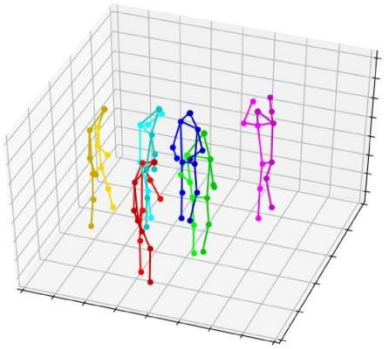
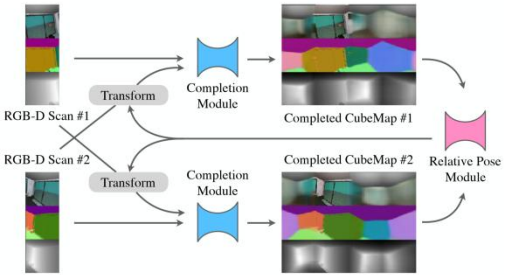
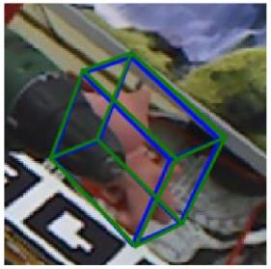
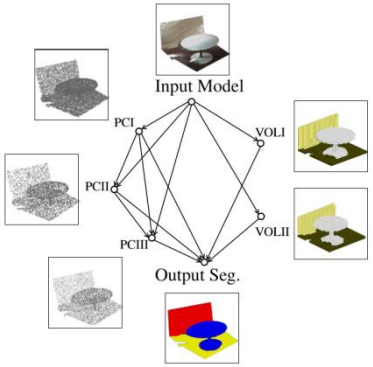
CS376 Computer Vision
Lecture 18: Introduction to Visual Recognition



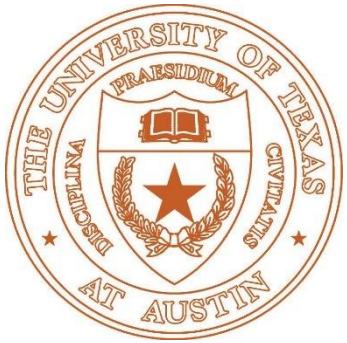






Qixing Huang

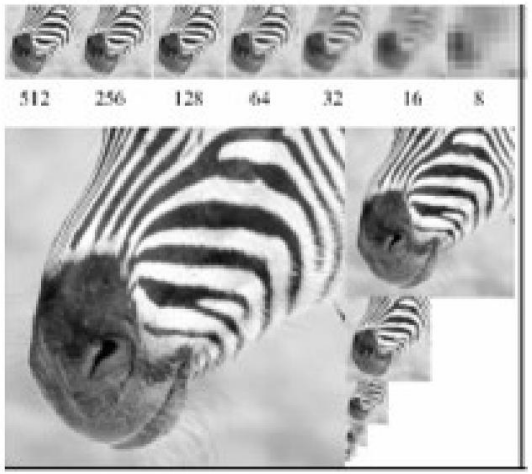
April 3th 2019

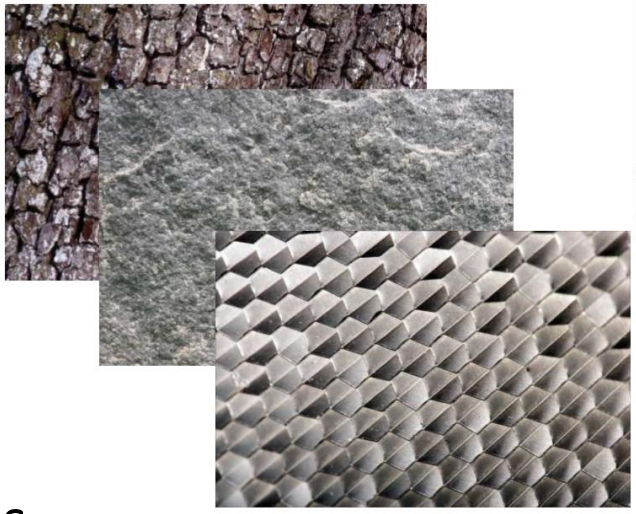


Topics covered/to be covered

- Features & filters
- Grouping & fitting
- Multiple views
- Recognition

Features and filters

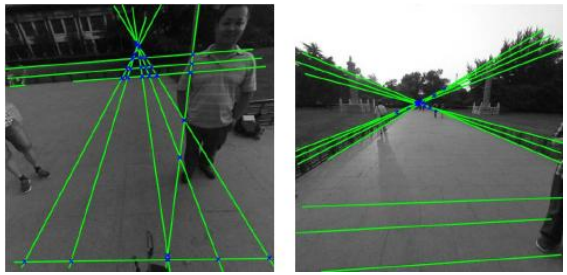


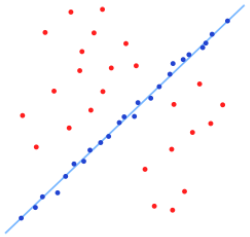


Transforming and describing images; Textures, colors, edges

Building blocks for neural networks

Grouping & fitting

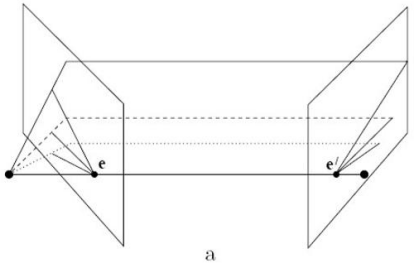




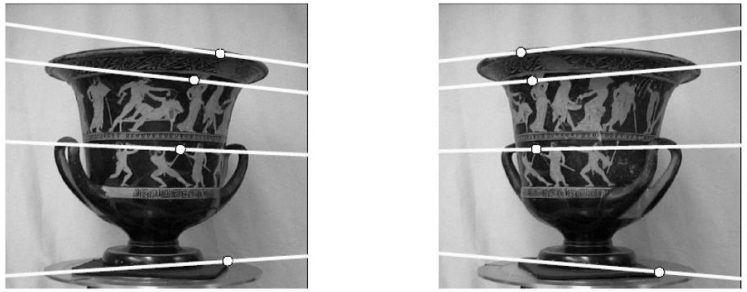
Shi et al.

Clustering, Segmentation, fitting; what parts belong together?

Multiple Views

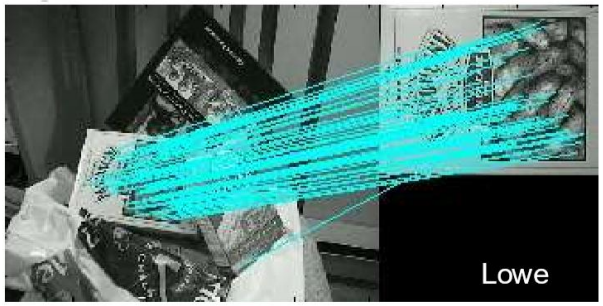


a

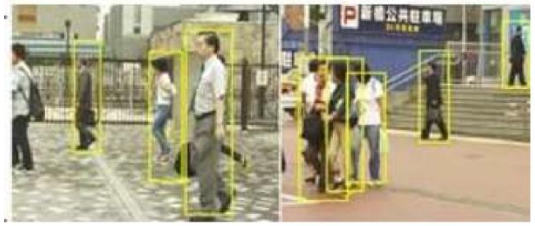


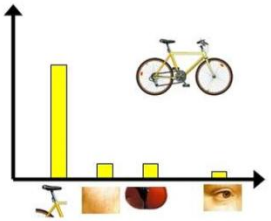
Hartley and Zisserman

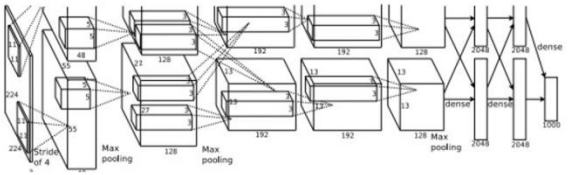
Invariant features, matching
Epipolar geometry
Structure-from-motion, stereo

