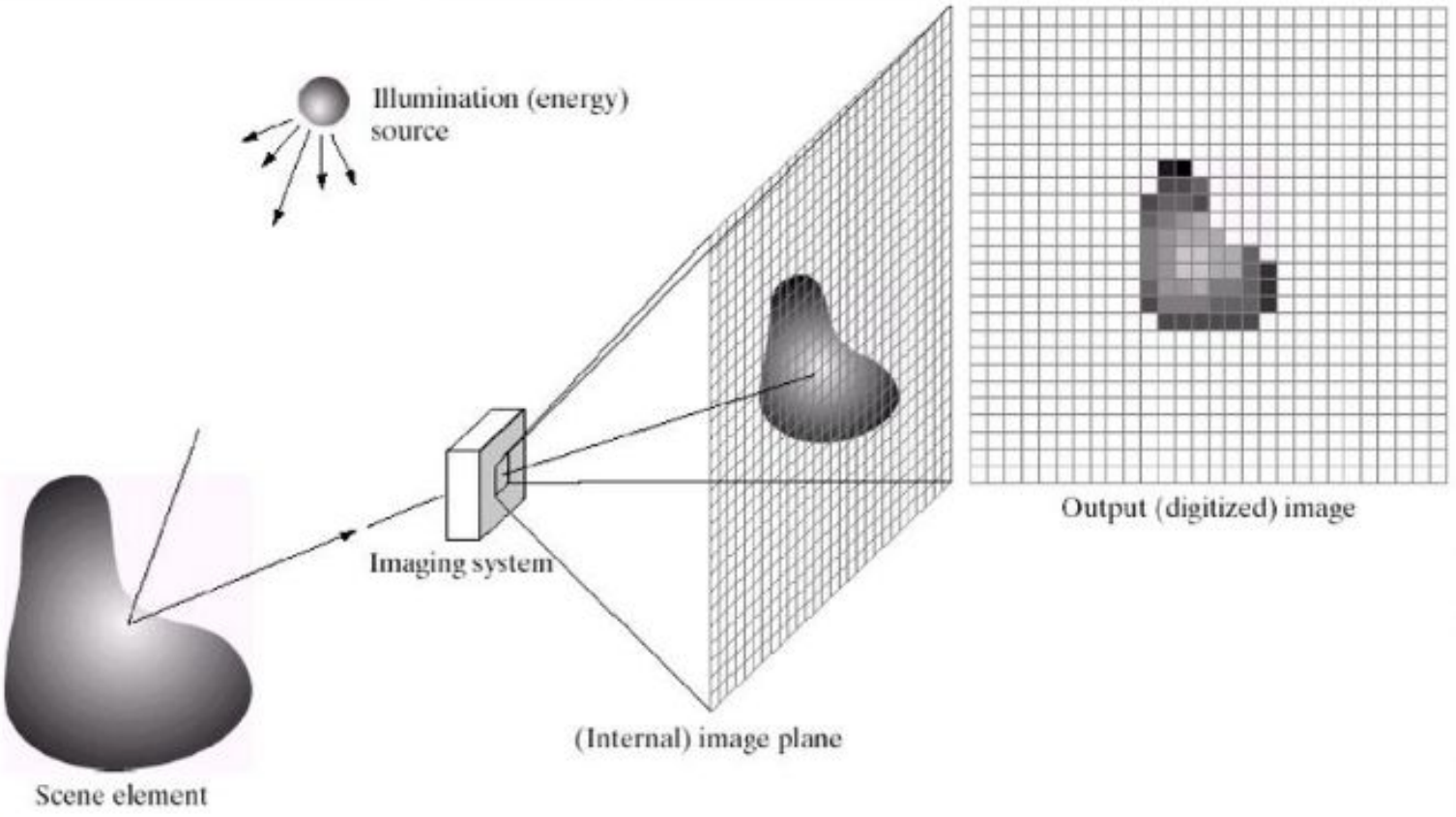
FUNDAMENTALS OF DIGITAL IMAGE FORMATION

Image Acquisition Process



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.

Introduction

- What is Digital Image Processing?

Digital Image

— a two-dimensional function $f(x, y)$

x and *y* are spatial coordinates

The amplitude of *f* is called **intensity** or **gray level** at the point (x, y)

Digital Image Processing

— process digital images by means of computer, it covers low-, mid-, and high-level processes

low-level: inputs and outputs are images

mid-level: outputs are attributes extracted from input images

high-level: an ensemble of recognition of individual objects

Pixel

— the elements of a digital image

A Simple Image Formation Model

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

$f(x, y)$: intensity at the point (x, y)

$i(x, y)$: illumination at the point (x, y)

(the amount of source illumination incident on the scene)

$r(x, y)$: reflectance/transmissivity at the point (x, y)

(the amount of illumination reflected/transmitted by the object)

where $0 < i(x, y) < \infty$ and $0 < r(x, y) < 1$

What is a Digital Image? (cont…)

- Common image formats include:
  - 1 sample per point (B&W or Grayscale)
  - 3 samples per point (Red, Green, and Blue)
  - 4 samples per point (Red, Green, Blue, and "Alpha", a.k.a. Opacity)



- For most of this course we will focus on grey-scale images

Image processing

- An **image processing** operation typically defines a new image g in terms of an existing image f.
- We can transform either the range of f.

