PS2
Shaurye Aggarwal

2.1 a)

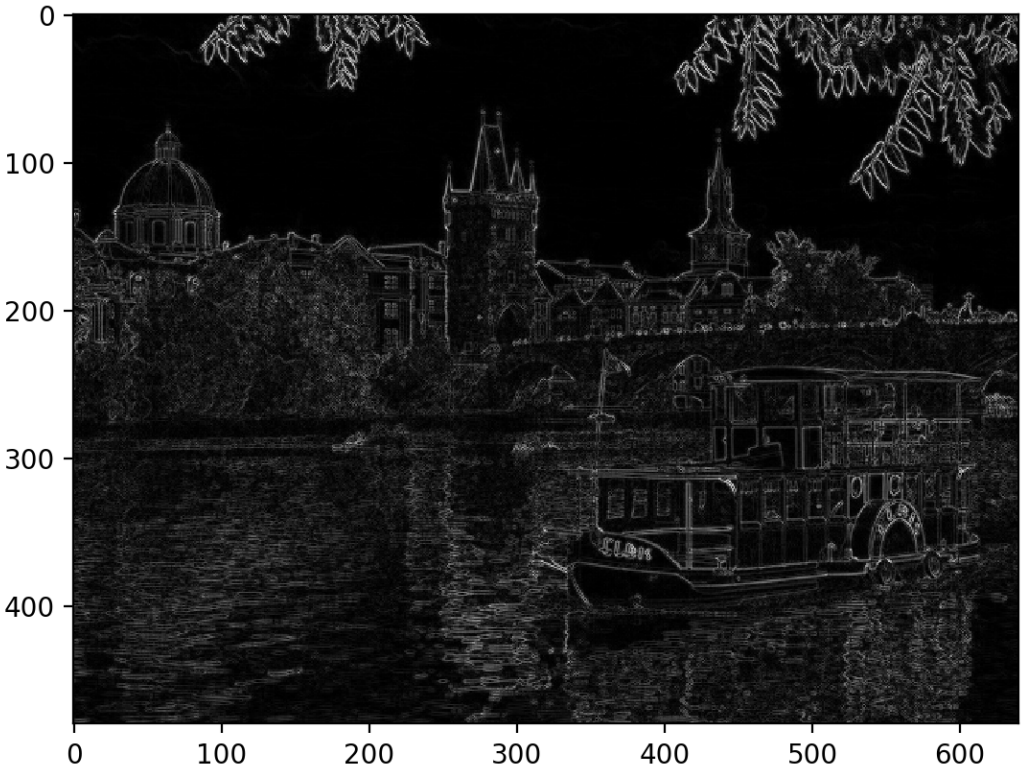
b)

2.2 a)

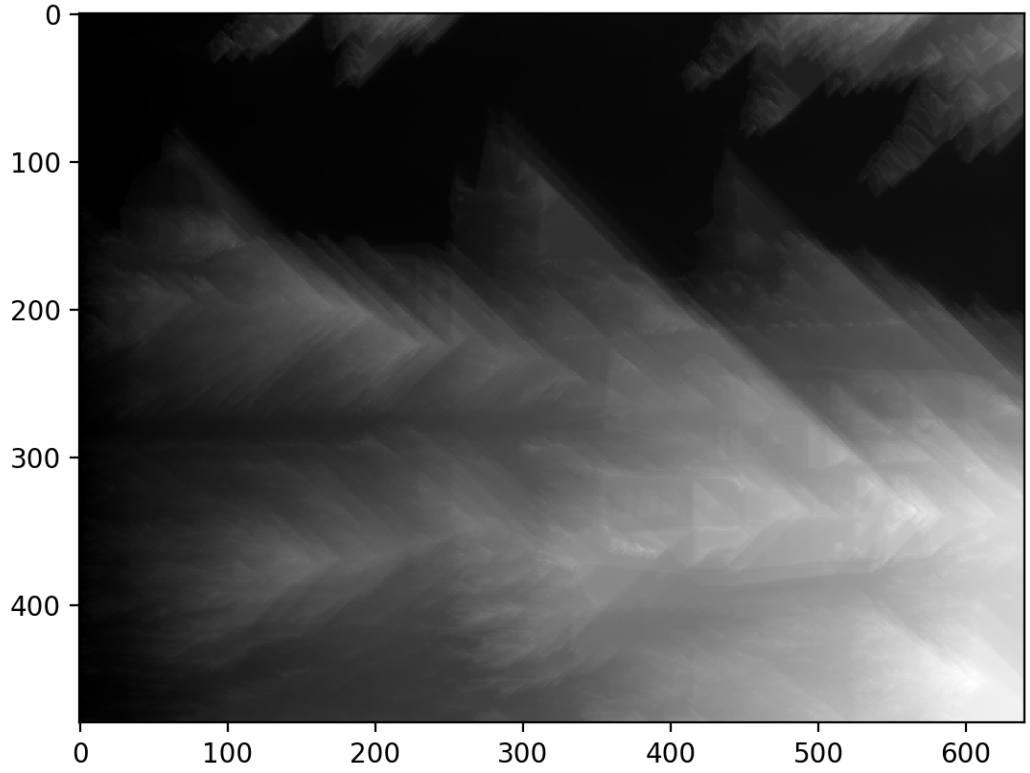
b)

