Jump into filtering

IMAGE PROCESSING IN PYTHON

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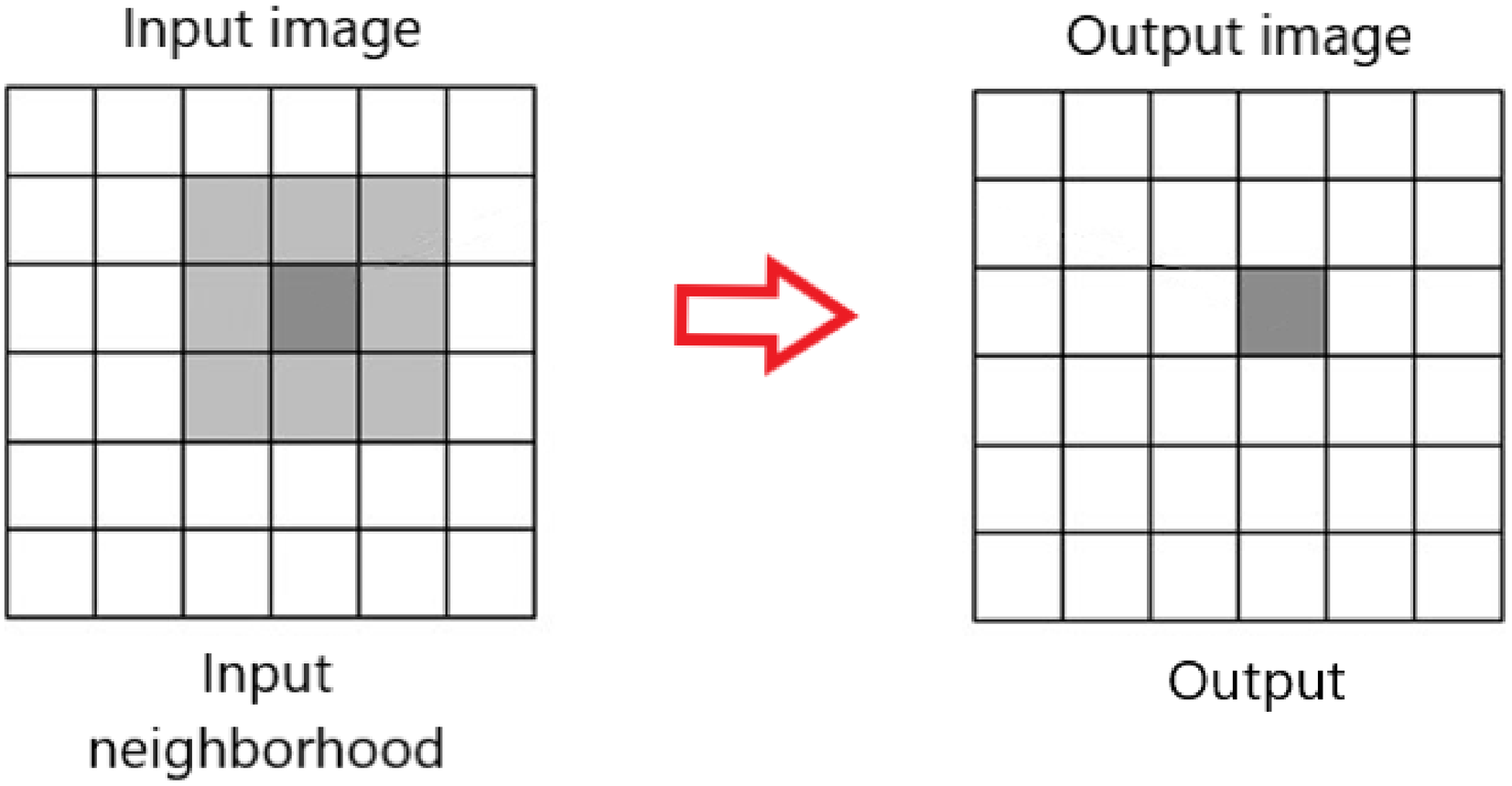
datacamp

Filters

- Enhancing an image
- Emphasize or remove features
- Smoothing
- Sharpening
- Edge detection

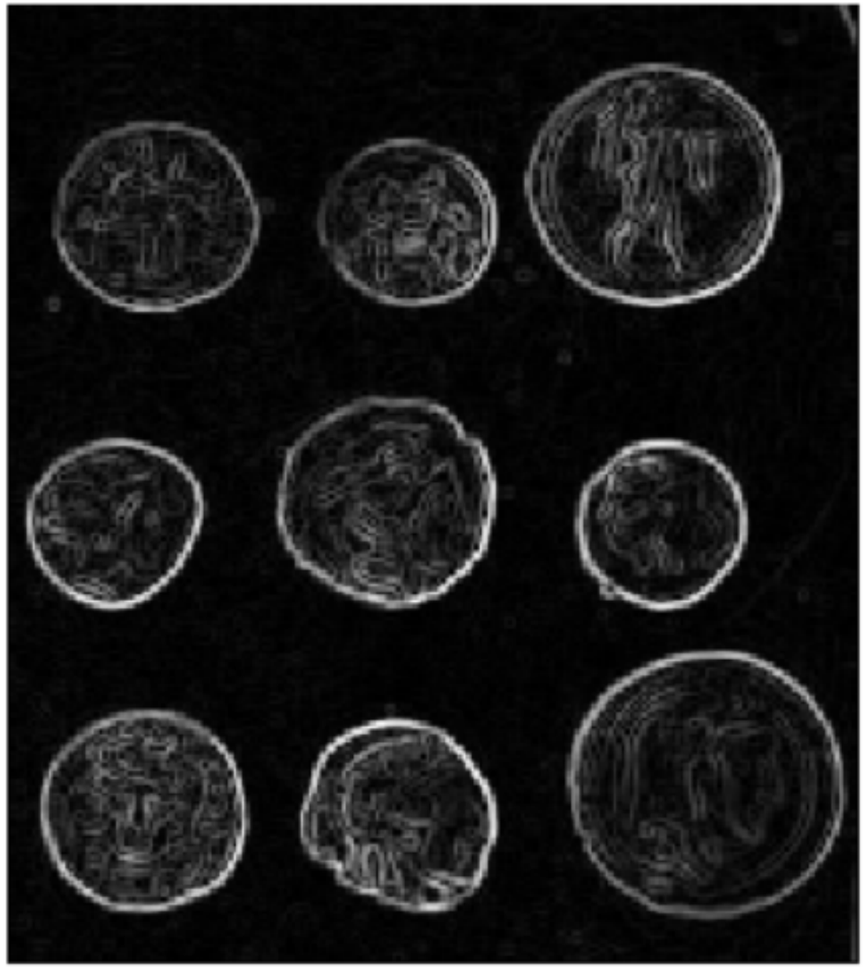
Neighborhoods



Edge detection

Original

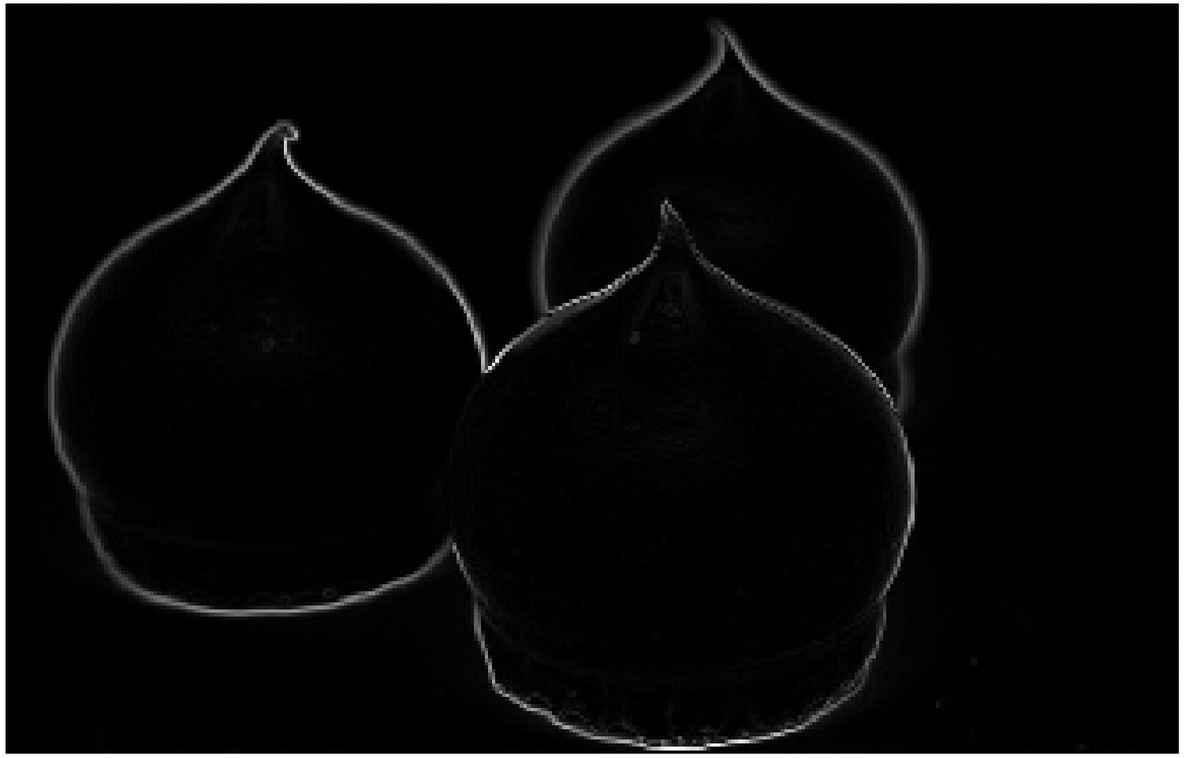
Edges with Sobel



Edge detection

Original chocolate kisses

Edges with Sobel



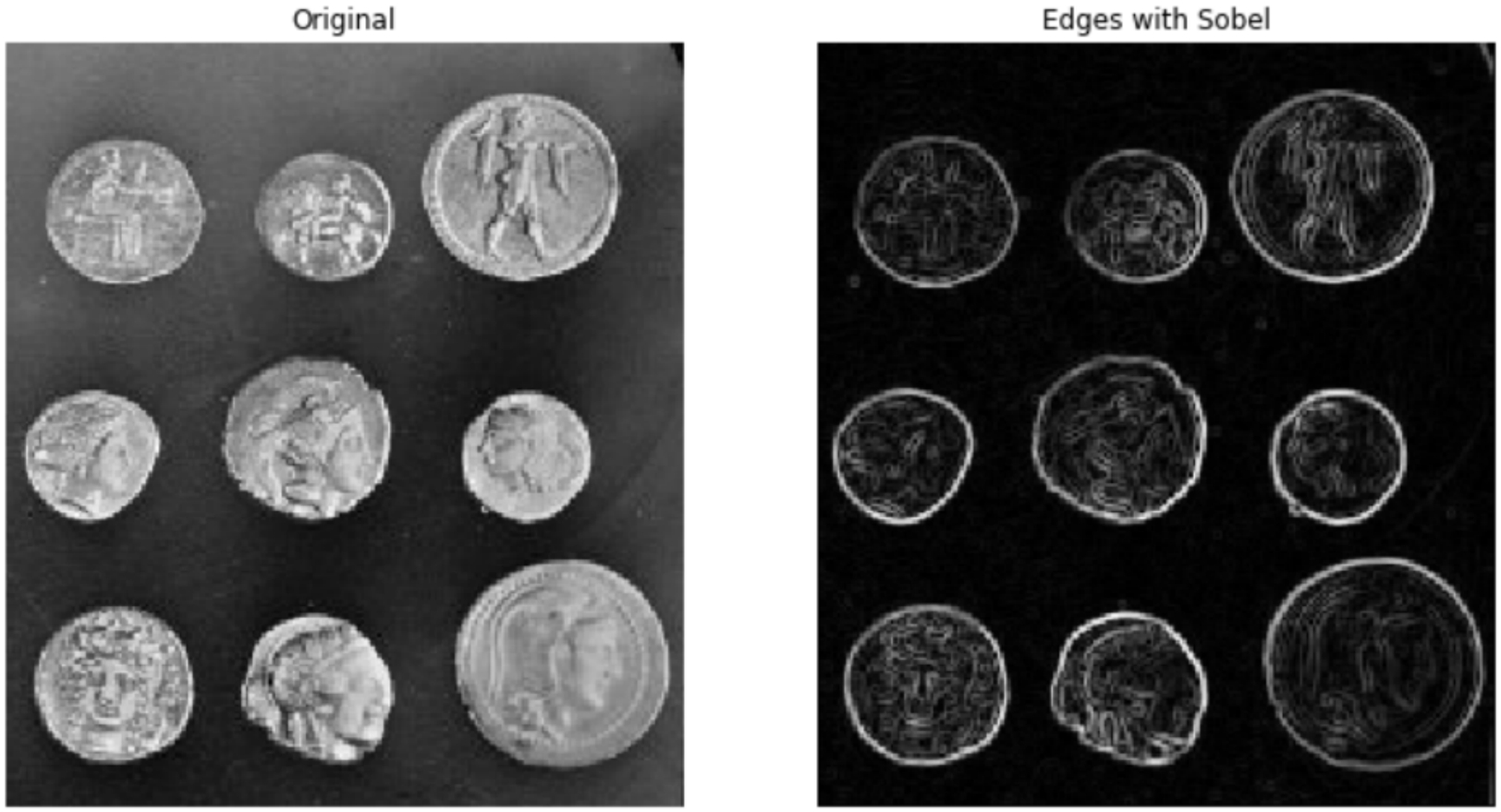
Edge detection

Sobel

```
# Import module and function
from skimage.filters import sobel

# Apply edge detection filter
edge_sobel = sobel(image_coins)

# Show original and resulting image to compare
plot_comparison(image_coins, edge_sobel, "Edge with Sobel")
```

