



Computer Vision

Digital Image Basics



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Data Scientist & AI dev



Professional experience

- PhD: Molecular Biologist (4 ans)
- Data Science Project Leader (3 ans)

Teaching experience

Topics (2020):

- Data / IA
- Code / programming
- Algorithmes
- Mathématiques

Plan



➤ Image analysis

- Pixel notions
- Colors
- Image histogram

➤ Image filtering

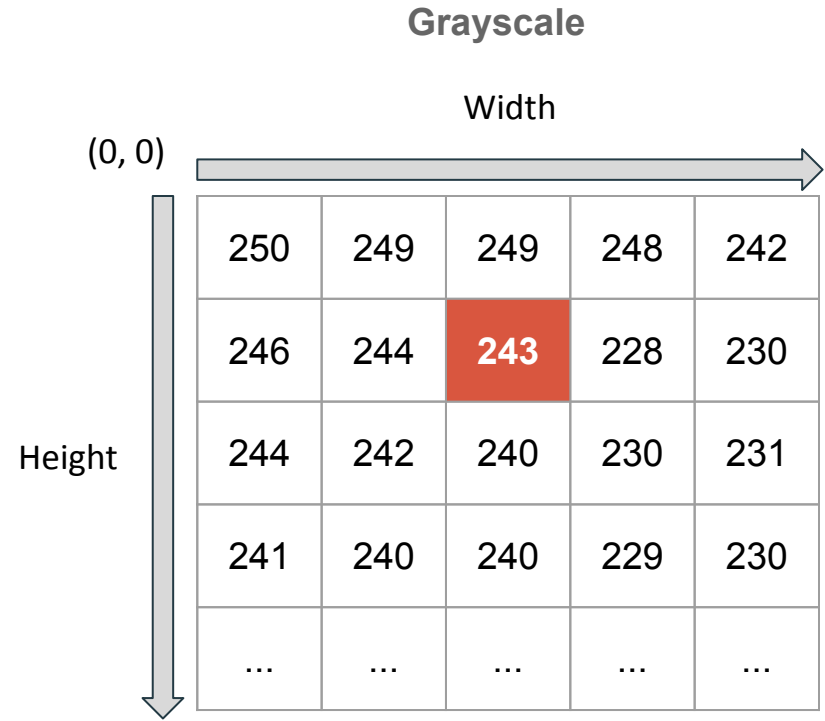
- Convolution filtering

Image Analysis

Pixel notions & histograms

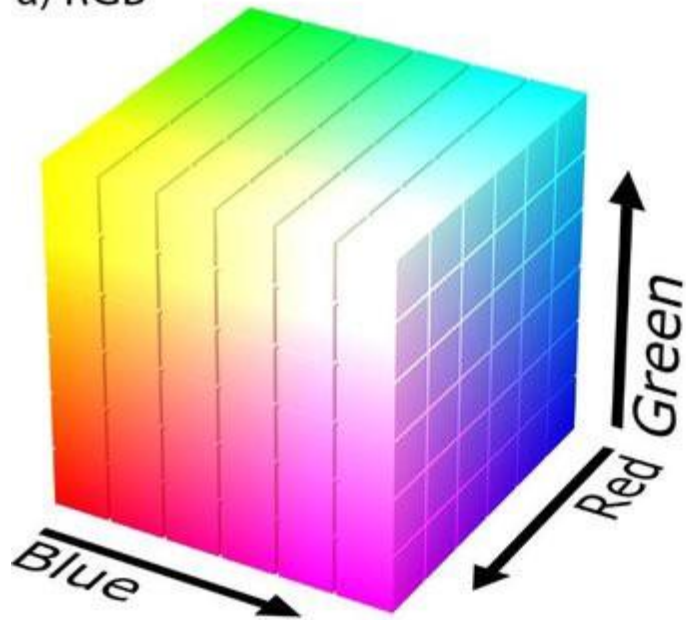
Pixel notions

- Image sampling : **divide** image in **small areas** (pixels) containing a **value** (or a list of values)
- Coordinates : **Width & Height** position of a pixel
- Quantification : number of **possible values**
- Definition : W X H
- Resolution : Pixels / Length unit



