

Pattern Recognition in English

圖形辨識-英

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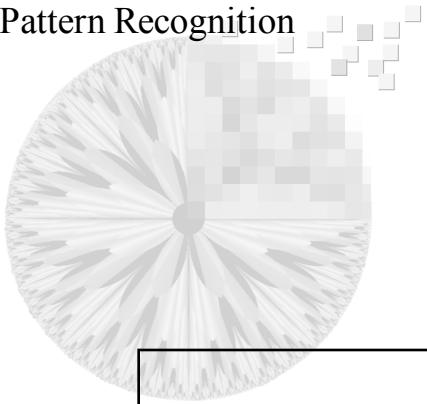
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2016



Goal

- **Know applications of image recognition**
 - Face recognition/Facial expression recognition
 - Fingerprint recognition
 - Object detection and tracking
 - ...
- **Learn a special topic of pattern recognition:**
deep learning and deep neural network



What Is the Course ?

Who Will Teach This Course

- **Teacher**

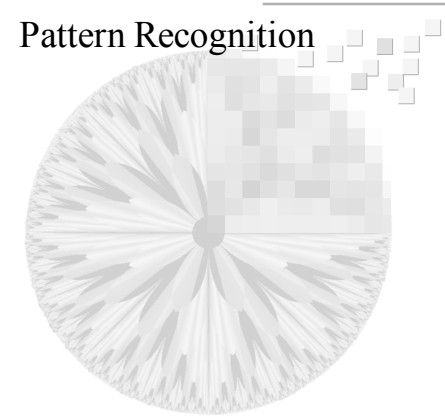
- **王元凱(Wang, Yuan-Kai)**

- Associate Professor in
Department of Electrical Engineering
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- Email: ykwang@fju.edu.tw



Course Contents

- **Unit 1 Introduction to pattern recognition**
- **Unit 2 Background of classification**
- **Unit 3 Neural network**
- **Unit 4 Deep neural network**
- **Unit 5 Pedestrian detection
by deep neural network**



Who can Study this Course ?



If You

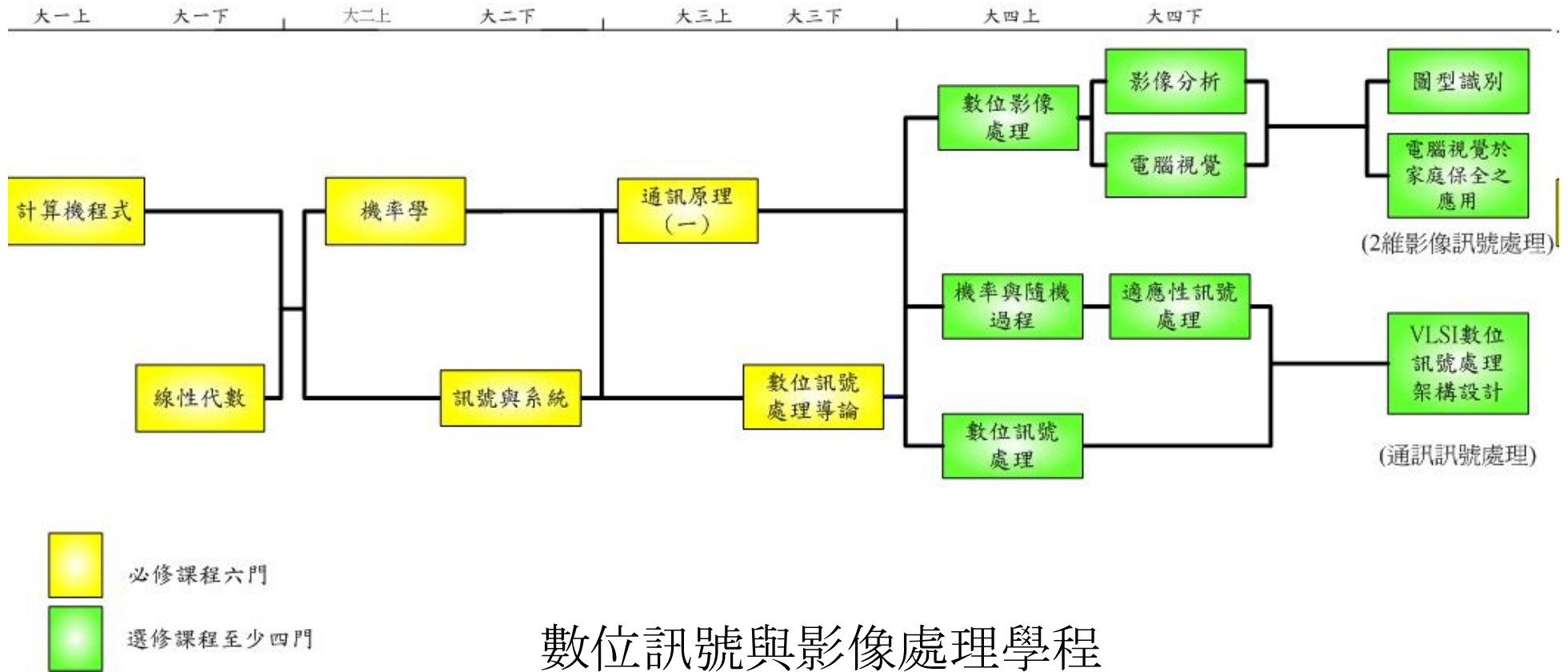
- **Are**
 - **Not afraid of *mathematics*, especially *Probability, Statistics, Linear algebra***
 - **Eager to learn advanced knowledge**
- **Want to**
 - **Know something about image recognition**
 - **Follow the research trend of CV(Computer vision) and PR(pattern recognition)**
 - **Learn *deep learning* and *deep neural network***

