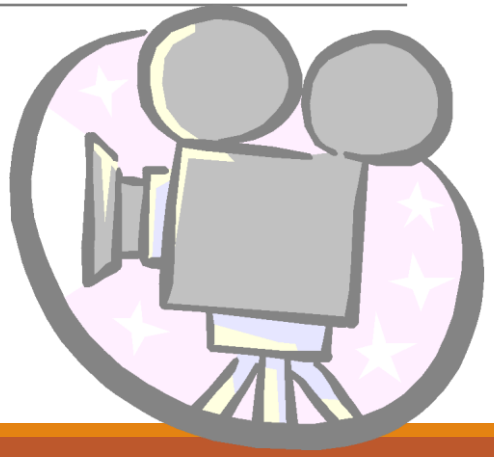
Image Processing

CS-317/CS-341



Outline

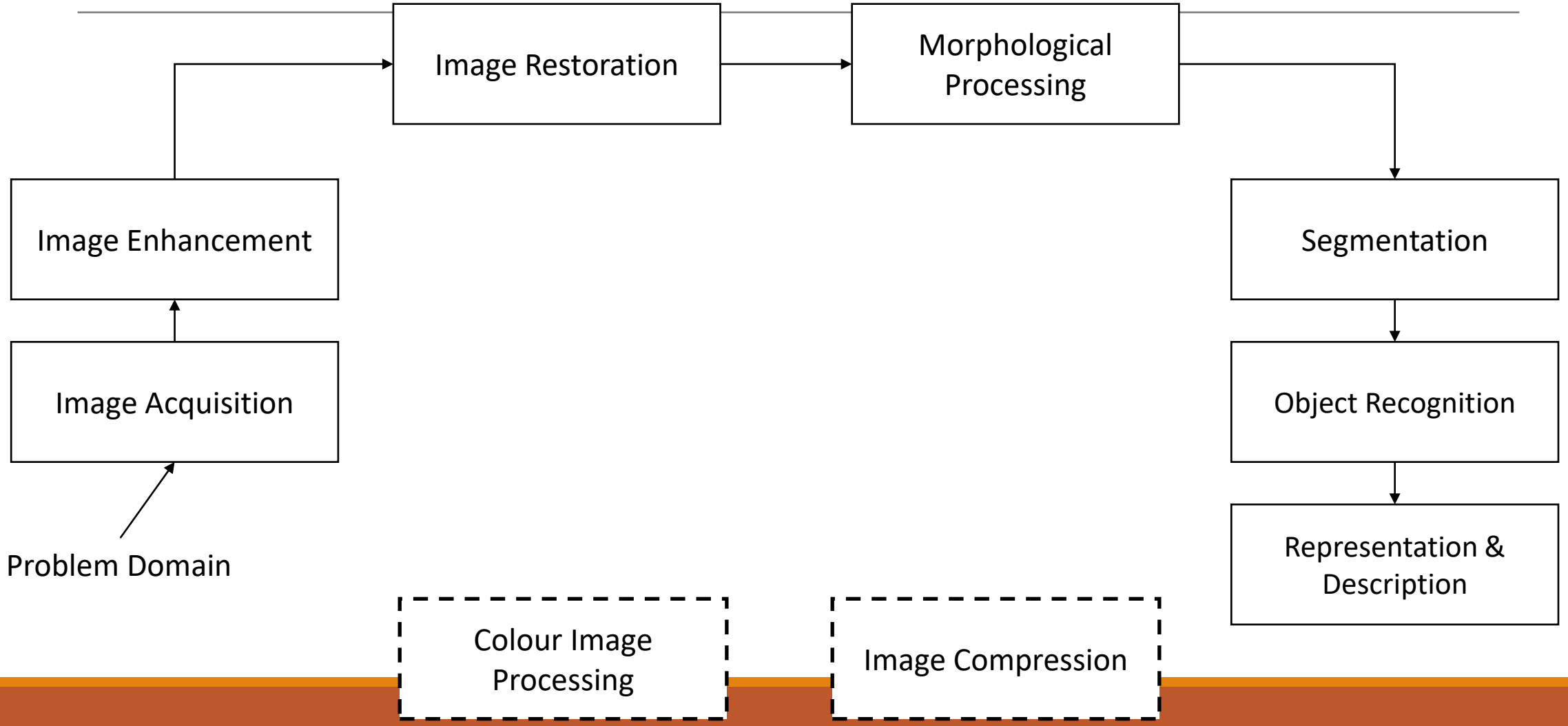
- Fundamental steps in DIP
- Elements of Visual Perception
  - Structure of Human Eye

Key Stages in Digital Image Processing

- Methods Whose Input and Output are Images

- Methods Whose Inputs are Images but Outputs are Attributes, extracted from these Images

