MGM657 Outils Numériques pour l'Ingénieur

Traitement d'Images

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1. Lecture/Écriture
2. Opérations basiques
3. Filtrage
4. Histogramme
5. Seuillage
6. Érosion / Dilatation
7. Comptage
8. Contours

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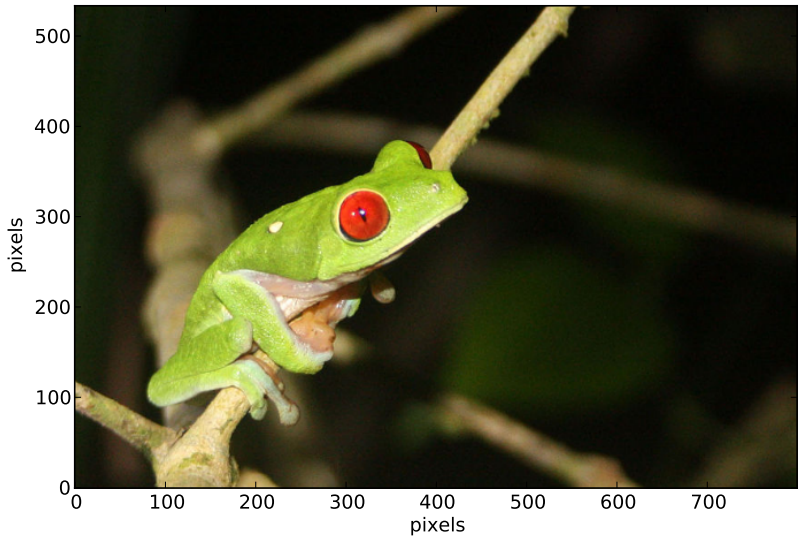
Lire et afficher une image

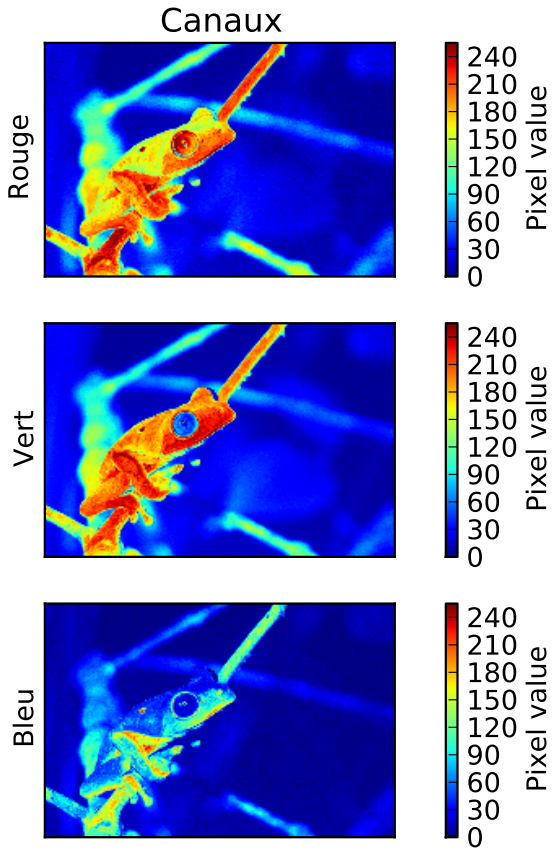



```
1  from PIL import Image
2  import numpy as np
3  import matplotlib.pyplot as plt
4  im = Image.open(
5     '../data/grenouille.jpg')
6  fig = plt.figure(0)
7  plt.clf()
8  plt.imshow(im, origin = "lower")
9  plt.xlabel("pixels")
10 plt.ylabel("pixels")
11 plt.show()
```

Points clés

- `PIL` : utile pour lire et écrire divers formats d'images.
- `Matplotlib` : permet d'afficher les images

Canaux et couleurs




```
1 from PIL import Image
2 import numpy as np
3 from matplotlib import pyplot as plt
4 im = Image.open('../data/grenouille.jpg')
5 rouge, vert, bleu = im.split()
6 rouge = np.array(rouge)
7 vert  = np.array(vert)
8 bleu  = np.array(bleu)
```

Types d'images

- Canal : 1 information (entier 8 bits)
- Image couleur : 3(+1) canaux
- Imagerie monochrome : 1 canal

Remarque

- Contexte scientifique : généralement un seul canal.
- On peut afficher une image monochrome avec une échelle de couleurs.

