19CSE367 Digital Image Processing

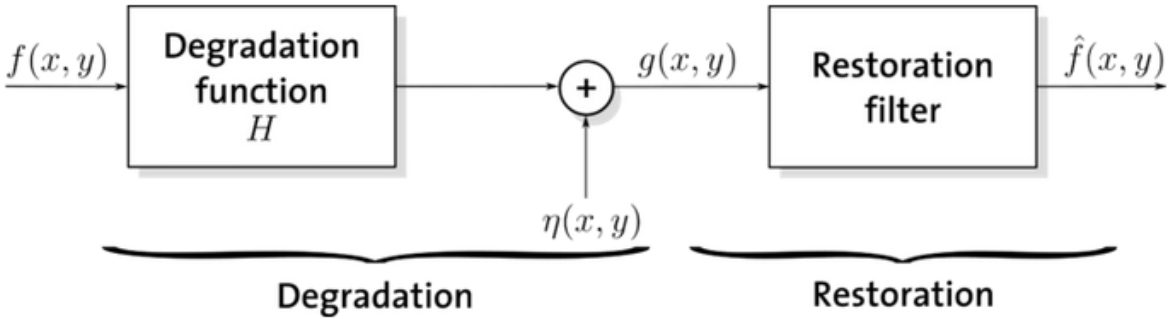
SARATH TV

Last lecture

- Image Transforms
- FT on images
- High pass and low pass filtering in frequency domain.

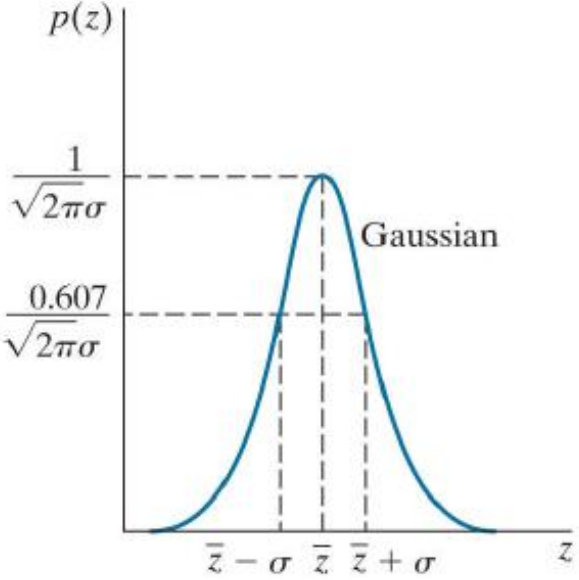
Image restoration

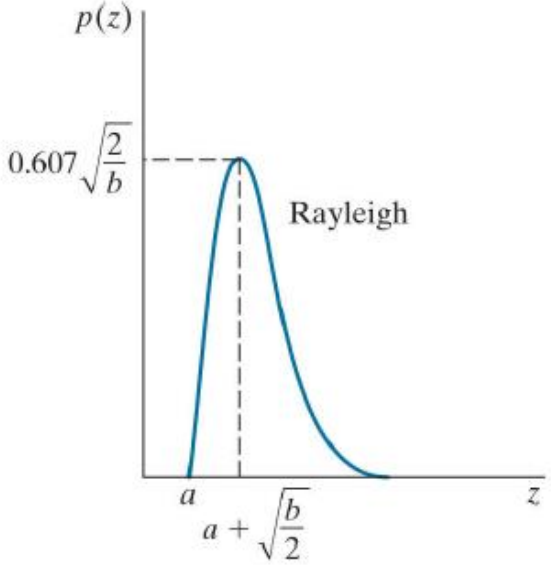
- Restoration-improve an image in some predefined sense.
- Image enhancement –Subjective
- Image restoration – Objective process
- Knowledge of the degradation process.
- Model the degradation and apply inverse process & recover original image

