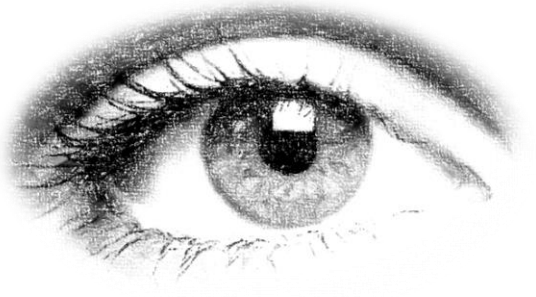


電腦視覺
Computer Vision: from Recognition to Geometry

簡韶逸 Shao-Yi Chien

王鈺強 Yu-Chiang Frank Wang

Department of Electrical Engineering

National Taiwan University

Fall 2018

Computer Vision

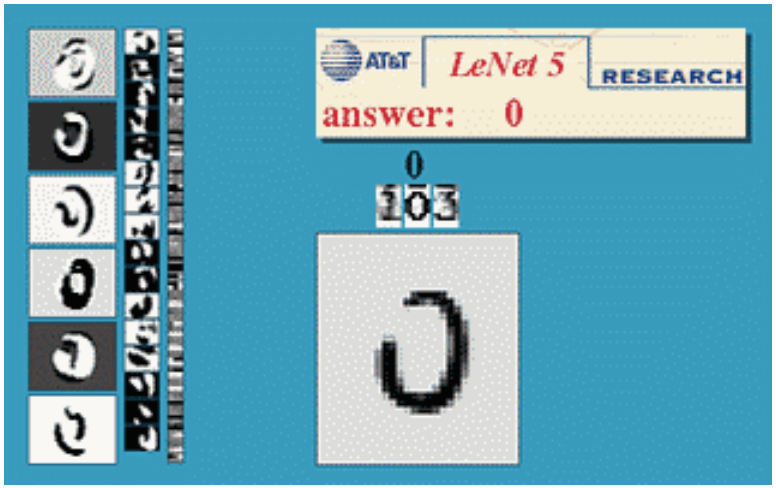
- Describe the world that the computer see in one or more images and to reconstruct its properties, such as shape, illumination, and color distribution
- Is it hard? An inverse problem

Computer Vision

[R. C. James]

Wide Applications of Computer Vision

- Optical character recognition (OCR)



Digit recognition, AT&T labs
http://www.research.att.com/~yann/

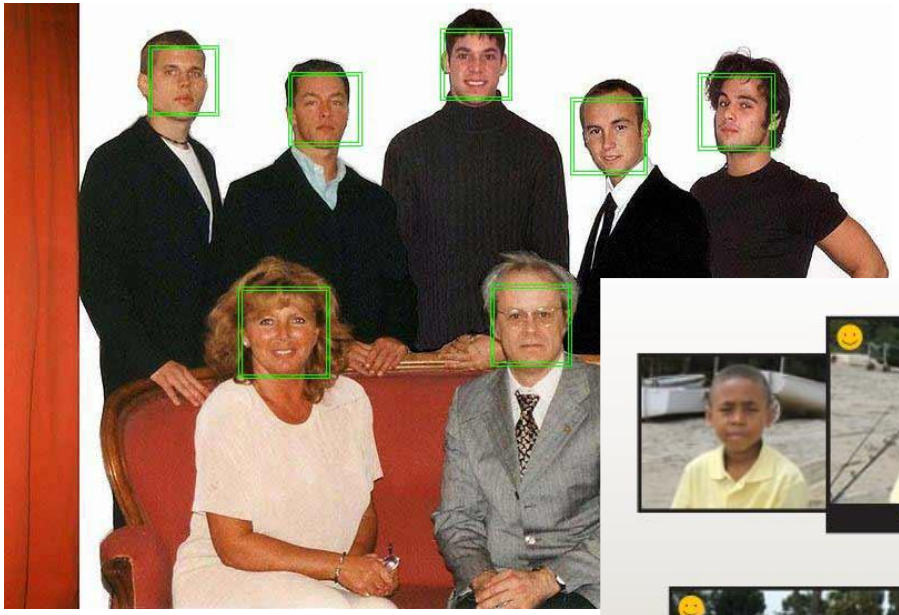
License plate readers
http://en.wikipedia.org/wiki/Automatic_number_plate_recognition

