Digital Image Processing

Lecture # 2

Introduction - II

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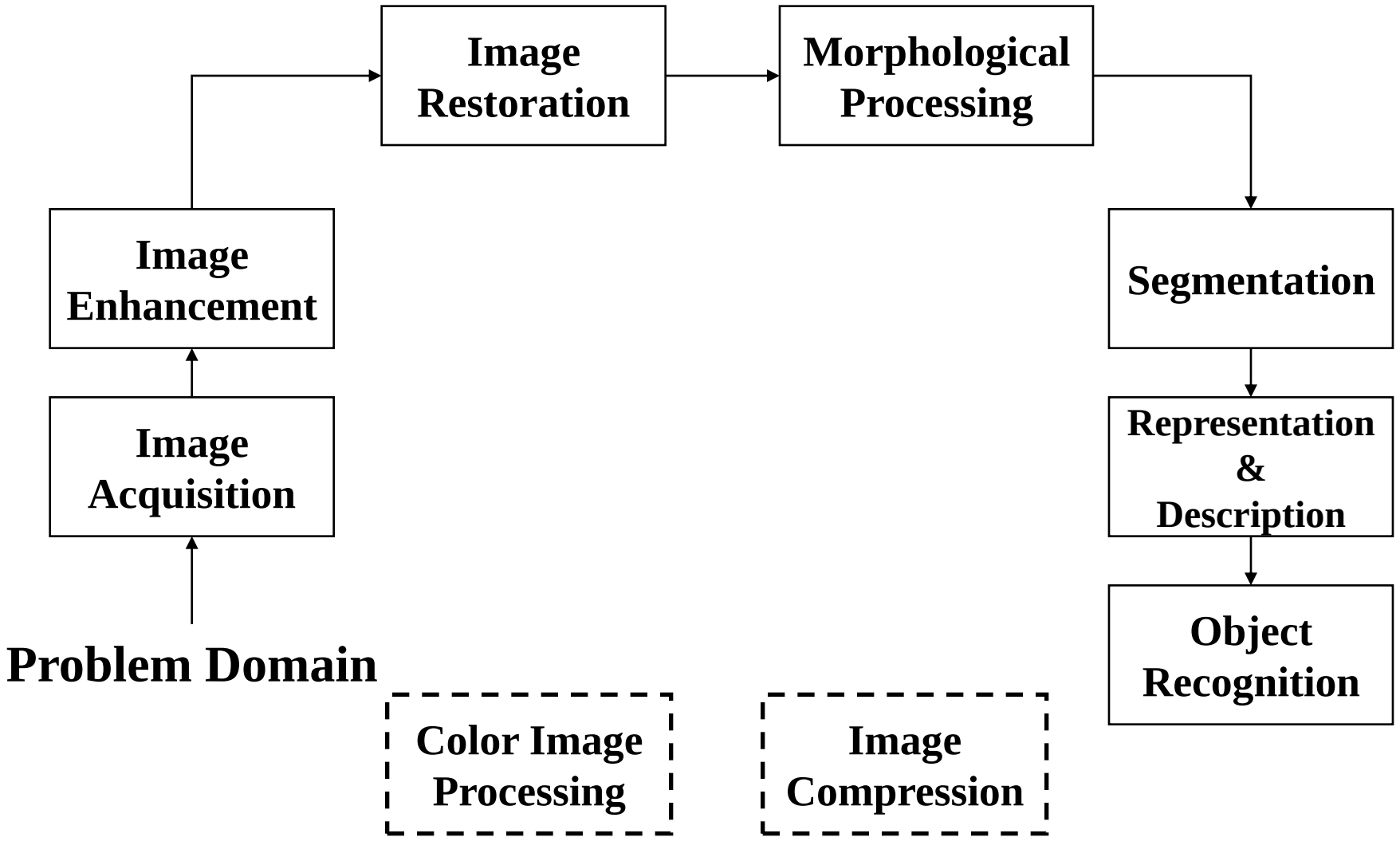
Grading Criteria

- Assignments 10%
- Quizzes 10%
- Mid Exam 20%
- Final Exam 50%
- Term Project 10%

