Trabalho 1

March 9, 2023

[85]:
```python
import imageio
import numpy as np
from PIL import Image, ImageOps
import matplotlib.pyplot as plt
```

[322]:
```python
file = open("filter.txt", "r")

matrix_filter = []

for row in file:
    values = row.split()
    matrix_filter.append(values)

file.close()

for row in range(len(matrix_filter)):
    for column in range(len(matrix_filter[0])):
        matrix_filter[row][column] = float(matrix_filter[row][column])
```

[323]:
```python
matrix_filter = np.array(matrix_filter)
matrix_filter
```

[323]:
```
array([[ 1.,  0., -1.],
       [ 2.,  0., -2.],
       [ 1.,  0., -1.]])
```

0.1 Funções para plotar

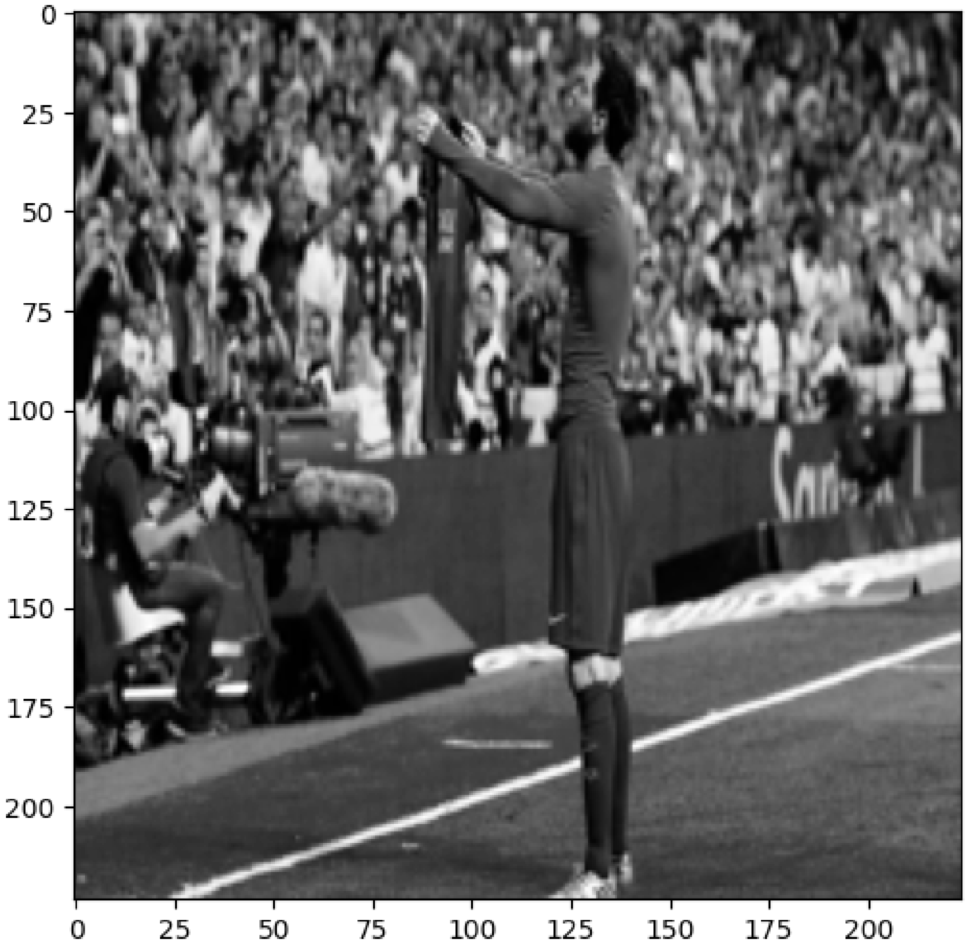
[324]:
```python
# Plota 1 imagem

def plot_image(img: np.array):
    plt.figure(figsize=(6, 6))
    plt.imshow(img, cmap='gray');

# Plota as 2 imagens

def plot_two_images(img1: np.array, img2: np.array):
    _, ax = plt.subplots(1, 2, figsize=(12, 6))
    ax[0].imshow(img1, cmap='gray')
    ax[1].imshow(img2, cmap='gray');
```

0.2 Carrega a imagem e aplica a cor cinza

[325]:

```
img = Image.open('messi.webp')
img = ImageOps.grayscale(img)
img = img.resize(size=(224, 224))
plot_image(img=img)
print(np.array(img).shape)
```

```
(224, 224)
```