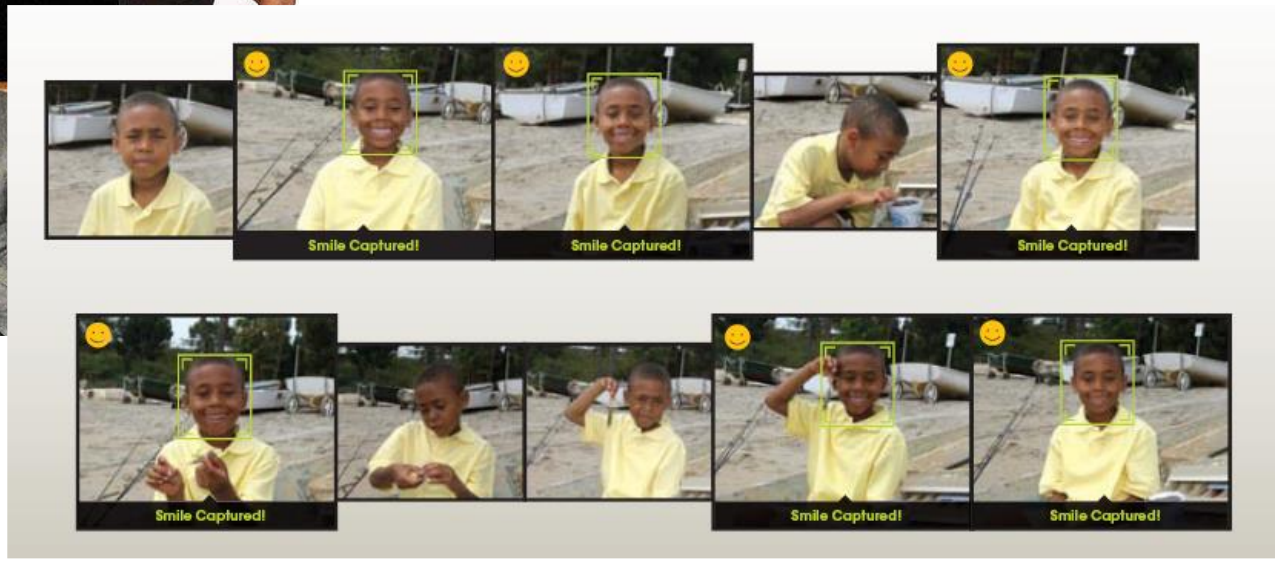
Wide Applications of Computer Vision

- Face detection: in all digital cameras and smart phones

Wide Applications of Computer Vision

- Face detection: in all digital cameras and smart phones





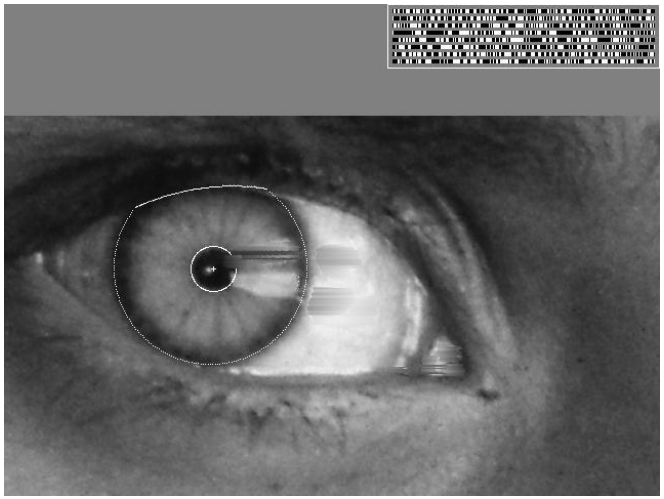
[Sony]

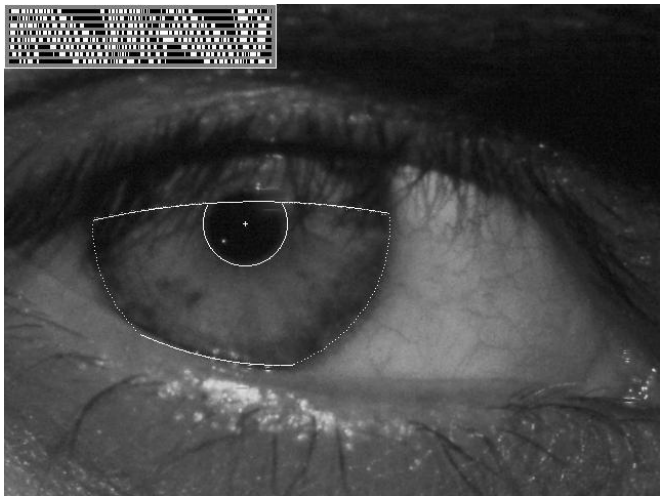
Wide Applications of Computer Vision

- Iris recognition

  (Vision-based biometrics)