Image = np.array

```
1 from PIL import Image
2 import numpy as np
3 from matplotlib import pyplot as plt
4 from matplotlib import cm
5 im = Image.open('../data/grenouille.jpg')
6 rouge, vert, bleu = im.split()
7 z = np.array(rouge)
```

```
1  >>> z
2  array([[16, 17, 19, ..., 10,  9,  8],
3         [14, 15, 17, ..., 10,  9,  8],
4         [15, 16, 18, ..., 11,  9,  8],
5         ...,
6         [25, 24, 24, ..., 19, 20, 20],
7         [24, 23, 23, ..., 17, 19, 19],
8         [23, 23, 22, ..., 18, 18, 18]], dtype=uint8)
9  >>> z.shape
10 (534, 800)
11 >>> nx, ny = z.shape
12 >>> z.dtype
13 dtype('uint8')
```

Sauvegarde

```
1  from PIL import Image
2  import numpy as np
3  from matplotlib import pyplot as plt
4  from matplotlib import cm
5  im = Image.open('../data/grenouille.jpg')
6  rouge, vert, bleu = im.split()
7  z = np.array(rouge)
8  z = np.uint8(cm.copper(z)*255)
9  im2 = Image.fromarray(z)
10 im2.save("grenouille_saved.jpg")
```

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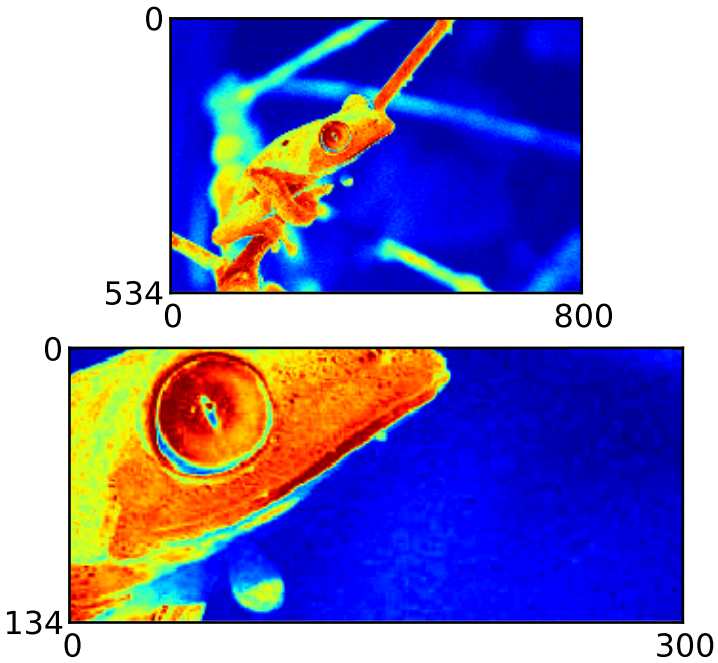
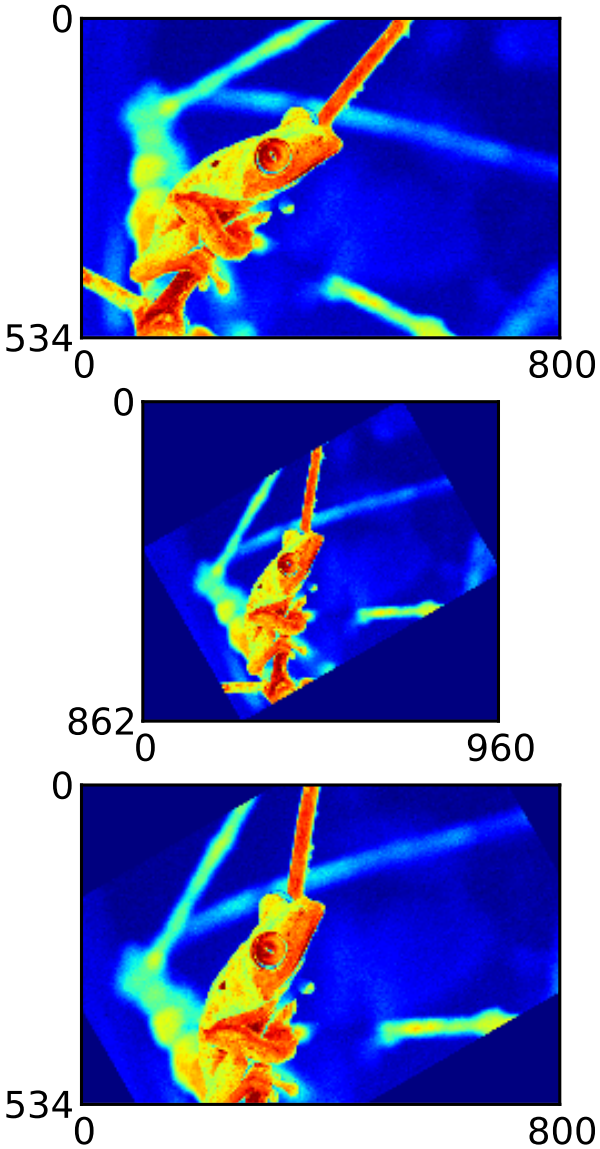
Rognage (*Crop*)




```
1  from PIL import Image
2  import numpy as np
3  from matplotlib import pyplot as plt
4  from matplotlib import cm
5  im = Image.open('../data/grenouille.jpg')
6  rouge, vert, bleu = im.split()
7  z = np.array(rouge)
8  ny, nx = z.shape
9  cx, cy = 200, 250
10 zc = z[cx:-cx, cy:-cy]
11 nyc, nxc = zc.shape
12
13 fig = plt.figure(0) # On cree une figure
14 plt.clf()
15 ax1 =fig.add_subplot(3,1,1)
16 plt.imshow(z, origin = "upper")
17 plt.xticks([0, nx])
18 plt.yticks([0, ny])
19 ax2 =  fig.add_subplot(3,1,2)
20 plt.imshow(zc, origin = "upper",
       interpolation = "nearest")
21 plt.xticks([0, nxc])
22 plt.yticks([0, nyc])
23 plt.show()
```

