Image Processing
COMP 4421
Fall 2019

Instructor: Albert Chung

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COMP 4421

- Lecture:

  Wednesday and Friday, 1:30pm-2:50pm, Room 1103.
- Tutorial 1: Monday, 2pm-2:50pm, Rm 2463, Lift 25-26.
- Tutorial 2: Thursday, 5pm-5:50pm, Rm 6591, Lift31-32.
- Class Dates: Sep 2, 2019 – Nov 30, 2019.
- Lecture notes will be available on-line.
- Office Hours: by appointment.
- No lab sessions.

Teaching assistants (TAs)

- TA 1: MOK, Chi Wing (Tony), cwmokab@connect.ust.hk
- TA 2: WANG Jierong, jwangdh@connect.ust.hk

- Office: Room 4208, Medical Image Analysis Laboratory
- Office Hours: By appointment.

Computing requirements

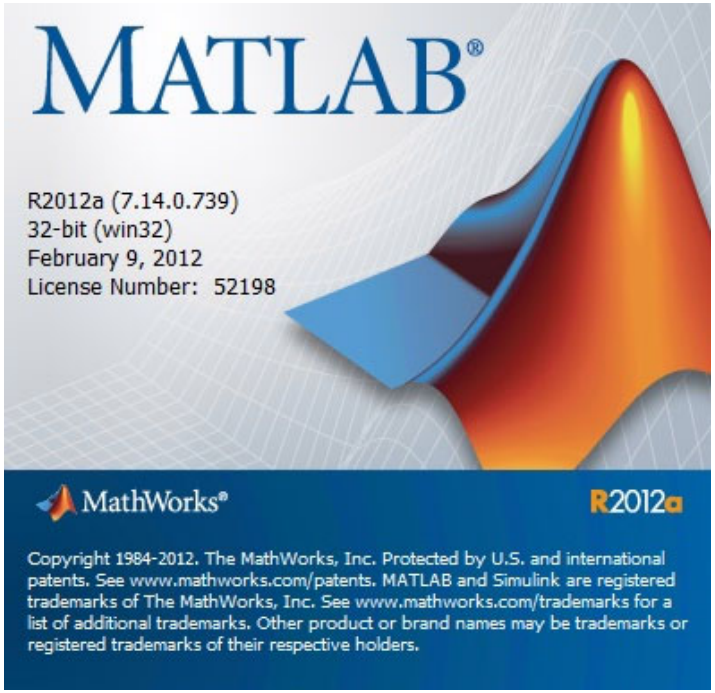


Image Source: http://www.mathworks.com/

We use MATLAB http://www.mathworks.com/ for assignments

- Workstations in ITSC Computer Barns http://www.ust.hk/itsc/computerbarn/
- MATLAB software and related toolboxes are available in the computer barns, e.g., image processing toolbox.

Expected background and related courses

- Basic partial derivatives and multiple integrals (mainly two-dimensional)
- Programming in C++/MATLAB
- Basic linear algebra, e.g., eigenvalues and eigenvectors
- Basic statistics and probability

Course topics

Topics

1. Introduction, Image Representation, MATLAB
2. Enhancement in the Spatial Domain
3. Enhancement in the Frequency Domain
4. Restoration and Filtering, Non-linear Filtering
5. Morphological Image Processing
6. Segmentation of Images
7. Registration of Images
8. Image Compression
9. Feature Descriptors, e.g., LBP/LTP, SIFT and others
10. Applications, e.g., Face/Iris Recognition and Fingerprint Recognition.
11. Guest lectures (1-2)

Course outcomes

On successful completion of this course, students are expected to be able to

1. Identify basic image enhancement techniques in both the spatial and frequency domains
2. Enhance an image in the presence of noise and distortion
3. Apply basic morphological image processing techniques
4. Segment image components from an image
5. Register images with similarity metrics and transformations
6. Compress an image with lossless or lossy compression methods
7. Represent and describe an image using different feature descriptors

