

# 02501 Image analysis, vision, and computer graphics

*Kursusansvarlig:*

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<http://www.imm.dtu.dk/courses/02501>

# Min Baggrund

Deltidslektor ved DTU Informatik

Teknisk direktør, stifter af Videometer A/S

Adjungeret professor ved KU Life

Uddannet civilingeniør, Ph.D. fra IMM/DTU

# Lecture 1

**8.00 Introduction - Digital image analysis, vision and computer graphics**

**8.15 Course outline – Practical matters**

**8.45 Break**

**8.55 Digital images I**

**9.30 Break**

**9.40 Digital images II**

**10.10 Forming of groups**

**10.20 Exercise 1 in the databar**

**12.00 End of lecture 1**

# Image analysis ?



Source: [www.louvre.fr](http://www.louvre.fr)

# Image analysis ?

- Rembrandt / Picasso
- Image editing / manipulation
- Using images when solving a technical problem

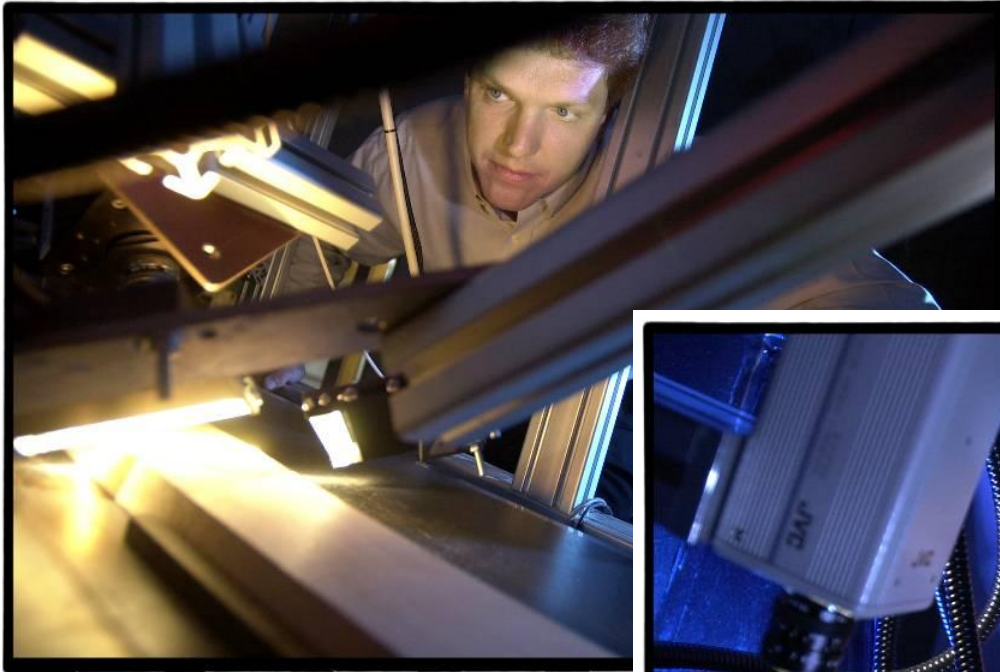
## Digital image analysis ?

- Using digital images when solving a technical problem

# Application domains

- Industrial inspection / quality control
- Robot guidance
- Medical diagnosis and treatment monitoring
- Security and safety
- Traffic control
- Science

# Image analysis at DTU Informatics



# Industrial vision system



**Automatisk sortering  
af klæberskiver**

**Coloplast A/S**

**Udviklet i samarbejde med  
ProInvent A/S - Teknologiuudvikling  
Videometer A/S - Visionsteknologi**

# Food sorting

Example: Raw Peanuts with stones, sticks, corn, colored glass and in-shell



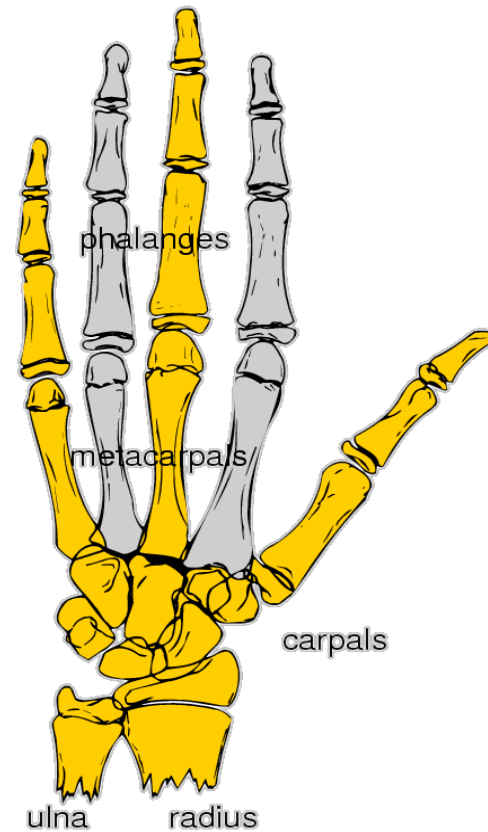
# 3D scanning





# Robot guidance

# Metacarpals



# Course homepage

- [www.imm.dtu.dk/courses/02501](http://www.imm.dtu.dk/courses/02501)

# Visual characteristics

- Color (or Gray level)
- Topographical texture
- Spectral texture
- Gloss
- Shape
- Size
- Position and orientation
- Count

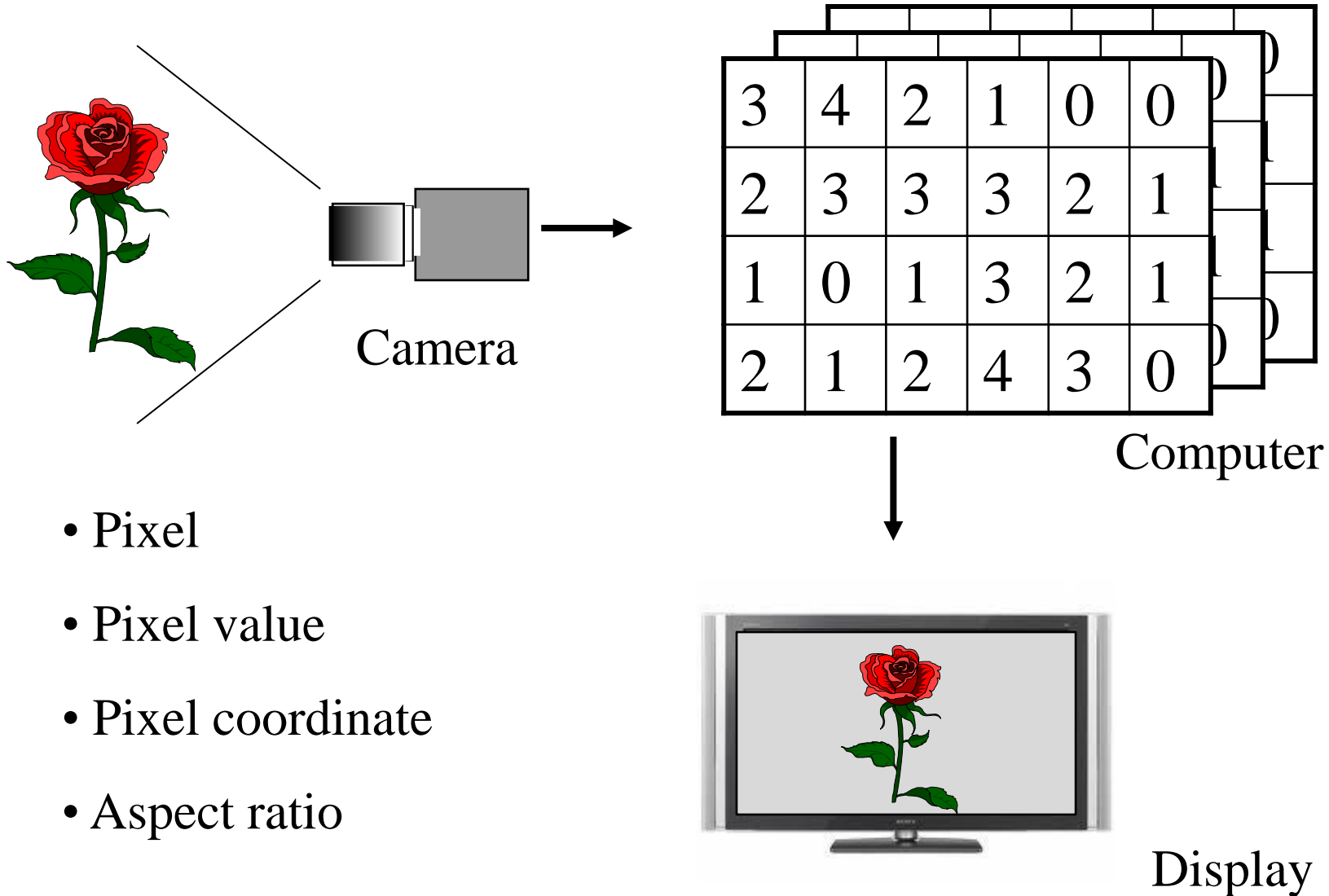


# Why use imaging?

- Mimic human vision
- Eliminate subjective assessment
- Non-homogeneous samples
- Focusing on certain areas of a sample
- When the shape, size and texture of the object is of special interest



