

# Pengantar Interpretasi dan Pengolahan Citra (Bagian 2)

IF4073 Interpretasi dan Pengolahan Citra

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Sekolah Teknik Elektro dan Informatika  
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2021

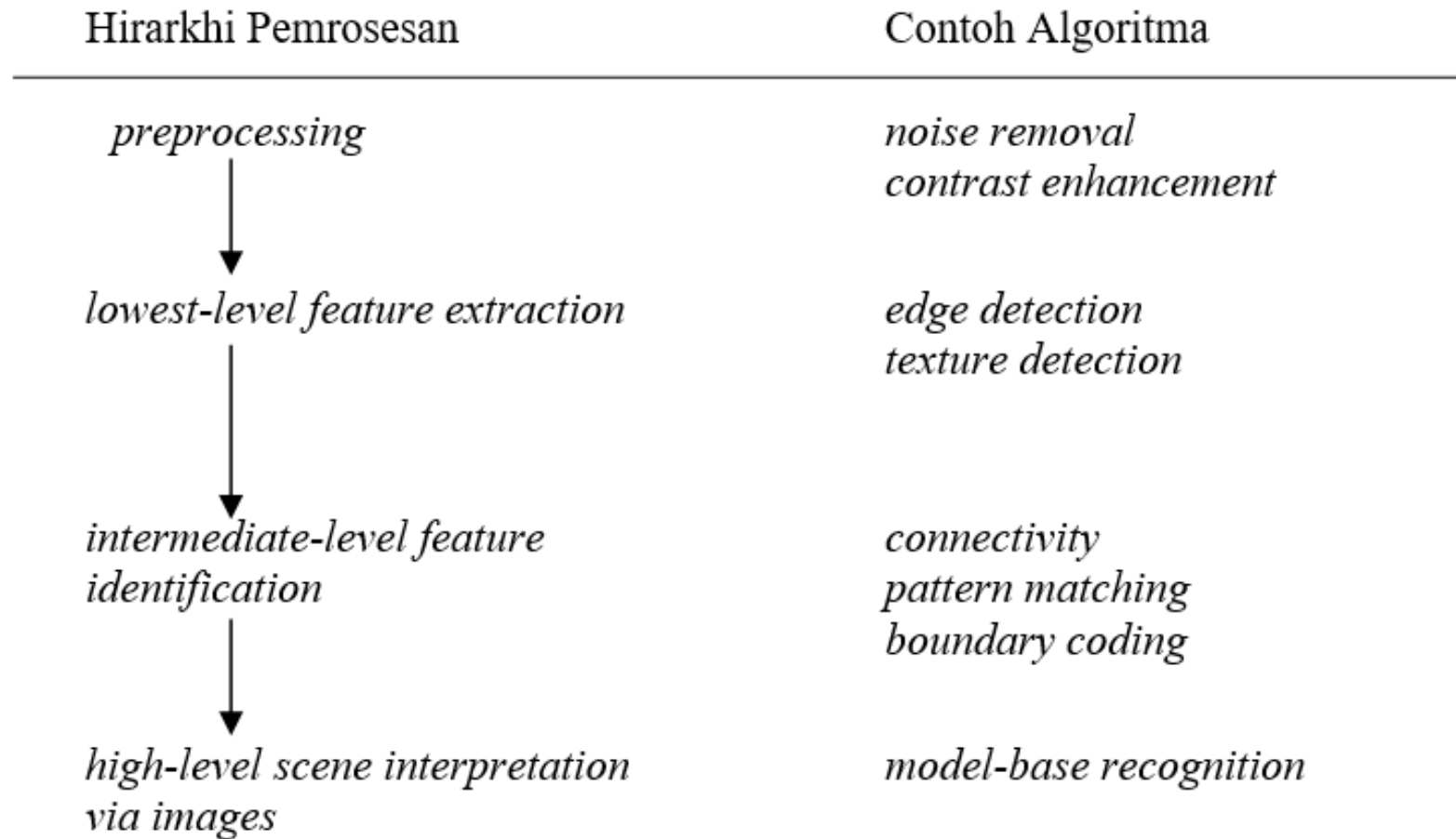
# Computer Vision

- *Computer vision* merupakan proses otomatis yang mengintegrasikan sejumlah besar proses untuk persepsi visual, seperti akuisisi citra, pengolahan citra, klasifikasi, pengenalan (*recognition*), dan membuat keputusan.
- *Computer vision* terdiri dari teknik-teknik untuk mengestimasi ciri-ciri objek di dalam citra, pengukuran ciri yang berkaitan dengan geometri objek, dan menginterpretasi informasi geometri tersebut.
- *Vision = Geometry + Measurement + Interpretation*

- Pada hakikatnya, *computer vision* mencoba meniru cara kerja sistem visual manusia (*human vision*).
- *Human vision* sesungguhnya sangat kompleks. Manusia melihat objek dengan indera penglihatan (mata), lalu citra objek diteruskan ke otak untuk diinterpretasi sehingga manusia mengerti objek apa yang tampak dalam pandangan matanya.
- Hasil interpretasi ini mungkin digunakan untuk pengambilan keputusan (misalnya menghindar kalau melihat mobil melaju di depan).

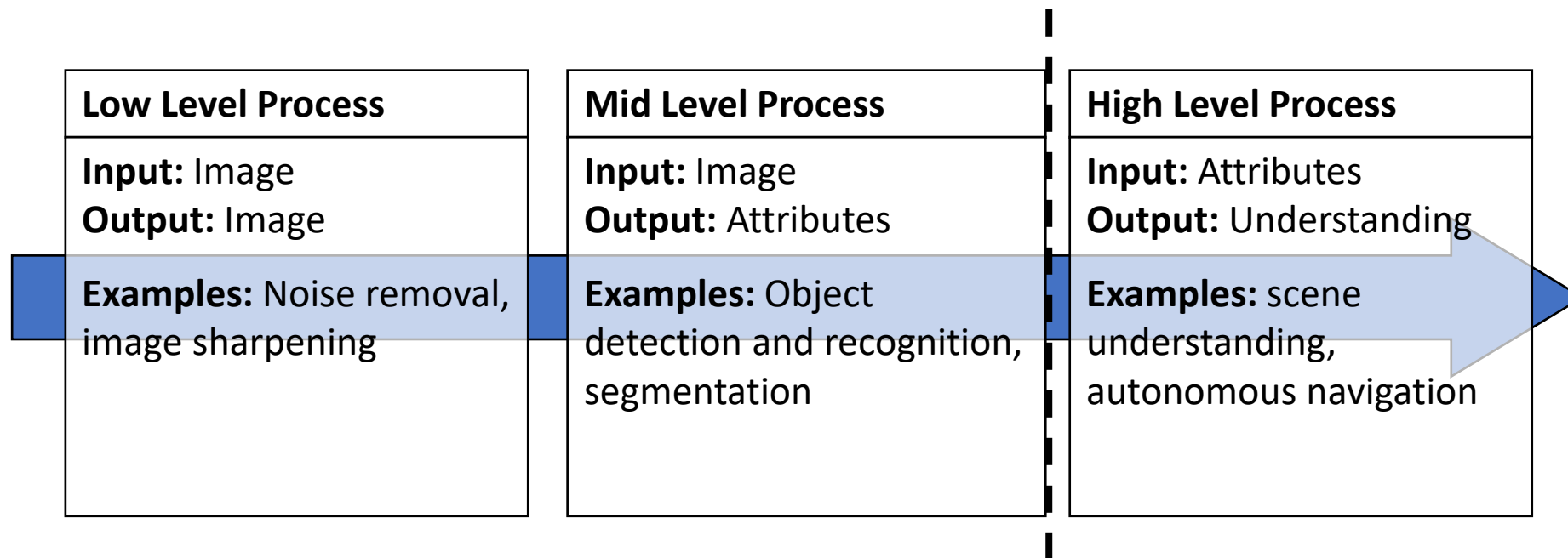
- Proses-proses di dalam *computer vision* dapat dibagi menjadi tiga aktivitas:
  1. Memperoleh atau mengakuisisi citra digital.
  2. Melakukan teknik komputasi untuk memproses atau memodifikasi data citra (operasi-operasi pengolahan citra).
  3. Menganalisis dan menginterpretasi citra dan menggunakan hasil pemrosesan untuk tujuan tertentu, misalnya memandu robot, mengontrol peralatan, memantau proses manufaktur, dan lain-lain.

- Proses-proses di dalam *computer vision* dalam hirarkhi sebagai berikut :



# Image Processing → Computer Vision

- Rangkaian kesatuan dari *image processing* ke *computer vision* dapat dipecah menjadi *low-*, *mid-* dan *high-level processes*



