Computer Vision

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Instructor:

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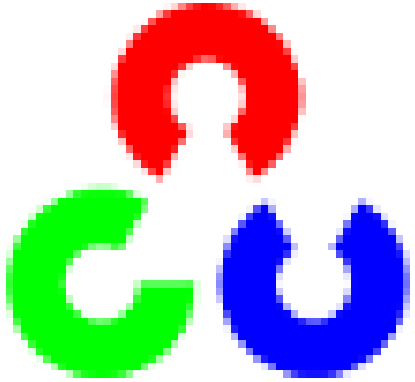
Office hours: Mon. 13:00~15:00
Tue. 13:00~15:00

★ References:



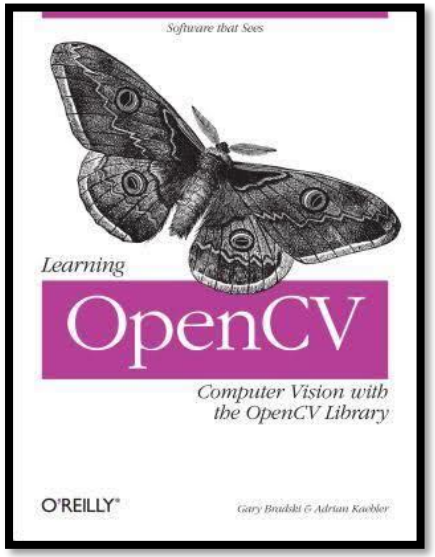
OpenCV

Open Source Computer Vision

https://docs.opencv.org/4.0.1/

Learning OpenCV

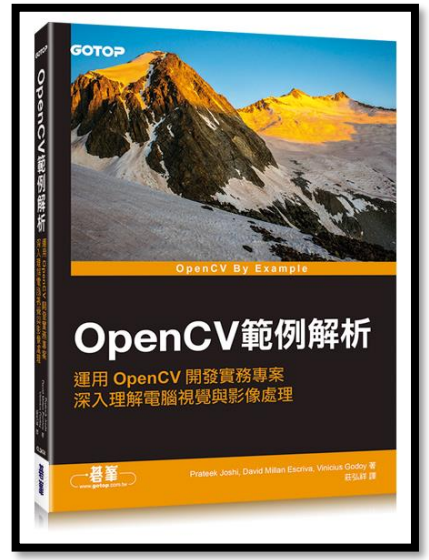
Bradski & Kaehler



OpenCV By Example

Prateek Joshi

David Millan Escriva



Outline:

Ch1. Computer Vision Introduction

Ch2. OpenCV introduction

Ch3. Color Spaces

Ch4. Object Segmentation

Ch5. Filtering

Ch6. Morphological Operations

Ch7. Connected Component Labeling & Contours

Ch8. Image Smoothing

Ch9. Object Detection

Instruction of installation

Grading:

Exercise 30% (*.exe, *.cpp, *.ppt – 3 files)

Midterm Exam 30%

Final Project 40%

TA:

TA: Shao-Chi Fu (傅紹齊)
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E-mail: 20511asdfghjkl@gmail.com

TA office hours: Wed.16:00~17:00

Exercise: Upload to 彰師大雲端學院

Computer Vision

Ch.1 Introduction

Prof. Po-Yueh Chen (陳伯岳)
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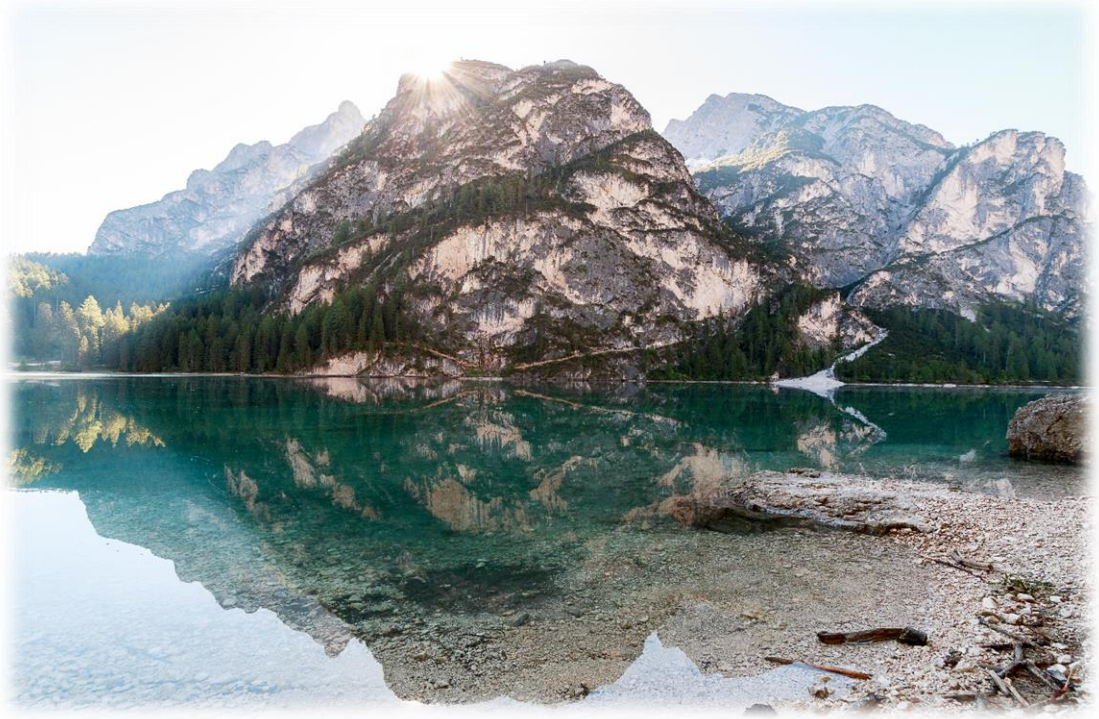
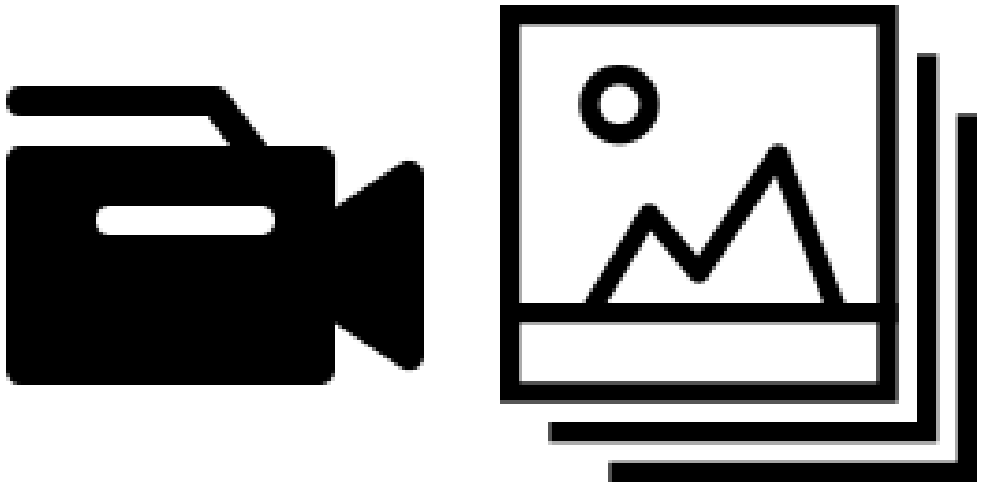
What is Computer Vision? (1/4)

- **Computer Vision (CV)**



- **Image**

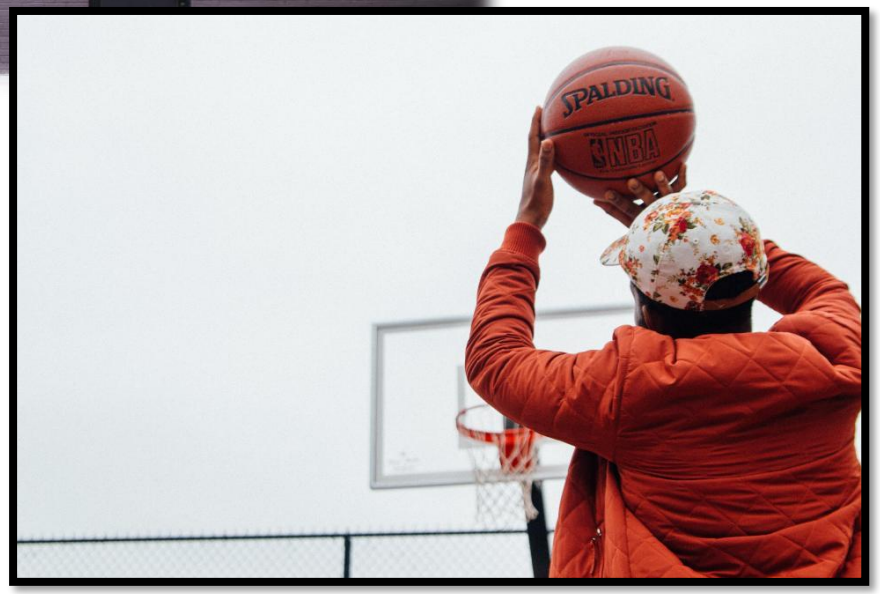


- **Videos**

What is Computer Vision? (2/4)

- **Analysis**
  - ✓ Security surveillance
  - ✓ Traffic surveillance
  - ✓ Sports video analysis
  - ✓ Vehicle Technology
  - ✓ Factory production line
  - ✓ Road analysis

  . . . etc.