2.3) a)

White pixels in the following image have a higher value, i.e. they represent higher energy level. Our energy function computes the change in x and y direction for every pixel and sums them to give energy level for each pixel. Changes at the edges of different objects is high and hence the energy is high that in turns makes the edges white in the picture. The whiter is the pixel, the stronger change in color is present in the image.

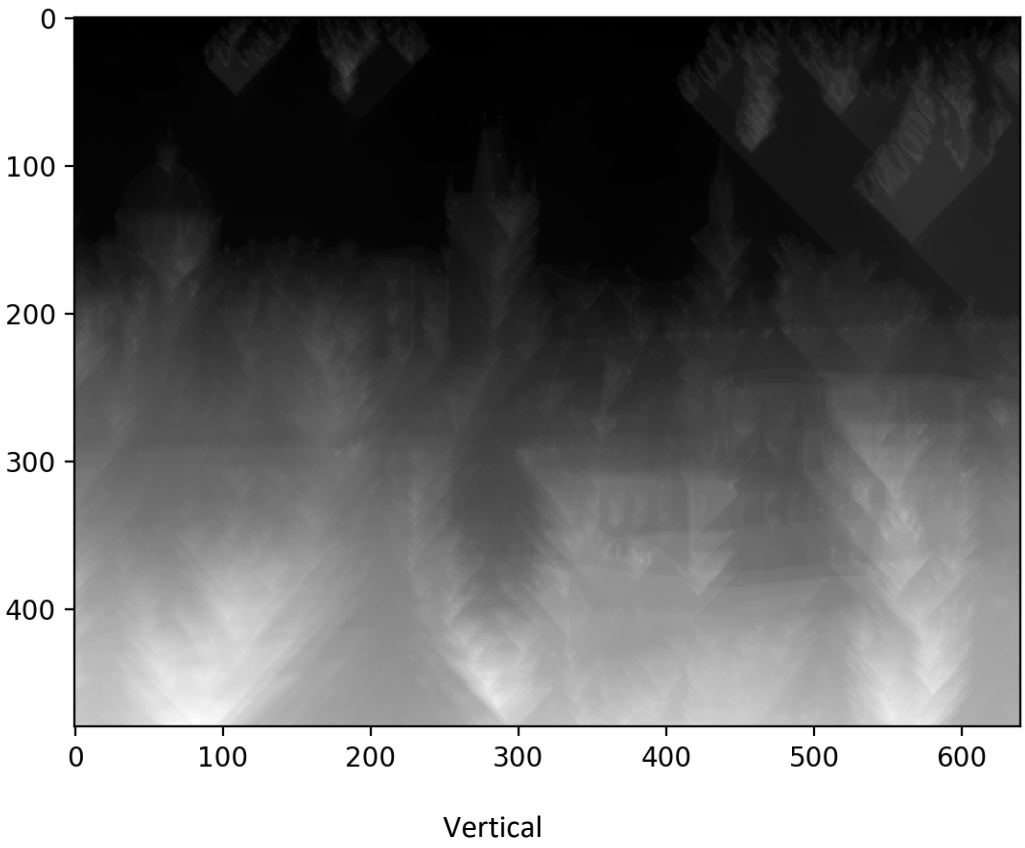


b)