Kuliah IF4073 sampai di  
sini saja

# Image Processing v.s. Computer Vision

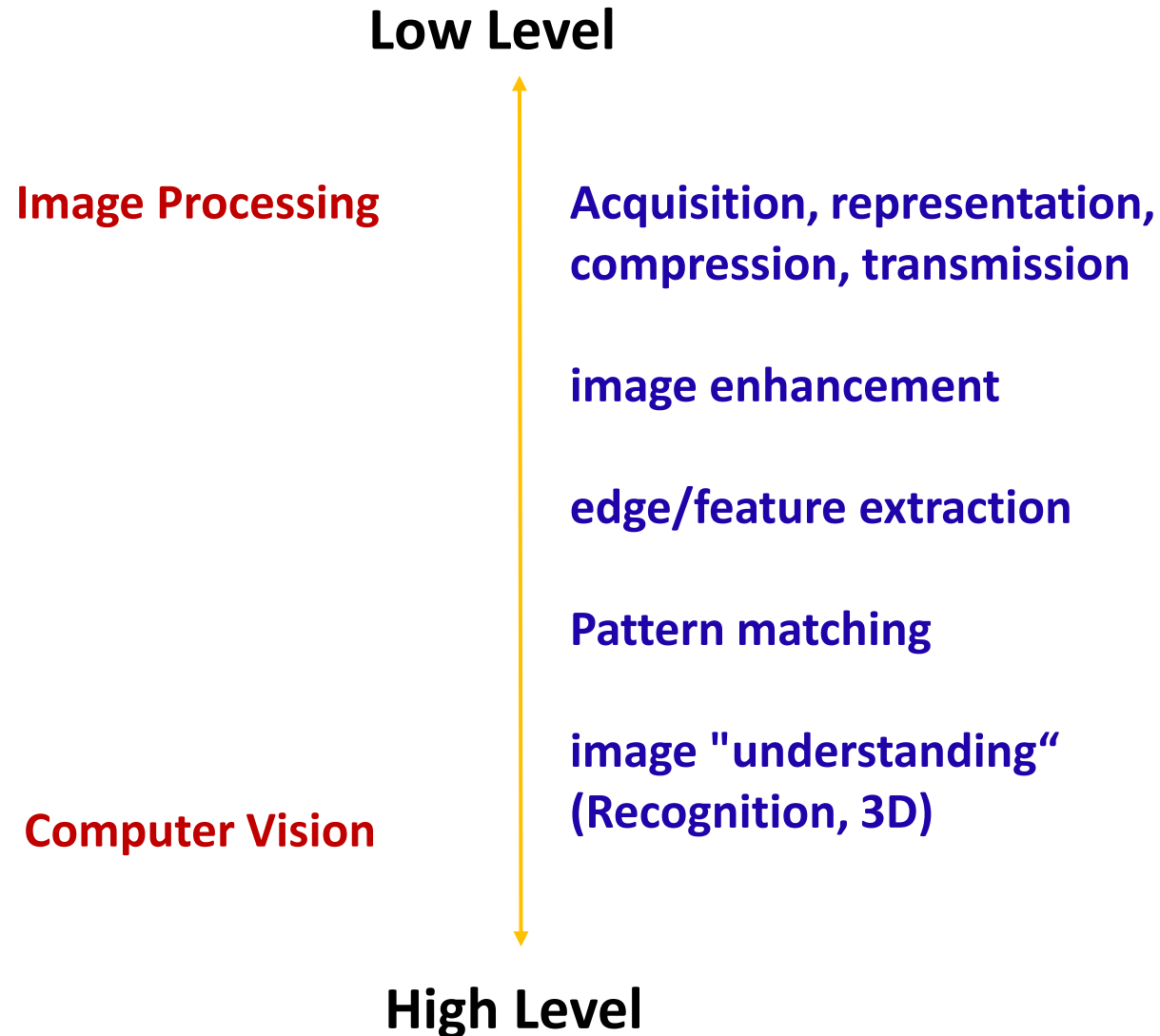


Image Acquisition



License Plate Extraction



License Plate Segmentation

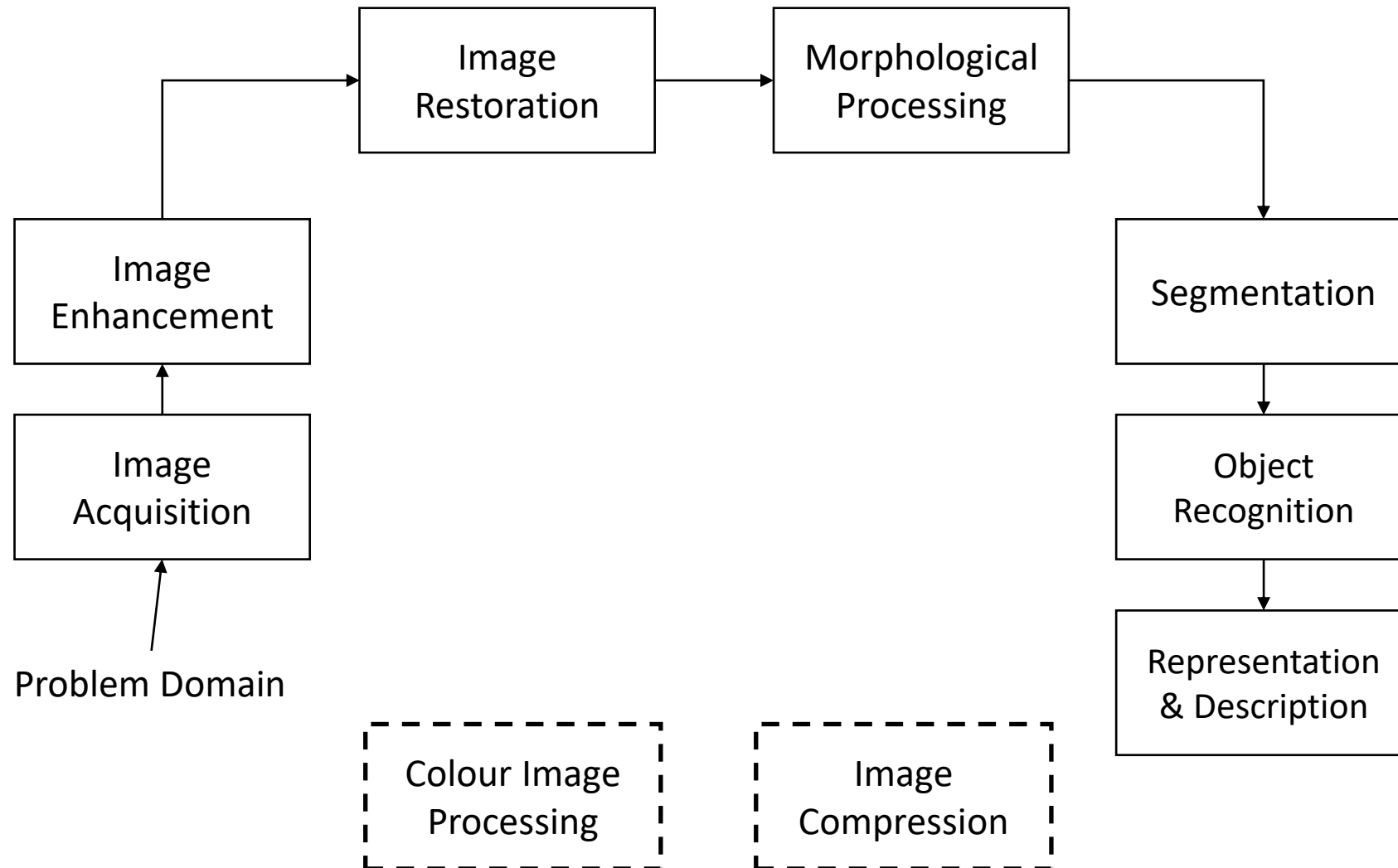
JRE 366

Character Recognition

**JRE366**

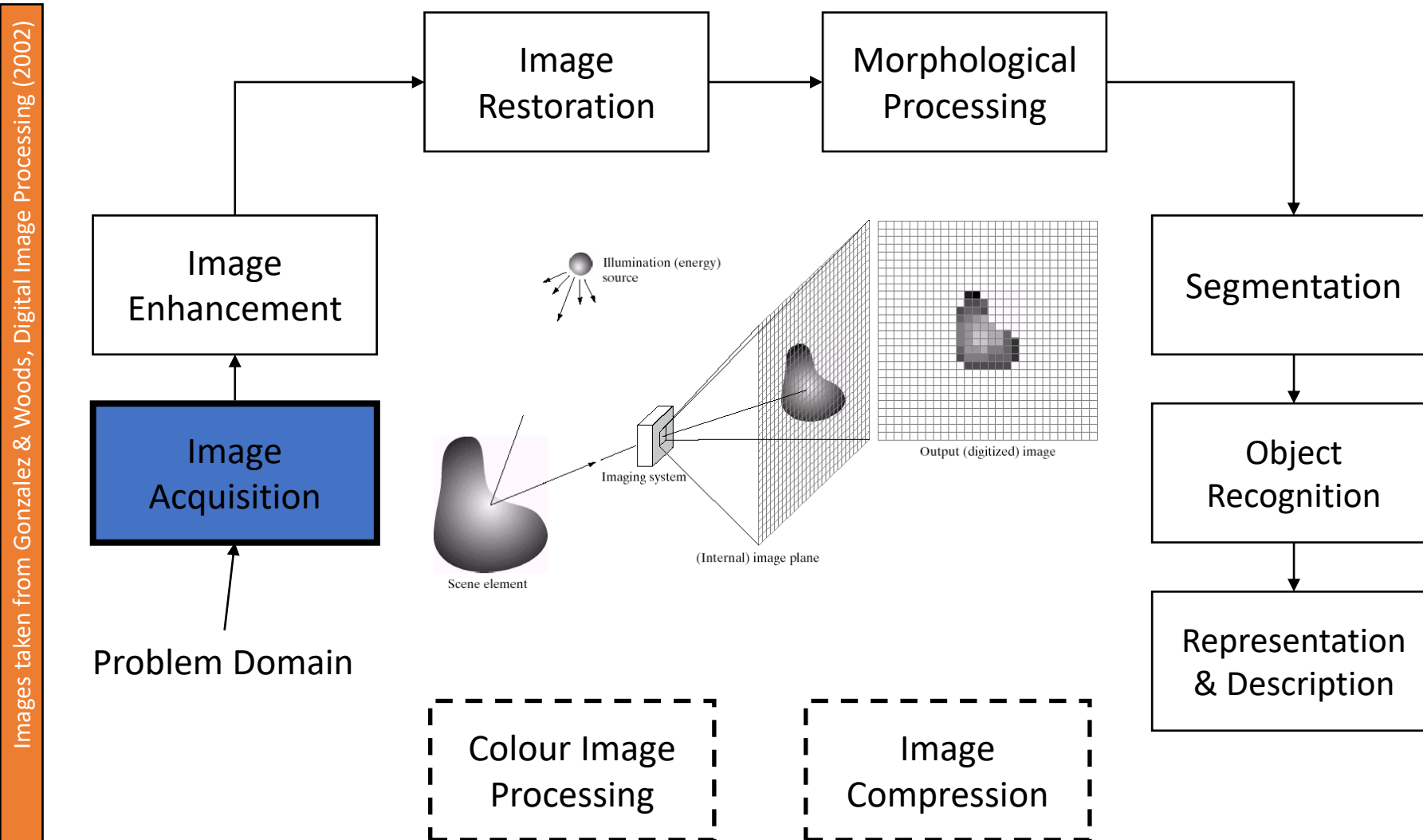


# Key Stages in Digital Image Processing



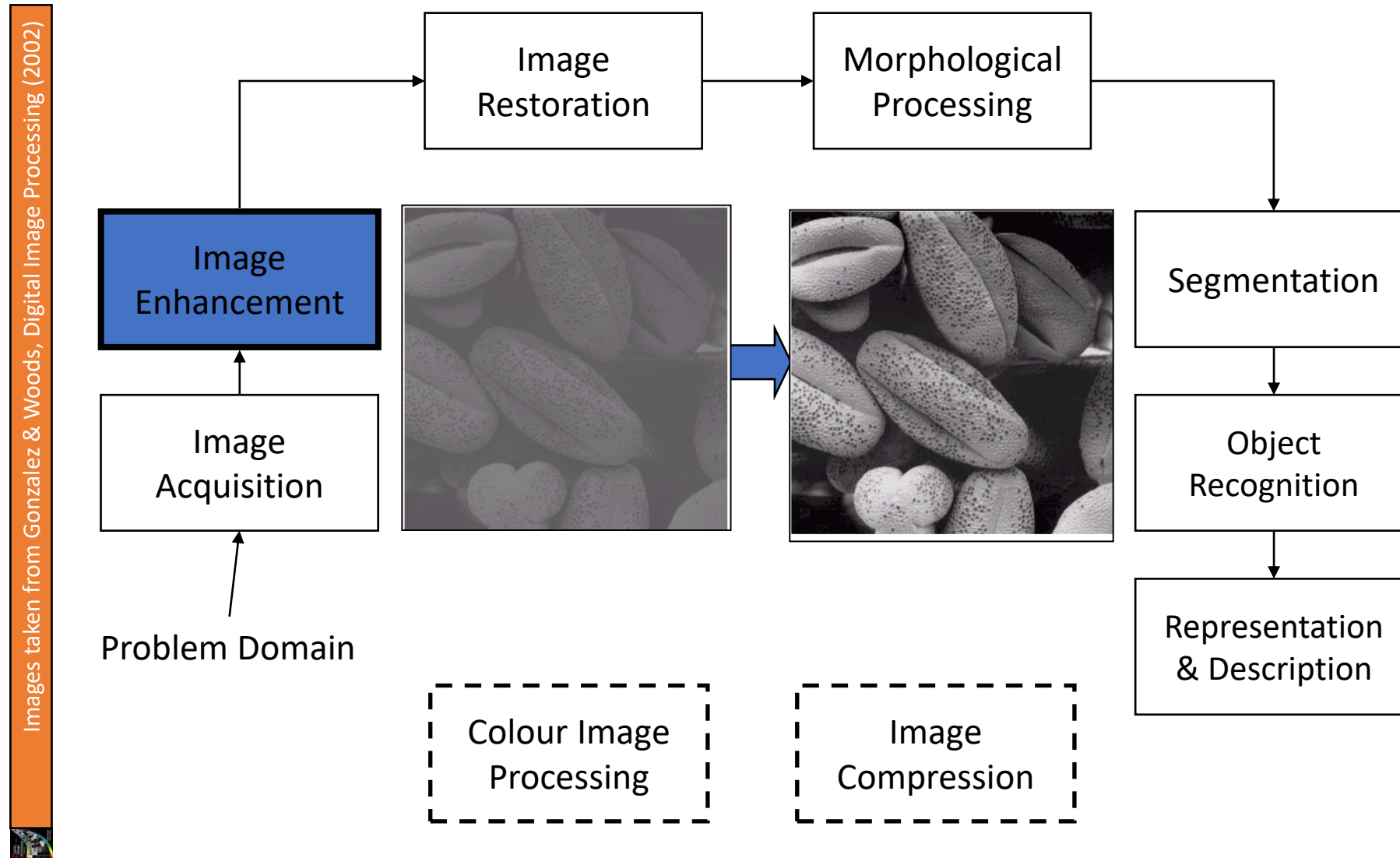
# Key Stages in Digital Image Processing: Image Acquisition

