CS 4475 - Computation Photography QUIZ 1

Your Name: _____ Your T-Square ID: _____

- ***You must show all work to receive full credit.*** Correct answers with no work shown will receive minimal partial credit, while incorrect answers with correct work shown will receive generous partial credit. Illegible answers are wrong answers.

- Integrity: By taking this quiz, you pledge that this is your work and you have neither given nor received inappropriate help during the taking of this quiz in compliance with the Academic Honor Code of Georgia Tech.

- Academic Misconduct: Academic misconduct will not be tolerated. You are to uphold the honor and integrity bestowed upon you by the Georgia Institute of Technology.
  - Keep your eyes on your own paper.
  - Do your best to prevent anyone else from seeing your work.
  - Do NOT communicate with anyone other than a proctor for ANY reason in ANY language in ANY manner.
  - Do NOT share ANYTHING during the quiz. (This includes no sharing of pencils, paper, erasers or calculators).
  - Do not use notes or books, etc during the quiz.

Problem	Points	Lost	Gained	Running Total	Grader
1	5				
2	10				
3	10				
4	10				
5	5				
Total:	40				

1. (5 points) What is Helmholtz Reciprocity, how does it apply to Dual Photography, and what does it allow us to do? What are the benefits we gain from exploiting it?

2. a: (5 points) If you have two gray scale unsigned 8 bit images, and you subtract them and place the output into a signed 32-bit grayscale image, what math do you use to convert/scale the result so that it will fit into an unsigned 8-bit image again? Show the formulas you would use, and demonstrate how they would be applied using the smallest (-255) and largest (255) input values. You may assume a full scale output range, such that the largest number would be mapped to 255, and the smallest number would be mapped to zero.

   b: (5 points) If you have two gray scale unsigned 8 bit images, and you multiply them together and place the output into a signed 32-bit grayscale image, what math do you use to convert/scale the result so that it will fit into an unsigned 8-bit image again? Show the formulas you would use, and demonstrate how they would be applied using the smallest (50) and largest (65000) input values. You may assume a full scale output range, such that the largest number would be mapped to 255, and the smallest number would be mapped to zero.

   3. (10 points) If you have two 1000x1000 images represented as numpy arrays (A and B), write the python code that would copy a 400x400 region with upper left corner at (100,100) from image B into image A. Use array slicing notation, not iteration through all pixels.

4. (10 points) Given the following 3x3 kernel and single point (impulse) image, show the result of a cross-correlation of the kernel with the image, as well as a convolution of the kernel with the image. (You do not need to reduce fractions.)

5/9	0	0
0	3/9	0
0	0	1/9

Kernel

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	10	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Image

Cross-correlation

Convolution

5. (5 points) Explain how finite differences can be used to approximate a derivative. Provide a brief numerical example that includes a kernel that can be applied to an image using cross-correlation.