

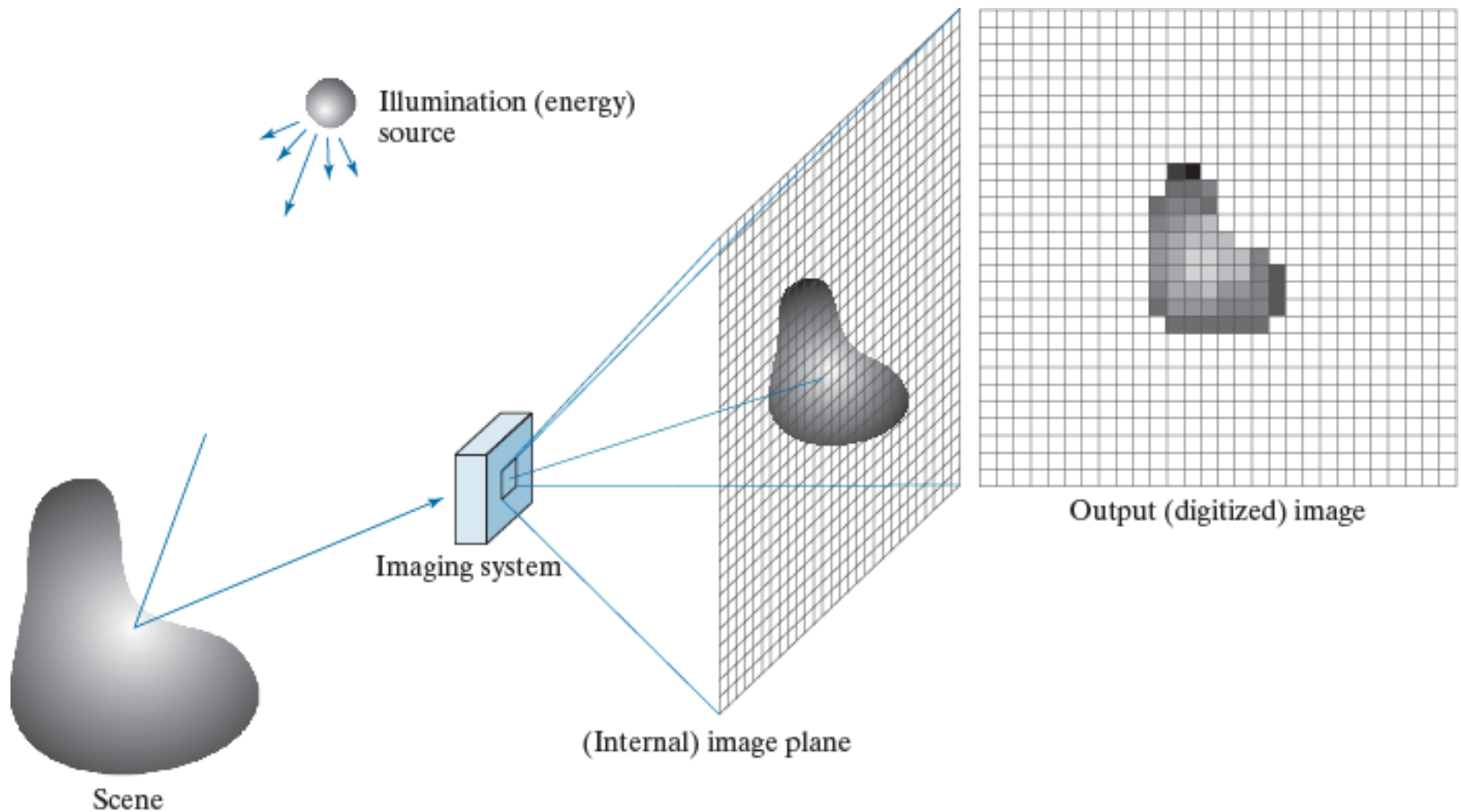
Image Acquisition, Geometric Transformations, and Image Interpolation

