Image Processing
COMP 4421
Spring 2016

Albert Chung

Department of Computer Science and Engineering

achung@cse.ust.hk

http://www.cse.ust.hk/~achung

COMP 4421

- Instructor: Albert Chung

- Room 3516, Dept. of Computer Science and Engineering.

- Lecture: Mondays &Wednesdays, 10:30am-11:50am, Rm2406.

- Tutorial: Tuesdays (except the 1st week), G009B, CYT Bldg.

- Class Dates: Feb 1, 2016 – May 9, 2016.

- Lecture notes will be available on-line.

- Office Hours: by appointment.

- Personal Homepage: www.cse.ust.hk/~achung

- No lab sessions.

Teaching assistant (TA)

- TA: Ms Siqi (Portia) BAO, sbao@cse.ust.hk

- Office: Room 4208, Lo Kwee-Seong Medical Image Analysis

  Laboratory

- Office Hours: By appointment.

Computing requirements

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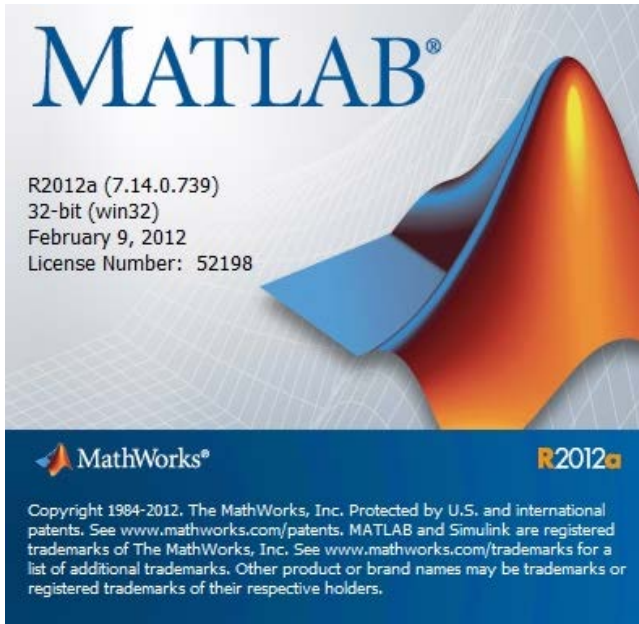
We use MATLAB
http://www.mathworks.com/
for assignments

- 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 2D)

- Programming in C++/MATLAB

- Basic linear algebra

- Basic statistics and probability

Course aim and 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, Motion detection
7. Registration of Images
8. Image Compression
9. Feature Descriptors, e.g., LBP and SIFT
10. Applications, e.g., Face Recognition, Fingerprint Recognition.

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 and

  - Programming: write executable and correct

    computer programs

- Midterm and Final

  - 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

Examination (70%)

- Midterm: April 6, 2016 (Wed), in class

- Final: TBC

What is Image Processing?