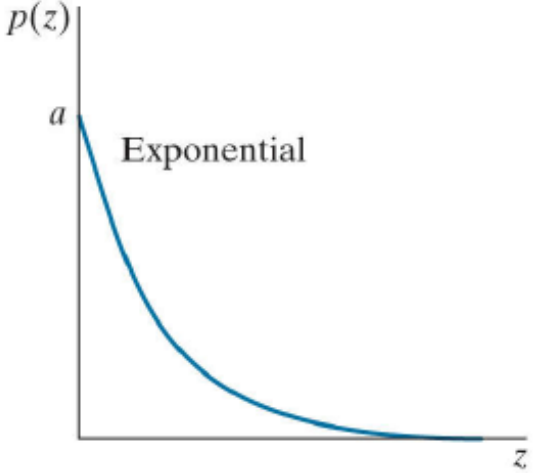


Noise Models

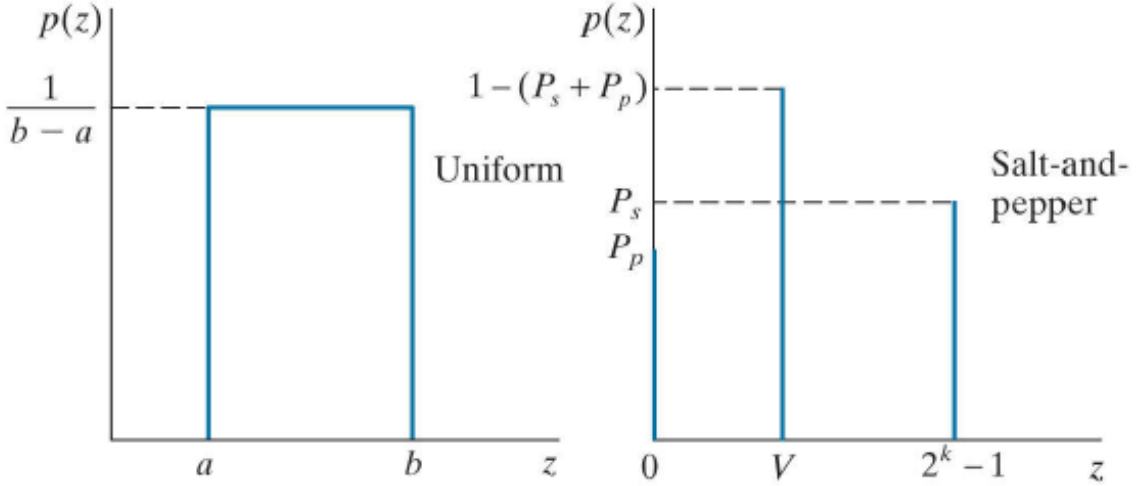
- Noise in images-image acquisition and/or transmission.
- Spatial & frequency characteristics of noise.
- Various noise probability density functions.
  - Gaussian
  - Uniform
  - Salt and pepper noise
- Noise component –same size as the input image.
- Array with intensity values –random numbers with a specified density function.



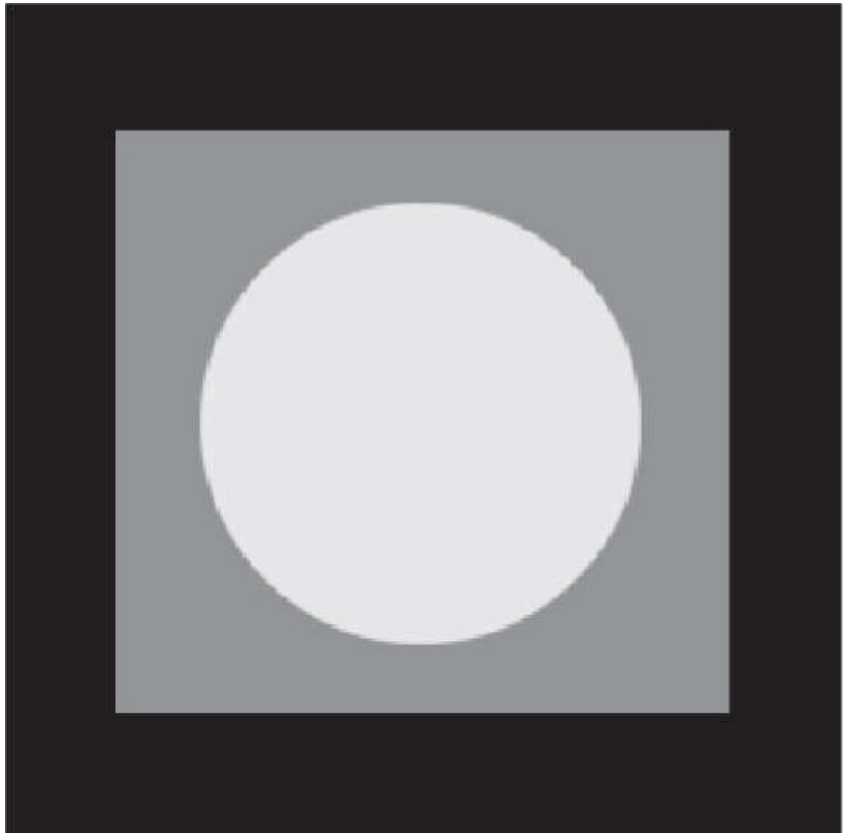




$$p(z) = \frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{(z-\bar{z})^2}{2\sigma^2}} \qquad -\infty < z < \infty$$



