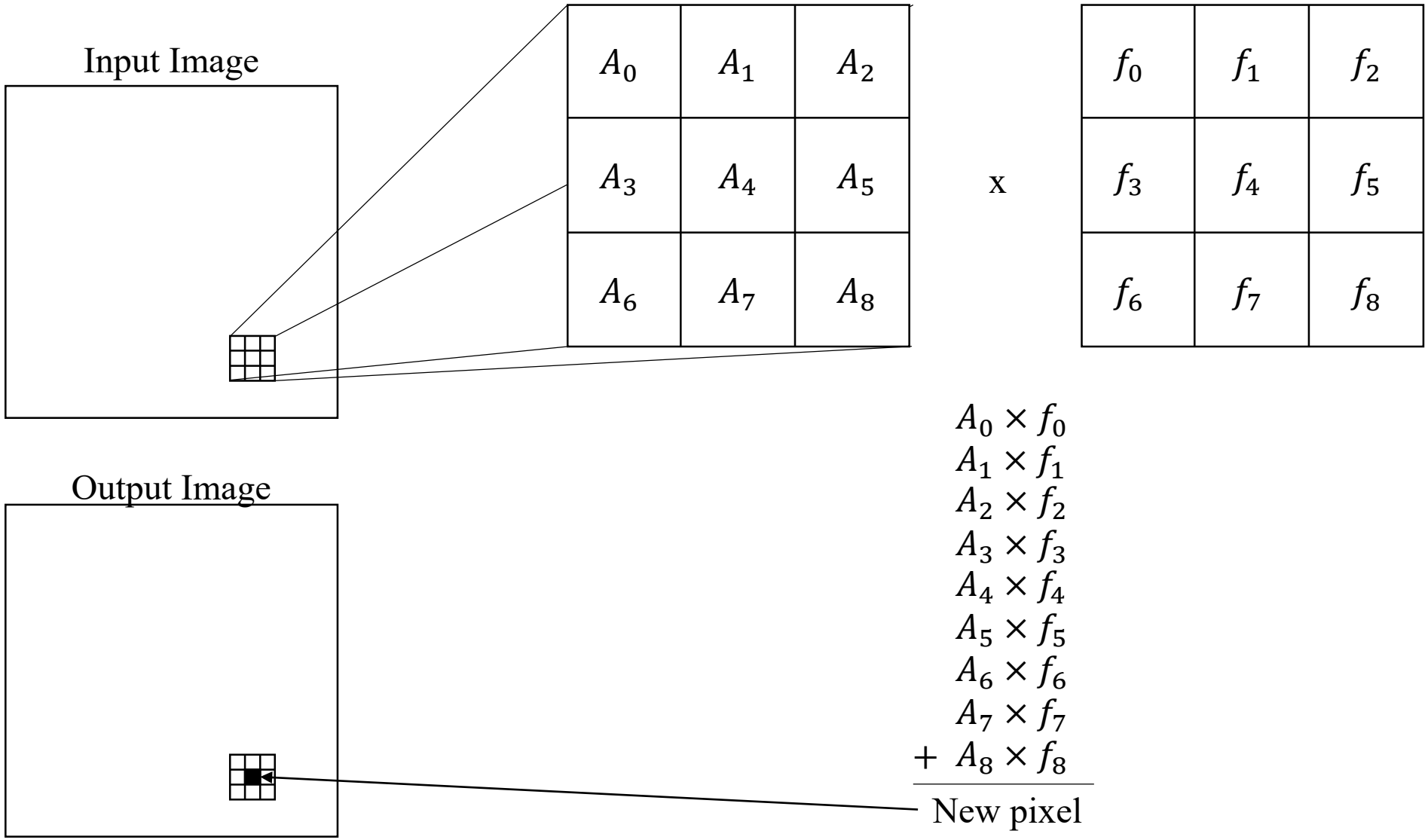
Window Operation

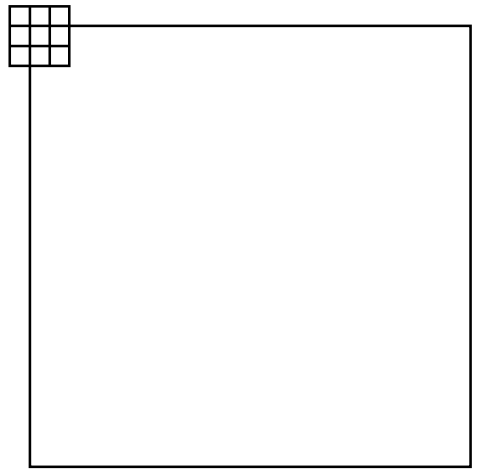
강석원

Convolution



Convolution

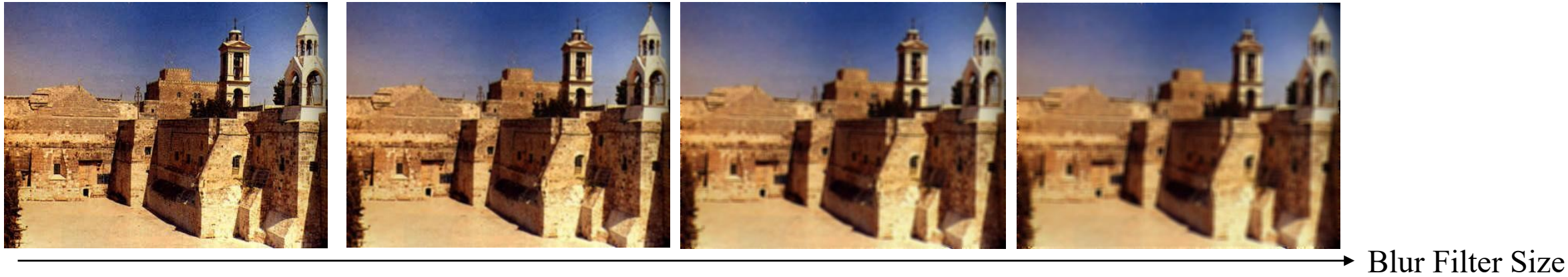
- Edge에서의 Convolution