Key Stages in Digital Image Processing



Key Stages in Digital Image Processing: Image Aquisition

Problem Domain

Image Acquisition

Image Enhancement

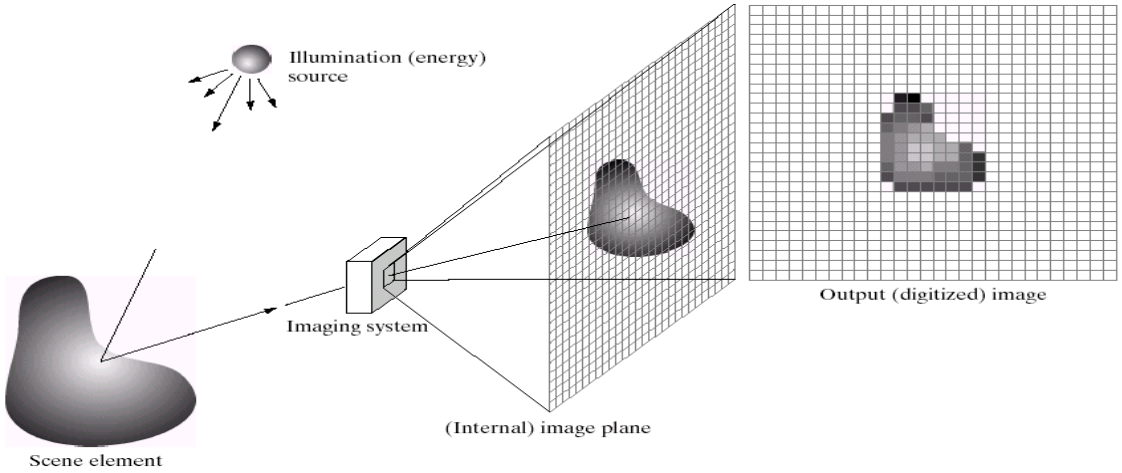
Image Restoration

Morphological Processing

Segmentation

Object Recognition

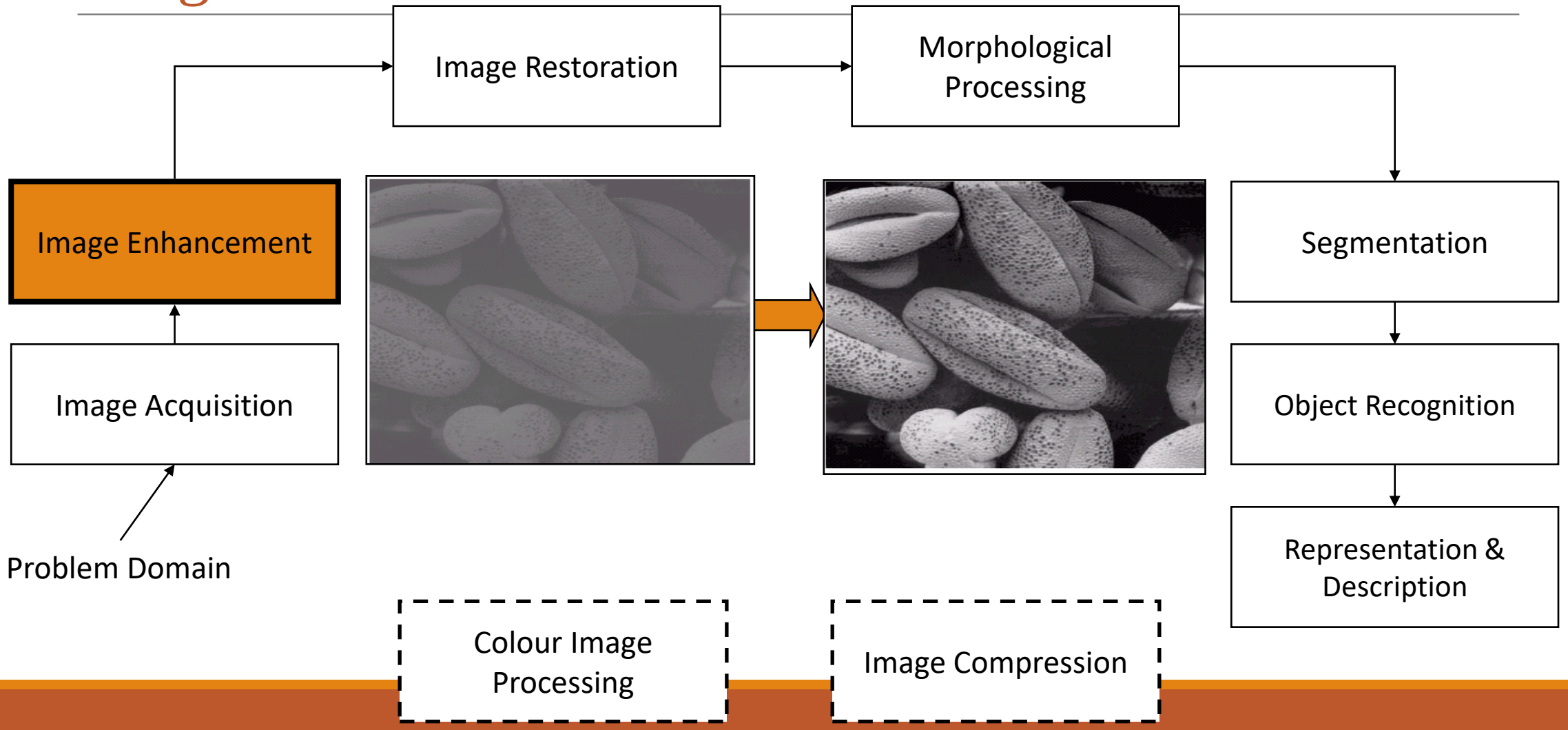
Representation & Description



Colour Image Processing

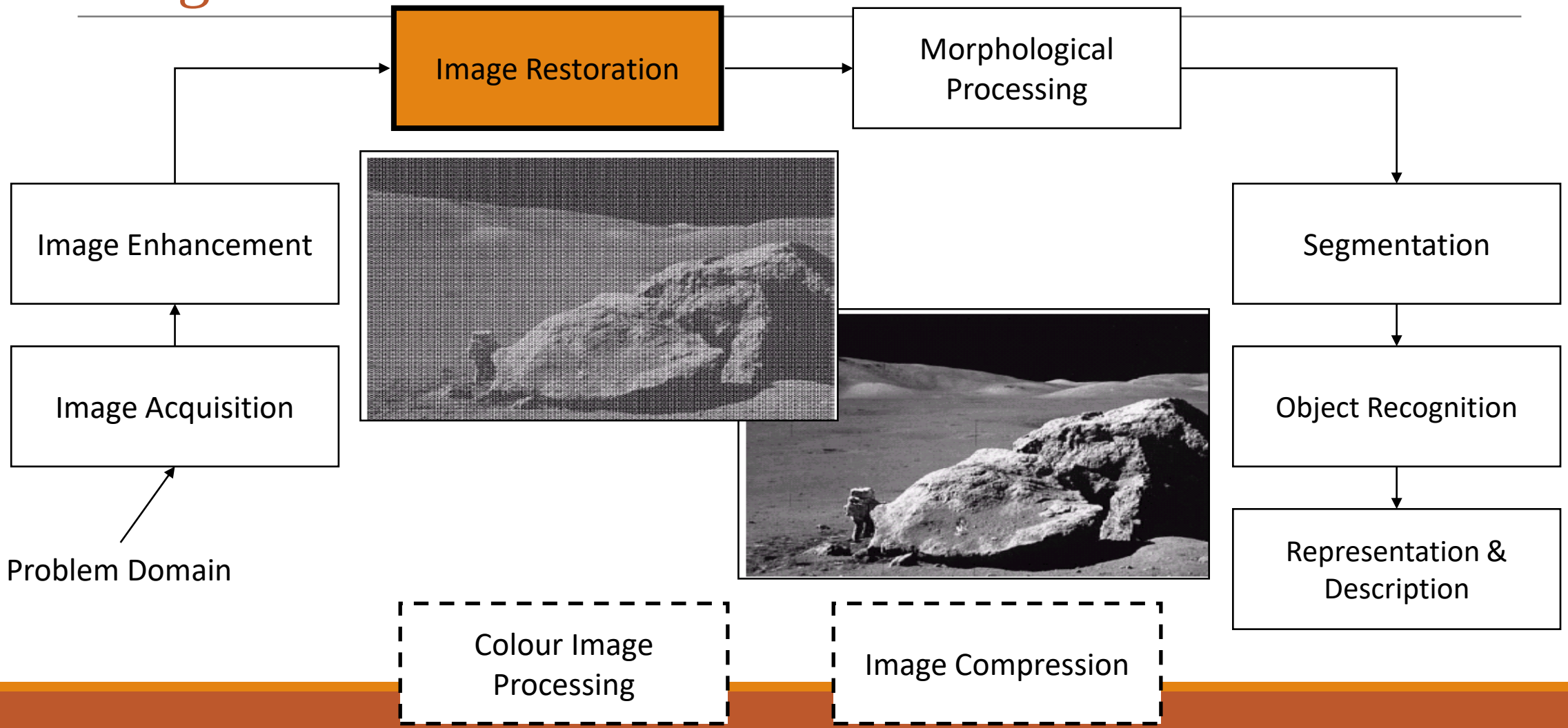
Image Compression

Key Stages in Digital Image Processing: Image Enhancement



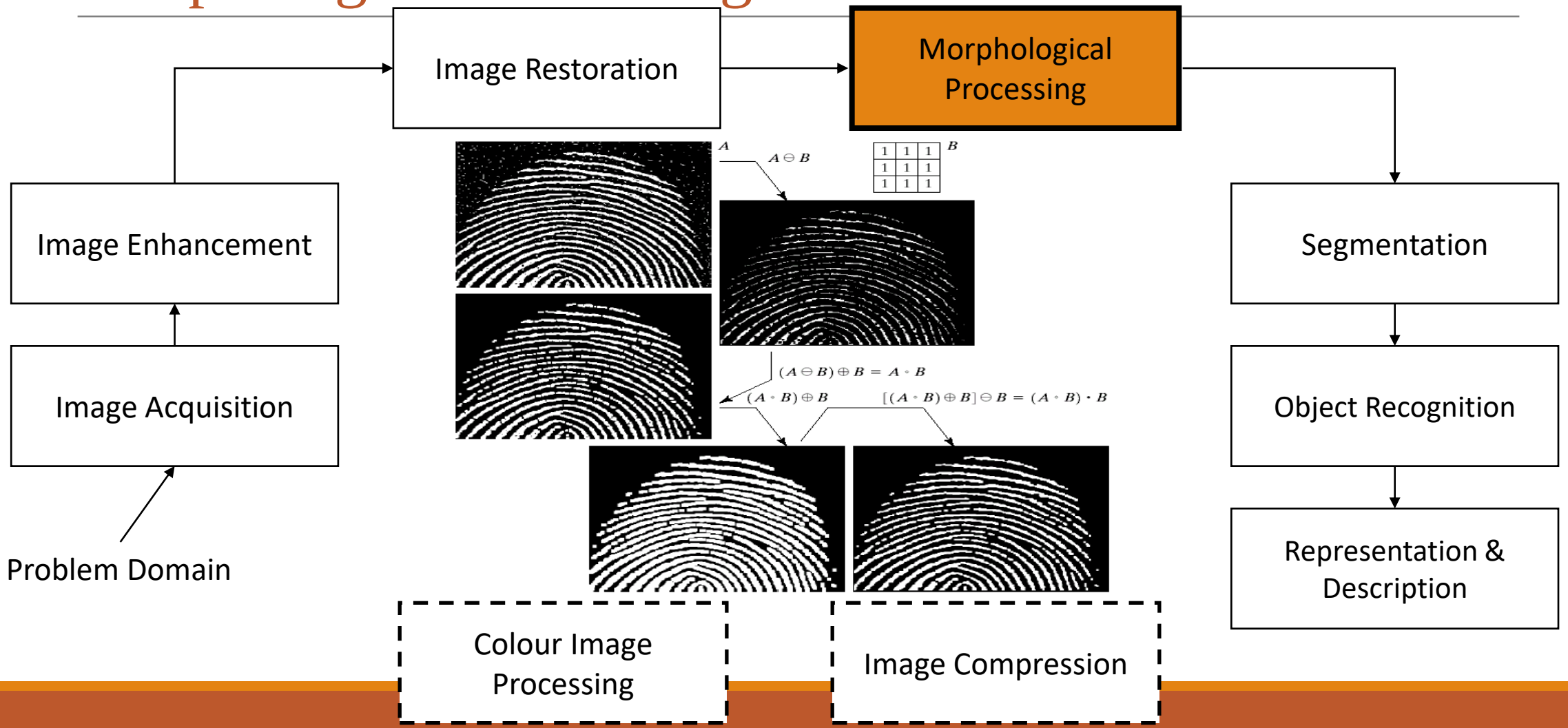
Images taken from Gonzalez & Woods, Digital Image Processing (2002)