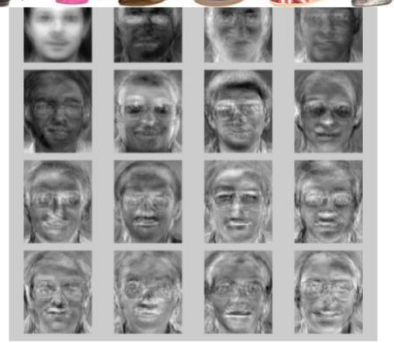


Recognition and learning

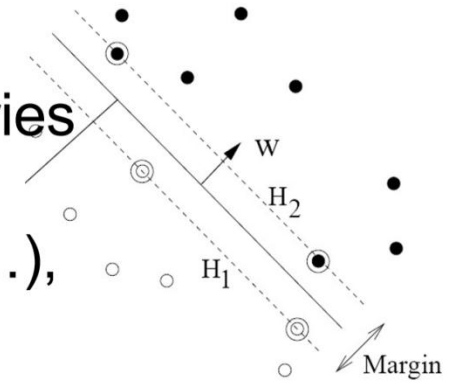




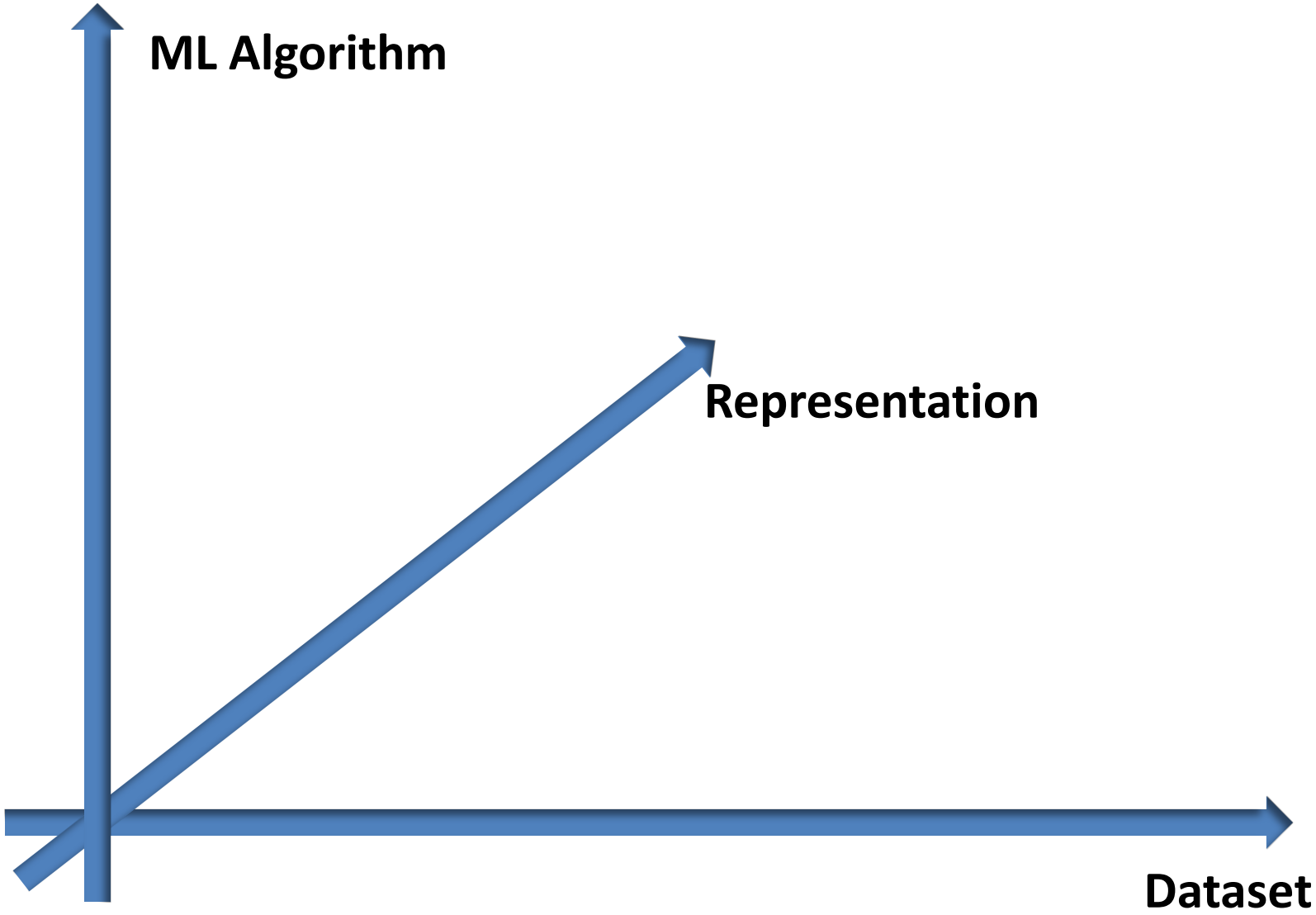




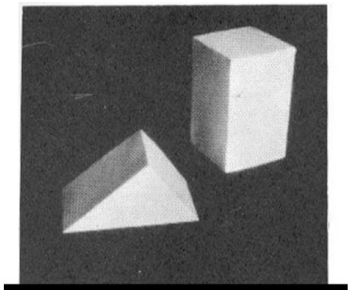
Recognizing categories (objects, scenes, activities, attributes…), learning techniques