Colors

a) RGB



b) HSV

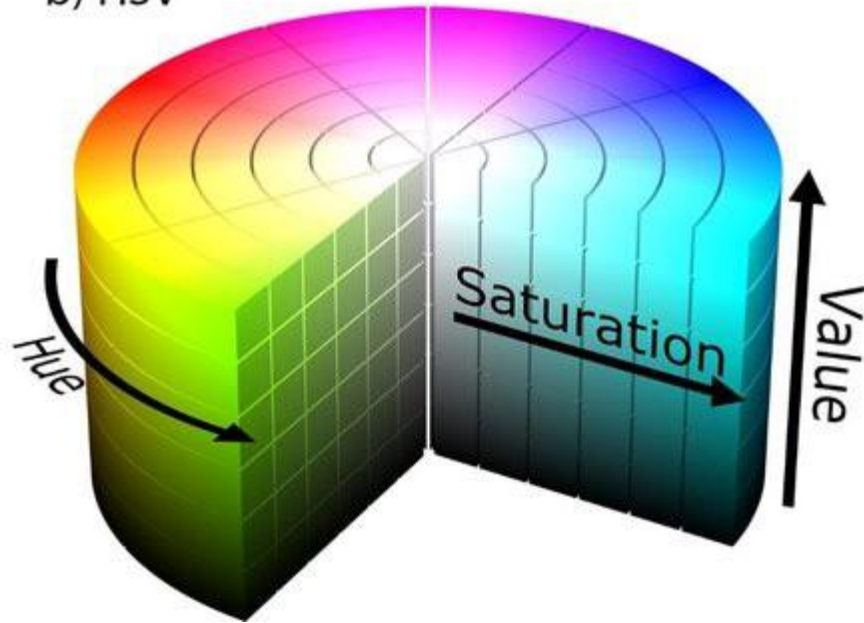


Image Histogram

Original



Pixel intensity distribution

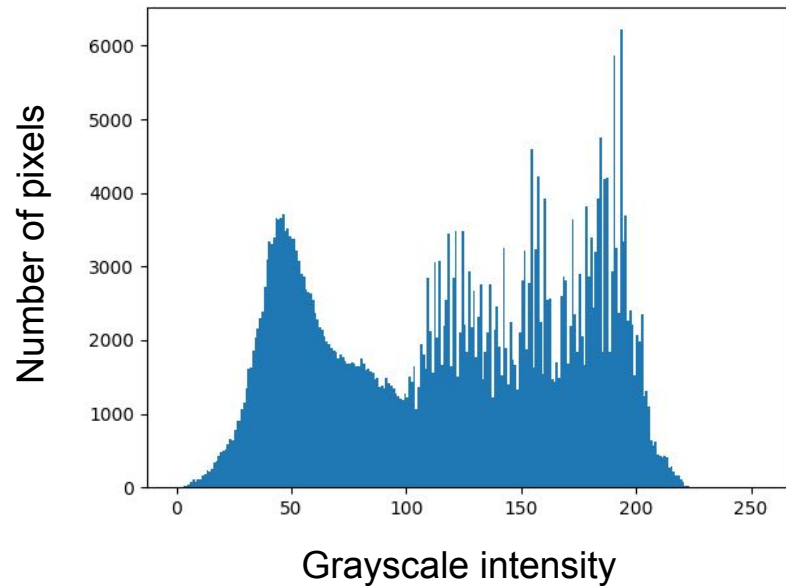


Image Histogram

Under exposed



Pixel intensity distribution

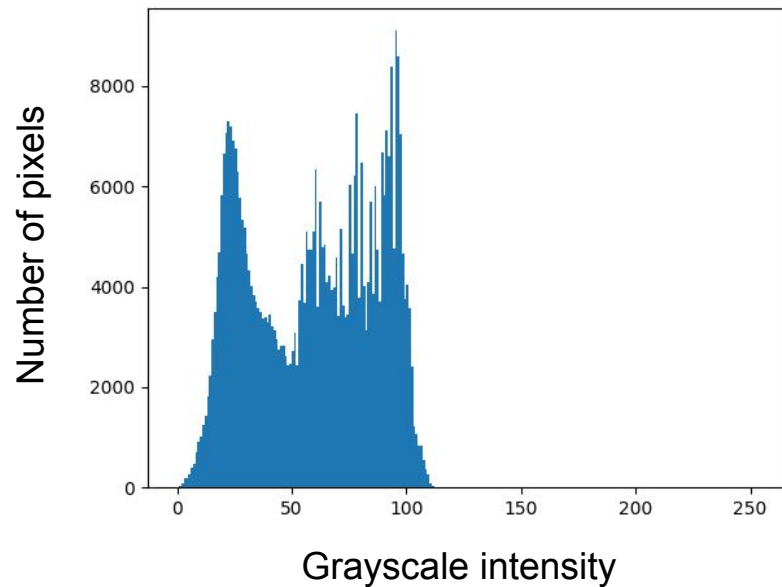
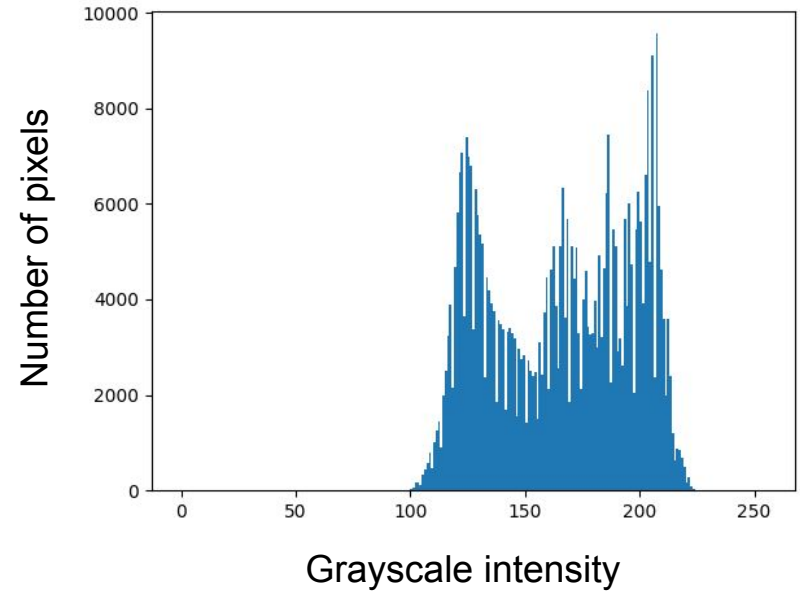