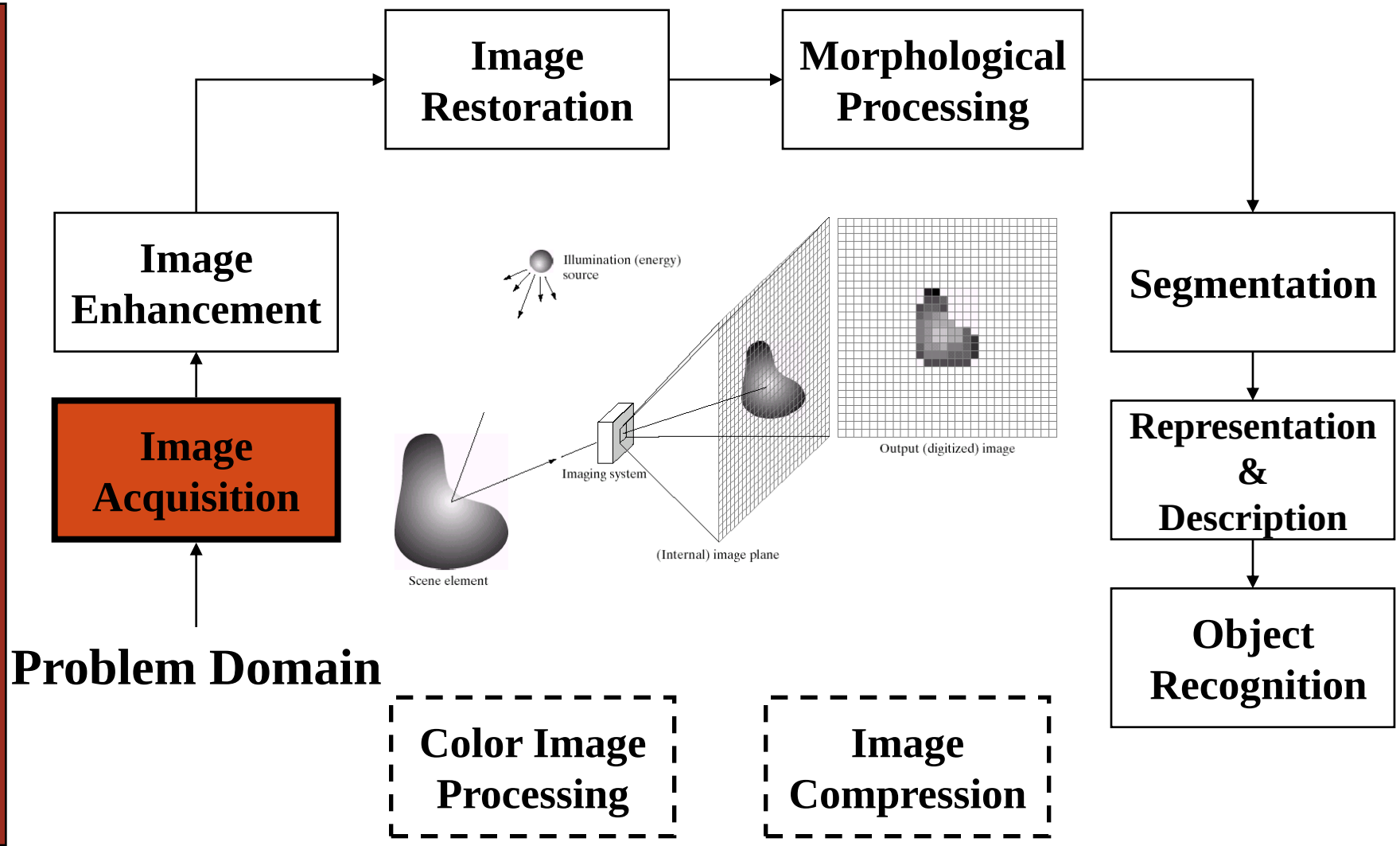
Presentation Outline

- Key Stages in Digital Image Processing
  - Image Acquisition
  - Image Enhancement
  - Image Restoration
  - Image Compression
  - Color Image Processing
  - Morphological Image Processing
  - Image Segmentation
  - Representation and Description
  - Image Recognition
- Image Processing Components
  - Image Sensing device
  - Storage Media
  - Processing Systems
  - Displays
  - Communication Media
  - Hardcopy devices (e.g Printer)

Key Stages in Digital Image Processing



Key Stages in Digital Image Processing: Image Acquisition



Images taken from Gonzalez & Woods, Digital Image Processing (2002)

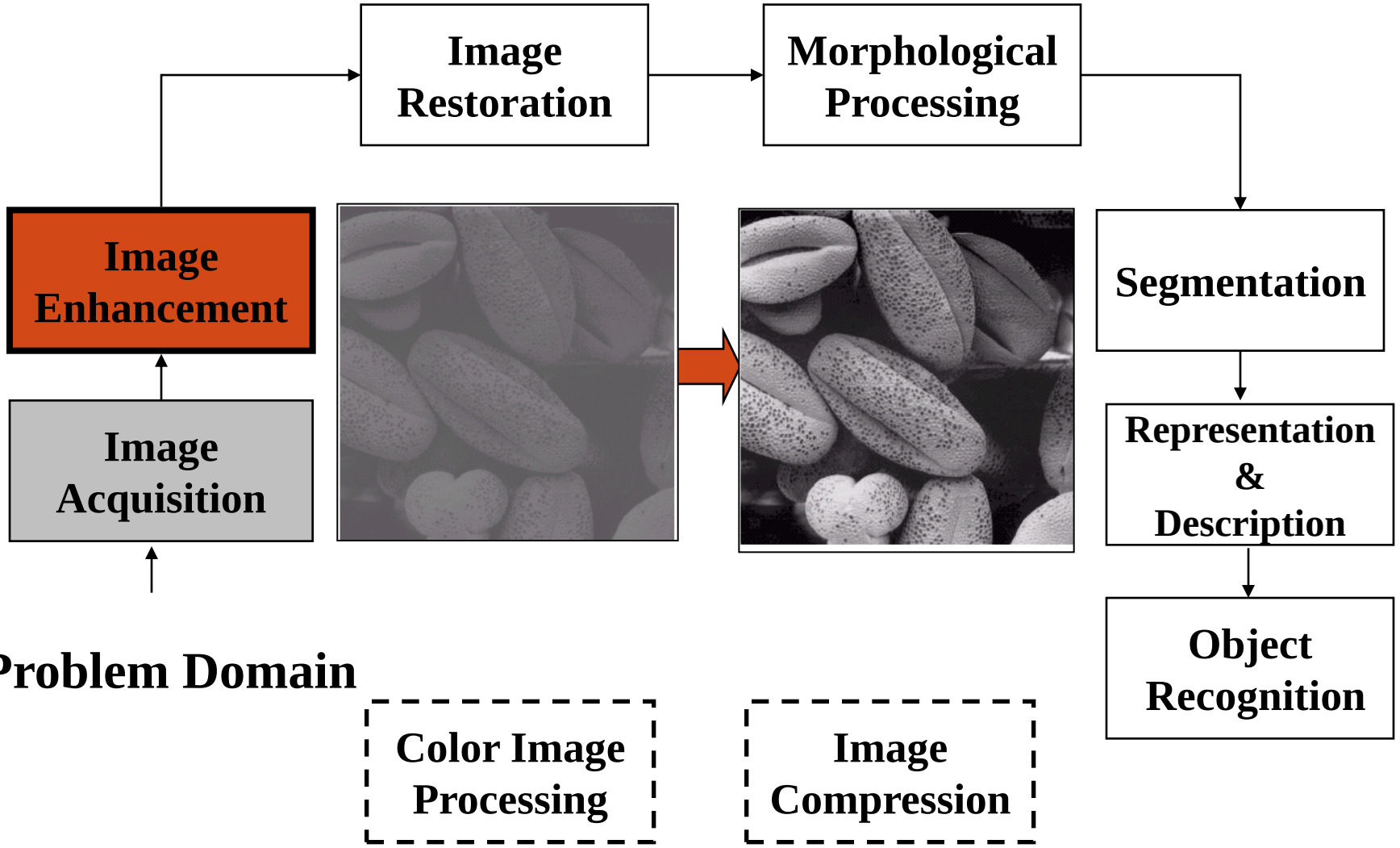
Image Acquisition

- The first stage of any vision system is the image acquisition stage.

- After the image has been obtained, various methods of processing can be applied to the image to perform the many different vision tasks required today.

