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ECS189G Spring'15

Problem Set 1

Short Answers Part I:

1. Give an example of how one can exploit the associative property of convolution to more efficiently filter an image.

(Associative : (f*g) * h = f *(g*h) f and g are filters)

The associative property allows us to have an two alternatives when filtering an image. We can either convolve the image first with a Gaussian filter then with the derivative filter. The alternative is to convolve the derivative filter with the Gaussian filter to produce a new filter which is the derivative of the Gaussian Filter, and lastly convolve this to the image. This helps our image processing efficiency because we can convolve one filter to the image.

2. This is the input image: [0 0 1 1 0 0 1 1].
What is the result of dilation with a structuring element [1 1 1]?

f: [0 0 1 1 0 0 1 1]
g: [1 1 1]
After dilation: h: [0 1 1 1 1 1 1 1]
The image will only have a darker spot on the left side where the zero is.

3. 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 of f''? (Hint: Asymmetric filters must be flipped prior to convolution.)

The second derivatives of the the image can be used to give the edges of the image.

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

Gaussian filters are independent, so if one was to apply too many additive Gaussians on an image s/he might defeat the purpose of applying a Gaussian filter. For example, if an image was slightly blurred and applying multiple Gaussians filters to sharpen might produce too sharp of an image which eliminates any kind of gradients in the image.

5. Design a method that takes video data from a camera perched above a conveyor belt at an automotive equipment manufacturer and report any flaws in the assembly of a part. Your response should be a list of concise, specific steps, and should incorporate several techniques covered in class thus far. Specify and important assumptions your method makes.

1. Assuming the camera is stationary, adjust the lens so there is focus on the object.
2. Assuming any automotive equipment is placed evenly and orientated the same way
3. Apply filter with derivative of gaussian noise
4. Find magnitude and orientation gradient
5. Use canny edge detector
6. Compare the image with an "ideal" edge sketch of a perfect product
7. If edge sketch does not match, a flaw is found.
8. Remove object out of the assembly line and fix

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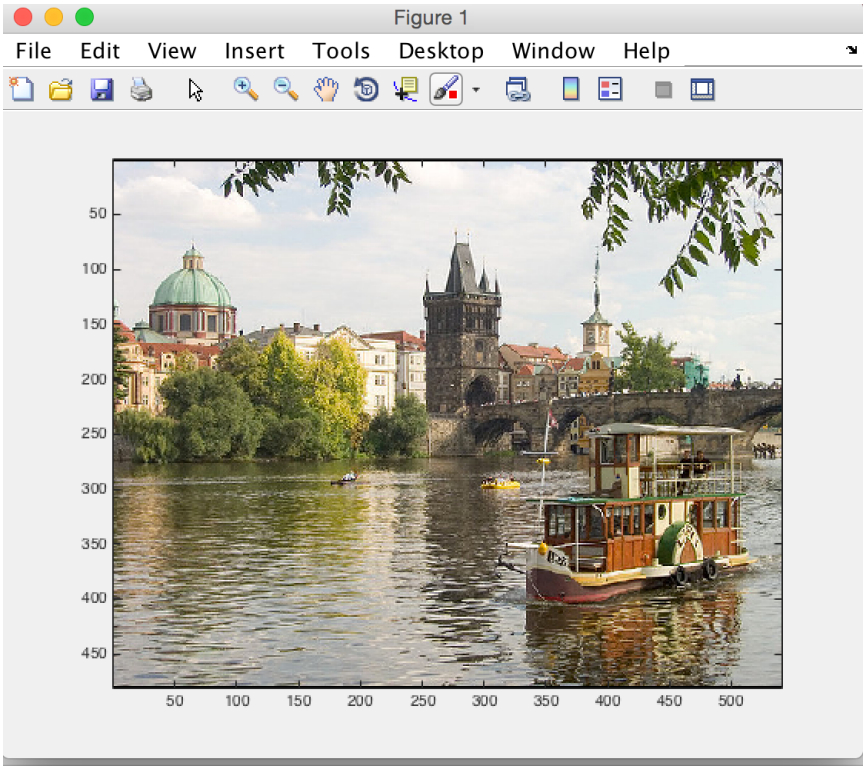
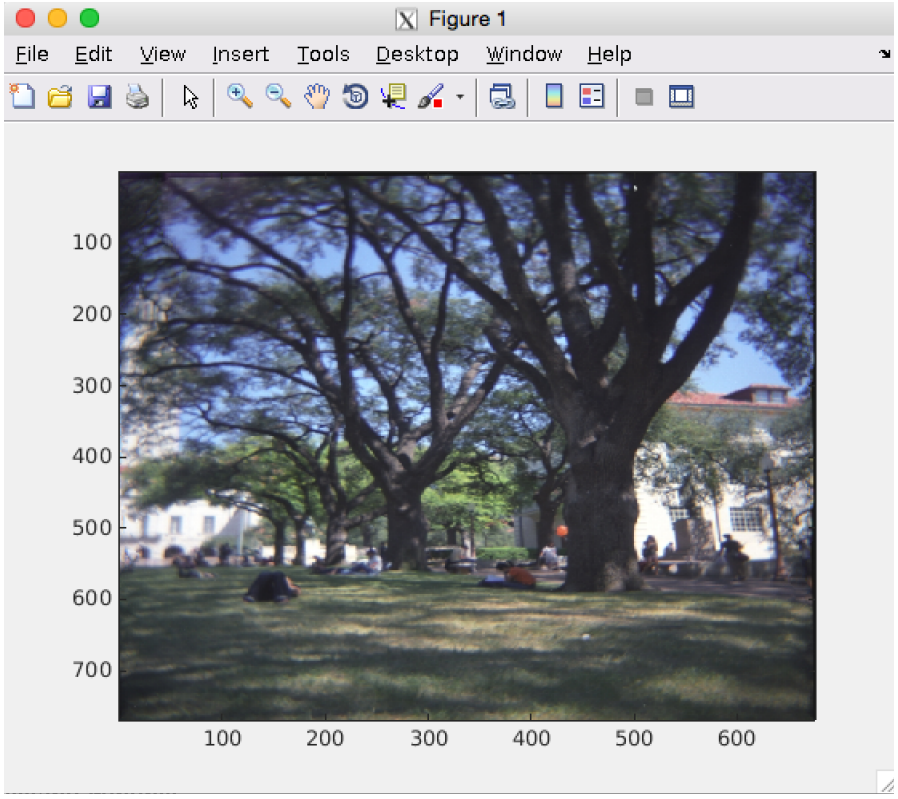
Programming Part II:

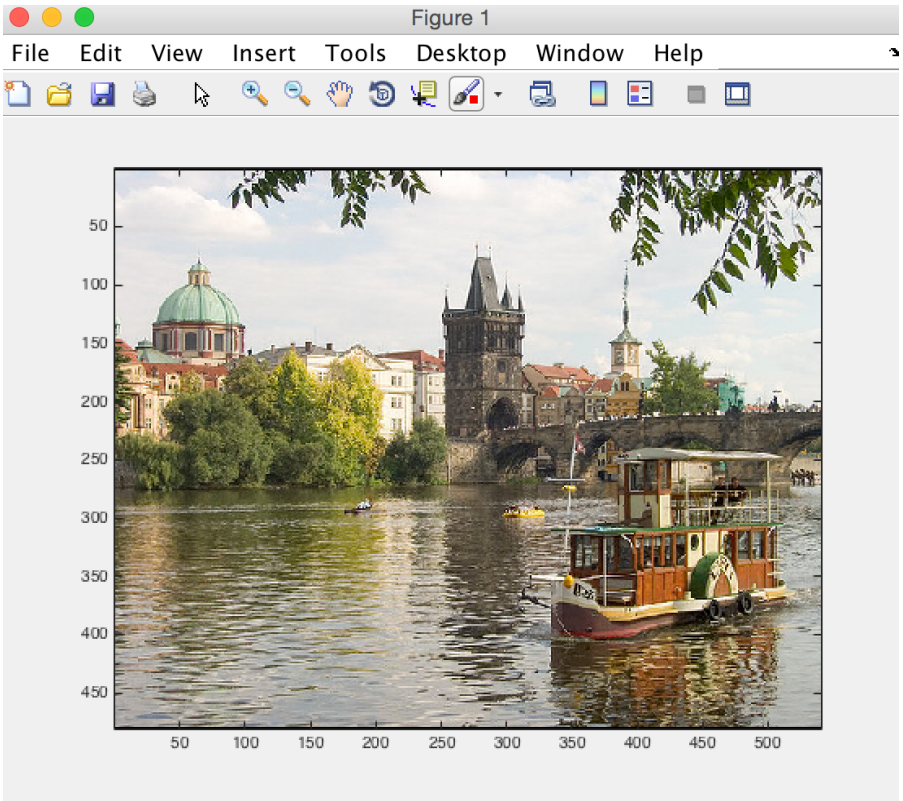
1) After running seam_carving_reduce_width.m, reduced by 100 pixels.

