

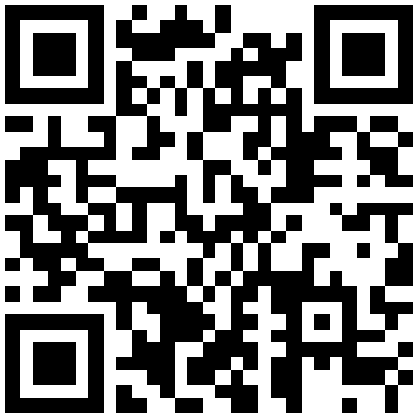
# Introduction: Image Informatics

Dr Deepayan Bhowmik

# Ice breaker

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- ▶ Group of 3-4 and discuss on
  - ▶ What is image informatics?
  - ▶ Where can we use it?
- ▶ Write most important 3 words about image informatics



Join at  
**slido.com**  
**#2872 961**

# Why Image Informatics?

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- ▶ **Computer Vision:**

- ▶ Essential for many applications from day-to-day tasks to medical, remote sensing, and many more etc.

- ▶ **Image Processing:**

- ▶ Fundamental underpinning theory behind digital image processing.

- ▶ **Deep learning:**

- ▶ Advancement to many vision tasks over traditional techniques

- ▶ This module will teach the fundamentals of image processing and computer vision, and basic use of deep learning in vision algorithm developments.

# Module Teaching

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- ▶ Lectures
- ▶ Lab
- ▶ Self-directed learning (reading, doing assignments, homework, and so on)
- ▶ May also instigate drop-in clinic, as required.
- ▶ Assessments
  - ▶ Assignment 100%

# Module Outline

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- ▶ Fundamental image processing and computer vision
- ▶ Image transformations
- ▶ Filtering
- ▶ Histogram
- ▶ Colour
- ▶ Fourier
- ▶ Segmentation
- ▶ Mathematical Morphology
- ▶ Convolutional Neural Network (CNN) and its application in vision

# Introduction to Image processing

Dr Deepayan Bhowmik

# Reading list

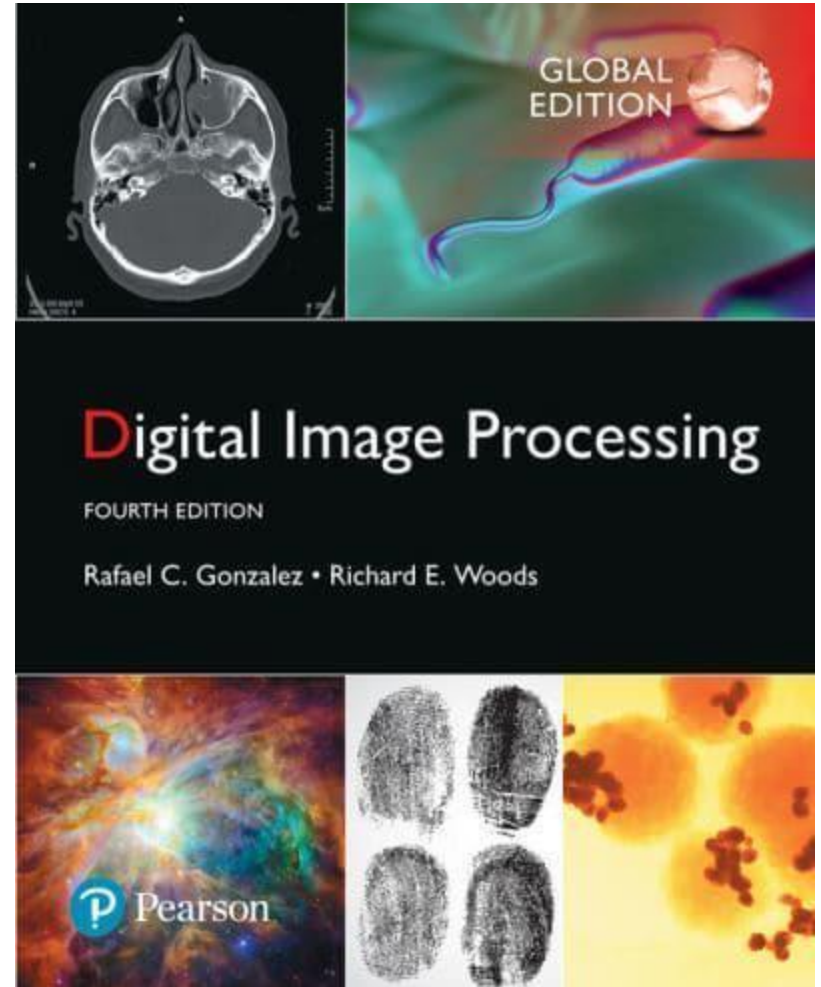
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## Digital Image Processing

Rafael C. Gonzalez (author),  
Richard E. Woods (author)

We will cover many topics in this text book

We will also include special topics on recent  
progresses on image processing and  
computer vision