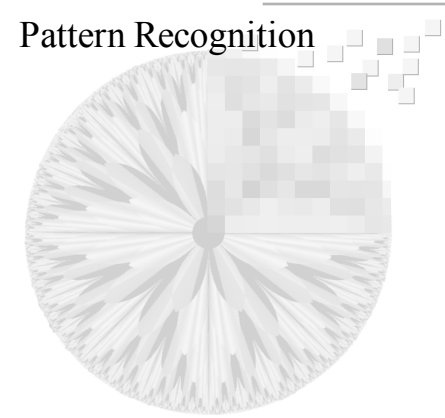


Related Courses

- **Background courses**
 - **Linear algebra, probability and statistics**
 - **Signal and systems, digital signal processing**
- **Advanced courses**
 - **Digital image processing, computer vision, artificial intelligent**
 - **Artificial neural network, robotics**

Program of Digital Signal Processing and Image Processing

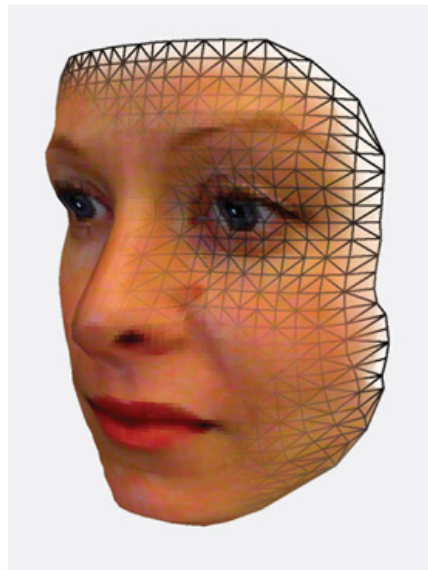
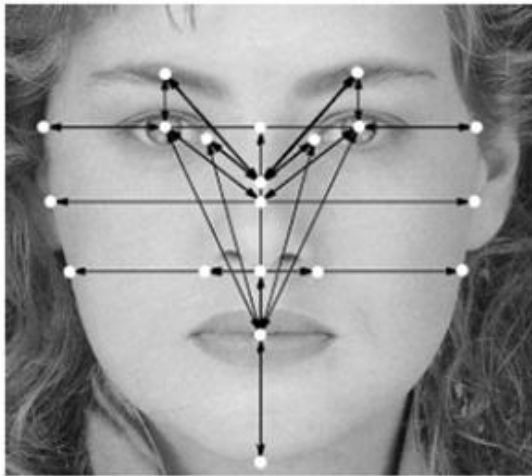




Why To Study This Course

Recognition Becomes Popular (1/3)

Face Recognition



Recognition Becomes Popular (2/3)

Fingerprint Recognition

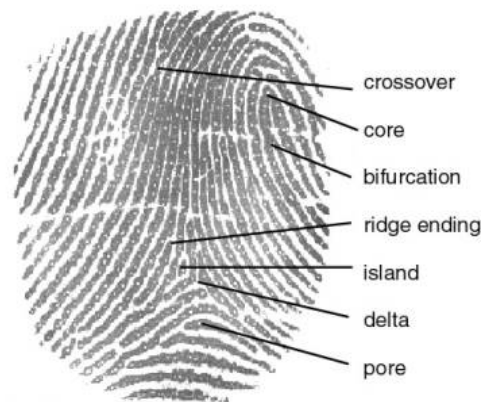
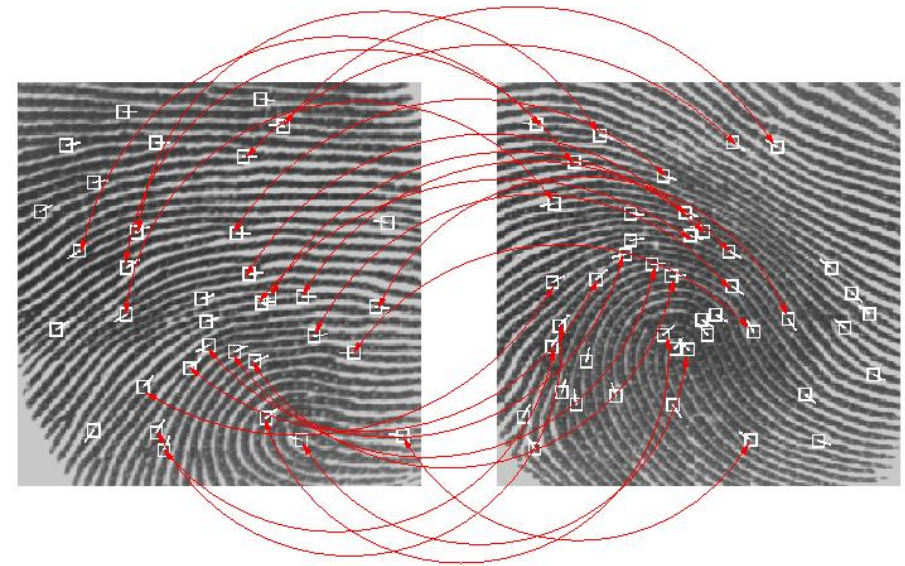
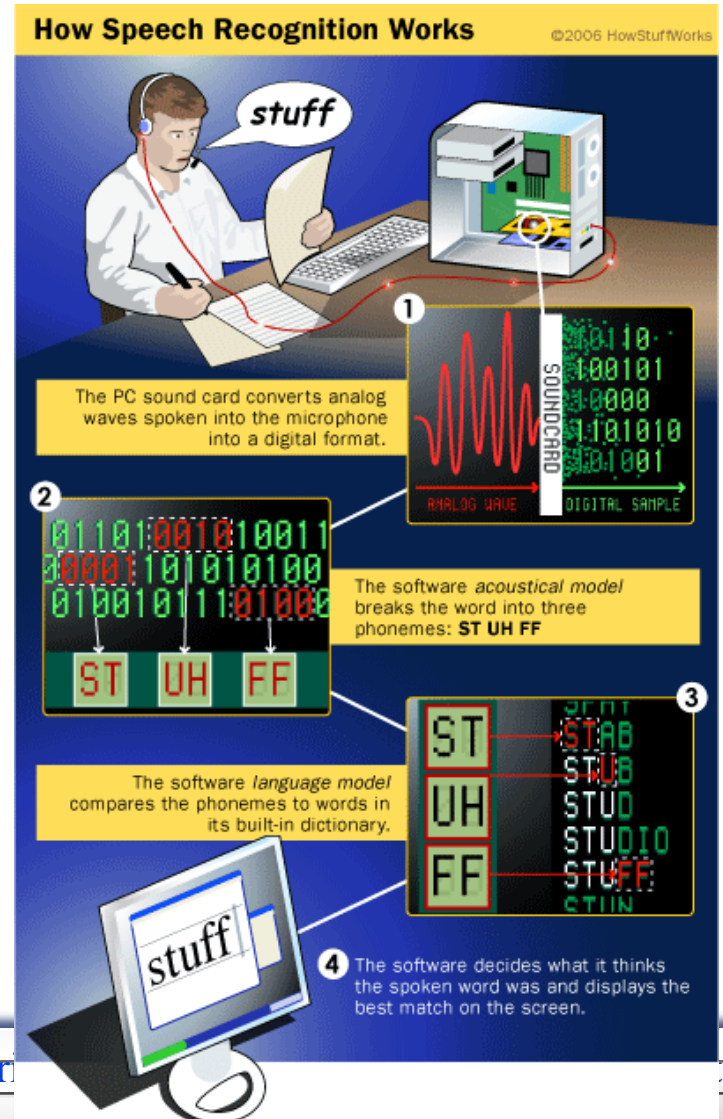


