جَامعة
المَنارة
MANARA UNIVERSITY

# Computer Vision

# Text

- We will be covering material from several different textbooks and research papers.

**[Szeliski11]** *Computer Vision: Algorithms and Applications*, by R. Szeliski, Springer-Verlag, 2011 (freely available from **http://szeliski.org/Book/**)

**[Jain95]** *Machine Vision*, by R. Jain et. al, McGraw Hill, 1995.

**[Trucco98]** *Introductory Techniques for 3-D Computer Vision,* by E. Trucco, and A. Verri, Prentice Hall, 1998.

**[Nawla93]** *A Guided Tour of Computer Vision*, by V. Nawla, Addison-Wesley, 1993.

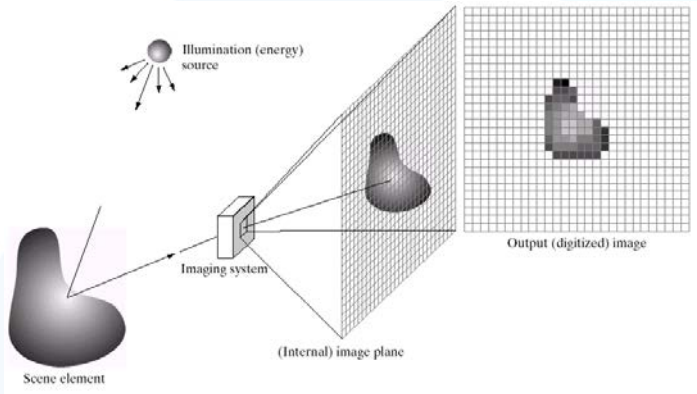
# Course requirements

- Prerequisites—*these are essential*!
  - A good working knowledge of C/C++ programming
  - Data structures
  - Calculus, Linear algebra and Probabilities/Statistics (recommended)
- Course does ***not*** assume prior imaging experience

# Course Outline (tentative)

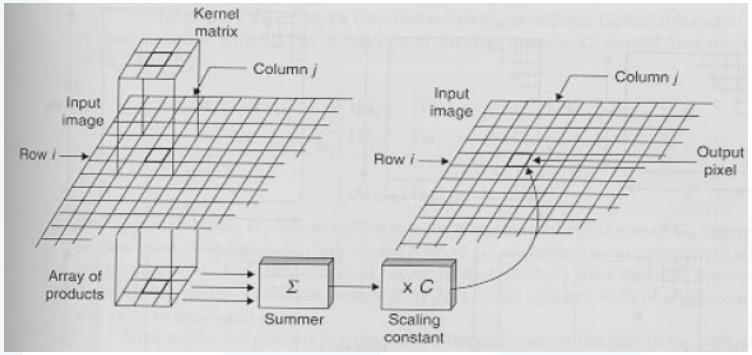
- Introduction to CV
  - Relation to other fields
  - Main challenges
  - Applications

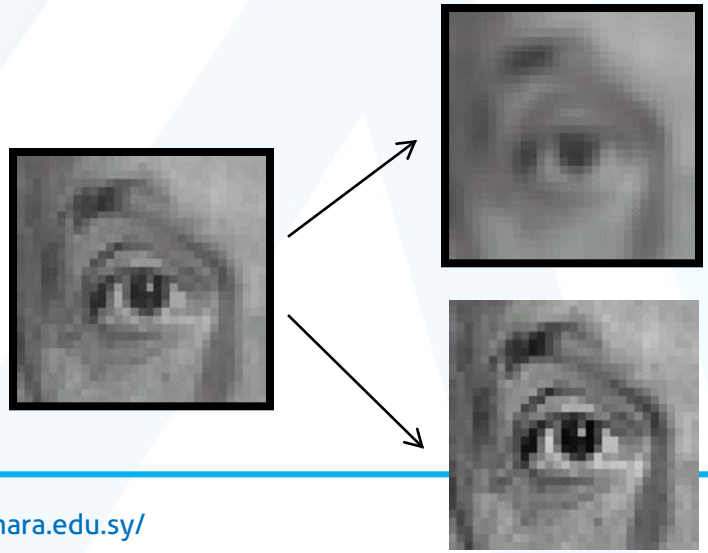
- Image Formation and Representation
  - Pinhole camera
  - Cameras & lenses
  - Human eye
  - Digitization