# Major topics covered in this part

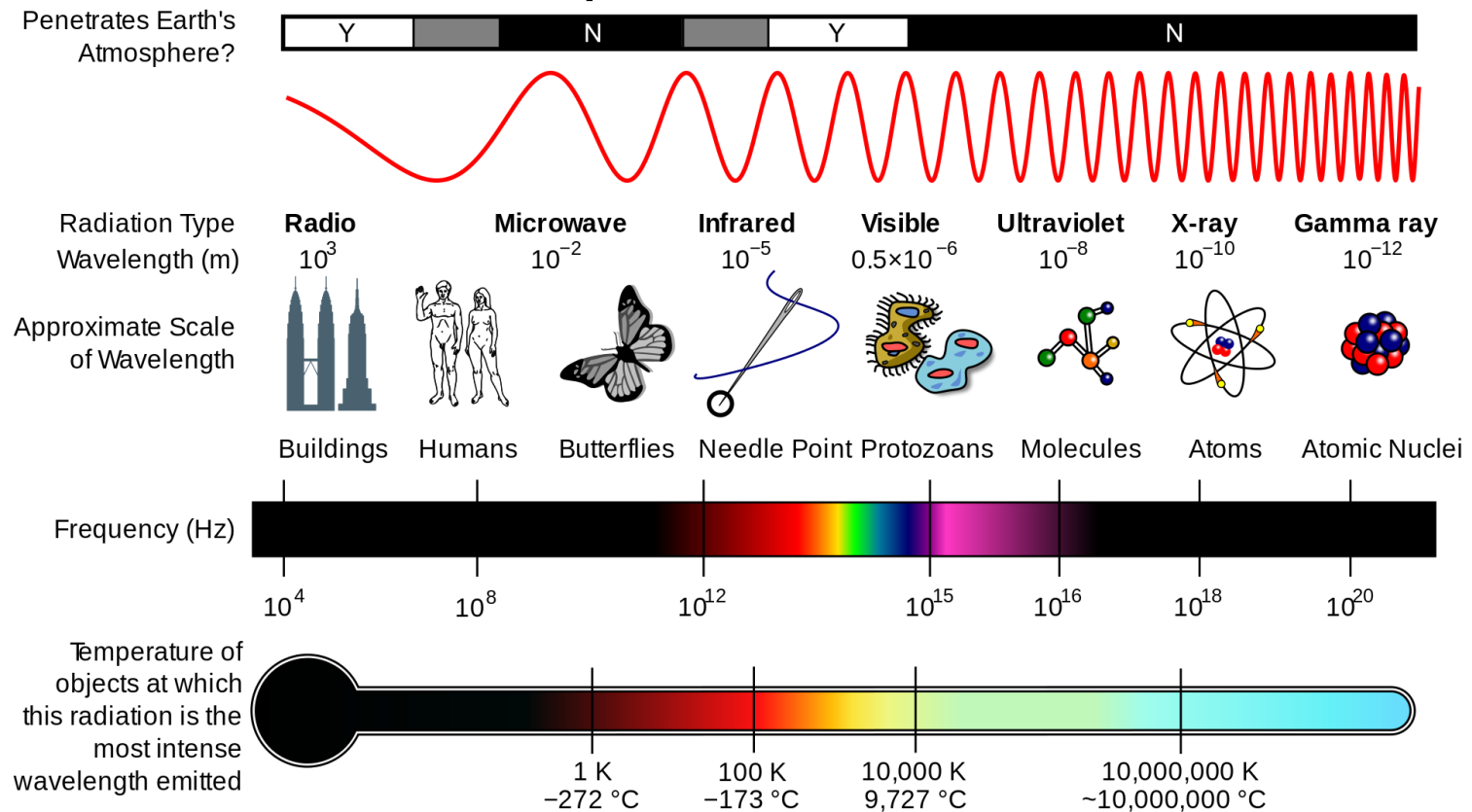
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- ▶ Image acquisition and digital image representation
- ▶ Image enhancement
- ▶ Image restoration
- ▶ Colour image processing
- ▶ Image compression
- ▶ Image segmentation
- ▶ Morphological image processing
- ▶ Special topics on recent progresses on digital image processing