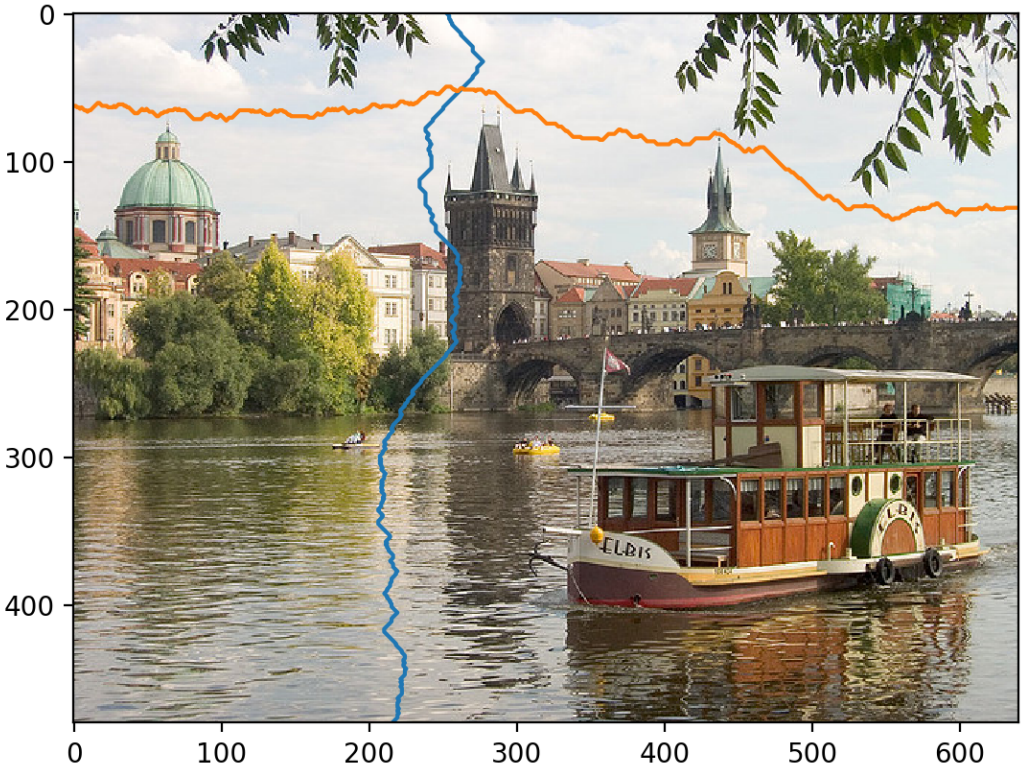
Horizontal

Since in horizontal cumulative energies are summed from left to right, we see an increase in the value of pixels (or whiter pixels) as we move towards the right. Since we only look at the 3 rows in the previous columns, strokes are created that combine to make triangular patterns.



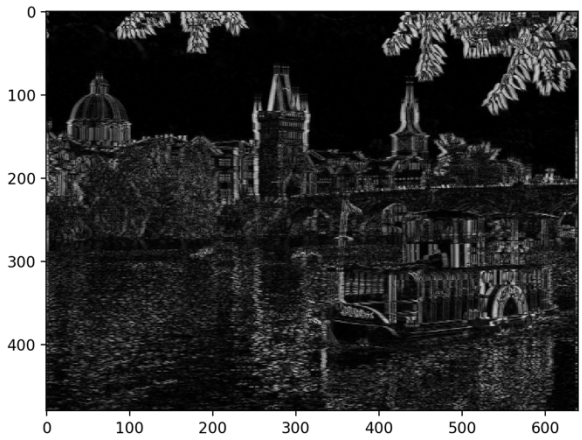
Similar to the Horizontal case, in vertical, cumulative energies are summed from top to bottom, and hence we see an increase in the values of pixels (or whiter pixels) as we move towards the bottom. Since we only look at the 3 rows in the previous columns, strokes are created that combine to make triangular patterns.

