The basics of digital image processing with measurement information

Lecture 1

Introduction

Digital image representation

ЖИТОМИРСЬКА
ПОЛІТЕХНІКА
ДЕРЖАВНИЙ УНІВЕРСИТЕТ

About me

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Terms

- 16 lecture, 8.

- **Grading system:**

20 points for lectures: 1 lecture – 1 point (*there will be a other number of lectures. maybe less*).

64 points for labs (8 labs): 1 labs – 8 point

16 points for test work: 1 test work – 16 point

- Reports to prepare in pdf after each classes and send me on Teams or e-mail (***reports consist of program and screenshot***).

Digital image representation

Mathematic representation of a digital image

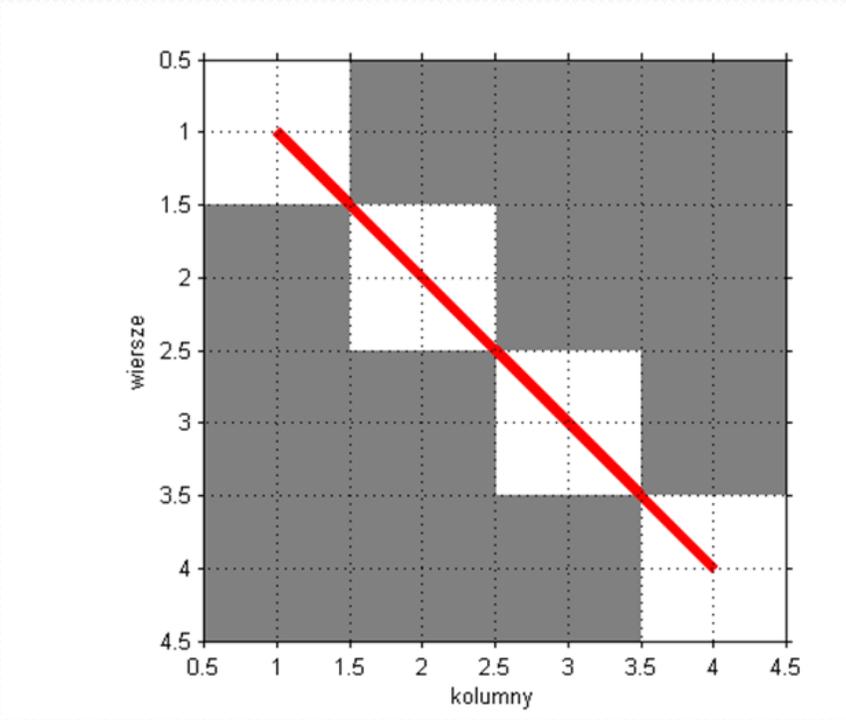Digital image could be described as a matrix

$$[f] = f_{i,j}: i = 1, \dots, M; \; j = 1, \dots, N \qquad\qquad (1)$$

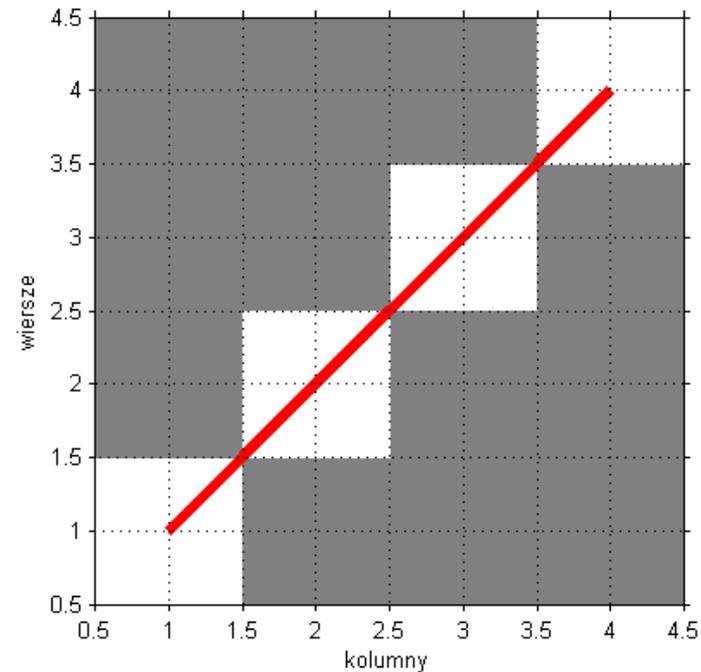where $f_{i,j}$ – values of the image function in the i-th row and j-th column.