# Human Perception VS Machine Vision

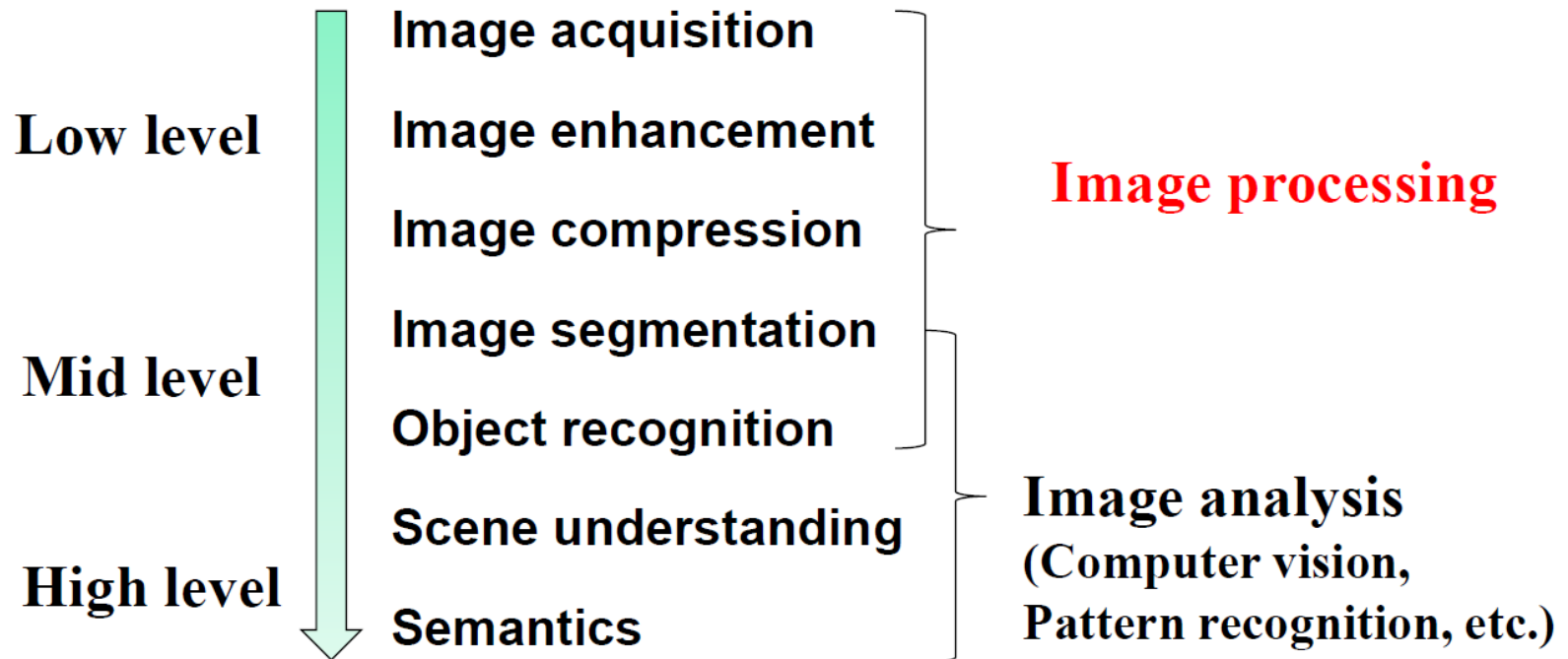
## ► Limited vs entire EM spectrum



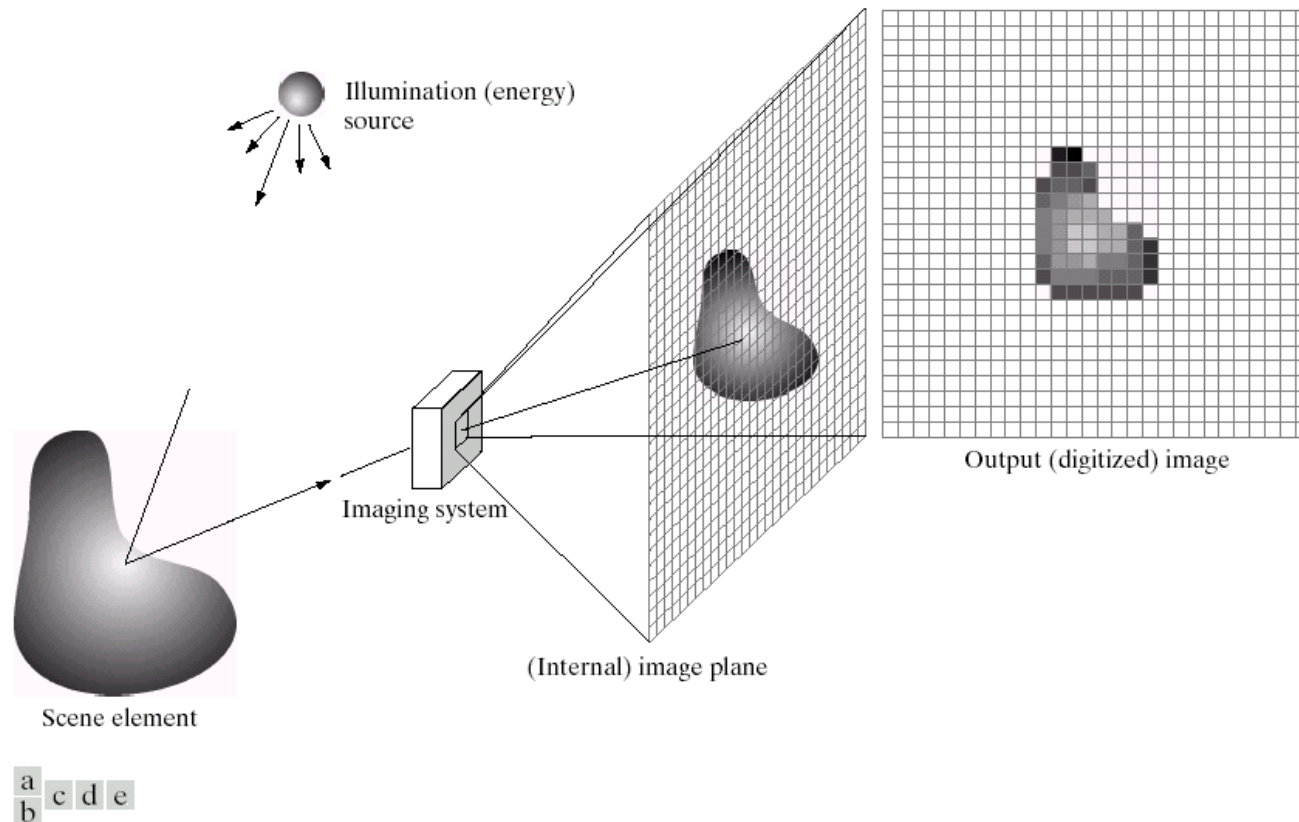
[https://en.wikipedia.org/wiki/Electromagnetic\\_spectrum](https://en.wikipedia.org/wiki/Electromagnetic_spectrum)

