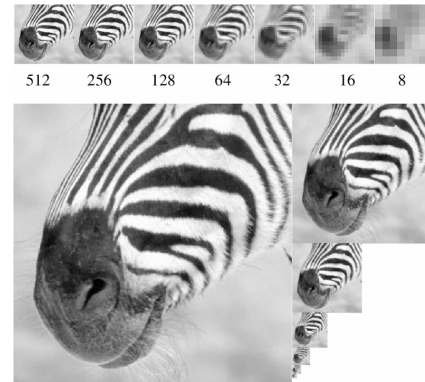Image filtering

image pyramids
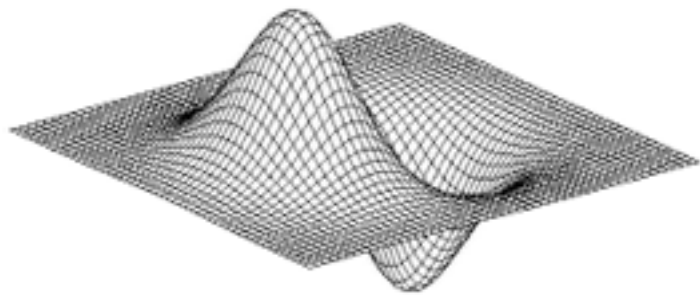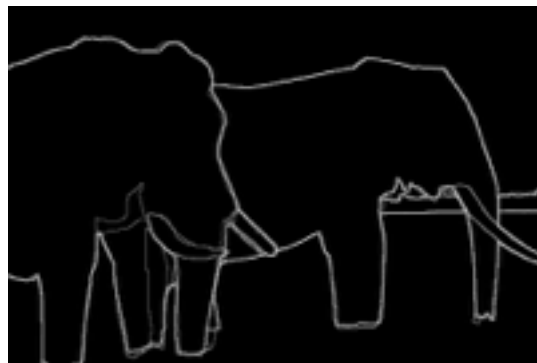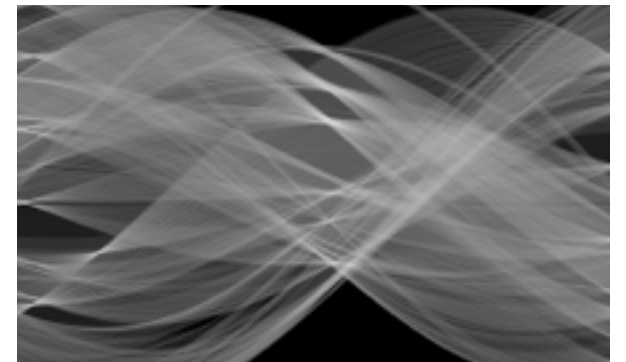

Image gradients

Boundaries

Hough Transform

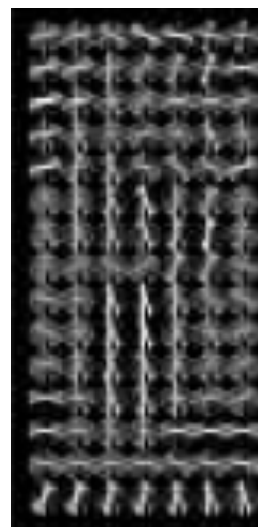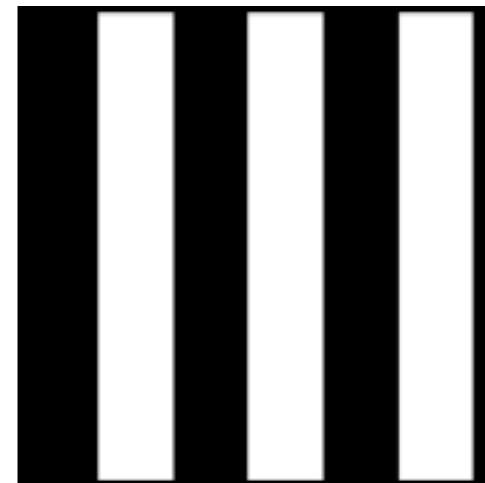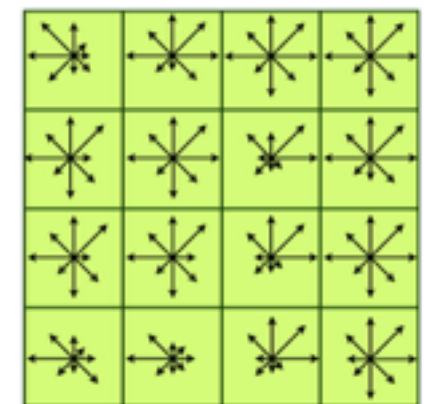**Image Manipulation** (January)