# Course Outline (tentative)

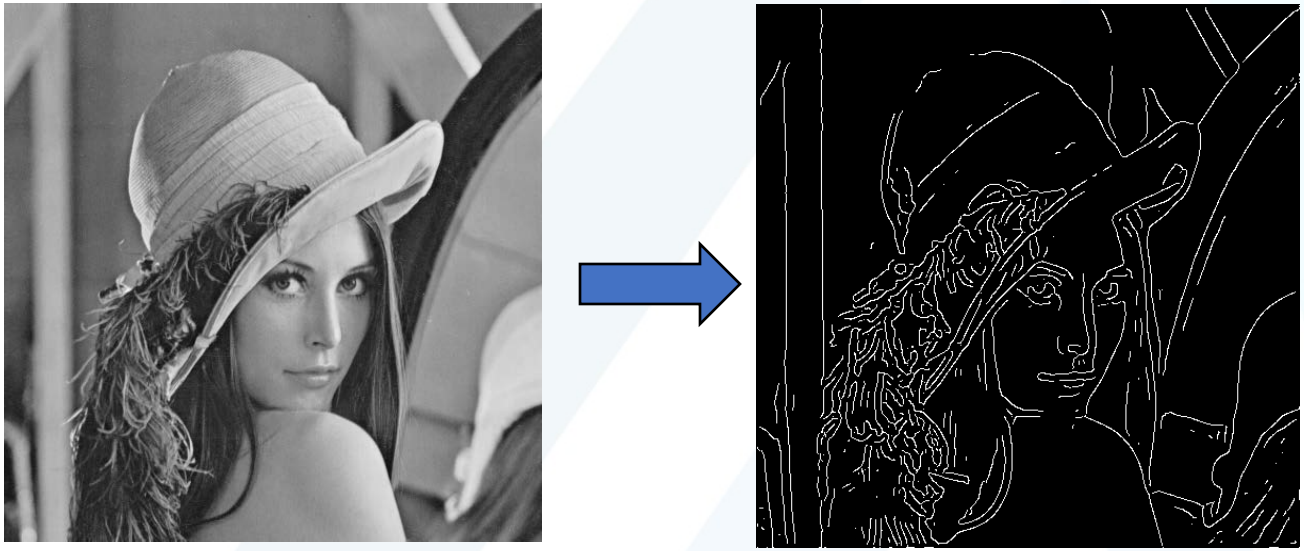
- Image Filtering (spatial domain)
  - Mask-based (e.g., correlation, convolution)
  - Smoothing (e.g., Gaussian), Sharpening (e.g., gradient)



# Course Outline (tentative)

- Edge Detection (e.g., Canny, Laplacian of Gaussian)



# Course Outline (tentative)

- Interest Point Detection (e.g., Moravec, Harris)

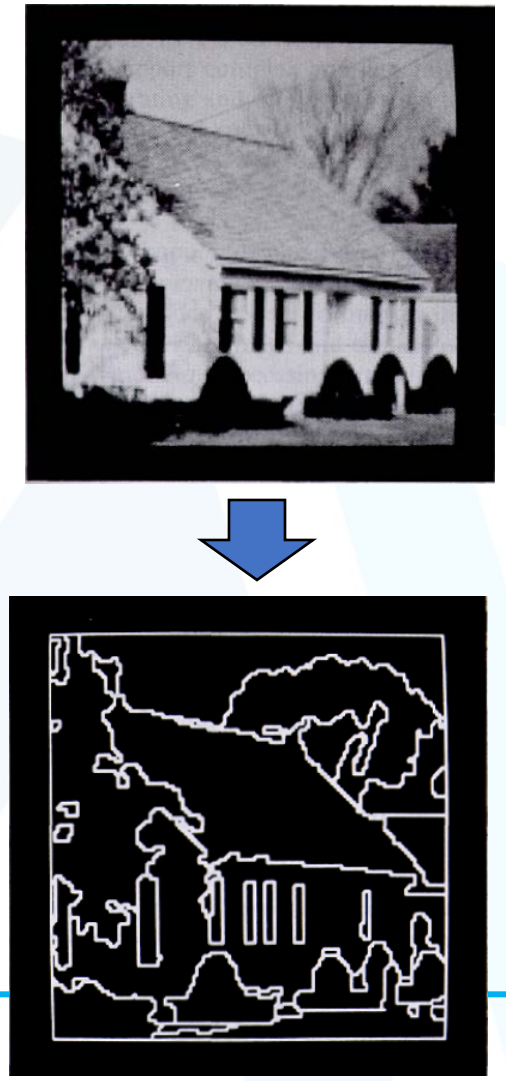
# Course Outline (tentative)

