ECE 468 / CS 519:
Digital Image Processing

Image Elements

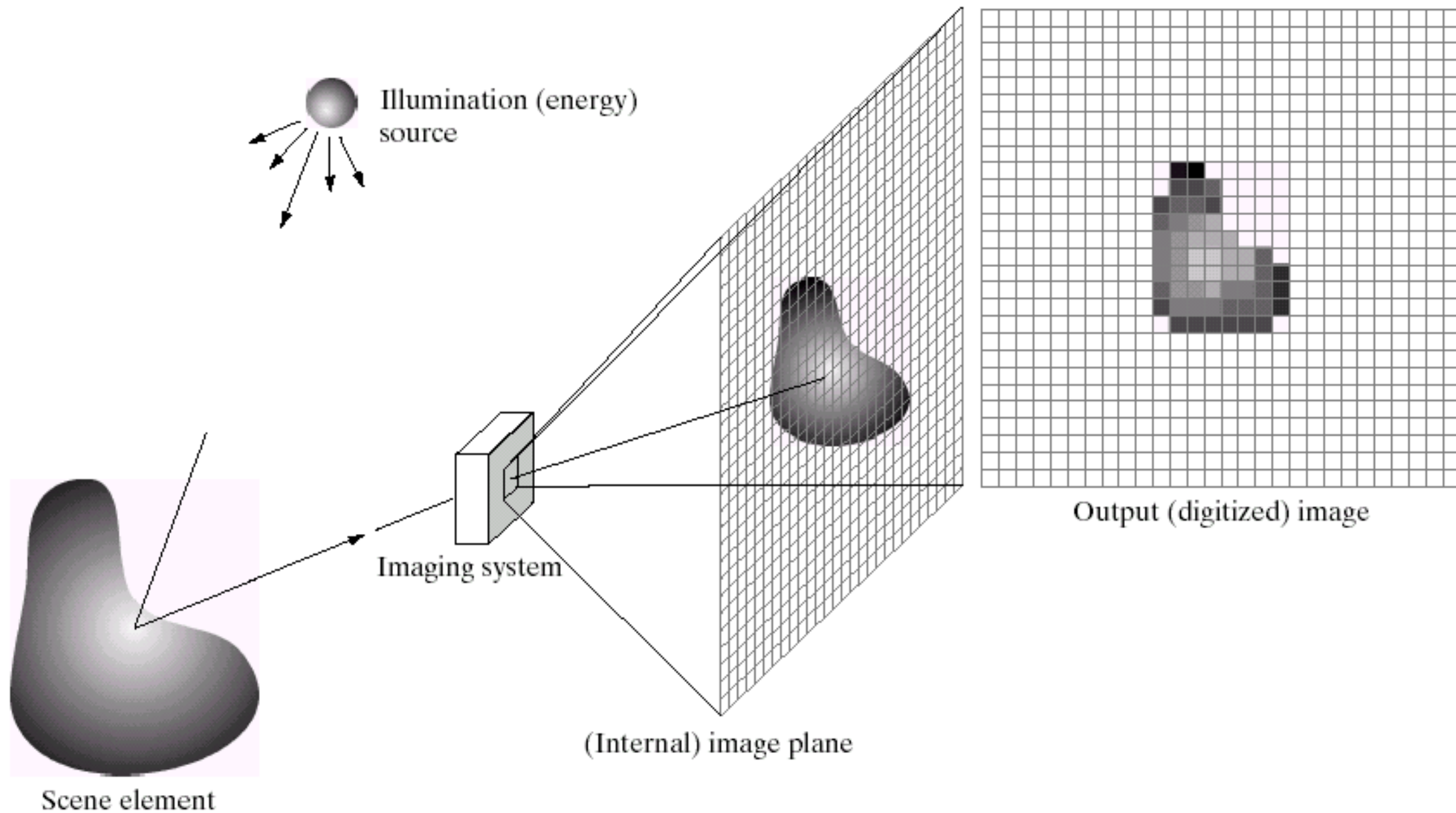## Prof. Sinisa Todorovic

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Outline

