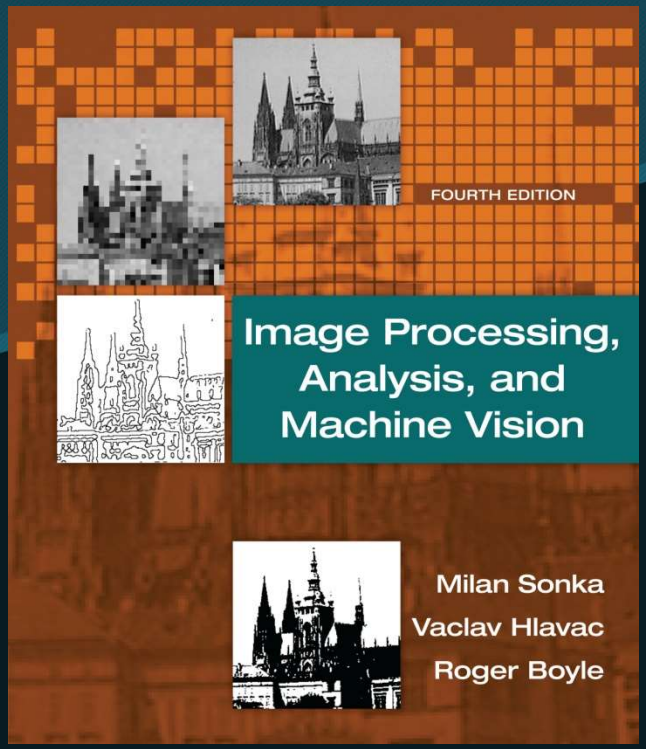
Chapter 1

Introduction



Motivation

- Video
  - Frame v.s. image

Figure 1.1: A frame from a video of a typical farmyard scene: the cow is one of a number walking naturally from right to left. *Courtesy of D. R. Magee, University of Leeds.*

