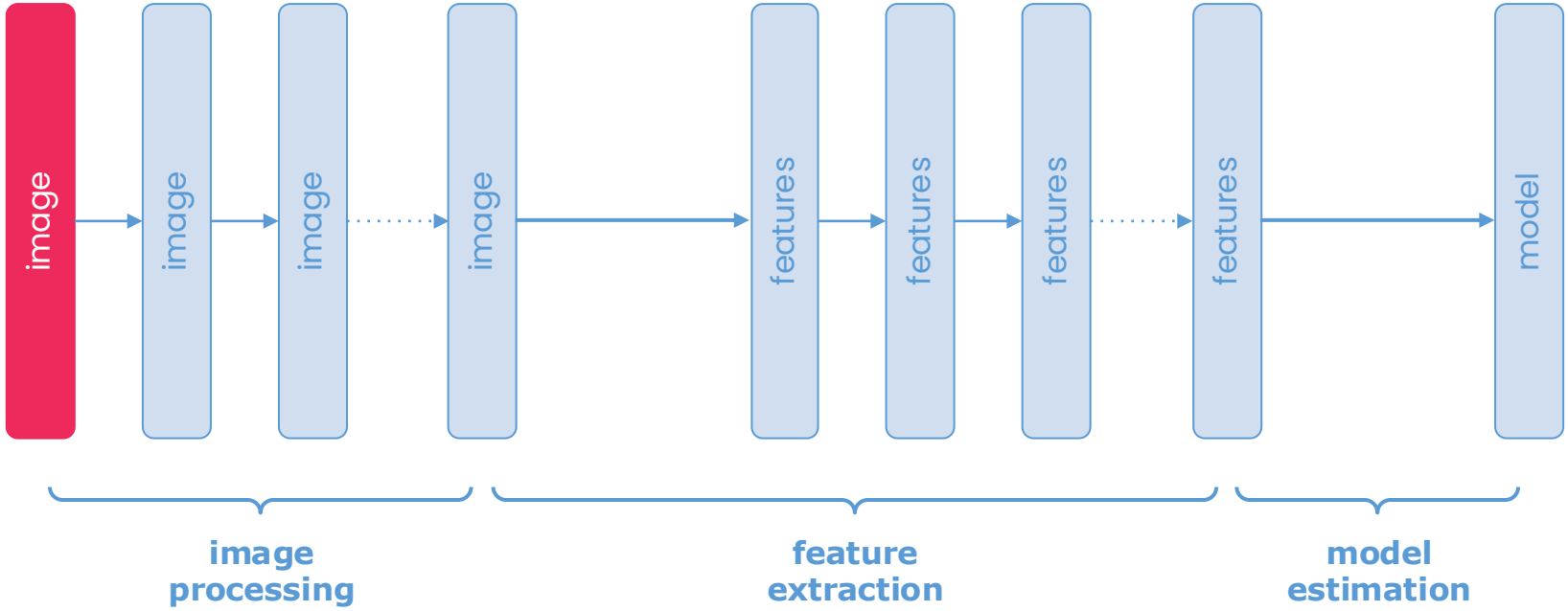
Insper

Computer Vision

Class 4: Brightness and Contrast Adjustment

image representation



Data tensor:

a multidimensional array that represents an input or an output

multi-channel

```
[[???, ???, ???, ..., ???, ???, ???],
 [???, ???, ???, ..., ???, ???, ???],
 [???, ???, ???, ..., ???, ???, ???],
  ...,
 [???, ???, ???, ..., ???, ???, ???],
 [???, ???, ???, ..., ???, ???, ???],
 [???, ???, ???, ..., ???, ???, ???]]
```

Data tensor:

a multidimensional array that represents an input or an output

single-channel

```
[[197, 198, 199, ..., 194, 194, 195],
 [198, 198, 196, ..., 195, 193, 194],
 [197, 197, 196, ..., 196, 193, 194],
  ...,
 [182, 182, 179, ...,  67,  61,  66],
 [187, 187, 181, ...,  80,  76,  76],
 [187, 186, 183, ...,  91,  94,  97]]
```

Gray level:

bivariate function in limited
non-negative integer domains

$$P\colon [0,w] \times [0,h] \to [0,255]$$

Gray level:

bivariate function in limited
non-negative integer domains

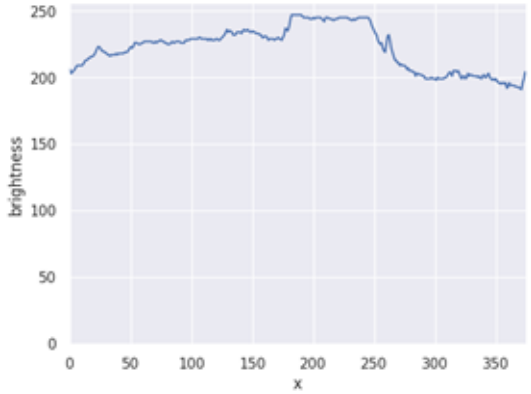
$$P\colon [0, w] \times [0, h] \to [0, 255]$$