0.3 Calcula o tamanho da imagem depois da aplicação do filtro

[326]:

```
def calculate_target_size(img_size: int, kernel_size: int) -> int:
    num_pixels = 0

    print("kernel: ", kernel_size)

    for i in range(img_size):
        added = i + kernel_size

        if added <= img_size:
            num_pixels += 1

    return num_pixels
```

[327]:

```
calculate_target_size(img_size=228, kernel_size=5)
```

```
kernel:  5
```

[327]:

```
224
```

0.4 Função para aplicar a convolução

[328]:

```
def convolve(img: np.array, kernel: np.array, extension = False) -> np.array:

    kernel_size = 0

    tgt_size_r = calculate_target_size(
        img_size=img.shape[0],
        kernel_size=len(kernel)
    )

    tgt_size_c = calculate_target_size(
        img_size=img.shape[1],
        kernel_size=len(kernel[0])
    )

    k = kernel.shape[0]
    l = kernel.shape[1]

    convolved_img = 0

    if extension:
        range_img_r = img.shape[0] - (kernel.shape[0]-1)
        range_img_c = img.shape[1] - (kernel.shape[1]-1)

        convolved_img = np.zeros(shape=(range_img_r, range_img_c))
        for i in range(range_img_r):

            for j in range(range_img_c):

                mat = img[i:i+k, j:j+l]

                convolved_img[i, j] = np.sum(np.multiply(mat, kernel))

    else:
        range_img_r = tgt_size_r
        range_img_c = tgt_size_c

        convolved_img = np.zeros(shape=(tgt_size_r, tgt_size_c))

        for i in range(range_img_r):

            for j in range(range_img_c):

                mat = img[i:i+k, j:j+l]

                convolved_img[i, j] = np.sum(np.multiply(mat, kernel))


    return convolved_img
```

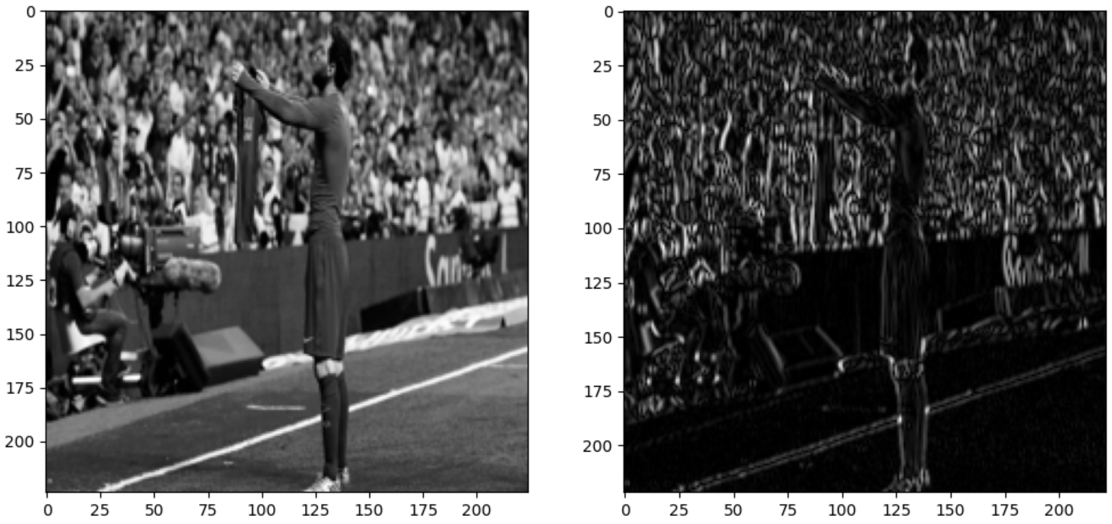
[329]:

```
img_result = convolve(img=np.array(img), kernel=matrix_filter)
print(img_result.shape)

max_val=0
for i in range(0, img_result.shape[0]):
    for j in range(0, img_result.shape[1]):
        img_result[i][j] = abs(img_result[i][j])
        if(max_val<img_result[i][j]):
            max_val = img_result[i][j]

for i in range(0, img_result.shape[0]):
    for j in range(0, img_result.shape[1]):
        img_result[i][j] /= max_val
        img_result[i][j] *= 255;
```

```
kernel:  3
kernel:  3
(222, 222)
```

