Image and Video Processing
EQ2330

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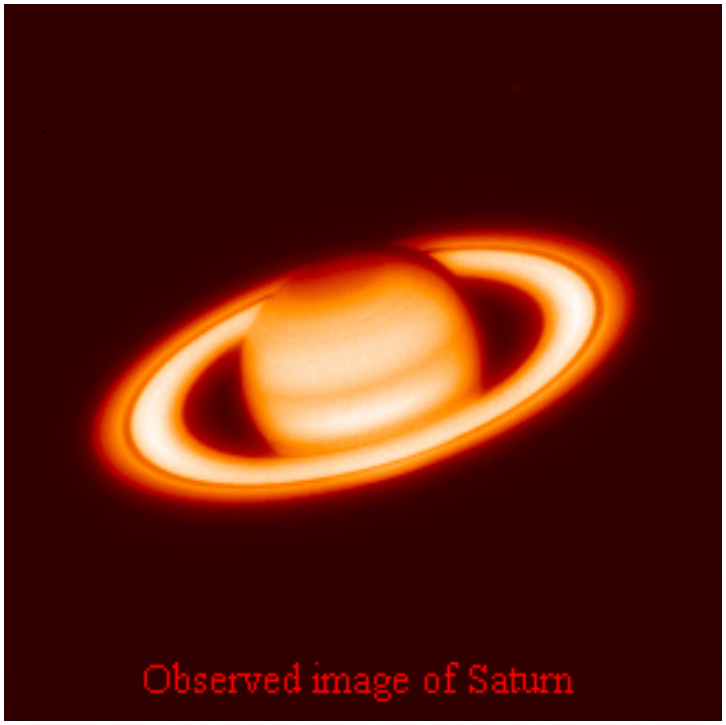
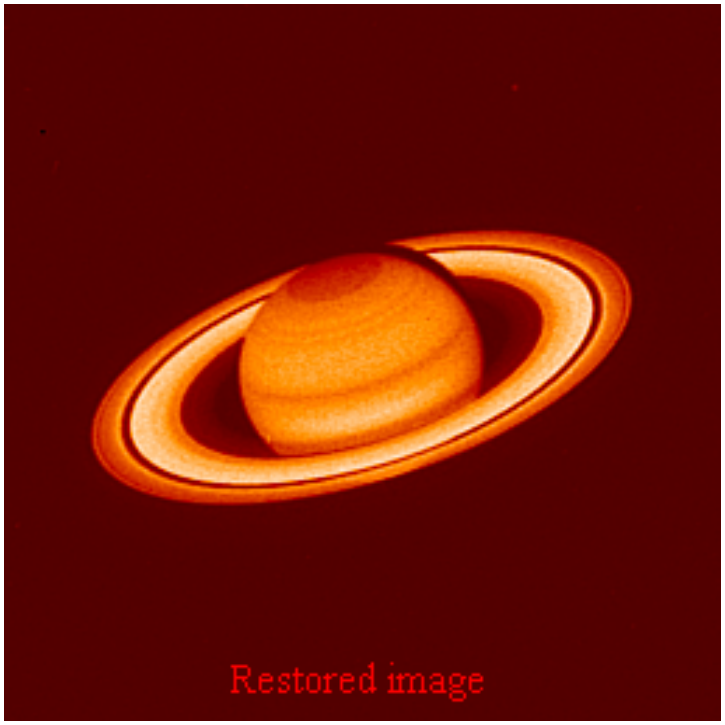
Why Do We Process Images?

- Acquire an image
  - *Correct aperture and color balance*
  - *Reconstruct image from projections*
- Prepare for display or printing
  - *Adjust image size*
  - *Halftoning*
- Facilitate picture storage and transmission
  - *Efficiently store an image in a digital camera*
  - *Send an image from Mars to Earth*
- Enhance and restore images
  - *Remove scratches from an old movie*
  - *Improve visibility of tumor in a radiograph*
- Extract information from images
  - *Read the ZIP code on a letter*
  - *Measure water pollution from aerial images*