Gray level:

bivariate function in limited
non-negative integer domains

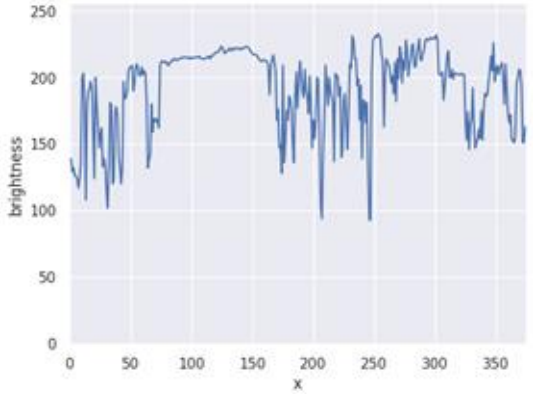
Gray level:

bivariate function in limited
non-negative integer domains



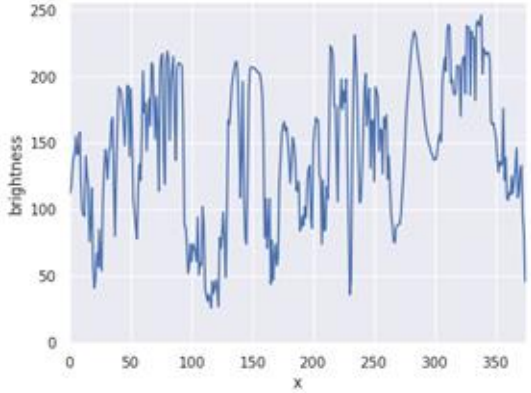
Gray level:

bivariate function in limited
non-negative integer domains



Gray level:

bivariate function in limited
non-negative integer domains



We know that the goal is extracting information...

...but how can we enhance images to favor this information extraction?

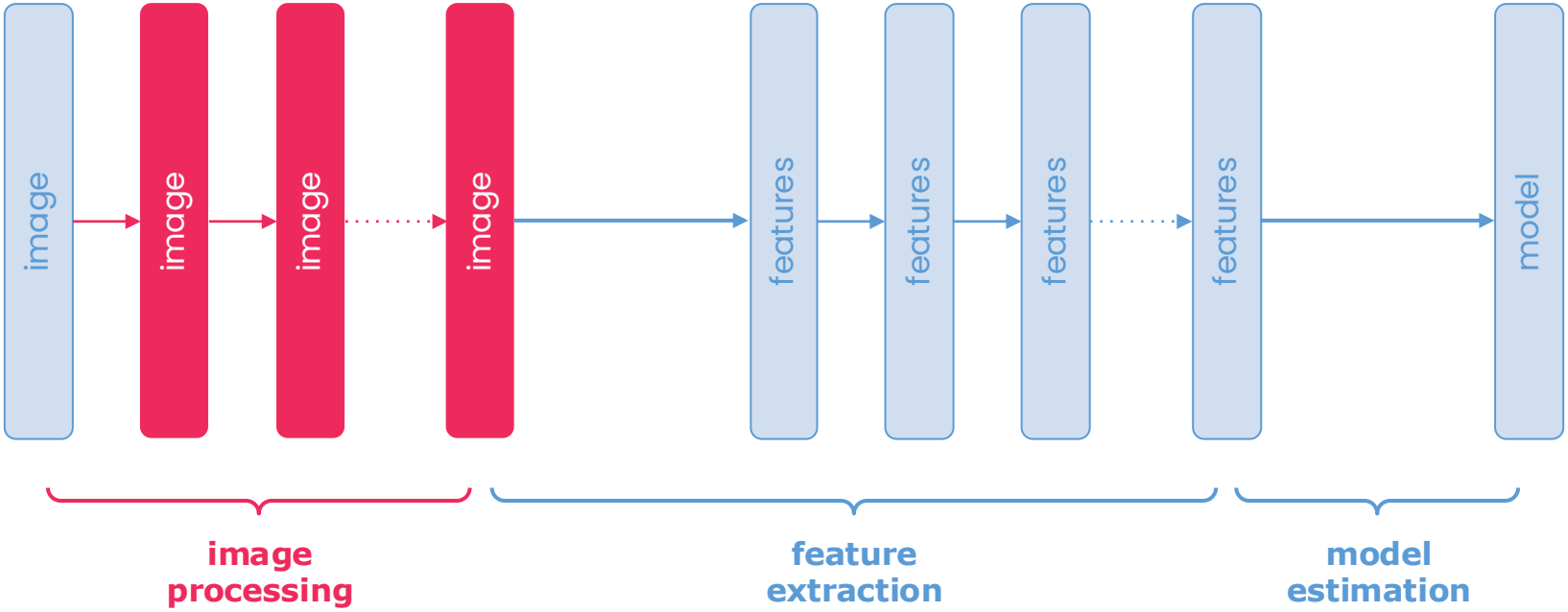


image
image
image
image
features
features
features
features
model
image processing
feature extraction
model estimation

Basic adjustment

Basic adjustment

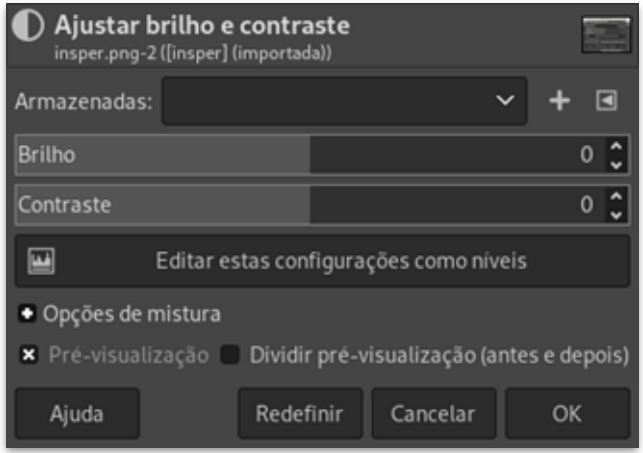
- **Hue** *(previous class)*
- **Saturation** *(previous class)*