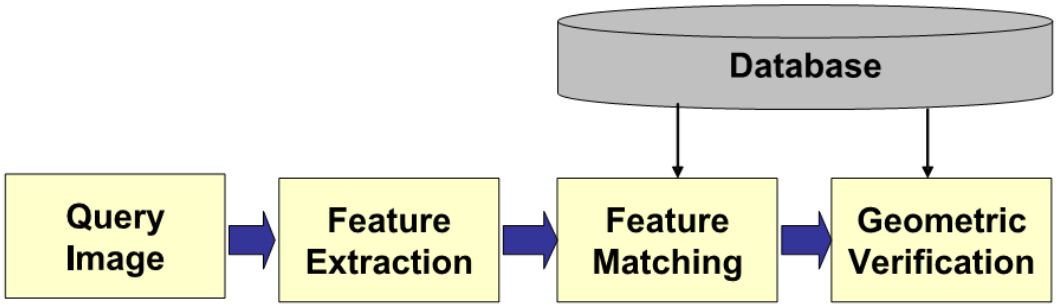
"*How the Afghan Girl was Identified by Her Iris Patterns*" Read the story



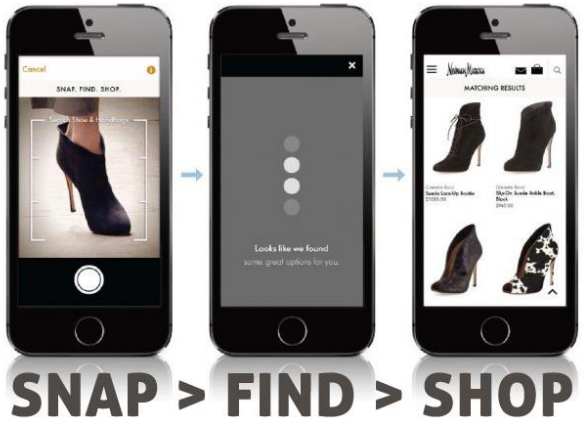


Wide Applications of Computer Vision

- Object recognition



[Girod et al. 2011]



[slyce.it]

