

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

FAILURE PRESS PHOTO EXHIBITION

失敗新聞攝影展 09.01.2018 - 09.10.2018

開幕 Reception 09.01 02:00 p.m.

新北市政府 1 樓大廳東側
New Taipei City Hall 1F East



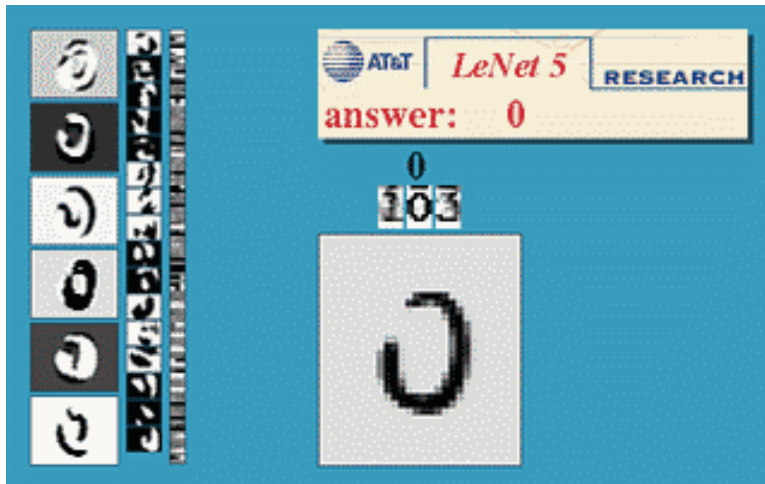
220 新北市板橋區中山路一段 161 號 1 樓

協力贊助

Avocado

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

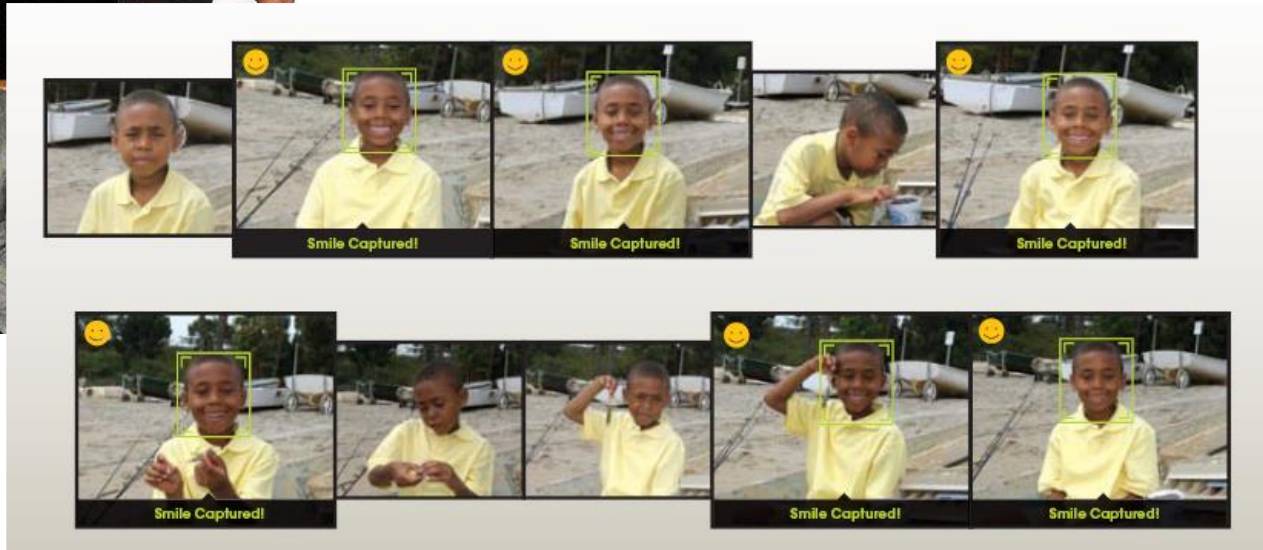
Wide Applications of Computer Vision