Edge detection

Sobel



Comparing plots

```
def plot_comparison(original, filtered, title_filtered):

    fig, (ax1, ax2) = plt.subplots(ncols=2, figsize=(8, 6), sharex=True,
                                   sharey=True)
    ax1.imshow(original, cmap=plt.cm.gray)
    ax1.set_title('original')
    ax1.axis('off')
    ax2.imshow(filtered, cmap=plt.cm.gray)
    ax2.set_title(title_filtered)
    ax2.axis('off')
```

Gaussian smoothing

Original

Blurred with Gaussian filter

Gaussian smoothing

Gaussian smoothing

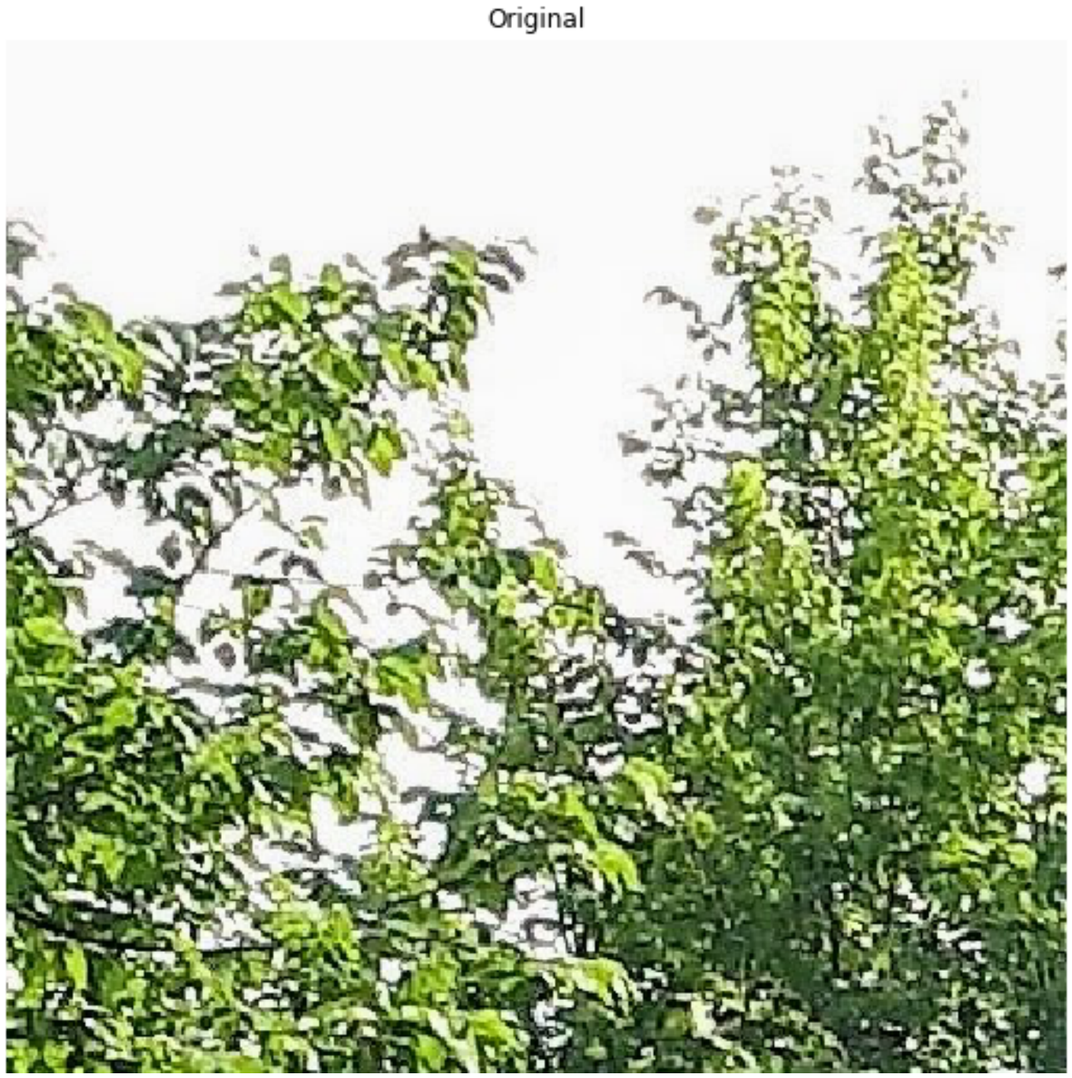
```
# Import the module and function
from skimage.filters import gaussian

# Apply edge detection filter
gaussian_image = gaussian(amsterdam_pic, multichannel=True)

# Show original and resulting image to compare
plot_comparison(amsterdam_pic, gaussian_image, "Blurred with Gaussian filter")
```

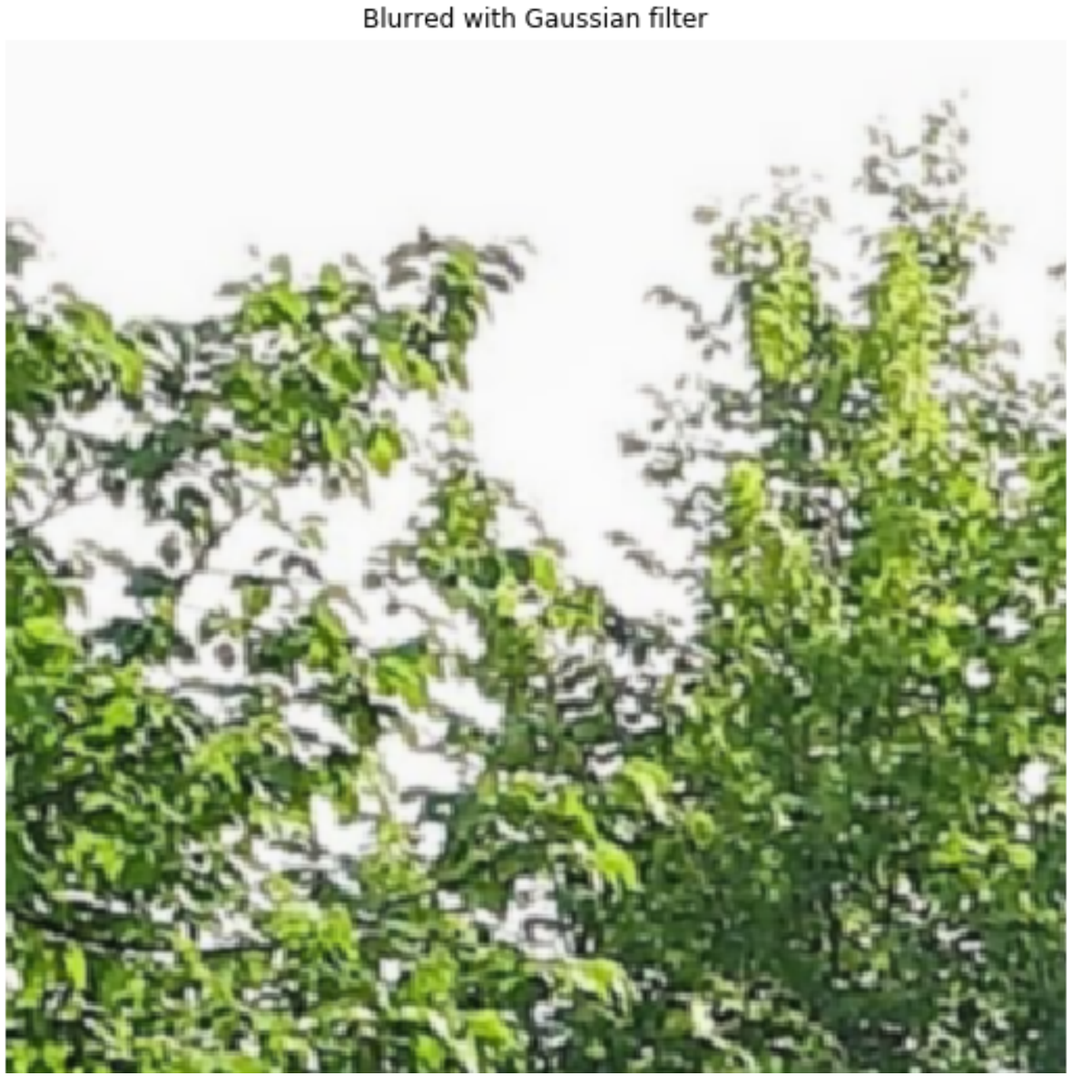
Gaussian smoothing

Original

Blurred with Gaussian filter

Gaussian smoothing





Let's practice!

