Prof. Marios Savvides

PATTERN RECOGNITION THEORY 18-794

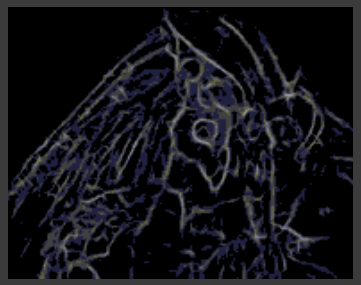
Lecture 0: Introduction

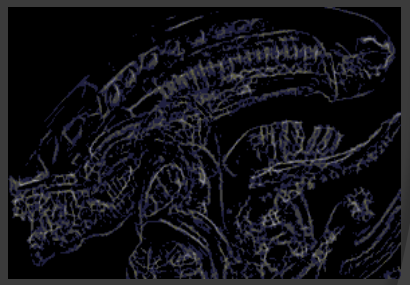
Pattern Recognition Components

Real-world observations

Sensors

Feature Extraction





Classifier

Decision

Predator!

Alien!

Pattern Recognition Components

Sensors

- Cameras, Shape, Temperature, Weight

Feature Extraction

- Domain Specific Knowledge
  - Gradients, DCT Coefficients, Fourier Coefficients, Phase Information etc.

Classifier

- Decision boundaries built using statistical knowledge

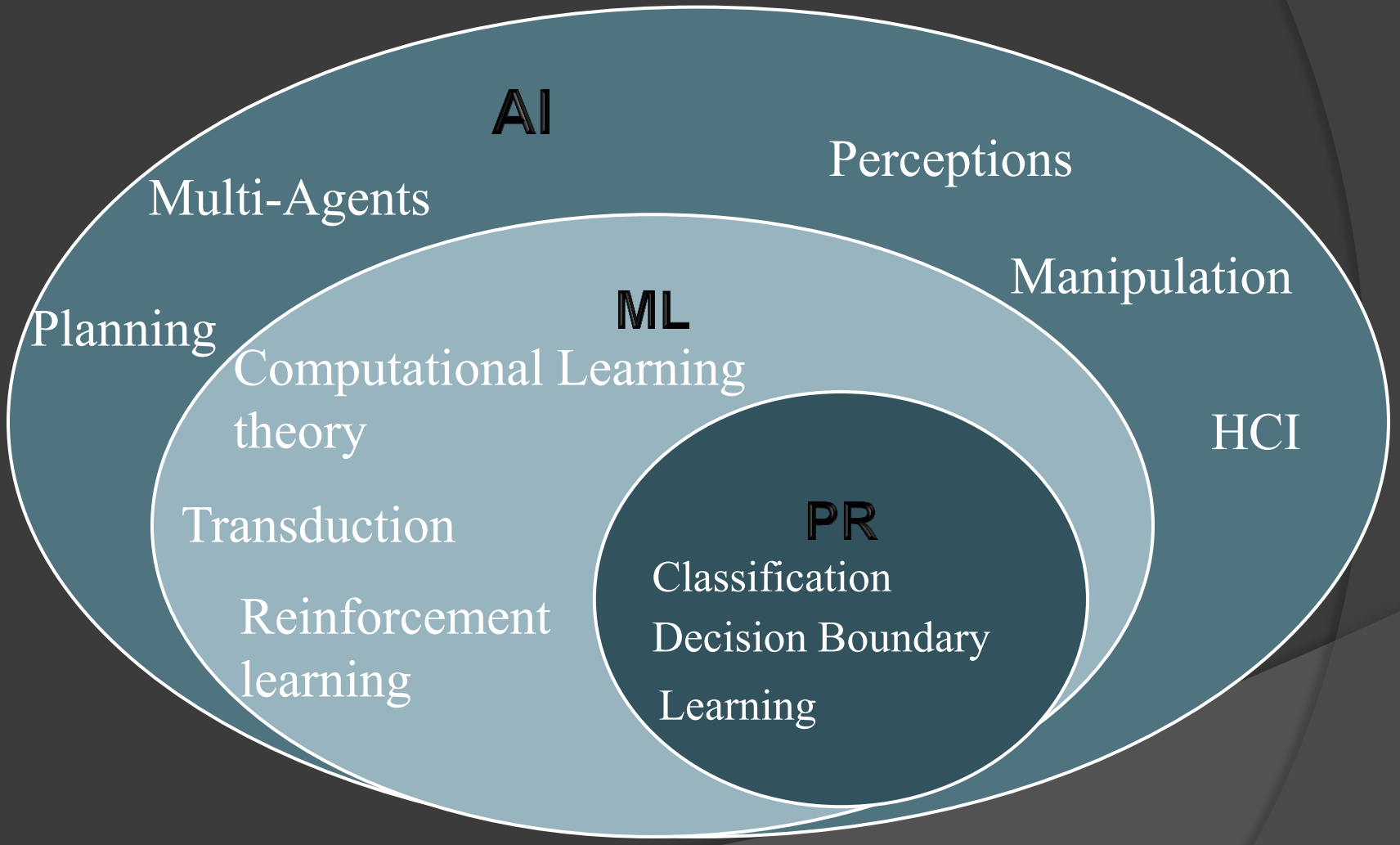
Topics to Be Covered

- Review of linear algebra and basic statistics
- Introduction to Bayesian Learning
  - Likelihood Ratio Test, Neyman-Pearson criterion, Minimax Criterion
