Sistemas de Representação Digital em Design

FA.Ulisboa
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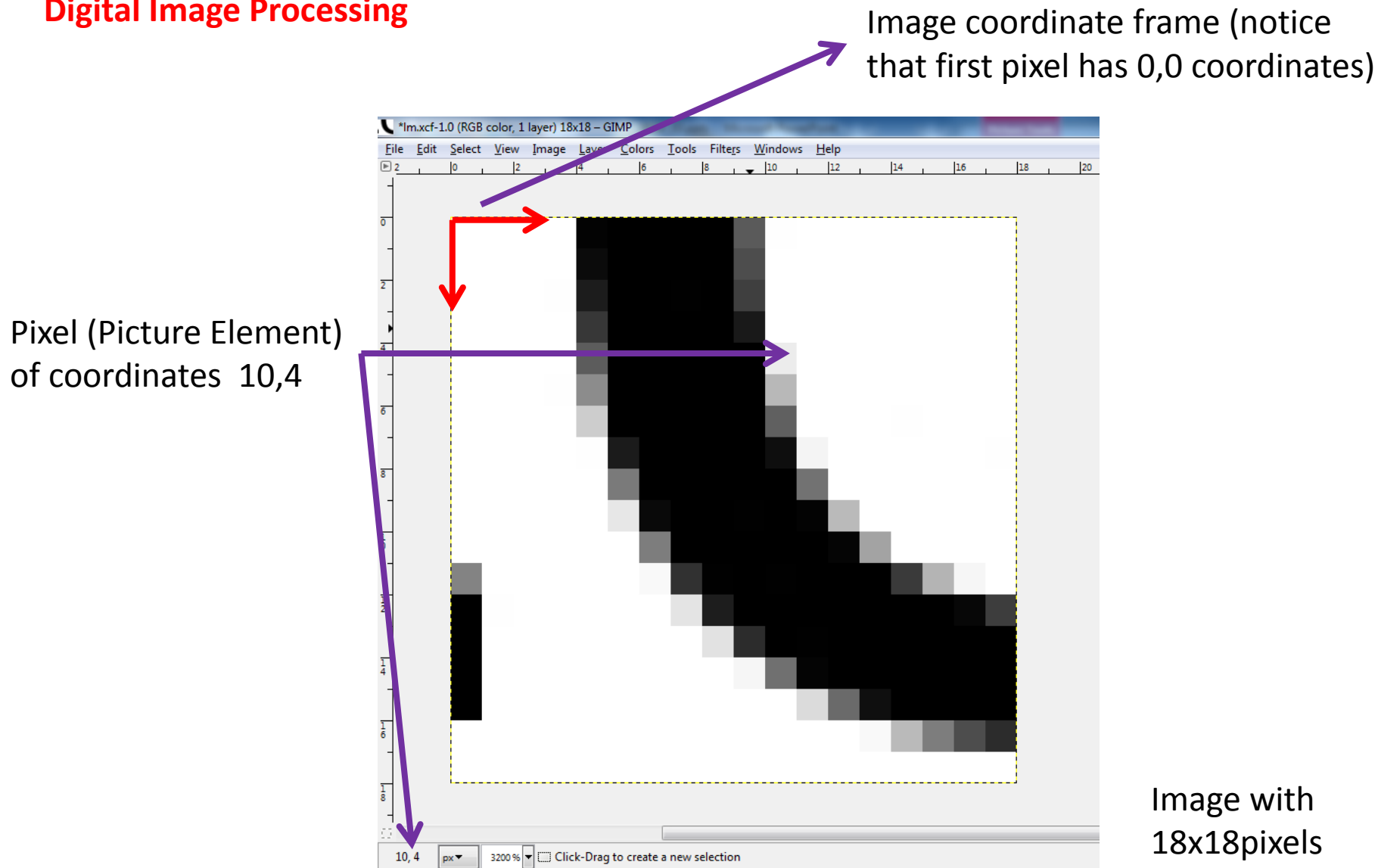2º semestre
Licenciatura em Design