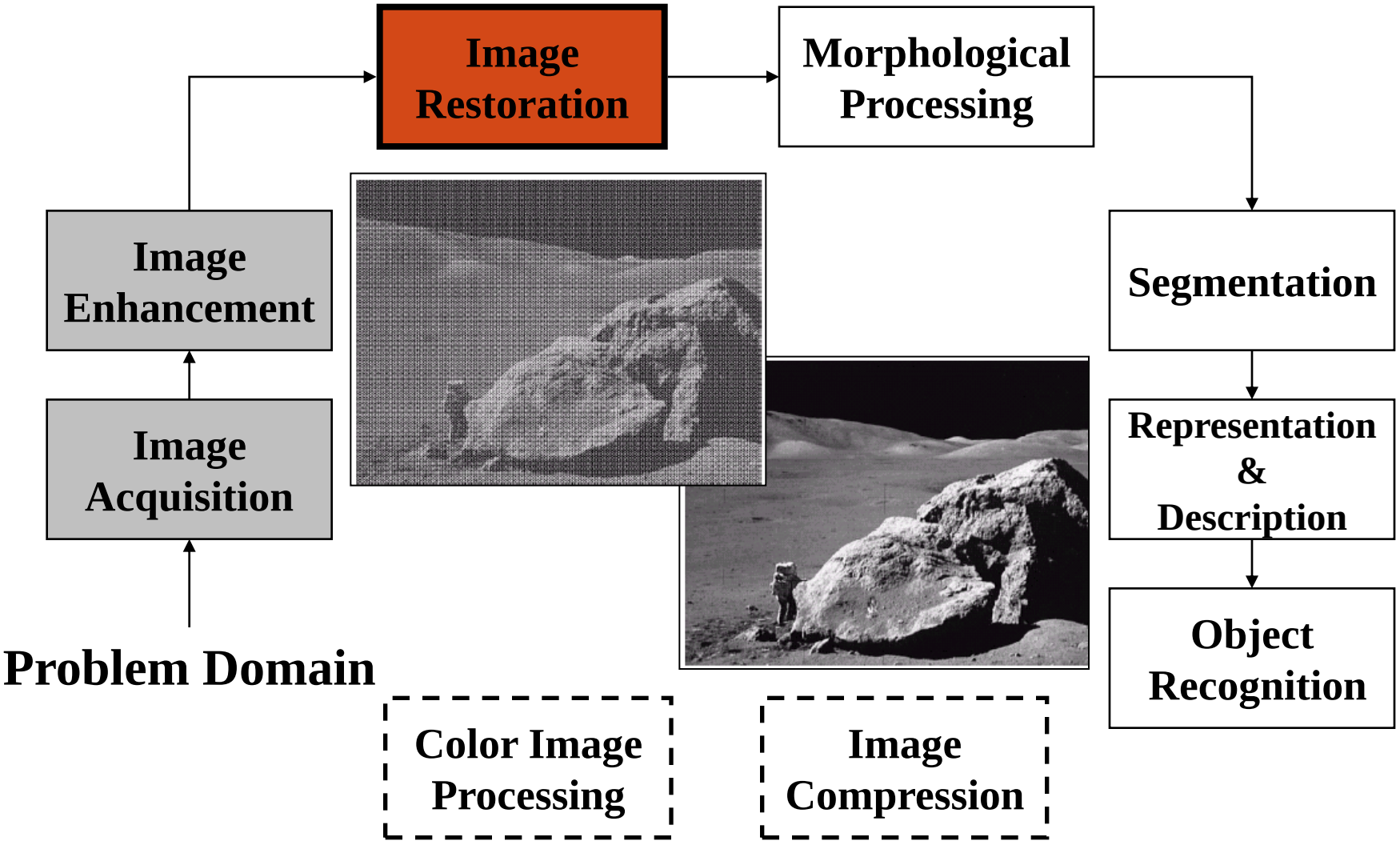
- However, if the image has not been acquired satisfactorily then the intended tasks may not be achievable