- Image acquisition

- Image elements

- Matlab

Image Sampling and Quantization

Illumination (energy) source

Imaging system

(Internal) image plane

Output (digitized) image
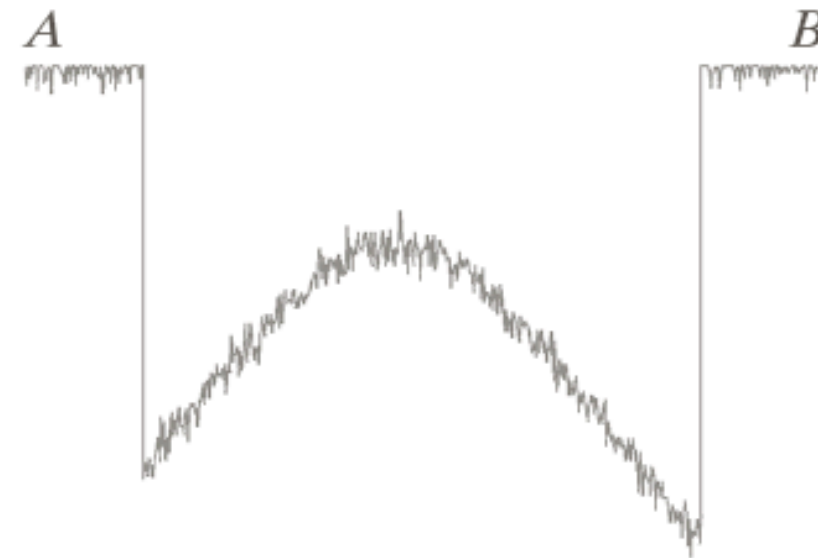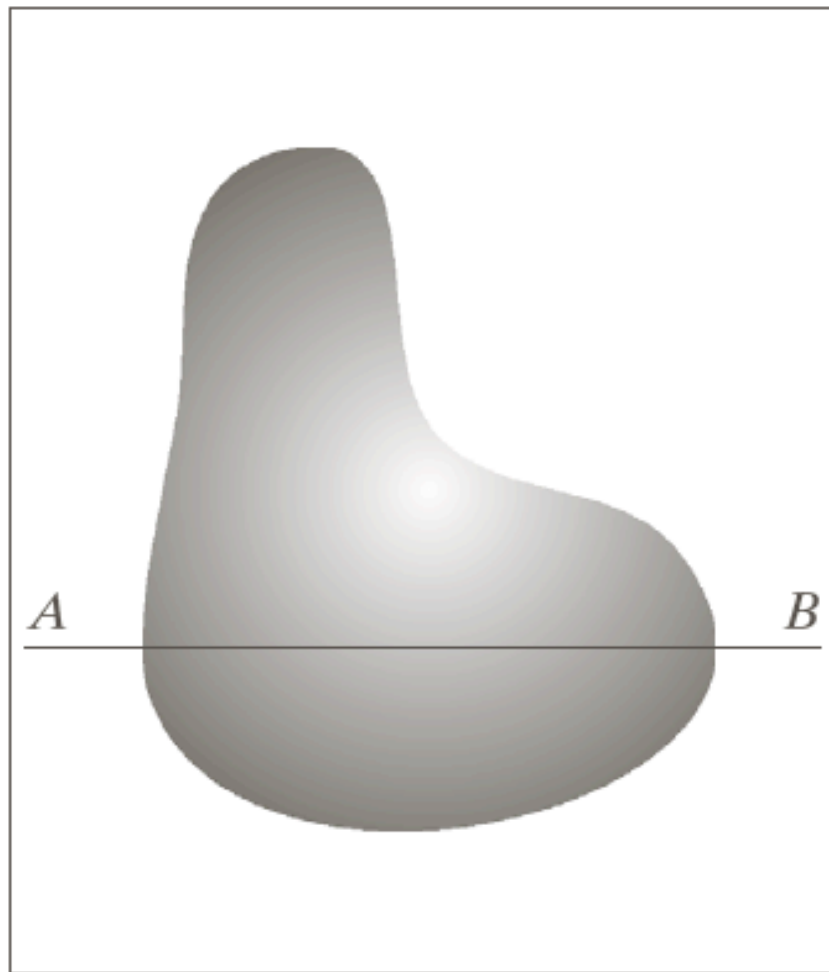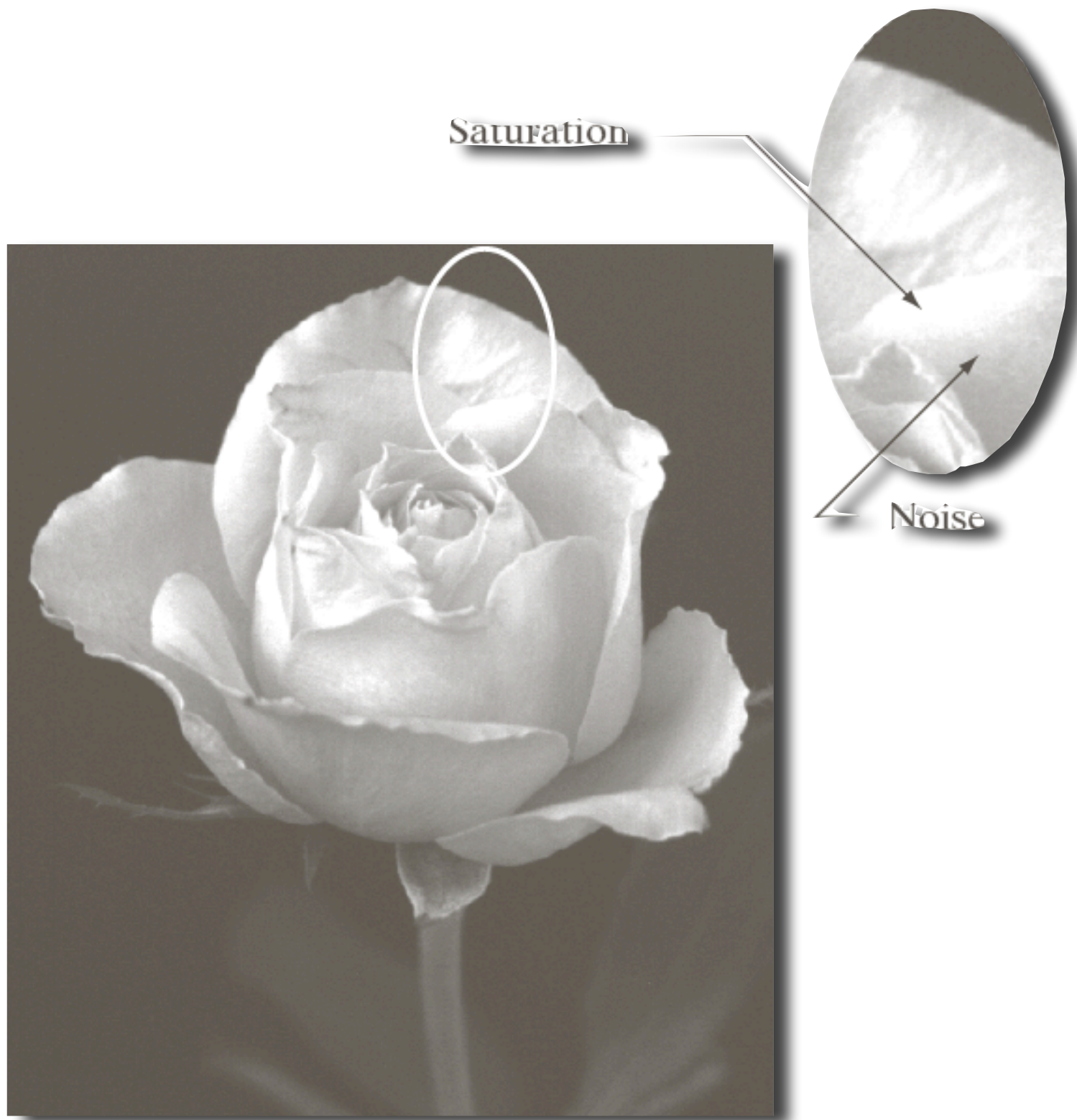
Scene element