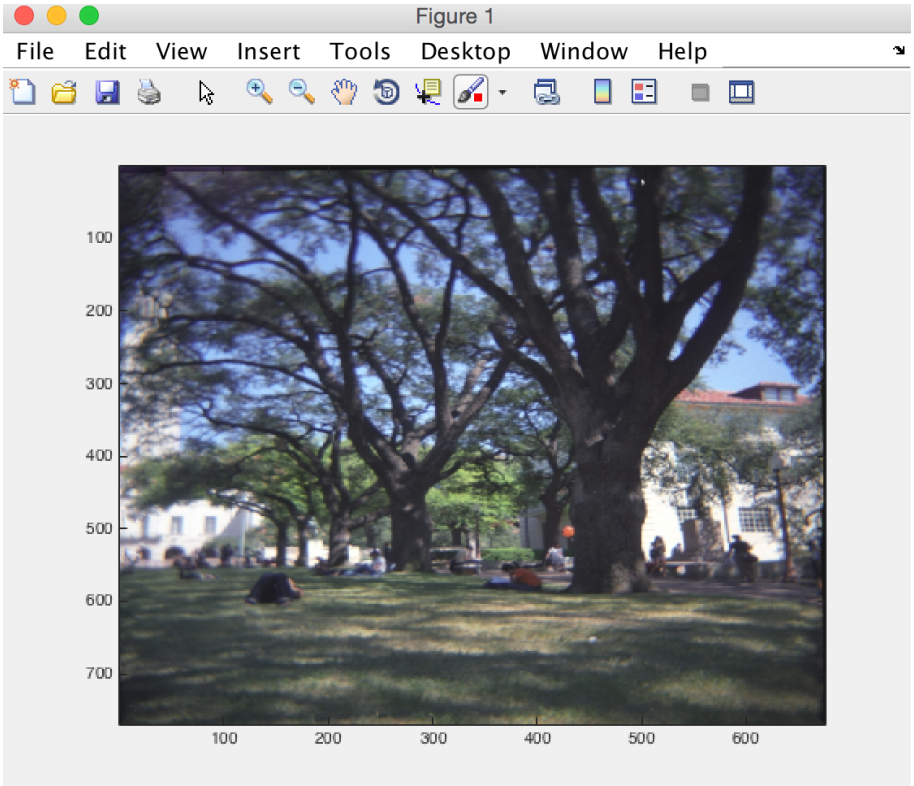




Chau, Vincent
998947424
ECS189G Spring'15

2. After running seam_carving_reduce_width.m, reduced by 100 pixels.





Chau, Vincent
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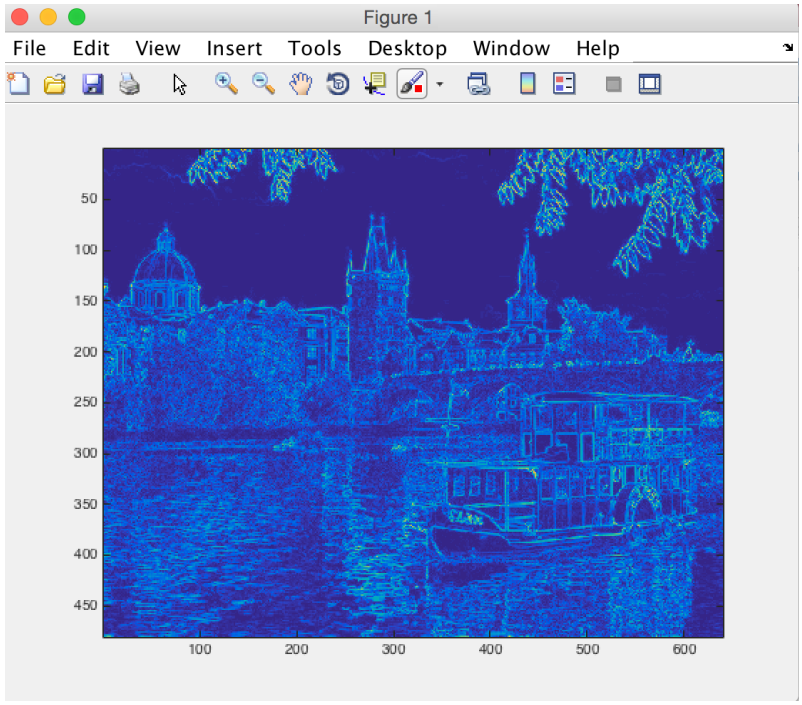
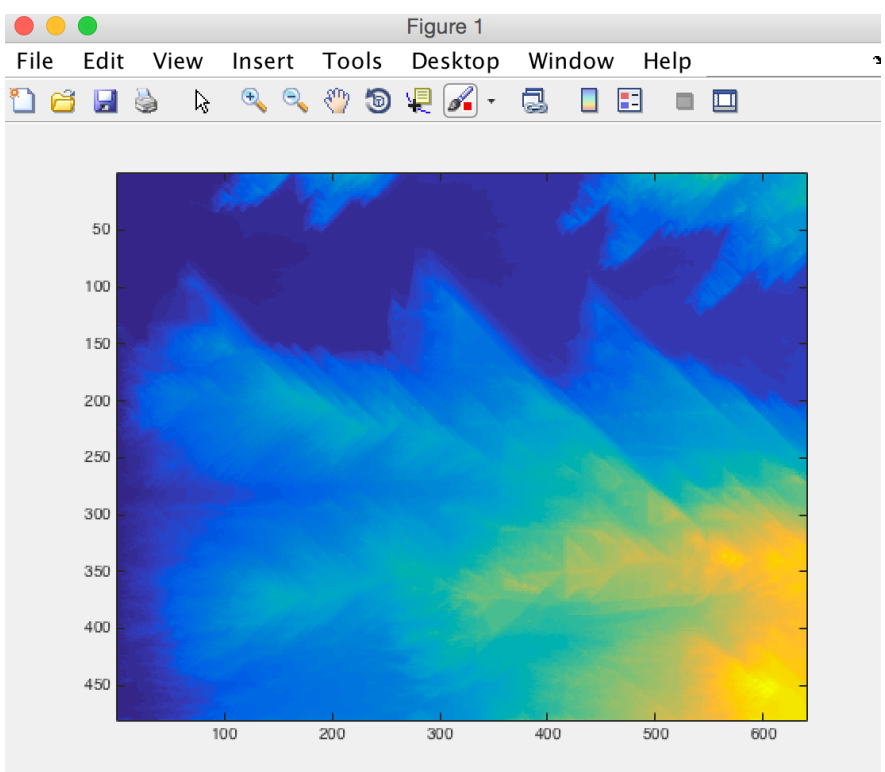
ECS189G Spring'15

3. a) This image is the energy_map() using the built-in gradient function. I then took the absolute value, squared it, and computed the energy image.



This is the horizontal cumulative minimum energy map, it is expected for the optimal seam to go horizontal across, going a little on the tip of the tower. It is the path that has the minimal energy because it will avoid the lighter blue areas such as the trees on the top right corner. The optimal seam will touch through tower because it is goes through the least amount of light blue areas which are higher energy than the dark blue.