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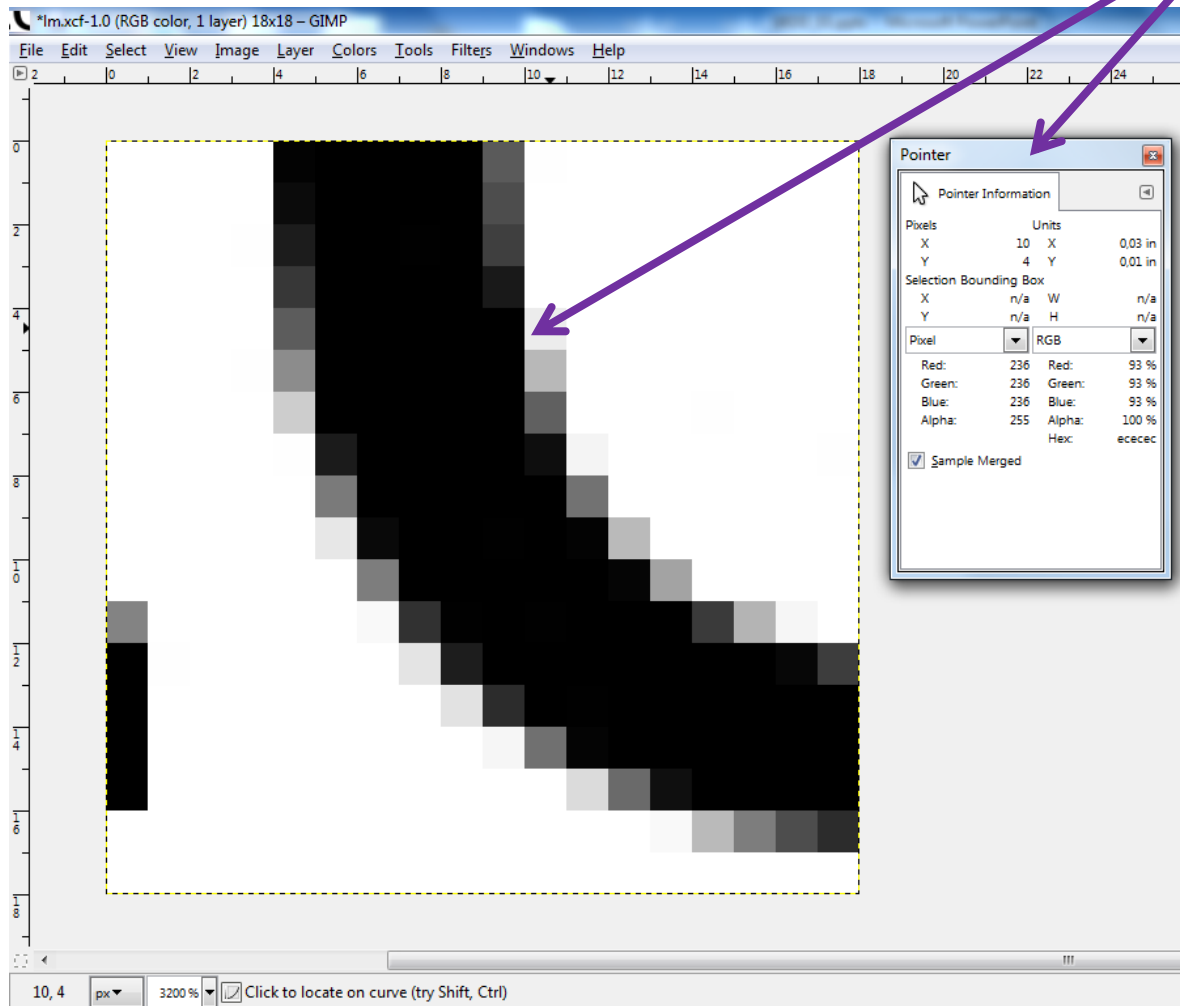
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Digital Image Processing

Image coordinate frame (notice that first pixel has 0,0 coordinates)

Pixel (Picture Element) of coordinates 10,4

Image with 18x18pixels

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Digital Image Processing (color image)
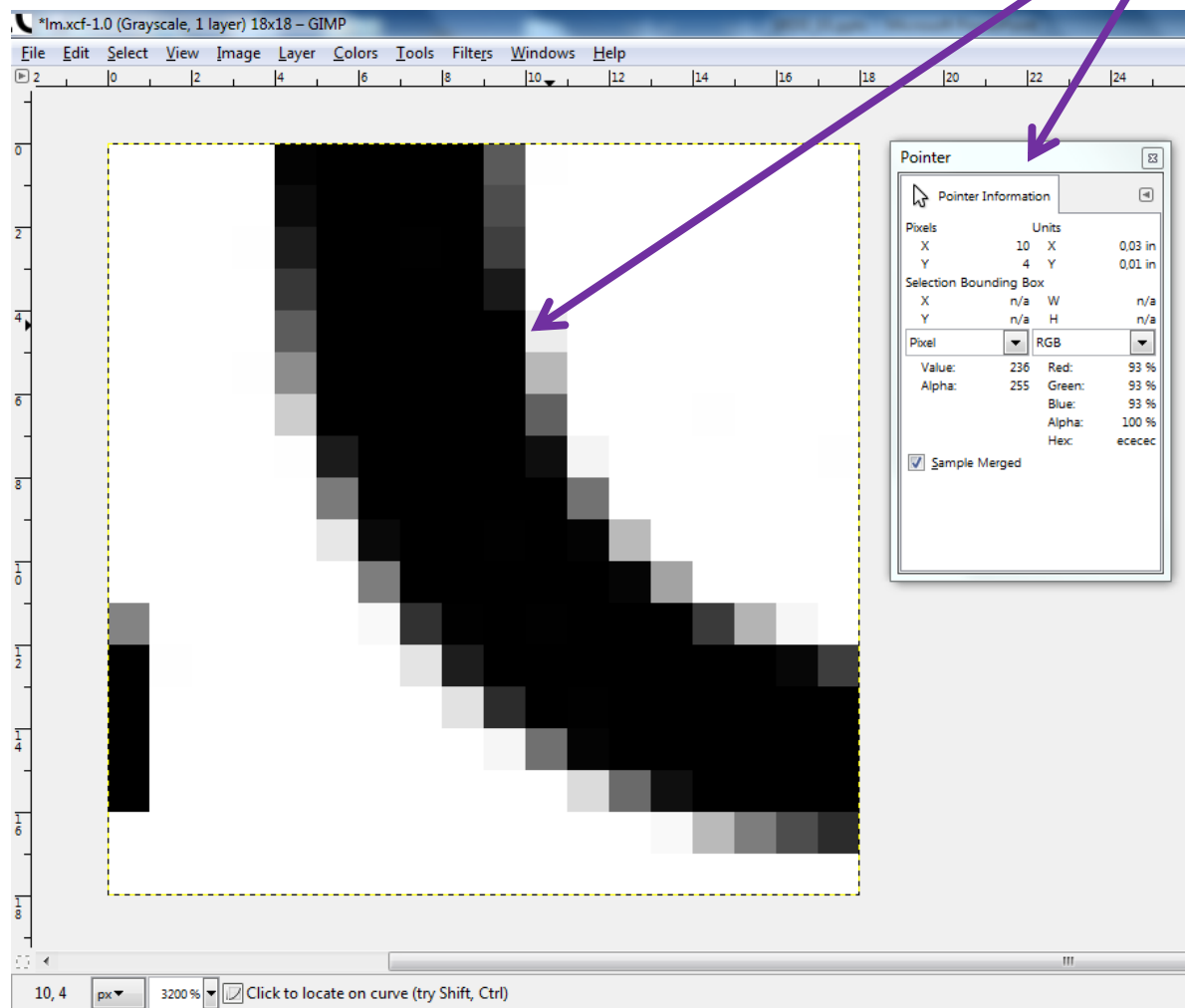

Color info of the pixel (10,4)
Red = 236
Green = 236
Blue = 236
The scale ranges from 0 to 255 (8 bit).If the three values are the same, then color is gray (0,0,0 means black and 255,255,255 means white).

