

1. Short Answer Problems

1. The associative property of convolution allows us to more efficiently filter an image by convolving several filters before convolving with the image.
2. Dilating $[0\ 0\ 1\ 1\ 0\ 0\ 1\ 1]$ with structuring element $[1\ 1\ 1]$ gives $[0\ 1\ 1\ 1\ 1\ 1\ 1\ 1]$
3. $[1/4\ 0\ -1/2\ 0\ 1/4]$
4.
 1. Non-maximum suppression can be used to thin wide edges.
 2. Hysteresis can be used to reduce light edges by defining a low and high threshold.
5. Additive Gaussian noise requires a (smoothing) Gaussian filter, leading to loss of detail.
6.
 1. Take photos of working parts that have already been completed.
 2. Use canny edge detection with non-maximum suppression and hysteresis thresholding to get photos of part edges from the assembly line and use Chamfer distances to compare the initial photos of complete parts to parts moving through the assembly line.

2. Programming problem: content-aware image resizing

1. Reduce Width





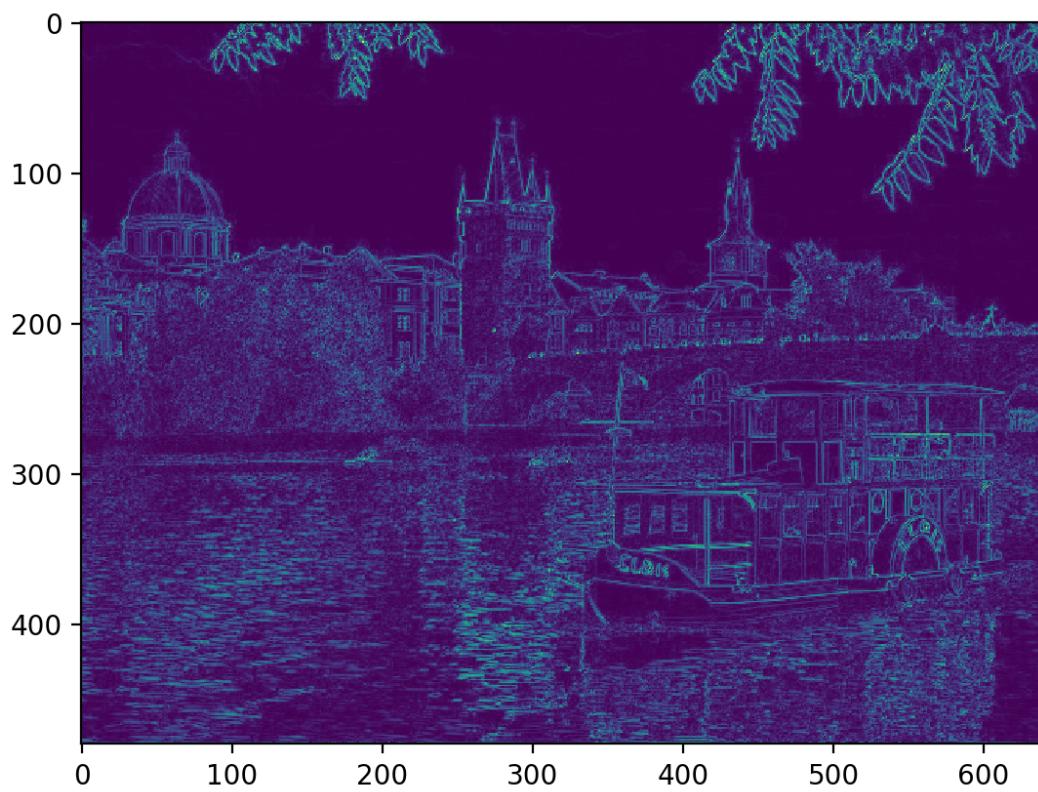
2. Reduce Height



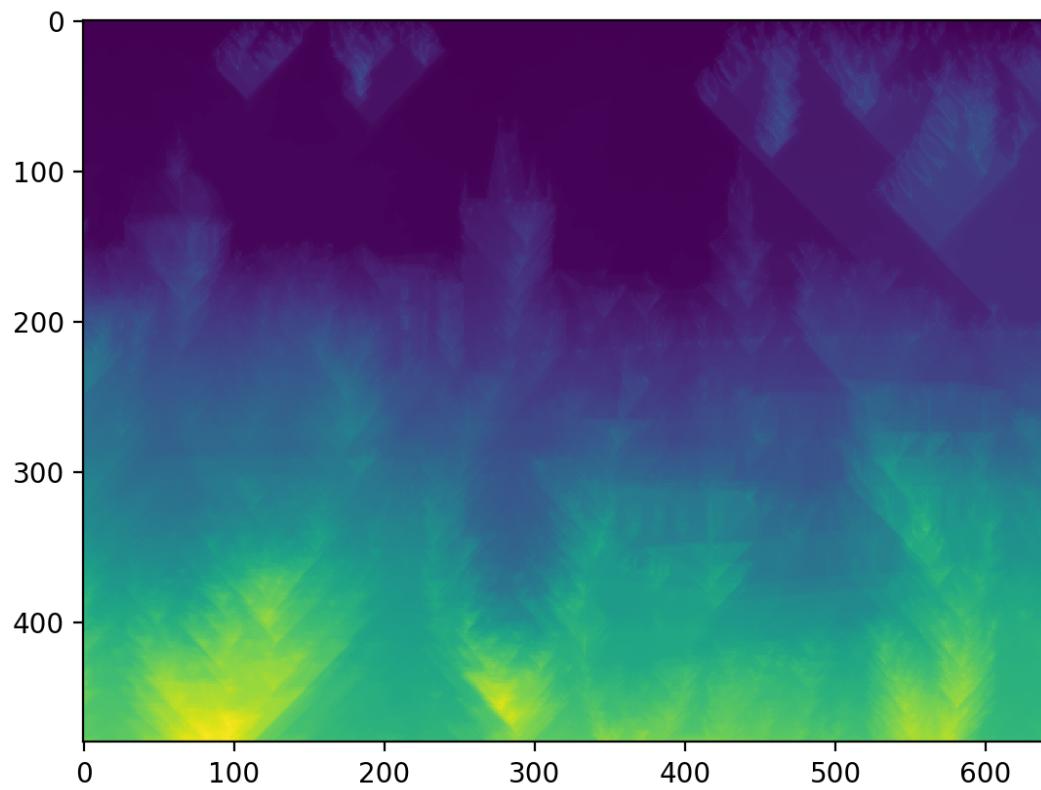
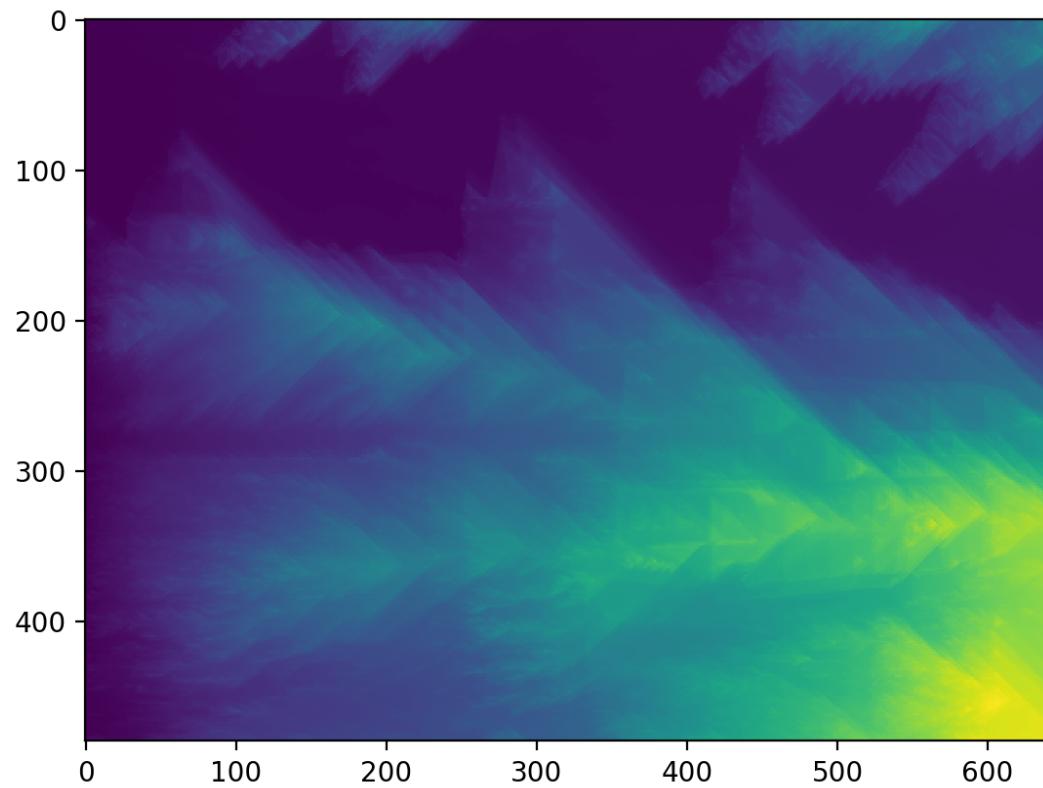


