

Solution

$$a) \quad m_{i,j} = \sum_x \sum_y x^i y^j f(x, y)$$

Solution

b) Image 1: $m_{1,0} = 3 \cdot 3 +$
 $1 \cdot 1 + 2 \cdot 1 + 3 \cdot 1 + 4 \cdot 1 + 5 \cdot 1 +$
 $2 \cdot 3 +$
 $1 \cdot 2 + 1 \cdot 3 + 1 \cdot 4 +$
 $2 \cdot 3$
 $= 45$

Image 2: $m_{1,0} = 90$

Solution

c) Central moments, invariant by translation:

$$\mu_{i,j} = \sum_x \sum_y (x - \bar{x})^i (y - \bar{y})^j f(x,y)$$

$$\text{where } \bar{x} = \frac{m_{1,0}}{m_{0,0}} \text{ and } \bar{y} = \frac{m_{0,1}}{m_{0,0}}$$

$$\text{Image 1: } \mu_{2,0} = 12$$

$$\text{Image 2: } \mu_{2,0} = 12$$