a
b c d e

FIGURE 2.15 An example of the digital image acquisition process. (a) Energy ("illumination") source. (b) An element of a scene. (c) Imaging system. (d) Projection of the scene onto the image plane. (e) Digitized image.
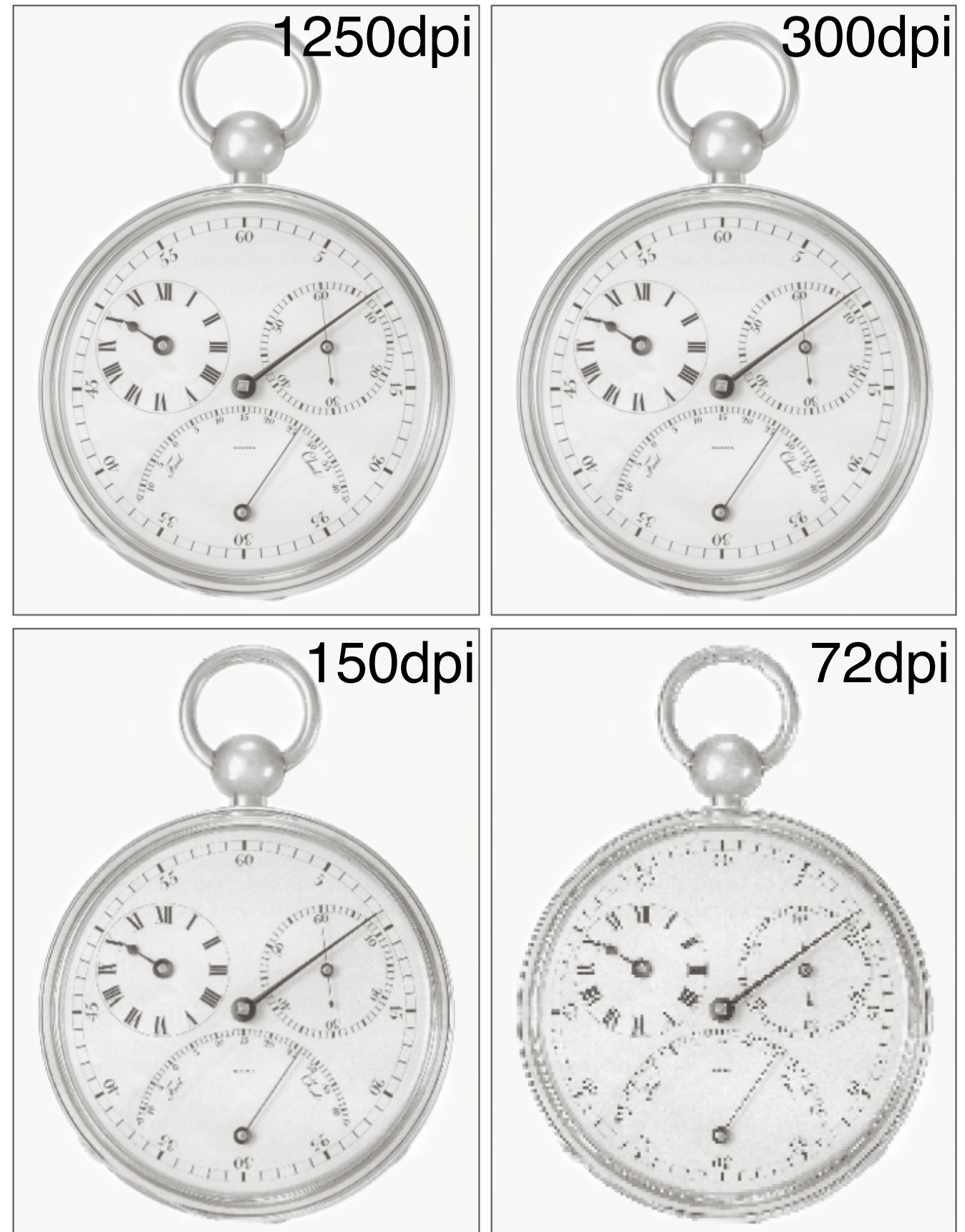
Image Sampling and Quantization