What is Computer Vision? (3/4)

✓ Interdisciplinary

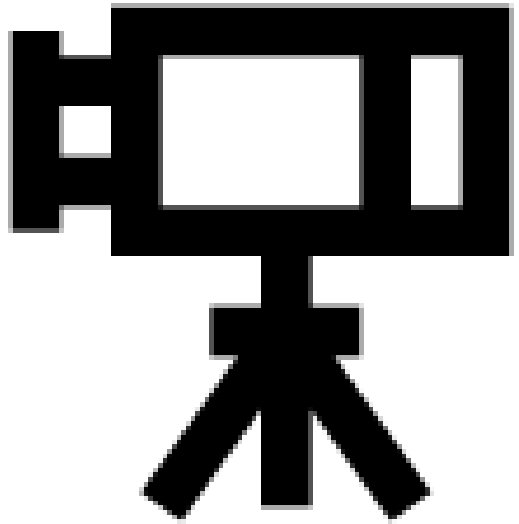
- Artificial intelligence (AI)
- Information engineering
- Signal processing
- Physics
- Neurobiology
- … etc.

What is Computer Vision? (4/4)

Human Vision *VS.* Computer Vision

- Low frequency content

Lena

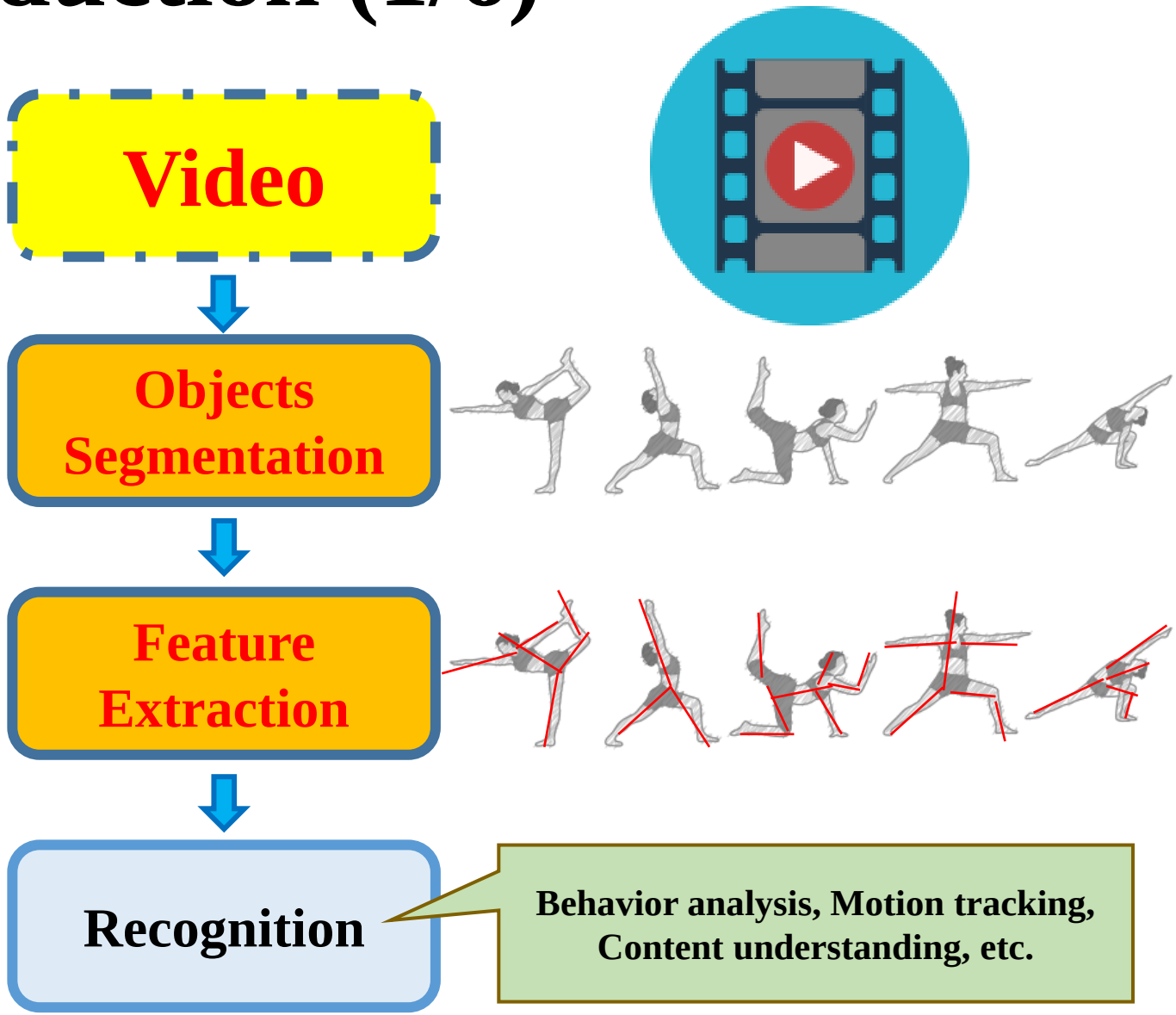


- High frequency content

Computer Vision Introduction (1/6)

Tasks:

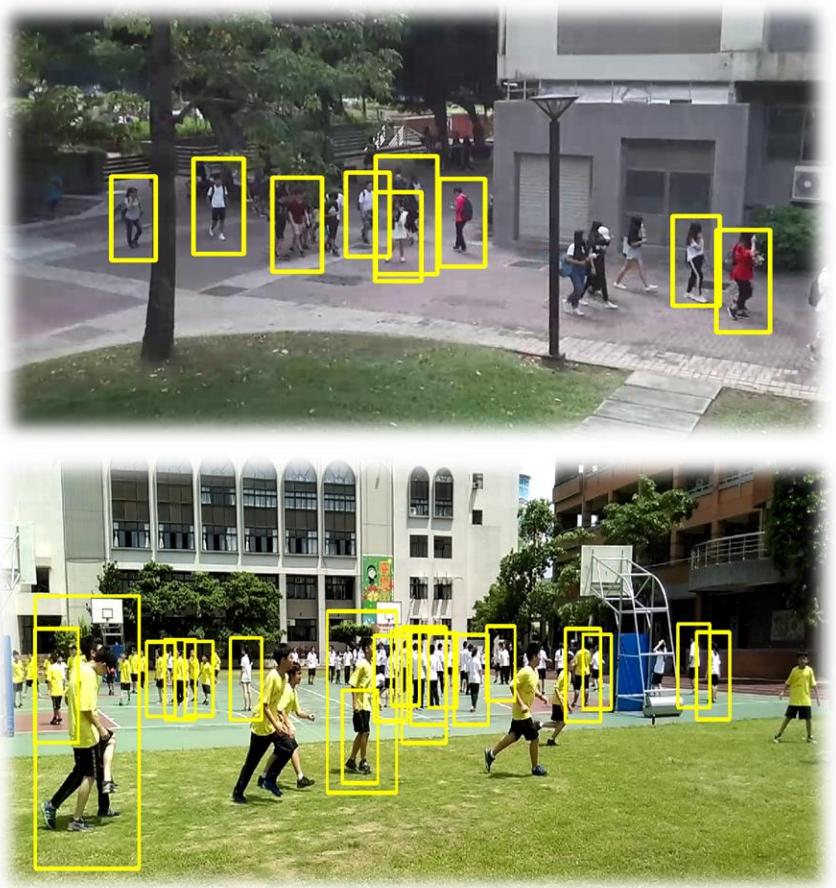
- Detection
- Recognition
- Analysis
- Image Restoration



Computer Vision Introduction (2/6)

- Detection

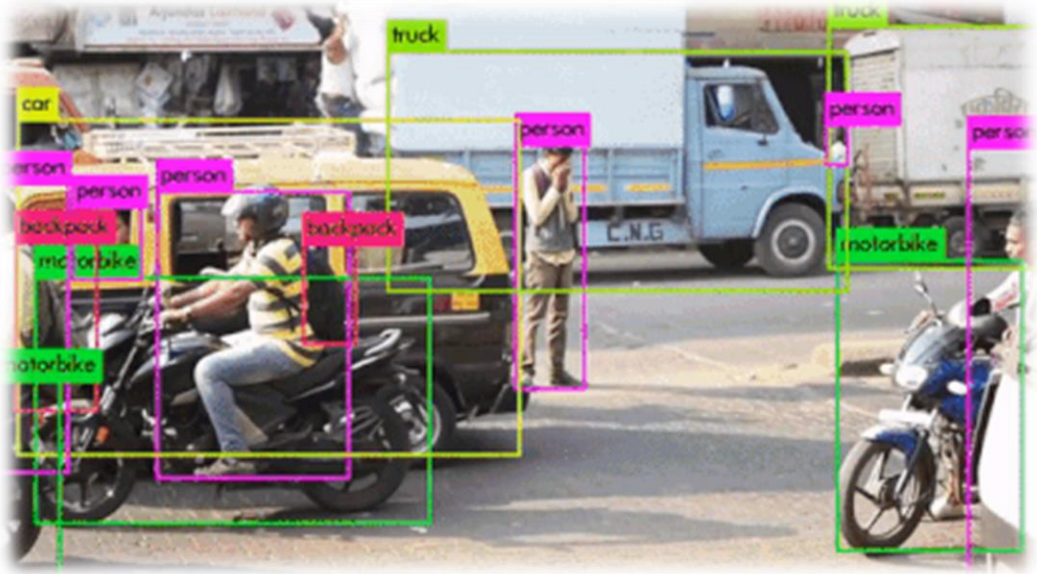
Source: http://vision.seecs.edu.pk/wp-content/uploads