IMAGE PROCESSING IN PYTHON

Contrast enhancement

IMAGE PROCESSING IN PYTHON

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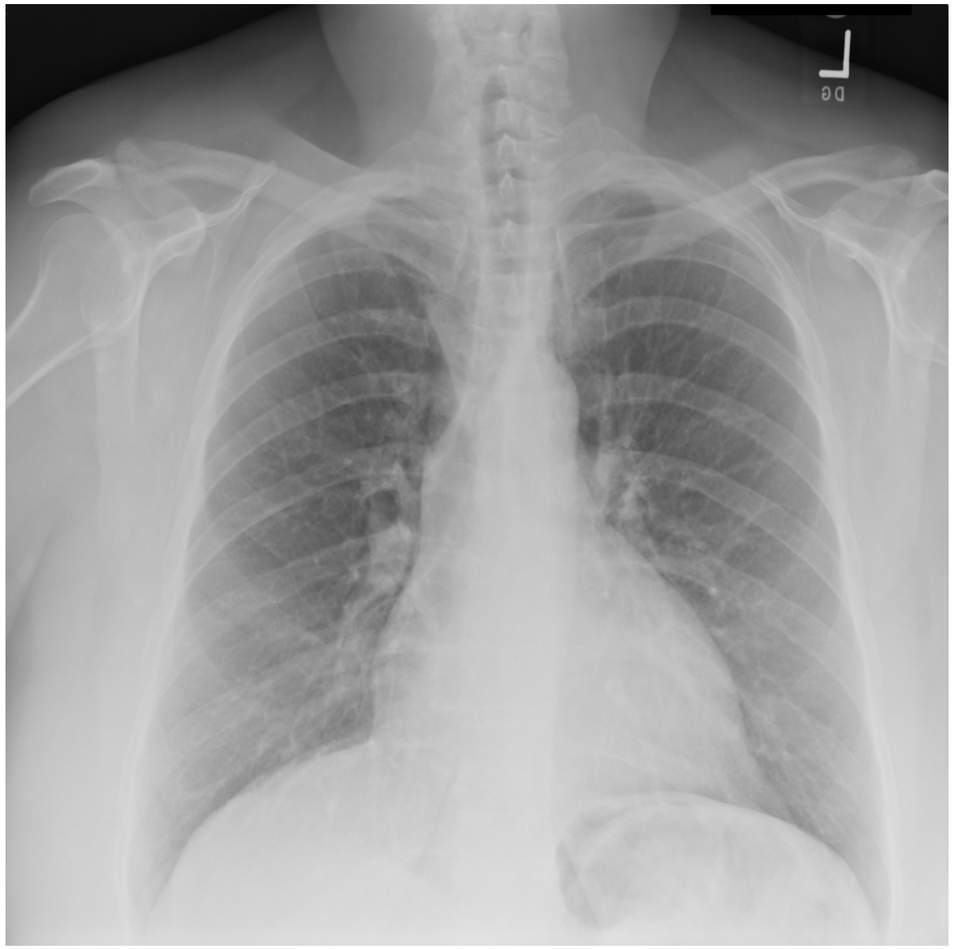
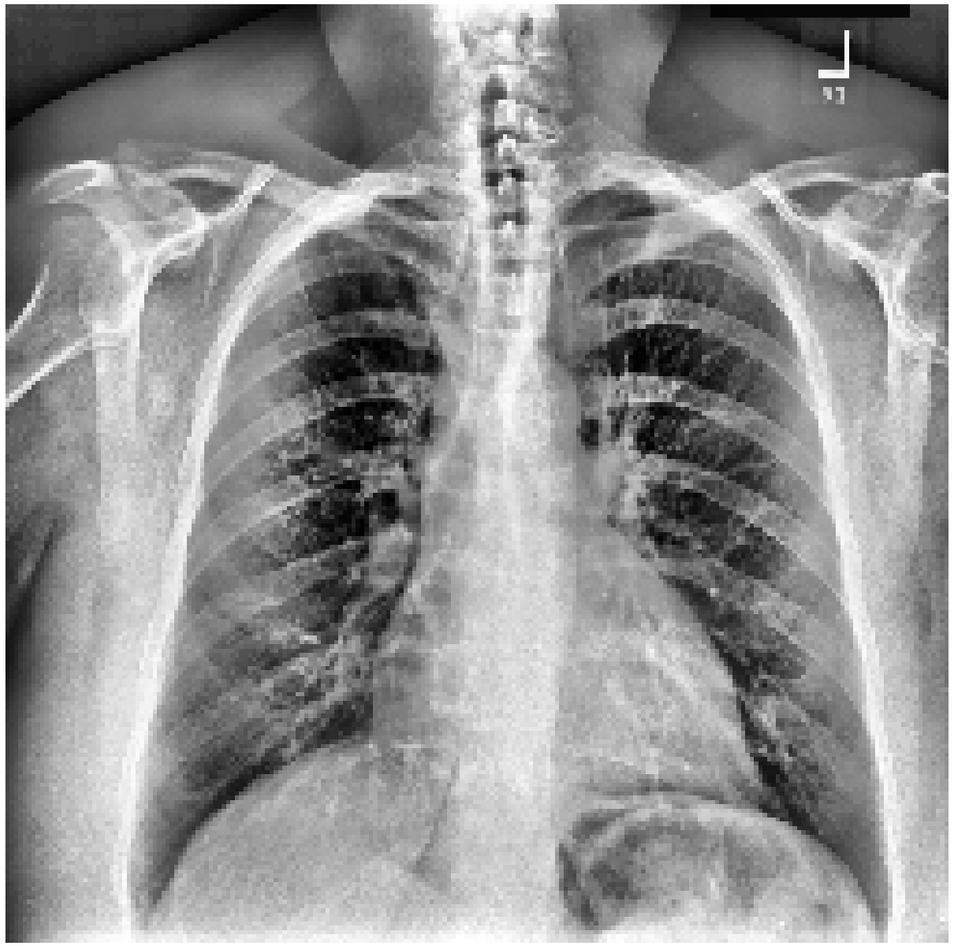
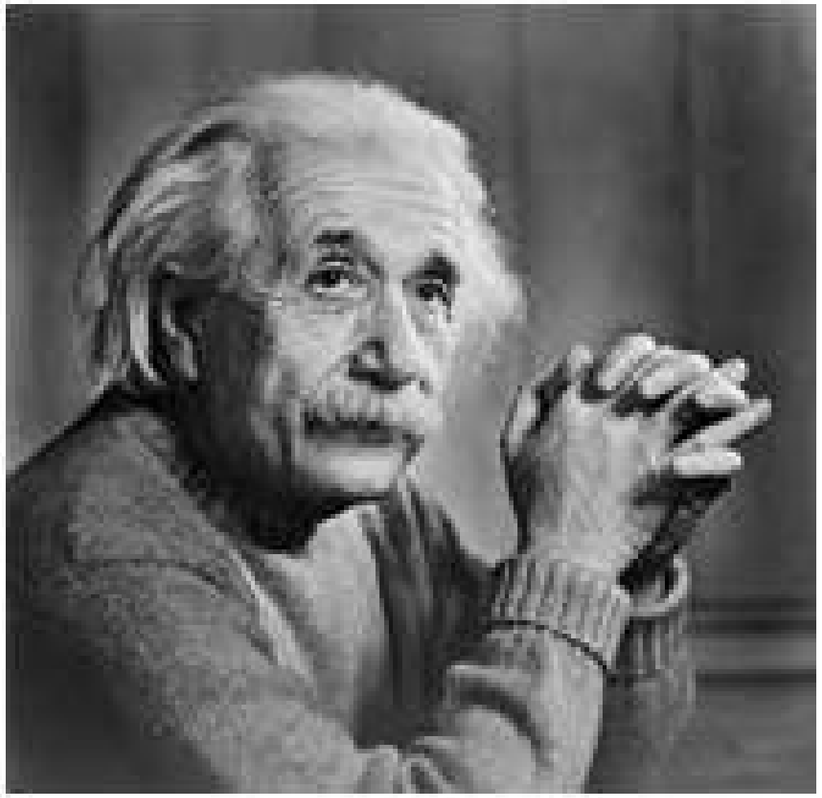
Contrast enhancement

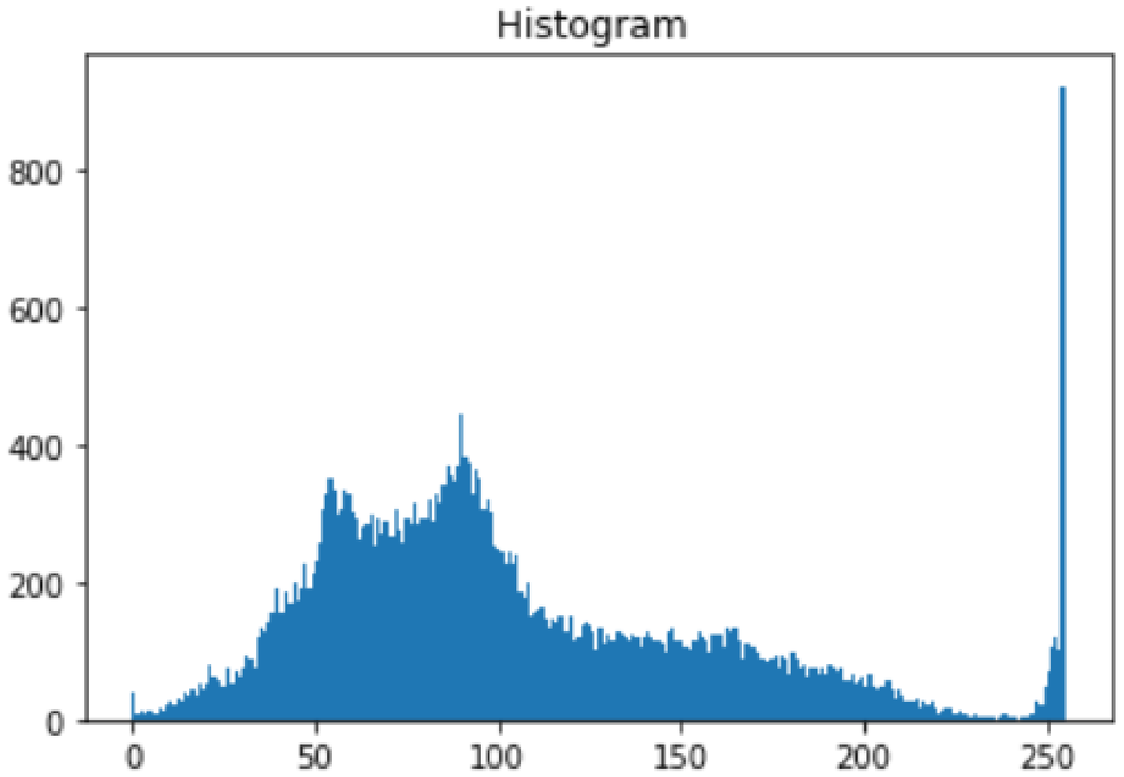




Contrast

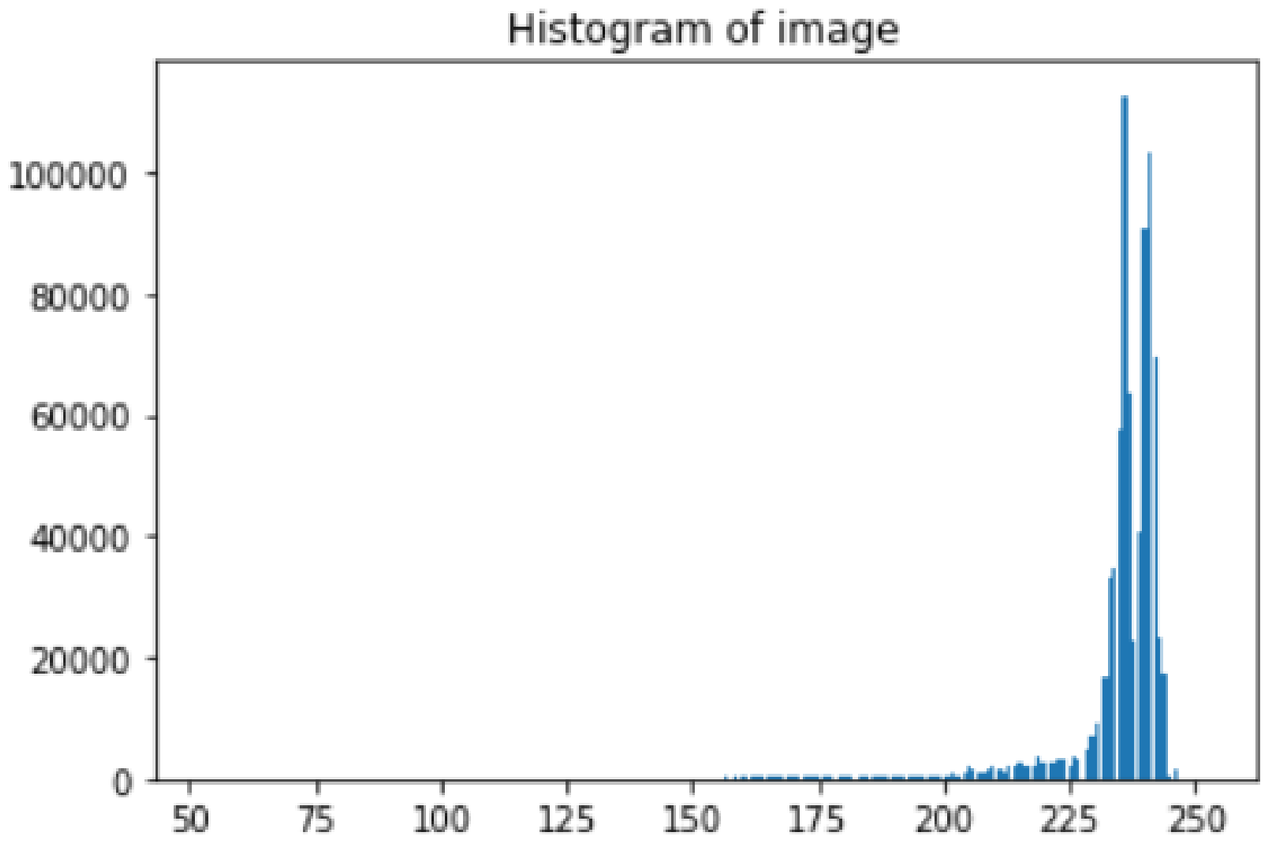
Histograms for contrast enhancement





Contrast


Low contrast image - light


Histogram of image
100000
80000
60000
40000
20000
0
50
75
100
125
150
175
200
225
250

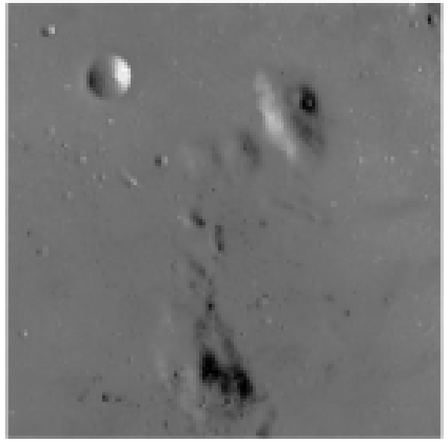
Enhance contrast

- Contrast stretching
- Histogram equalization

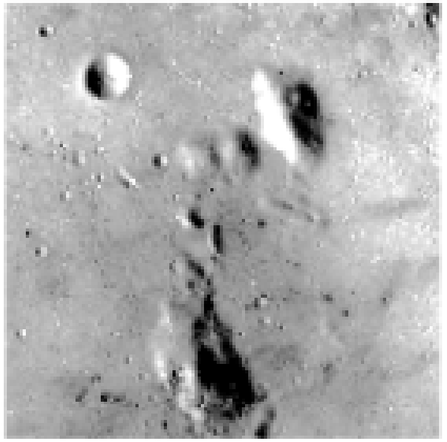
Types

- Histogram equalization
- Adaptive histogram equalization
- Contrast Limited Adaptive Histogram Equalization (CLAHE)

