電腦視覺
Computer Vision: from Recognition to Geometry

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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]

Computer Vision

Wide Applications of Computer Vision

- Optical character recognition (OCR)
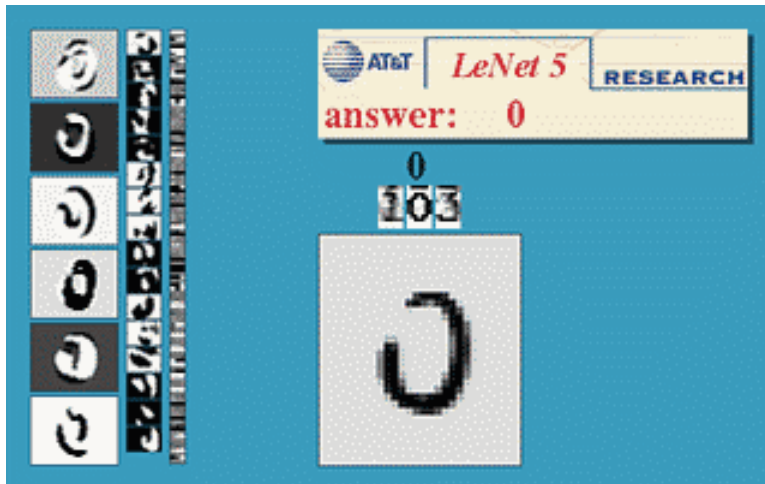
Digit recognition, AT&T labs
http://www.research.att.com/~yann/