Key Stages in Digital Image Processing: Image Enhancement

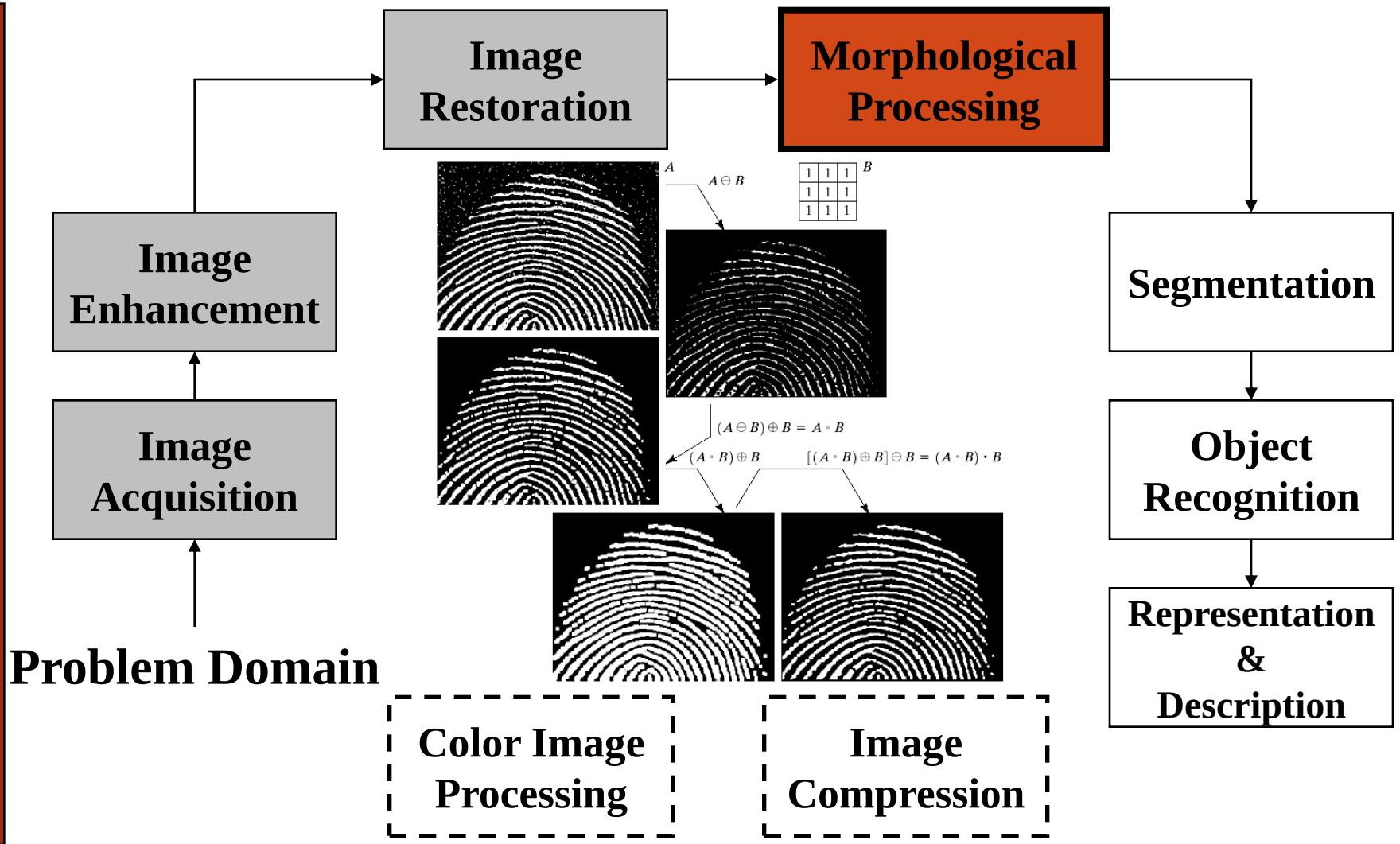


Images taken from Gonzalez & Woods, Digital Image Processing (2002)

Key Stages in Digital Image Processing: Image Restoration



Key Stages in Digital Image Processing: Morphological Processing



Images taken from Gonzalez & Woods, Digital Image Processing (2002)

Key Stages in Digital Image Processing: Segmentation

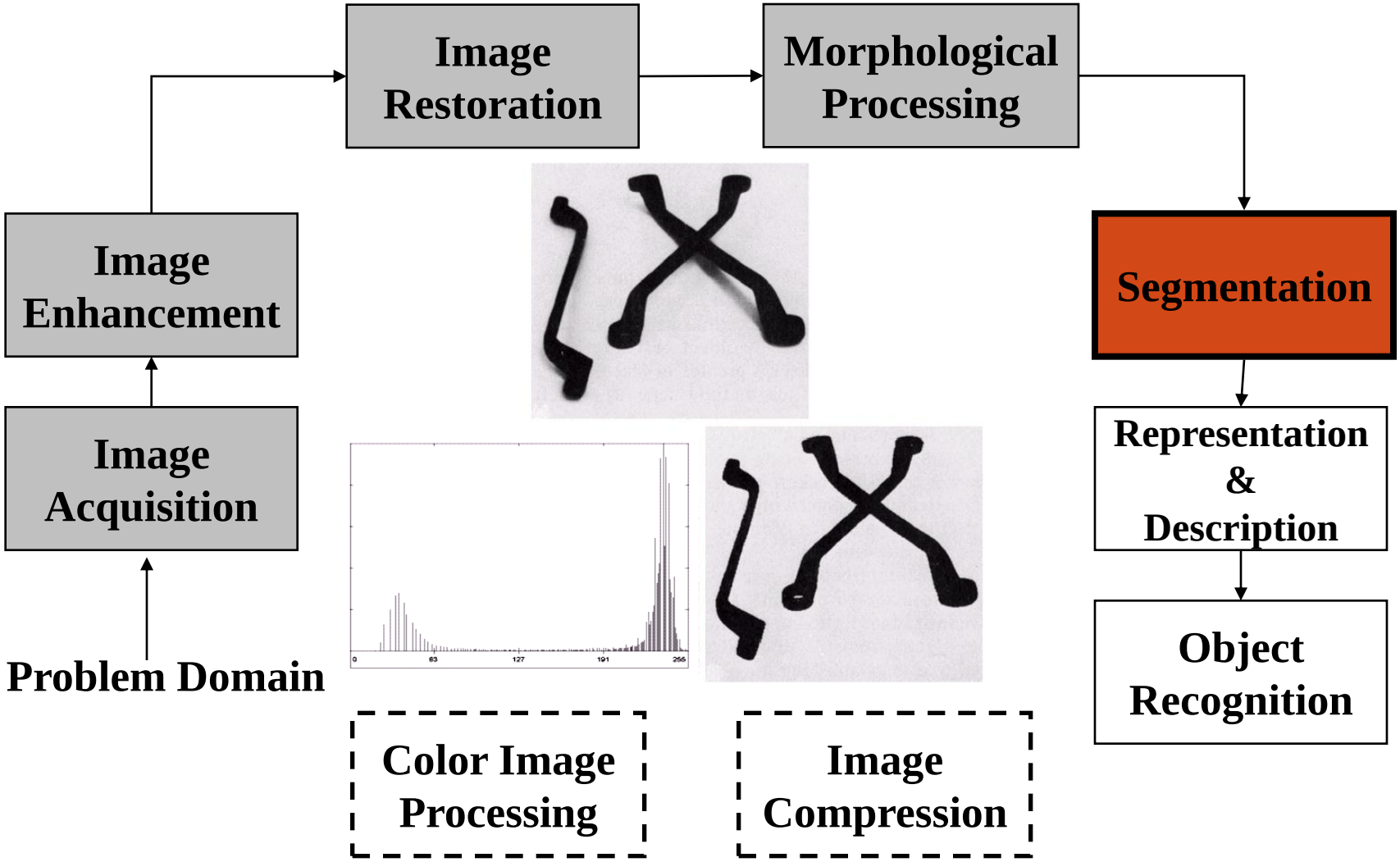


Image Segmentation

- segmentation refers to the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.

- Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images.

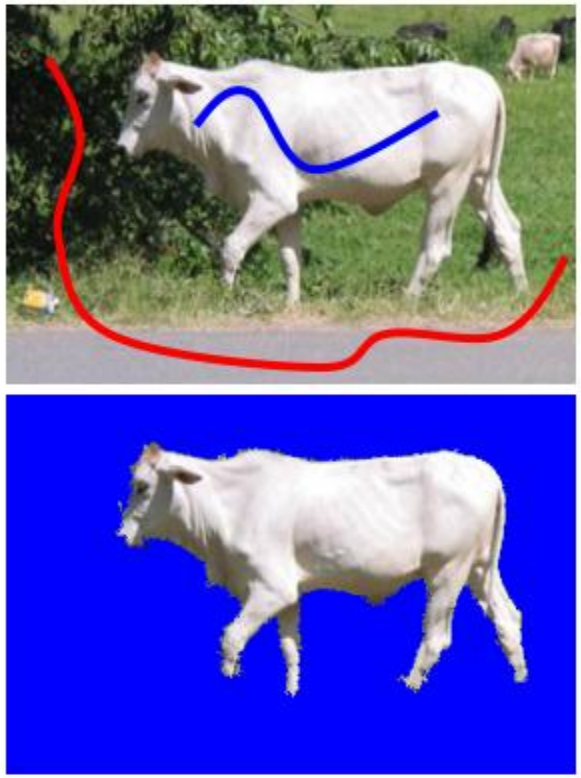
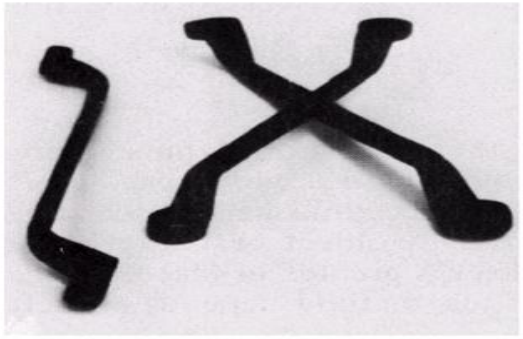