$$p(z) = \begin{cases} P_s & \text{for } z = 2^k - 1 \\ P_p & \text{for } z = 0 \\ 1 - (P_s + P_p) & \text{for } z = V \end{cases}$$



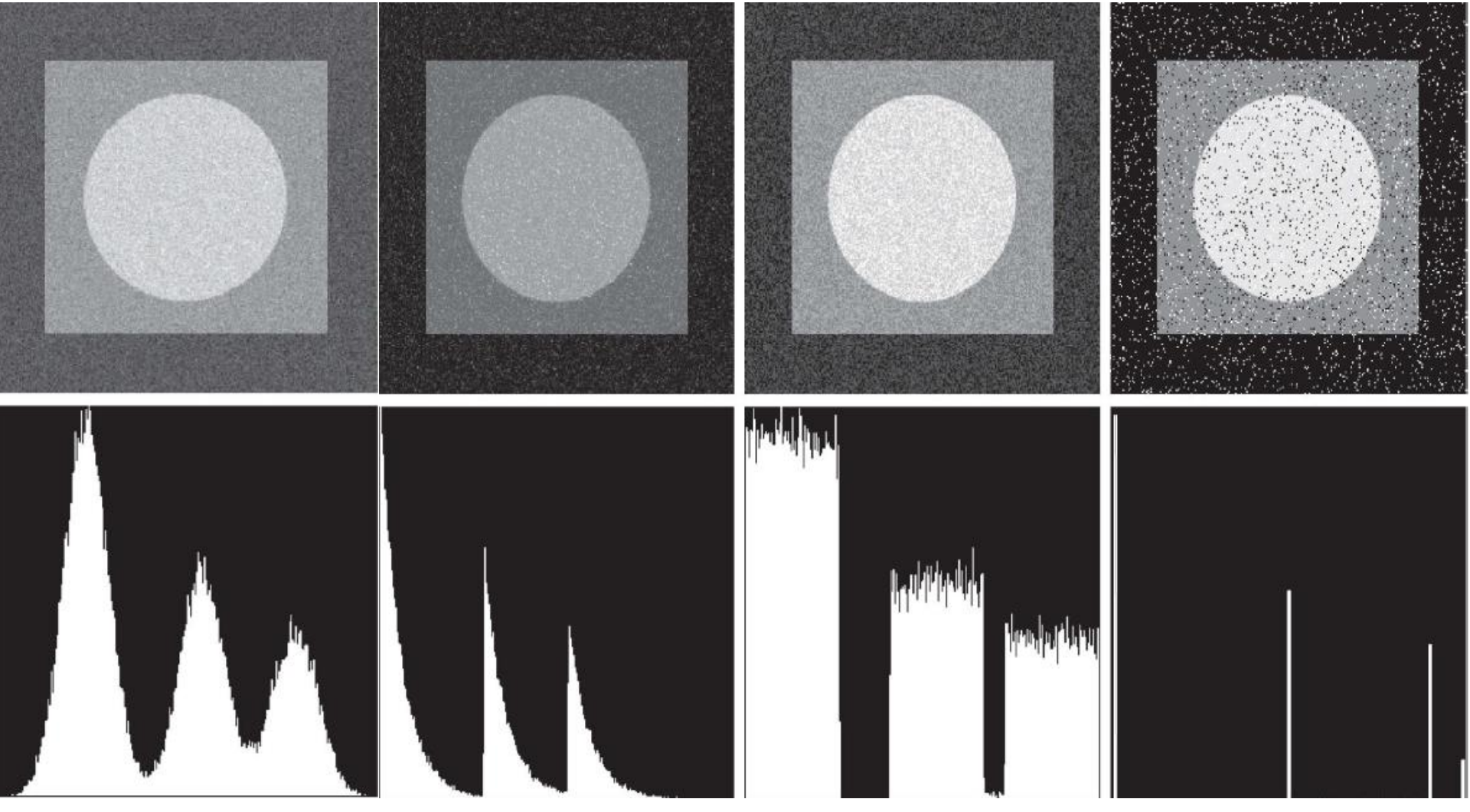


Image denoising

- When an image is degraded only by additive noise

$$g(x,y) = f(x,y) + \eta(x,y)$$

