CS 3630

Practice Problems on Image Processing

1. What is the effect of convolving an image using the following filter:

   a. Convert the image to grayscale
   b. **Blur the image**
   c. Sharpen the image
   d. This is not a valid filter

1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

2. You have taken an image of a scene that contains a single dominant plane (e.g., the front wall of a building) at unknown orientation, plus a smaller number of other scene points (e.g., from trees, poles and a street) that are not part of this plane. Describe the steps required to use RANSAC to detect the orientation of the plane in the scene from the scene points.

   1. Randomly choose 3 samples

   2. Fit a plane to these samples

   3. Count the number of points that are within some distance threshold t of the plane, consider those the inliers that vote in support of the current model

   4. Repeat steps 1-3 N times

   5. Choose the plane that has the largest set of inliers. (optional: retrain the plane using the entire set of inliers voting for that model)

3. Give an example of a monadic (single pixel) image processing operation.

   Many possible answers: making an image grayscale, applying histogram normalization, posterization, etc.

4. How do spatial convolutions, such as linear filtering, compare to monadic image processing? (1-2 sentences)

   In monadic image processing, the output pixel value is only a function of the single input pixel. In linear filtering, the output pixel value is calculated based on a set of neighboring pixels in a given window.

5. When running RANSAC, suppose 20% of the points are outliers, and we want to fit the correct line with 99% probability. How many iterations of RANSAC do we need?

   Let w be the probability of selecting an inlier (.8 in this example)

   We need $n = 2$ points to fit a model (line)

   What is the probability of selecting $n = 2$ inliers to create a good model? $w^2 = .8^2 = 0.64$

   Then the probability of selecting points that result in a bad model is $1 - w^2 = .36$

   If we run N iterations of RANSAC and want the correct answer with some probability p (99% above):

$$(1 - w^n)^N = 1 - p$$

$$N = \frac{\log(1 - p)}{\log(1 - w^n)}$$

$$N = \frac{\log(1 - .99)}{\log(1 - .8^2)} = 4.5$$

   Answer: 5 iterations