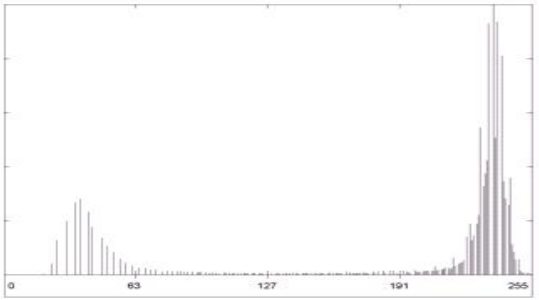
Image Segmentation

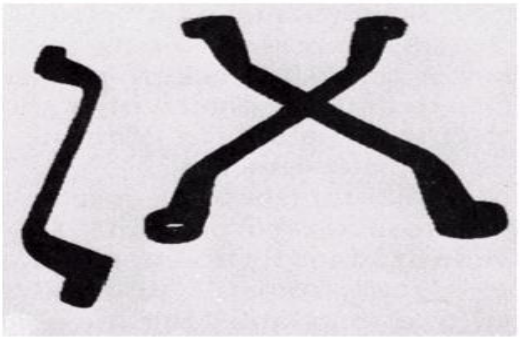
- Image Segmentation algorithms generally are based on one of two basic pro perties of intensity values:: Discontinuity and Similarity

- Through Discontinuity the approach is to partition an image based on abrupt changes in intensity, such as edges in an image

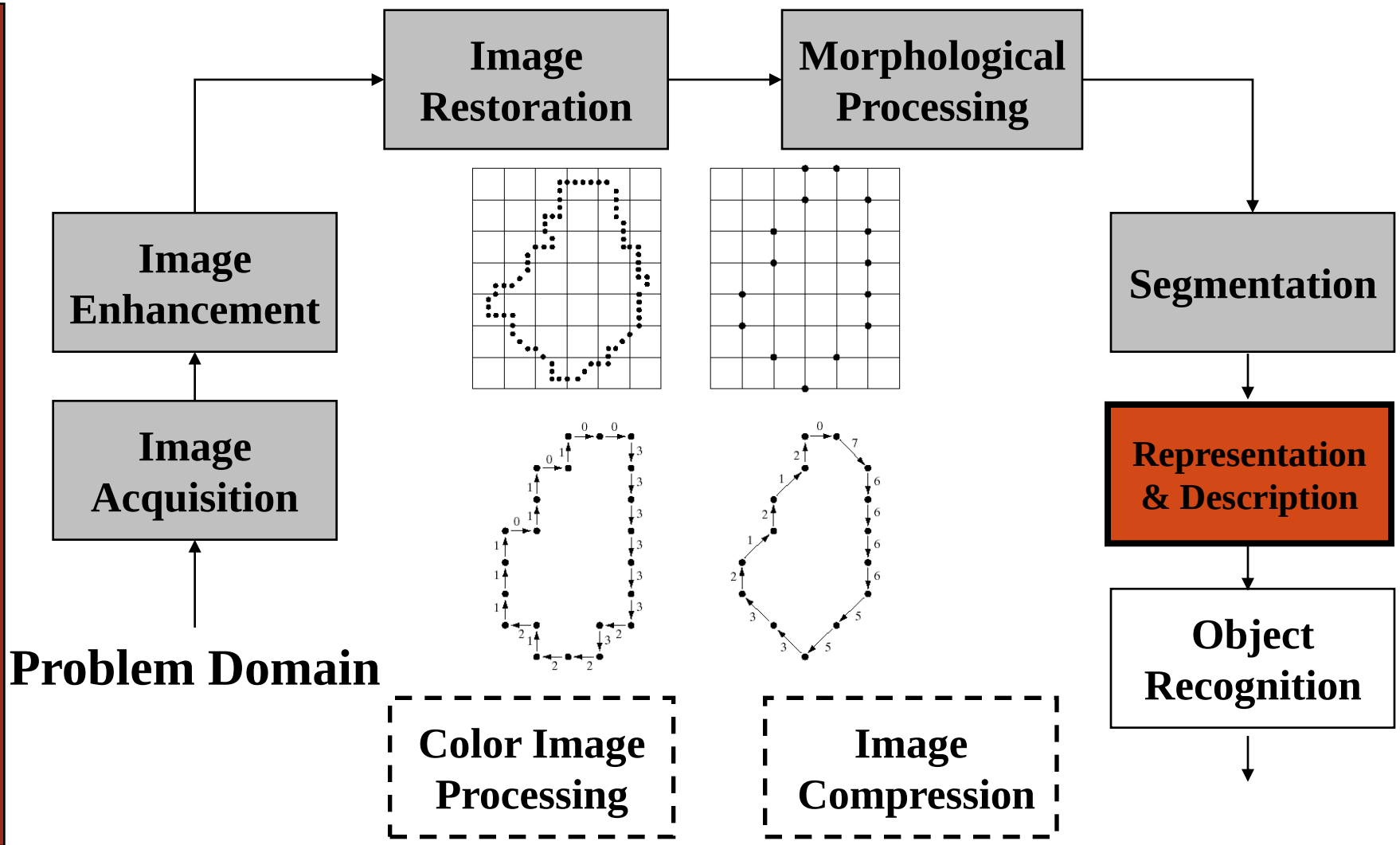
- Through Similarity the approach is based on partitioning an image into regions that are similar according to a set of predefined criteria. Thresholding, region growing, region splitting and merging are examples of methods in this category





