Image Basics

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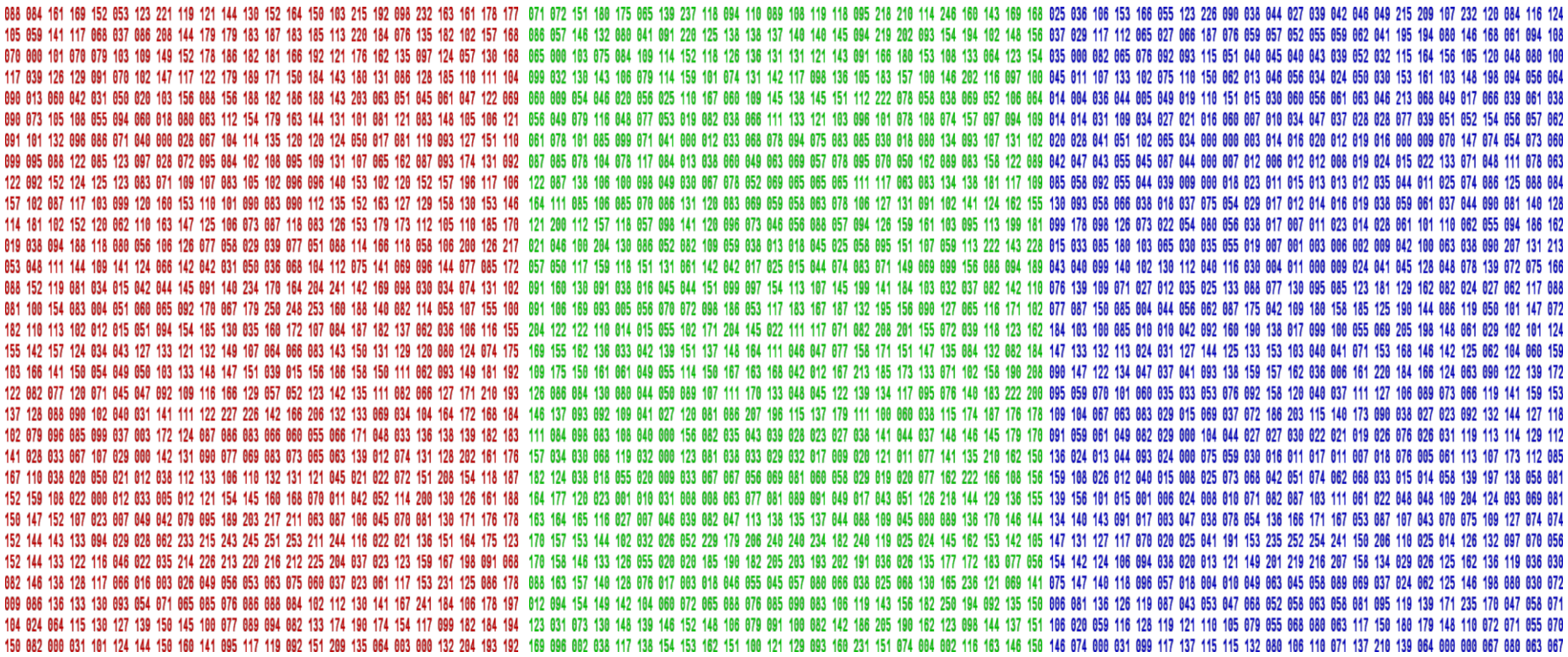
Many slides in this lecture are due to other authors; they are credited on the bottom right