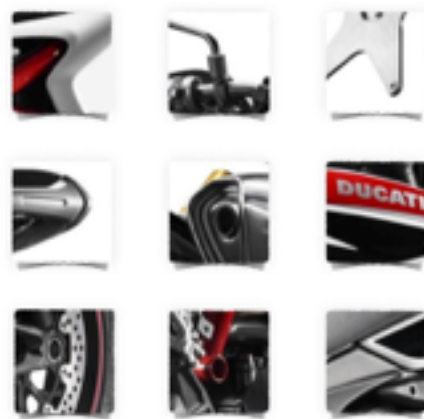Corner detection

Multi-scale detection

Haar-like

HOG

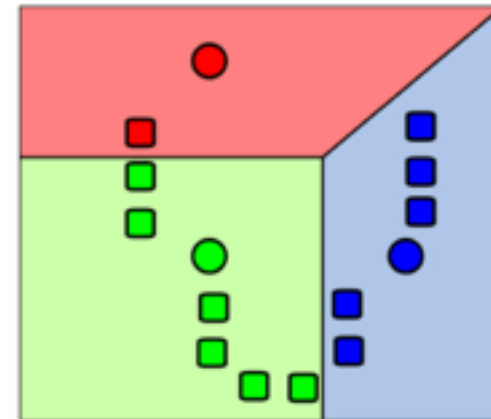

SURF

SIFT

Image Features (February)

Bag-of-words

K-means

Look at the neighbors

Nearest Neighbor

$p(z)$

z

class
(random variable)

edge
(dependence relation)