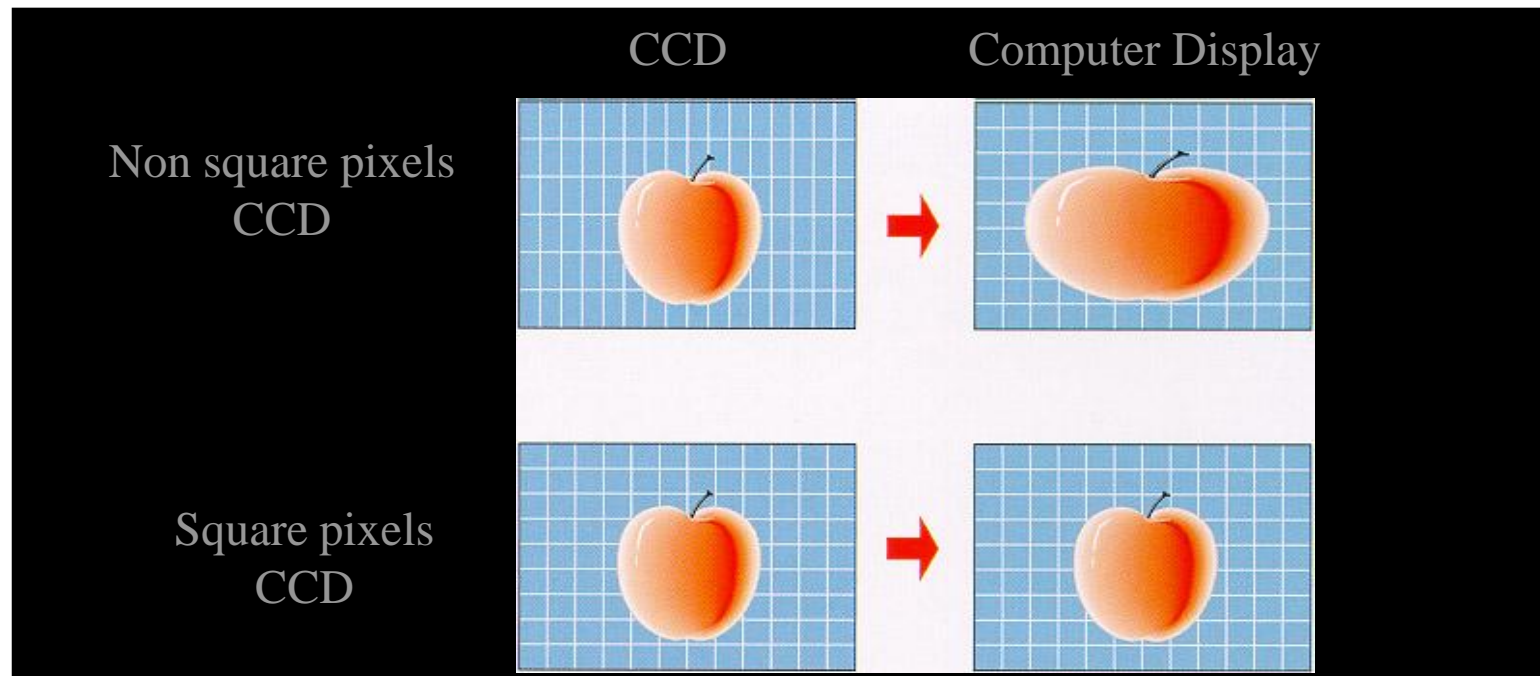
# Image acquisition



- Pixel
- Pixel value
- Pixel coordinate
- Aspect ratio

# Square pixels

- TV standard means non square pixels
- Square pixels simplifies measurements and display



# Resolution

- Spatial resolution
  - Number of rows and columns
  - Pixel dimension
  - Or ?
- Gray level resolution
  - Number of gray levels
  - Or ?
- Contrast!

# Spatial resolution

- 256x256
- 128x128
- 64x64
- 32x32
- 16x16
- 8x8



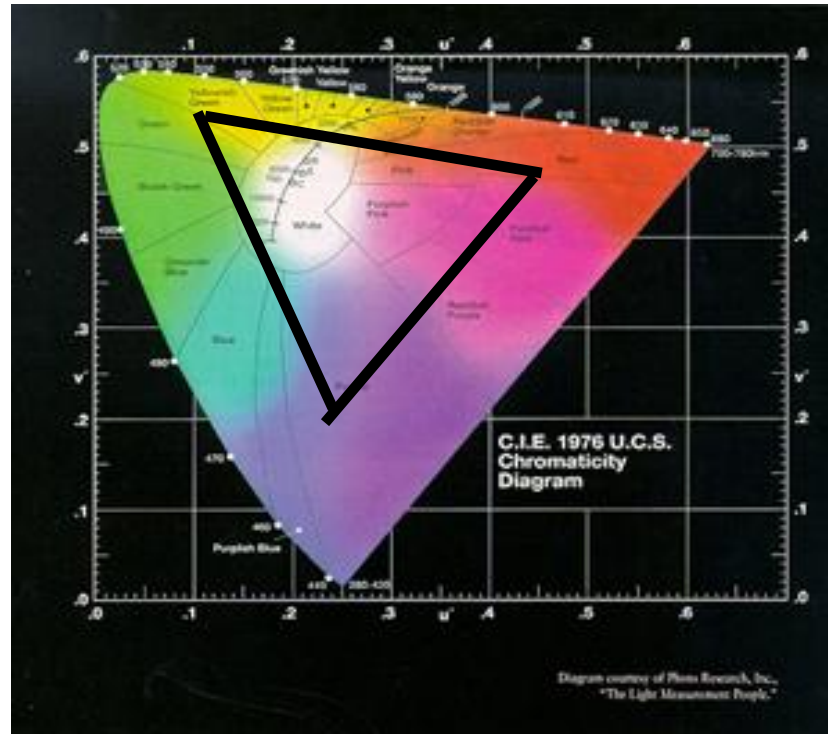
# Gray level resolution

- 256
- 64
- 16
- 8
- 4
- 2



# CIE Colour Chart

Y



X

**Video Camera could not reproduce all area of colour signals.**

# CIE Color

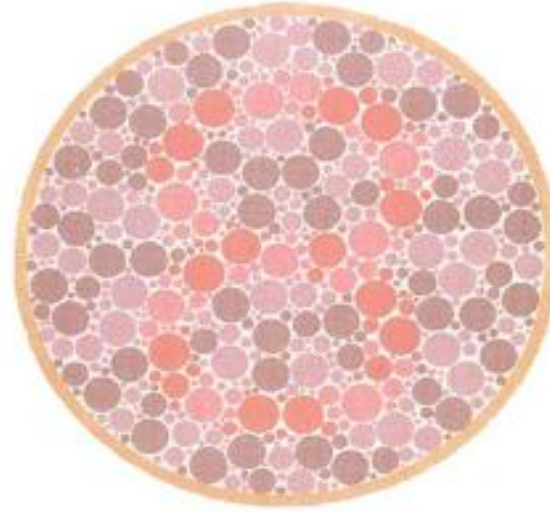
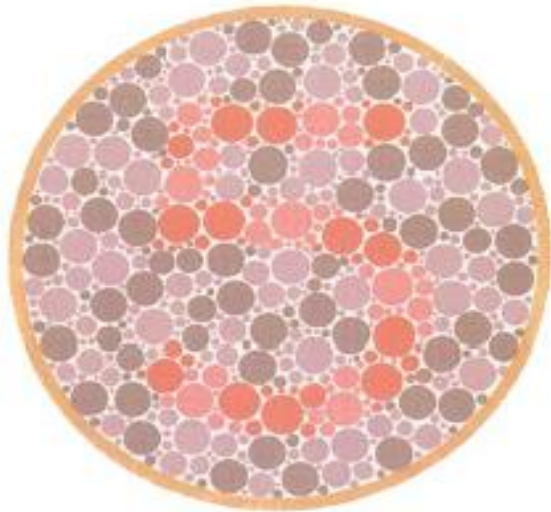
Note. – Perceived color depends on the spectral distribution of the color stimulus, on the size, shape, structure and surround of the stimulus area, on the state of adaption of the observer's visual system, and on the observer's experience of the prevailing and similar situations of observations.