3.

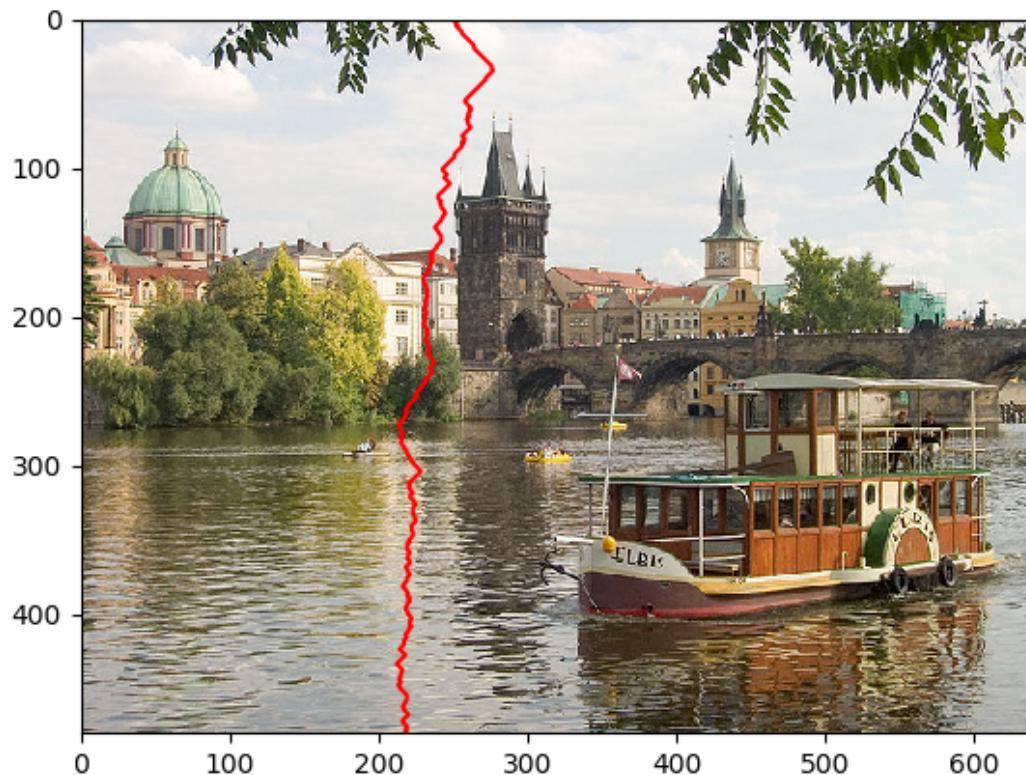
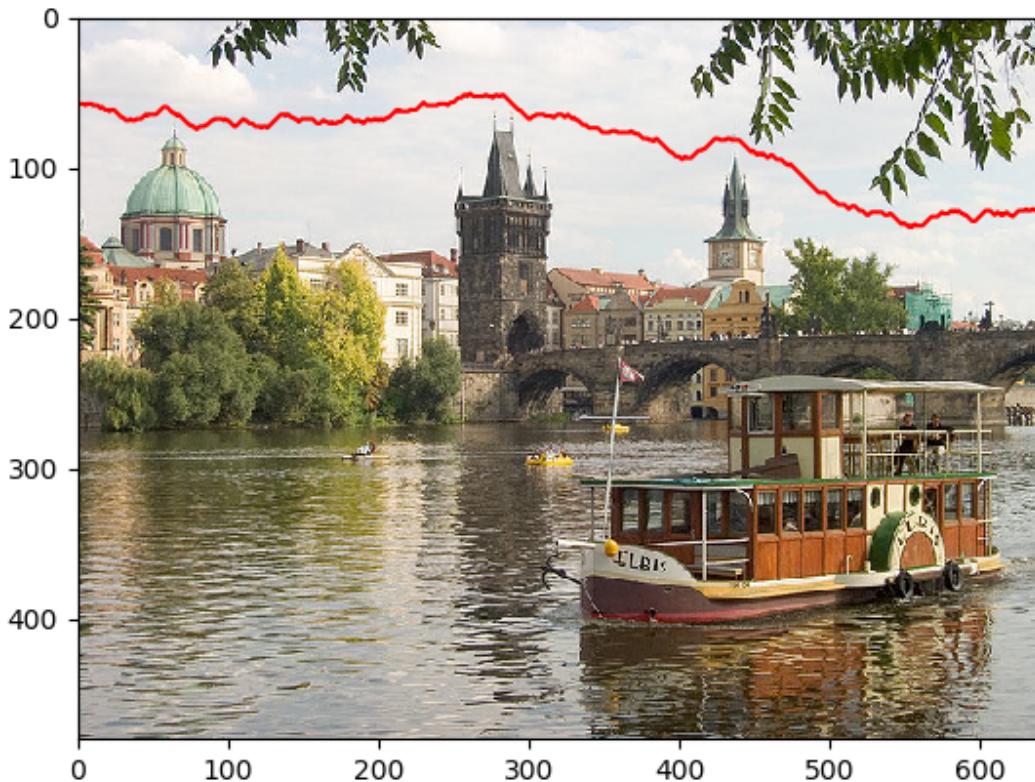
a. energy function output for the provided image inputSeamCarvingPrague.jpg