Figure 1

Recognition Becomes Popular (3/3)

Speech Recognition



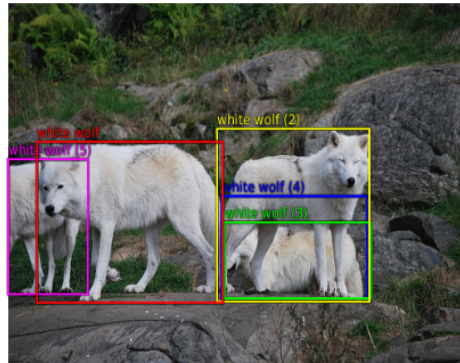
Object Classification



classification

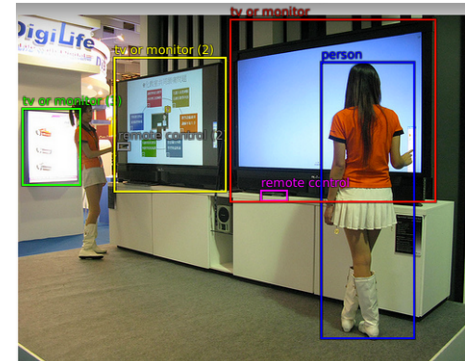
Top 5:
 pencil sharpener
 pool table
 hand blower
 oil filter
 packet

Groundtruth:
 pencil sharpener



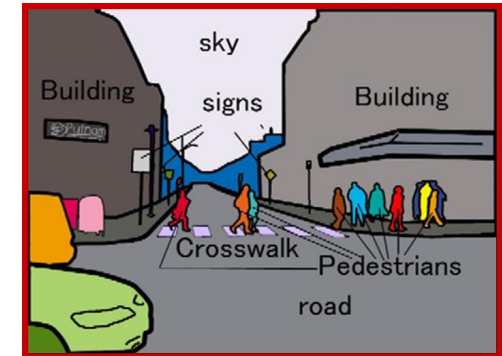
localization

Groundtruth:
 white wolf
 white wolf (2)
 white wolf (3)
 white wolf (4)
 white wolf (5)



detection

Groundtruth:
 tv or monitor
 tv or monitor (2)
 tv or monitor (3)
 person
 remote control
 remote control (2)



segmentation



More difficult

Why is object detection important?

- Perception is one of the biggest bottlenecks of

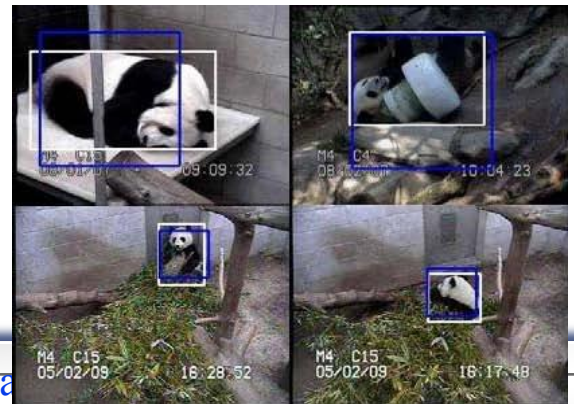
Robotics

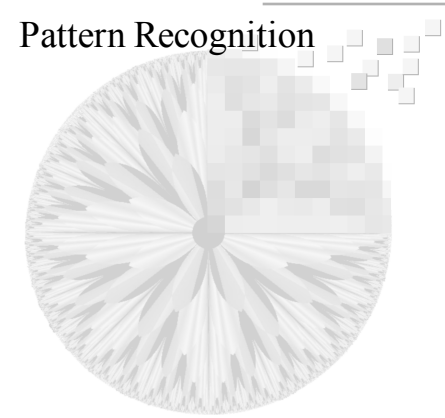


Self-driving cars



Surveillance





How To Study This Course



Course Material

- **Web URL**
 - <http://pattern-recognition.weebly.com>
 - <http://www.elearn.fju.edu.tw>
- **The course in the web site contains all course materials, such as**
 - **Syllabus**
 - **News**
 - **Lecture Handouts**
 - **Homework, Assignments**
 - **...**