Image Processing Examples

Restoration of image from Hubble Space Telescope





Source: IVPL Northwestern University, Chicago

Image Processing Examples

Color photo enhancement

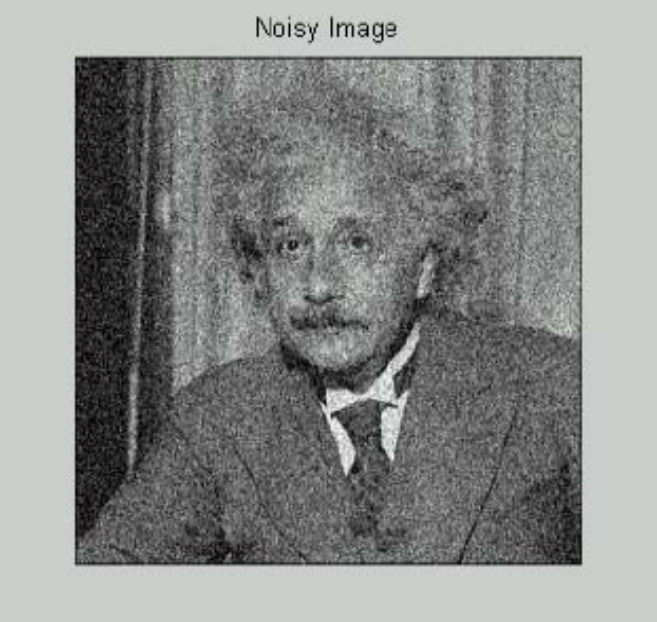
Original

Automatic enhancement

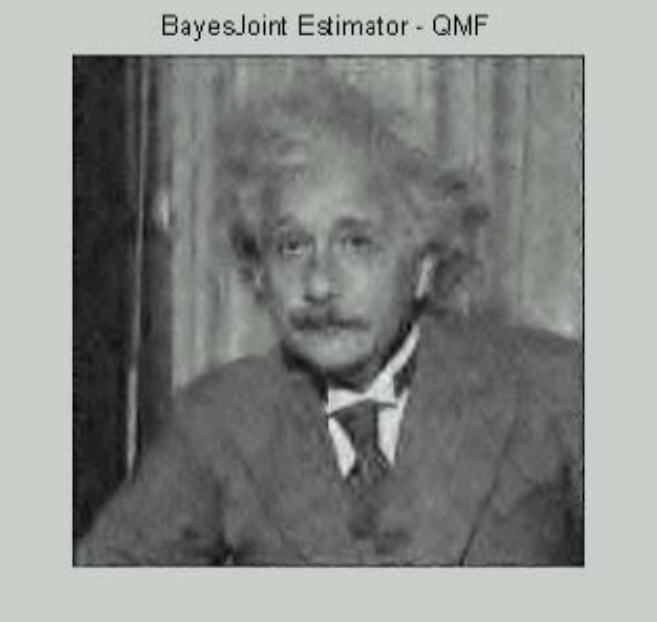
Software: Picture Project 1.5, 2005, Nikon Corporation