- Face detection: in all digital cameras and smart phones



Wide Applications of Computer Vision

- Face detection: in all digital cameras and smart phones



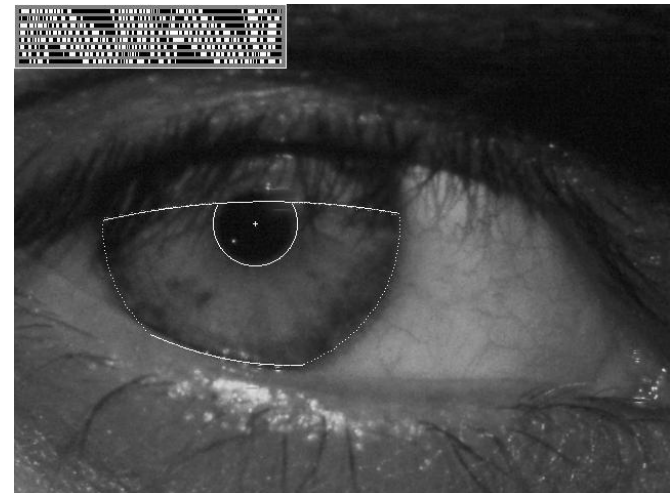
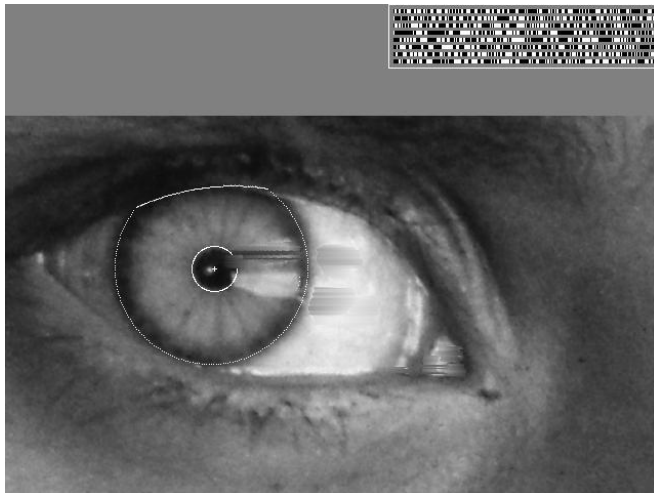
[Sony]

Wide Applications of Computer Vision

- Iris recognition
(Vision-based biometrics)

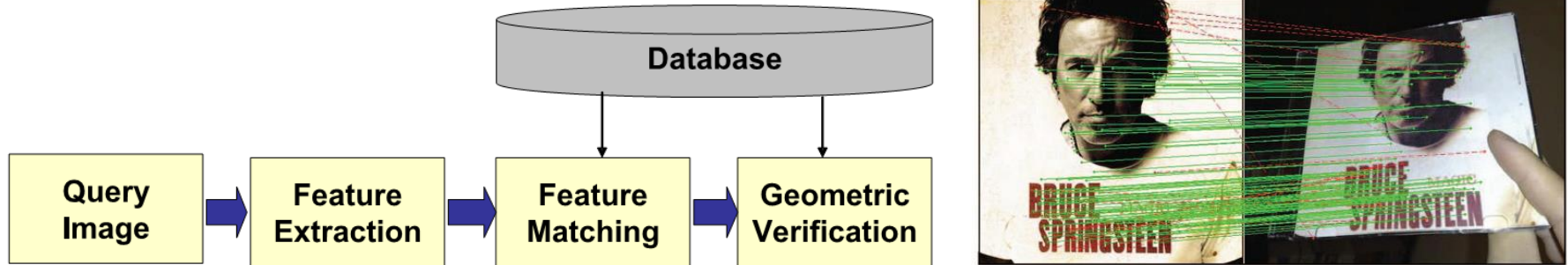


“How the Afghan Girl was Identified by Her Iris Patterns” Read the [story](#)

