Klevens ITEN

Bonus Homework Assignment

Using 2nd order derivative given:

$$\frac{\partial^2 f}{\partial x^2} = \frac{f(x_{i+1}, y_j) - 2f(x_i, y_j) + f(x_{i-1}, y_j)}{(x_{i+1} - x_i)^2}$$

$$\frac{\partial^2 f}{\partial y^2} = \frac{f(x_i, y_{j+1}) - 2f(x_i, y_j) + f(x_i, y_{j-1})}{(y_{j+1} - y_j)^2}$$

Assume $(x_{i+1} - x_i) = (y_{j+1} - y_j) = 1$ pixel and using:

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} \qquad \text{(The LAPLACIAN.)}$$

$$= f(x_{i+1}, y_j) + f(x_{i-1}, y_j) + f(x_i, y_{j+1}) + f(x_i, y_{j-1}) - 4f(x_i, y_j)$$

$$= \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix} * f \begin{bmatrix} (i-1, j+1) & (i, j+1) & (i+1, j+1) \\ (i-1, j) & (i, j) & (i+1, j) \\ (i-1, j-1) & (i, j-1) & (i+1, j-1) \end{bmatrix}$$

2nd order derivative filter

Where [*] denotes the (discrete) convolution operation.