Image Histogram

Over exposed



Pixel intensity distribution

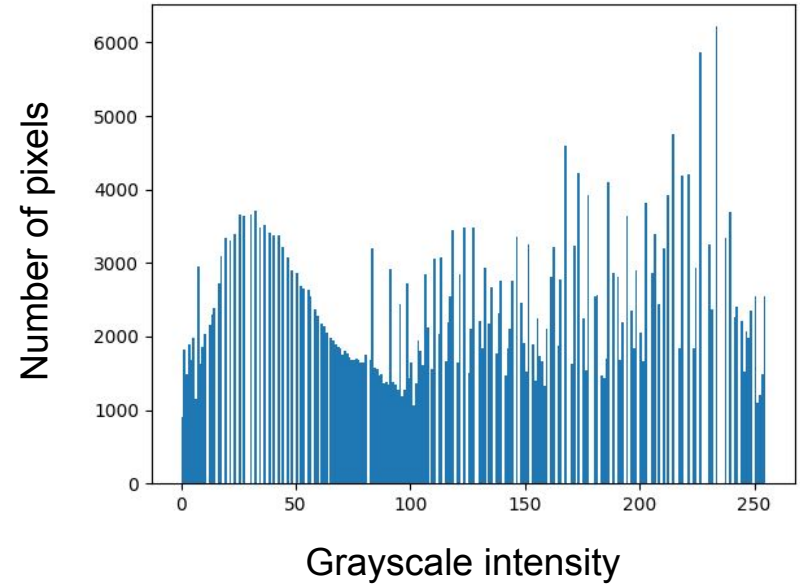


Histogram Equalization

Contrast adjusted



Pixel intensity distribution



Histogram Equalization

Contrast adjusted



Cumulative pixel intensity frequency

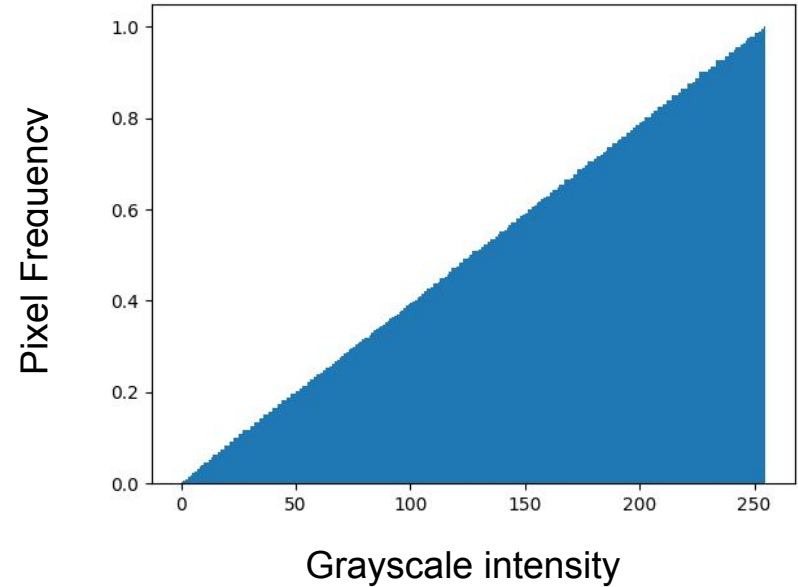


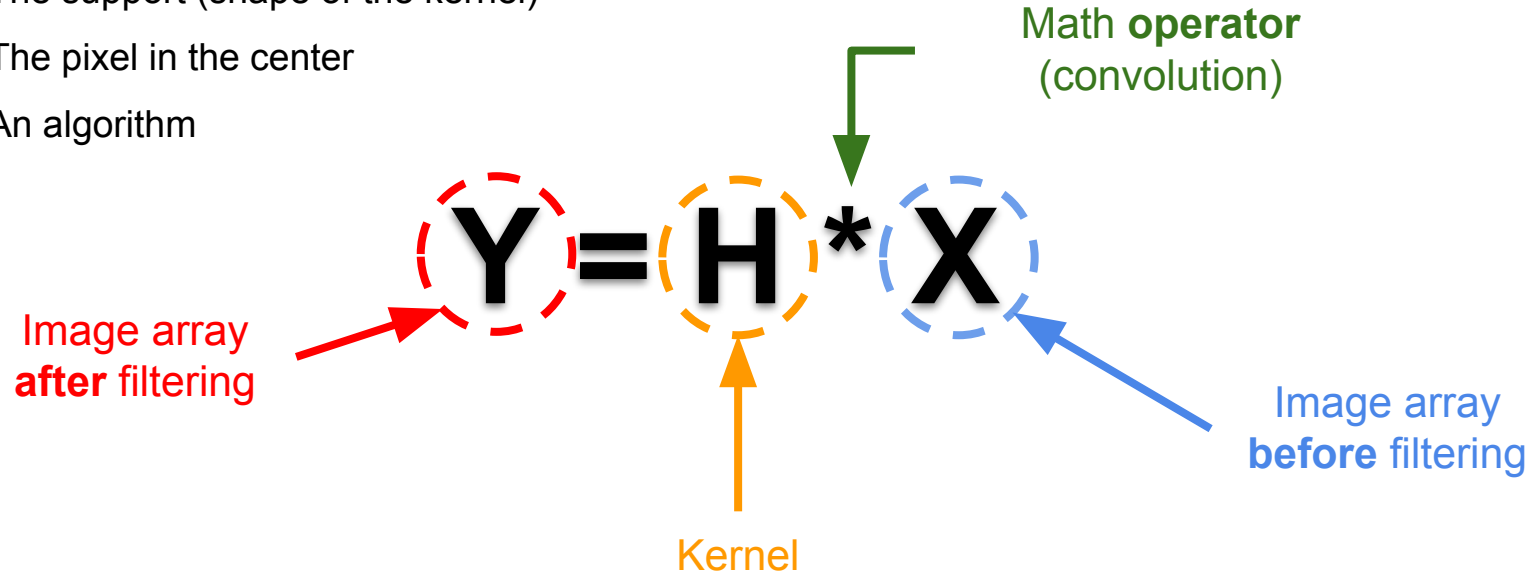
Image Filtering

Convolution & Spatial Frequency

Convolution (or linear) Filtering

Defined by:

- The support (shape of the kernel)
- The pixel in the center
- An algorithm



Neighbors Averager Filter

Convolution

$$(1*141+1*158+1*174+1*184+1*90+1*205+1*175+1*129+1*113) / 9$$

Kernel

1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

141	158	174	170	168
184	90	205	196	204
175	129	113	125	201
155	164	195	145	109
169	222	235	146	182

Before

141	158	174	170	168
184	152	205	196	204
175	129	113	125	201
155	164	195	145	109
169	222	235	146	182

After

Neighbors Averager Filter

Convolution

$$(1*158+1*174+1*170+1*90+1*205+1*196+1*129+1*113+1*125) / 9$$

Kernel

1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

