CSCI 350: Data Analytics
Spring 2017
Proj#4
Confidence Intervals in Computer Vision
Out: 3/6/2017
Due: 3/12/2017@11:59:59pm

Total: 100 points

Name: _____

Goal:

The goal of this assignment will be to experiment with confidence intervals in computer vision for grayscale images.

Assignment:

In the course module "Lecture # 16" we discussed image formation, namely the pinhole camera abstraction to what happens in the mammalian eye. In the course module "Lecture #17" we focused on an image as an intensity surface whose shape we measure using local slope.
In our discussion, we walked through a MATLAB code example that used a convolution mask for the first derivative, $\frac{\partial}{\partial x} I(x,y) = -\frac{1}{2}\,\mathrm{I}(\mathrm{x}-1,\mathrm{y}) + 0 \cdot I(x,y) + \frac{1}{2} I(x+1,y)$. This convolution resulted in an edge map. Because the derivative operator is a statistics that employs a sum, we know from the Central Limit Theorem that the distribution of derivatives (i.e. resulting edge map) is a Normal distribution. As such, we can construct a confidence interval using appropriate z-scores (p-quantiles for the standard Normal distribution).

Once we have computed confidence interval [a,b] we used the b-value as a filter to select a top percentage of edges from the edge map. We use these "top edges" to construct a mask whose pixels we color white (255) to identify the strongest edges.

In this assignment, you will experiment with the example code associated with "Lecture #17" and examine how the confidence interval impacts the resulting strongest edges.

In this assignment your preparation will include:

1. Review the slides for module "Lecture 16" and "Lecture #17"
2. Review and understand the MATLAB code and information for the edge map example
    a. `computeEdges.m`
    b. `SimpleImageExamples.m`
    c. `Doorway.png`
    d. `HarryWilliamsFaceShot.jpg`

e. `HarryWilliamsBigCheck.jpg`
f. `MATLAB_Commands_EdgeExample.pdf`

3. Using an image search such as Google Image Search, find 2 images of your choosing that satisfy the following properties:
    a. One image that you feel has many edges
    b. One image that you feel has relatively few edges
4. Save your selected images
5. Using the supplied MATLAB code as your starting point, design an experiment that uses confidence intervals in 10% increments (10%, 20%,…,90%) to select the top 45%, 40%,…,5% strongest edges respectively.
6. Run your experiment code on both of your selected images
7. In writing (MS-Word or PDF only), discuss the result of your experiments
    a. How did the resulting edge image look and change as you varied the confidence intervals?
    b. Did your assumption about your selection for a high-edge-count image hold true? Discuss why or why not?
    c. Did your assumption about your selection for a low-edge-count image hold true? Discuss why or why not?

Submitting your work

- Don't forget to include pictures in your submission describing your results.
- Do not include a JPEG or image file. All images must be inserted into a single document along with any discussion. I refer here to images that are pictures of your written work.
- Of course the image files that you use for your experiments must be included as image files (JPEG, PNG, BMP, etc.).
- Late assignments will not be accepted. Please manage your time appropriately.
- Write a single MS-Word or PDF file for your report. If you submit a scan or image of handwritten work, it must be legible. Illegible work will receive a zero.
- Include every MATLAB file you write. Your program must run. Nonfunctioning programs will receive zero.
- Upload via Blackboard ONLY!!! Email will not be accepted.
- If you consult references and or other material from published work (book, paper, etc.), please cite your source.
- Submit all of your files as a single ZIP file (no Rar, Gzip, 7-ZIP, or TAR)

Assessment:

Code to compute confidence intervals from sampling dists: 20 points
Filtering and calculation of edge map: 20 points
Design of experiment: 20 point
Approach and results/discussion: 20 points
Total: 80 point