$$g(x, y) = t(f(x, y))$$

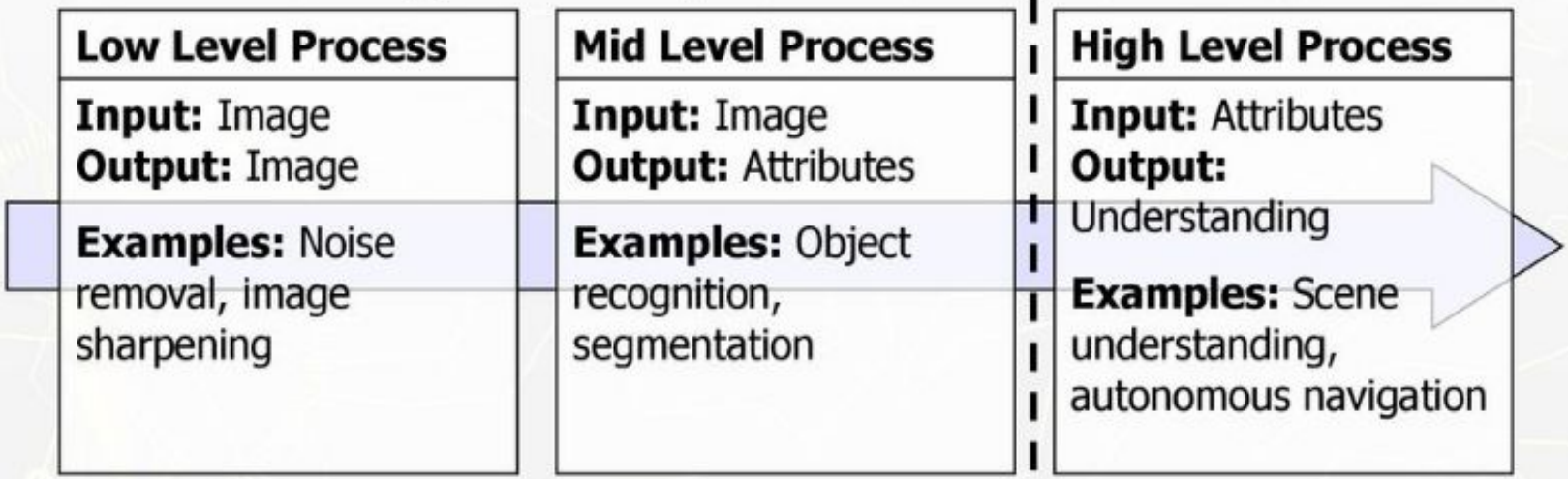
- Or the domain of *f*:

$$g(x, y) = f(t_x(x, y), t_y(x, y))$$

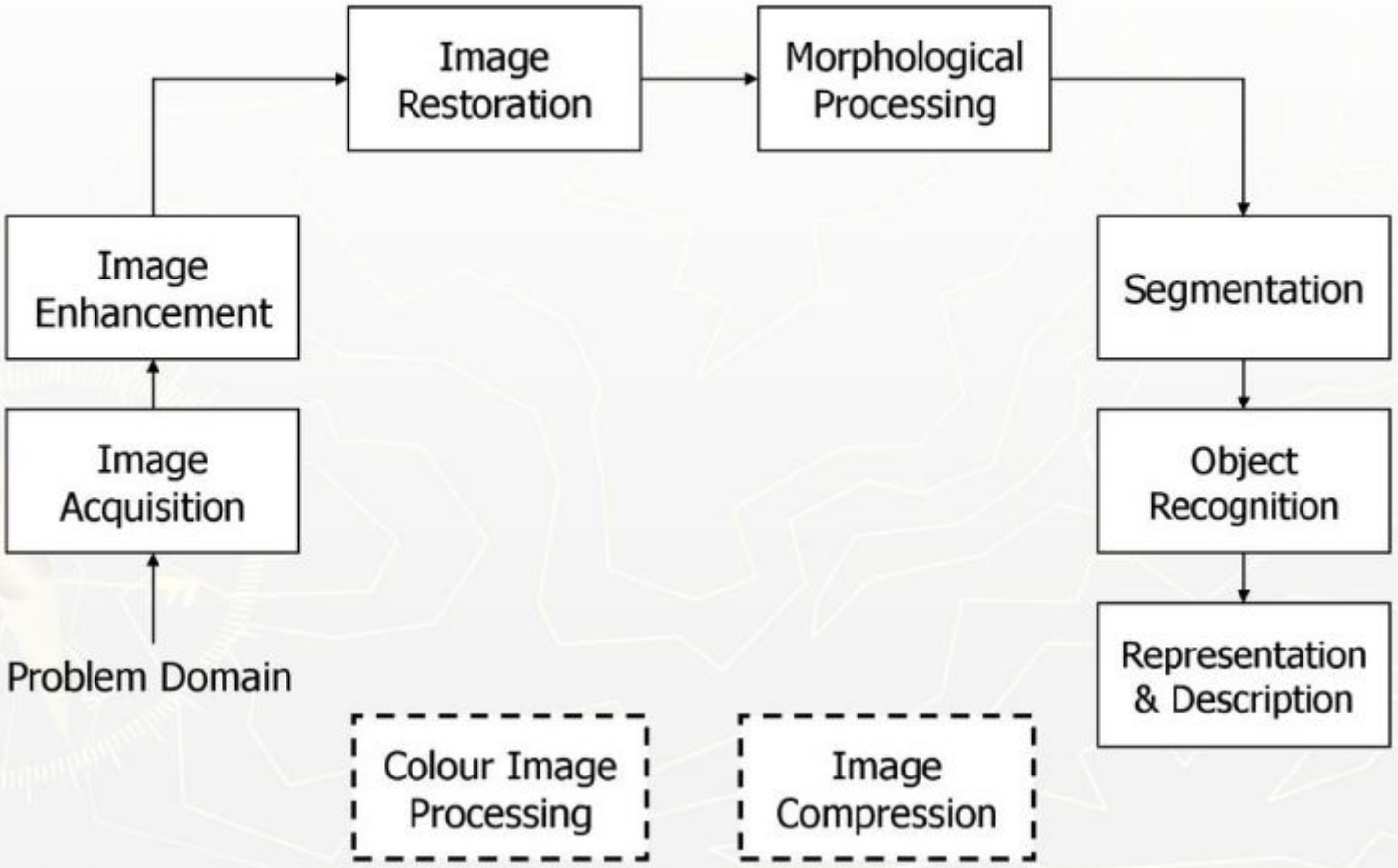
- What kinds of operations can each perform?