Rotation




```
1  from PIL import Image
2  import numpy as np
3  from matplotlib import pyplot as plt
4  from matplotlib import cm
5  from scipy import ndimage
6  im = Image.open('../data/grenouille.jpg')
7  rouge, vert, bleu = im.split()
8  z = np.array(rouge)
9  zrr = ndimage.rotate(z, 30.)
10 zrn = ndimage.rotate(z, 30.,
11   reshape = False)
12
13 ny, nx = z.shape
14 nyrr, nxrr = zrr.shape
15 nyrn, nxrn = zrn.shape
16
17 fig = plt.figure(0) # On cree une figure
18 plt.clf()
19 ax1 =fig.add_subplot(3,1,1)
20 plt.imshow(z, origin = "upper")
21 plt.xticks([0, nx])
22 plt.yticks([0, ny])
23 ax2 =  fig.add_subplot(3,1,2)
```

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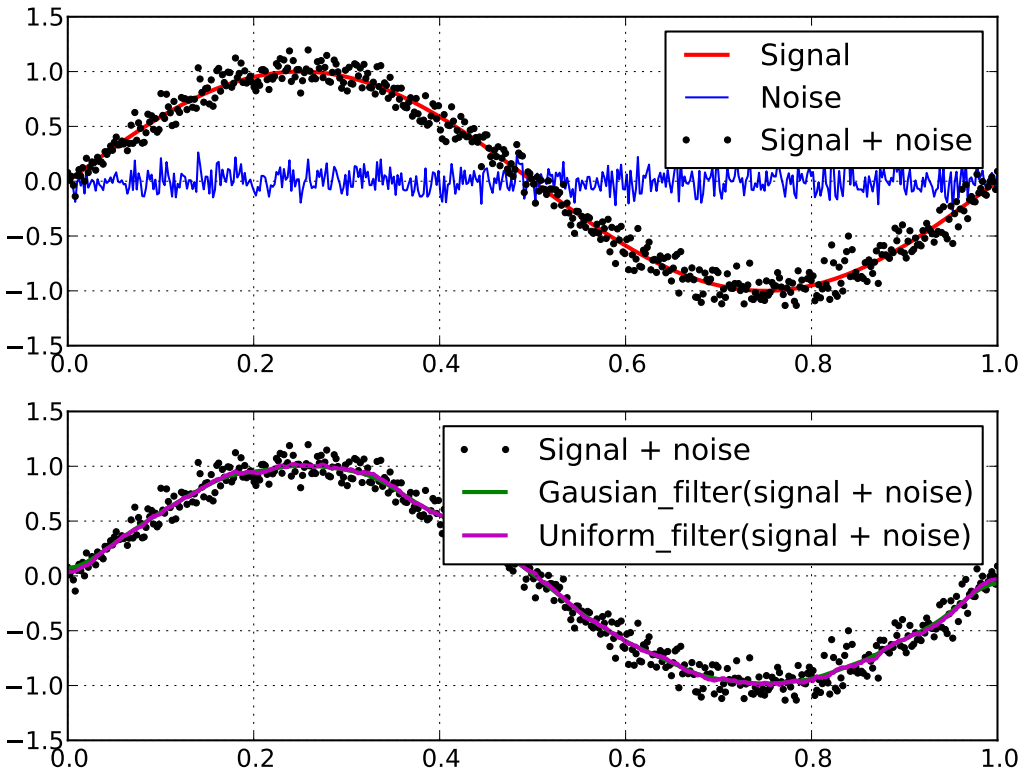
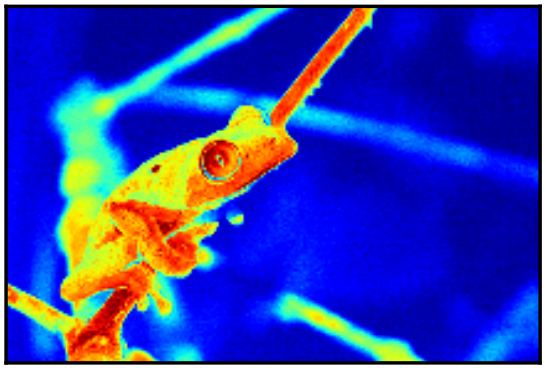
Lissage : exemple sur un signal 1D



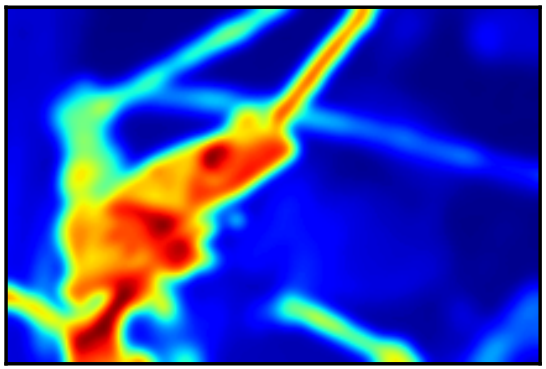

```
1 import numpy as np
2 from matplotlib import pyplot as plt
3 from scipy import ndimage
4 x = np.linspace(0., 1., 500)
5 y_perf = np.sin(2. * np . pi * x)
6 noise = np.random.normal(loc = 0.,scale = .1,  size = len(x))
7 y = y_perf + noise
8 yg = ndimage.gaussian_filter(y, 10.)
9 ym =  ndimage.uniform_filter(y, 20)
```