$$0 \leq f_{i,j} < B$$

B – an integer corresponding to the number of brightness or intensity levels adopted

Numbering of rows and columns in the image matrix

"Matrix" coordinate system

Cartesian coordinate system

Notation of the image color
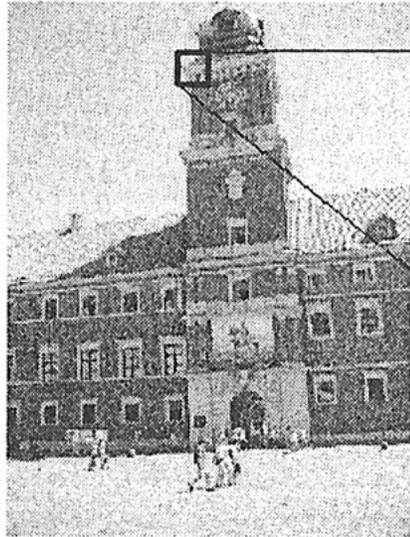
binary image matrix

L_{BIN}

Notation of the image color

Binary image (bi-level, black-white)

Notation of the image color

grayscale image matrix

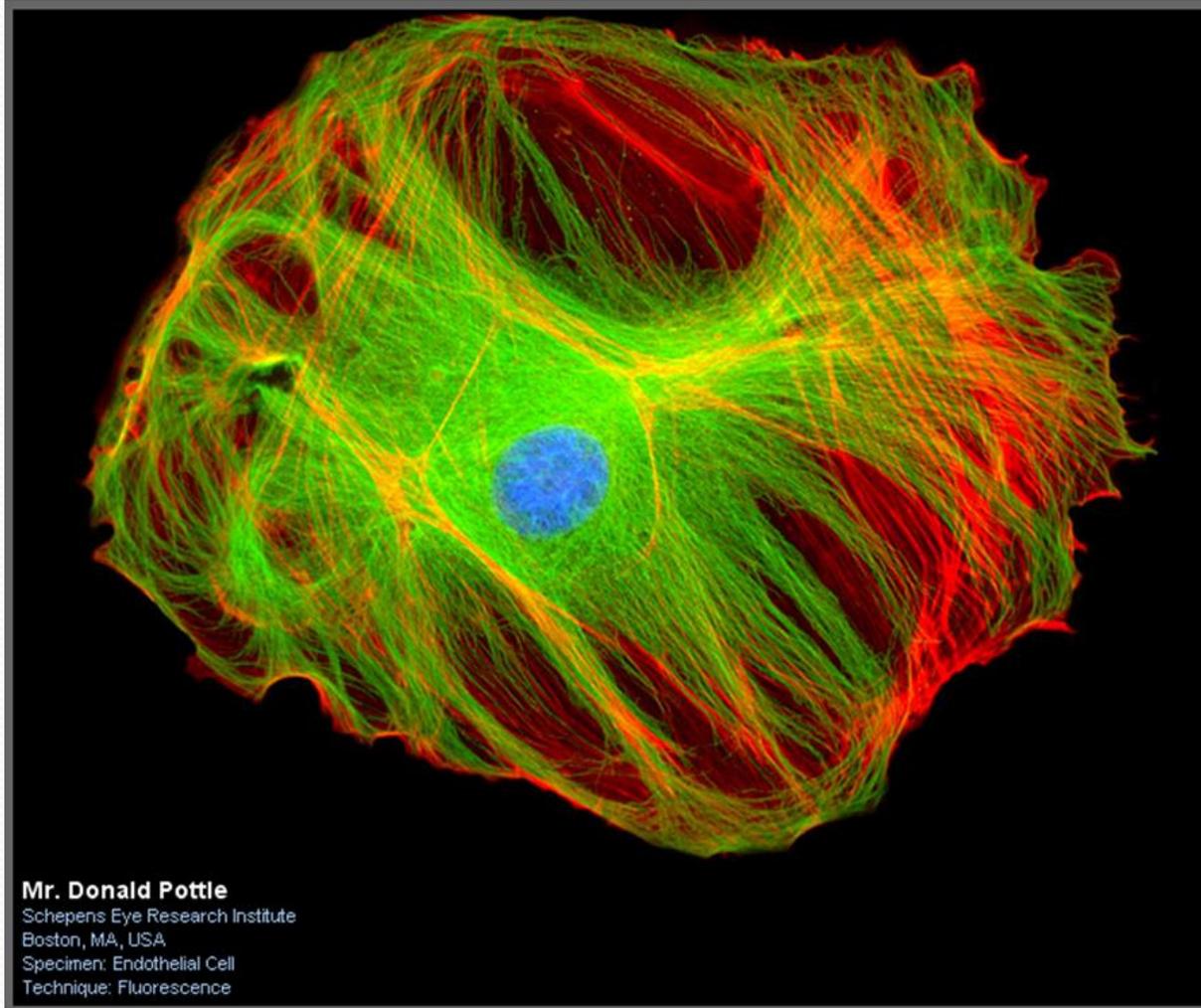| 0	0.0314	0.0627	0.0941	0.1255	0.1569	0.1882
0.0039	0.0353	0.0667	0.0980	0.1294	0.1608	0.1922
0.0078	0.0392	0.0706	0.1020	0.1333	0.1647	0.1961
0.0118	0.0431	0.0745	0.1059	0.1373	0.1686	0.2000
0.0157	0.0471	0.0784	0.1098	0.1412	0.1725	0.2039
0.0196	0.0510	0.0824	0.1137	0.1451	0.1765	0.2078
0.0235	0.0549	0.0863	0.1176	0.1490	0.1804	0.2118
0.0275	0.0588	0.0902	0.1216	0.1529	0.1843	0.2157