- Parameter Estimation
  - MLE, MAP, GMM, EM
- Non-parametric methods and Clustering
  - Kernel density estimation, k-NNs
- Feature Extraction, Dimensionality Reduction
  - PCA, LDA, Linear Discriminant Functions
- Introducing sparsity in classifiers
  - Support Vector Machines
- Kernel tricks
  - Kernel PCA, Kernel LDA, Kernel SVM
- Artificial Neural Networks
  - Multillayer Perceptrons
- Correlation Filters
- Basic Image Processing Algorithms

Topics We Don’t Cover

- Reinforcement Learning
- Markov Learning Process
- Decision Trees
- Graphical Models

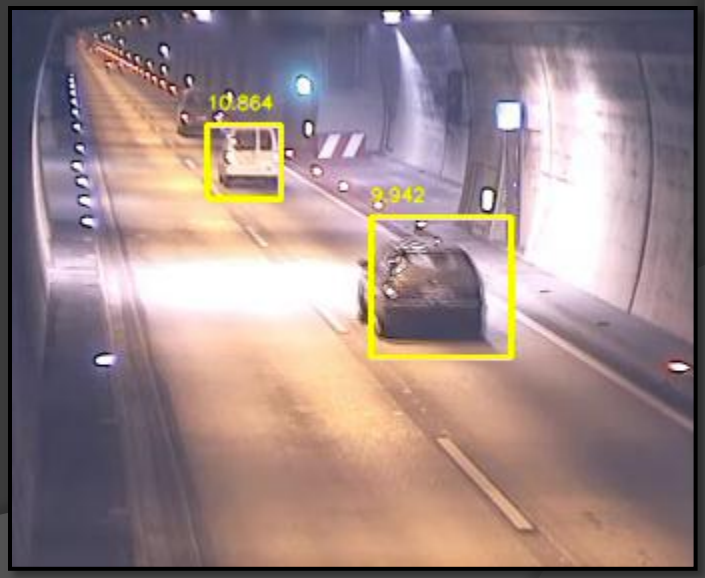
The Big Picture



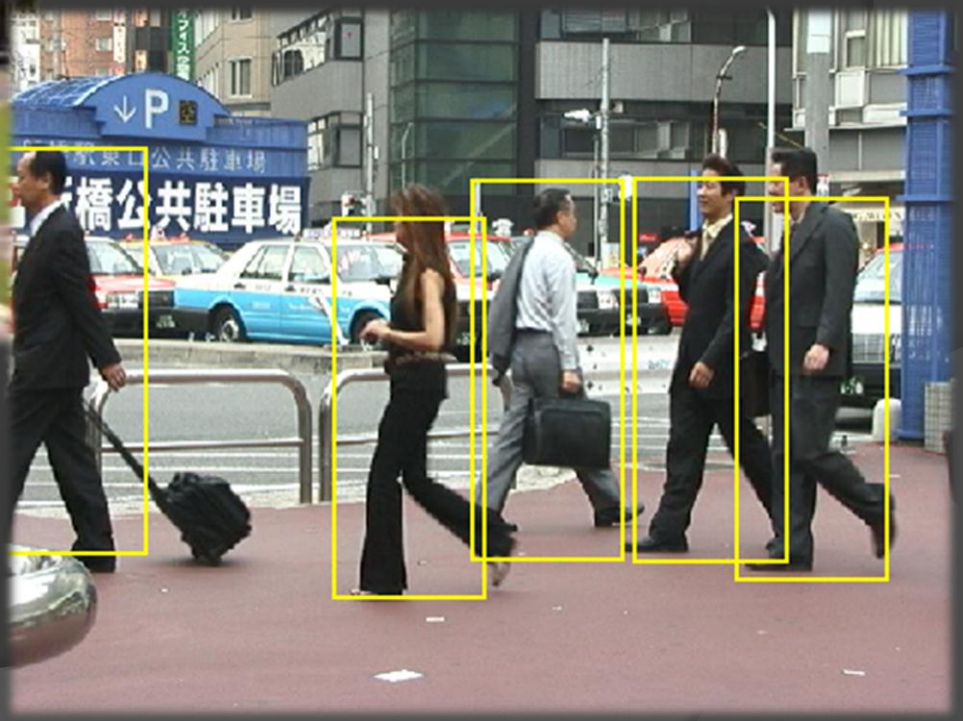
A few applications…

Surveillance
Access Control
Navigation/ Motion Planning
Segmentation
Biomedical Applications
Object Detection