Grading

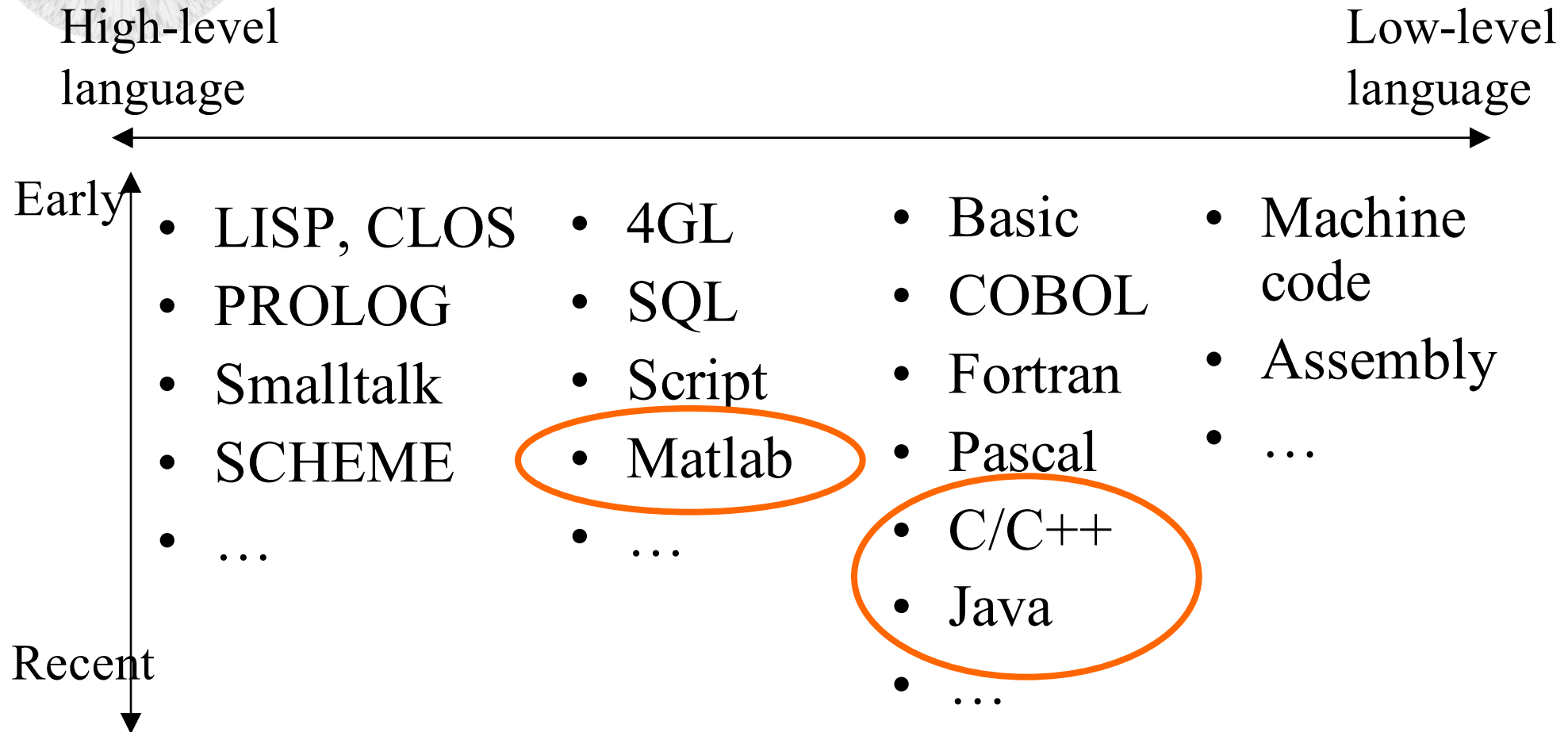
- **Reading report** **40%**
- **Paper study** **20%**
 and presentation
- **Group discussion** **15%**
- **Project** **20%**
- **Presence** **5%**