Wide Applications of Computer Vision

- Shape capture

The Matrix movies, ESC Entertainment, XYZRGB, NRC

Wide Applications of Computer Vision

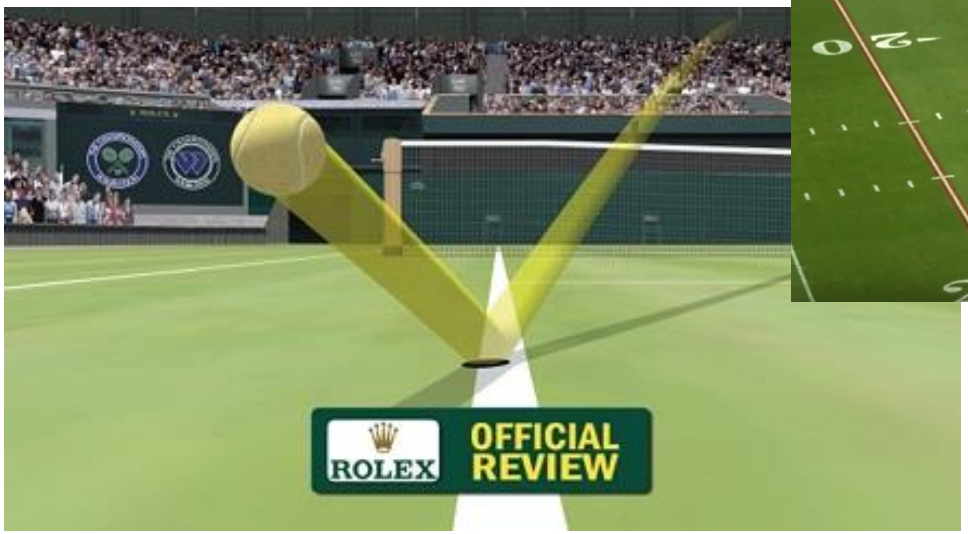
- Motion capture

Pirates of the Carribean,
Industrial Light and Magic

Wide Applications of Computer Vision

- Computer vision in sports

Intel: freeD technology



Hawk-Eye: helping/improving referee decisions

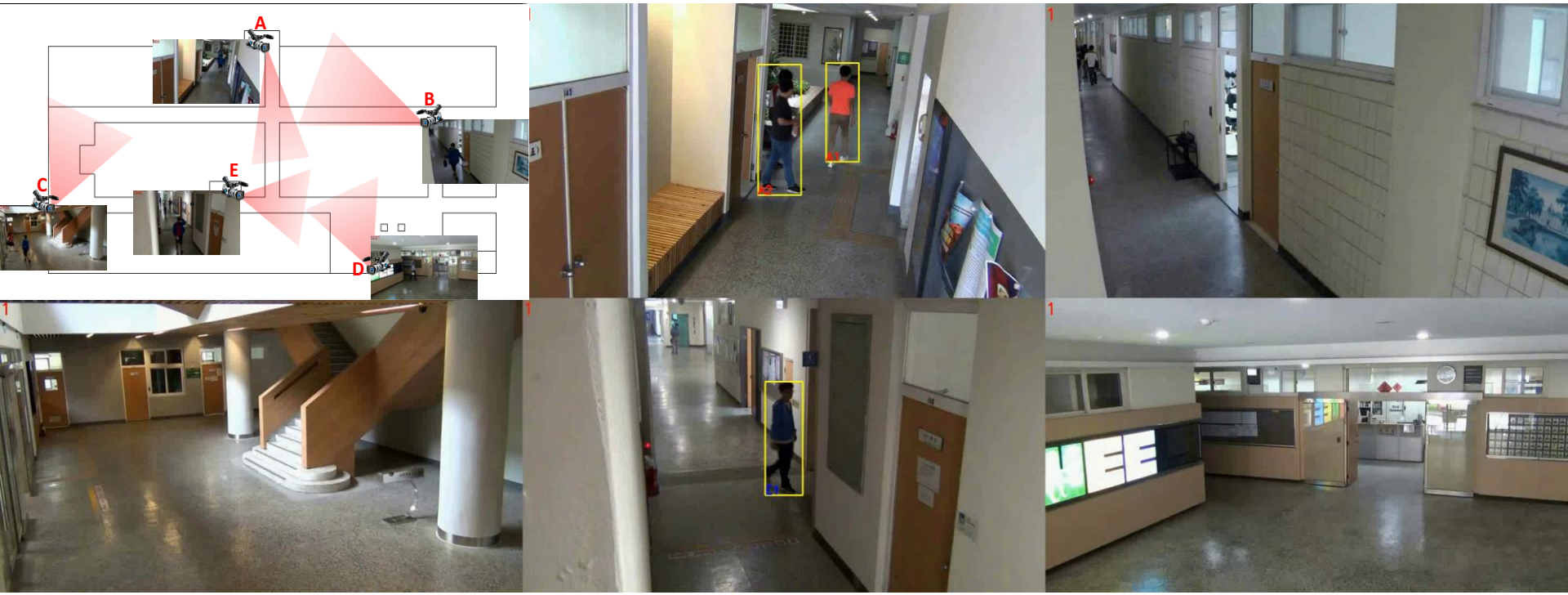
Wide Applications of Computer Vision

- Smart cars: ADAS

[Intel Mobileye]

Wide Applications of Computer Vision

- Surveillance system



Ref: Chih-Wei Wu, Meng-Ting Zhong, Yu Tsao, Shao-Wen Yang, Yen-Kuang Chen, and Shao-Yi Chien, "Track-clustering Error Evaluation for Track-based Multi-camera Tracking System Employing Human Re-identification," *CVPR 2016 Workshop*.

