ANACONDA
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scikit learn

pandas
$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$

jupyter

19.04.2018

Вычислительные модели с использованием научных библиотек Python

Обработка изображений

Фильтры

F_1	F_2	F_3
F_4	F_5	F_6
F_7	F_8	F_9

Фильтр

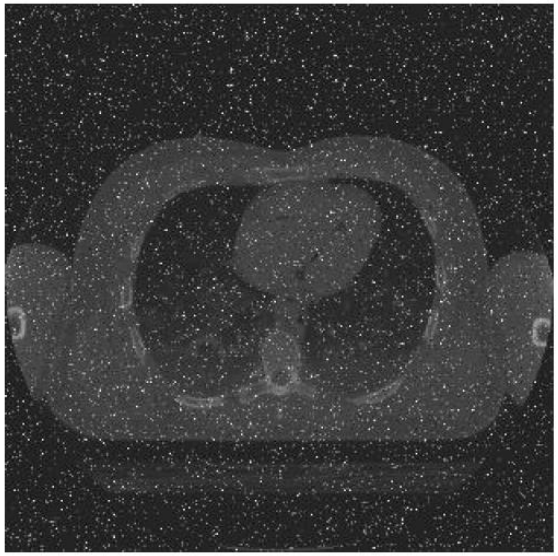
$I(i-1, j-1)$	$I(i-1, j)$	$I(i-1, j+1)$
$I(i, j-1)$	$I(i, j)$	$I(i, j+1)$
$I(i+1, j-1)$	$I(i+1, j)$	$I(i+1, j+1)$

Изображение

$$I_{new}(i,j) = F_1 * I(i-1,j-1) + F_2 * I(i-1,j) + F_3 * I(i-1,j+1)$$
$$+ F_4 * I(i,j-1) + F_5 * I(i,j) + F_6 * I(i,j+1)$$
$$+ F_7 * I(i+1,j-1) + F_8 * I(i+1,j) + F_9 * I(i+1,j+1)$$

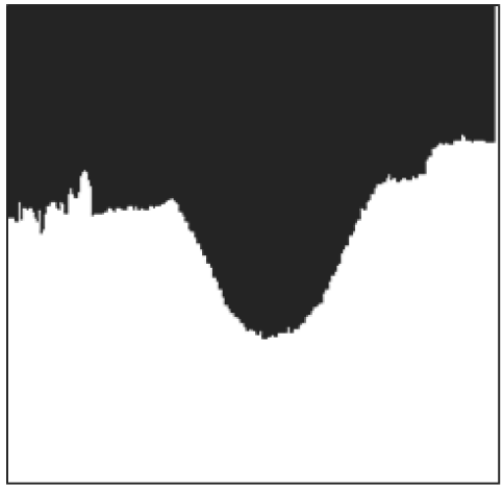
Медианный фильтр

```
import scipy.misc
import scipy.ndimage
from scipy.misc.pilutil import Image
# opening the image and converting it to
grayscale
a =
Image.open(../Figures/ct_saltandpepper.png).
convert(L)

# performing the median filter
b = scipy.ndimage.filters.median_filter(a,size=5,
footprint=None,output=None,mode='reflect',
cval=0.0,origin=0)

# b is converted from an ndarray to an image
b = scipy.misc.toimage(b)
b.save(../Figures/median_output.png)
```



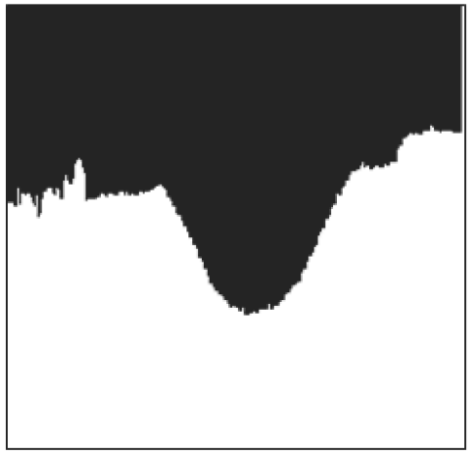
Max фильтр

```
import scipy.ndimage
from scipy.misc.pilutil import Image

# opening the image and converting it to
grayscale
a = Image.open(../Figures/wave.png).convert(L)

# performing maximum filter
b =
scipy.ndimage.filters.maximum_filter(a,size=5,
footprint=None,output=None,mode=reflect,
cval=0.0,origin=0)

# b is converted from an ndarray to an image
b = scipy.misc.toimage(b)
b.save(../Figures/maxo.png)
```



Min фильтр

```
import scipy.misc
import scipy.ndimage
from scipy.misc.pilutil import Image

# opening the image and converting it to
grayscale
a = Image.open(../Figures/wave.png).convert(L)

# performing minimum filter
b =
scipy.ndimage.filters.minimum_filter(a,size=5,
footprint=None,output=None,mode=reflect,
cval=0.0,origin=0)

# b is converted from an ndarray to an image
b = scipy.misc.toimage(b)

# saving b as mino.png
b.save(../Figures/mino.png)
```