Course references

- References:
  - *Digital Image Processing*, by Gonzalez and Woods, 3rd Ed., Prentice Hall, 2008.
  - *Digital Image Processing using MATLAB*, by Gonzalez and Woods, Prentice Hall, 2004.
  - *The Image Processing Handbook*, by John C. Russ (On-line at UST Library).
  - *Digital Image Processing*, by Kenneth R. Castleman, Prentice Hall, 1996.
  - *Two-dimensional Signal and Image Processing*, by Jae S. Lim, Prentice Hall, 1990.
  - *Computer Vision: A Modern Approach* by Forsyth and Ponce, Prentice Hall, 2003.

Course requirements

- Homework assignments
  - 3 assignments
  - Written: write answers on paper
  - Programming: write computer programs using MATLAB
- Midterm and Final examinations
  - Written: write answers on paper

Evaluations

Assignments (30%)

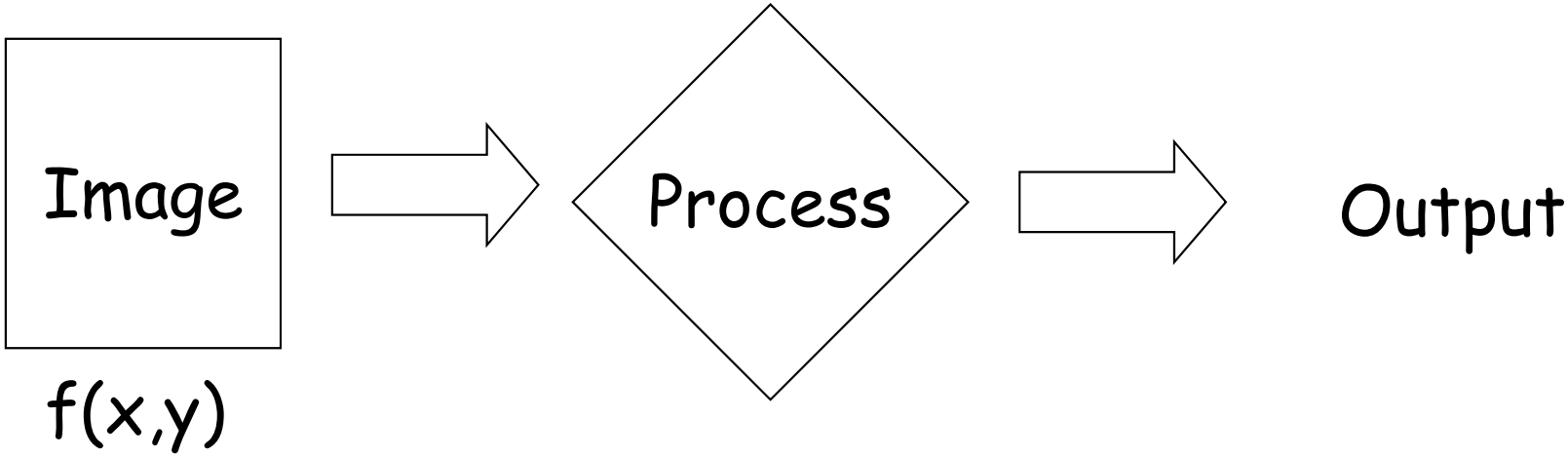
- Written and programming based; analyzing and implementing topics we cover in class
- Assignments must be submitted by midnight of the due day. Late assignments will incur a 10% penalty
- Assignments more than one day late will not be accepted
- More information about the submission procedure will be given

Examinations (70%)

- Midterm (20-30%): Nov 1, 2019, Friday. The midterm exam will be given in-class, and venue and coverage will be announced.
- Final (40-50%): TBC

What is Image Processing?

