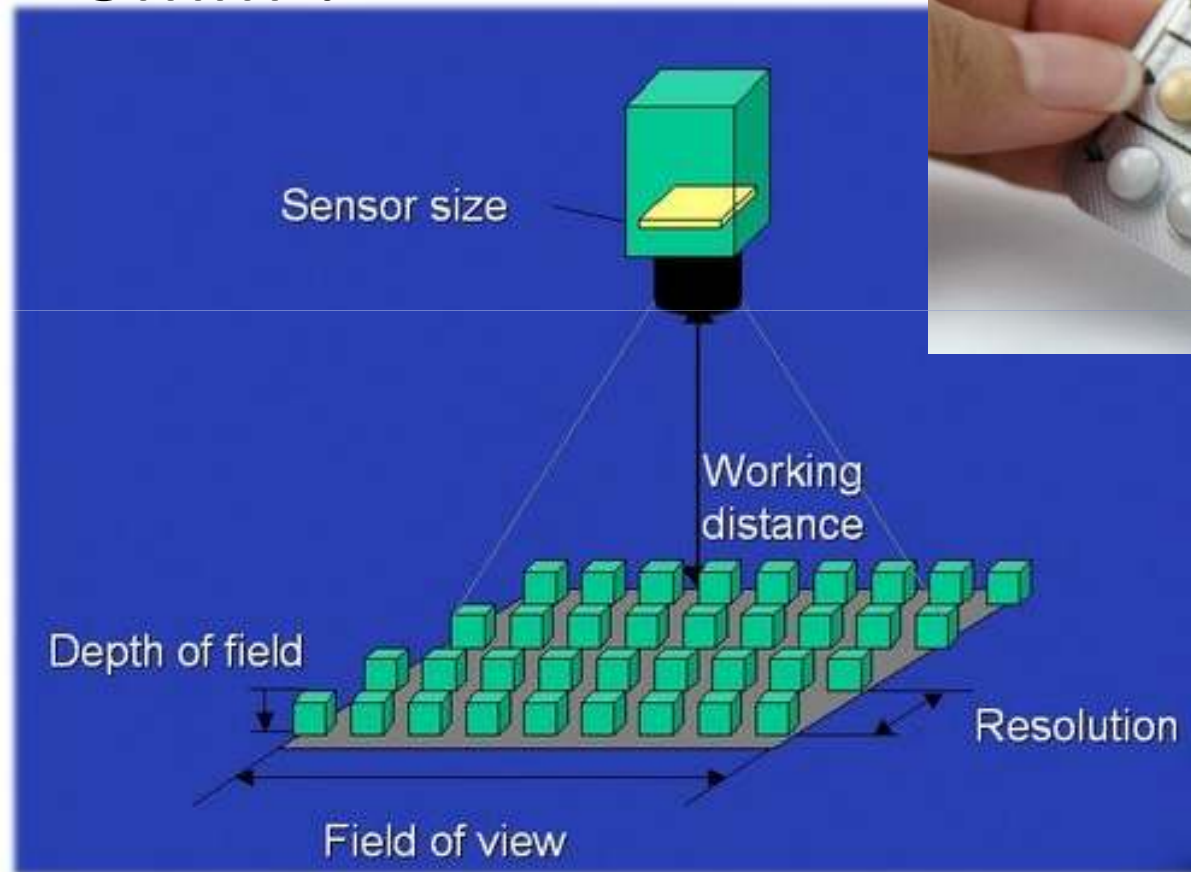


Calculate minimum spatial resolution for a camera to detect pills with a diameter of 5mm ?



Working Distance=1m  
Focal Distance=50mm  
Sensor size=35mm  
Diameter of pills=5mm  
Minimum Spatial  
Resolution of camera?