Low contrast image



Contrast stretching

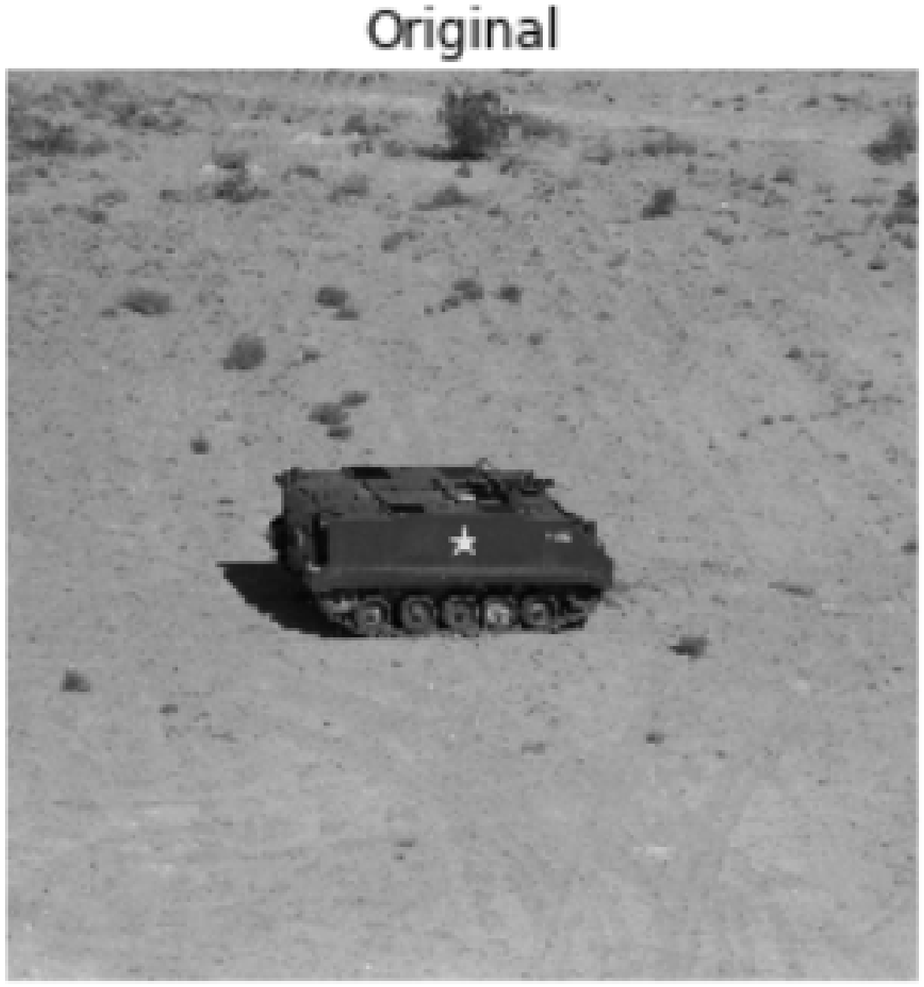


Histogram equalization

Adaptive equalization

Histogram equalization

Histogram equalization



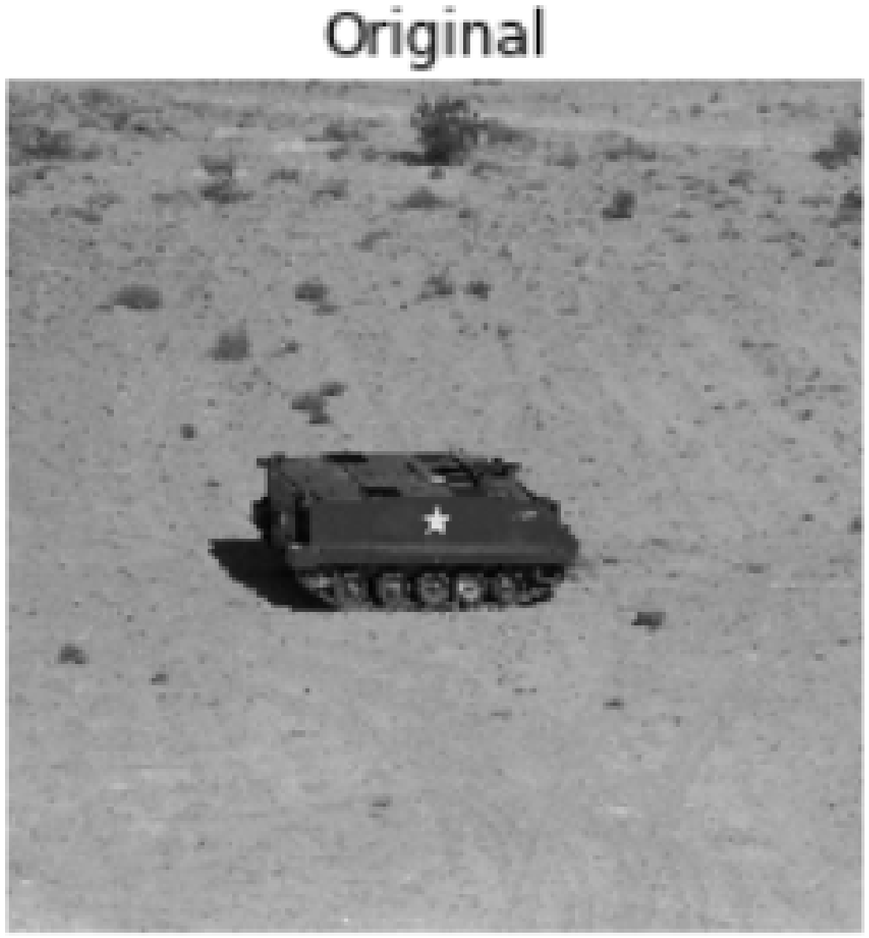
Histogram equalization

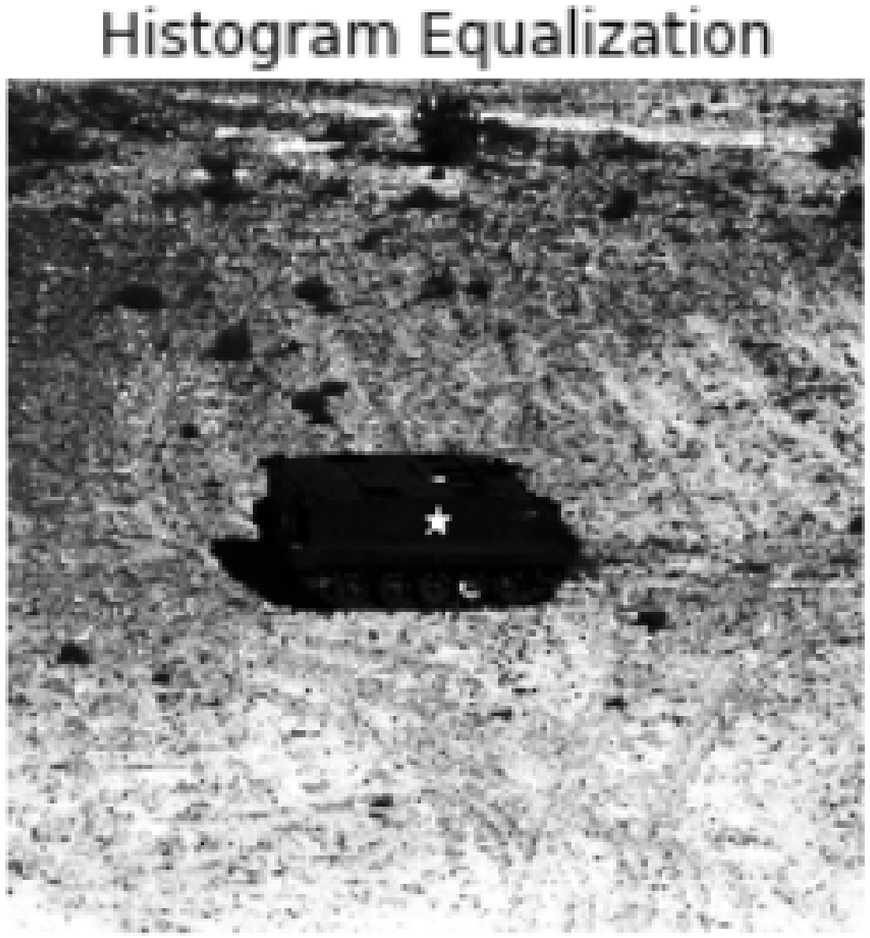
```
from skimage import exposure

# Obtain the equalized image
image_eq = exposure.equalize_hist(image)

# Show original and result
show_image(image, 'Original')
show_image(image_eq, 'Histogram equalized')
```

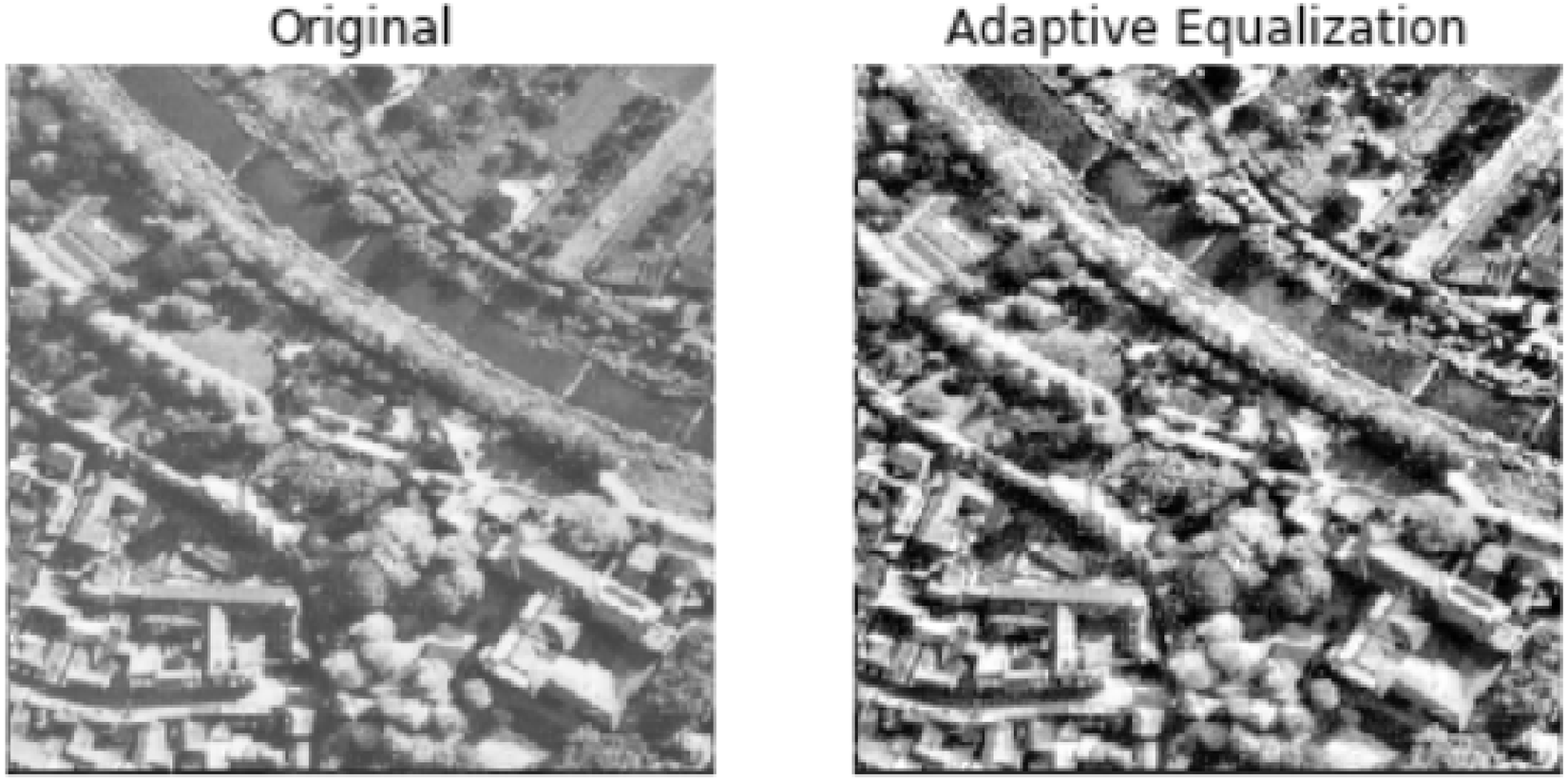
Histogram equalization





Adaptive Equalization

- Contrastive Limited Adaptive Histogram Equalization



Contrastive Limited Adaptive Equalization

Original

Histogram Equalization

Adaptive Equalization

CLAHE in scikit-image

```
from skimage import exposure

# Apply adaptive Equalization
image_adapteq = exposure.equalize_adapthist(image, clip_limit=0.03)

# Show original and result
show_image(image, 'Original')
show_image(image_adapteq, 'Adaptive equalized')
```

CLAHE in scikit-image

Original

Adaptive Equalization

Let's practice!

IMAGE PROCESSING IN PYTHON

Transformations

IMAGE PROCESSING IN PYTHON

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Why transform images?