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

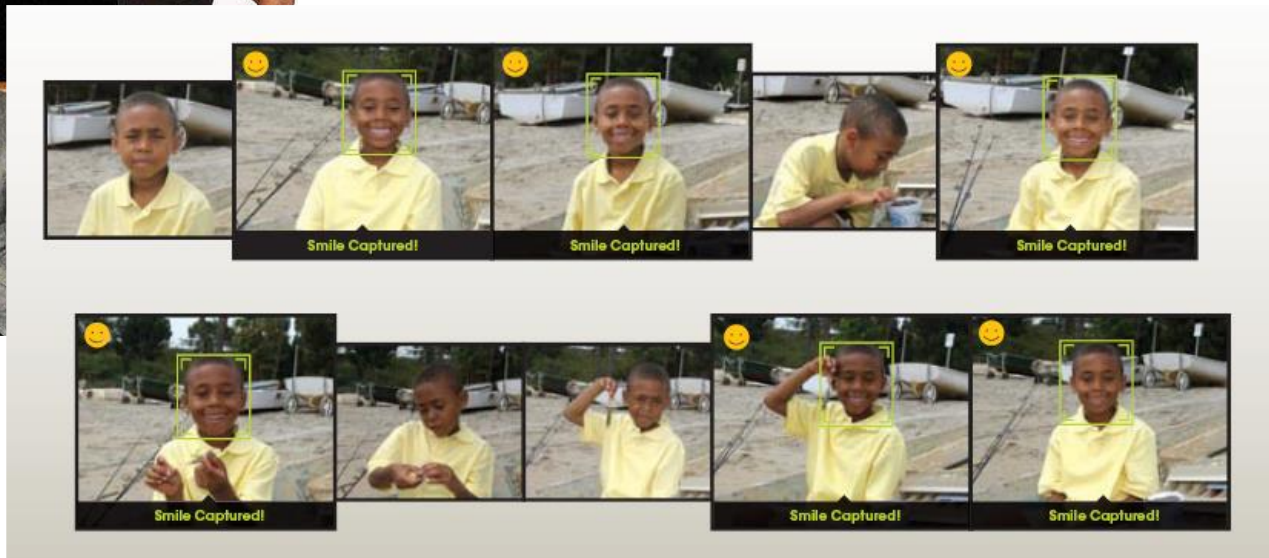# Wide Applications of Computer Vision

- Face detection: in all digital cameras and smart phones
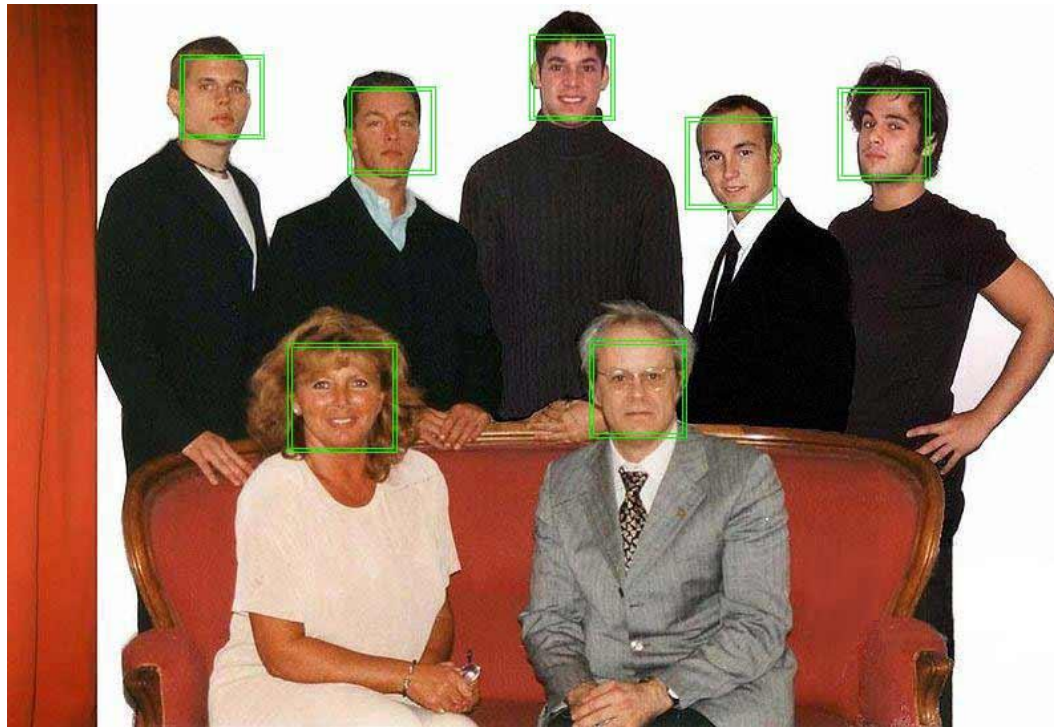
Wide Applications of Computer Vision

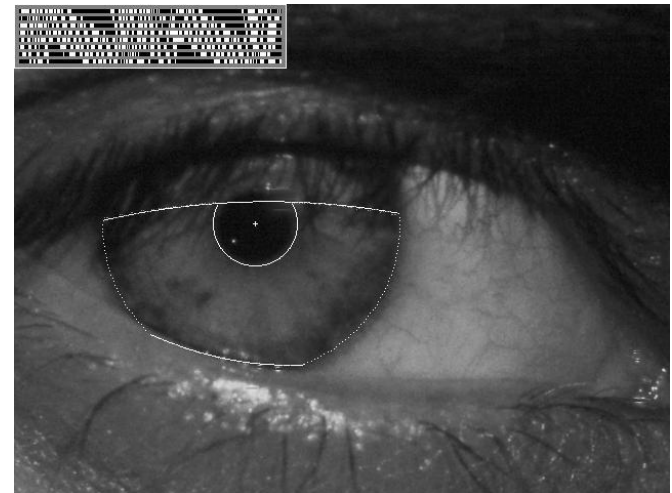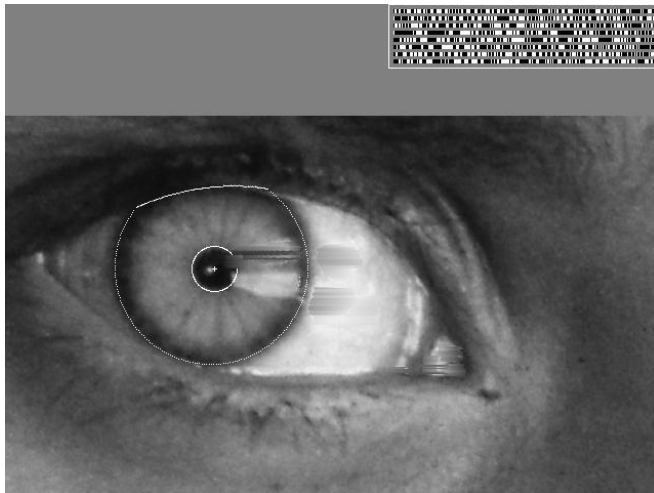- Face detection: in all digital cameras and smart phones