$p(x_1|z)$ $p(x_2|z)$ $p(x_3|z)$ $p(x_4|z)$

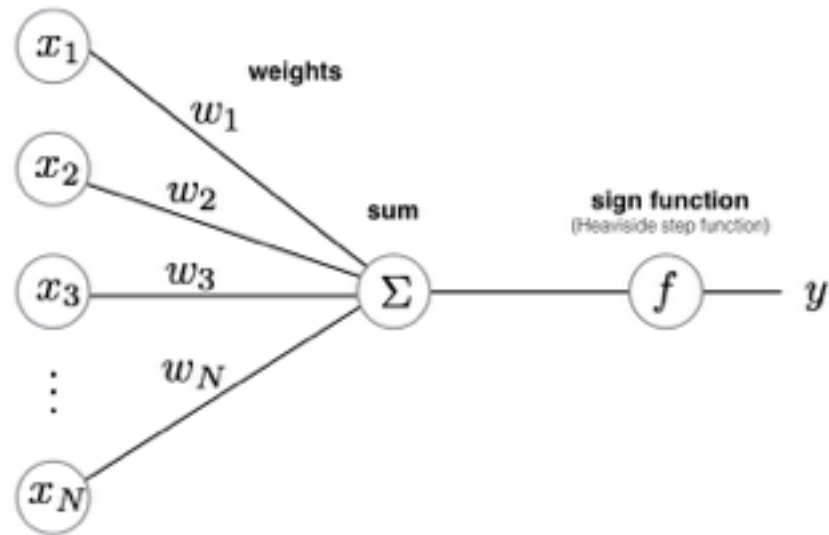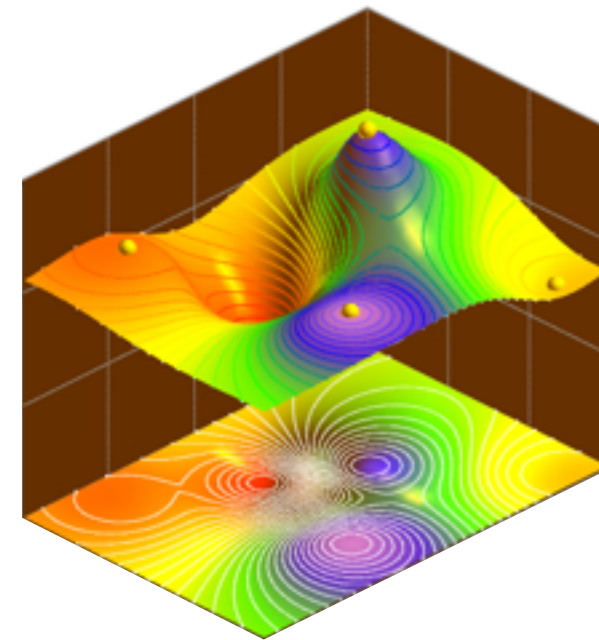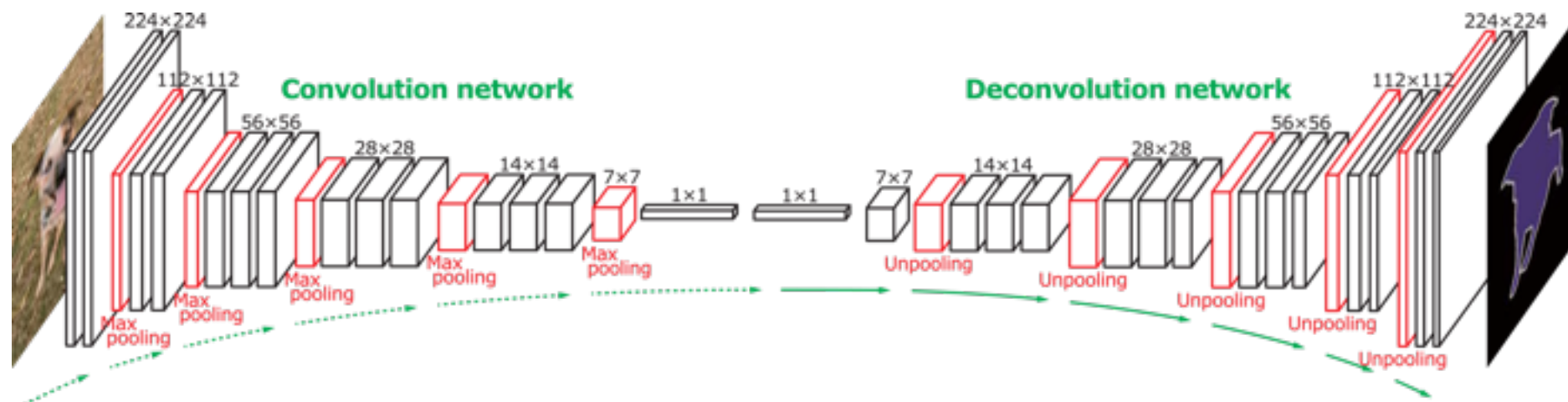x_1 x_2 x_3 x_4
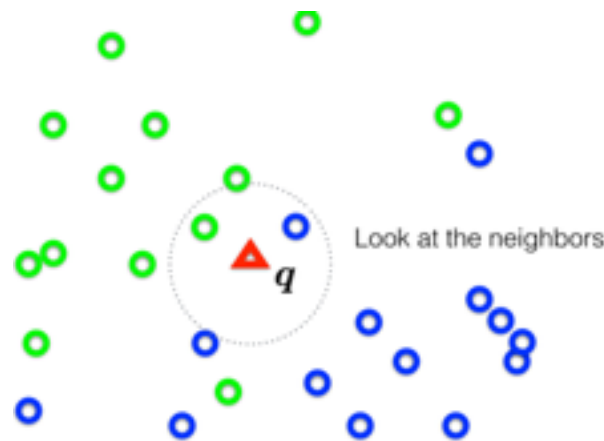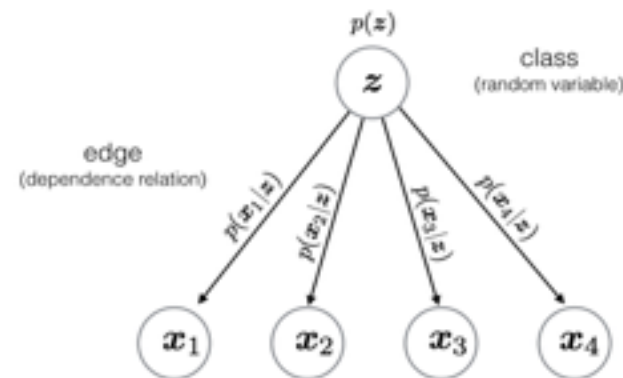
Naive Bayes
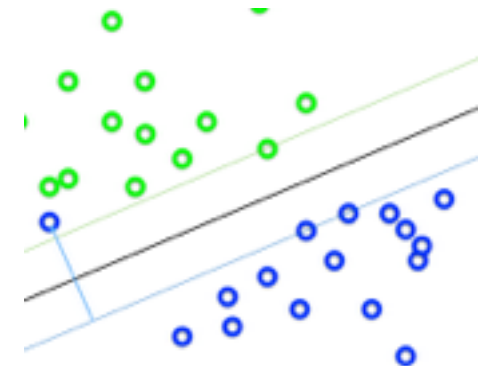
SVM