Chau, Vincent
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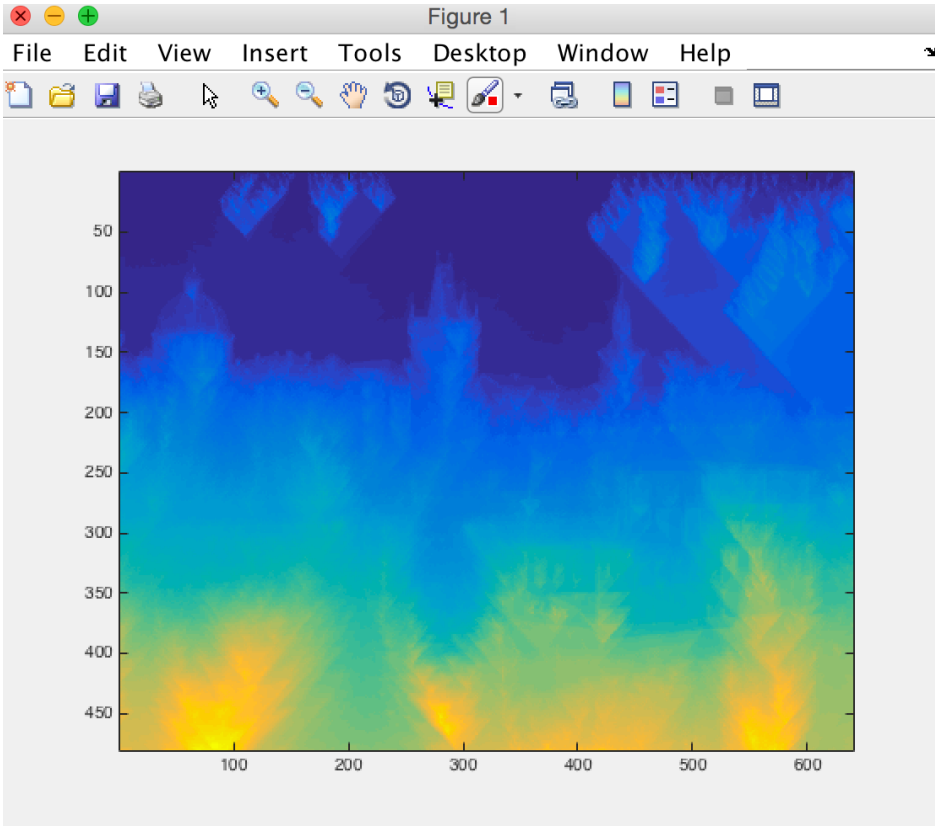
ECS189G Spring'15

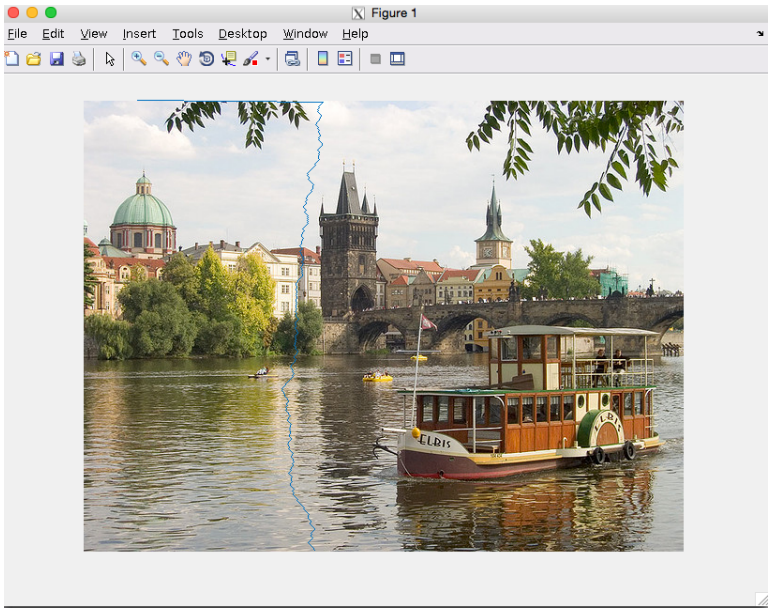
For the vertical energy map in theory, the seam is optimal because it goes through the white building. Going down the path of the white building shows the least significant amount of change. As shown below, the optimal seam would go down from the left side of the tower, and down towards the green section avoiding the yellow. The yellow is high intensity so the optimal seam would avoid it.



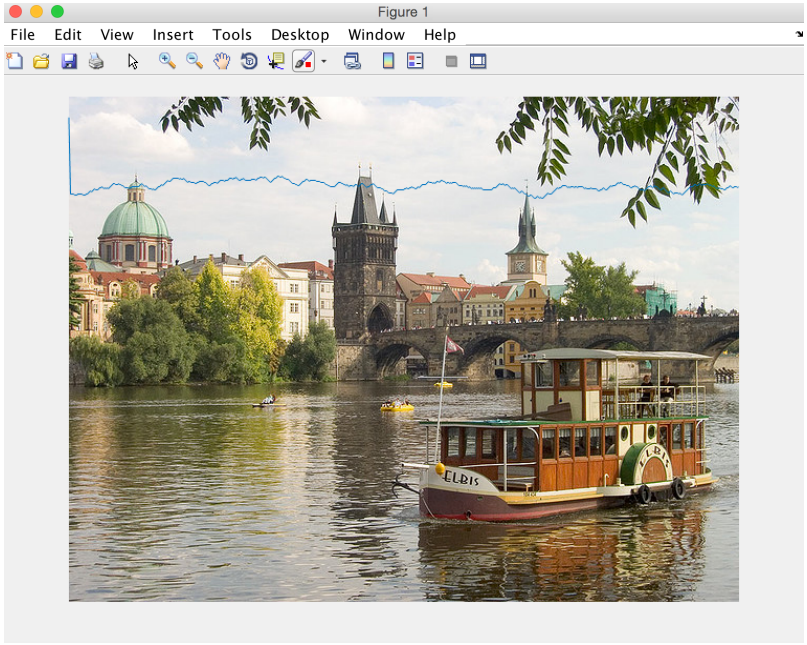
Chau, Vincent
998947424
ECS189G Spring'15

4.

This is the optimal vertical seam. By looking at the vertical energy map, I can tell this is optimal because the seam specifically goes through the blue shaded area and the blue part of the ocean(in the energy map). The more blue the part of the image is, the lower it's energy. Furthermore, it is taking out the reflection of the white building and the white building because they have the least amount of change, which makes the seam optimal.



This is the optimal seam, the neighboring pixels going that direction makes it not possible to loop around the middle tower and remove pixels from the sky. I feel that the true optimal seam would be to go above the dark tower and loop around it removing the sky instead of the tower. My implementation have been inaccurate because the optimal seam should go through the sky.