- Preparing images for classification Machine Learning models
- Optimization and compression of images
- Save images with same proportion

Rotating

Original

Rotated 90 degrees clockwise

Rotating

Original

Rotated 90 degrees anticlockwise

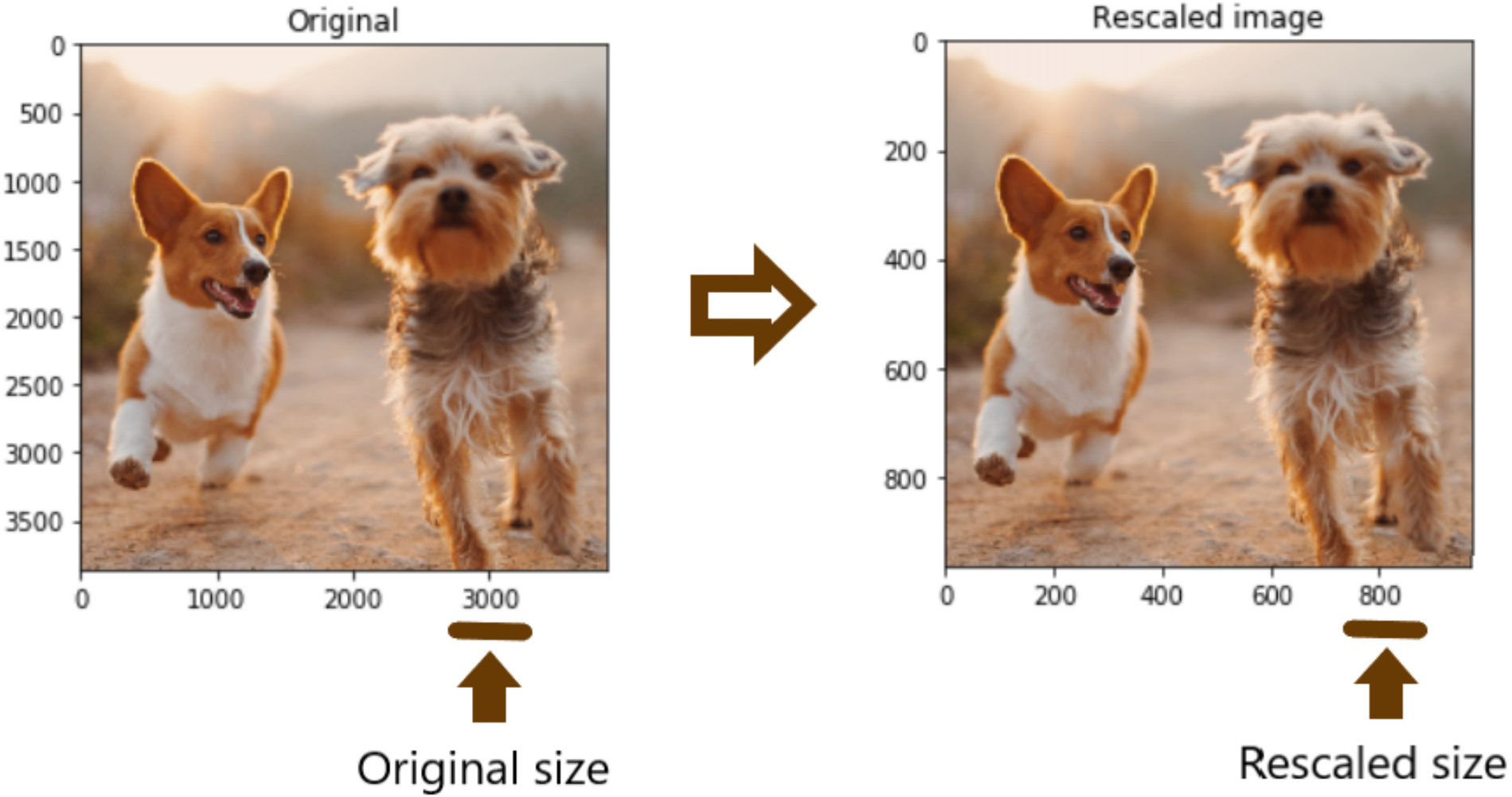
Rotating clockwise

```
from skimage.transform import rotate

# Rotate the image 90 degrees clockwise
image_rotated = rotate(image, -90)

show_image(image, 'Original')
show_image(image_rotated, 'Rotated 90 degrees clockwise')
```

Rotating anticlockwise

```
from skimage.transform import rotate

# Rotate an image 90 degrees anticlockwise
image_rotated = rotate(image, 90)

show_image(image, 'Original')
show_image(image_rotated, 'Rotated 90 degrees anticlockwise')
```

Rescaling

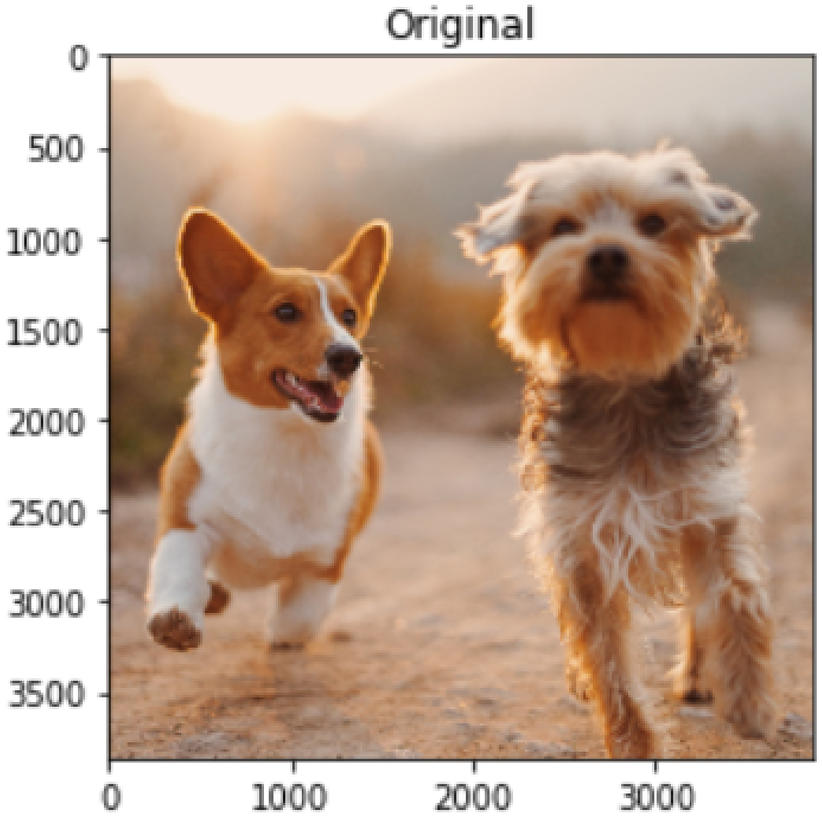

Original
0
500
1000
1500
2000
2500
3000
3500
0
1000
2000
3000
Original size
Rescaled image
0
200
400
600
800
0
200
400
600
800
Rescaled size

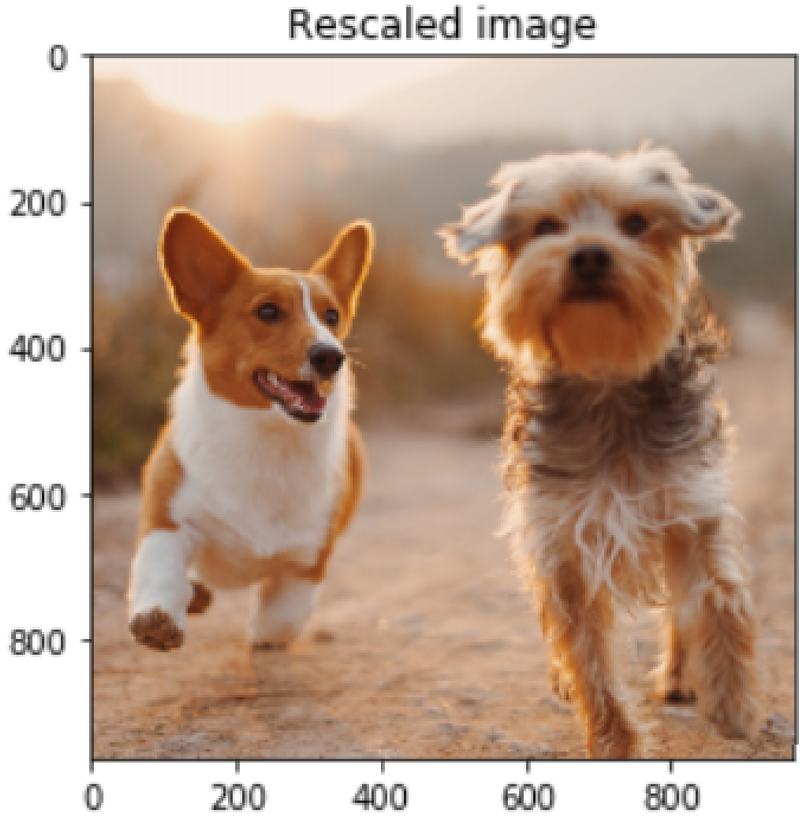
Rescaling

Downgrading

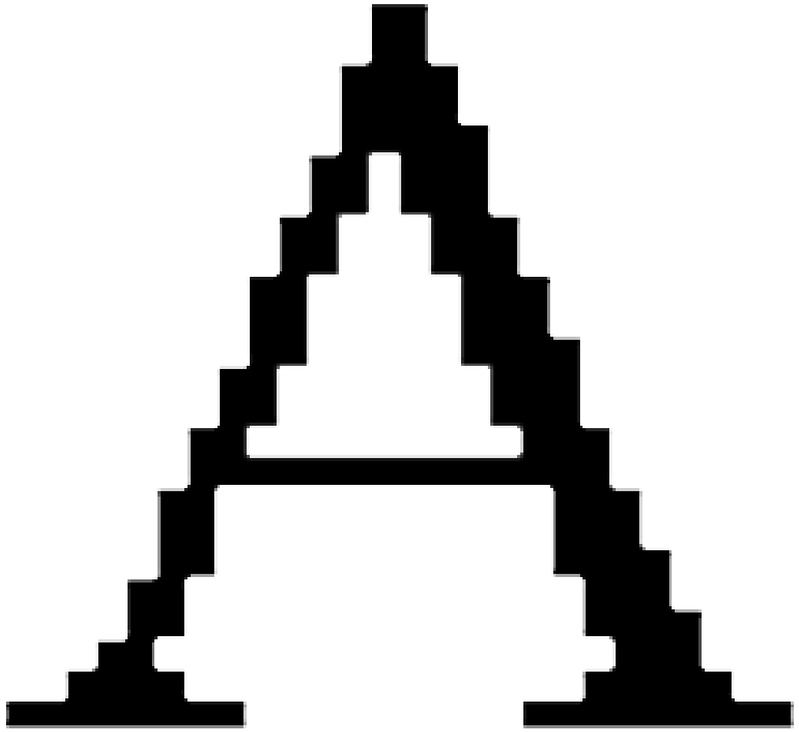
```
from skimage.transform import rescale

# Rescale the image to be 4 times smaller
image_rescaled = rescale(image, 1/4, anti_aliasing=True, multichannel=True)

show_image(image, 'Original image')
show_image(image_rescaled, 'Rescaled image')
```