# Spatial/Intensity Resolution: How much is enough?



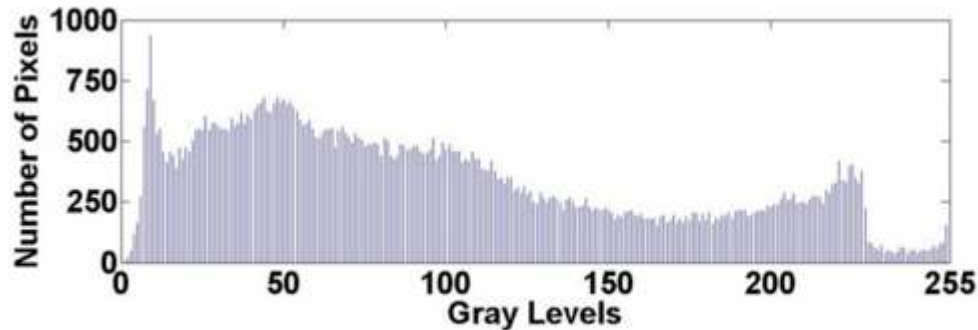
Saturation: Highest intensity level above which color is washed out.



Noise: Grainy texture patterns

# Histogram

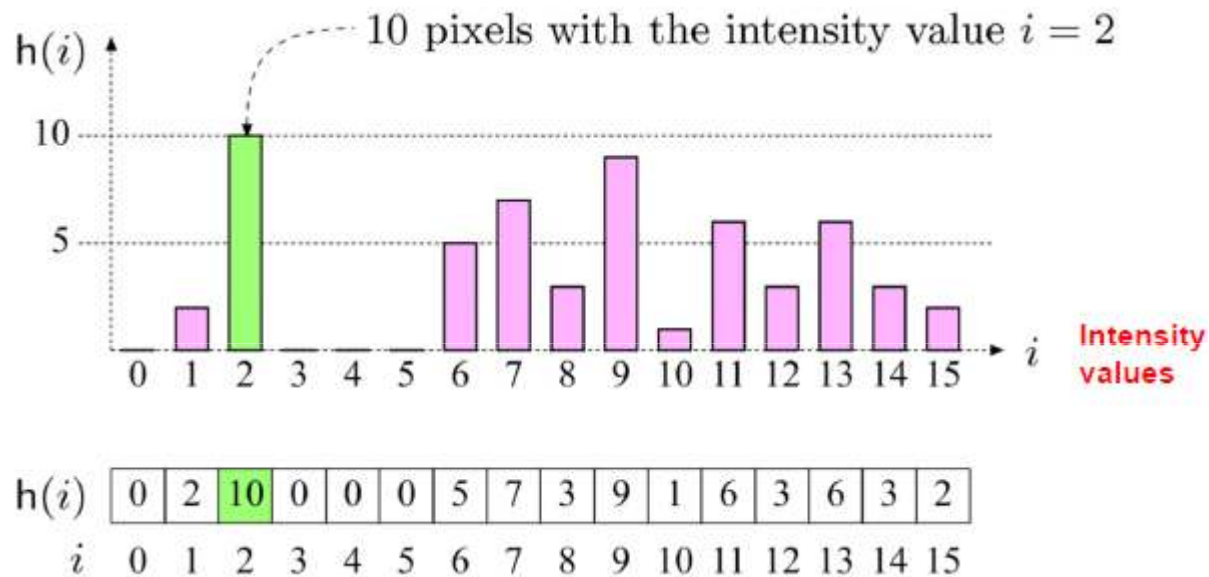
- Histogram plots how many times each intensity value appears in image.