Source: Python with OpenCV Testing by Y.J. Dai

Computer Vision Introduction (3/6)

- Recognition

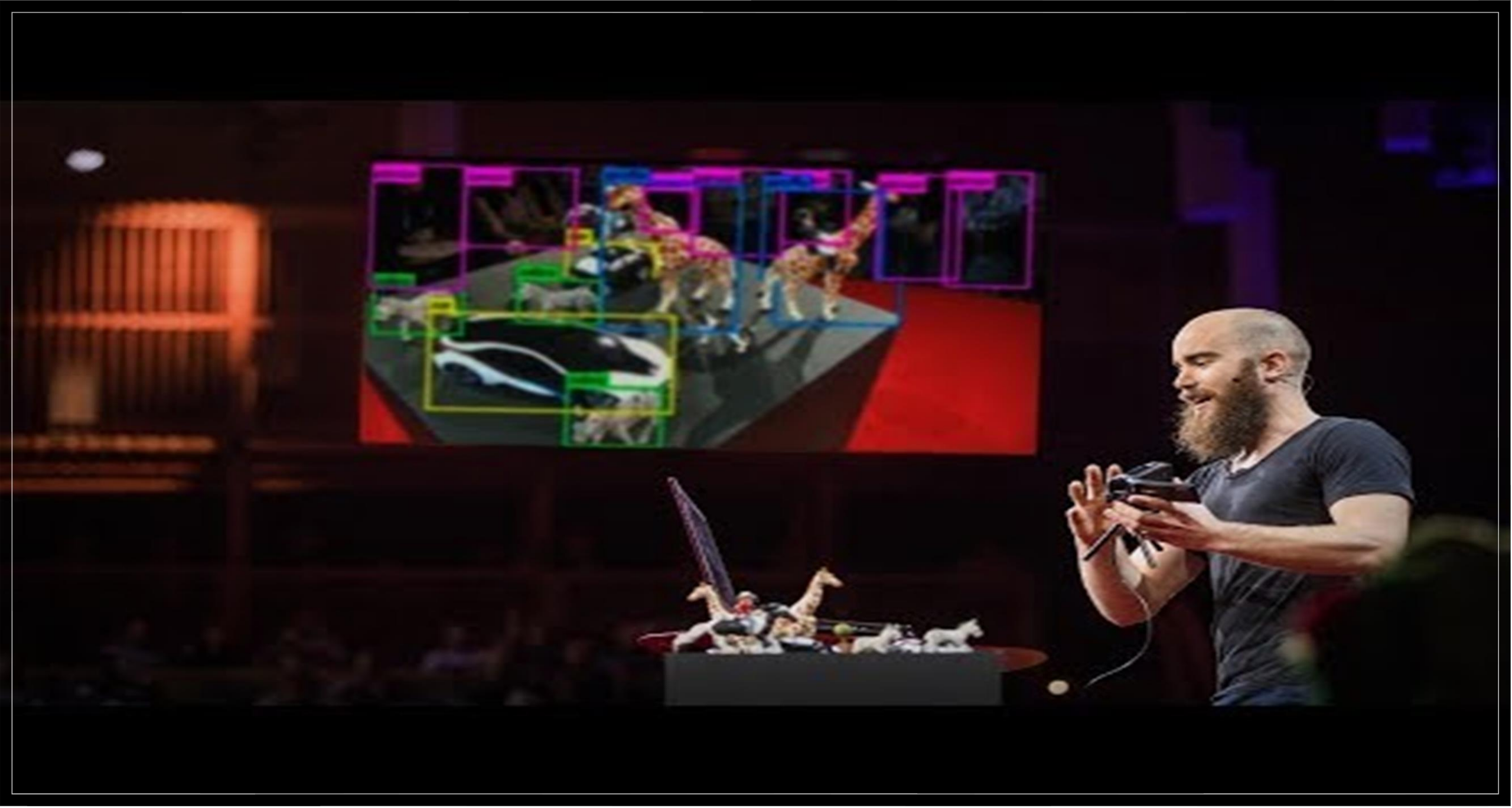


YOLO
(You Only Look Once)

- Joseph Redmon

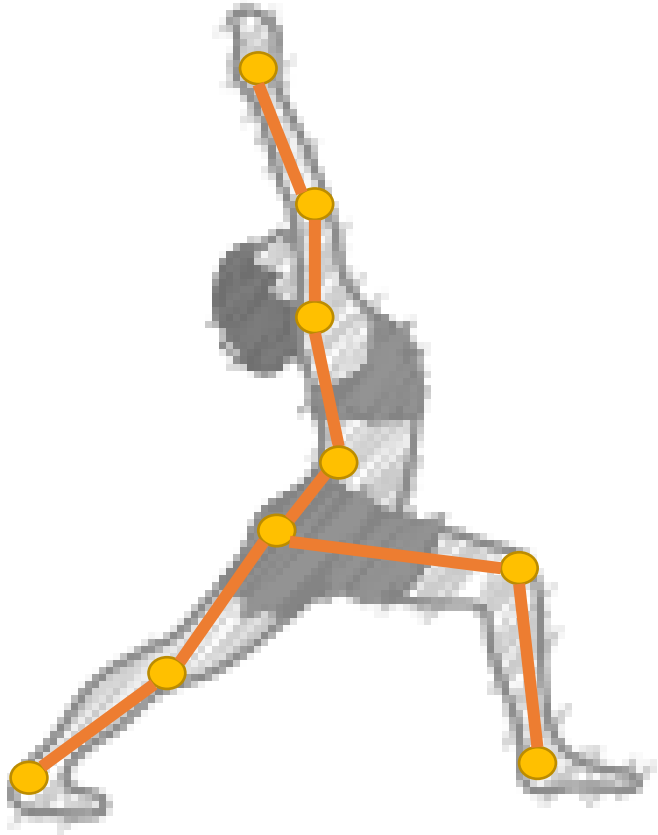
Official Website: https://pjreddie.com/darknet/yolo/

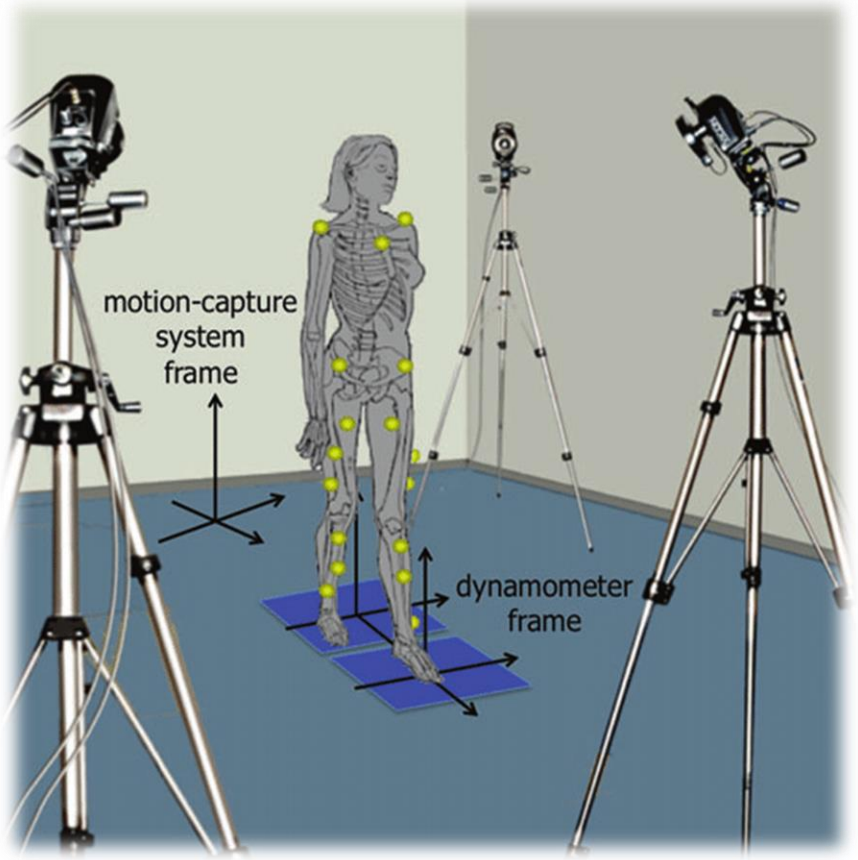
2020 Yolo v4 Paper :
https://arxiv.org/pdf/2004.10934.pdf



Computer Vision Introduction (4/6)

