Wrap-up

http://16385.courses.cs.cmu.edu/

16-385 Computer Vision
Fall 2023, Lecture 26

Class evaluation*s* – please take them!

- CMU's Faculty Course Evaluations (FCE): https://cmu.smartevals.com/
- 16-385 end-of-semester survey (see Piazza for link)
- Please take both, super helpful for developing future offerings of the class.
- Thanks in advance!

Course overview

1. Image processing. ← Lectures 1 – 6
   See also 18-793: Image and Video Processing

2. Geometry-based vision. ← Lectures 7 – 12
   See also 16-822: Geometry-based Methods in Vision

3. Semantic vision. ← Lectures 13 – 17
   See also 16-824: Vision Learning and Recognition
   See also 10-703: Deep Reinforcement Learning

4. Dealing with motion. ← Lectures 18 – 20
   See also 16-831: Statistical Techniques in Robotics
   See also 16-833: Robot Localization and Mapping

5. Physics-based vision. ← Lectures 21 – 25
   See also 16-823: Physics-based Methods in Vision
   See also 15-462: Computer Graphics
   See also 15-463: Computational Photography

Image processing

Image filtering

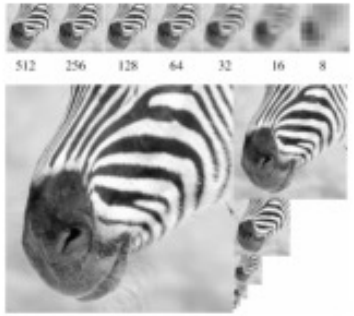


image pyramids

Fourier filtering

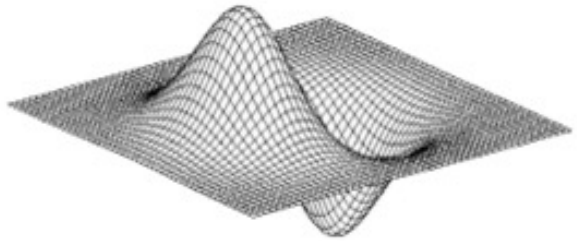
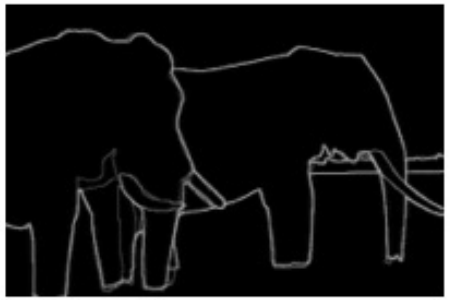
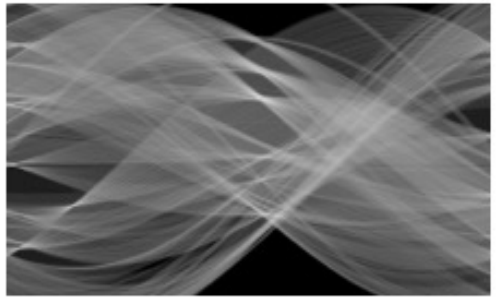