Objection Detection: Cars



Object Detection: Pedestrians



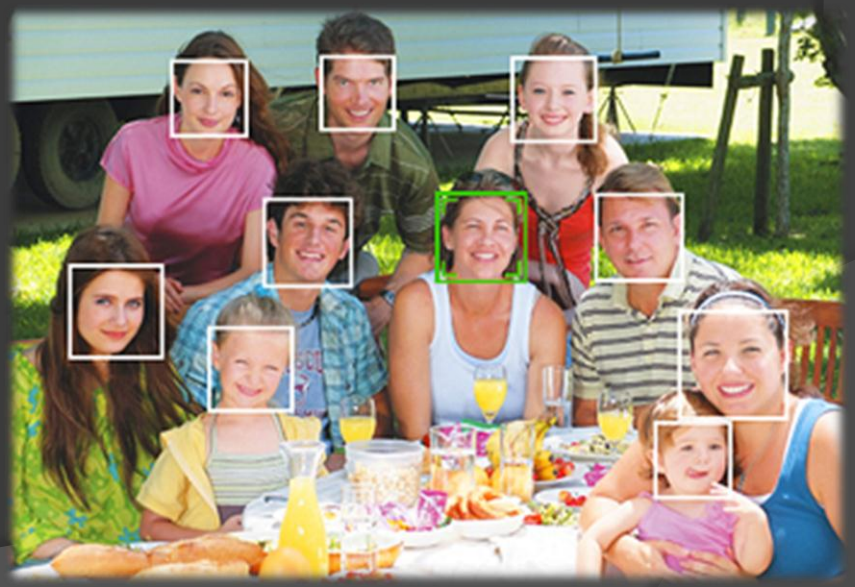
Pedestrian Detection

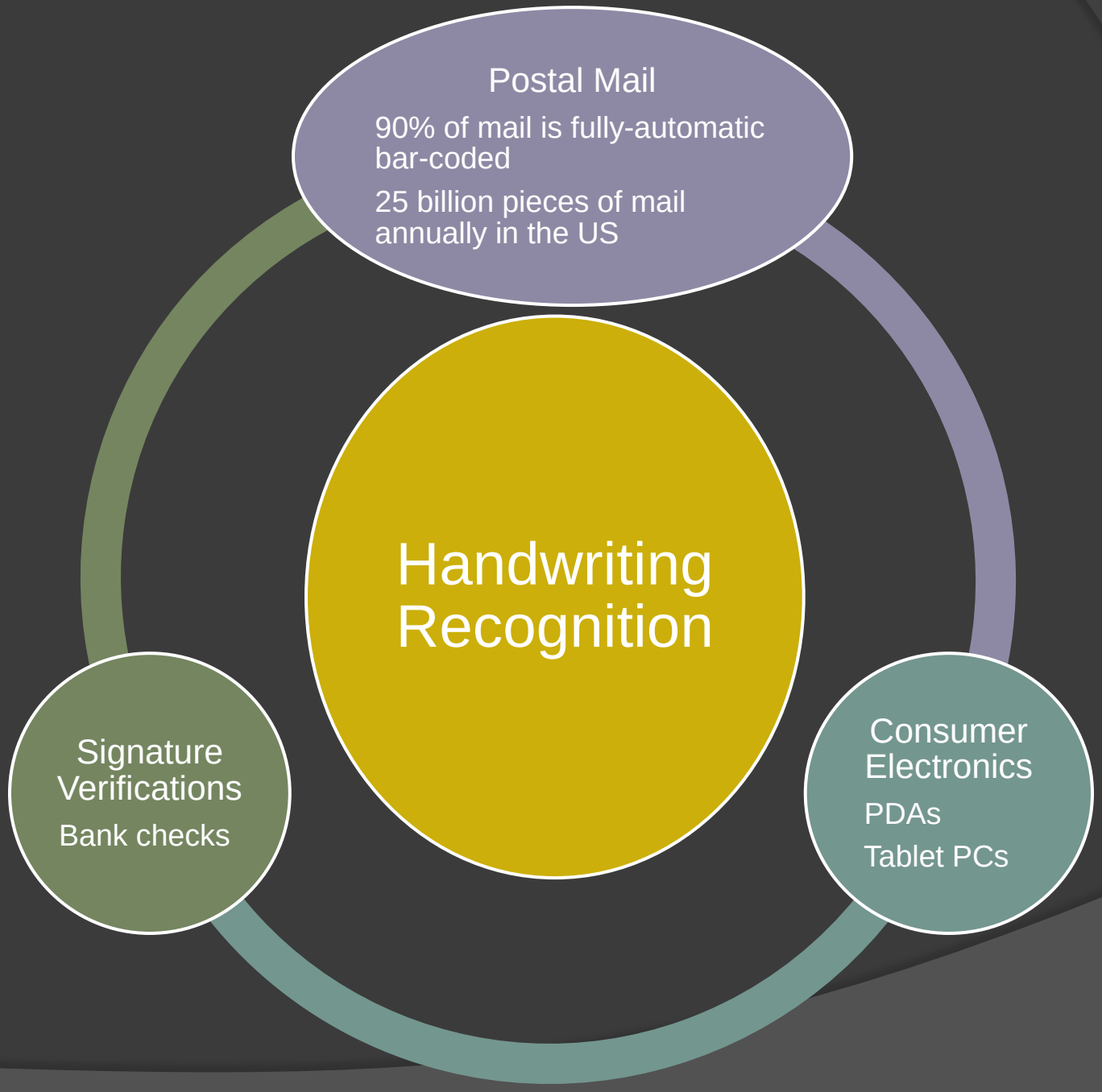
Object Detection: Faces

Face Detection and Alignment

Face Alignment

Face Detection: Commercial Applications

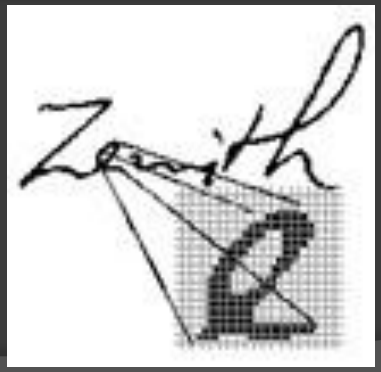


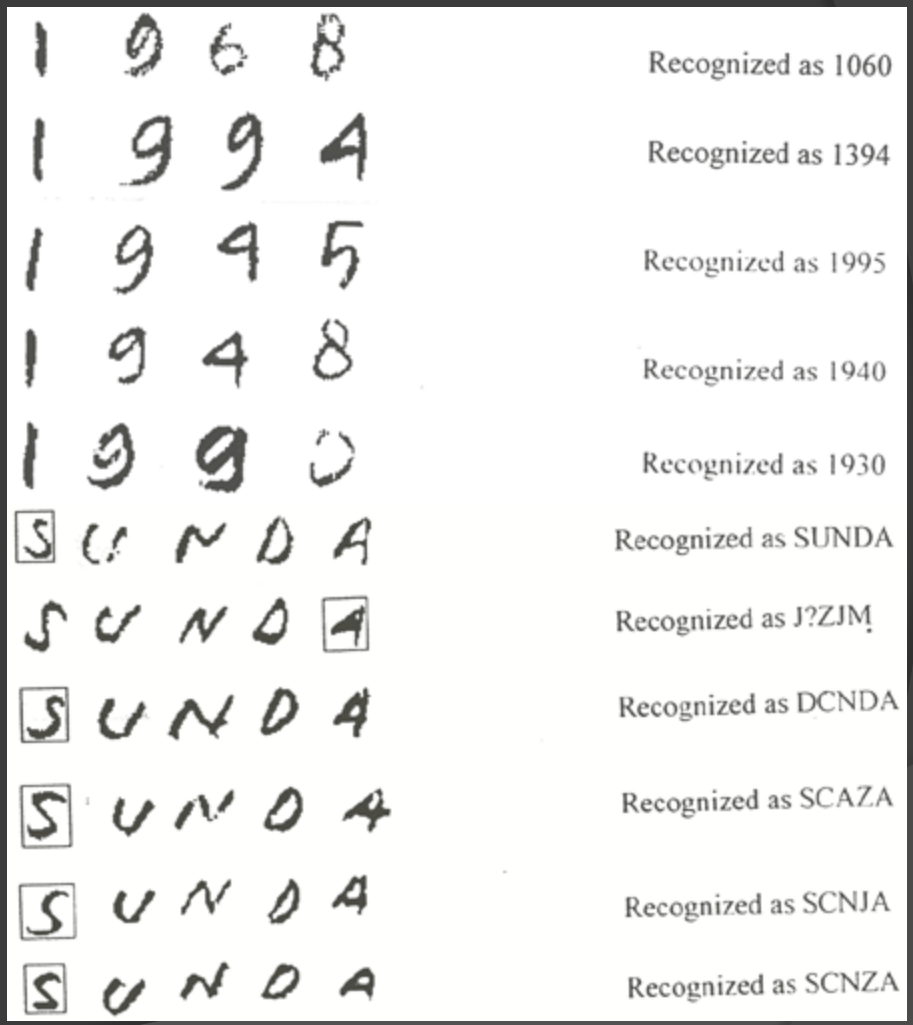

Postal Mail
90% of mail is fully-automatic bar-coded
25 billion pieces of mail annually in the US
Handwriting Recognition
Signature Verifications
Bank checks
Consumer Electronics
PDAs
Tablet PCs

Handwriting Recognition: OCR

Postal Mail	• 90% of mail is fully-automatic bar-coded • 25 billion pieces of mail annually in the US
Signature Verifications	• Bank checks
Consumer Electronics	• PDAs • Tablet PCs

Handwriting Recognition





iPhone Handwriting Recognition

Type

OR

Write!!

