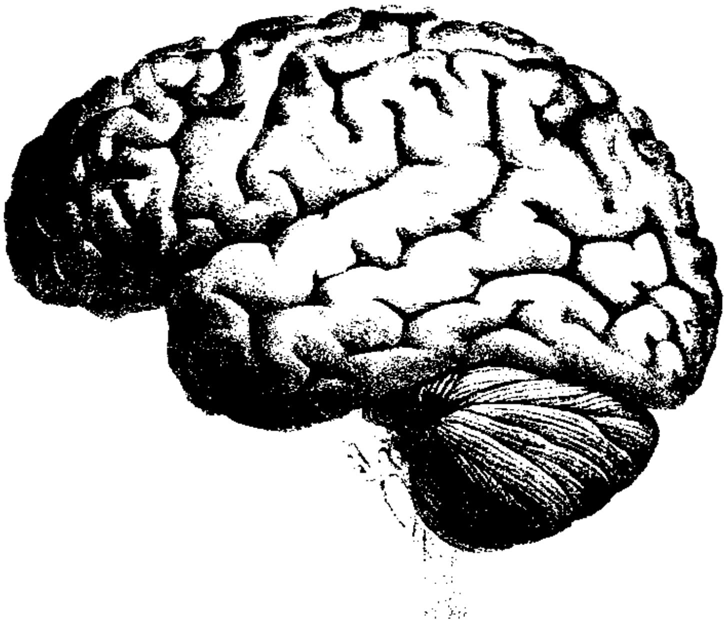
Otsu thresholding is a method for determine the threshold for gray-scale images. In this method, image is considered as two parts, background and foreground. Then for all possible thresholds, variances are computed. The optimum threshold is found when the variance difference between background and foreground is minimum. Threshold of the difference images are tend to be different. Also if the color transition between the pixels and the neighbors are sharp, the transition can be seen better, which might be beneficial in many areas. However, result are may not be perfect all the time. Because unnecessary objects inside of the image can affect the threshold, the important distinction between necessary objects can be omittable. In addition to this, Images are open with cv2 library, which is a computer vision library for python programming language. While iterating through pixels of the image, 2D array is created and pixels and its values are counted. The result is plotted by using matplotlib library.

a. Otsu threshold for Figure3_a



Threshold of this image is 153.

b. Otsu threshold for Figure3_b

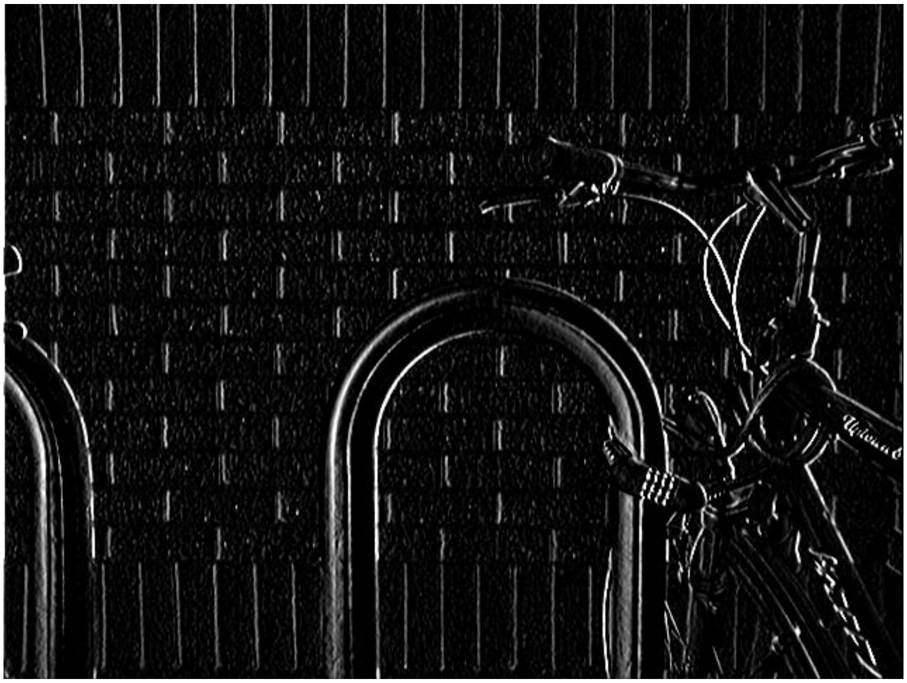


Threshold of this image is 121.