The dream of a machine that can see

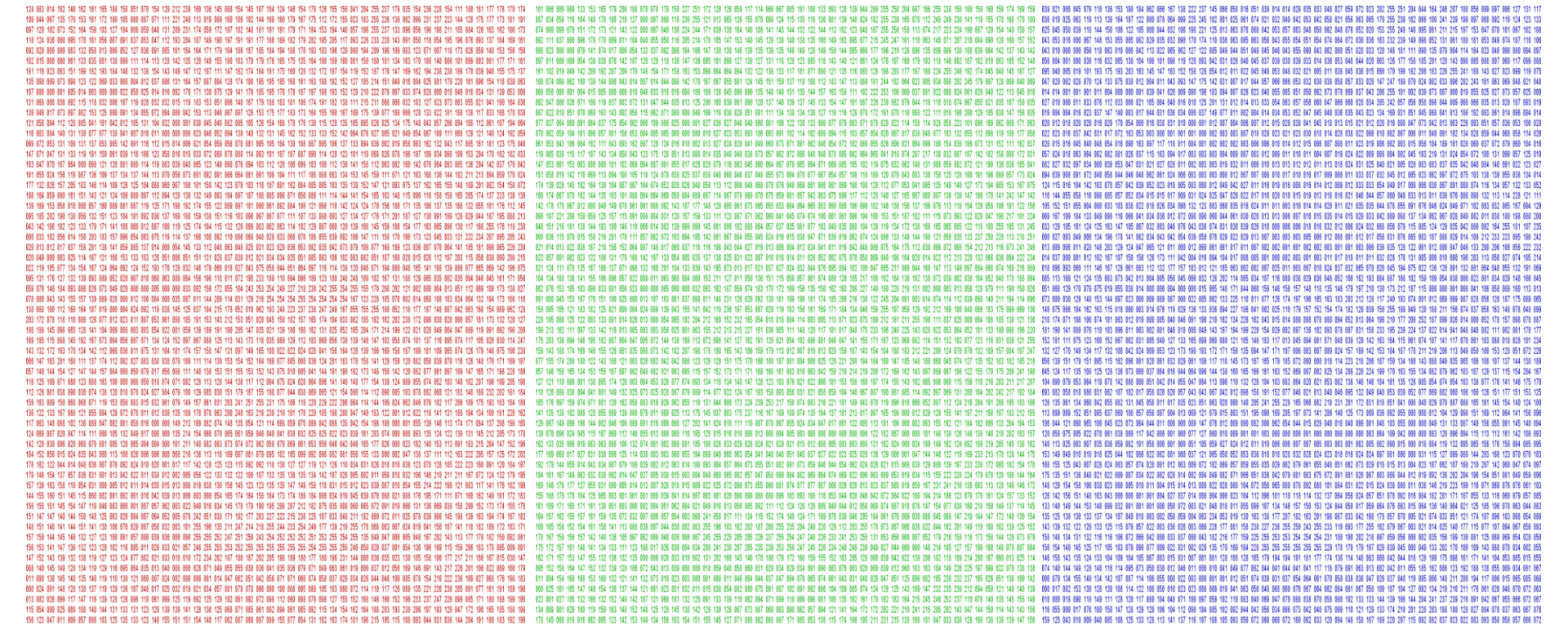
credit: The Terminator (1984) dir James Cameron

First encounter



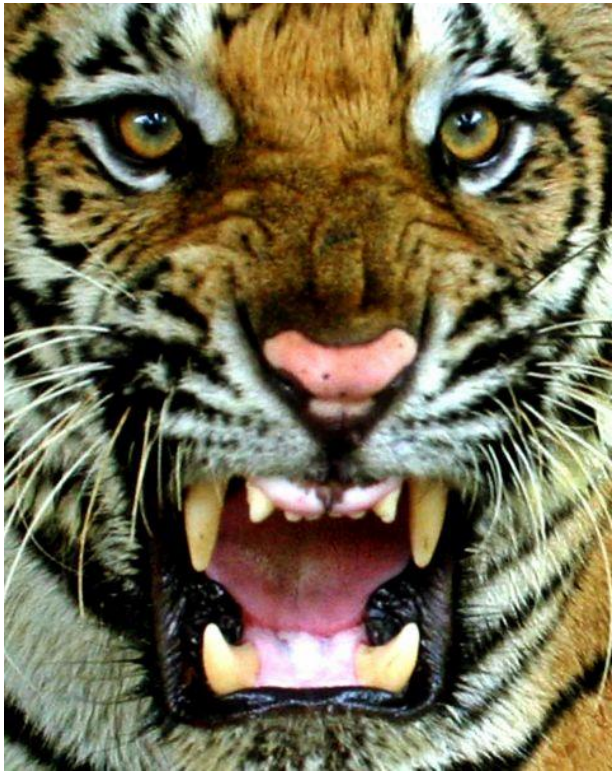
What do you see ?

Second centroid



And now ?

