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COMP 478 Assignment 1

1.

a) The discrete histogram equalization uses a finite set of numbers, which are integers as well to approximate a PDF through a discrete sum as opposed to its continuous counterpart that uses an integral instead. Though an input intensity of a pixel would be mapped to a new output intensity, the probability of the new intensity would be roughly equal to the probability of the input intensity. In other words, the equalized histogram would not be flat, but would have its pixels spread uniformly across all intensity levels.

b) A histogram-equalized image would have its pixels spread uniformly across all intensity levels. Doing a second pass would only yield a linear transformation as the input image is already histogram-equalized. In other words, there would be no change in intensity.

2.

Given 2 sets of numbers, A = {1,-1,9} and B = {4,5,6}, and a and b both equal to 1, we define H to be the median operator. Using H[af(x,y) + bg(x,y)] = H[A + B] = H[ {5,4,15} ], the operator yields 5. Now, H[f(x,y)] = H[A] = 1 and H[B] = 5, given a sum of 6, which is not equal to H[A + B], violating the property: H[af(x,y) + bg(x,y)] = aH[f(x,y)] + bH[g(x,y)]. Therefore, the median operator is non-linear.

3.

a) Chart

Description automatically generated

b)

i)

We can find s­­k using this formula: sk = with given values:

Table

Description automatically generated

Yields:

Graphical user interface, application, table

Description automatically generated

ii)

Chart, histogram

Description automatically generated

Chart

Description automatically generated

c)

Chart

Description automatically generated

4. For f(x,y) + g(x,y), let h(x,y) be the sum of the 2 images. Given that pixels of f(x,y) have an intensity level of rk and that the pixels of g(x,y) have an intensity of constant value c, the output image h(x,y) would have the resulting intensities of its pixels shifted by c (as in rk + c), but the spacing in the resulting histogram remains the same. Similarly for the case of f(x,y) \* g(x,y), let j(x,y) be the product of the 2 images. This output image would have all the intensities of f(x,y) multiplied by constant c, which doesn’t affect the ratio of the number of pixels per intensity, meaning that the spacing in the resulting histogram, also, remains the same.