[Sony]

Wide Applications of Computer Vision

- Iris recognition

  (Vision-based biometrics)
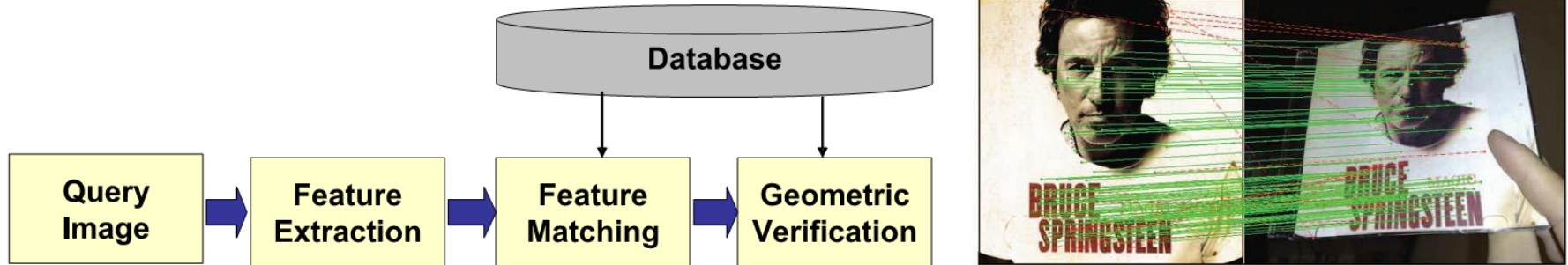

"How the Afghan Girl was Identified by Her Iris Patterns"   Read the story

Wide Applications of Computer Vision

- Object recognition

Database

Query Image → Feature Extraction → Feature Matching → Geometric Verification

[Girod et al. 2011]

SNAP > FIND > SHOP
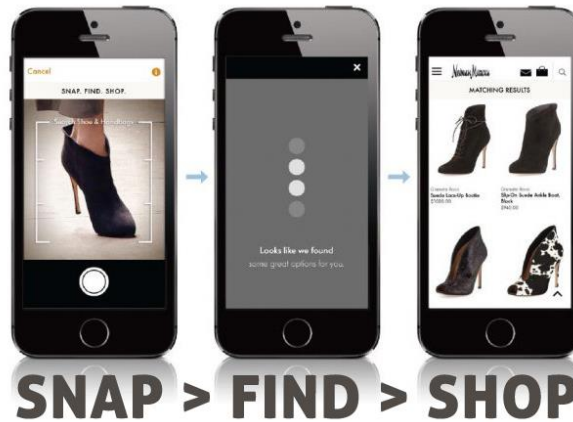
[slyce.it]

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

Hawk-Eye: helping/improving referee decisions

Intel: freeD technology

Wide Applications of Computer Vision

- Smart cars: ADAS

[Intel Mobileye]