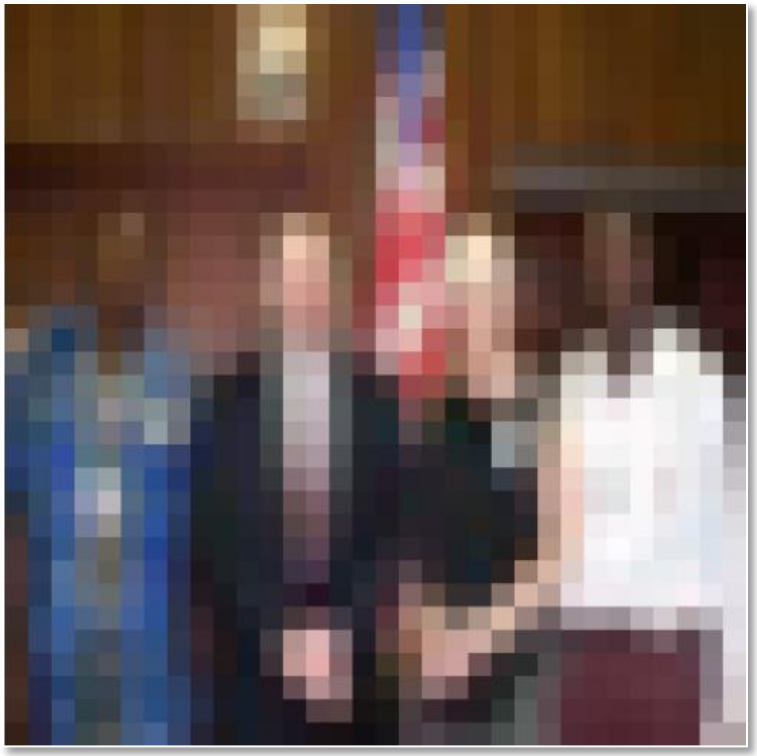
First encounter



Rapid visual recognition is important !

The goal of computer vision

To extract “meaning” from pixels



Humans are remarkably good at this…

Source: “80 million tiny images” by Torralba et al.

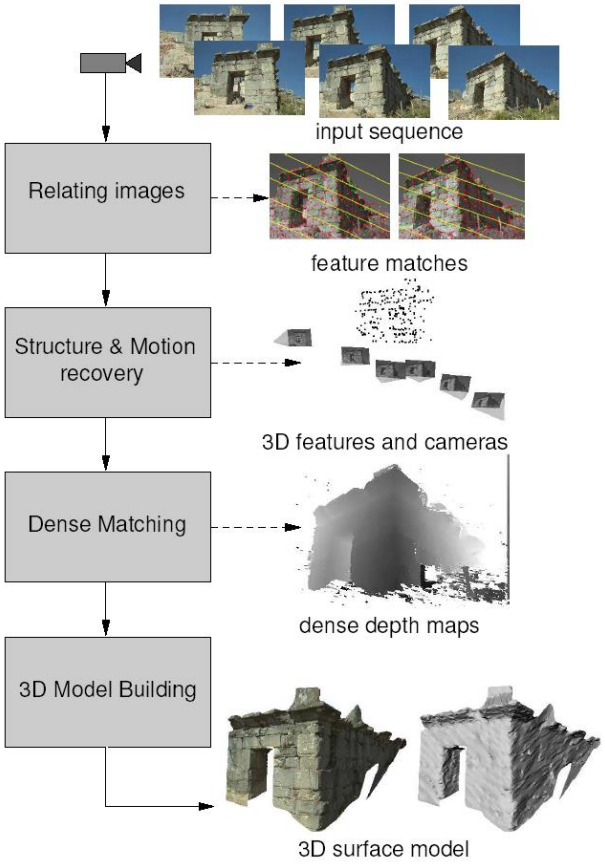
What kind of information can be extracted from an image?

- 2D/3D measurements
- Semantics / meaning
- Counts
- Quantities used for decisions (e.g. medical)

Vision as measurement device

NASA Mars Rover

Pollefeys et al.