Image Processing

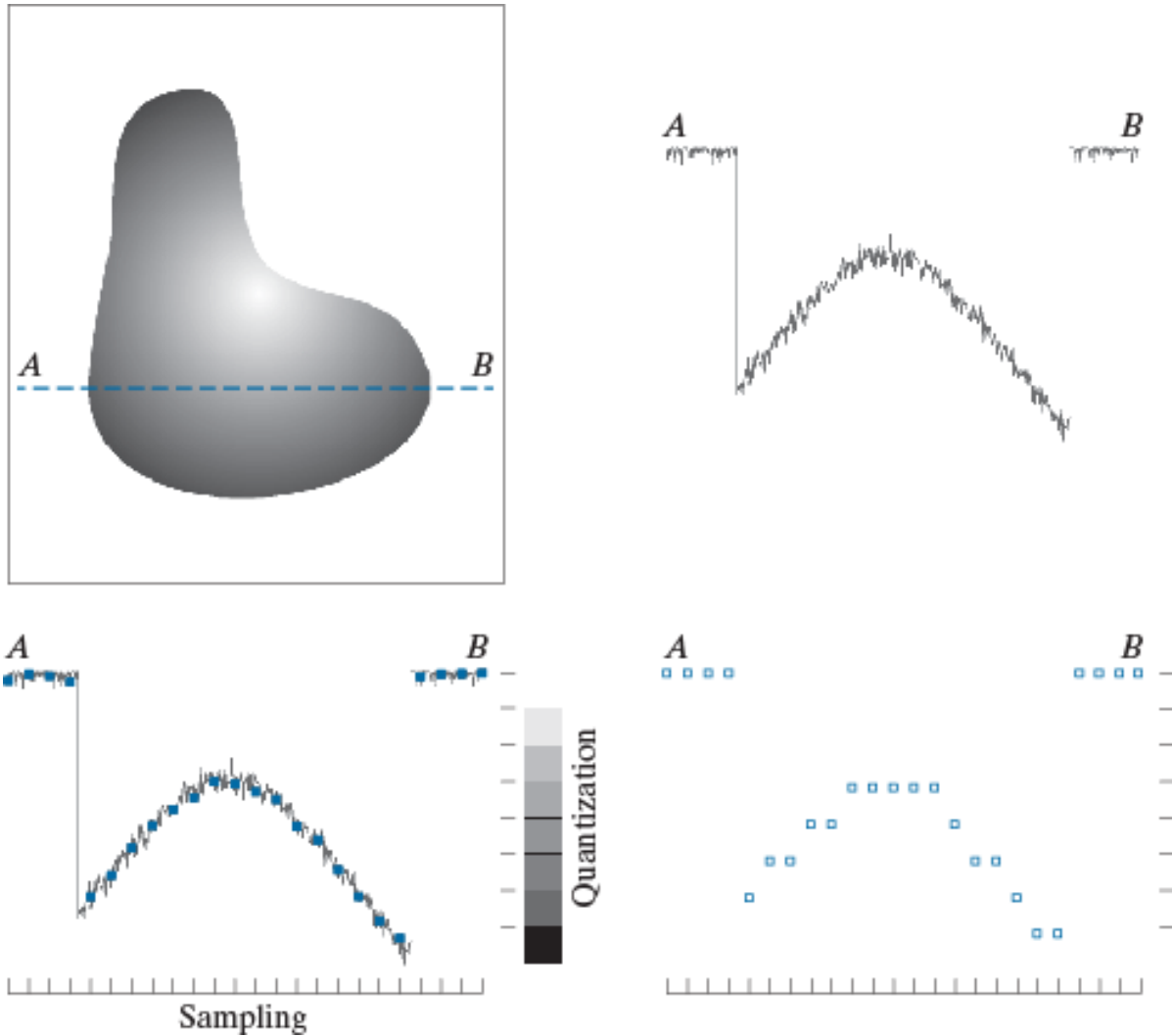
CSE 166

Lecture 2

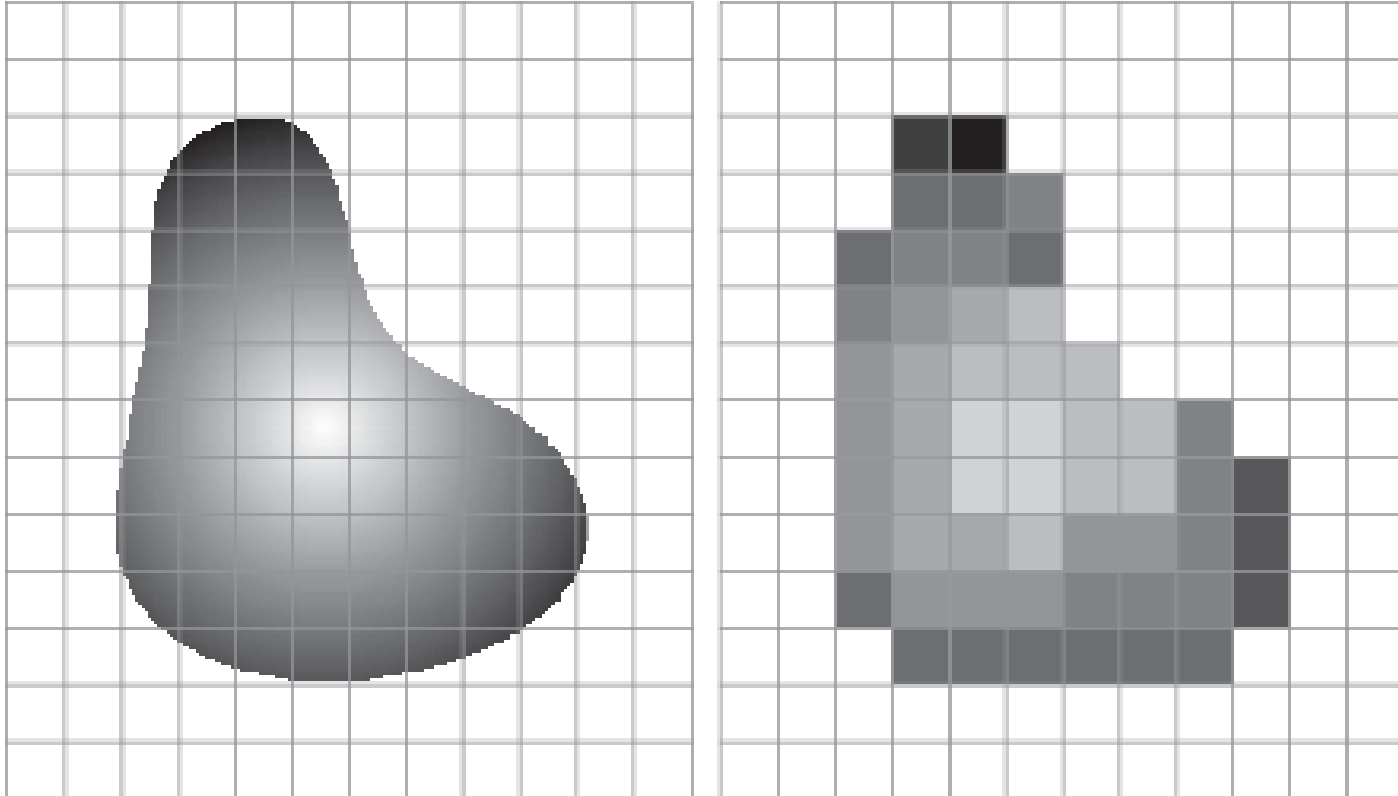
Image acquisition



Digitization, one row of image