# Image Processing -> Image Analysis

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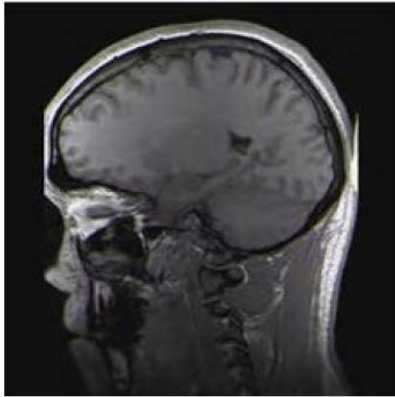
# Image Acquisition and Representation



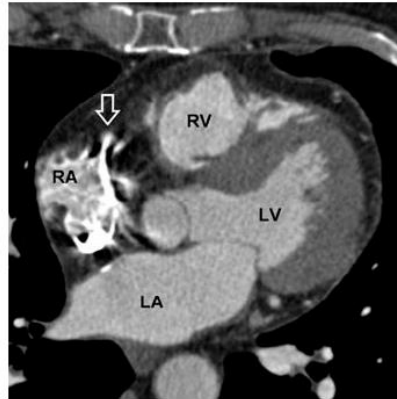
**FIGURE 2.15** An example of the digital image acquisition process. (a) Energy ("illumination") source. (b) An element of a scene. (c) Imaging system. (d) Projection of the scene onto the image plane. (e) Digitized image.

# Examples

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**1. Brain MRI**



**2. Cardiac CT**



**3. Fetus Ultrasound**



**4. Satellite image**



**5. IR image**

1 and 3. <http://en.wikipedia.org>

2. <http://radiology.rsna.org>

4. <http://emap-int.com>

5. <http://www.imaging1.com>

# Image Acquisition

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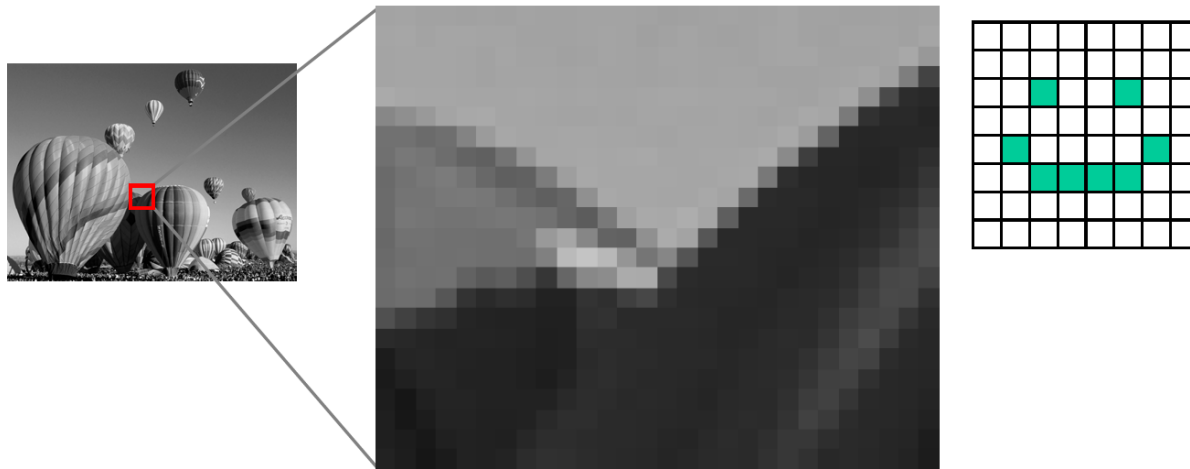
Camera + Scanner => Digital Camera (including mobile phones): Get images into computer



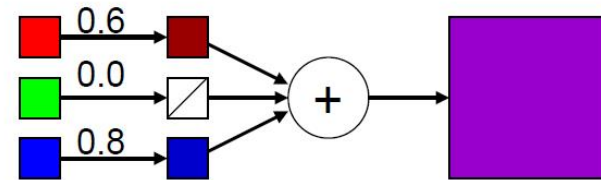
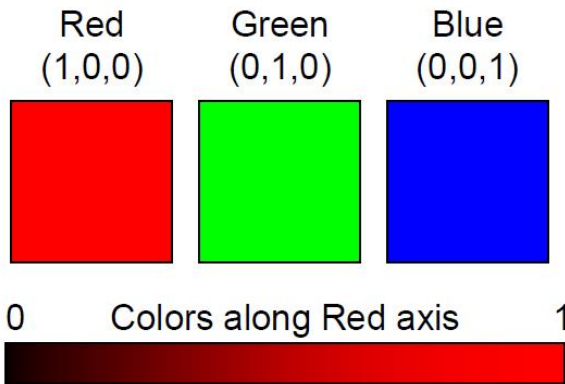
# Image Representation