Rescaling

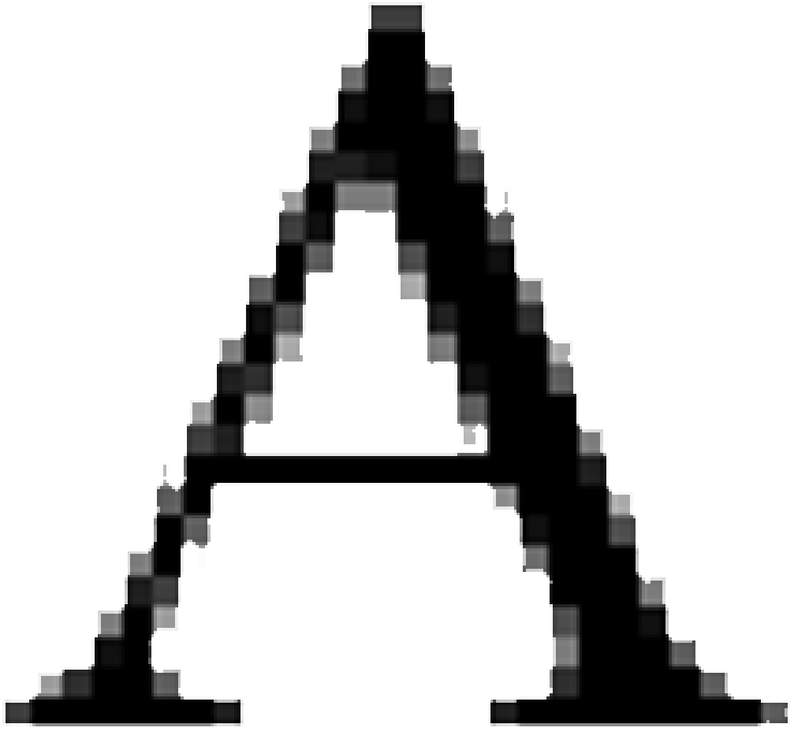

Original
0
500
1000
1500
2000
2500
3000
3500
0
1000
2000
3000


Rescaled image
0
200
400
600
800
0
200
400
600
800

Aliasing in digital images

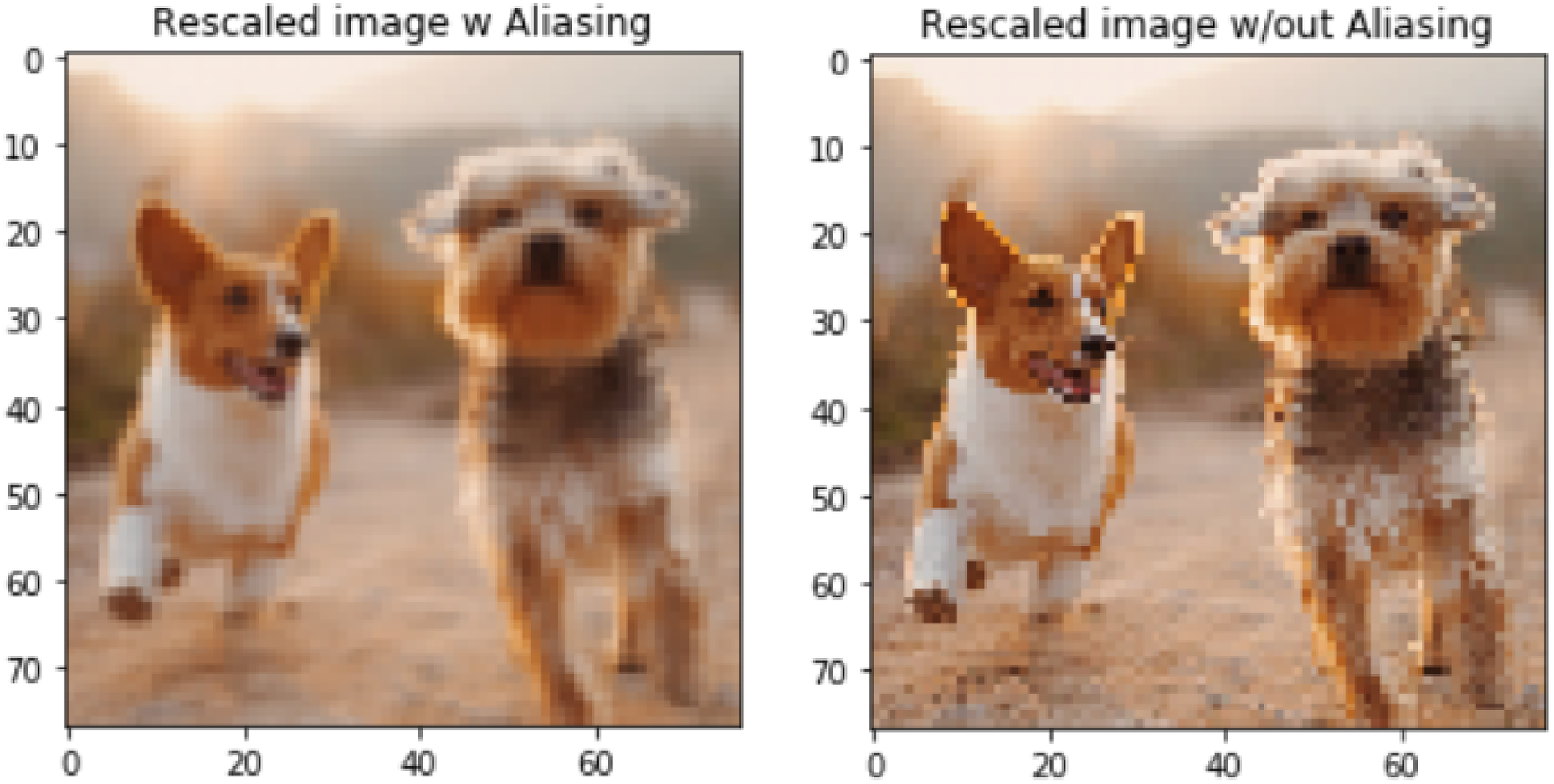


Original letter A

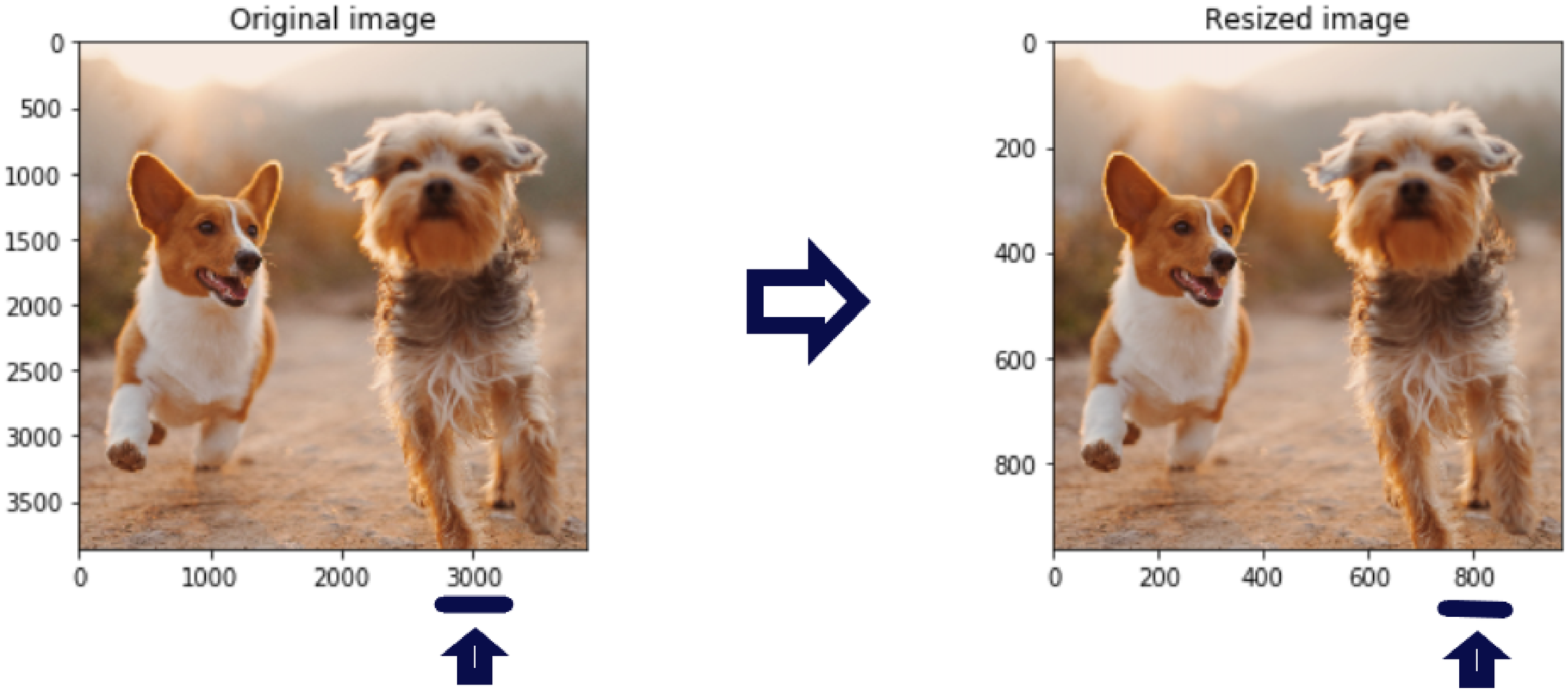


Aliased letter A

Aliasing in digital images



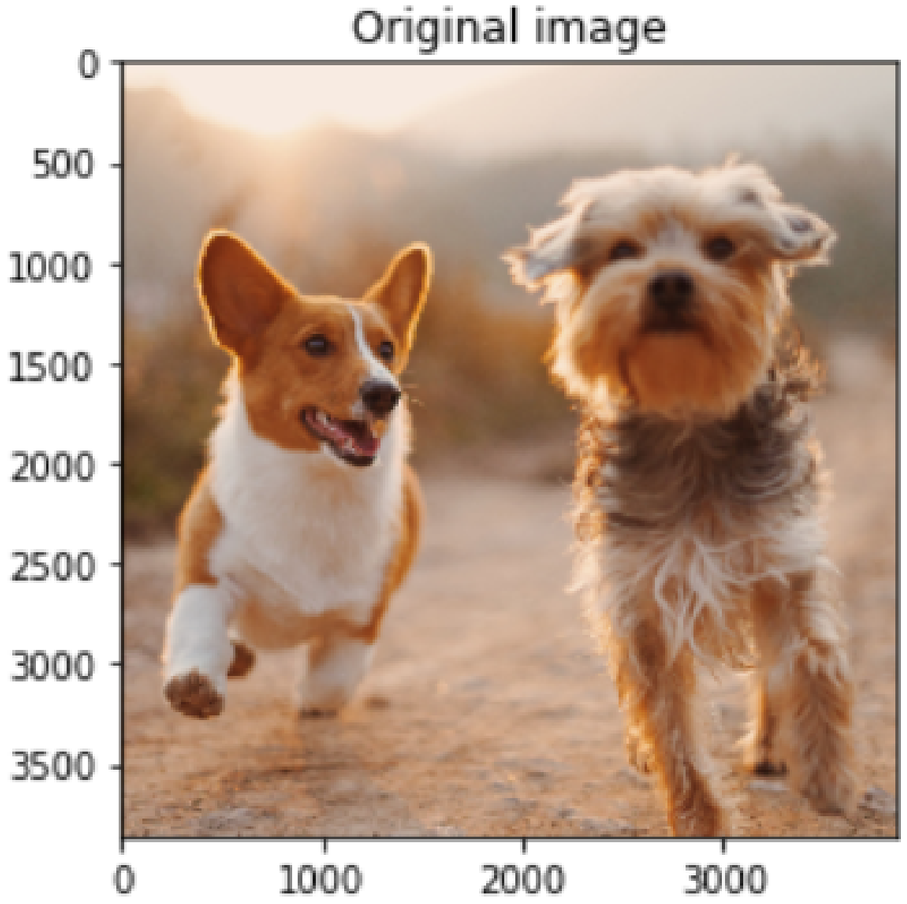
Resizing

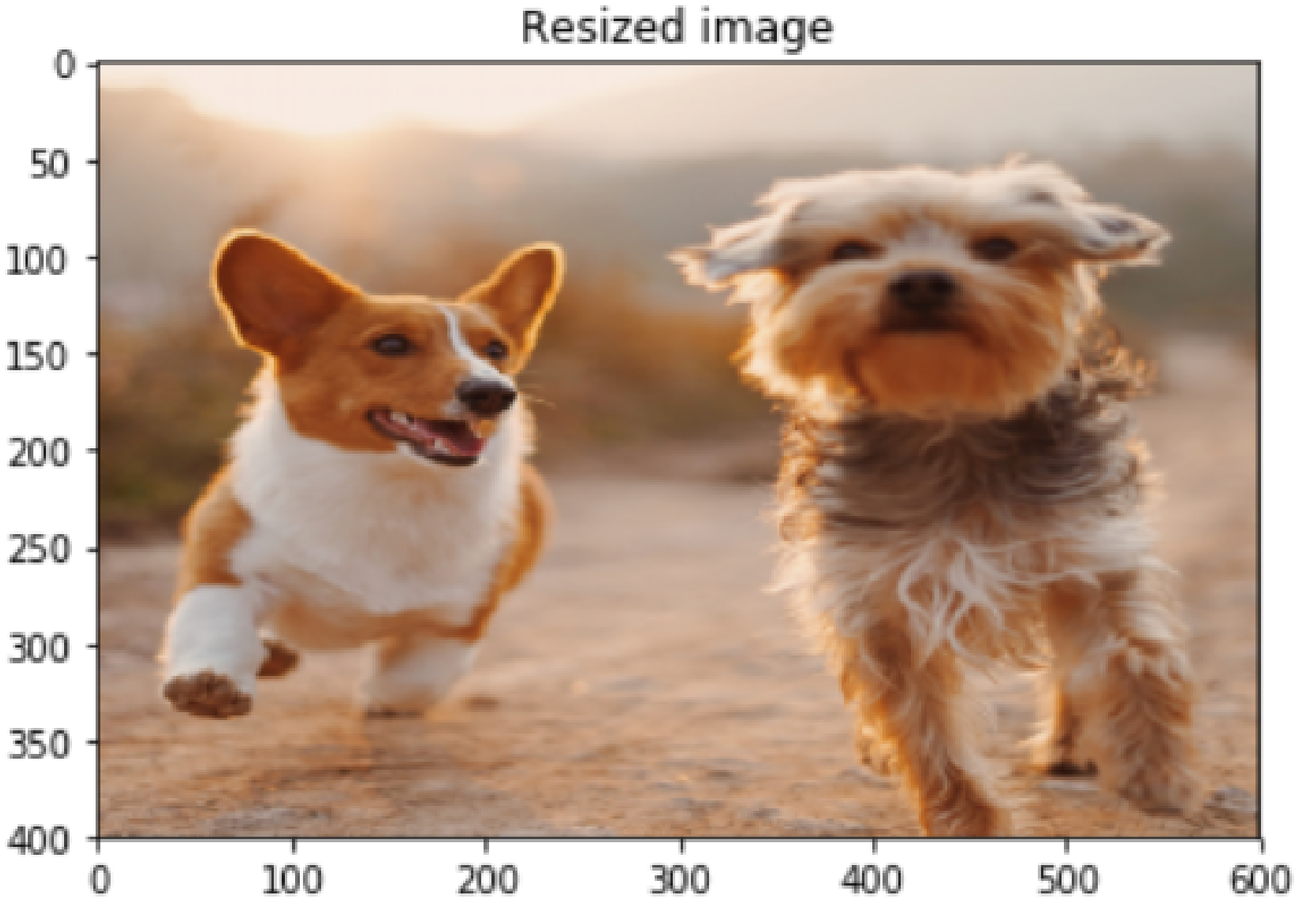

Original image
0
500
1000
1500
2000
2500
3000
3500
0
1000
2000
3000
Resized image
0
200
400
600
800
0
200
400
600
800

Resizing

```
from skimage.transform import resize

# Height and width to resize
height = 400
width = 500

# Resize image
image_resized = resize(image, (height, width), anti_aliasing=True)

# Show the original and resulting images
show_image(image, 'Original image')
show_image(image_resized, 'Resized image')
```