Image gradients



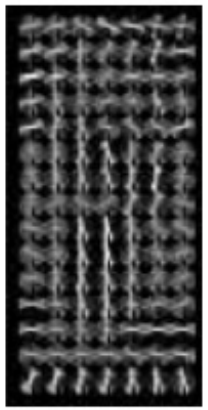
Boundaries

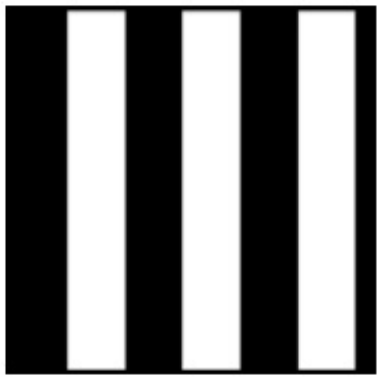


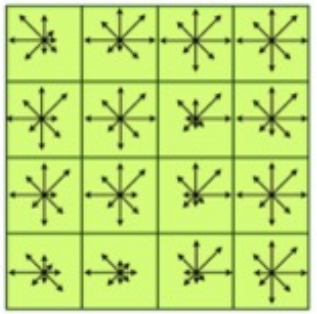
Hough Transform

Image features

Corner detection Multi-scale detection







Haar-like HOG SURF SIFT

2D alignment

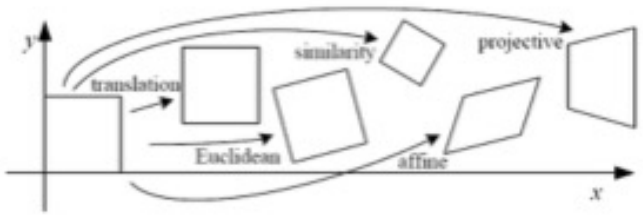


Figure 1: Basic set of 2D planar transformations

2D Transforms

DLT

RANSAC

H

Homography

Camera and multi-view geometry

$$x = \mathbf{P}\mathbf{X}$$

camera matrix

$$\mathbf{P}$$

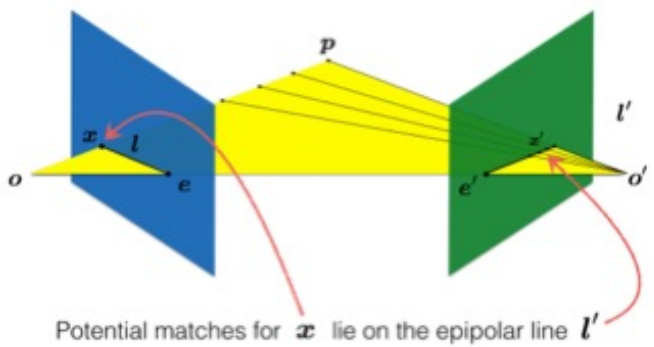
pose estimation

$$\mathbf{X}$$

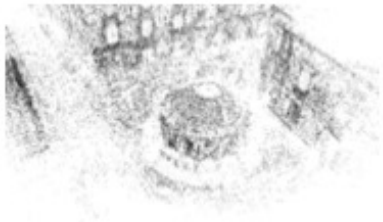
triangulation

