a)INTRODUCTION-:

In this question I use a software which is called GIMP (https://www.gimp.org/) it is a image filtering software. In this many image operation are available like noise detection ,edge detection etc. In that software i choose edge detection filter by using sobel algoritham.

Abstract:-

Sobel operator-what is sobel operator?

The Sobel operator performs a 2-D spatial gradient measurement on an image and so emphasizes regions of high spatial frequency that correspond to edges. Typically it is used to find the approximate absolute gradient magnitude at each point in an input grayscale image.

How it work?

In theory at least, the operator consists of a pair of 3×3 convolution kernels . One kernel is simply the other rotated by 90°. This is very similar to the Robert cross operator.

Gb=[[-1,0,1],[-2,0,2],[-1,0,1]] , Gy=[[1,2,1],[0,0,0],[-1,-2,-1]]

These kernels are designed to respond maximally to edges running vertically and horizontally relative to the pixel grid, one kernel for each of the two perpendicular orientations. The kernels can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation (call these *Gx* and *Gy*). These can then be combined together to find the absolute magnitude of the gradient at each point and the orientation of that gradient. The gradient magnitude is given by:

$$|G| = \sqrt{Gx^2 + Gy^2}$$

Typically, an approximate magnitude is computed using:

$$|G| = |Gx| + |Gy|$$

which is much faster to compute.

The angle of orientation of the edge (relative to the pixel grid) giving rise to the spatial gradient is given by:

$$\theta = \arctan(Gy/Gx)$$

In this case, orientation 0 is taken to mean that the direction of maximum contrast from black to white runs from left to right on the image, and other angles are measured anti-clockwise from this.

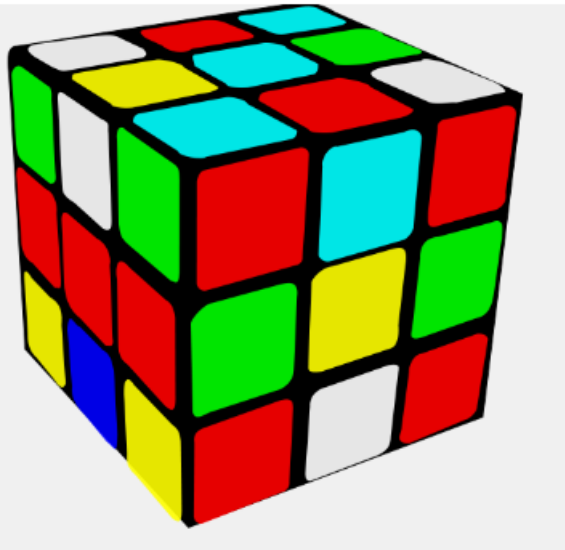
Often, this absolute magnitude is the only output the user sees --- the two components of the gradient are conveniently computed and added in a single pass over the input image using the pseudo-convolution operator shown in below.

Mat=[[p1,p2,p3],[p4,p5,p6],[p7,p8,p9]]

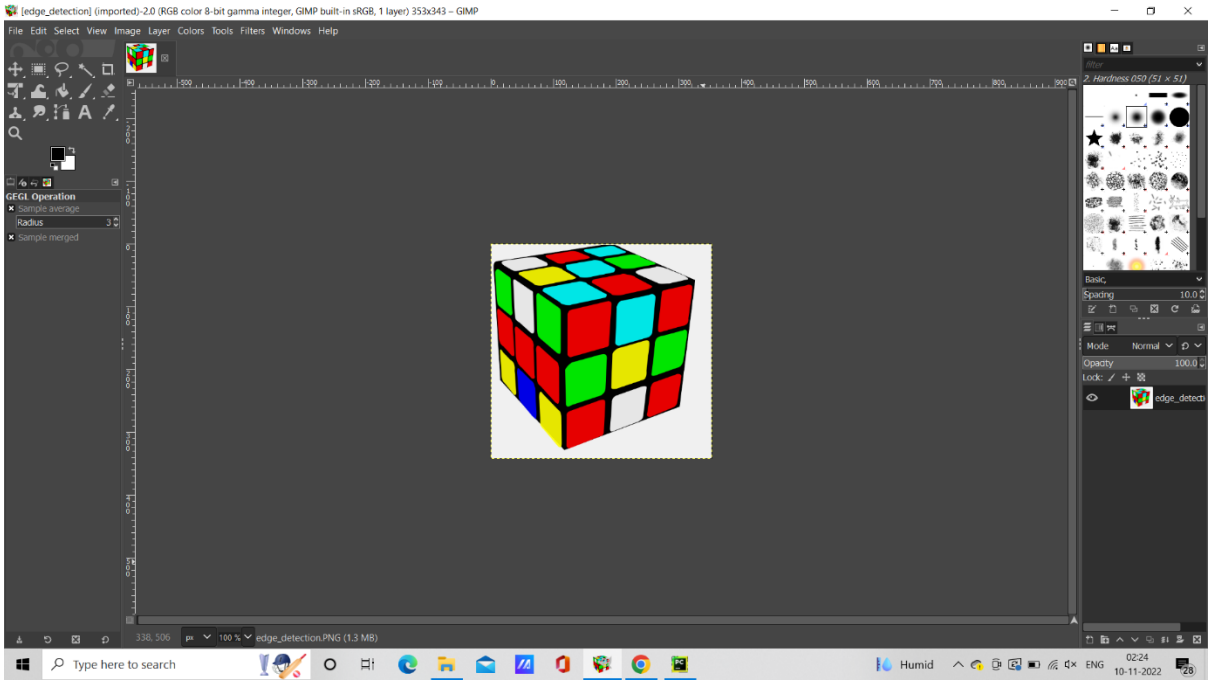
Using this kernel the approximate magnitude is given by:

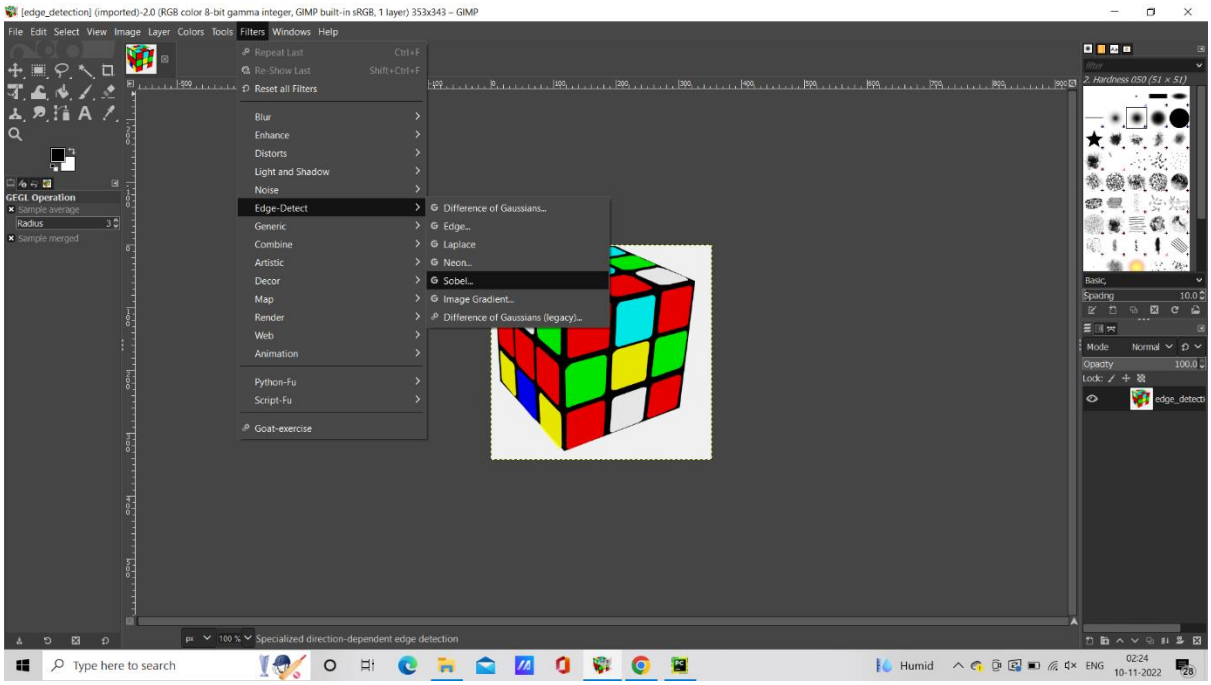
$$|G| = |(P_1 + 2 \times P_2 + P_3) - (P_7 + 2 \times P_8 + P_9)| + |(P_3 + 2 \times P_6 + P_9) - (P_1 + 2 \times P_4 + P_7)|$$