Wide Applications of Computer Vision

- Vision-based interaction

[Microsoft Xbox]

Wide Applications of Computer Vision

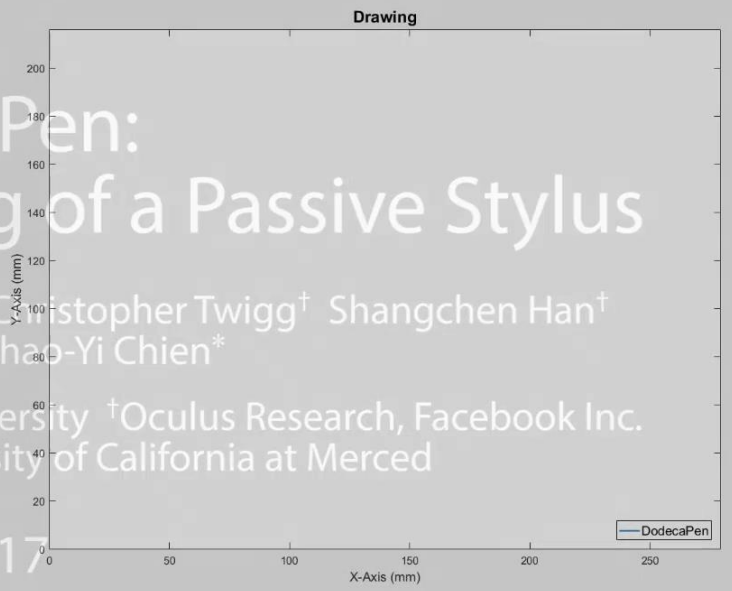
DodecaPen: Puppy

DodecaPen:
Accurate 6DoF Tracking of a Passive Stylus

Po-Chen Wu*† Robert Wang† Kenrick Kin† Christopher Twigg† Shangchen Han†
Ming-Hsuan Yang‡ Shao-Yi Chien*

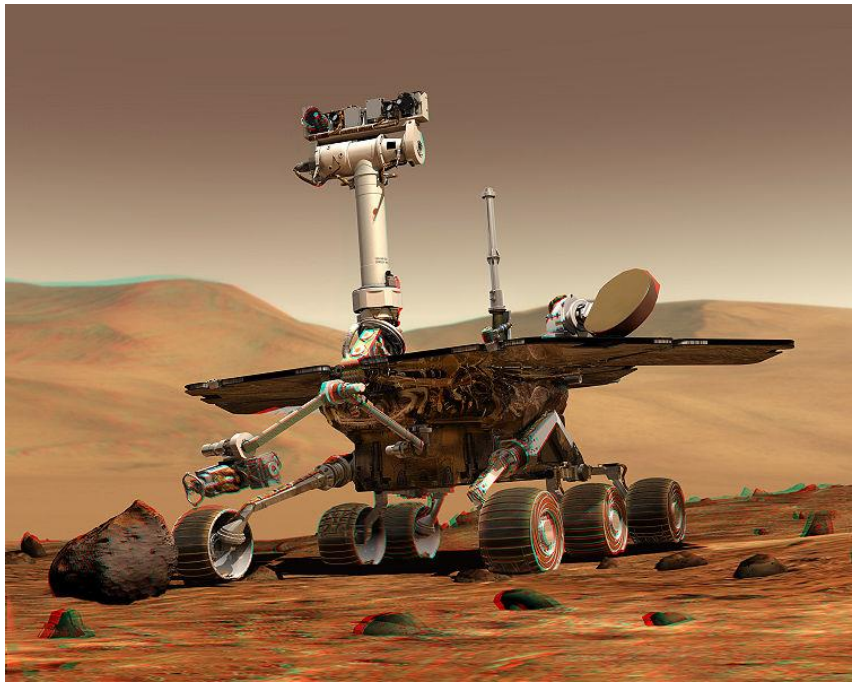
*Media IC & System Lab, National Taiwan University †Oculus Research, Facebook Inc.
‡Vision and Learning Lab, University of California at Merced