What is DIP? (cont…)

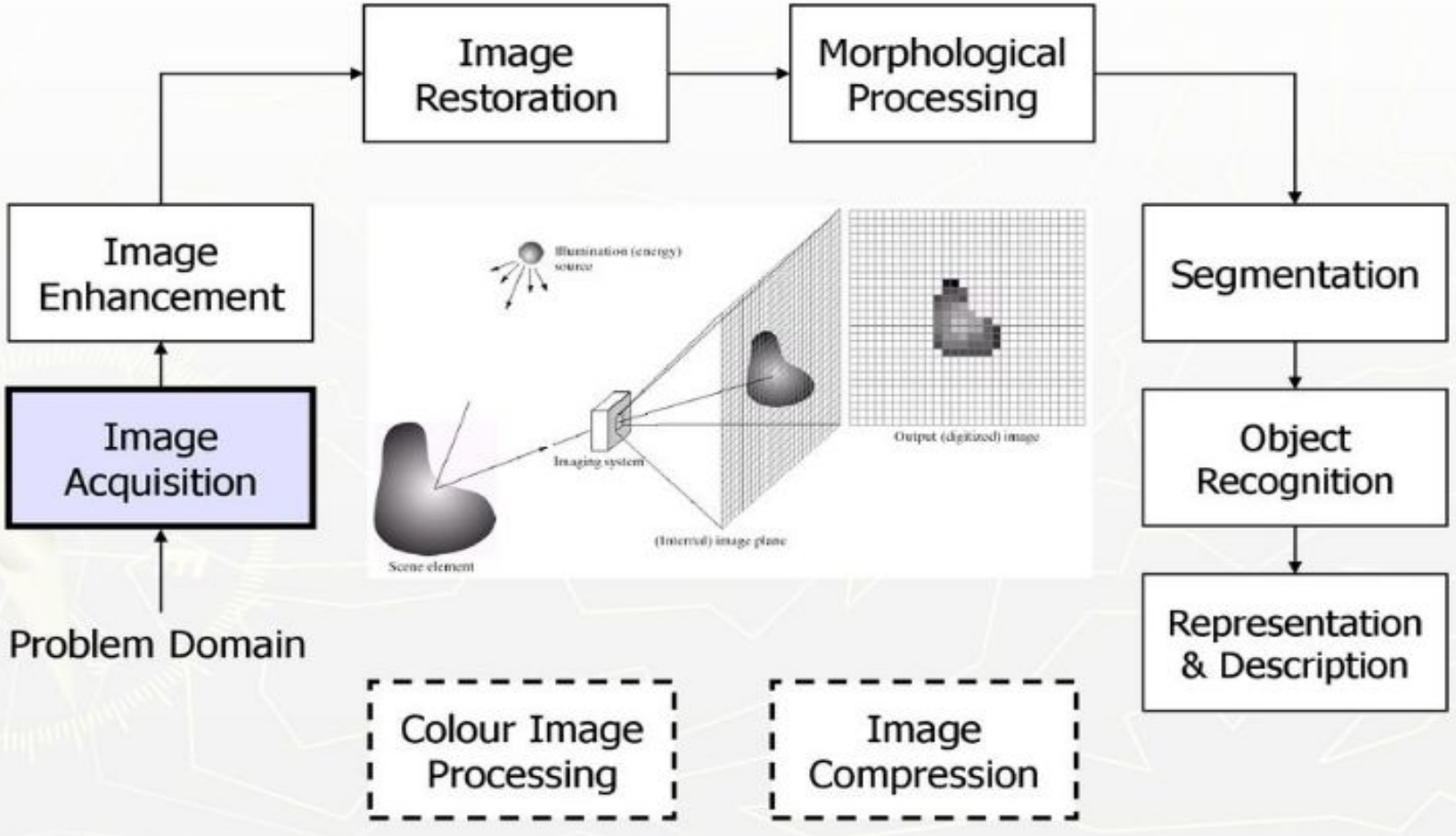
- The continuum from image processing to computer vision can be broken up into low-, mid- and high-level processes