(a)



# Histograms



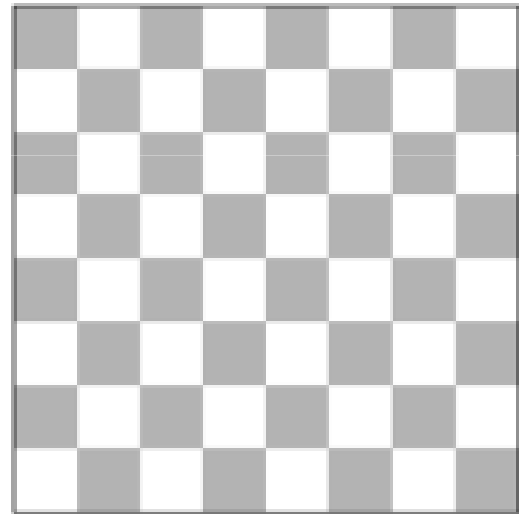
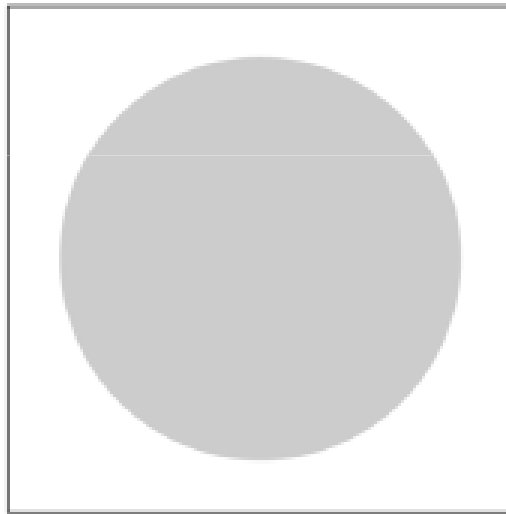
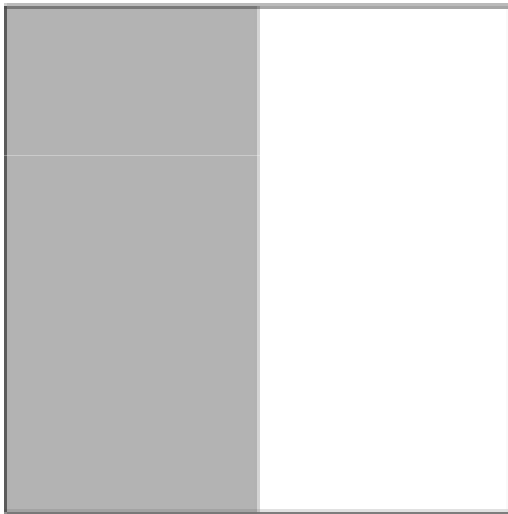
$$h(i) = \text{card}\{(u, v) \mid I(u, v) = i\}$$

Number (size of set) of pixels
such that

Histograms contain only statistical information and no indication of location of pixels.

# Histogram

- Different images can have same histogram

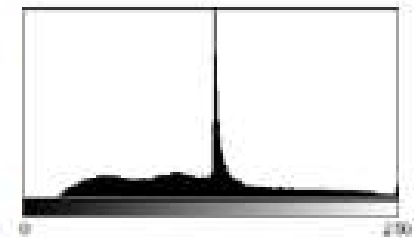


# Color Histogram

- Two types:
  - Intensity Histograms:  
Convert color images to gray scale.  
Display histogram of grayscale.
  - Individual Color Channel Histograms:  
3 histograms(R,G,B)



(a)



(b)  $h_{Lum}$



(c) R



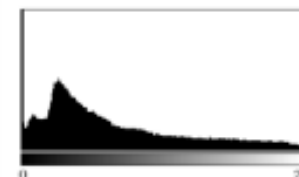
(d) G



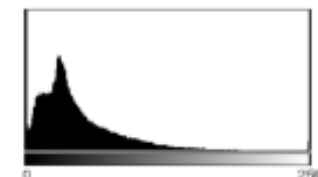
(e) B



(f)  $h_R$



(g)  $h_G$



(h)  $h_B$

# Histogram

- Histograms help to detect image acquisition issues.
- Problems with images can be detected on histograms.
  - Over and under exposure
  - Brightness
  - Contrast

Point operation can be used to alter histograms.

- Addition
- Multiplication
- Exp and Log functions