Today’s Topics

- Revisit smoothing (Mean, Gaussian, Median)
- Global image processing techniques
- Histogram
- Example uses of histograms
- Histogram Equalization for Contrast enhancement
- Using histograms for segmentation
- Comparing histograms to determine similarity
Global techniques

• Until now, the image processing techniques we covered were local techniques.
• Local because the resulting pixel value calculations were based on a small neighborhood of the pixel.
  – A pixel was determined to be an edge based on the pixel itself and its neighbors
  – A pixel was “smoothed” by computation on itself and neighbors
  – A pixel was converted to grayscale solely on its own RGB values
Global techniques

- Global techniques in image processing cause a pixel to change value based on more than just its neighbors, sometimes based on computation on the whole image (all the pixels).
- One example of a global computation is representing the colors (or grayvalues) of an image in a histogram. Then alter the pixels based on some use of the histogram.
Histogram

• A histogram is not an image concept. It is just a representation (sometimes in graph form) of frequencies of occurrences of certain things.
Histogram

"Black cherry tree histogram". Licensed under Creative Commons Attribution 2.5 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Black_cherry_tree_histogram.svg#mediaviewer/File:Black_cherry_tree_histogram.svg
Histogram

• Given a grayscale image, one could make a histogram with 256 bins (numbered 0..255) and each bin could hold a count of how many pixels have that particular grayvalue.

• If 256 is too fine grained, you could make a histogram with say 8 bins (numbered 0..7).
  – Bin 0 could hold the count of how many pixels have gray values between 0 and 31
  – Bin 1 could hold the count of the pixels that have gray values between 32 and 63
  – ...
  – Bin 7 would hold a count of pixels with gray values between 224 and 255
Histogram

• Let's look at champlain.jpg in gimp and show the graylevel histogram.

• Notice peaks and valleys for segmentation purposes.
Histogram

• Let's read a bit about histogram equalization and then look at an example:
• http://en.wikipedia.org/wiki/Histogram_equalization
Histogram

• I implemented histogram equalization for grayscale images. Let's see that code and run it now.
Histogram

- Histograms have been used as global representations of images.
- They can be used to segment the image into regions of like colors/intensities.
- Let's see how.

- To compare two images for how alike they are (in terms of color content) their color histograms can be compared to determine similarity.