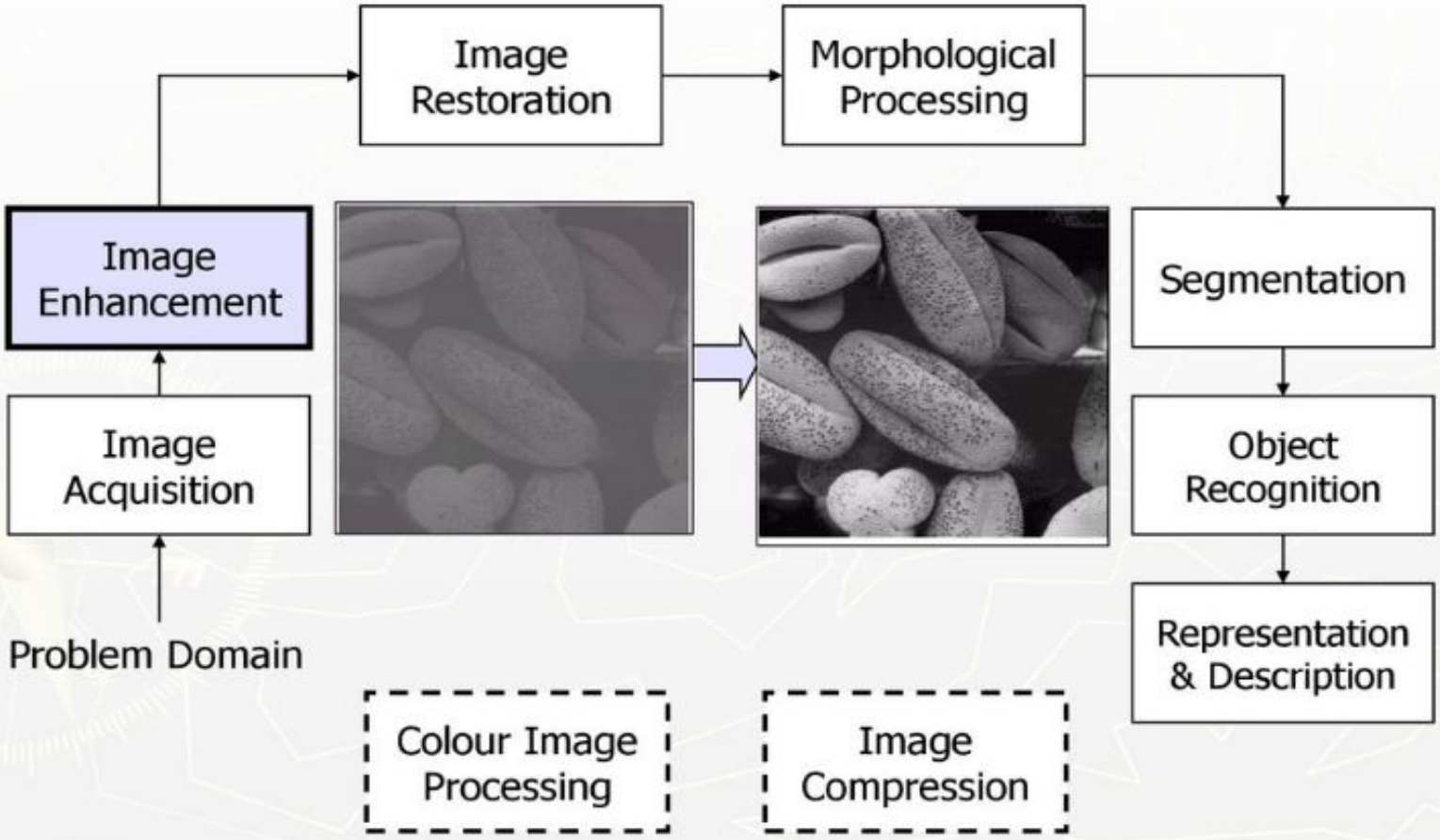
Key Stages in Digital Image Processing



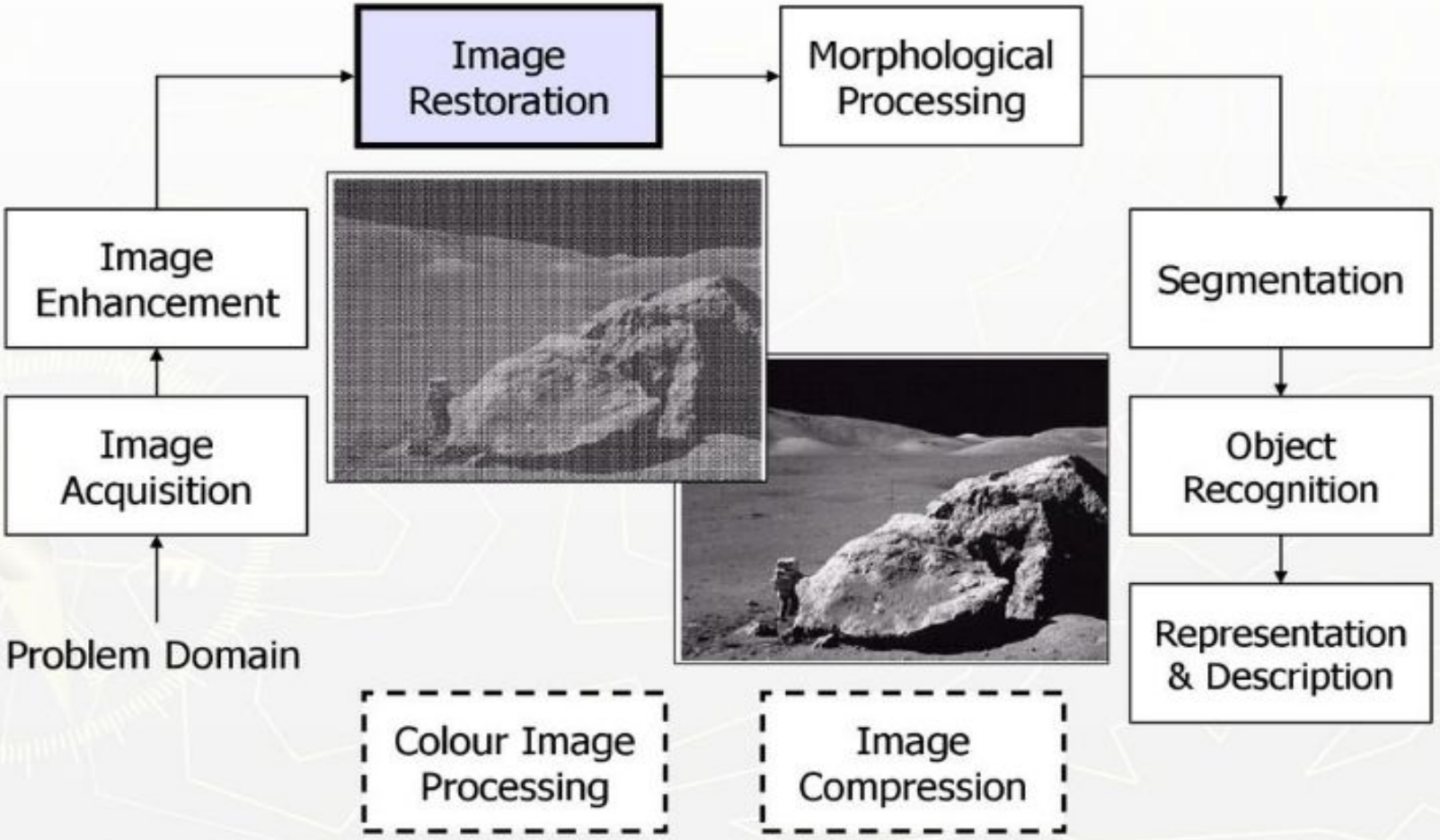
Key Stages in Digital Image Processing: Image Aquisition