$$\mathbf{F}$$

fundamental matrix

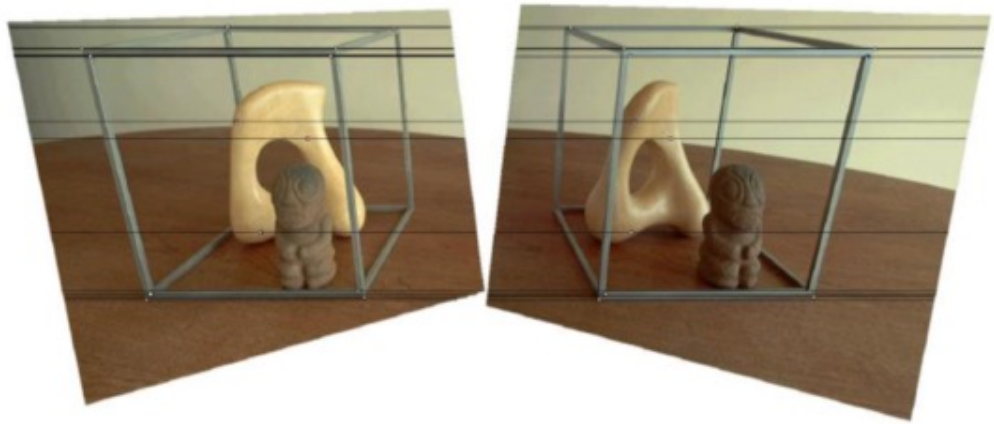


epipolar geometry

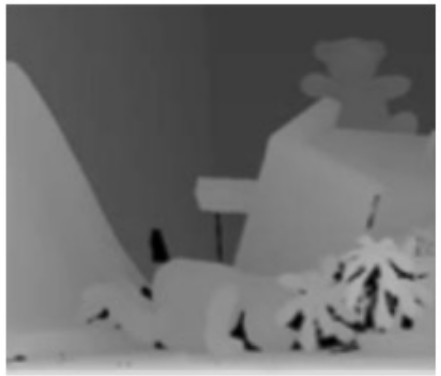


Reconstruction

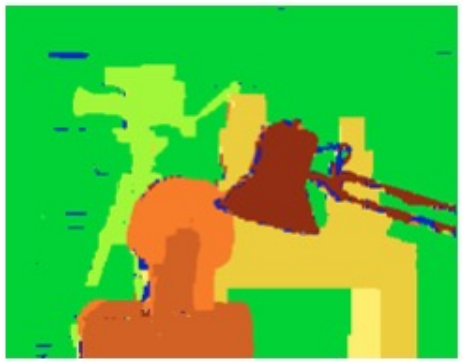
Stereo



Stereo Rectification



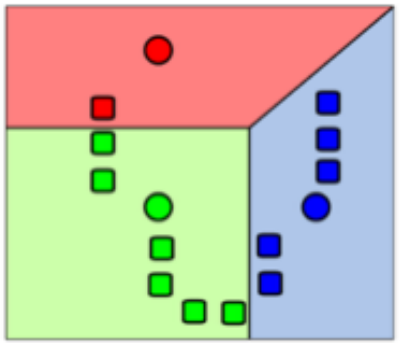
Block matching



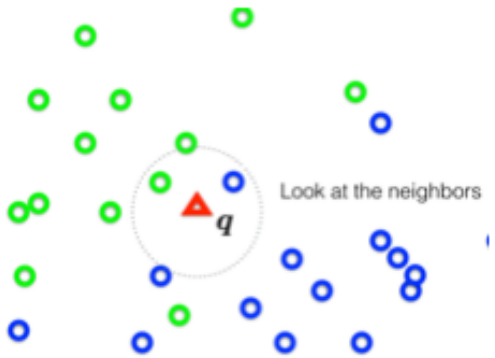
Energy minimization

Object recognition

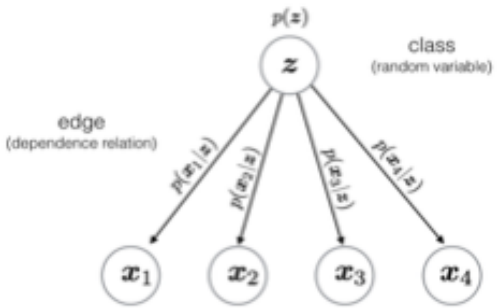
Bag-of-words



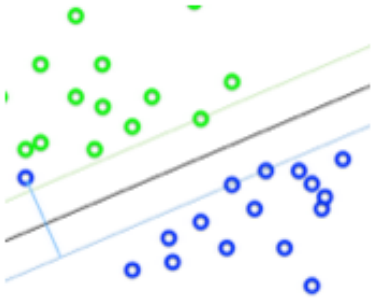
K-means



Nearest Neighbor

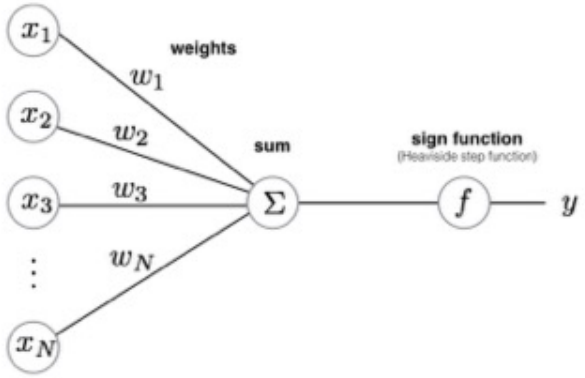


Naive Bayes

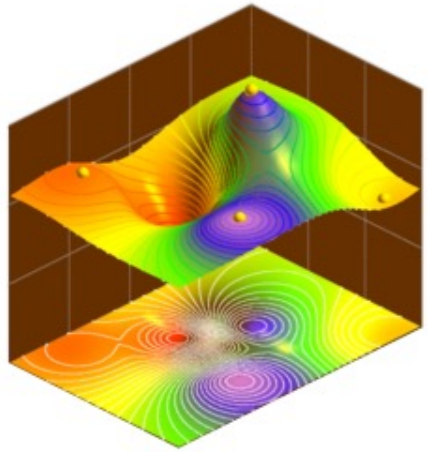


SVM

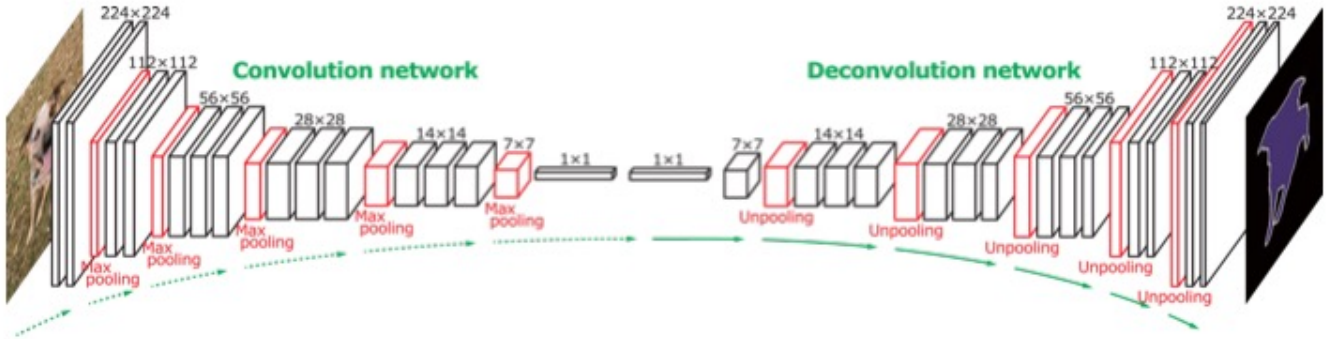