Image Processing Examples

Noise reduction



Degraded image



Noise-reduced image

Source: Class project, Stanford University

Image Processing Examples

Special effects

Photo

Simulated color pencils

Simulated oil painting

Source: Class project, Stanford University

Image Processing Examples

Halftoning

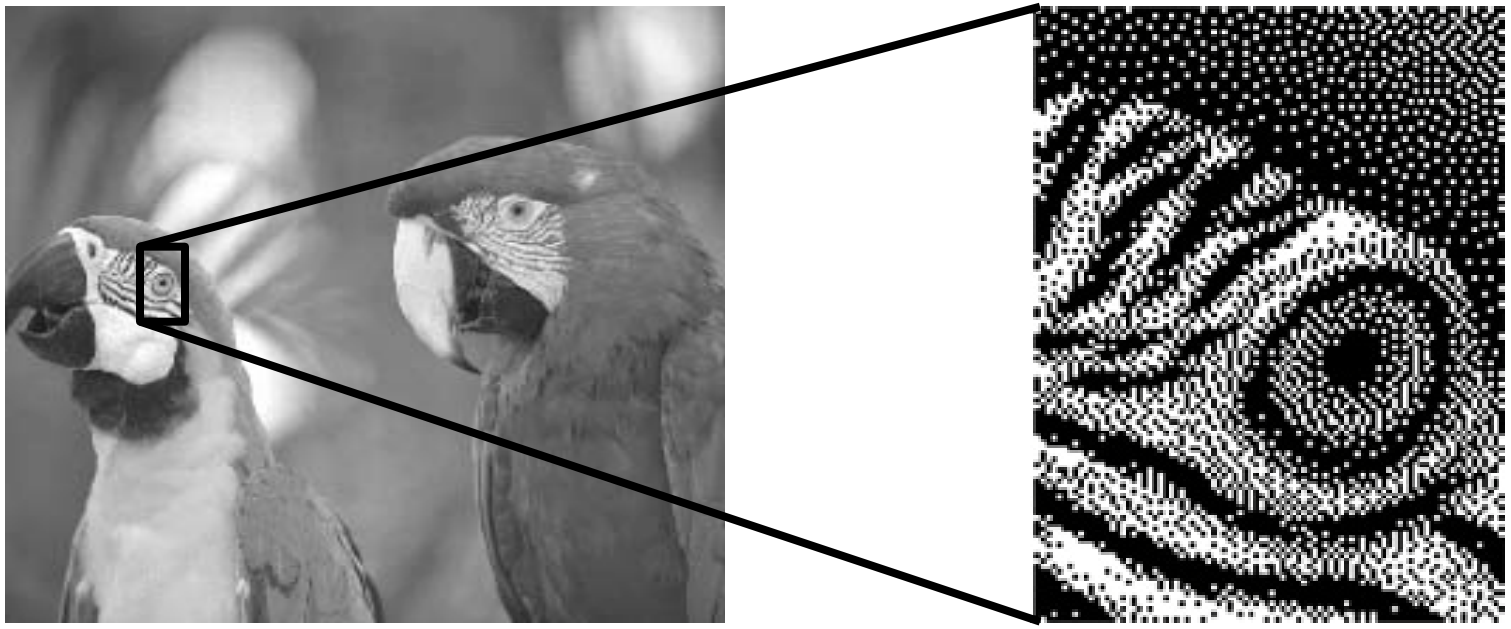
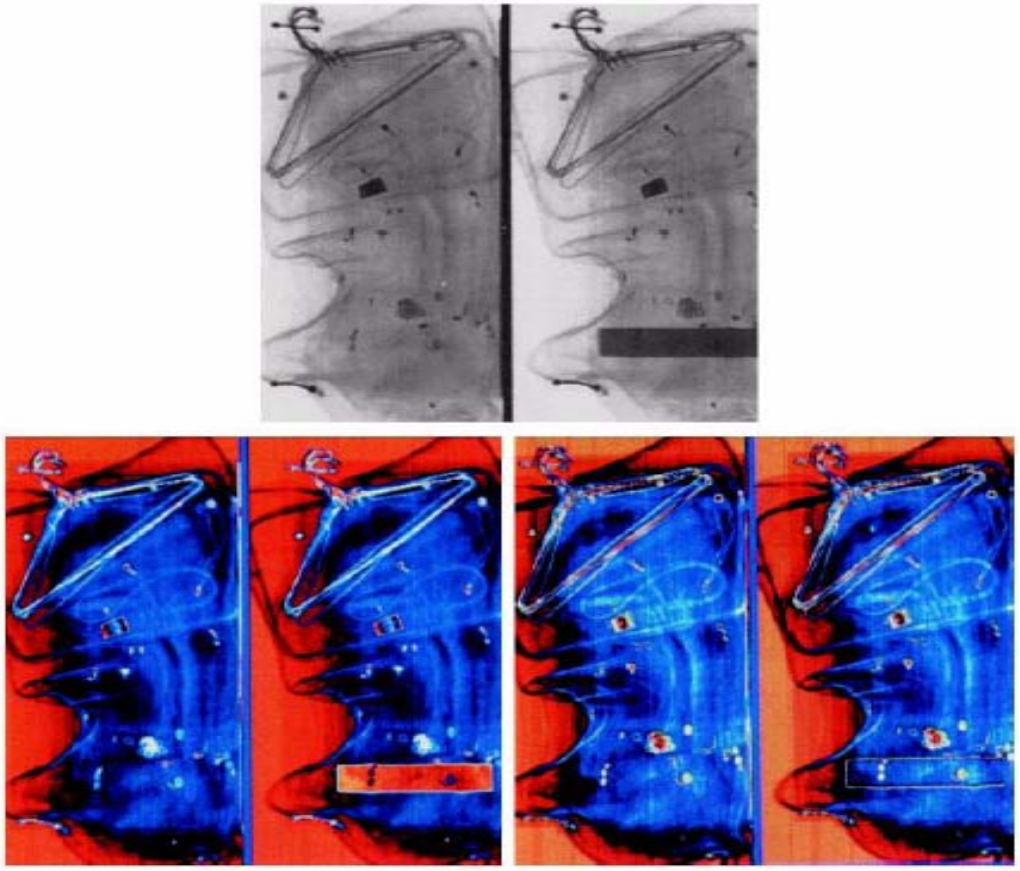