Handwriting Recognition

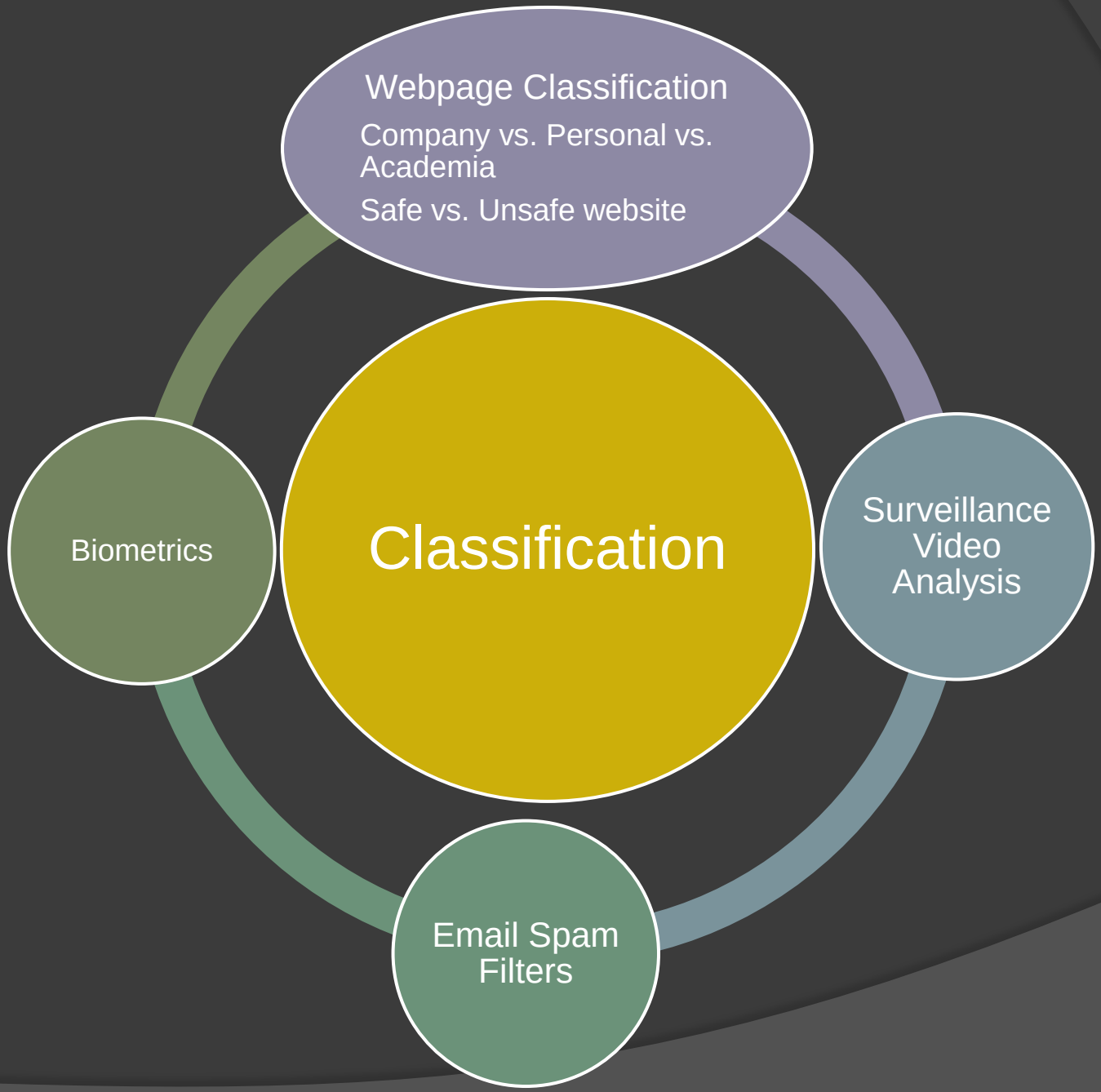
Text Recognition

Webpage Classification

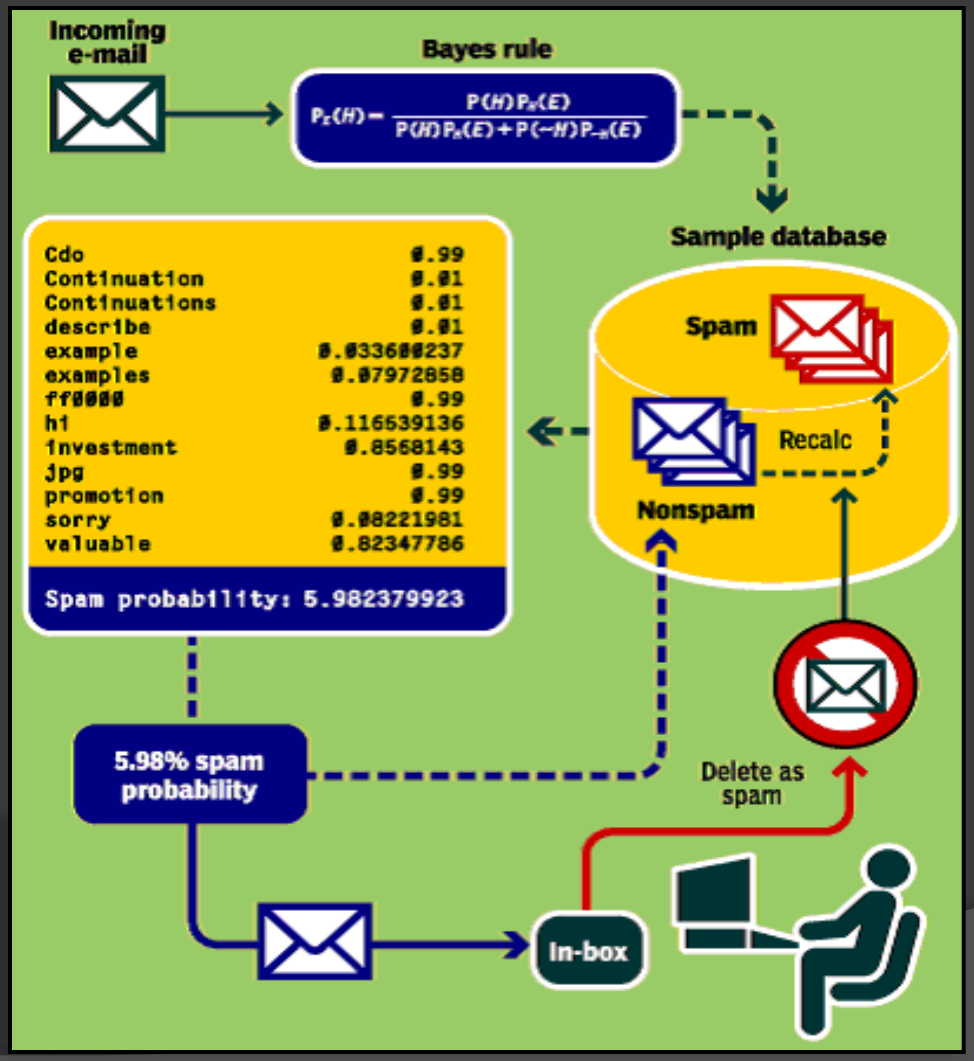
- Company vs. Personal vs. Academia
- Safe vs. Unsafe website