Sampling

Quantization

Saturation

Saturation

Noise
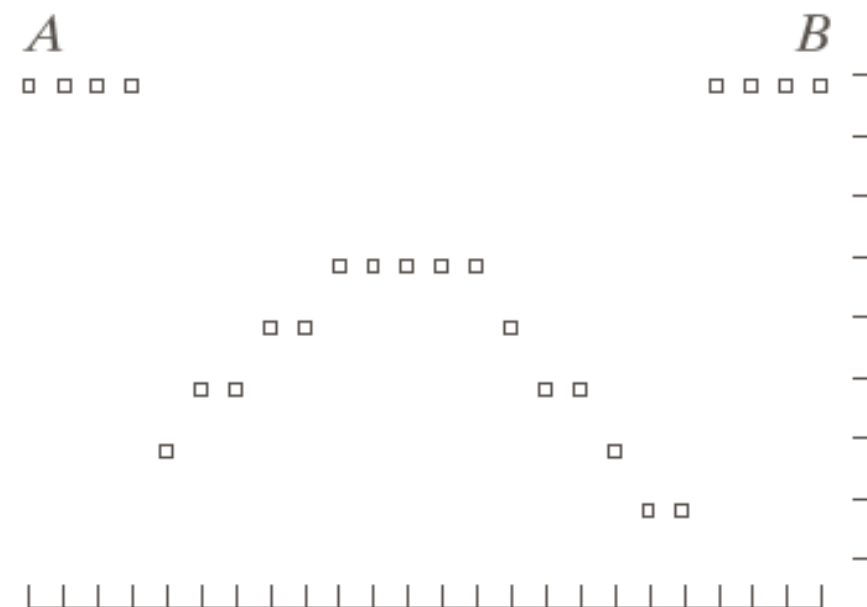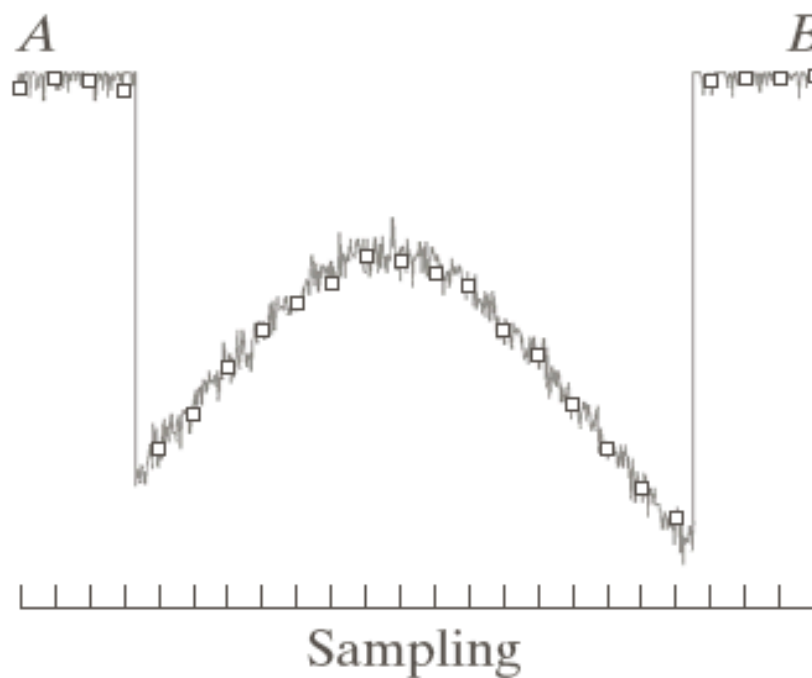
Spatial Resolution

- Dots (pixels) per inch -- DPI

- Examples:

    - Newspapers 75dpi

    - Magazines 133dpi
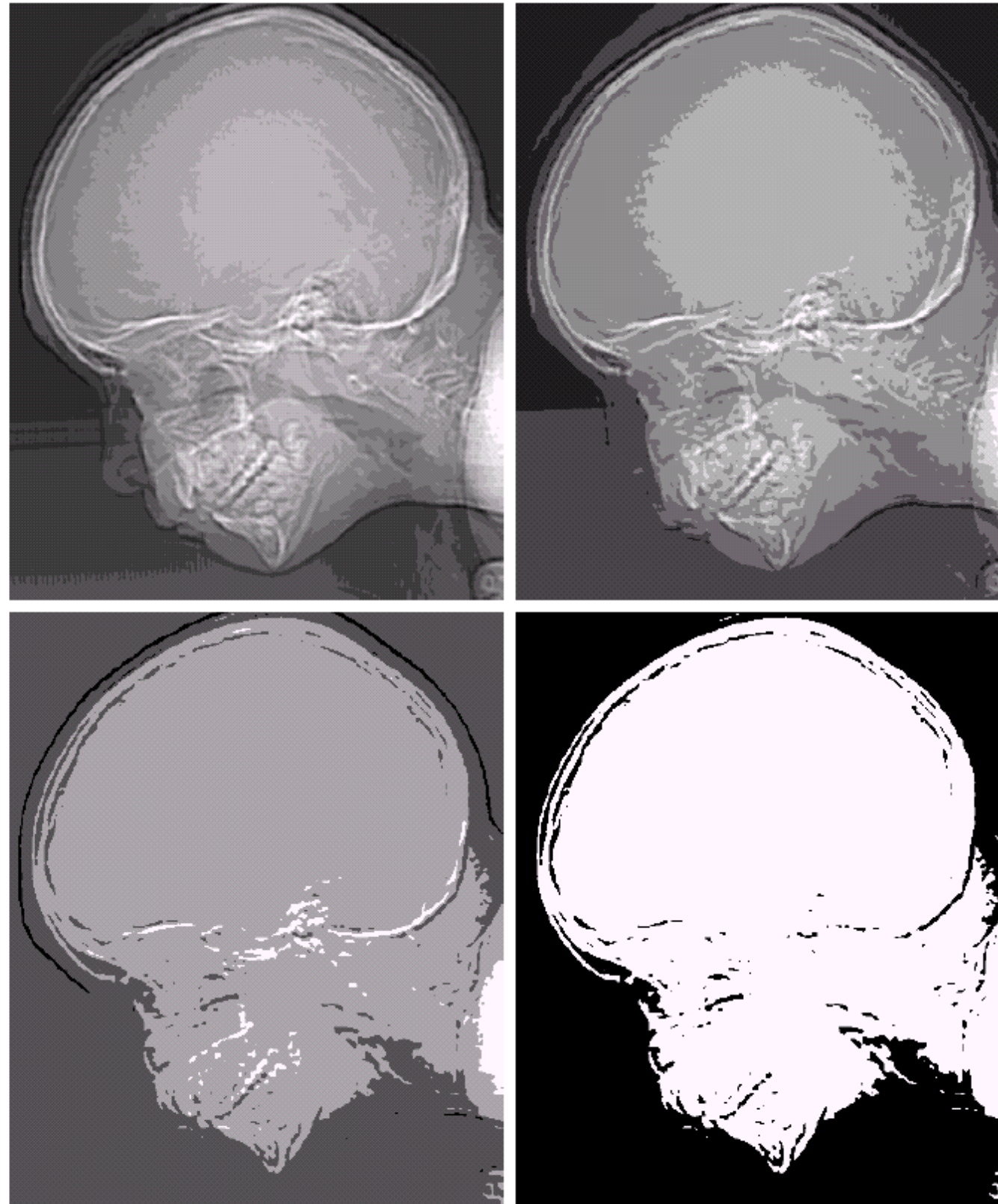
    - Glossy brochures 175dpi

Intensity Resolution

Number of intensity levels -- usually 8 or 16 bits

e f
g h

FIGURE 2.21
(Continued)
(e)–(h) Image displayed in 16, 8, 4, and 2 gray levels. (Original courtesy of Dr. David R. Pickens, Department of Radiology & Radiological Sciences, Vanderbilt University Medical Center.)