Object Recognition (February)

Perceptron

Gradient Decent

Convolutional Neural Networks (February)
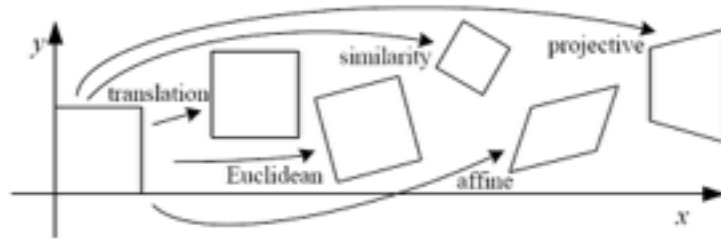
Figure 1: Basic set of 2D planar transformations

2D Transforms

DLT
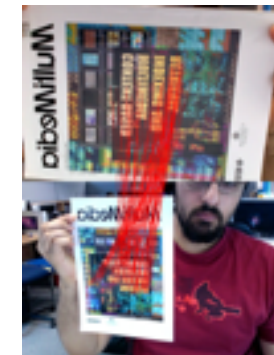
RANSAC

H

Homography

2D Alignment (March)

$$x = \mathrm{PX}$$

camera matrix

$$\mathrm{P}$$

pose estimation

$$\mathrm{X}$$

triangulation

$$\mathrm{F}$$

fundamental matrix

Potential matches for x lie on the epipolar line l'
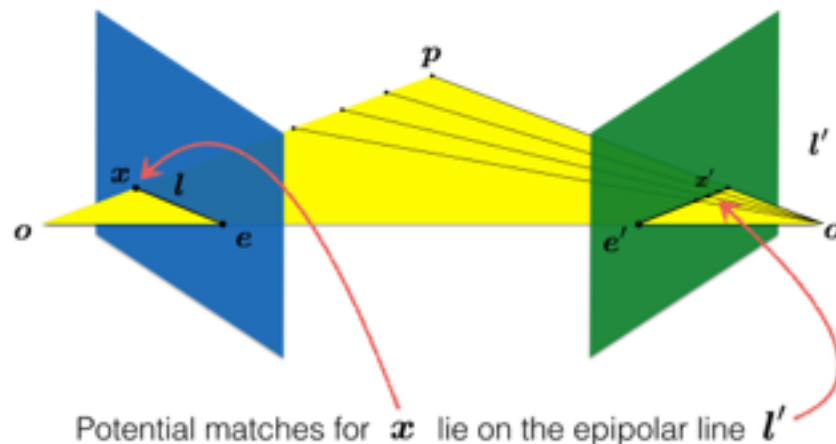
epipolar geometry

Reconstruction

2 view geometry (March)

Stereo Rectification

Block matching

Energy minimization

Stereo (April)