Email Spam Filters

Surveillance Video Analysis

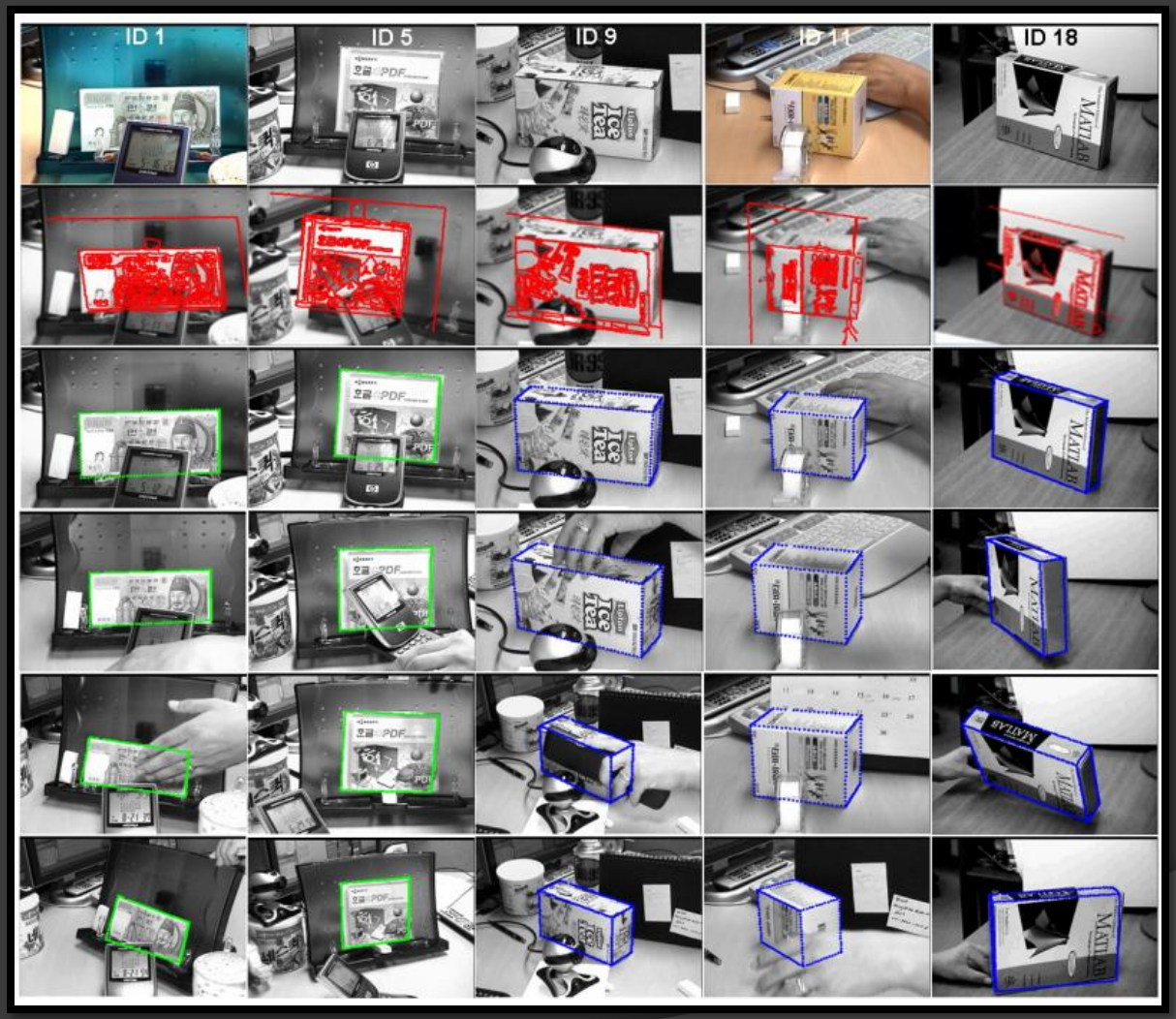

Webpage Classification
Company vs. Personal vs. Academia
Safe vs. Unsafe website
Classification
Biometrics
Surveillance Video Analysis
Email Spam Filters