MATLAB Image Processing Toolbox

Basic MATLAB Commands

- img = imread('name')

- size(img)

- imshow(img)

- imwrite(img, 'name')

- im2double(img)

- rgb2gray(img),

- im2bw(img)

- img1 = img(1:3:end-4,1:4:end-2)

- zeros(m,n), ones(m,n)

- rand(m,n), randn(m,n)

- min(min(I1)), max(max(I2))

Basic MATLAB Commands

- figure;
- subplot(2,2,1);
- imshow(I1);
- title('Fig. 1 caption');

- subplot(2,2,2);
- imshow(I2);
- title('Fig. 2 caption');

- subplot(2,2,3);
- imshow(I3);
- title('Fig. 3 caption');

- Scaled = uint8(255.0 * (I1 - min(min(I1))) ...
-                     /(max(max(I1))-min(min(I1))));
- subplot(2,2,4);
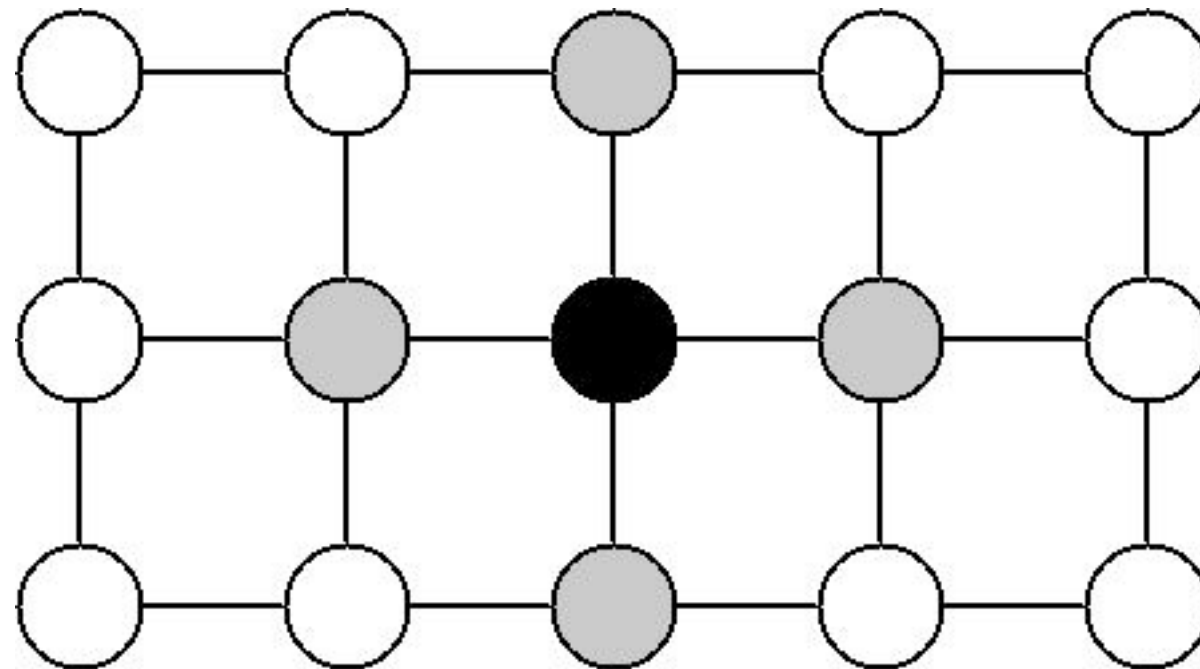- imshow(Scaled);
- title('Fig. 4 caption');

Basic MATLAB Commands

- print -dpsc hw1.ps

- print -djpeg hw1.jpg

Image Structure

Image Structure

- Pixels, 4-adjacency, 8-adjacency, m-adjacency

4-adjacency

Interest Points (e.g Harris Corners)