$$G(u,v) = F(u,v) + N(u,v)$$

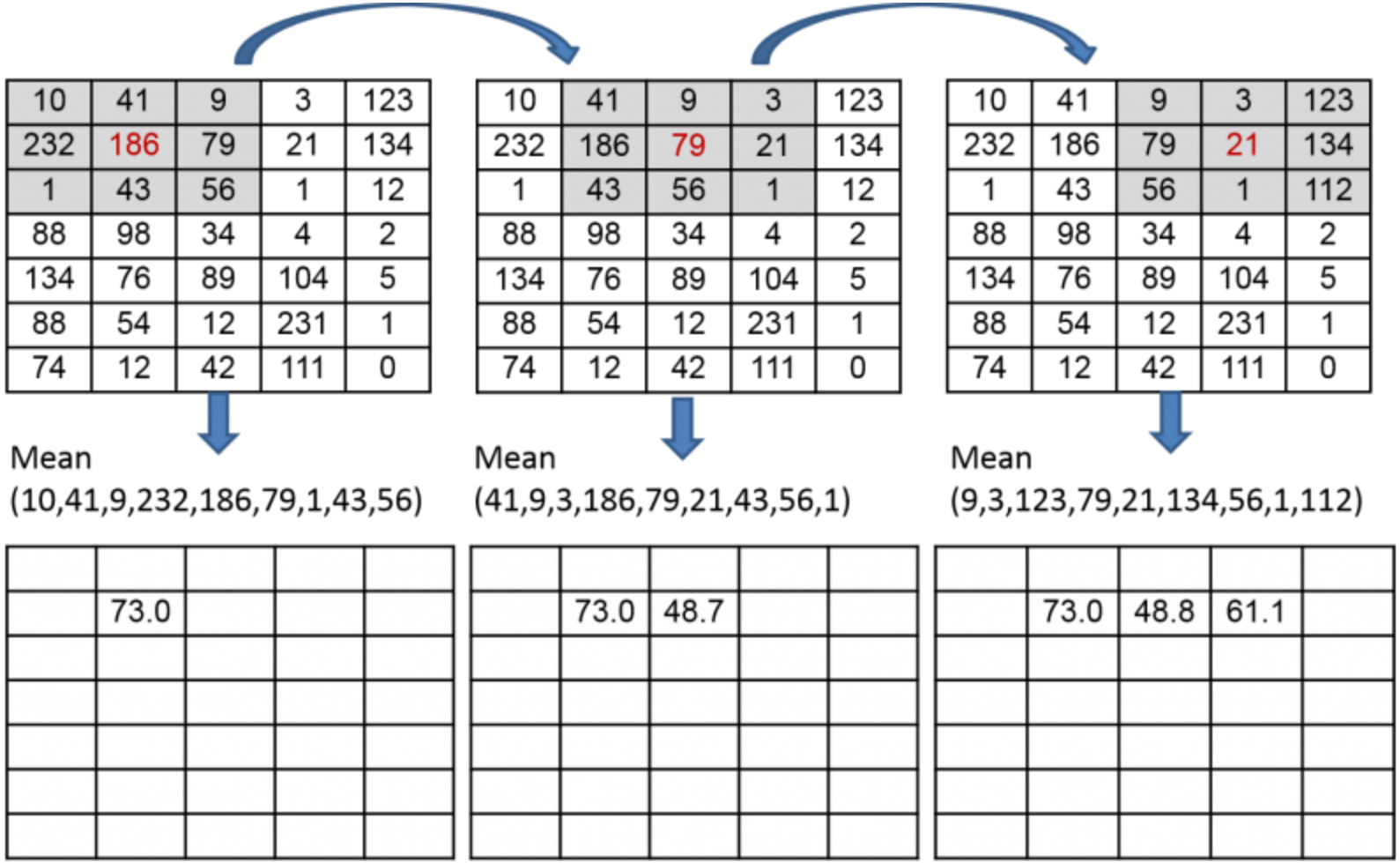
- The noise terms generally are unknown,
- Spatial filtering is the method of choice for estimating *f*(*x*, *y*) [i.e., *denoising* image *g*(*x*, *y*)] in situations when only additive random noise is present.