- Processing of "pictorial" information

Image
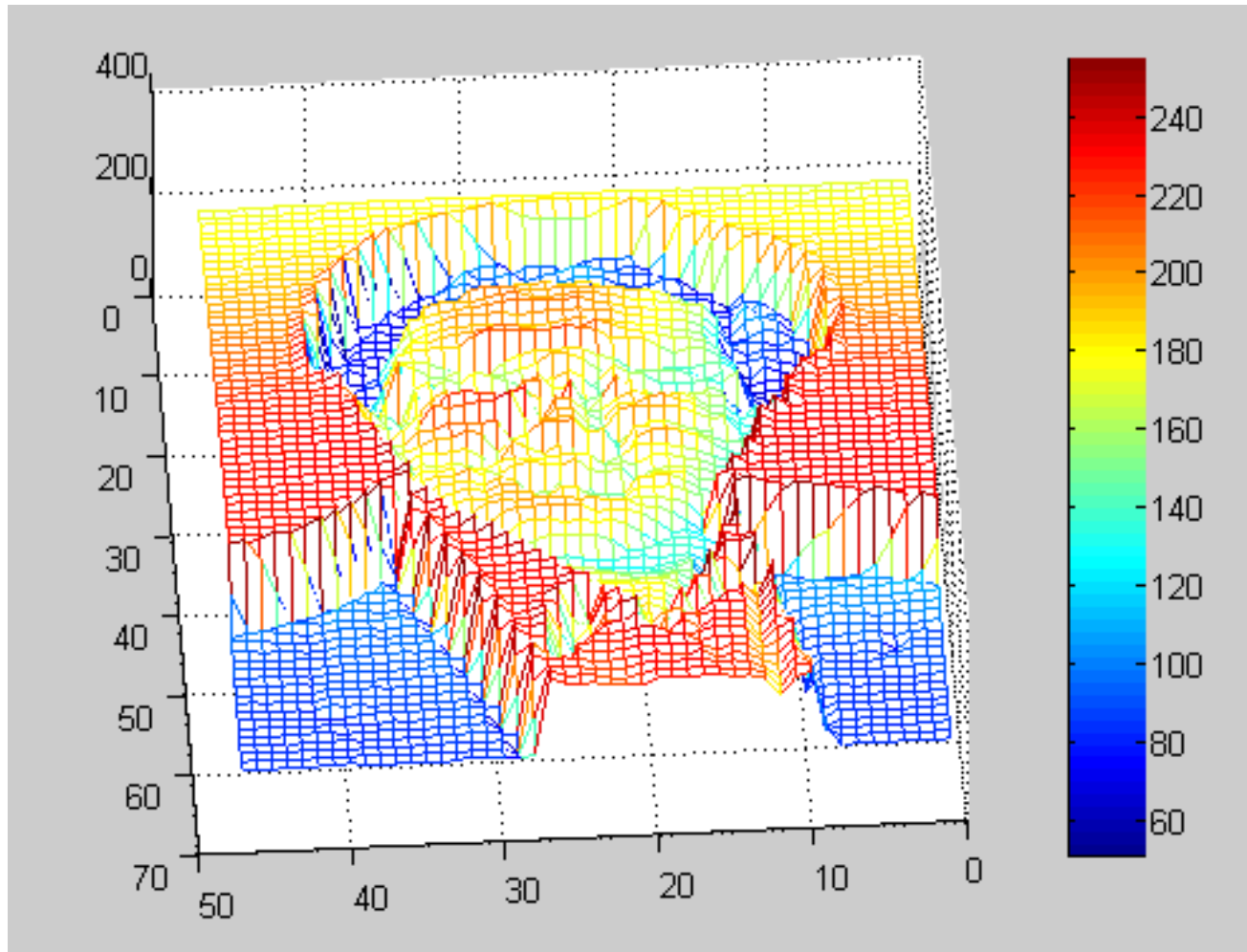f(x,y) → Process → Output
