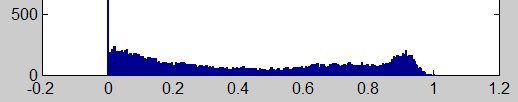
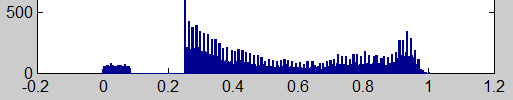
CS498 Midterm Exam Name:

You may use an 8.5x11 note-sheet, printed on both sides. Review all questions before you get started. Write your initials on the front of each page (except this one). Show all work.

1. (2 points) An original image has a histogram that looks like:

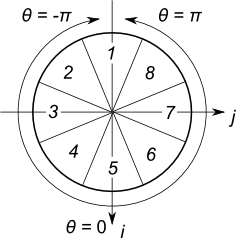


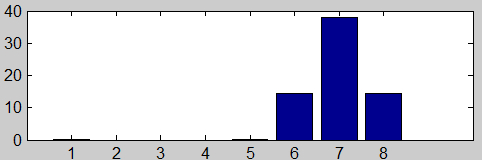
After modification, the image’s histogram looks like:



***Circle one***. Compared to the original, the modified image appears…

* 1. Darker, but with a light patch added
  2. Darker, but with a dark patch added
  3. Lighter, but with a light patch added
  4. Lighter, but with a dark patch added

1. (2 points) An edge histogram is created using the bins illustrated by the circular figure on the right. (A pixel falls into a bin if the image intensity increases in the direction of the bin’s wedge.) The resulting histogram looks like:



***Select*** the image that was used to create this histogram:

* 1. 
  2. 
  3. 
  4. 

1. (6 points) ***Describe*** what will be wrong with output of a blurring filter that does not sum to one
2. (15 points) ***Write*** a few lines of code to compute a blurred version I2 of an image I. The blur should be in multiple dimensions, but does not need to be Gaussian. The best solutions will not use loops and run quickly.
3. (5 points) ***Explain*** why all the colors we can see can be represented with just three numbers.
4. (5 points) ***Write*** the (R, G, B) value needed to produce the color yellow in an 8-bit unsigned image (i.e., using uint8, not double for each value)
5. (8 points) ***Compute*** the matrix product
6. (7 points) Write Matlab code to find a solution *h* to the equation *Ph* = *r*, where *P* is a 3x3 matrix, and r is a column vector. You may use inv(…) if you wish.

1. (5 points) Considering this transformation: , ***rewrite*** the square matrix below, filling in the question-marks. When any point [x; y] is **rotated** 90 degrees counter-clockwise around the origin, it will come to point [x2; y2].

1. (5 points) Consider this transformation: , ***rewrite*** the square matrix below, filling in the question-marks. The image is **scaled down by a factor of two**; that is, when any point [x; y] moves half-way to the origin, it will come to point [x2; y2].
2. (10 points) ***Apply*** the full projective homographic transform to the homographic point. You do not need to convert the result back to a “real” point.
3. (5 points) Suppose after applying a homographic transformation, you find a homogeneous point = [40; 30; 2]. ***Write*** the “true” point in the image, [i; j].

1. (15 points) Considering that the matrix satisfies and , ***find any*** value for that satisfies .

1. (5 points) ***Explain*** why computing tr2(H)/det(H) < 10 is preferable to computing λ1 > 10 λ2.

1. (5 points) Consider the following algorithm to rotate and scale up an image:

For each point *p*1 in the original image:

Rotate and scale up *p*1 to find a point *p*2 in the destination image

Set the pixel at *p*2 in the destination image to have the color   
of the pixel *p*1 in the original image.

***Describe*** the undesirable artifact that this algorithm will produce in the destination image.