UIST 2017

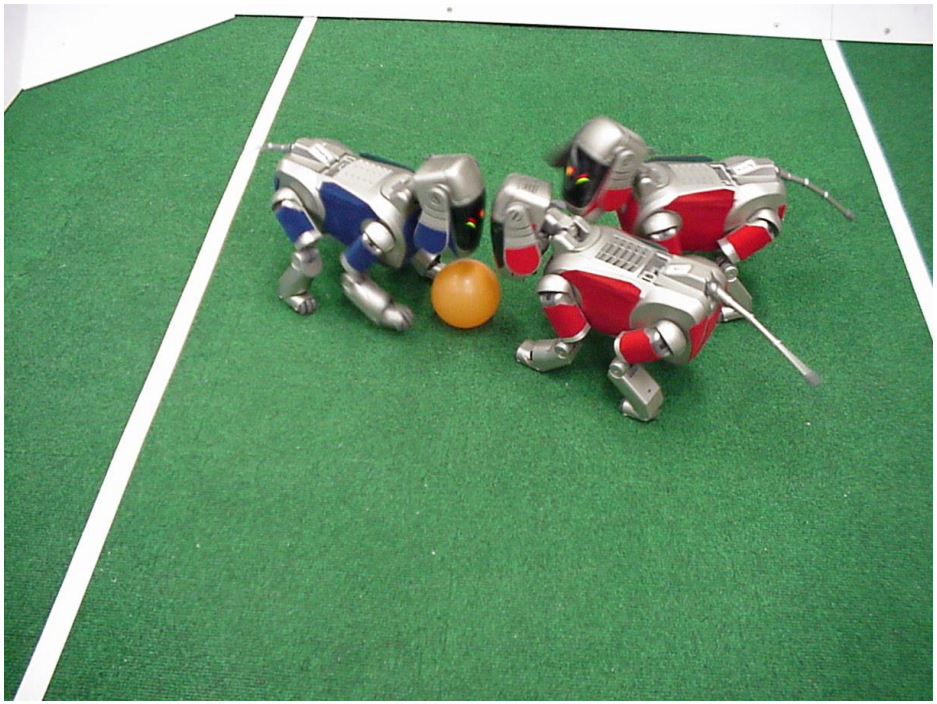


Wide Applications of Computer Vision

- Robotics



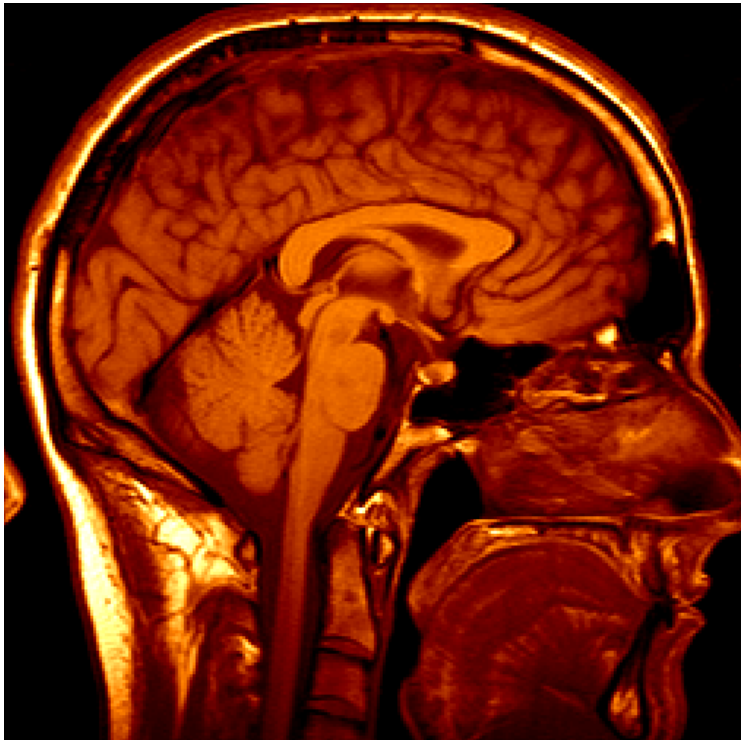
NASA's Mars Spirit Rover
http://en.wikipedia.org/wiki/Spirit_rover



