

I. Short answer problems [30 points]

1. Describe a possible flaw in the use of additive Gaussian noise to represent image noise.

Assuming the noise to be Random distributed is somehow too ideal, the real noise values are usually not random distributed.

2. The filter $f' = [0, -1/2, 0, 1/2, 0]$ gives an estimate of the first derivative of the image in the x direction. What is the corresponding second derivative filter f'' ? (Hint: asymmetric filters must be flipped prior to convolution.)

[1/4, 0, -1/2, 0, 1/4]

3. Consider the filter $f = [1, 2, 1]$ and the 1D image $I = [0, 1, 2, 3, 3, 3, 1, 3, 6]$. What is the result of $f * I$? Pad the image with zeros at the boundaries if necessary.

[1, 4, 8, 11, 12, 10, 8, 13, 15]

4. Name two specific ways in which one could reduce the amount of fine, detailed edges that are detected with the Canny edge detector.

(1) Increase the threshold value to remove the relatively weak edges.

(2) Use another filter which can blur the image to some small degree, the new image will become smooth. Now use Canny again, the important edge will keep but detailed edges will be gone.

5. Design a method that takes video data from a camera perched above a conveyor belt on which customers place their produce (apples, oranges, broccoli, etc), and automatically computes the bill. Your response should be a list of concise, specific steps, and should incorporate at least two techniques covered in class thus far. Specify any important assumptions your method makes.

Assume the fruit will come one by one to camera's vision, which means they won't overlap or become each other's background.

Assume there is a fruit texture database contains all kinds of fruit texture, and shape database contains all fruit shapes. Also a database contains fruit price.

When a fruit comes to camera's vision, run 2 tests.

First test is texture analysis, get the possible fruit and scores associated together by using texture database.

Next do shape test, use Canny filter to do binary analysis, then get the Chamfer distance as the score of Template matching.

Combine the result of the 2 tests, get the sum of every fruit's texture test score and shape test score. Sort the scores and find the fruit with highest value. Add its price to bill.

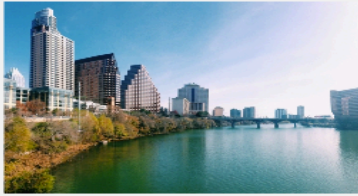
II

1.