Фильтра Собеля

-1	-2	-1
0	0	0
1	2	1

Горизонтальный

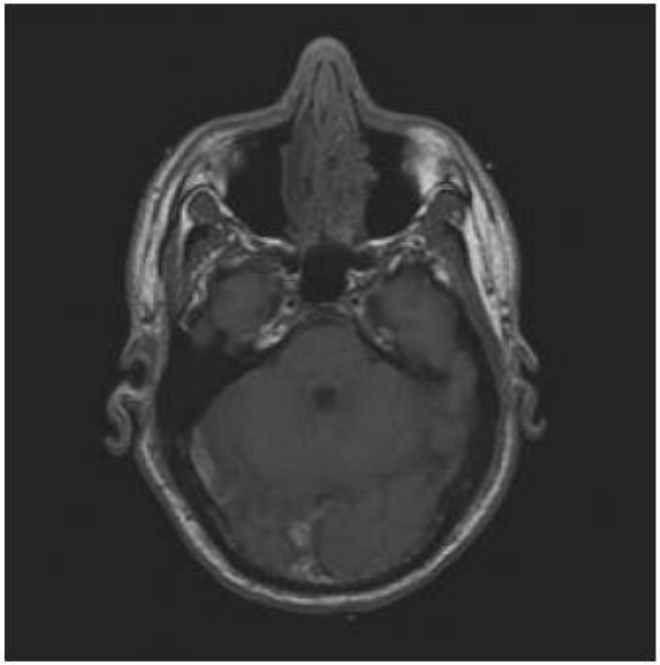
-1	0	1
-2	0	2
-1	0	1

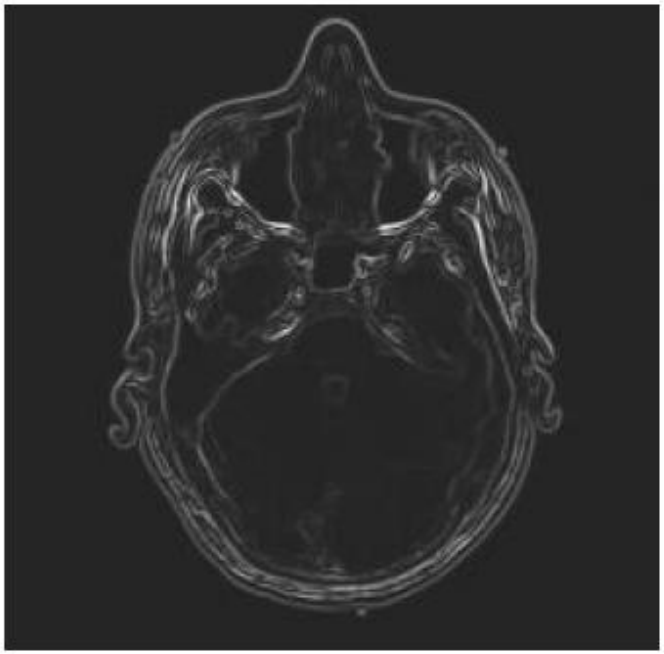
Вертикальный

0	1	2
-1	0	1
-2	-1	0

-2	-1	0
-1	0	1
0	1	2

Диагональный





Определение границ по градиенту яркости

Фильтра Прюитта

-1	-1	-1
0	0	0
1	1	1

Горизонтальный

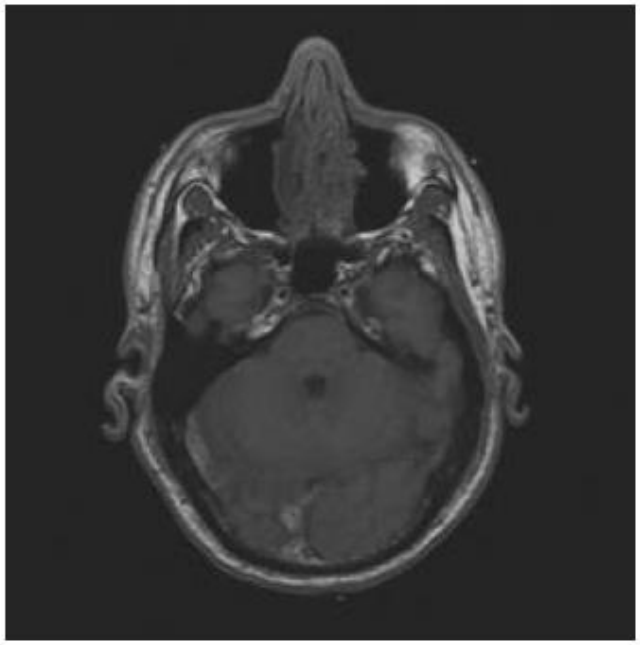
-1	0	1
-1	0	1
-1	0	1

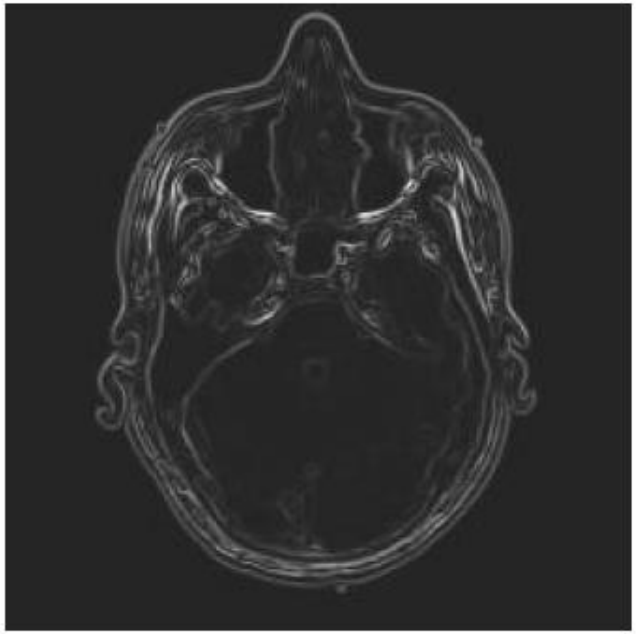
Вертикальный

0	1	1
-1	0	1
-1	-1	0

-1	-1	0
-1	0	1
0	1	1

