Computer Vision

Introduction

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Literature:

- Sonka, M., Hlavac, V., Boyle R.: Image Processing, Analysis, and Machine Vision, Thomson Learning, 2008
- Szeliski, R.: Computer Vision: Algorithms and Applications, 2010
- Šikudová E., et al.:Počítačové videnie. Detekcia a rozpoznávanie objektov.

Webpage: https://flurry.dg.fmph.uniba.sk/webog/sk/balko-vyucba/101-balko/439-pocitacove-videnie

What is computer vision

- Describe the world that we see in one or more pictures and reconstruct its properties.

What do you see on this picture?

What is computer vision

What about this one?

How to make a computer to see

- Try to imitate our visual system.

How to make a computer to see

- Try to imitate our visual system.

Problem?

How to make a computer to see

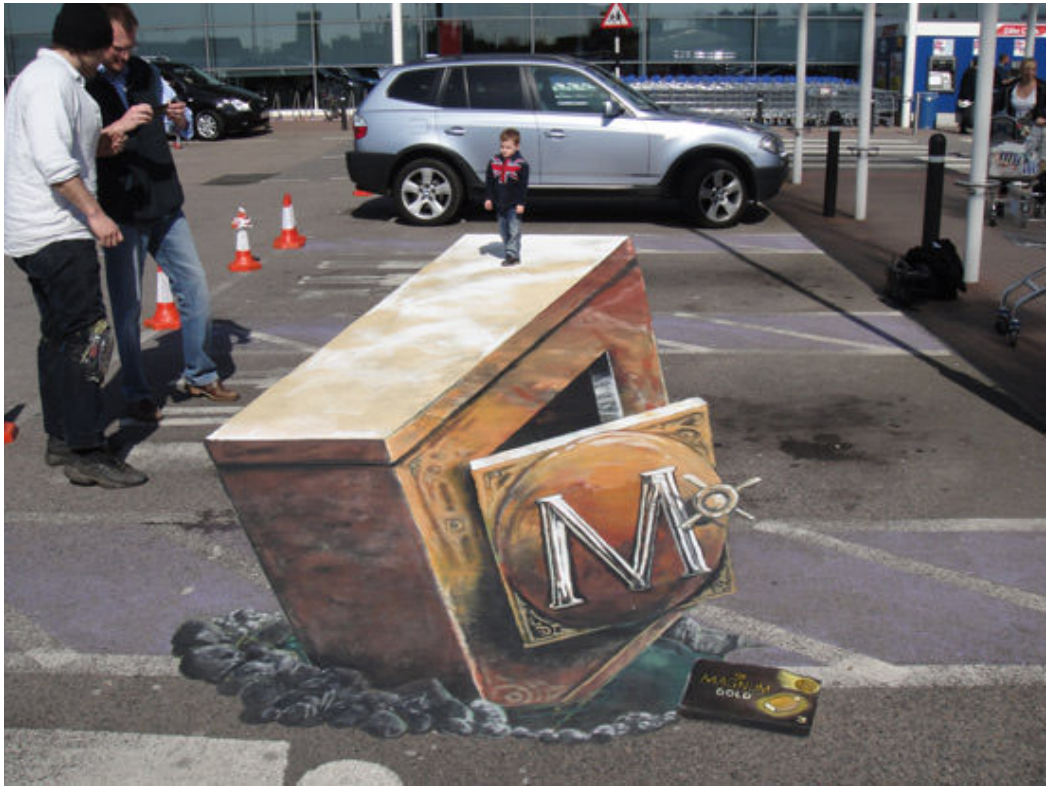
- Try to imitate our visual system.

Problem?

- We do not fully understand how our visual system works.