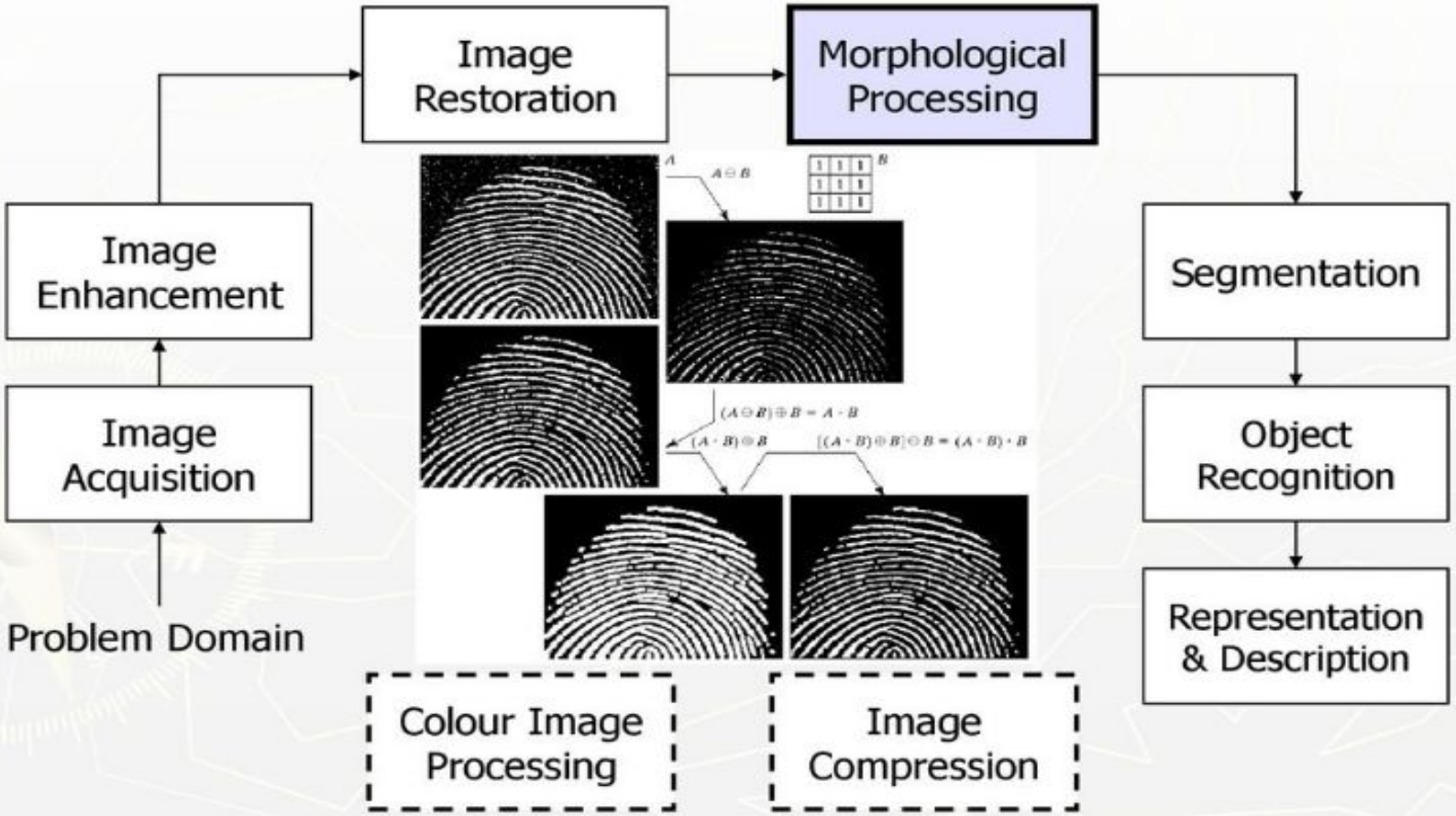
Key Stages in Digital Image Processing: Image Enhancement