Key Stages in Digital Image Processing: Image Restoration



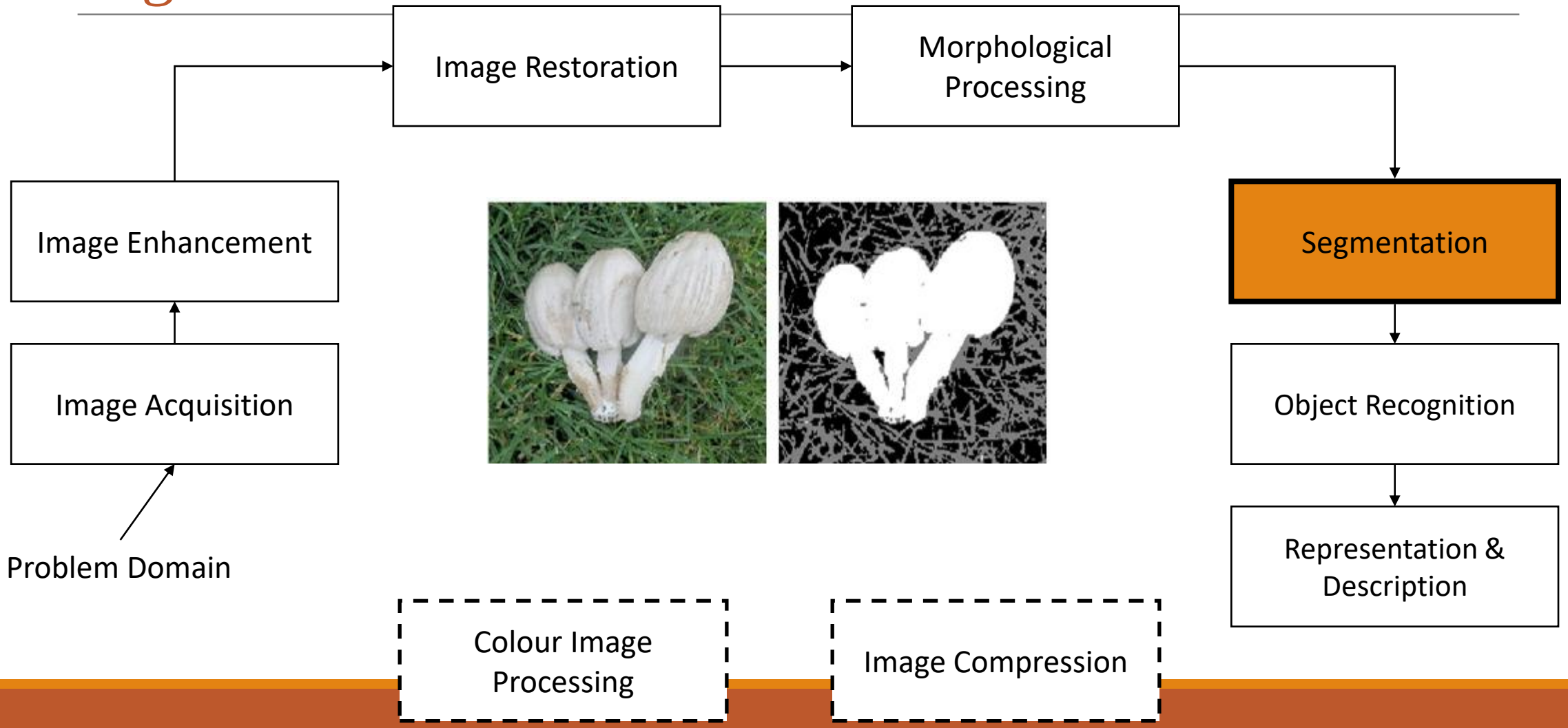
Images taken from Gonzalez & Woods, Digital Image Processing (2002)