CIE Publication 17.4, International Lighting Vocabulary

CIE = Commission Internationale de l'Eclairage

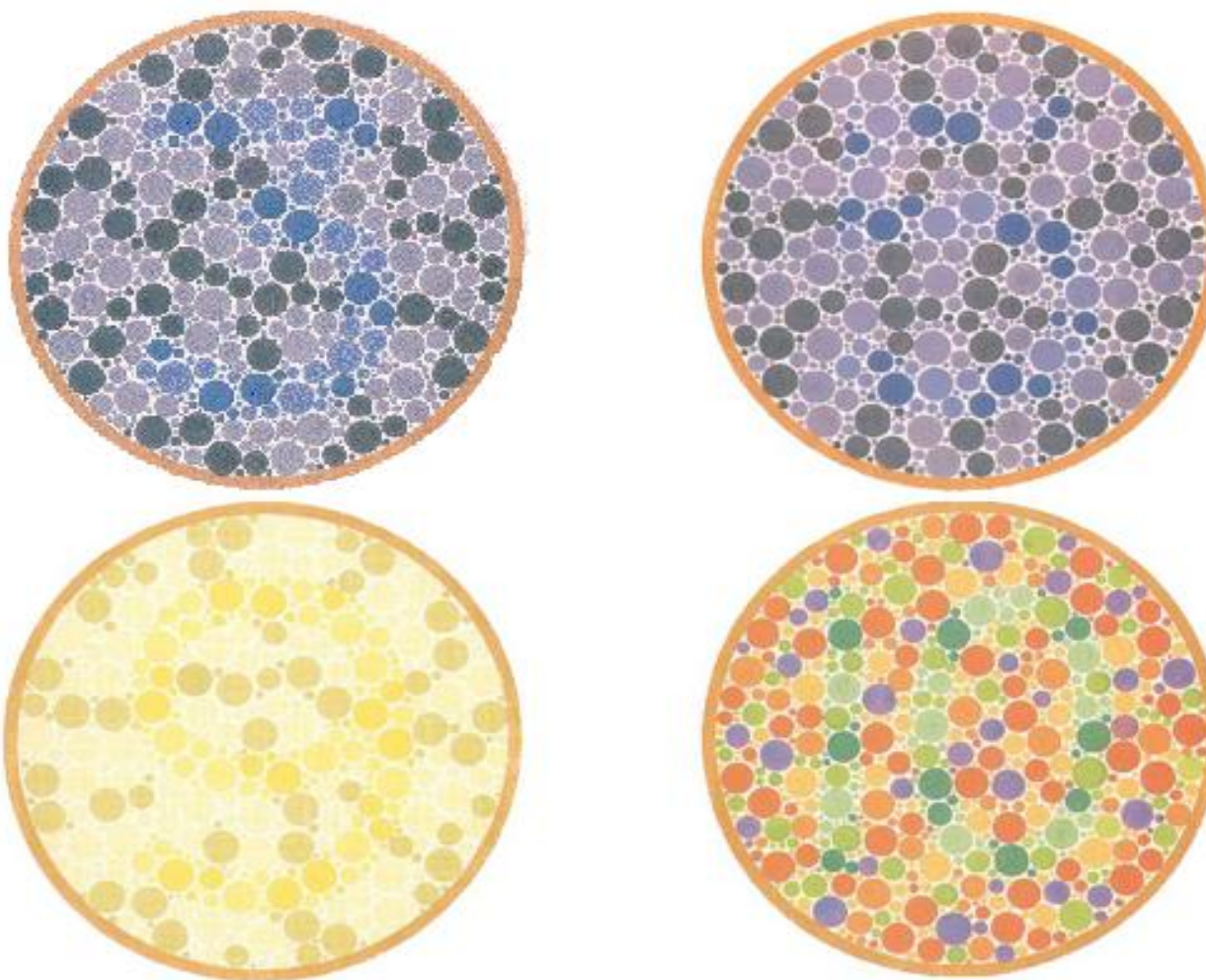
# Farvesyn

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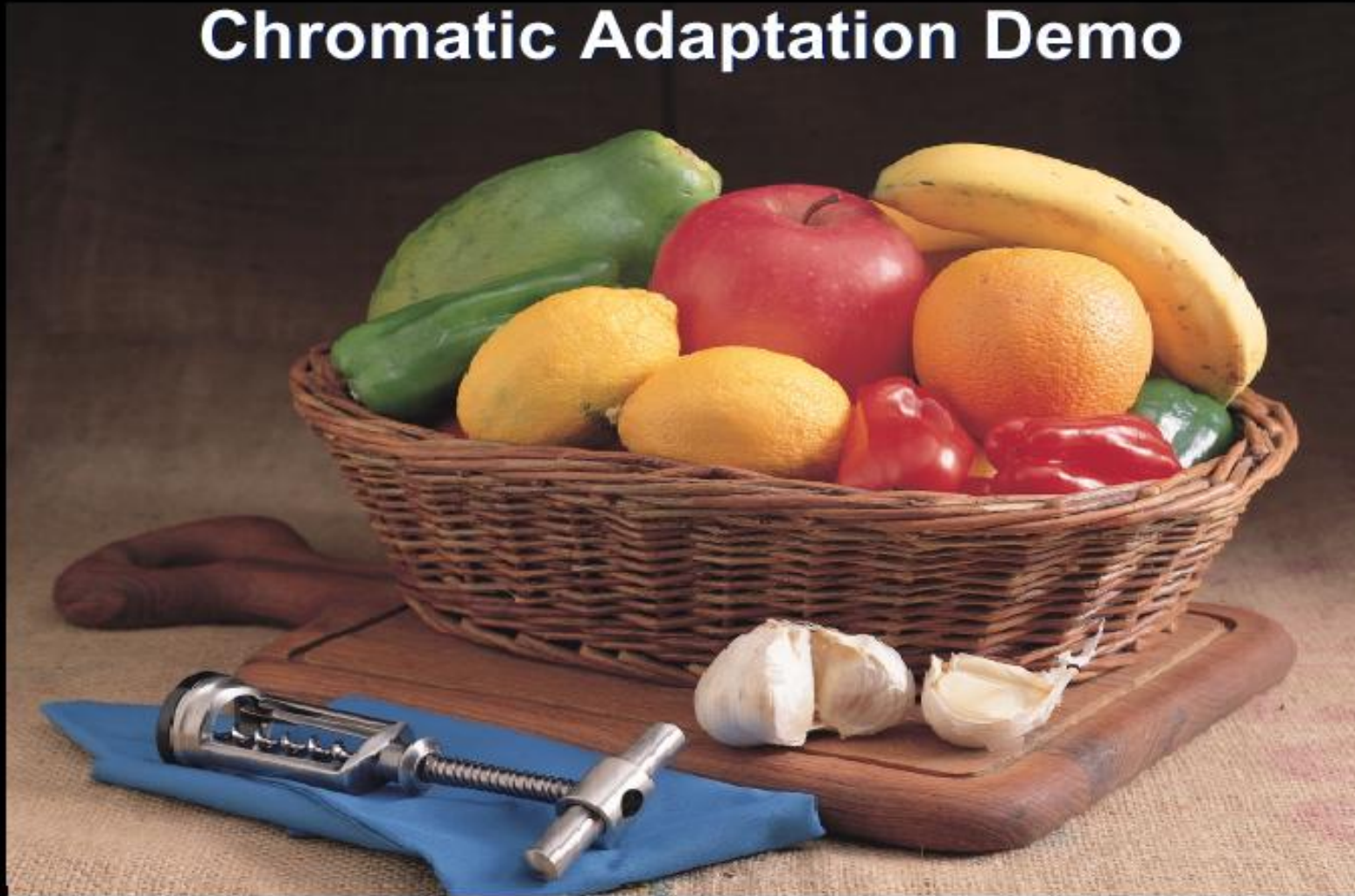
Source: Pekka Laihanen, HUT