Spam Filters



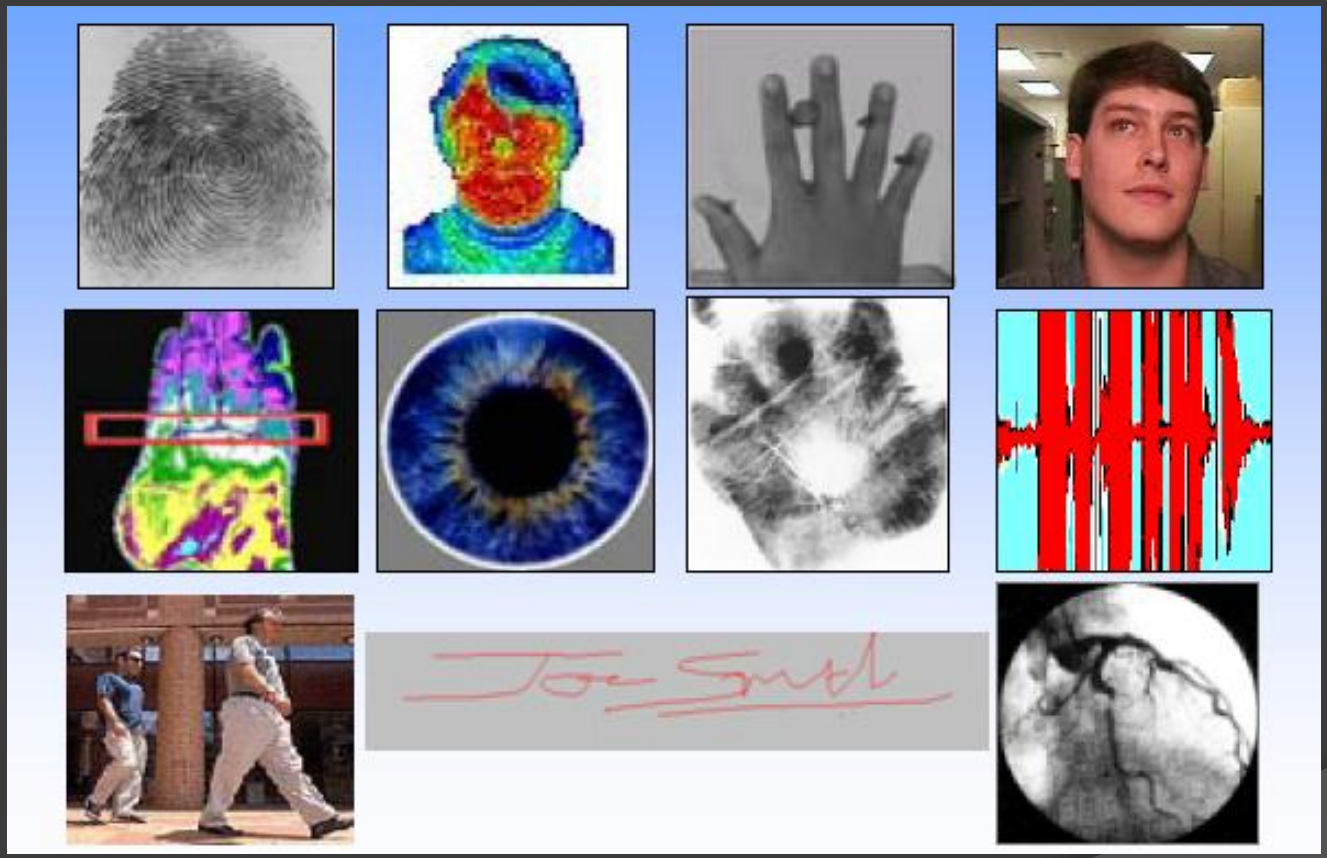
Surveillance Video Analysis

Object Classification

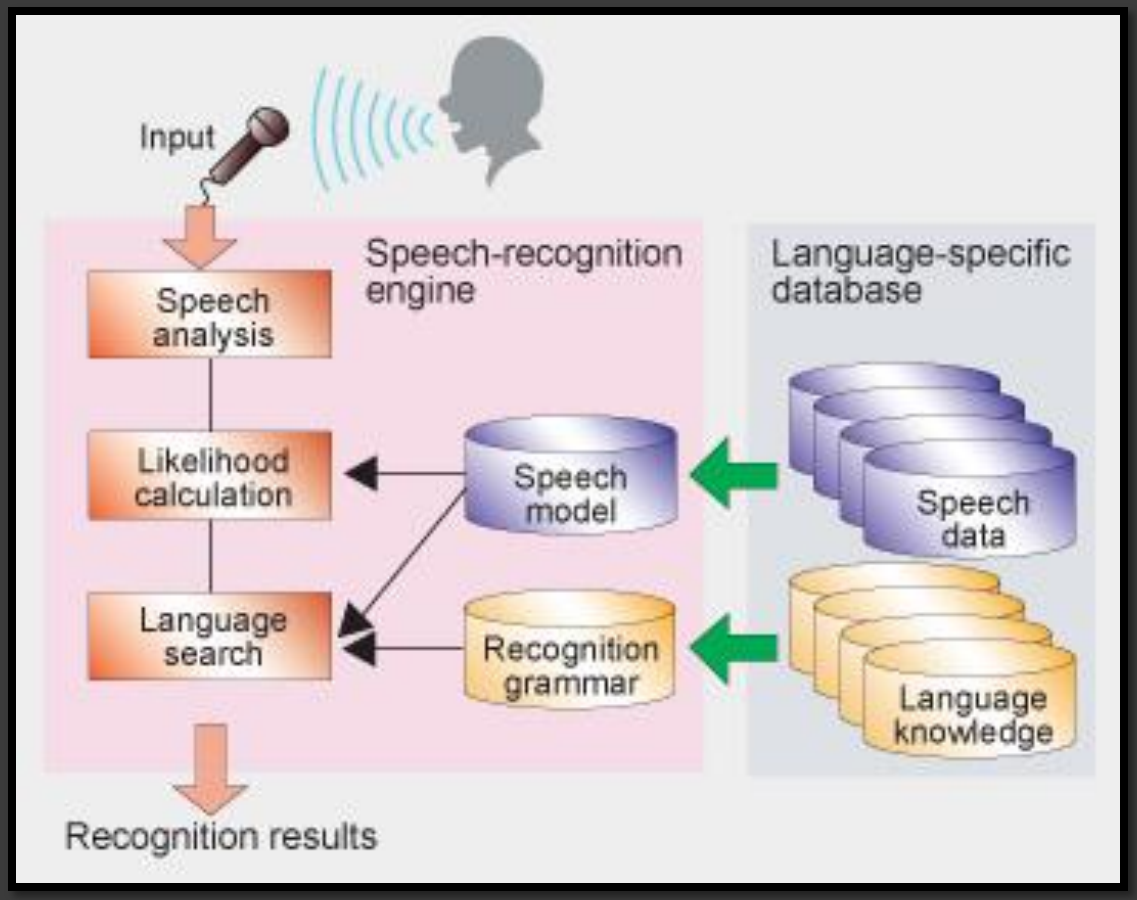


Google Goggles

Biometrics



Speech Recognition



Face Recognition

Face Recognition

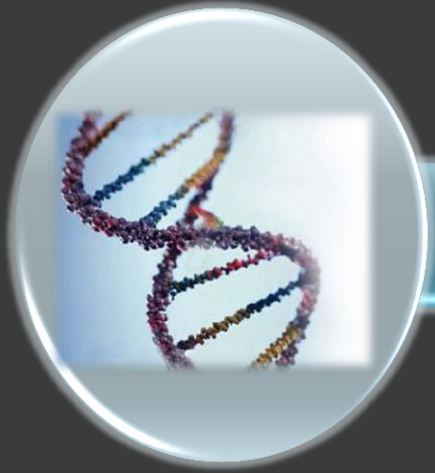
Face Recognition 2

Facial Expression Recognition

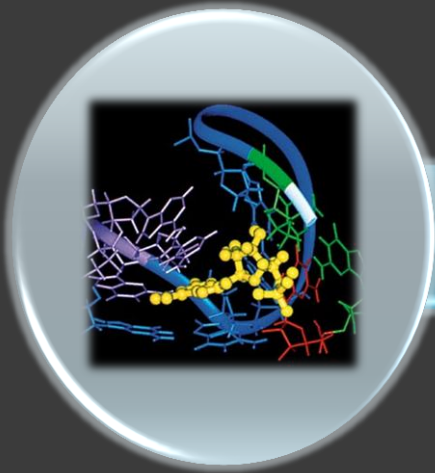
Minority Report Iris scan

Iris Recognition

More Applications …



DNA Sequencing



Cancer Detection

In Conclusion…

Humans can process different patterns easily.

However, it is a challenge to teach machines to recognize patterns automatically.

In this course, we explore many popular automatic pattern recognition and decision making algorithms