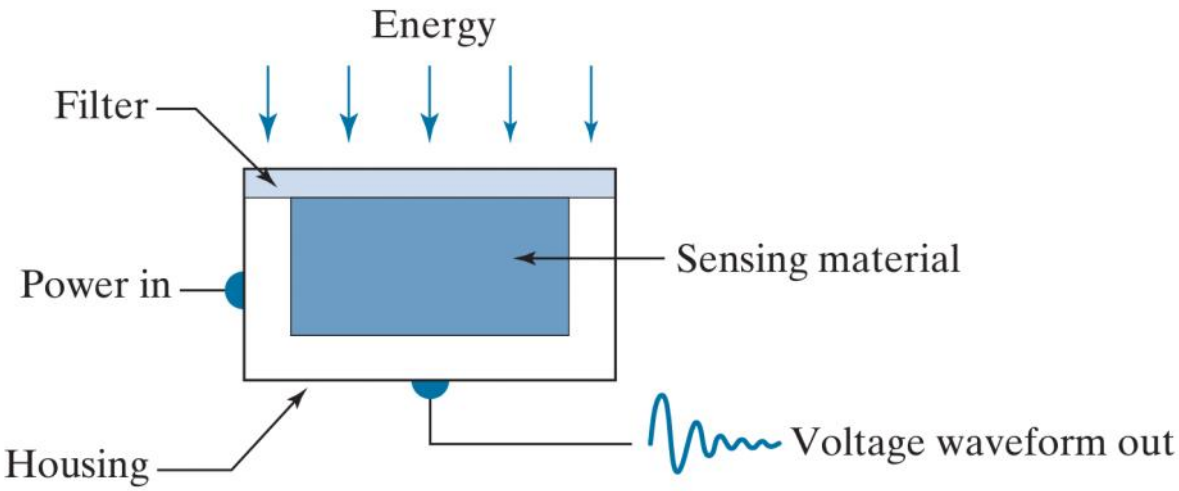
Digital Image Fundamentals (17/01/24) Lecture-2

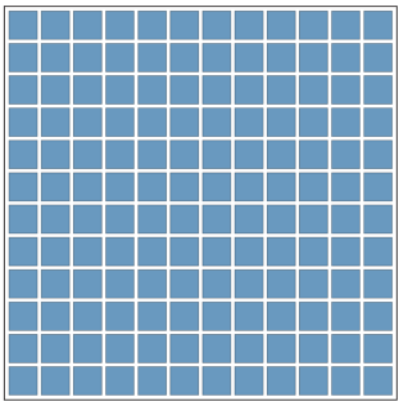
16 January 2024 18:13

Source: Digital Image Processing, 4e, Rafael C. Gonzalez, Richard E. Woods

1. Image Sensing and Acquisition

Using Sensors: Input to the sensor is light intensity and the output is voltage.





2. Image Sampling and Quantization

Images are denoted as a two-dimensional function

$f(x,y)$

- x, y are the spatial coordinates

- Value of *f(x,y)* at each coordinate is a nonnegative and finite scalar quantity.

Hence, $0 \leq f(x,y) < \infty$

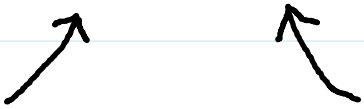
Components of *f(x,y)*:

1. Illumination (*i(x,y)*)
2. Reflectance (*r(x,y)*)

$$f(x,y) = i(x,y)r(x,y)$$

$$0 \leq i(x,y) < \infty$$

$$0 \leq r(x,y) \leq 1$$



Total absorption Total reflectance

Gray-scale Images:

