1 Short answer problems

1. In cases when we are doing template matching, if we are looking for multiple templates, we need to use multiple filters in succession. Then we can convolve the multiple filters into a single filter using the associative property of convolution before performing the filtering operation on images, especially when we have a lot of images to deal with. This can save us a lot of time.

2. [0 1 1 1 1 1 1 1]

3. [0 0 1/4 0 -1/2 0 1/4 0 0]

4. Non-maximum suppression and Hysteresis thresholding

5. When we try to represent the noise of high contrast images, such as the image of optical telescope systems, there is a possible flaw because the low contrast approximation is not valid and the noise is dependent on the signal while in additive Gaussian noise we regard noise as independent of signal.

6.(1) Filter image with derivative of Gaussian

Assumption: the image is low contrast and the noise can be represented by additive Gaussian noise

(2) Find magnitude and orientation of the image gradient to detect edges

(3) Use Non-maximum suppression and Hysteresis thresholding to process the edges detected.

(4) Calculate the Chamfer distance to compare the edges in the images with pre-set contours

(5) If there is any mismatch, there may be some flaws in the assembly of a part

2 Programming problem:

1(c) outputReduceWidthPrague

(d) outputReduceWidthMall

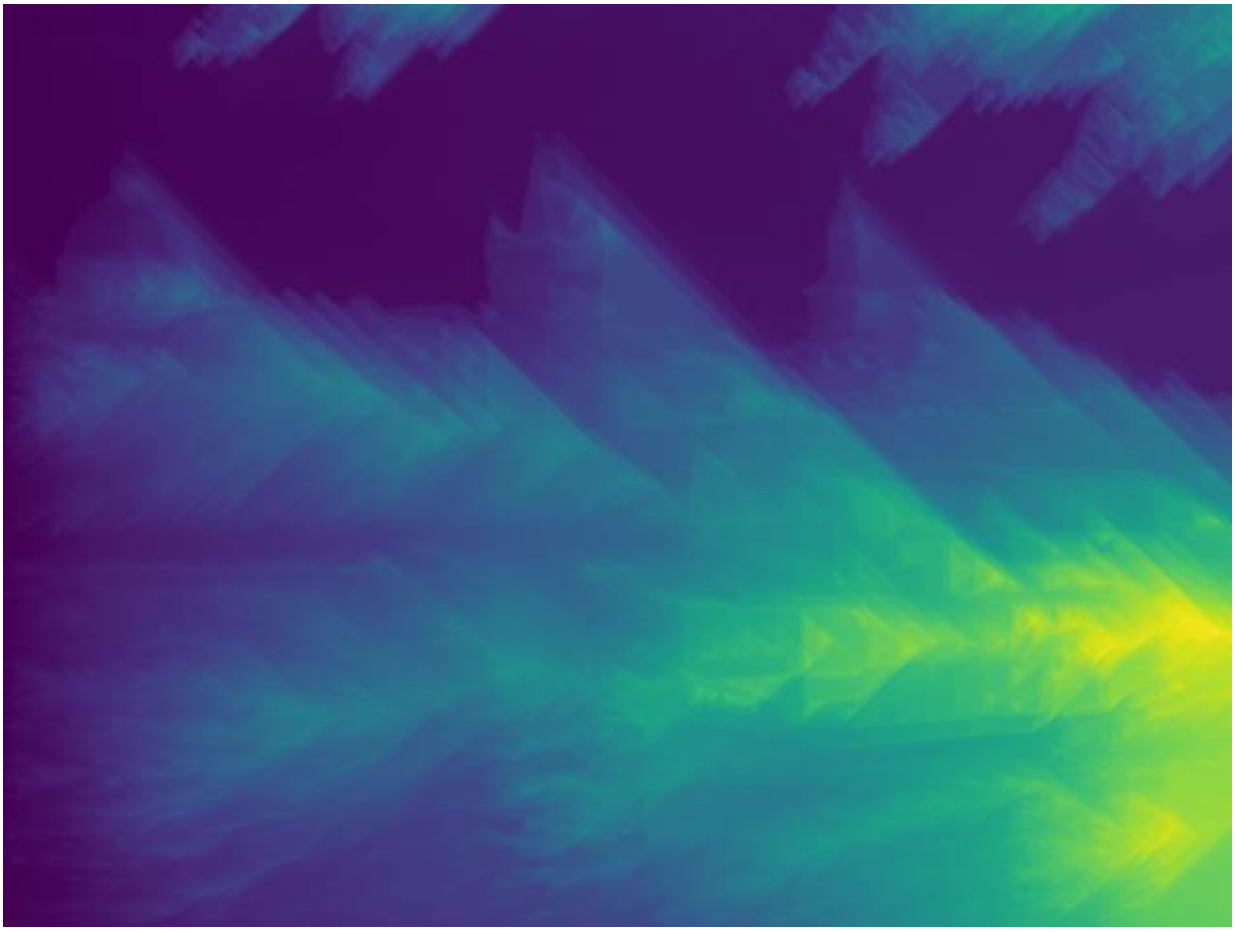
2outputReduceHeightPrague

outputReduceHeightMall

3(a) energy function output

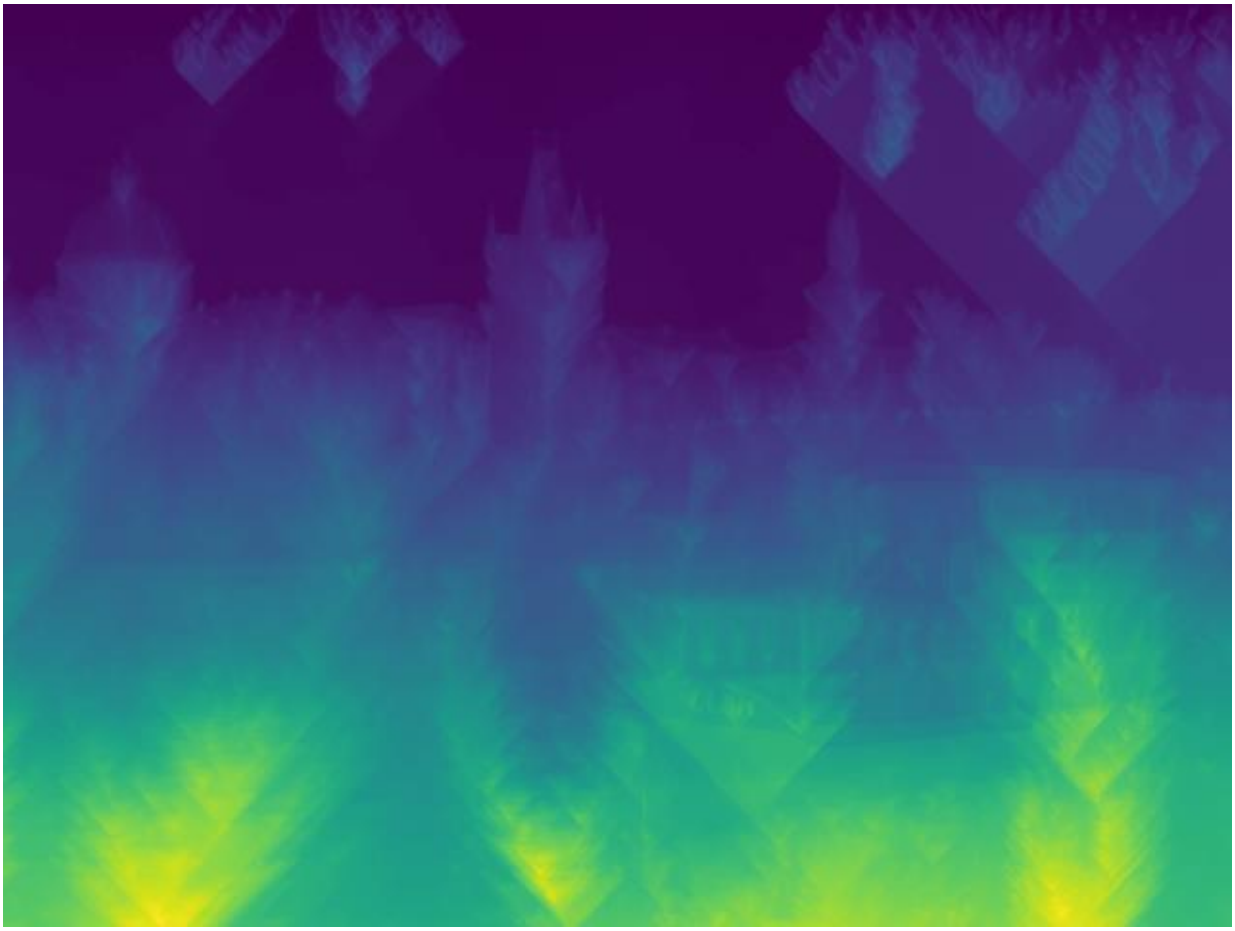
The energy function output has larger value where there are edges in the original image because the energy is calculated by the sum of the absolute value of gradients in x and y direction. So the energy function output has lowest value in the upper part of the image where there is sky in the original image except the leaves.