Sumber: Yacov Hel-Or, *Image Processing*, Spring 2010



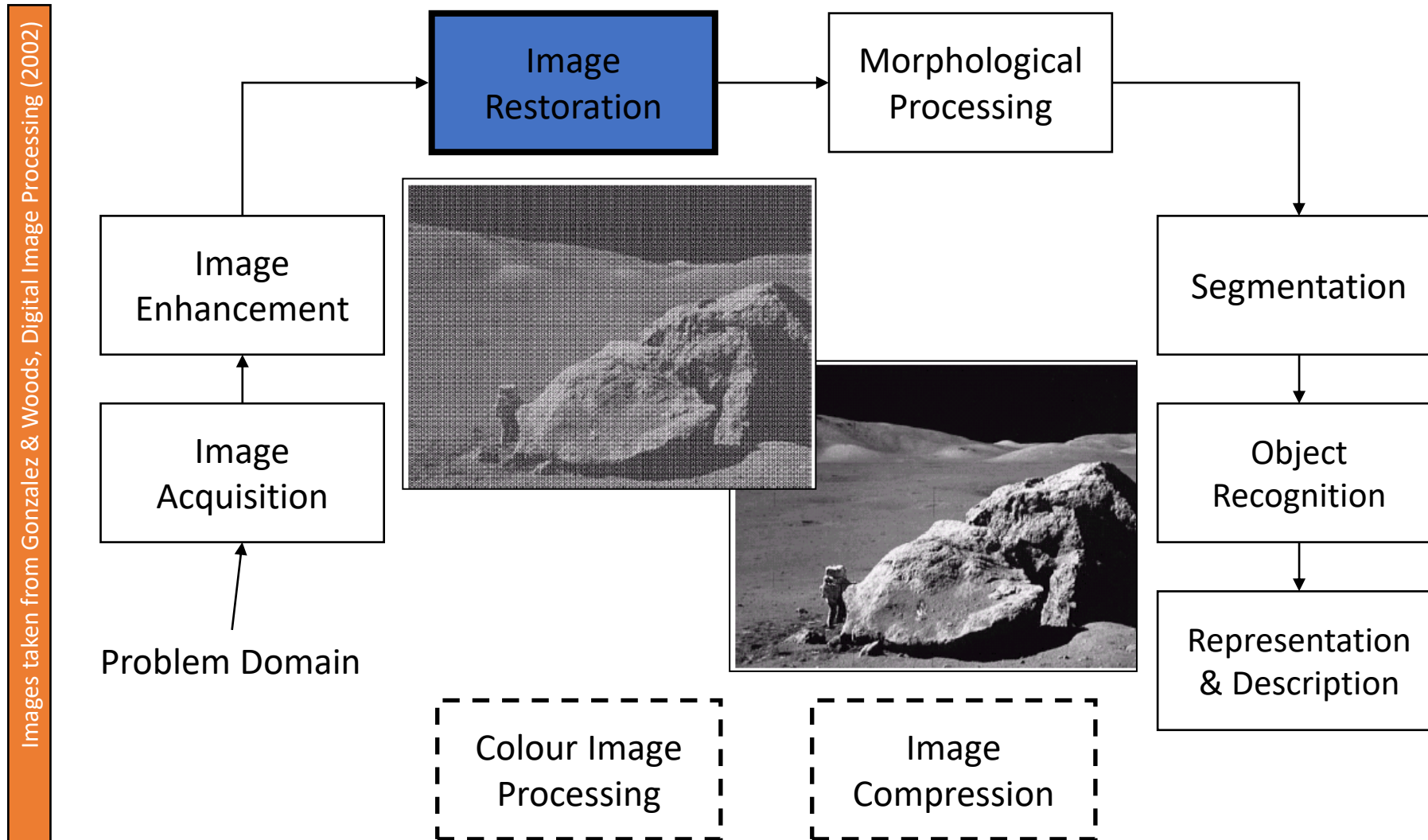
# Key Stages in Digital Image Processing: Image Enhancement

Sumber: Yacov Hel-Or, *Image Processing*, Spring 2010



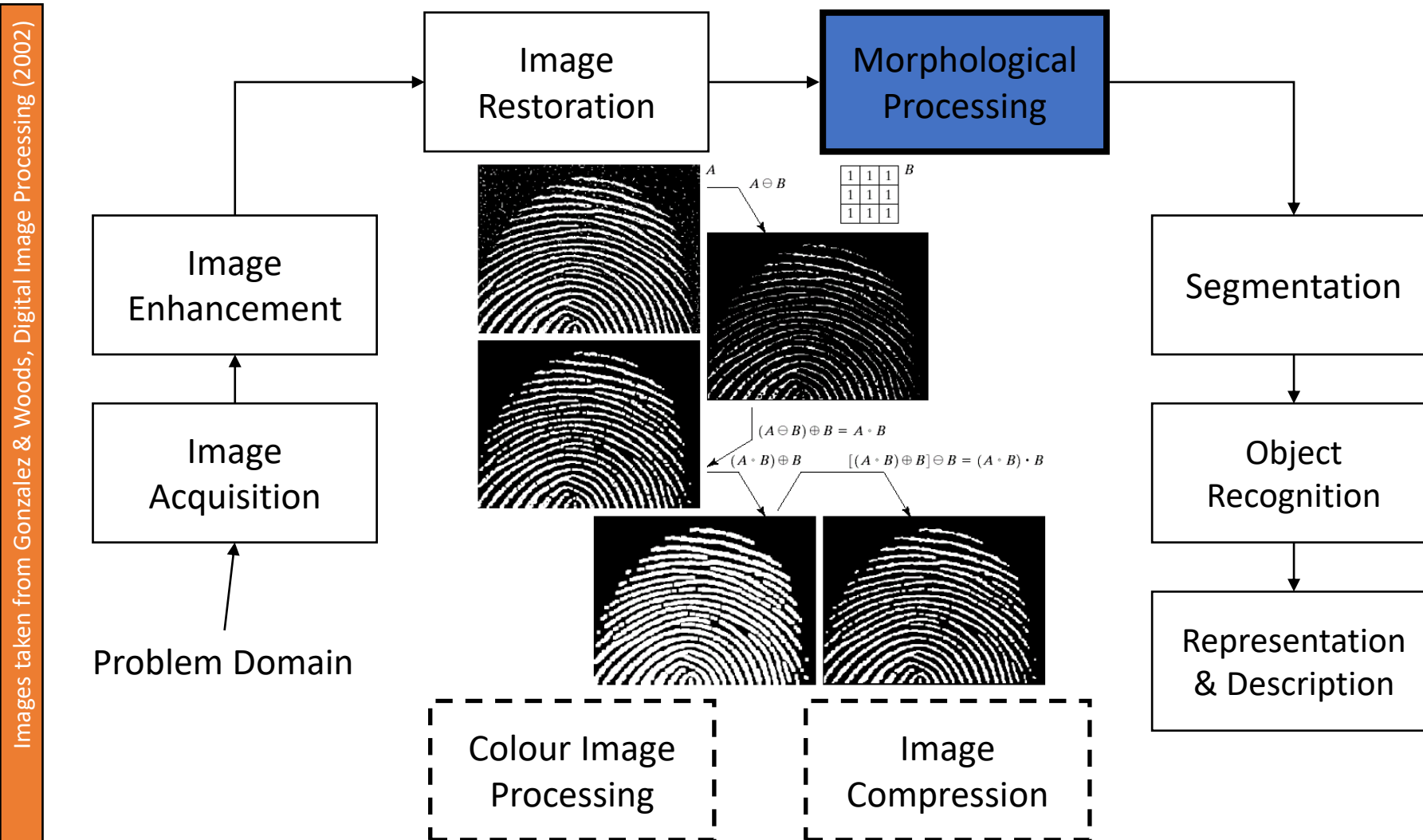
# Key Stages in Digital Image Processing: Image Restoration

Sumber: Yacov Hel-Or, *Image Processing*, Spring 2010



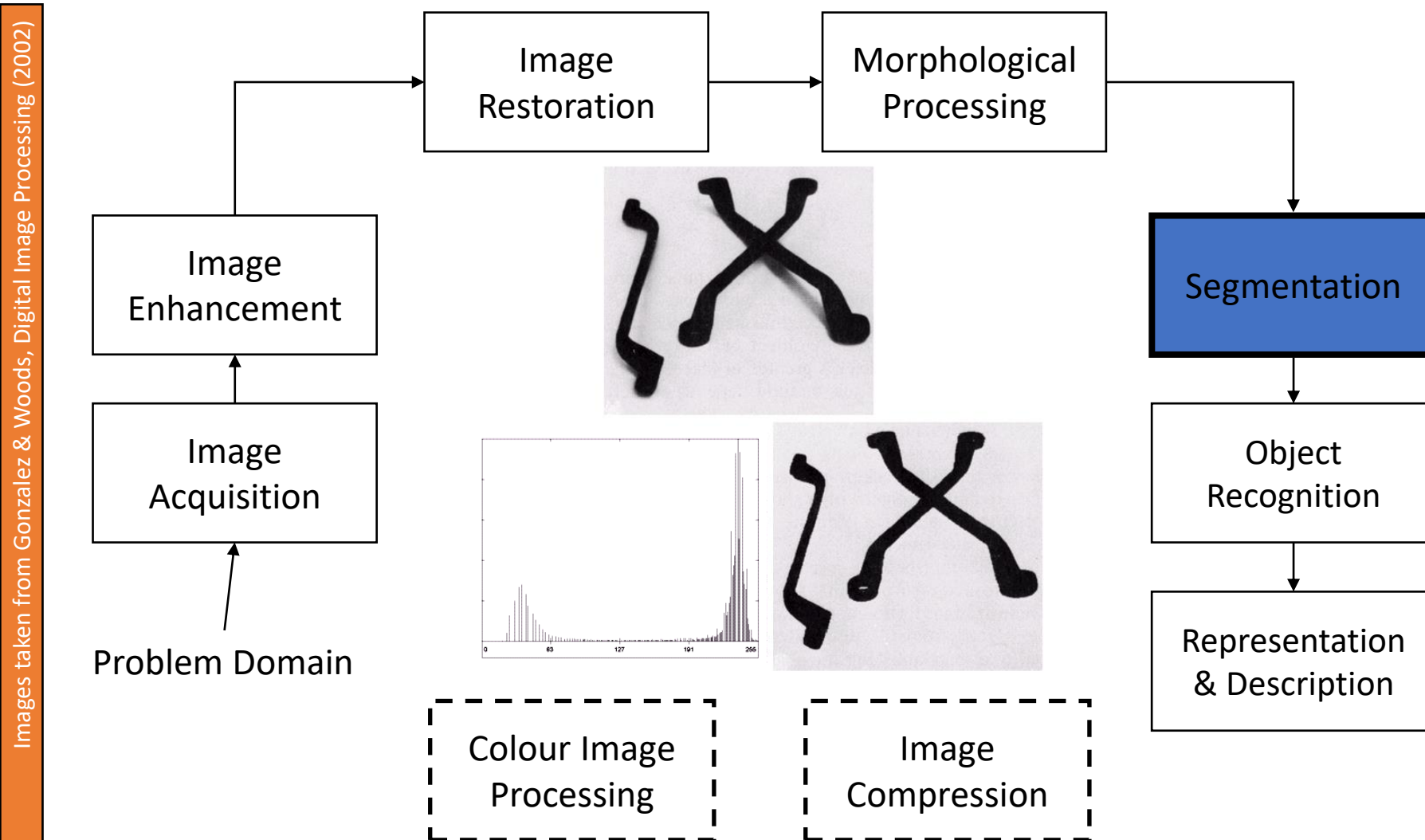
# Key Stages in Digital Image Processing: Morphological Processing