Neural networks



Perceptron



Gradient Decent



Convolutional Neural Networks

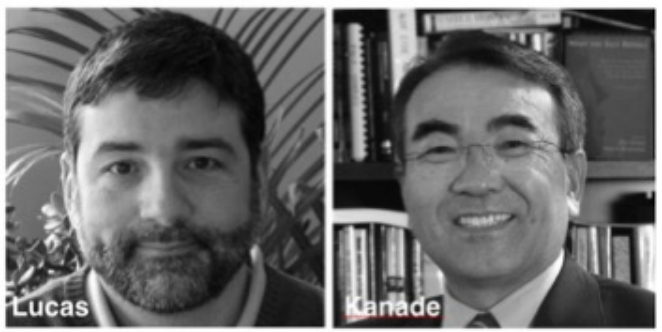
Optical flow and alignment

$$\begin{bmatrix} I_x(\boldsymbol{p}_1) & I_y(\boldsymbol{p}_1) \\ I_x(\boldsymbol{p}_2) & I_y(\boldsymbol{p}_2) \\ \vdots & \vdots \\ I_x(\boldsymbol{p}_{25}) & I_y(\boldsymbol{p}_{25}) \end{bmatrix} \begin{bmatrix} u \\ v \end{bmatrix} = - \begin{bmatrix} I_t(\boldsymbol{p}_1) \\ I_t(\boldsymbol{p}_2) \\ \vdots \\ I_t(\boldsymbol{p}_{25}) \end{bmatrix}$$

Constant Flow

$$\min_{\boldsymbol{u},\boldsymbol{v}} \sum_{ij} \left\{ E_d(i,j) + \lambda E_s(i,j) \right\}$$

