CS-555 Assignment 2: Written Part

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Answer 1:

Order of smoothness from light smoothness to heavy smoothness:

1. M4 – This mask will have no smoothing effect on the image as all pixels other than the center pixel have a value of zero
2. M3 – In this mask, the value of the center pixel will be divided by (4 + 1 + 1 + 1 + 1) = 8 after calculating the average of the neighboring pixels. This will result in more smoothing at the center of the mask, but very little smoothing on the edges of the mask.
3. M1 – This mask will result in comparatively more smoothing as compared to mask M4 as this mask has values 1 at all pixels apart from the center pixel. This mask is also called the box filter and it replaces each pixel value with an average of its neighborhood.
4. M2 – This mask is also called the Gaussian mask. This mask achieves the highest degree of smoothness out the list of masks.

Answer 2:

Choosing between using the first order derivative and second order derivative would depend on the type of image that is to be enhanced.

In the case of making use of first order derivatives, by definition, the first order derivative must be non-zero in areas of constant intensity, must be non-zero at the onset of an intensity step or ramp and must be non-zero along ramps.

Any definition of second derivative must be non-zero in constant areas, must be non-zero at the onset and end of an intensity step or ramp, must be zero along ramps of constant slope.

Edge detection is a key step towards image enhancement. The edges in images often contain ramp like transitions in intensity. If the first derivative were to be applied, the resulting image would consist of thicker edges. This is because the first derivative along a ramp is non-zero.

The second derivative would produce a double edge one pixel thick separated by zeroes. Hence, the second derivative enhances fine detail much better than the first derivative, and would be more suitable for enhancing objects that contain a high level of edges.

Answer 3:

Mask S =

0 -1 0

-1 5 -1

0 -1 0

Answer 4:

Method (a) is better for extracting edge information of an image in cases when the image has a considerable amount of false data due to noise. Noise consists of sharp changes in pixel intensity values. Edge detection works on the principle of highlighting the changes in pixel intensity values among neighbors.

If edge detection were to be applied on an image that consists of noise, the edge image would incorrectly highlight noise as edges.

Hence, by blurring the image first, we can reduce the noise in the image and then perform edge detection to obtain an accurate edge image.

Answer 5:

In the given image I, all values other than 4 and 64 are assumed to be noise. Hence we will apply the median filters on those pixels that do not have the value 4 or 64.

1. On applying the 3\*3 square shaped median filter, we get M1 as:

4 4 4 4 4 4 4 4

4 4 4 4 4 4 4 4

4 4 48 64 64 4 4 4

4 4 64 64 64 64 4 4

4 4 64 64 64 64 4 4

4 4 56 64 64 23 4 4

4 4 4 4 4 4 4 4

4 4 4 4 4 4 4 4

1. On applying the 5\*5 cross shaped median filter, we get M2 as:

4 4 4 4 4 4 4 4

4 4 4 4 4 4 4 4

4 4 64 64 64 64 4 4

4 4 64 64 64 64 4 4

4 4 64 64 64 64 4 4

4 4 64 64 64 64 4 4

4 4 4 4 4 4 4 4

4 4 4 4 4 4 4 4

1. On comparing M1 and M2 obtained above, we can see that image M2 has more consistent pixel intensity values than M1, after application of the 5\*5 cross shaped median filter. This further indicates that image M2 has less noise and more accurate data. Hence, the 5\*5 cross shaped median filter is better.