Диагональный



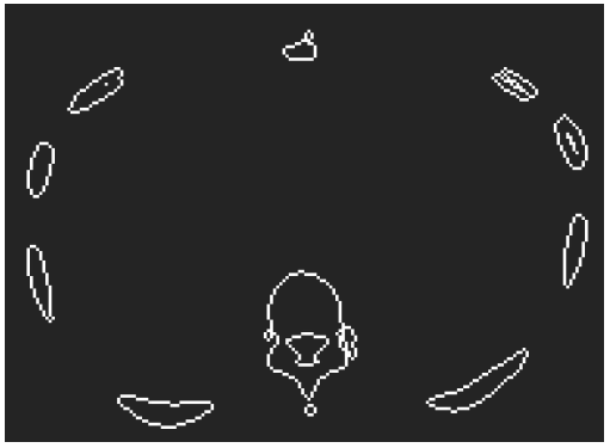


Определение границ по градиенту яркости

Фильтра Лапласа

0	1	0
-1	4	-1
0	-1	0

-1	-1	-1
-1	8	1
-1	-1	- 1

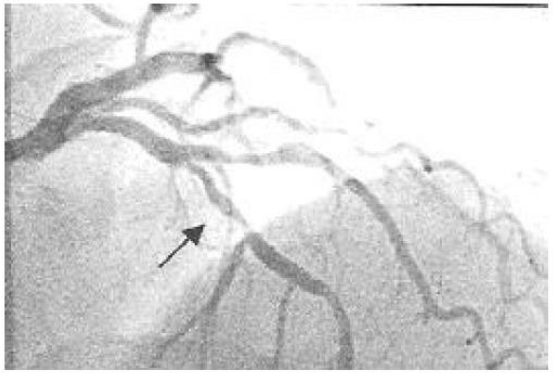


```
b = scipy.ndimage.filters.gaussian_laplace(a,1,
mode=reflect)
# b is converted from an ndarray to an image
b = scipy.misc.toimage(b)
b.save(../Figures/log_vh1.png)
```

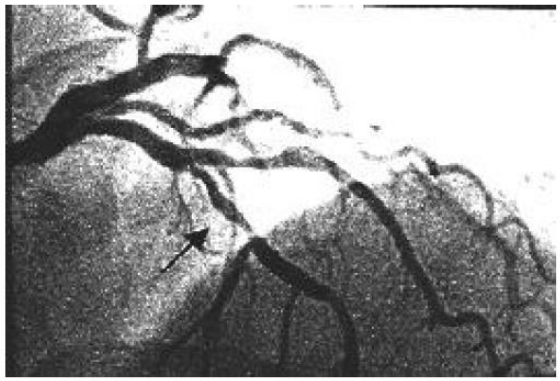
0	0	-1	0	0
0	-1	-2	-1	0
-1	–2	16	-2	-1
0	-1	-2	-1	0
0	0	-1	0	0