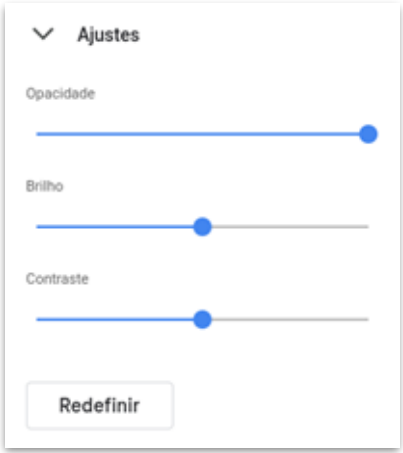
Basic adjustment

- **Hue** *(previous class)*
- **Saturation** *(previous class)*
- **Brightness:** the absolute luminance. *(previous class)*
- **Contrast:** the relative luminance of different elements.

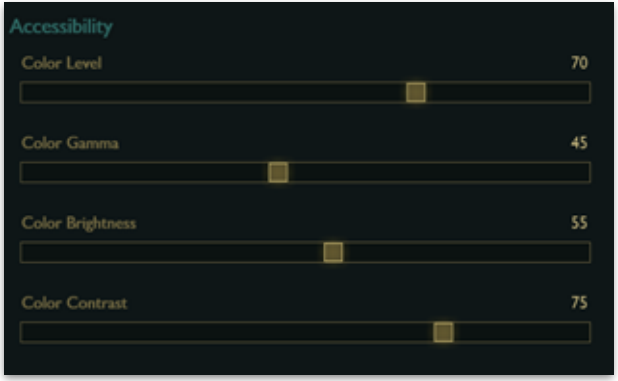
brightness

contrast


Ajustar brilho e contraste
insper.png-2 ([insper] (importada))
Armazenadas:
Brilho
0
Contraste
0
Editar estas configurações como niveis
Opções de mistura
Pré-visualização
Dividir pré-visualização (antes e depois)
Ajuda
Redefinir
Cancelar
OK

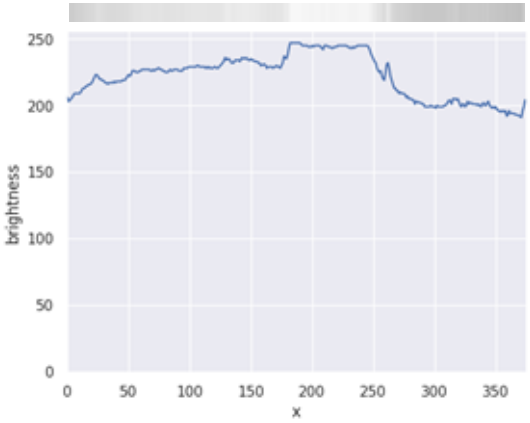

Ajustes
Opacidade
Brilho
Contraste
Redefinir

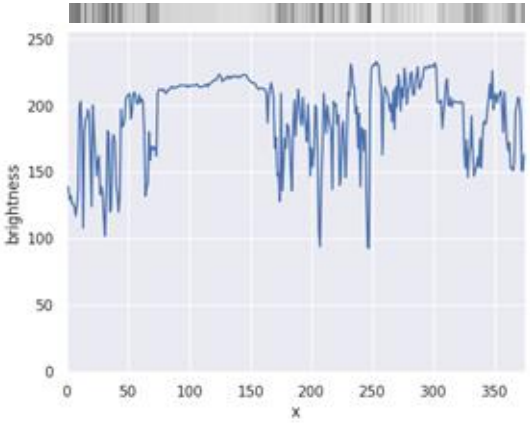
Video Adjust
Presets
NORMAL
ENHANCED
GREYSCALE
CUSTOM
Brightness
100
Saturation
100
Contrast
100
OK
CANCEL

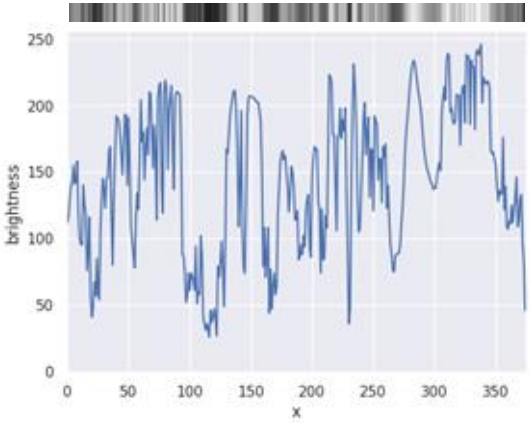

Accessibility
Color Level
70
Color Gamma
45
Color Brightness
55
Color Contrast
75

Brightness?