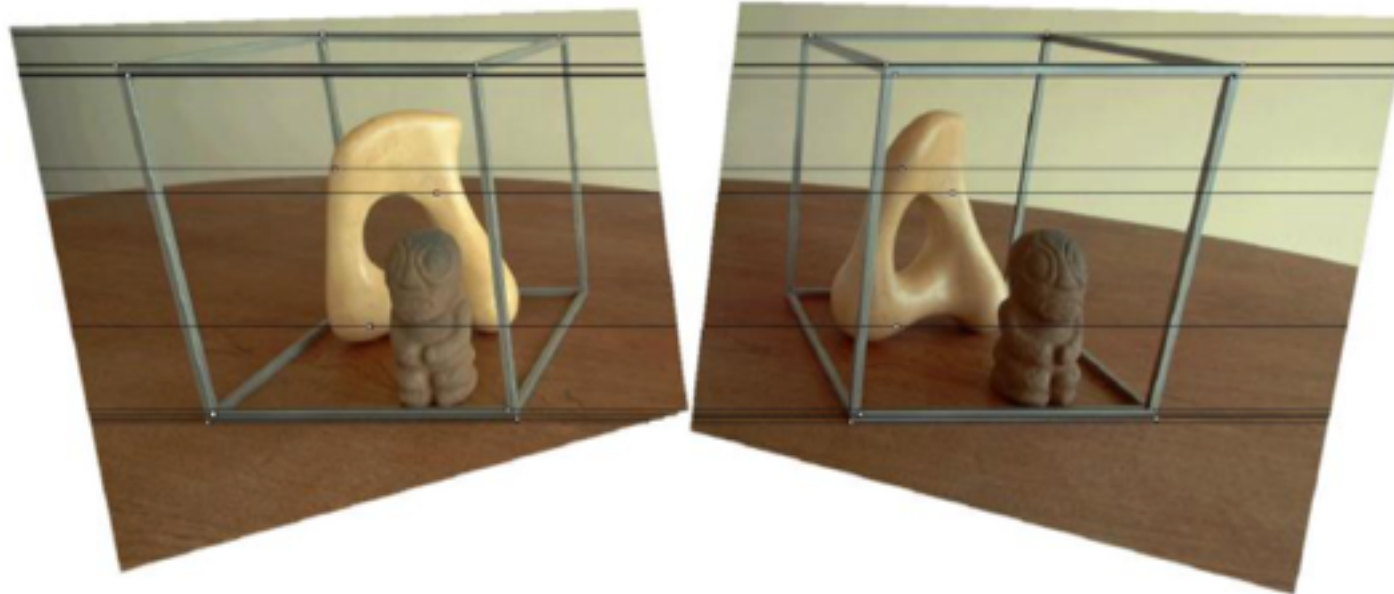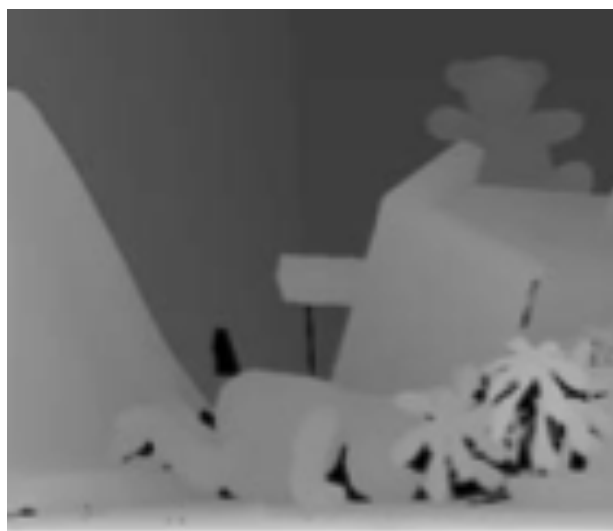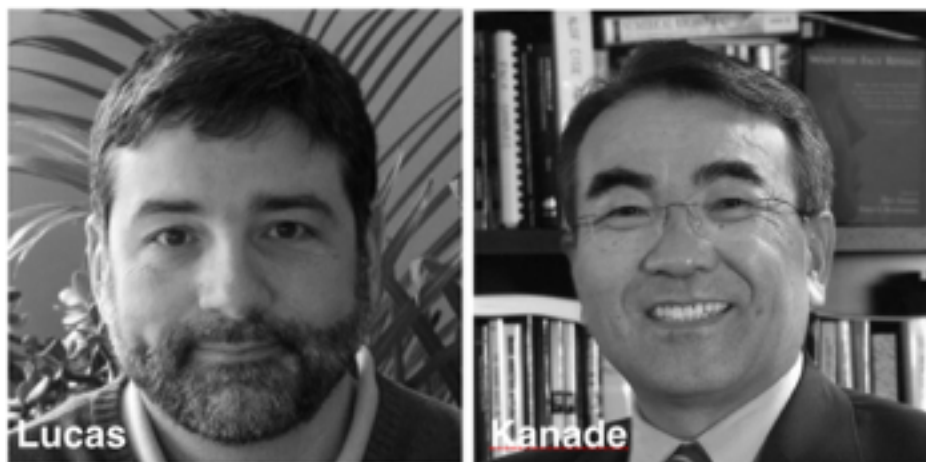$$\begin{bmatrix} I_x(\boldsymbol{p}_1) & I_y(\boldsymbol{p}_1) \\ I_x(\boldsymbol{p}_2) & I_y(\boldsymbol{p}_2) \\ \vdots & \vdots \\ I_x(\boldsymbol{p}_{25}) & I_y(\boldsymbol{p}_{25}) \end{bmatrix} \begin{bmatrix} u \\ v \end{bmatrix} = - \begin{bmatrix} I_t(\boldsymbol{p}_1) \\ I_t(\boldsymbol{p}_2)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