Data representation (vectorized) -> machine learning techniques


ML Algorithm
Representation
Dataset

Progress charted by datasets



Roberts 1963

COIL

1963 ⋯ 1996

Progress charted by datasets

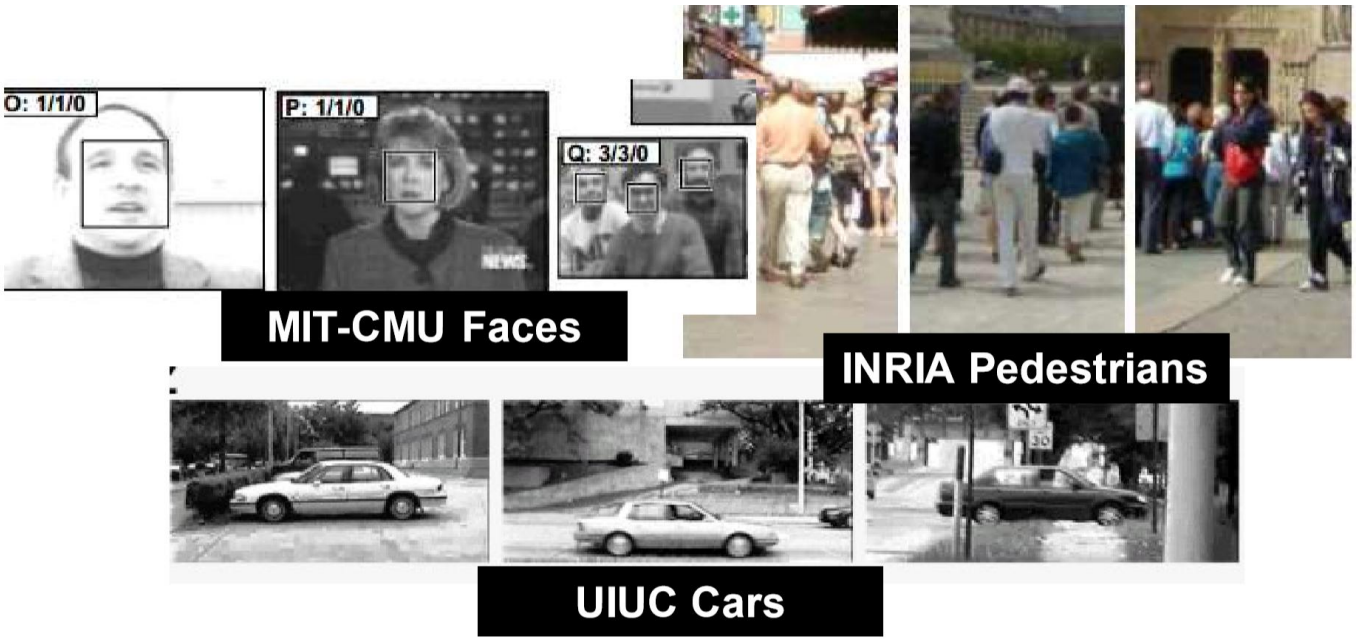
MSRC 21 Objects

Caltech-101

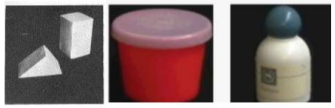
Caltech-256

1963 … 1996 2000 2005

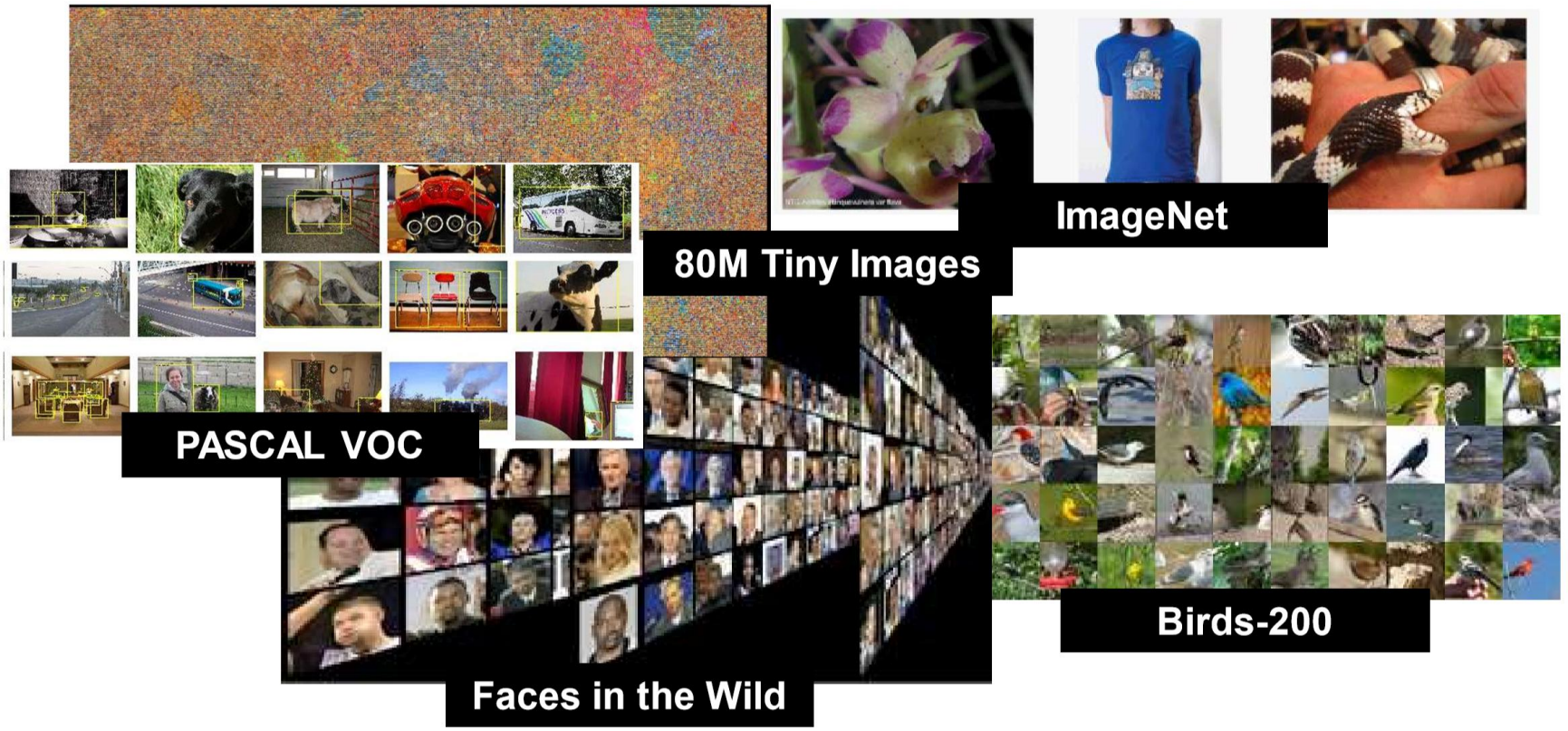
Progress charted by datasets

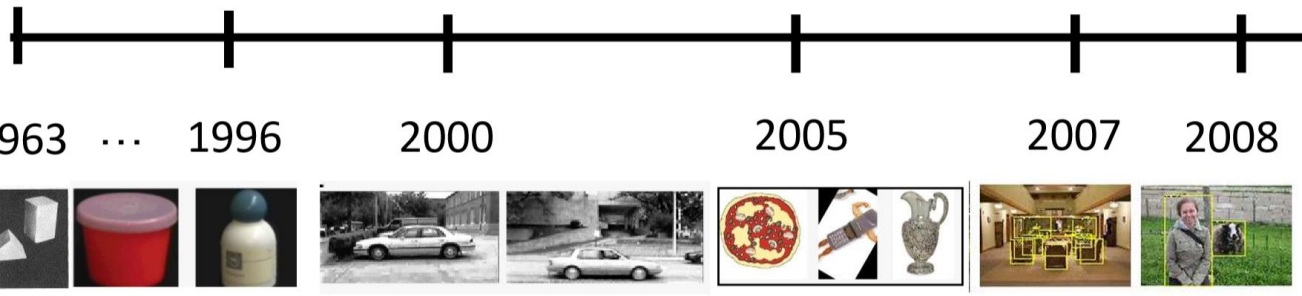


1963 ⋯ 1996 2000

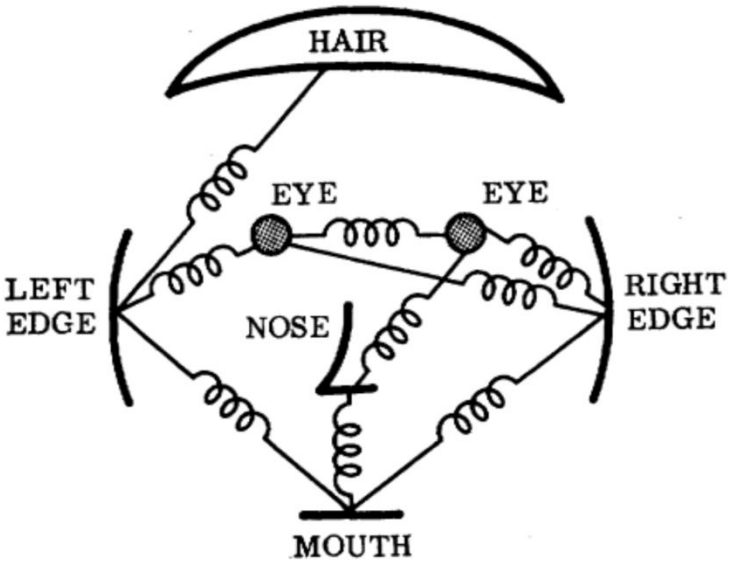


Progress charted by datasets

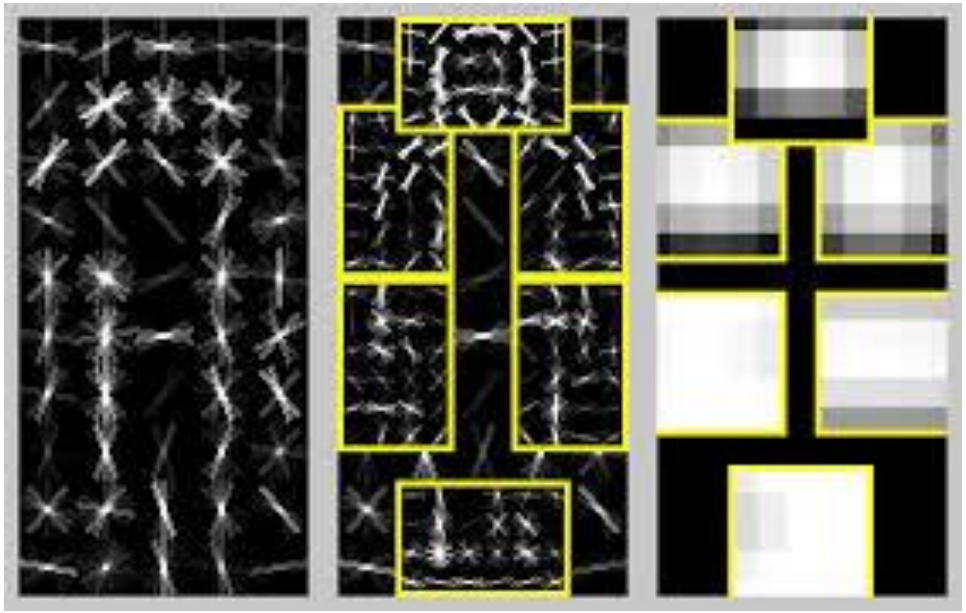




Data Representations



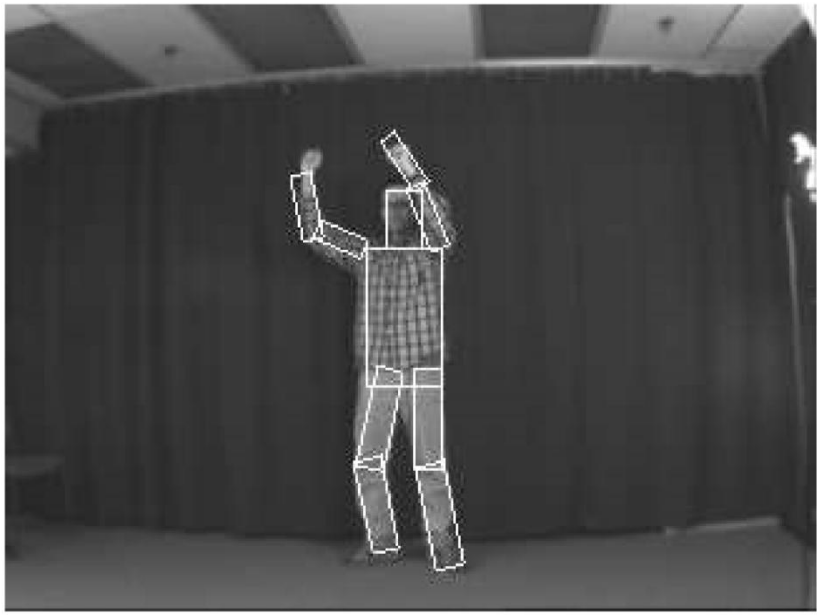
Pictorial Structures
(Fischler et al. 73)



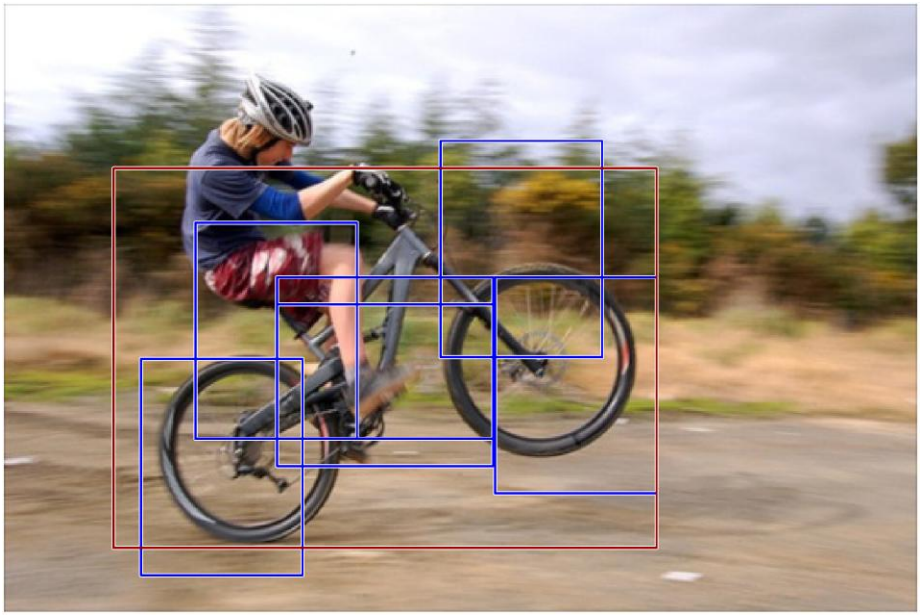
Deformable-Part-Model
(Felzenszwalb et al. 10)

1973

2010



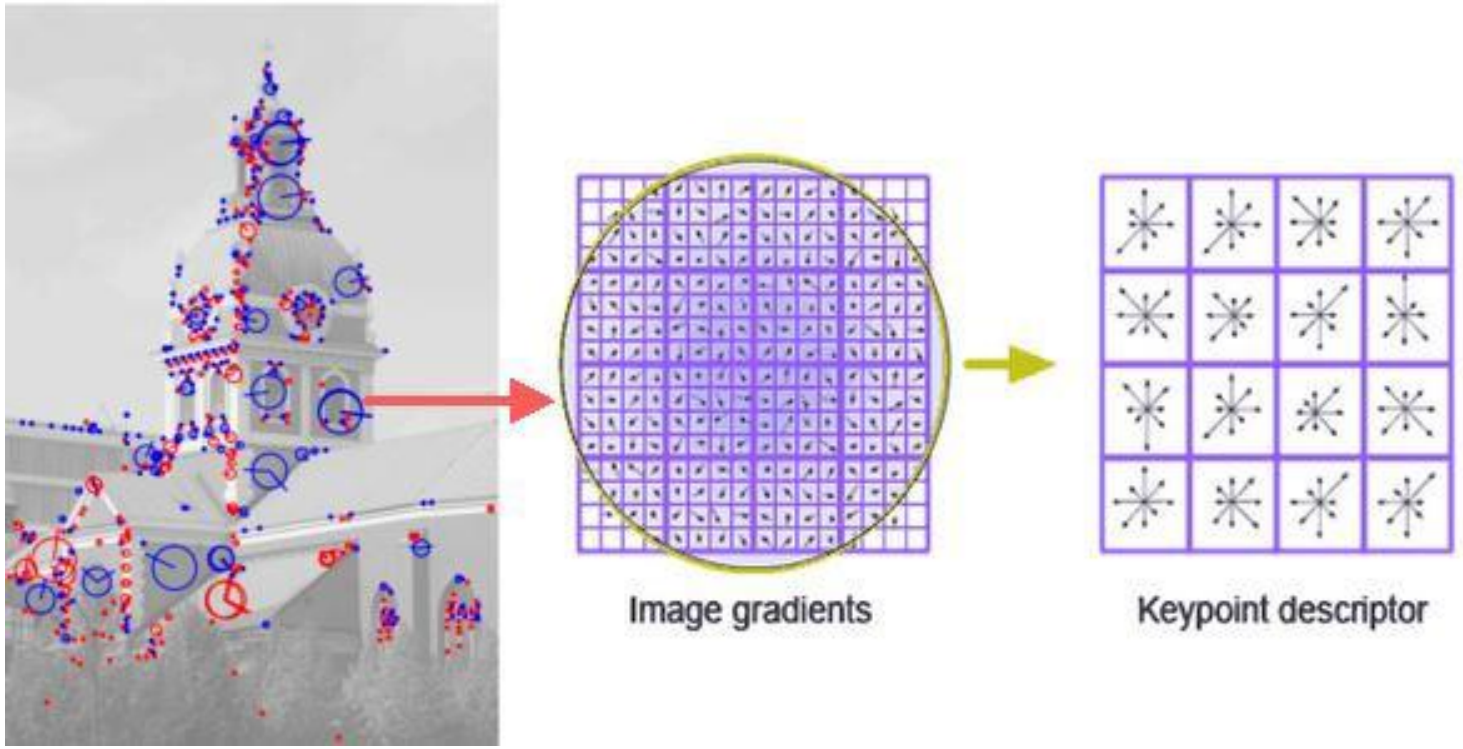
Pictorial Structures
(Fischler et al. 73)



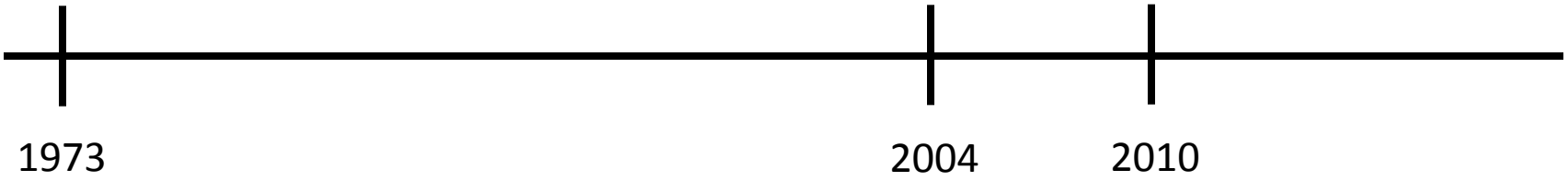
Deformable-Part-Model
(Felzenszwalb et al. 10)