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- ▶ Discrete representation of images
  - ▶ we'll carve up image into a rectangular grid of pixels  $P[x,y]$
  - ▶ each pixel  $p$  will store an intensity value in  $[0\ 255]$
  - ▶  $0 \Rightarrow$  black;  $255 \Rightarrow$  white; in-between  $\Rightarrow$  gray
- ▶ Image size  $M \times N \Rightarrow (MN)$  pixels



# Colour Image





# Video: Frame by Frame

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30 frames/second





# Image Enhancement

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# Image Restoration

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# Image Compression

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100% fidelity  
Image is 725kB



90%  
250kB



10%  
37kB

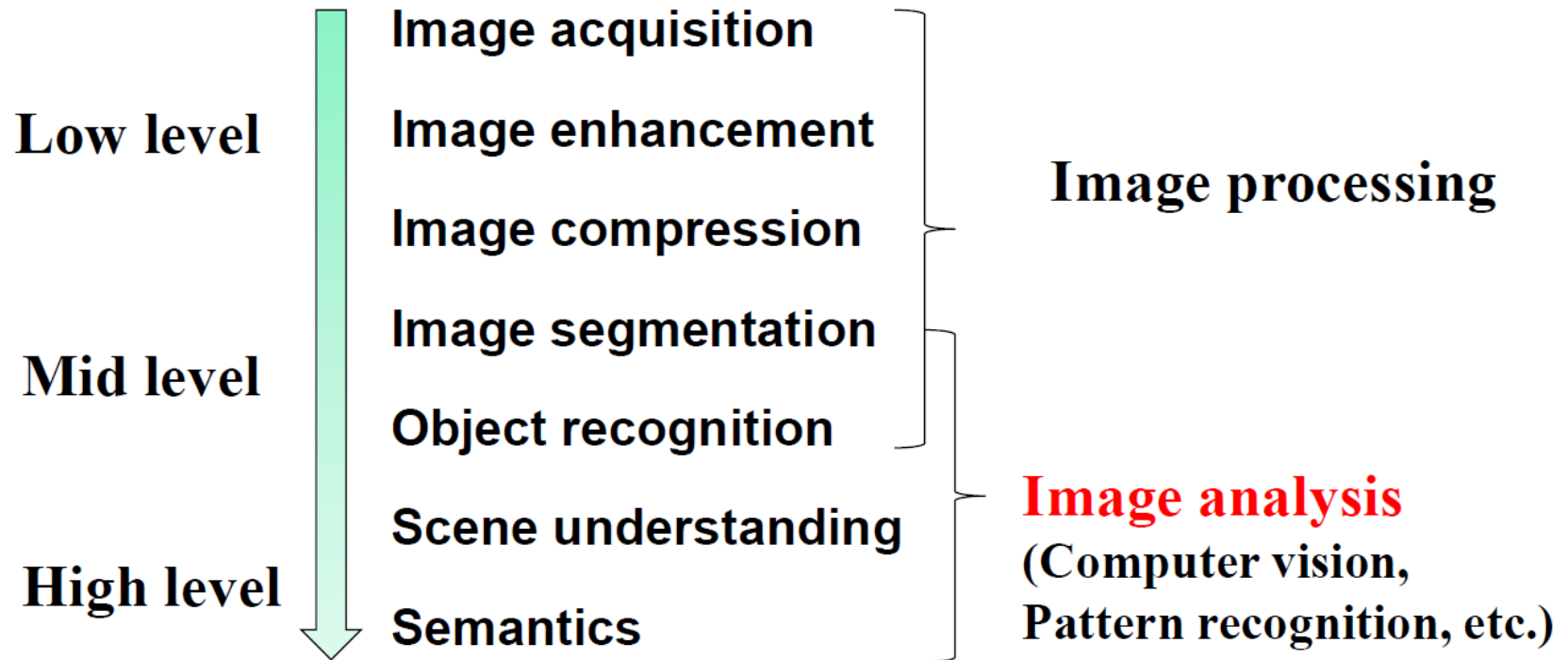


1%  
20kB



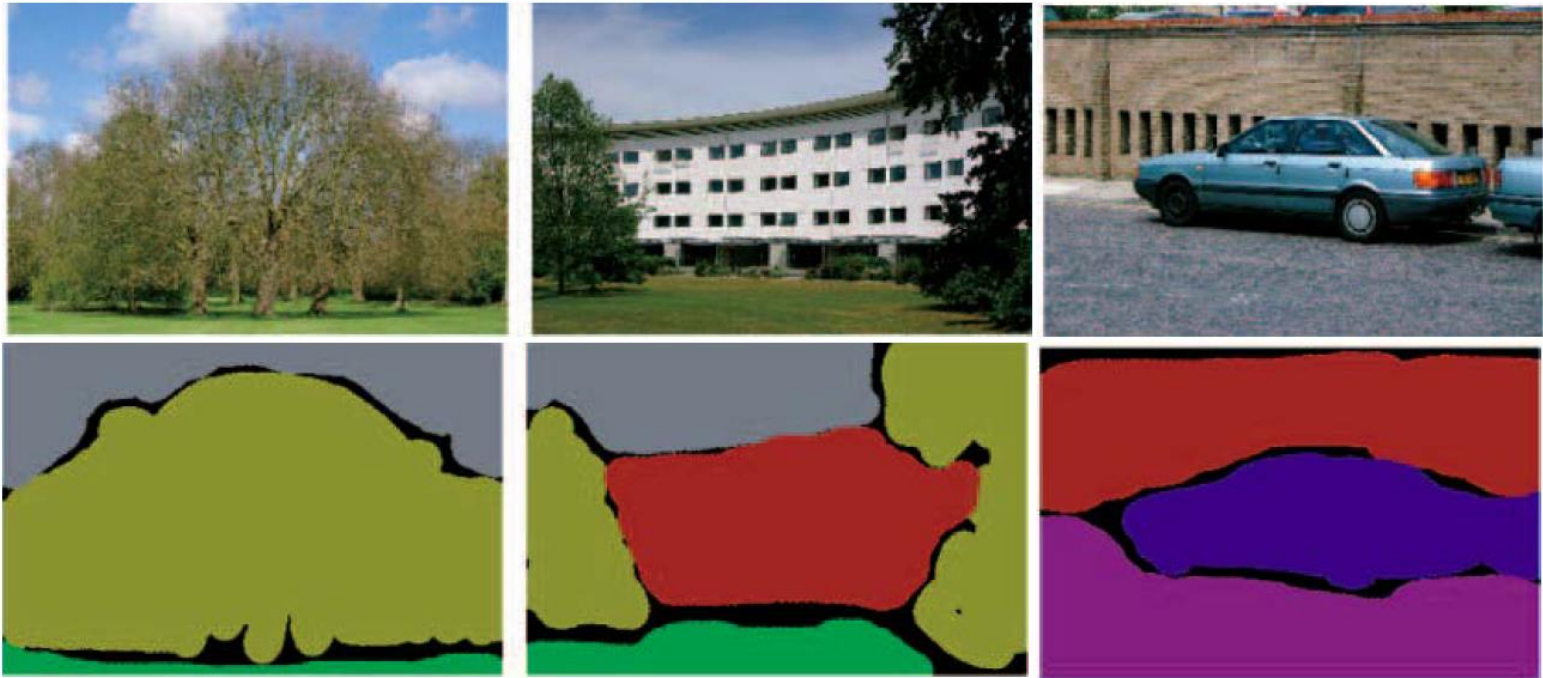
# Image Processing → Image Analysis

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# Image Segmentation

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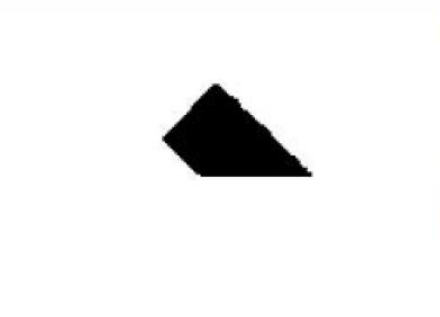
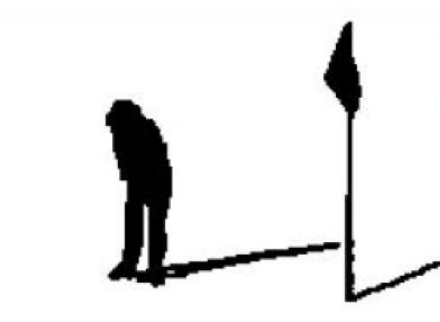
**Microsoft multiclass segmentation data set**



# Image Completion

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**Interactively select objects. Remove them and automatically fill with similar background (from the same image)**



I. Drori, D. Cohen-Or, H. Yeshurun, SIGGRPAH'03

# More Examples

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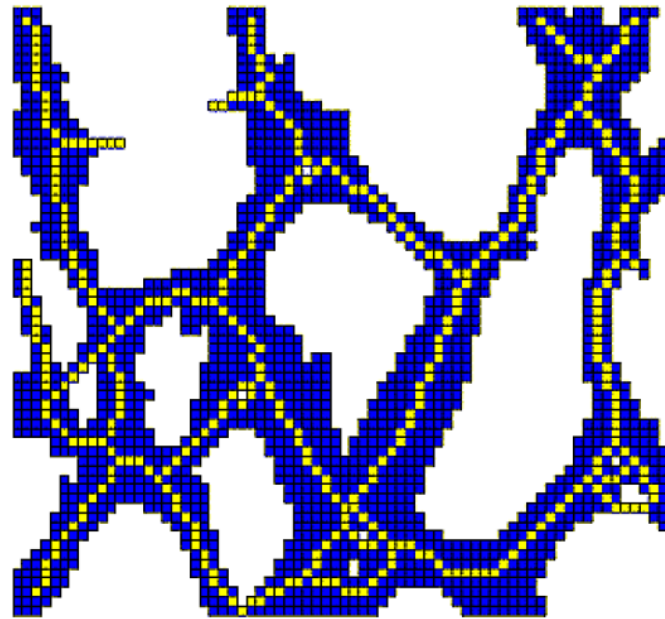