- Motion Analysis



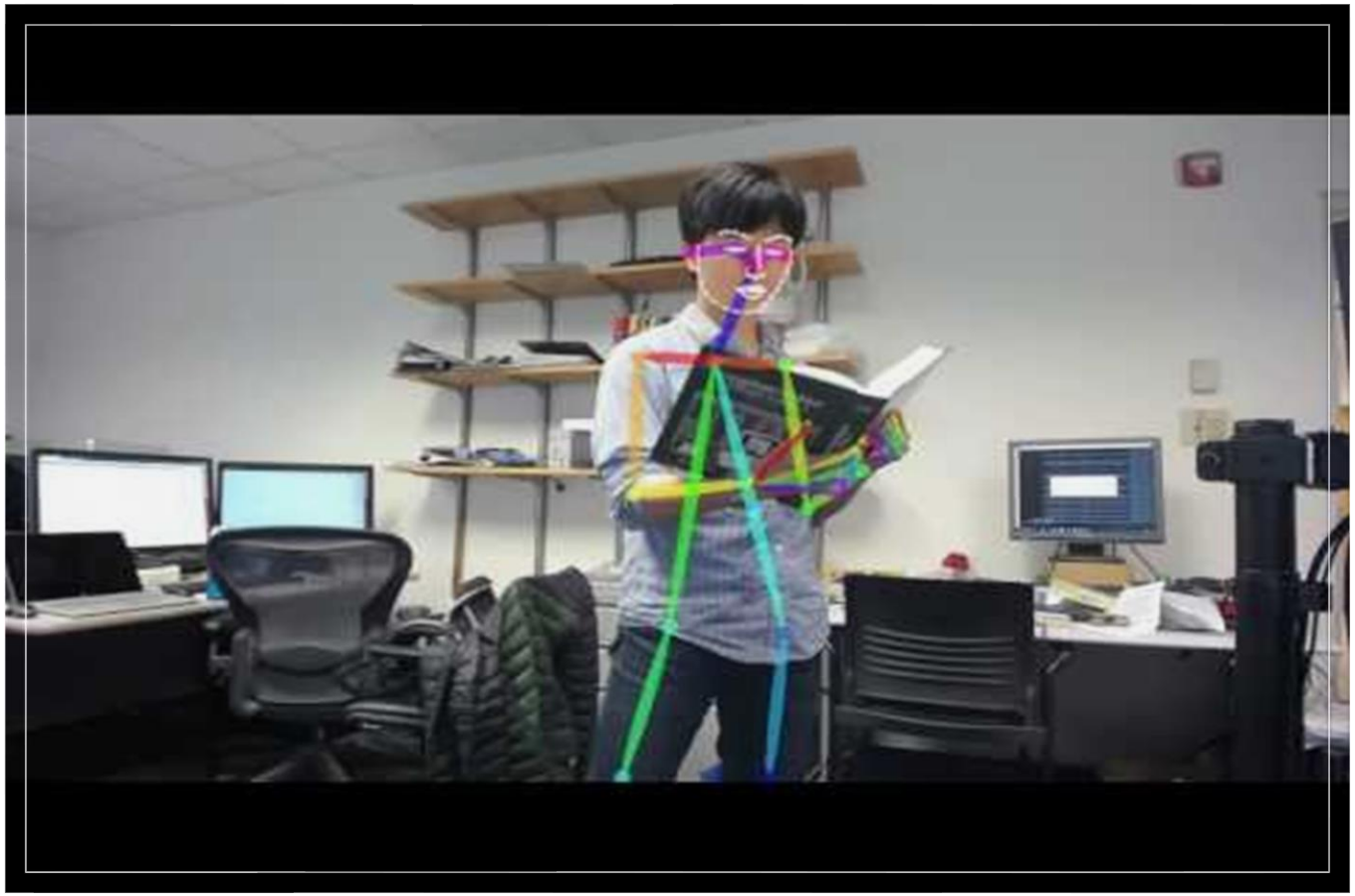


Source: https://www.researchgate.net/publication/318141412_Three-Dimensional_Reconstruction_of_the_Human_Skeleton_in_Motion

Computer Vision Introduction (5/6)

- Motion Analysis

Source: https://blog.techbridge.cc/2019/01/18/openpose-installation



OpenPose: Hand, Face, and Body Keypoint Detection in Realtime

Computer Vision Introduction (6/6)

How does the Computer Vision determine the object?

- Features
- Morphology
- Geometry
- Color
- Shape
- Motion

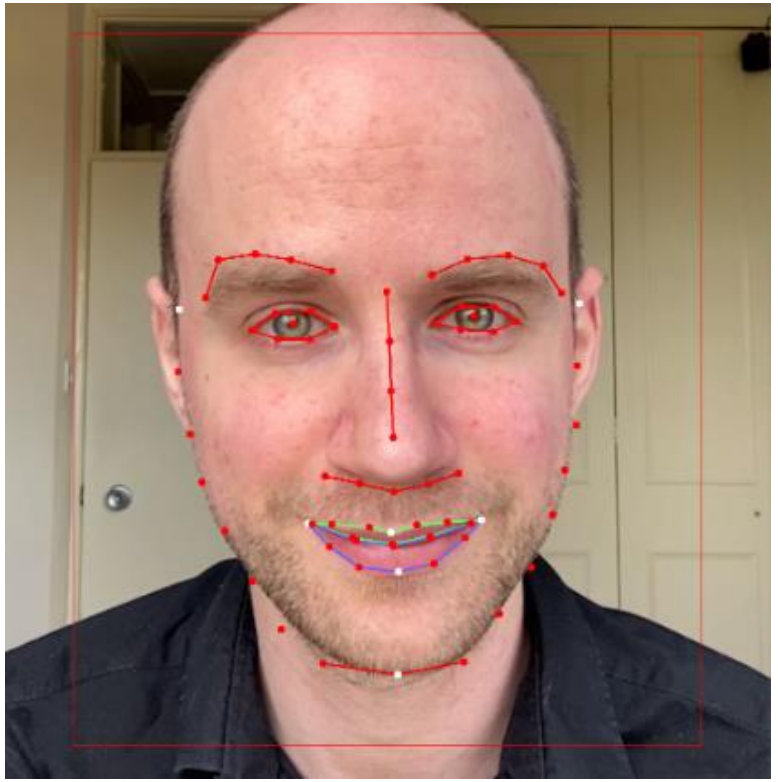
- Light
- Other signal…

Computer Vision Introduction (6/6)

- Dlib - Face Recognition

  Website: http://dlib.net/

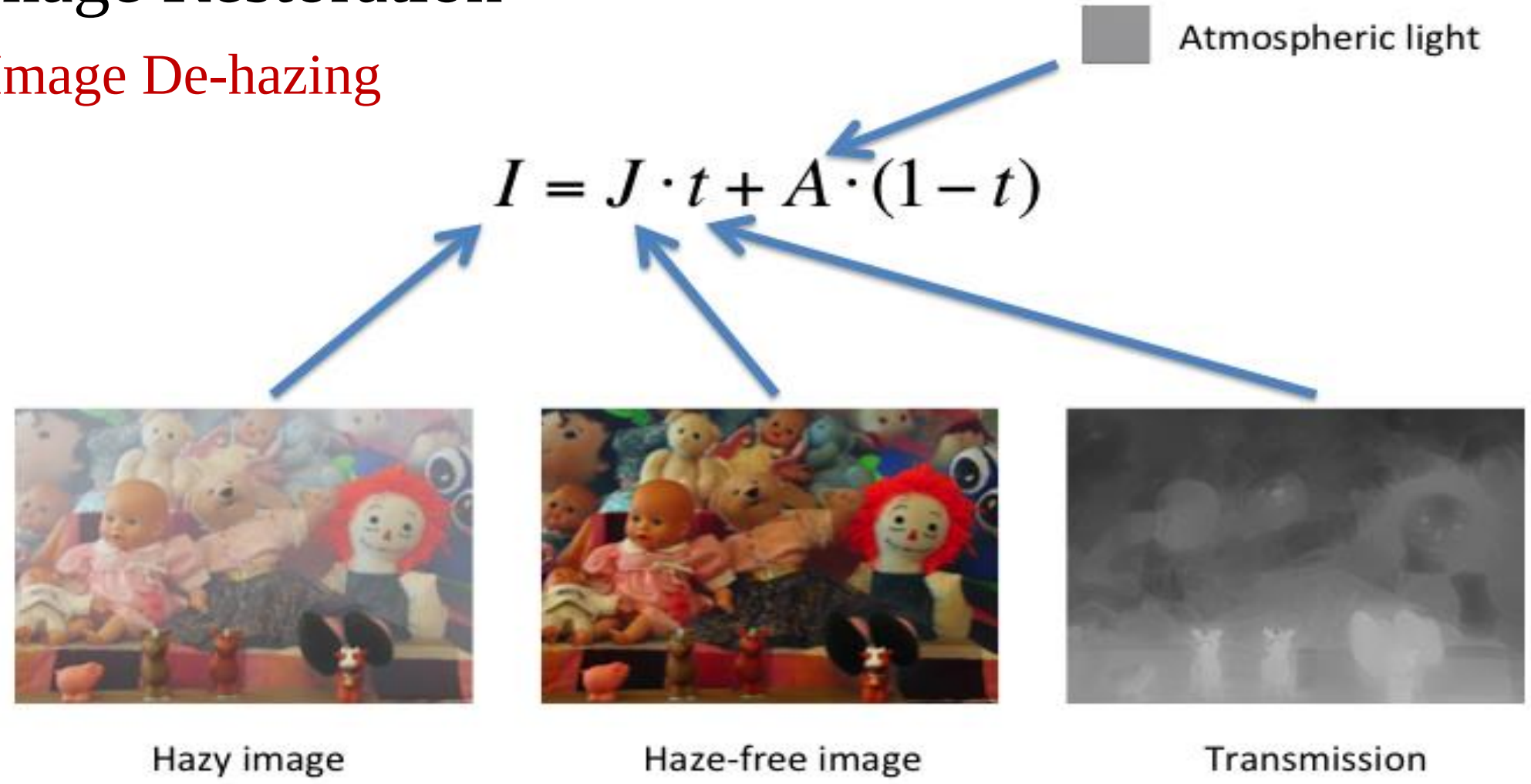
First look at StrongTrack, a free face tracking tool for UE4/Blender