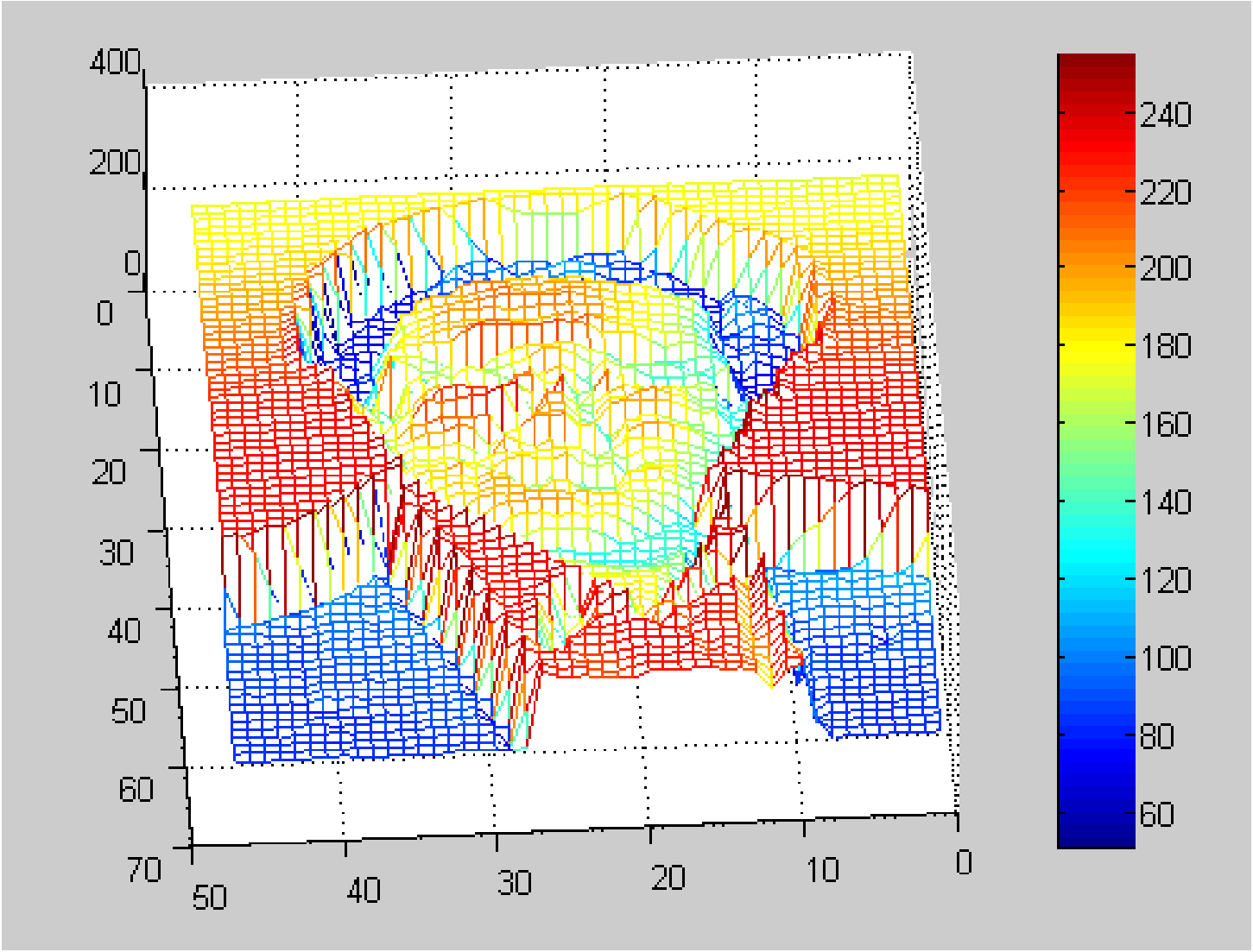
- Processing of “pictorial” information