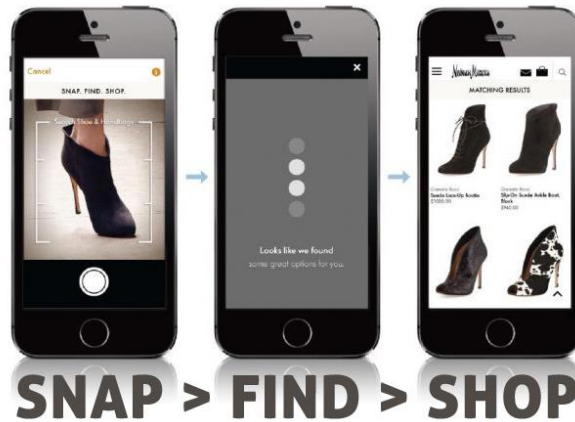


Wide Applications of Computer Vision

- 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



Hawk-Eye: helping/improving referee decisions



Intel: freeD technology

Wide Applications of Computer Vision

- Smart cars: [ADAS](#)

▶ manufacturer products consumer products ◀◀

Our Vision. Your Safety.

rear looking camera forward looking camera

side looking camera

▶ **EyeQ** Vision on a Chip



> read more

▶ **Vision Applications**

Road, Vehicle, Pedestrian Protection and more



> read more

▶ **AWS** Advance Warning System



> read more

News

- > [Mobileye Advanced Technologies Power Volvo Cars World First Collision Warning With Auto Brake System](#)
- > [Volvo: New Collision Warning with Auto Brake Helps Prevent Rear-end](#)

> all news

Events

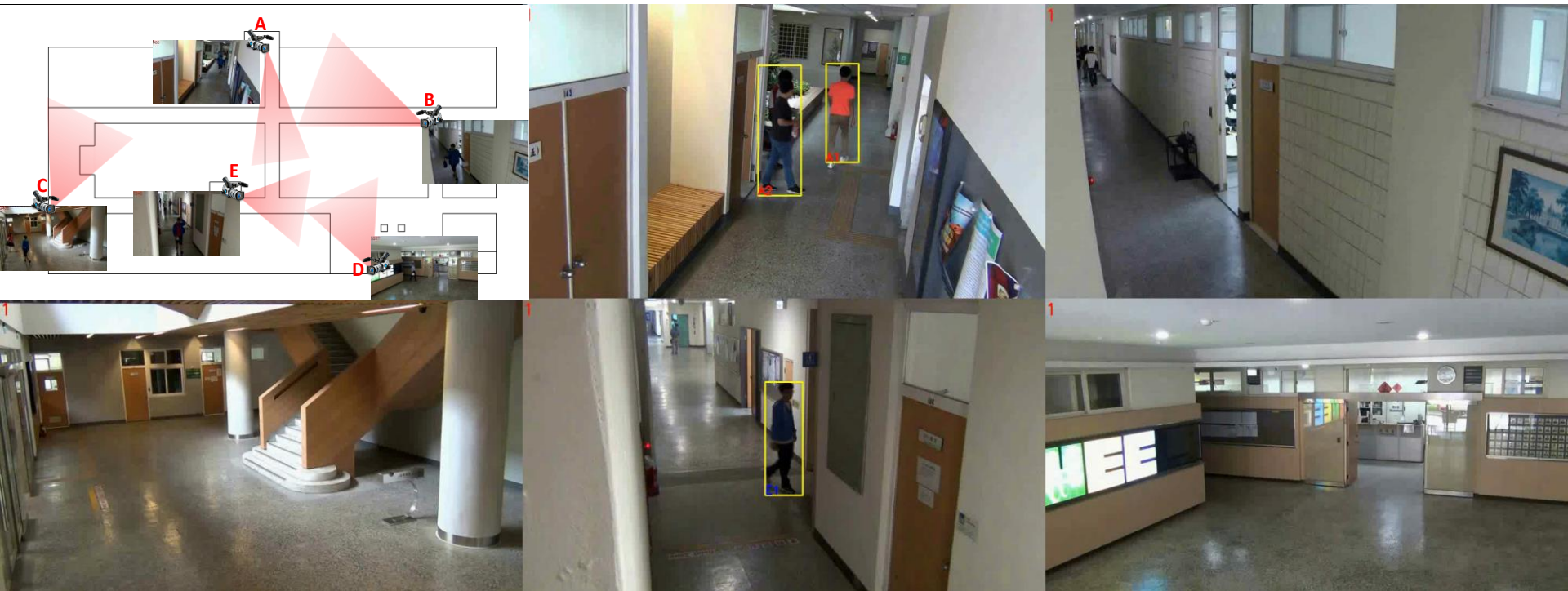
- > [Mobileye at Equip Auto, Paris, France](#)
- > [Mobileye at SEMA, Las Vegas, NV](#)