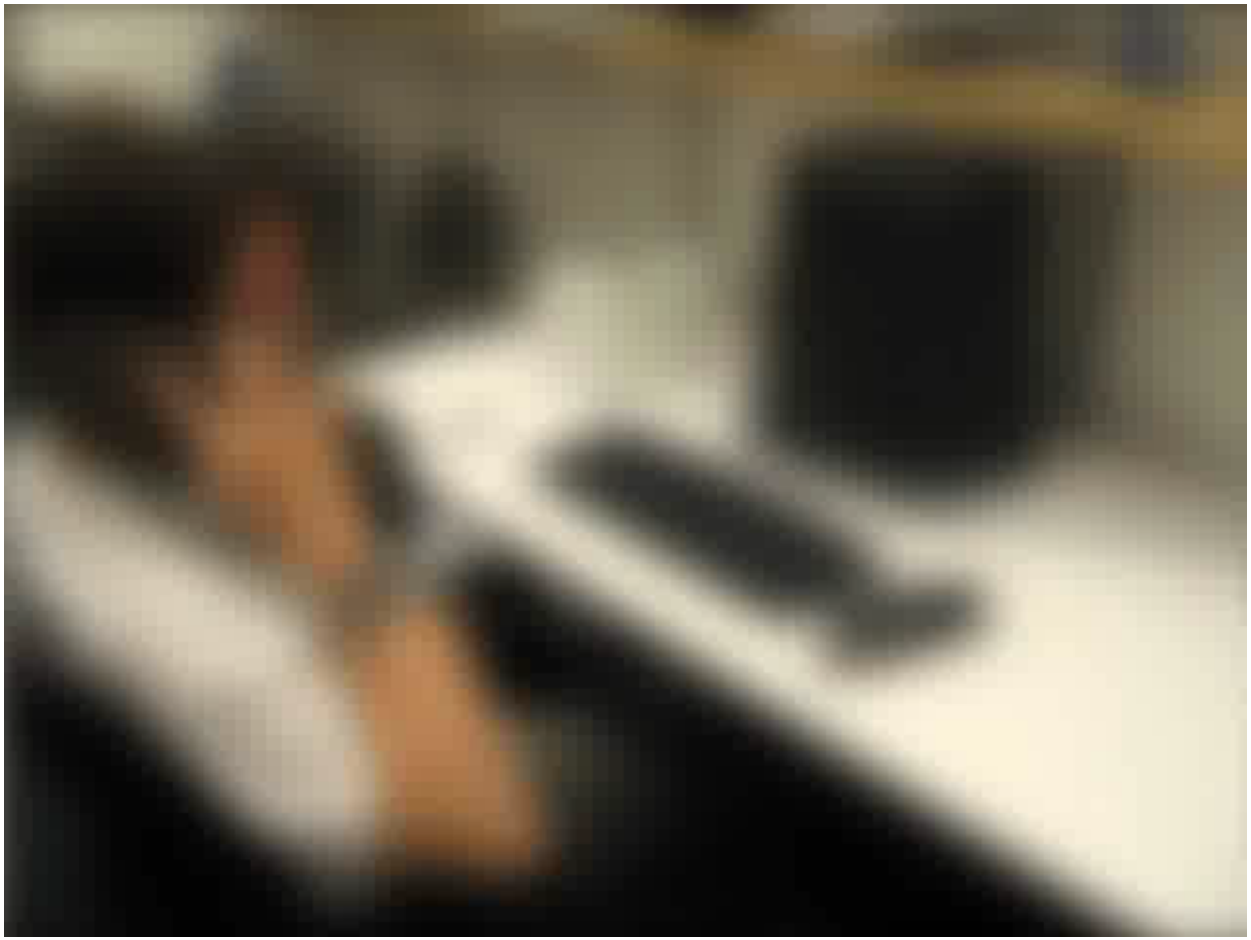
Computer vision difficulties

- Loss of information



Computer vision difficulties

- Interpretation



Computer vision difficulties

- Interpretation

Computer vision difficulties

- Local vs. global view

Figure: From Sonka, Hlavac, Boyle: Image Processing, Analysis, and Machine vision