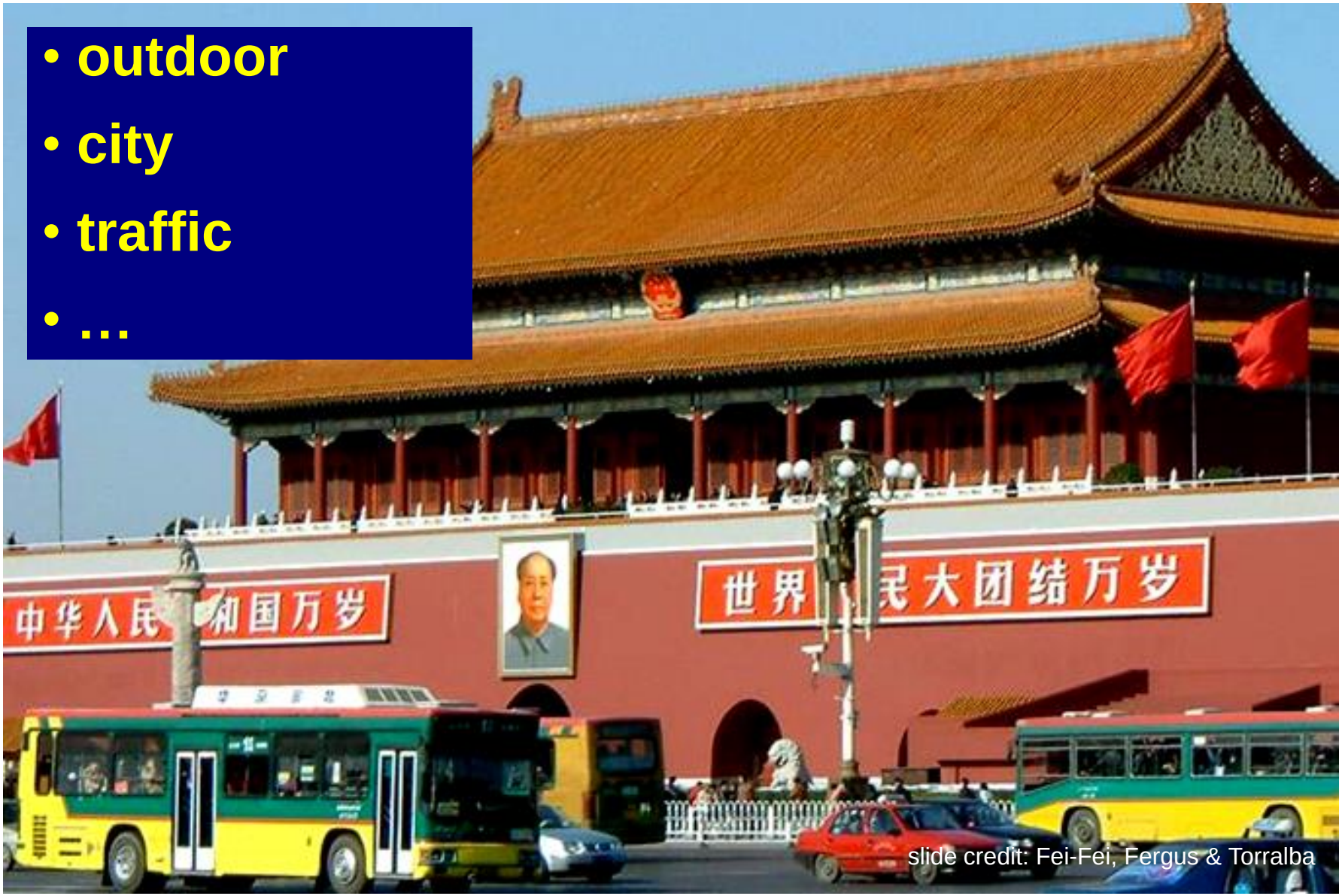
Goesele et al.

Vision as a source of semantic information