Key Stages in Digital Image Processing: Morphological Processing



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

Key Stages in Digital Image Processing: Segmentation



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

Key Stages in Digital Image Processing: Object Recognition

Image Restoration

Morphological Processing

Segmentation

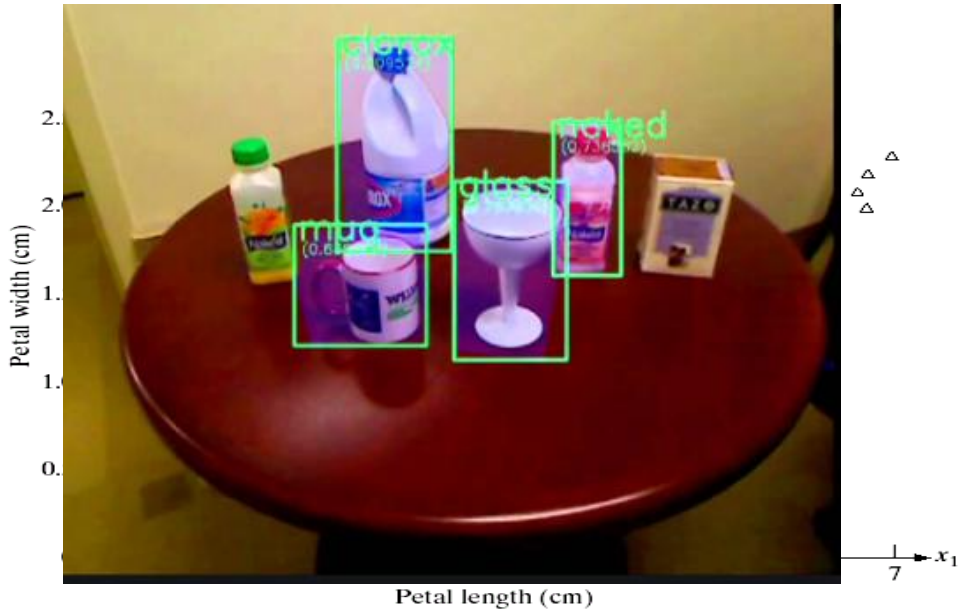
Object Recognition

Representation & Description

Image Enhancement

Image Acquisition

Problem Domain

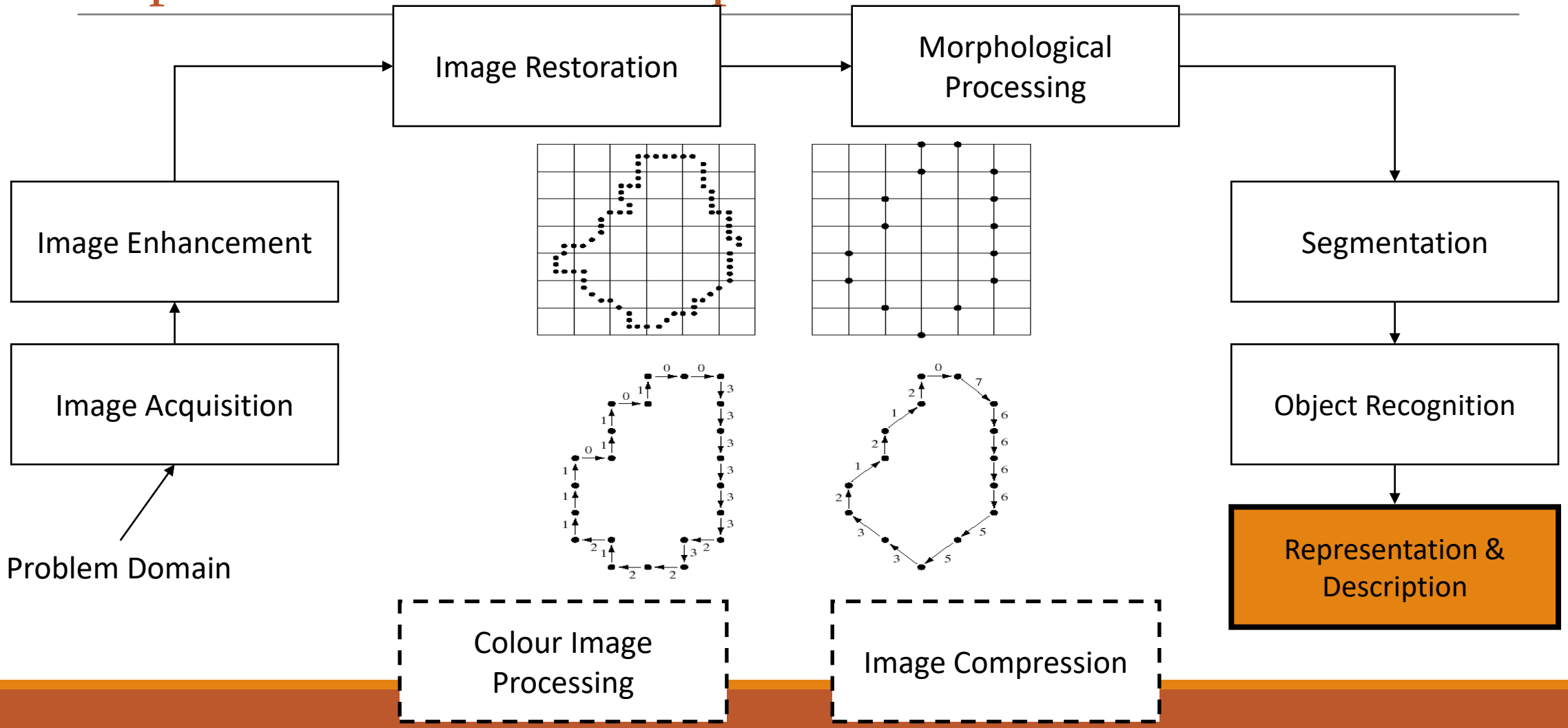


Colour Image Processing

Image Compression

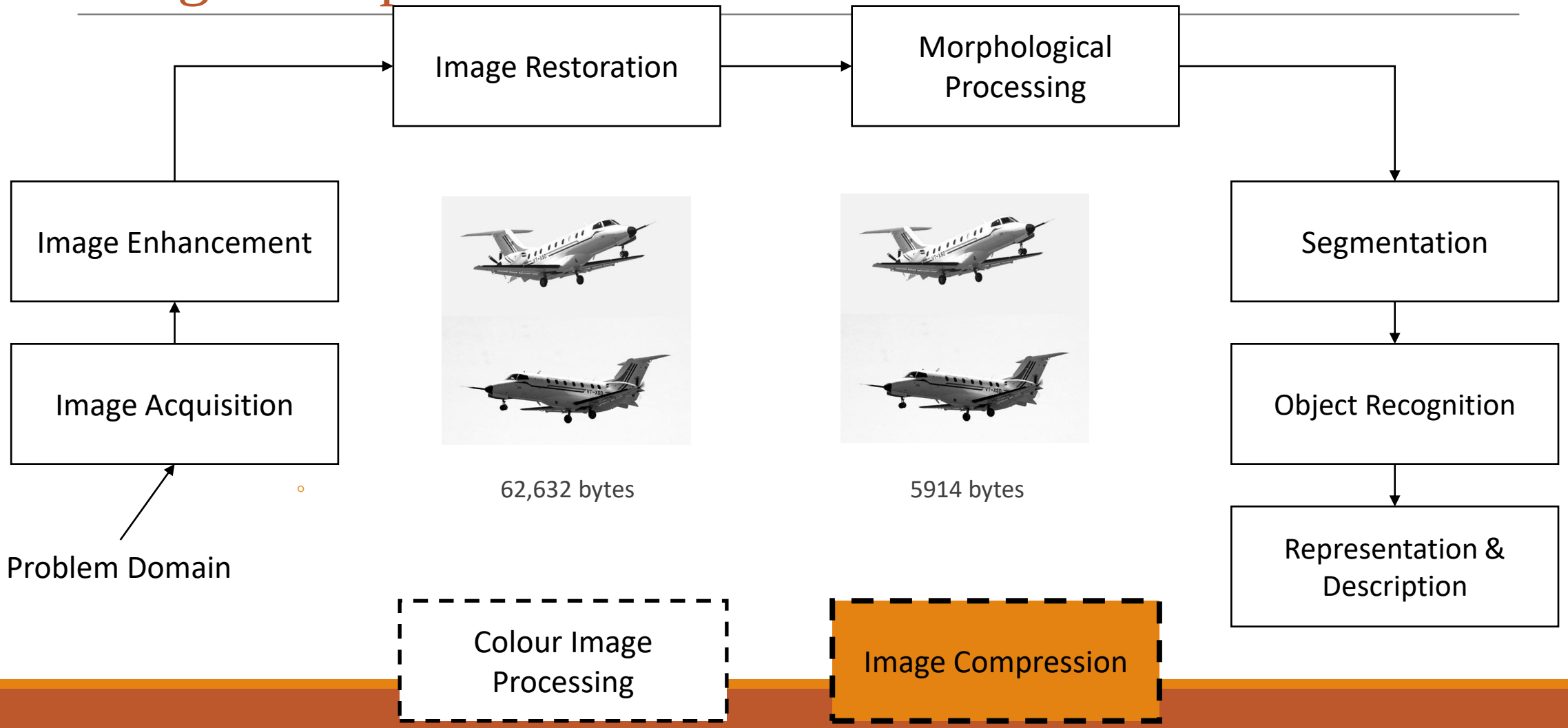
Images taken from Gonzalez & Woods, Digital Image Processing (2002)