Image Processing Examples

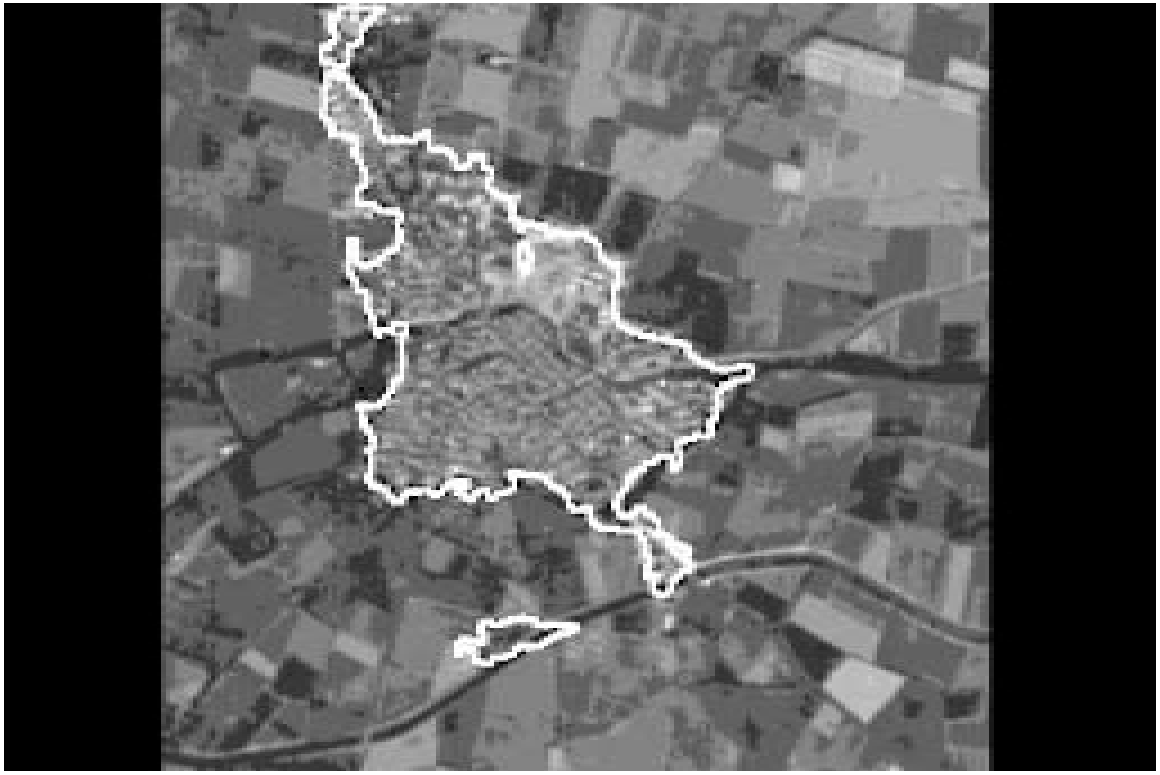
Pseudocolor enhancement for security screening