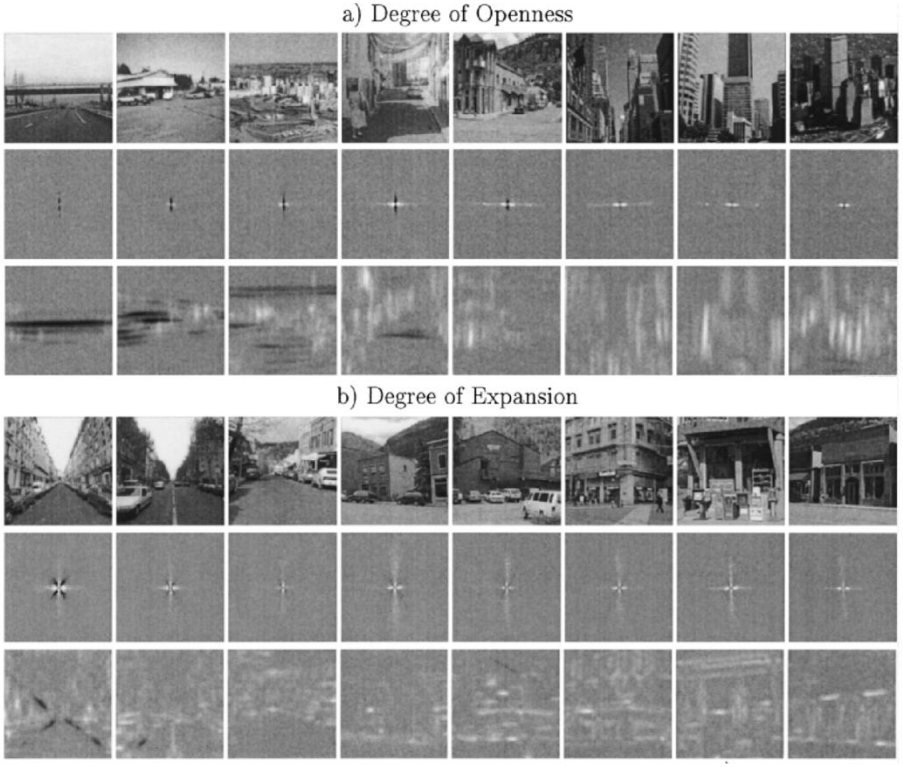
1973

2010

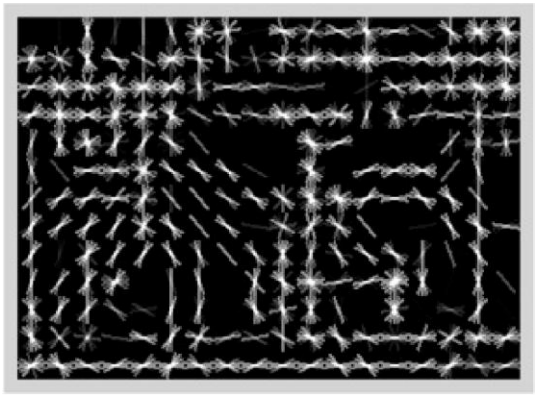


SIFT (Lowe 04)

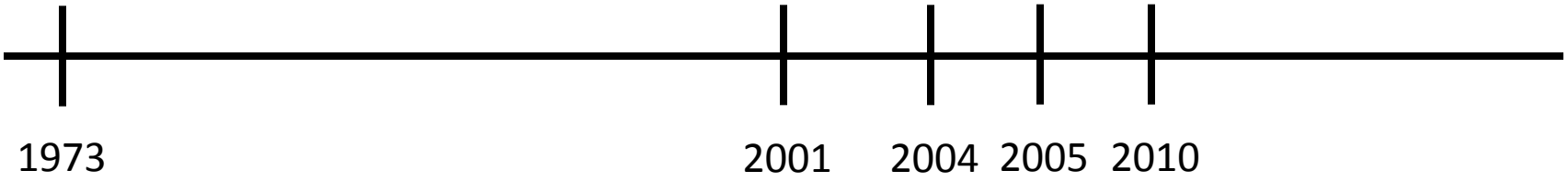


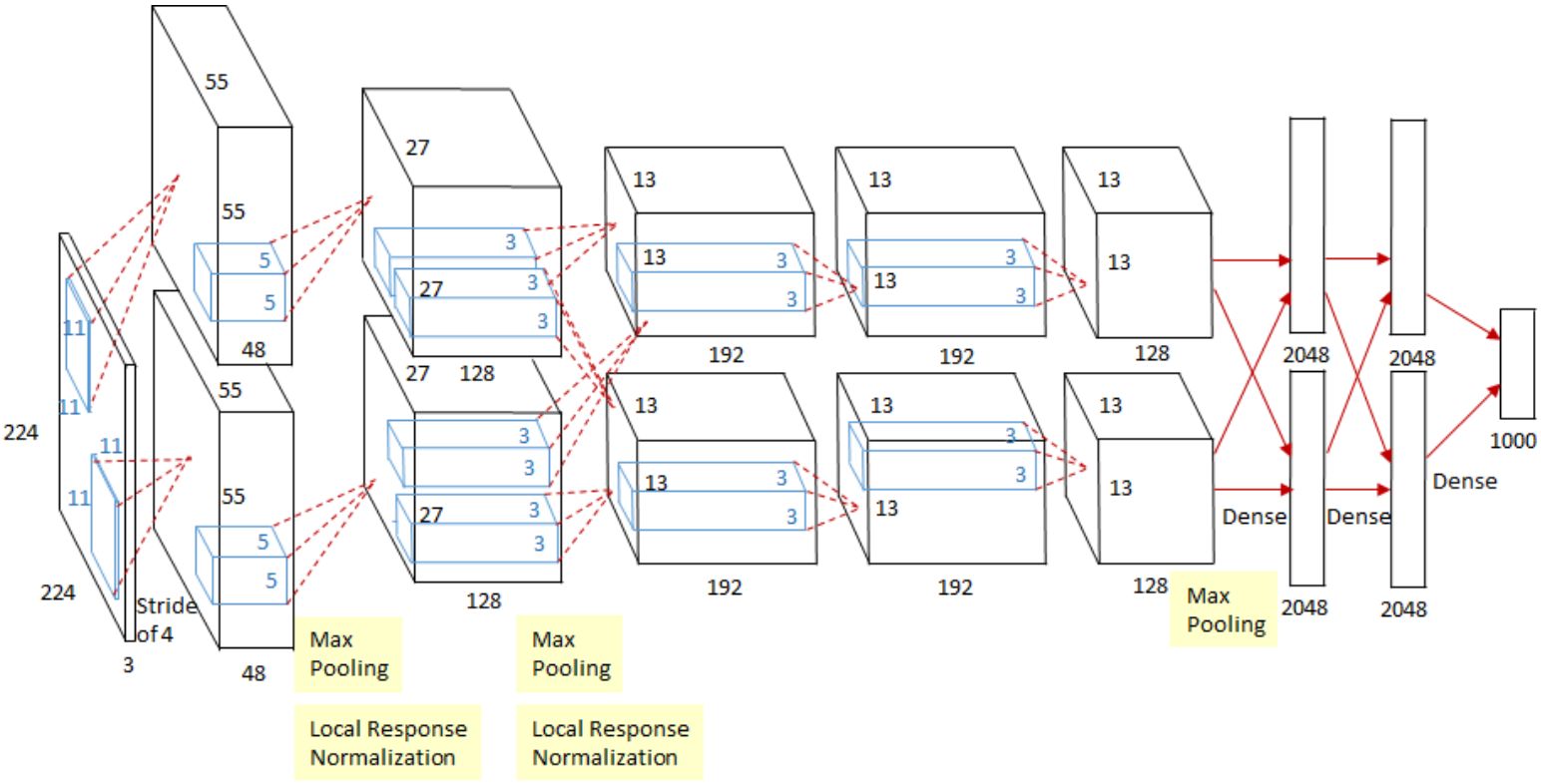


GIST (Oliva and Torralba 01)