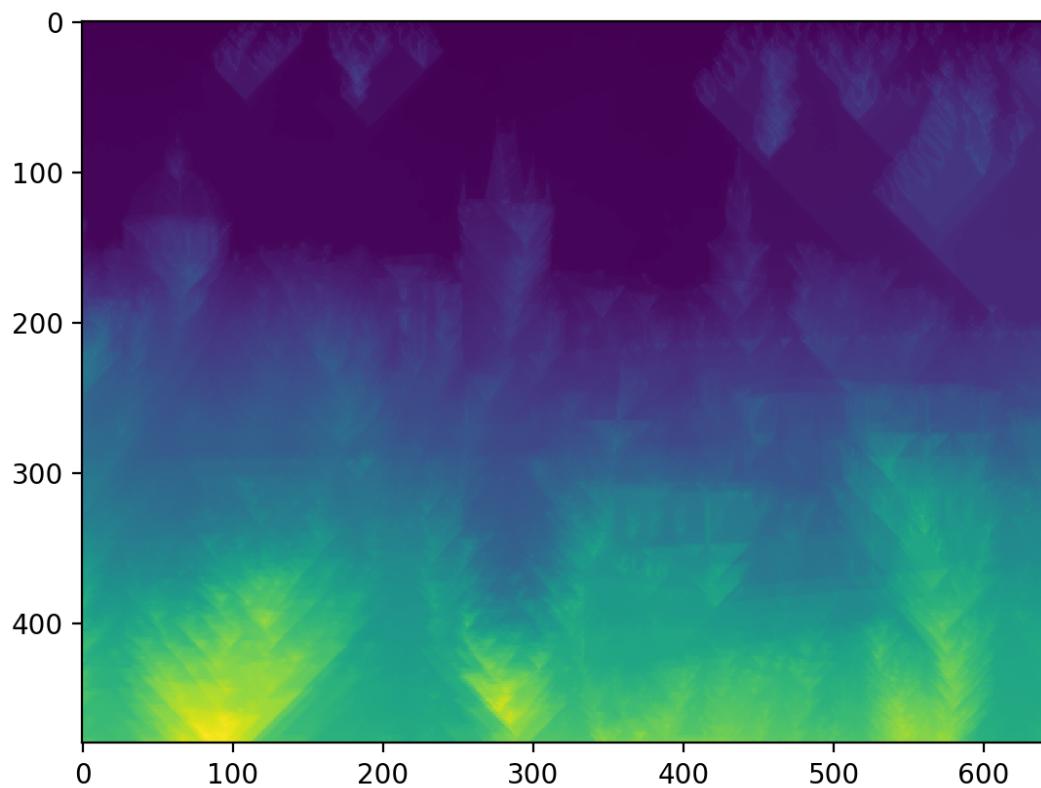