# Farvesyn



Source: Pekka Laihanen, HUT

# Chromatic Adaptation Demo



Source: Pekka Laihanen, HUT

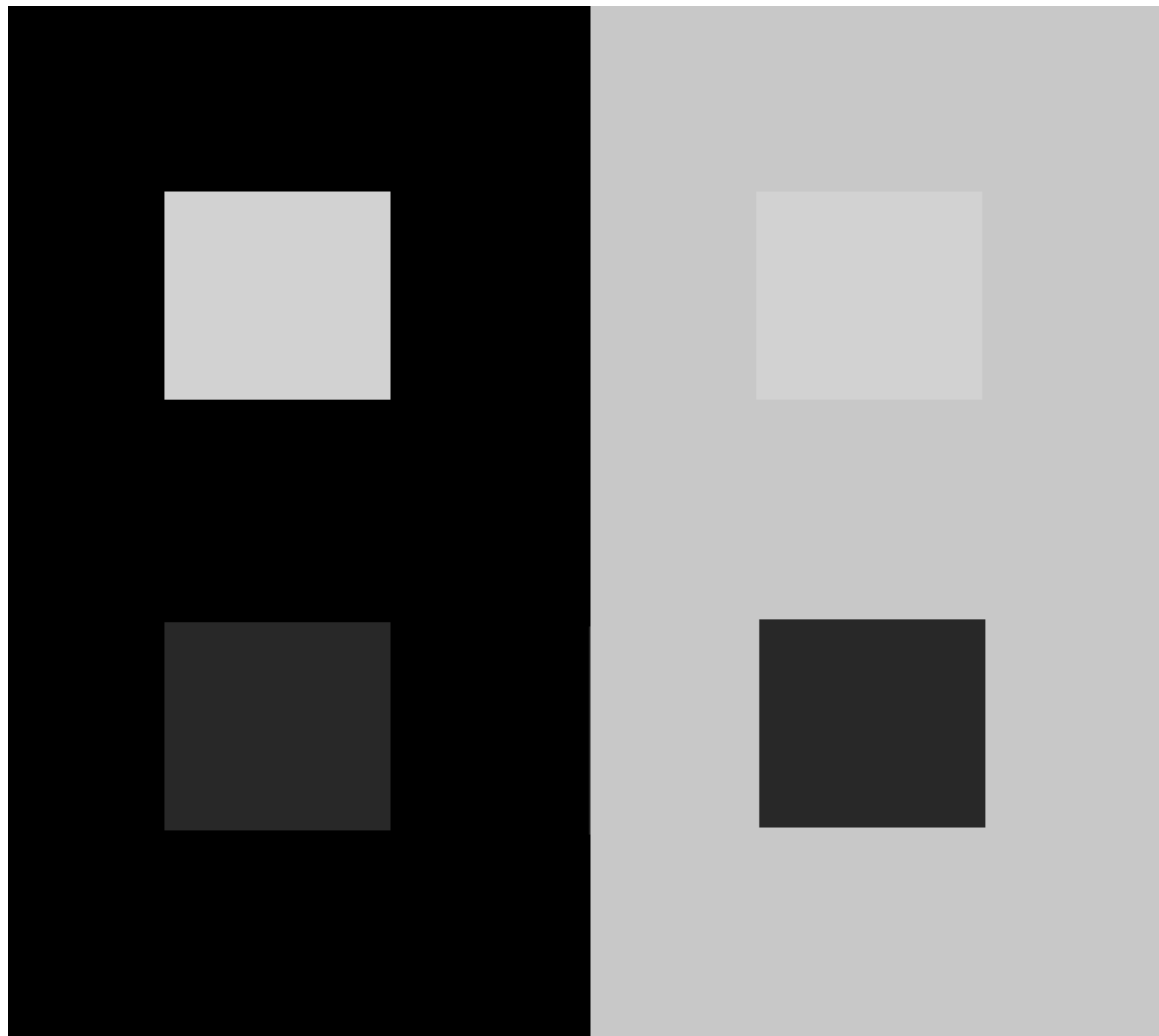


Source: Pekka Laihanen, HUT

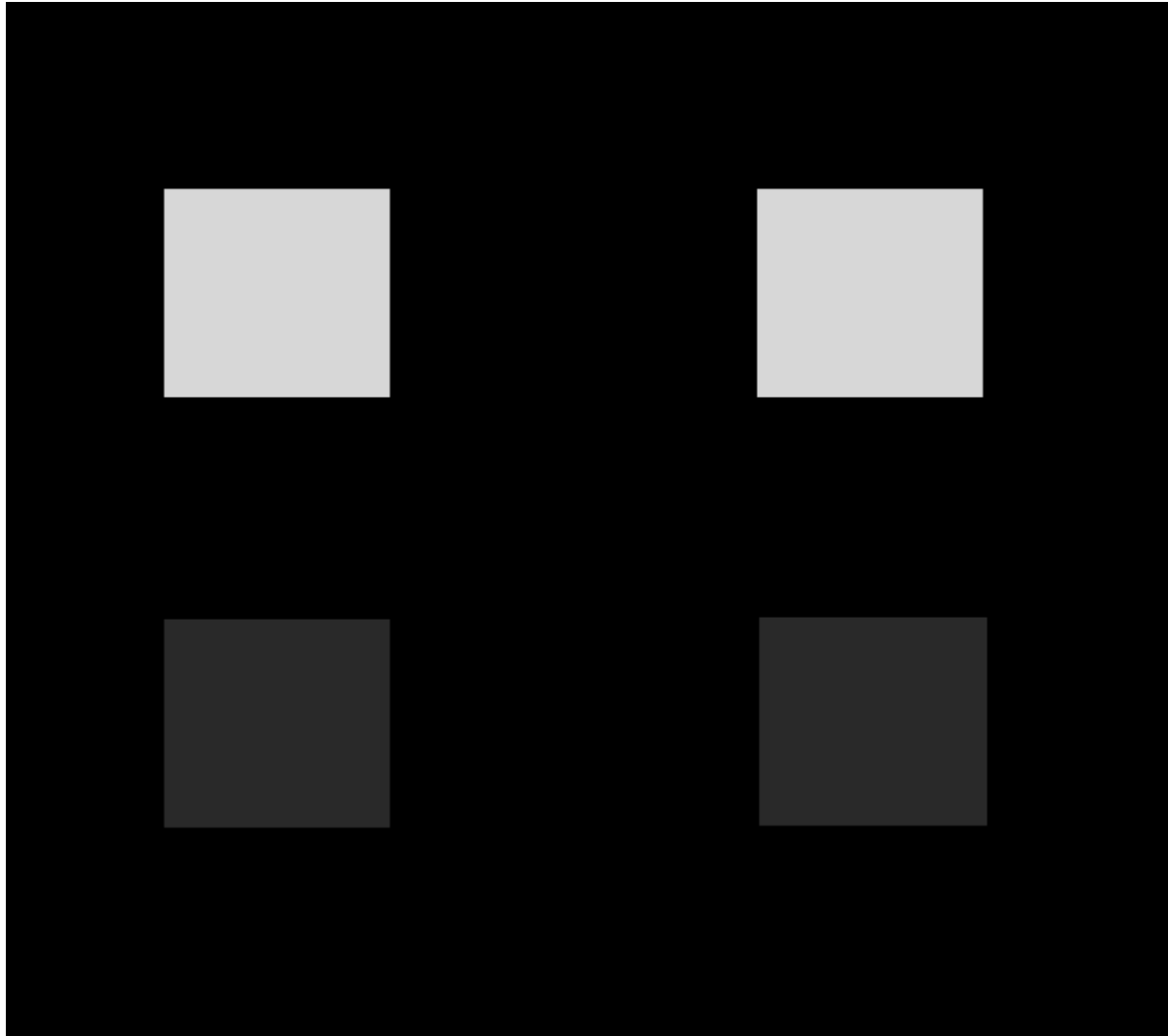


Source: Pekka Laihanen, HUT

# Relativ kontrast

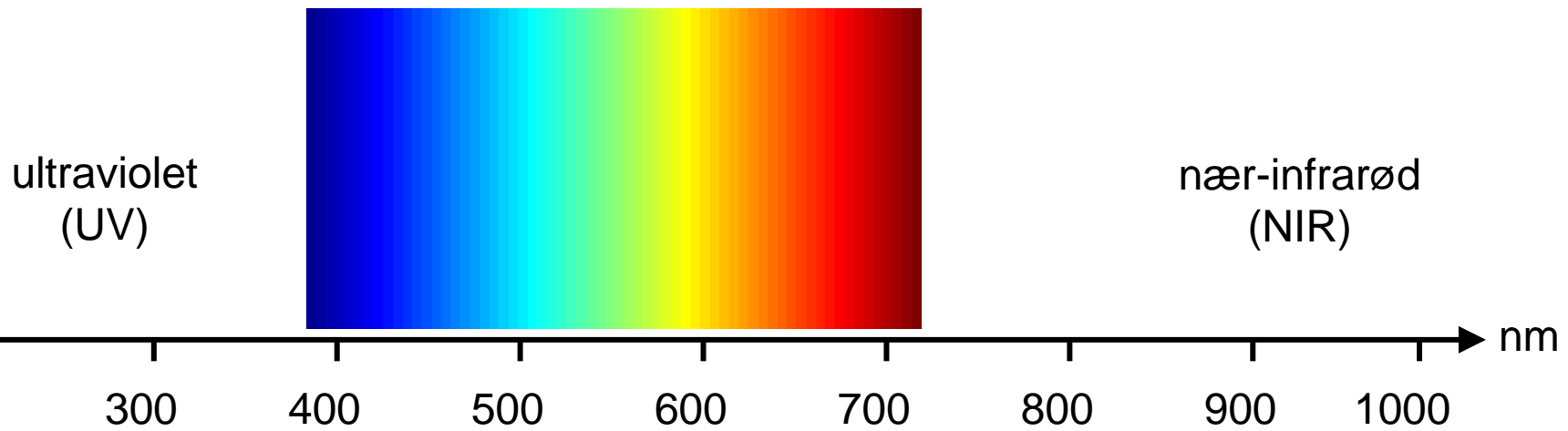