Computer vision difficulties

- Local vs. global view

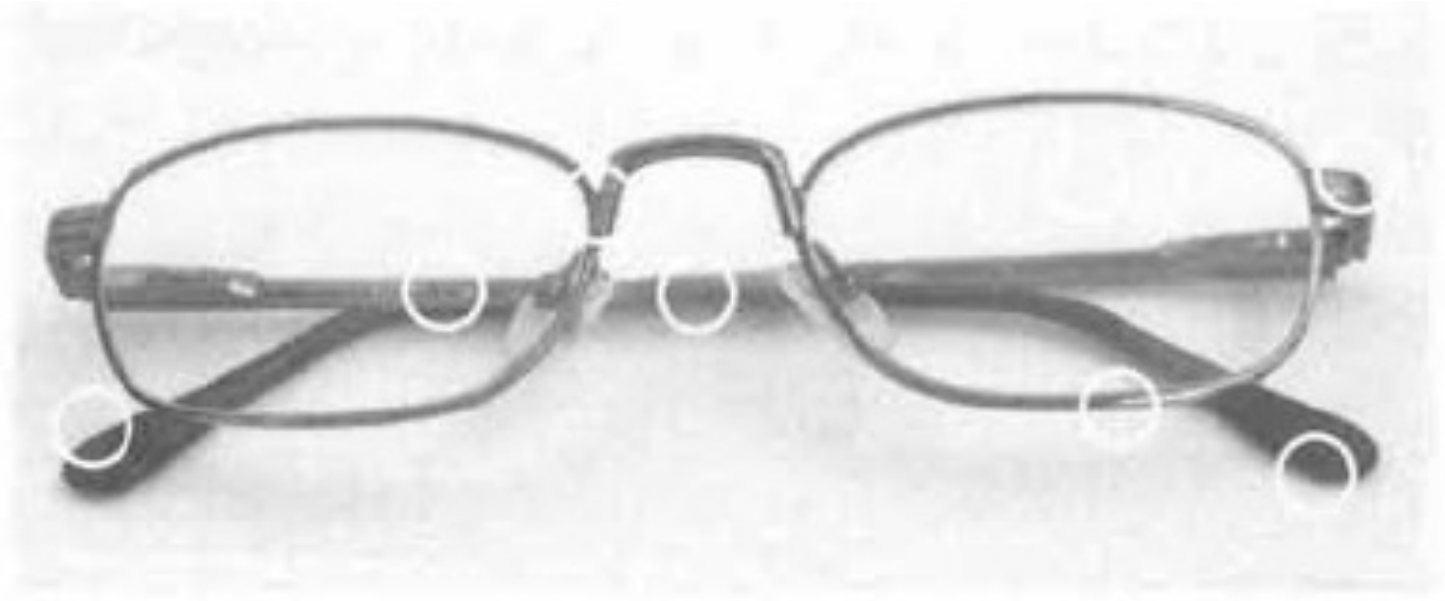


Figure: From Sonka, Hlavac, Boyle: Image Processing, Analysis, and Machine vision

Computer vision difficulties

- Noise
- Too much data
- Brightness measured
- ...