Lissage d'image

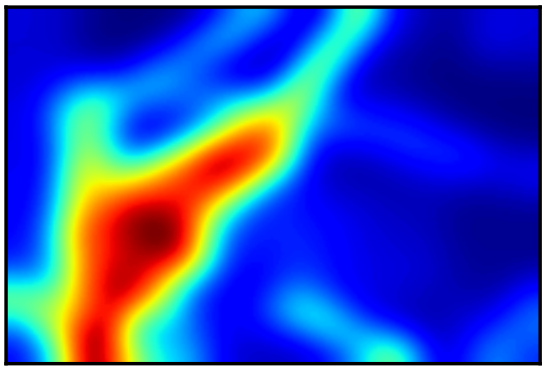
Raw



Blurred



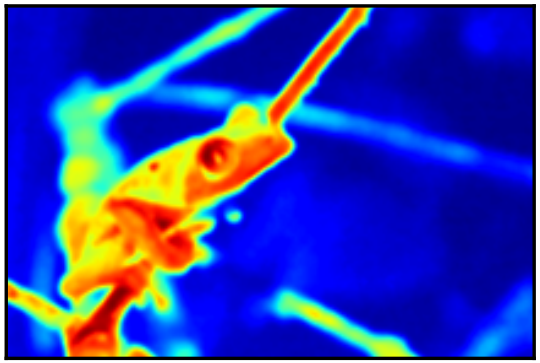
Blurred more !



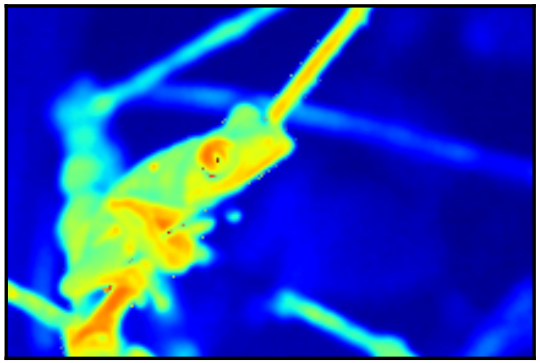
```
1  from PIL import Image
2  import numpy as np
3  from matplotlib import pyplot as plt
4  from scipy import ndimage
5  im = Image.open('../data/grenouille.jpg')
6  rouge, vert, bleu = im.split()
7  z = np.array(rouge)
8  # Blur
9  zg10 = ndimage.gaussian_filter(z, 10.)
10 # Blur more !
11 zg30 = ndimage.gaussian_filter(z, 30.)
```

Accentuation d'image

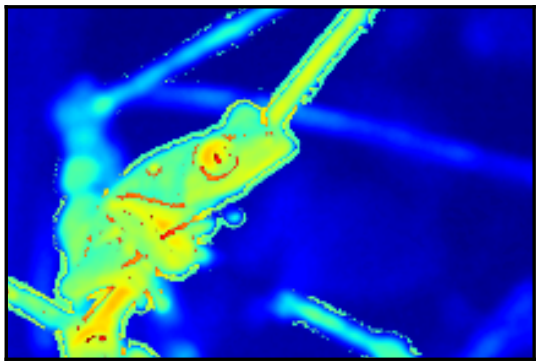
Raw (blurred)



Sharpened



Sharpened



```
1  from PIL import Image
2  import numpy as np
3  from matplotlib import pyplot as plt
4  from scipy import ndimage
5  im = Image.open('../data/grenouille.jpg')
6  rouge, vert, bleu = im.split()
7  z =  ndimage.gaussian_filter(np.array(rouge),
       4)
8  # Sharpen
9  k = .5
10 zs1 = z + k * (z - ndimage.gaussian_filter(z,
       1.))
11 zs2 = z + k * (z - ndimage.gaussian_filter(z,
       2.))
```