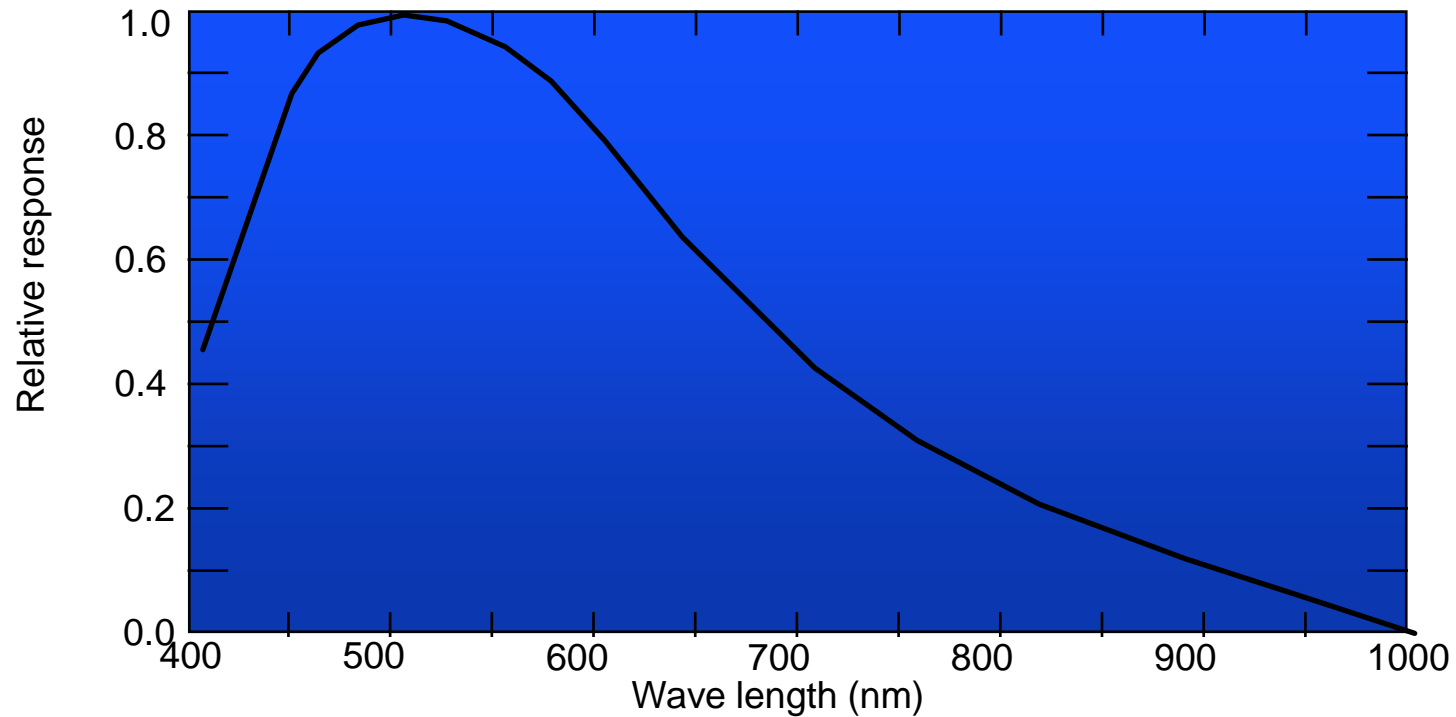


Source: Pekka Laihanen, HUT



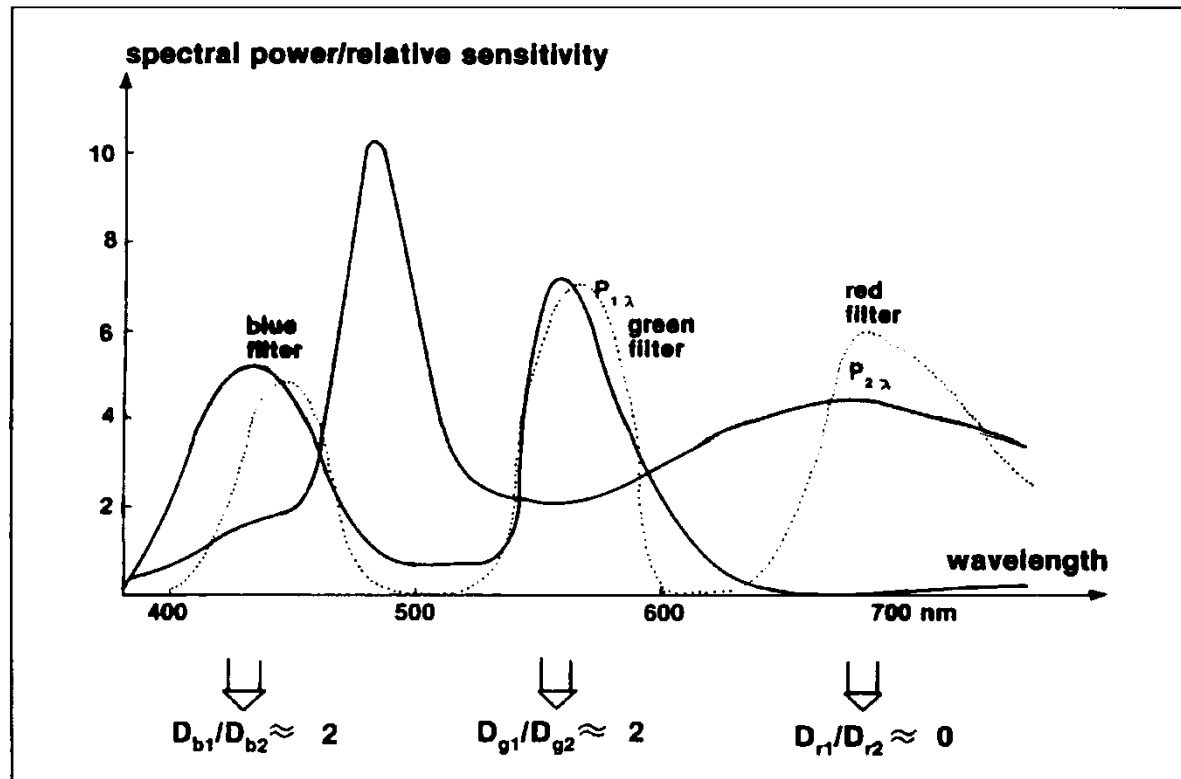
Source: Pekka Laihanen, HUT

# Monochrome CCD Sensor



# Metameri

Two spectrally different but visually similar colours ( $P_1$ ,  $P_2$ ) with different density values