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Digital Image Processing (gray scale image)

Color info of the pixel (10,4)
Value = 236

The scale ranges from 0 to 255 (8 bit). In a gray scale image only one value is needed (0 means black and 255 means white).

Eight bit means that values can range from 00000000 to 11111111 in binary representation. Each number (0 or 1) is a bit. For example 00100100 represents the number 36. Binary can be converted to decimal according to the following rule: abcdefgh

->

$a_x2^7+b_x2^6+c_x2^5+d_x2^4+e_x2^3+f_x2^2+g_x2^1+h_x2^0$

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Digital Image Processing (numeral systems)

Depending on the base that is used, a number can be written in multiple ways. The most common numeral system is decimal. In the image bellow, the number 236 (in decimal notation) is converted to multiple numeral systems.

(http://www.convertworld.com/pt/numerais/)

| 236 | Sistema decimal | ▼ |

Notação posicional		Sistema de numeração	
Sistema binário	11101100	Algarismos arábicos	236
Base 3	22202	Numeração romana	CCXXXVI
Base 4	3230		
Base 5	1421		
Base 6	1032		
Base 7	455		
Sistema octal	354		
Base 9	282		
Sistema decimal	236		
Base 11	1A5		
Sistema duodecimal	178		
Base 13	152		
Sistema hexadecimal	EC		
Sistema vigesimal	BG		

For example the colors (236,192,125) and #ECC07D are, in fact, the same color. The first one is expressed in RGB and the second one in hexadecimal notation (HEX). Use the above URL to convert numbers from one system to another.

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Digital Image Processing (displays and resolutions)

Resolution is not just an image size in pixels although sometimes the term is used with this meaning, for example, resolution of 4000x3000px.

But resolution is in fact something that is related with physical size. A common way to express resolution is DPI (dots per inch) or PPI (pixels per inch).

DPI refers to something printed in a physical support such as paper. To read black and with text in white paper with comfort you should consider a resolution of 300DPI. For color images you should consider 600DPI for better results. But notice that the physical support (for example a sheet of paper) should support that resolution.

PPI refers to the amount of pixels that are displayed in one inch of computer screen. Traditional resolution of computer screens is 72PPI. More recent screens support the resolution of 96PPI. And some tablets have resolutions up to 200PPI.

To be able to print with 300DPI an image should have a resolution of bigger or equal amount. So, resolution is always some kind of image scale.

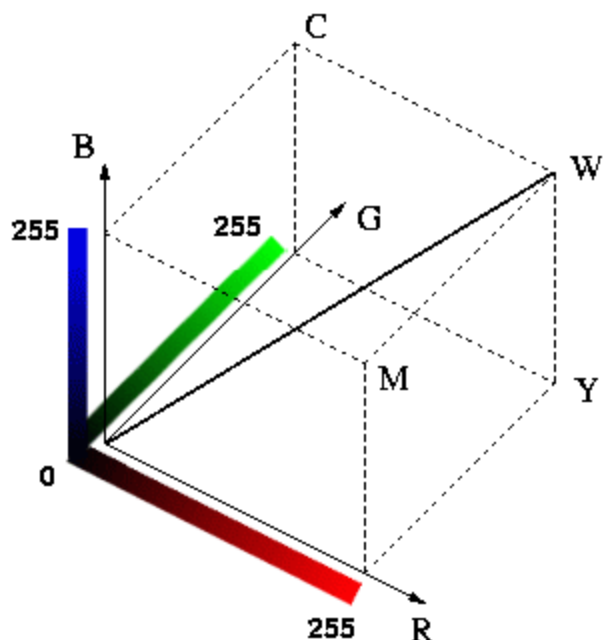# SRDD – Aula 3

Digital Image Processing (additive color)

"**Additive color** is color created by mixing light of two or more different colors. **Red**, **green**, and **blue** are the additive primary colors normally used in additive color system. Additive color is in contrast to subtractive color, in which colors are created by subtracting (absorbing) parts of the spectrum of light present in ordinary white light, by means of colored pigments or dyes, such as those in paints, inks, and the three dye layers in typical color photographs on film."
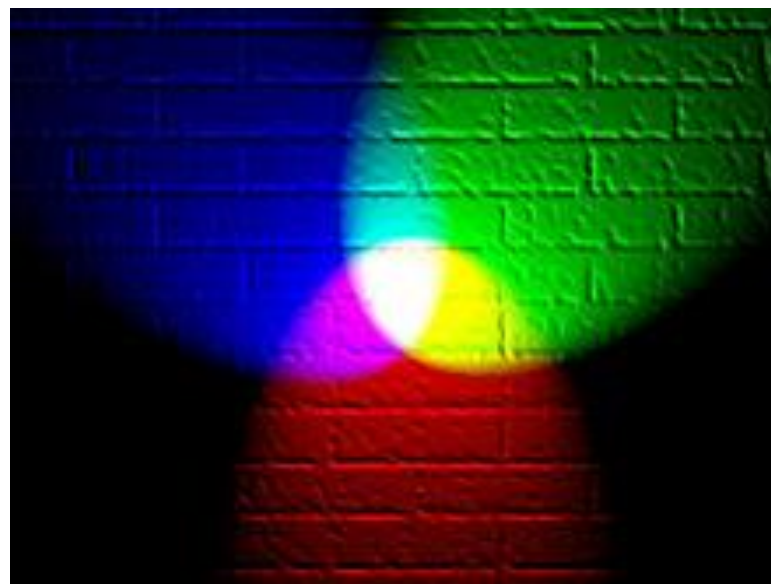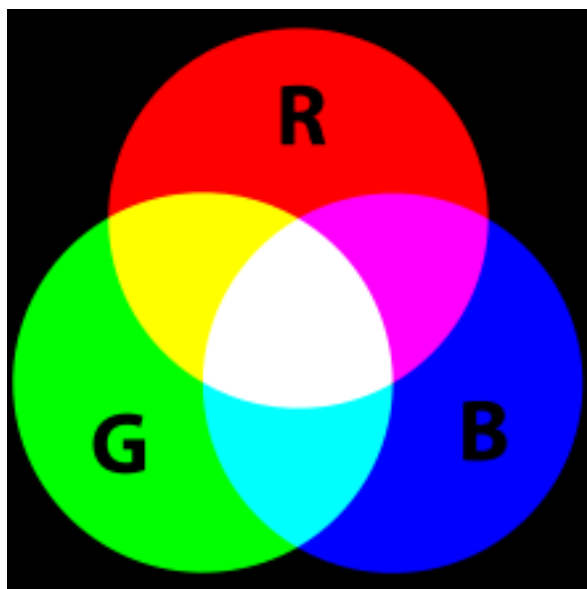
(http://en.wikipedia.org/wiki/Additive_colors)