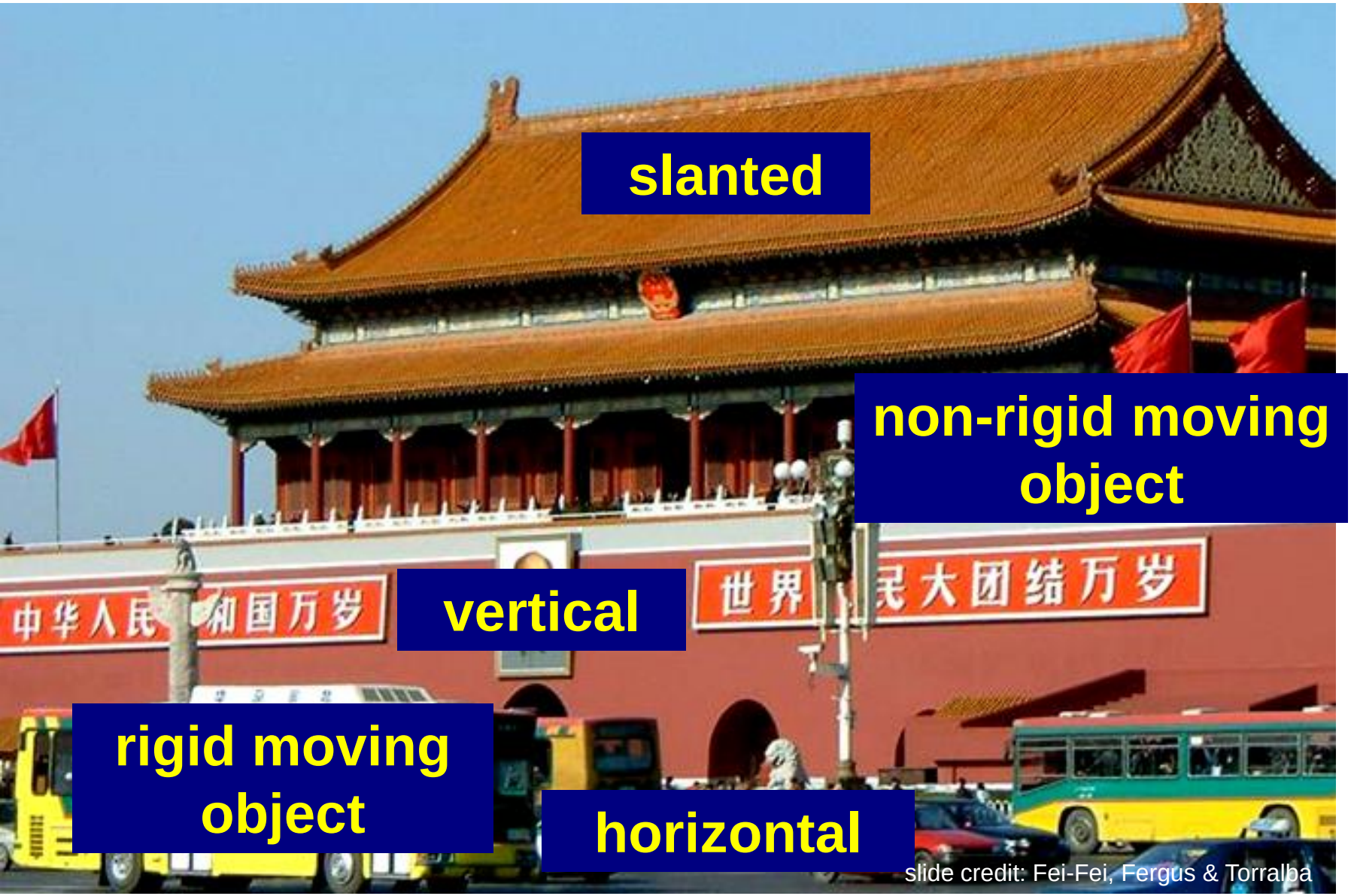
slide credit: Fei-Fei, Fergus & Torralba