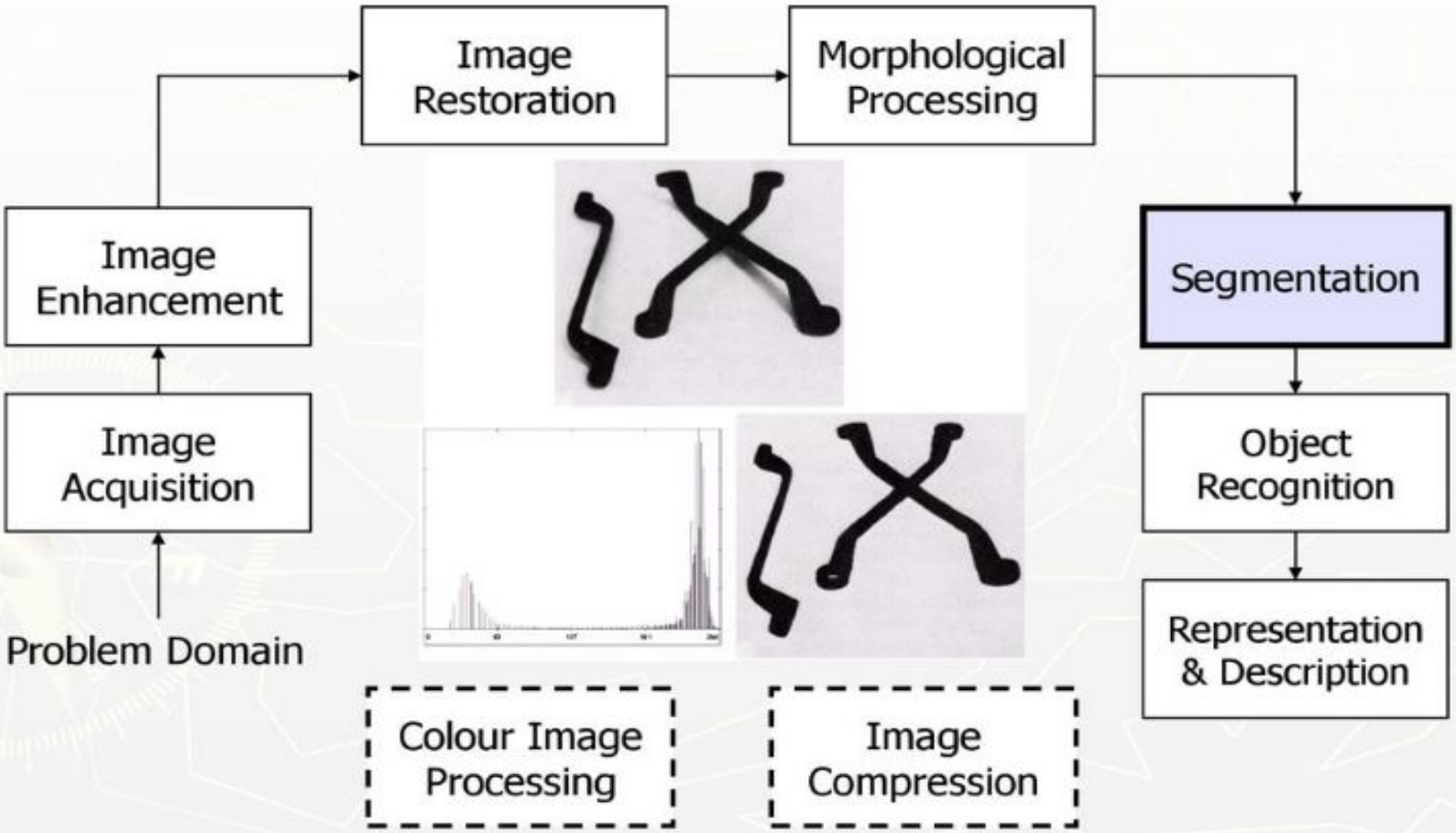
Key Stages in Digital Image Processing: Image Restoration



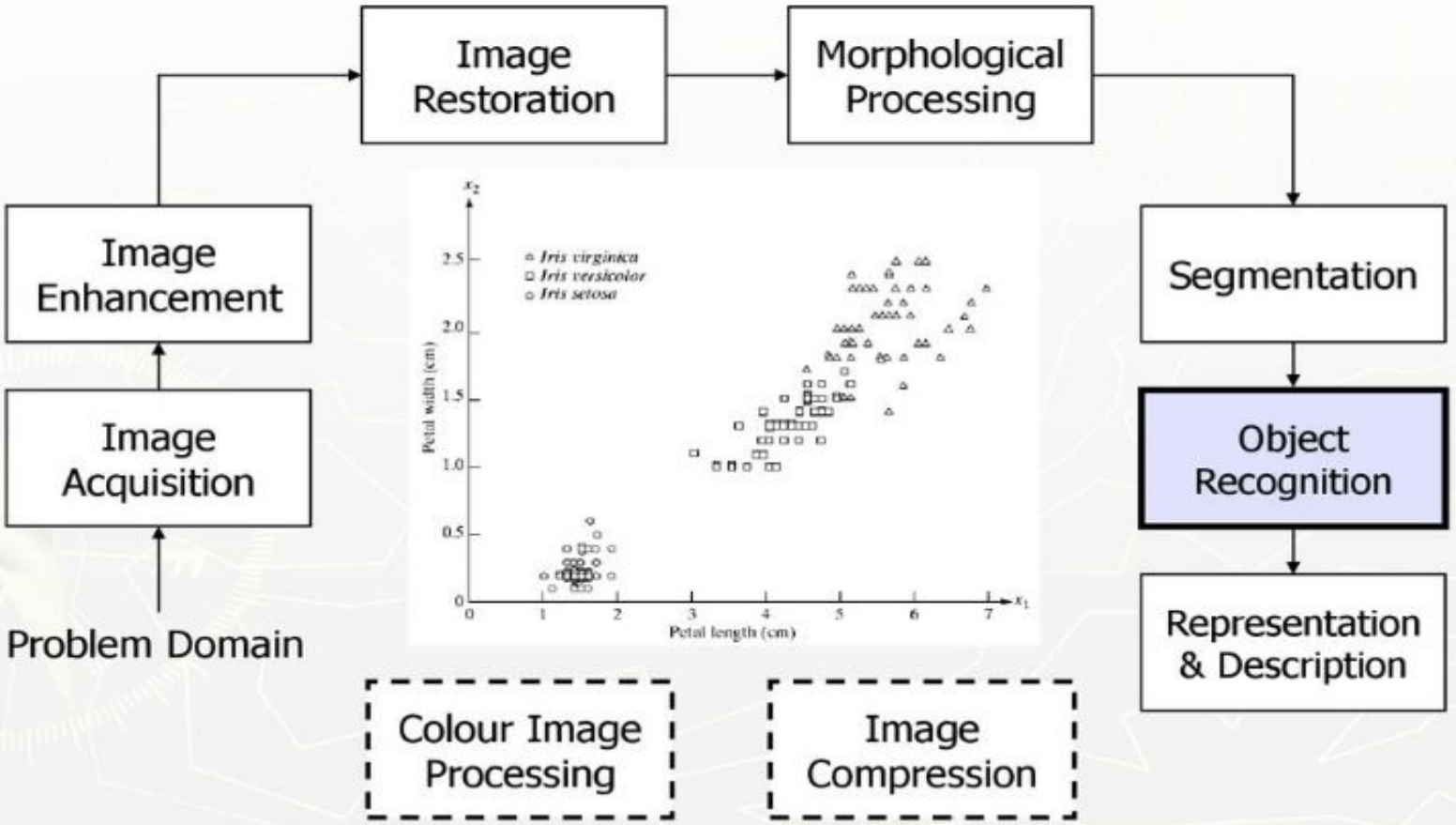
Key Stages in Digital Image Processing: Morphological Processing



