Muhammad Rayyan Alam, [illegible]
[illegible]-01 Summer-2023, [illegible]
Deadline: 18th Nov 2023

Answer-01

(a) Given,

$$F = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$g(i,j) = \sum_{u=0}^{2} \sum_{0}^{2} F(u,v) \cdot I(i+u, j+v)$$

$$g(0,0) = 0 \cdot 0 + 0 \cdot 0 + 0 \cdot 0 + 0 \cdot 7 + 1 \cdot 0 + 0 \cdot 8 + 0 \cdot 0 + 0 \cdot 0 + 0 \cdot 0 + 0 \cdot [illegible]$$

$$= 0$$

$$g(0,0) = 0 \cdot 0 + 0 \cdot 0 + 0 \cdot 0 + 0 \cdot 4 + 1 \cdot 7 + 0 \cdot 5 + 0 \cdot 0 + 0 \cdot 0 + 0 \cdot 0$$

$$= 0 \cdot 7$$

Using Calculator,

$$G = \begin{bmatrix} 0 & 7 & 4 \\ 0 & 8 & 5 \\ 0 & 9 & 6 \end{bmatrix}$$

(b)

$$F = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

~~G(0,~~

$$G(0,0) = 1.0 + 0.0 + 0.0 + 0.7 + 0.0 + 0.8 + 0.0 + 0.0 + 0.0$$

$$= 0$$

$$G(0,1) = 1.0 + 0.0 + 0.0 + 0.4 + 0.7 + 0.5 + 0.0 + 0.0 + 0.0$$

$$= 0$$

Using calculator,

$$G = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

(c) $F = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix}$

This filter is performing edge detection.

It calculates the difference between the sum of pixel values on the top side and the sum of pixel values on the bottom side of the filter.

$$\text{Resulting filter} = \begin{bmatrix} -4 & -4 & -4 \\ -4 & 0 & 4 \\ 4 & 4 & 4 \end{bmatrix}$$

(d) $F' = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$

Difference between F & F':

(i) F' is oriented vertical where F is oriented horizontally.

(ii) F' is used for vertical edge detection while F' is used for horizontal edge detection.

(e)

$$F = \frac{1}{16}\begin{bmatrix} 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$$

This filter is a simple blur. It calculate the weighted avgerage of the pixel values in the neighbours. The resulting q for this filter will be a blurred version of the input image

$$G = \frac{1}{16}\begin{bmatrix} 22 & 27 & 32 \\ 33 & 38 & 43 \\ 39 & 44 & 49 \end{bmatrix}$$

(1) $F = \frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$

$$G = \frac{1}{9}\begin{bmatrix} 15 & 17 & 18 \\ 22 & 24 & 25 \\ 30 & 31 & 32 \end{bmatrix}$$

, F is a simple averaging filter

, G is the smoothed version of the input image.

Answer 02 ⓐ

$G(i,j) = f^T t_{ij}$ where f is the vector-representat of the filter and t = vector representation of neighbourhood patch of image

$$= [f_1, f_2, \text{---}, f_{mn}]^T [t_{ij1}, t_{ij2}, \text{---}, t_{ijmn}]$$

$$= [f_1 t_{ij1} + f_2 t_{ij2} + f_3 t_{ij3} + \text{---} + f_{mn} t_{ijmn}]$$

Answer 02 ⓑ

Code Provided