# Multiband images

Multispectral images  
from satellites

Landsat TM image

Red: Band 7,  $2.2 \mu\text{m}$

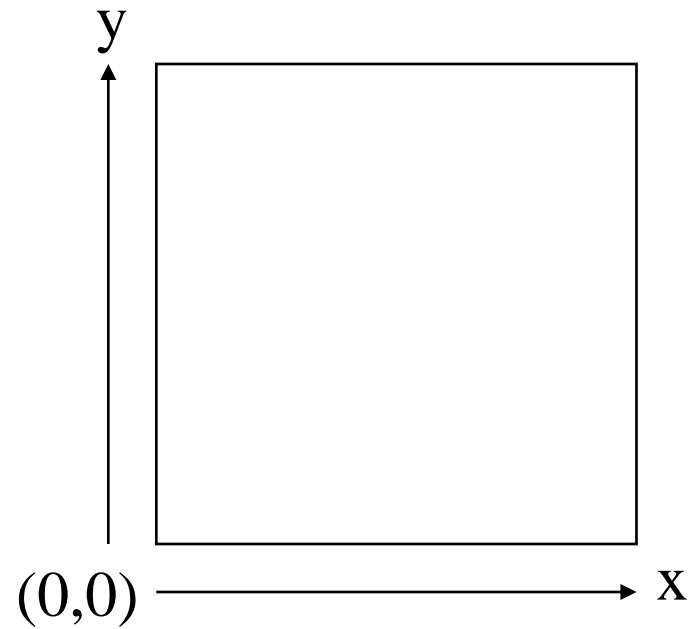
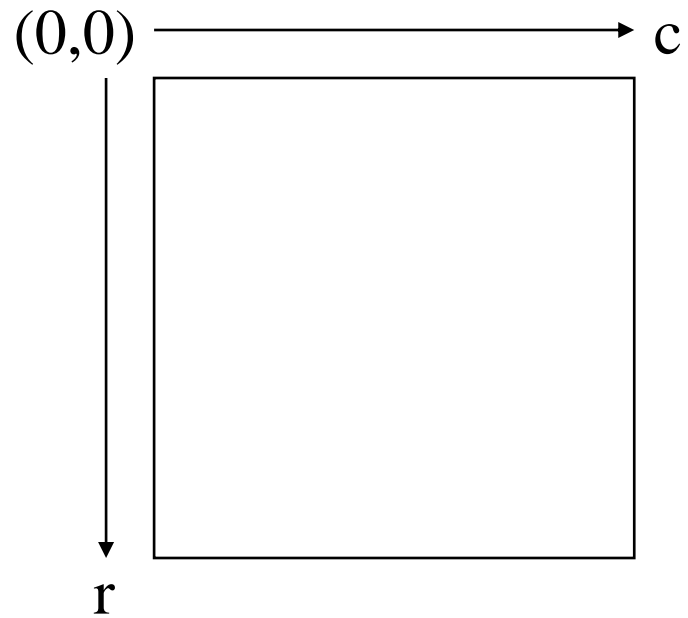
Green: Band 4,  $0.8 \mu\text{m}$

Blue: Band 1,  $0.5 \mu\text{m}$



# Break

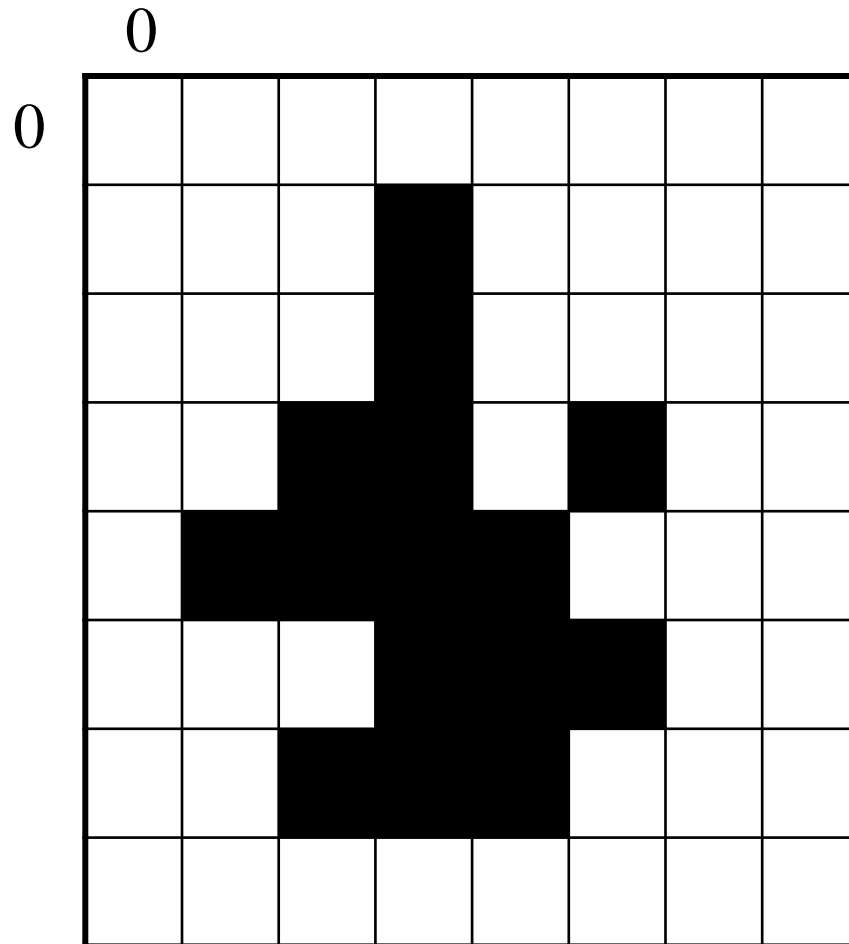
# Pixel coordinate systems



# Chain code

3	2	1
4	X	0
5	6	7

(1,3)(667157544134112)