Chau, Vincent
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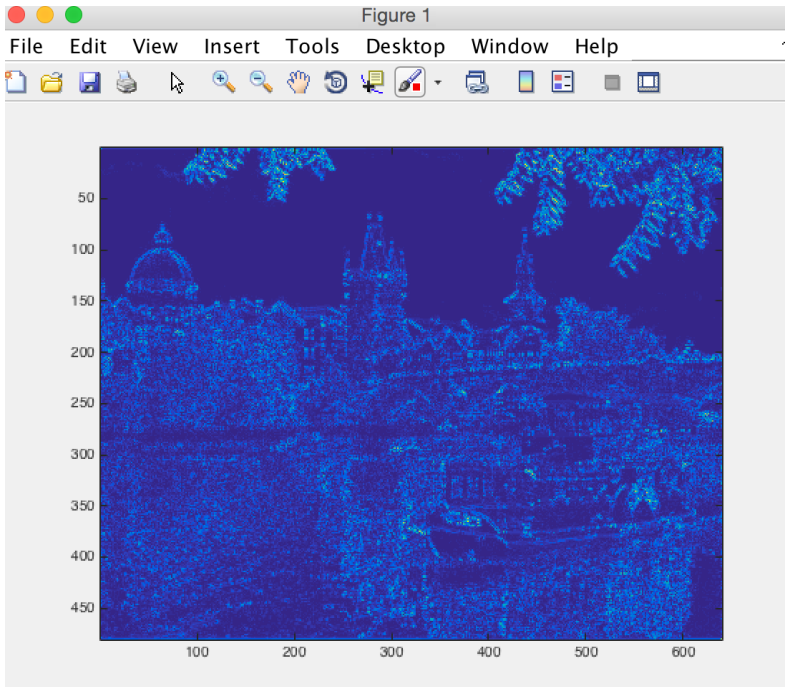
ECS189G Spring'15

5) Changing the gradient function. I tried applying the 'sobel' filter then taking its derivative and calculating a new energy image. This was the result:



Applying the 'sobel' filter then taking the derivative gave a much less sharp image and it contains more random noise. The edges are less defined. Further testing the effect, I calculated the vertical seam using this kind of gradient and energy image.

This is a less optimal seam than the built-in gradient function. The seam is removing the water when there are lesser energy seams in the sky. Using the 'sobel' filter and taking the derivative [1 -1], [1, -1]' does not provide a better seam in my experiment/ implementation. The seam is calculating blue spots in-between the noise of the water.

Chau, Vincent
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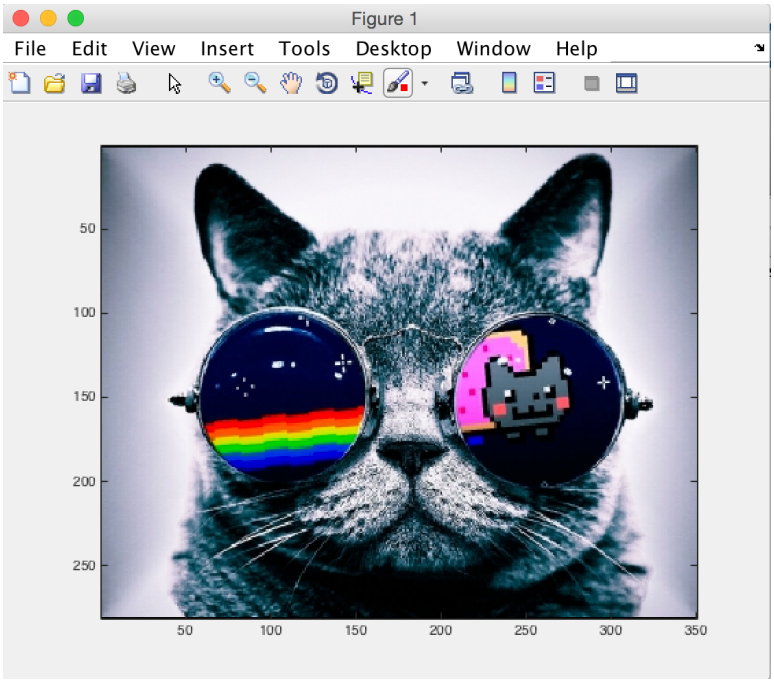
ECS189G Spring'15

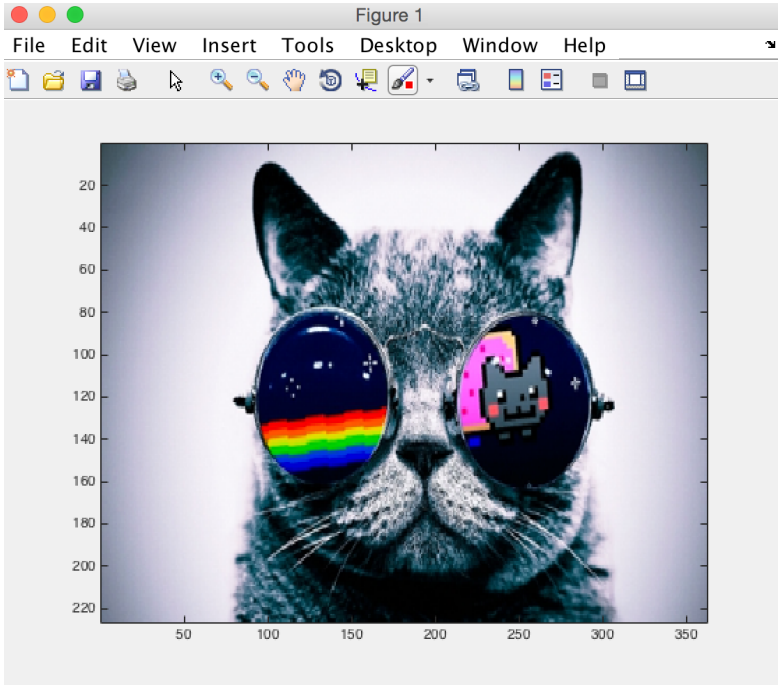
6. SRC: http://cache.desktopnexus.com/thumbseg/1335/1335347-bigthumbnail.jpg (Good Case Against imresize):

The optimal seam is found around the cat because there is the least amount of energy, least amount of change. This case shows Seam Carving effective against mat lab's imresize. Matlab resize makes the kitten look skinnier than the original image. Furthermore, the seam carved kitten looks like a more up close picture of the cat with the cat's face still proportional. The seam carving approach took out the gradient spotlight background without interfering with the kitten's face.