Wide Applications of Computer Vision

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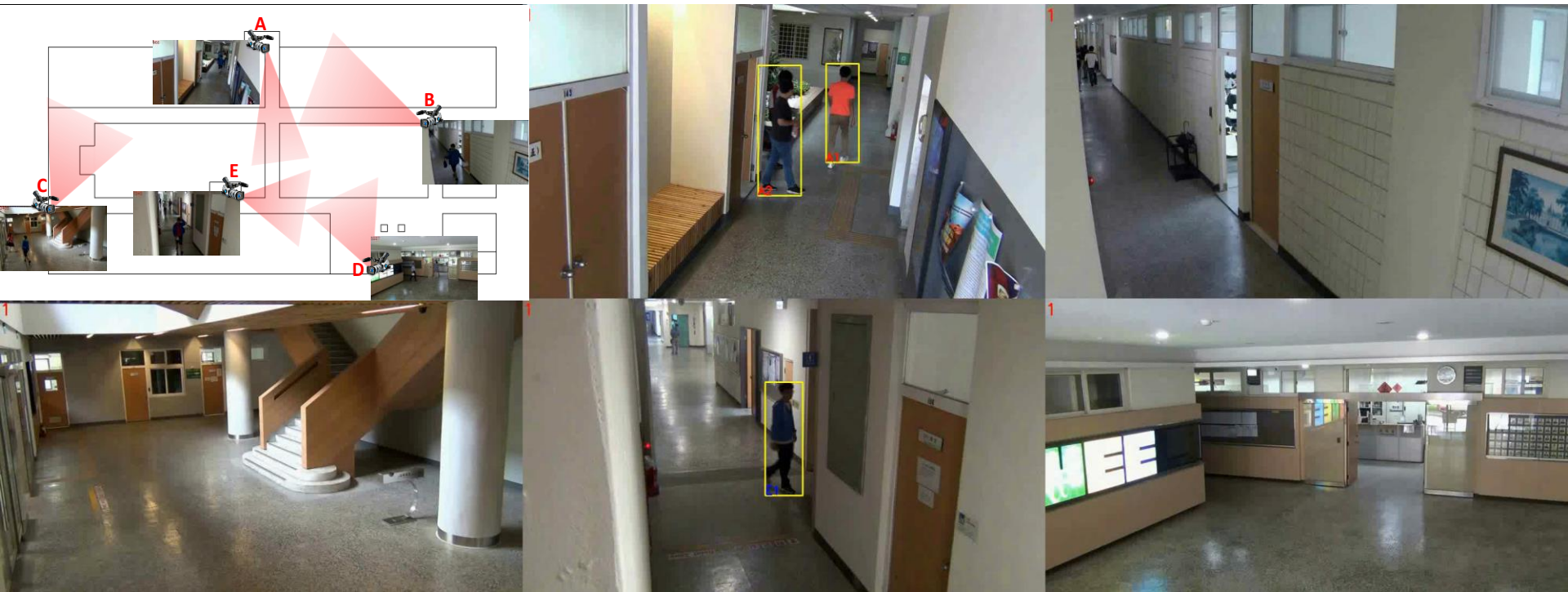
Ref: Chih-Wei Wu, Meng-Ting Zhong, Yu Tsao, Shao-Wen Yang, Yen-Kuang Chen, and Shao-Yi Chien, "Track-clustering Error Evaluation for Track-based Multi-camera Tracking System Employing Human Re-identification," *CVPR 2016 Workshop*.