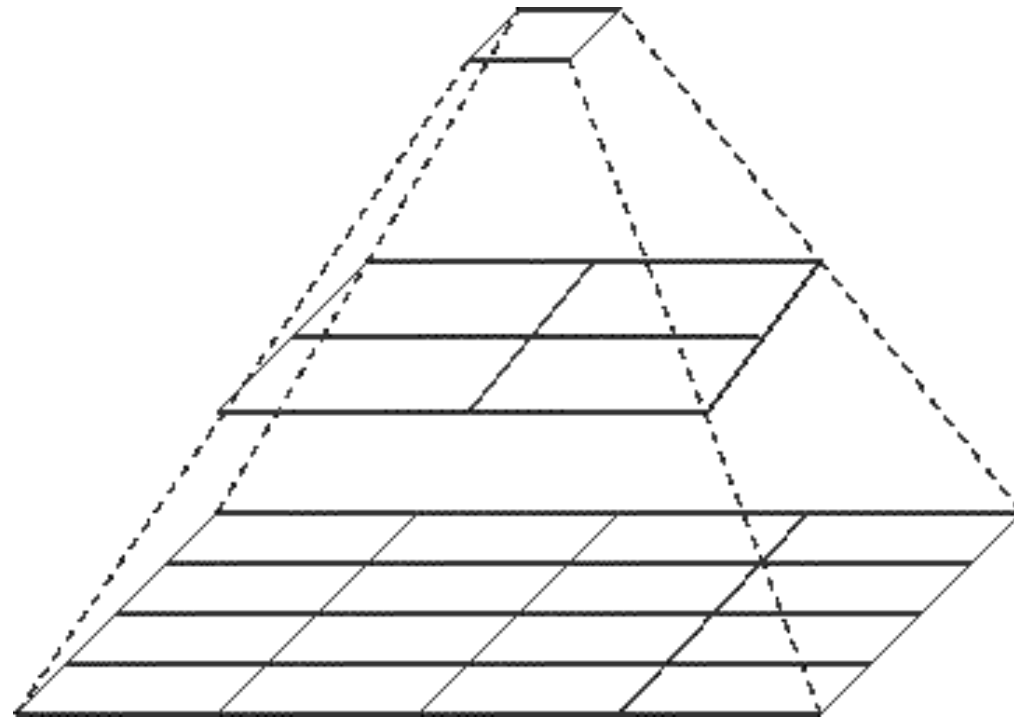


# Pyramid representation

Level 2

Level 1

Level 0



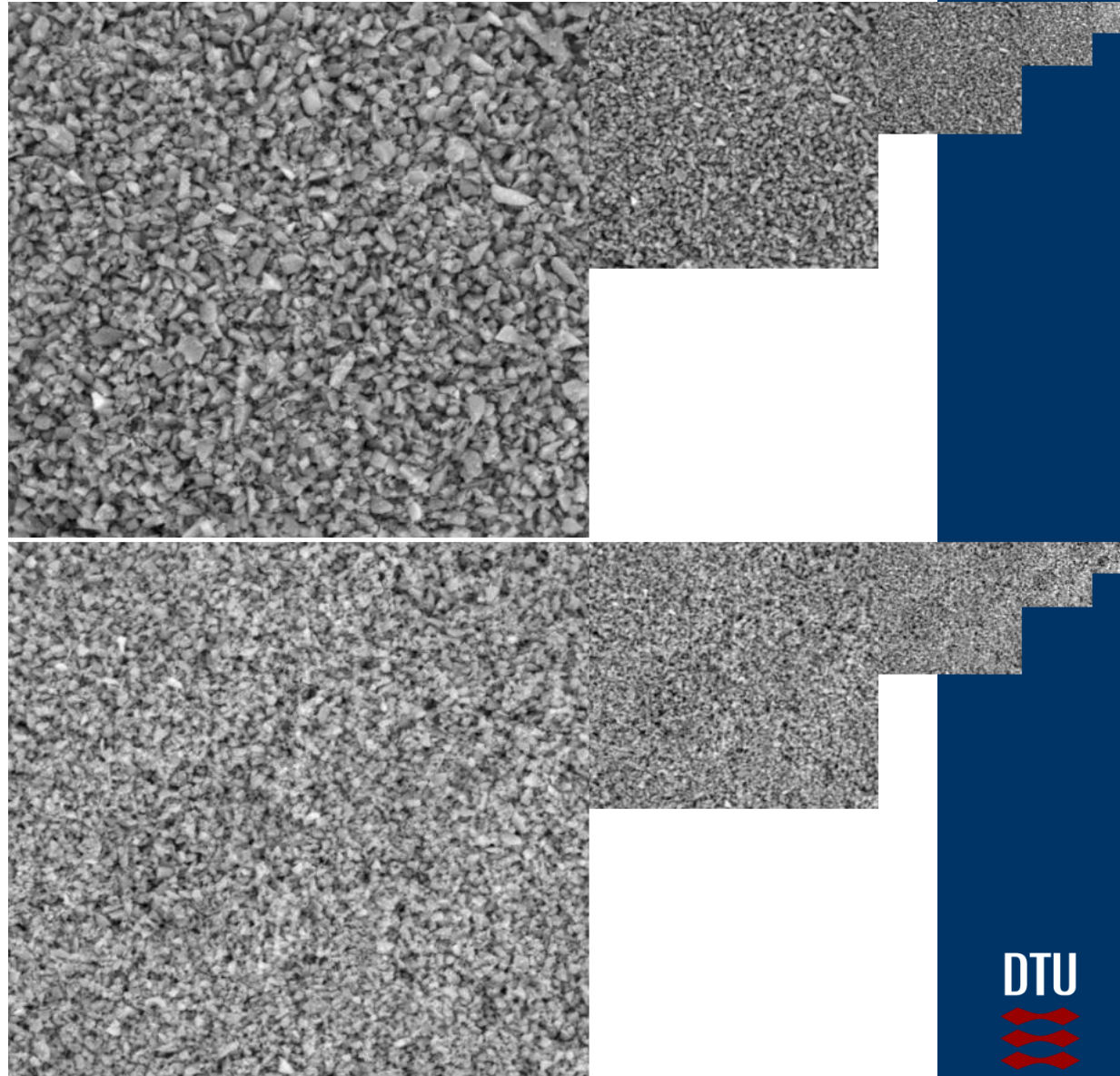
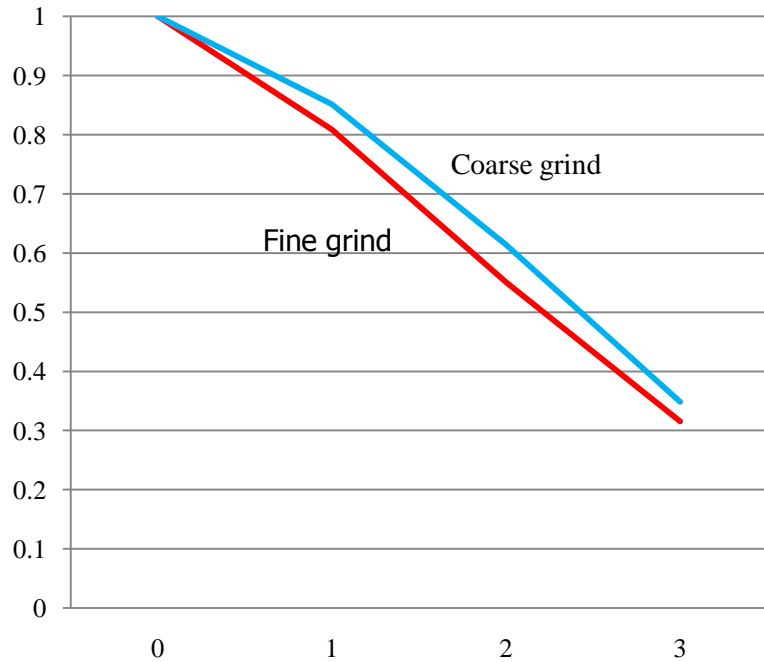
# Gaussian pyramid