Sumber: Yacov Hel-Or, *Image Processing*, Spring 2010



# Key Stages in Digital Image Processing: Segmentation

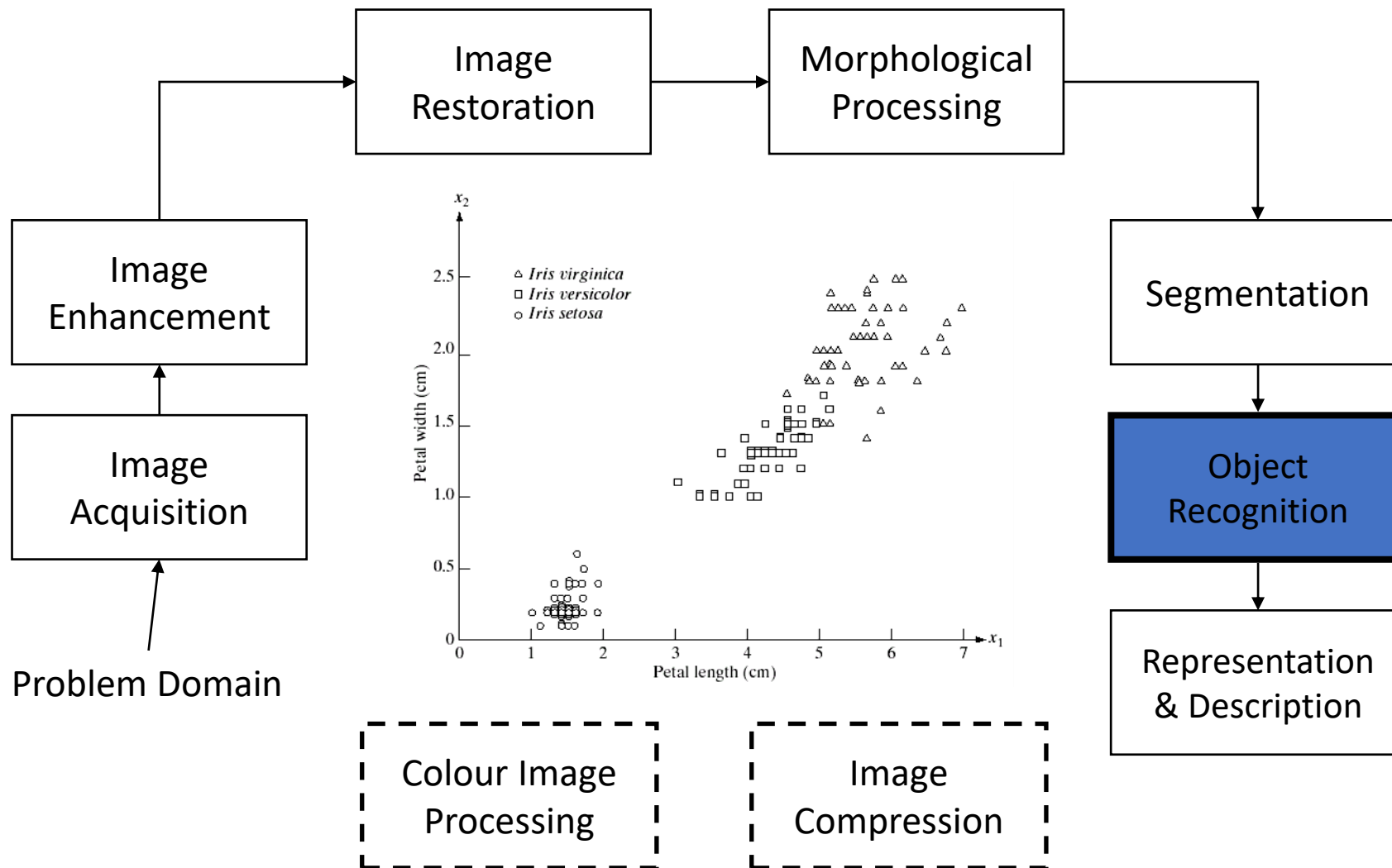
Sumber: Yacov Hel-Or, *Image Processing*, Spring 2010



# Key Stages in Digital Image Processing: Object Recognition

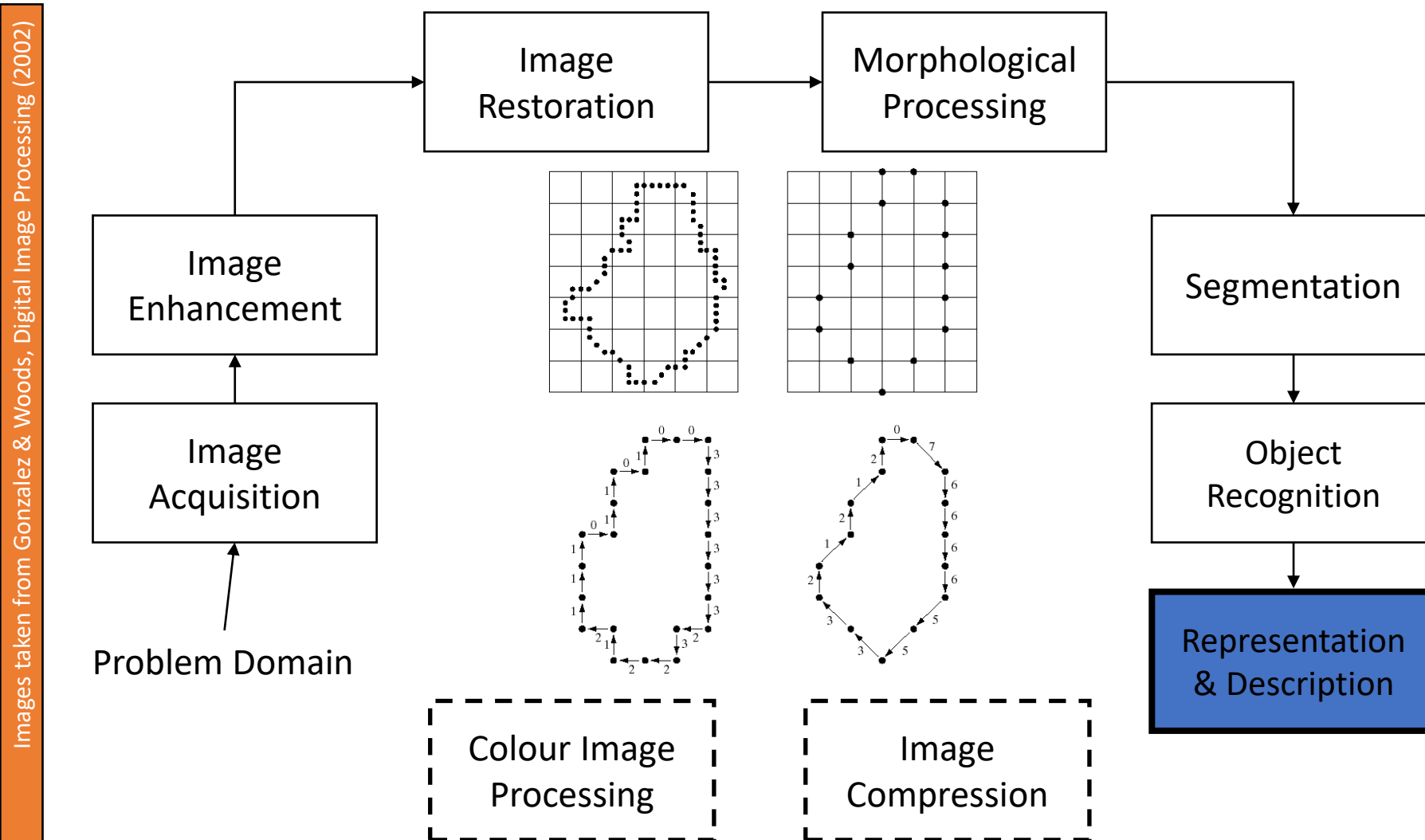
Sumber: Yacov Hel-Or, *Image Processing*, Spring 2010

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



# Key Stages in Digital Image Processing: Representation & Description

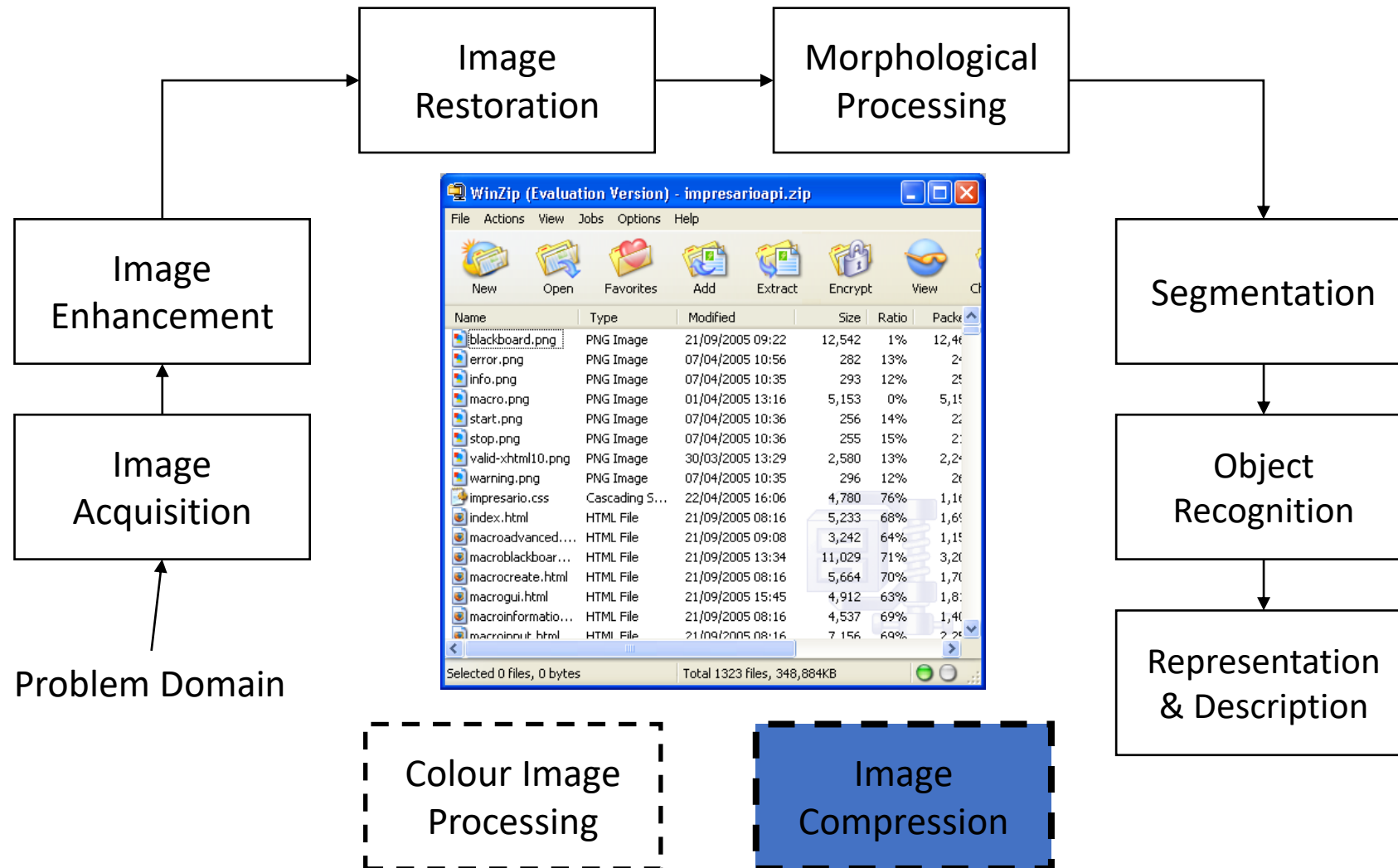
Sumber: Yacov Hel-Or, *Image Processing*, Spring 2010





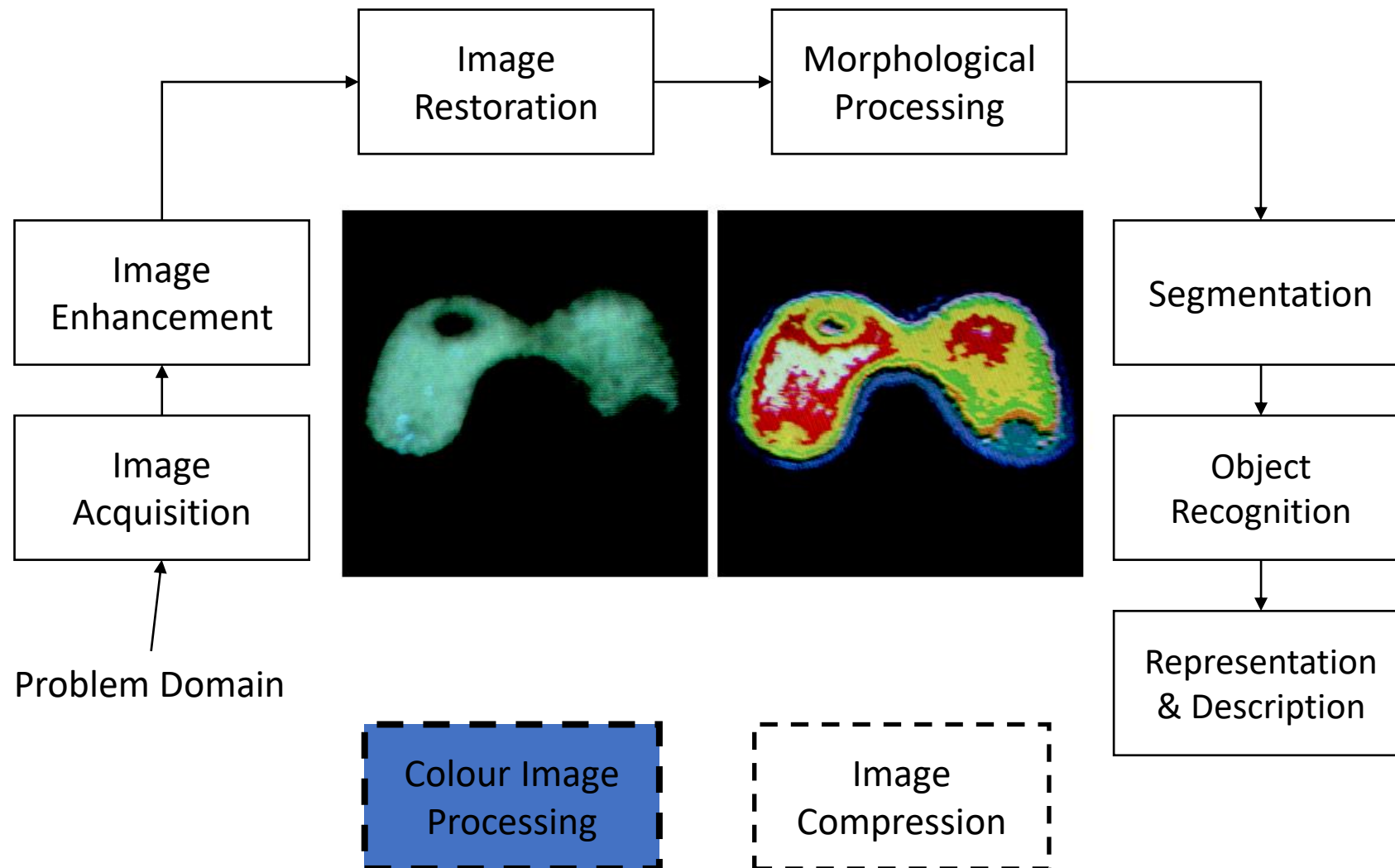
# Key Stages in Digital Image Processing: Image Compression