$$G(r) = -e^{\frac{-r^2}{2\sigma^2}}$$ - Сглаживание Гаусса

Гамма - коррекция



γ=0.5

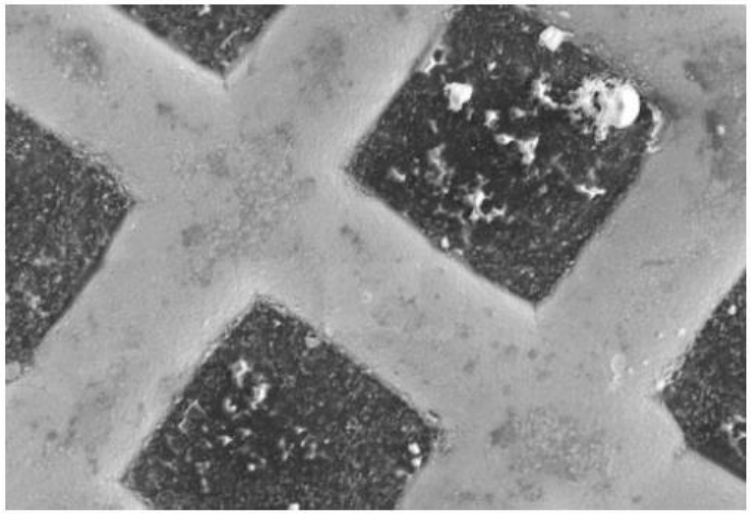


γ=5

$$t(i,j) = e^{\gamma * \ln(I_{norm})} * 255.$$

```
# opening the image and converting it to grayscale
a = Image.open(../Figures/angiogram1.png).
convert(L)
# a is converted to an ndarray
b = scipy.misc.fromimage(a)
# gamma is initialized
gamma = 0.5
# b is converted to type float
b1 = b.astype(float)
# maximum value in b1 is determined
b3 = numpy.max(b1)
# b1 is normalized
b2 =b1/b3
# gamma-correction exponent is computed
b3 = numpy.log(b2)*gamma
# gamma-correction is performed
c = numpy.exp(b3)*255.0
# c is converted to type int
c1 = c.astype(int)
# c1 is converted from ndarray to image
d = scipy.misc.toimage(c1)
```

Log – преобразование



$$t(i,j) = k \log(1 + I(i,j))$$

$$k = \frac{L-1}{\log(1 + |I_{max}|)}$$

```
a = Image.open(../Figures/bse.png).convert(L)
b = scipy.misc.fromimage(a)
b1 = b.astype(float)
# maximum value in b1 is determined
b2 = numpy.max(b1)
# performing the log transformation
c = (255.0*numpy.log(1+b1))/numpy.log(1+b2)
# c is converted to type int
c1 = c.astype(int)
# c1 is converted from ndarray to image
d = scipy.misc.toimage(c1)
```

Выравнивание гистограммы

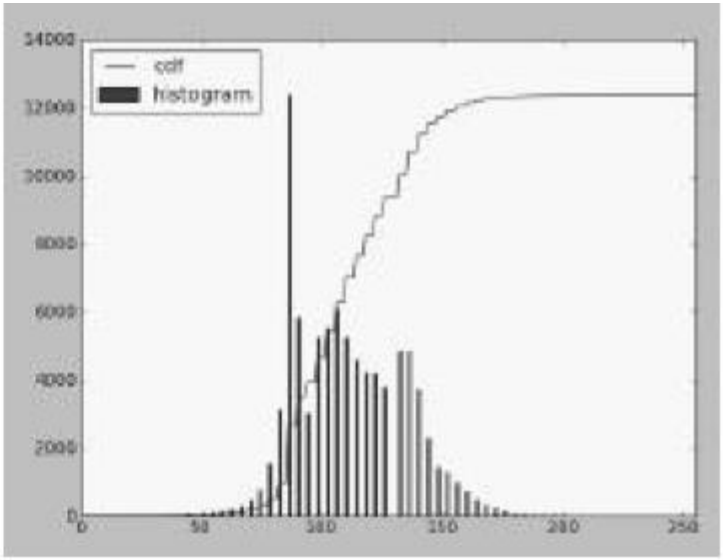
$$C(i) = \sum_{j=0}^{i} p_x(j) \qquad 0 \leq i \leq L-1$$