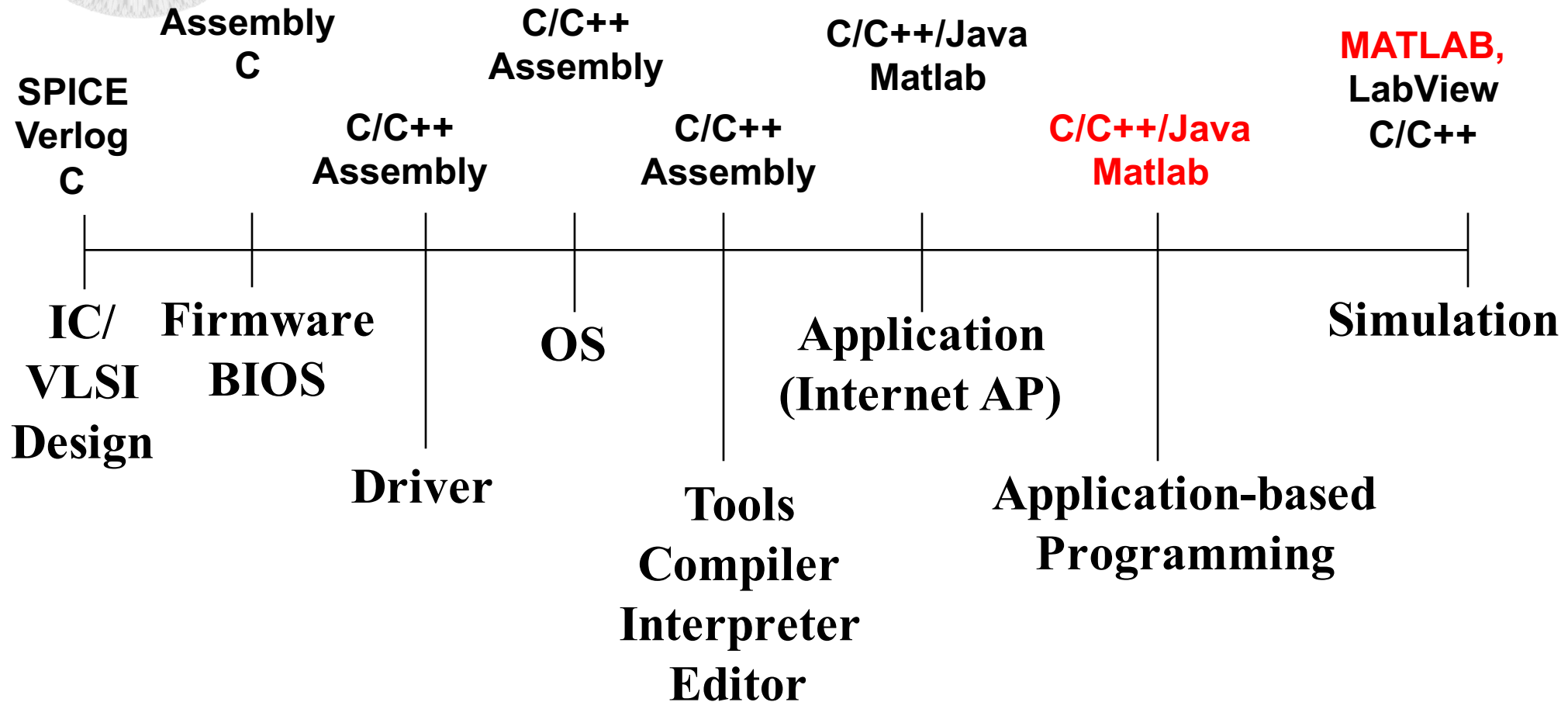
Prerequisite

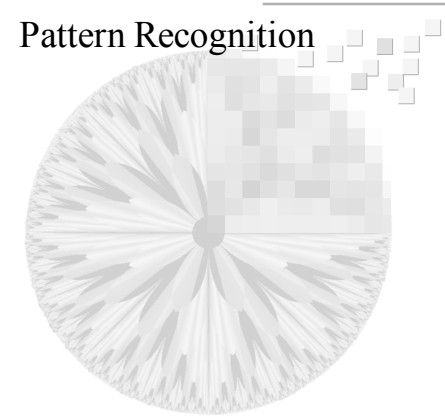
- **Mathematics**
 - **Linear Algebra, Probabilistic, Statistics**
- **Programming skill**
 - **Matlab, C/C++, Java**

Programming Languages for PR



Spectrum of Computer Languages





Textbook & Reference Books

Textbook

- **No textbook**
- **But papers, tutorial videos and lecture notes**

Reference Books (1/4)

- Neural Networks and Deep Learning, by Michael Nielsen, 2015. (Free online book)
 - <http://neuralnetworksanddeeplearning.com/>
- Deep Learning, MIT Press, in preparation, Y. Bengio, I. Goodfellow, A. Courville, 2015. (Free PDF)
 - <http://www.deeplearningbook.org>
- L. Deng, D. Yu. “Deep learning: methods and applications.” Foundations and Trends in Signal Processing, NOW Publishers, 7.3–4, 197-387, 2014. (Free PDF)
 - <http://research.microsoft.com/apps/pubs/?id=209355>

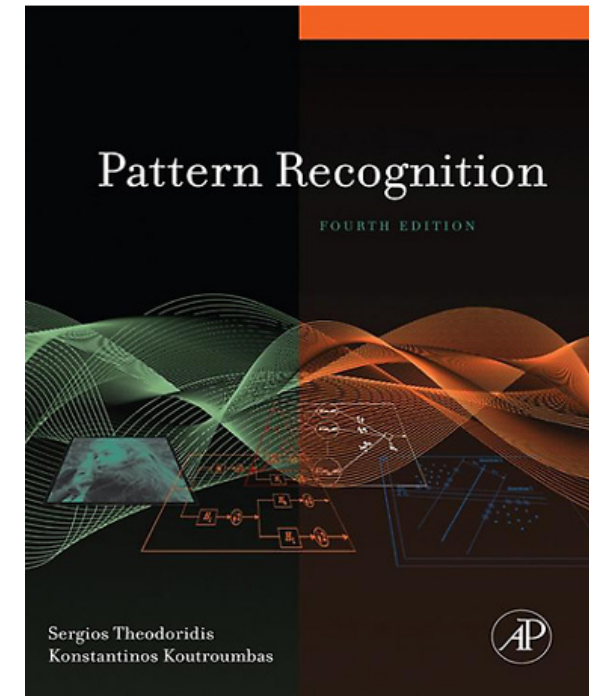


Reference Books (2/4)