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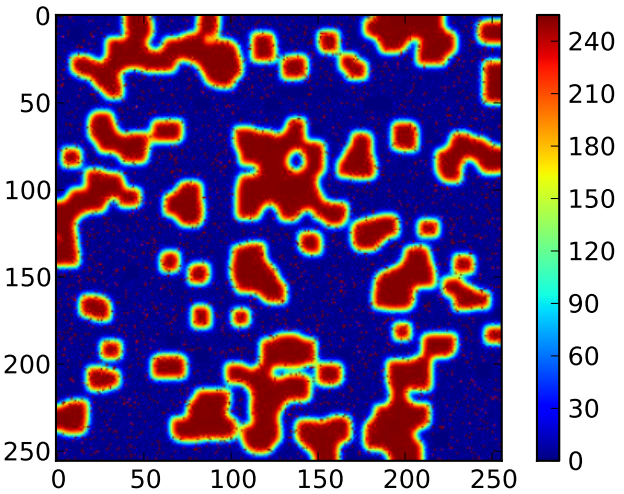
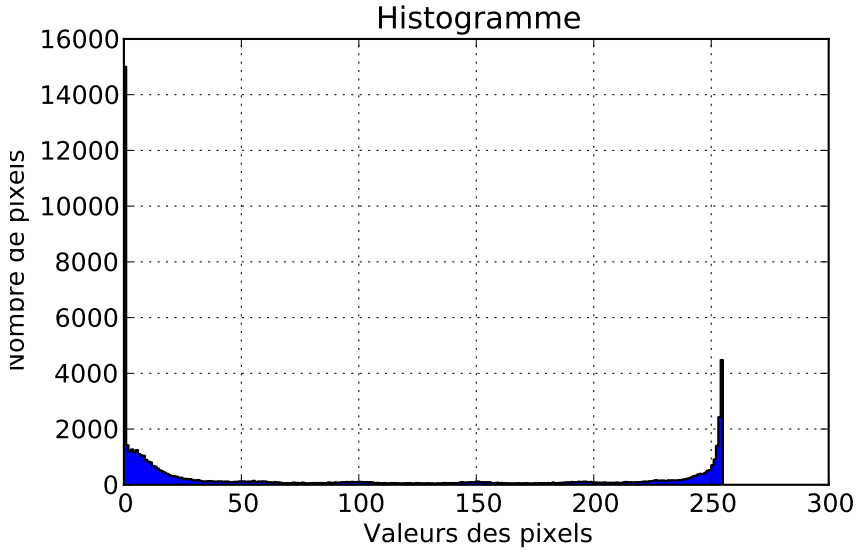
Histogramme






```
1  from PIL import Image
2  import numpy as np
3  from matplotlib import pyplot as plt
4  im = Image.open('../Slides/figures/
       image.jpg')
5  channels = im.split()
6  z = np.array(channels[0])
7  N  = z.size
8  n_classes = int(N**.5)
9  fig = plt.figure()
10 plt.clf()
11 fig.add_subplot(2, 1, 1)
12 plt.imshow(z, origin = "upper")
13 plt.colorbar()
14 fig.add_subplot(2, 1, 2)
15 plt.title('Histogramme')
16 plt.ylabel('Nombre de pixels')
17 plt.xlabel('Valeurs des pixels')
18 plt.hist(z.flatten(), bins=n_classes
       , histtype = "stepfilled")
19 plt.grid()
20 plt.show()
```

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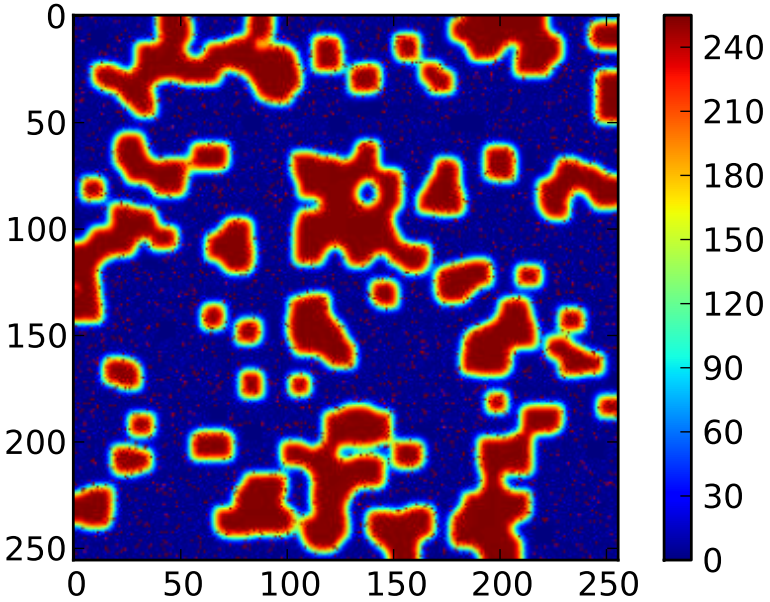
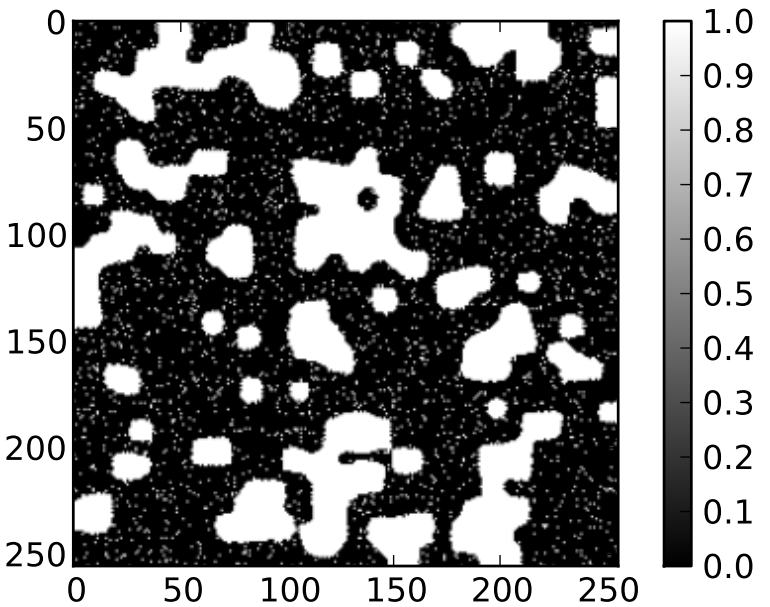
Seuillage






```
1  from PIL import Image
2  import numpy as np
3  from matplotlib import pyplot as plt
4  from matplotlib import cm
5  im = Image.open('../Slides/figures/
       image.jpg')
6  channels = im.split()
7  z = np.array(channels[0])
8  seuil = 150.
9  zs = z > seuil
10 fig = plt.figure()
11 plt.clf()
12 fig.add_subplot(2, 1, 1)
13 plt.imshow(z, origin = "upper")
14 plt.colorbar()
15 fig.add_subplot(2, 1, 2)
16 plt.imshow(zs, origin = "upper", cmap =
       cm.gray)
17 plt.colorbar()
18 plt.show()
```