  1. Zero Padding
  2. Edge의 pixel 복사 또는 Round
  3. (0, 0) 대신 (1,1)화소에서의 시작



Smoothing(Bluring)

- 목적
  - Noise 제거 및 윤곽선 제거

- 효과

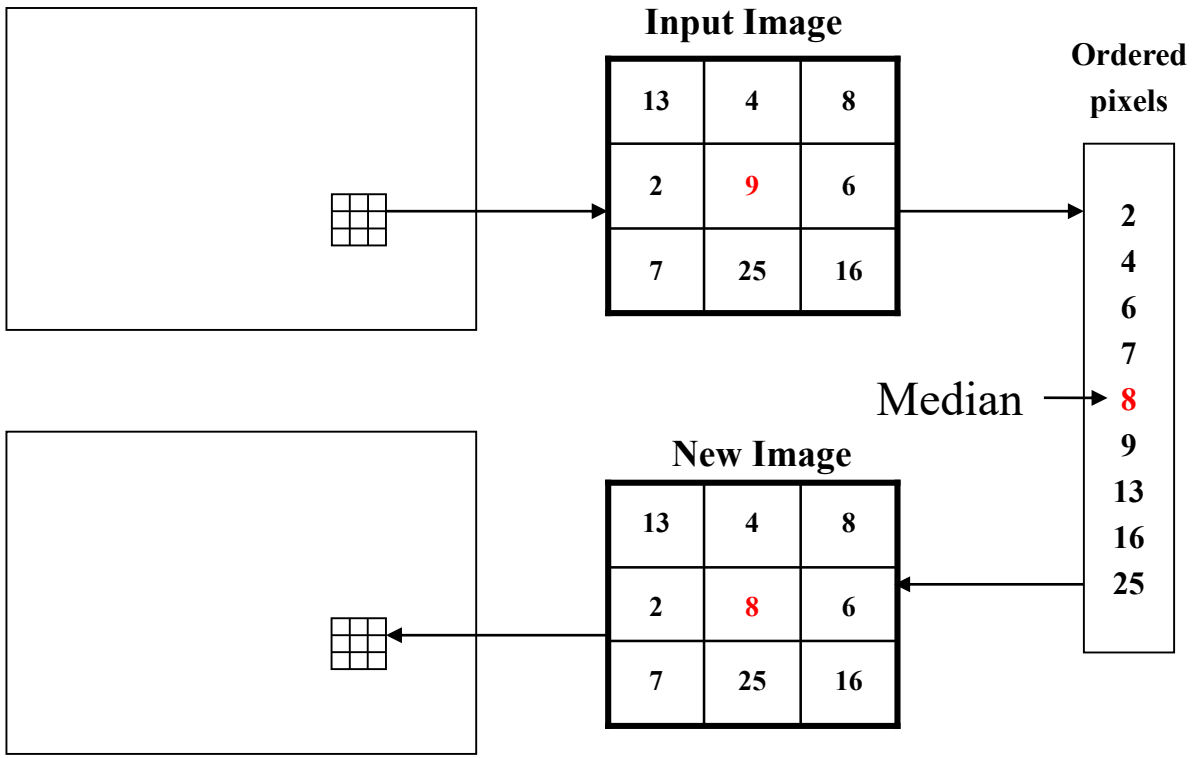


Smoothing(Bluring)