Strong Track v0.6

Extended Research (1/2)

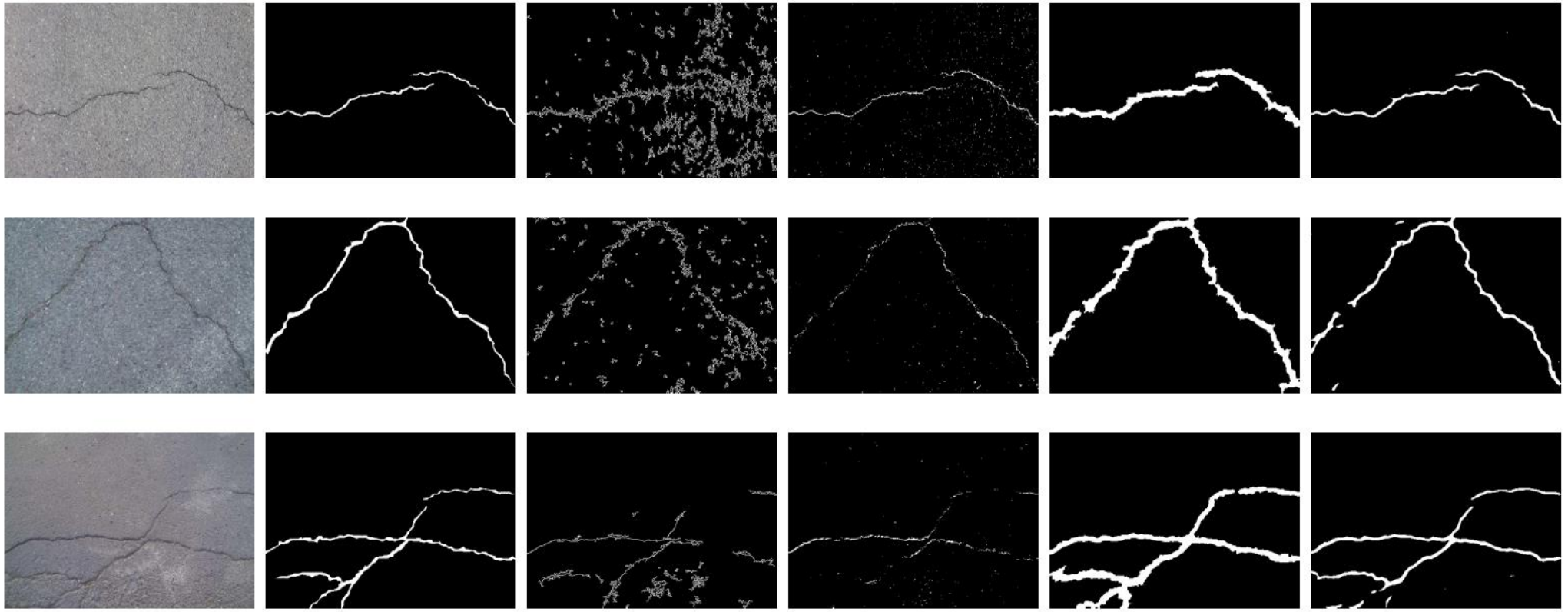
- Image Restoration
  - Image De-hazing



Source: https://yennanlin.com/projects/image-dehazing.html

Extended Research (2/2)

- Image Analysis
  - Pavement Crack Detection



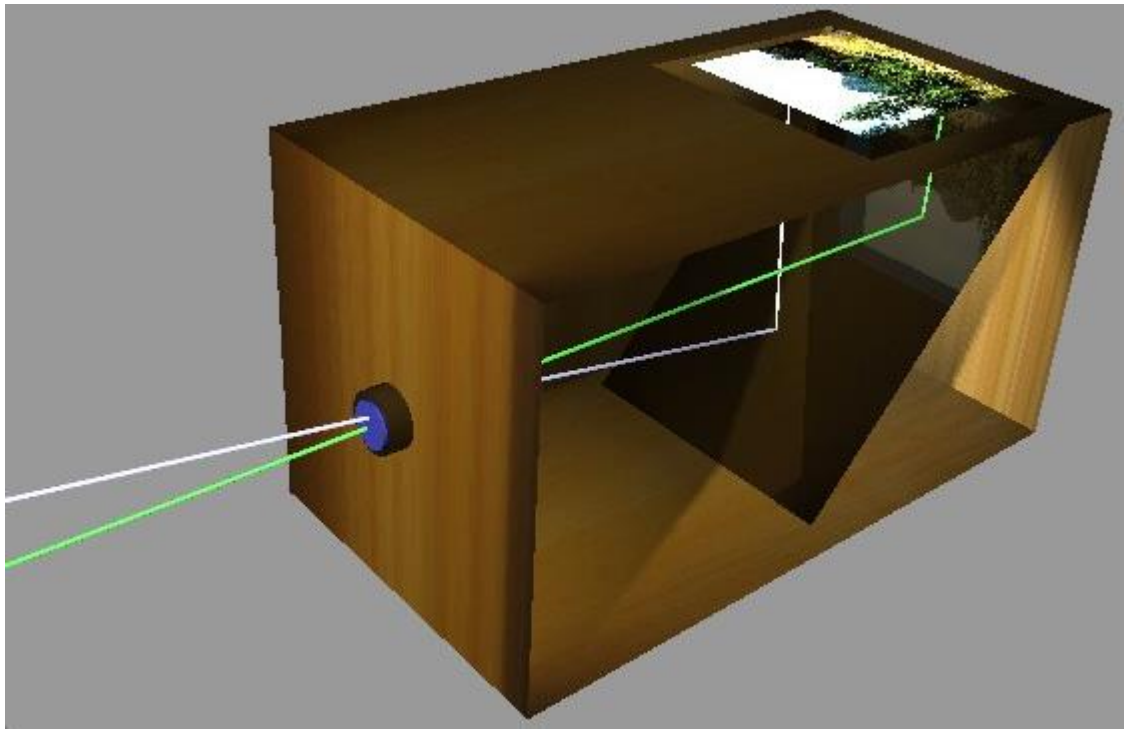
Results comparing on CFD (from left to right: original image, ground truth, Canny, local thresholding, CrackForest, the proposed method)

Source: https://arxiv.org/pdf/1802.02208.pdf

Photo forming (1/7)