http://www.robocup.org/

Wide Applications of Computer Vision

- Medical image



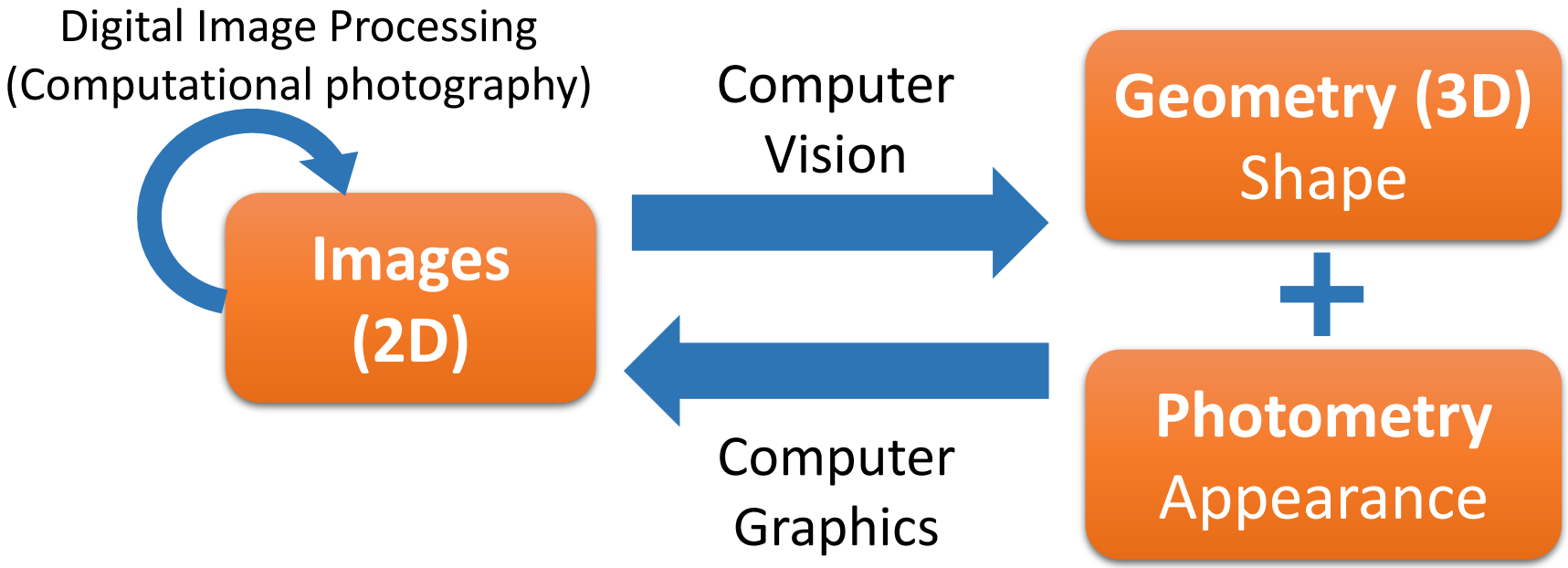
3D imaging
MRI, CT

Image guided surgery
Grimson et al., MIT

Important Near-Future Applications

- AR/VR
- Autonomous vehicle
- Robot
- IoT: AIoT (AT+IoT), IoVT (Internet-of-Video-Things)
- Medical imaging
- Large-scale video analysis
- Computational photography/image synthesis
- Industrial automation
- …

Related Fields



- The boundaries between digital image processing/computer vision/computer graphics become vague nowadays

About this Course…

- Provide a comprehensive introduction to the field of computer vision (CV)
  - From classical methods to deep learning based methods
  - From recognition to geometry
  - No experiences in CV and image process are required
- The two courses, Computer Vision and Deep Learning for Computer Vision, can give you a complete view of modern CV techniques
- Grading
  - Four homeworks: 60%
  - Class participation: 5%
  - Group final project: 35%

Course Website

- Course website
  - http://media.ee.ntu.edu.tw/courses/cv/18F/

- TA
  - 塗偉志
  - MD-726
  - wctu@media.ee.ntu.edu.tw
  - Will lead TA teams for each homework

Schedule

Week	Date	Topic
1	9/12	Introduction to human vision systems
2	9/19	Camera basic, image formation and basic Image processing
3	9/26	Feature detection and matching
4	10/3	Machine learning basics
5	10/10	國慶日放假
6	10/17	Deep learning basics
7	10/24	Recognition and detection
8	10/31	Segmentation
9	11/7	Projective Geometry, Transformations and Estimation/Camera calibration
10	11/14	Camera Geometry and Single View Geometry
11	11/21	Two-View Geometry
12	11/28	Dense motion estimation/stereo
13	12/5	Structure from motion
14	12/12	3D reconstruction/depth sensing
15	12/19	Computational photography
16	12/26	Object tracking
17	1/2	Advanced topics in CV
18	1/9	CES
19	1/16	Final Project