> read more

[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

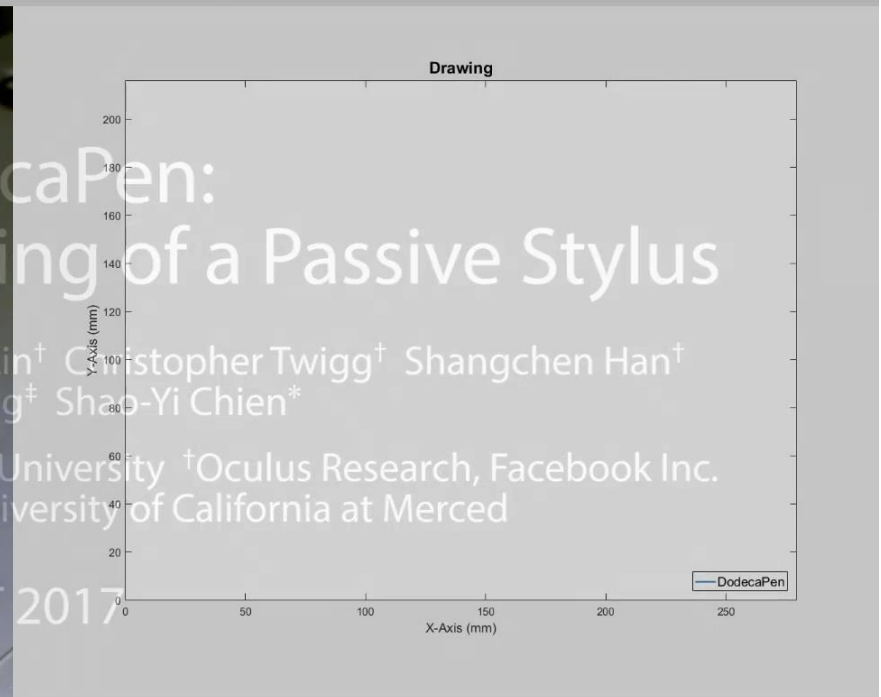
- Vision-based interaction



[Microsoft Xbox]

