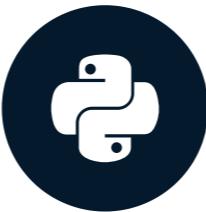


Jump into filtering

IMAGE PROCESSING IN PYTHON

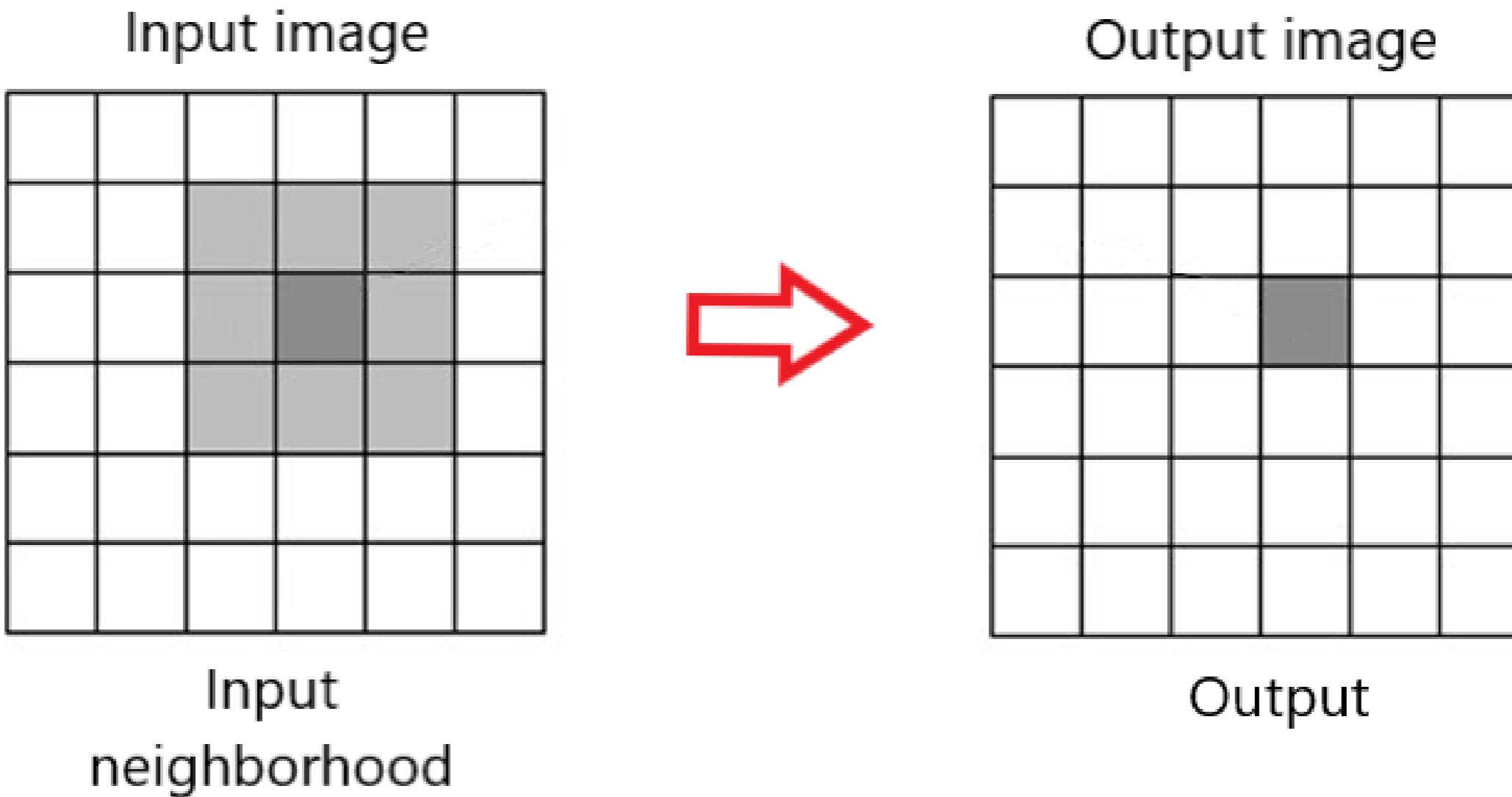


Rebeca Gonzalez
Data Engineer

Filters

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

Neighborhoods

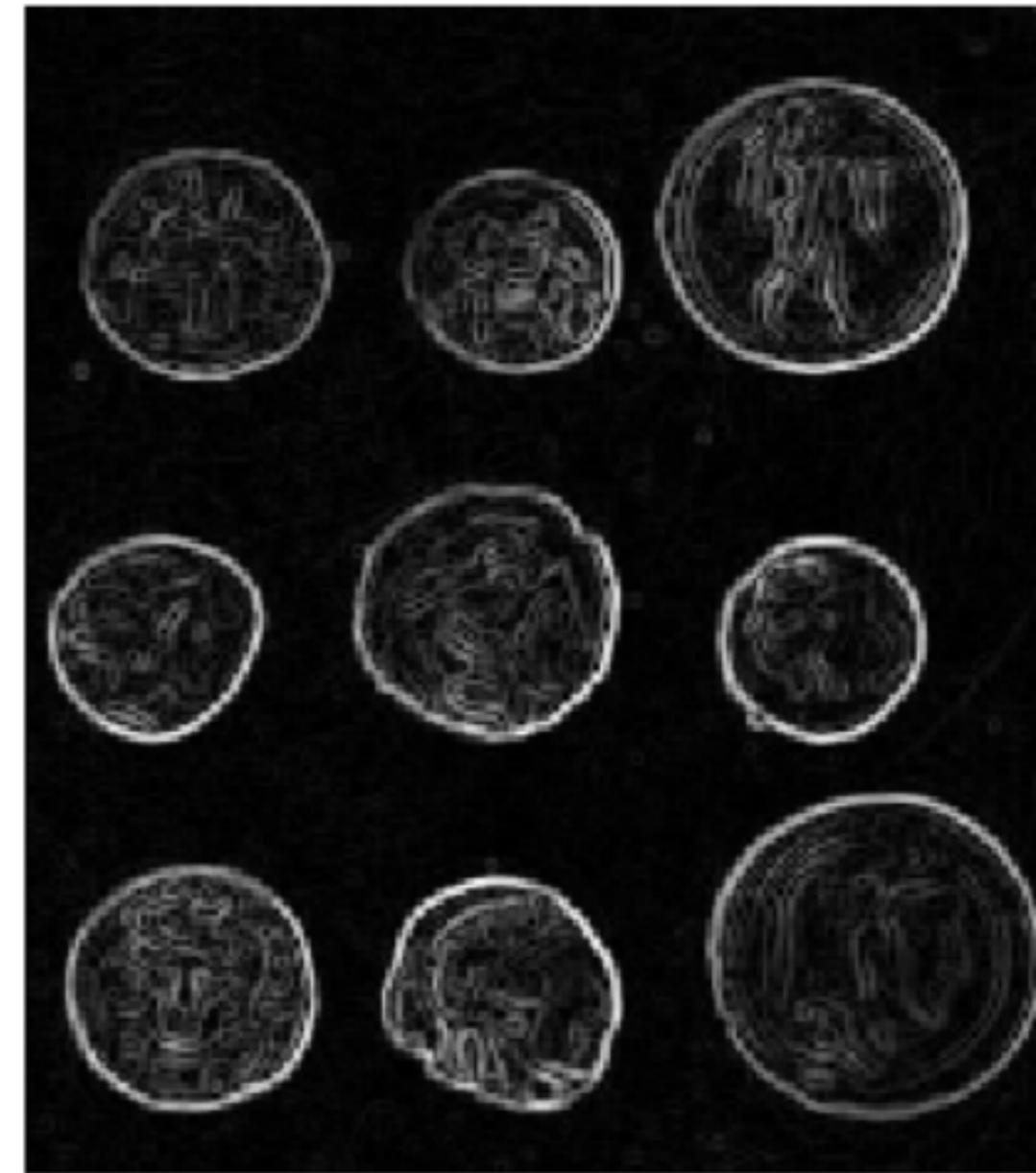


Edge detection

Original



Edges with Sobel

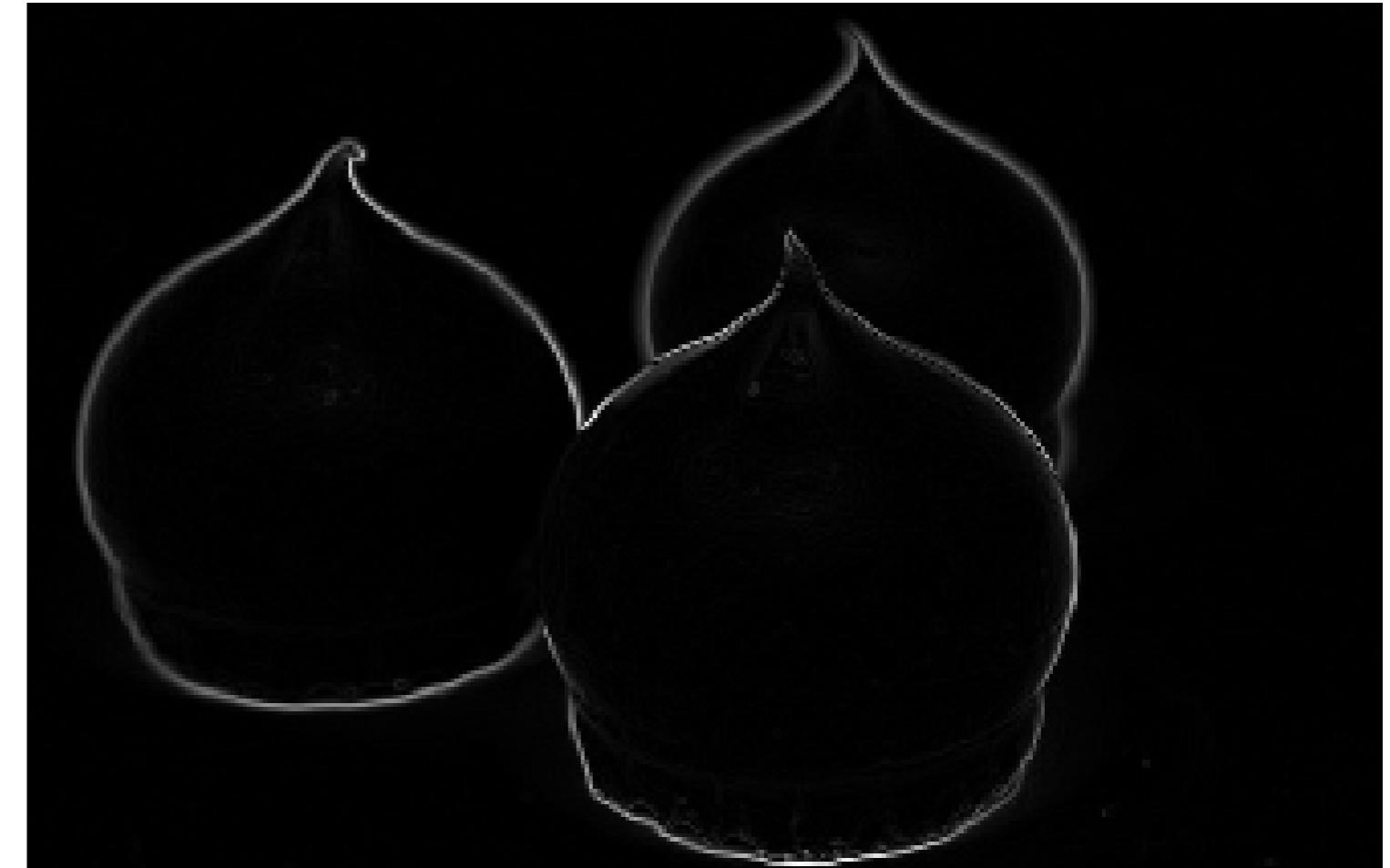


Edge detection

Original chocolate kisses



Edges with Sobel



Edge detection

Sobel

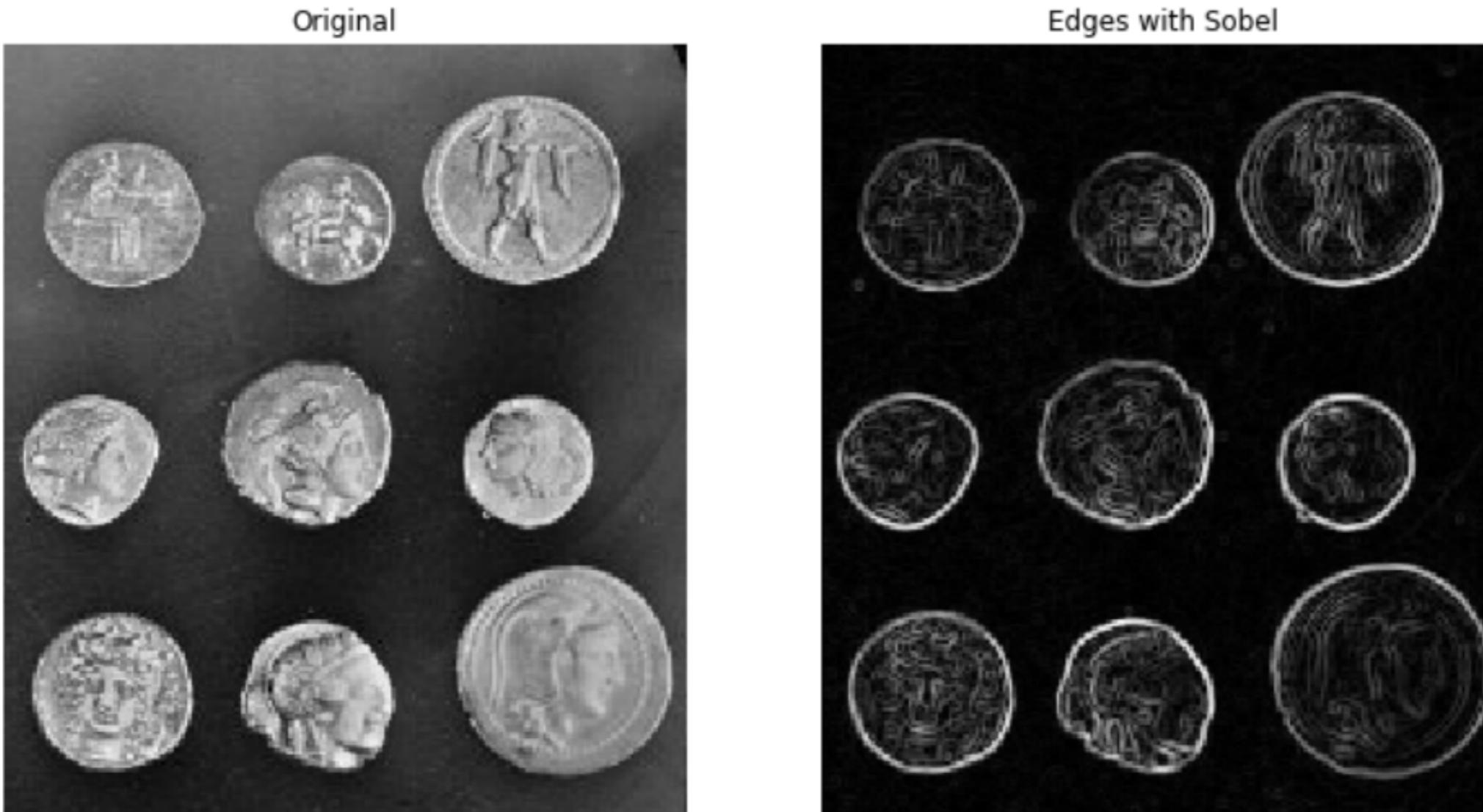
```
# Import module and function
from skimage.filters import sobel

# 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

Original



Blurred with Gaussian filter

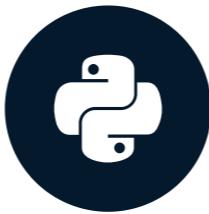