- Segmentation
  - Edge-based (e.g., voting, optimization, perceptual grouping)

    Examples: Hough Transform, Snakes, Tensor Voting

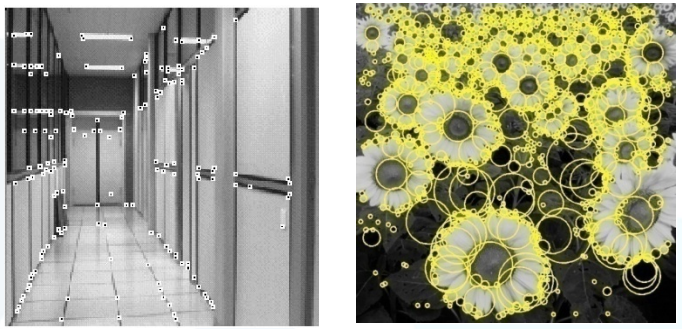
  - Pixel-based (e.g., clustering)

    Examples: Histogram-based, Graph- Cuts, Mean-Shift)



# Course Outline (tentative)

- Feature Extraction
  - Geometric (e.g., lines, circles, ellipses etc.)
  - Blobs

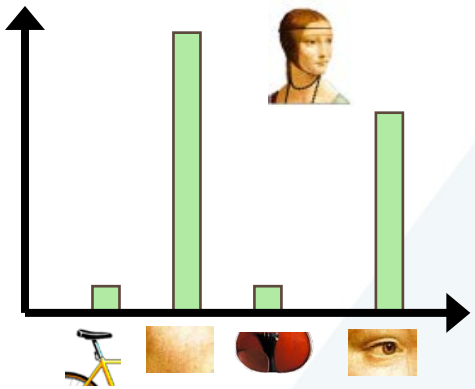


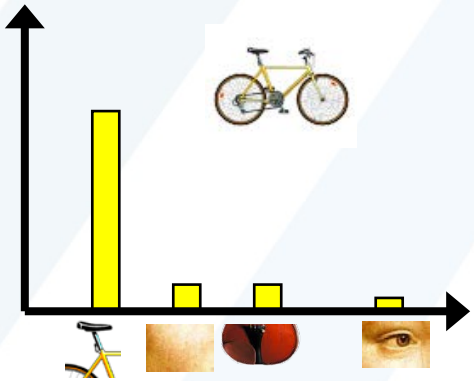
Feature extraction

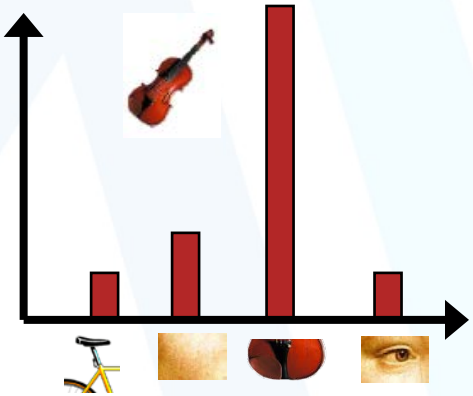
- Description and Matching
  - SIFT, SURF, HOG, WLD, LBP

# Course Outline (tentative)

- Recognition
  - Geometry-based (e.g., alignment, geometric hashing)
  - Appearance-based (e.g., subspace, bag-of-features)