[330]:

```
plot_two_images(
    img1=img,
    img2=img_result
)
```



0.5 Corrigindo o problema do padding

[331]:

```
def get_padding_width_per_side(kernel_size: int) -> int:

    return kernel_size // 2
```

[332]:

```
def add_padding_to_image(img: np.array, padding_width_r: int, padding_width_c:␣
 ↪int) -> np.array:

    img_with_padding = np.zeros(shape=(
        img.shape[0] + padding_width_r * 2,
        img.shape[1] + padding_width_c * 2
    ))

    img_with_padding[padding_width_r:-padding_width_r, padding_width_c:
 ↪-padding_width_c] = img

    print("imgg: ", img_with_padding.shape[0], img_with_padding.shape[1])

    return img_with_padding
```

[333]:

```
matrix_filter.shape[0]
```

[333]:

```
3
```

[334]:

```
matrix_filter.shape[1]
```

[334]:

```
3
```

[335]:

```
pad_3x3_r = get_padding_width_per_side(kernel_size=matrix_filter.shape[0])
pad_3x3_c = get_padding_width_per_side(kernel_size=matrix_filter.shape[1])
```

[336]:

```
print(pad_3x3_r,pad_3x3_c)
```

```
1 1
```

[337]:

```
img_with_padding_result = add_padding_to_image(
    img=np.array(img),
    padding_width_r=pad_3x3_r,
    padding_width_c=pad_3x3_c
)
```

```
imgg:  226 226
```

[338]:

```
img_with_padding_result.shape[0]
```

[338]:

```
226
```

[339]:

```
img_with_padding_result.shape[1]
```

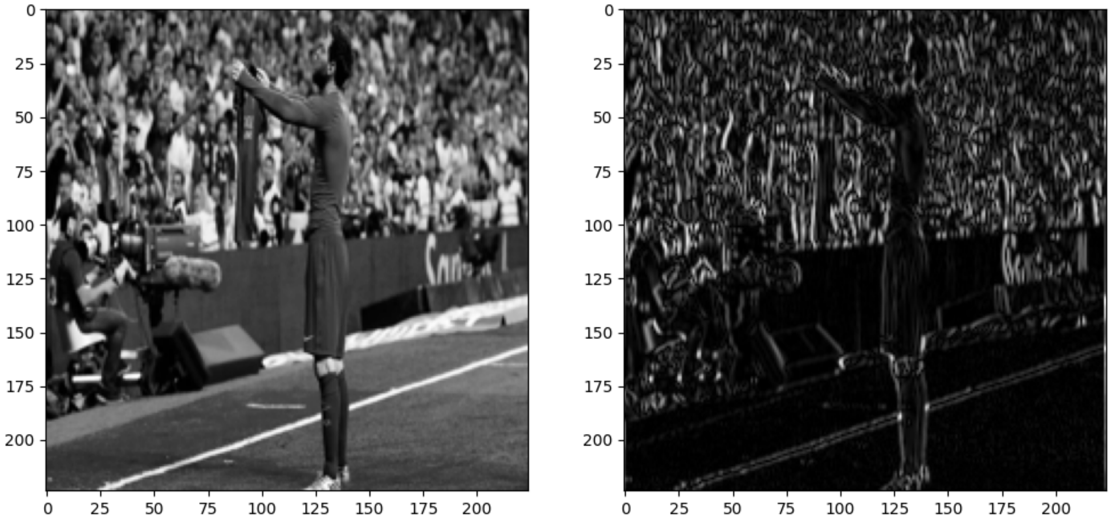
[339]:

```
226
```

[340]:

```
img_padded_result = convolve(img=img_with_padding_result, kernel=matrix_filter, extension=True)
print(img_padded_result.shape)

max_val=0
for i in range(0, img_padded_result.shape[0]):
    for j in range(0, img_padded_result.shape[1]):
        img_padded_result[i][j] = abs(img_padded_result[i][j])
        if(max_val<img_padded_result[i][j]):
            max_val = img_padded_result[i][j]

for i in range(0, img_padded_result.shape[0]):
    for j in range(0, img_padded_result.shape[1]):
        img_padded_result[i][j] /= max_val
        img_padded_result[i][j] *= 255;

plot_two_images(
    img1=img,
    img2=img_padded_result
)
```

```
kernel:  3
kernel:  3
(224, 224)
```



[ ]:

[ ]: