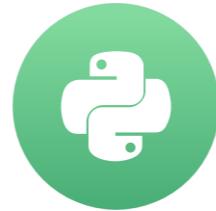


# Jump into filtering

IMAGE PROCESSING IN PYTHON

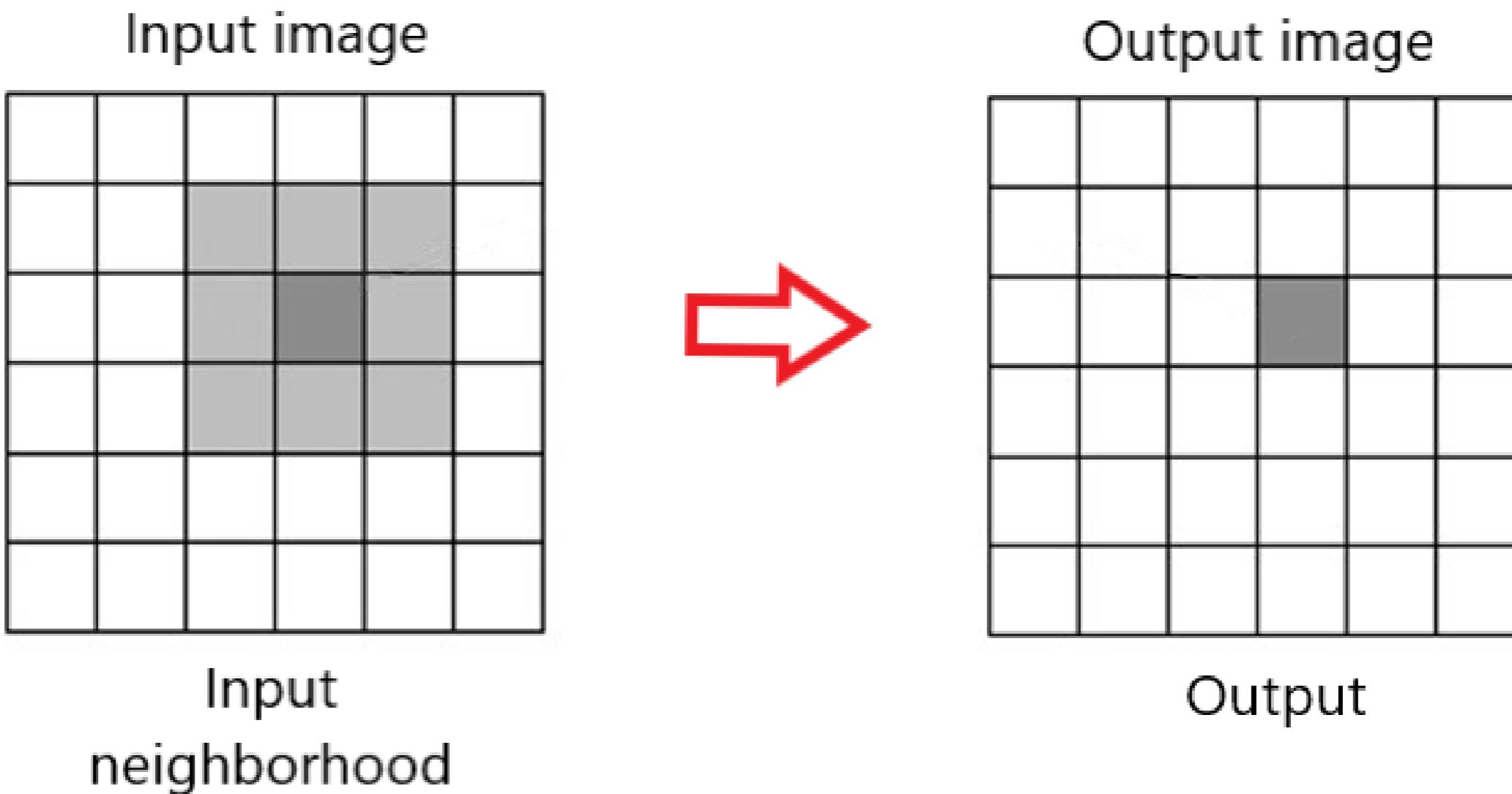


**Rebeca Gonzalez**  
Data Engineer

# Filters

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

# Neighborhoods

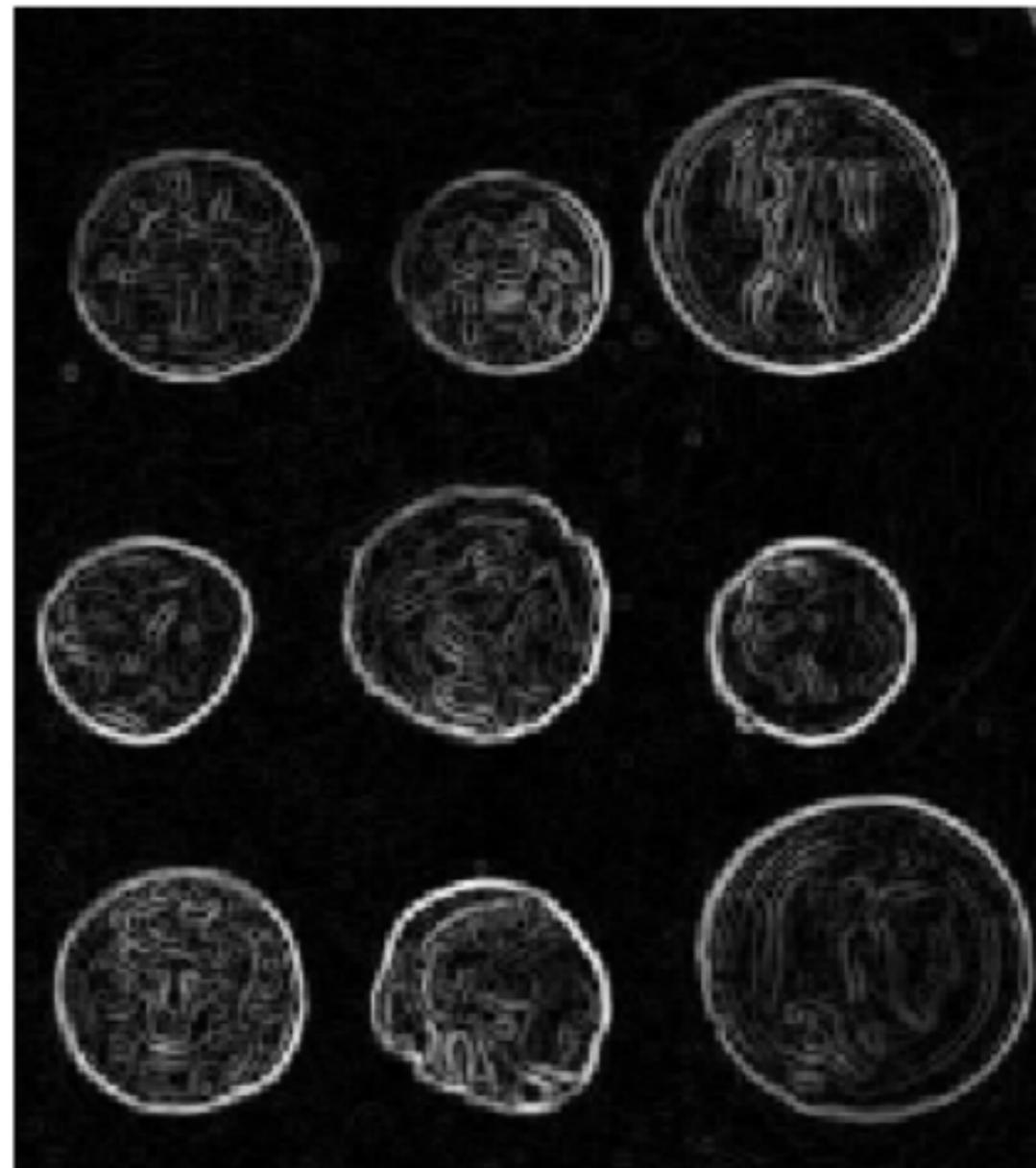


# Edge detection

Original



Edges with Sobel

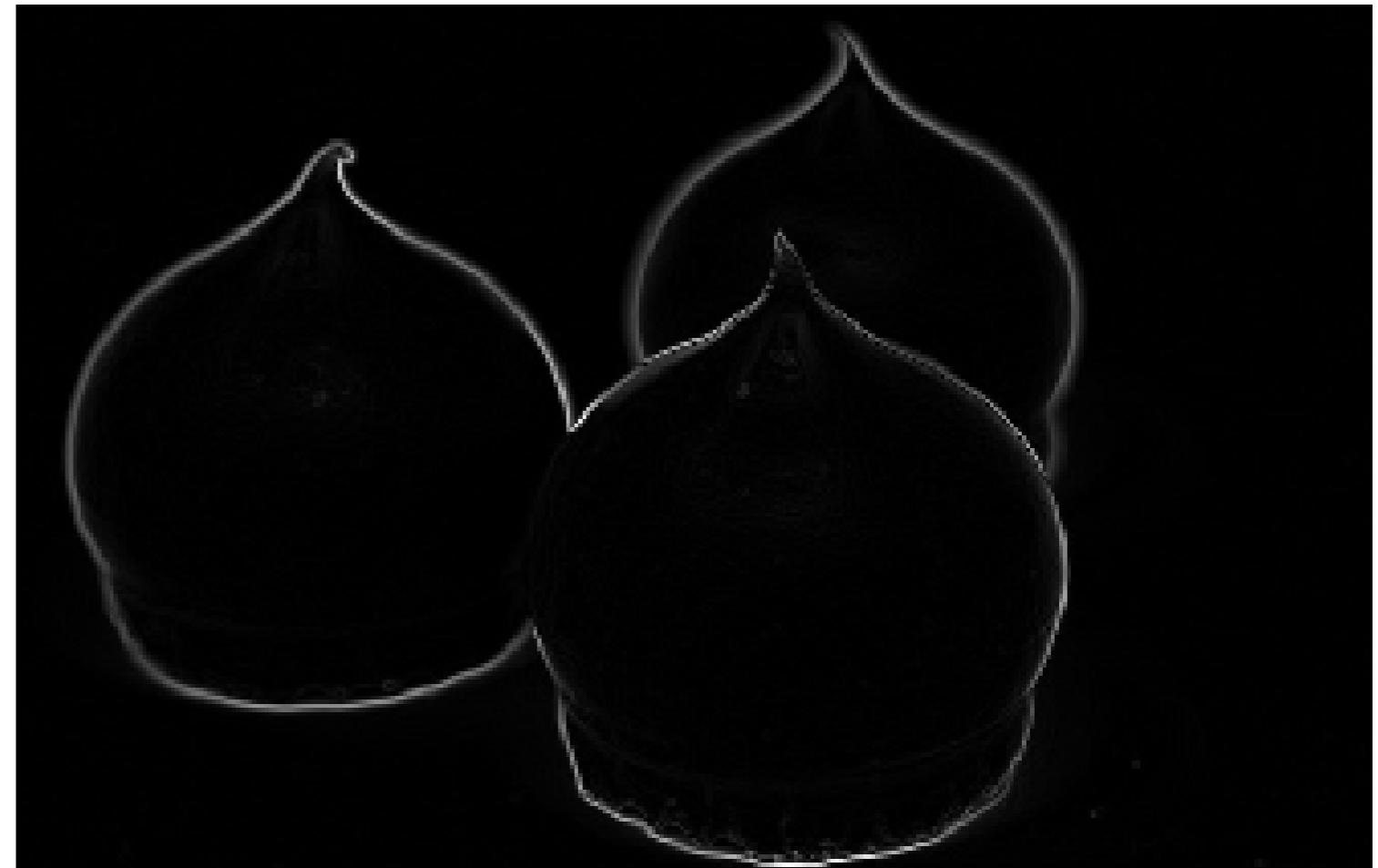


# Edge detection

Original chocolate kisses



Edges with Sobel