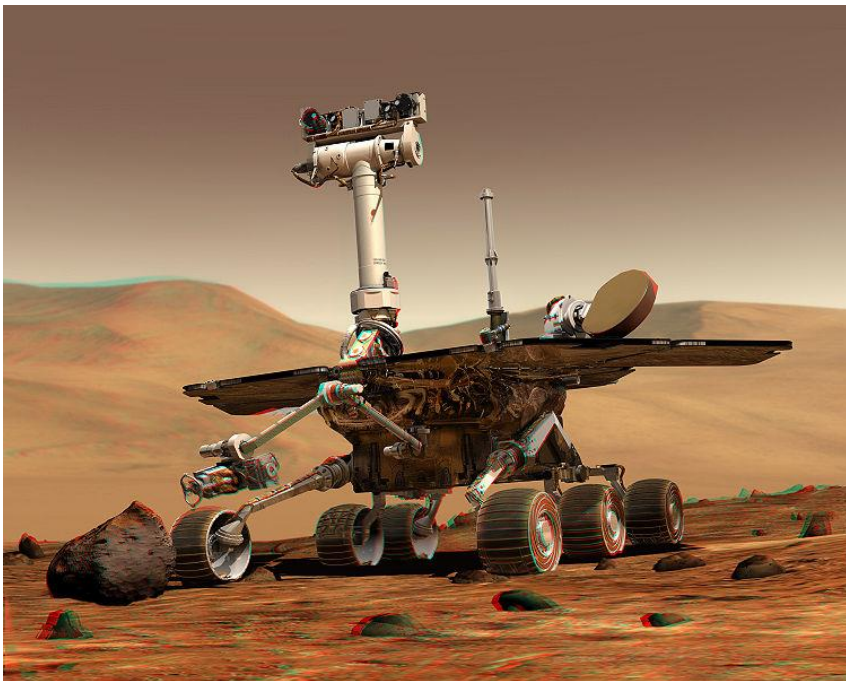
Wide Applications of Computer Vision

DodecaPen: Puppy



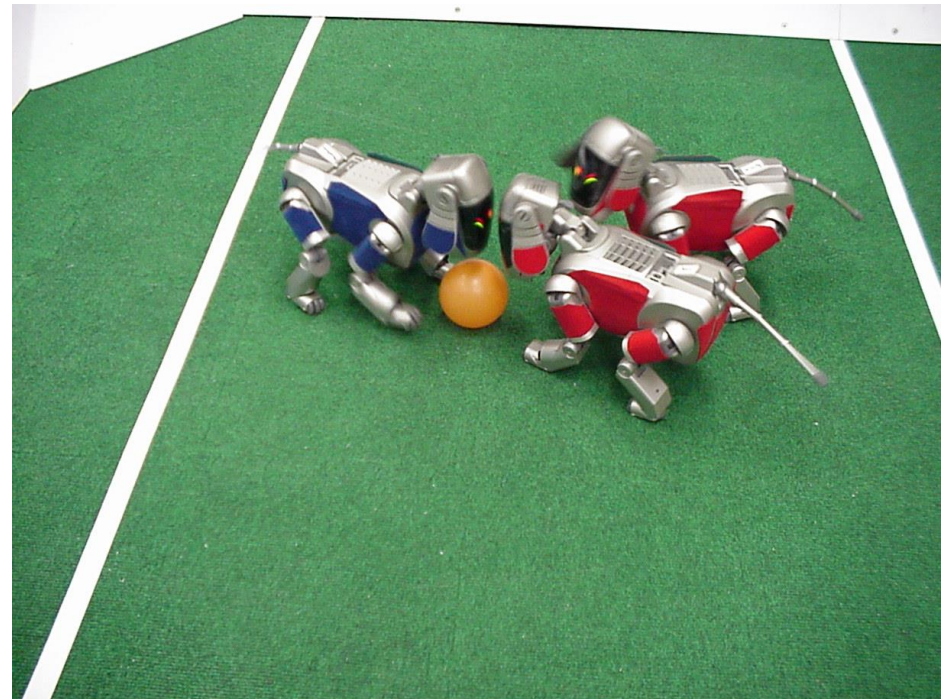
Wide Applications of Computer Vision

- Robotics



NASA's Mars Spirit Rover

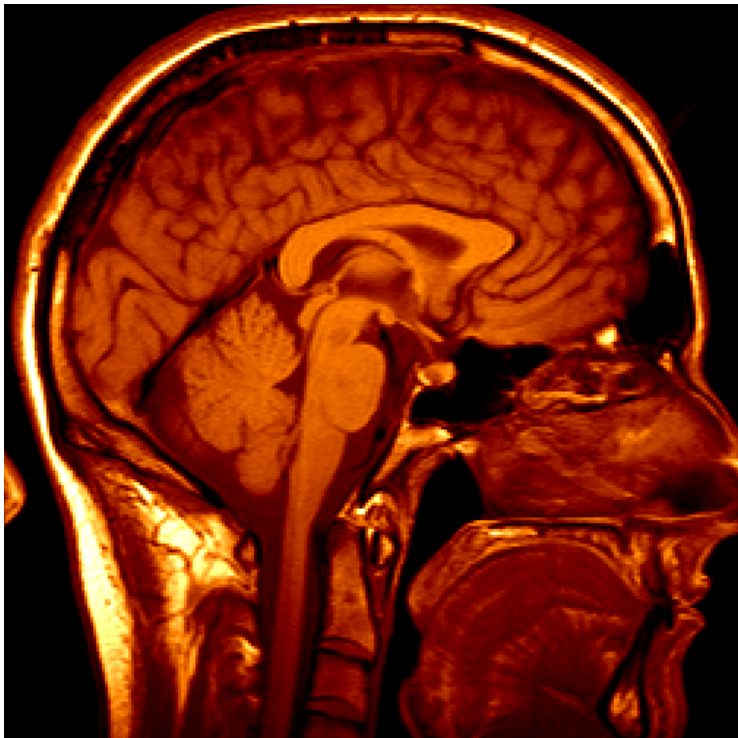
http://en.wikipedia.org/wiki/Spirit_rover



<http://www.robocup.org/>

Wide Applications of Computer Vision

- Medical image



3D imaging
MRI, CT



Image guided surgery
[Grimson et al., MIT](#)

Wide Applications of Computer Vision



Wide Applications of Computer Vision

Wide Applications of Computer Vision

- AR/VR devices for the metaverse

光機、微顯示器

(MicroLED, LCD, OLED, LCoS...)