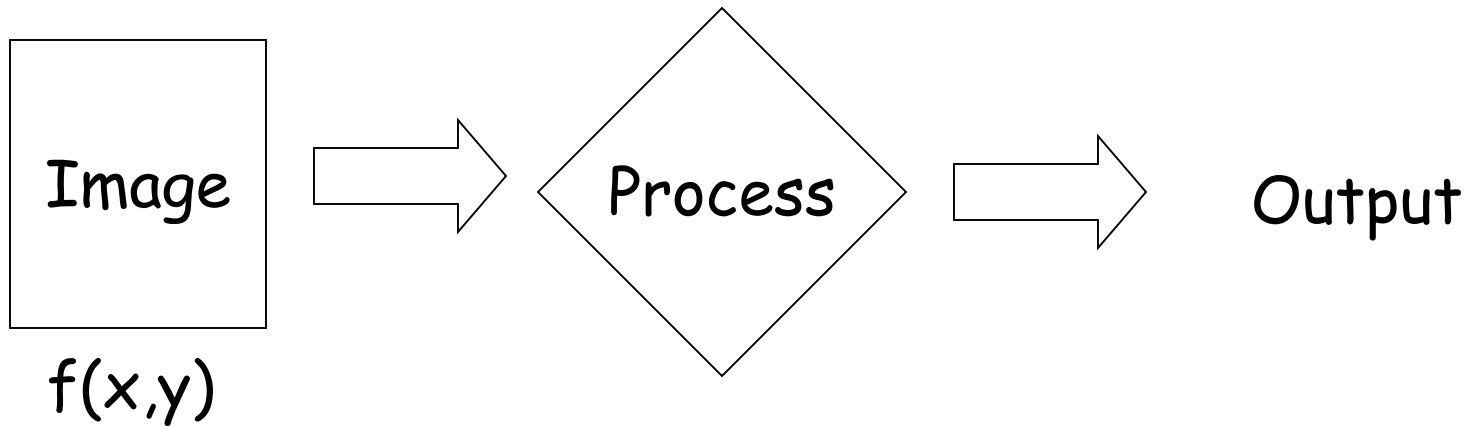
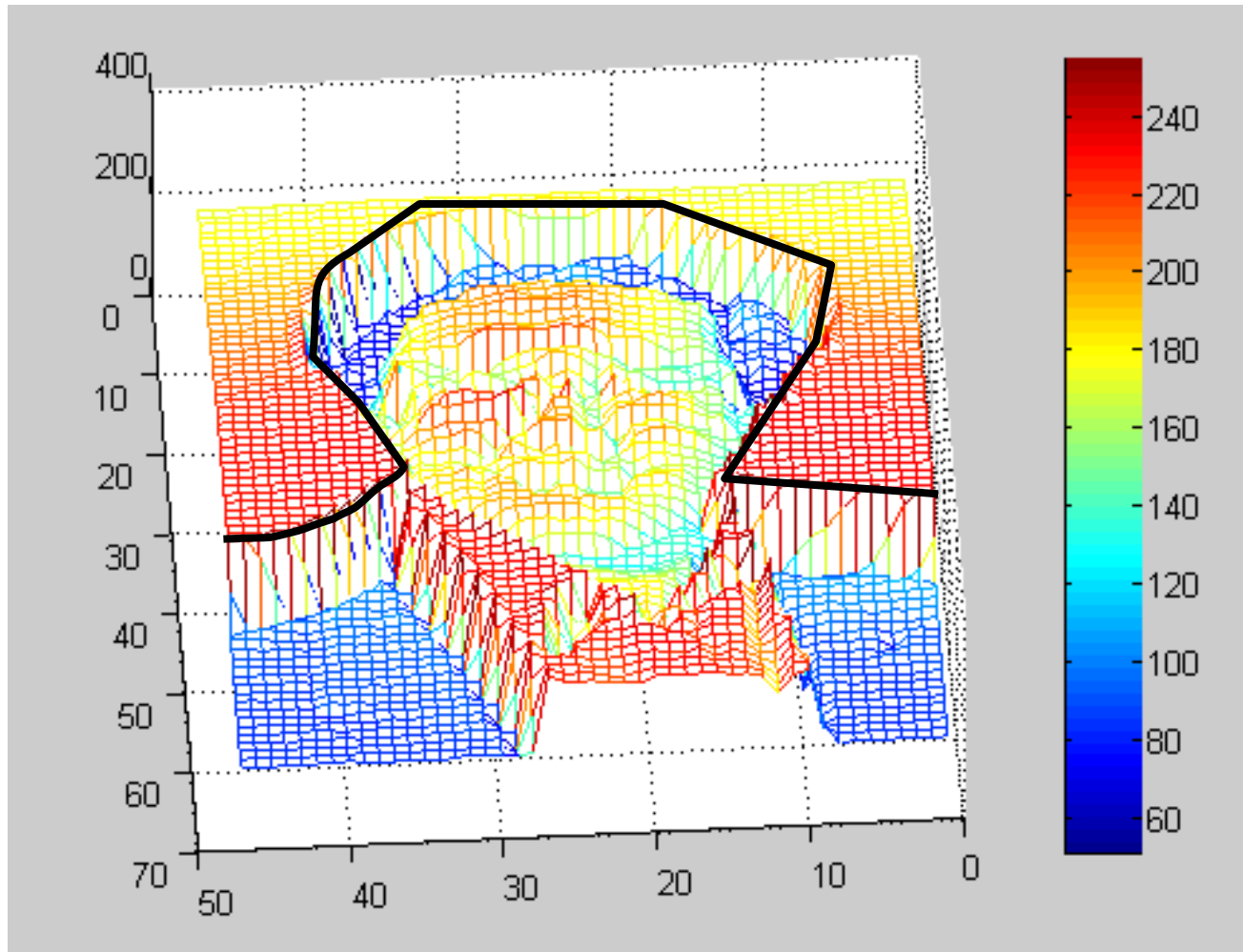# Pictorial Information