Sumber: Yacov Hel-Or, *Image Processing*, Spring 2010



# Key Stages in Digital Image Processing: Colour Image Processing

Sumber: Yacov Hel-Or, *Image Processing*, Spring 2010



# Aplikasi Pengolahan Citra (dan *Computer Vision*)

- *Image editing ...*

1. *Cropping*



2. Removal of unwanted element



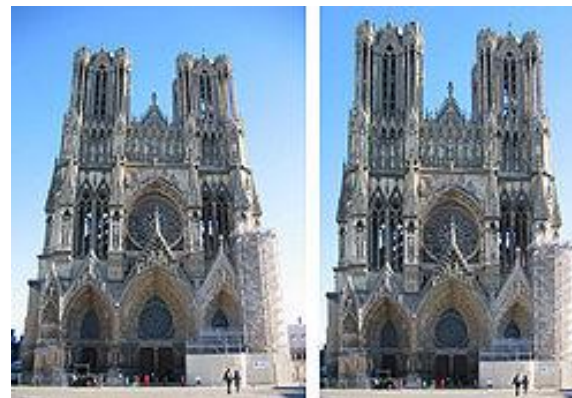
# Aplikasi Pengolahan Citra (dan *Computer Vision*)

- *Image editing ...*

## 3. Selective color change



## 4. Perspective correction and distortion



# Aplikasi Pengolahan Citra (dan *Computer Vision*)

- *Image editing ...*

- 5. Selecting and merging of images



# Aplikasi Pengolahan Citra (dan *Computer Vision*)

- *Image editing*

6. Special effects



# Aplikasi Pengolahan Citra (dan *Computer Vision*)



## Image Inpainting 1

# Aplikasi Pengolahan Citra (dan *Computer Vision*)



Image Inpainting 2

Images of Venus taken by the Russian lander Venera-10 in 1975



# Aplikasi Pengolahan Citra (dan *Computer Vision*)



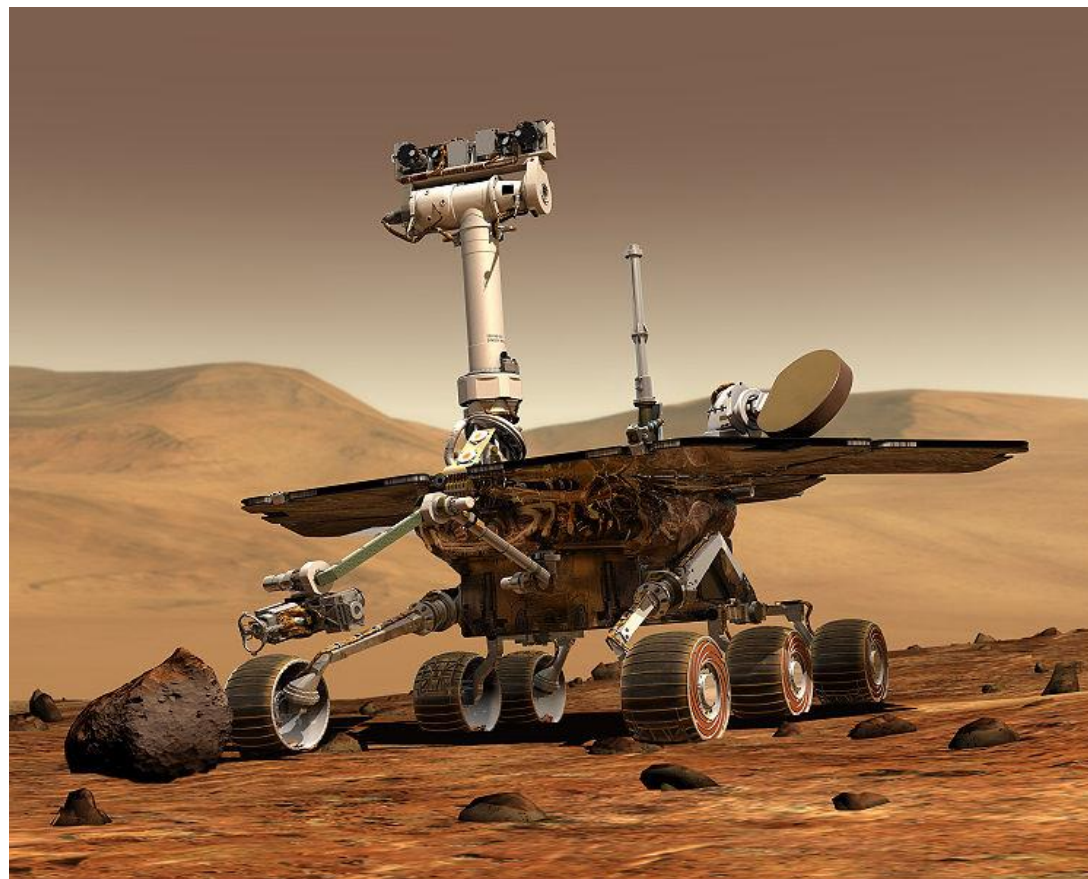
## Video Inpainting

Y. Wexler, E. Shechtman and M. Irani 2004



# Aplikasi Pengolahan Citra (dan *Computer Vision*)

- *Robotika*



# Aplikasi Pengolahan Citra (dan *Computer Vision*)

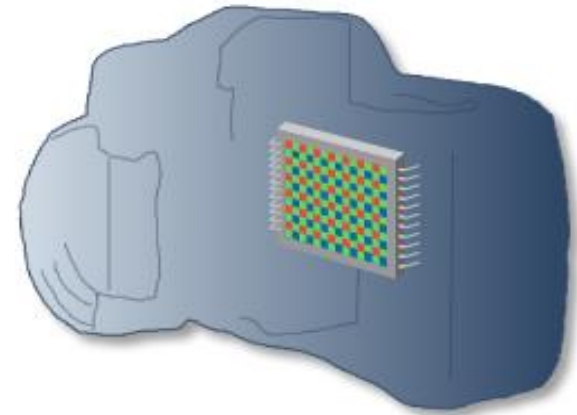


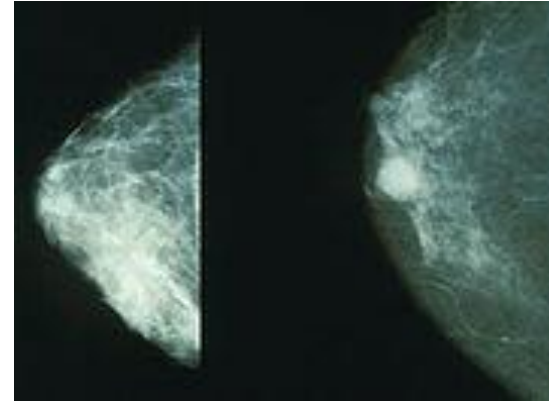
Image Demosaicing

# Aplikasi Pengolahan Citra (dan *Computer Vision*)

- Medis



**Magnetic resonance imaging  
(MRI) of brain**

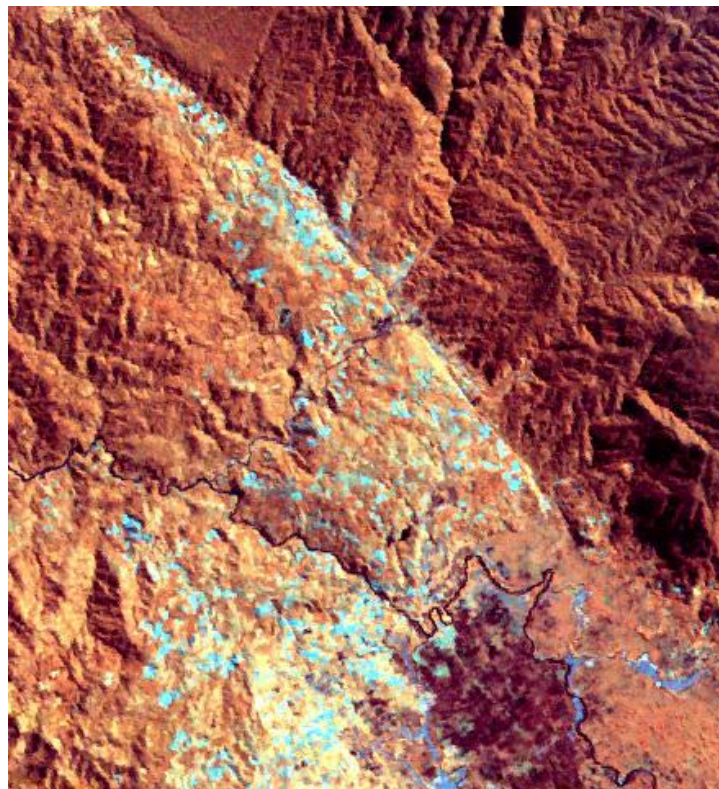


Normal (left) versus cancerous (right)  
mammography image.



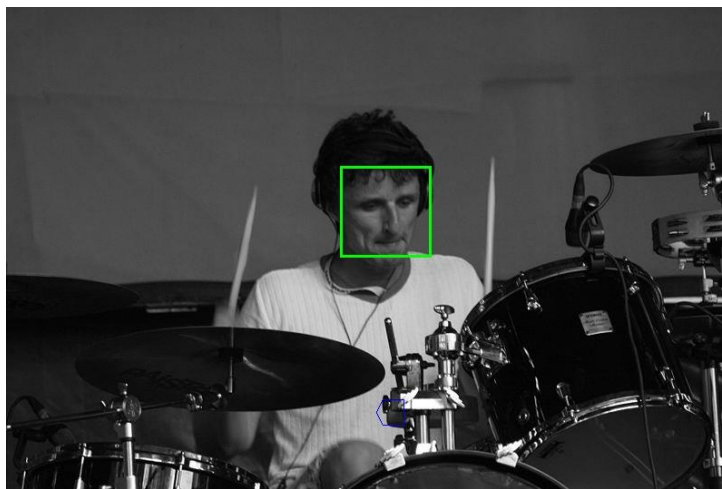
# Aplikasi Pengolahan Citra (dan *Computer Vision*)

- *Remote sensing*



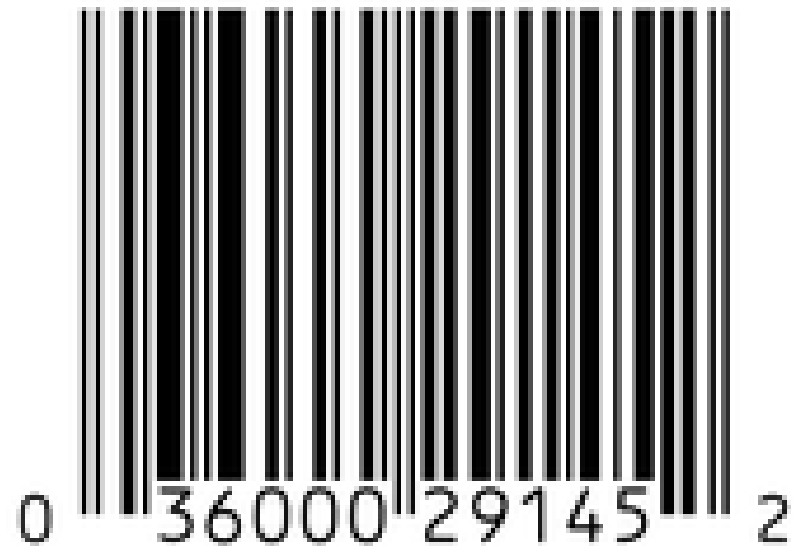
# Aplikasi Pengolahan Citra (dan *Computer Vision*)