# Edge detection

## Sobel

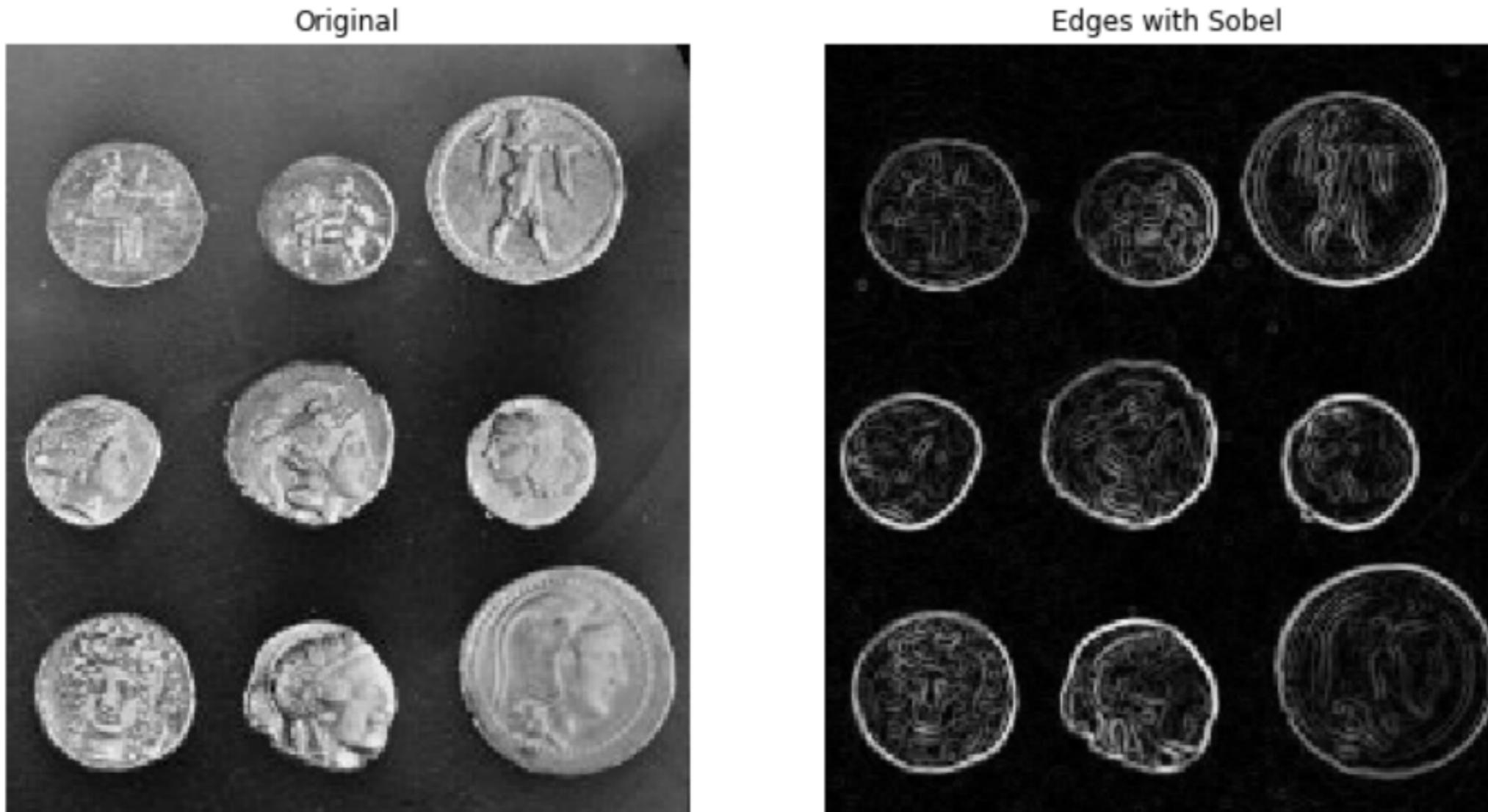
```
# Import module and function
from skimage.filters import sobel

# 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

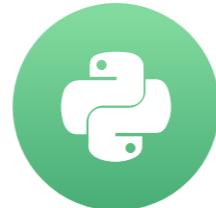


# Let's practice!

IMAGE PROCESSING IN PYTHON