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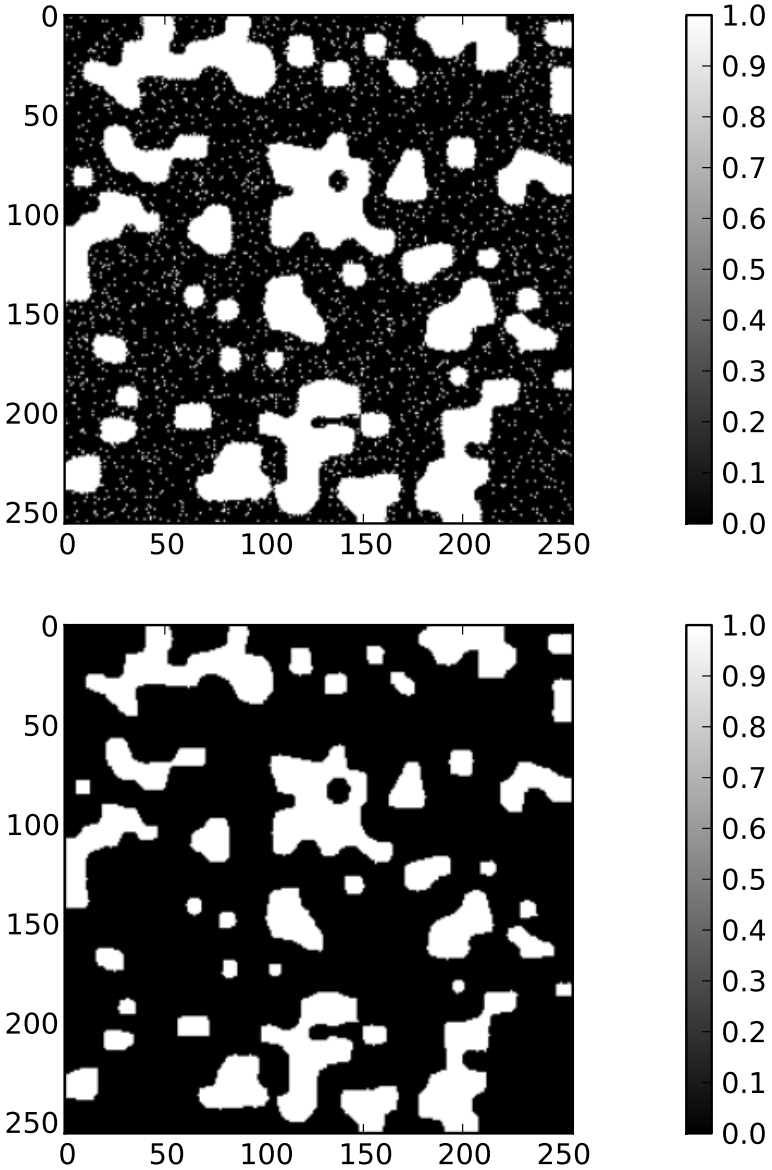
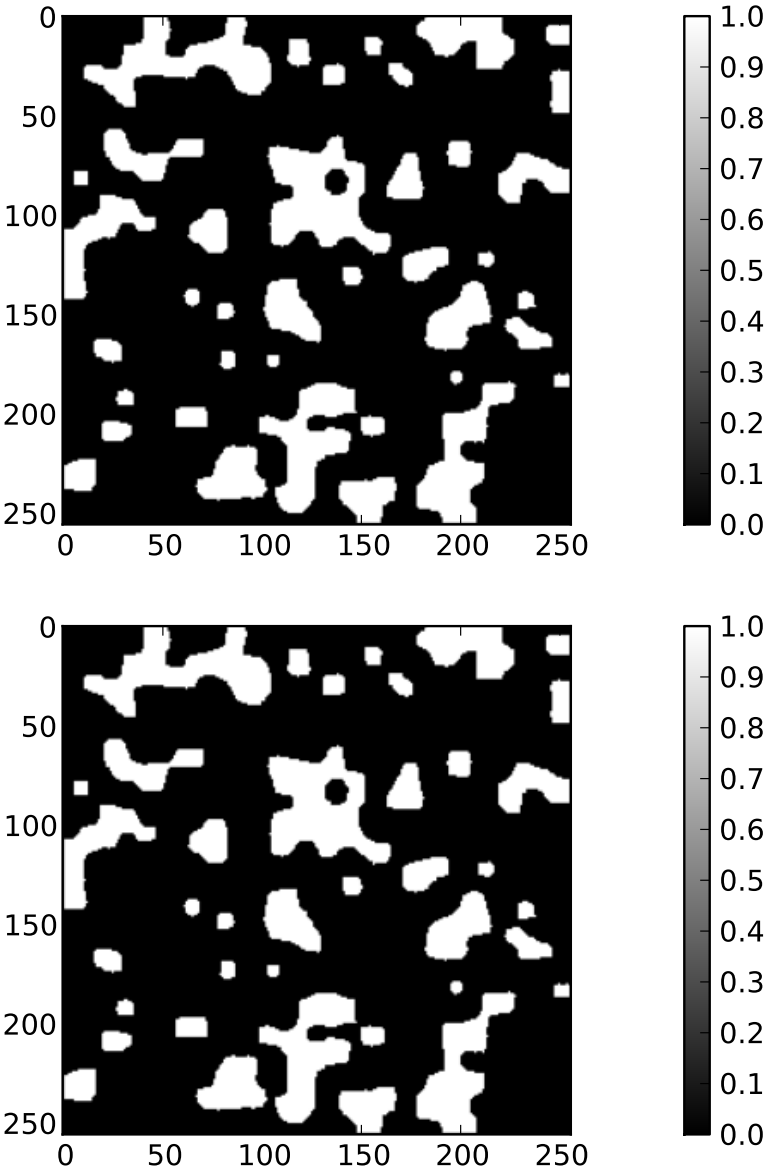
Érosion




```
1  from PIL import Image
2  import numpy as np
3  from matplotlib import pyplot as plt
4  from matplotlib import cm
5  from scipy import ndimage
6  im = Image.open('../Slides/figures/
       image.jpg')
7  channels = im.split()
8  z = np.array(channels[0])
9  seuil = 150.
10 zs = z > seuil
11 zss = ndimage.morphology.binary_erosion
       (zs, structure=np.ones((3,3)))
12 fig = plt.figure()
13 plt.clf()
14 fig.add_subplot(2, 1, 1)
15 plt.imshow(zs, origin = "upper", cmap =
       cm.gray)
16 plt.colorbar()
17 fig.add_subplot(2, 1, 2)
18 plt.imshow(zss, origin = "upper", cmap
       = cm.gray)
19 plt.colorbar()
20 plt.show()
```