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Digital Image Processing (RGB color space)

The RGB color space is an **additive color space** that can be represented through a cube as it can be seen in the following images. A color comes as a combination of three values that range from 0 to 255 (8 bit). Therefore in RGB color space (8bit) there can be represented 256^3 colors (approximately 16.8 million colors). One of the cube diagonals represents the gray scale.
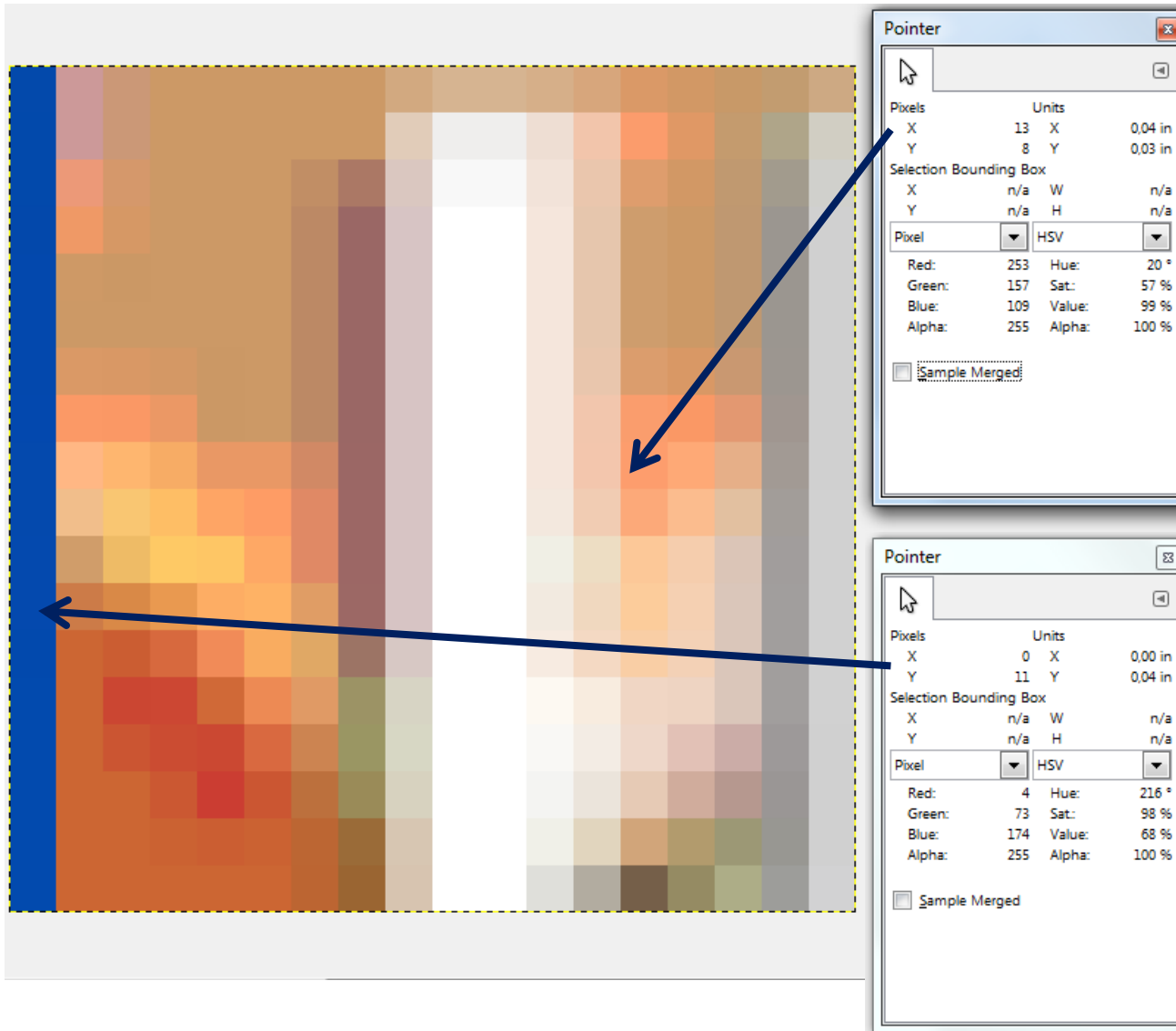