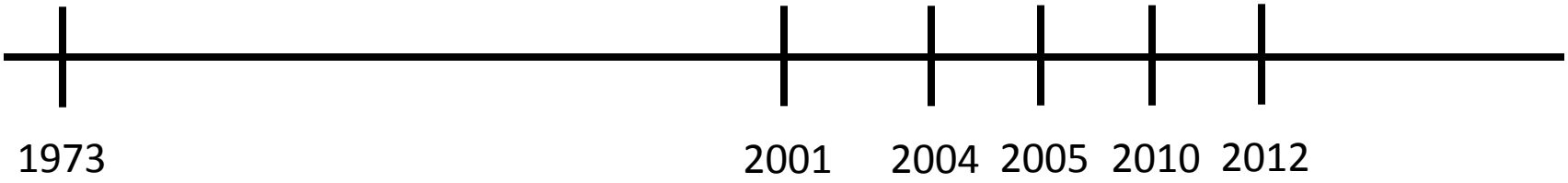


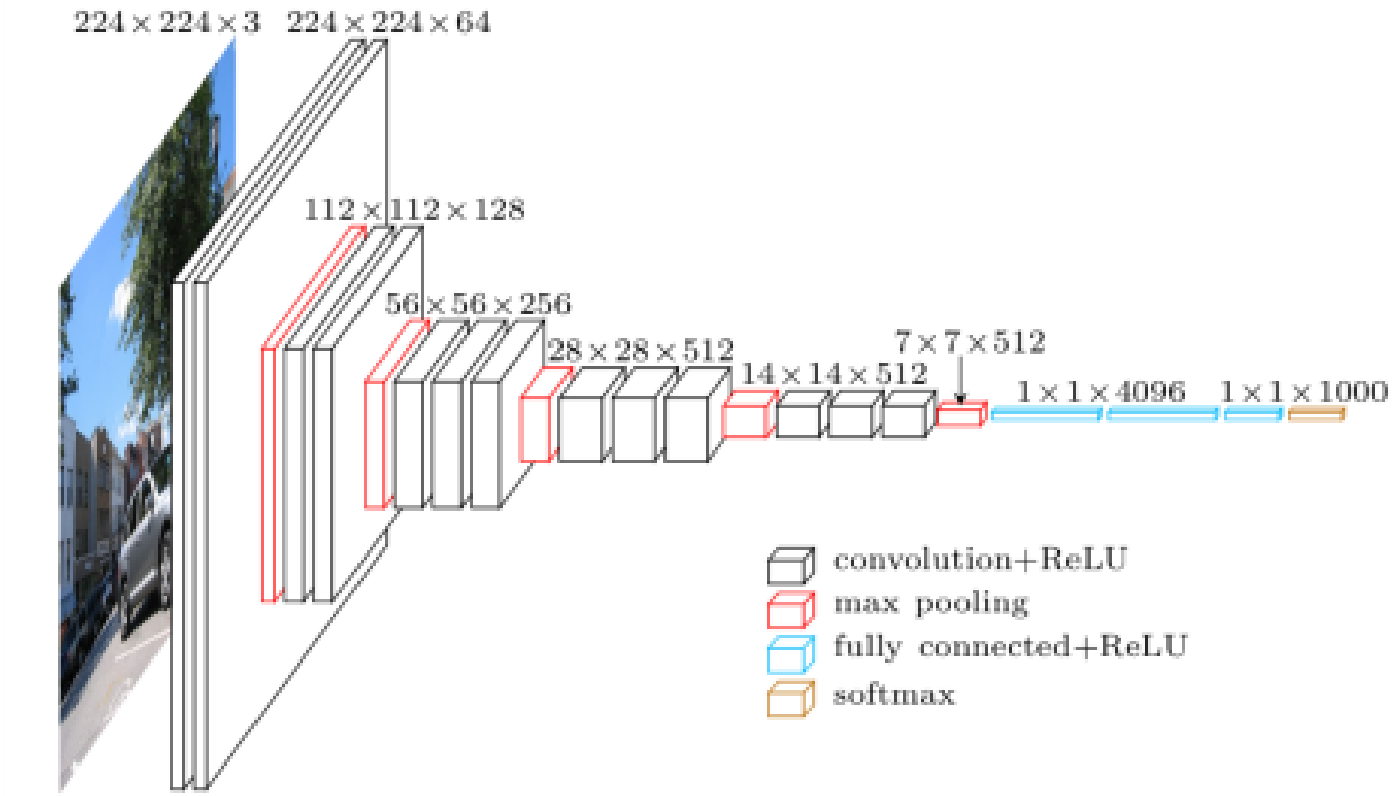
HOG (Dalal and Triggs 05)



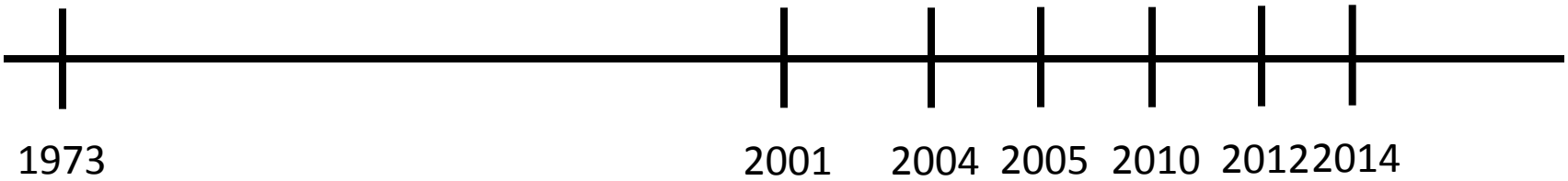


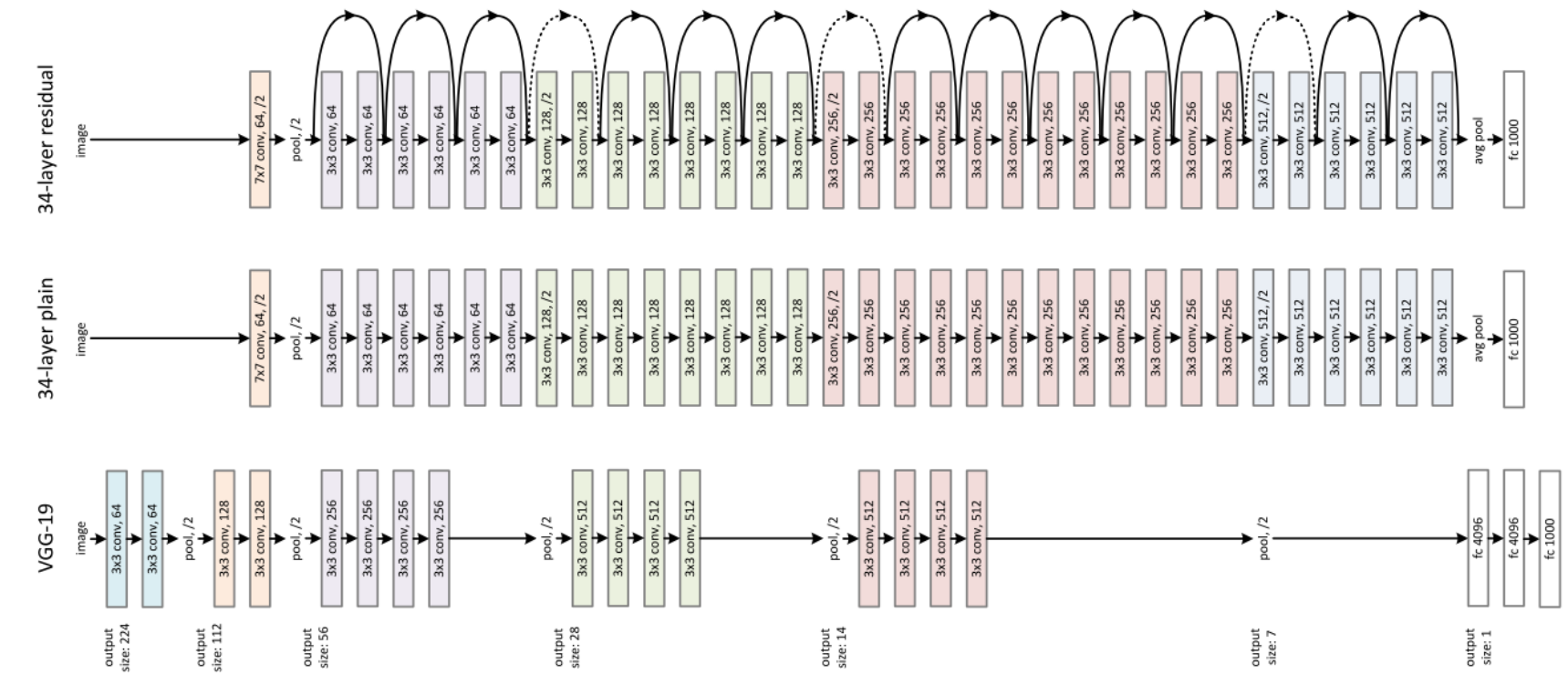
AlexNet (Krizhevsky et al. 12)



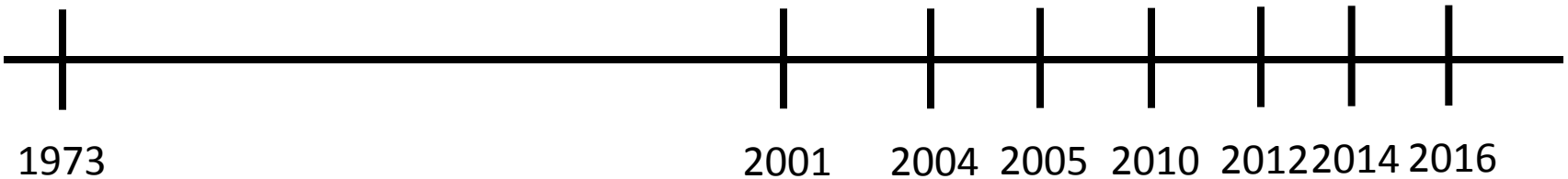


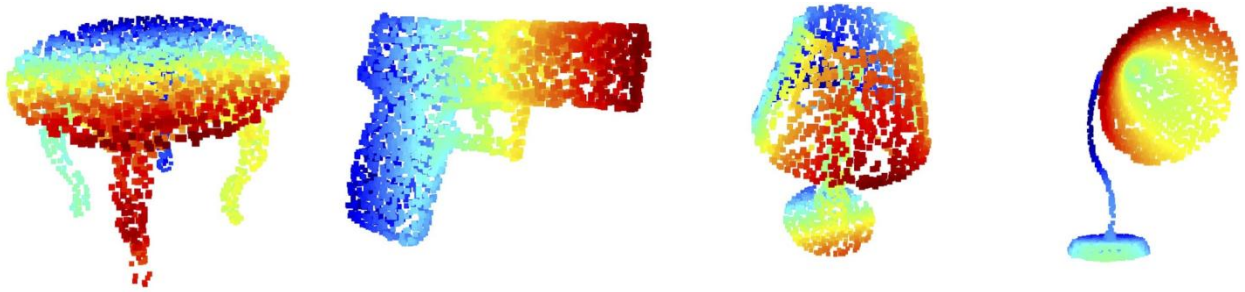
VGG19 (Simonyan and Zisserman 14)