Dilatation




```
1  from PIL import Image
2  import numpy as np
3  from matplotlib import pyplot as plt
4  from matplotlib import cm
5  from scipy import ndimage
6  im = Image.open('../Slides/figures/
       image.jpg')
7  channels = im.split()
8  z = np.array(channels[0])
9  seuil = 150.
10 zs = z > seuil
11 zse = ndimage.morphology.binary_erosion
       (zs, structure=np.ones((3,3)))
12 zsd = ndimage.morphology.
       binary_dilation(zse, structure=np.
       ones((3,3)))
13 fig = plt.figure()
14 plt.clf()
15 fig.add_subplot(2, 1, 1)
16 plt.imshow(zse, origin = "upper", cmap
       = cm.gray)
17 plt.colorbar()
18 fig.add_subplot(2, 1, 2)
19 plt.imshow(zse, origin = "upper", cmap
       = cm.gray)
20 plt.colorbar()
21 plt.show()
```

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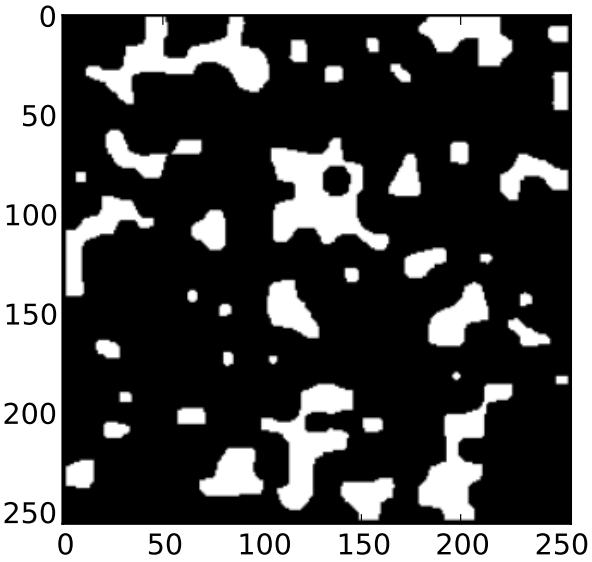
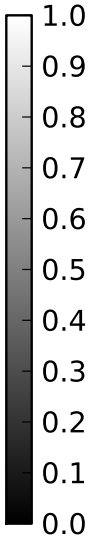
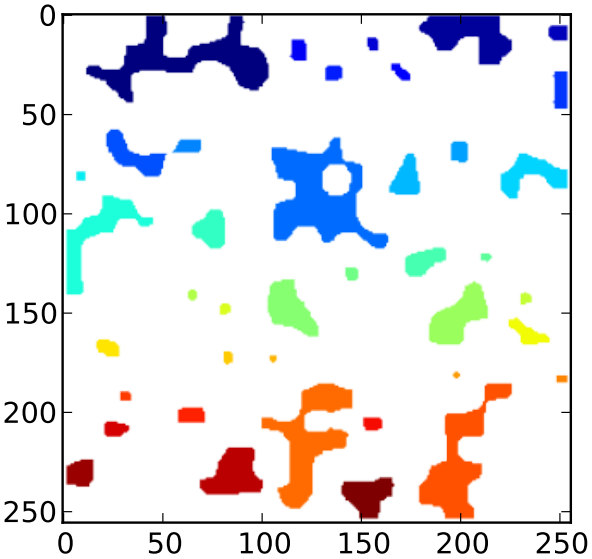
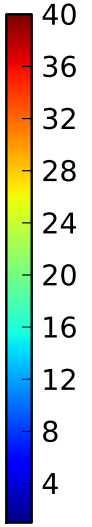
Comptage










```
1  from PIL import Image
2  import numpy as np
3  from matplotlib import pyplot as plt
4  from matplotlib import cm
5  from scipy import ndimage
6  im = Image.open('../Slides/figures/
       image.jpg')
7  channels = im.split()
8  z = np.array(channels[0])
9  seuil = 150.
10 zs = z > seuil