R: red
G: green
B: blue
C: cyan
M: magenta
Y: yellow
W: white

http://www.dig.cs.gc.cuny.edu/manuals/Gimp2/Grokking-the-GIMP-v1.0/node50.html
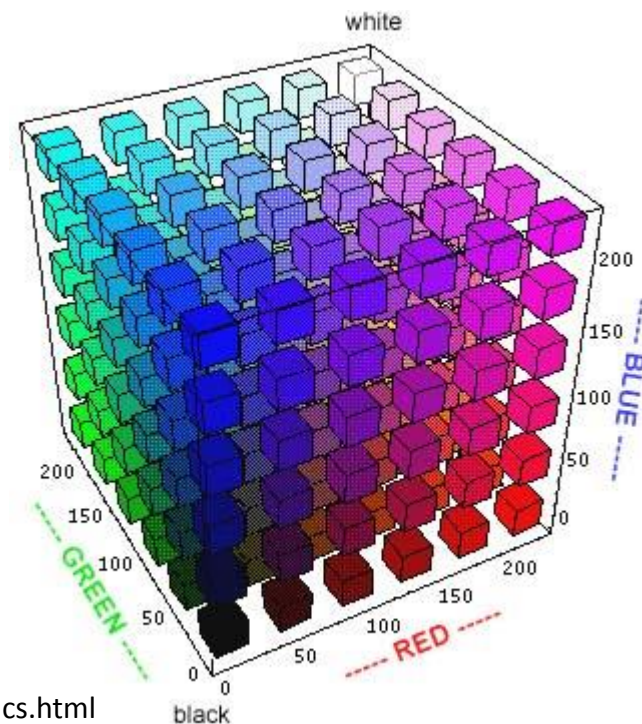
http://www.udel.edu/johnmack/apec480/480digital_image_basics.html

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Digital Image Processing (HSV/HSB)

The RGB color space is not the only one. There are other color spaces.

Here we look at two pixels, (13,8) and (0,11) and see the color values both in RGB and HSV.

HSV stands for Hue, Saturation and Value.

In fact this color space is a rearrangement of the RGB color space to make it more intuitive.

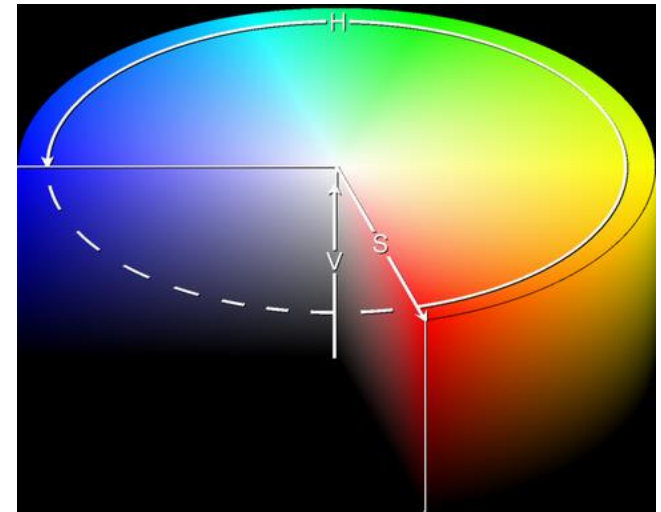# SRDD – Aula 3

Digital Image Processing (HSV color space)

Here we look at two pixels, (13,8) and (0,11) and see the color values both in RGB and HSV.

HSV stands for Hue ("matiz"), Saturation ("saturação") and Value ("brilho").

Hue is represented as an angle ("It ranges from 0 to 360 degree, with red at 0 degree, green at 120 degree, blue at 240 degree…"

**Saturation** ranges from 0% to 100%. The smaller the value, the closer to the cylinder axis.

Value (brightness) ranges from 0% to 100%. The bigger the value, the lighter the color.

http://www.acasystems.com/en/color-picker/faq-hsb-hsv-color.htm

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Digital Image Processing (CMYK color space)

"The CMYK color model (process color, four color) is a **subtractive color model**, used in color printing, and is also used to describe the printing process itself. CMYK refers to the four inks used in some color printing: cyan, magenta, yellow, and key (black)."
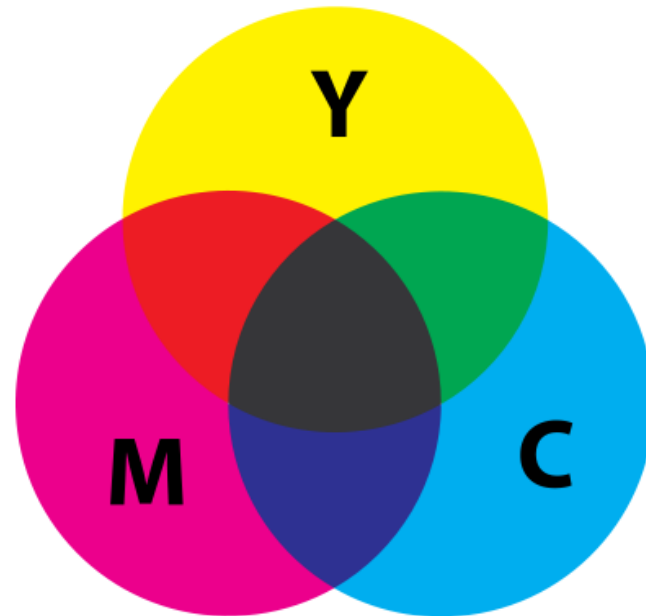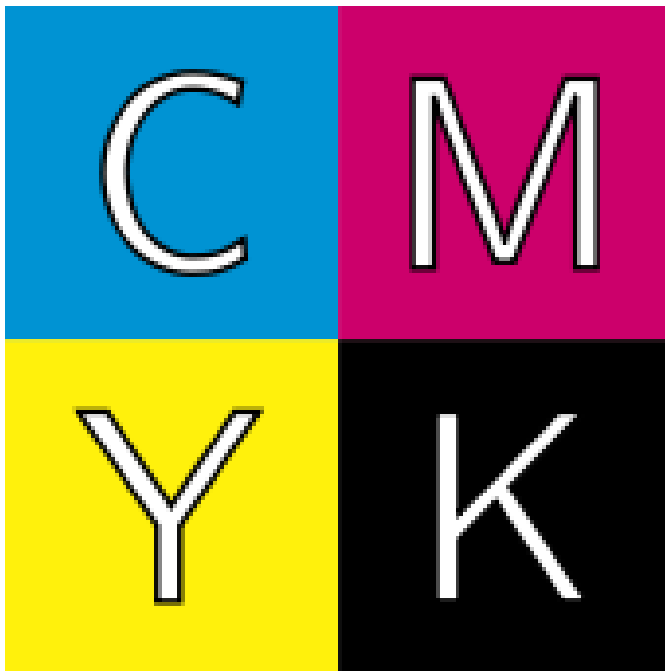
http://en.wikipedia.org/wiki/CMYK_color_model