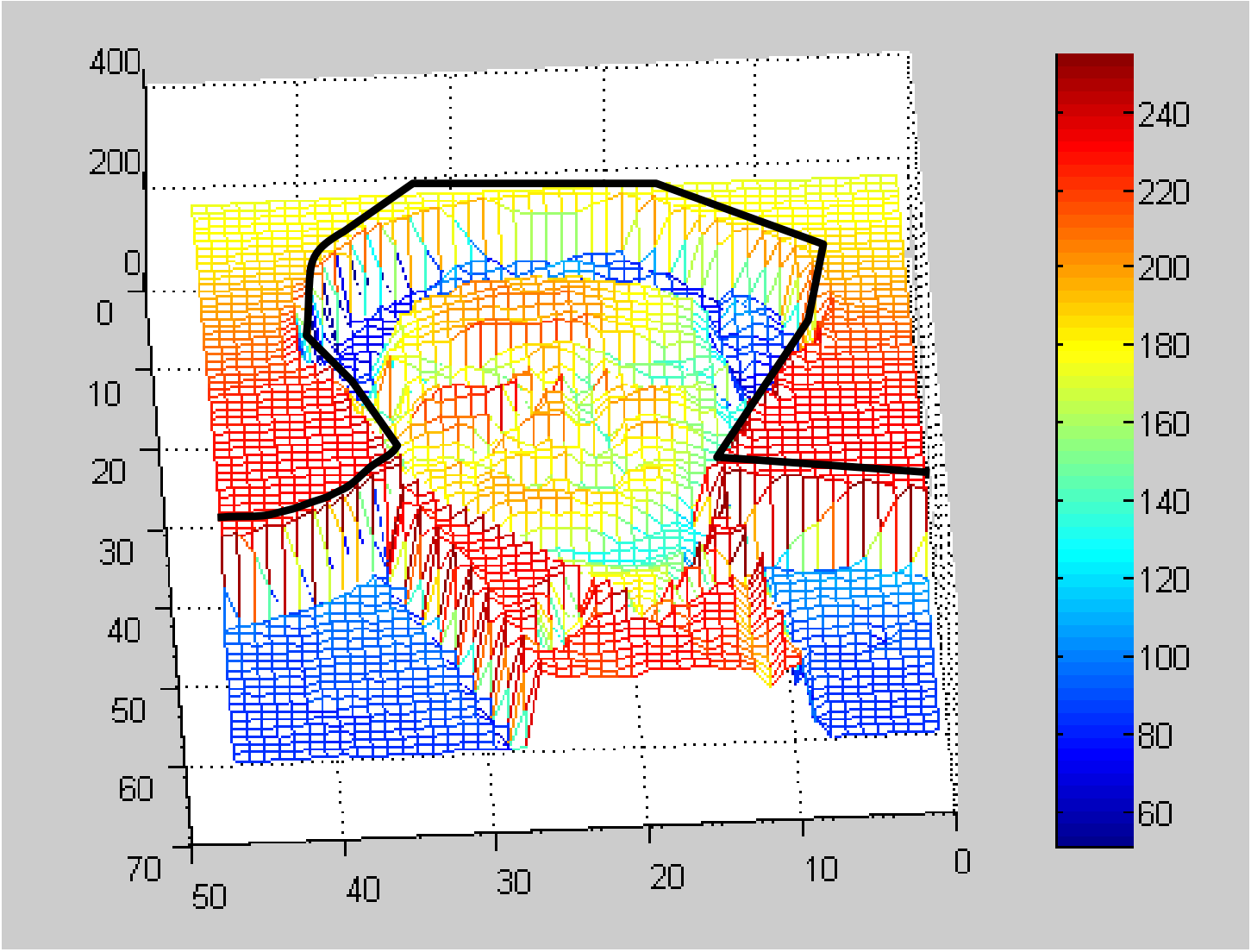
Find face from an image

Problem: How to find a person in an image?