Let's practice!

IMAGE PROCESSING IN PYTHON

Contrast enhancement

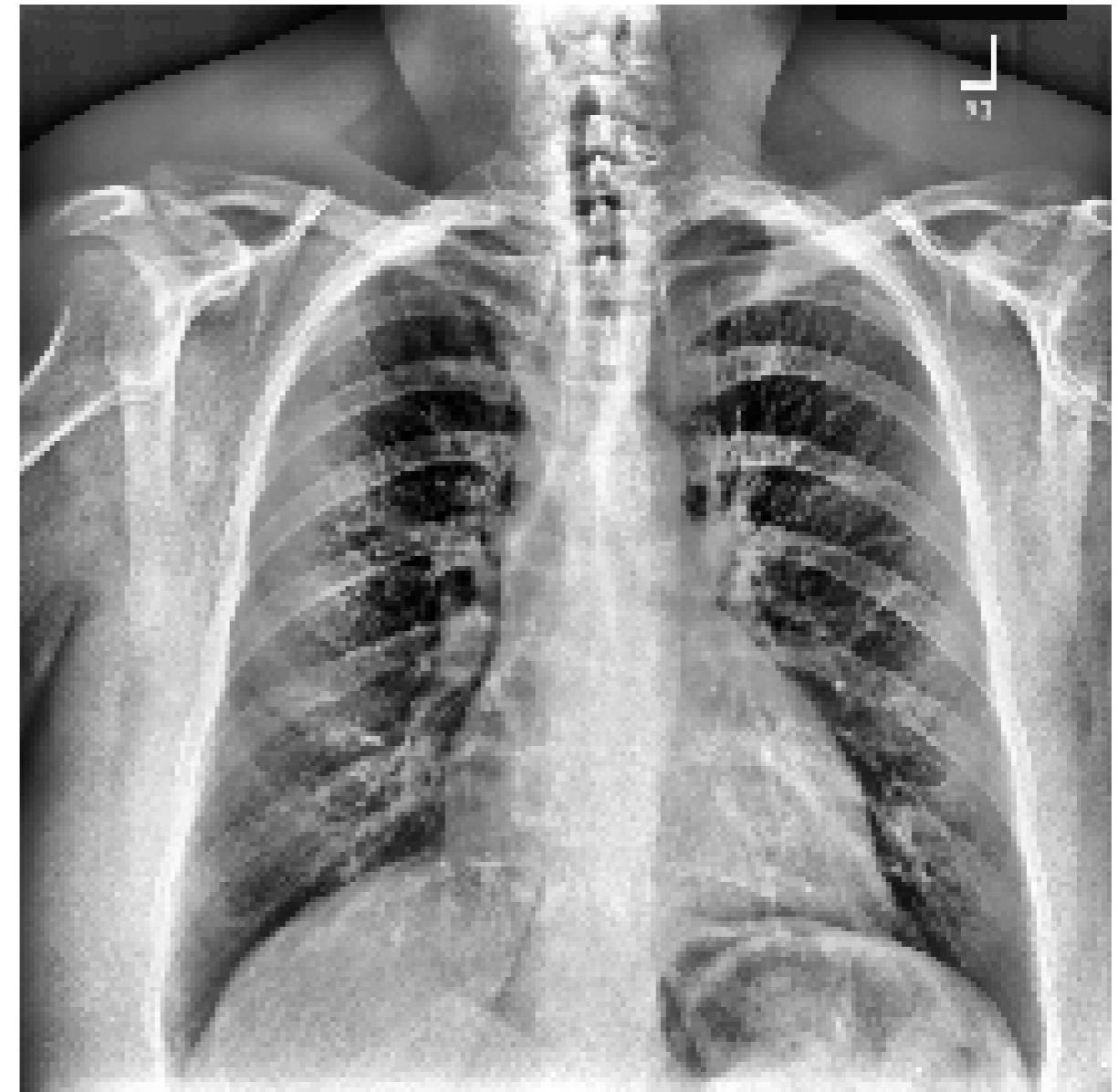
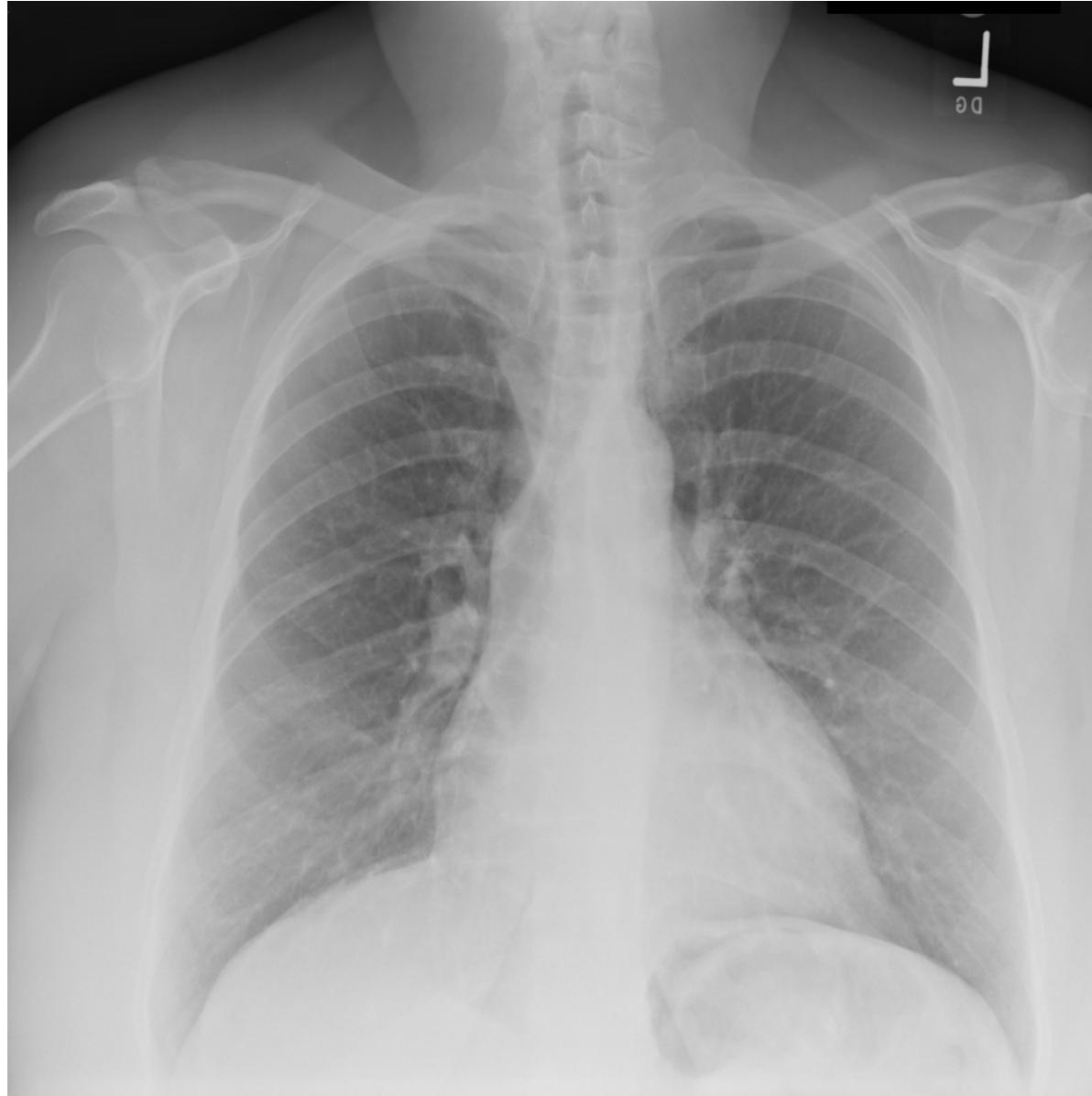
IMAGE PROCESSING IN PYTHON



Rebeca Gonzalez

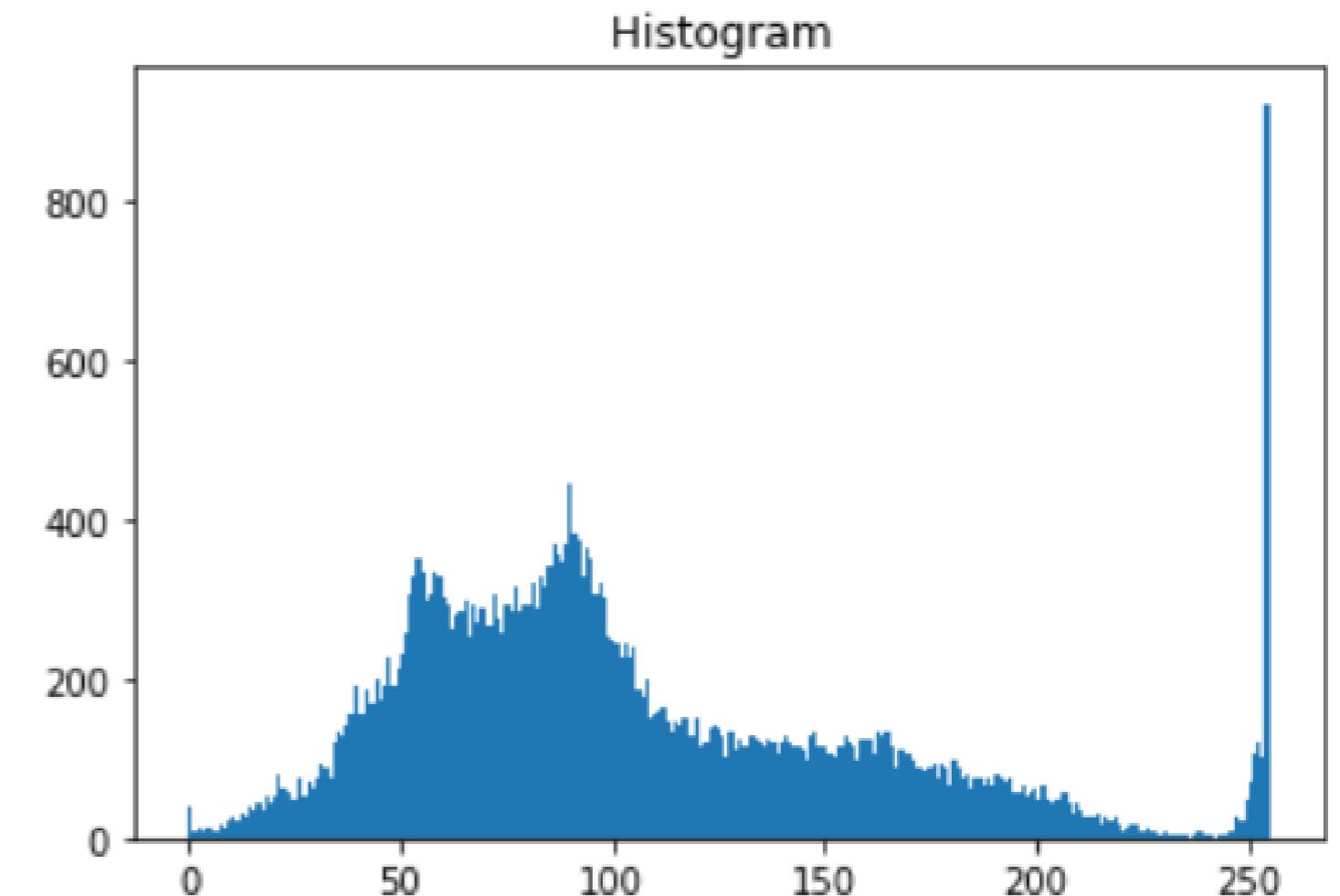
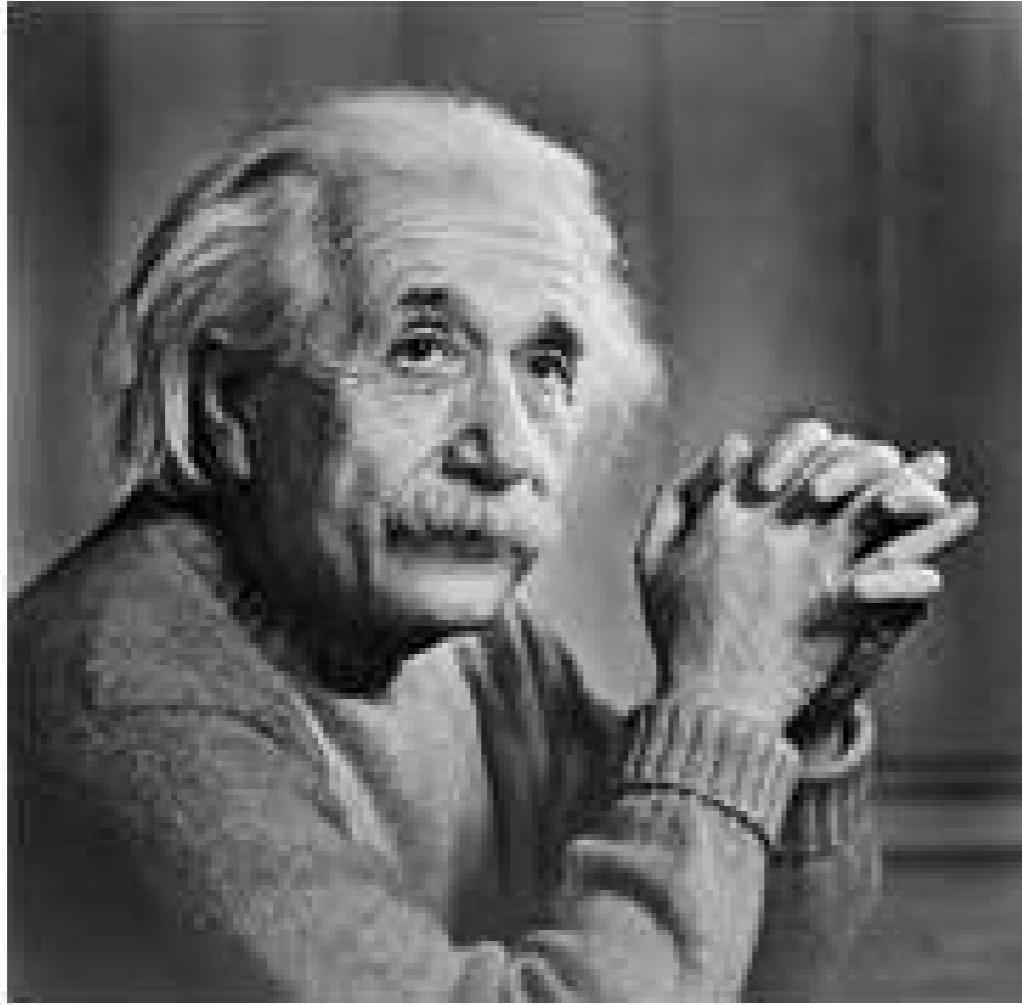
Data engineer

Contrast enhancement



Contrast

Histograms for contrast enhancement

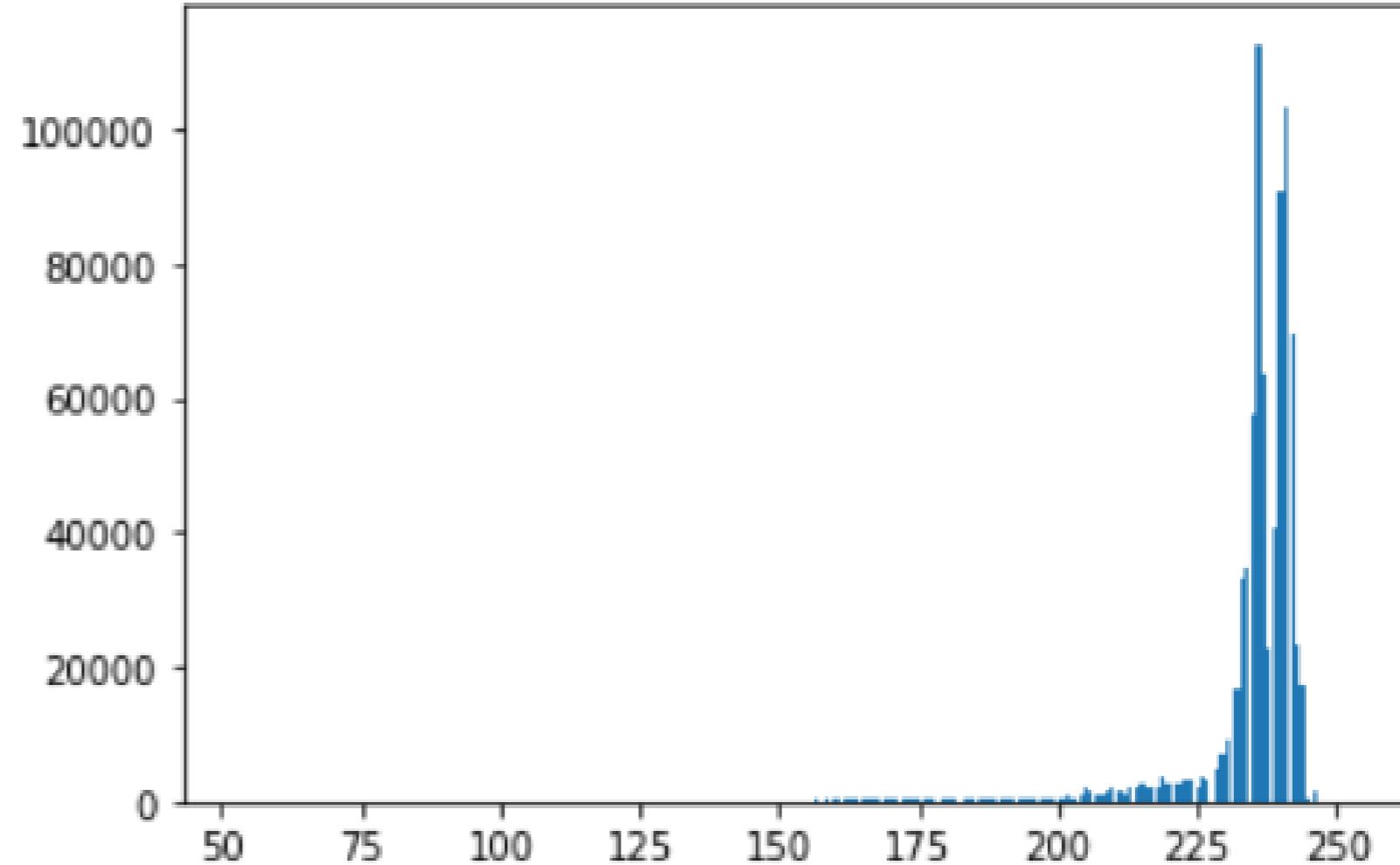


Contrast

Low contrast image - light



Histogram of image



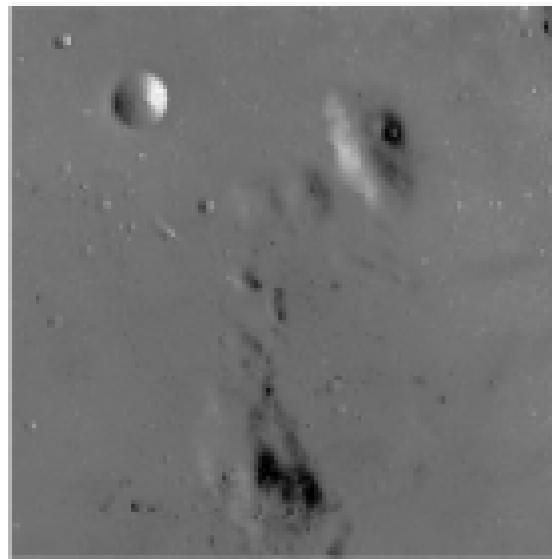
Enhance contrast

- 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

Original



Histogram Equalization



Histogram equalization

Original



Histogram equalization