Original austin



Content-aware resizing austin



Traditional resizing austin



Original disney



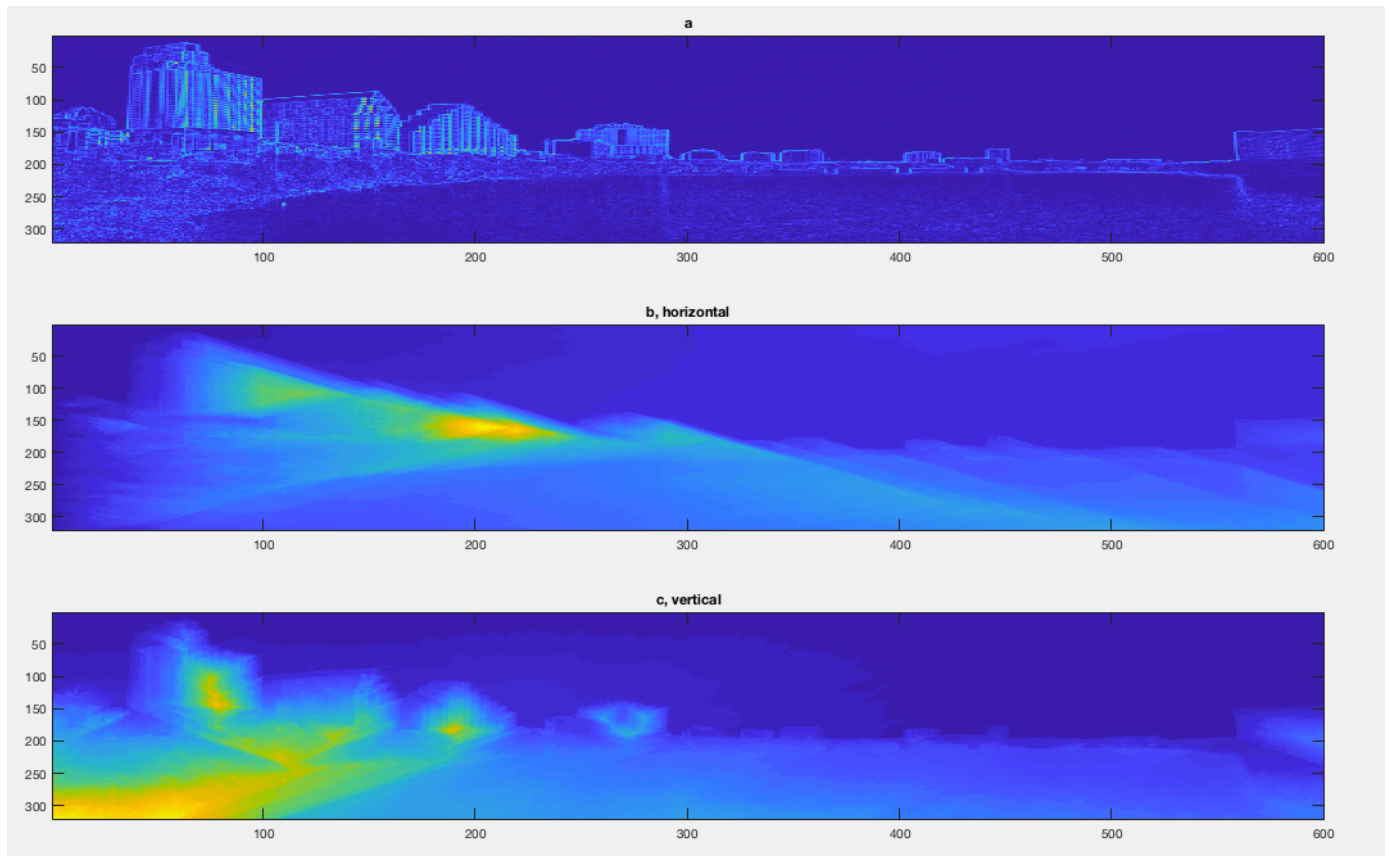
Content-aware resizing disney



Traditional resizing disney



2.



The last column of b contains the value of cumulative energy of the horizontal seam going through that pixel. Darker color indicates the seam through that pixel has lower total energy.

Similarly, the last row of c contains the value of cumulative energy of the vertical seam going through that pixel. Darker color indicates the seam through that pixel has lower total energy.

3.

Original austin



(b)



(a)



The seam in b is the one with lowest cumulative values among all vertical seams, chosen by dynamic programming. Compared with other seams, the sky-sea line has less energy change. It is the seam to be removed.

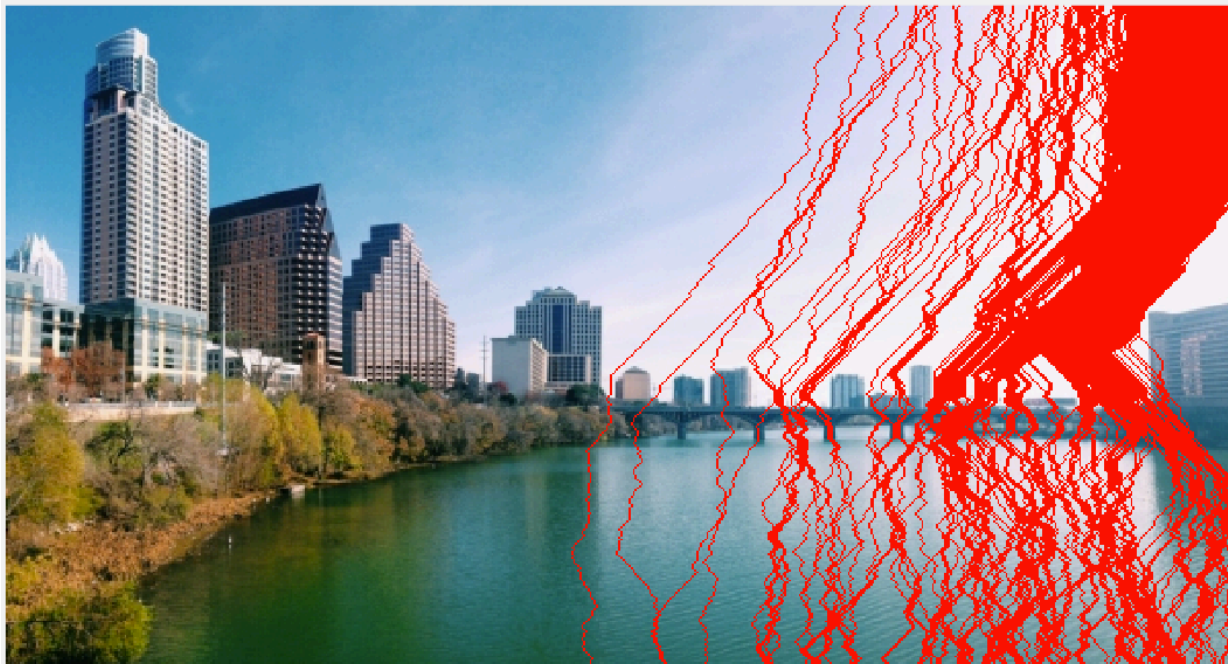
The seam in c is the one with lowest cumulative values among all horizontal seams, chosen by dynamic programming. Compared with other seams, the whole color change and energy change is the smallest. It is the seam to be removed.