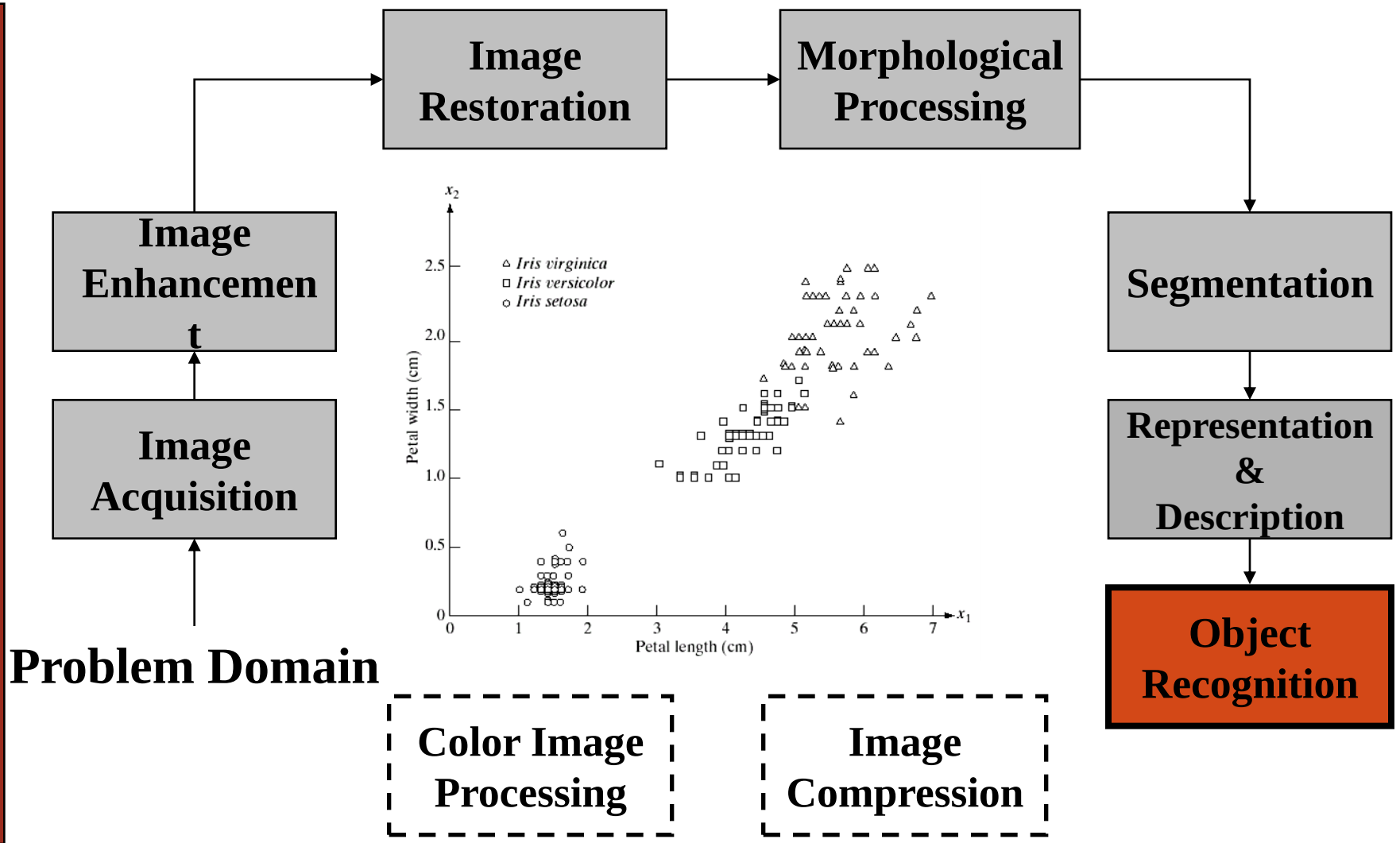


Key Stages in Digital Image Processing: Representation & Description



Images taken from Gonzalez & Woods, Digital Image Processing (2002)