Motivation

- Training
  - Creating model

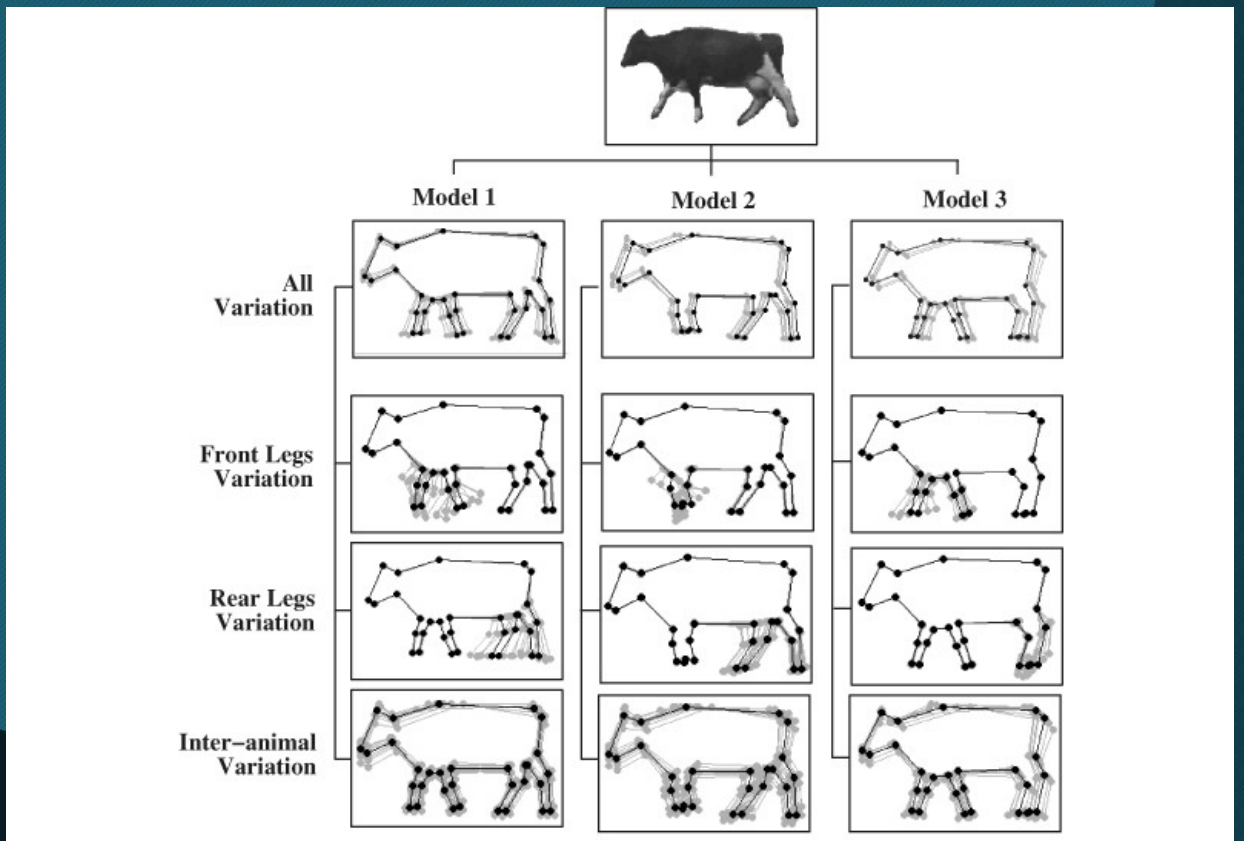


Figure 1.2: Various models for a cow silhouette: a straight-line boundary approximation has been learned from training data and is able to adapt to different animals and different forms of occlusion. *Courtesy of D. R. Magee, University of Leeds.*