141	158	174	170	168
184	90	205	196	204
175	129	113	125	201
155	164	195	145	109
169	222	235	146	182

Before

141	158	174	170	168
184	152	151	196	204
175	129	113	125	201
155	164	195	145	109
169	222	235	146	182

After

Gaussian Filter

Convolution

$$(1 \cdot 141 + 2 \cdot 158 + 1 \cdot 174 + 2 \cdot 184 + 4 \cdot 90 + 2 \cdot 205 + 1 \cdot 175 + 2 \cdot 129 + 1 \cdot 113) / 16$$

Kernel

1/16	2/16	1/16
2/16	4/16	2/16
1/16	2/16	1/16

141	158	174	170	168
184	90	205	196	204
175	129	113	125	201
155	164	195	145	109
169	222	235	146	182

Before

141	158	174	170	168
184	145	205	196	204
175	129	113	125	201
155	164	195	145	109
169	222	235	146	182

After

Borders management

- Zero padding
- Duplication
- Partial convolution

	141	158	174	170	168
	184	90	205	196	204
	175	129	113	125	201
	155	164	195	145	109
	169	222	235	146	182



Exercices

Coding games & images filtering

Let's play some Codingame !



- easy:
 - flip the sign
 - Reverse minesweeper
 - sudoku validator
 - lumen
 - pirate's treasure
- medium:
 - forest fire
 - battleship