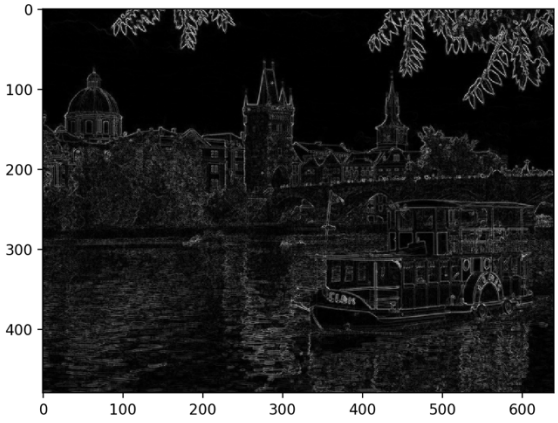
2.4)

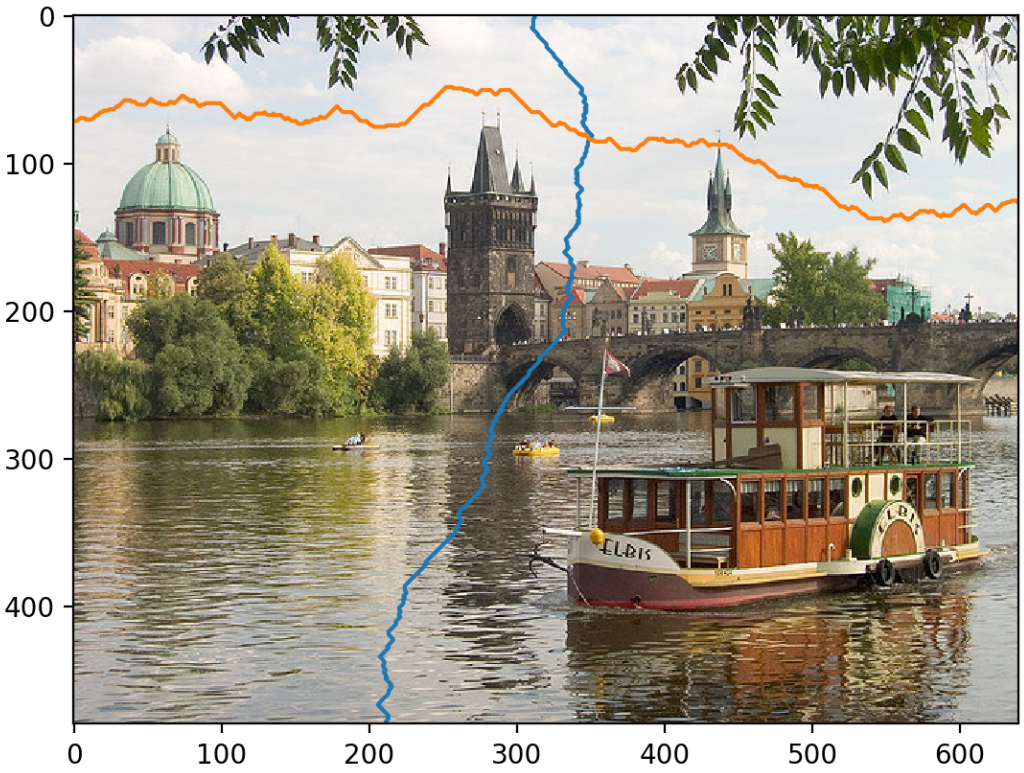


The first seam we found is that of lowest energy and a lowest energy seam would consist of pixels that are relatively the same with little or no difference to their neighboring pixels. For the horizontal seam in orange, it can be seen that it mainly passes through the sky having colors blue and white, barely touching the leaves in the upper part of the picture, the top of the buildings, and some prominent clouds. Similarly, the vertical seam passes through water where there is a long shadow of constant color. In the other parts of the water, there are a lot of disturbances from objects, their shadows, and water ripples. Moreover, it is seen that the seam also passes through the tower at the end of the bridge instead of the building on the left as the building on the left is more detailed and a seam through the building would have higher changes and hence higher energies.

2.5) I applied the sobel filter on the image to generate the energy image (left). It somewhat sharpened/enhanced the edges of the objects while also giving more energies for pixels that had less energies in the original energy image.