影像sensor、3D感測 (結構光、ToF、LIDAR)

See-Through Display

Scene Reconstruction

Virtual Scene Rendering

Real-time rendering, GPU

Pose Estimation

6DoF tracking, IMU, Visual Odometry

Image Processing

ISP

Nature UI

眼球追蹤、手勢、語音

Application Processor
電池
通訊網路

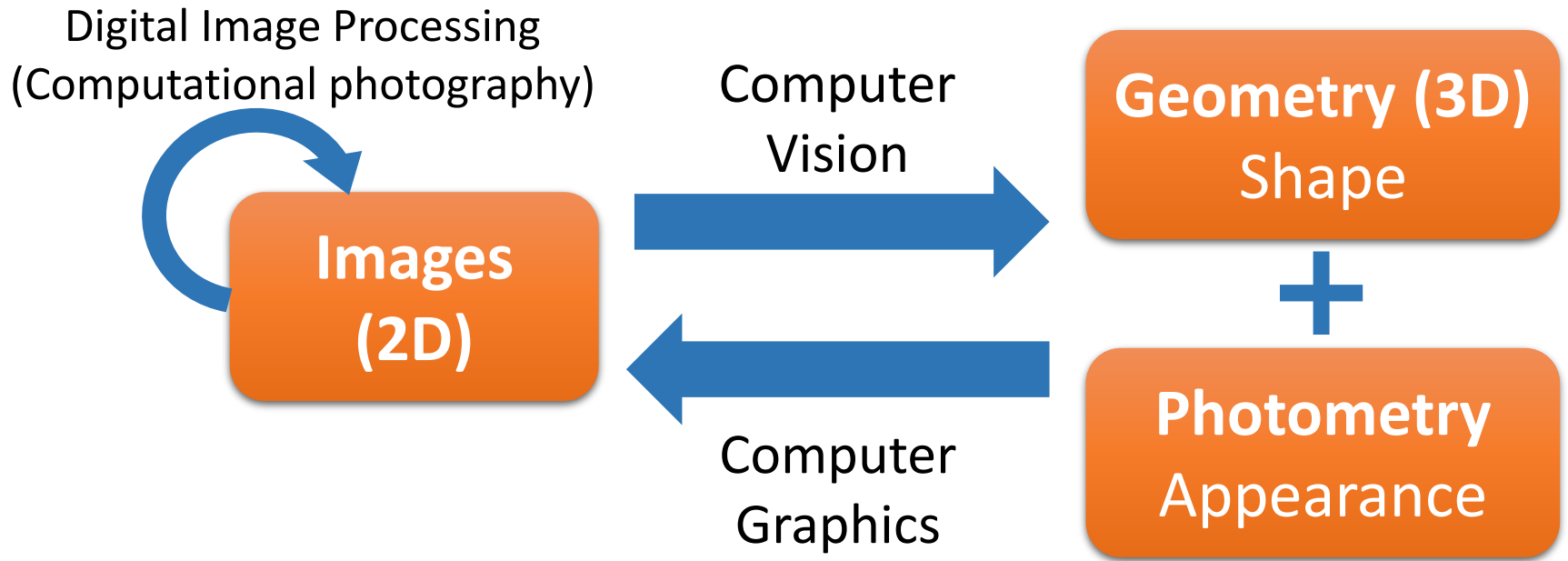
Avatar AI



Important Near-Future Applications

- AR/VR, Metaverse
- 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 processing 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/22S/>
- TA
 - 劉致廷
 - BL-421
 - jackieliu@media.ee.ntu.edu.tw
 - Will lead TA team for each homework

(Tentative) Schedule: May be Modified...