Wide Applications of Computer Vision
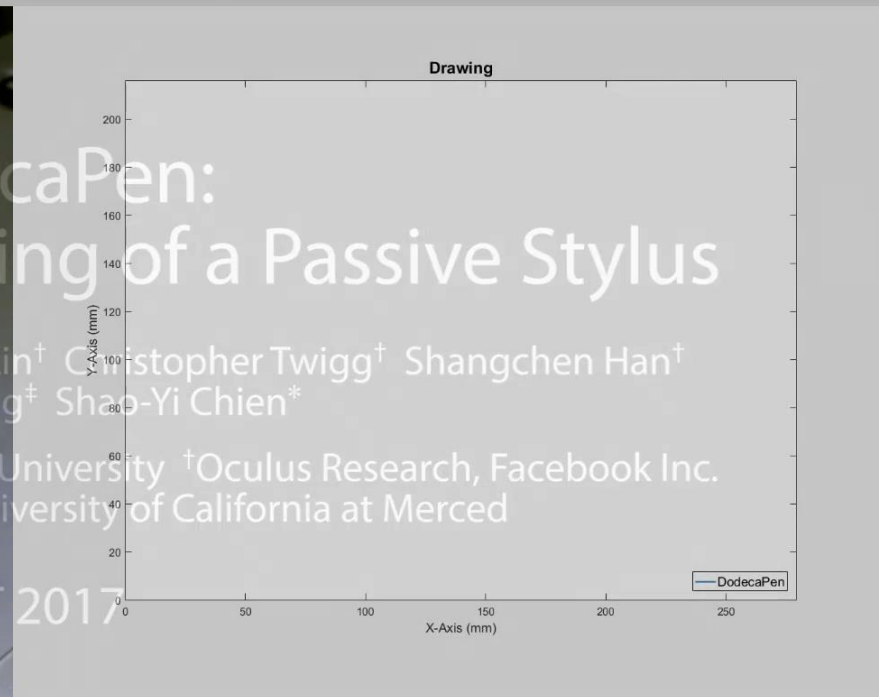
- Vision-based interaction

[Microsoft Xbox]

Wide Applications of Computer Vision

Wide Applications of Computer Vision

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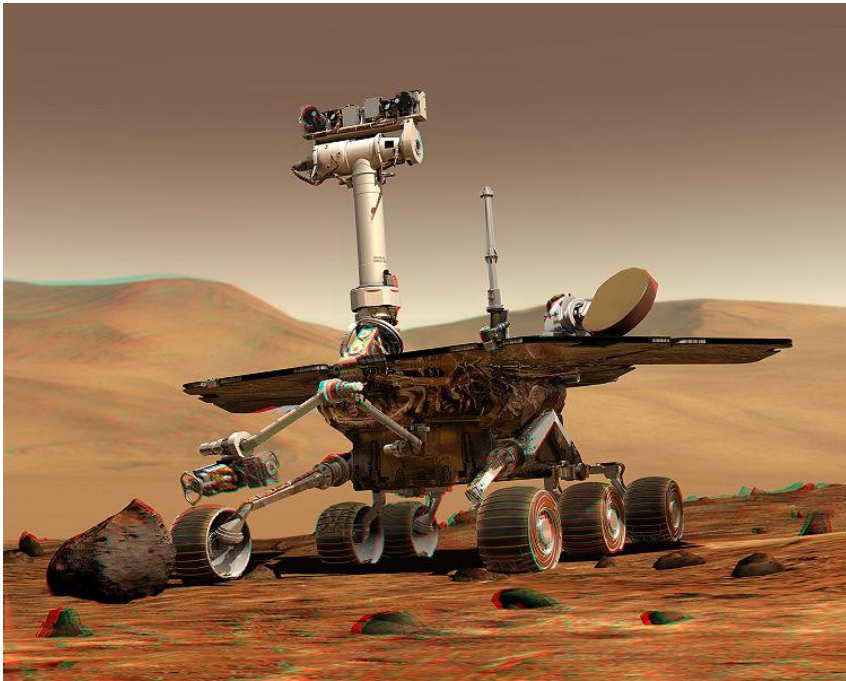
NASA's Mars Spirit Rover
http://en.wikipedia.org/wiki/Spirit_rover