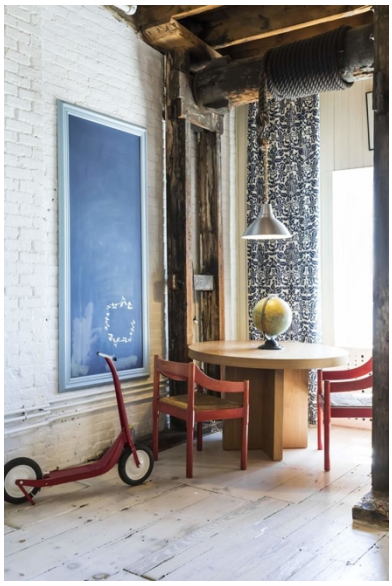




It is also seen that due to a different energy image, the first vertical seem has changed it's direction and horizontal seem is almost similar to the original one. However due to the vertical seem, the scaling is more context aware with energies calculated using sobel filter. The image on the left is the one obtained when sobel operator is used and the image's width is reduced by 100. The bridge tower here is better preserved compared to the image on the right that represents the resized image using the original energy function.

2.6) 1)

a) Original Image



b) System Resized Image

c) Normal Resized Image

d) Original : 600 x 900
   Resized: 300 x 600
e) 300 vertical seems removed followed by 300 horizontal seems
f) Here there are 2 things worth noticing:
    a. Due to the textures of the surfaces, the simple gradient energy function we use is unable to find the most optimal with least energy as at every pixel since there is more probability of gradient change, the overall energies of the pixels are higher.
    b. Furthermore, the brightness of the sunlight changes colors of the objects and our algorithm may perceive it as another seem which leads to erroneous results.

I believe due to these reasons the resized image becomes highly deformed especially near areas with lot of light (eg. tables) or textures (eg. Wooden floor)

2)

a) Original Image

b) System Resized Image

c) Normal Resized

d) Original : 750 × 504
   Resized: 750 × 204
e) 300 horizontal seems
f) This image has situations similar to the previous case. Notice the platform of the statue and the statue. Due to the bright, prominent reflections the resizing is not accurate. Moreover, the advertisements are destroyed to some extent since most of them are rich in color that may lead top suboptimal seams. Some building however do retain their context for example the Allianz on the right of the statue.

3)

a) Original Image

b) System Resized Image

c) Original Resized Image

d) Original : 600 × 480
Resized: 520 × 400

e) Horizontal Seam 1 , Vertical Seam 1, Horizontal Seam 2, Vertical Seam 2, …, Horizontal Seam 80, Vertical Seam 80

f) This image has situations similar to the previous case. Notice the platform of the statue and the statue. Due to the bright, prominent reflections the resizing is not accurate. Moreover, the advertisements are destroyed to some extent since most of them are rich in color that may lead top suboptimal seams. Some building however do retain their context for example the Allianz on the right of the statue.

g) Compared to normally resized image, it can be seen that the system resized image maintains better details and ratios. The blue trapezoidal roofs near the windows for example are more textured in the system resized image and

the ratio between the two trapezoidal roofs is more accurate and greater in the system resized image. Moreover, the fence in front of the houses and the thin stilts of the docks on the back are move prominent in the system resized picture.

Question 1

1.1) Assume I to be an image of size m x n, and A and B to be our filters of size k x k and l x l respectively. Assume k > l.
Say we need to convolve I with A and then convolve the result with B.

(I * A) * B

Here we are convolving m x n matrix with k x k matrix and then again an m x n matrix with k x k.
However due to associativity we can compute the same result by convolving A and B and then convolving the image with the result.

i.e. I * (A * B)

Here we are convolving k x k matrix with l x l matrix and then by an m x n which is computationally much more efficient than the former.

1.2) [0 1 1 1 1 1 1 1]

1.3) [1/4 0 -1/2 0. 1/4]

1.4) 1) Hysteresis Thresholding
2) Non-maximum suppression

1.5) Firstly, gaussian noise assumes that noise processes are independent from pixel to pixel which may not always be the case. Moreover, in a picture with large number of detailed objects, the pixels won't necessarily be like their neighbors.

1.6) 1) Gaussian Blur to remove Noise
2) Use canny edge detector and hysteresis thresholding to get edges
3) Use Absolute Sum of Differences between the canny image and a model image produced by running canny edge detector on a equipment with correctly assembled parts. If the overall sum of differences of the two images is greater than the threshold then the part is not installed like it is the correctly assembled equipment and hence the flaw would be reported.
This method shall work as the camera will be fixed and the subsequent images taken from the video stream won't differ in the positioning of the equipment to a great extent.