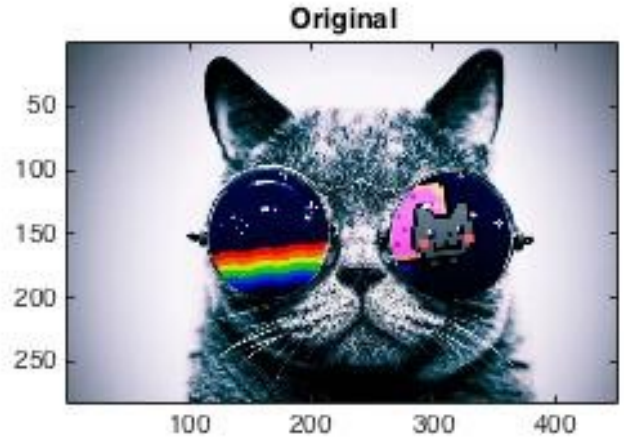
Seam Carved:

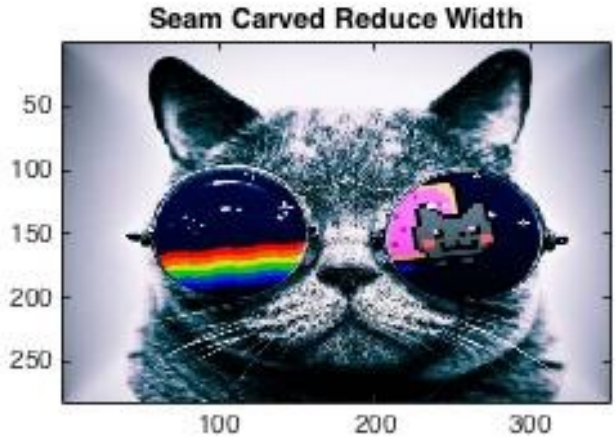


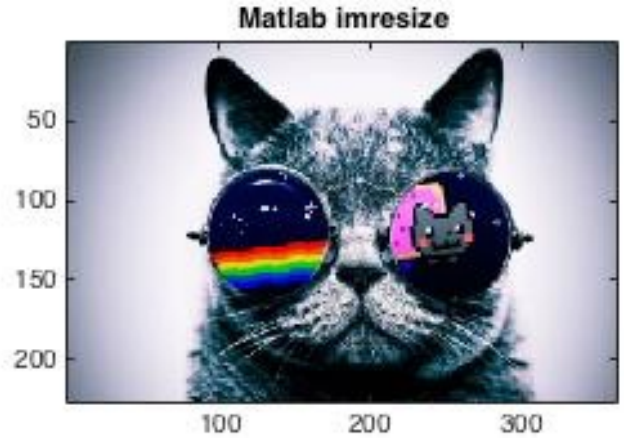
Matlab imresize:

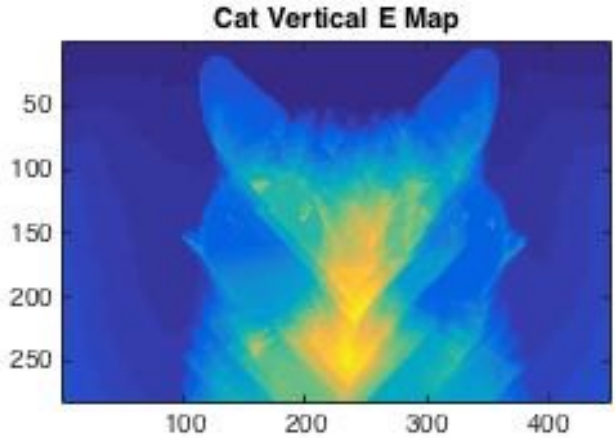


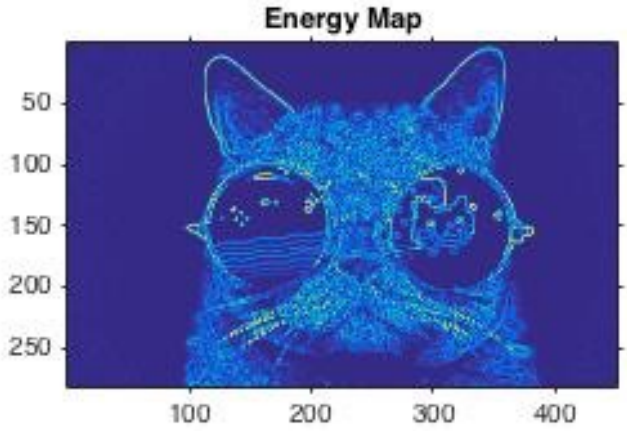
Chau, Vincent
998947424
ECS189G Spring'15