- Yoshua Bengio, Learning Deep Architectures for AI, Foundations and Trends in Machine Learning, 2(1), pp.1-127, 2009. (Free PDF)
- Deep Belief Nets in C++ and CUDA C, by Timothy Masters, 2015.
 - http://www.timothymasters.info/Deep_learning.html

Reference Books (3/4)

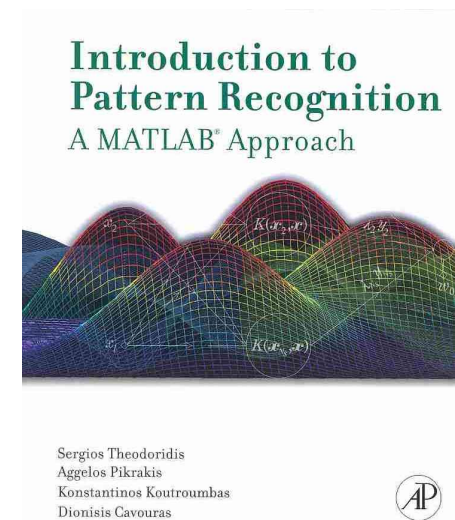
- **Pattern Recognition, 4th**
 - S. Theodoridis & K. Koutroumbas,
 - Academic Press, 2009
 - <http://cgi.di.uoa.gr/~stpatrec/>
for supplements and web resources



全華圖書代理

Reference Books (4/4)

- *Introduction to Pattern Recognition – A Matlab Approach*
 - S. Theodoridis, A. Pikrakis, K. Koutroumbas, D. Cavouras,
 - Academic Press, 2010.
 - Complimentary with the textbook
 - **Ebook and Matlab code can be downloaded online**

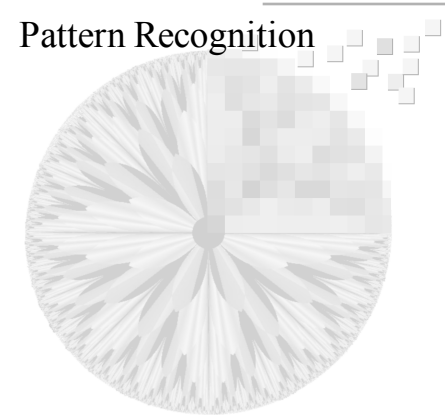


全華圖書代理



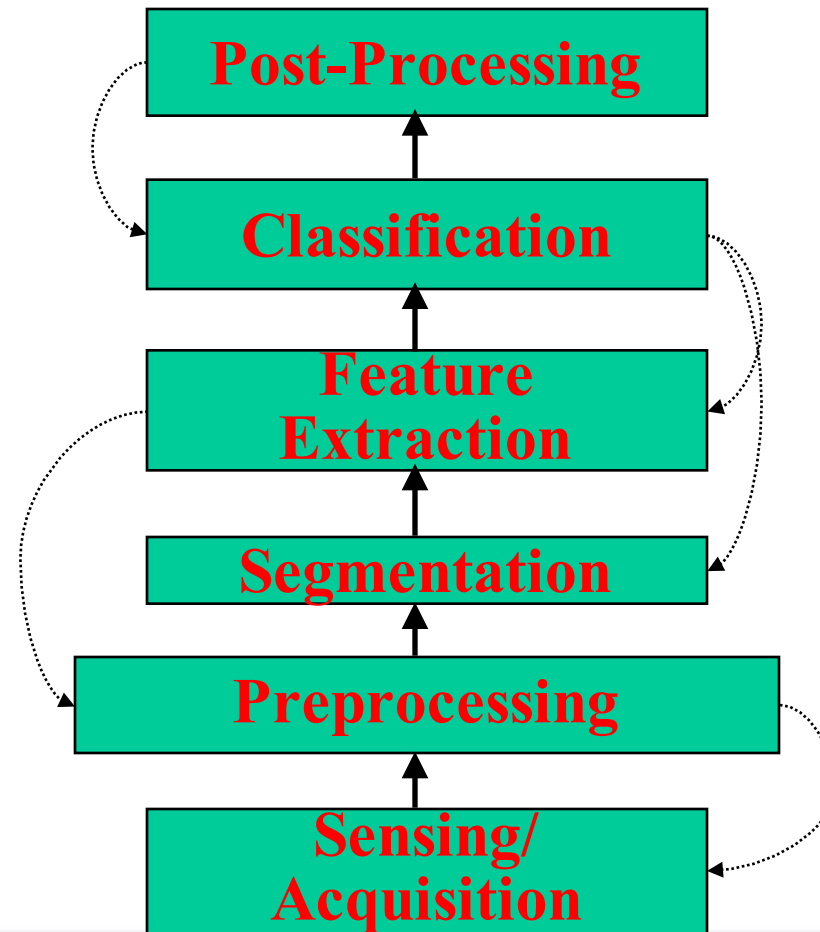
What Will You Learn

- **What is deep neural network**
- **What are the applications of deep neural network**
- **How to apply deep neural network for pedestrian detection**
- **How to apply deep neural network for image enhancement**