```
from skimage import exposure

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

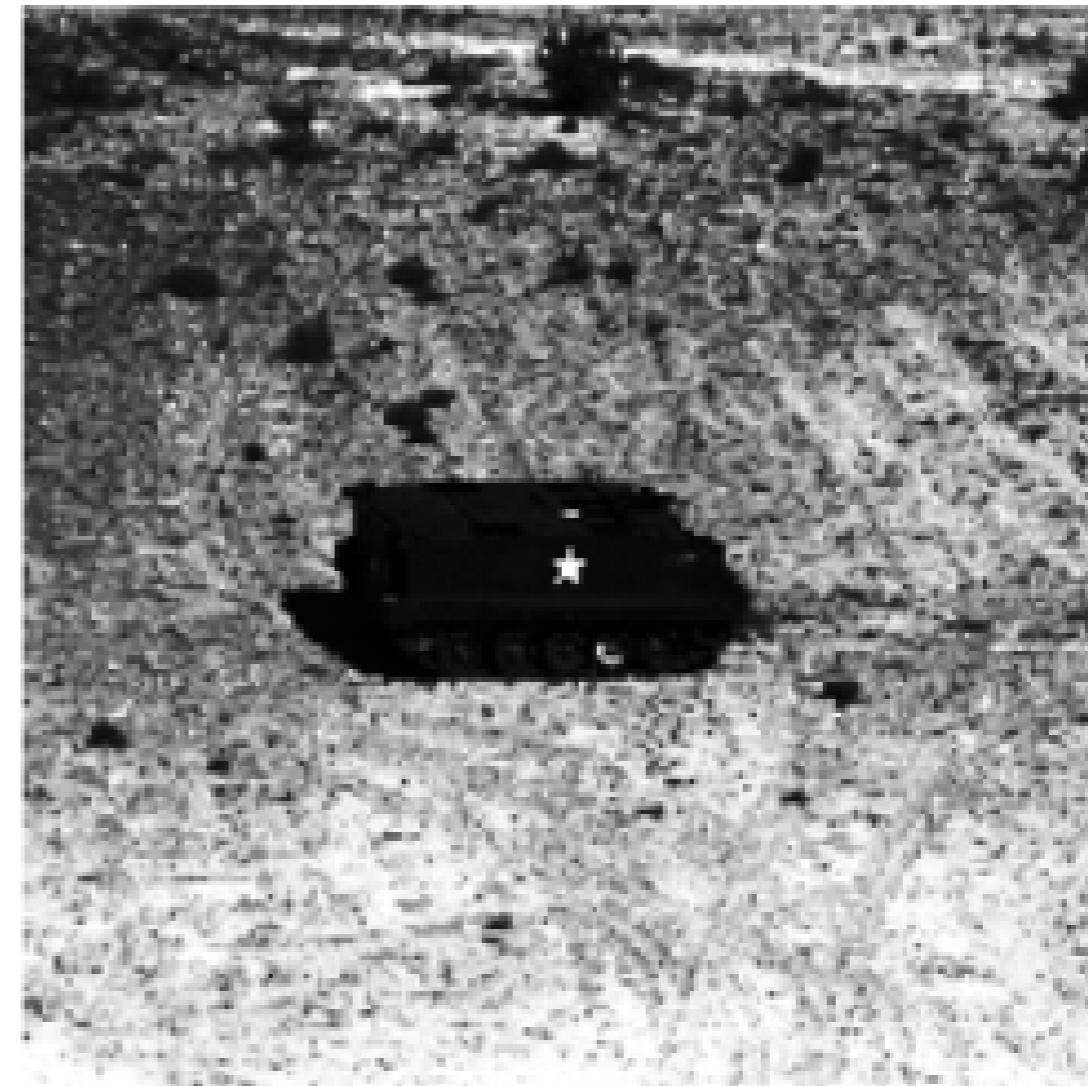
# Show original and result
show_image(image, 'Original')
show_image(image_eq, 'Histogram equalized')
```

Histogram equalization

Original



Histogram Equalization



Adaptive Equalization

- Contrastive Limited Adaptive Histogram Equalization

Original



Adaptive 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

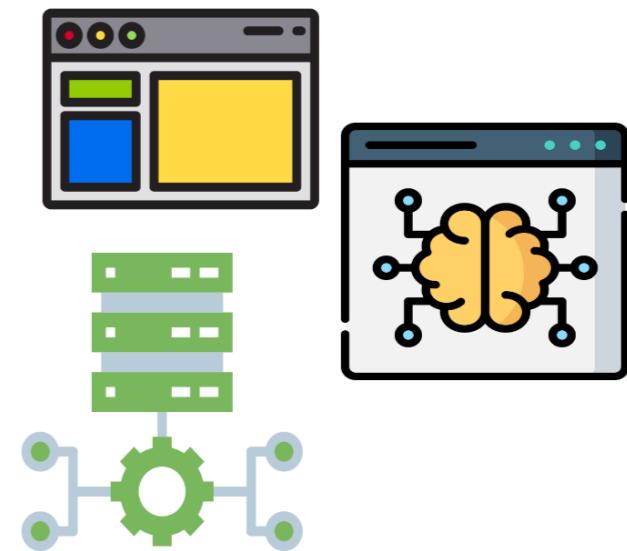
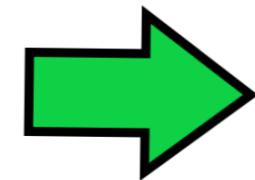
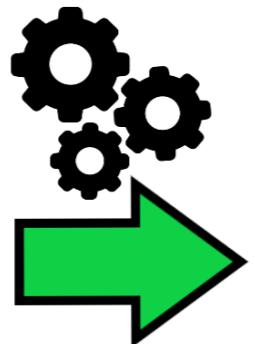
IMAGE PROCESSING IN PYTHON



Rebeca Gonzalez
Data Engineer

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

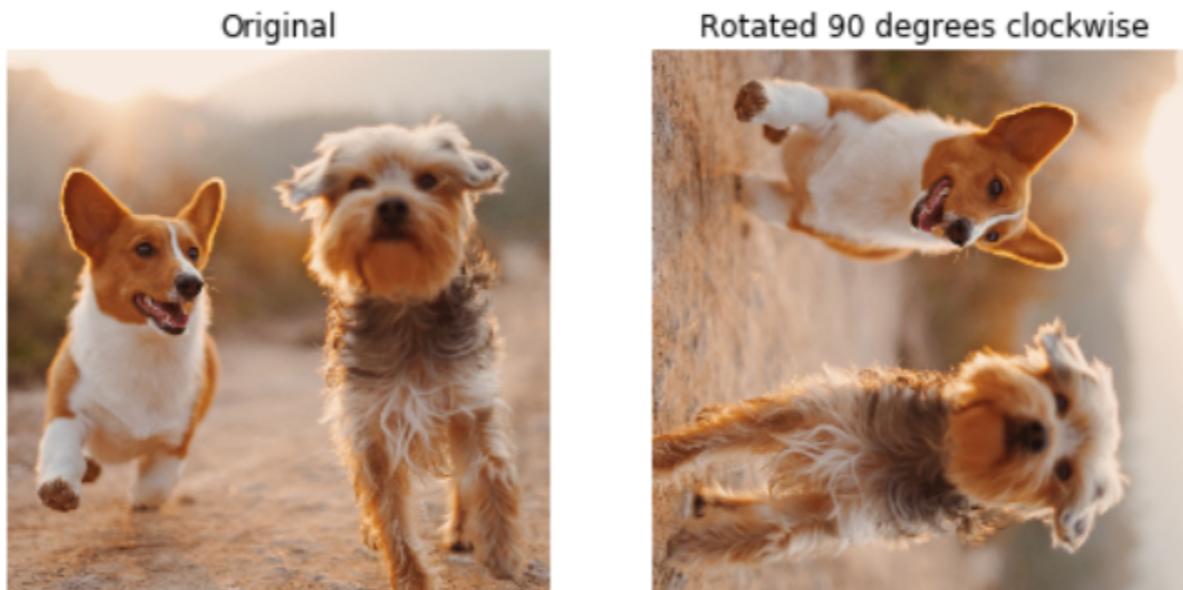


Rotating clockwise