Problem: How to find a person in an image?

"Pictorial" Information based on Image Intensity

Pictorial Information
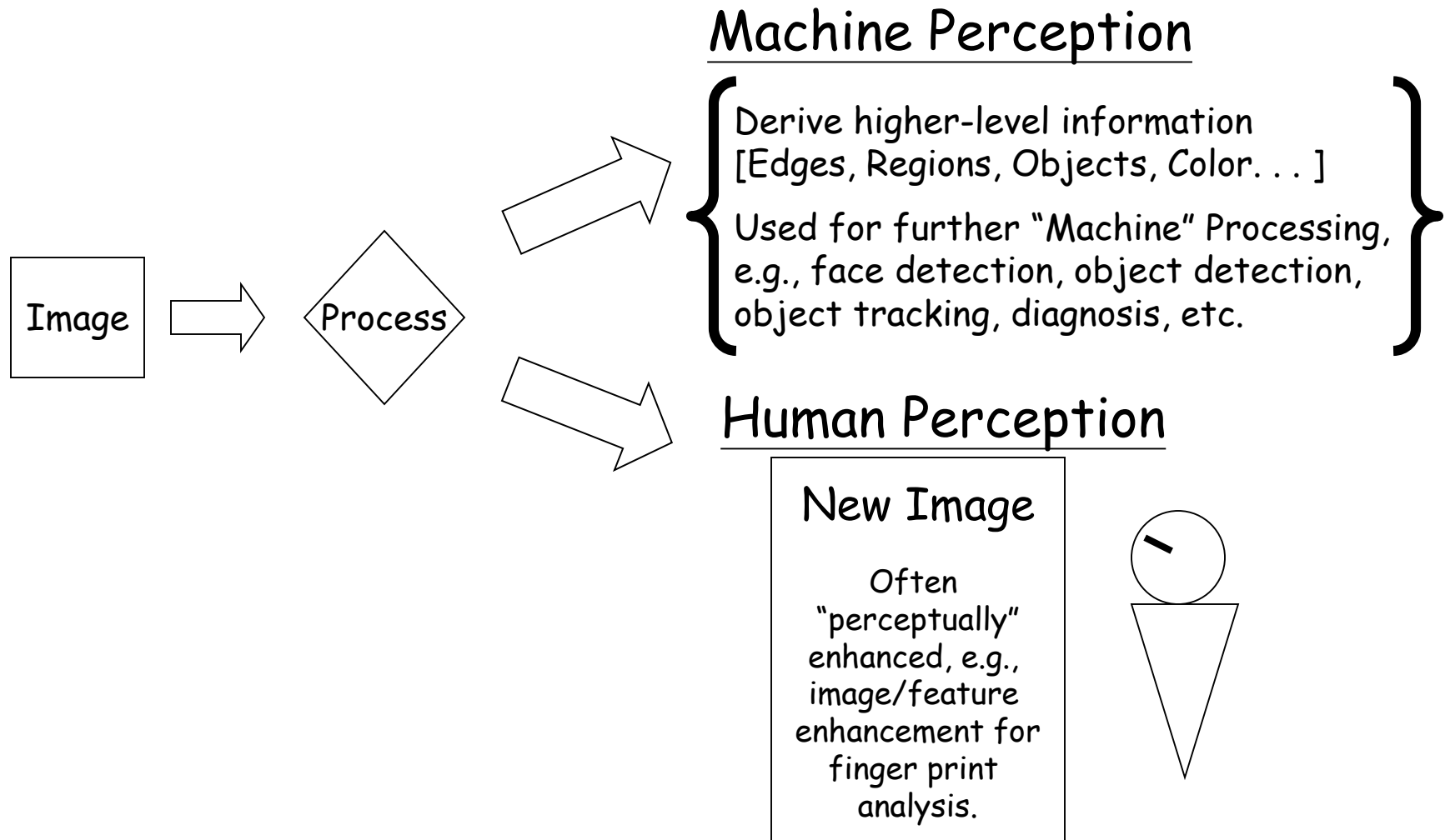
Pictorial Information

Two principal applications

Image → Process

Machine Perception

{
Derive higher-level information [Edges, Regions, Objects, Color. . .]

Used for further "Machine" Processing, e.g., face detection, object detection, object tracking, diagnosis, etc.
}

Human Perception

New Image

Often "perceptually" enhanced, e.g., image/feature enhancement for finger print analysis.
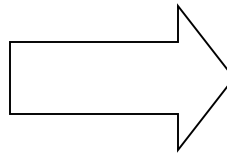
Two principal applications

- 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
    - Detection
    - Analysis
  - Deriving higher level semantics

Examples of image processing usage
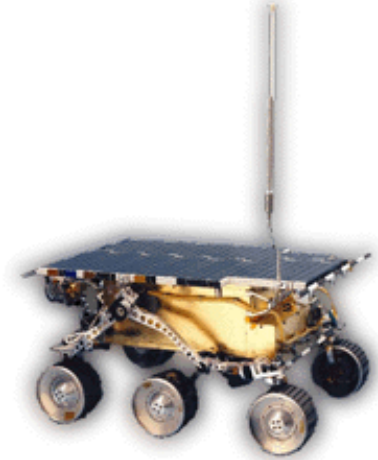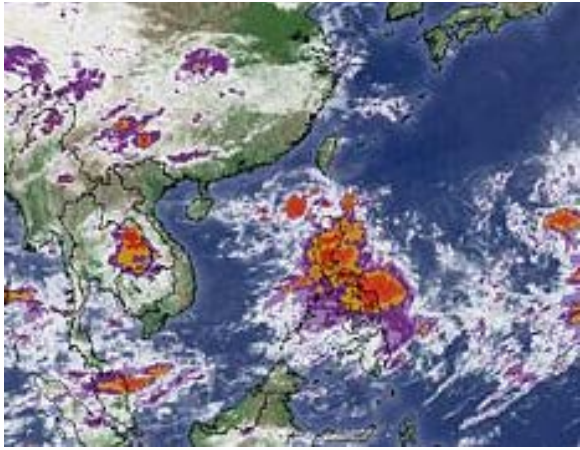
Where does image processing fit in?