Key Stages in Digital Image Processing: Representation & Description



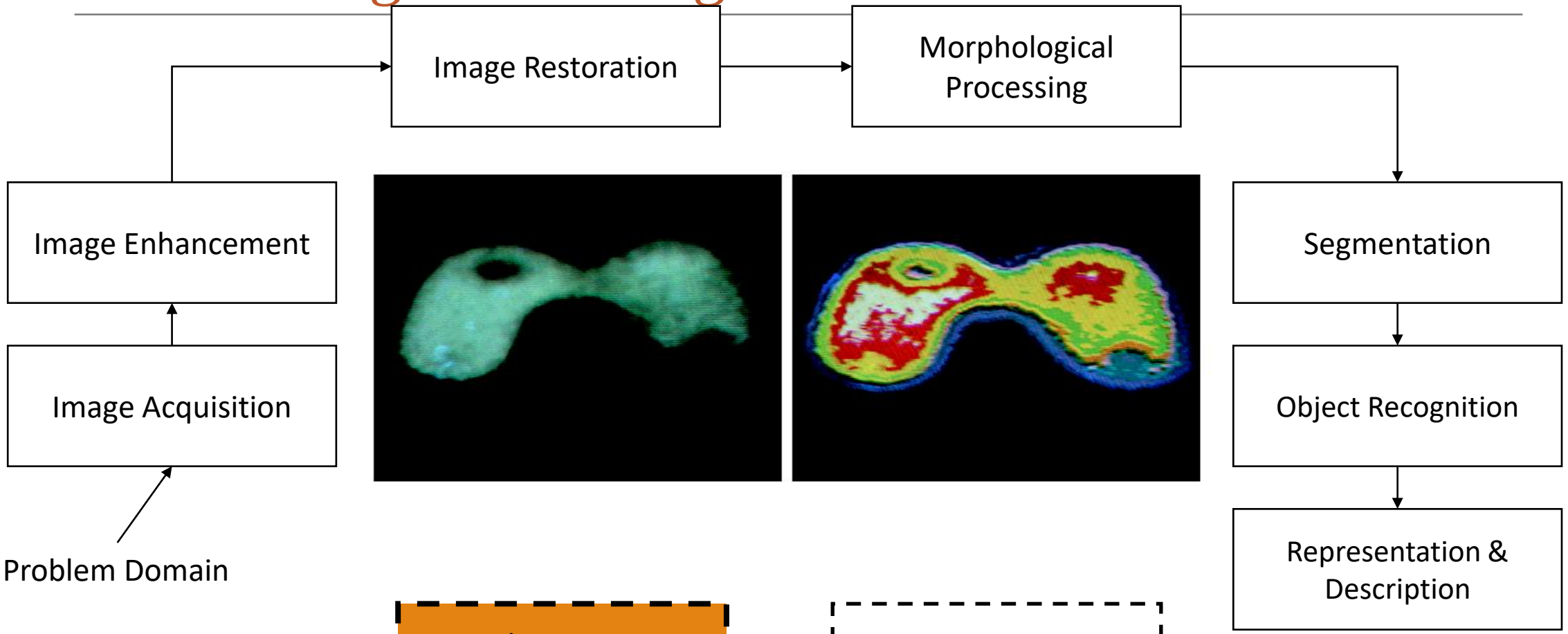
Images taken from Gonzalez & Woods, Digital Image Processing (2002)

Key Stages in Digital Image Processing: Image Compression



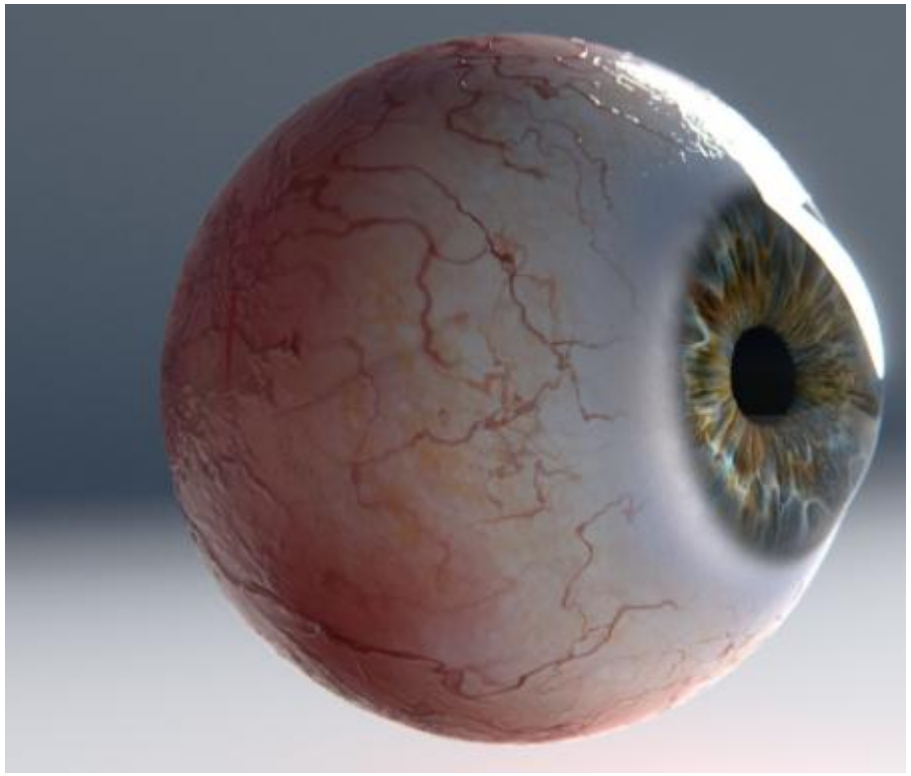
Images taken from Gonzalez & Woods, Digital Image Processing (2002)

Key Stages in Digital Image Processing: Colour Image Processing



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

Structure of Human Eye



- Shape is nearly sphere
- Average diameter = 20 mm
- Consists of 3 membranes:
- Cornea and sclera : Outer Cover
- Choroid
- Retina- enclose the eye

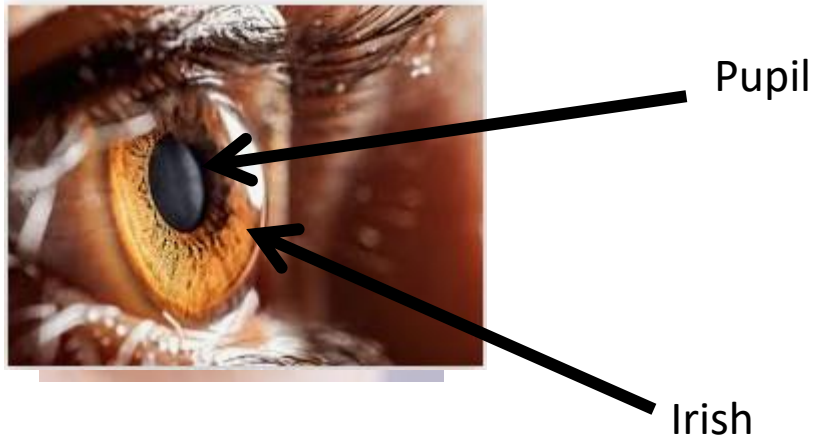
Images taken from Gonzalez & Woods, Digital Image Processing (2002)

Structure of Human Eye

Brown eye, Blue eye?

Iris have pigment, which reflects specific type of light

Black spot on the iris is called pupil, through which light enters in the eye.