- Mean Filter $\frac{1}{9}\begin{bmatrix}1 & 1 & 1\\ 1 & 1 & 1\\ 1 & 1 & 1\end{bmatrix}$ $\frac{1}{10}\begin{bmatrix}1 & 1 & 1\\ 1 & 2 & 1\\ 1 & 1 & 1\end{bmatrix}$ $\frac{1}{4}\begin{bmatrix}0 & 1 & 0\\ 1 & 0 & 1\\ 0 & 1 & 0\end{bmatrix}$
- Gaussian Filter $\frac{1}{16}\begin{bmatrix}1 & 2 & 1\\ 2 & 4 & 2\\ 1 & 2 & 1\end{bmatrix}$

Smoothing(Bluring)

- Median Filtering



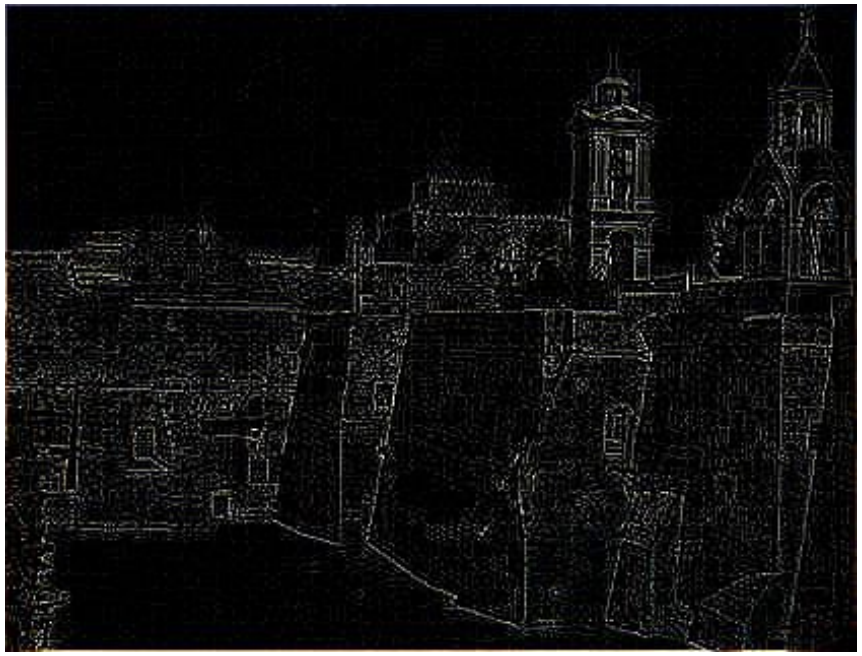
Original image
(Noise Added)

Median Filter(3x3)

Median Filter(5x5)

Median Filter(9x9)

Edge Detection



Edge Detection

- Gradient Filter

$$G[f(x,y)] = \begin{bmatrix} \frac{\partial f(x,y)}{\partial x} \\ \frac{\partial f(x,y)}{\partial y} \end{bmatrix}$$

$$\frac{\partial f(x,y)}{\partial x} \cong \frac{f(x,y) - f(x+1,y)}{\Delta x} = \frac{f(x,y) - f(x+1,y)}{1} = f(x,y) - f(x+1,y)$$

$$\frac{\partial f(x,y)}{\partial y} \cong \frac{f(x,y) - f(x,y+1)}{\Delta y} = \frac{f(x,y) - f(x,y+1)}{1} = f(x,y) - f(x,y+1)$$

$$\frac{\partial f(x,y)}{\partial x} \cong f(x,y) - f(x+1,y) \Rightarrow \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & -1 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\frac{\partial f(x,y)}{\partial y} \cong f(x,y) - f(x,y+1) \Rightarrow \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & -1 & 0 \end{bmatrix}$$

$$\frac{\partial f(x,y)}{\partial x} \cong f(x+1,y) - f(x-1,y) \Rightarrow \begin{bmatrix} 0 & 0 & 0 \\ -1 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\frac{\partial f(x,y)}{\partial y} \cong f(x,y+1) - f(x,y-1) \Rightarrow \begin{bmatrix} 0 & -1 & 0 \\ 0 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