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Digital Image Processing (histogram)

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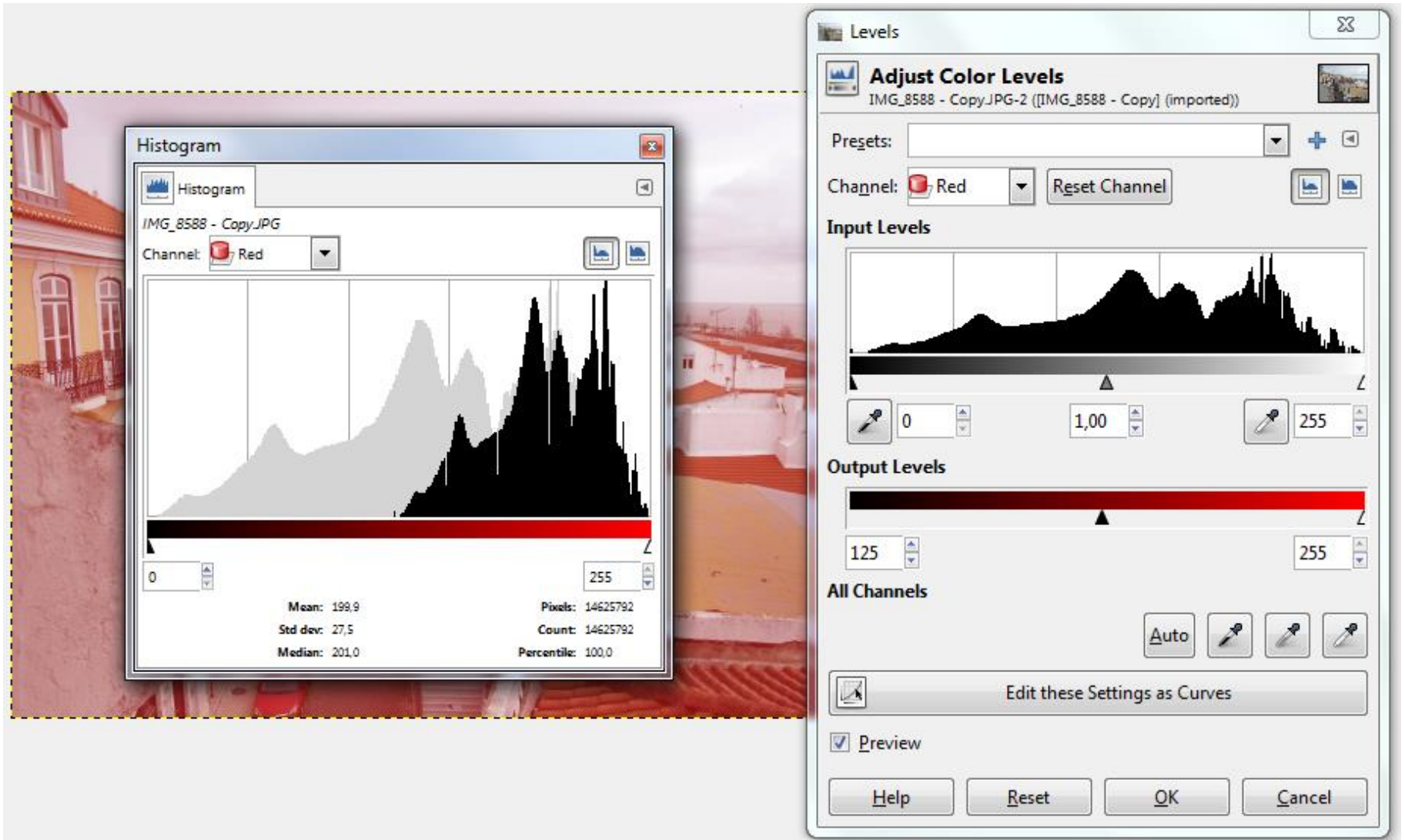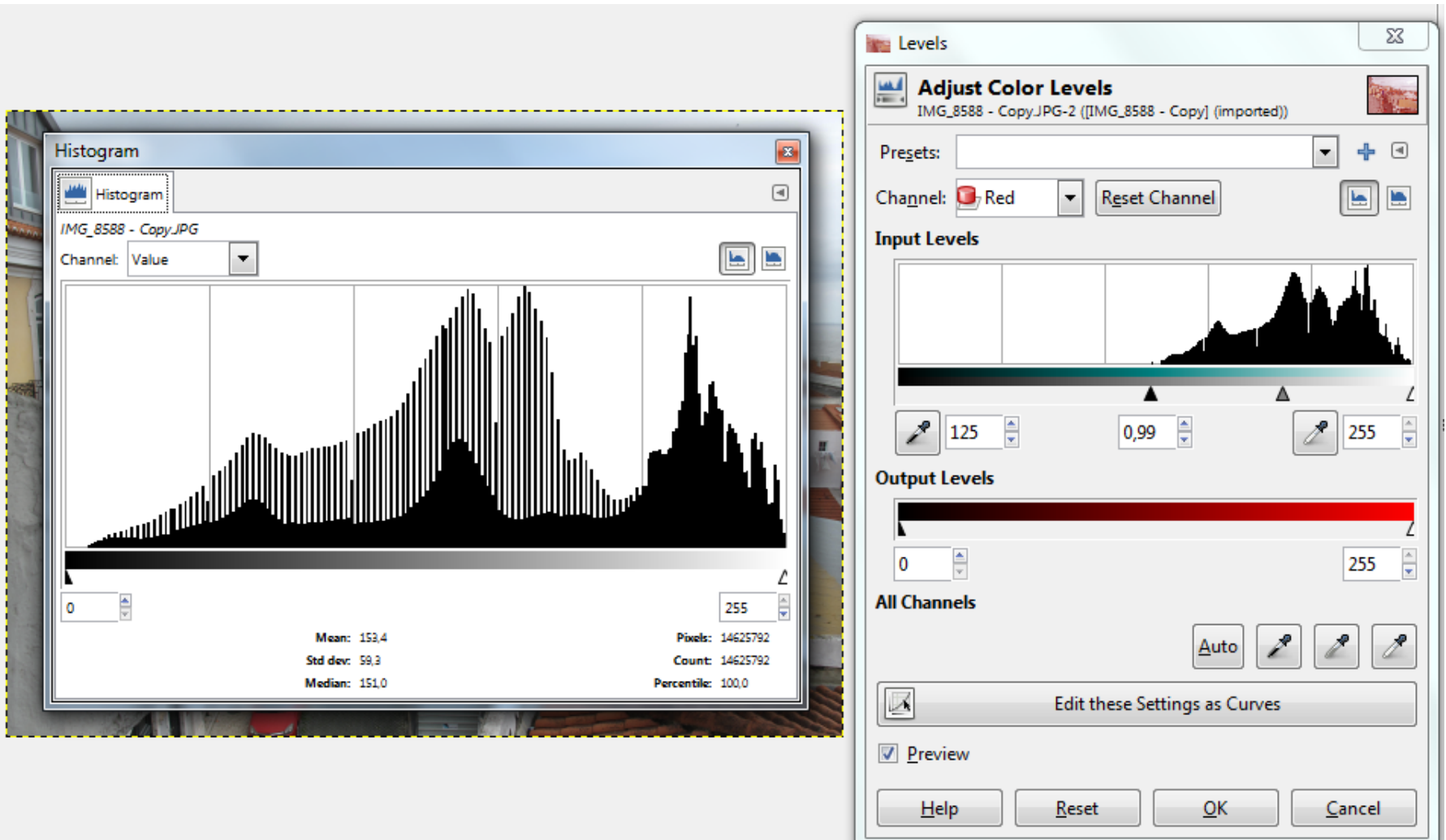**Digital Image Processing (histogram)**