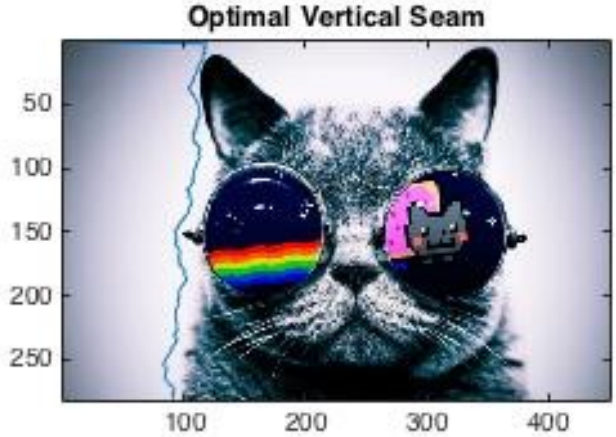












Chau, Vincent
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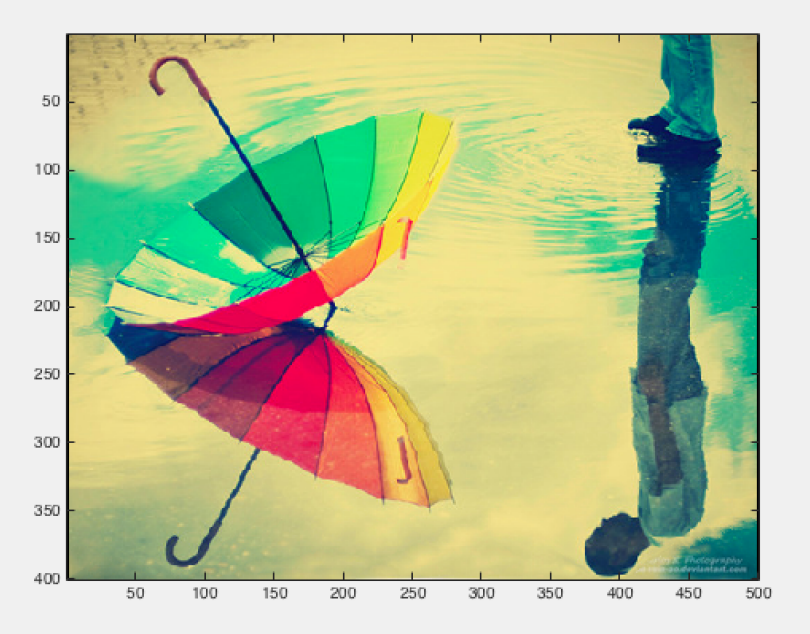
ECS189G Spring'15

SRC: http://favim.com/image/193308/

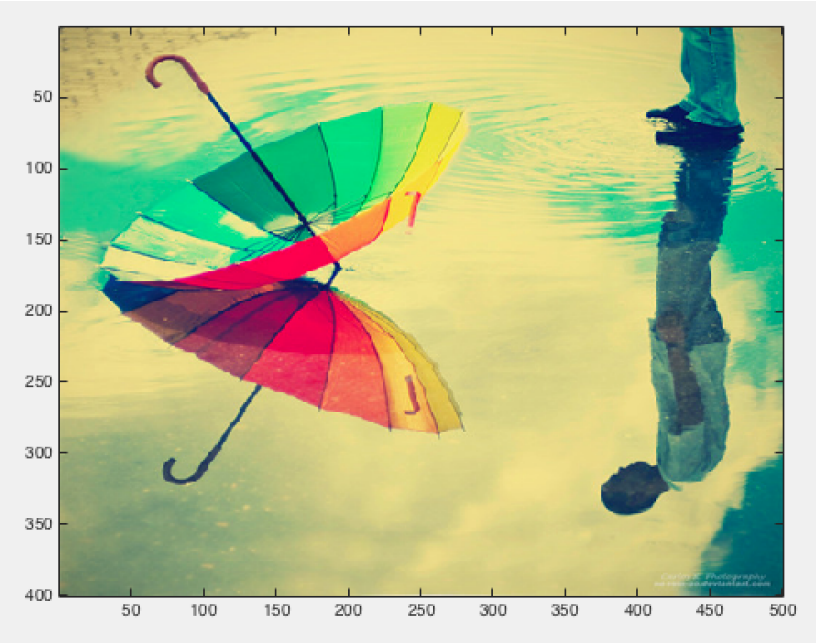
(Good Case)

The Optimal seam is going around the reflections, such as the umbrella and the man's head. Notice that the matlab's imresize shortened the mans height, and made him look humpback. The water at the bottom has been cropped out because that is the only area in the image where there are not much changes in energy.

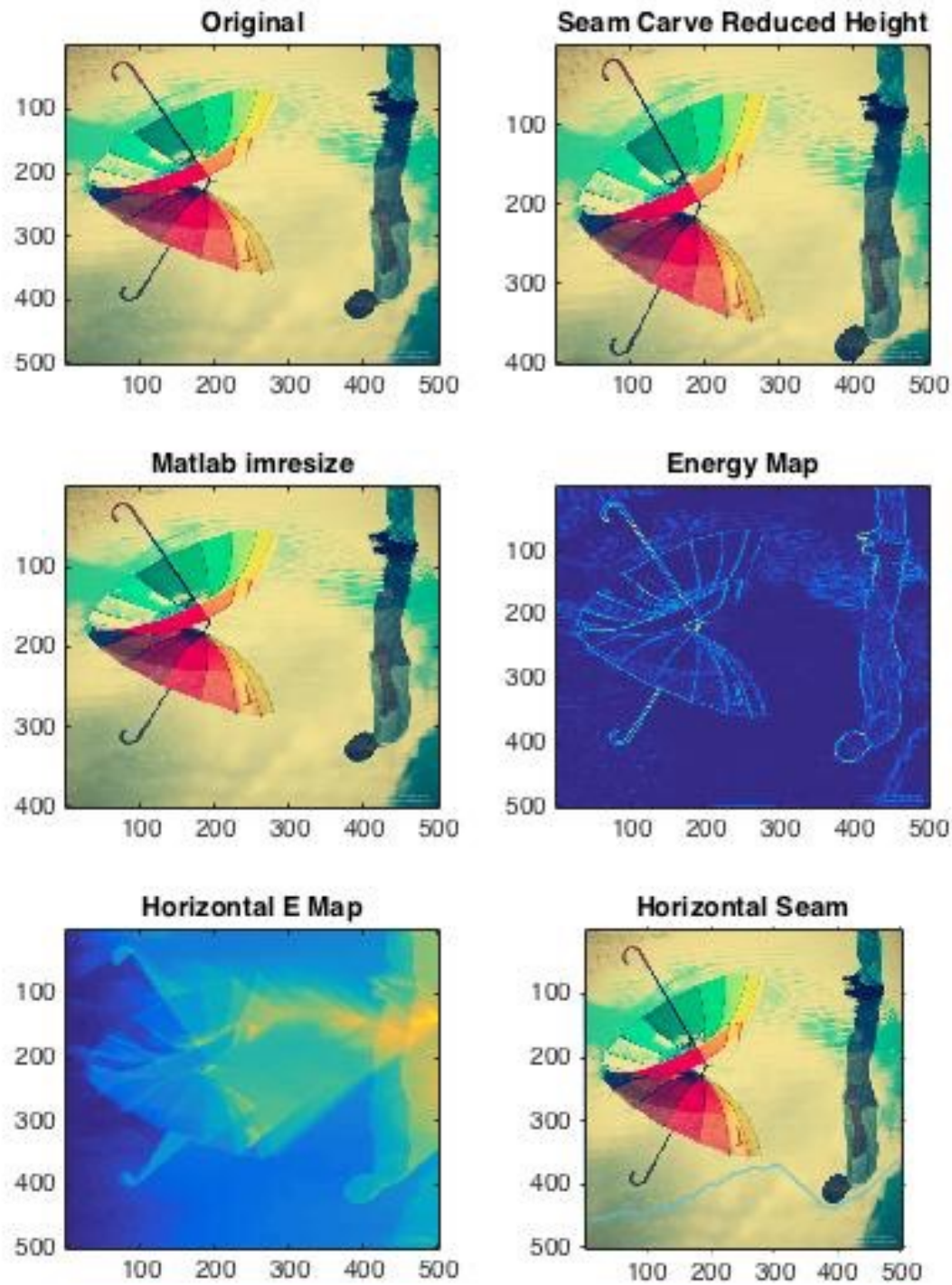
Seam Carving Reduce Height:



Matlab imresize:



Chau, Vincent
998947424
ECS189G Spring'15



Chau, Vincent
998947424
ECS189G Spring'15

SRC: http://www.linkedstrategies.com/contemplating-the-upgrade-to-the-paid-linkedin-program/ben-franklin-close-up/

(BAD CASE)

Original:

Seam Carve Reduce Width:

Matlab Resize:

Chau, Vincent
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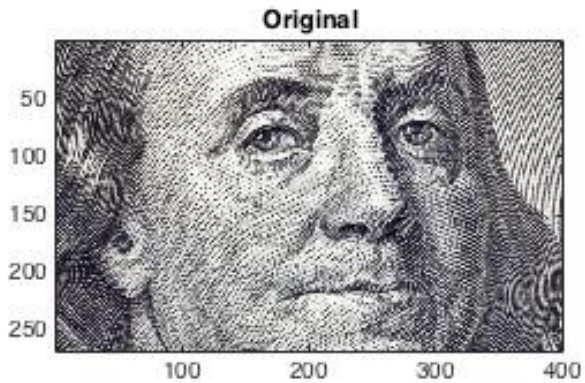
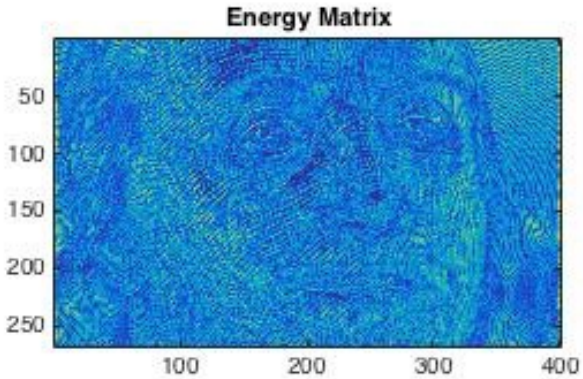
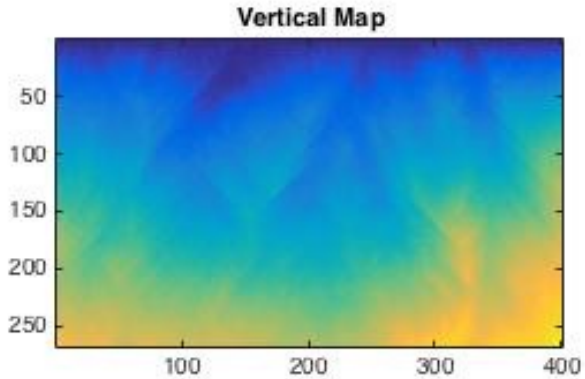
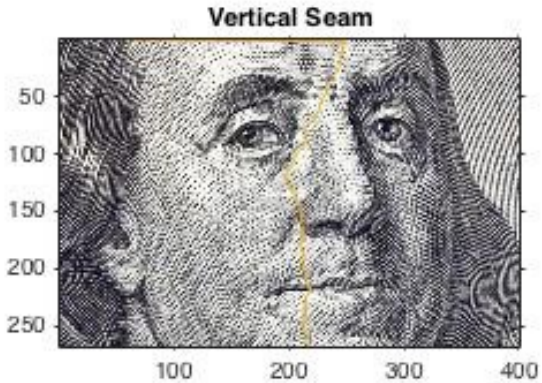
ECS189G Spring'15









This is a bad case of seam carving. The image is an up-close shot of a $100 bill. The seam carving made Benjamin's Franklin's face deformed. This is because the vertical seam carved areas of his face where the shadow does not have much variety. From the vertical map, it is shown that the middle section contains less of the high energy because the shadow on his face is more consistent in color towards the left side of his nose.