Week	Date	Topic
1	2/18	Introduction to human vision systems
2	2/25	Camera basic, image formation and basic Image processing
3	3/4	Feature detection and matching
4	3/11	Machine learning basics
5	3/18	Deep learning basics
6	3/25	Recognition
7	4/1	Segmentation
8	4/8	Projective Geometry
9	4/15	Estimation of Transformations
10	4/22	Single Camera Geometry/Camera calibration
11	4/29	Two-View Geometry
12	5/6	Dense motion estimation/stereo
13	5/13	Optical flow + object tracking
14	5/20	3D reconstruction/depth sensing
15	5/27	Structure from motion
16	6/3	端午節
17	6/10	Final project presentation
18	6/17	

Homeworks

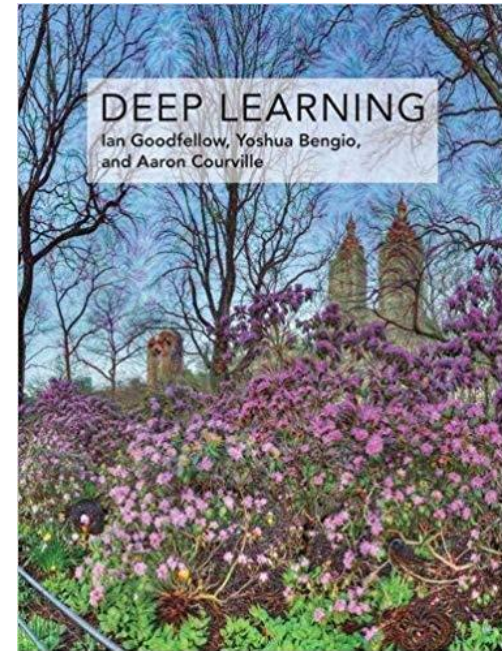
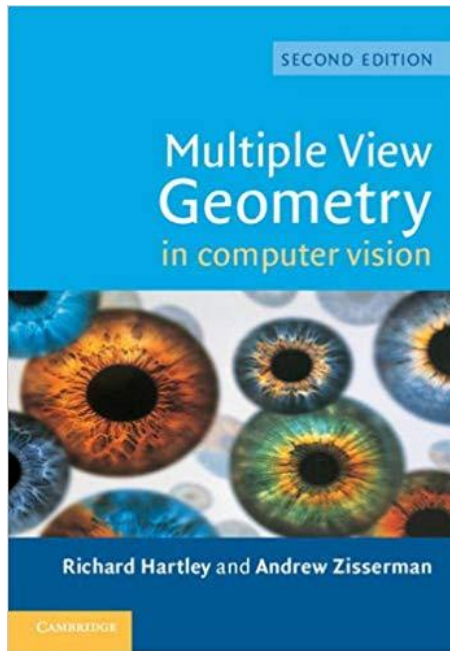
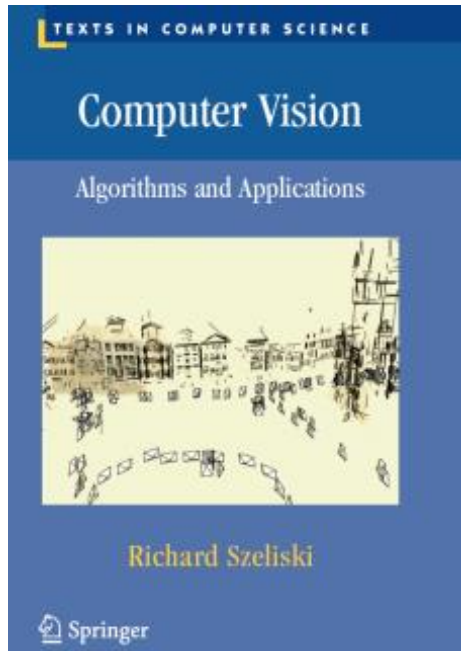
- Four assignments:
 - HW1: Image filters
 - HW2: Detection or recognition
 - HW3: Pose estimation
 - HW4: Stereo matching
- Official language is Python
- Lab0: Python and basic image processing
 - 2/22 18:30--20:00 @ TBD

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/dMroYN4JZyVJcn5U7>
- 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