```
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')
```

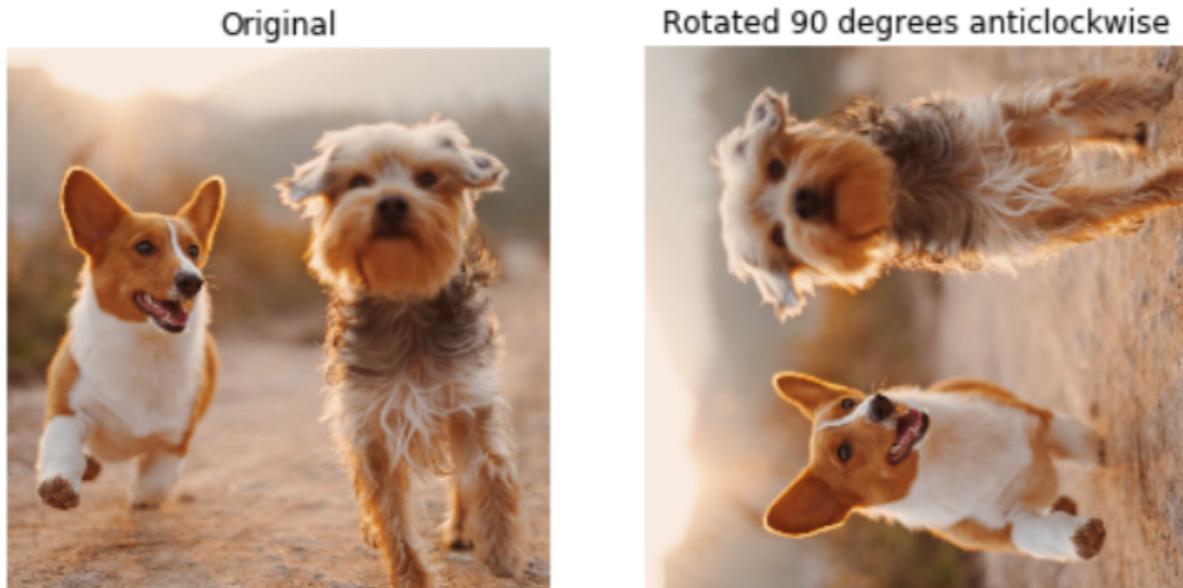


Rotating anticlockwise

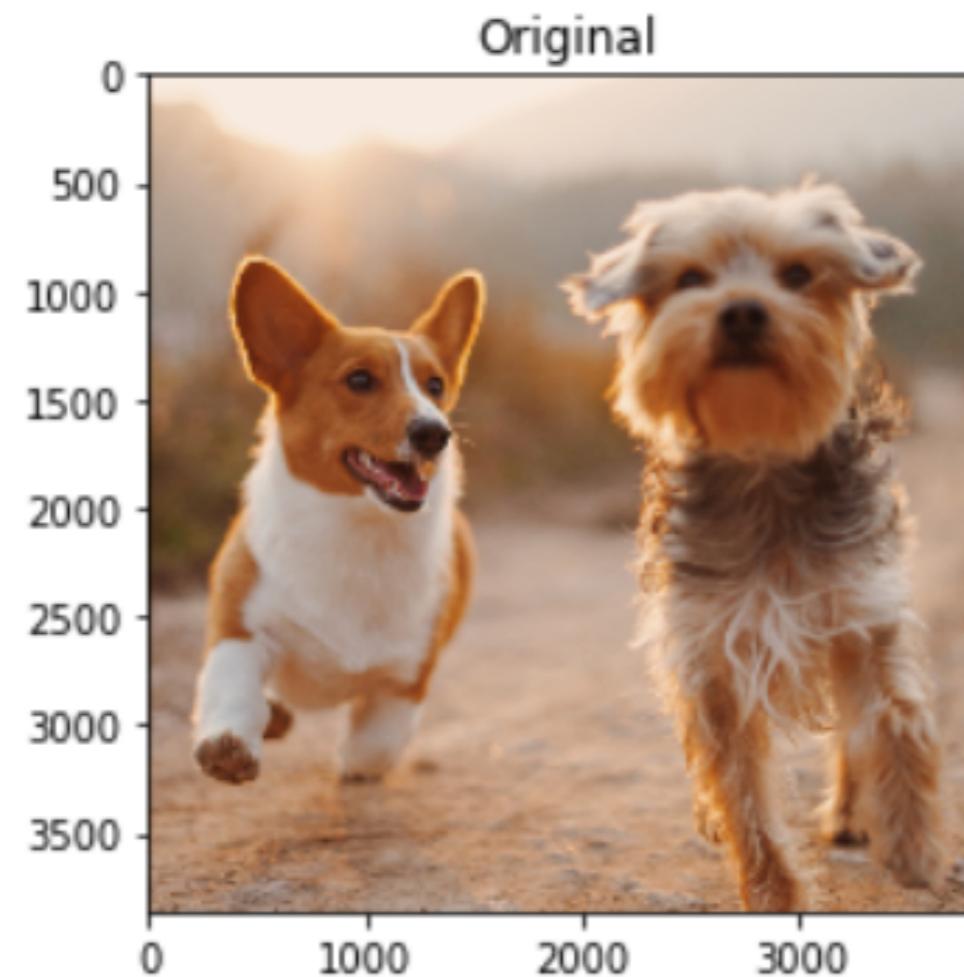
```
from skimage.transform import rotate

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

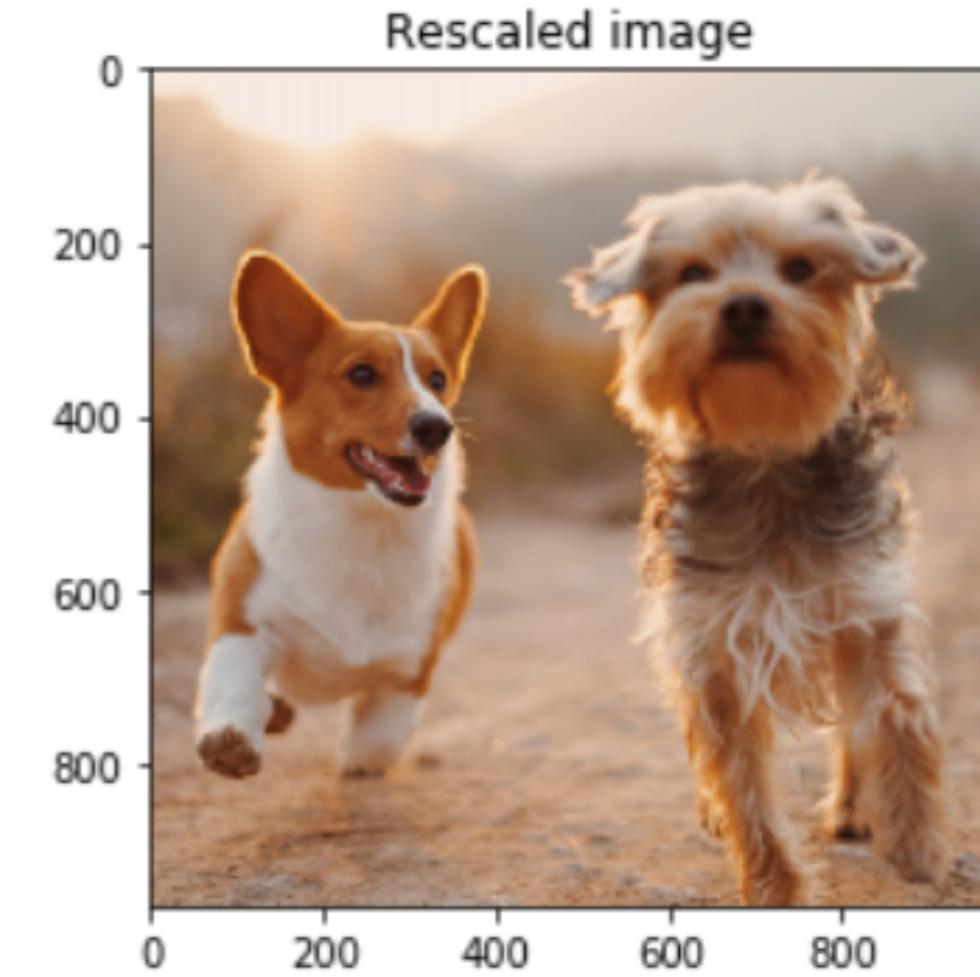
show_image(image, 'Original')
show_image(image_rotated, 'Rotated 90 degrees anticlockwise')
```



Rescaling



Original size



Rescaled size



Rescaling

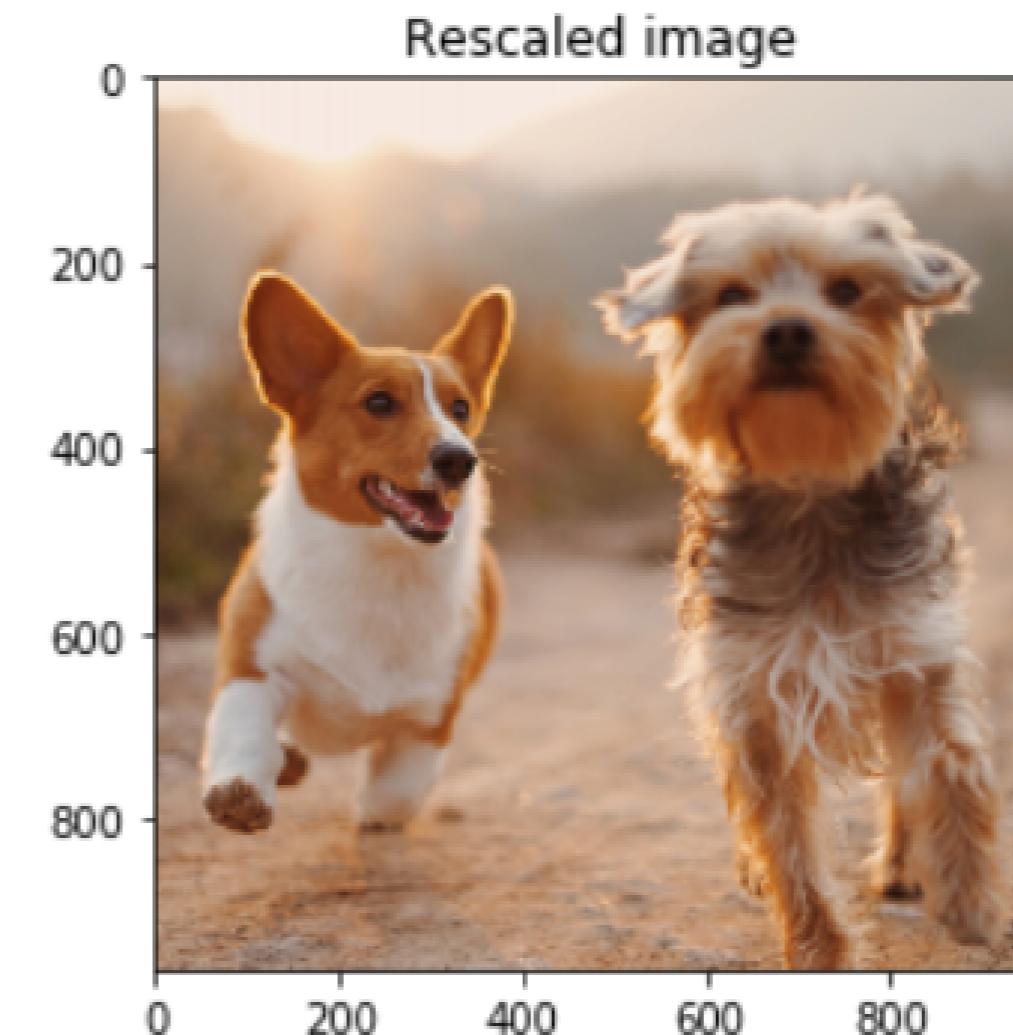
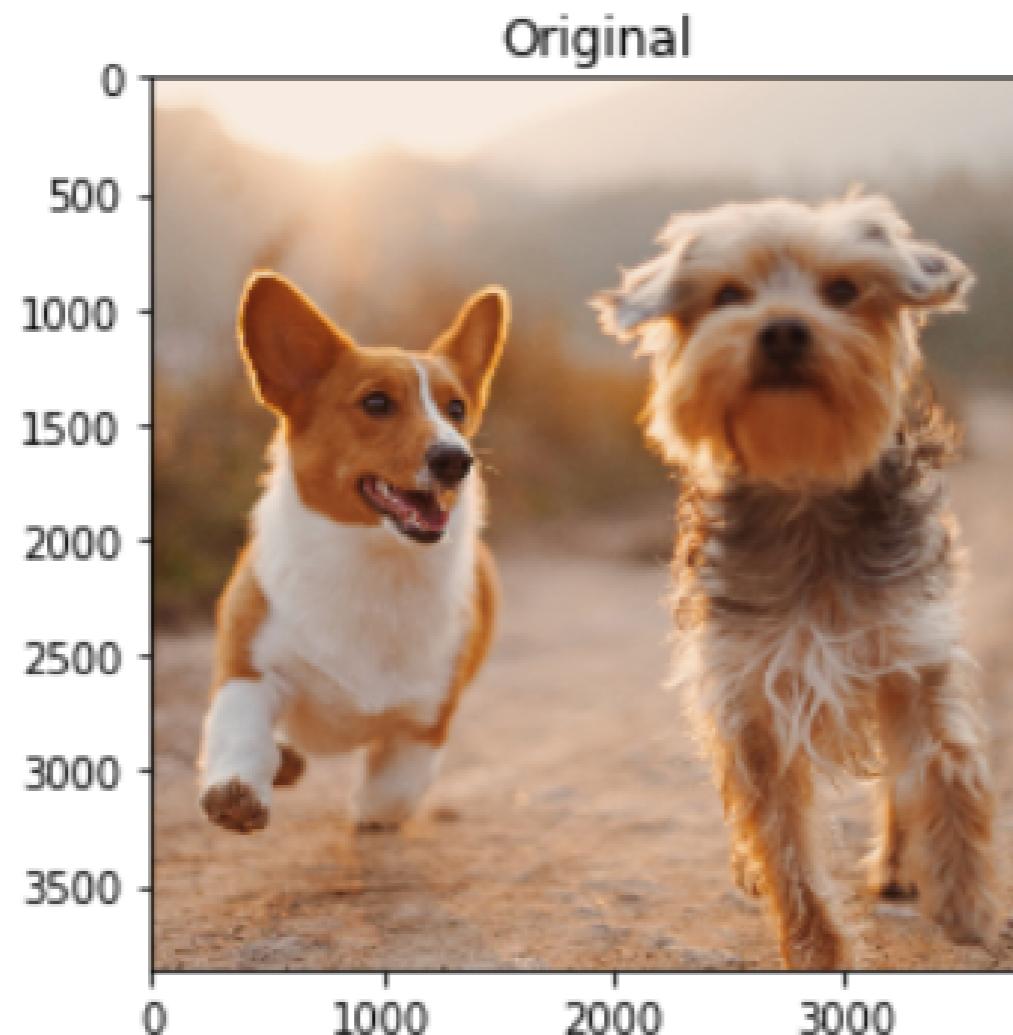
Downgrading

```
from skimage.transform import rescale

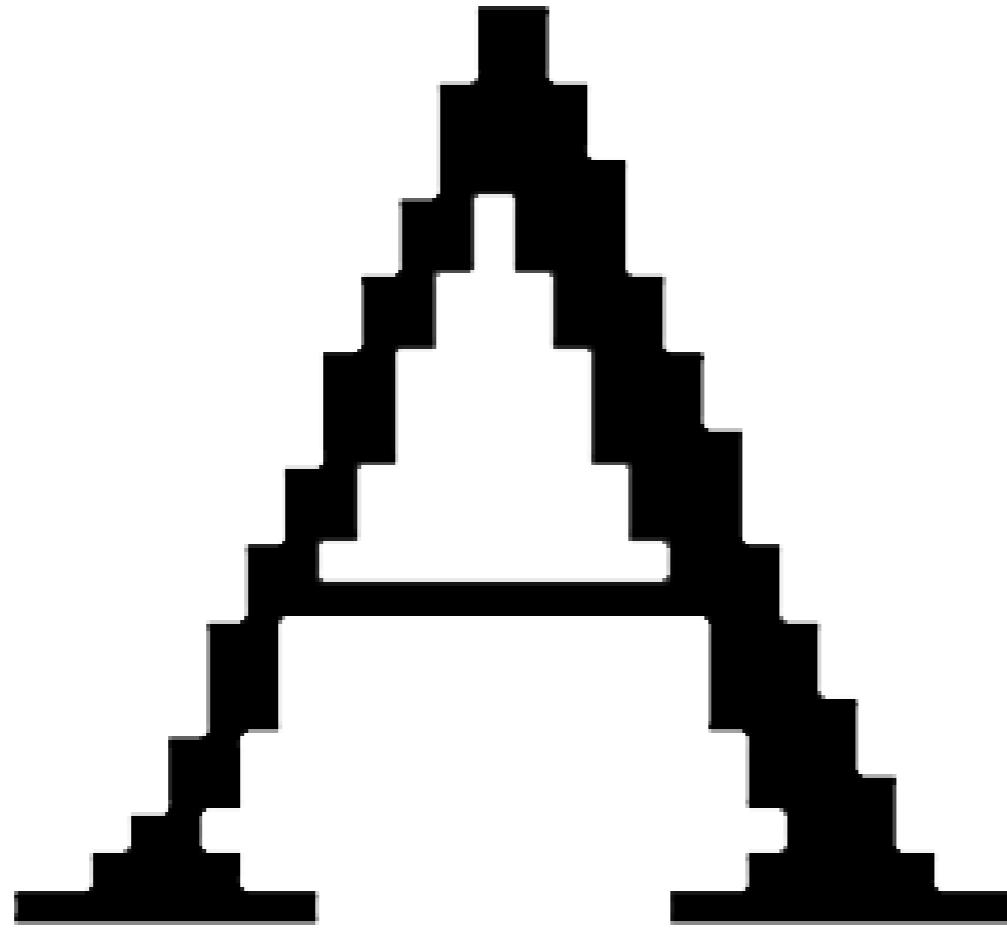
# Rescale the image to be 4 times smaller
image_rescaled = rescale(image, 1/4, anti_aliasing=True, multichannel=True)

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

Rescaling



Aliasing in digital images

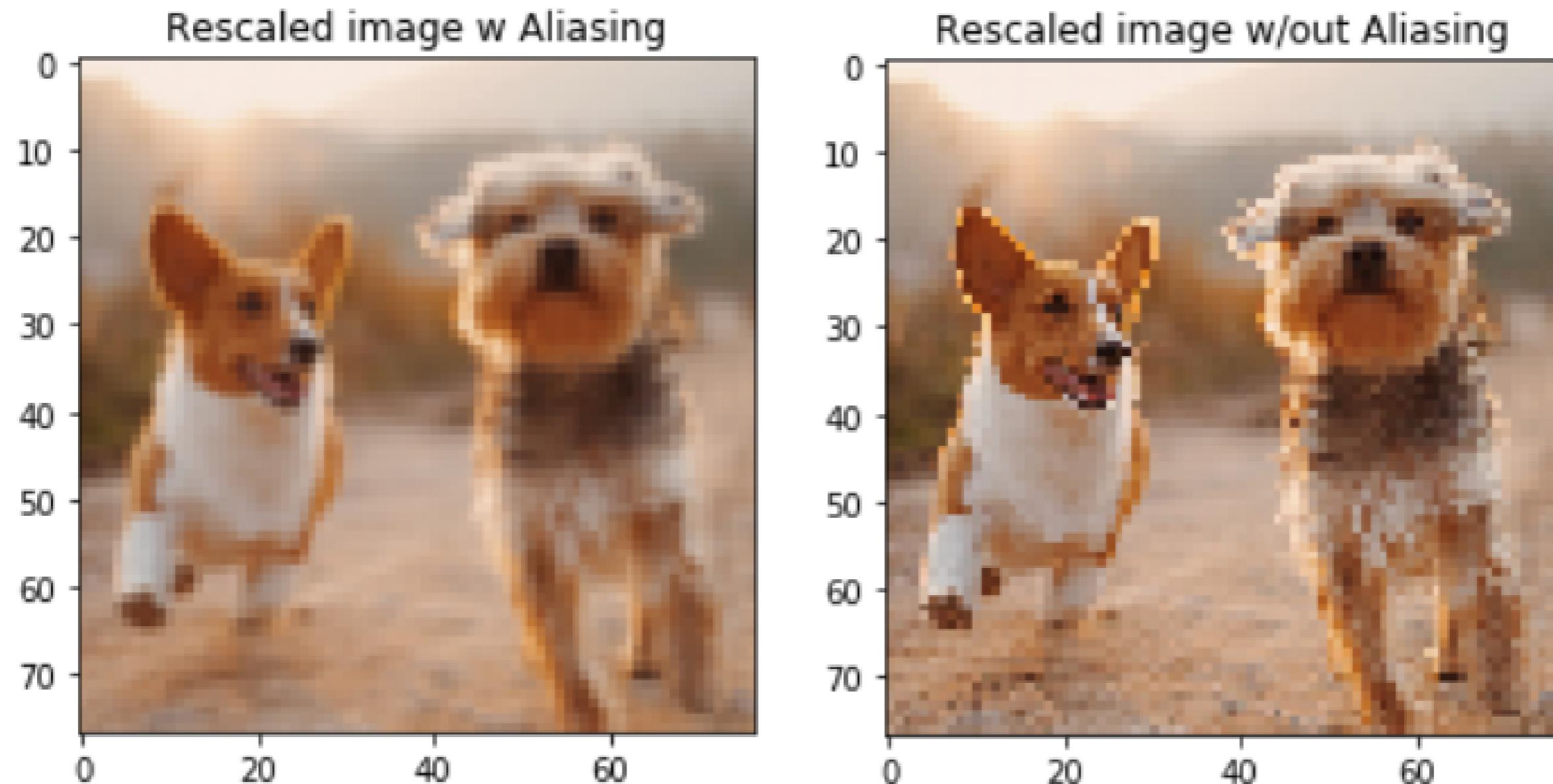


Original letter A

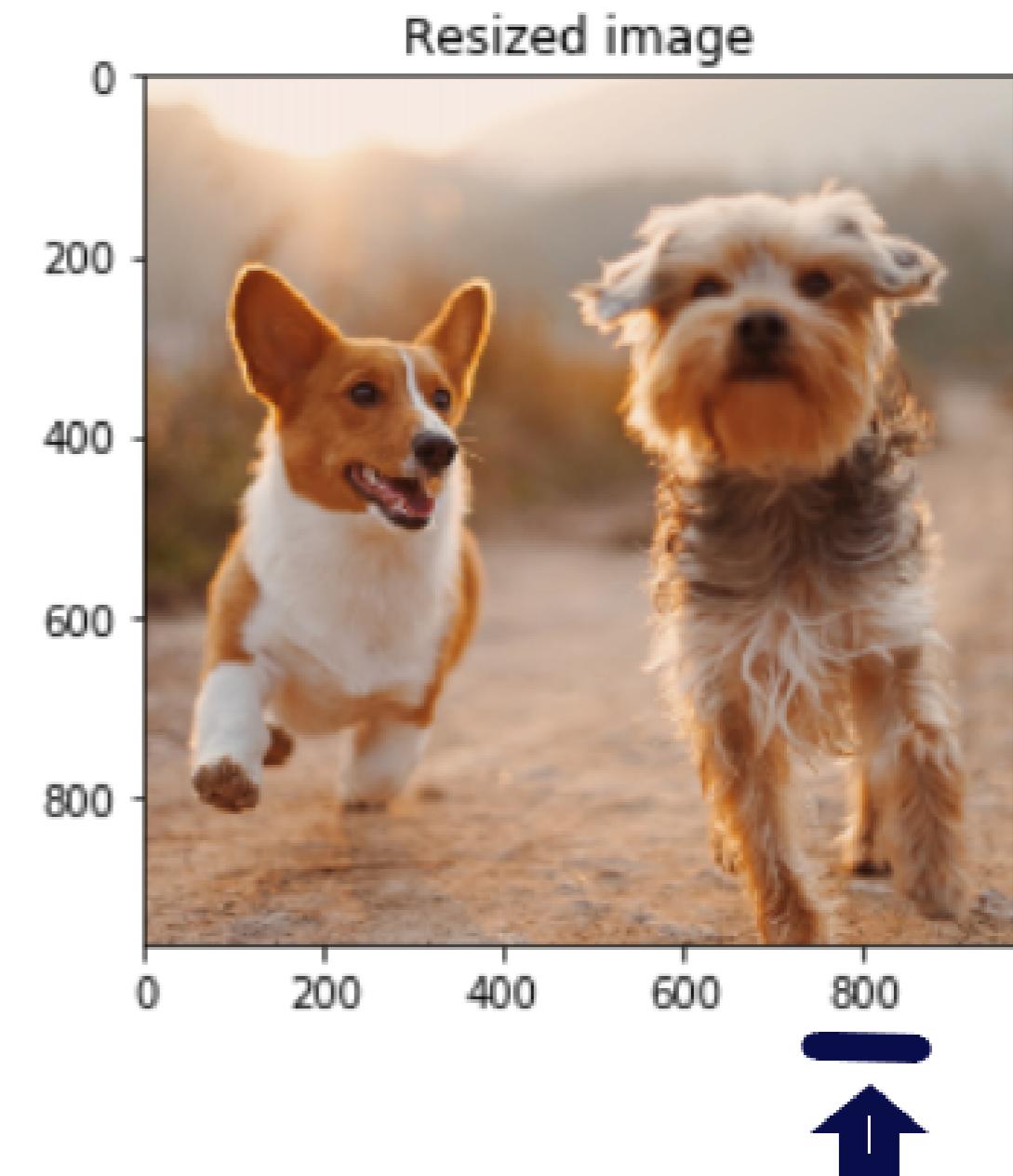
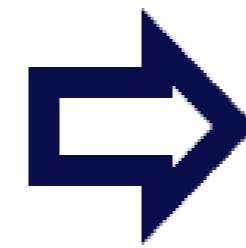
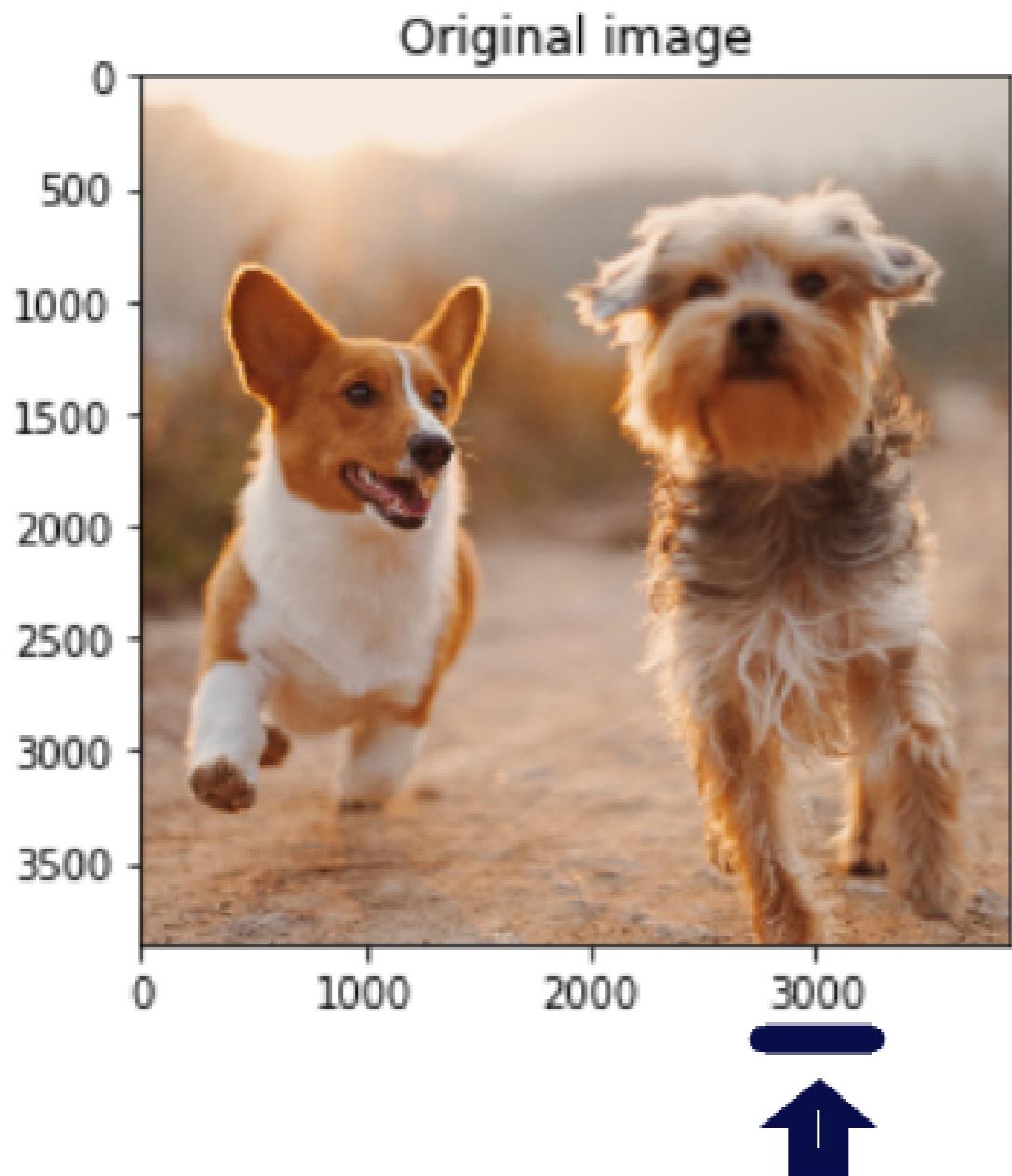