$$f_b(P(x,y))$$

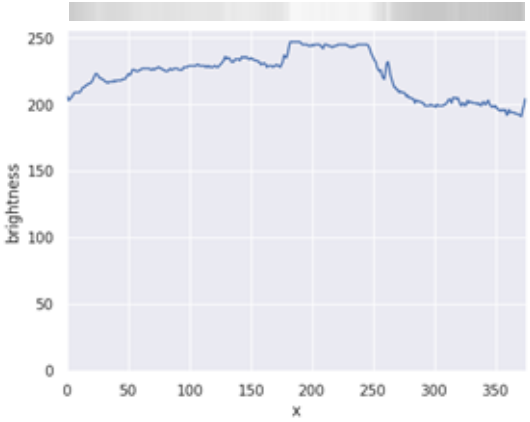


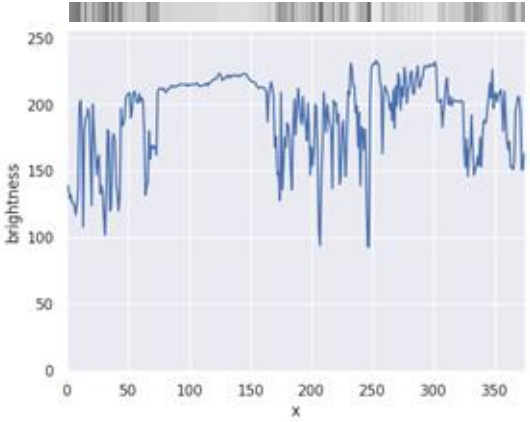


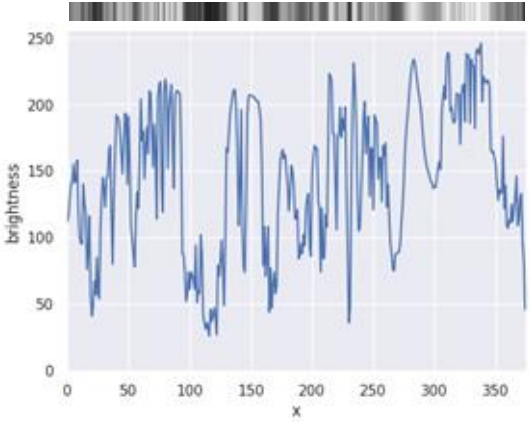


Brightness:
additive constant

$$P(x, y) + b$$

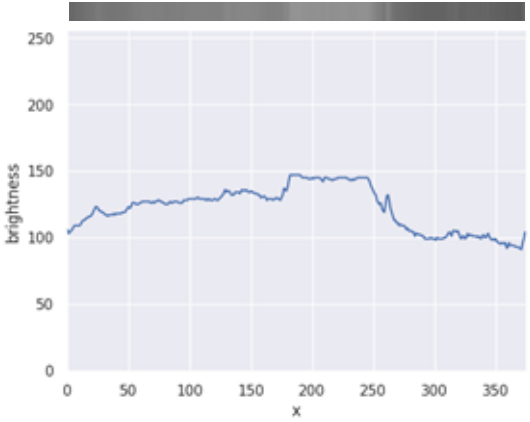


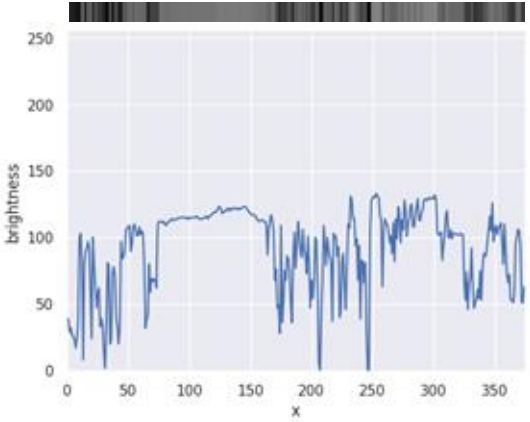


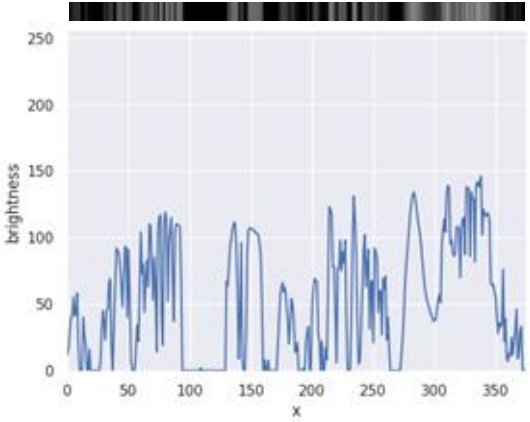


Brightness:
additive constant

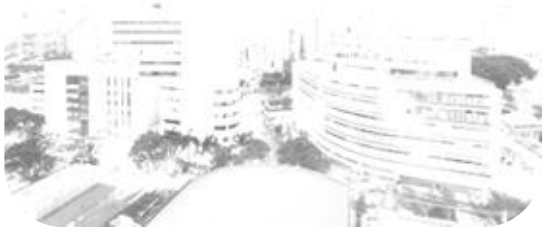
$$P(x, y) - 100$$