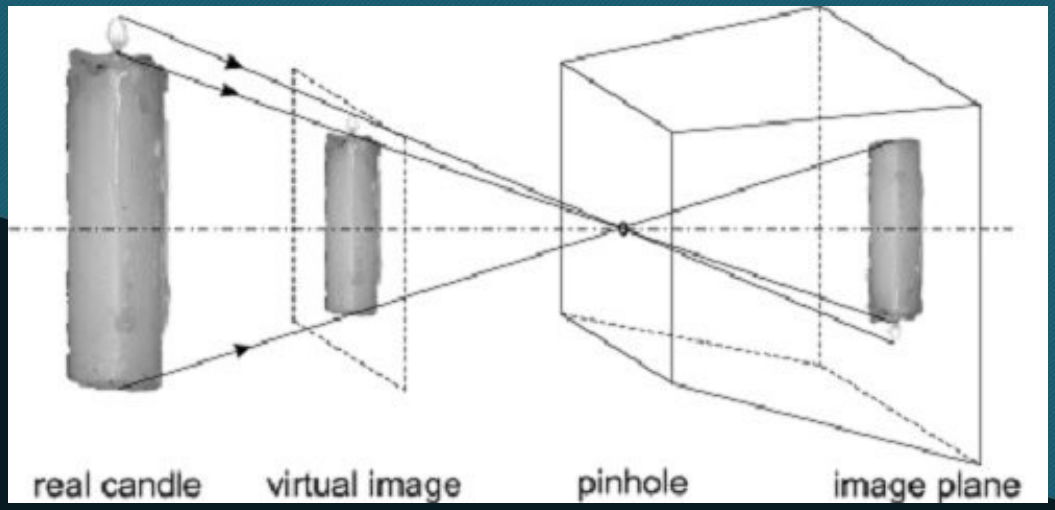
Motivation

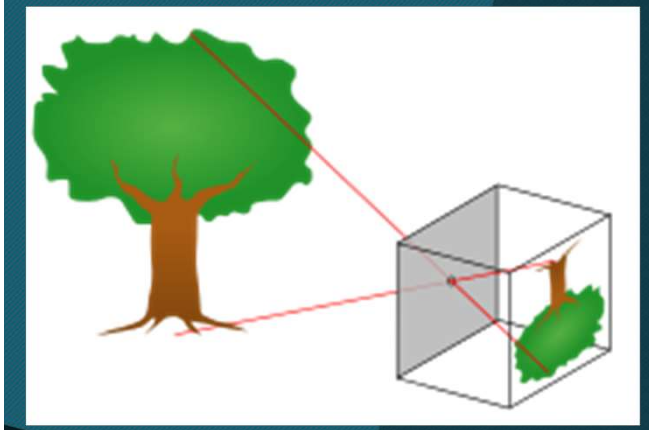
- Detection (testing)

Figure 1.3: Three frames from a cow sequence: notice the model can cope with partial occlusion as the animal enters the scene, and the different poses exhibited. *Courtesy of D. R. Magee, University of Leeds.*

Why is computer vision difficult?

- Loss of information in 3D to 2D
  - The pinhole model of imaging geometry does not distinguish size of objects.





https://en.wikipedia.org/wiki/Pinhole_camera_model

Why is computer vision difficult?

- Interpretation
  - Interpretation: image data → model
  - There may be several interpretations of the same image(s).
- Noise
  - Noise is inherently present in each measurement in the real world.
- Too much data
  - Images are big, and videos are correspondingly bigger.
- Brightness measured
  - Brightness measured in images is given by complicated image formation physics.
  - The brightness depends on the light source type, intensity and position, the observer's position, the surface local geometry, and the surface reflectance properties.
  - The inverse tasks are ill-posed.

Why is computer vision difficult?

- Local window v.s. need for global view
  - Commonly, image analysis algorithms analyze a particular storage bin in an operational memory and its local neighborhood.
  - The computer sees the image through a keyhole.
  - This makes it very difficult to understand more global context.

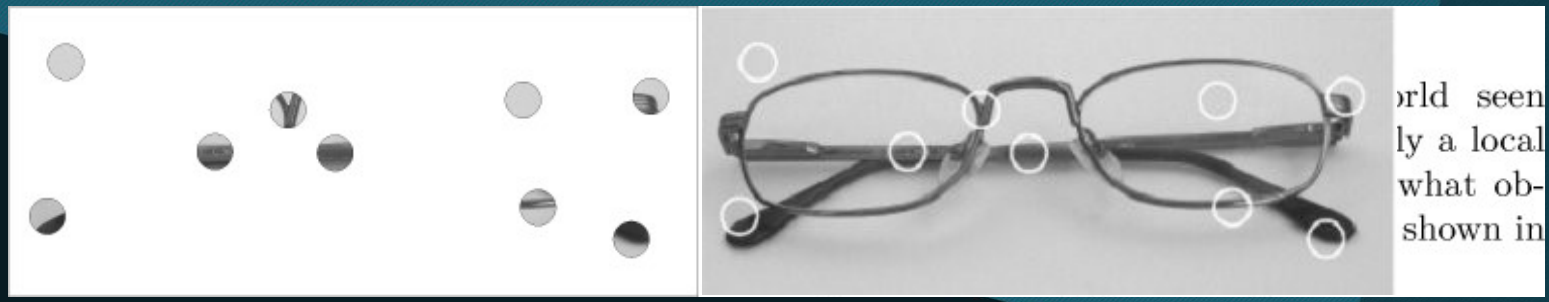


Image representation and image analysis task

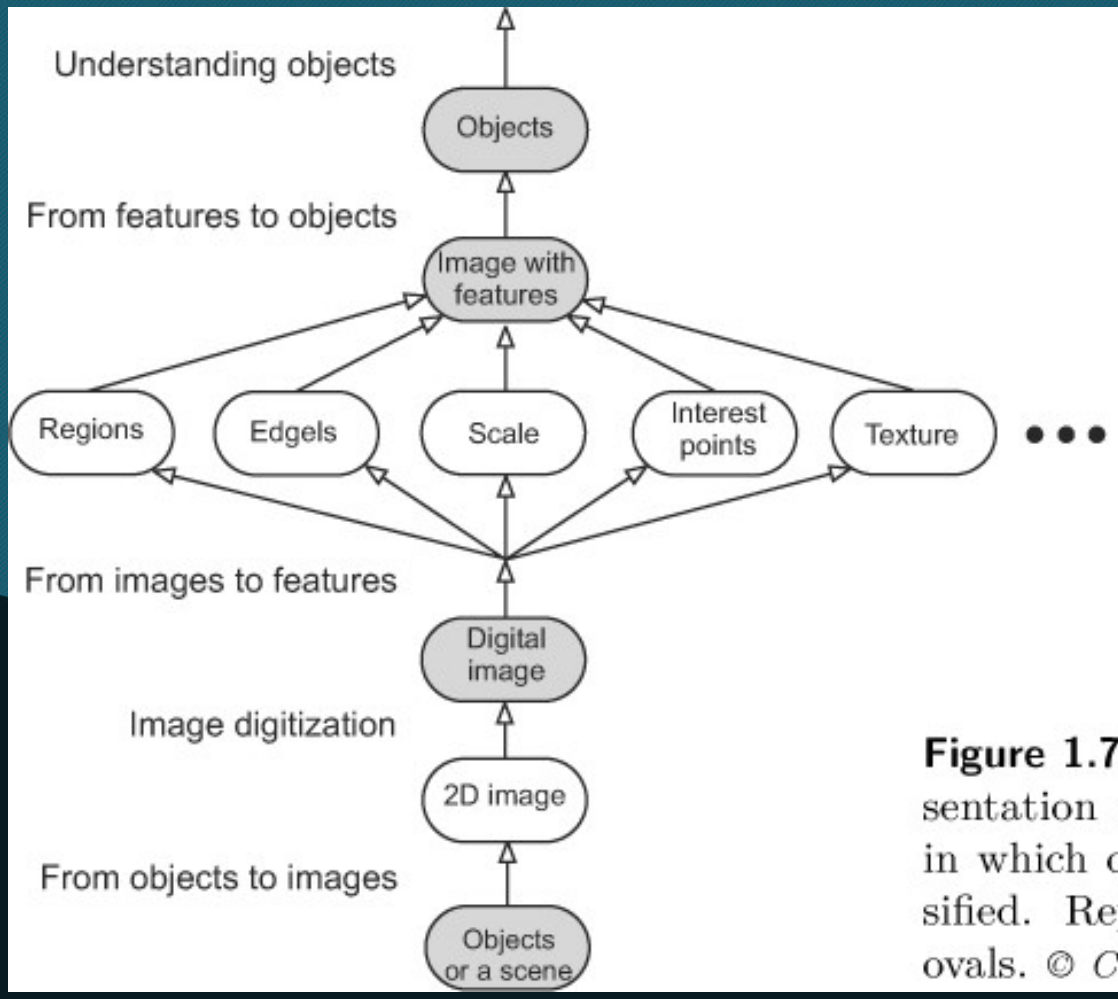


Figure 1.7: Four possible levels of image representation suitable for image analysis problems in which objects have to be detected and classified. Representations are depicted as shaded ovals. © *Cengage Learning 2015.*

Image representation and image analysis task

- Both representations contain exactly the same information.
  - Human observer v.s. machine recognizer

Figure 1.9: Another representation of Figure 1.8. © *R.D. Boyle 2015.*

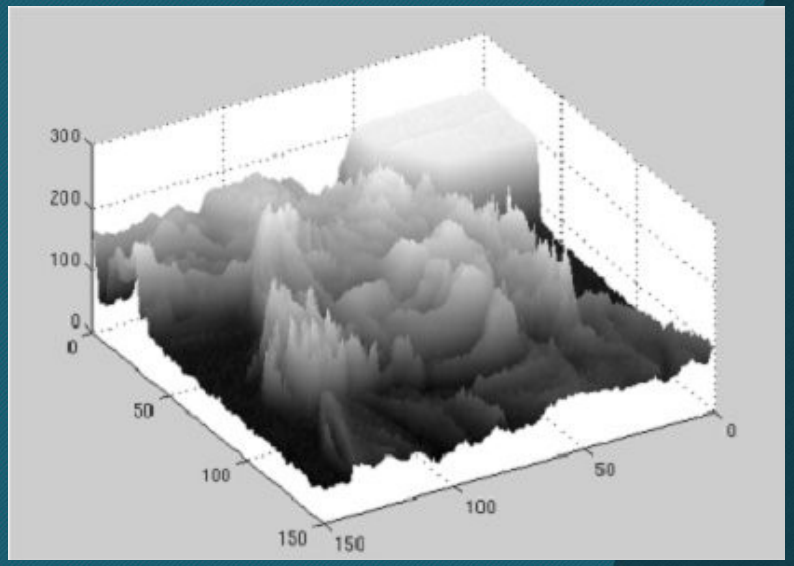
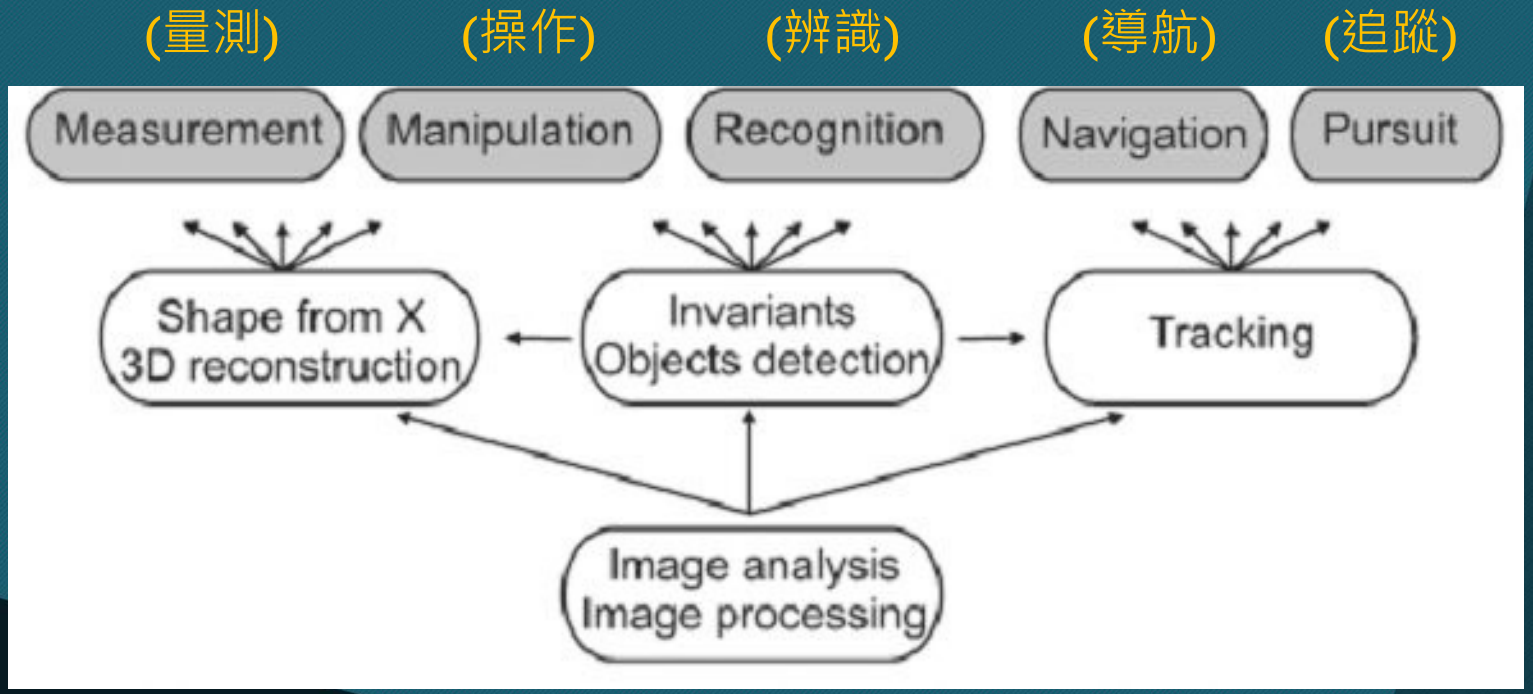


Figure 1.8: An unusual image representation. © *R.D. Boyle 2015.*

Image representation and image analysis task



- Several 3D computer vision tasks from the user's point of view are on the upper line.
- Algorithm components on different hierarchical levels support it in a bottom-up fashion.

Homework 1 :
image read/write and rotation

作業一：
影像的讀寫與旋轉