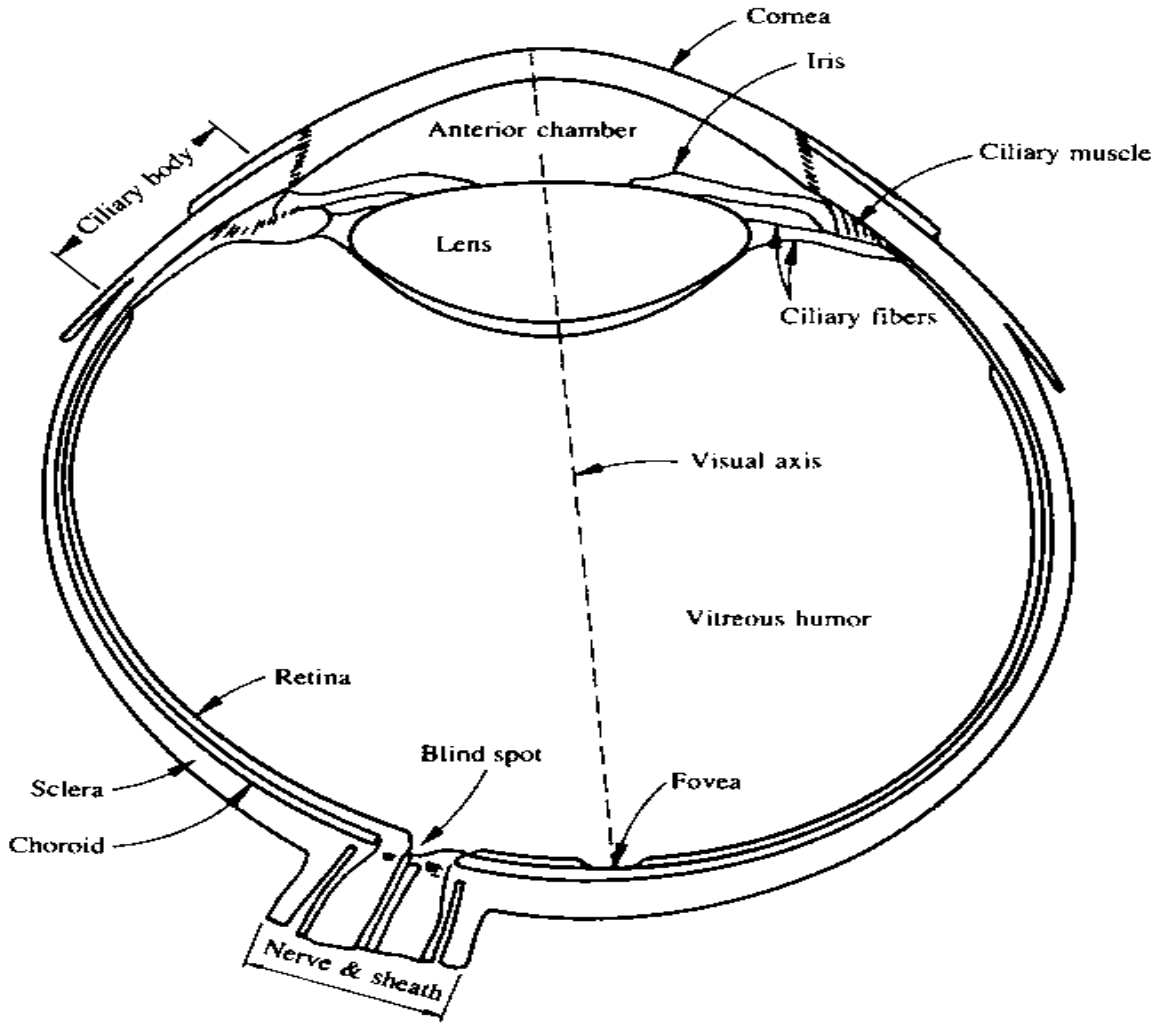


- Iris: contracts or expands to control amount of light
- Pupil: central opening of iris, 2 to 8 mm in diameter

High absorption in infrared and ultraviolet (can cause damage to eye)

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

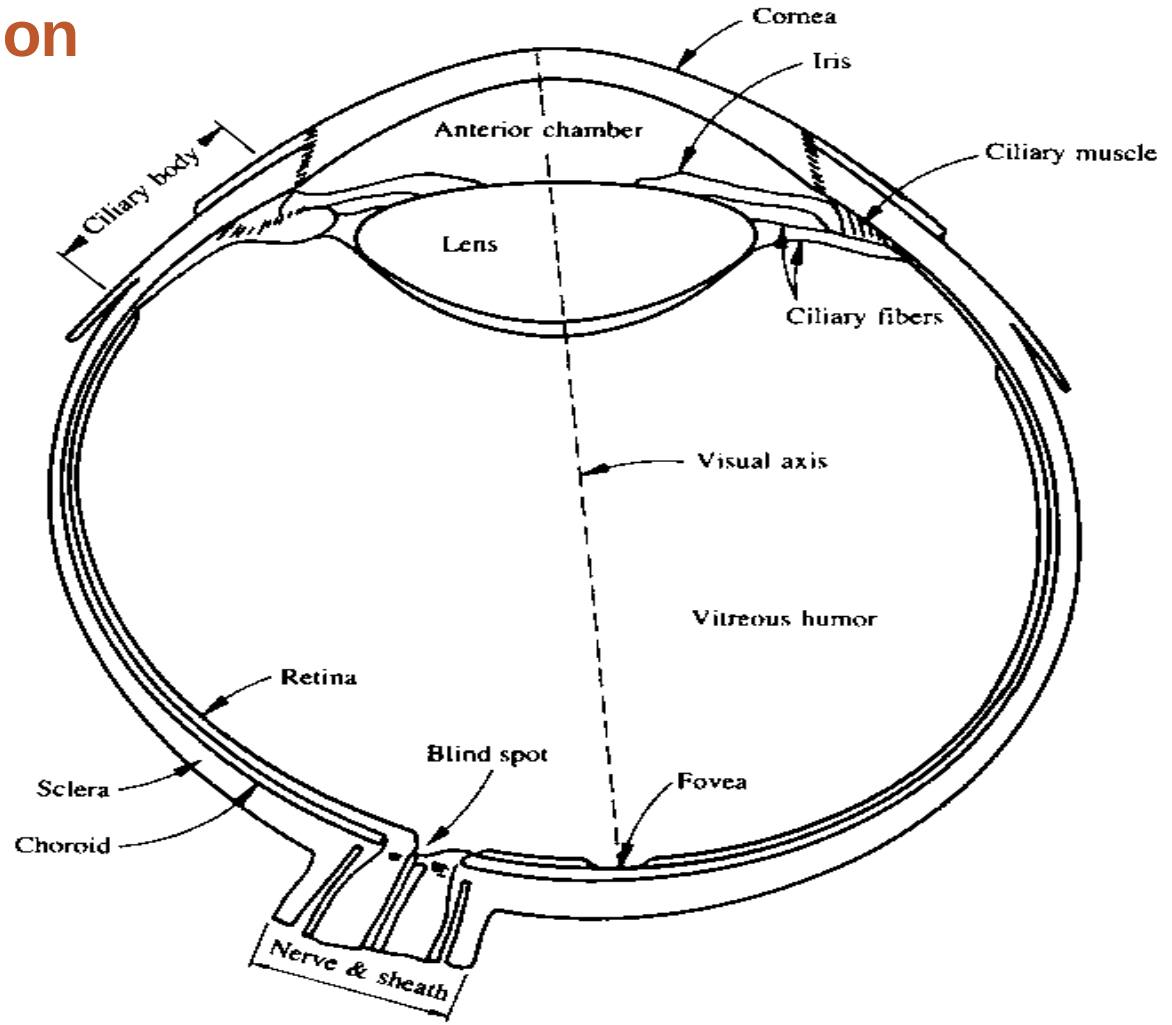
- Shape is nearly sphere
- Average diameter = 20 mm
- Consists of 3 membranes:
- Cornea and sclera : Outer Cover
- Choroid
- Retina- enclose the eye



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

Elements of Visual Perception

- **Cornea :**
  - tough, transparent tissue, covers the anterior surface of the eye.
- **Sclera :**
  - Opaque membrane, encloses the remainder of the optic globe.
- **Choroid :**
  - Lies below the sclera, contains network of blood vessels that serve as the major source of nutrition to the eye.
  - Choroid coat is heavily pigmented and hence helps to reduce the amount of extraneous light entering the eye and the backscatter within he optical globe.



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

Elements of Visual Perception

•

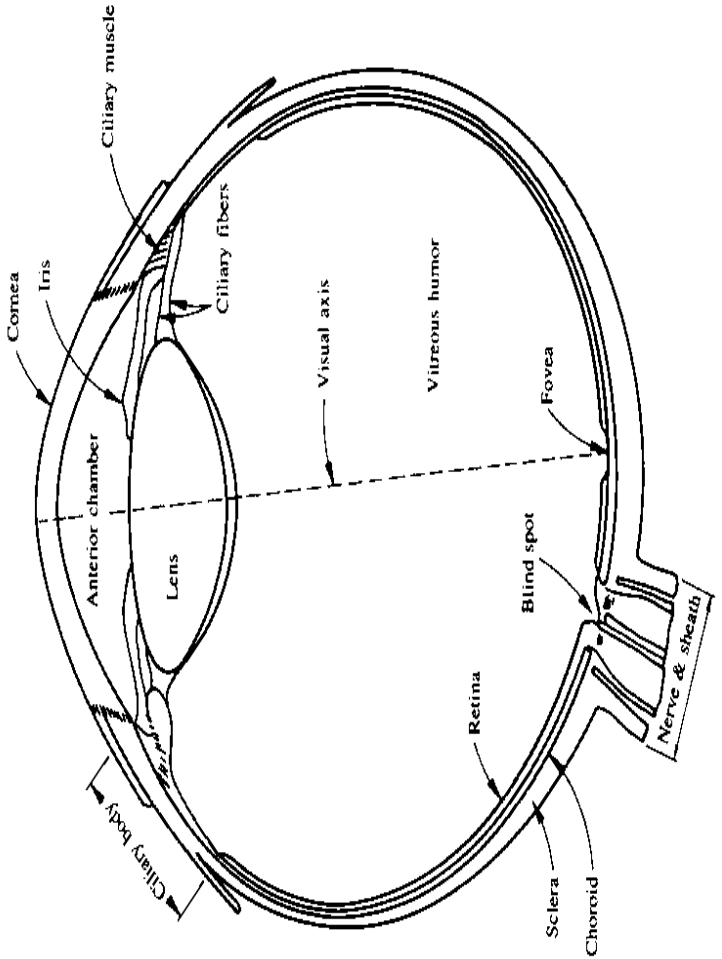
•Lens focus the image on retina

•The area between Cornea and lens is filled with water called aqueous humor.