Digitization, whole image



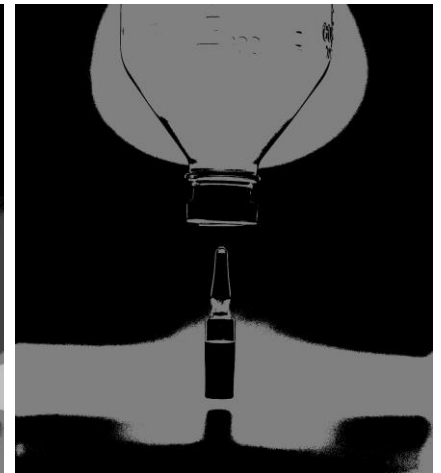
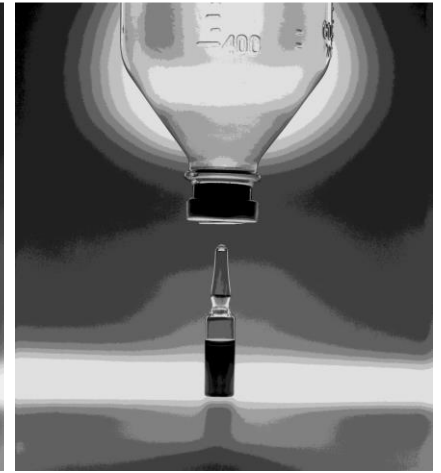
Number of quantization levels

256

128

16

8



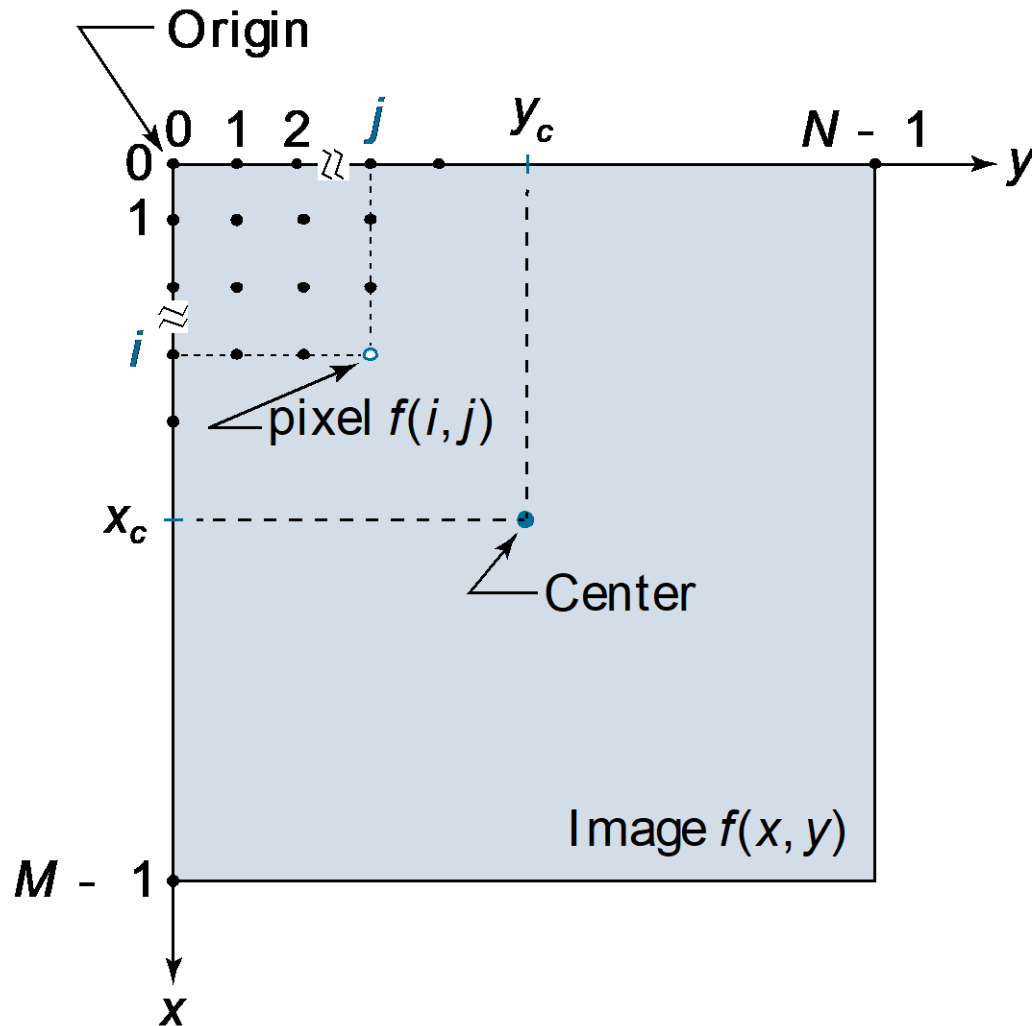
64

32

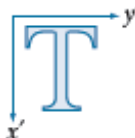
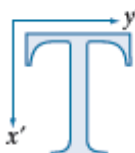
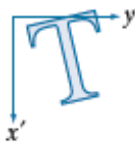
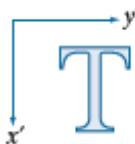
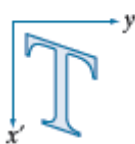
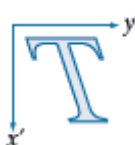
4

2

Image coordinates



Geometric transformations

| Transformation Name | Affine Matrix, A | Coordinate Equations | Example |
|---|--|--|---|
| Identity | $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ | $\begin{aligned} x' &= x \\ y' &= y \end{aligned}$ |  |
| Scaling/Reflection (For reflection, set one scaling factor to -1 and the other to 0) | $\begin{bmatrix} c_x & 0 & 0 \\ 0 & c_y & 0 \\ 0 & 0 & 1 \end{bmatrix}$ | $\begin{aligned} x' &= c_x x \\ y' &= c_y y \end{aligned}$ |  |
| Rotation (about the origin) | $\begin{bmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$ | $\begin{aligned} x' &= x \cos \theta - y \sin \theta \\ y' &= x \sin \theta + y \cos \theta \end{aligned}$ |  |
| Translation | $\begin{bmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \\ 0 & 0 & 1 \end{bmatrix}$ | $\begin{aligned} x' &= x + t_x \\ y' &= y + t_y \end{aligned}$ |  |
| Shear (vertical) | $\begin{bmatrix} 1 & s_v & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ | $\begin{aligned} x' &= x + s_v y \\ y' &= y \end{aligned}$ |  |
| Shear (horizontal) | $\begin{bmatrix} 1 & 0 & 0 \\ s_h & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ | $\begin{aligned} x' &= x \\ y' &= s_h x + y \end{aligned}$ |  |

Transformation with interpolation