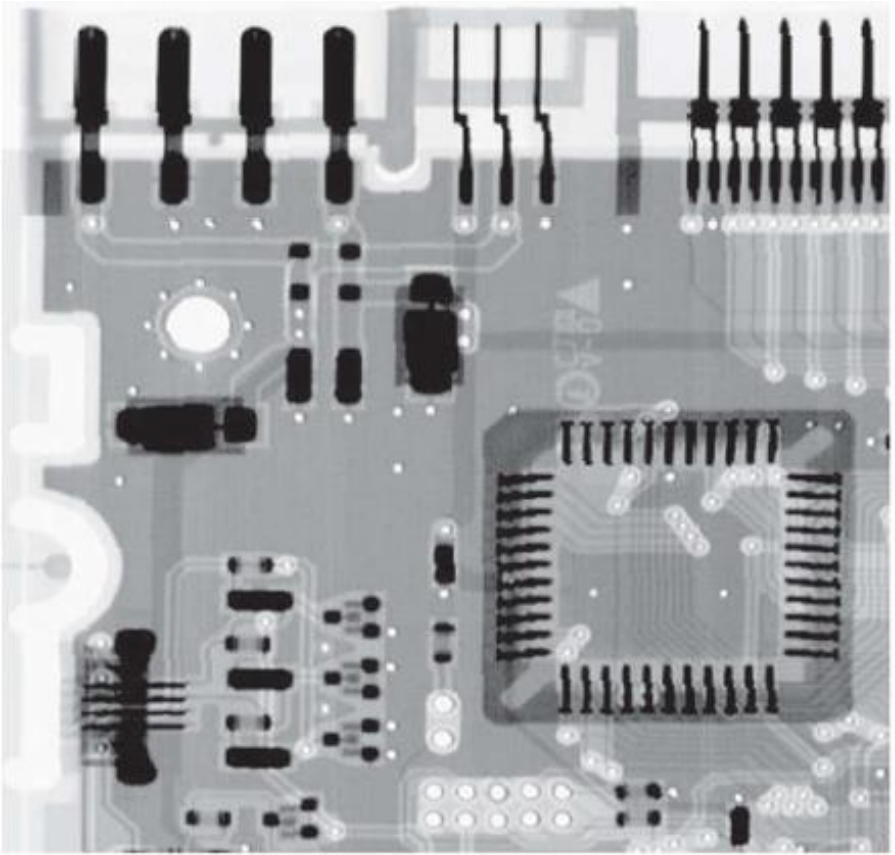
Mean Filters-Arithmetic Mean Filter

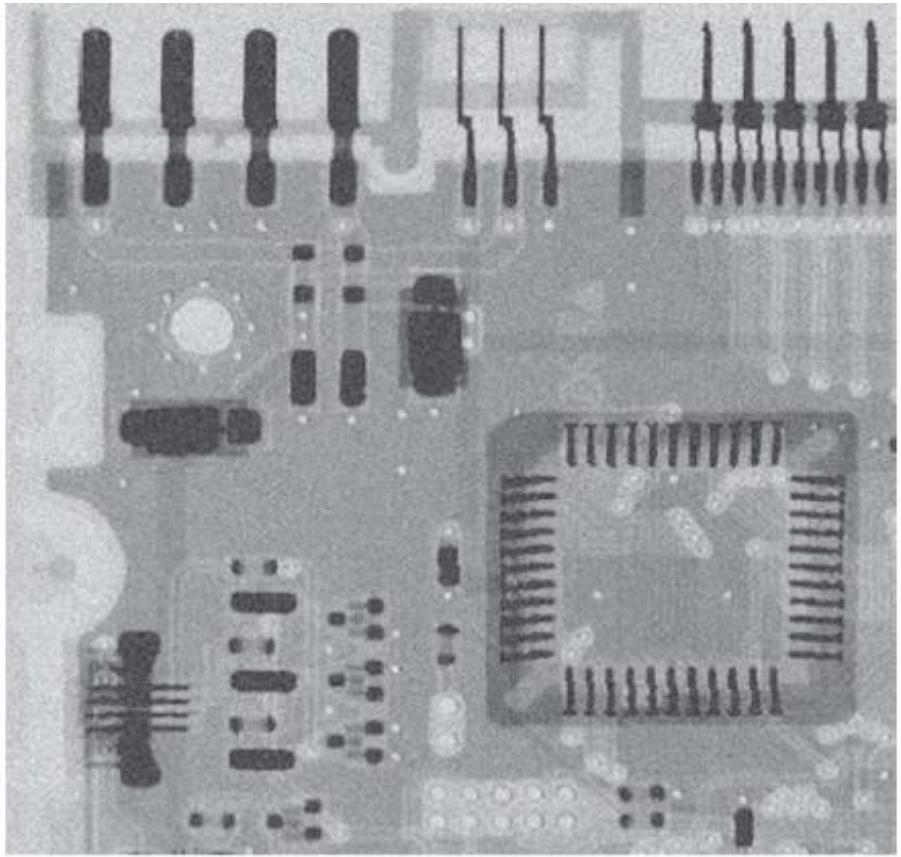
- The arithmetic mean filter is the simplest of the mean filters -same as the box filter.
- S_{xy} s