•Maximum refraction take place at Cornea, when light enters from air to Cornea then through lens an image is formed on retina.

Retina is made of light sensitive cells which activates when light falls on it.

This light is further converted into electrical signals, which reaches to brain through optic nerves.

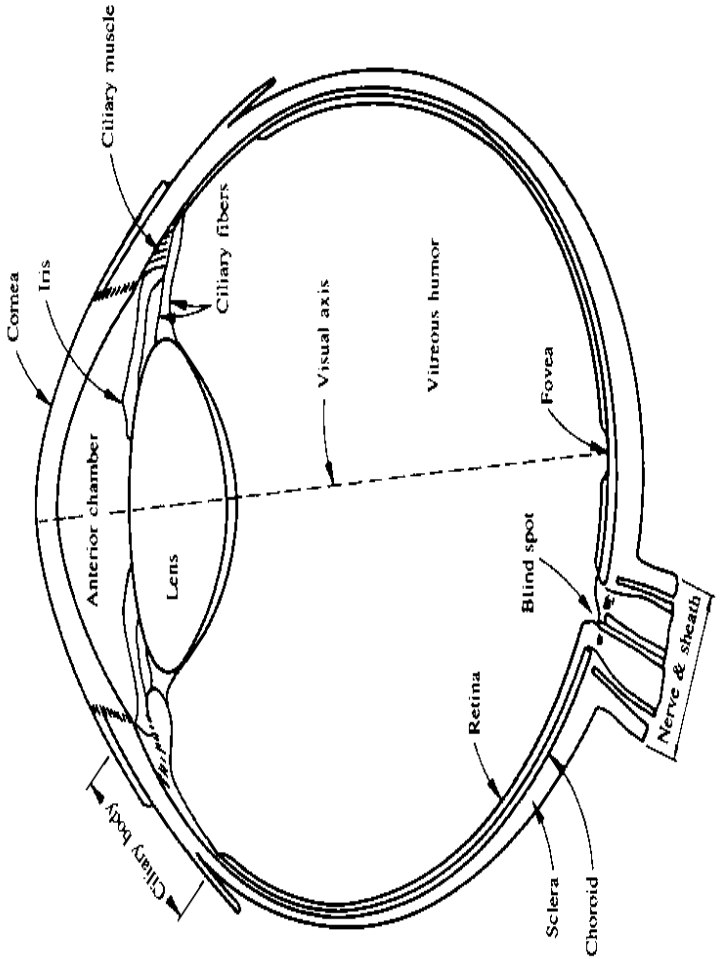


Images taken from Gonzalez & Woods, Digital Image Processing (2002)

Elements of Visual Perception

The portion between retina and lens is called Vitreous humor (jelly or glassy), it provides support to eye ball.

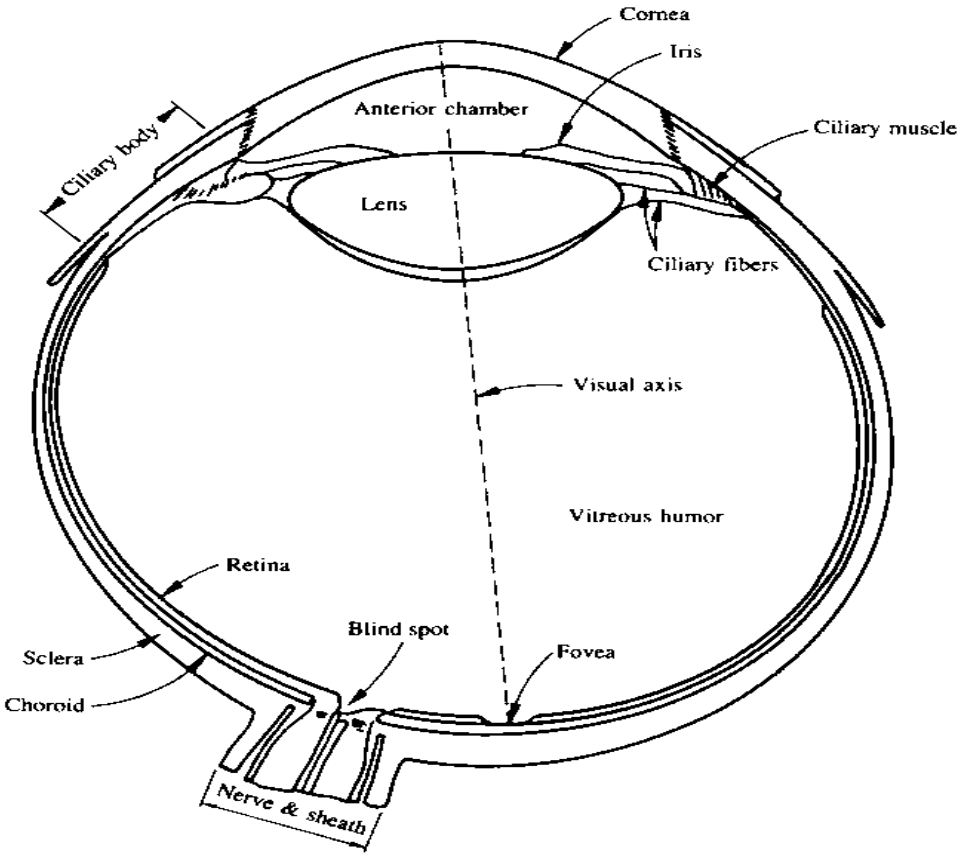
Cilliary muscle can change the shape of lens.



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

Elements of Visual Perception

- **Lens:**
  - Focuses light on retina.
  - Contains 60% to 70% water.
  - Absorbs 8% of visible light.
  - High absorption in infrared and ultraviolet (can cause damage to eye).
- **Retina:**
  - The inner most layer, covers the posteriori portion of eye.
  - When eye is properly focused, light of an object is imaged on the retina.
  - Light receptors are distributed over the surface of retina.



