Department of Computer Science
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MATHCOMPPH-546: PATTERN RECOGNITION

Lesson 1 phys546 Review of The Spatial Domain

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6.6 Suppose an image is scaled upwards in size by a factor k, and the result is then scaled downwards in size by the same factor. Is the final result exactly the same as the original image? If not, why not? What if the image is reduced in size first, and the result enlarged?

Ans. When a picture is scaled up by a factor k and then scaled down by a factor k, the image's size is multiplied by k and then divided by the same factor k. When the image is scaled up and down by the same factor, the final output remains unchanged. Even when the image is shrunk by a factor and then extended by the same factor, the results are the same. The same image size will be sent once more. However, if a picture is SCALED DOWN by a factor k before being SCALED UP by the same factor k, there will be a loss of quality. This occurs because when images are compressed to a smaller number of pixels, information about the image is already gone. Attempting to recover the lost image quality by scaling up does not work.

6.7 Suppose an image is rotated and then the result rotated back by the same amount (using either (i) nearest-neighbor or (ii) bilinear interpolation). Is the resulting image exactly the same as the original? If not, why not?

Ans. Because of the loss generated by the interpolation approach, if we rotate an image by a certain amount and then rotate it back by the same amount, the outcome will not be the same as the original image. When reversing an image by the same degree, quality is compromised. Although the loss can be reduced, the inverted image will not be identical to the original.

6.8 What is the result of convolving the following (symmetric) one-dimensional masks? (In each case you should slide one (M1) past the other (M2), doing a sum of-products, replacing the center term (pixel) of M2, and then shifting M1 by a single term (pixel).)

(i) $[1\,1\,1] * [1\,1\,1]$;

(ii) $[1\,1\,1] * \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$;

(iii) $[1\,2\,1] * \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}$;

(iv) $[1\,1\,1] * \begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}$;

(v) $[-1\,0\,1] * \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$;

(vi) $[-1\,0\,1] * \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}$;

(vii) $[1\,2\,1] * \begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}$.

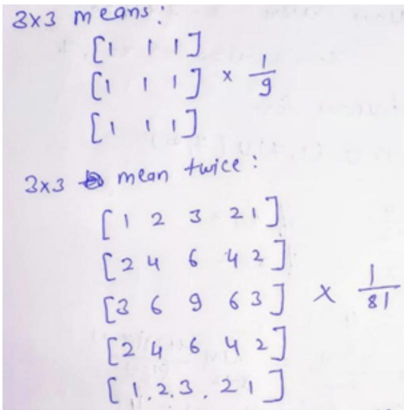
(Note: the results of (iv) and (v) give the Prewitt operators, and the results of (vi) and (vii) give the Sobel operators.)

Ans.

1. [1 2 3 2 1]
2. [111; 111; 111]
3. [1 2 1; 2 4 2; 1 2 1]
4. [-1 -1 -1; 0 0 0; 1 1 1]
5. [-1 0 1; -1 0 1; -1 0 1]
6. [-1 0 1; -2 0 2; -1 0 1]
7. [-1 -2 -1; 0 0 0; 1 2 1]

6.9 Applying a 3 × 3 averaging mask twice does not produce the same result as applying a 5 × 5 averaging mask once. To what is it equivalent?

Ans.



Through one or more intermediate 3*3 windows, each cell contributes indirectly. Consider the collection of stage 1 windows that contribute to a specific stage, such as stage 2 computation. The contribution of a cell is determined by the number of such 3*3 windows in which that cell appears. All nine windows, for example, contain the central cell. As a result, 9*1/9*1/9*1/9 is its contribution.

6.10 Is the 3 × 3 median mask separable (i.e. can it be implemented by a 3 × 1 mask followed by a 1 × 3 mask)? Explain your answer.

Ans. No, because it's non-linear, it's not separable. To get the correct median value with the 3*3 median mask, you'll need all 9 values.

6.11 Can unsharp masking be used to reverse the effect of blurring? Choose an image and apply an unsharp mask after a 3 × 3 averaging mask. Describe the result.

Ans. Just a little bit. To restore the original and reverse the blurring, the blurring and sharpening effects would have to be the inverse of each other.

6.12 An averaging mask is applied to an image to reduce noise, and then a Laplacian mask is applied to the result to enhance small details. Would the result be the same if the order of these operations were reversed? Explain.

Ans. These aren't commutative operations at all. The outcome will be different if their sequence is reversed.