Image analysis

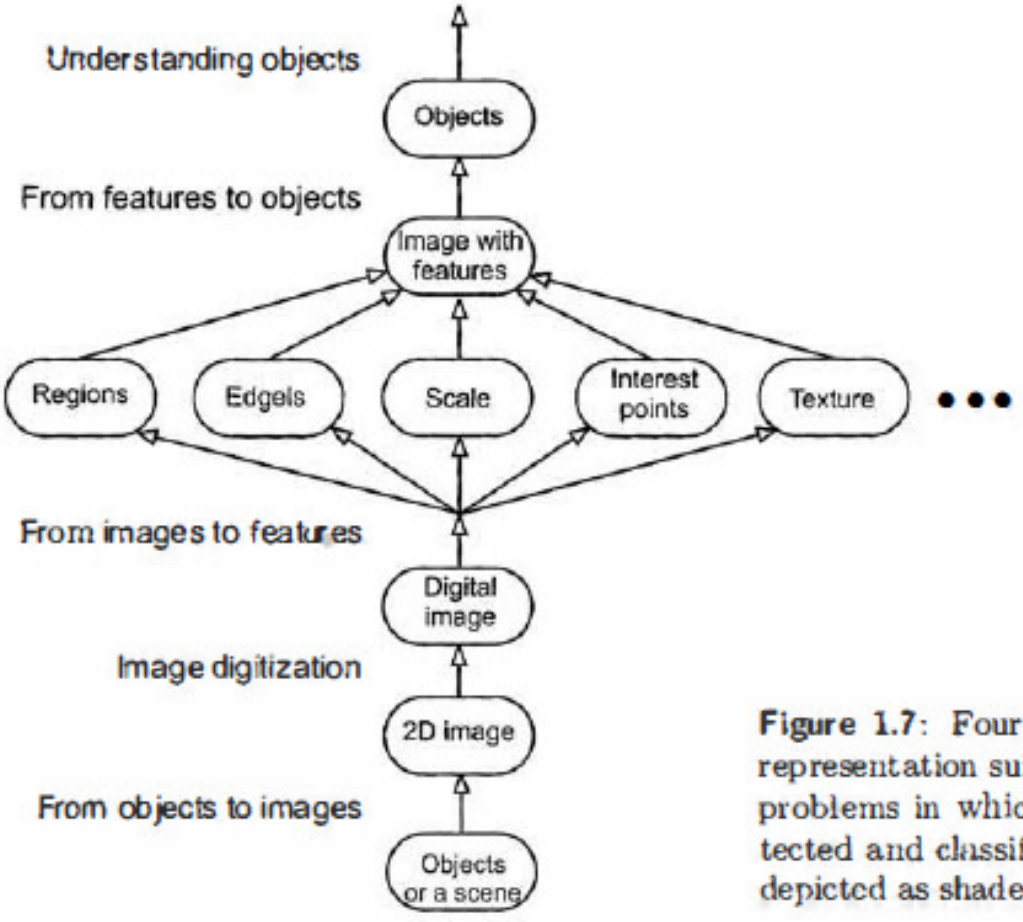


Figure 1.7: Four possible levels of image representation suitable for image analysis problems in which objects have to be detected and classified. Representations are depicted as shaded ovals.

Figure: From Sonka, Hlavac, Boyle: Image Processing, Analysis, and Machine vision

Image analysis

Low-level image processing

- uses data which resemble the input image,
- noise filtering, edge extraction, image sharpening...

High-level image processing

- Starts with a model of the world,
- compares this model with 'reality' in the form of digitized images,
- (partial) matches are sought,
- updates the model by information obtained by low-level processing,
- repeats the process iteratively.

Image representation–what does the computer 'see'

Can you tell what this image represents?