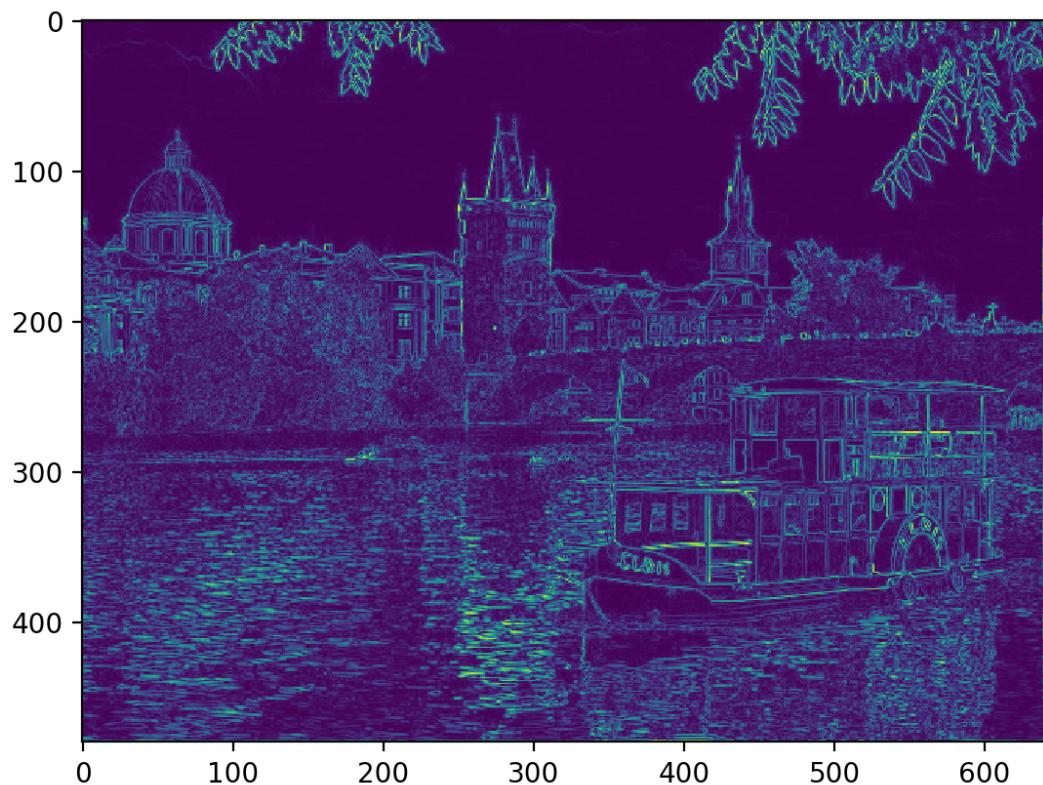
b.