Homeworks

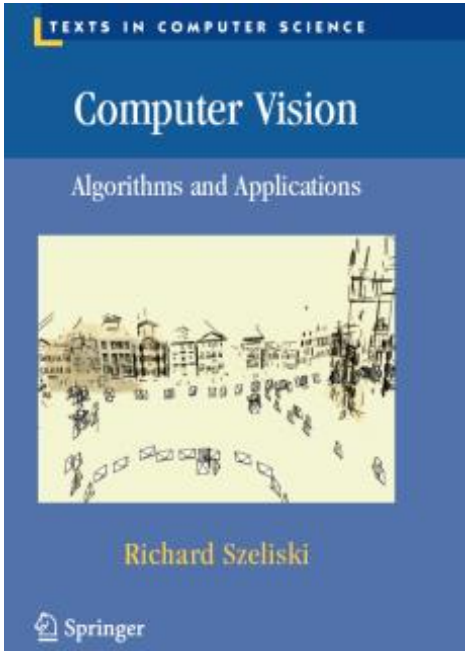
- Four assignments:
  - HW1: Image filters
  - HW2: Detection and recognition
  - HW3: Pose estimation
  - HW4: Stereo matching
- Official language is Python
- Lab0: Python and basic image processing
  - 9/19 18:30--20:00 @ EEII-143

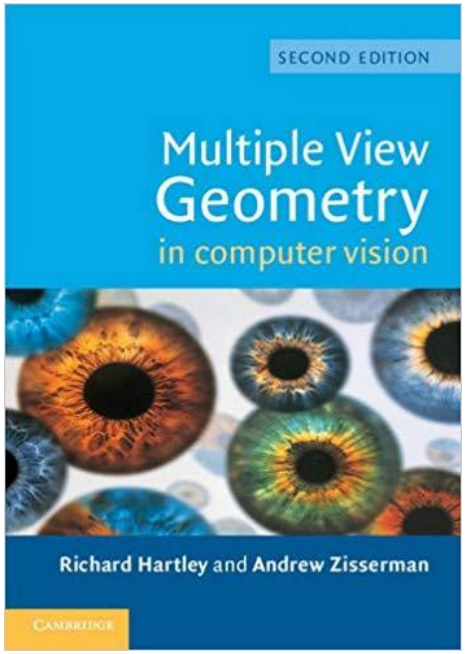
Final Project

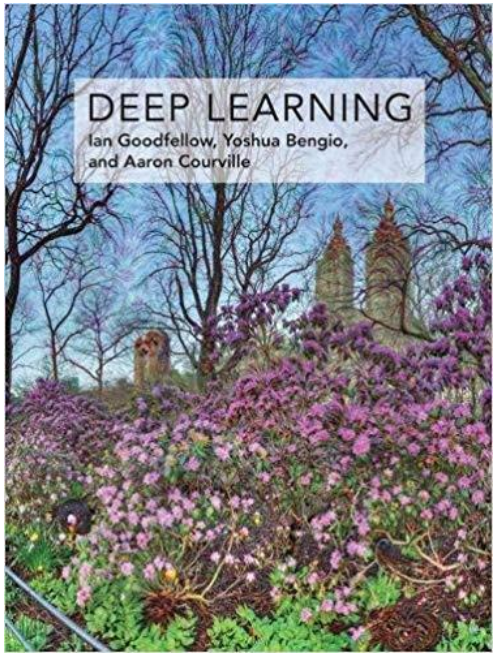
- Will have one or two problems/challenges
- Each team should have 3—4 members
- Project will be supported by industry with awards
- Evaluated by professor, TAs, guest judges from industry, and you (peer review)!
- The problems/challenges will be announced around the week of mid exam

Reference Materials

- Reference books







http://szeliski.org/Book/

- And papers in CVPR, ICCV, ECCV, BMVC, WACV, ACCV, ….

加簽規則

- 第一次開課，請慎重考慮……
- 以教室容量為限，可加簽50位同學
- 篩選順序
  - 電資學院 (含輔系) > 工學院 > 理學院 > 其他
  - 博班 > 碩二 > 碩一 = 大四 > 大三 > 大二 > 大一
- 請於第二節上課之前填寫好下列表單：
  - https://goo.gl/fxocvg
- 第三節上課時將公布獲選名單
- 有選上的同學第三節下課後親自拿學生證(或是可證明身份之文件)來領授權碼