INPUT IMAGE:-

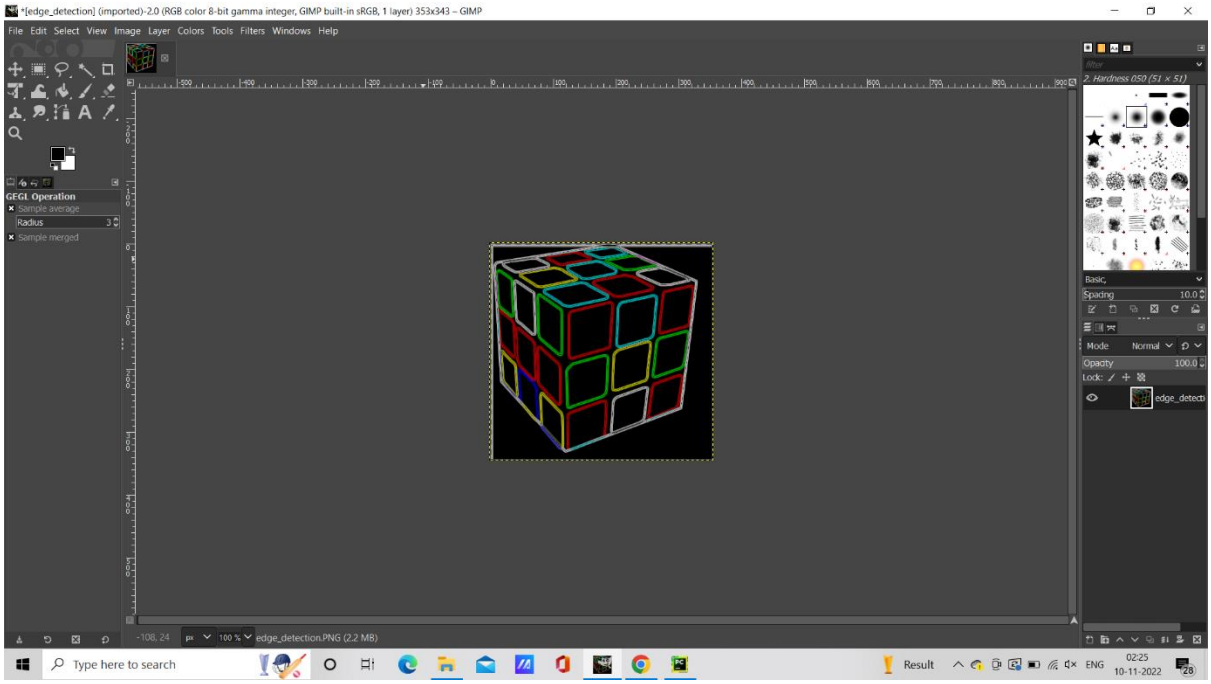


AFTER APPLYING FILTER:-





FINAL OUTPUT IMAGE:-

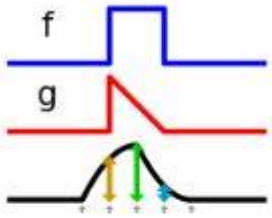


In this filter edges are detecte with colours.

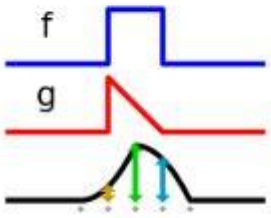
B) i) analytical question

q) Below given images are two operations performed on a signal. Can you identify which is which?

Operation 1



Operation 2



Answer –

For correlation

$$R(x) = f(x) \star g(x)$$

$$R(x) = \int_{-\infty}^{\infty} f(z)g(x+z)dz$$

For convolution

$$G(x) = f(x) * g(x)$$

$$G(x) = \int_{-\infty}^{\infty} f(z)g(x-z)dz$$

Operation 1 is cross correlation between signal f and signal g, whereas operation 2 is convolution function applied to signal f and signal g

Correlation and convolution are two different methods with give different result. Convolution defines how much the signals overlap, whereas correlation tries to find the relation between the signals

ii)MCQ questions

1) Which statements are true about k-means clustering –
   a) time complexity of data assignment =o(KN)
   b) time complexity of updating mean=o(N)
   c) total time complexity =o(KTN)
   d) we must know the exact number of means before starting.

Answer- a, c, d

2) Which technique is best fit for removing salt and pepper noise –
   a) mean filtering
   b) median filtering
   c) gaussian filtering
   d) none of above

Answer - b