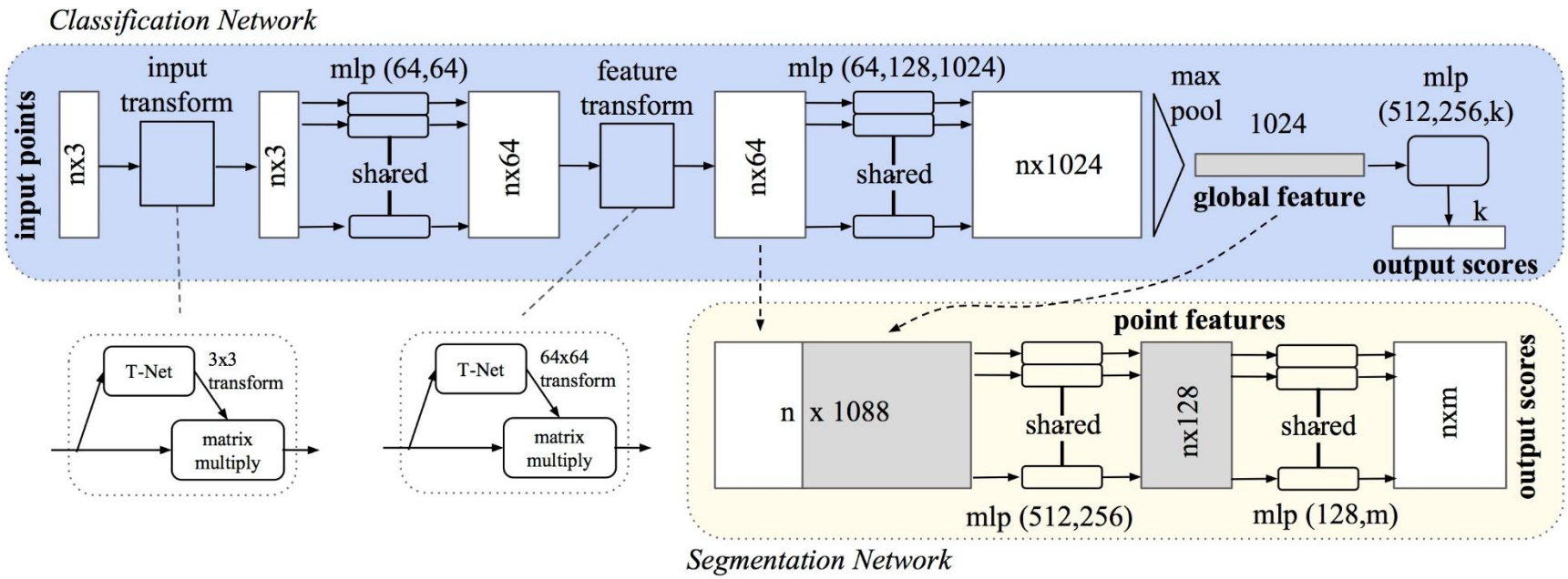




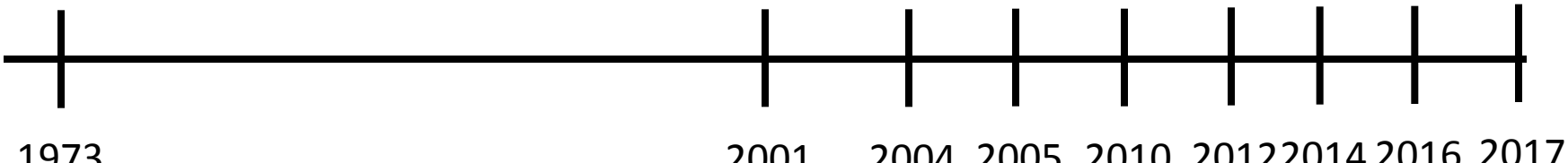
ResNet (He et al. 16)



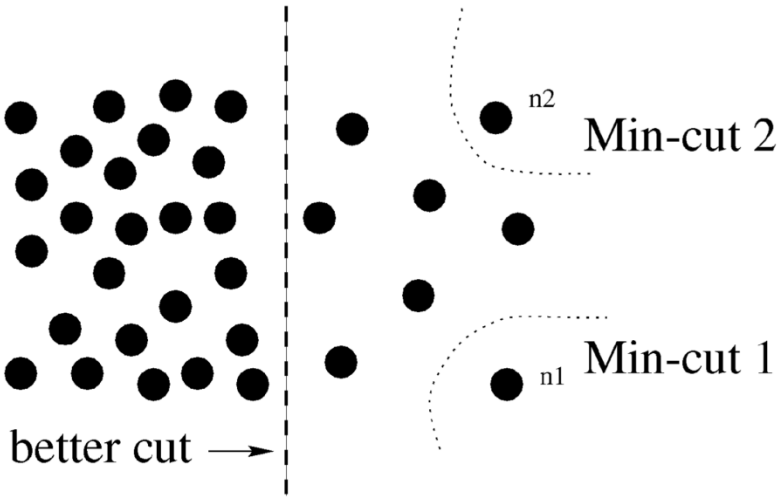




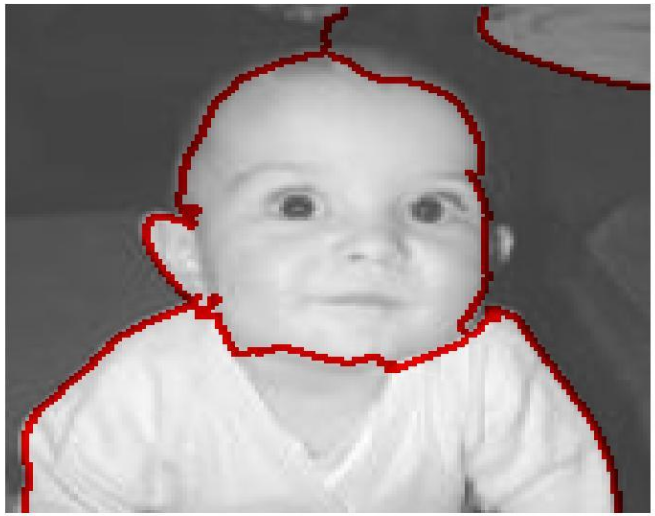
PointNet (R. Qi and Su et al. 17)



Machine Learning Algorithms

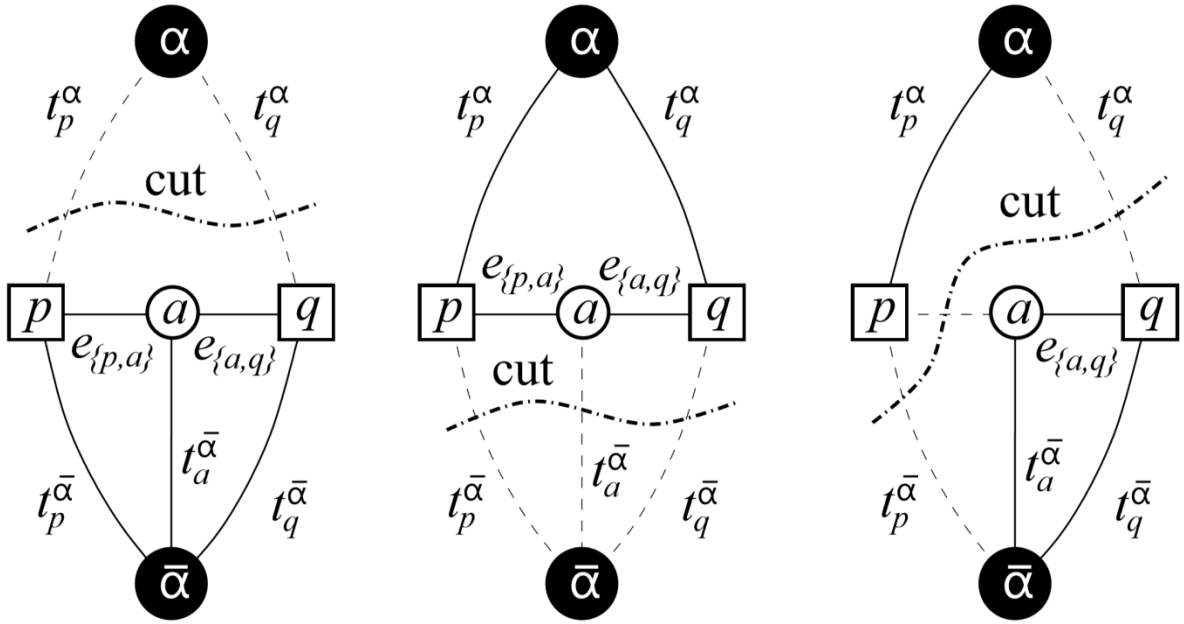


$$Ncut(A,B) = \frac{cut(A,B)}{assoc(A,V)} + \frac{cut(A,B)}{assoc(B,V)}$$



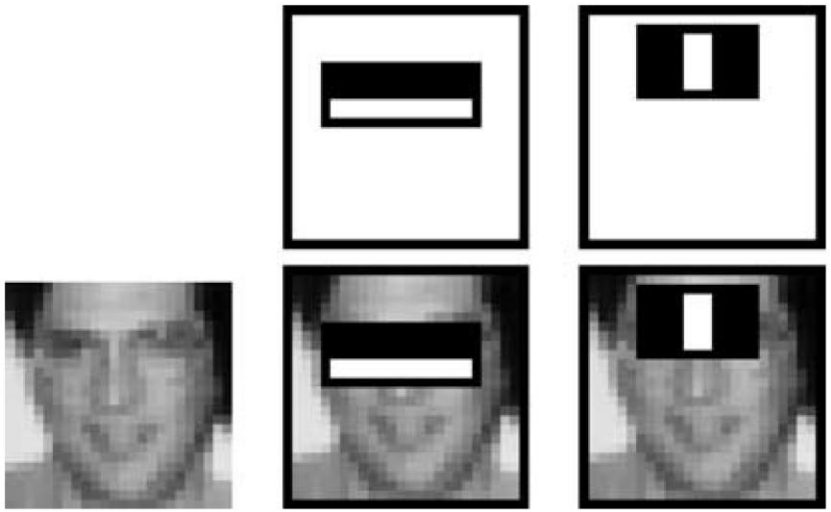
Normalized Cut (Shi and Malik 97)

1997

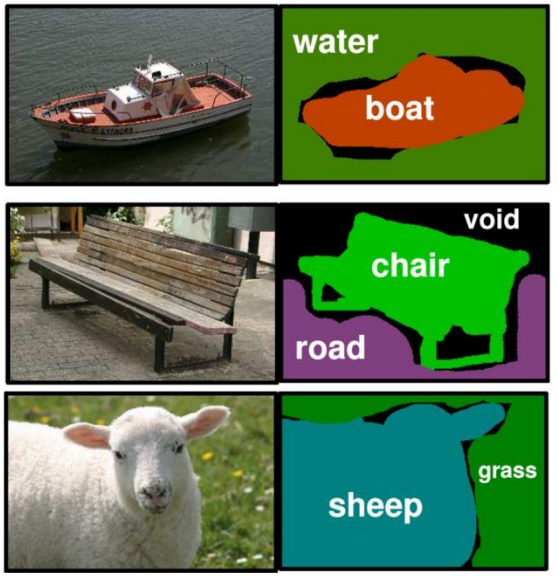


Graph Cut (Boykov et al. 99)

1997 1999

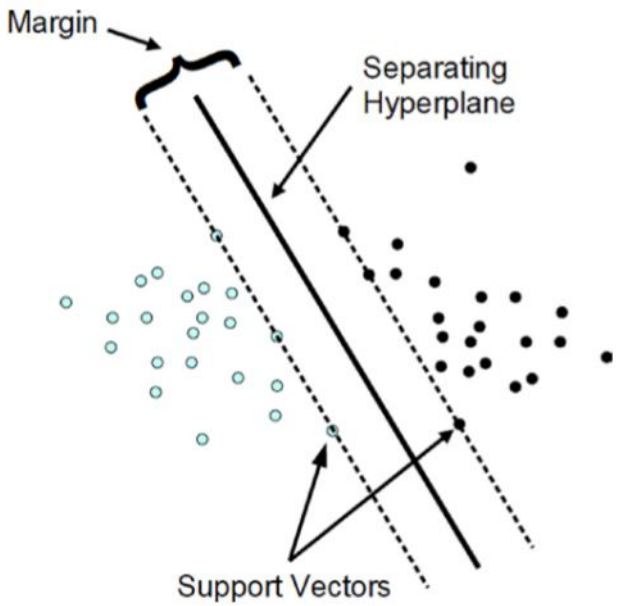


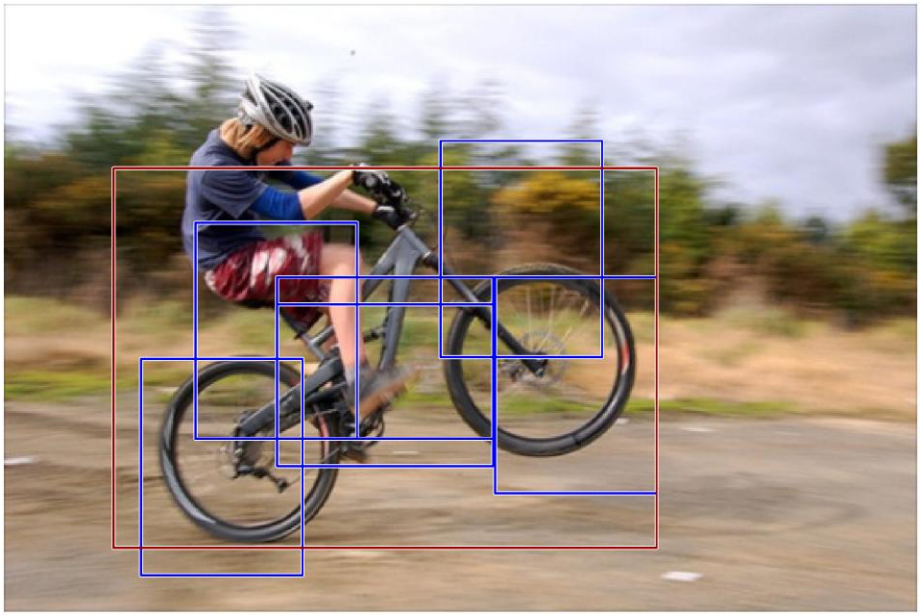
AdaBoosting for face detection
(Viola and Jones 04)