(b) Horizontal cumulative minimum energy map



In the horizontal cumulative minimum energy map, the color is brighter at the right part in general because energy is calculated cumulatively from left to right. The minimum is at the upper part where there is sky in the original image. The maximum is at the lower part where there is a boat in the original image.

Vertical cumulative minimum energy map



In the vertical cumulative minimum energy map, the color is brighter at the lower part in general because energy is calculated cumulatively from top to bottom. The minimum is at the left part where there are no leaves in the sky and the height of the building is smallest in the original image. The maximum is at the extreme left part where there are leaves in the sky and the height of the building is largest in the original image. The maximum is also at the extreme right part where the are leaves in the sky and a boat in the river in the original image.

4(a) the original image together with the first selected horizontal seam

This is the optimal horizontal seam because it only goes through the sky part in the original image excluding the leaves and the buildings.

(b) the original image together with the first selected vertical seam

This is the optimal vertical seam because it only goes through the sky, the building and river part in the original image excluding the leaves, the towers of the building and the boat in the river.

5. At first, I used Sobel filter with kernel size=3. For this question, I changed kernel to size=7. This blurred the output image a little bit.

I have to mention that this effect is hard to see in the example I provide. However, there is a slight image file size reduction which I believe can show that the image is blurred if scaling up the kernel size to 15 or larger.

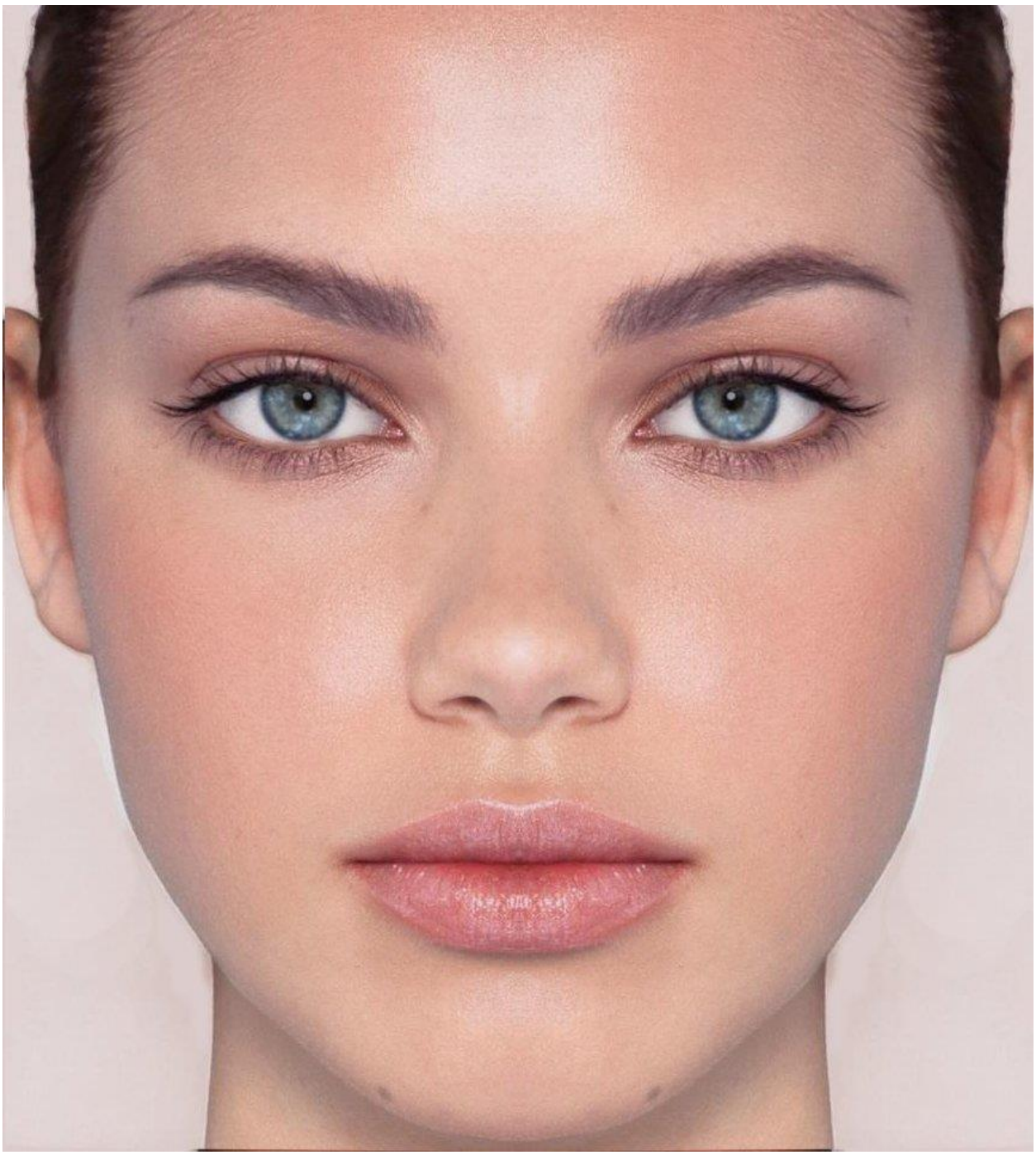
After change kernel size:

6

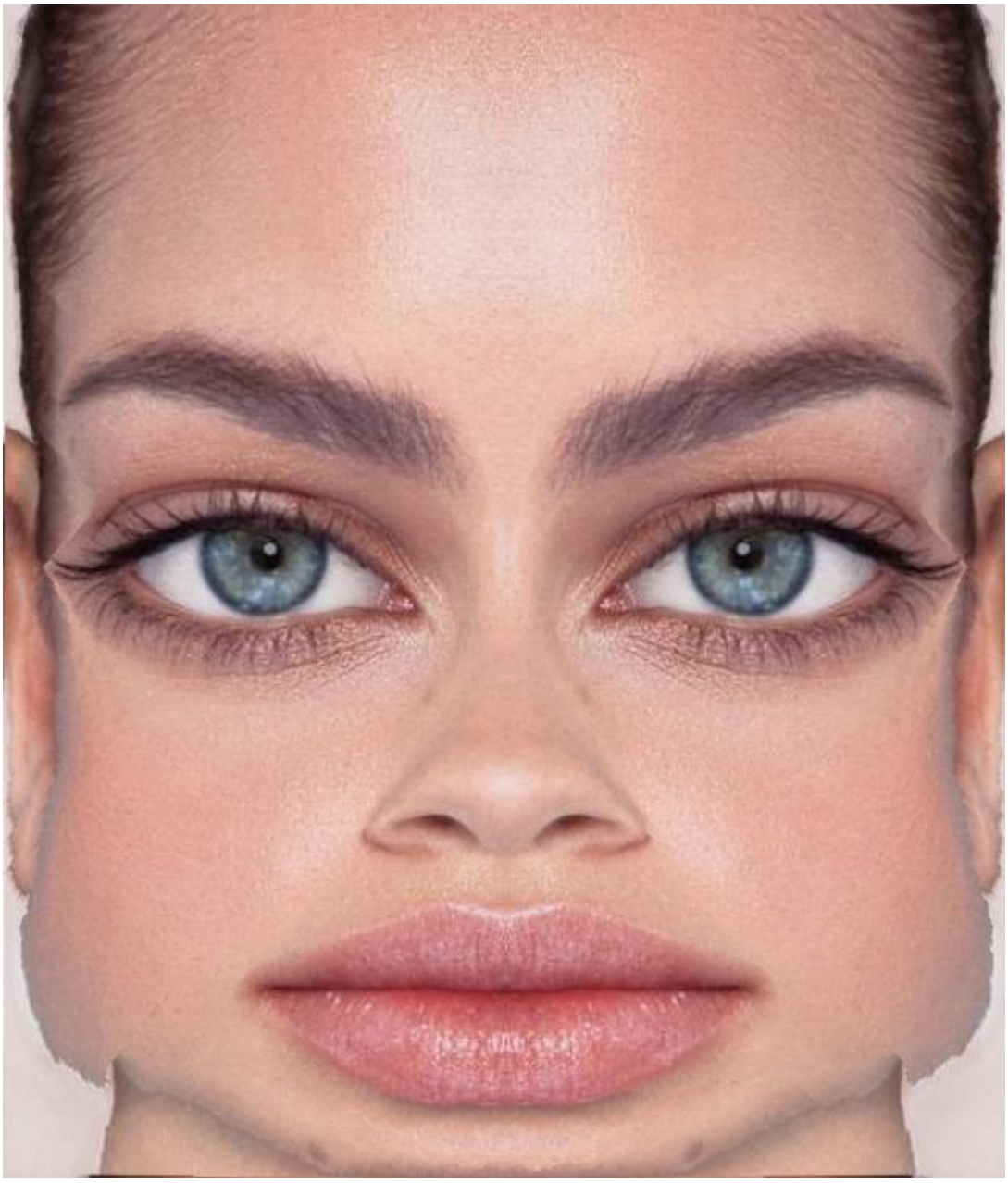
Example 1

(a) original imput image:

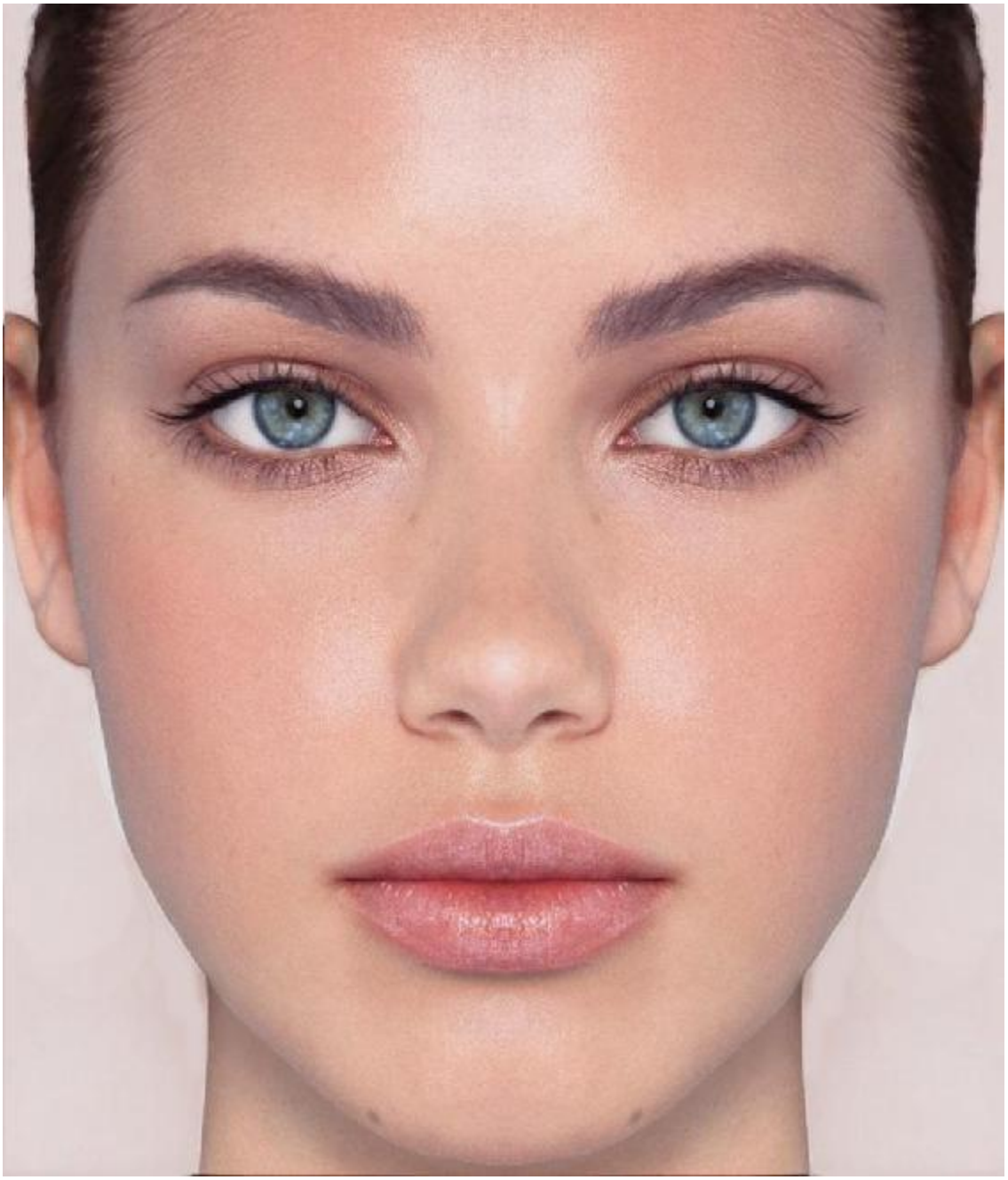
https://images.app.goo.gl/bBXnuFZ7FDit19A89