Source: Gonzalez, Woods, Fig. 6.24

Image Processing Examples

Extraction of settlement area from an aerial image



Source: INRIA, Sophia-Antipolis, France

Image Processing Examples

Earthquake analysis from Space

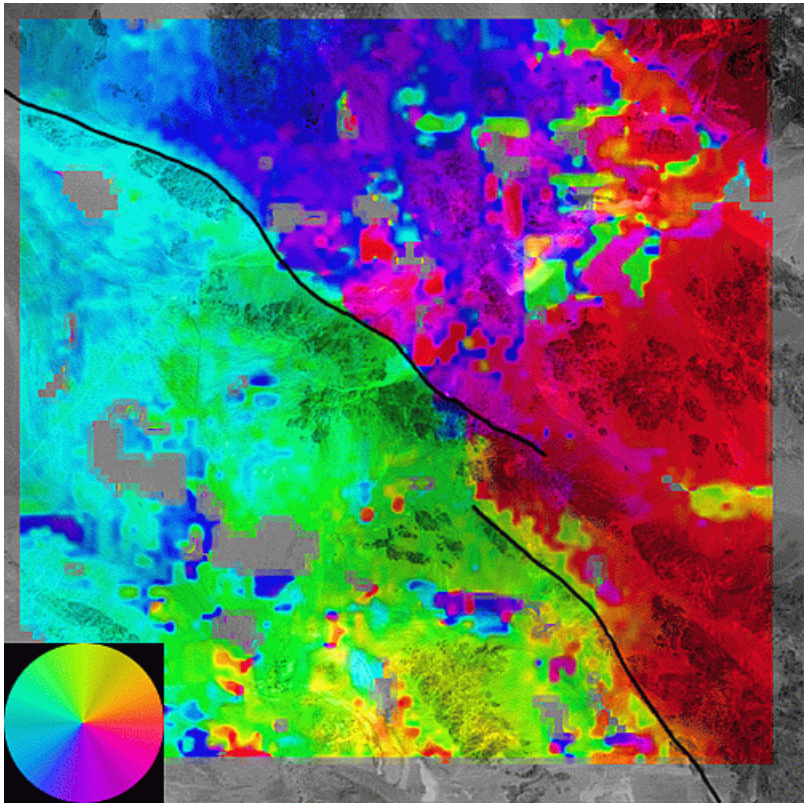
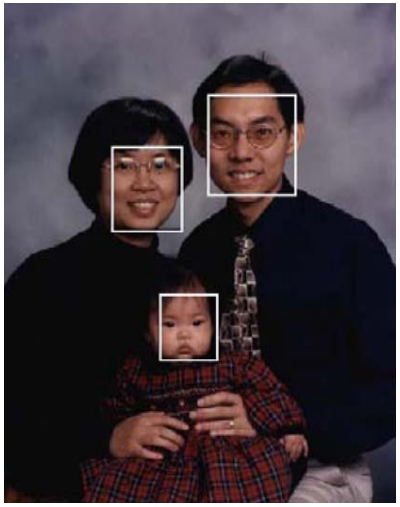


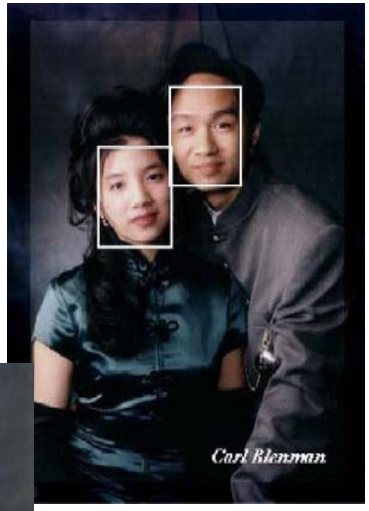
Image shows the ground displacement

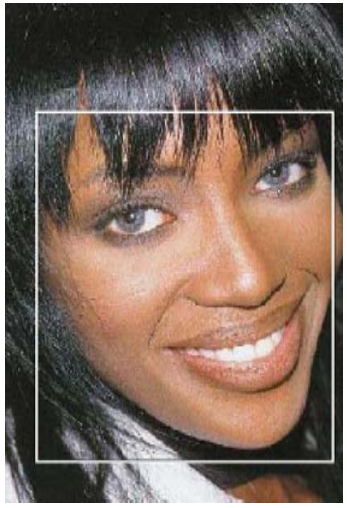
Source: JPL, Pasadena, QUAKEFINDER project