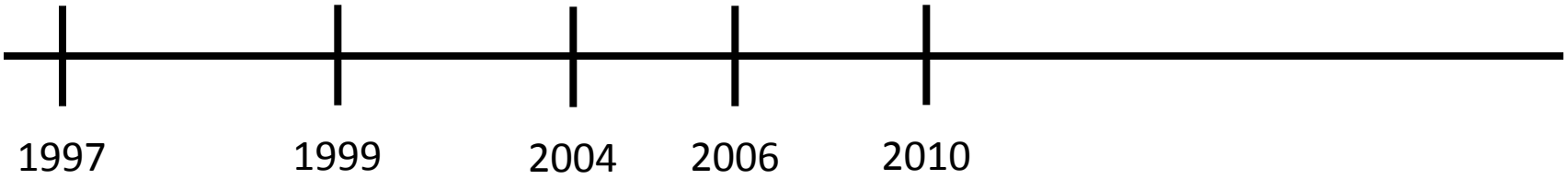
TextonBoost for segmentation
(Shotton et al. 06)

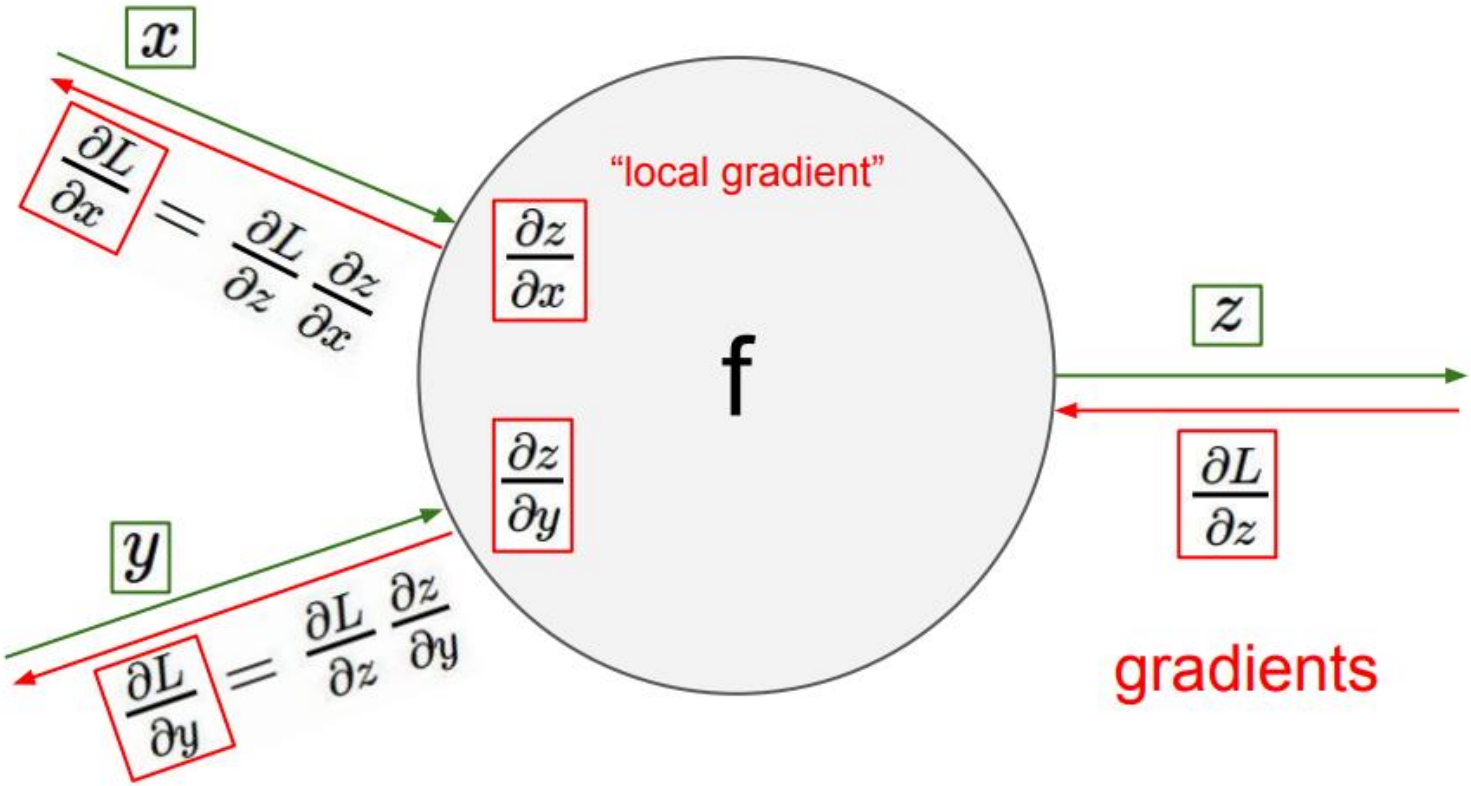
1997 1999 2004 2006



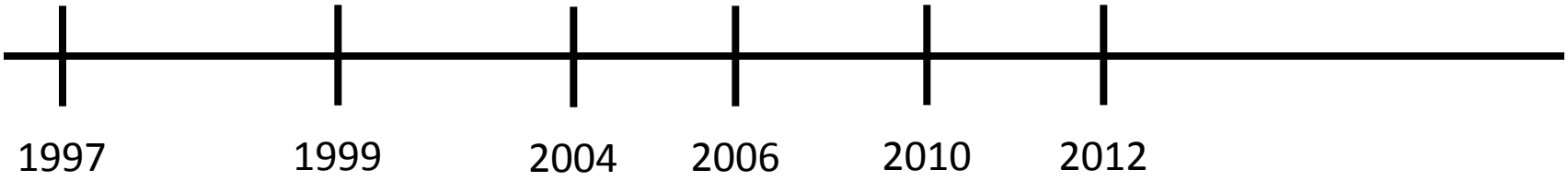


Support Vector Machine in Deformable Part Model
(Felzenszwalb et al. 10)

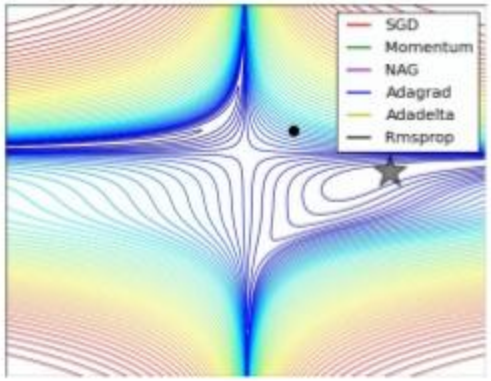


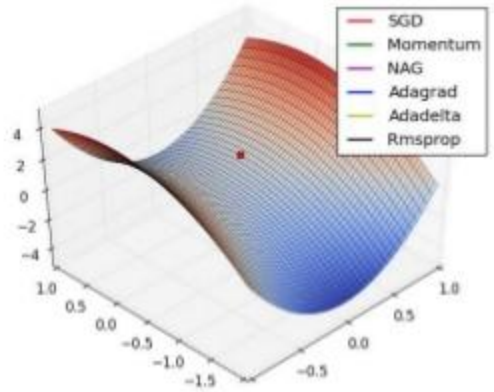


Back-propagation in neural network training/implementation
(Rumelhart et al. 86, LeCun et al. 98, Abadi et al. 16)

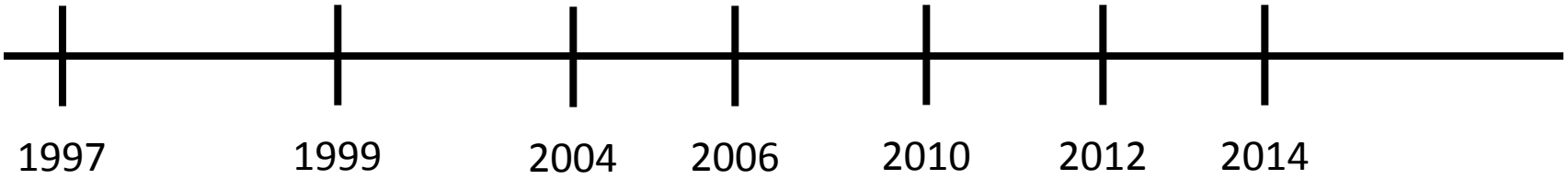


Optimization





Adam: A method for stochastic optimization
(Kingma and Ba 14)



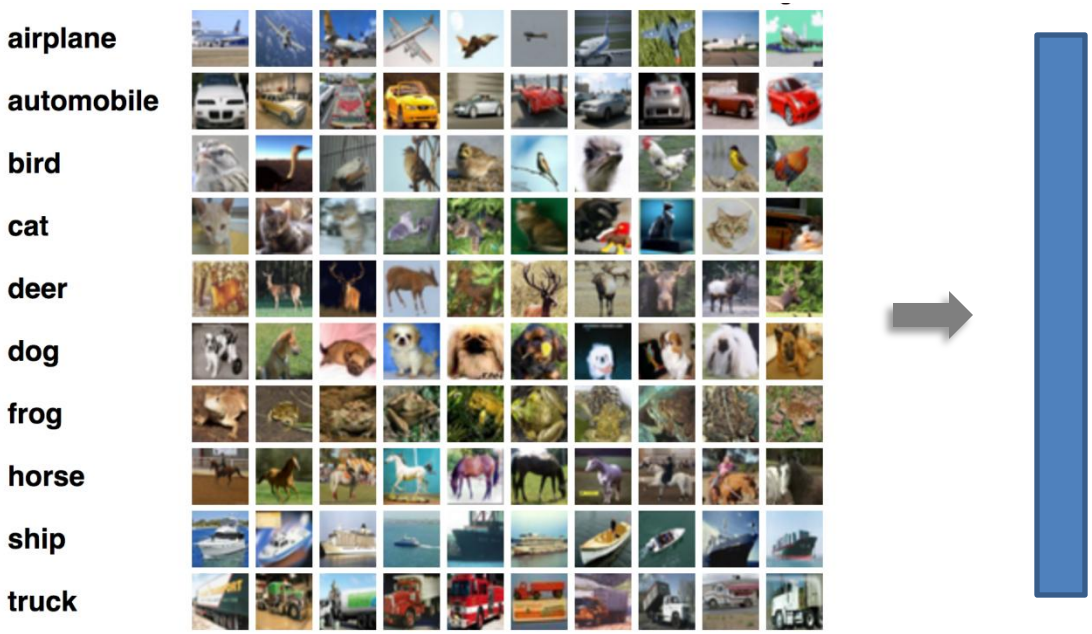
Topics to be Covered

Machine Learning Basics

- Unsupervised Learning
  - K-means
  - K-nearest
  - Graph cut (Mincut, Normalized Cut)
- Supervised Learning
  - SVM
  - Random forests
  - Boosting

Machine Learning Basics

- Convert data in their vectorized forms



What we have leaned in class?