“Pictorial” Information based on Image Intensity

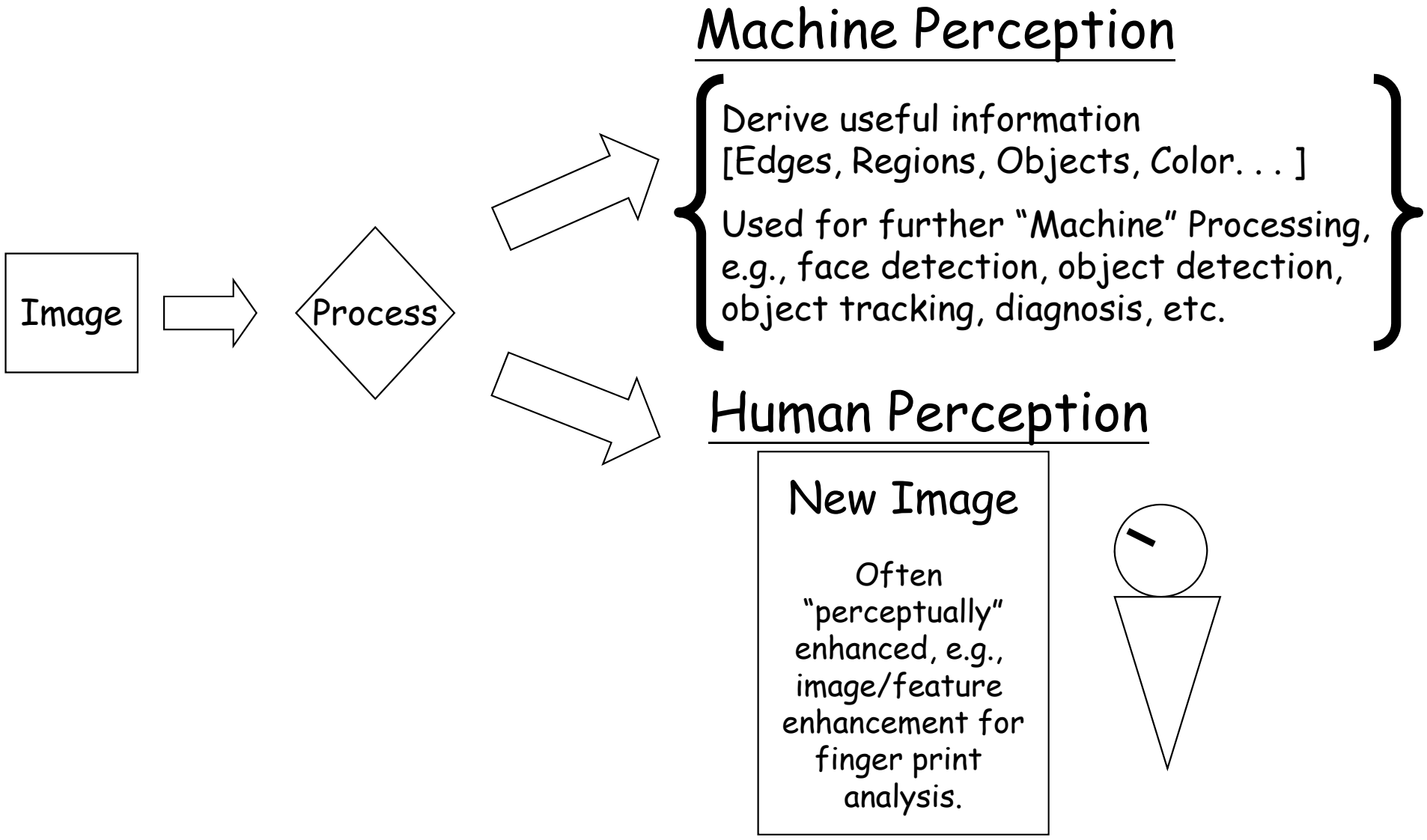


“Pictorial” Information based on Image Intensity and after processing



After processing of pictorial information, we find a face

Two principal applications

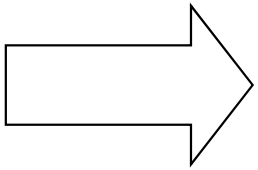


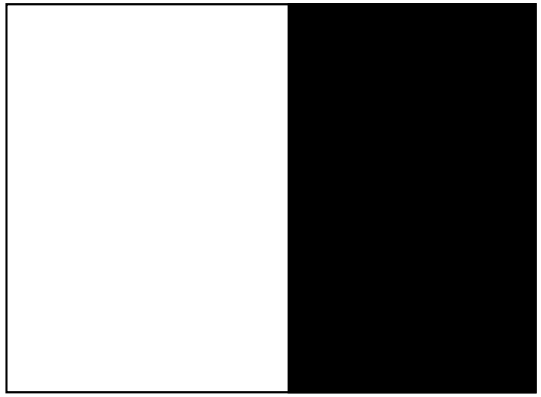
Two principal applications

- Machine Perception

- Human Perception

Image has 2 colors





Still has two colors
(perceptually clearer)

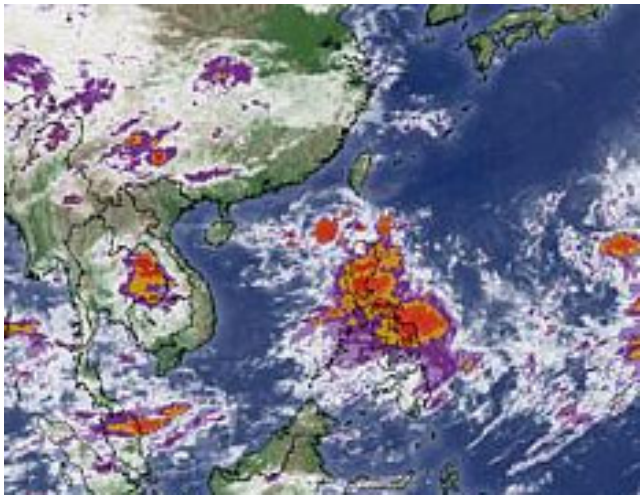
Two words: image processing