- *Face detection*

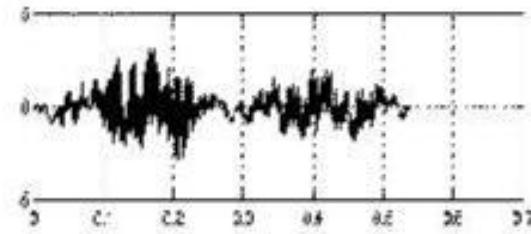


# Aplikasi Pengolahan Citra (dan *Computer Vision*)

- Perdagangan



# Aplikasi Pengolahan Citra (dan *Computer Vision*)



Biometrics

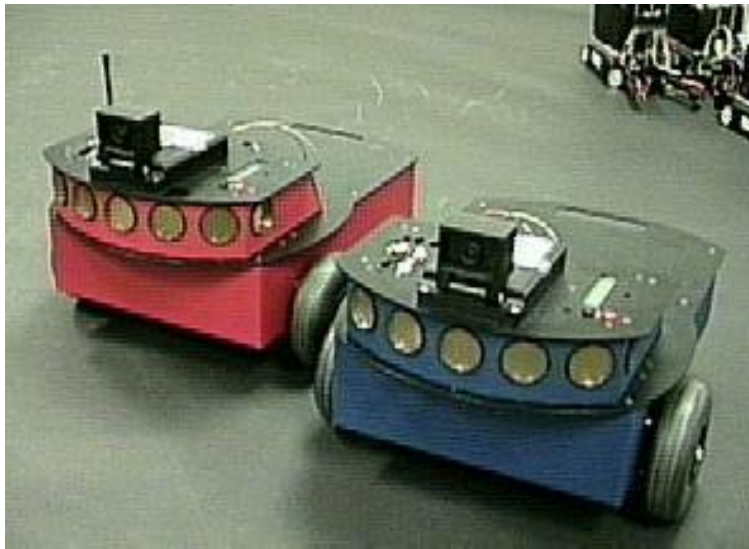
Sumber: Dr. Sanjeev Kumar, *Mathematical Imaging Techniques*, Department of Mathematics, IIT Roorkee



# Aplikasi Pengolahan Citra (dan *Computer Vision*)

- Land, Underwater, Space

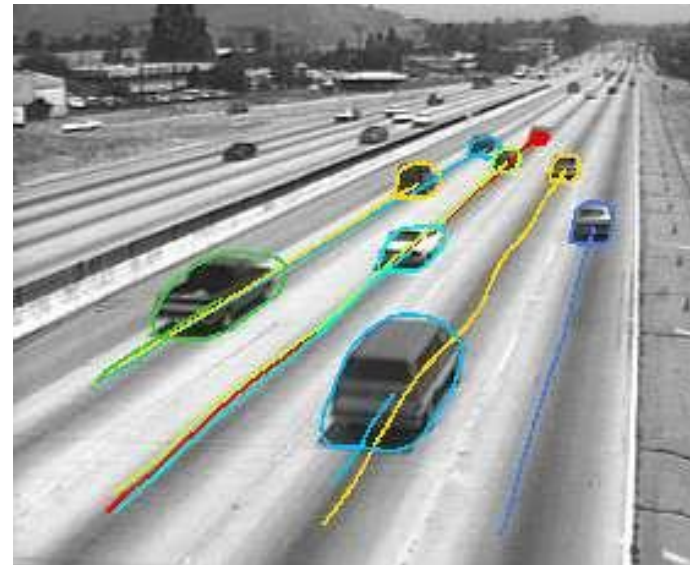
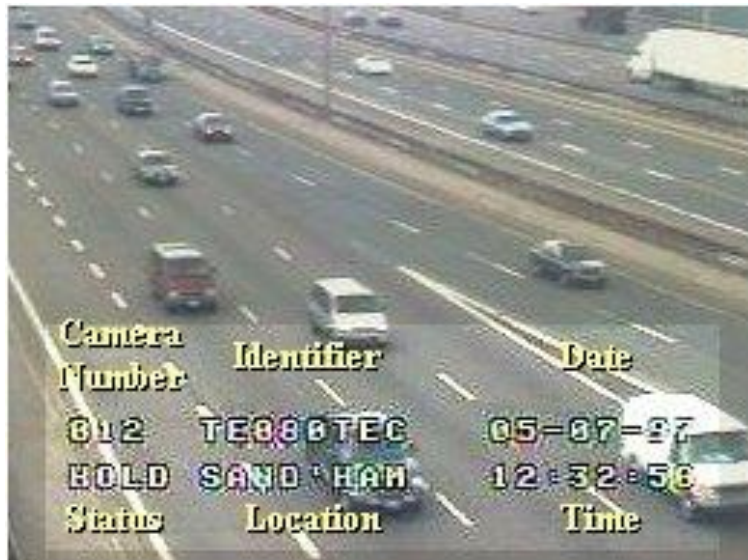
## Autonomous Vehicles



Sumber: Dr. Sanjeev Kumar, *Mathematical Imaging Techniques*, Department of Mathematics, IIT Roorkee

# Aplikasi Pengolahan Citra (dan *Computer Vision*)

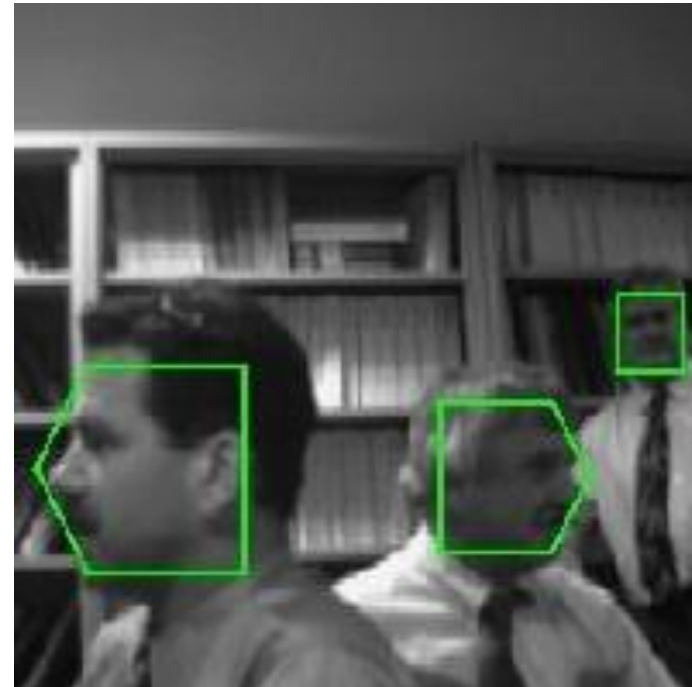
## Traffic Monitoring



Sumber: Dr. Sanjeev Kumar, *Mathematical Imaging Techniques*, Department of Mathematics, IIT Roorkee

# Aplikasi Pengolahan Citra (dan *Computer Vision*)

## Face Detection



Sumber: Dr. Sanjeev Kumar, *Mathematical Imaging Techniques*, Department of Mathematics, IIT Roorkee

# Aplikasi Pengolahan Citra (dan *Computer Vision*)



Face Recognition

Sumber: Dr. Sanjeev Kumar, *Mathematical Imaging Techniques*, Department of Mathematics, IIT Roorkee

# Aplikasi Pengolahan Citra (dan *Computer Vision*)



Sumber: Dr. Sanjeev Kumar, *Mathematical Imaging Techniques*, Department of Mathematics, IIT Roorkee

## Facial Expression Recognition

# Aplikasi Pengolahan Citra (dan *Computer Vision*)

- Smart Human-Computer User Interfaces
- Sign Language Recognition

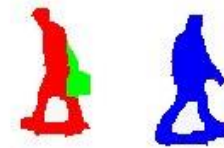
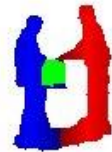
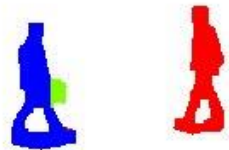


Sumber: Dr. Sanjeev Kumar, *Mathematical Imaging Techniques*, Department of Mathematics, IIT Roorkee

## Hand Gesture Recognition

# Aplikasi Pengolahan Citra (dan *Computer Vision*)

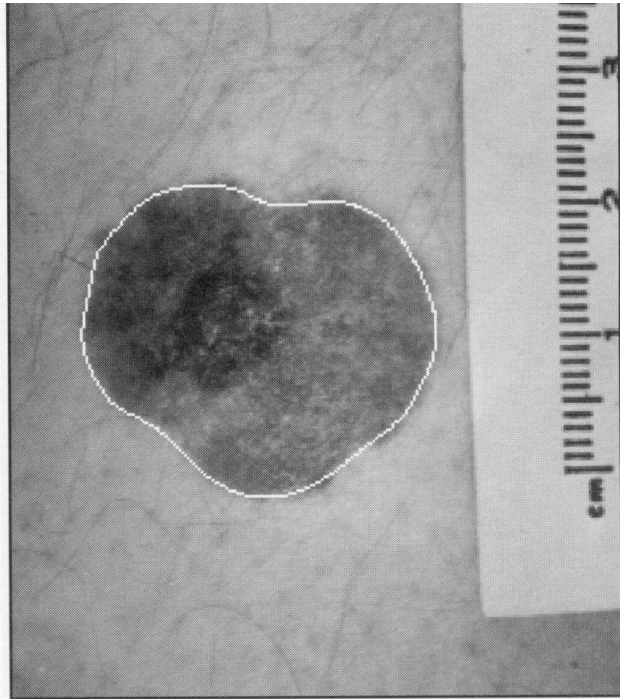
## Human Activity Recognition



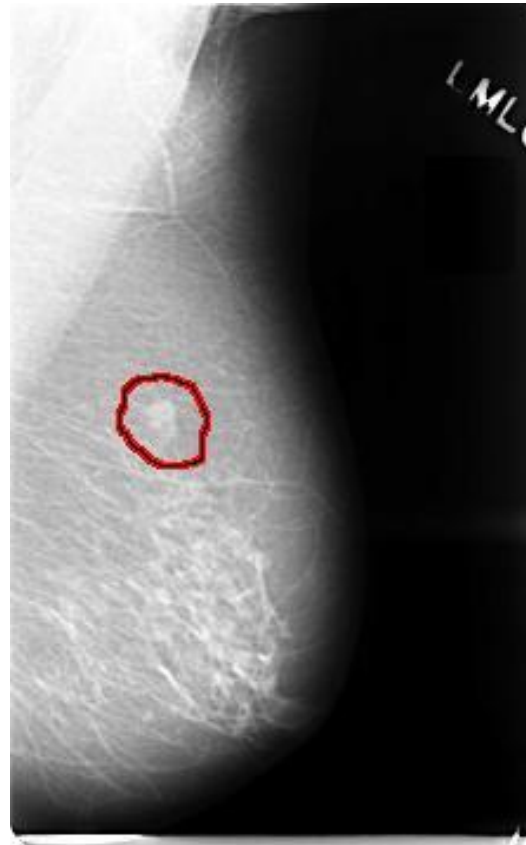
Sumber: Dr. Sanjeev Kumar, *Mathematical Imaging Techniques*, Department of Mathematics, IIT Roorkee

# Aplikasi Pengolahan Citra (dan *Computer Vision*)

skin cancer



breast cancer



Medical Applications

Sumber: Dr. Sanjeev Kumar, *Mathematical Imaging Techniques*,  
Department of Mathematics, IIT Roorkee



