**CSC 545 Computer Speech, Music and Images**

**Assignment: Seam Carving**

**Due March 2, 2016**

Seam Carving is a method for resizing images while preserving objects in the image. The algorithm works by identifying *low-energy seams* then removing the pixels along those seams. *Energy* is defined as the magnitude of the *gradient* at a given pixel coordinate. Seam carving is usually defined to use a *dual gradient* energy function in which the gradient is calculated both horizontally and vertically. The formula you will use for this assignment is:

energy(x, y) = sq(red(x, y – 1) – red(x, y + 1)) + sq(green(x, y – 1) – green(x, y + 1)) +

sq(blue(x, y – 1) – blue(x, y + 1)) + sq(red(x – 1, y) – red(x+1, y)) +

sq(green(x – 1, y) – green(x + 1, y)) + sq(blue(x – 1, y) – blue(x + 1, y))

Complete Asn2.pde, and SeamCarver.pde, to implement seam carving. You must implement the API as designed in the Asn2 code on trace. Implement the following functionality:

‘o’ displays the image in its current state (some seams may have already been removed)

‘e’ displays the energy, scaled to fit in a PImage

‘v’ displays the lowest-energy vertical seam, superimposed on the current display

‘h’ displays the lowest-energy horizontal seam, superimposed on the current display

‘LEFT’ arrow removes the lowest-energy vertical seam

‘DOWN’ arrow removes the lowest-energy horizontal seam

Left-button mouse drag selects a section that will be protected from removal

Use a red rectangle to show the selection rectangle

‘c’ clears the protection so the region is no longer protected

Right-button mouse drag selects a section that will be erased by seam removal

‘BACKSPACE’ erases a selected region by removing vertical seams

‘DELETE’ erases a selected region by removing horizontal seams

Find seams using dynamic programming. While you’ll have an image that holds the energy for display, that is unsuitable for seam discovery because of the need to scale values to the range 0 to 255. So you’ll want to keep an energy matrix of float values with the same dimensions as the image. This matrix will hold unscaled energy values—but it won’t be used directly to find seams, either. You’ll have to build a cumulative energy matrix to use for discovering seams via dynamic programming.

There may be several, or many, seams with the lowest score. Carry out your dynamic programming as follows:

Calculate cumulative energy from top to bottom; backtrace from bottom to top

Favor vertical moves over diagonal moves

Favor seams to the left over seams farther to the right

The Asn2 code on trace does not provide a structure for implementing protection and erasure of selected regions. There are various ways to manage those operations. One way is to use another image that is empty except for selected regions. Protected regions might be set to one color (blue, for example) and removal regions to a different color (green, perhaps). When calculating the energy matrix, locations that are set to blue in that image will be set to INFINITY in the energy matrix. Locations set to green will be set to negative INFINITY in the energy matrix. That image must be resized in step with the carver image.

This assignment is based on one used at UC-Berkeley and published at <http://nifty.stanford.edu/2015/hug-seam-carving/>. There is a good discussion on the web site but there are some minor differences in our specs—and keep in mind the API on the web site is designed for Java.

Your program should be titled Asn2; put it in your upload folder on trace by 11:59 PM on the due date.

**Deliverables**

Processing program, described above

Be sure your program is well documented internally.