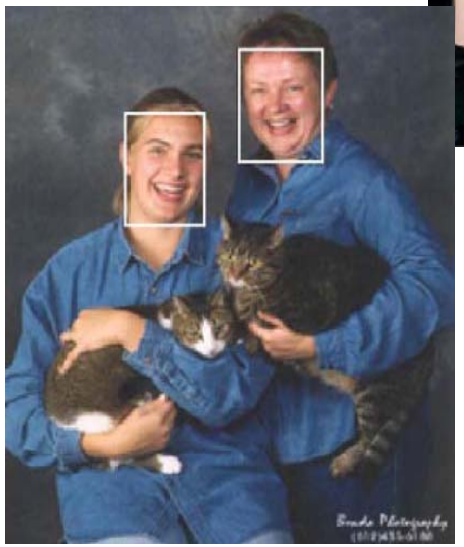
Image Processing Examples

Face detection









Source: Class project, Stanford University

Image Processing Examples

Image segmentation

Image Processing Examples

Mosaic from multiple source images

Source: Class project, Stanford University

Image Processing Examples

Face morphing

Source: Class project, Stanford University

Image Processing Examples

Handwriting recognition

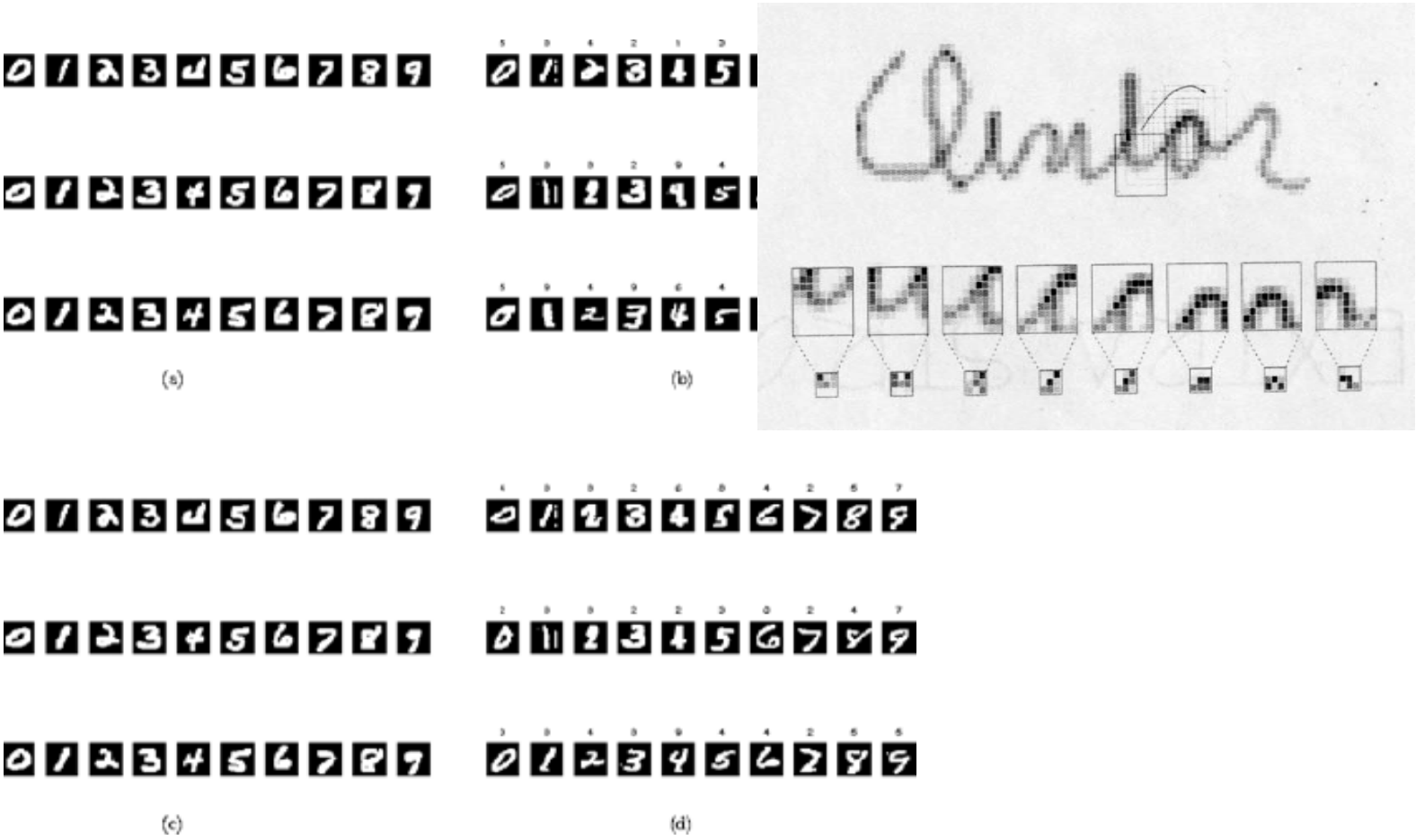
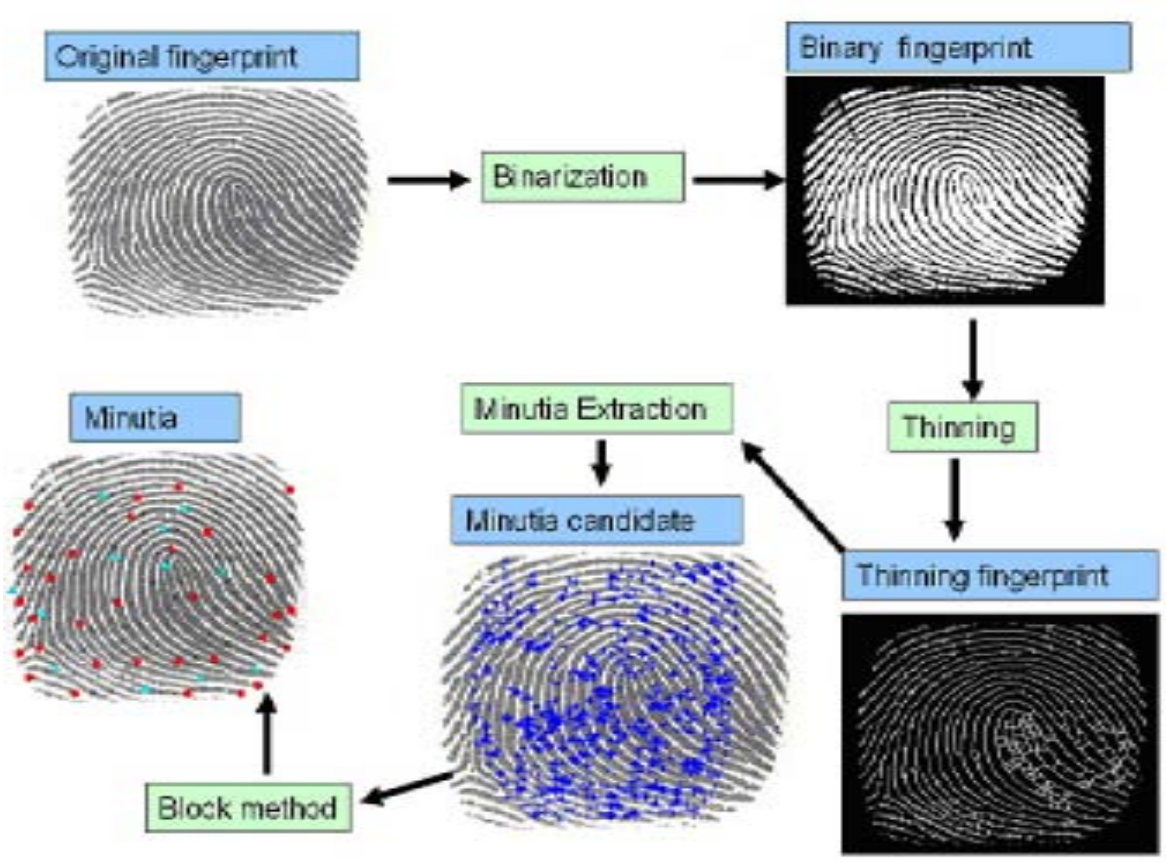