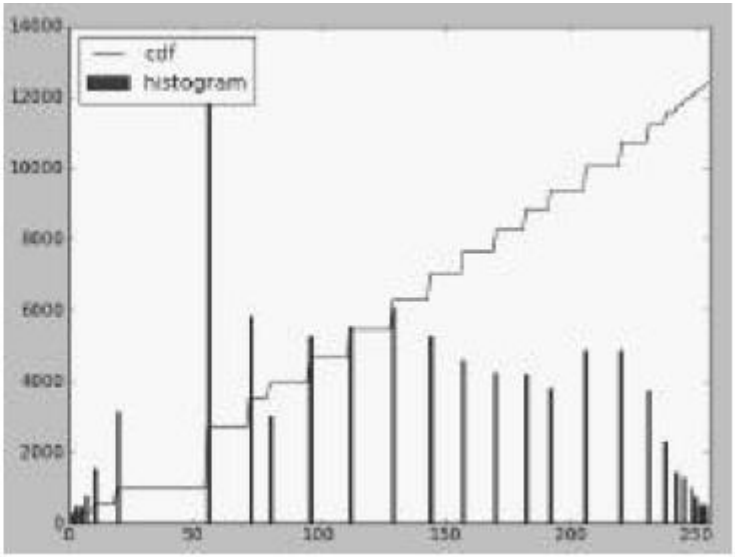
$$h(u) = round\left(\frac{C(u) - C_{min}}{1 - C_{min}} * (L-1)\right)$$

```
# img is converted to an ndarray
img1 = scipy.misc.fromimage(img)
# 2D array is convereted to an 1D
fl = img1.flatten()
# histogram and the bins of the image are
computed
hist,bins = np.histogram(img1,256,[0,255])
# cumulative distribution function is computed
cdf = hist.cumsum()
# places where cdf=0 is masked or ignored and
# rest is stored in cdf_m
cdf_m = np.ma.masked_equal(cdf,0)
# histogram equalization is performed
num_cdf_m = (cdf_m - cdf_m.min())*255
den_cdf_m = (cdf_m.max()-cdf_m.min())
cdf_m = num_cdf_m/den_cdf_m
```

```
# the masked places in cdf_m are now 0
cdf = np.ma.filled(cdf_m,0).astype(uint8)
# cdf values are assigned in the flattened array
im2 = cdf[fl]
# im2 is 1D so we use reshape command to
# make it into 2D
im3 = np.reshape(im2,img1.shape)
# converting im3 to an image
im4 = scipy.misc.toimage(im3)
# saving im4 as hequalization_output.png
# in Figures folder
im4.save(../Figures/hequalization_output.png)
```

