Problem Set 1

Problem 1

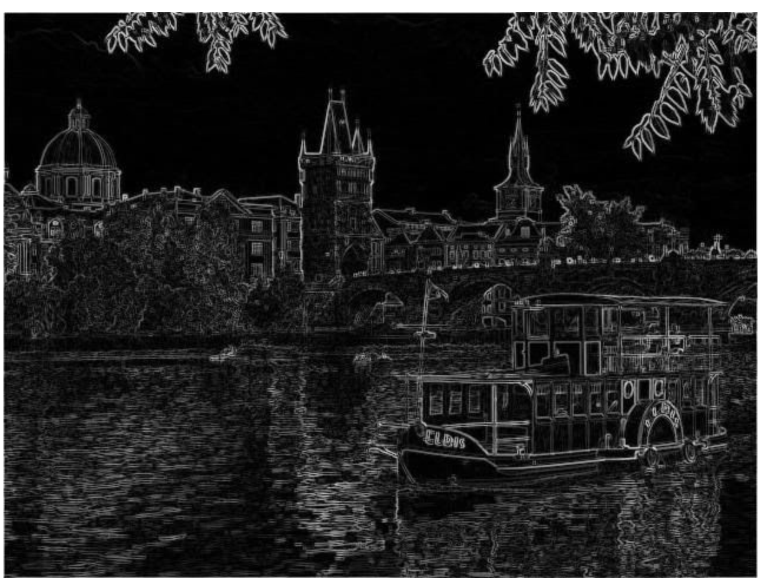
1. Given a large image A and two filters a and b, instead of first convolving A with a and then the result of that with b, we can simply convolve a and b first. Then convolve the result of that with A. This way, we don't have to apply each filter separately to the large image and can just apply both filters in one go.
2. [0 1 1 1 1 1 1 1]
3. [0 -½ 0 ½ 0] * [0 ½ 0 -½ 0] = [0 -¼ 0 -¼ 0] ← (since we are convolving, we have to flip the kernel)
4. (1) increase upper threshold in hysteresis thresholding (2) use a larger gaussian kernel
5. Noise in the environment will not always match up with simulated Gaussian noise. Some types of noise such as salt and pepper noise and impulse noise cannot be handled by additive Gaussian noise.
6. Assuming the item is placed on the conveyor belt the same every time and flaws are large and easily detectable by looking at the shape of the design. Also assuming environment noise is minimum we can:
    a. Take an initial picture of the background from the camera feed
    b. When parts show up, extract the part from the camera feed using background subtraction
    c. Use edge detection, thresholding, dilation, etc. to clean up and enhance important features of the part.
    d. Compare the part outline to that of a working part.
    e. If differences are greater than a certain threshold, flag the part for greater inspection by a more advanced algorithm or get a human worker to check it.

Problem 2B

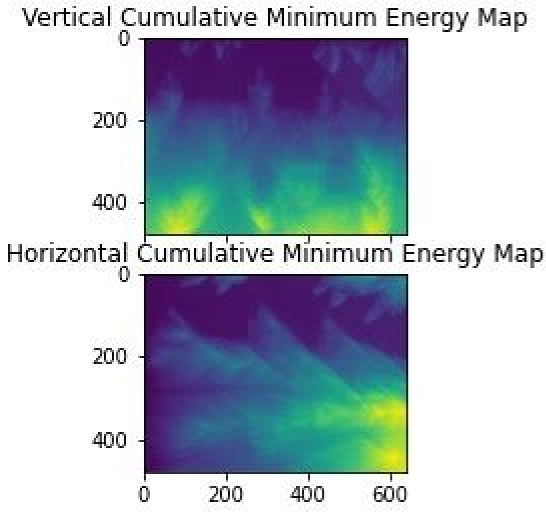
1. 

2.

3. Energies:



a.



b.

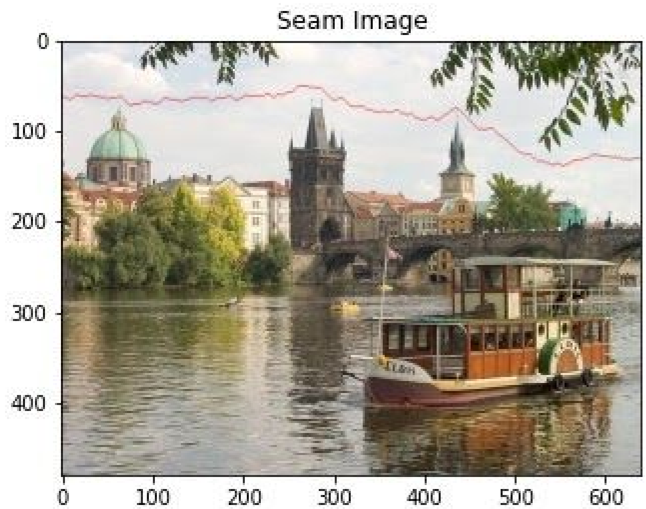
c. Why?

   i. The energy function highlights where the x and y gradients are large, which specifically makes edges stand out. So the tower and boat are clearly outlined since they have sharp contrasts with their backgrounds.