**HOLLYWOOD**



# Morphological Image Processing

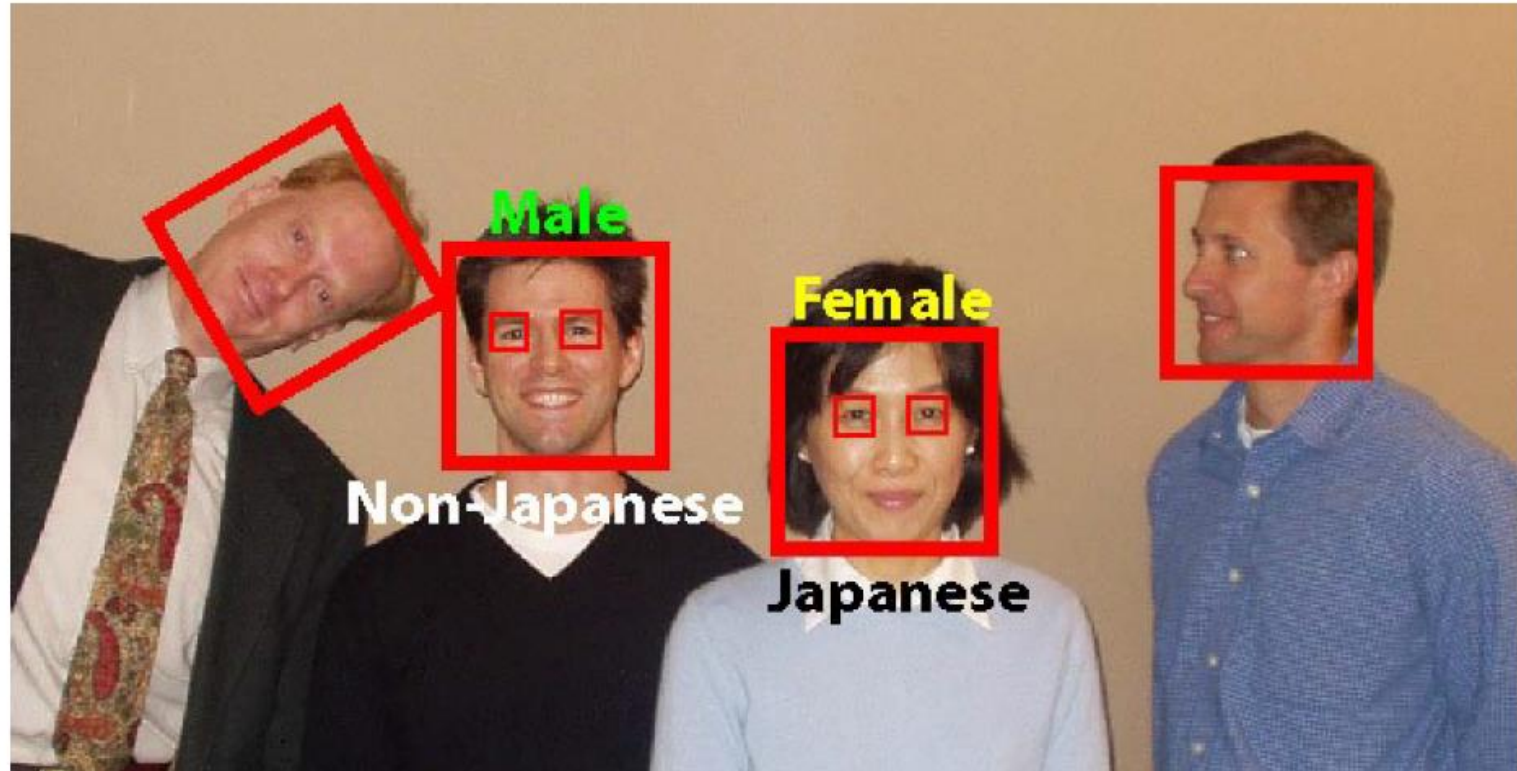
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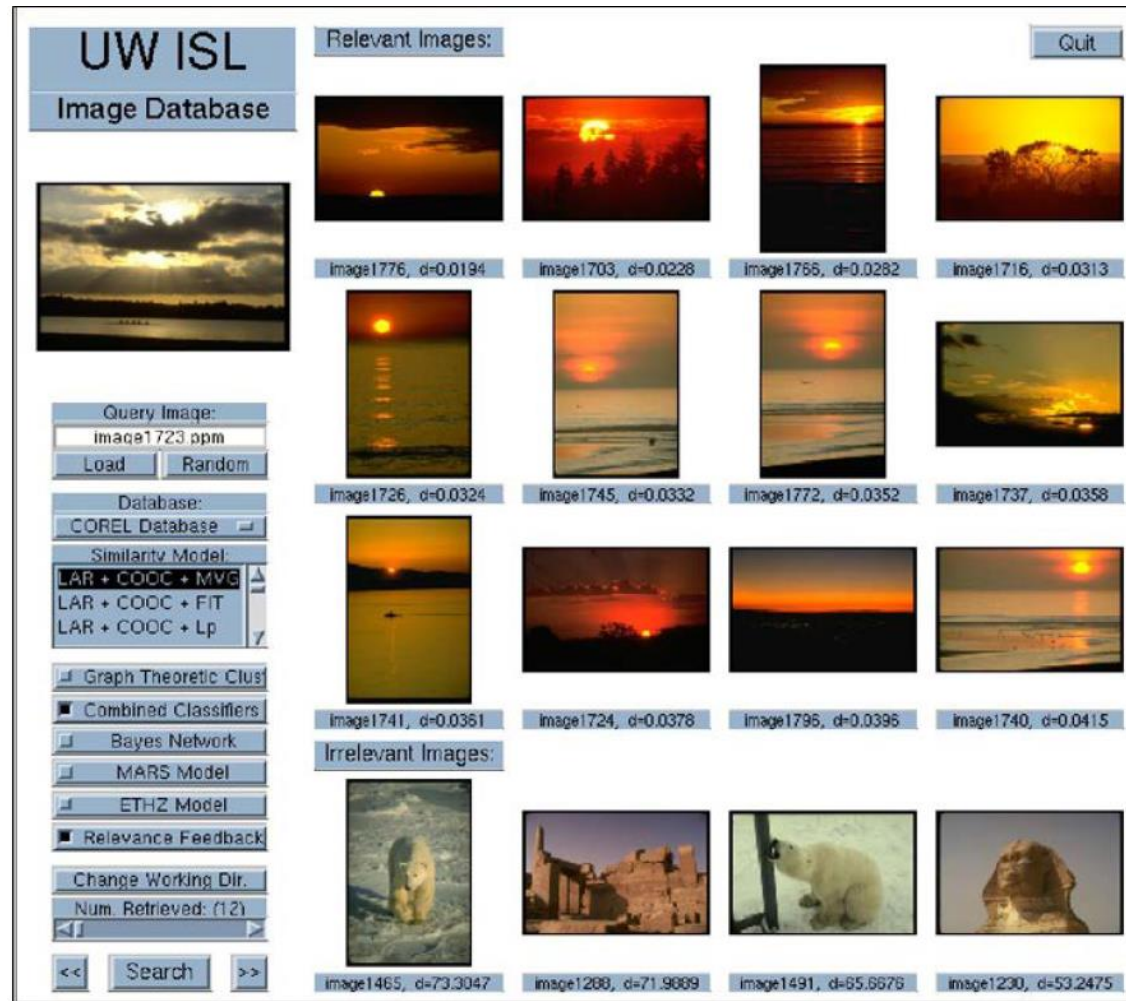