http://www.robocup.org/
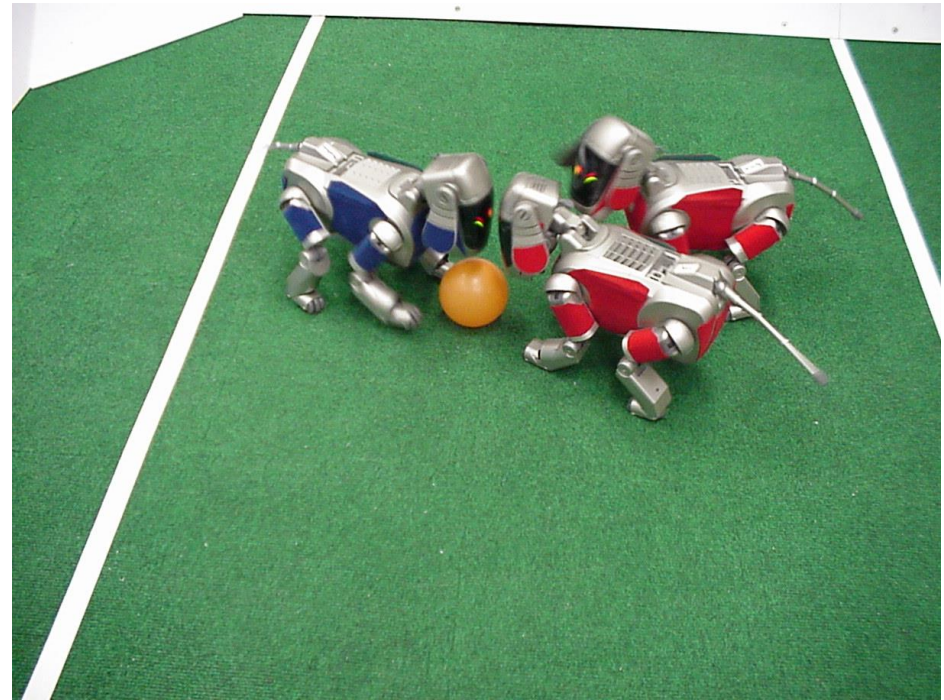
Wide Applications of Computer Vision