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Digital Image Processing (GIMP colors -> levels)
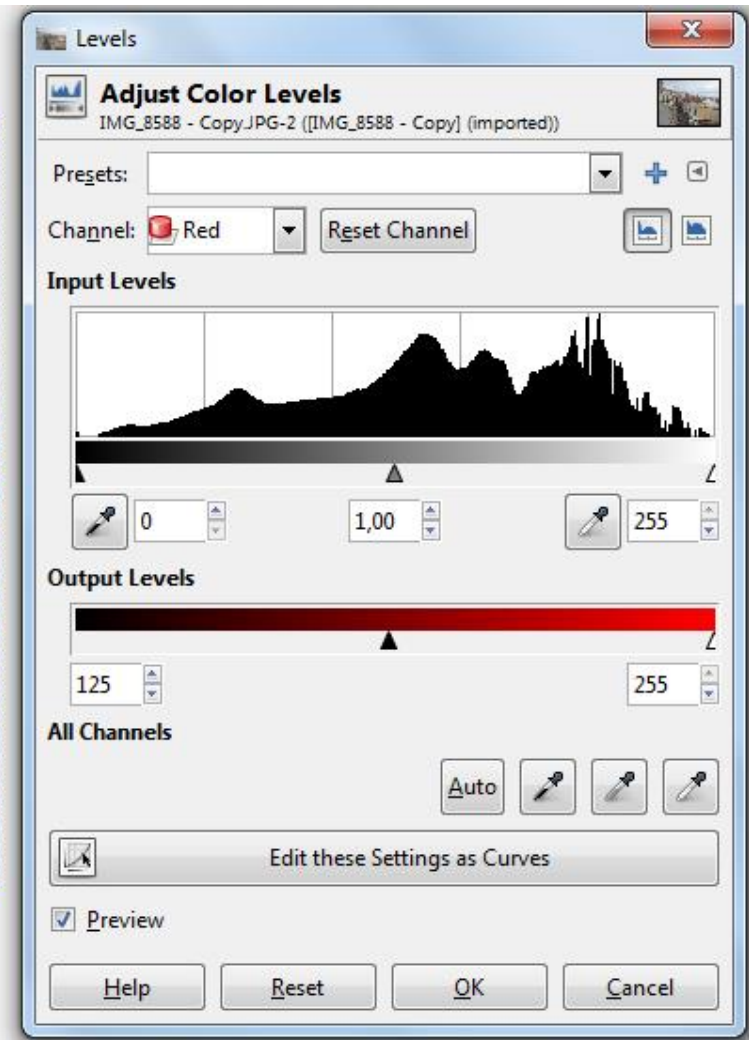
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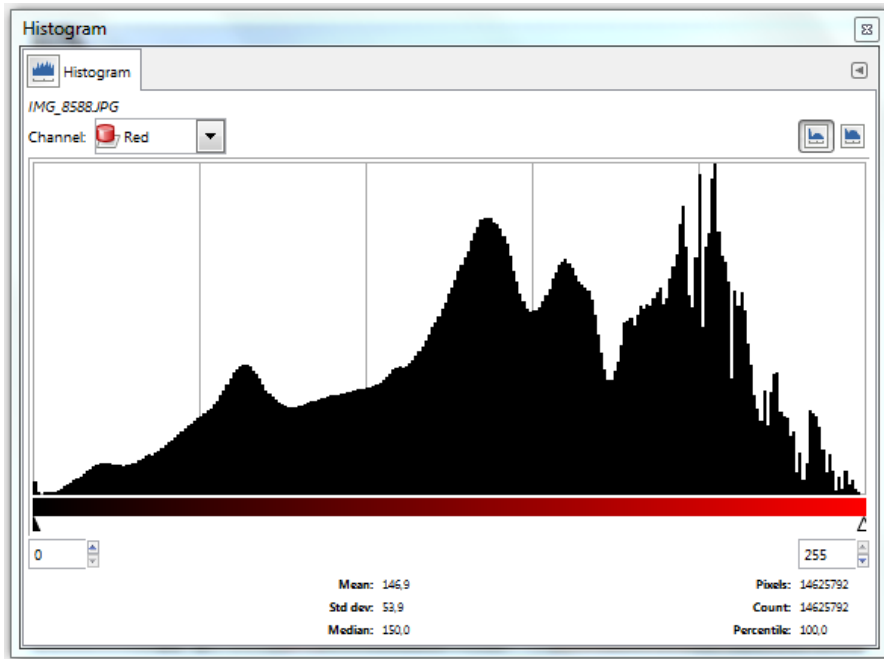**Digital Image Processing (GIMP colors -> levels)**