Deep Learning Basics

- Convolution layers/Fully connection layers/Max pooling/RELU
- Stochastic gradient descent/Dropout/ADAM

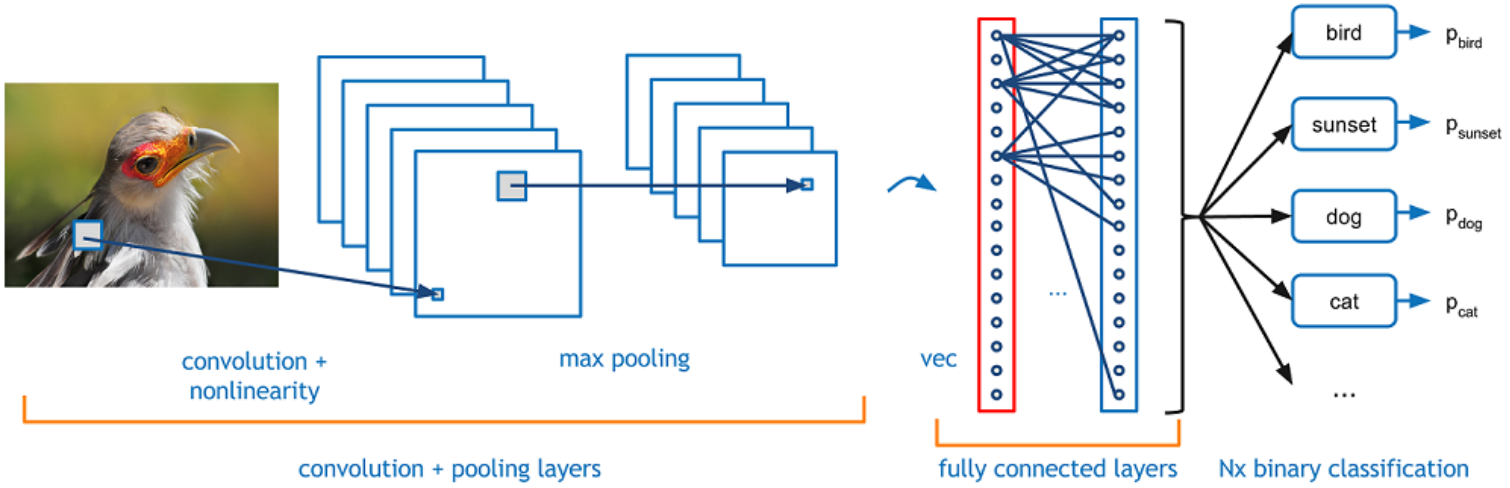
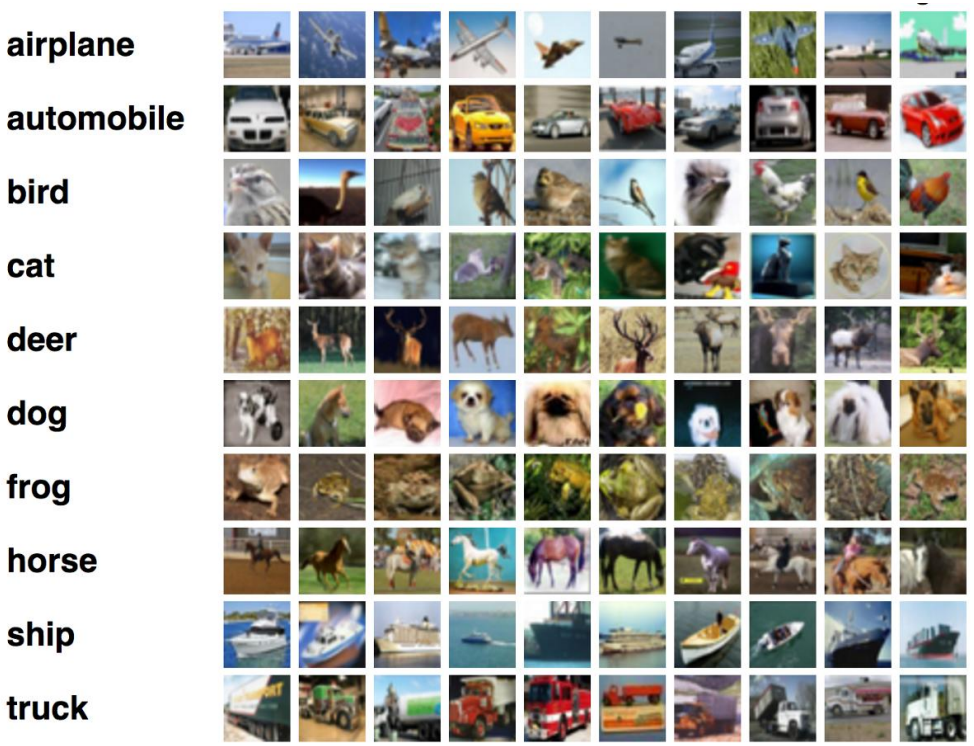


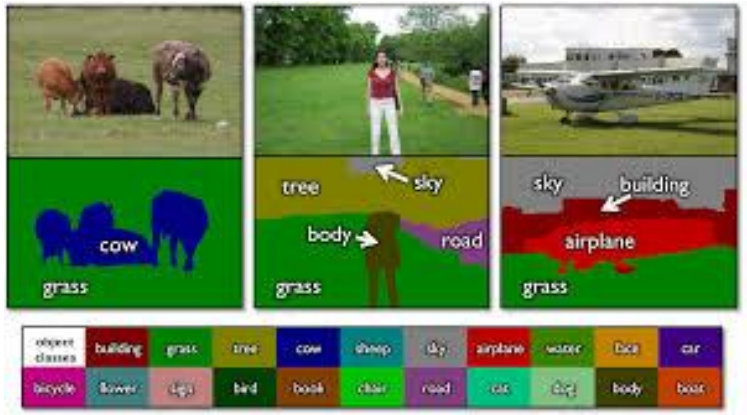
Image Classification

- K-nearest neighbor classification
- SVM classification
- Boosting
- AlexNet

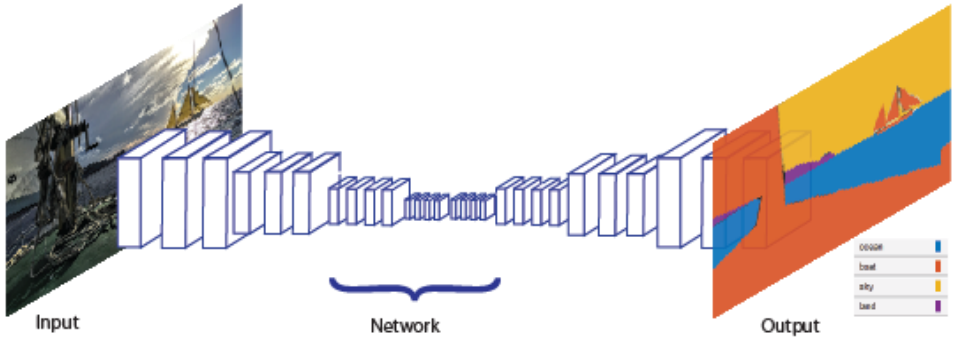


Semantic Segmentation

- Texton boosting
  [Shotton et al. 07]
  - MRF Formulation

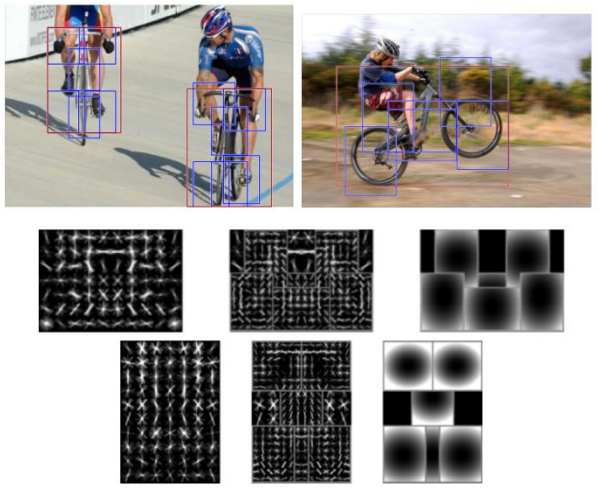


- Fully connected neural networks
  - Conv + Deconv
    [Noh et al. 15]



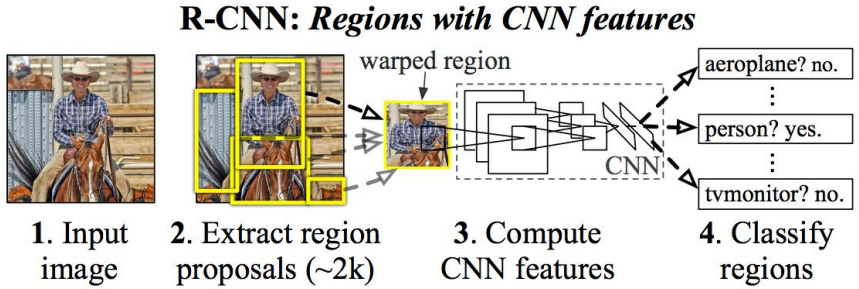
Object Detection

- Deformable part model [Felzenszwalb et al. 10]



- Region CNN and variants [Girshick et al. 14]

- Regression-based techniques [Law and Deng 18]



Other Topics

- Human pose estimation
- Monocular reconstruction
- 3D understanding

Announcement

- Last lecture is the final exam

- Last assignment is due later