Object categorization

Scene and context categorization



Qualitative spatial information



Why is computer vision difficult?

Challenges: viewpoint variation

Michelangelo 1475-1564

slide credit: Fei-Fei, Fergus & Torralba

Challenges: illumination

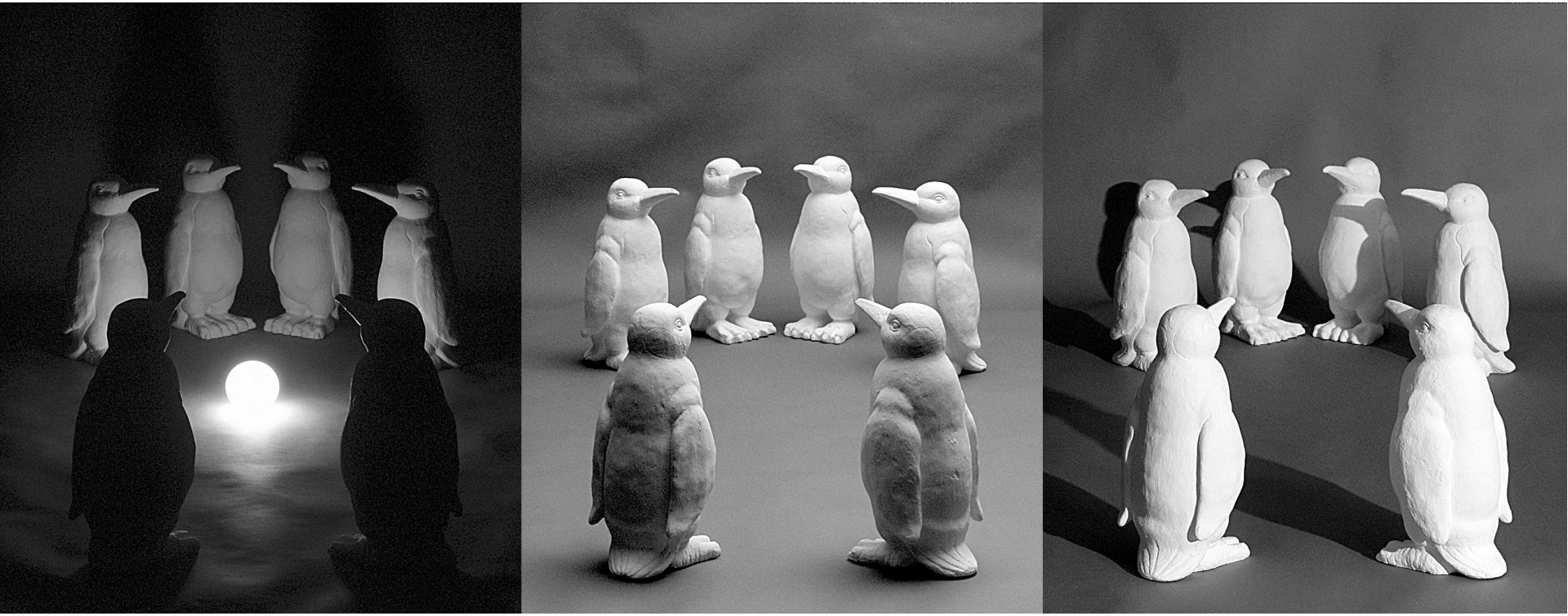
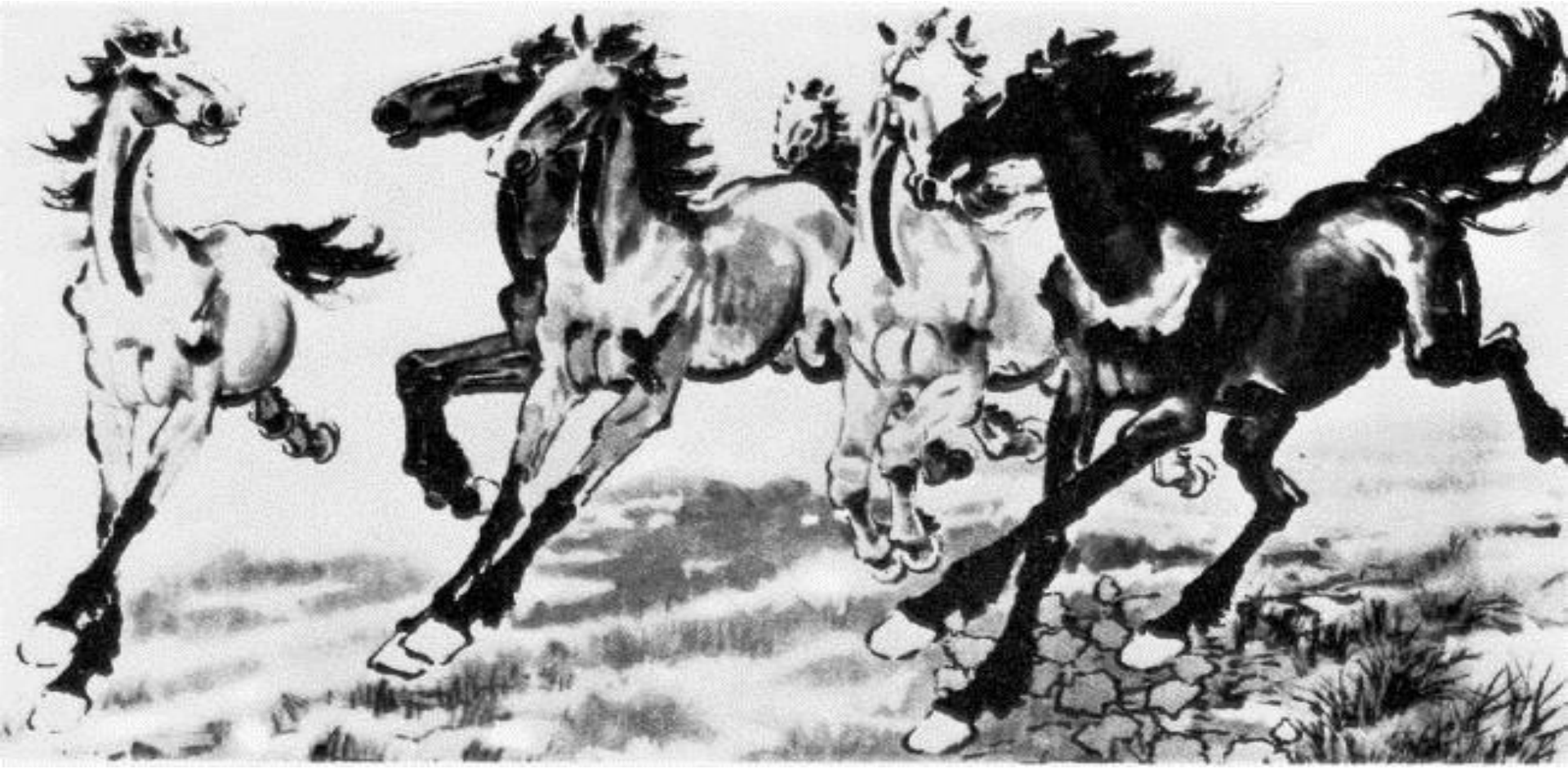