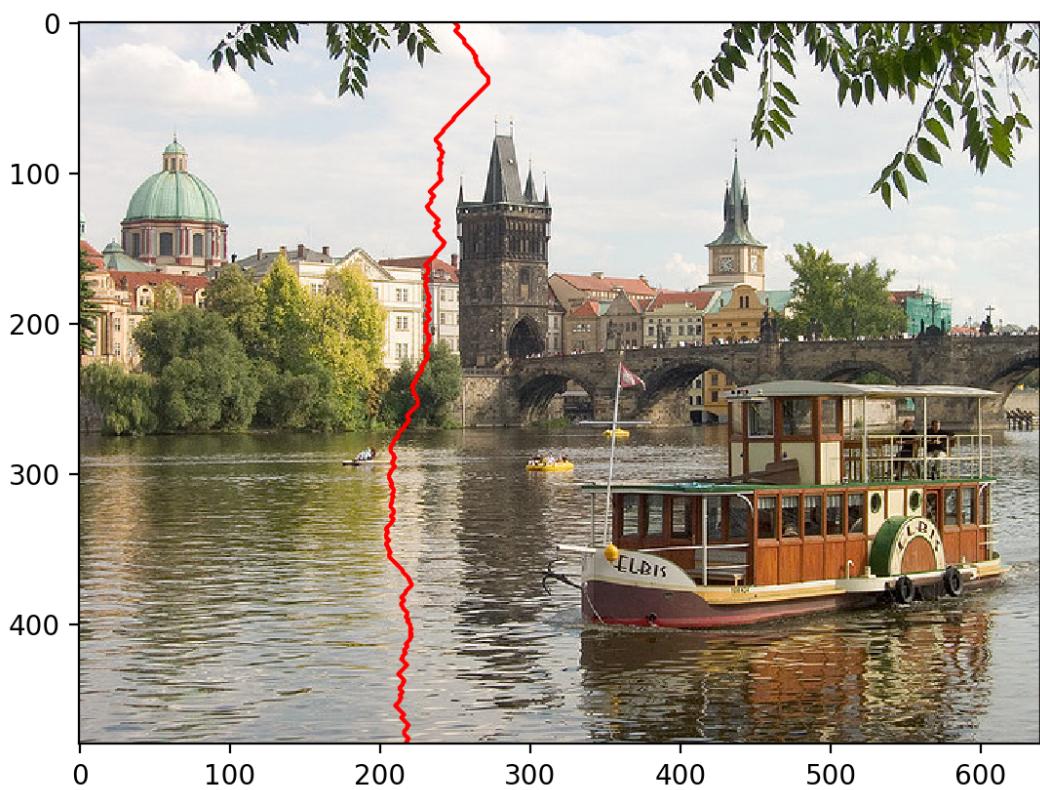
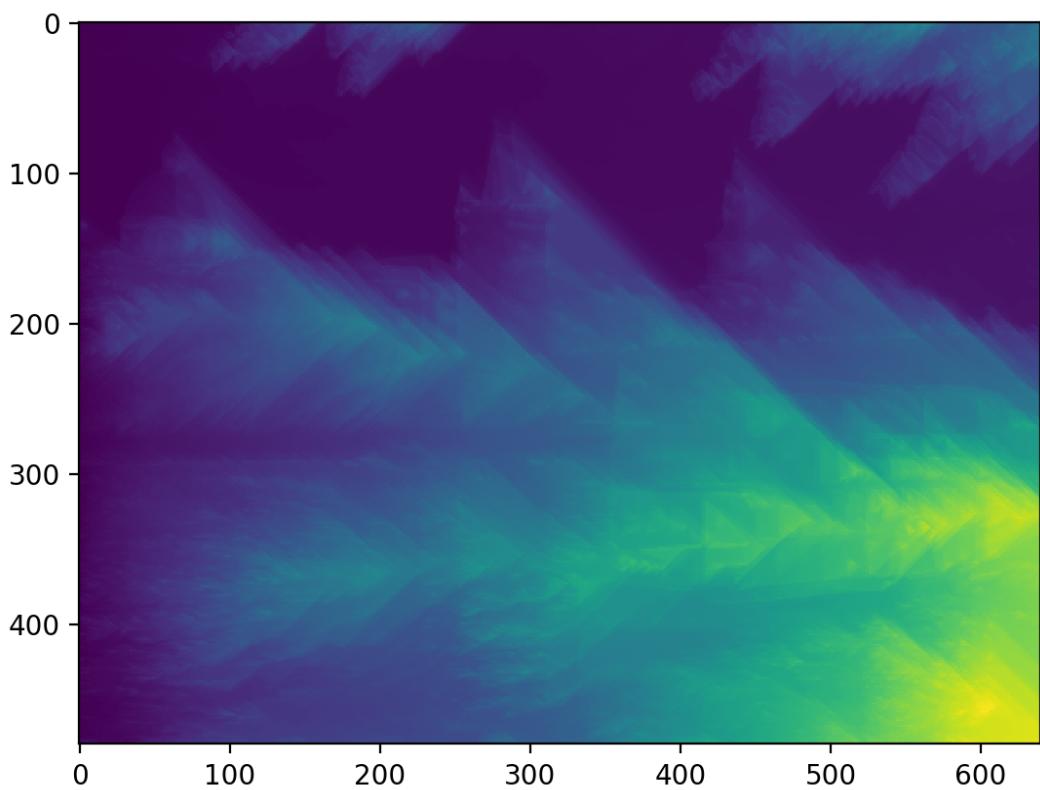