Выравнивание гистограммы





Сегментация на основе гистограммы

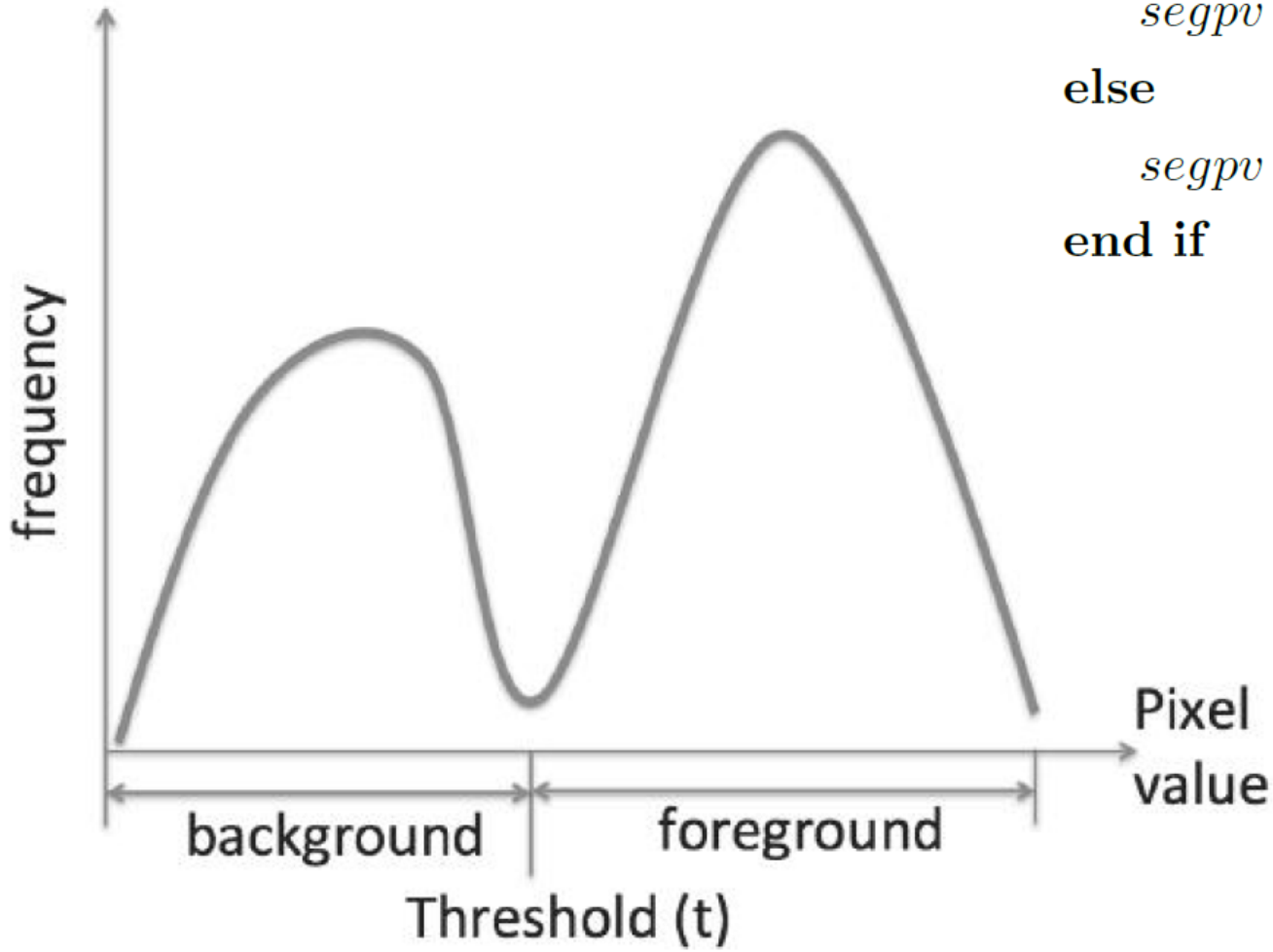
if $pv \geq threshold$ **then**

$segpv = 1$

else

$segpv = 0$

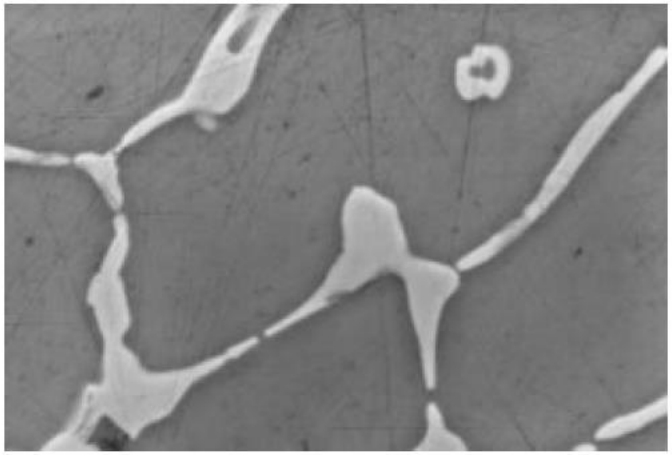
end if



Сегментация. Метод Оцу

$$v_{within} = P_b(t)v_b + P_f(t)v_f$$

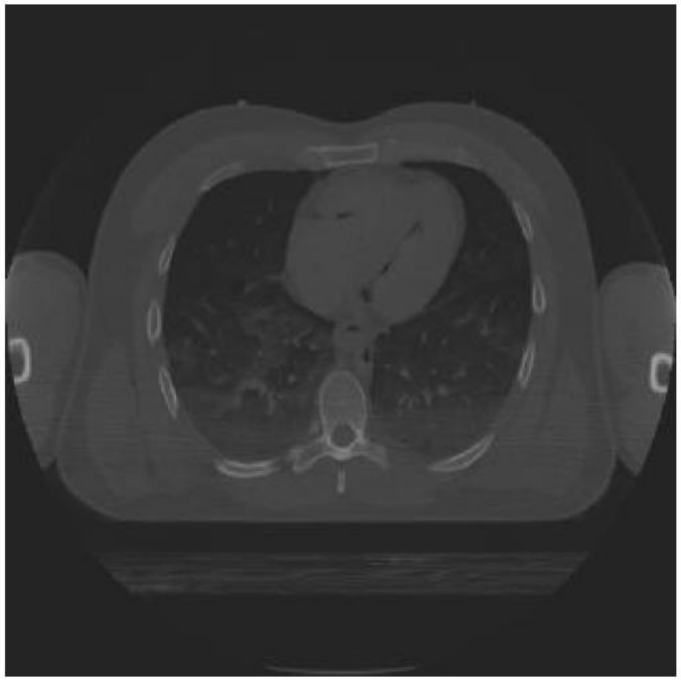
$$v_{inbetween} = v - v_{within} = P_b P_f (m_b - m_f)^2.$$

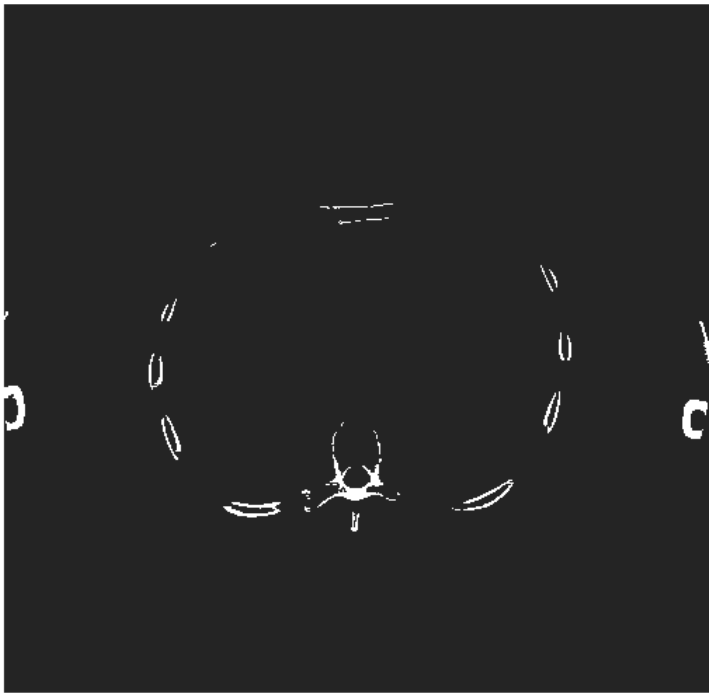


```
a =
Image.open(../Figures/sem3.png).convert(“L”)
# a is converted to an ndarray
a = scipy.misc.fromimage(a)
# performing Otsus thresholding
thresh = threshold_otsu(a)
# pixels with intensity greater than
# theshold are kept
b = a > thresh
# b is converted from ndimage to
b = scipy.misc.toimage(b)
```