# Object Detection / Recognition

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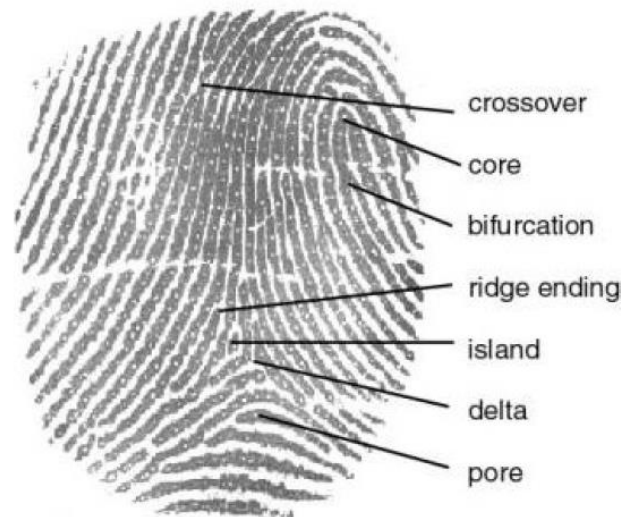
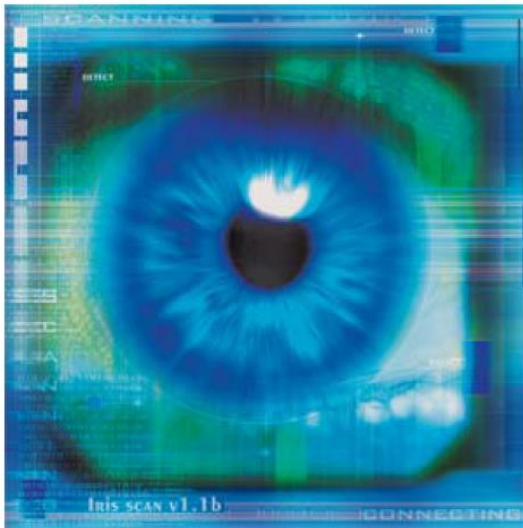


# Content-based Image Retrieval



# Biometrics

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# Applications of Digital Image Processing

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- ▶ Digital camera
- ▶ Photoshop
- ▶ Human computer interaction
- ▶ Medical imaging for diagnosis and treatment
- ▶ Surveillance
- ▶ Automatic driving
- ...
- ▶ Fast-growing market!