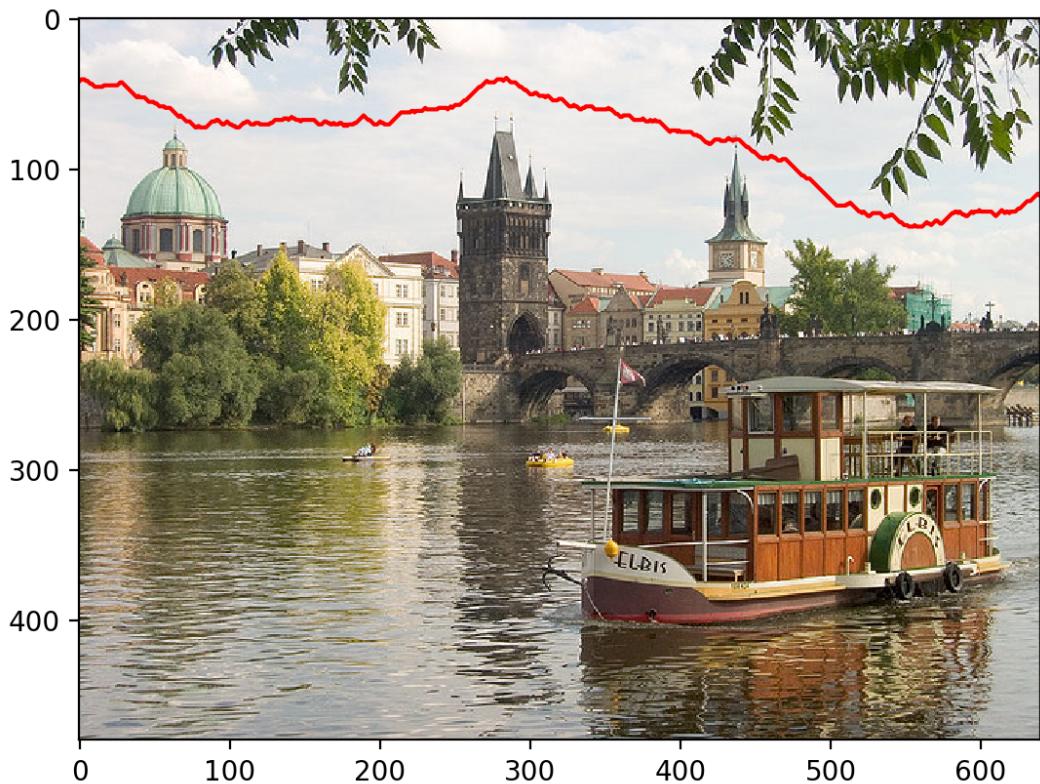
4. Display first seam The seams below are the likely candidates because they are unlikely to be noticed if removed. These seams are based on connected paths of low cumulative energy.