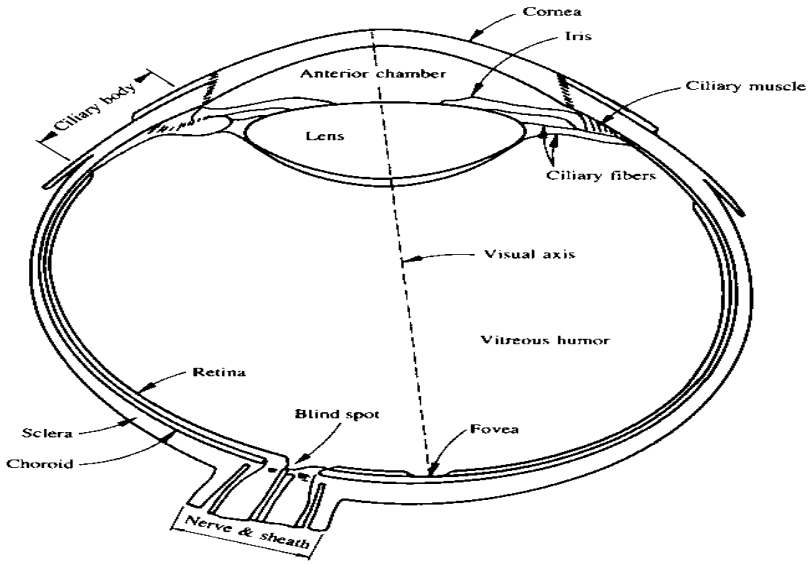
Images taken from Gonzalez & Woods, Digital Image Processing (2002)

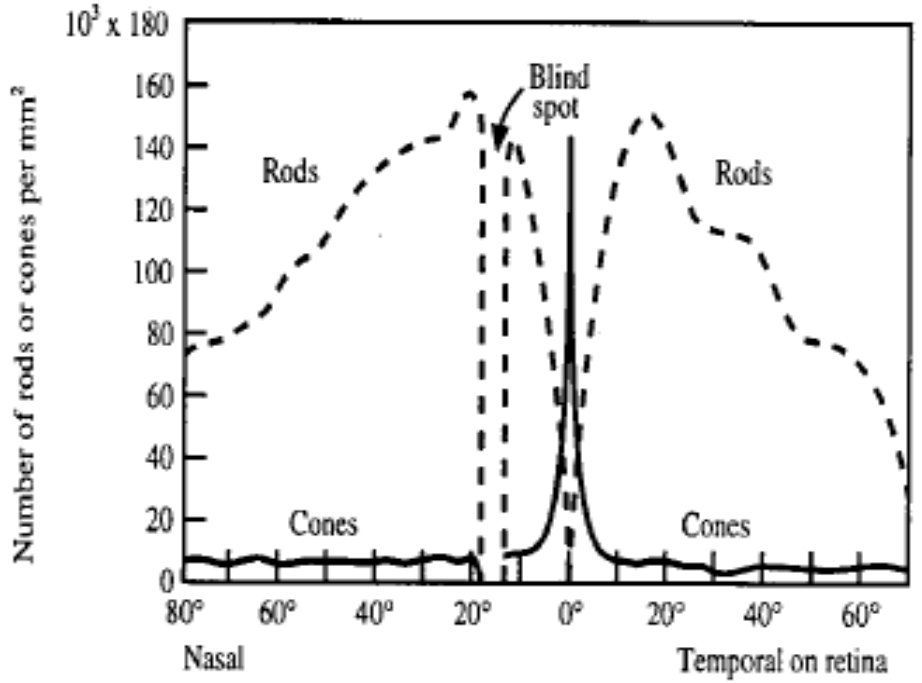
Elements of Visual Perception

Structure of the Human Eye ....

Retina: contains light receptors - Cones & Rods

- **Cones**:
  - 6 to 7 million
  - located mainly in central part of retina fovea (muscles controlling the eye rotate the eyeball until the image falls on the fovea)
  - High sensitive to color,
  - Can resolve fine details because each one is connected to its own nerve.
  - Cone vision: photopic or bright-light vision.
- **Rods:**
  - 75 to 150 million, Distributed a wide region on the retina surface.
  - Several rods are connected to a single nerve end reduce the amount of detail observation.
  - Serve to give a general, overall picture of the field of view.
  - Not involved in color vision, responsible for low level of illumination.
  - Rod vision is called scotopic or dim-light vision.

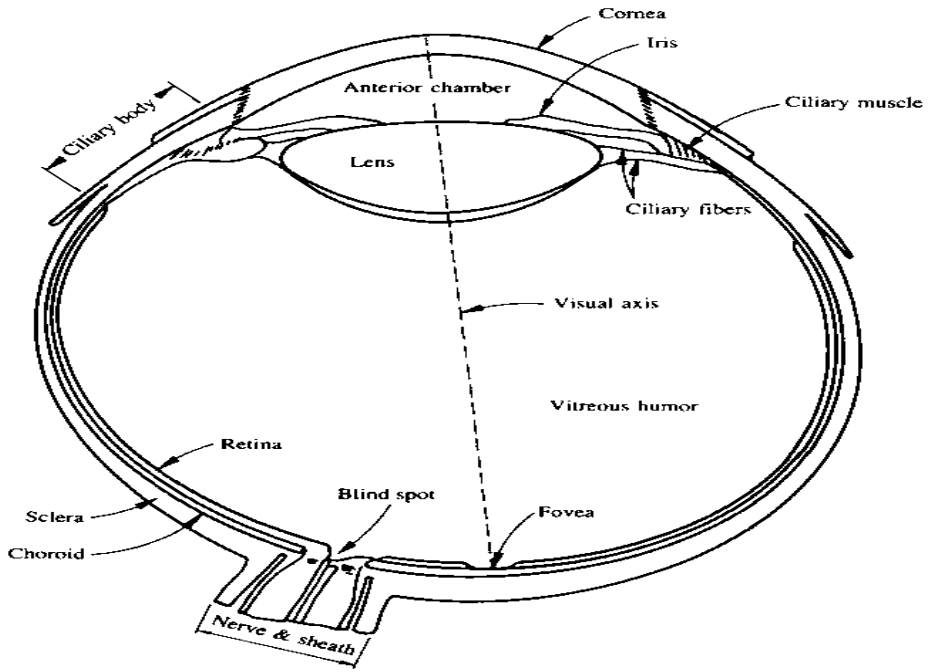




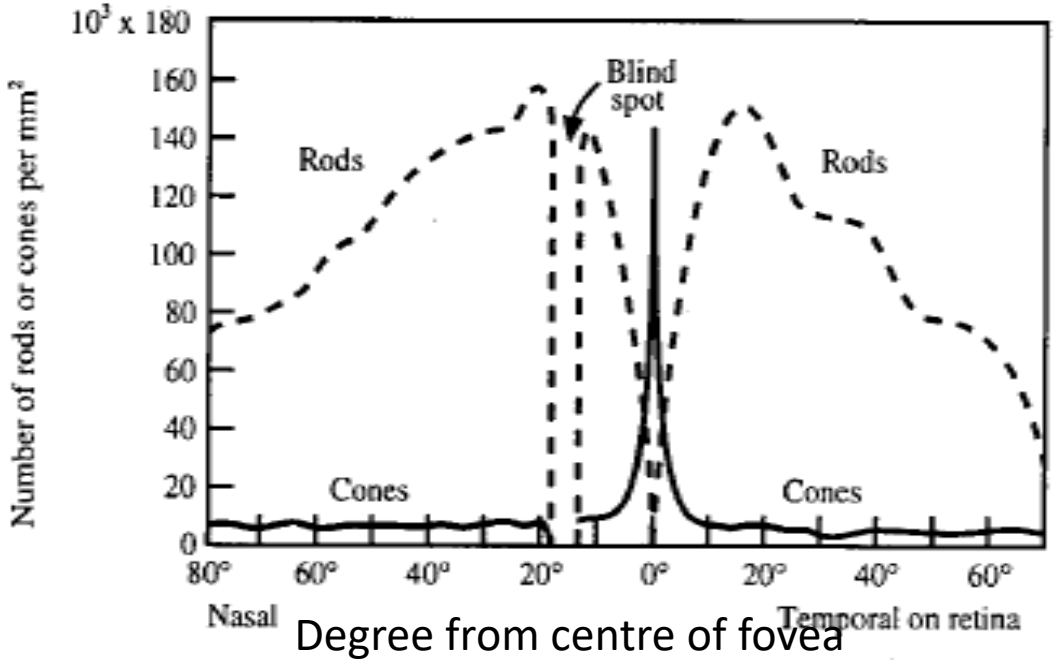
Images taken from Gonzalez & Woods, Digital Image Processing (2002)

Elements of Visual Perception

- **Blind spot:** A region of retina without receptors, optic nerves go through this part.
- **Fovea:** A circular area of about 1.5 mm in diameter.



- - - Rods
___ Cones



Except for blind spot the distribution of receptors is radially symmetric about the fovea.
Receptors density is measured in degrees from the fovea.

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

Suggested Readings

- **Digital Image Processing by Rafel Gonzalez, Richard Woods, Pearson Education India, 2017.**

- **Fundamental of Digital image processing by A. K Jain, Pearson Education India, 2015.**

Thank you