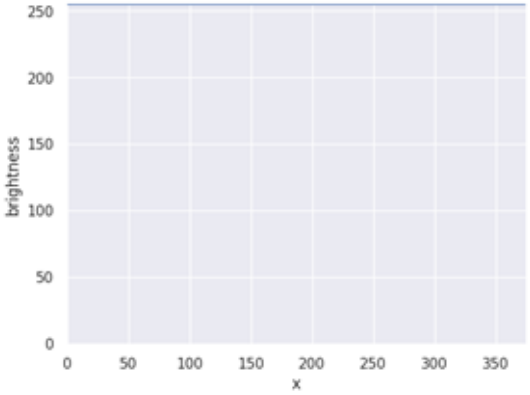


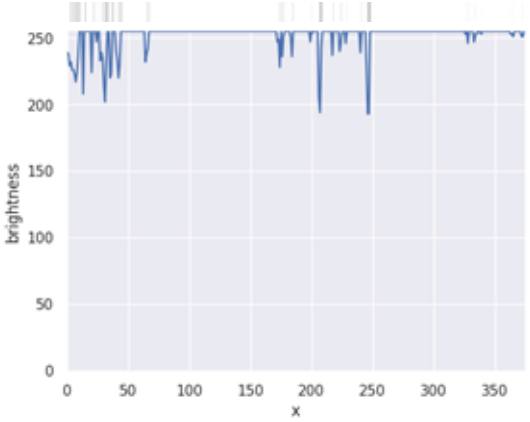


Brightness:
additive constant



$$P(x, y) + 100$$





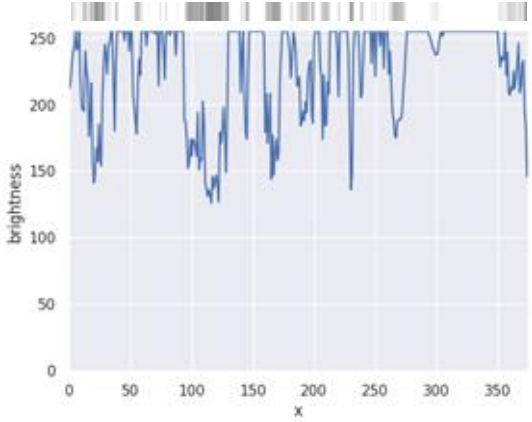
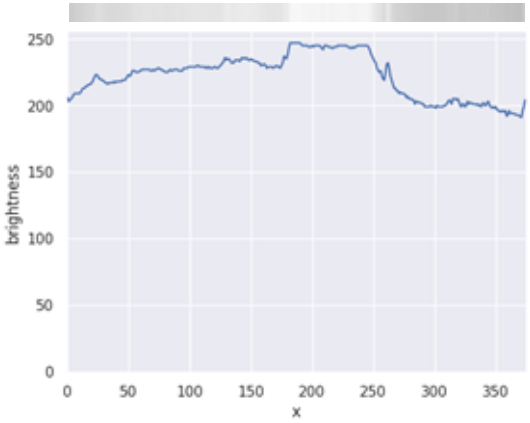


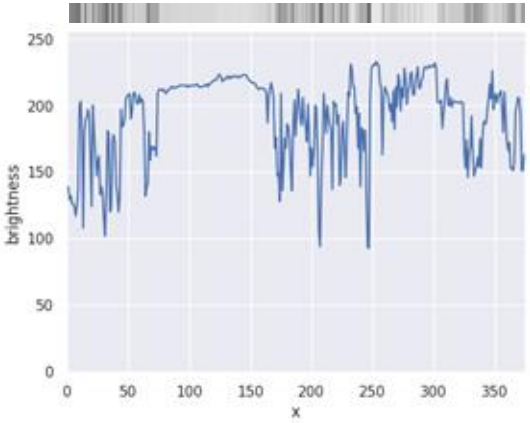
Image processing can lead to irreversible information loss.

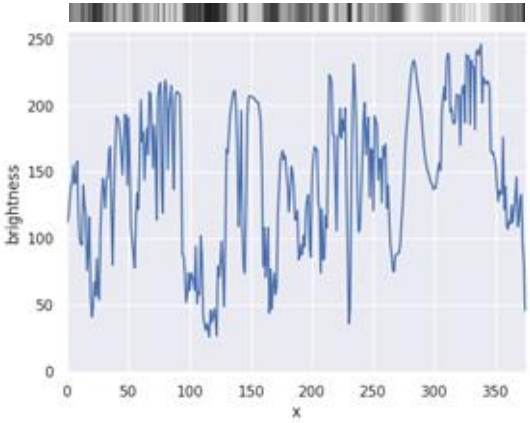
There are strategies to interpolate lost information, but not to recover it.

Contrast?