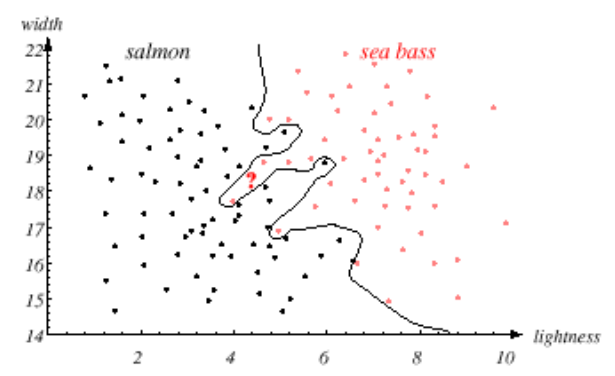
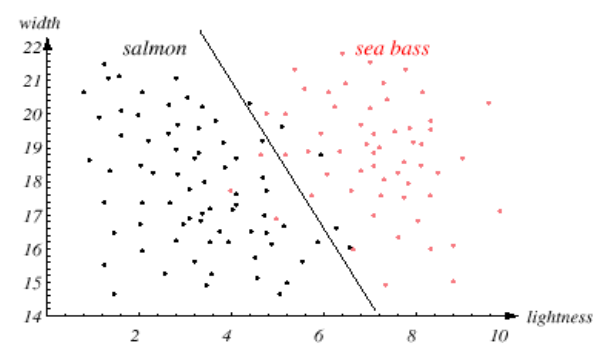
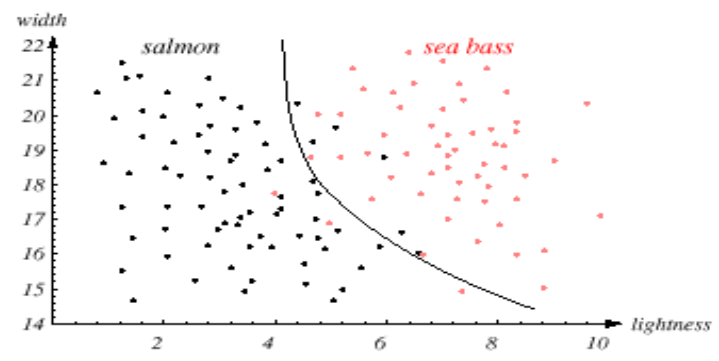
Introduction of Course Units

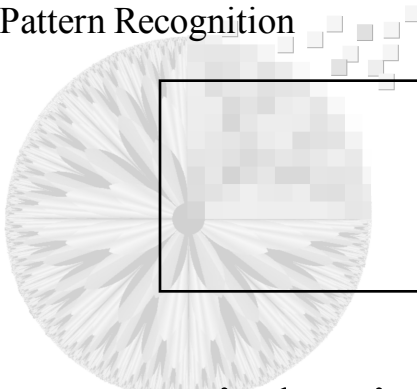
Unit 1 Introduction to Pattern Recognition



Unit 2

Background of Classification

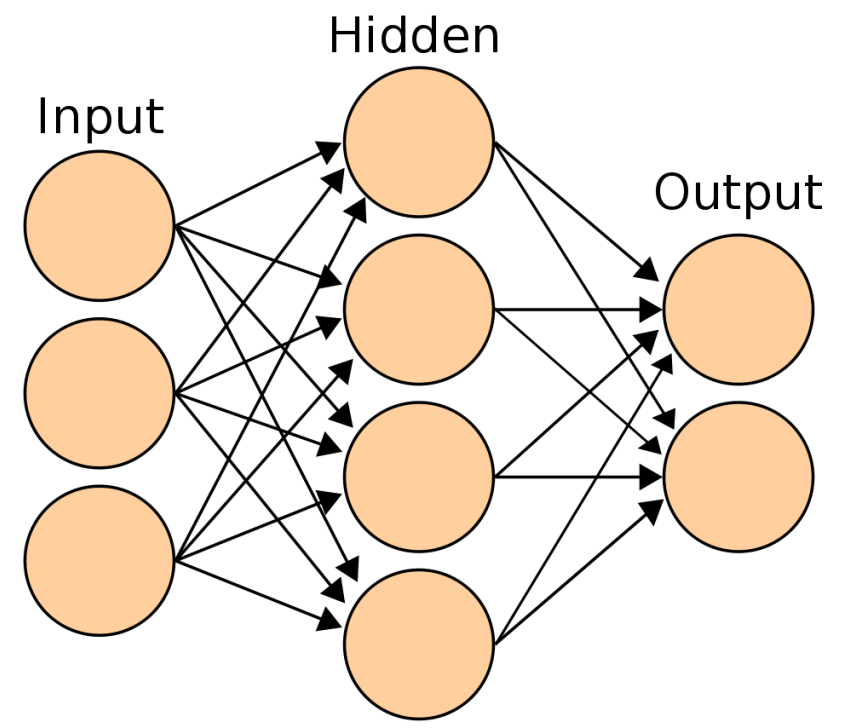
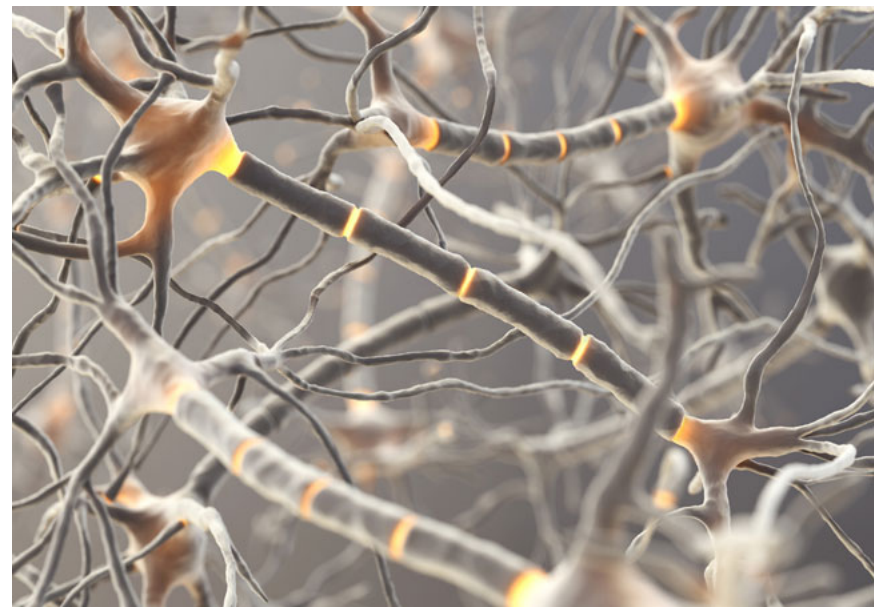