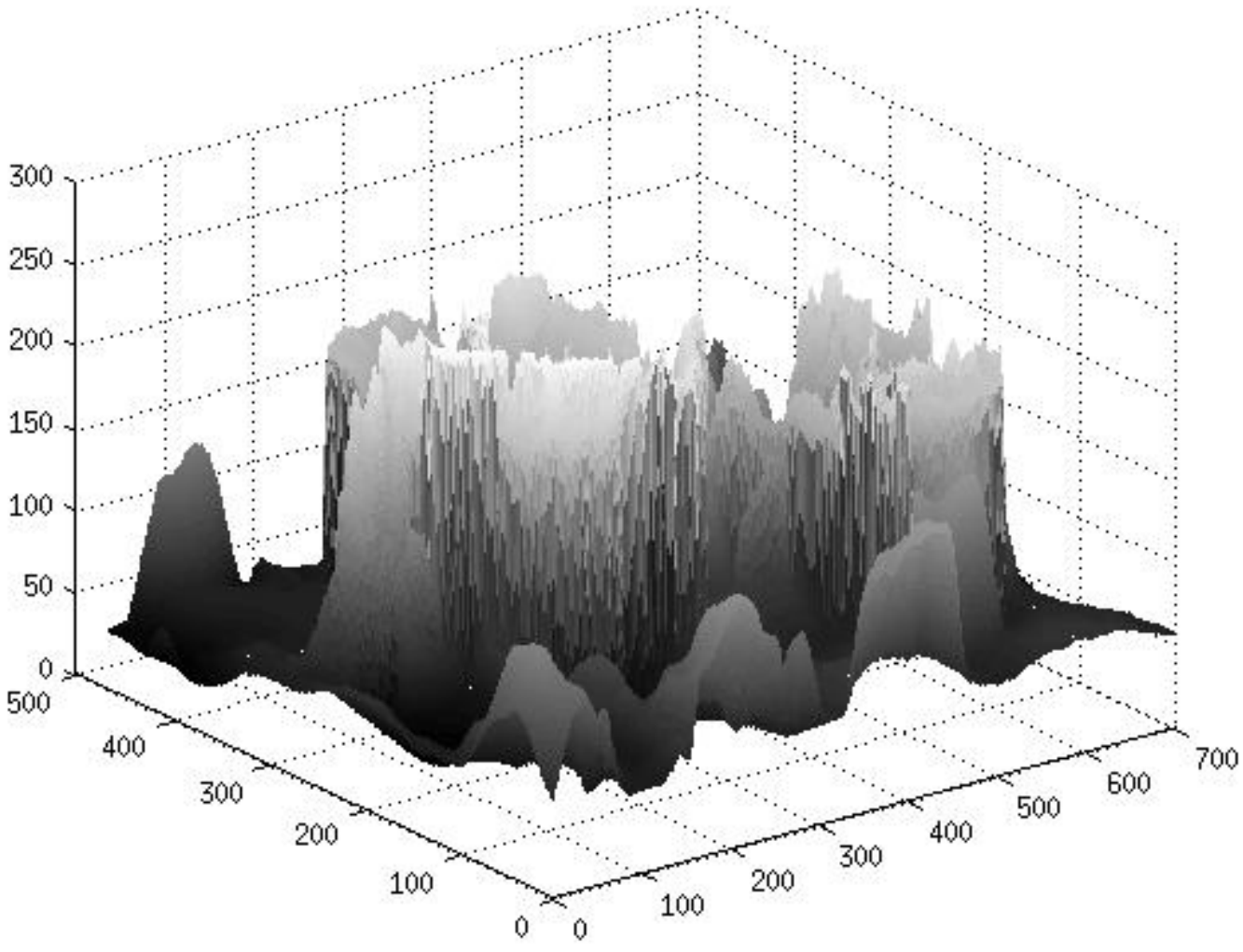


Image representation–what does the computer 'see'

We have already seen it.

Applications of computer vision

Applications of computer vision

- Industry, e.g. quality control

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- Autonomous cars

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- Robot vision

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- Medicine

Applications of computer vision

- Industry, e.g. quality control
- Autonomous cars
- Robot vision
- Photography
- Medicine
- Entertainment
- ...