image credit: J. Koenderink

Challenges: scale

slide credit: Fei-Fei, Fergus & Torralba

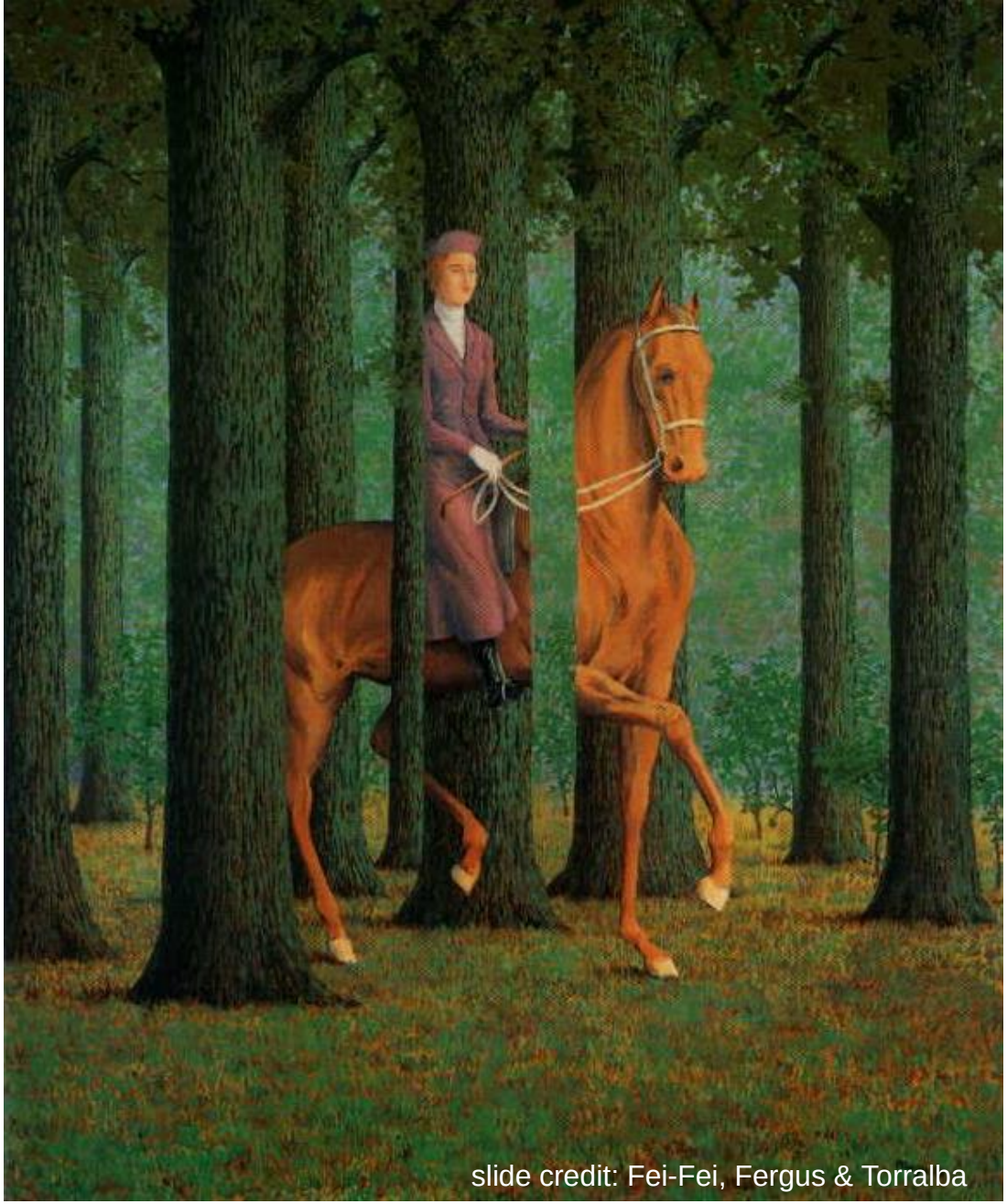
Challenges: non-rigid deformation



Xu, Beihong 1943

slide credit: Fei-Fei, Fergus & Torralba

Challenges: occlusion



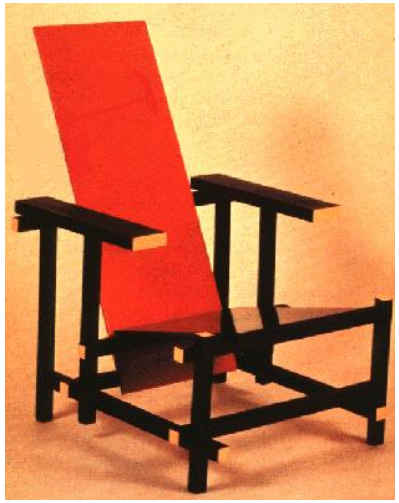
slide credit: Fei-Fei, Fergus & Torralba