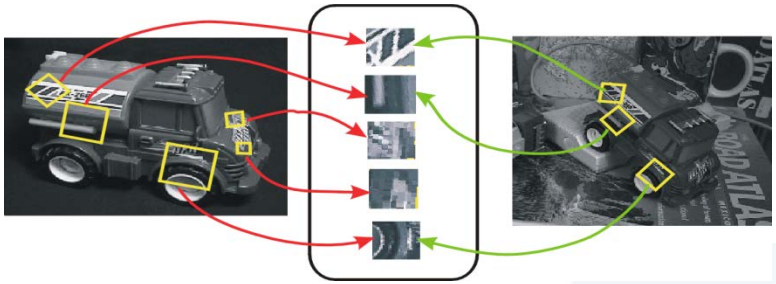


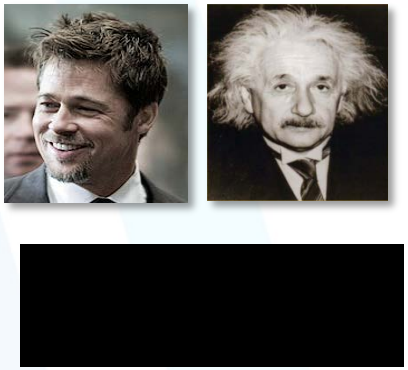




# Course Outline (tentative)

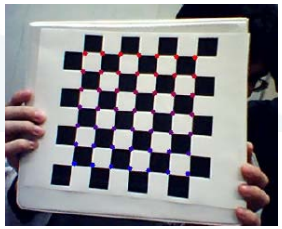
- Recognition (cont'd)
  - Object recognition (single / category)
  - Face recognition

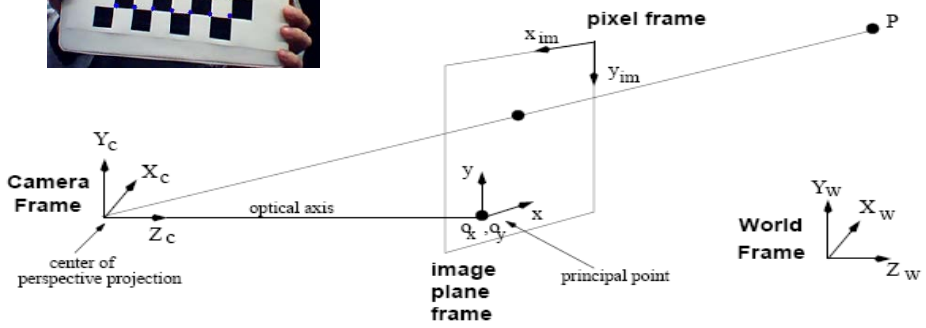




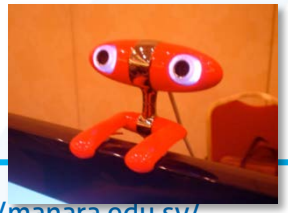
# Course Outline (tentative)

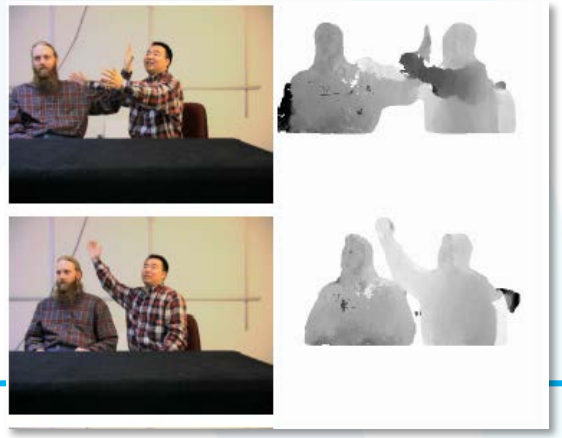
- Camera Calibration
  - Camera parameters
  - 3D to 2D transformation






- Stereo Vision
  - 3D reconstruction from pairs of 2D images.





# Grading

- Three exams (two midterm, final)
- Programming assignments
- Homework will be assigned but not graded

- Midterm: ~ 40%
- Final: ~ 50%
- Programming assignments: ~ 10%

# Software

- You will not use any software package for most assignments.
- There might 1-2 programming assignments where you would need to use *OpenCV*.

**http://opencv.willowgarage.com/wiki/**

**[OpenCV08]** *Learning OpenCV: Computer Vision with the OpenCV Library,* by G. Bradski and A. Kaehler, O'Reilly Press, 2008.

# Course Policies

- Lecture slides, assignments, and other useful information will be posted on web.
- If you miss a class, you are responsible for all material covered or assigned in class. .
- Discussion of the programming assignments is allowed and encouraged. However, each student should do his/her own work.

**Assignments which are too similar will receive a zero.**

# Course Policies (cont'd)

- **No** late programming assignments will be accepted unless there is an extreme emergency.

# Questions?