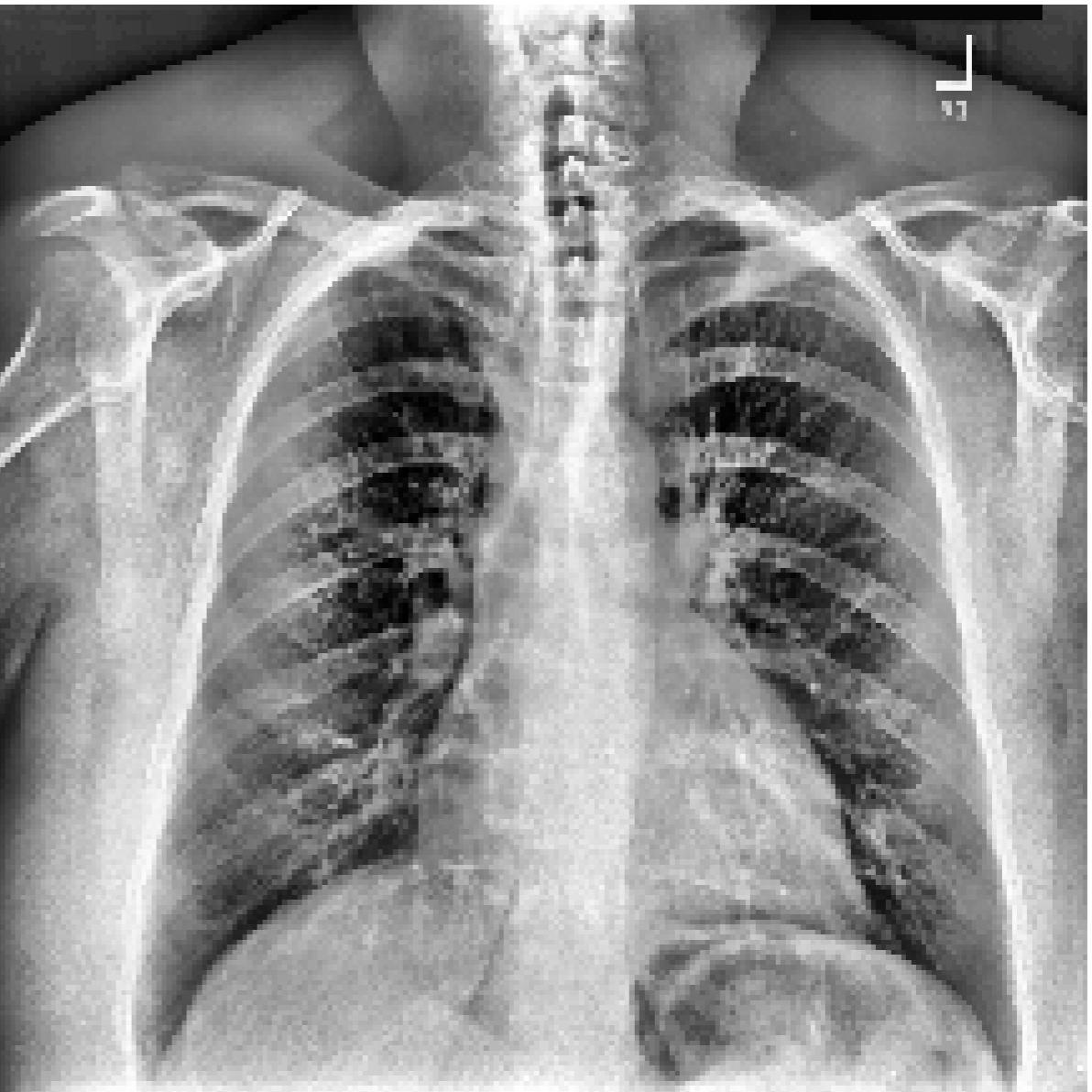
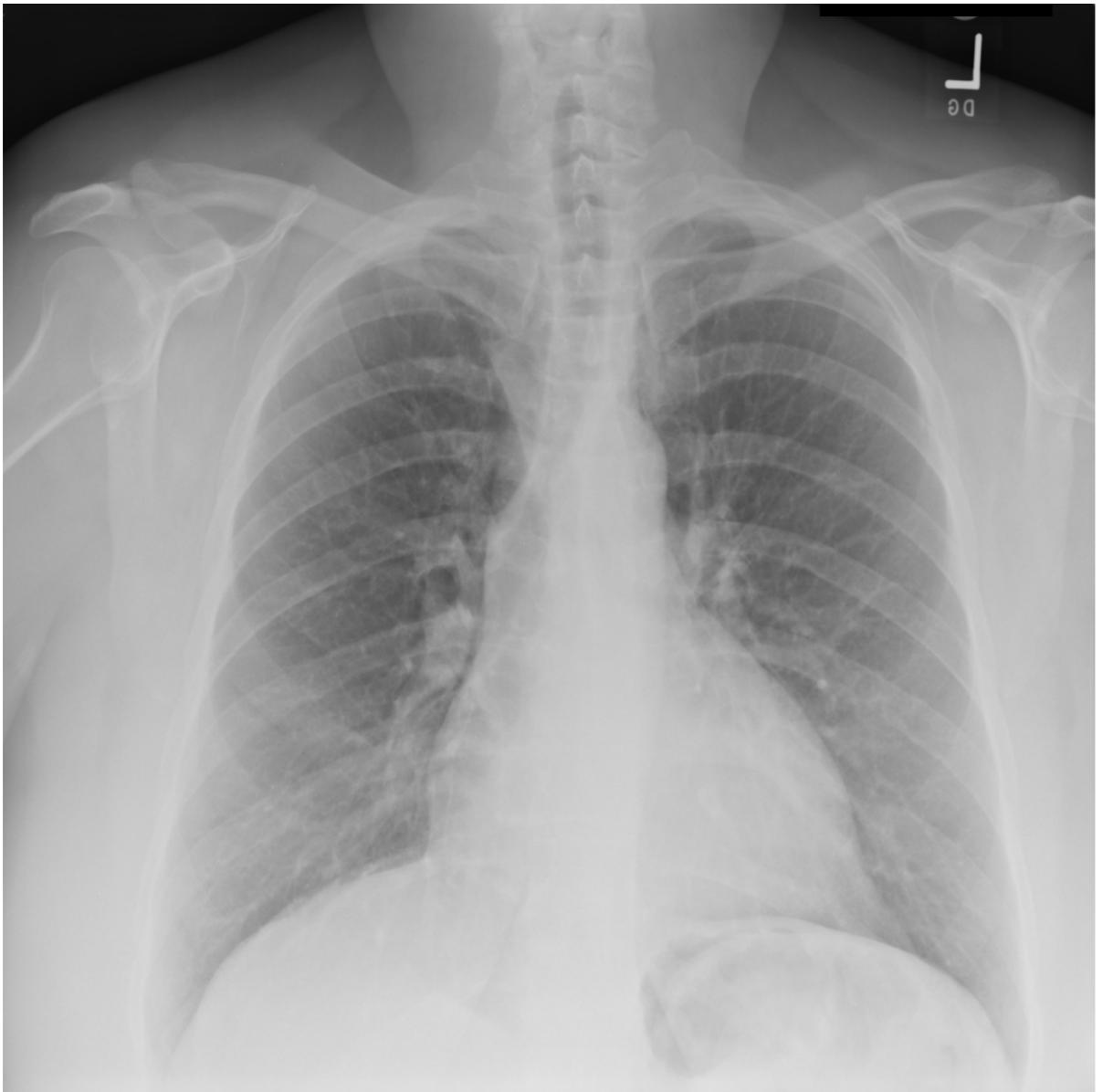
# Contrast enhancement

IMAGE PROCESSING IN PYTHON



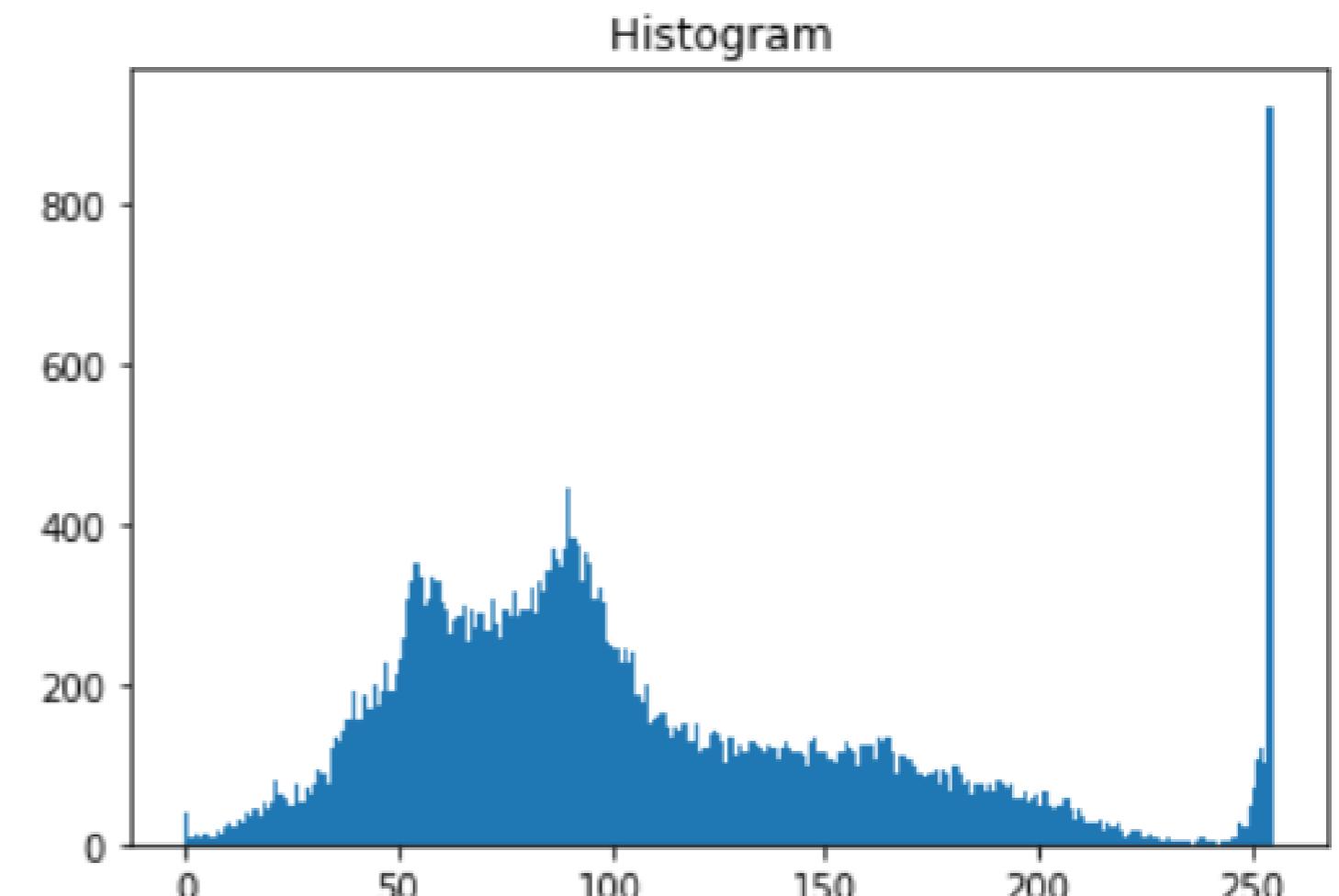
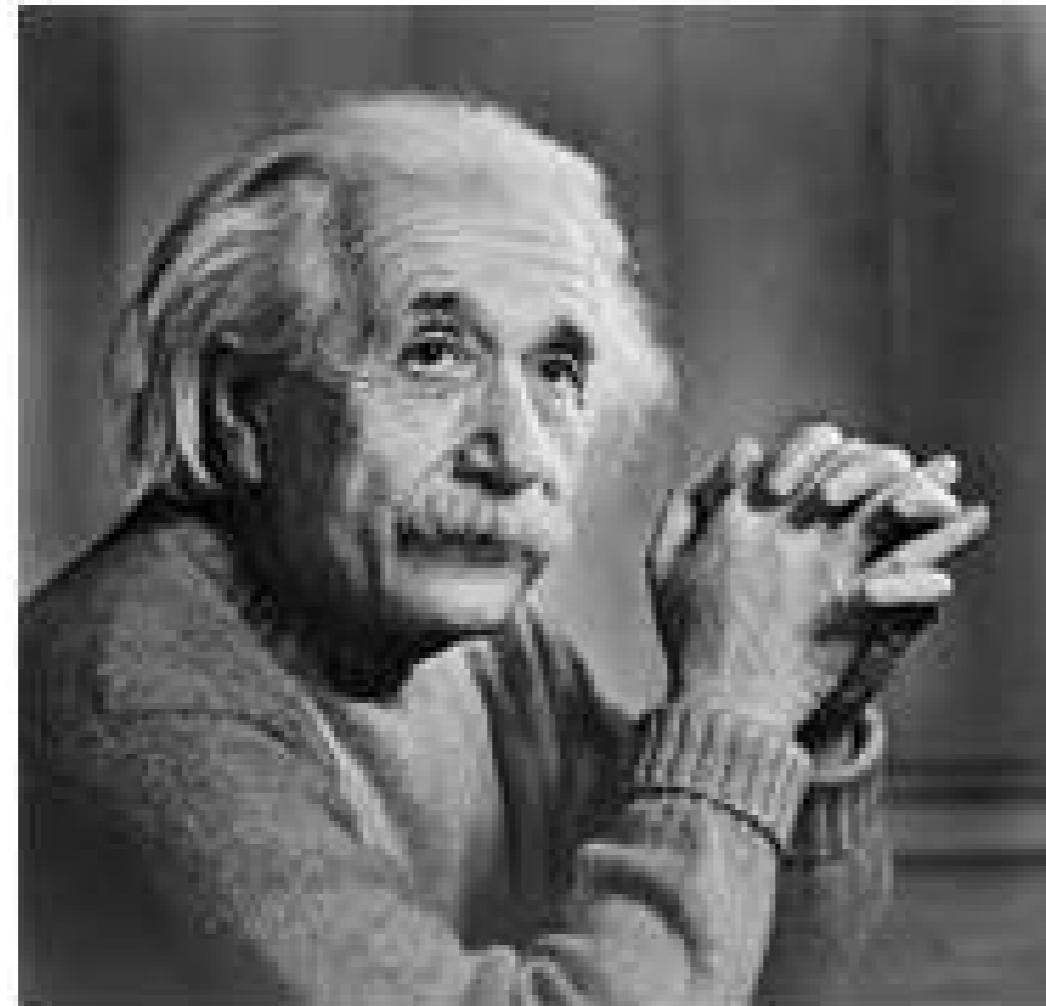