Constant Flow

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

Horn-Schunck
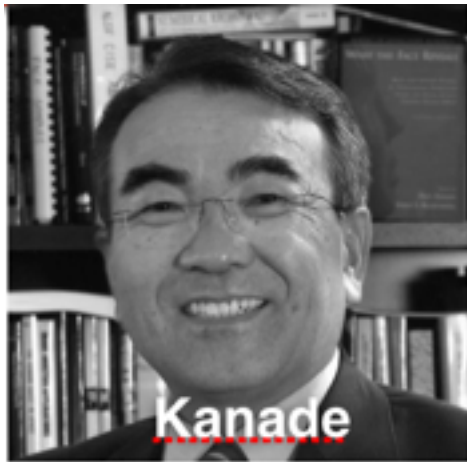
Optical Flow (April)
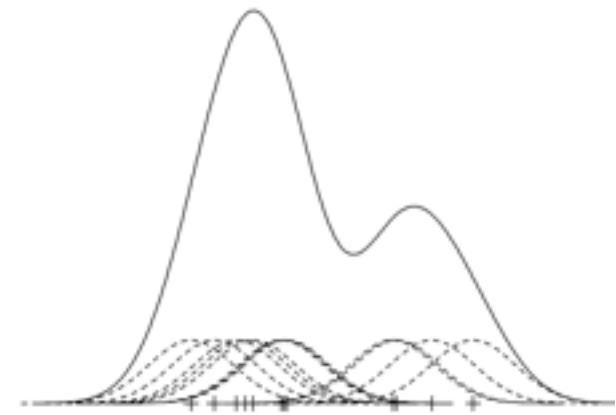
Lucas-Kanade
(Forward additive)

Baker-Matthews
(Inverse Compositional)

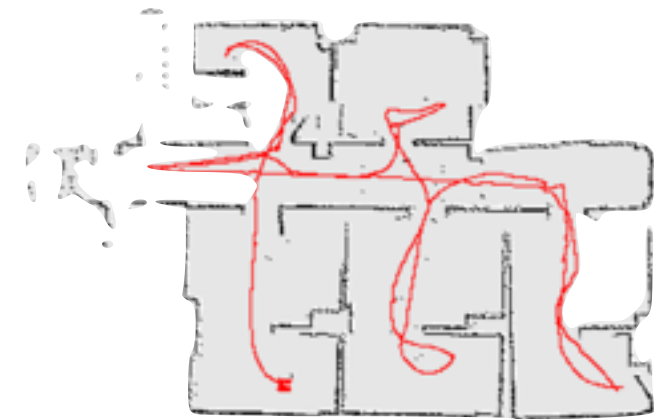**Image Alignment** (April)

KLT

Mean shift

Kalman Filtering

SLAM

Tracking in Video (April)

What you can do now

- Detect lines (circles, shapes) in an image

- Recognize objects using a bag-of-words model

- Recognize using Deep Convolutional Neural Networks

- Automatic image warping (homography) and basic AR

- Reconstruct 3D scene structure from two images

- Track objects in video (LK, Mean-Shift)