Сегментация. Метод Реньи

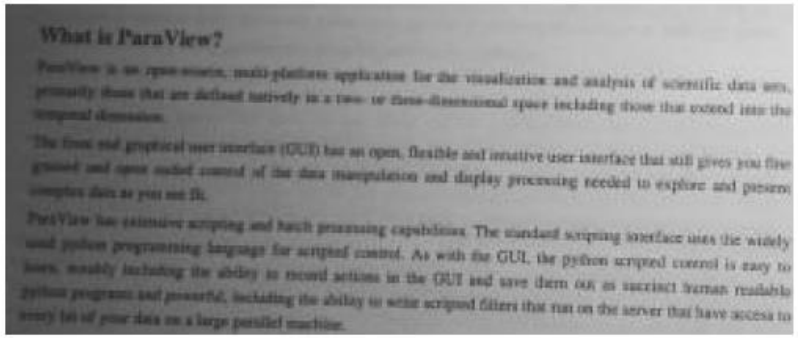
$$H_\alpha(x) = \frac{1}{1-\alpha}\log_a\left(\sum_{i=1}^{n}(p(x_i))^\alpha\right)$$



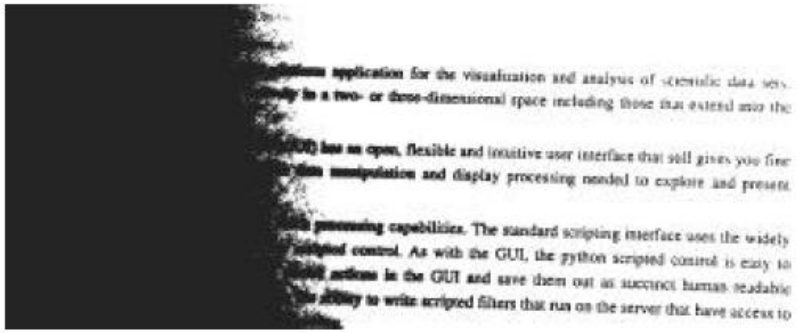


Сегментация небольших объектов

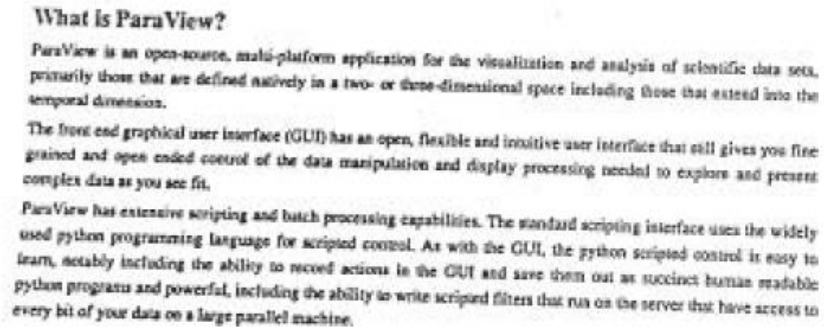
Адаптивная сегментация.