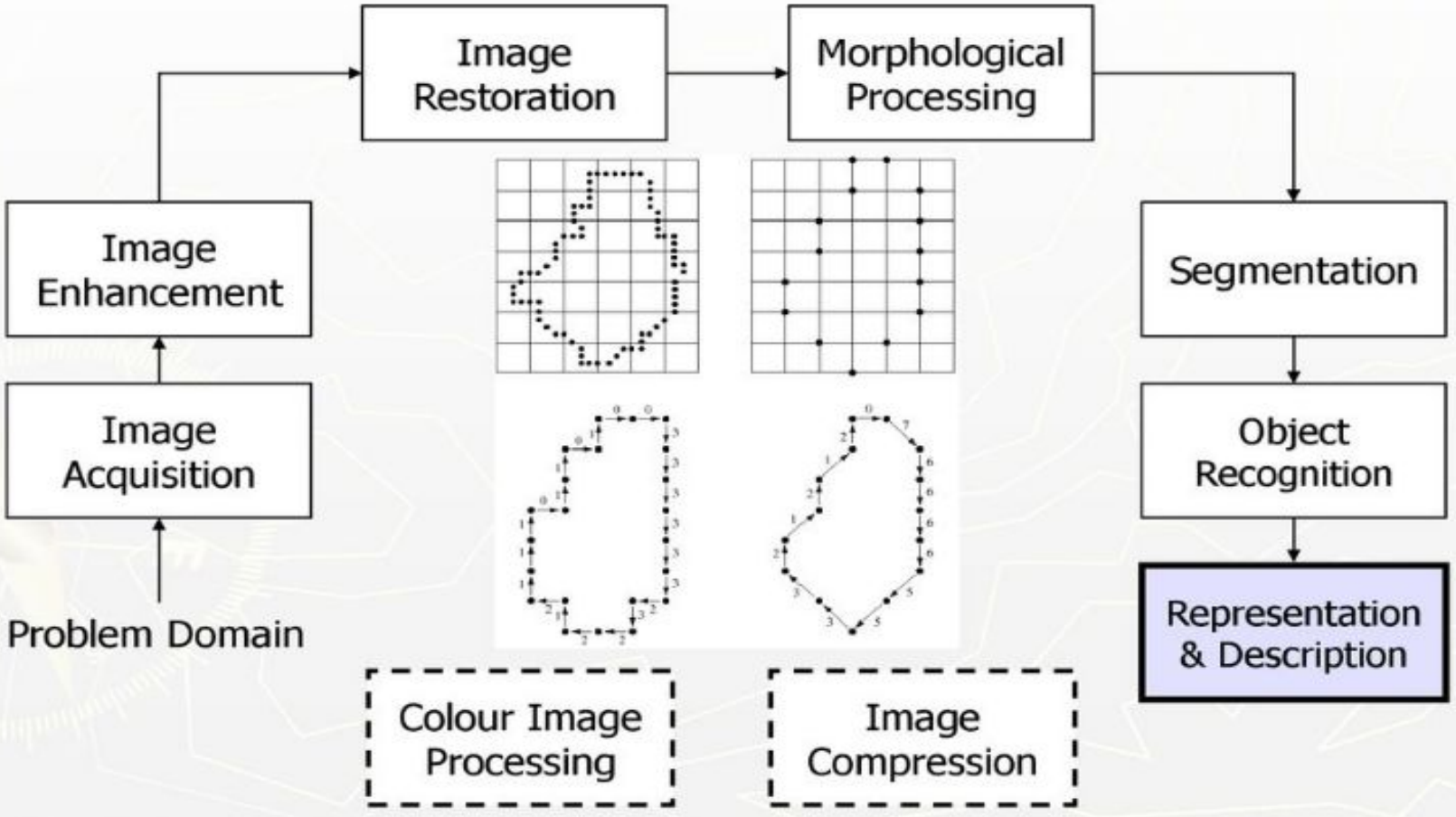
Key Stages in Digital Image Processing: Segmentation



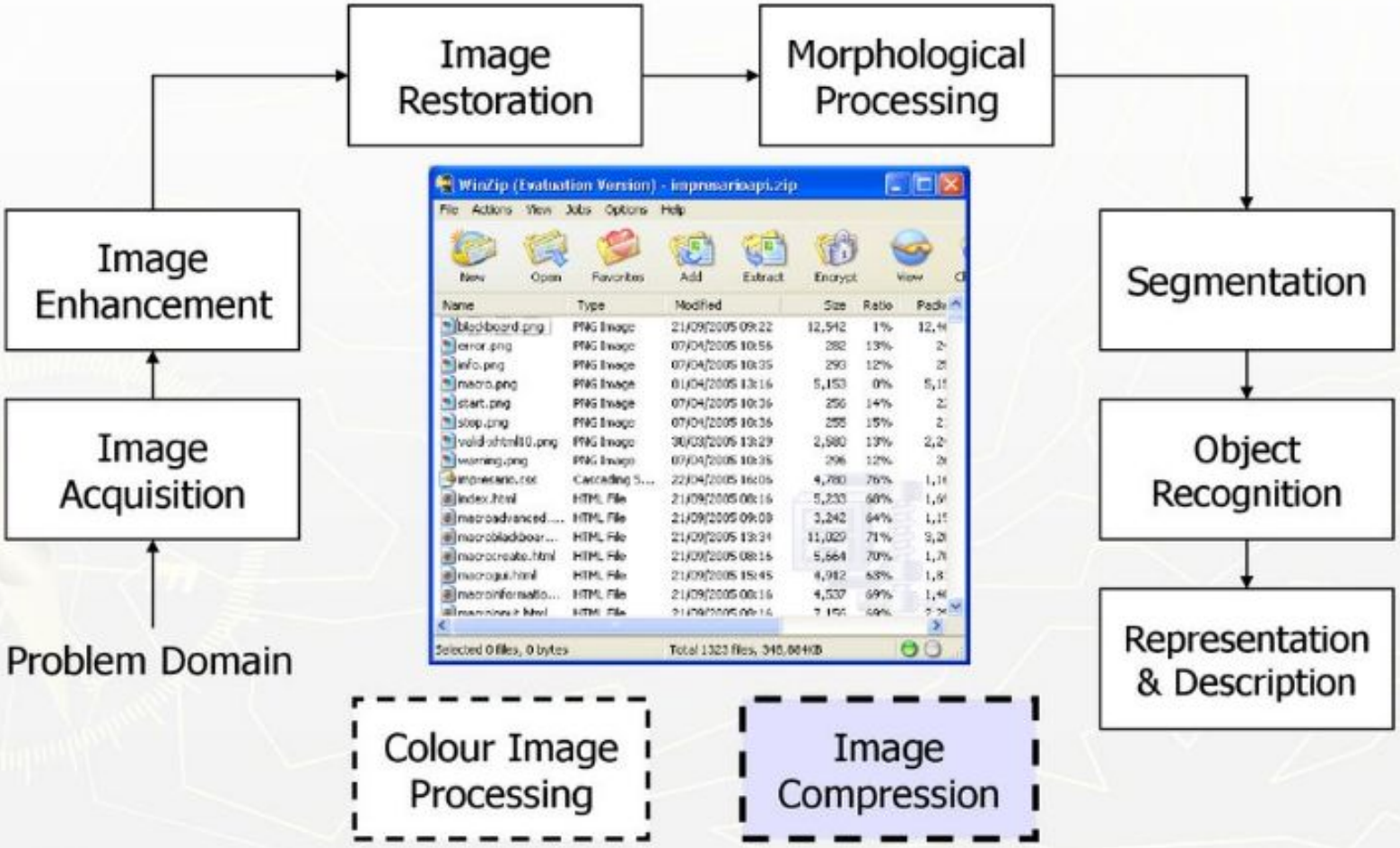
Key Stages in Digital Image Processing: Object Recognition