Horn-Schunck

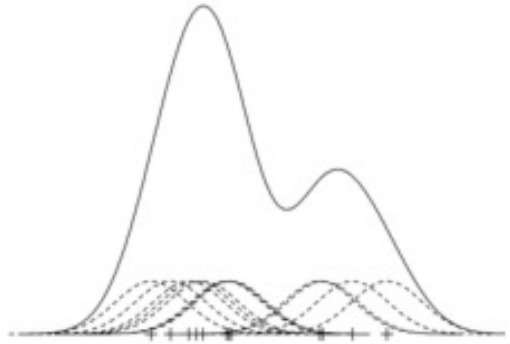


Lucas-Kanade
(Forward additive)

Baker-Matthews
(Inverse Compositional)

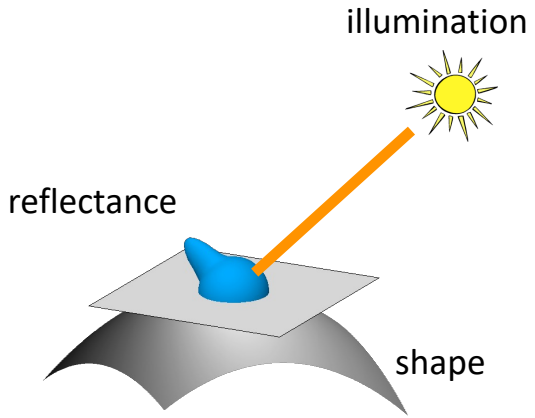
Tracking in videos

KLT



Mean shift

Image formation and physics



Radiometry and image formation

Photometric stereo

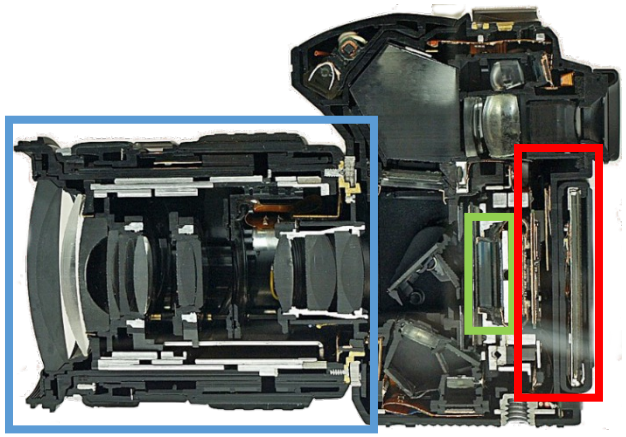
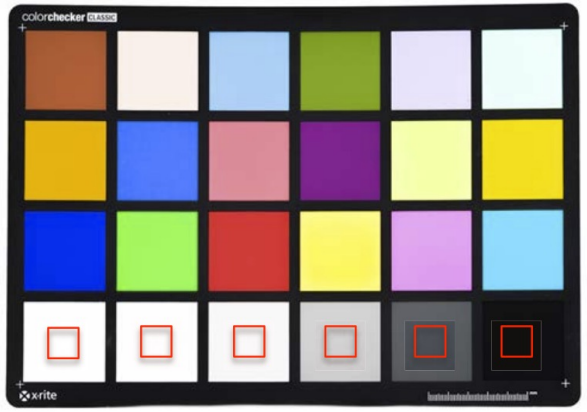


Image processing pipeline



Radiometric and color calibration

Things you should know how to do

1. Detect lines (circles, shapes) in an image.
2. Perform automatic image warping and basic AR.
3. Reconstruct 3D scene structure from two images.
4. Do photometric stereo and render simple images.
5. Recognize objects using a bag-of-words model.
6. Recognize objects using deep CNNs.
7. Track objects in video.

Questions?

Do you plan on taking any other vision courses?

Which part of the class did you like the most?

Which part of the class did you like the least?

Any topics you wanted to learn more about?

Any topics you wanted to learn less about?

Which was your favorite programming assignment?

Which was your least favorite programming assignment?