Resizing

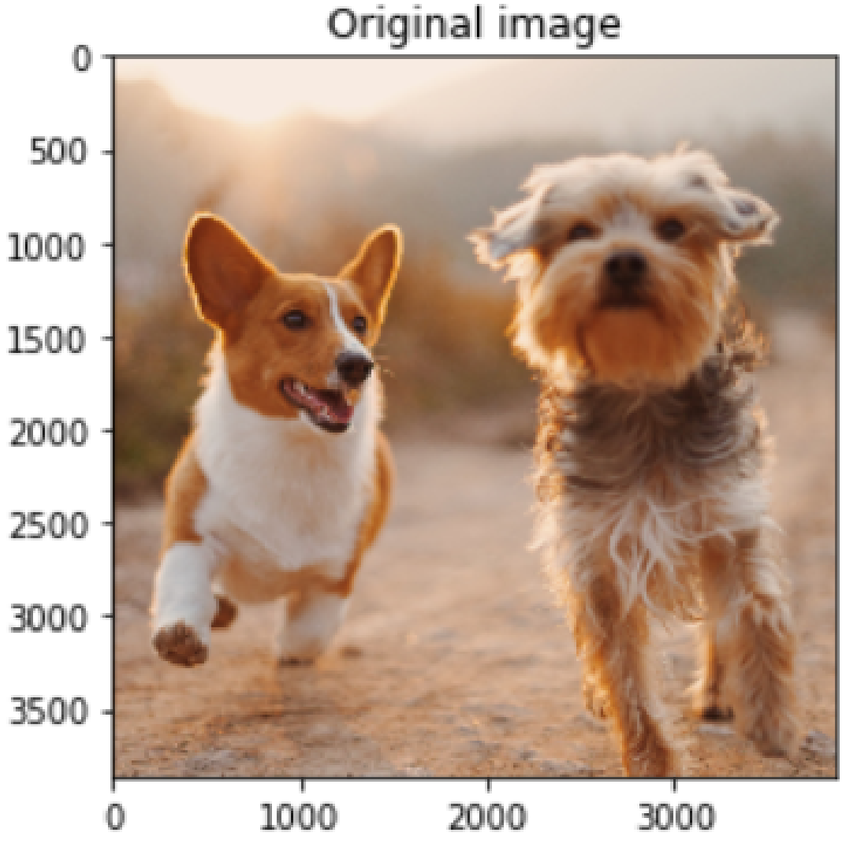

Original image
0
500
1000
1500
2000
2500
3000
3500
0
1000
2000
3000

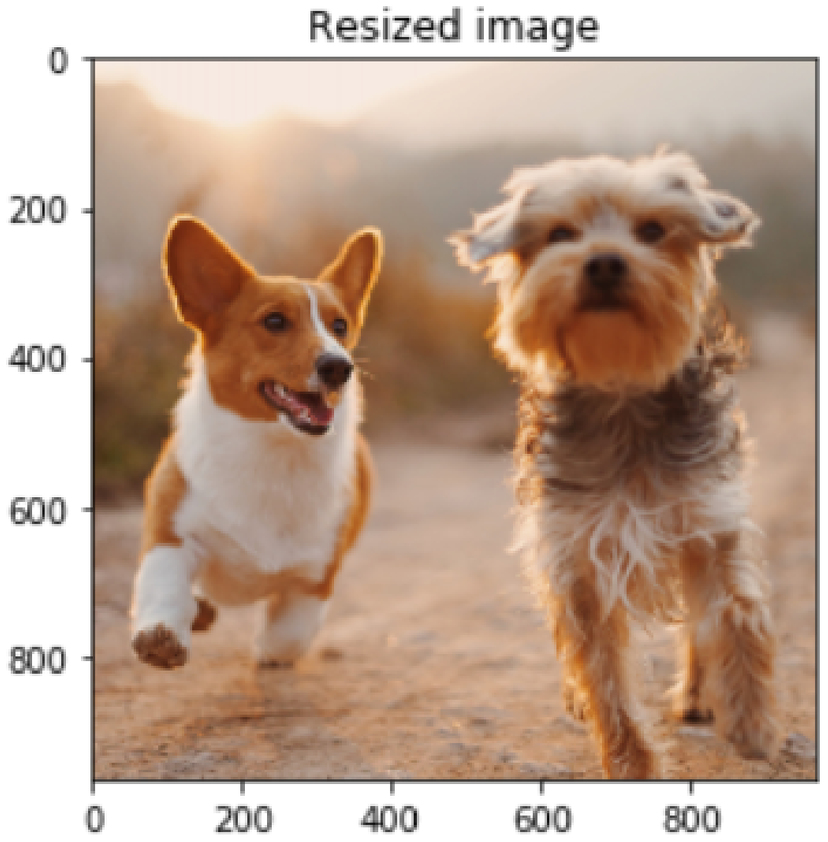

Resized image
0
50
100
150
200
250
300
350
400
0
100
200
300
400
500
600

Resizing proportionally

```
from skimage.transform import resize

# Set proportional height so its 4 times its size
height = image.shape[0] / 4
width = image.shape[1] / 4

# Resize image
image_resized = resize(image, (height, width), anti_aliasing=True)

show_image(image_resized, 'Resized image')
```

Resizing proportionally





Let's practice!

IMAGE PROCESSING IN PYTHON

Morphology

IMAGE PROCESSING IN PYTHON

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Binary images

Morphological filtering

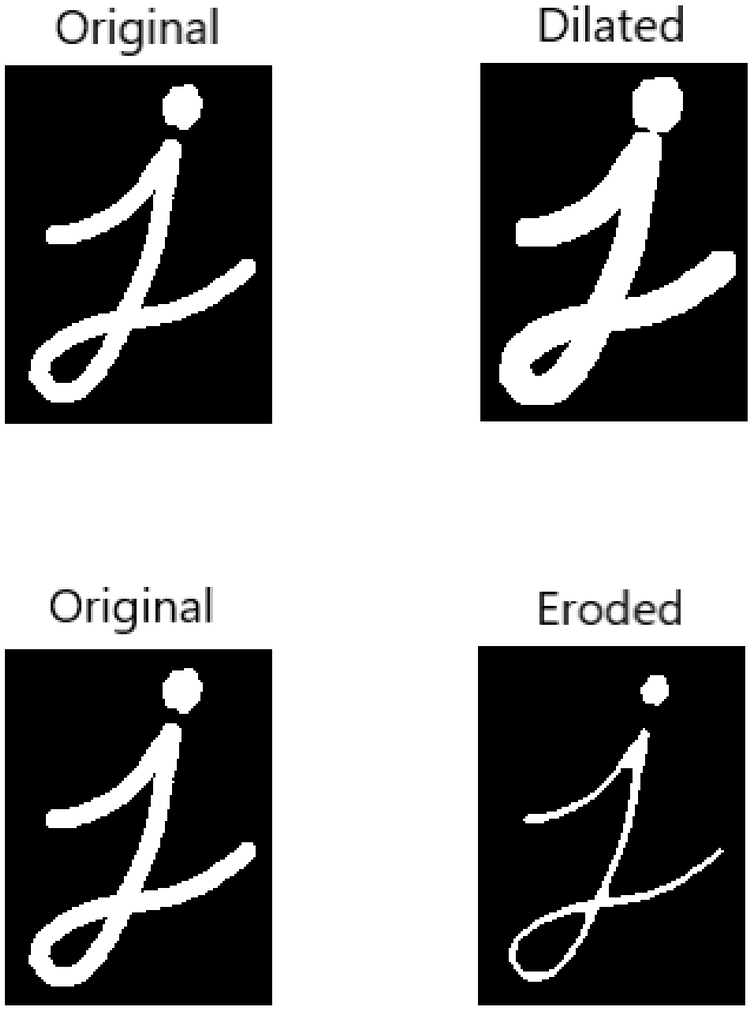
- Better for binary images
- Can extend for grayscale

Binary image

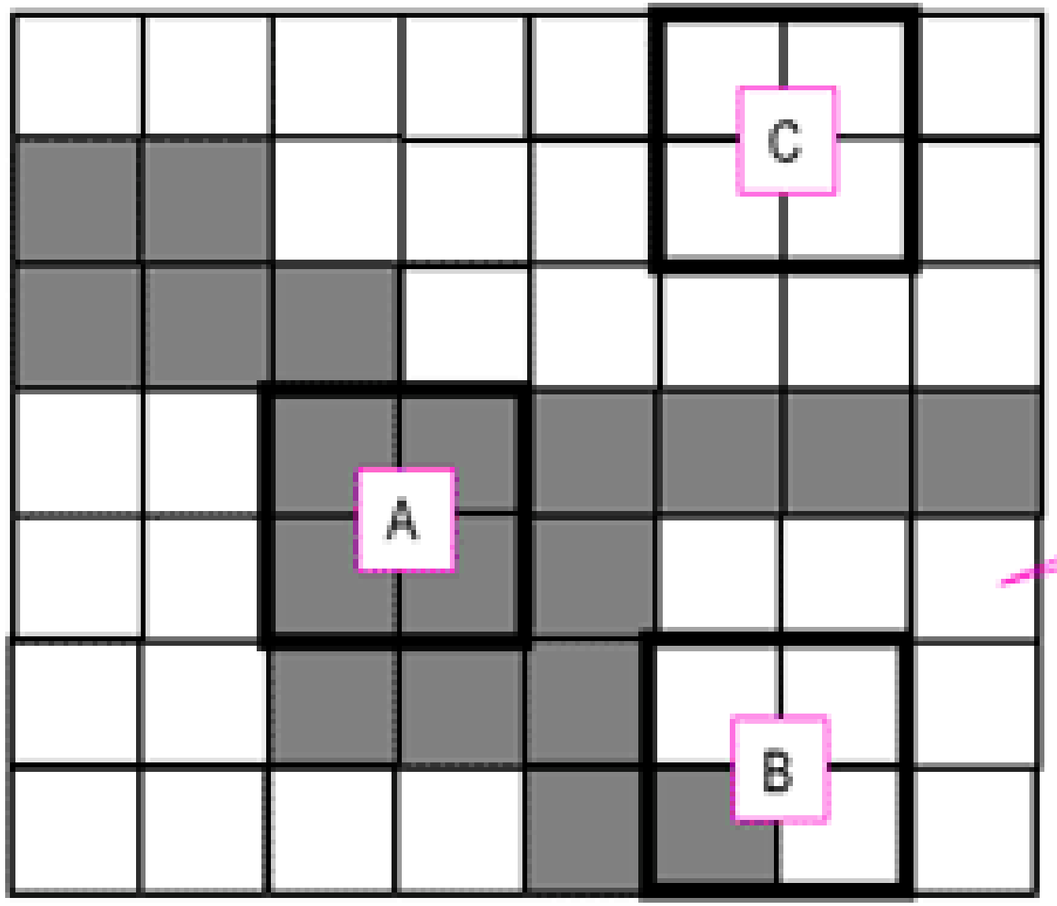
Grayscale

Morphological operations

- Dilation
- Erosion

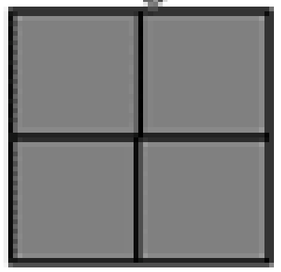


Structuring element

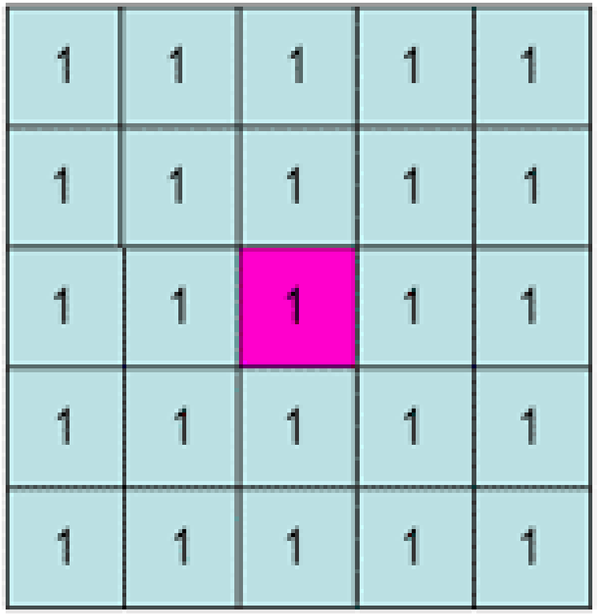


A - the structuring element fits the image
B - the structuring element hits (intersects) the image
C - the structuring element neither fits, nor hits the image