Image Processing Examples

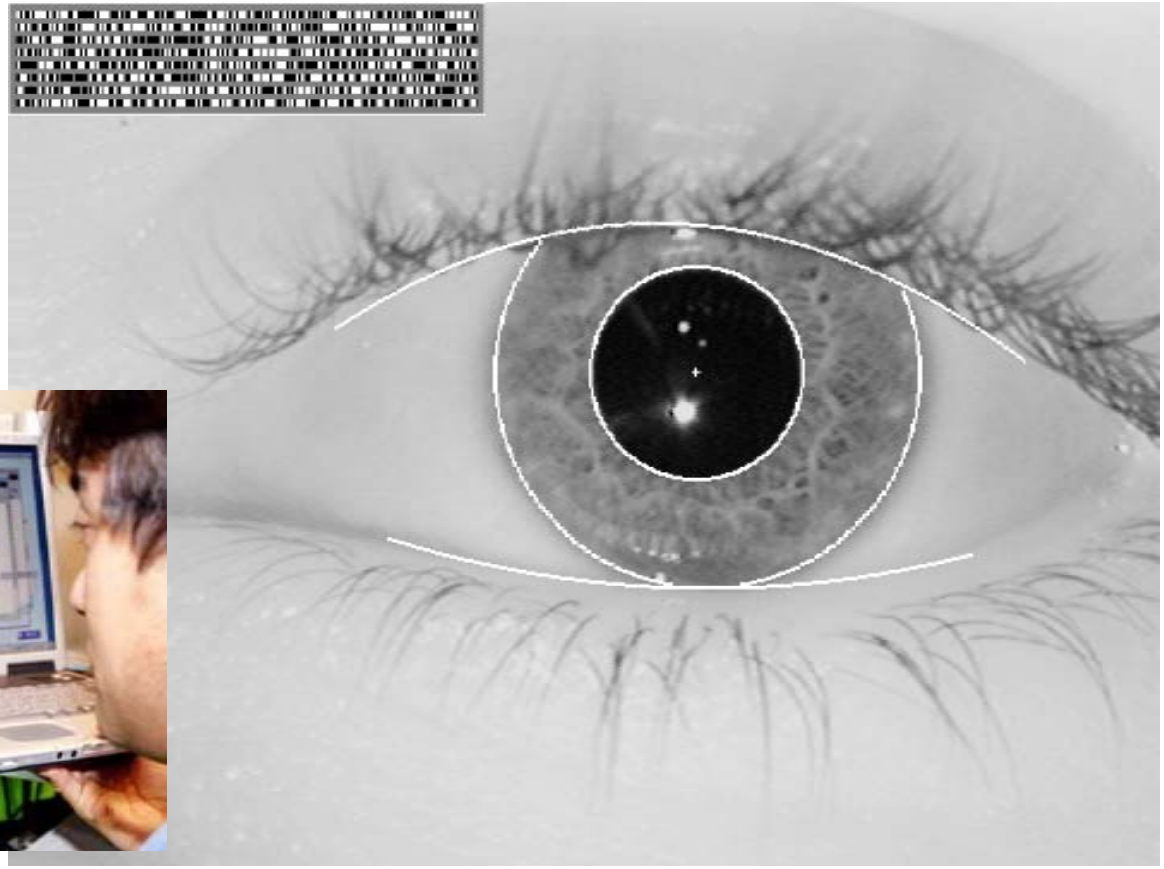
Biometrics: Fingerprint recognition



FBI's Integrated Automated Fingerprint Identification System IAFIS

Image Processing Examples

Biometrics: Iris recognition



Source: J. Daugman, U. Cambridge

Outline EQ2330

- Digital images
- Point operations
- Linear processing, filtering
- Color
- Multiresolution image processing
- Image compression
- Video compression
- Feature detection
- Image segmentation

Prerequisites EQ2330

- Required
  - Signals and Systems
  - Signal Theory or equivalent, e.g., EQ1220
- NOT required
  - Information theory, will be reviewed in class, as needed

EQ2330 Organisation

- Regularly check class home page:

  https://www.kth.se/social/course/EQ2330/

- Assistants:

Du Liu

Hanwei Wu

- Office hours: Markus Flierl We 12-13, Ov10, A:329

EQ2330 Organisation

- Access to files: KTH Web login
- Preparation assignments
  - We hand out prep assignments and you solve them before exercise sessions
  - Exercise sessions: In groups of 2-3, peer correction and discussion
  - Hand in your solution + your correction of peer solution at the end of each exercise session
  - If you miss a session: Hand in your solution and your correction of a peer solution within **two** days

EQ2330 Organisation

- Projects
  - 3 projects, require computer + Matlab
  - Groups of up to 2 students (one report per group)
- Grading
  - Hand in all prep assignments and peer corrections (pass/fail); pass is required to take exam
  - Projects and written exam contribute equally to final grade

Further Reading

- Slides available as hand-outs
- Recommended book:
  - R. C. Gonzales, R.E. Woods, “Digital Image Processing,” Prentice-Hall.
- Additional books:
  - A.K. Jain, “Fundamentals of Digital Image Processing,” Prentice-Hall, Addison-Wesley, 1989.
  - R. C. Gonzalez, R. E. Woods, S. L. Eddins, “Digital Image Processing using Matlab,” Pearson-Prentice-Hall, 2004.
  - Al Bovik (ed.), “Handbook of Image and Video Processing,” Academic Press, 2005.
  - J.W. Woods, “Multidimensional Signal, Image, and Video Processing and Coding,” Academic Press, 2006.