Image representation

Image as *continuous function* of continuous intensities

- Continuous domain and range

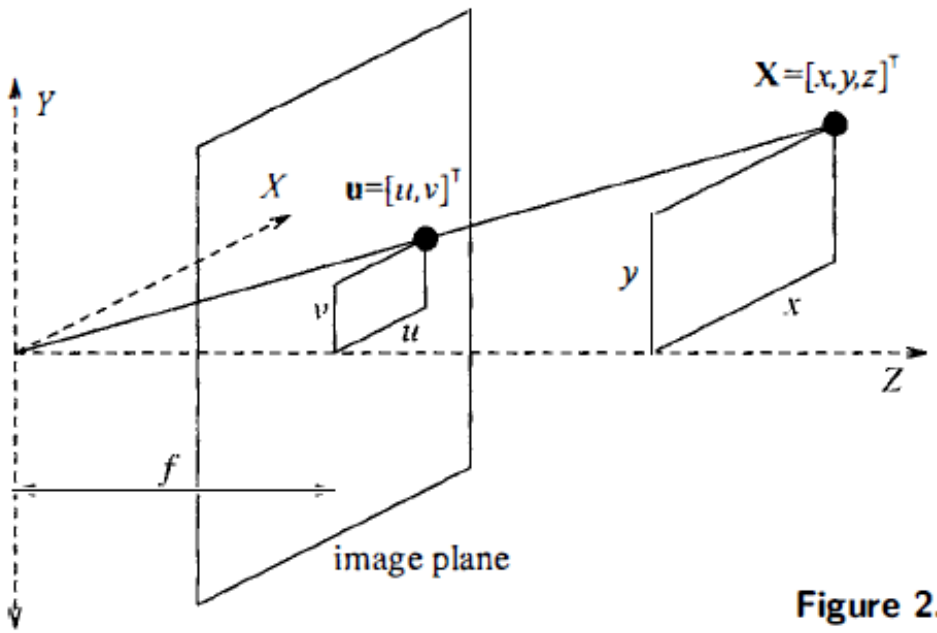

Figure 2.1: Perspective projection geometry.

Image representation

Image as a *discrete function* of intensities

- Discrete domain, continuous range
- Obtained by sampling a continuous image function
- Sampling causes problems – aliasing

Image as a *digital function*

- Discrete domain and range
- Obtained by quantization
- Possible false contours

Digital image acquisition

- Photosensitive sensors, e.g. CCD or CMOS
- Usually arranged in a grid
- Measure intensity of light, i.e. obtain gray-scale image.
- Use various methods to obtain colour images, Bayer filter is probably the most used. (Image from [Szeliski] pg. 86)

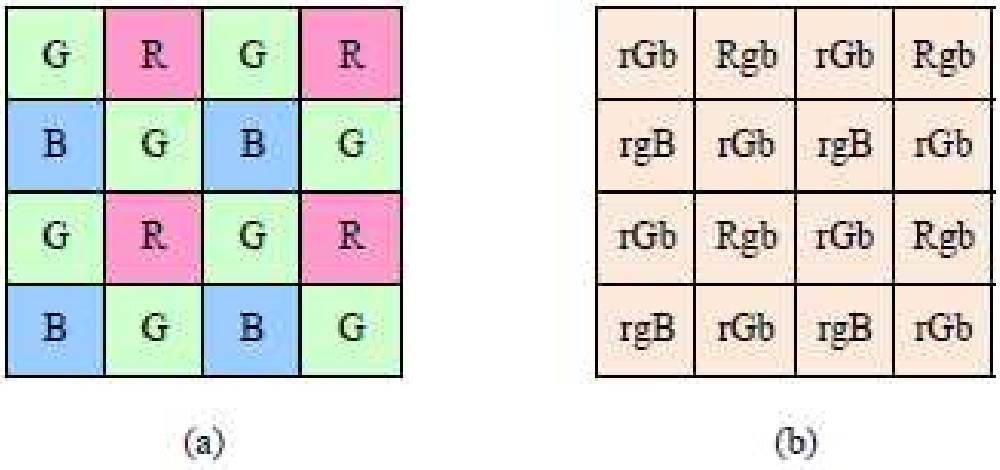

Figure 2.30 Bayer RGB pattern: (a) color filter array layout; (b) interpolated pixel values, with unknown (guessed) values shown as lower case.

Digital image acquisition

- For more information about digital cameras see part 2.3 of Szeliski's book or 2.5 in [Sonka, Hlavac Boyle]

Next lecture

- Image as a signal
- Frequency domain, Fourier analysis