AULA PRÁTICA 5. *PRACTICAL CLASS 5*

1. OPERAÇÕES MORFOLÓGICAS ELEMENTARES. *ELEMENTAR MORPHOLOGICAL OPERATIONS.*

```
import numpy as np
import matplotlib.pyplot as plt
from imageio import imread
from scipy import ndimage
from skimage.morphology import rectangle, erosion, dilation, opening, \
closing, local_minima, local_maxima, watershed
from copy import deepcopy
```

1.1. Sobre a imagem **marilyn.tif**, executar as operações de erosão, dilatação, abertura e fecho. *On the image **marilyn.tif**, perform the operations of erosion, dilation, opening and closing.*

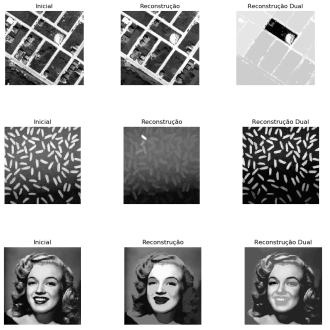
1.2. Determinar a imagem do gradiente morfológico. *Determine the morphological gradient image.*

- Exemplo da erosão. *Erosion example.*

```
Er = erosion(Img, ee)
```

2. RECONSTRUÇÃO GEODÉSICA NUMÉRICA. *NUMERIC GEODESIC RECONSTRUCTION.*

```
def reconstrucao_gray(mask, marker):
    a = 1
    ee = rectangle(3, 3)
    while a!=0:
        D = dilation(marker, ee)
        R = np.minimum(mask.astype(float), D.astype(float))
        a = np.count_nonzero(marker!=R)
        marker = deepcopy(R)
    return R
def reconstrucao_dual(mask, marker):
    a = 1
    ee = rectangle(3, 3)
    while a!=0:
        E = erosion(marker, ee)
        R = np.maximum(mask.astype(float), E.astype(float))
        a = np.count_nonzero(marker!=R)
        marker = deepcopy(R)
    return R
```



2.1. Aplicar a reconstrução geodésica às imagens (f_1) **ik01.tif**, (f_2) **grains.tif**, e (f_3) **marilyn.tif**. Para tal, construír as imagens marcadoras, respectivamente, (h_1), (h_2) e (h_3), considerando X_1 = {(79, 110)}, X_2 = {(35, 68)} e X_3 = {(113, 170)}. *Apply the geodesic reconstruction to the images (f_1) **ik01.tif**, (f_2) **grains.tif**, and (f_3) **marilyn.tif**. To do this, build the marker images respectively (h_1), (h_2) and (h_3), considering X_1 = {(79, 110)}, X_2 = {(35, 68)} and X_3 = {(139, 113)}.*

$$\begin{cases} h(x,y) = f(x,y), & if\ (x,y) \in X \\ h(x,y) = 0, & otherwise \end{cases}$$

2.2. Aplicar a reconstrução geodésica dual às mesmas imagens de 2.1, considerando X_1 = {(68, 111)}, X_2 = {(120, 216)} e X_3 = {(109, 183)}. *Apply the dual geodesic reconstruction to the same images of 2.1, considering X_1 = {(68, 111)}, X_2 = {(120, 216)} e X_3 = {(109, 183)}.*

$$\begin{cases} h(x,y) = f(x,y), & if\ (x,y) \in X \\ h(x,y) = 255, & otherwise \end{cases}$$

2.3. Determinar as imagens dos mínimos e máximos regionais de uma das imagens f da alínea 2.1. *Determine the images of the regional minimum and maximum of one of the images f of 2.1.*

3. TRANSFORMAÇÃO *WATERSHED*. *WATERSHED TRANSFORMATION.*

3.1. Determinar os mínimos regionais da imagem **marilyn.tif** (I) e do seu gradiente morfológico (G). *Determine the regional minima of the image **marilyn.tif** (I) and of the morphological gradient (G).*

3.2. Executar a transformação *watershed* de I e G, com os respectivos mínimos regionais como marcadores. Visualizar e comparar ambas as imagens das bacias de escoamento, representadas com os valores dos pixels da imagem inicial I. *Perform the I and G watershed transformation, with the respective regional minima as markers. Display and compare both catchment basins images, shown with the pixels values of the initial image I.*

```
#%% Watershed de F
markers, n = ndimage.label(rmin_F)
Ws = watershed(F, markers, mask=np.ones(F.shape))
d = 1
ee = disk(d)
Lint_f = Ws-erosion(Ws, ee)
Lext_f = dilation(Ws, ee)-Ws
```