# Laplacian pyramid

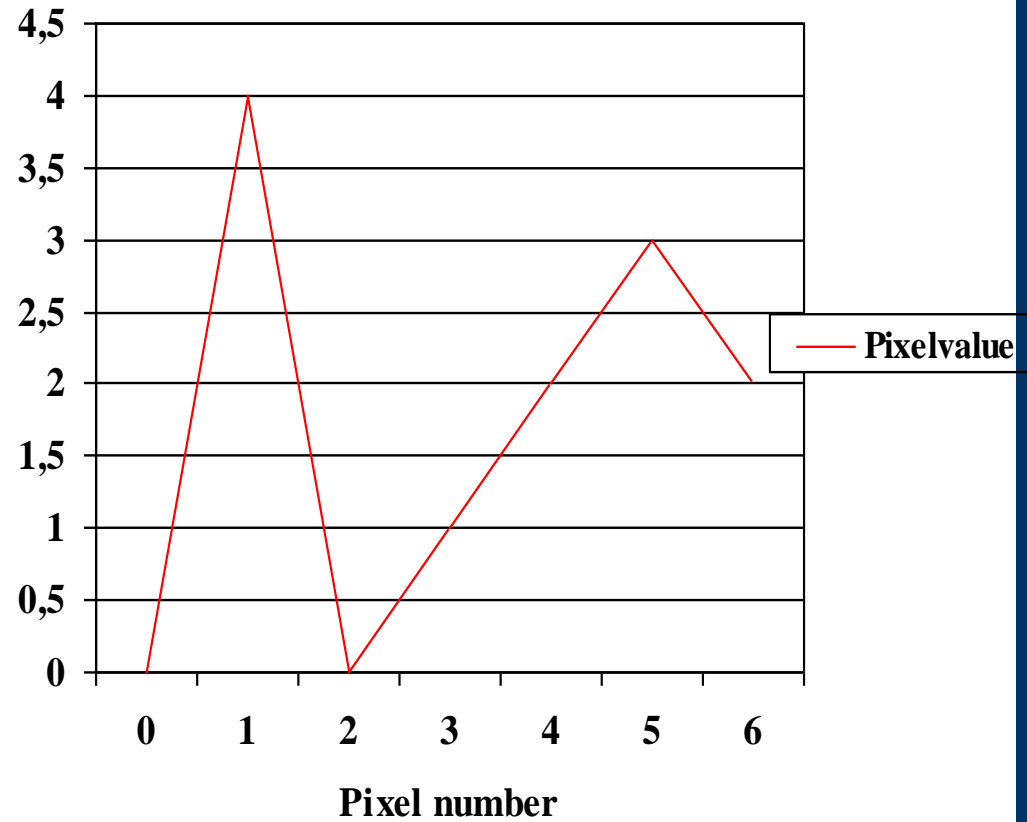


# Gaussian pyramids on coffee grind



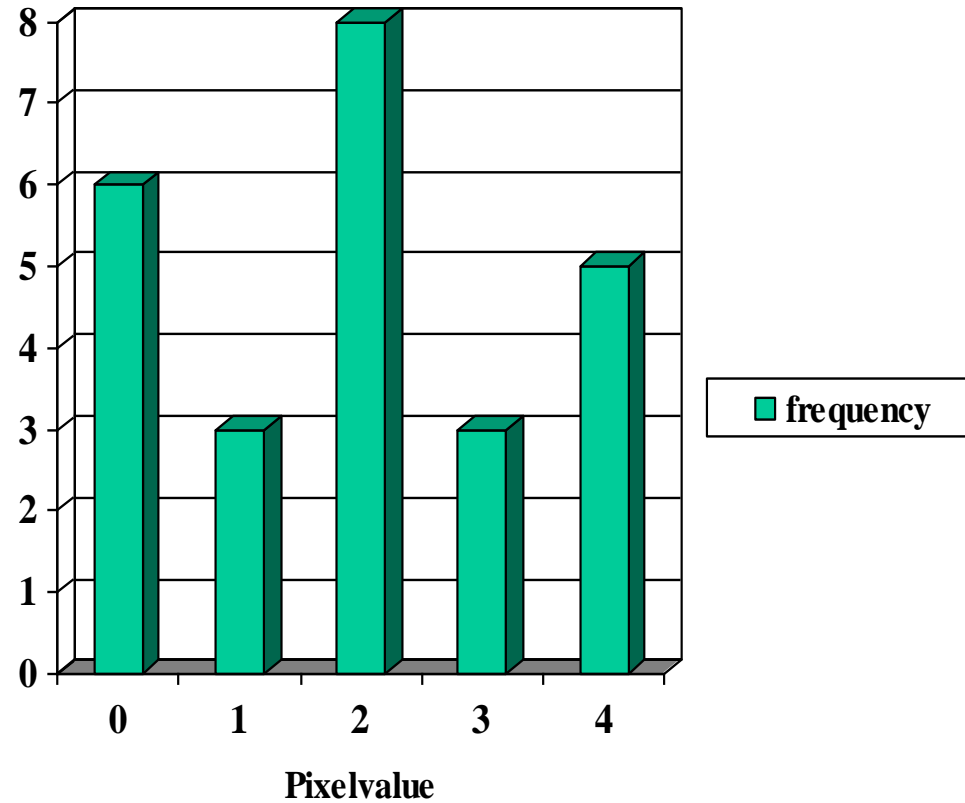
# Profile

2	1	0	0	2
1	0	2	3	4
4	4	2	3	2
4	0	0	1	2
2	0	2	3	4



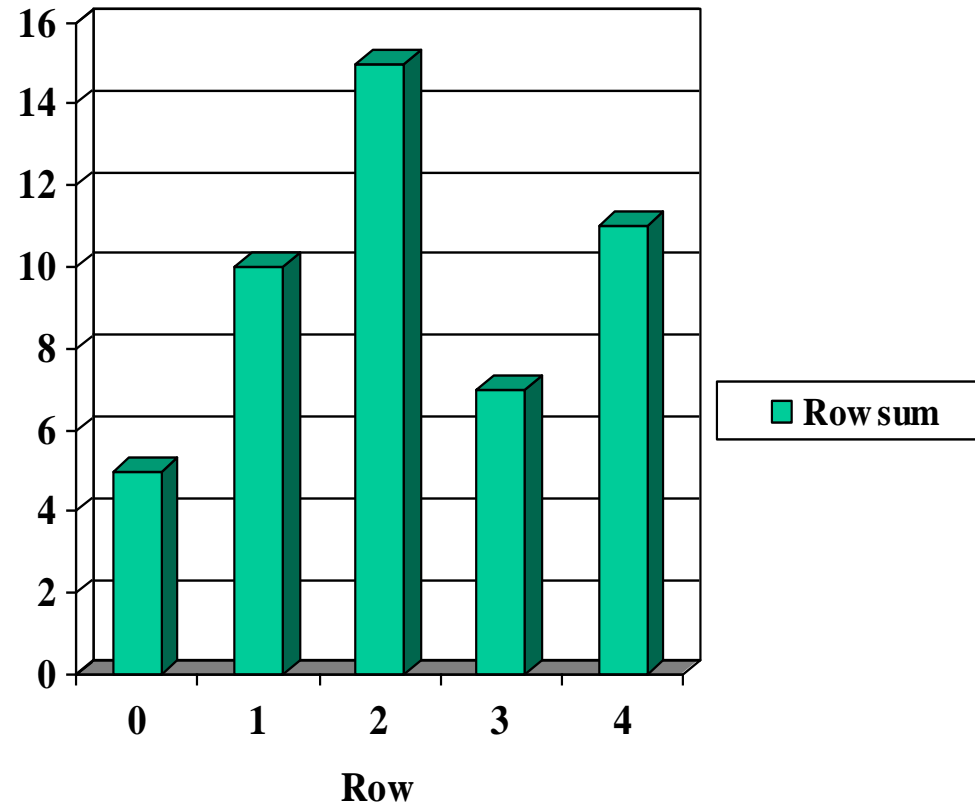
# Histogram

2	1	0	0	2
1	0	2	3	4
4	4	2	3	2
4	0	0	1	2
2	0	2	3	4



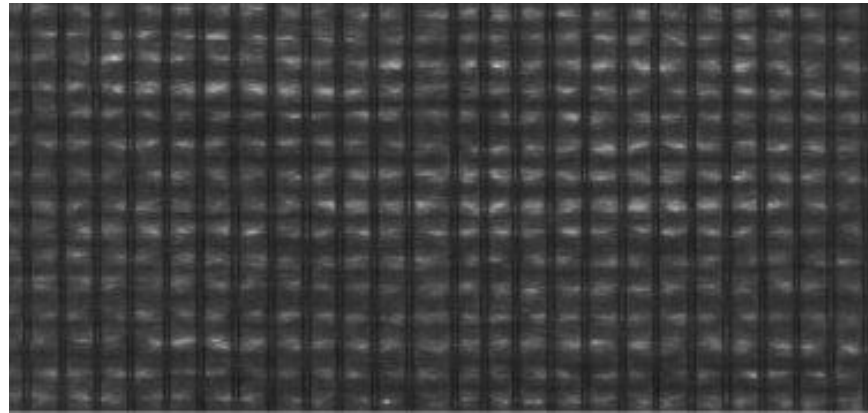
# Projection

2	1	0	0	2
1	0	2	3	4
4	4	2	3	2
4	0	0	1	2
2	0	2	3	4

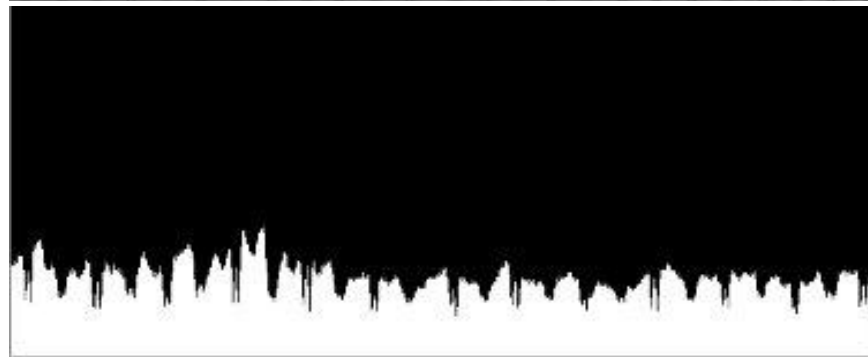


# Profile/projection

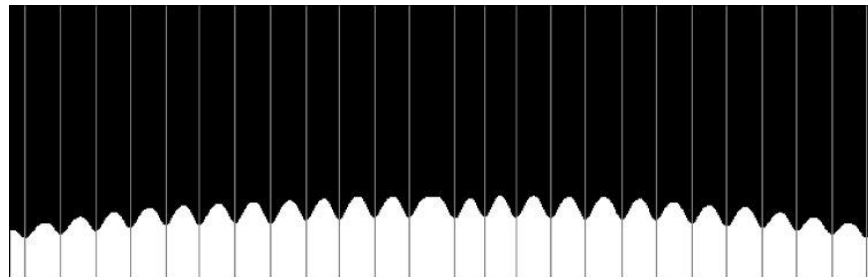
Textile



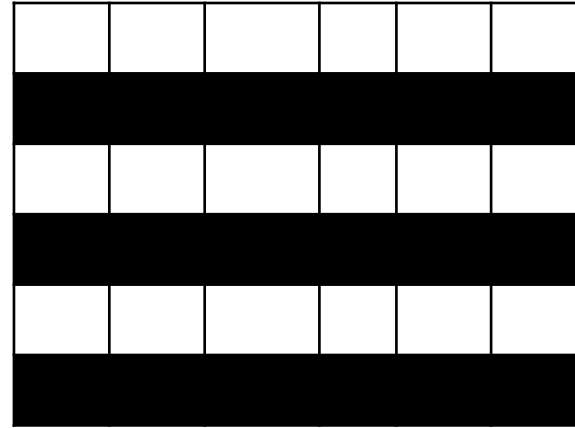
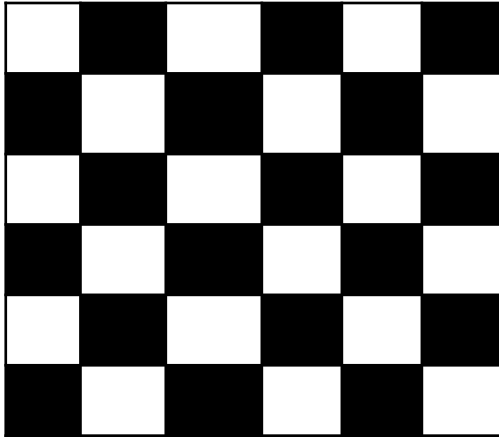
Profile



Projection



# Exercise



Which descriptor will be appropriate to distinguish between these two images?

1. Histogram
2. Horizontal projection
3. Vertical projection
4. An arbitrary vertical profile
5. Column sums