Edge Detection

- Roberts Operator

$$\frac{\partial f(x,y)}{\partial x} \cong f(x,y) - f(x+1,y+1) \Rightarrow \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

$$\frac{\partial f(x,y)}{\partial y} \cong f(x+1,y) - f(x,y+1) \Rightarrow \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & -1 & 0 \end{bmatrix}$$

Edge Detection

- Sobel Operator

$$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} \quad \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

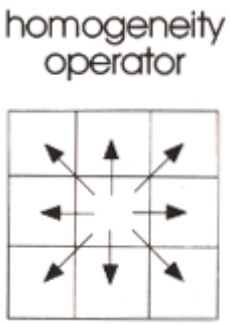
- Prewitt Operator

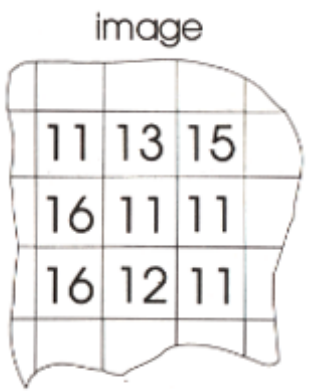
$$\begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix} \quad \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix}$$

- Frei-Chen Operator

$$\begin{bmatrix} -1 & 0 & 1 \\ -\sqrt{2} & 0 & \sqrt{2} \\ -1 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & \sqrt{2} & 1 \\ 0 & 0 & 0 \\ -1 & -\sqrt{2} & -1 \end{bmatrix}$$

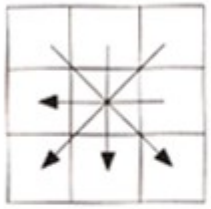
Edge Detection

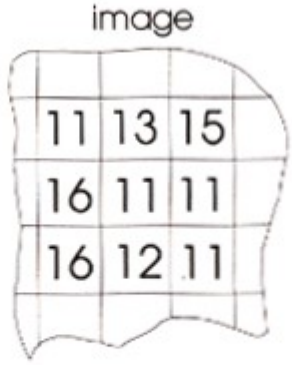




new pixel = maximum of { |11-11| |11-13| |11-15|
|11-16| |11-11|
|11-16| |11-12| |11-11| } =

유사 연산자의 수행 방법





new pixel = maximum of { |11-11| |13-12| |15-16| |11-16| } = 5

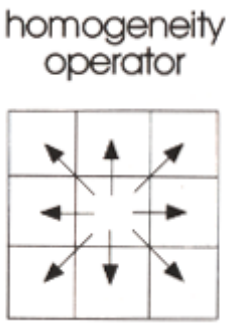
차연산자의 수행 방법

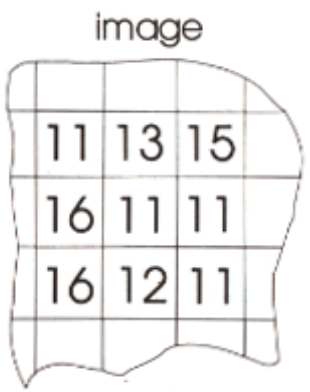
Edge Detection

- Laplace Operator

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix} \qquad \begin{bmatrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

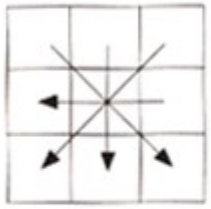
Edge Detection

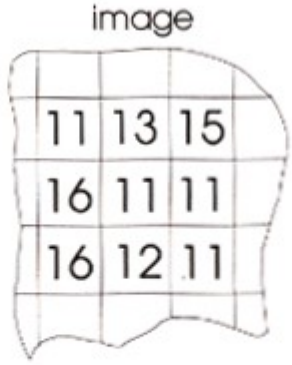




new pixel = maximum of { |11-11| |11-13| |11-15|
|11-16| |11-11|
|11-16| |11-12| |11-11| } =

유사 연산자의 수행 방법





new pixel = maximum of { |11-11| |13-12| |15-16| |11-16| } = 5

차연산자의 수행 방법