Key Stages in Digital Image Processing:Object Recognition



Key Stages in Digital Image Processing: Image Compression

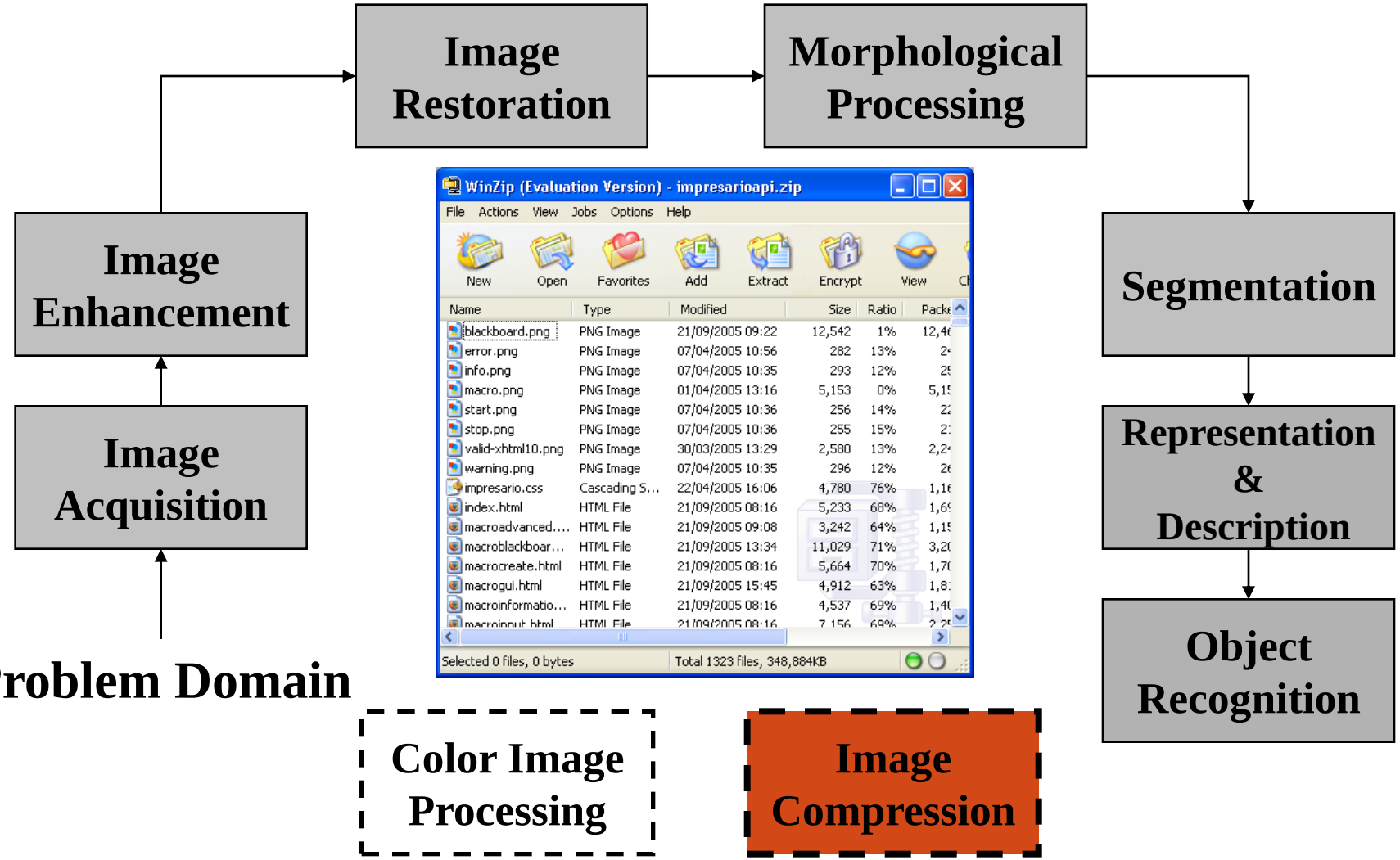


Image Compression

- Image compression is minimizing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level.

- The reduction in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the Internet or downloaded from Web pages.

- Image Compression methods can be based on either:

  - Lossy Compression methods

  - Lossless Compression methods

Image Compression

Original Image (lossless PNG, 60.1 KiB size) — uncompressed is 108.5 KiB

Medium compression (92% less information than uncompressed PNG, 4.82 KiB)

Low compression (84% less information than uncompressed PNG, 9.37 KiB)

High compression (98% less information than uncompressed PNG, 1.14 KiB)

Key Stages in Digital Image Processing: Color Image Processing

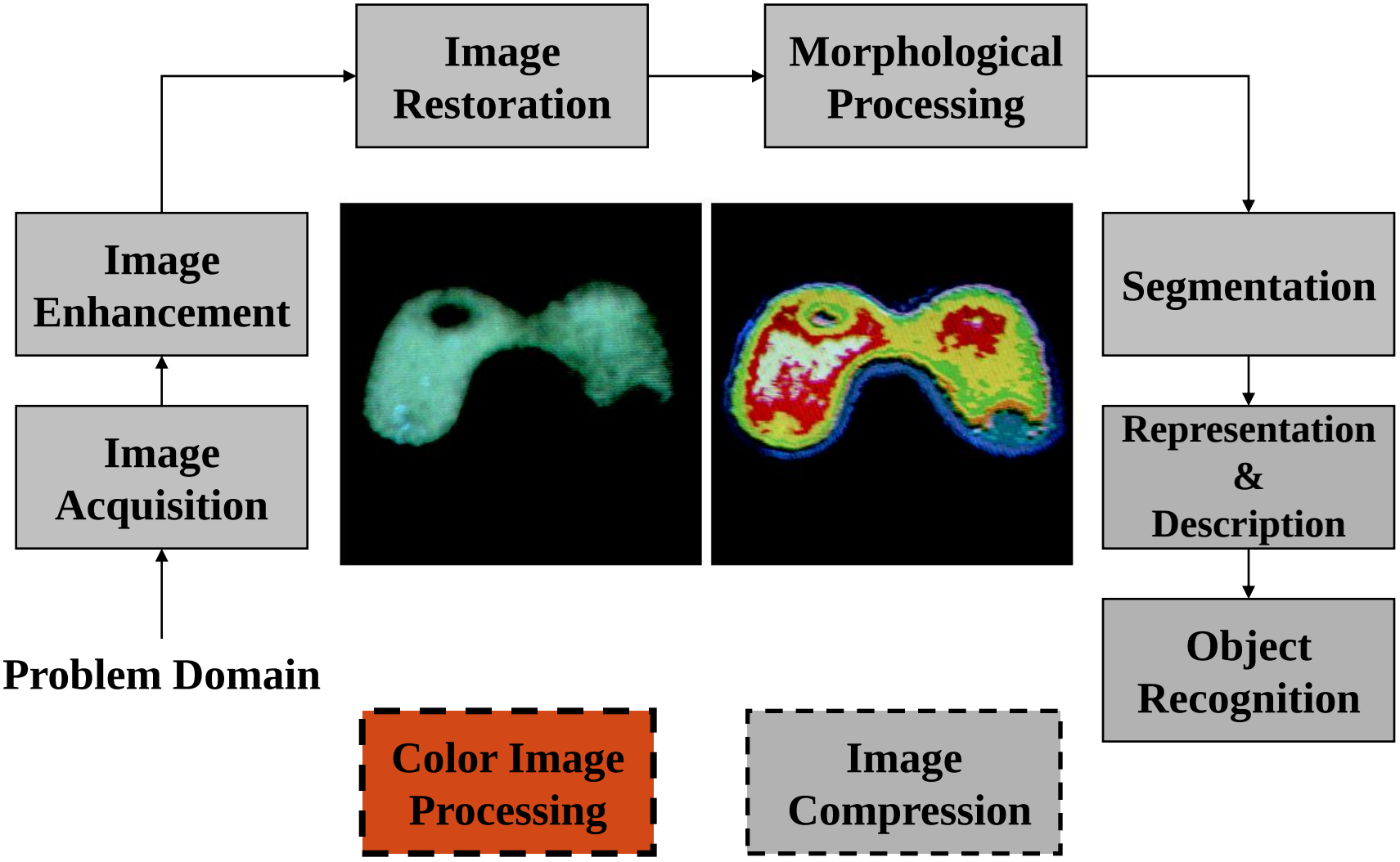
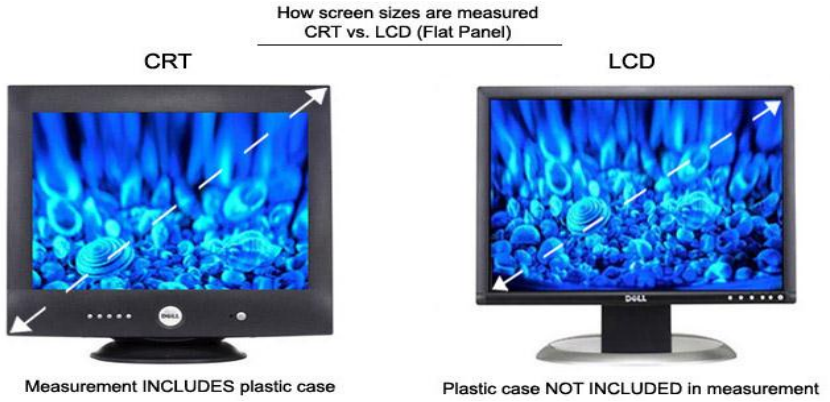