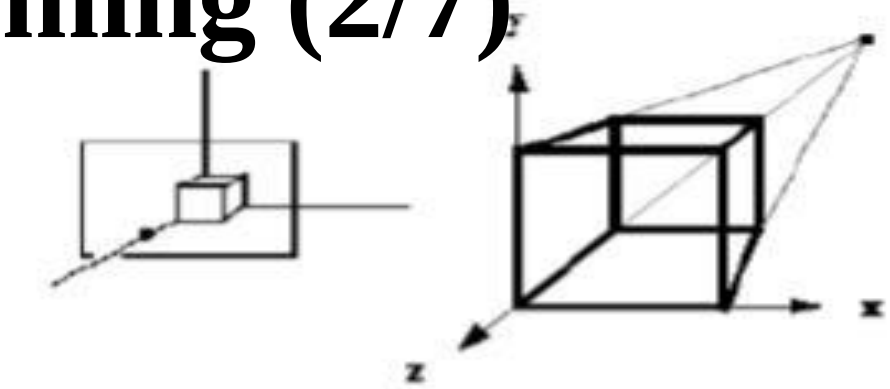
- Camera

- Human eyes

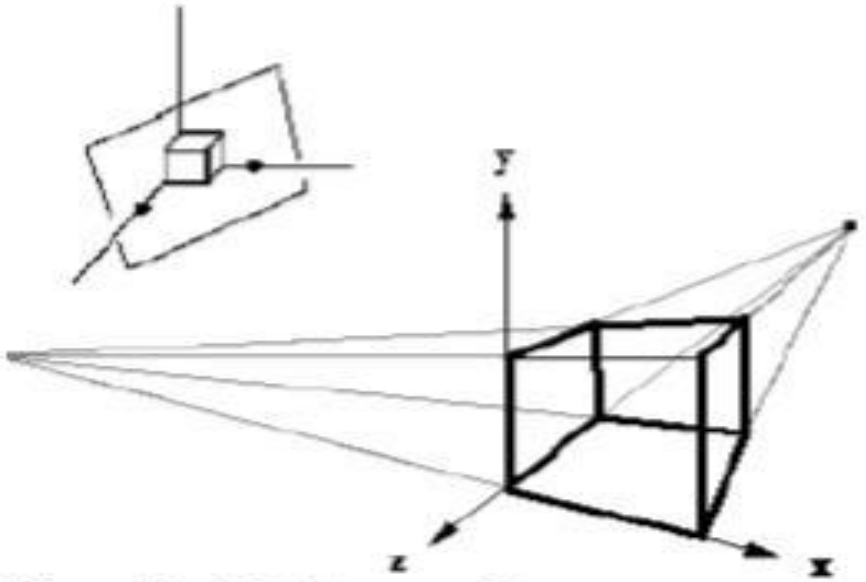


- Pinhole - obscura box

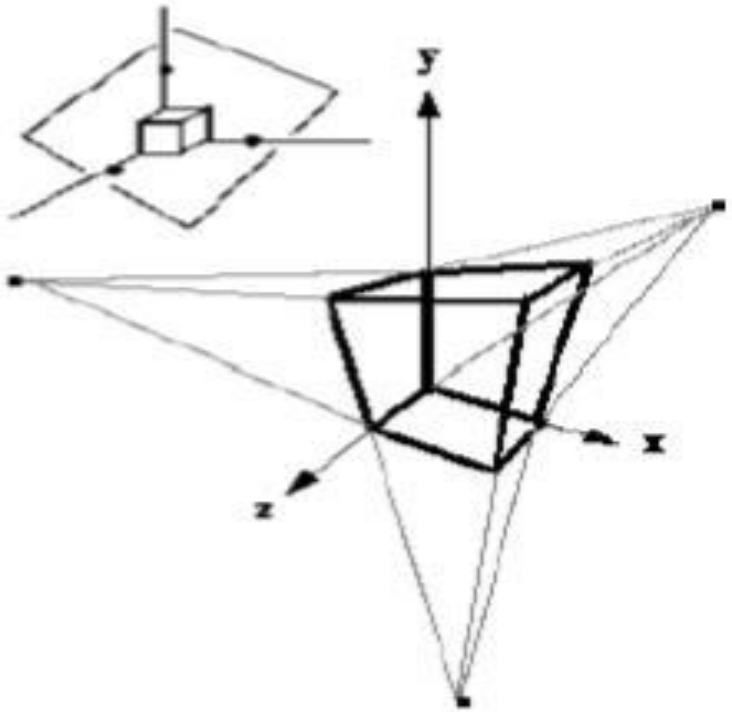
Photo forming (2/7)



One Point Perspective
(z-axis vanishing point)

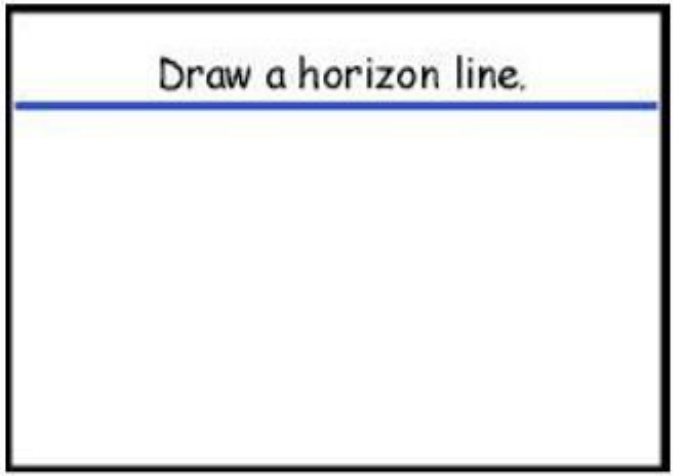


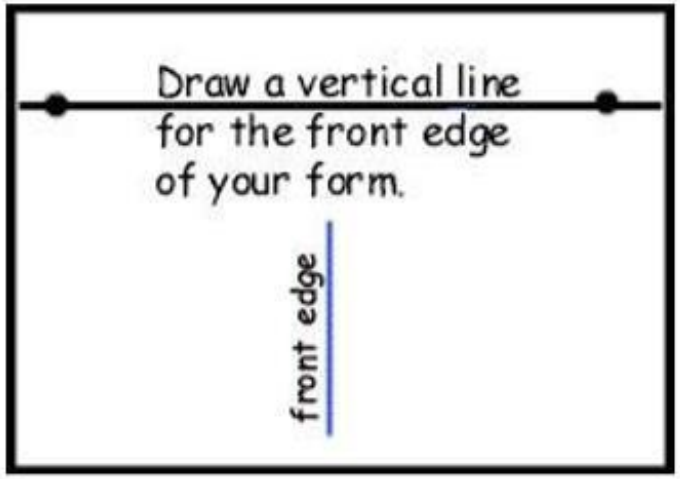
Two Point Perspective
z, and x-axis vanishing points

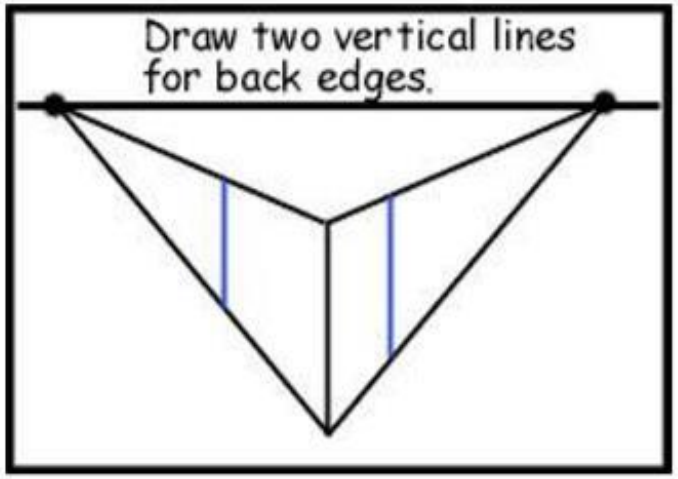


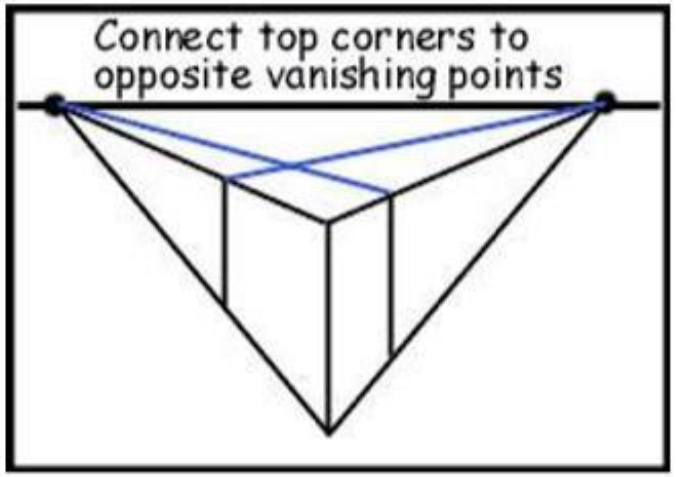
Three Point Perspective
(z, x, and y-axis
vanishing points)

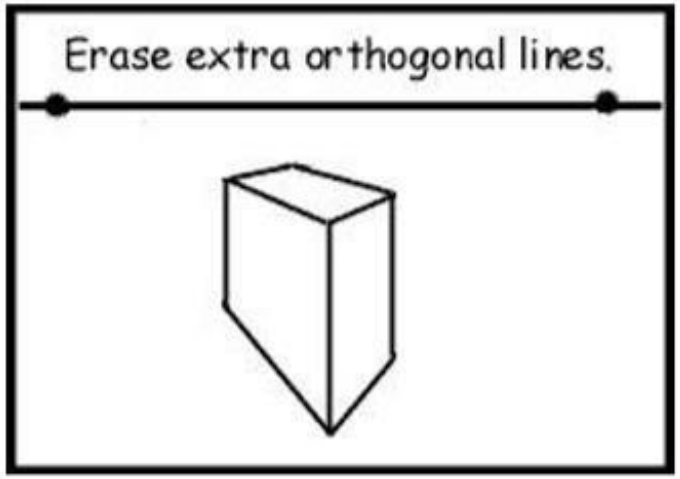
Photo forming (3/7)