L_{GRAY}

Notation of the image color
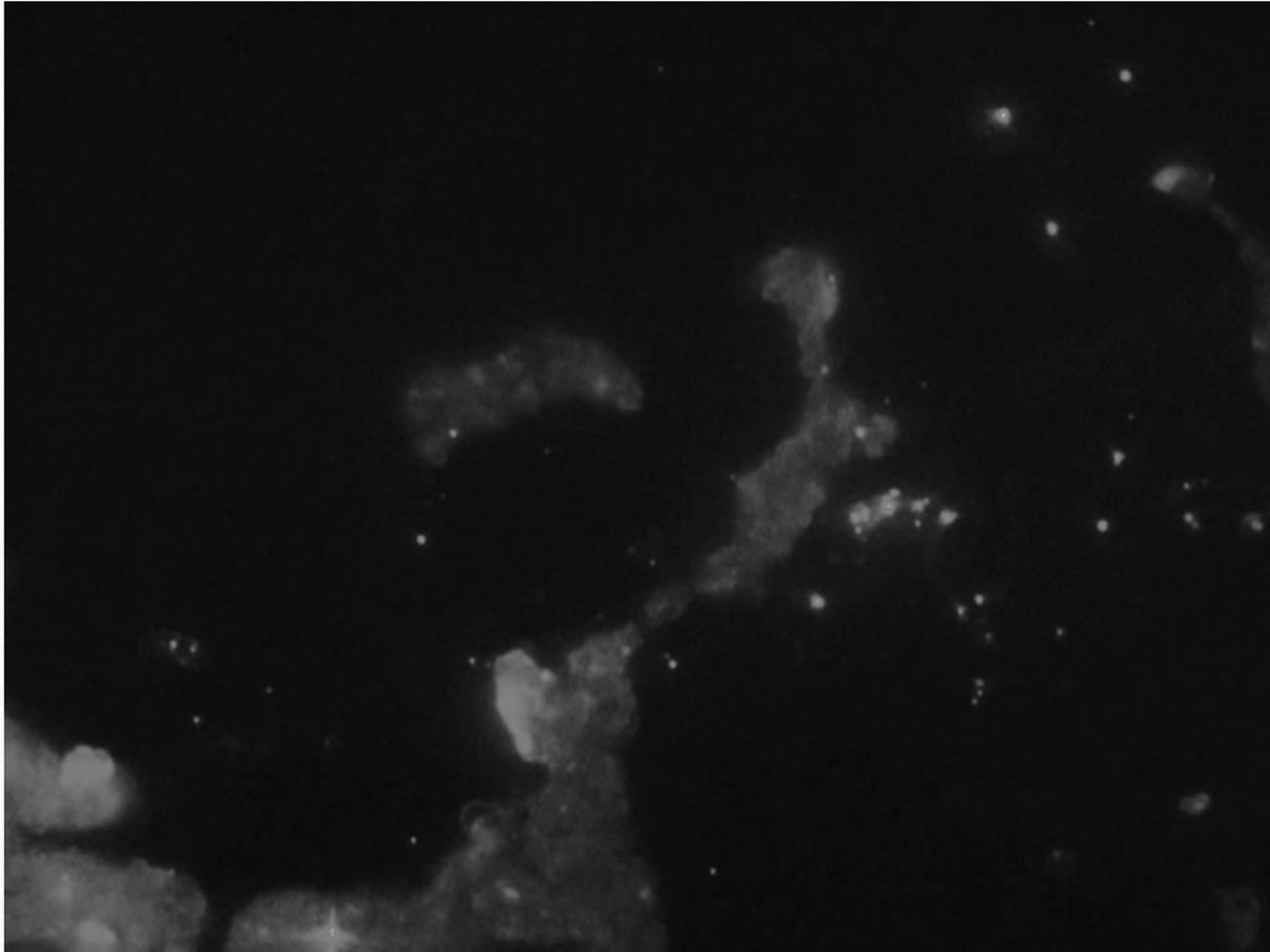
Monochrome image (grayscale, 256 levels of gray)