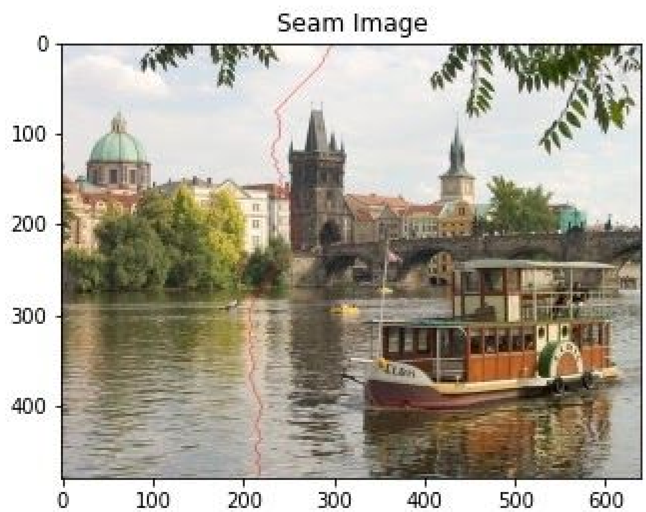
   ii. The vertical cumulative minimum energy map sets each pixel to its own energy plus the minimum of its 3 adjacent neighbors above (top left, top middle, and top right), so the values at the bottom are greater than the values at the top, hence the bottom is lighter than the top.

   iii. The horizontal cumulative minimum energy map sets each pixel to its own energy plus the minimum of its 3 adjacent neighbors to the left (top left, middle left, and bottom left), so the values at the right are greater than the values at the left, hence the right is lighter than the left.

4. 



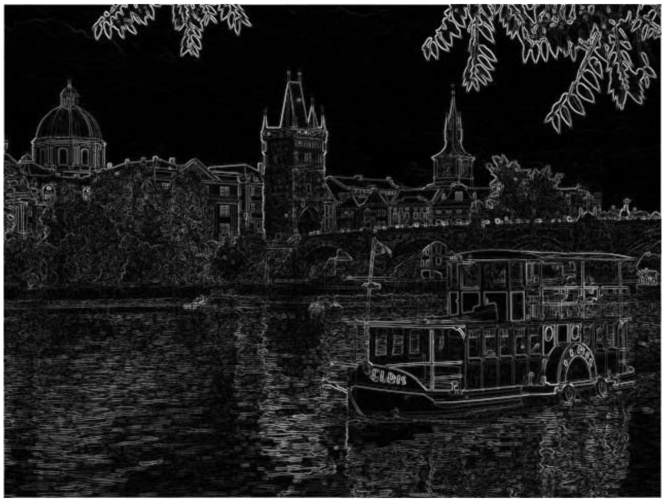
a.



b.

c. These are the optimal seams because they have the lowest total connected energy in the image. For the horizontal seam, the line through the sky is chosen since the sky doesn't have sharp edges. For the vertical seam, the line prioritizes going through the sky and then the water, avoiding distinct features such as the tower and the boat.

5. Change to Energy Function
   a. I changed the filters for the gradients to sobel filters ([[1 2 1][0 0 0][-1 -2 -1]]).

b. 

c. The edges now have a lesser amount of energy to them, which should allow some of the weaker edges to get picked more easily for seams.

6. Experiments
   i. Experiment 1

      a. 

      b. 

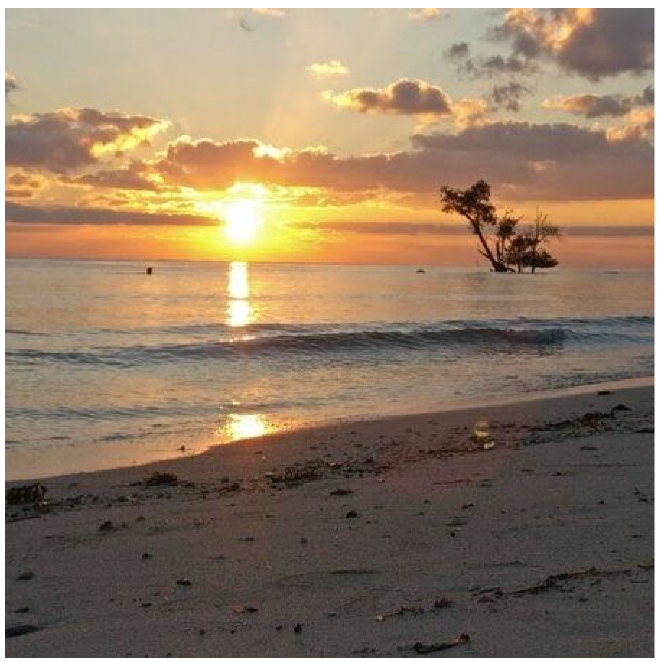
c. 

d. Input: 315x500 Output: 265x487

e. Reduce height by 50 then width by 13

f. Here the algorithm keeps all important objects in the image equal to their original size while decreasing the space between them. Notice the clouds get closer in the algorithm shortened image while the distance between them is proportional to the original in the basic resized picture.

ii. Experiment 2

a. 

b. 

c. 

d. Input: 450x450 Output: 350x350
e. Reduce width by 100 then reduce height by 100
f. This is an example of how normally reducing an image can be better than intelligently reducing it if the dimensions are kept the same. The normally resized image is basically a smaller version of the original whereas the intelligently resized image cuts out details

iii. Experiment 3

a. 

b. 

c. 

d. Input: 302x403 Output: 302x203
e. Reduce width by 200
f. Here is an example of when the algorithm can go amazingly horrible. When almost every pixel has high energy, it is difficult to detect which items are important and which can be reduced away. Since the baby has a lot of smooth skin without edges, her pixels are one of the first to be removed, resulting in the distorted image you see.