Image Structure

- T-junctions

Image Structure

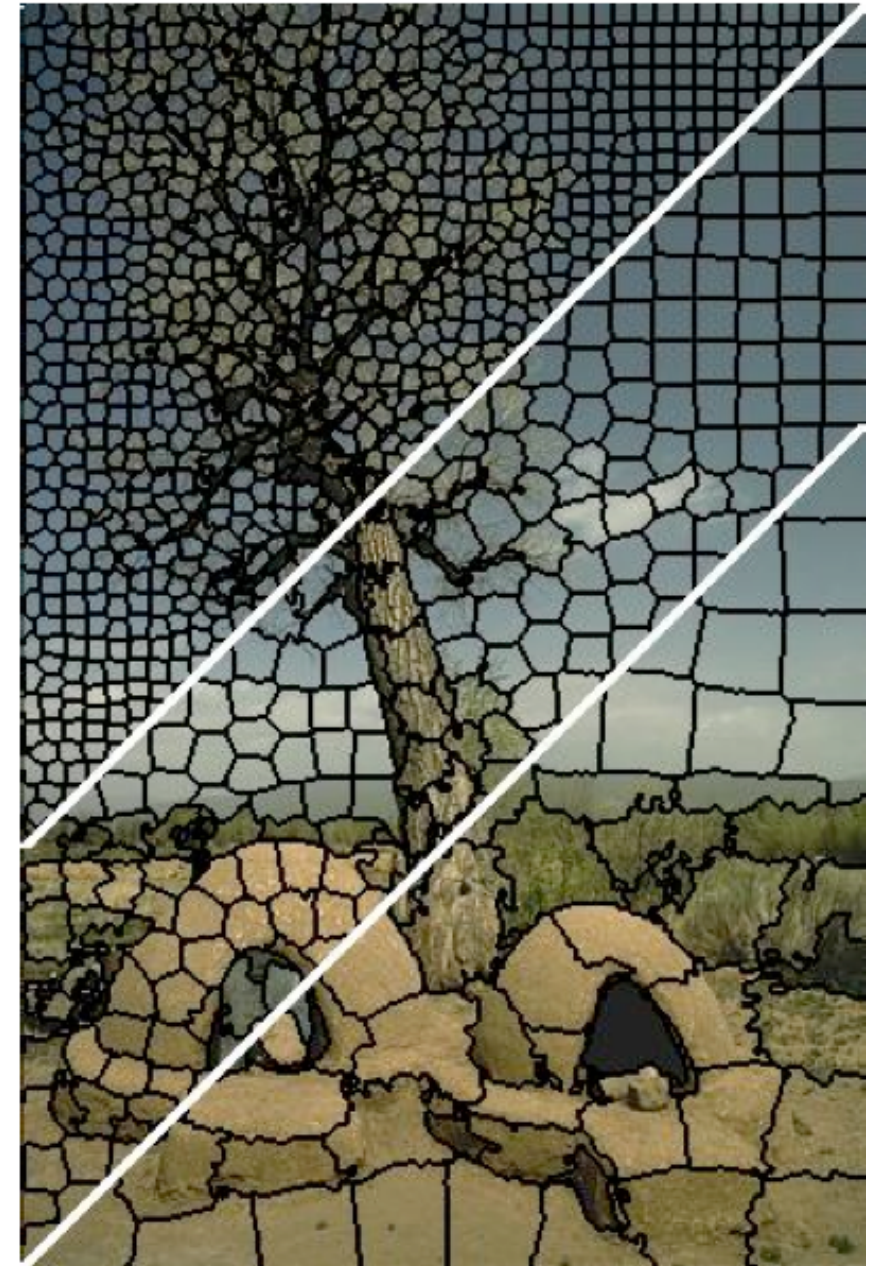- Edge = Connected pixels with high gradient values

Image Structure

- Region = Contiguous set of similar pixels

- How to define similarity?

SLIC superpixels

Image Structure

- Specularity = Highlights

Image Structure

- Highlights or specularities

- Lambertian surface = isotropic reflectance

- Specular surface = zero reflectance except at an angle