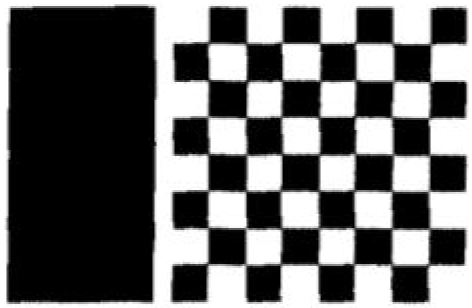
Questions 5-8 in Assignment 2 - Digital Image Processing

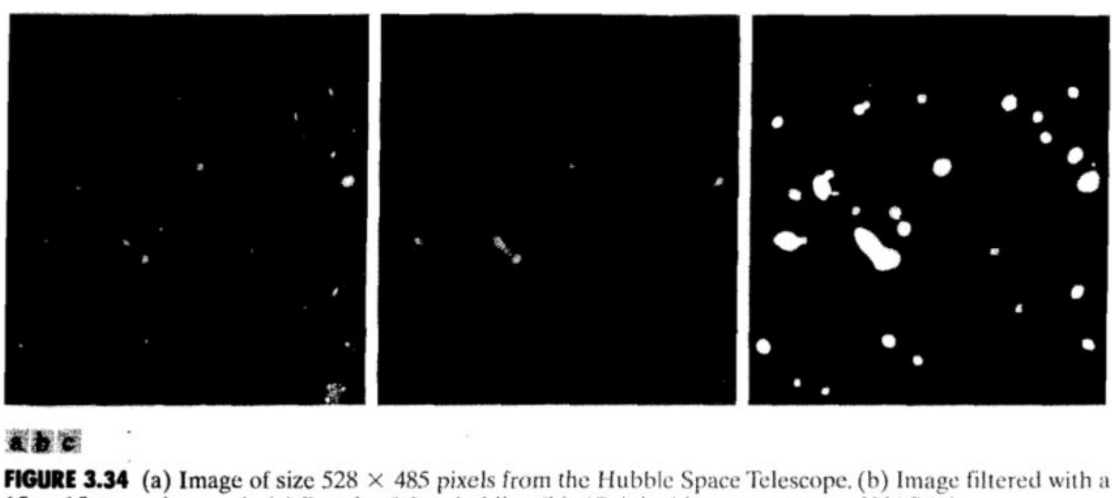
3.14 The images shown on the next page are quite different, but their histograms are the same. Suppose that each image is blurred with a 3×3 averaging mask.

(a) Would the histograms of the blurred images still be equal? Explain.

(b) If your answer is no, sketch the two histograms.



3.22 Consider an application such as the one shown in Fig. 3.34, in which it is desired to eliminate objects smaller than those enclosed by a square of size $q \times q$ pixels. Suppose that we want to reduce the average intensity of those objects to one-tenth of their original average value. In this way, those objects will be closer to the intensity of the background and they can then be eliminated by thresholding. Give the (odd) size of the smallest averaging mask that will accomplish the desired reduction in average intensity in only one pass of the mask over the image.



a b c

FIGURE 3.34 (a) Image of size 528×485 pixels from the Hubble Space Telescope. (b) Image filtered with a 15×15 averaging mask. (c) Result of thresholding (b). (Original image courtesy of NASA.)

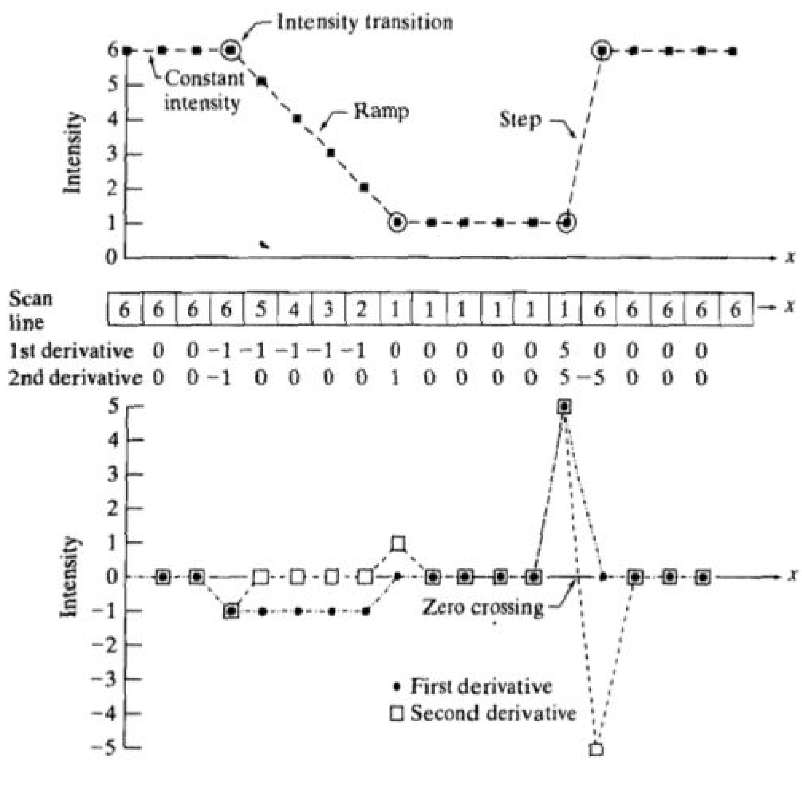
3.27 Give a 5 × 5 mask for performing unsharp masking in a single pass through an image. Assume that the average image is obtained using Gaussian filter.

★3.28 Show that subtracting the Laplacian from an image is proportional to unsharp masking. Use the definition for the Laplacian given in Eq. (3.6-6).

$$\frac{\partial f}{\partial x} = f(x + 1) - f(x) \tag{3.6-1}$$

$$\frac{\partial^2 f}{\partial x^2} = f(x + 1) + f(x - 1) - 2f(x) \tag{3.6-2}$$

Just for reference -



a
b
c

FIGURE 3.36 Illustration of the first and second derivatives of a 1-D digital function representing a section of a horizontal intensity profile from an image. In (a) and (c) data points are joined by dashed lines as a visualization aid.