Notation of the image color

RGB matrix

Notation of the image color

Mr. Donald Pottle
Schepens Eye Research Institute
Boston, MA, USA
Specimen: Endothelial Cell
Technique: Fluorescence

Colour image (RGB)
$(2^8)^3 = 256^3 = 16777216$
colours

Notation of the image color
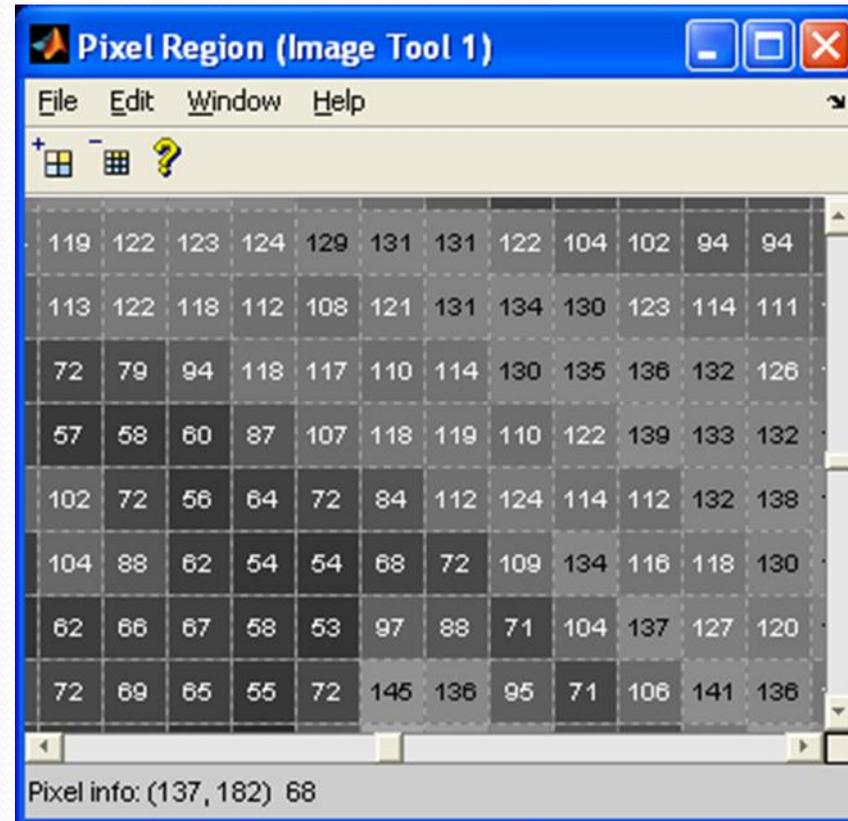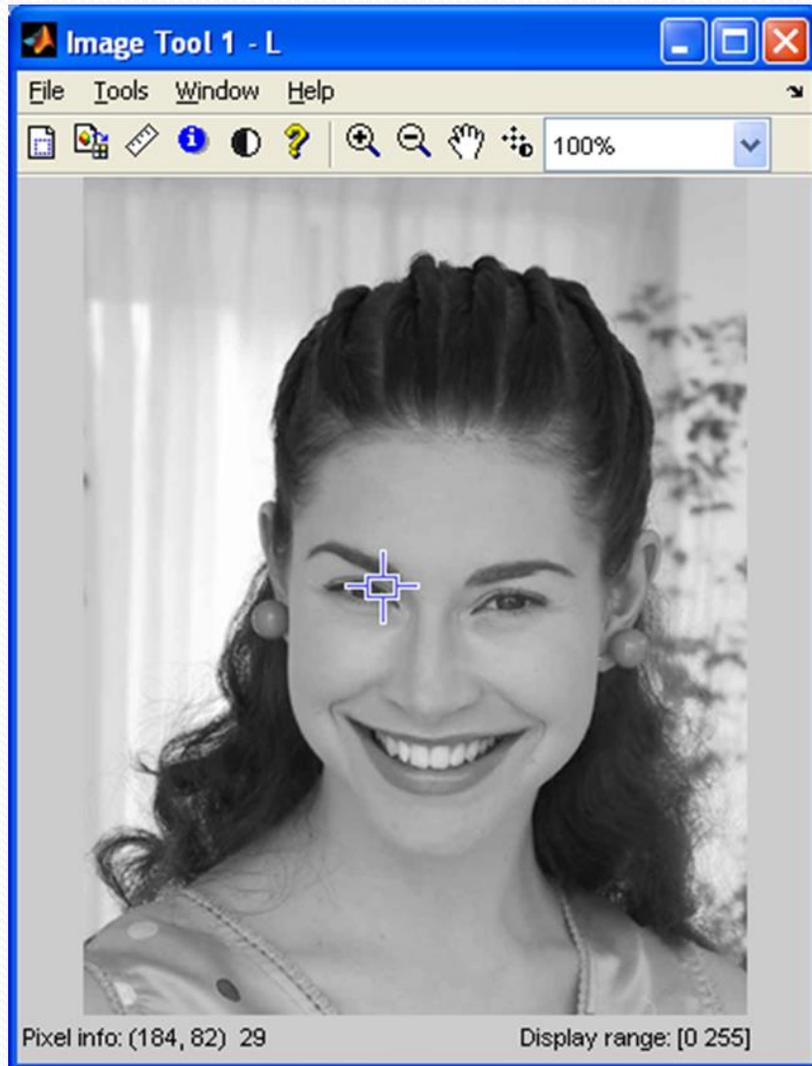
indexed color matrix
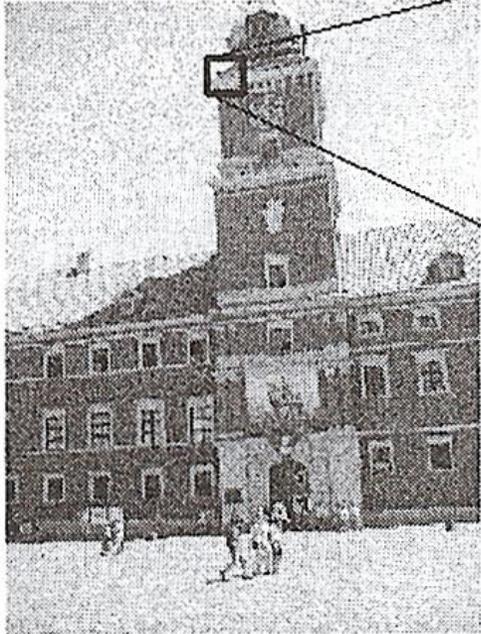
Notation of the image color