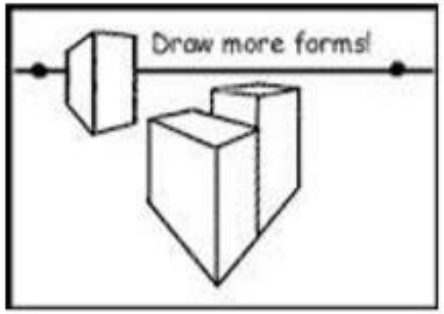


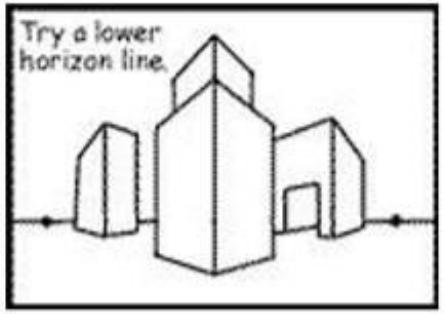


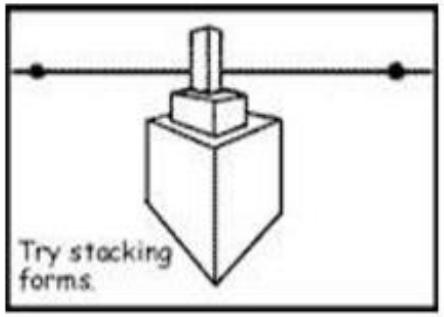












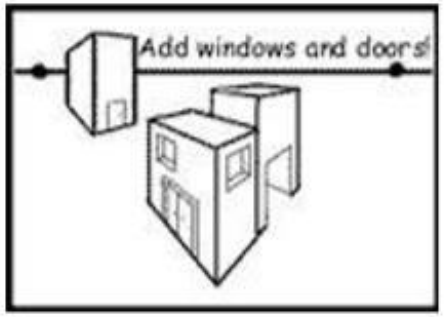
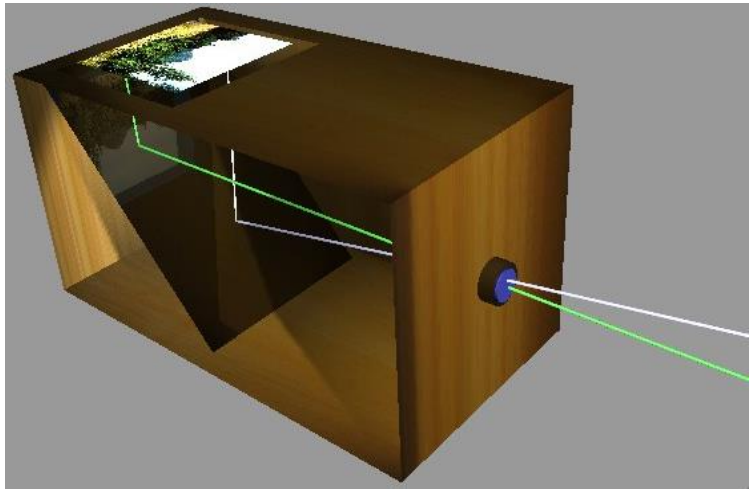


Photo forming (4/7)



Pinhole - obscura box

Pinhole camera -a box with a small hole in it.

- Image is upside down.
- We usually use a virtual plane on the opposite side of the image plane

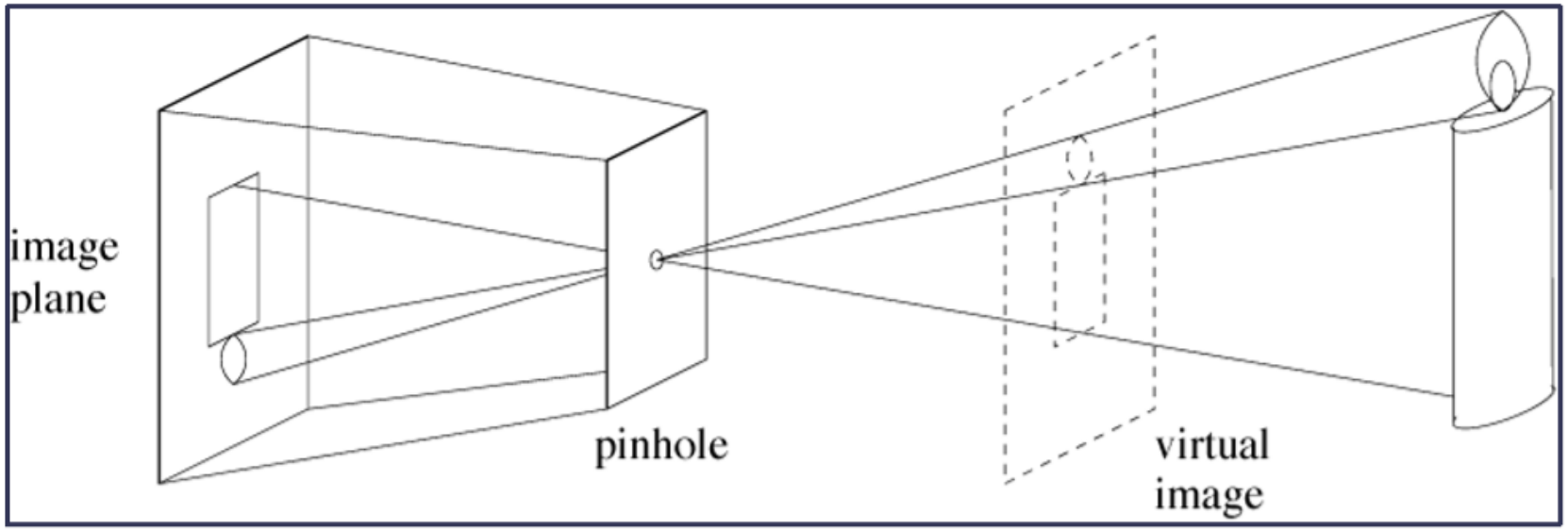


Photo forming (5/7)

- Pinhole image problem

  - Pinhole too big:
    brighter, but blurred.

  - Pinhole right size:
    sharp, but dark.

  - Pinhole too small:
    blurred due to diffraction.

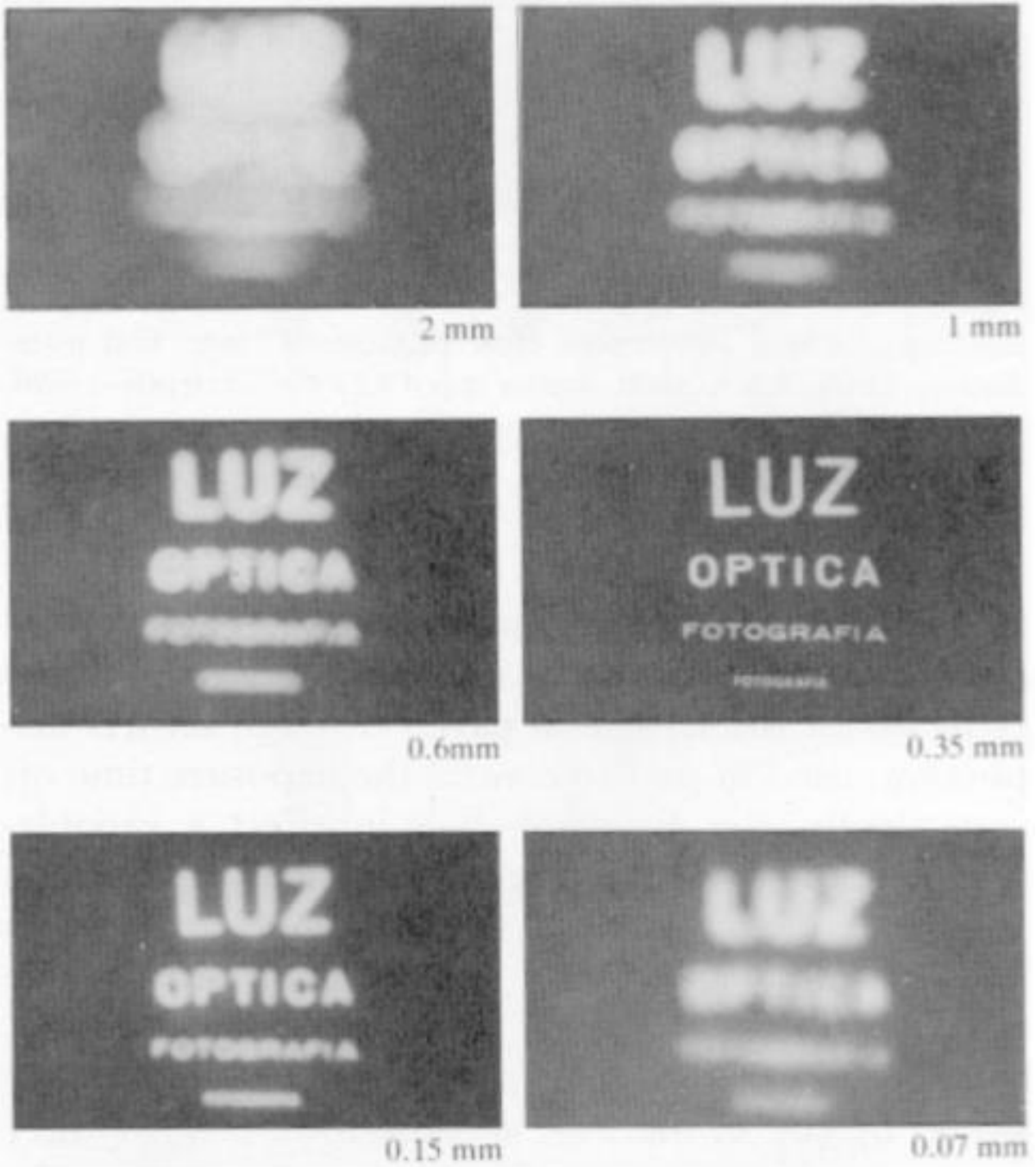
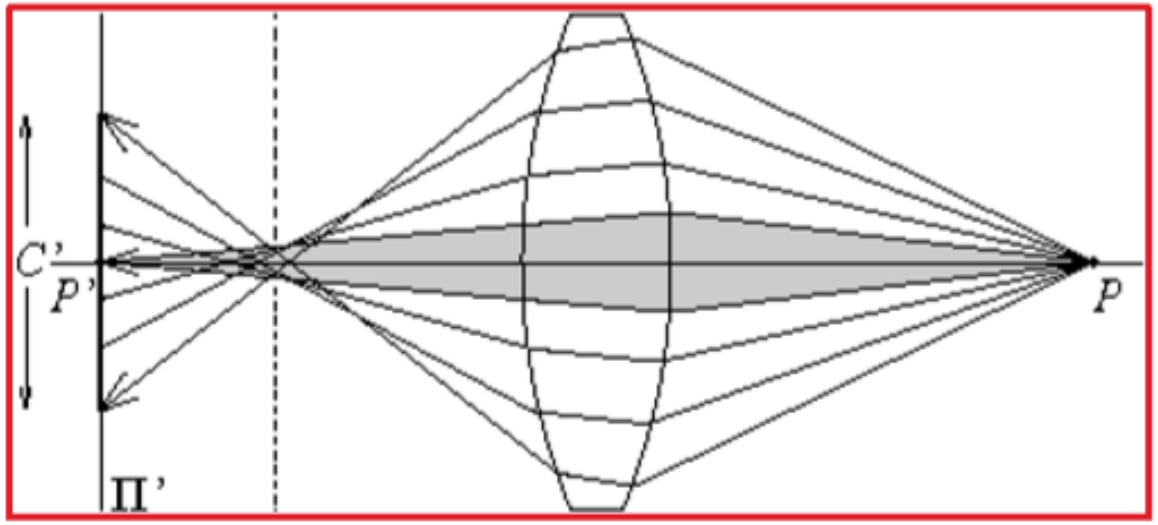