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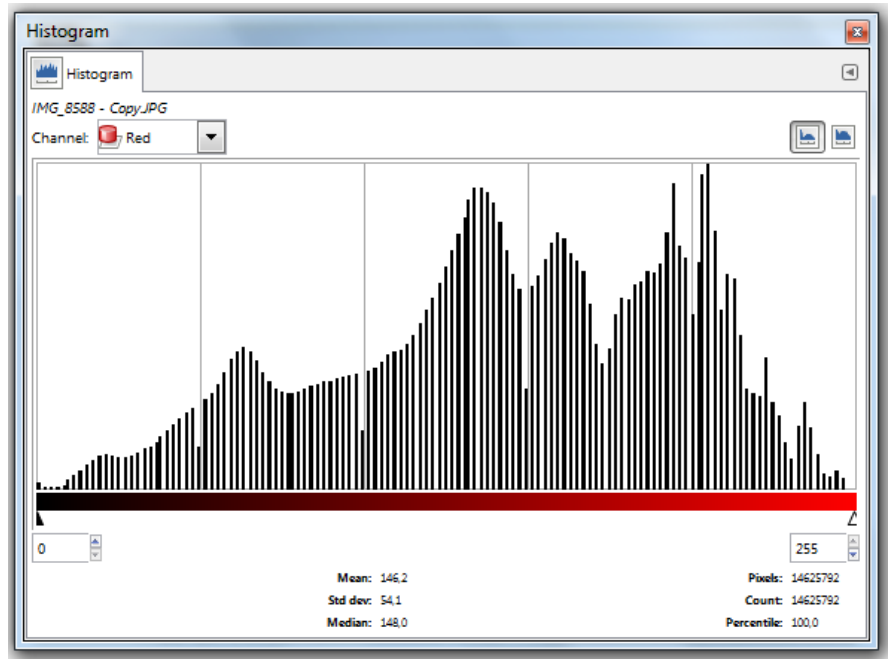**Digital Image Processing (GIMP colors -> levels)**

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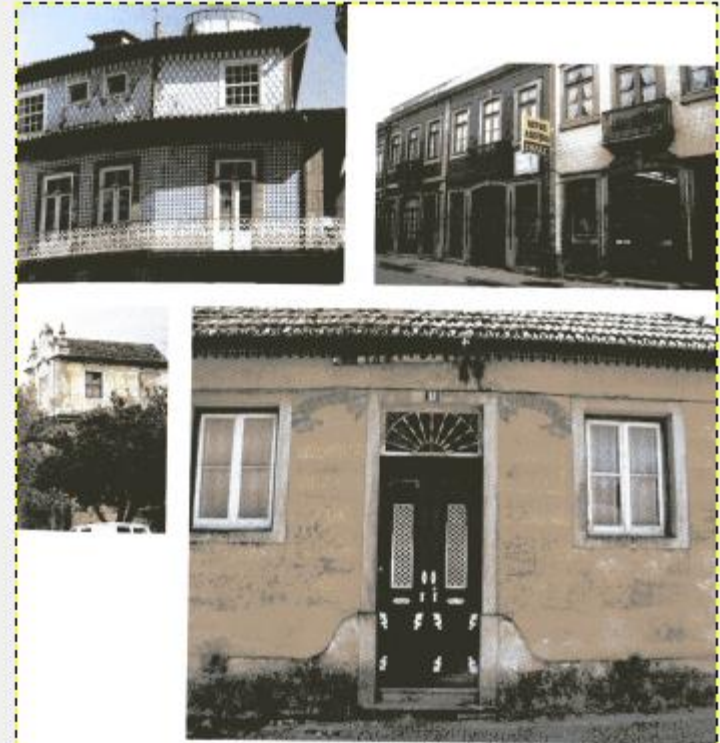
Digital Image Processing (GIMP colors -> levels)

Histogram of the red channel (original)

Histogram of the red channel (processed)

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Digital Image Processing (GIMP colors -> brightness and contrast)

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Digital Image Processing (GIMP colors -> curves)