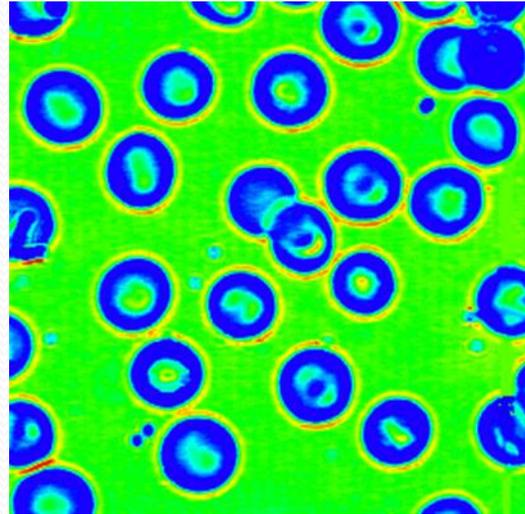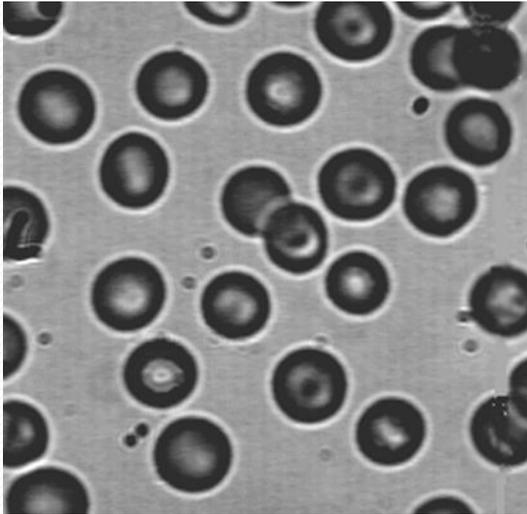
Indexed colour image
(colour maps)
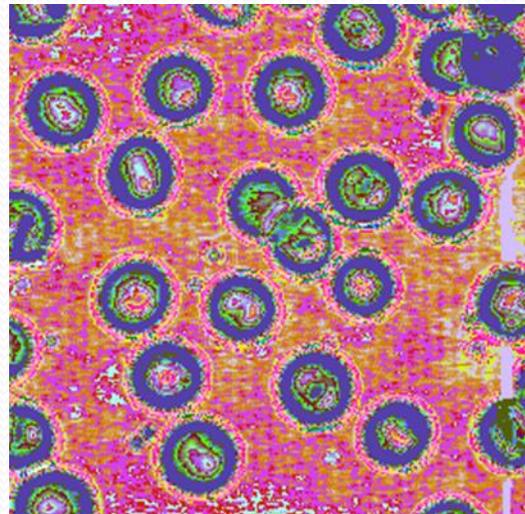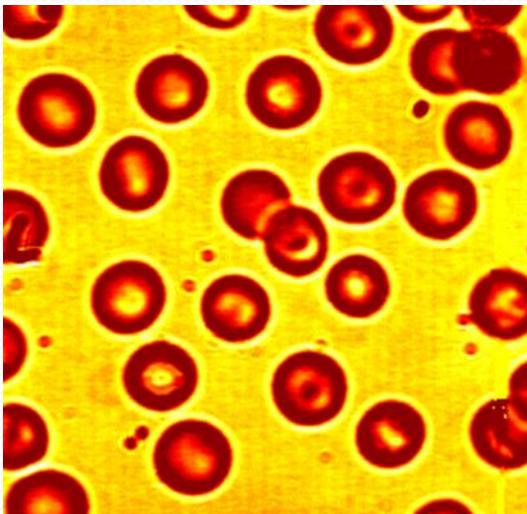
Notation of the image color