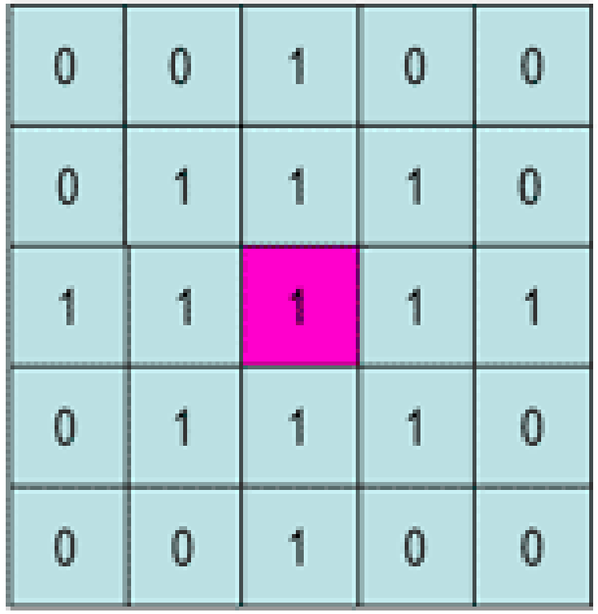
Structuring element



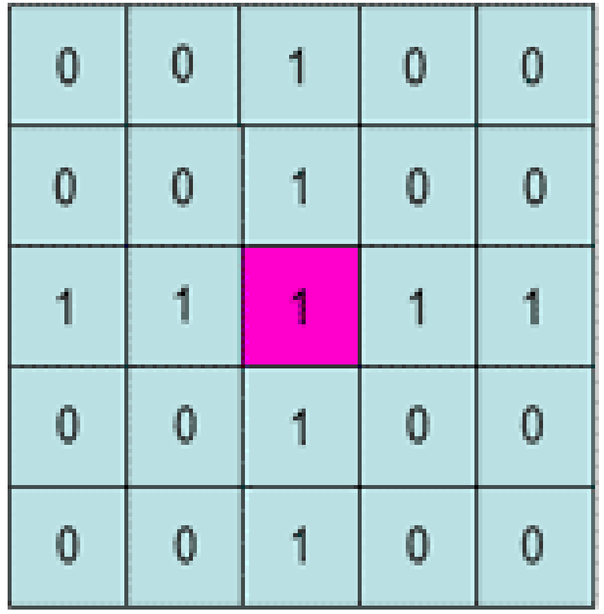
Structuring element



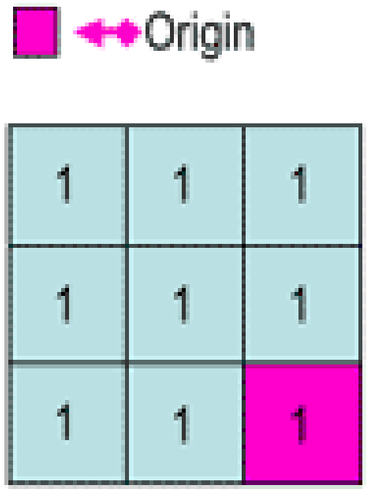
Square 5x5 element



Diamond-shaped 5x5 element



Cross-shaped 5x5 element



Square 3x3 element

Shapes in scikit-image

```
from skimage import morphology

square = morphology.square(4)
```

```
[[1 1 1 1]
 [1 1 1 1]
 [1 1 1 1]
 [1 1 1 1]]
```

```
rectangle = morphology.rectangle(4, 2)
```

```
[[1 1]
 [1 1]
 [1 1]
 [1 1]]
```

Erosion in scikit-image

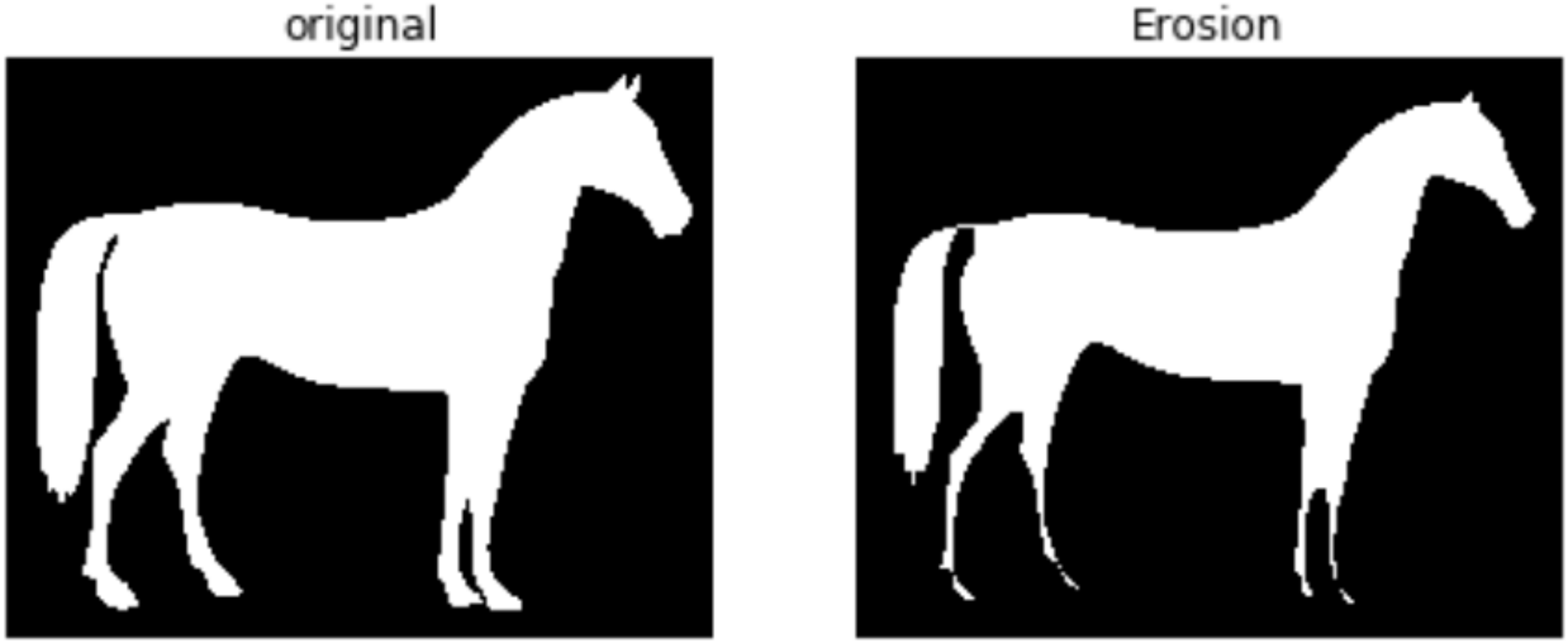
```
from skimage import morphology

# Set structuring element to the rectangular-shaped
selem = rectangle(12,6)

# Obtain the erosed image with binary erosion
eroded_image = morphology.binary_erosion(image_horse, selem=selem)
```

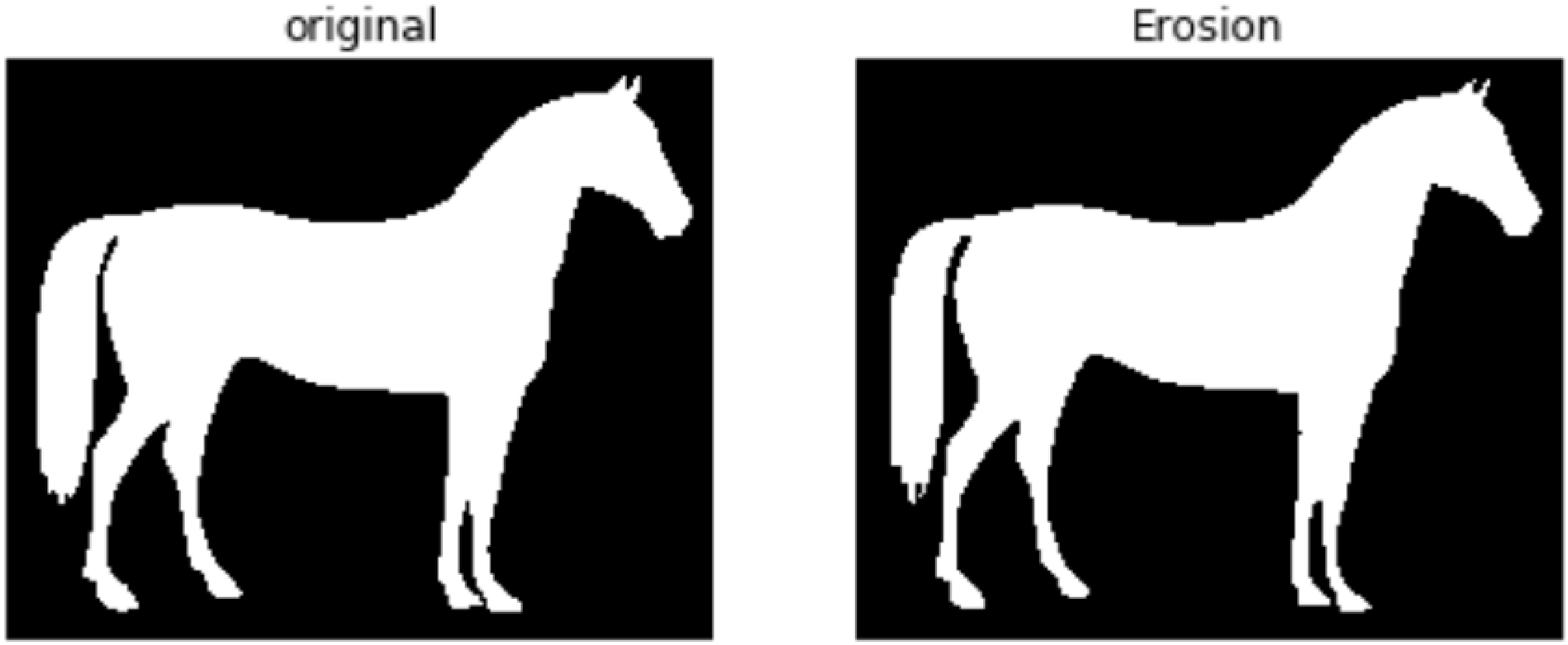
Erosion in scikit-image

```
# Show result
plot_comparison(image_horse, eroded_image, 'Erosion')
```



Binary erosion with default selem

```
# Binary erosion with default selem
eroded_image = morphology.binary_erosion(image_horse)
```



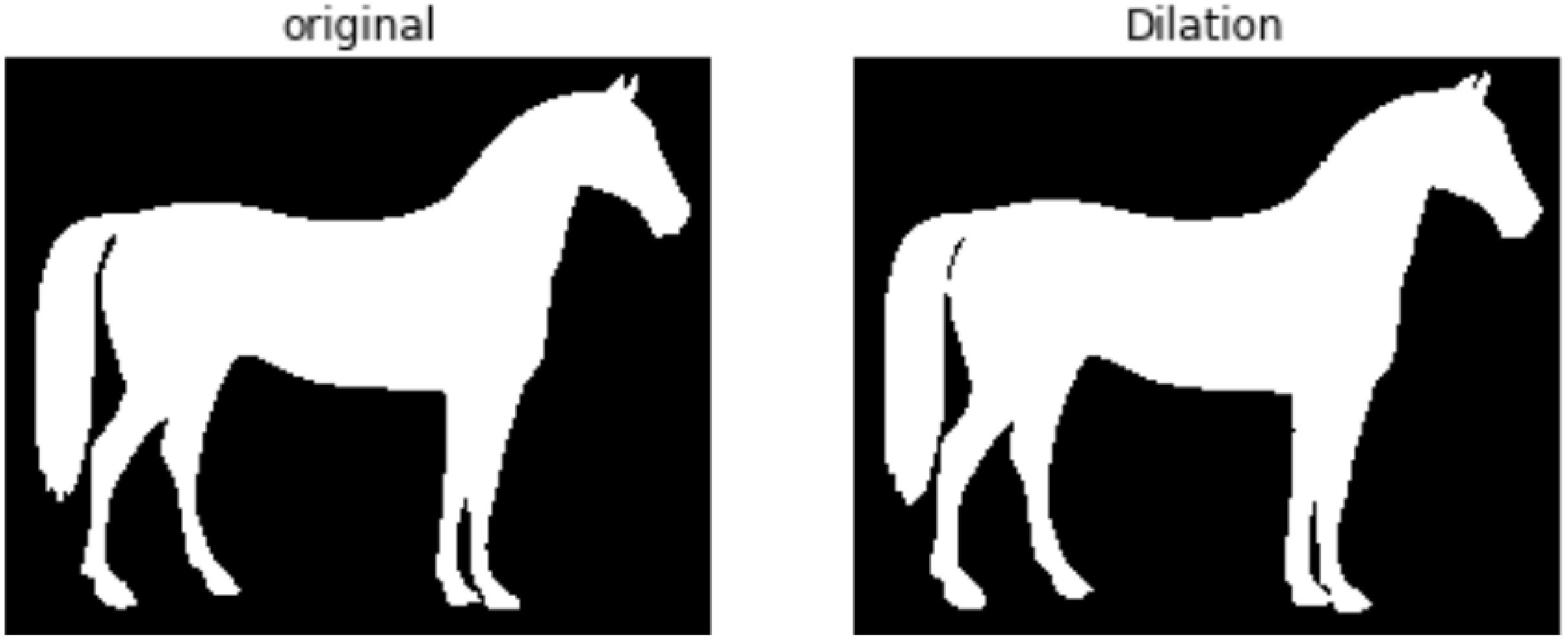
Dilation in scikit-image

```
from skimage import morphology

# Obtain dilated image, using binary dilation
dilated_image = morphology.binary_dilation(image_horse)

# See results
plot_comparison(image_horse, dilated_image, 'Erosion')
```

Dilation in scikit-image



Let's practice!

IMAGE PROCESSING IN PYTHON