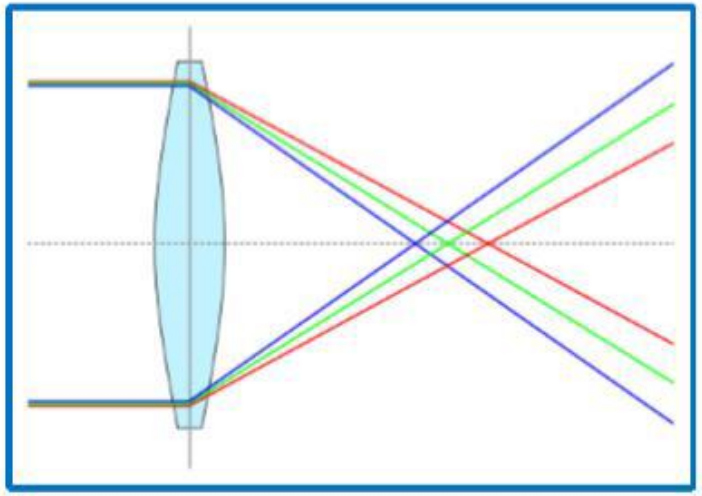
Photo forming (6/7)

➢ Optical aberration

In optical aberration is a property of optical systems such as lenses that causes light to be spread out over some region of space rather than focused to a point.



Spherical aberration

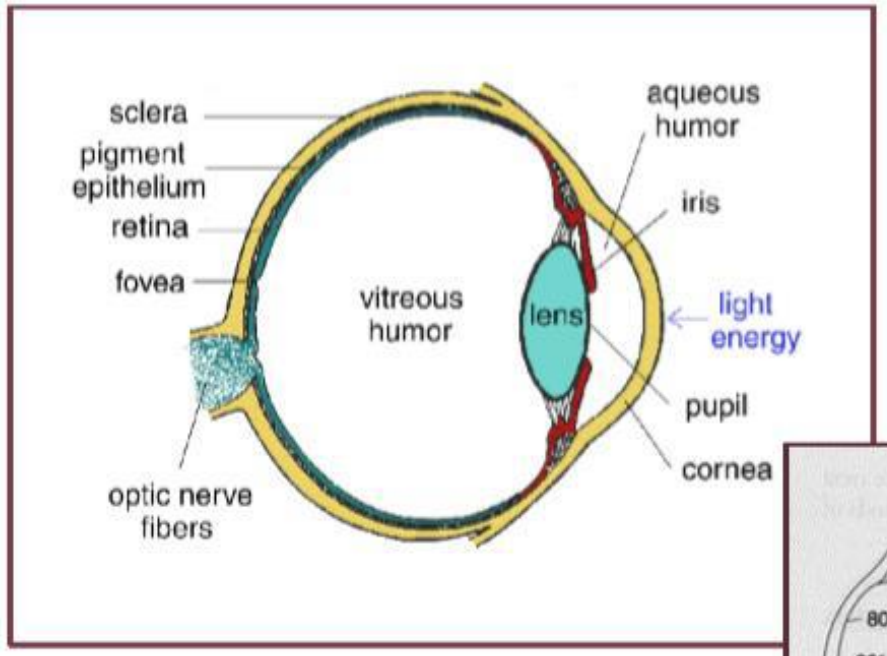


Chromatic aberration

Website: https://en.wikipedia.org/wiki/Optical_aberration

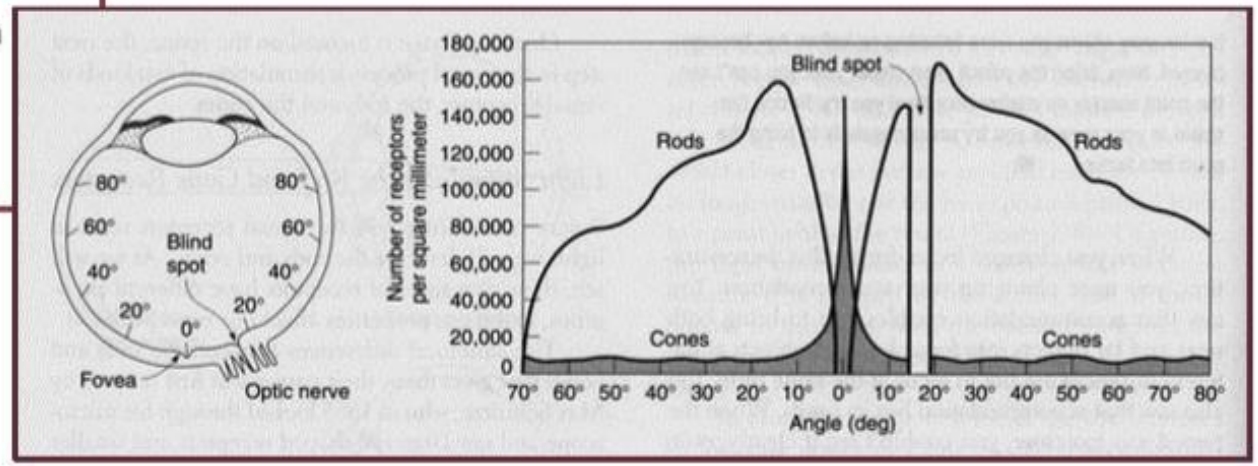
Photo forming (7/7)

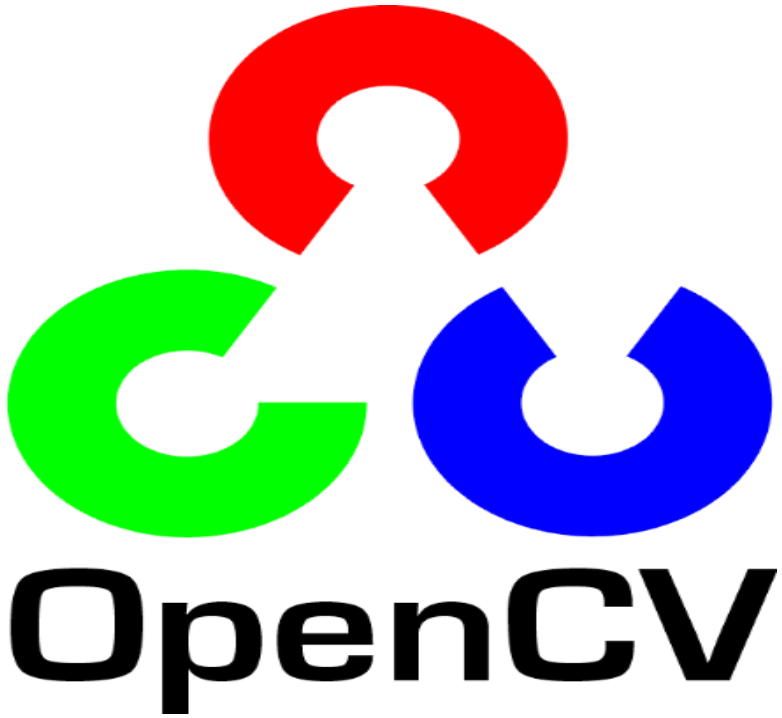
- Human eye and refraction



Large part of refraction occurs at air-cornea interface.

It is fine tune through the crystalline lens.





Website: https://opencv.org/

Website: https://visualstudio.microsoft.com/zh-hant/vs/

Thanks!

Any questions?