Aliased letter A

Aliasing in digital images



Resizing



Resizing

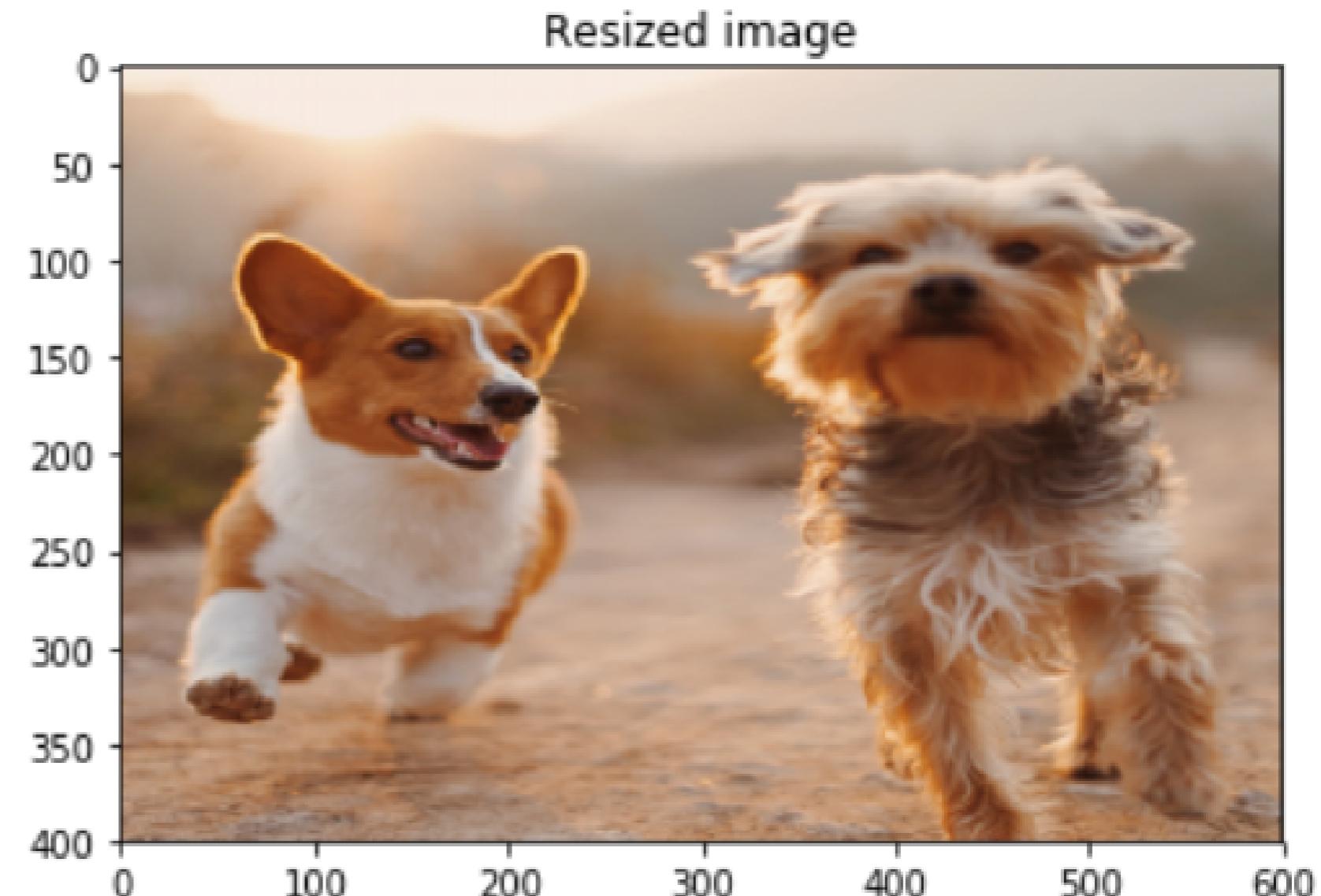
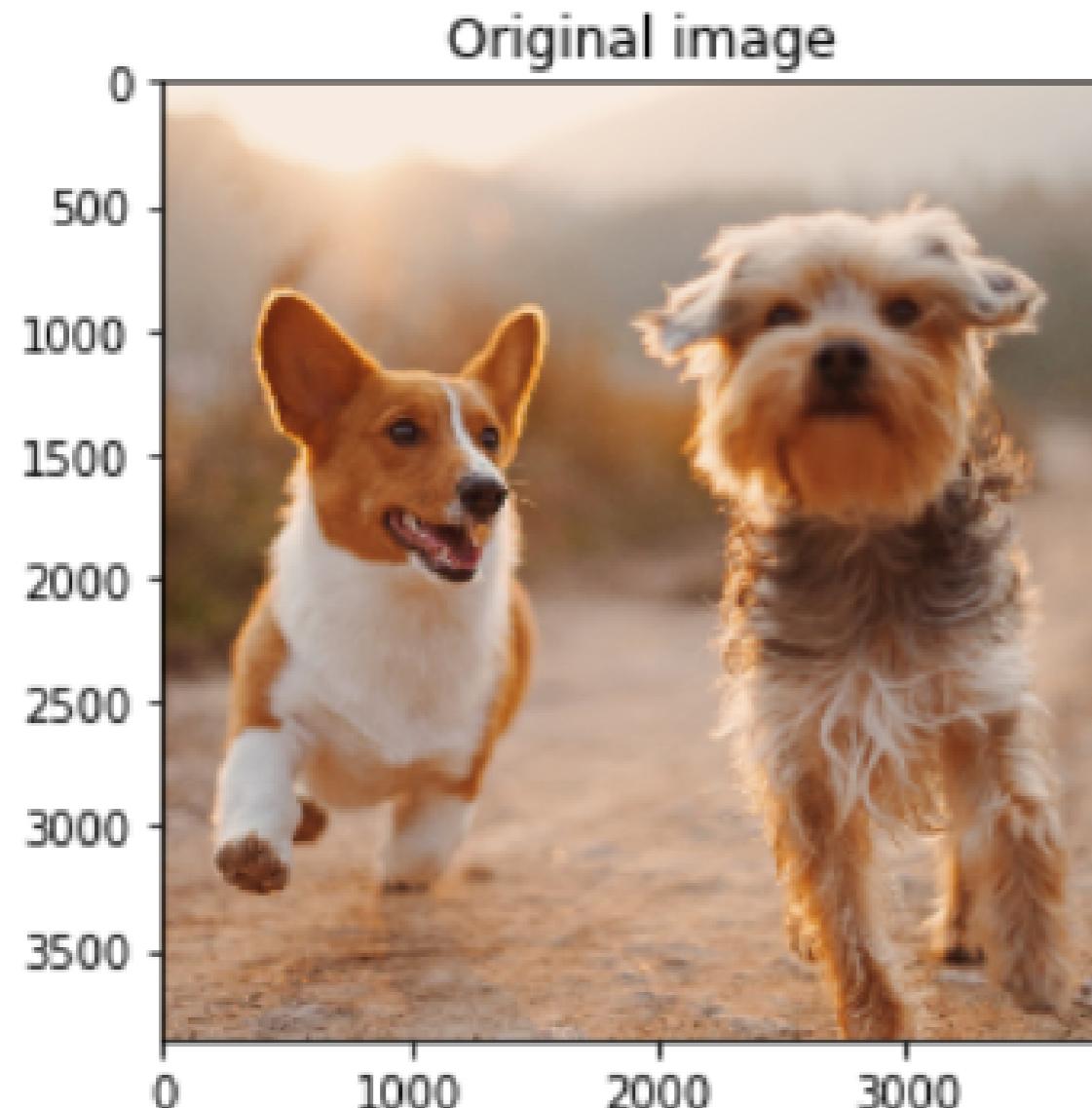
```
from skimage.transform import resize

# 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



Resizing proportionally

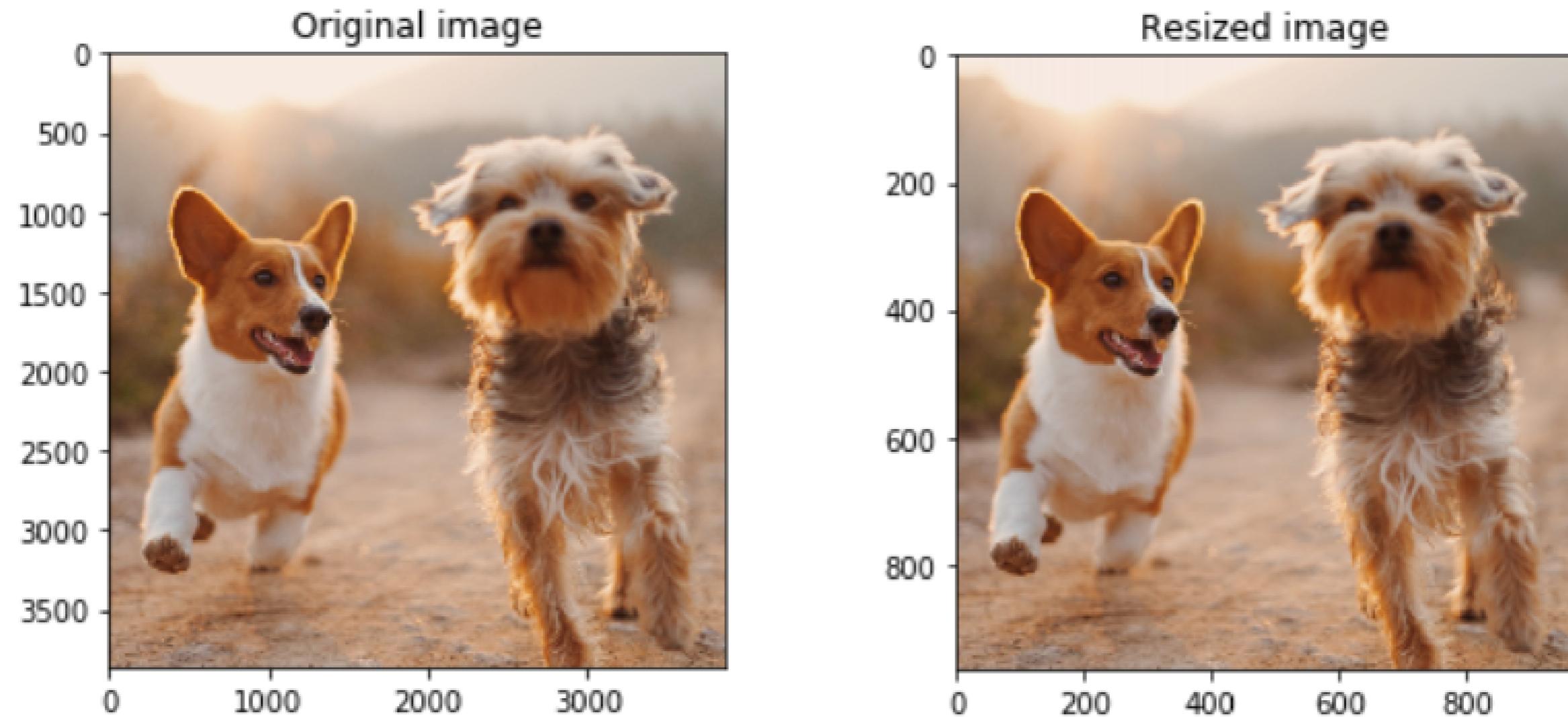
```
from skimage.transform import resize