(b) my system’s resized image



(c) simple resampling



(d) input 864X960, ouput 564X660

(e) first reduce height by 300 pixels, then reduce width by 300 pixels

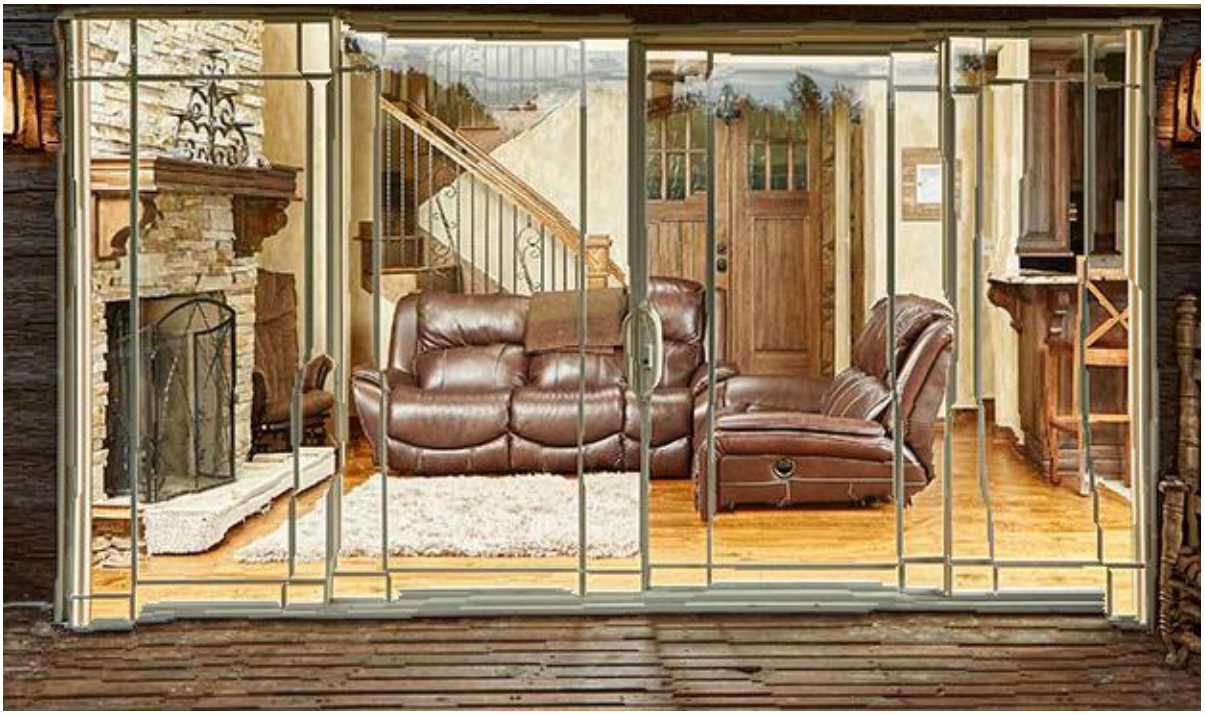
(f) In the original image, the human face occupies most of the space and there is only a little ground. So, when we use our system to reduce height and weight too much, we will first remove seams in the ground and then seams in the face which causes the distortion.

Example 2

(a) original input image

https://images.app.goo.gl/g6HdWn9Q1YLkeXZM6

(b) my system’s resized image



(c) simple resampling

(d) input 1024X768, output 624X368

(e) first reduce height by 400 pixels, then reduce width by 400 pixels

(f) Compared to the part in the window, the part of the wall is much darker and has less energy. So when we use our system to reduce height and width, the seams of the wall are first removed and the view inside the window is kept

Example 3:

(a) original input image

(b) my system’s resized image

(c) simple resampling

(d) input 634X423, output 384X373

(e) first reduce height by 50 pixels, then reduce width by 250 pixels

(f) Compared to other parts, the part of the head of the stork stuck in the mouth of the crocodile has most energy and is preserved at the center of the resized image when we use our system to reduce height and width