4.

Removed seams by filter $[-1, 1]$



Removed seams by sobel



In my opinion sobel is better, the seams removed according to the energy matrix are less important than the seams removed in $[-1,1]$. Especially in the middle part, $[-1,1]$ removed several “important” seams in human eyes while in sobel they were kept.

5.

(1)

Bad result:

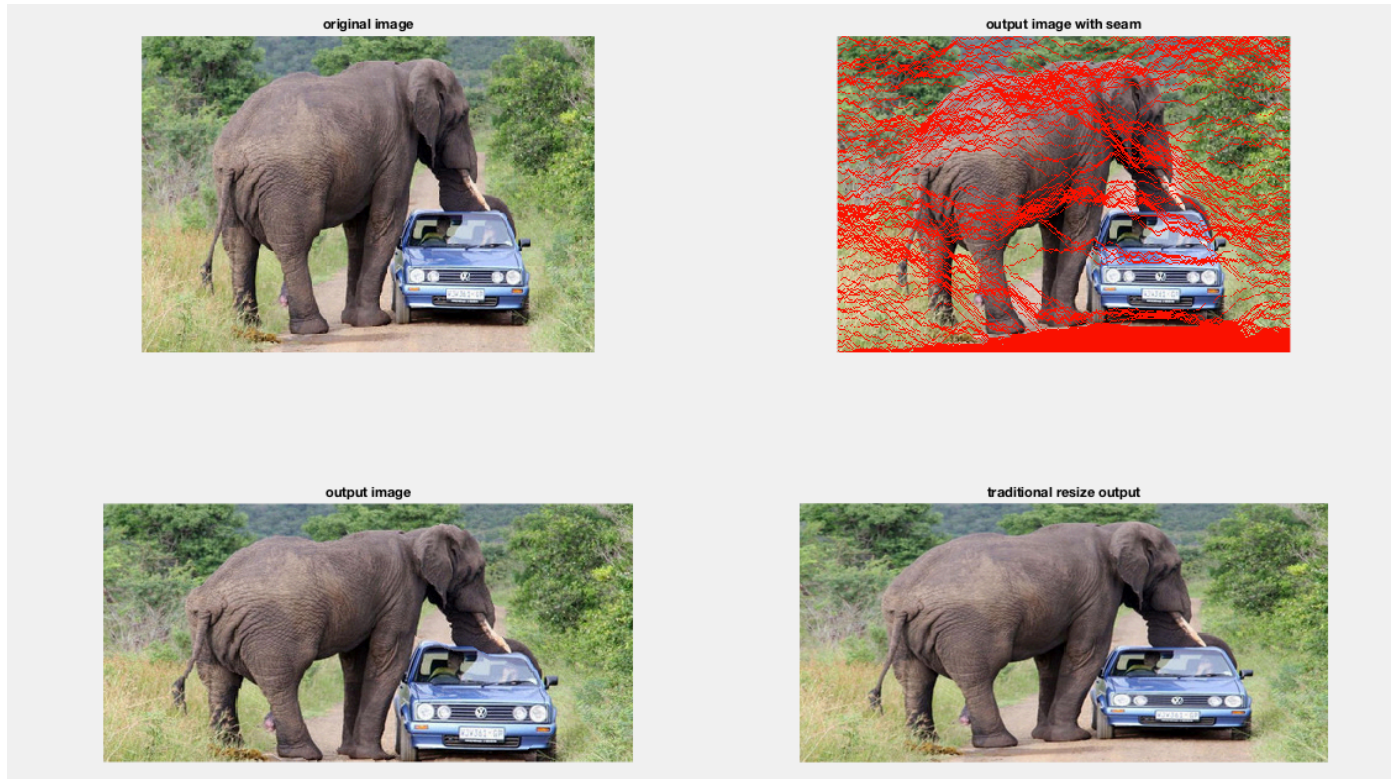


Reduce width by 80.