Spatial resolution of the image

Definition

Image resolution can be defined as an ordered pair:

$$\left\langle \frac{M}{d_x}, \frac{N}{d_y} \right\rangle \qquad\qquad (2)$$

where:

- d_x, d_y – linear size of the source image respectively on the x (horizontal) axis and the y (vertical) axis,

- M, N – the maximum number of pixels in the image, horizontally and vertically, respectively: $M = M_{max}$,

  $N = N_{max}$

Spatial resolution of the image

Image resolution is the number of points per unit of length.

Most often, it is defined in reference to inches and is referred to as ppi (pixels per inch) for display devices or dpi (dots per inch) for printing devices. Sometimes the term lpi (lines per inch) is used.
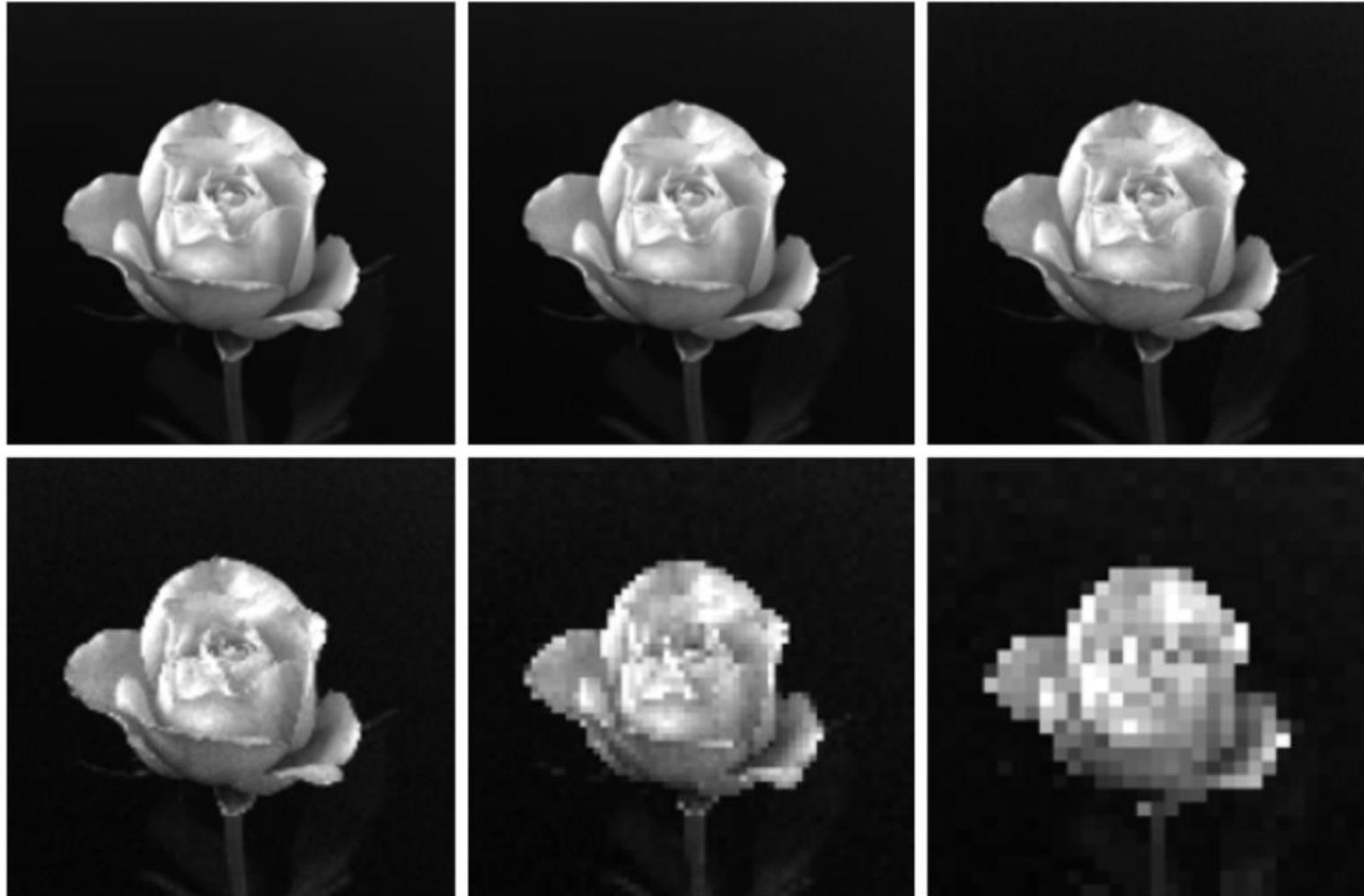
Spatial resolution or size?

Spatial resolution or size?