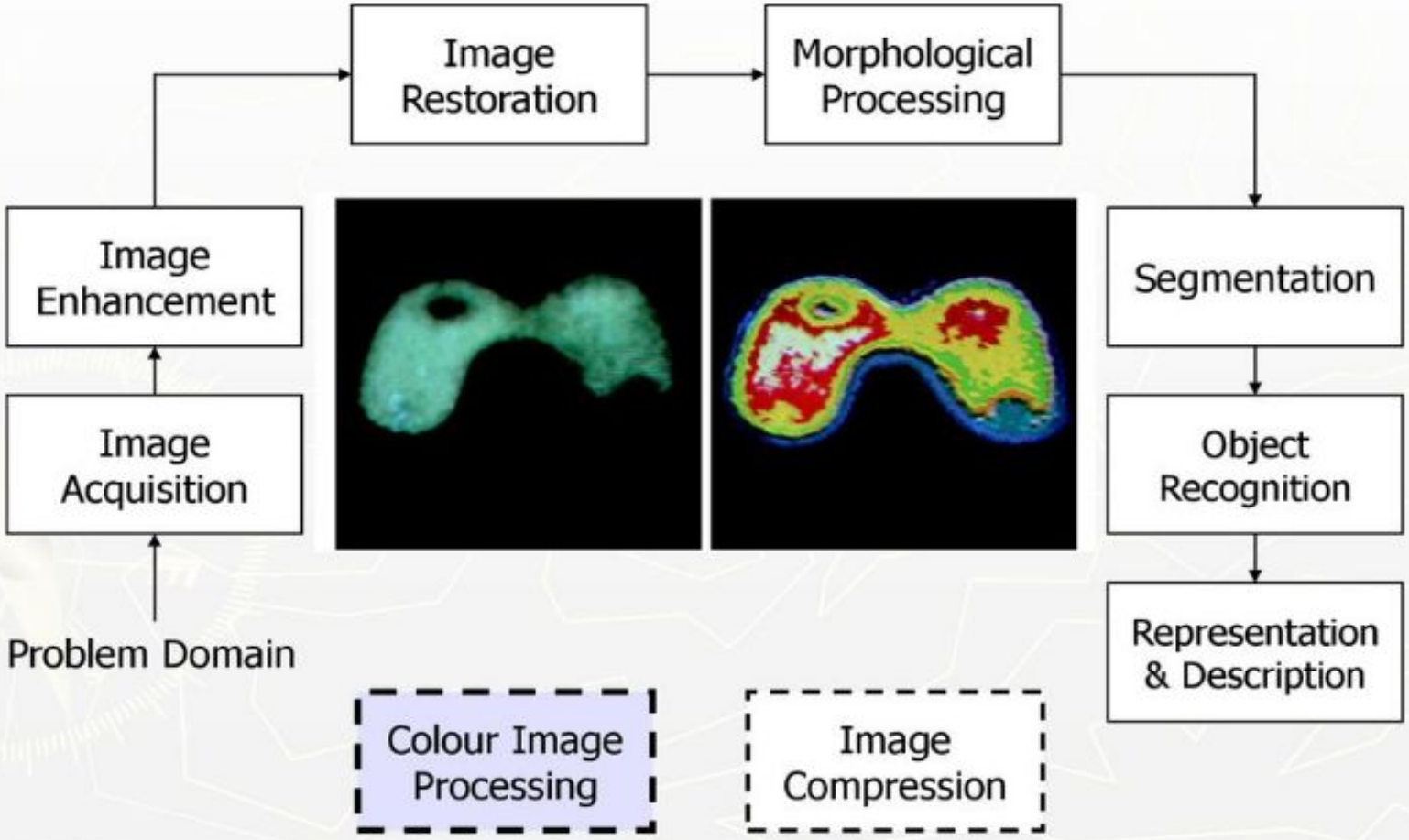
Key Stages in Digital Image Processing: Representation & Description



Key Stages in Digital Image Processing: Image Compression



Key Stages in Digital Image Processing: Colour Image Processing



THANK YOU