Let the intensity of a monochrome image at *(x,y)* is *l.*

$$l = f(x,y)$$

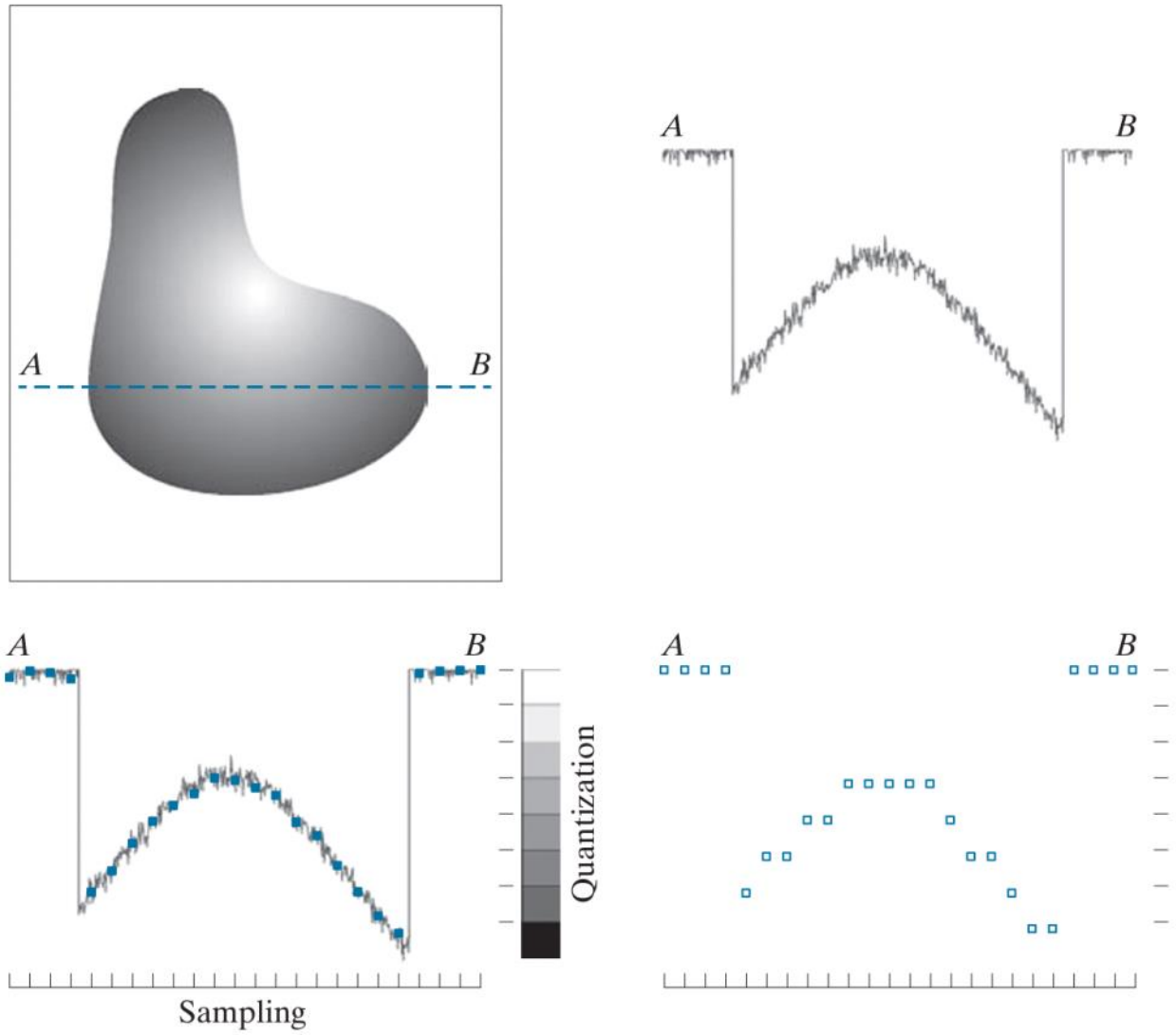
$$L_{min} \leq l \leq L_{max}$$

Intensity Scale: $[L_{min}, L_{max}]$

Digitizing is to sample the function in both coordinates and also in intensity.

Sampling: Digitizing the coordinate values.

Quantization: Digitizing the intensity values.