# 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



Rebeca Gonzalez
Data Engineer

Binary images

original



Thresholded image



Morphological filtering

- Better for binary images
- Can extend for grayscale

Binary image



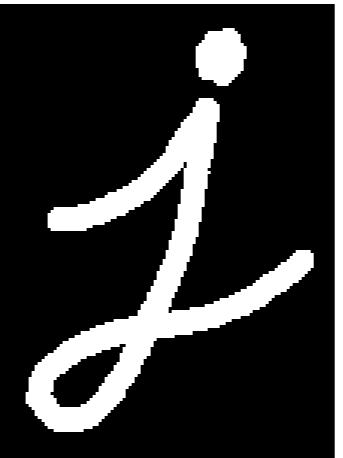
Grayscale



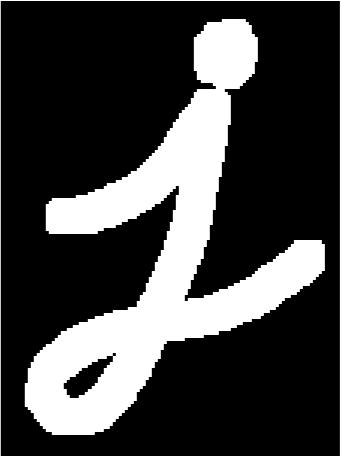
Morphological operations

- Dilation
- Erosion

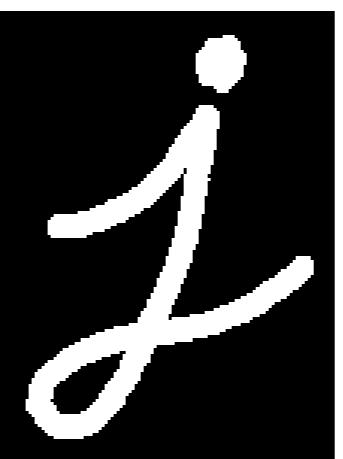
Original



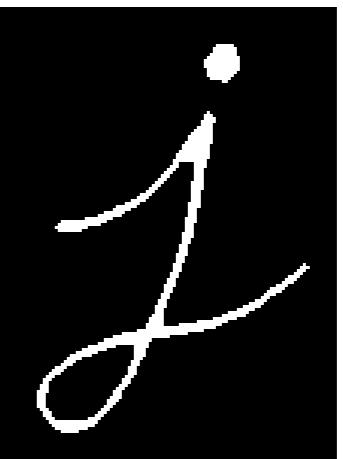
Dilated



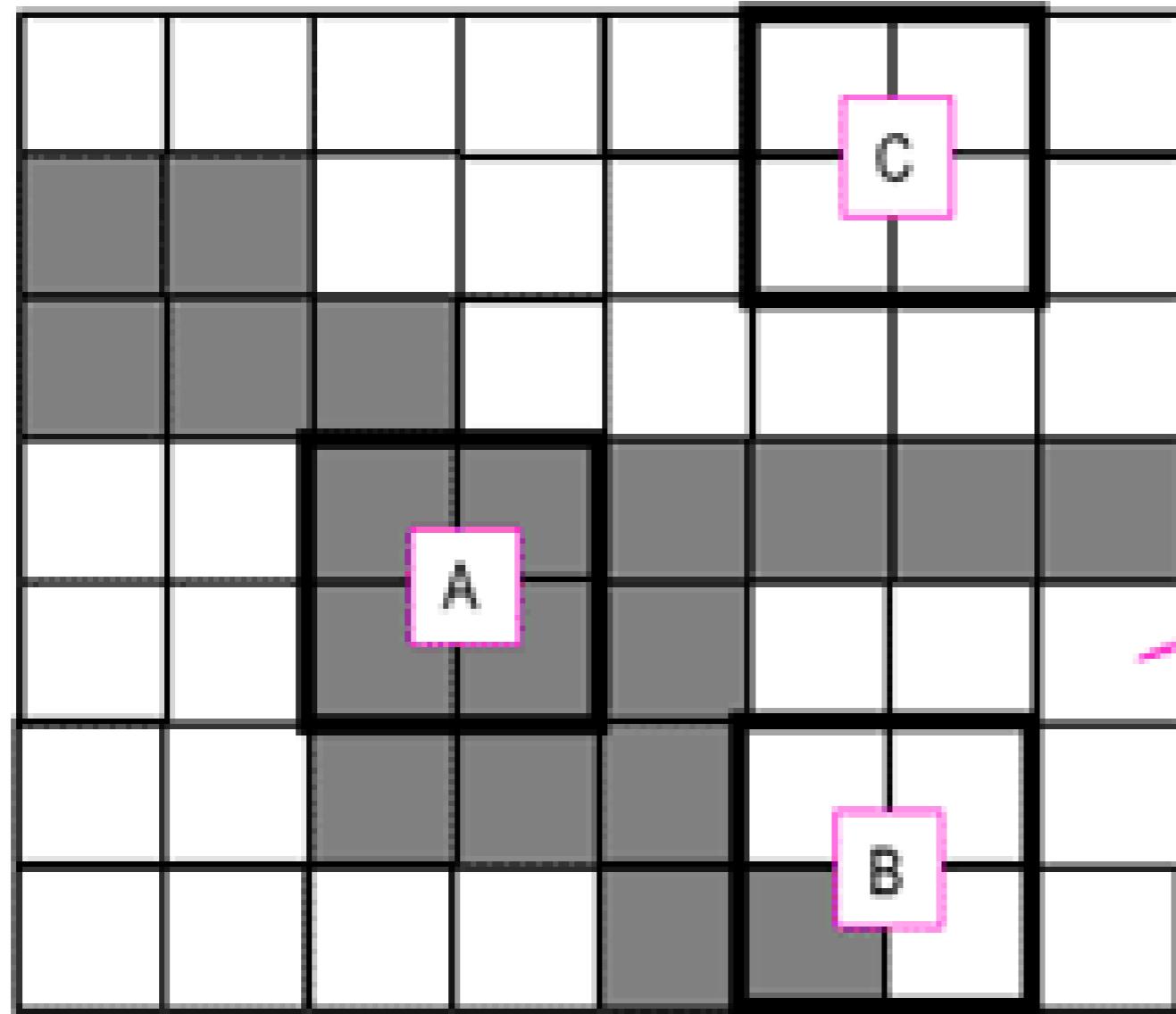
Original



Eroded

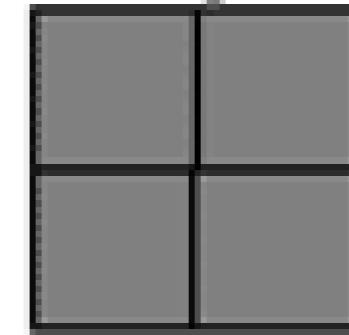


Structuring element



- 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

1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1

Square 5x5 element

0	0	1	0	0
0	1	1	1	0
1	1	1	1	1
0	1	1	1	0
0	0	1	0	0

Diamond-shaped 5x5 element

0	0	1	0	0
0	0	1	0	0
1	1	1	1	1
0	0	1	0	0
0	0	1	0	0

Cross-shaped 5x5 element

Origin

1	1	1
1	1	1
1	1	1

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

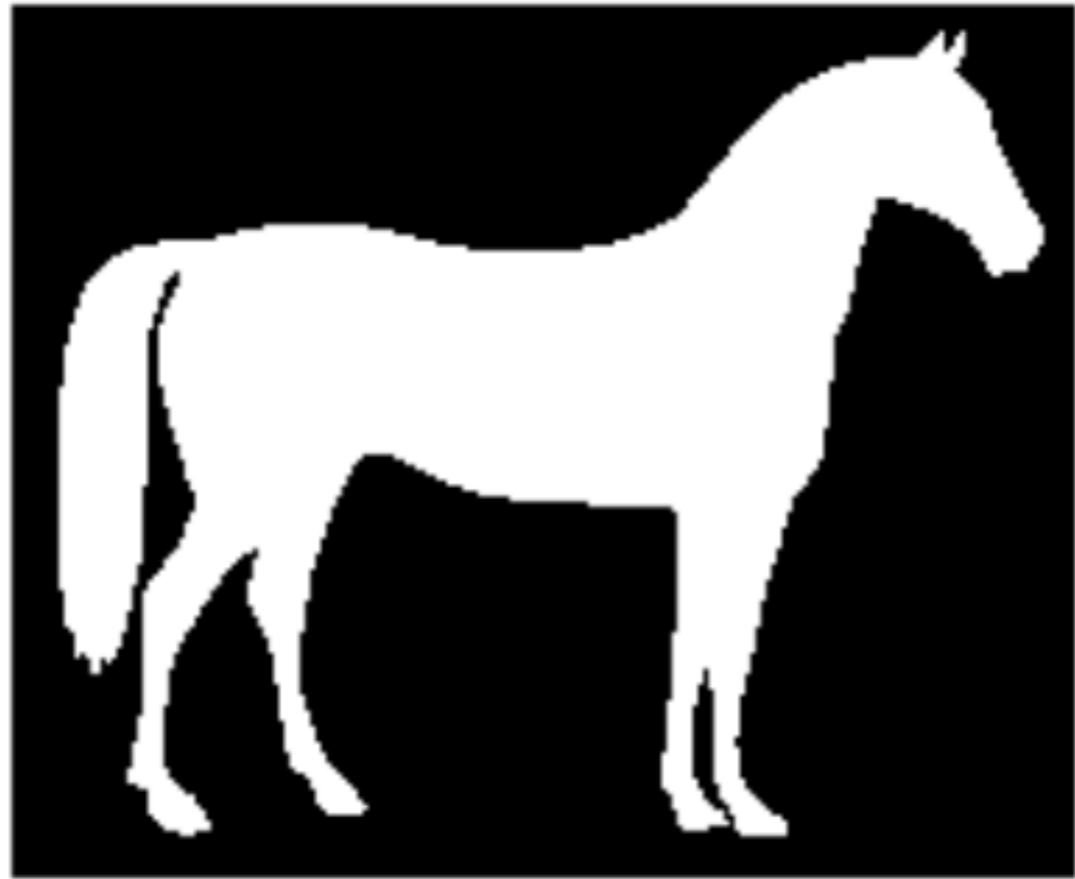
# Set structuring element to the rectangular-shaped
selem = rectangle(12,6)

