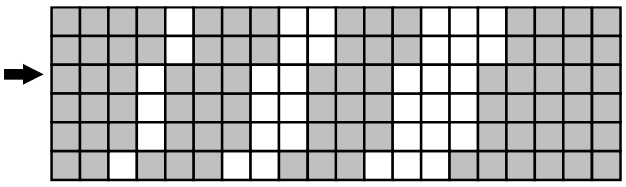
Image Processing Fall 2010 (Mid-term Exam Practice Problems)

1. In the image below, let the pixel values be 0 (shaded pixels) or 1 (white pixels).



(a) Determine the pixel values along the horizontal scanline marked by the arrow after processing by a 3x3 median filter.

(b) From (a), explain your observation of the effect of median filters on thin lines.

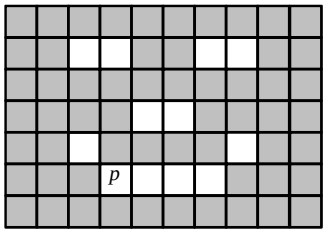
(c) What do you expect will happen if you use a 5x5 median filter? Briefly explain. You don't need to work out the numbers. Can you find a general rule (only approximately ok) between the median filter size and its effect on lines of various widths?

2. Interpolation: Let a_{00}, a_{01}, a_{10}, and a_{11} be the known values at the coordinates (0,0), (0,1), (1,0), and (1,1), respectively.

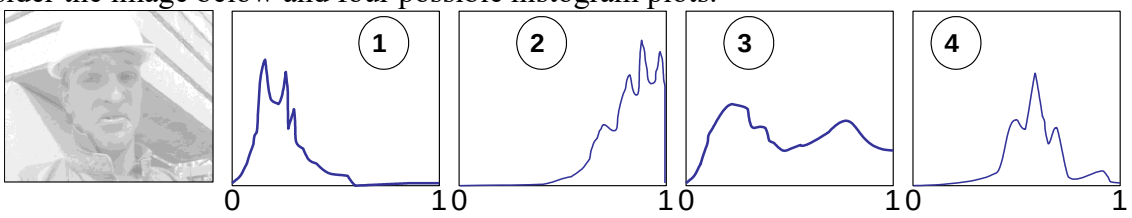
(a) Determine the interpolated values (using expressions of a_{00}, a_{01}, a_{10}, and a_{11}) at the points (0,1/3), (1/3,1/3), (2/3,1/3), and (1,1/3) using nearest-neighbor interpolation.

(b) Repeat (a) using bilinear interpolation.

3. In this image, mark all the pixels in the connected component that contains the pixel *p* according to 8-adjacency between pixels.



4. Consider the image below and four possible histogram plots.



(a) For the image to the left, indicate the most likely histogram among the four histograms given.

(b) If we want to use power-law transform to adjust the intensity values, suggest a gamma value that is likely to improve the overall contrast of the image. (Don't worry about being precise. The suggestion only needs to be reasonable.) State the reason of your suggestion, and also plot (only approximately) the resulting transform function.

(c) For your selected histogram, plot (only approximately) the transform function that results from histogram equalization.

5. When a certain RGB color [0.4 0 0] is changed to [0.8 0.4 0], which of the HSI components are increased, are decreased, or remain unchanged? Briefly explain. You do not need to compute the exact HSI component values.

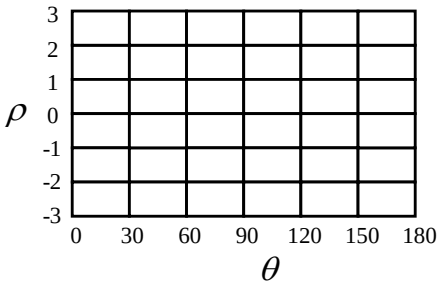
6. Describe how non-uniform illumination can affect global thresholding, and how adaptive thresholding solves the problem. Just give the basic idea.

7. Double thresholding is one of the techniques used in Canny edge detector. Explain how the two thresholds are used.

8. An image contains only two foreground pixels at (-1,0) and (1,1). Use Hough transform to find the equation of the most significant line. The line equation in polar coordinates is $x\cos\theta + y\sin\theta = \rho$.

(a) Fill the given accumulation bins. The resolutions of the accumulation bins are 30° for θ and one pixel for ρ. Use cos(45°)=sin(45°)=0.7, cos(75°)=sin(15°)=0.25, and cos(15°)=sin(75°)=0.95.

(b) Determine the equation of the most significant line.



9.

(a) For the central 5x5 part of the given image (the numbers are gray-level values), apply the given Laplacian filter, and then use the result to separate these pixels into two (bright and dark) regions using zero as the threshold.

(b) Explain what the "G" part of the "LoG" filter represents, and explain its main purpose.

5	5	5	5	8	5	5
5	5	5	8	9	8	6
5	4	5	5	8	5	6
5	4	5	5	5	5	6
5	6	7	6	5	5	6
5	6	7	6	6	5	6
5	5	6	6	5	5	6

0	-1	0
-1	4	-1
0	-1	0