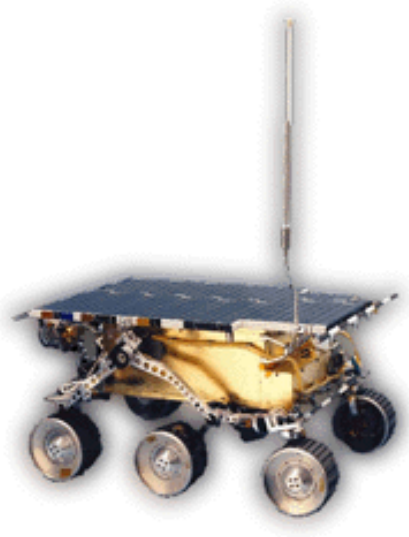
- image
  - Fundamentals
    - Image formation based on individual elements (pixels)
  - Representations
    - Sampling and Quantization
    - Alternative representations (Transforms)

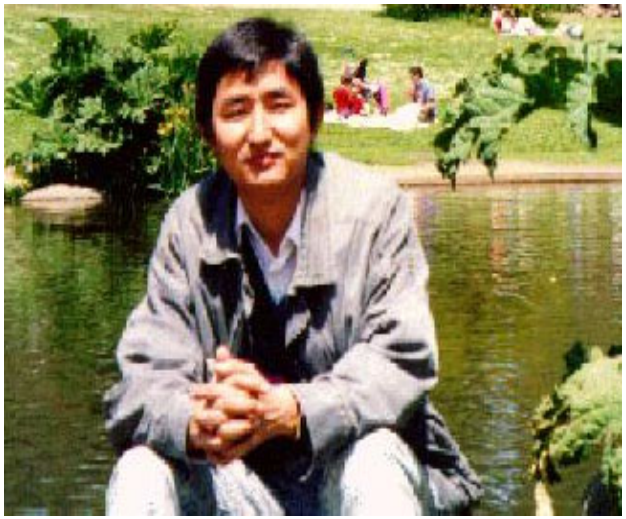
Two words: image processing

- processing
  - manipulation of the image data
    - Geometric transformations, e.g., rotation.
    - Enhancement/Restoration
    - Segmentation
    - Object Detection

Examples of image processing usage







Where does image processing fit in?