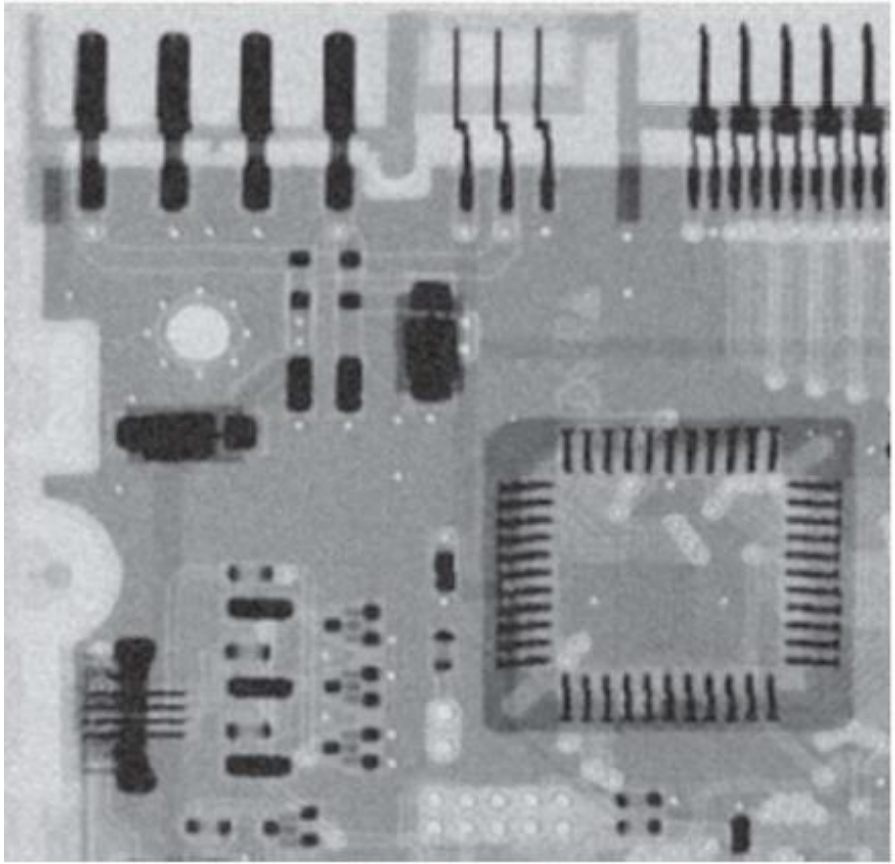
$$\hat{f}(x,y) = \frac{1}{mn} \sum_{(r,c) \in S_{xy}} g(r,c)$$

- A mean filter smooths local variations in an image,
- noise is reduced as a result of blurring.


10 41 9 3 123
232 186 79 21 134
1 43 56 1 12
88 98 34 4 2
134 76 89 104 5
88 54 12 231 1
74 12 42 111 0
Mean
(10,41,9,232,186,79,1,43,56)
73.0
10 41 9 3 123
232 186 79 21 134
1 43 56 1 12
88 98 34 4 2
134 76 89 104 5
88 54 12 231 1
74 12 42 111 0
Mean
(41,9,3,186,79,21,43,56,1)
73.0 48.7
10 41 9 3 123
232 186 79 21 134
1 43 56 1 12
88 98 34 4 2
134 76 89 104 5
88 54 12 231 1
74 12 42 111 0
Mean
(9,3,123,79,21,134,56,1,112)
73.0 48.8 61.1








THANKYOU!