3. Representation of Digital Images

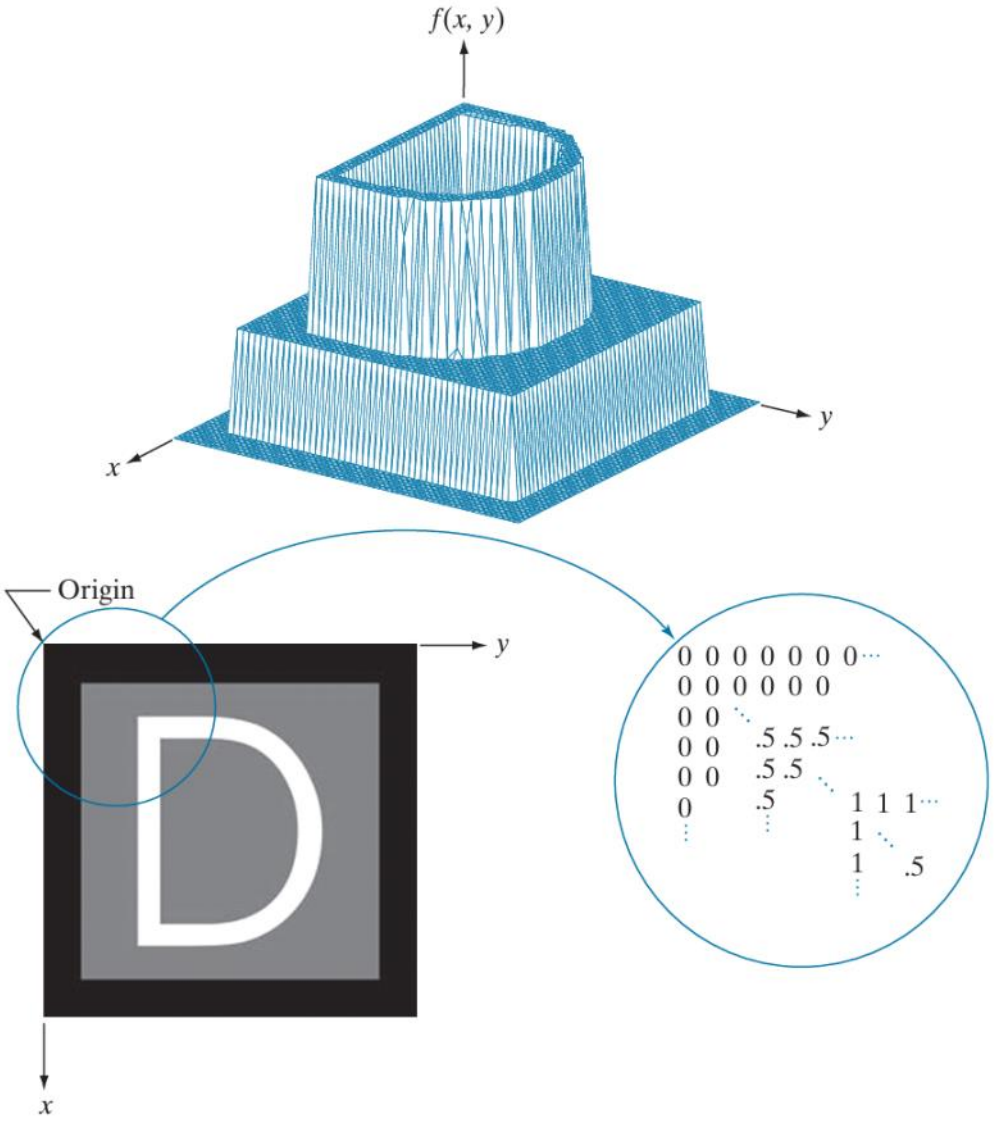
f (x ,y), containing M rows and N columns, integer values for these discrete coordinates: *x = 0, 1, 2, …… M-1* and *y = 0, 1, 2 , ……. N-1*

Spatial Domain, Spatial Coordinates

$$f(x,y)=\begin{bmatrix} f(0,0) & f(0,1) & \cdots & f(0,N-1) \\ f(1,0) & f(1,1) & \cdots & f(1,N-1) \\ \vdots & \vdots & & \vdots \\ f(M-1,0) & f(M-1,1) & \cdots & f(M-1,N-1) \end{bmatrix}$$

Matrix form:

$$\mathbf{A}=\begin{bmatrix} a_{0,0} & a_{0,1} & \cdots & a_{0,N-1} \\ a_{1,0} & a_{1,1} & \cdots & a_{1,N-1} \\ \vdots & \vdots & & \vdots \\ a_{M-1,0} & a_{M-1,1} & \cdots & a_{M-1,N-1} \end{bmatrix}$$


f(x, y)
x
y
Origin
y
x
0 0 0 0 0 0 0 ⋯
0 0 0 0 0 0 0
0 0 ⋱
0 0 .5 .5 .5 ⋯
0 0 .5 .5 ⋱
0 .5 1 1 1 ⋯
⋮ ⋮ 1 ⋱
1 .5
⋮