- Medical image
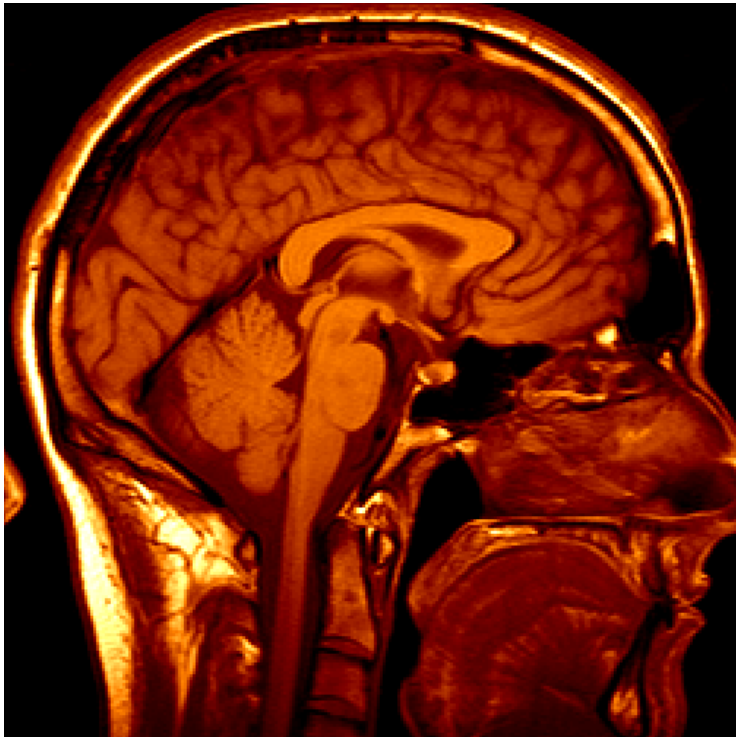
3D imaging
MRI, CT

Image guided surgery
Grimson et al., MIT

Important Near-Future Applications

- AR/VR
- Autonomous vehicle
- Robot
- IoT: AIoT (AI+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
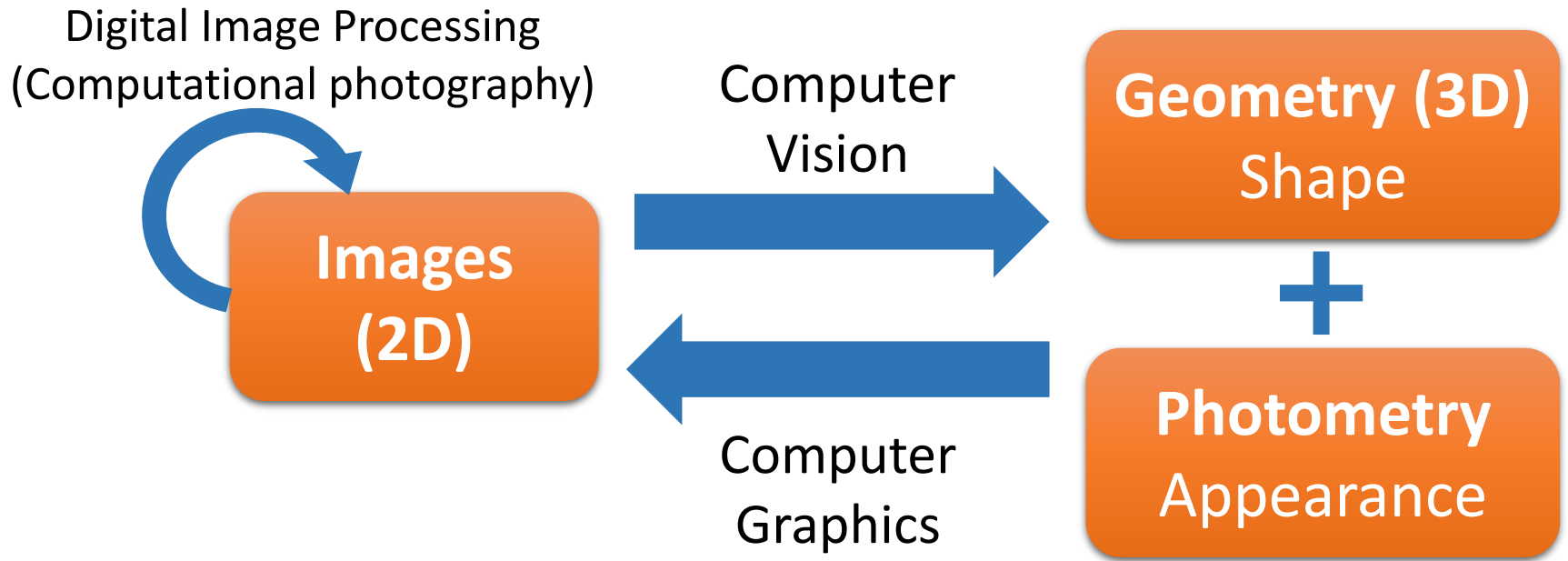 - No experiences in CV and image process are required
- The two courses, Computer Vision and Deep Learning for Computer Vision, can give you a complete view of modern CV techniques
- Grading
  - Four homeworks: 60%
  - Class/talk participation: 10%
  - Group final project: 30%

Course Website

- Course website
  - http://media.ee.ntu.edu.tw/courses/cv/21S/

- TA
  - 劉致廷
  - MD-431
  - jackieliu@media.ee.ntu.edu.tw
  - Will lead TA team for each homework

(Tentative) Schedule: May be Modified...

| Date	Topic
2/26	Introduction to human vision systems
3/5	Camera basic, image formation and basic Image processing
3/12	Feature detection and matching
3/19	Machine learning basics
3/26	Deep learning basics
4/2	春假
4/9	Recognition
4/16	Segmentation
4/23	Projective Geometry
4/30	Estimation of Transformations
5/7	Single Camera Geometry/Camera calibration
5/14	Two-View Geometry
5/21	Dense motion estimation/stereo
5/28	Structure from motion
6/4	3D reconstruction/depth sensing
6/11	Optical flow + object tracking
6/18	Advanced topics in CV
6/25	Final project presentation