# Aplikasi Pengolahan Citra (dan *Computer Vision*)

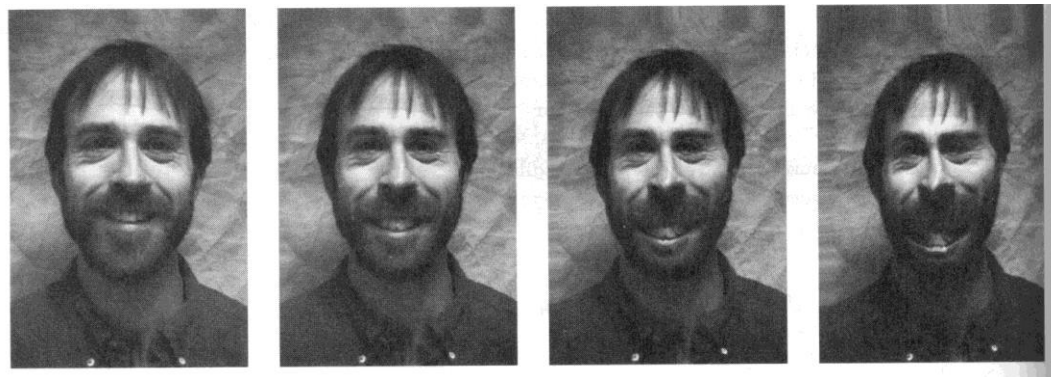
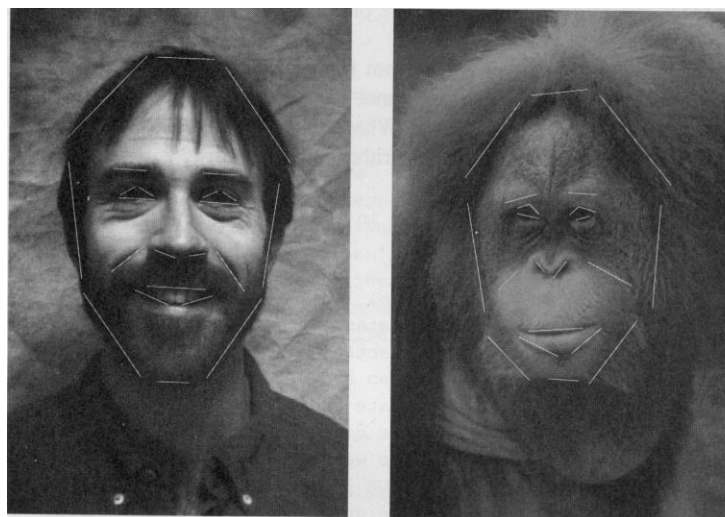
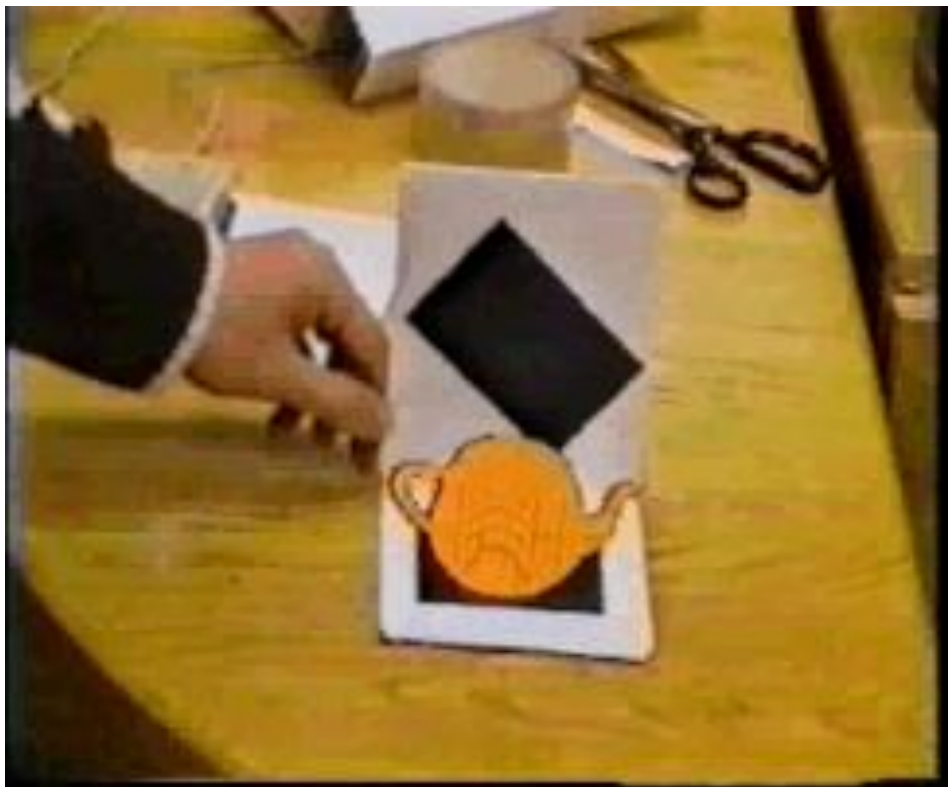


Image Morphing



# Aplikasi Pengolahan Citra (dan *Computer Vision*)



Sumber: Dr. Sanjeev Kumar, *Mathematical Imaging Techniques*, Department of Mathematics, IIT Roorkee

Inserting Artificial Objects into a Scene

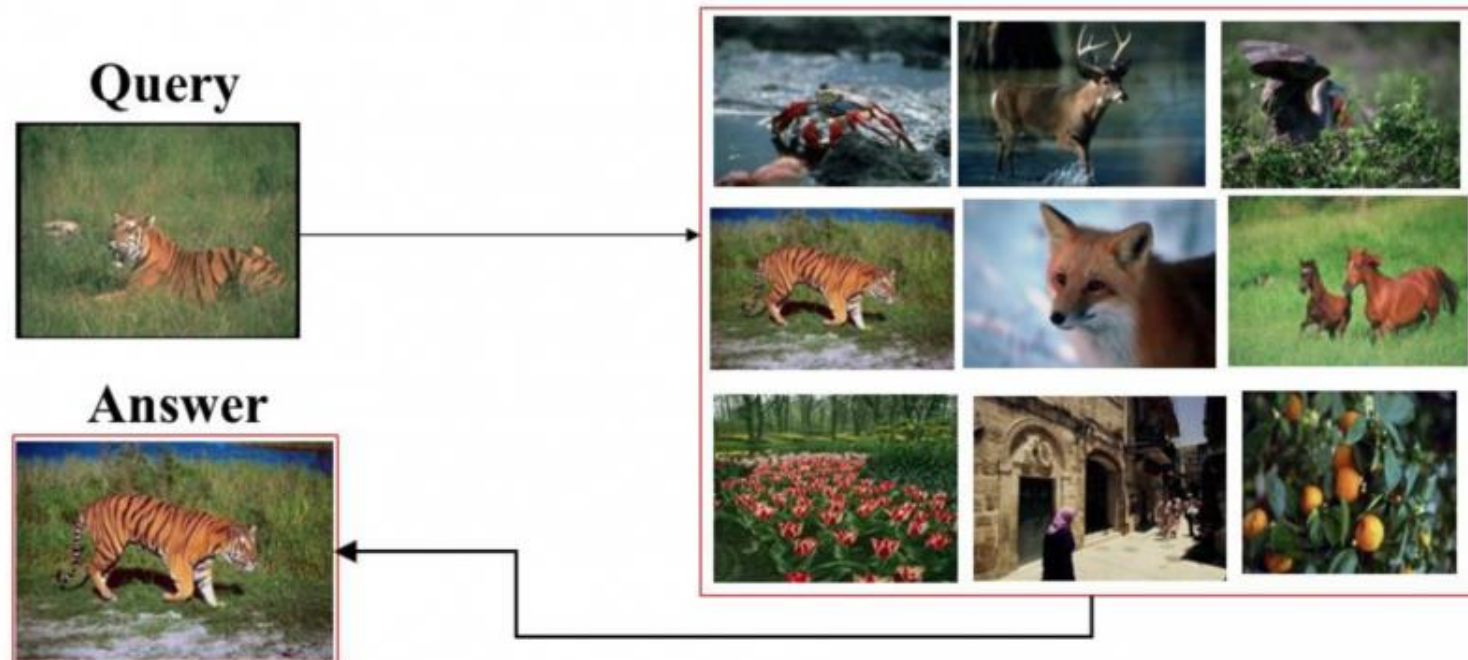
# Aplikasi Pengolahan Citra (dan *Computer Vision*)

An image retrieval system is a computer system for browsing, searching and retrieving images from a large database of digital images

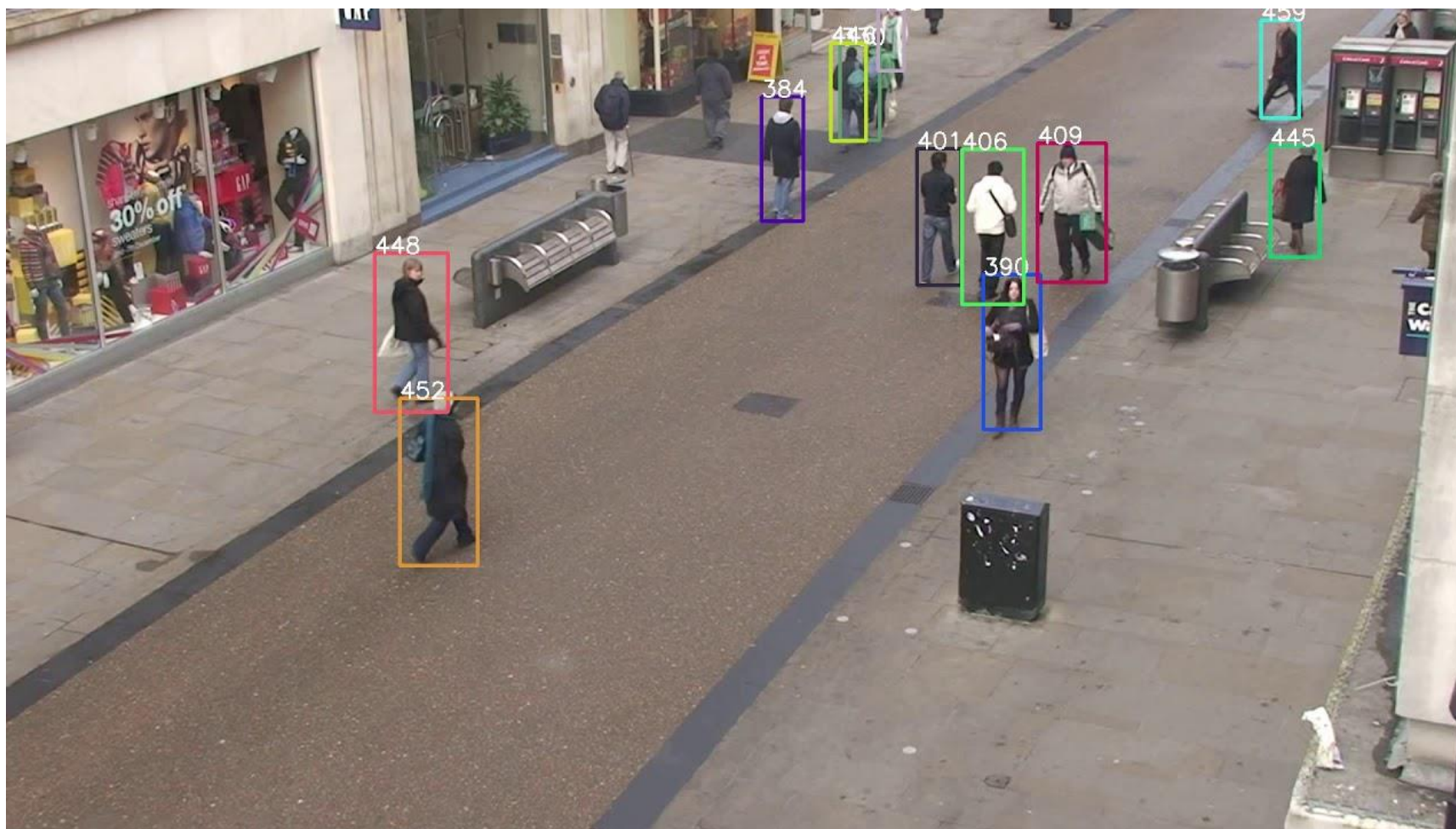
## Content-based Image Retrieval

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Given a query image, try to find visually similar images from an image database



# Aplikasi Pengolahan Citra (dan *Computer Vision*)



Human tracking

# Citra Uji Standard

- Terdapat sejumlah citra yang sering dipakai sebagai citra uji di dalam pengolahan citra atau *computer vision*.
- Citra-citra tersebut sering disebut sebagai *standard test image*, baik citra *grayscale* maupun citra berwarna.
- Umumnya citra uji berukuran persegi ( $N \times N$ ) untuk memudahkan beberapa operasi pengolahan citra yang mengasumsikan citra masukan sebagai citra persegi.
- Empat citra uji standard yang populer dan digunakan secara luas adalah citra *Lena*, *mandrill*, *camera*, dan *pepper*.
- Koleksi citra uji dapat dilihat di laman situs web saya:  
<http://informatika.stei.itb.ac.id/~rinaldi.munir/Koleksi/Citra%20Uji/CitraUji.htm>