Image Processing Components

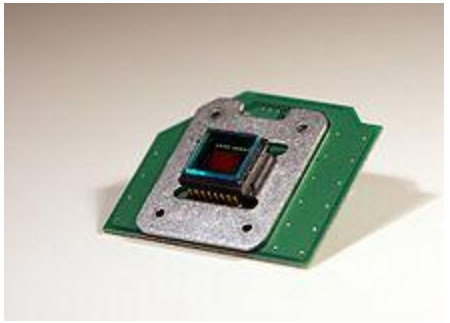
- Image Sensing device
- Storage Media
- Processing Systems
- Displays
- Communication Media
- Hardcopy devices (e.g Printer)
- Frame Grabber



Camera

- Lens (CMount, CSMount, Motorized)

- Optical Filter (Selectivity in EM waves)
- Imaging Sensor (CCD Sensor ,CMOS Sensor)



- Flash (Used for lighting/Illumination)
  - ❑ Front Illumination
  - ❑ Back Illumination

Camera Lens

- The function of the lens in the camera is to direct the light source to the camera sensor to help focusing the image.

- The main difference of the different lens brands will be the coating that they use.

- Different lens coating will give varying results from sharpness to color reproduction.

- Some "legendary" brands of camera/lens are Carl Zeiss, Leica, Schneider Kreuchnach, etc

Camera Filter/Optical Filter

- Camera filters alter the properties of light entering the camera lens for the purpose of improving the image being recorded.

- The filter can be a square or oblong shape mounted in a holder accessory, or , more commonly, a glass or plastic disk with a metal or plastic ring frame, which can be placed in front of the lens

- Filters can affect contrast, sharpness, highlight flare, color, and light intensity, either individually, or in various combinations.

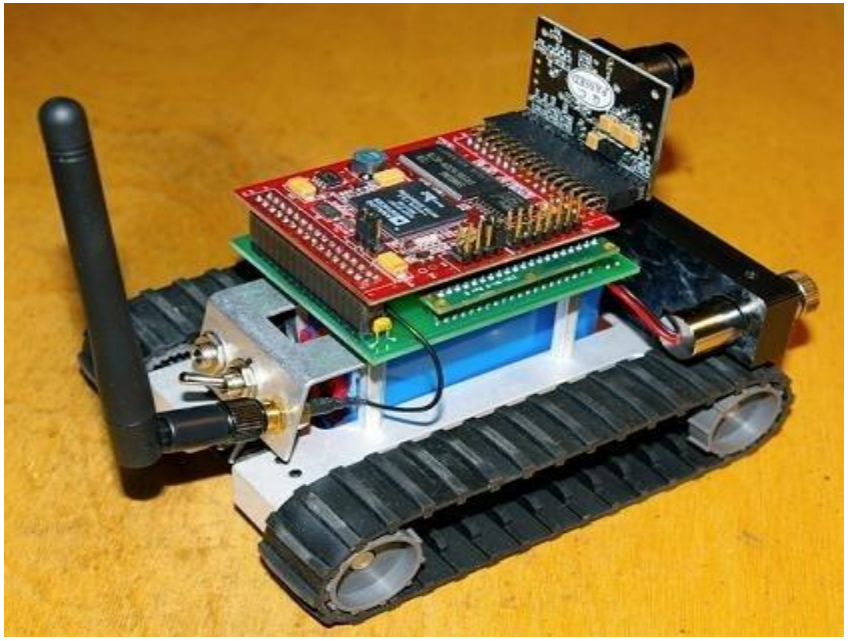
- The negative aspects of using filters, though often negligible, include the possibility of loss of image definition if using dirty or scratched filters

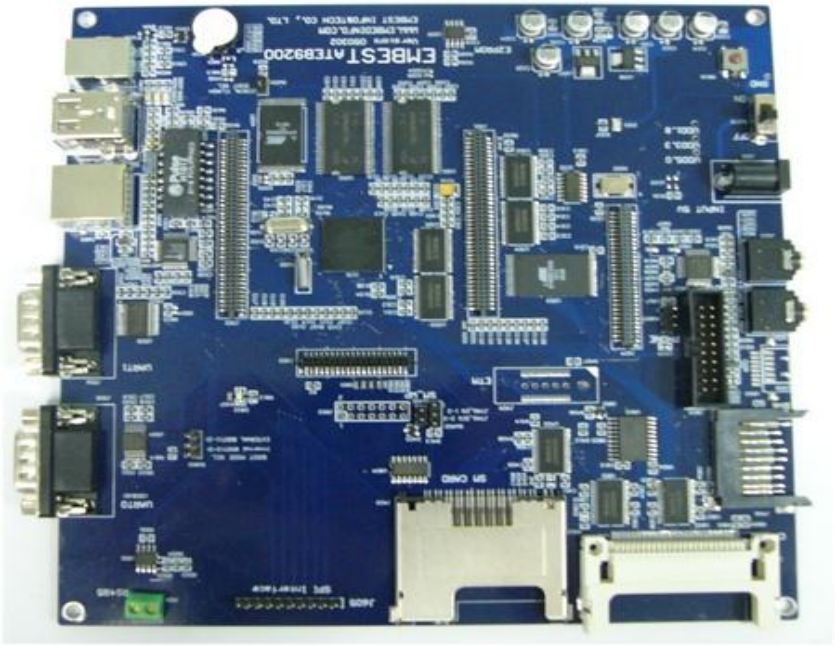
Processing systems

- PC based
  - General purpose PCs
  - Servers
  - Industrial PCs

Processing systems

- Embedded system based
  - DSP processor based
  - FPGA based
  - System on chip (SoC)





Frame Grabber

- A component of a computer vision system, in which video frames are captured in digital form and then displayed, stored or transmitted in raw or compressed digital form.

- Frame Grabber can be Analog as well as Digital

- Early frame grabbers had only enough memory to acquire (i.e., "grab") and store a single digitized video frame

- Modern frame grabbers are typically able to store multiple frames and compress the frames in real time using algorithms such as MPEG2 & JPEG

- Frame Grabber Types

  - **Active Frame Grabber**

    Frame grabbers that perform compression on the video frames are referred to as "Active Frame Grabbers".

  - **Passive Frame Grabber**

    Frame grabbers that simply capture the raw video data are referred to as "Passive Frame Grabbers."

Any question