Homeworks

- Four assignments:
    - HW1: Image filters
    - HW2: Detection or recognition
    - HW3: Pose estimation
    - HW4: Stereo matching
- Official language is Python
- Lab0: Python and basic image processing
    - 3/3 18:30--20:00 @ TBD

Final Project

- Will have one or two problems/challenges
- Each team should have 3—4 members
- Project may 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/
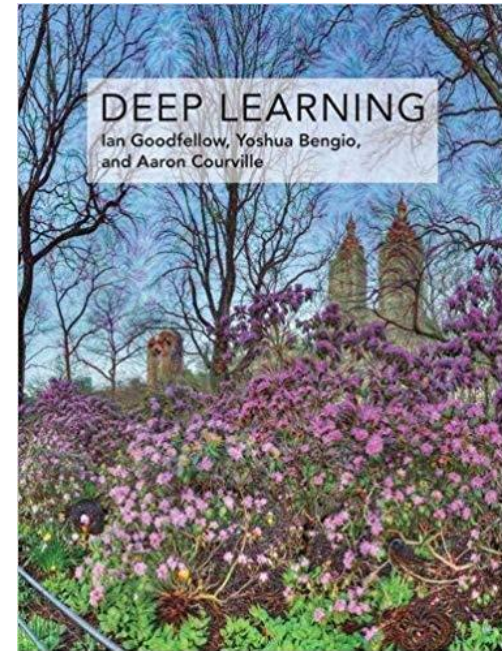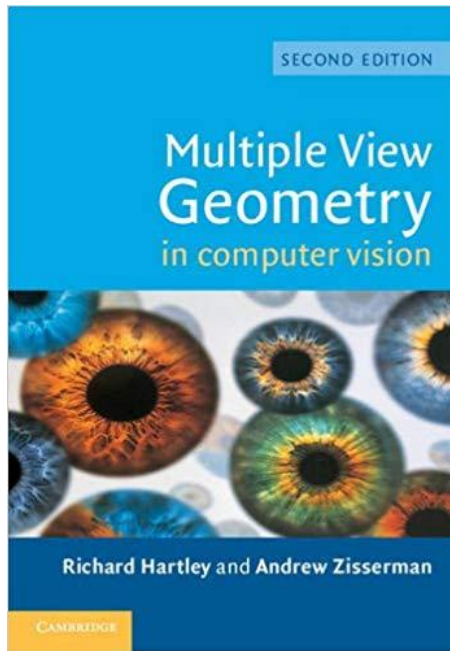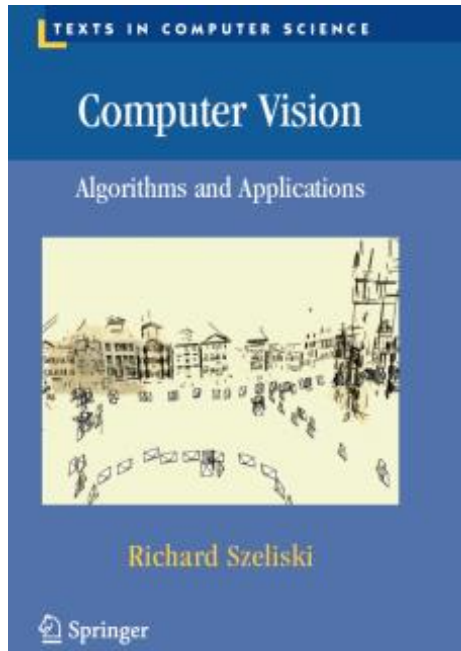
- And papers in CVPR, ICCV, ECCV, BMVC, WACV, ACCV, ….

加簽規則

- 請慎重考慮......
- 以教室容量為限，可加簽約30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://forms.gle/NZrLC8BnQnA9SbaB7
- 第三節上課時將公布獲選名單
- 有選上的同學將在一週內寄送授權碼