$$f_c(P(x,y))$$

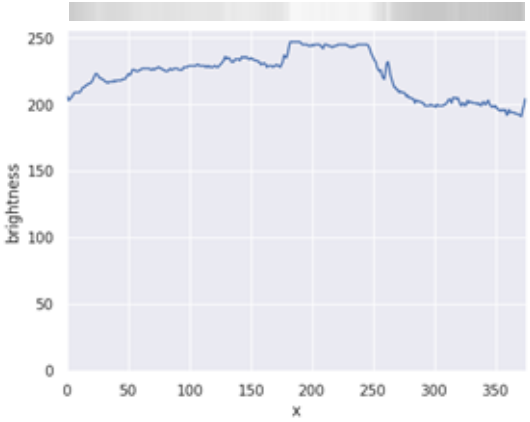


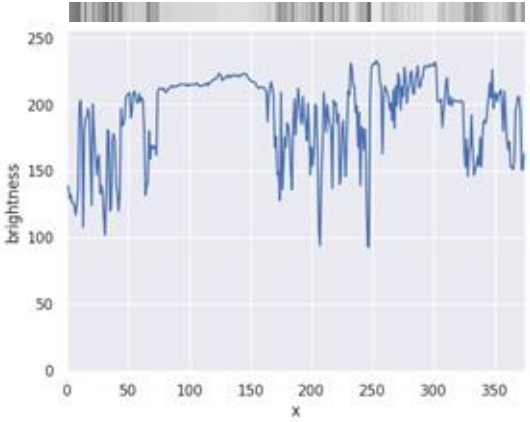


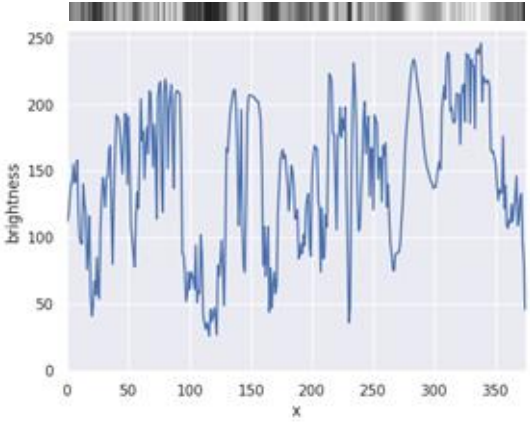


Contrast:
multiplicative constant?

$$a \cdot P(x, y)$$

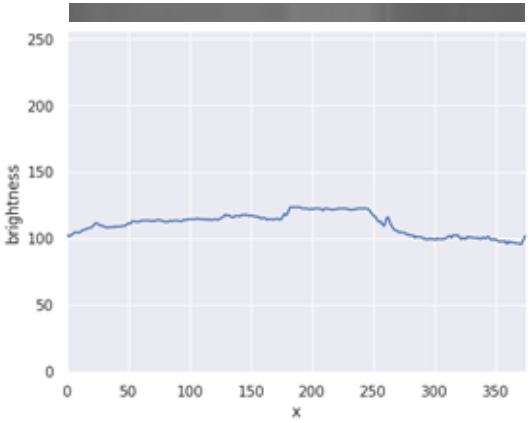


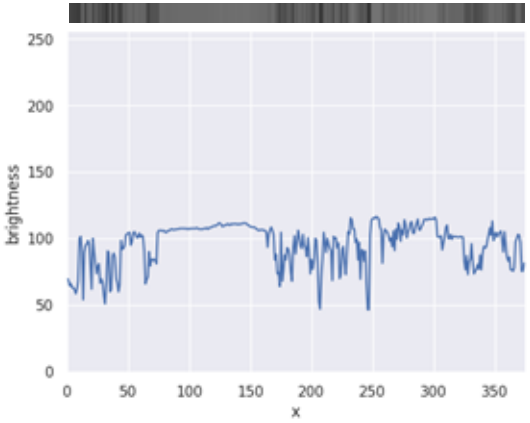


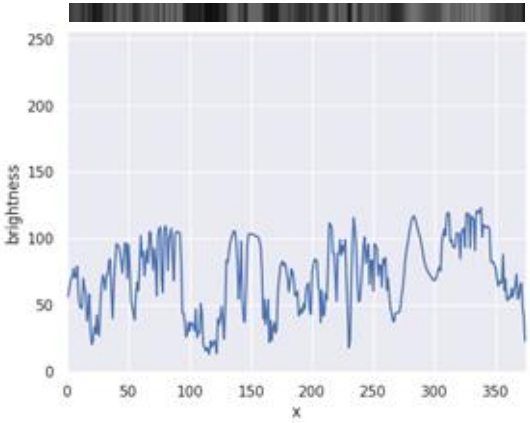


Contrast:
multiplicative constant?
(does not seem enough)

$$0.5 \cdot P(x, y)$$



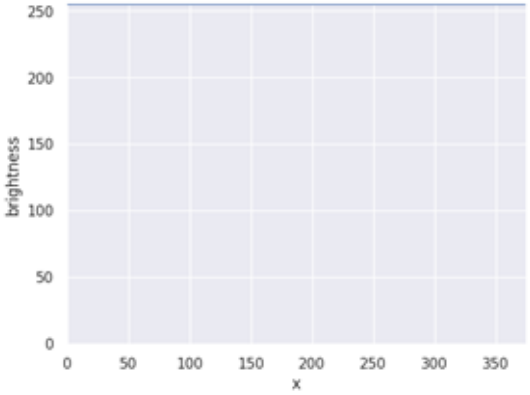


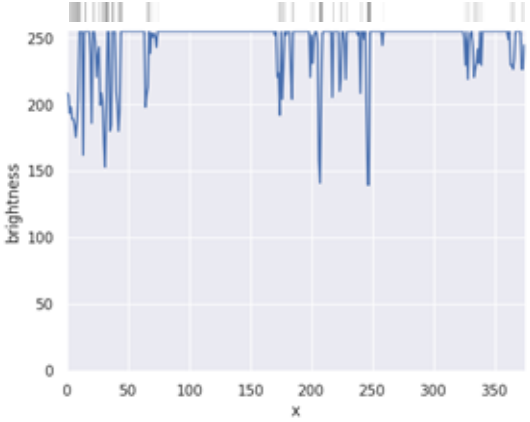


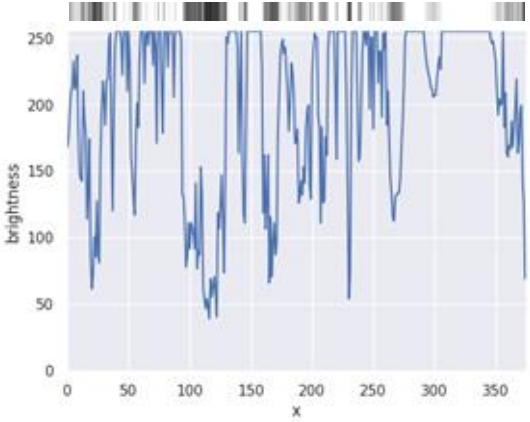
Contrast:

multiplicative constant?
(does not seem enough)

$$1.5 \cdot P(x, y)$$

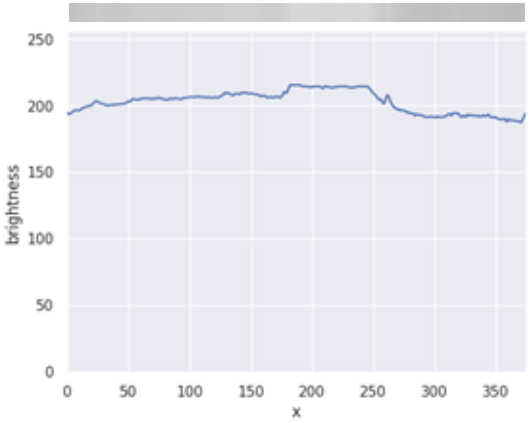


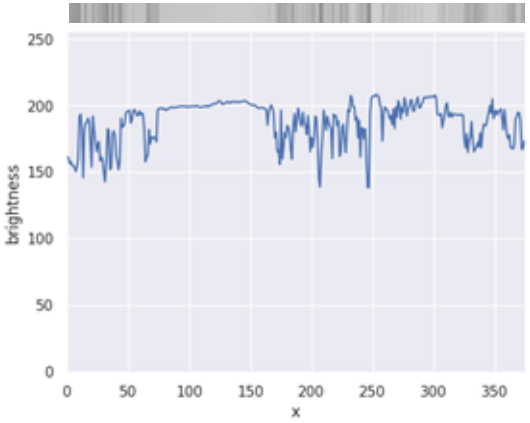


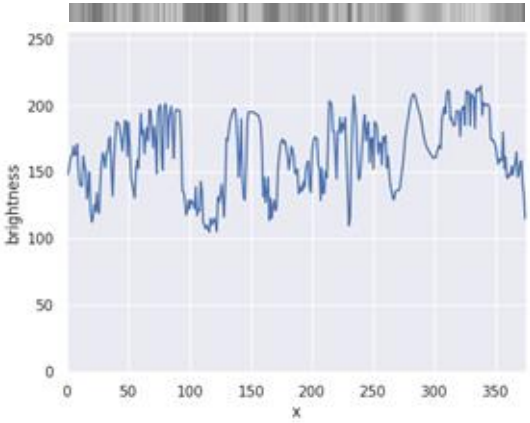


Contrast:
multiplicative constant,
but preserving the mean

$$0.5 \cdot (P(x,y) - \bar{p}) + \bar{p}$$

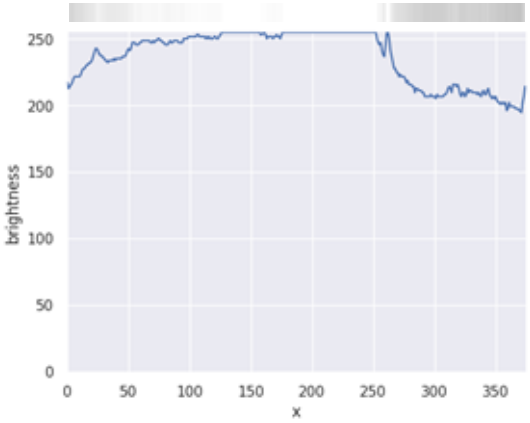


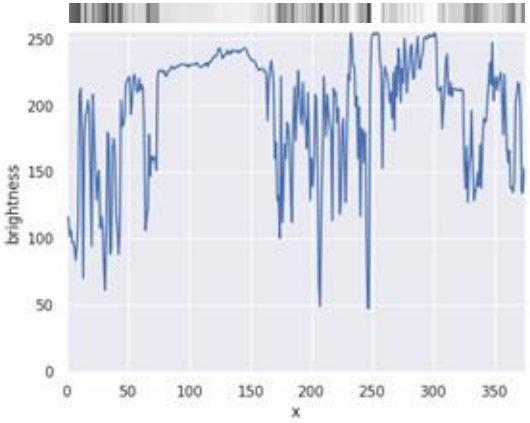


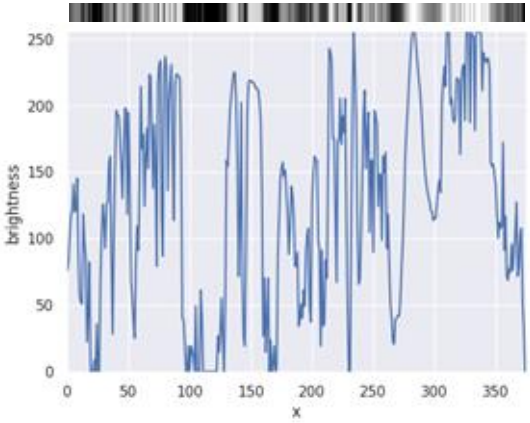


Contrast:
multiplicative constant,
but preserving the mean

$$1.5 \cdot (P(x,y) - \bar{p}) + \bar{p}$$



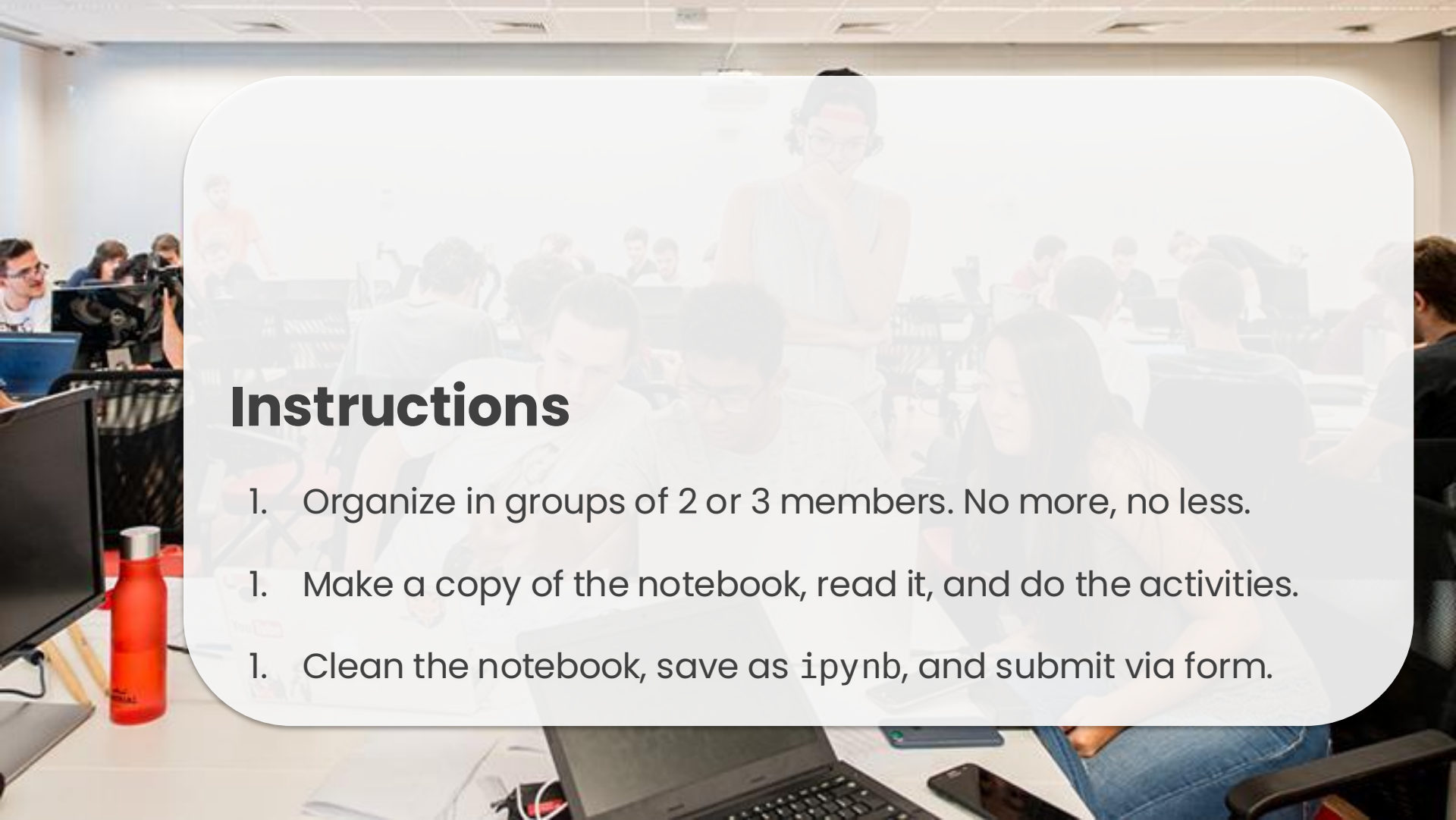




handout

Toolkit

- **Language:** Python
- **Library:** OpenCV
- **Platform:** Google Colab



Instructions

1. Organize in groups of 2 or 3 members. No more, no less.
1. Make a copy of the notebook, read it, and do the activities.
1. Clean the notebook, save as `ipynb`, and submit via form.

Next class:

- back to neural networks.

Credits

This material was based on the work of other professors, listed below.

- Fabio Miranda (fabiomiranda@insper.edu.br)
- Raul Ikeda (RaulIGS@insper.edu.br)
- Fabio Ayres (FabioJA@insper.edu.br)
- Igor Montagner (IgorSM1@insper.edu.br)
- Andrew Kurauchi (AndrewTNK@insper.edu.br)
- Luciano Silva (LucianoS4@insper.edu.br)
- Tiago Sanches (tiagoss4@insper.edu.br)

Well, except for the errors. Any errors you might find are probably my fault.

Images

https://www.insper.edu.br/campus/
https://www.downloadsource.net/how-to-adjust-netflix-image-settings-brightness-colour-contrast-saturation-etc/n/13253/
https://www.reddit.com/r/leagueoflegends/comments/d2oay8/color_settings_are_one_of_the_best_things_riot/
https://acidcow.com/pics/15485-mindfuck-pictures-74-pics.html