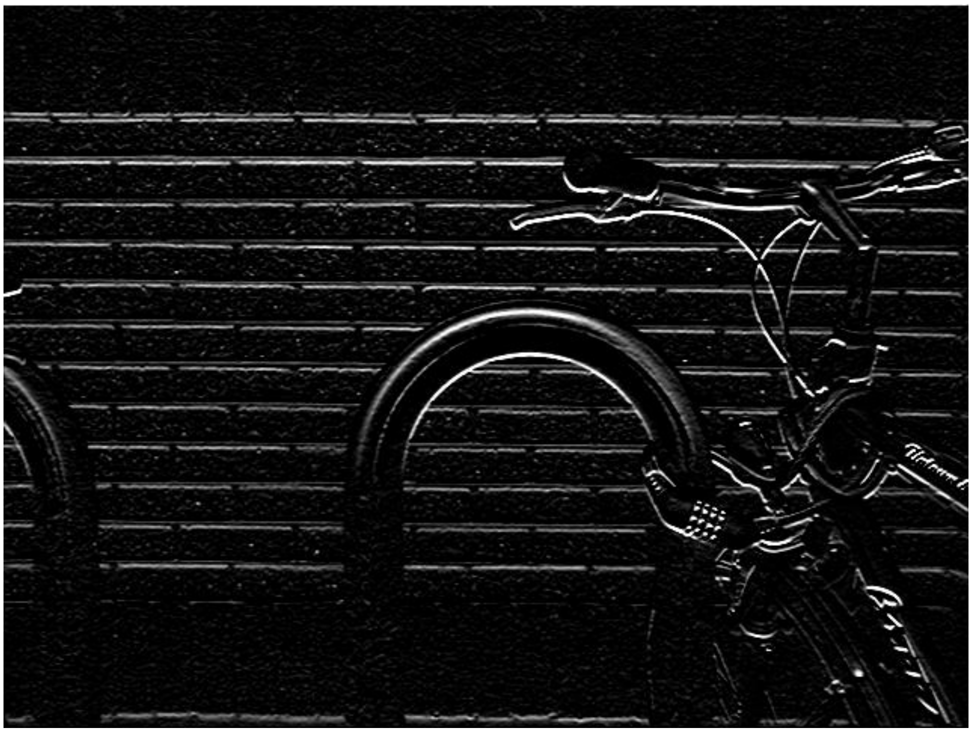
4) Question 4

Convolution function takes an image and operator matrix. First, paddings are added according to operator matrix. Then while iterating through image pixels, top-left corner indices of the edges are defined. Then calculation of row and column indices of bottom right corner of edges are defined by adding operator size to the indices. Then empty edge array is created, and values are passed. While iterating through edge array, it takes value from given image and adds it to the padded image. Below results of the Sobel and Prewitt operators as said in the pdf. In addition to this, Images are open with cv2 library, which is a computer vision library for python programming language. While iterating through pixels of the image, 2D array is created and pixels and its values are counted. The result is plotted by using matplotlib library.

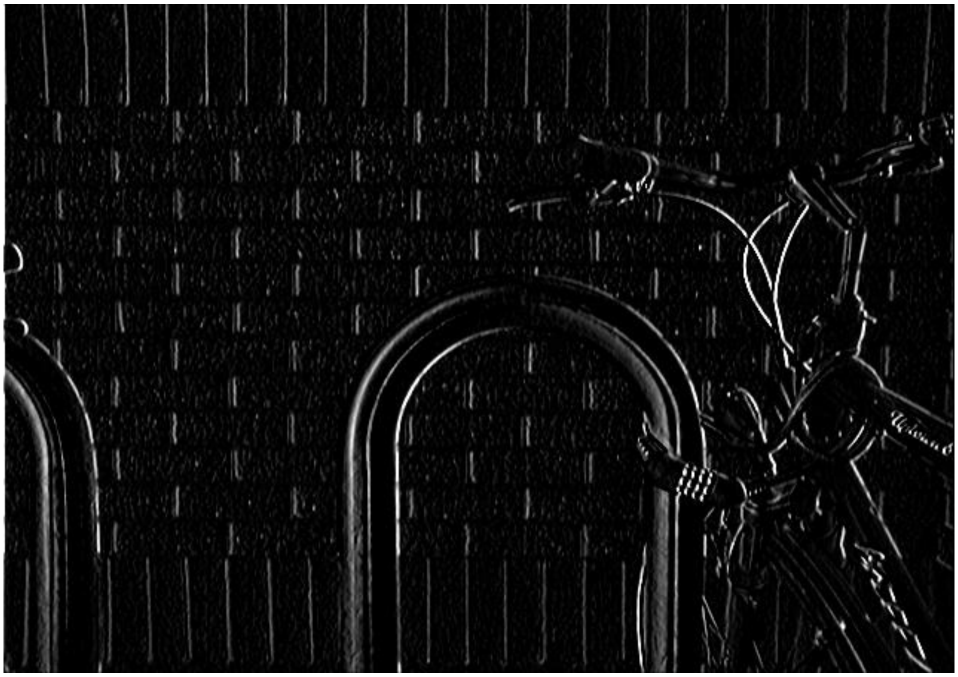
a. Sobel-X Operator = [-1 0 1; -2 0 2; -1 0 1]



b. Sobel-Y Operator = [-1 -2 -1; 0 0 0; 1 2 1]



c. Prewitt Operator [X-axis] = [-1 0 1; -1 0 1; -1 0 1]



d. Prewitt Operator [Y-axis] = [-1 -1 -1; 0 0 0; 1 1 1]