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

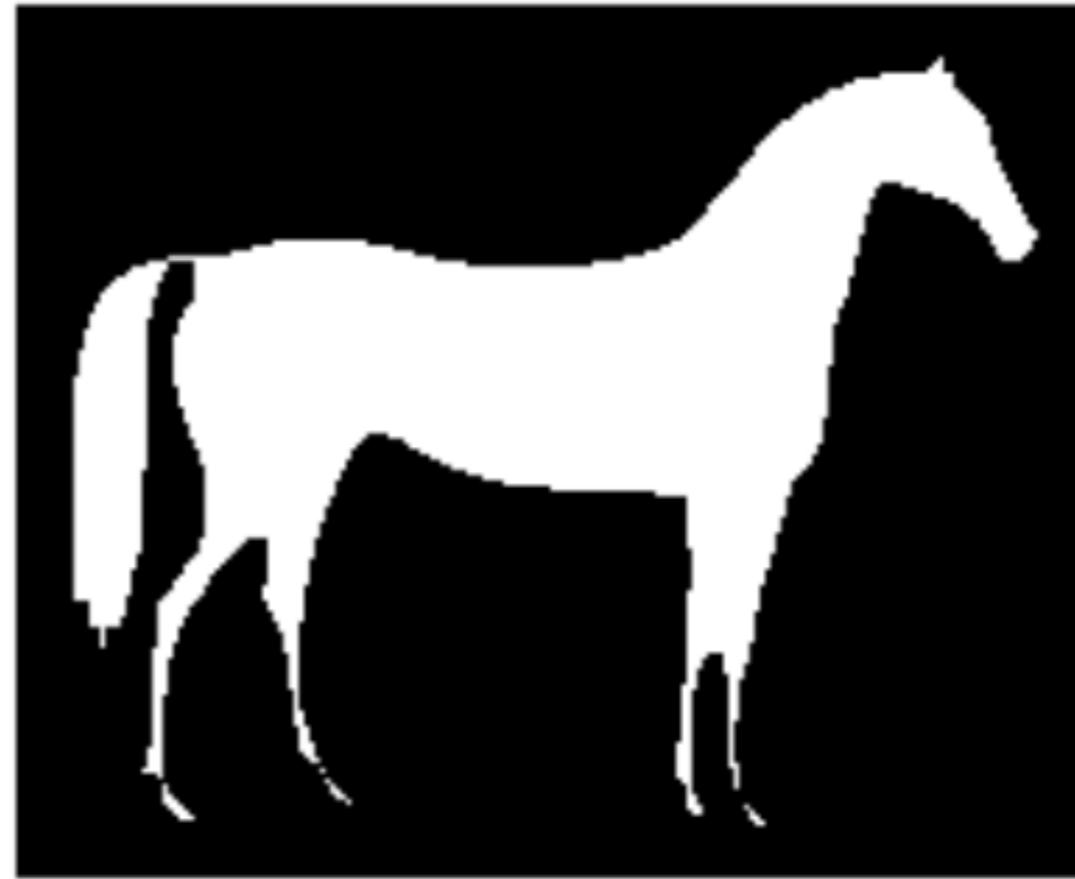
Erosion in scikit-image

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

original



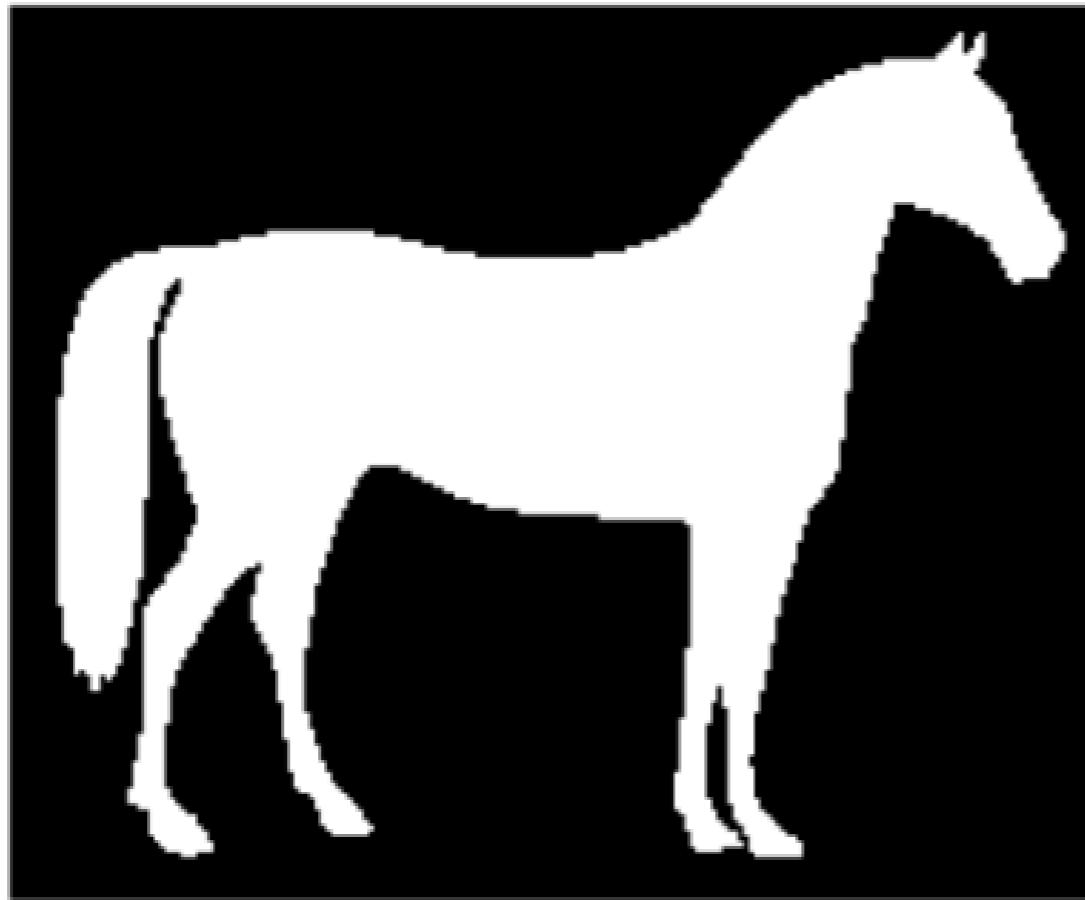
Erosion



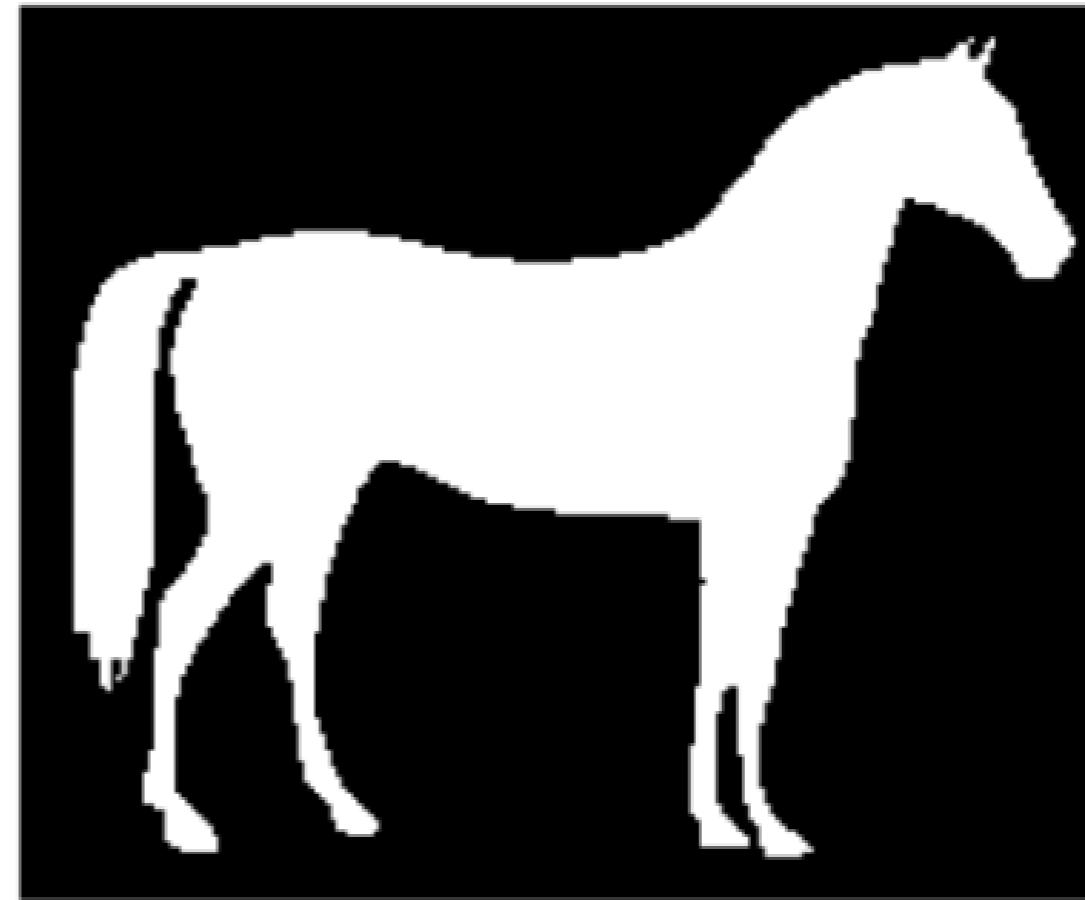
Binary erosion with default selem

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

original



Erosion



Dilation in scikit-image

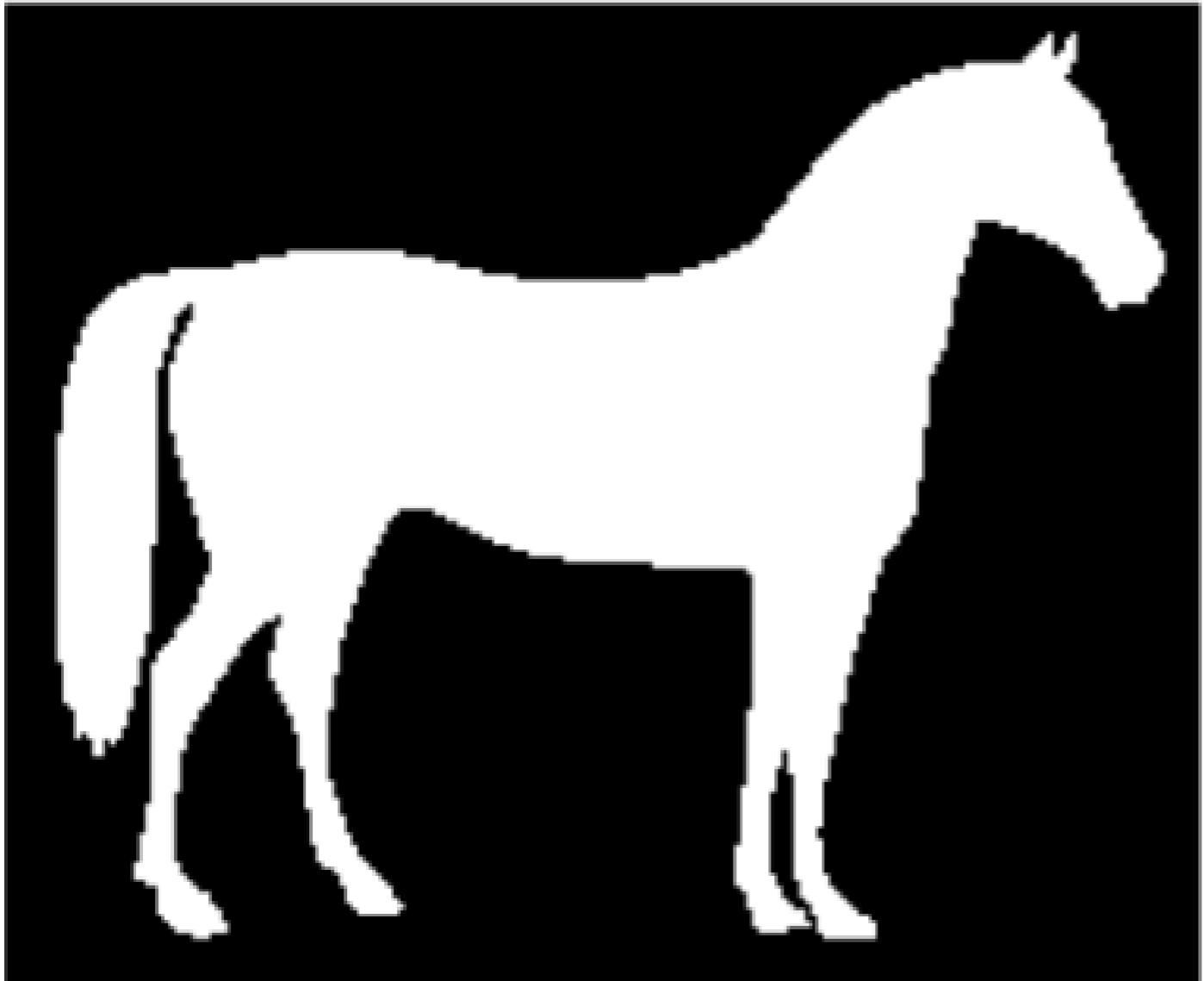
```
from skimage import morphology

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

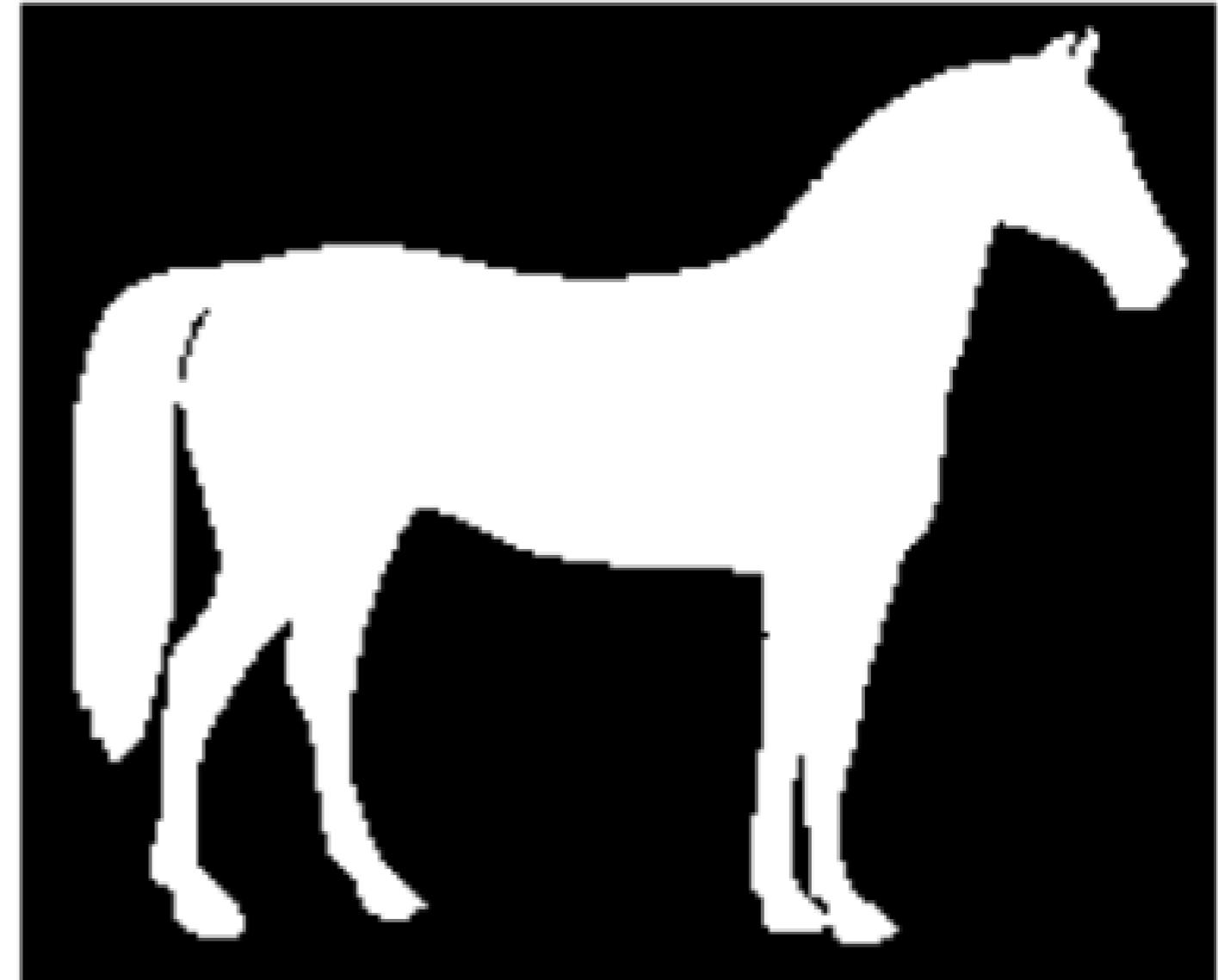
# See results
plot_comparison(image_horse, dilated_image, 'Erosion')
```

Dilation in scikit-image

original



Dilation



Let's practice!

IMAGE PROCESSING IN PYTHON