Исходное изображение



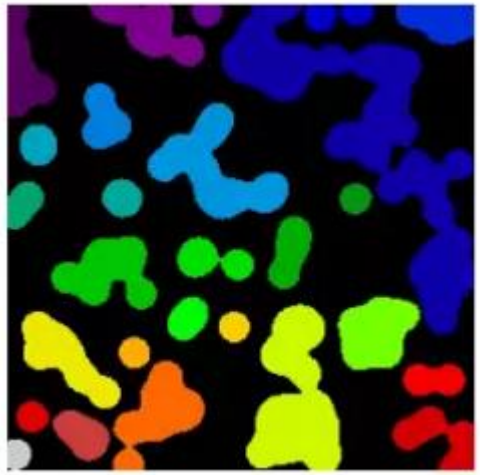
Метод Оцу



Адаптивная сегментация

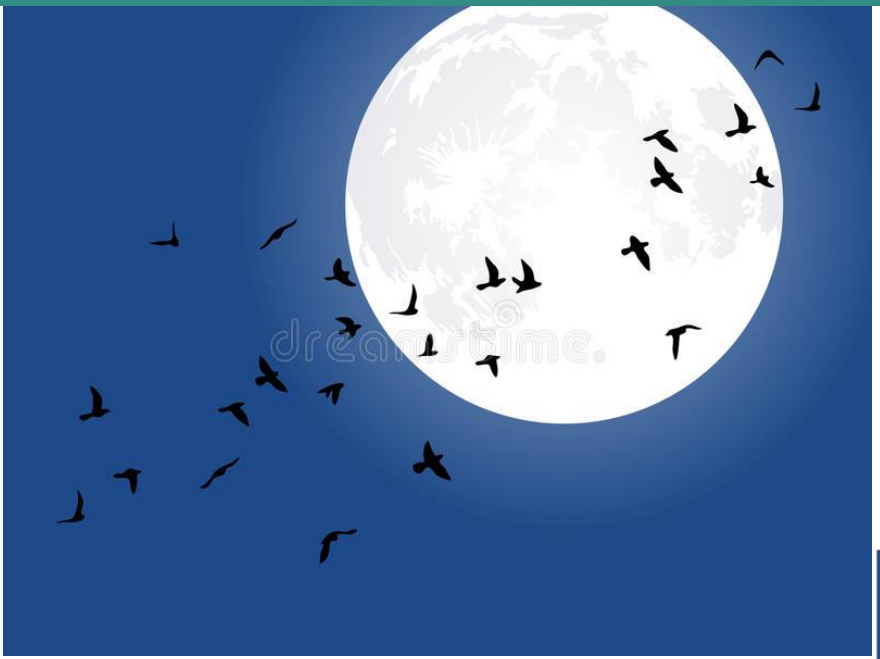
```
a = Image.open(.example1.png).convert(L)
# a is converted to an ndarray
a = scipy.misc.fromimage(a)
# performing adaptive thresholding
b =threshold_local(a,
block_size=11,offset=0)
```

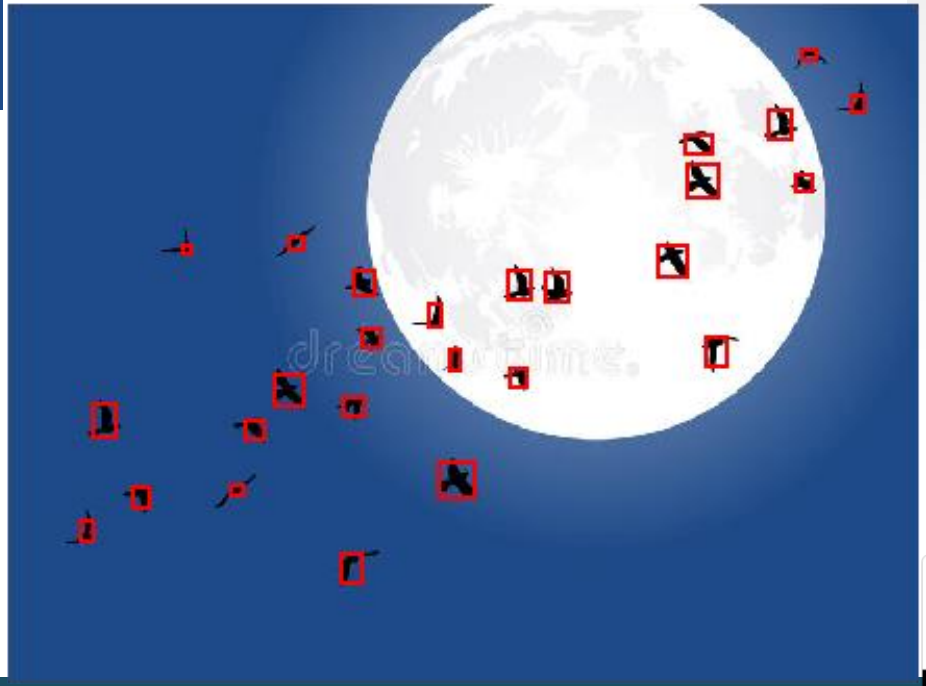
Сегментация. Связанные области



```
>>> n = 20
>>> l = 256

>>> im = np.zeros((l, l))
>>> points = l * np.random.random((2, n ** 2))
>>> im[(points[0]).astype(np.int), (points[1]).astype(np.int)] = 1

>>> im = filters.gaussian_filter(im, sigma=1 / (4. * n))

>>> blobs = im > im.mean()
>>> from skimage import measure

>>> all_labels = measure.label(blobs
>>> blobs_labels = measure.label(blobs, background=0)
```

Задание





Определить птиц на изображении