**Rebeca Gonzalez**  
Data engineer

# Contrast enhancement



# Contrast

## Histograms for contrast enhancement

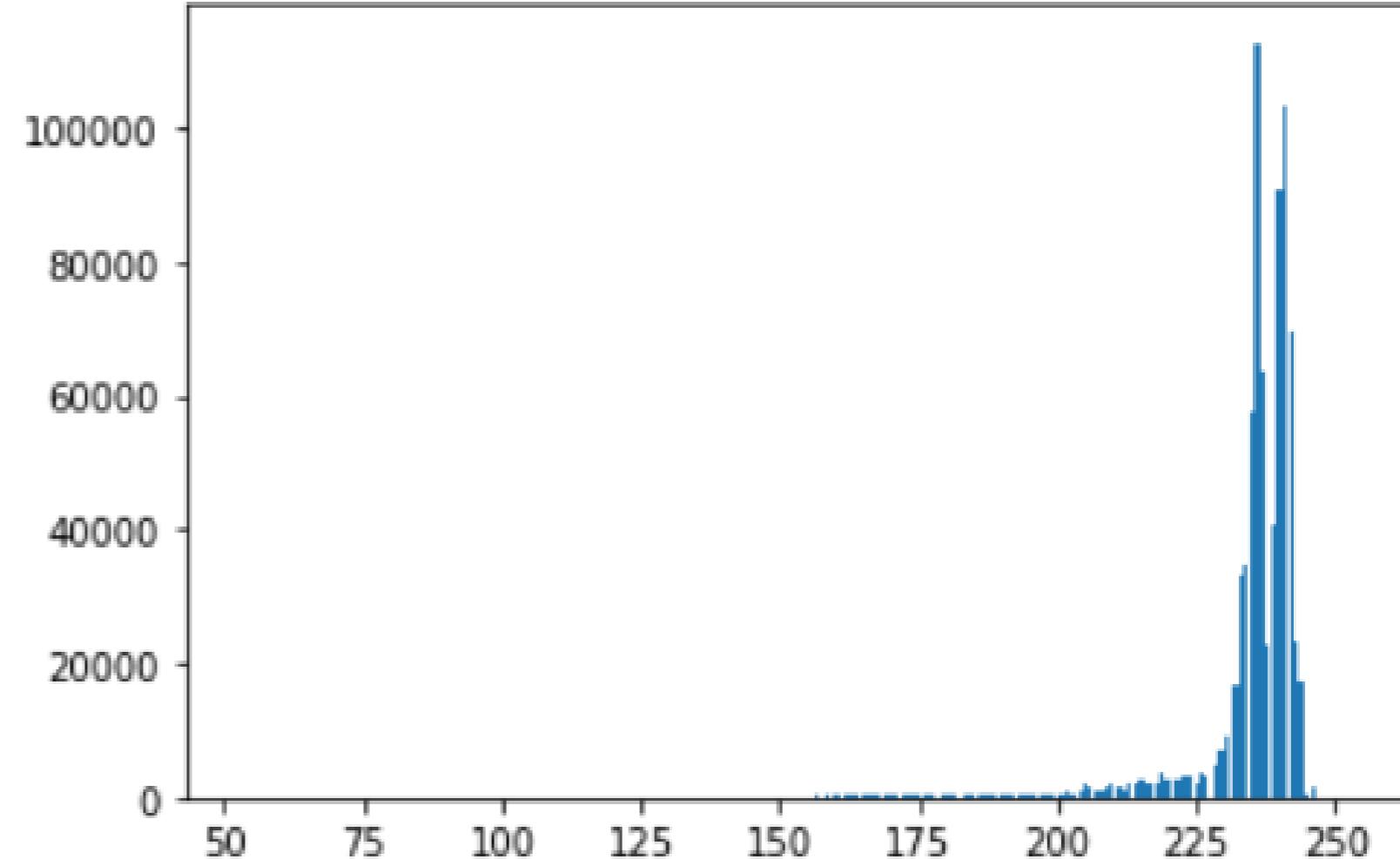


# Contrast

Low contrast image - light



Histogram of image



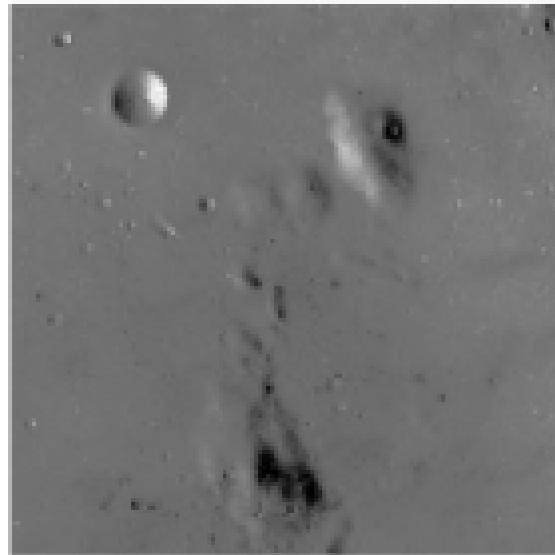
# Enhance contrast

- 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)

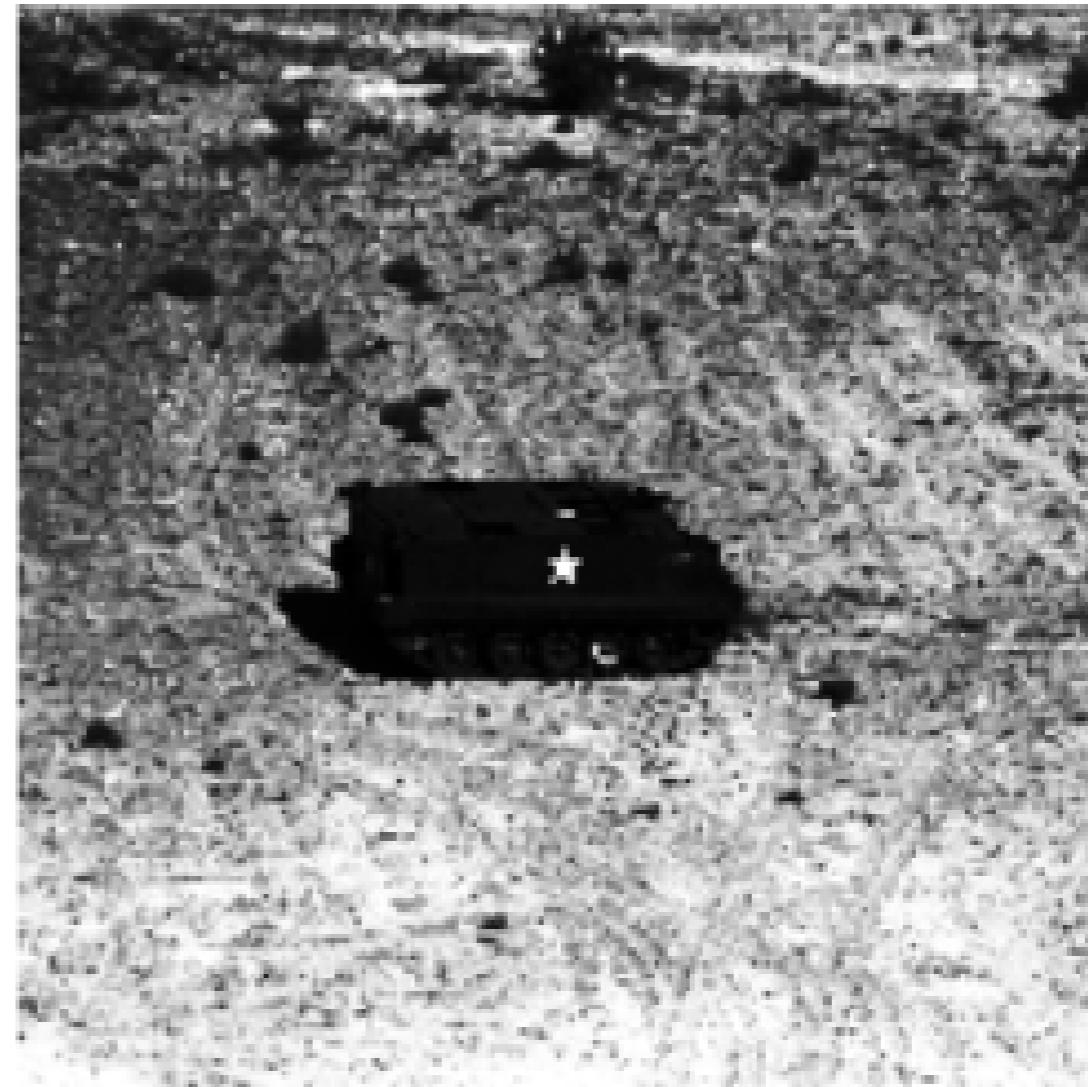
# Show original and result
show_image(image, 'Original')
show_image(image_eq, 'Histogram equalized')
```

# 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_eq, 'Adaptive equalized')
```

# CLAHE in scikit-image

Original



Adaptive Equalization



# Let's practice!

IMAGE PROCESSING IN PYTHON

# Transformations

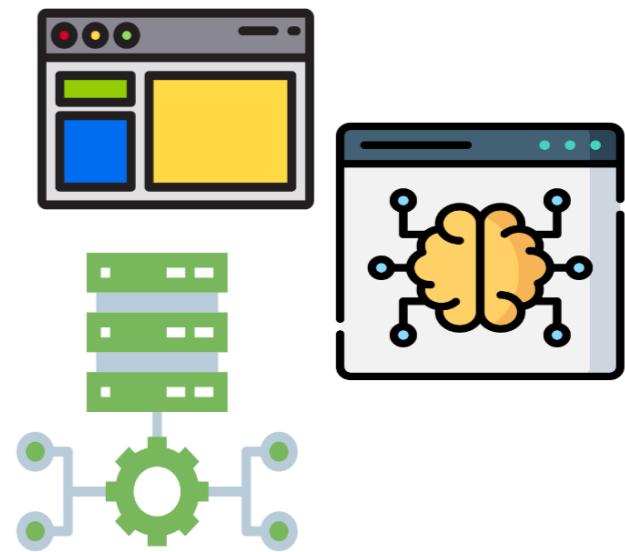
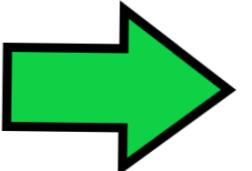
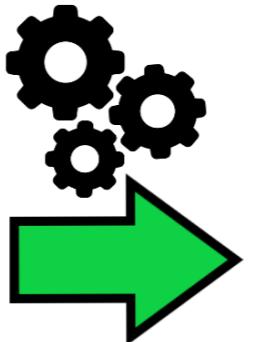
IMAGE PROCESSING IN PYTHON



**Rebeca Gonzalez**  
Data Engineer

# Why transform images?

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

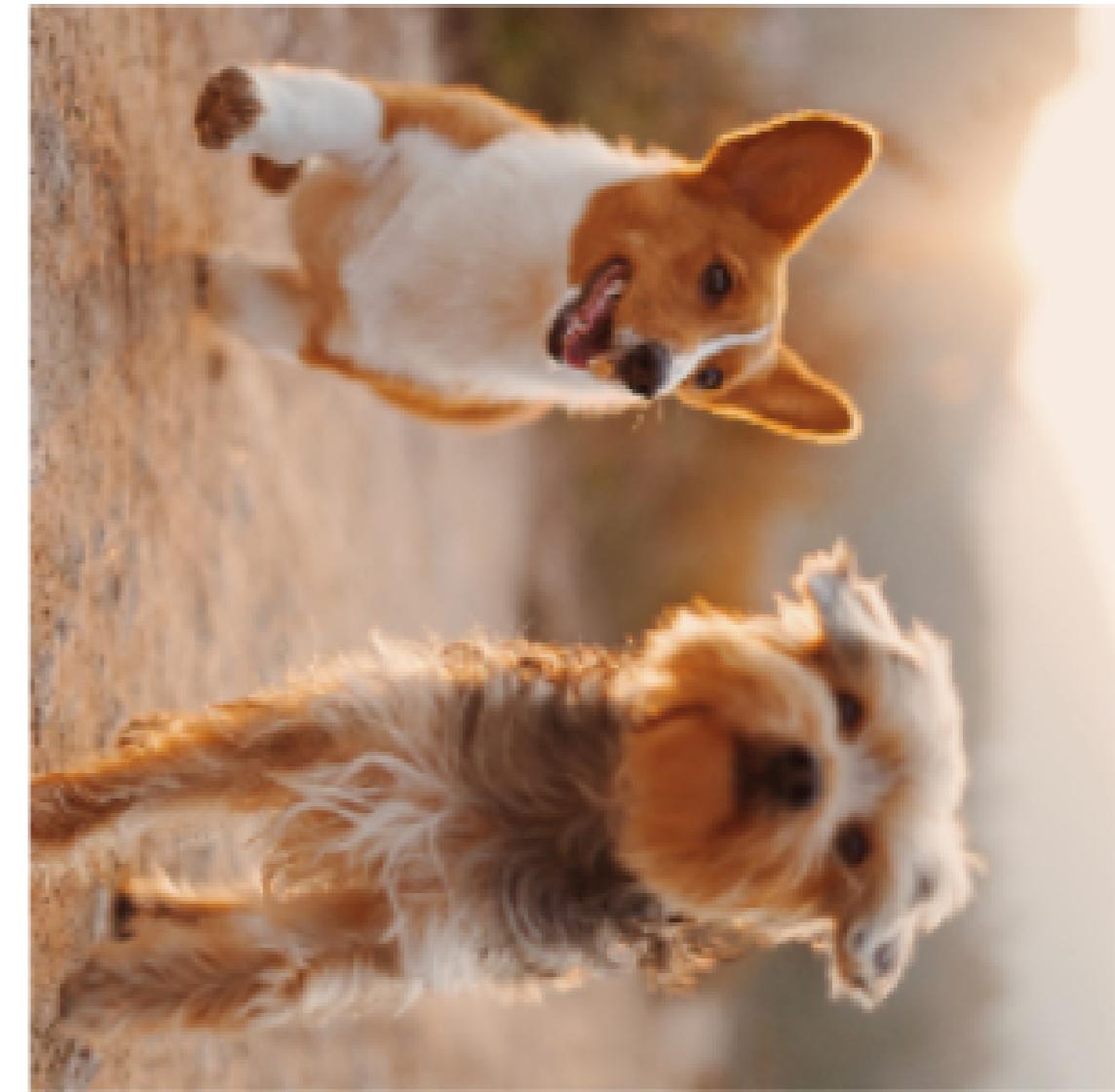


# Rotating

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

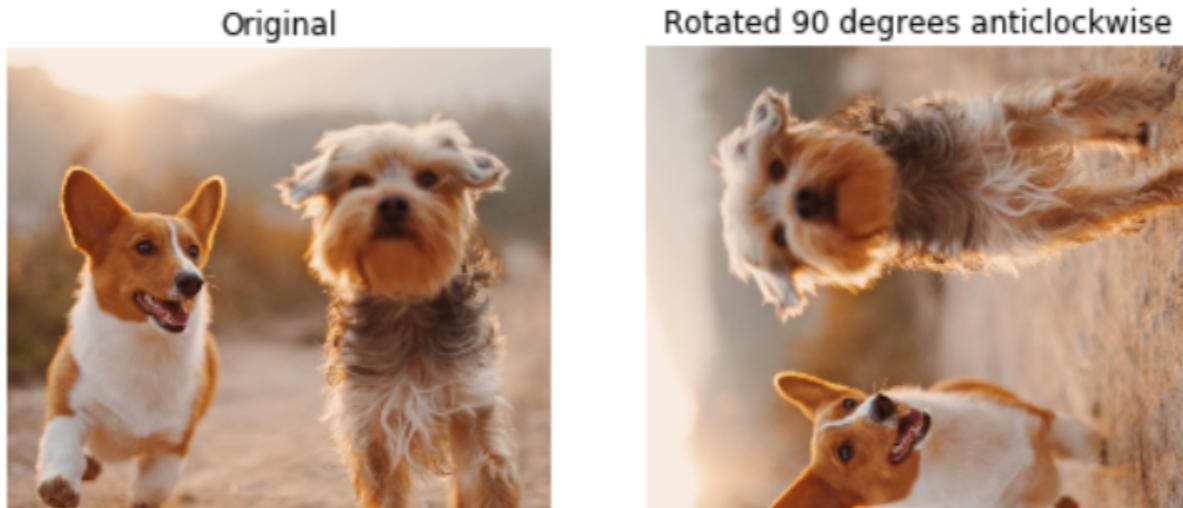


# Rotating anticlockwise

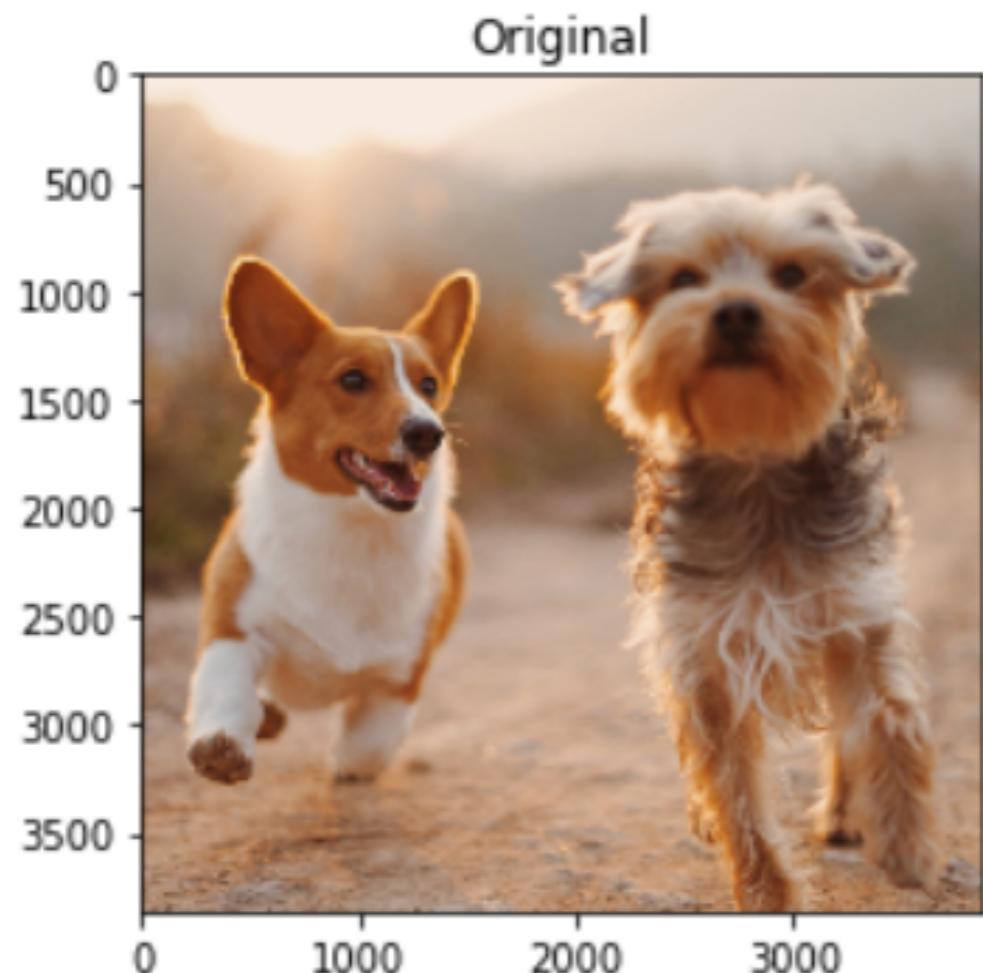
```
from skimage.transform import rotate