5. Roberts cross







The resulting seams using the Roberts operator are almost identical to the original seams since the energy map appears almost identical albeit stronger in magnitude for each pixel.

6.

a. Ink Original Image



b. Resized image



c. Imresize



d. Original: 640 x 360, Resized: 540 x 260

e. 100 widths removals followed by 100 height removals

f. My seam removal process removes the outer dark boundary given the low energy in that area.

a. Fire Original Image



b. Resized Image



c. Imresize



d. Original: 549 x 421, Resized: 449 x 321

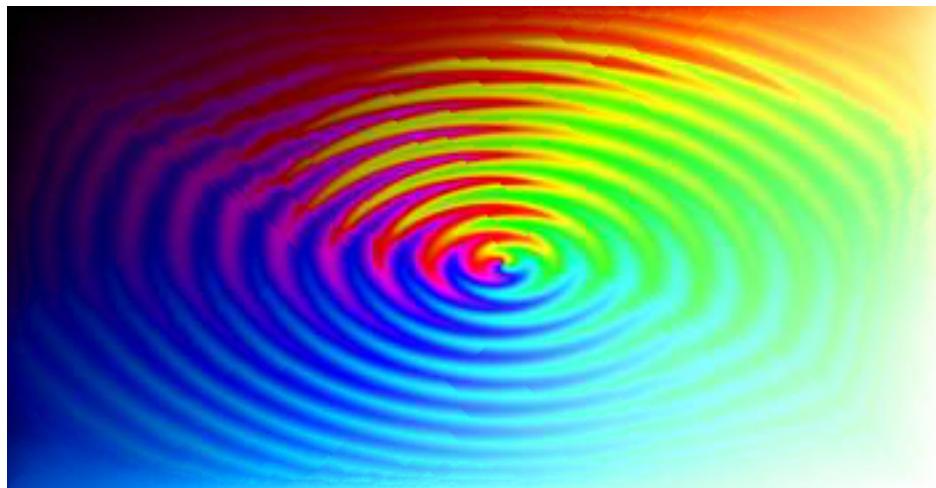
e. 100 widths removals followed by 100 height removals

f. My seam removal process removes the upper dark area given the low energy in that area as well as the dark vertical lines on the left region of the image. There are some artifacts from my image evident in the reduction of dark space in the bottom left region.

a. Ripple Original Image



b. Resized Image



c. Imresize



d. Original: 450 x 281, Resized: 350 x 181

e. 100 widths removals followed by 100 height removals

f. My seam removal process leaves some artifacts on the upper left given the lower energy in that region which leads to distortions in the ripple effect.