Magritte, 1957

Challenges: background clutter

credit V. Ferrari

Challenges: object intra-class variation



slide credit: Fei-Fei, Fergus & Torralba

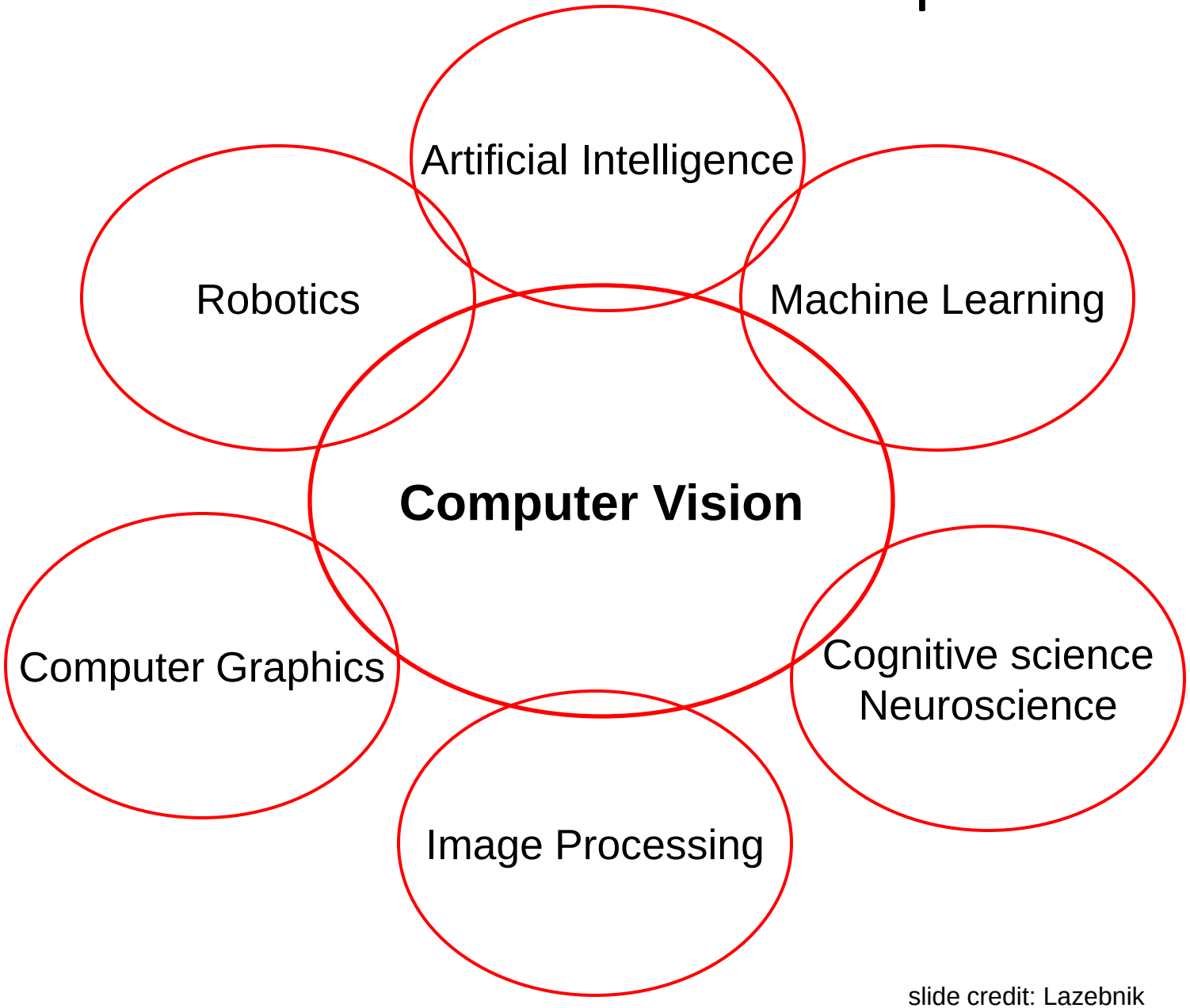
Inherent ambiguity of the problem

- Many different 3D scenes could have given rise to a particular 2D image

- Possible solutions
  - Bring in more constraints (more images)
  - Use prior knowledge about the structure of the world
- Need a combination of geometric and statistical methods

slide credit: Lazebnik

Connections to other disciplines



slide credit: Lazebnik

What have we learned?

- Images are numbers – hard to interpret
- Many kinds of results extractable from images
- Many issues make image analysis difficult
- Computer vision links to (and requires) many topics