11 zse = ndimage.morphology.binary_erosion
       (zs, structure=np.ones((3,3)))
12 zsd = ndimage.morphology.binary_erosion
       (zse, structure=np.ones((3,3)))
13 zl, nombre = ndimage.measurements.label
       (zsd) # On compte les zones
14 zl = np.where(zl == 0, np.nan, zl)
15 fig = plt.figure()
16 plt.clf()
17 fig.add_subplot(2, 1, 1)
18 plt.imshow(zsd, origin = "upper", cmap
       = cm.gray)
19 plt.colorbar()
20 fig.add_subplot(2, 1, 2)
21 plt.imshow(zl, origin = "upper", cmap =
       cm.jet)
22 plt.colorbar()
23 plt.show()
```

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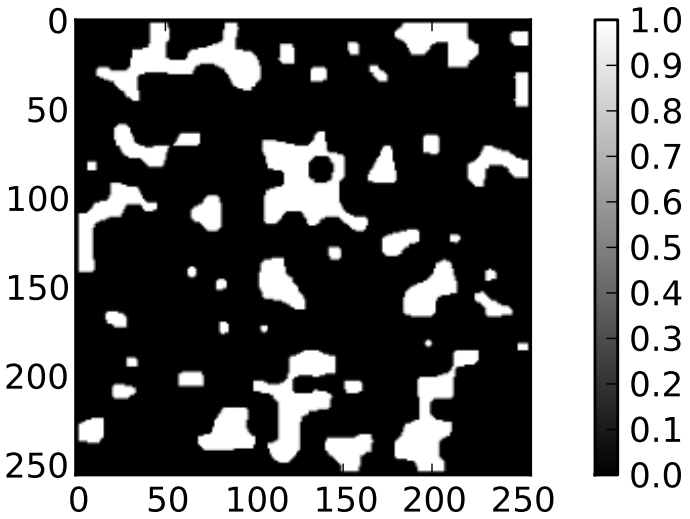

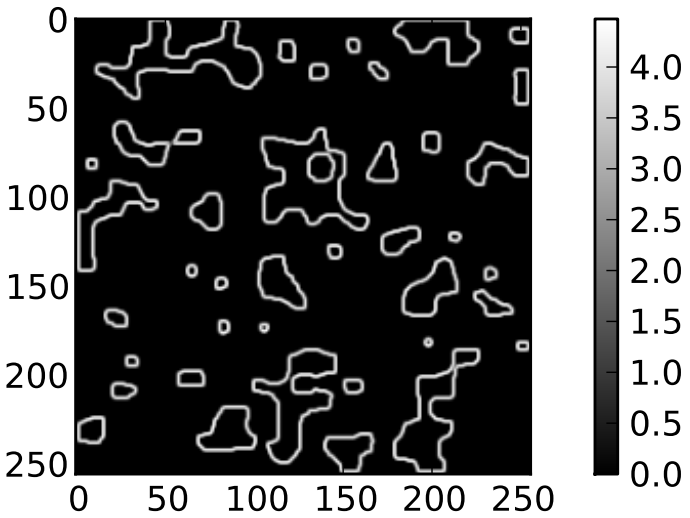


```
1  from PIL import Image
2  import numpy as np
3  from matplotlib import pyplot as plt
4  from matplotlib import cm
5  from scipy import ndimage
6  im = Image.open('../Slides/figures/image.
       jpg')
7  channels = im.split()
8  z = np.array(channels[0])
9  seuil = 150.
10 zs = z > seuil
11 zse = ndimage.morphology.binary_erosion(zs,
        structure=np.ones((3,3)))
12 zsd = np.float64(ndimage.morphology.
       binary_erosion(zse, structure=np.ones
       ((3,3))))
13 zgx = ndimage.sobel(zsd, axis=0, mode='
       constant')
14 zgy = ndimage.sobel(zsd, axis=1, mode='
       constant')
15 zsob = np.hypot(zgx, zgy)
```