Lena, 256 × 256



Peppers 512 × 512



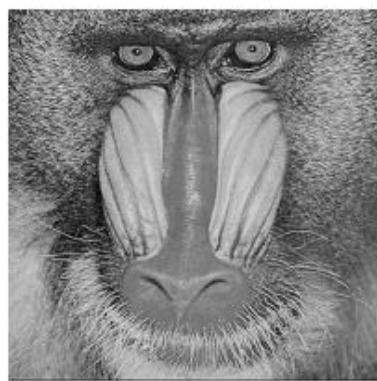
Zelda 512 × 512



Bird 256 × 256



Camera 256 × 256



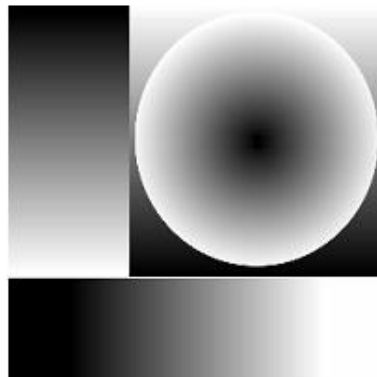
Mandrill 512 × 512



Barbara 512 × 512



Boat 512 × 512



Slope 256 × 256



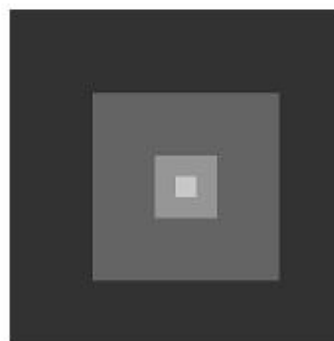
San Fransisco 256 × 256



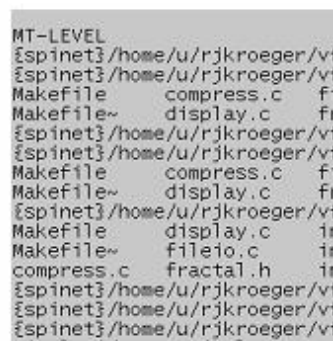
Collie 256 × 256



Circle 256 × 256



Squares 256 × 256



Text 256 × 256



Mountain 640 × 480



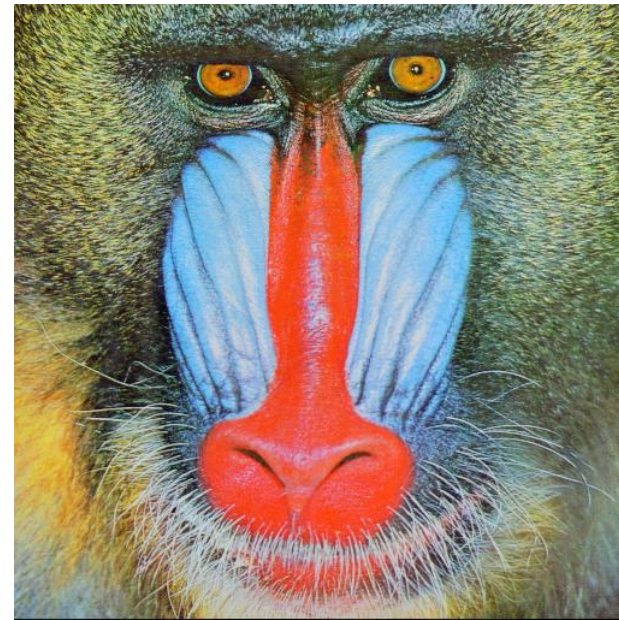
Goldhill 512 × 512



Eltoro 512 × 512



Girl 256 × 256



Citra uji lainnya:



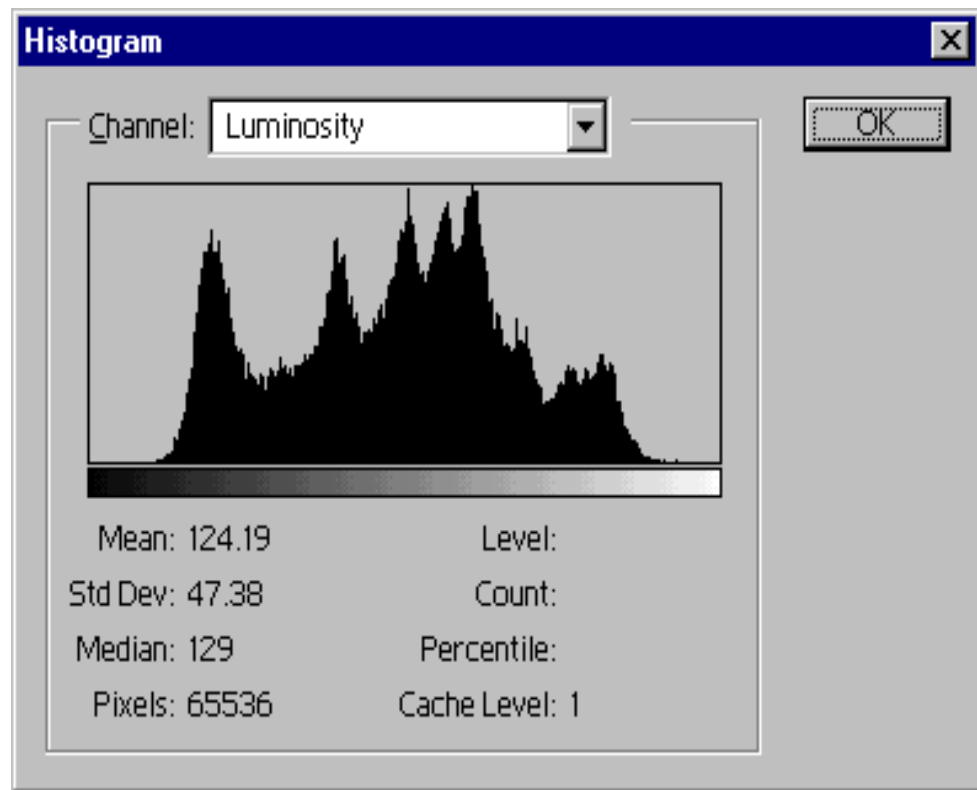
Empat citra populer dalam bidang *image processing*

# Sejarah Citra Lena



- **Lenna** atau **Lena** adalah nama citra uji standard yang digunakan secara luas di dalam bidang pengolahan citra sejak tahun 1973.
- Lena adalah citra seorang model Swedia bernama Lena Söderberg, yang dipotong dari majalah *Playboy*.
- Foto Lena dari majalah tersebut dipindai oleh Alexander Sawchuk, dia memerlukan foto wajah untuk ditampilkan di dalam sebuah artikel ilmiahnya di sebuah konferensi IEEE.
- Alasan penggunaan citra Lena sebagai citra uji adalah karena citra ini memiliki detail yang bagus, tekstur, dan bayangan, tetapi yang paling penting adalah nilai-nilai *pixel*-nya tersebar secara merata (histogram).
- Tidak dipungkiri juga alasan karena ia seorang wanita cantik, seorang model, dan seorang artis.



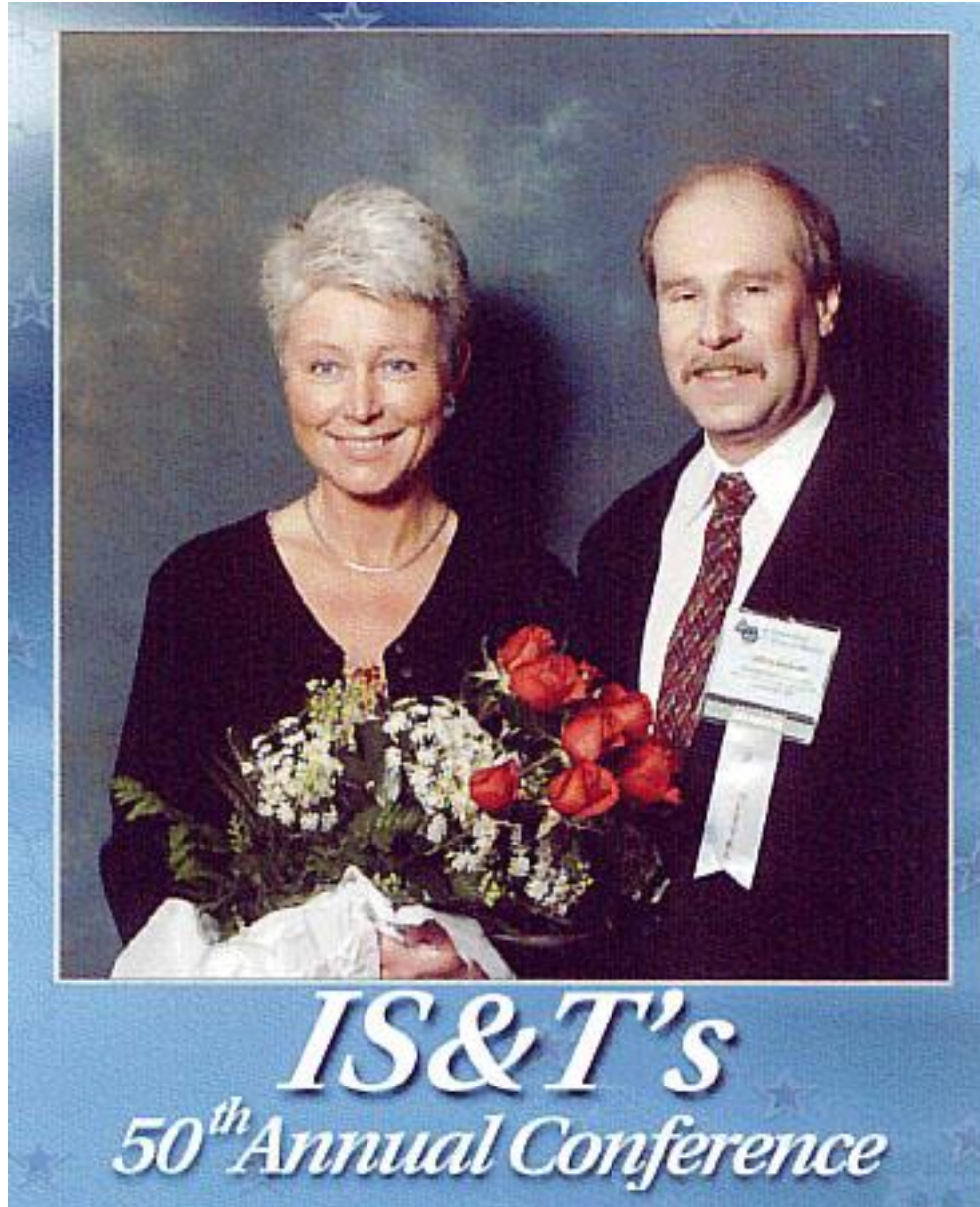


- Sejarah pertama kali citra Lenna dipakai sebagai citra uji ditulis sebagai berikut:

Alexander Sawchuk estimates that it was in June or July of 1973 when he, then an assistant professor of electrical engineering at the [University of Southern California](#) Signal and Image Processing Institute (SIPI), along with a graduate student and the SIPI lab manager, was hurriedly searching the lab for a good image to scan for a colleague's conference paper. They got tired of their stock of usual test images, dull stuff dating back to television standards work in the early 1960s. They wanted something glossy to ensure good output dynamic range, and they wanted a human face. Just then, somebody happened to walk in with a recent issue of *Playboy*.

The engineers tore away the top third of the centerfold so they could wrap it around the drum of their Muirhead wirephoto scanner, which they had outfitted with analog-to-digital converters (one each for the red, green, and blue channels) and a [Hewlett Packard 2100](#) minicomputer. The Muirhead had a fixed resolution of 100 lines per inch and the engineers wanted a 512×512 image, so they limited the scan to the top 5.12 inches of the picture, effectively cropping it at the subject's shoulders.

## Lena Söderberg tahun 1997:



Currently, Lenna lives near Stockholm and works for a government agency supervising handicapped employees archiving data using, appropriately, computers and scanners.

Sumber:

<http://www.ee.cityu.edu.hk/~Impo/lenna/Lenna97.html>

Lena saat ini:



I discovered that the last time she'd appeared in public was in 2015, as a "special guest" at an image processing industry conference in Quebec City.

"I'm just surprised that it never ends," Forsen says about her unusual fame.

Sumber: <https://www.wired.com/story/finding-lena-the-patron-saint-of-jpegs/>

# Sumber bahan ajar ini

1. Yacov Hel-Or, *Image Processing*, Spring 2010
2. Dr. Sanjeev Kumar, *Mathematical Imaging Techniques*, Department of Mathematics, IIT Roorkee