Unit 3 Neural Networks

Biological neural network

Computational neural network

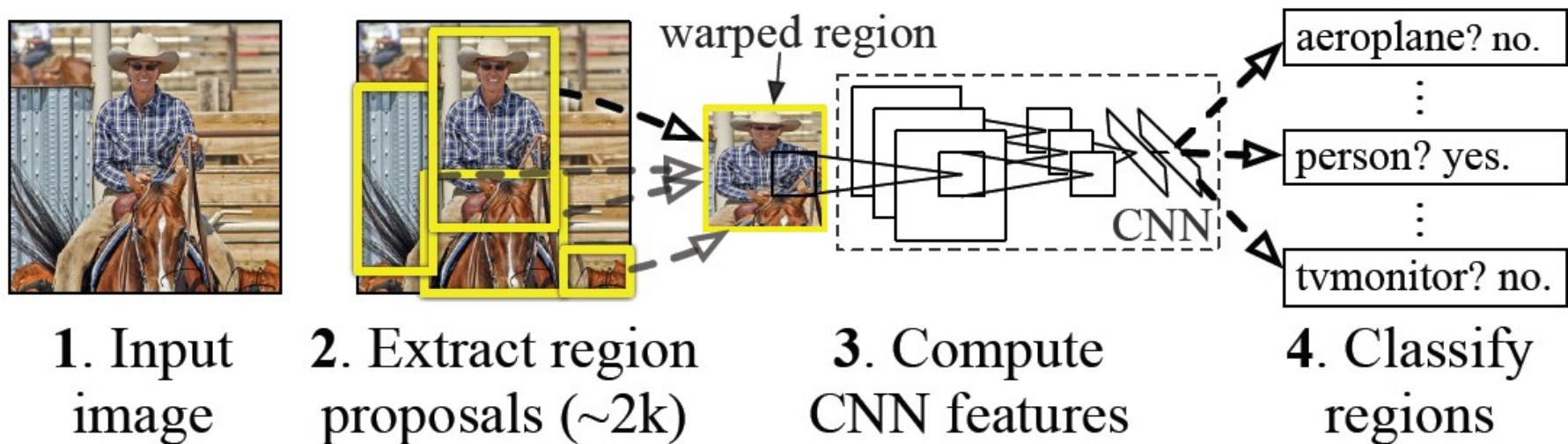


Unit 4

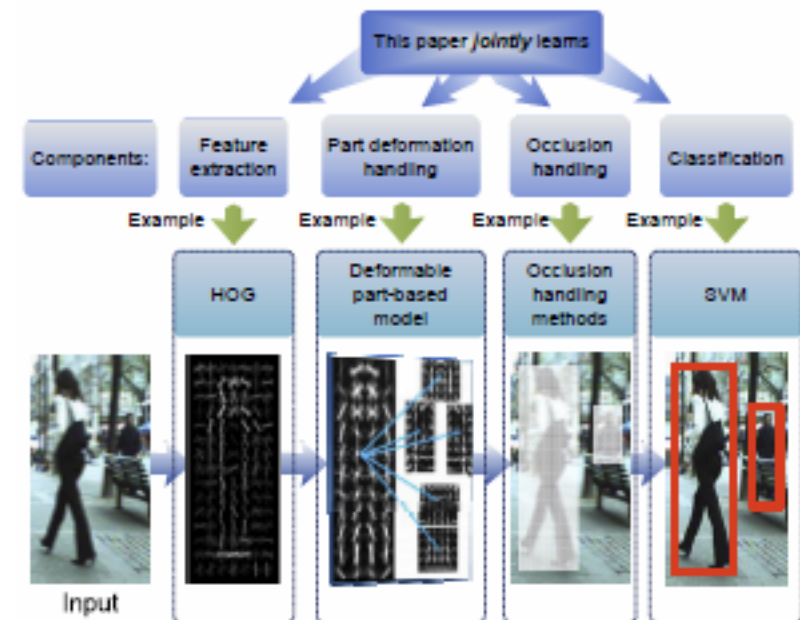
Deep Neural Network

- CNN: Convolutional neural network
- R-CNN: Region-based CNN

R-CNN: *Regions with CNN features*



Unit 5 Pedestrian Detection by Deep Neural Networks





Introductory Materials

- Deep learning, Wikipedia. https://en.wikipedia.org/wiki/Deep_learning.
- Lecture 1 Introduction, Deep Learning course,
by Nando de Freitas, University of Oxford, 2015.
<https://www.cs.ox.ac.uk/people/nando.defreitas/machinelearning/>
- Neural Networks and Deep Learning, by Michael Nielsen, 2015. Free online book.
<http://neuralnetworksanddeeplearning.com>.

Classroom English

- Classroom English: Vocabulary & Expressions for Students, Youtube video, 2015/01/31.
00:09:35.
- 下課
 - The class is dismissed right now!
 - The class will be dismissed in a minute.
 - Class dismissed!