From the result we can tell half of Patrick Star's body were removed because of the continuous light pink. Hard to identify him from the result.

(2)

fun result:

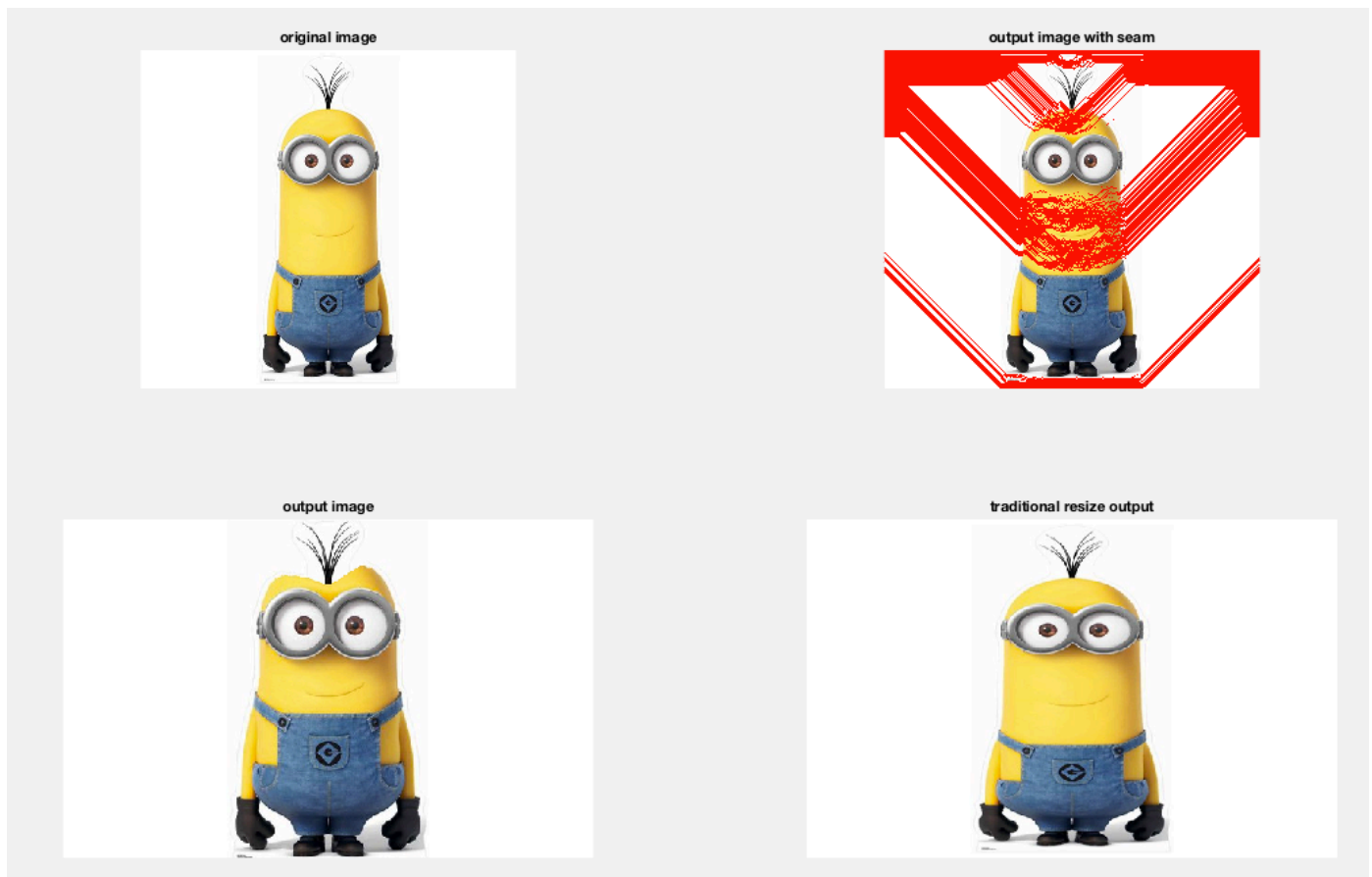


Reduce height by 90.

This is a fun output but also a bad case of using seam carving. In the original image the elephant was only touching the vehicle but no attacking it. While in the output generated by seam carving, we would say the elephant is trying to smash the vehicle.

(3)

fun output:



Reduce height by 150.

This is a fun but also a bad result generated by seam carving. The minion in output become shorter which is expected, but the shape of its head become distorted.