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

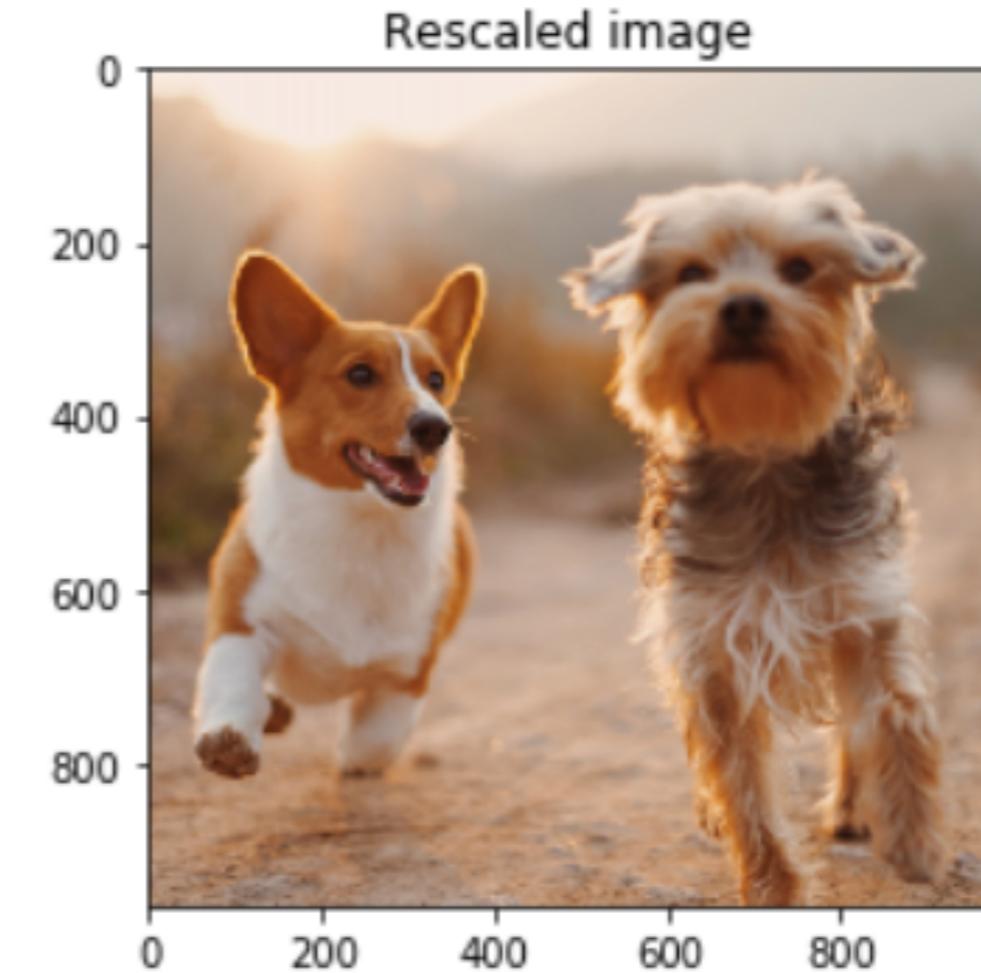
show_image(image, 'Original')
show_image(image_rotated, 'Rotated 90 degrees anticlockwise')
```



# Rescaling



Original size



Rescaled size

# Rescaling

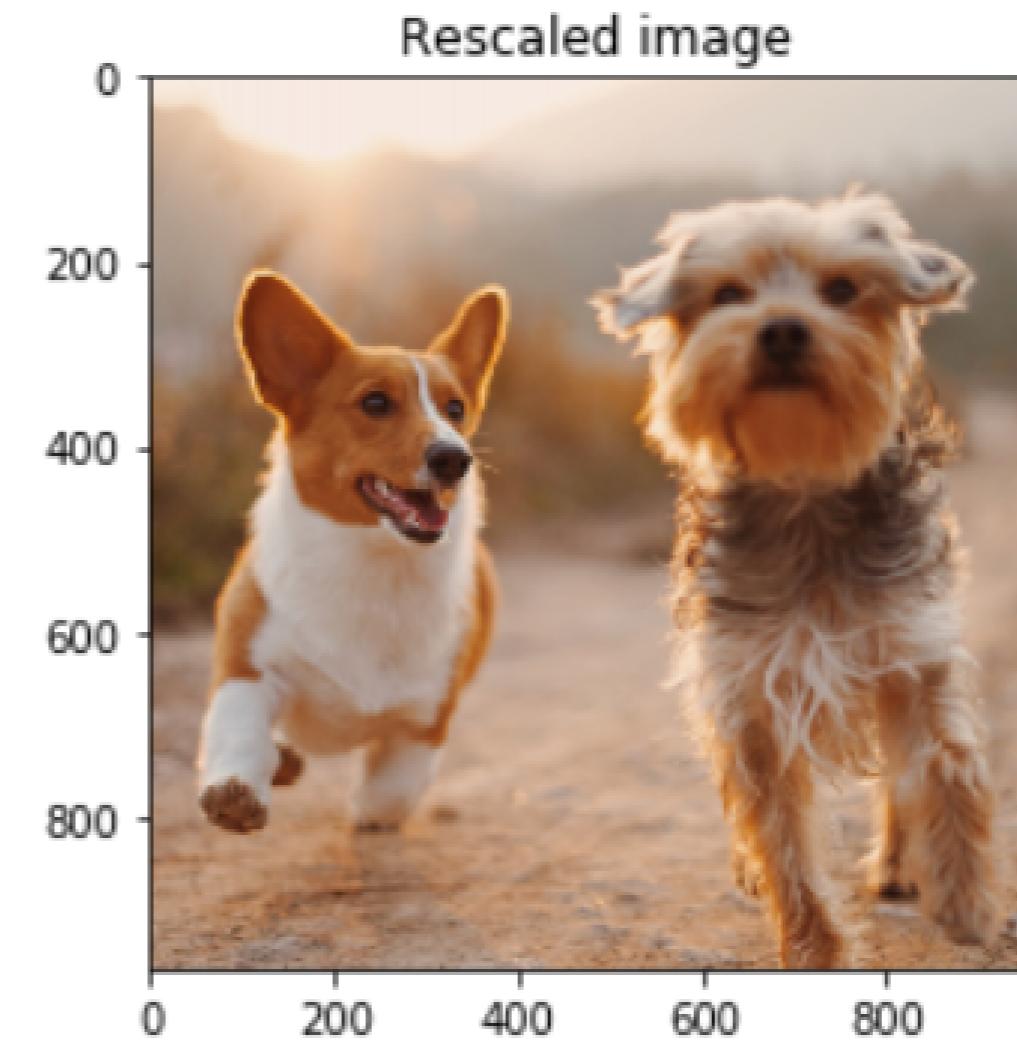
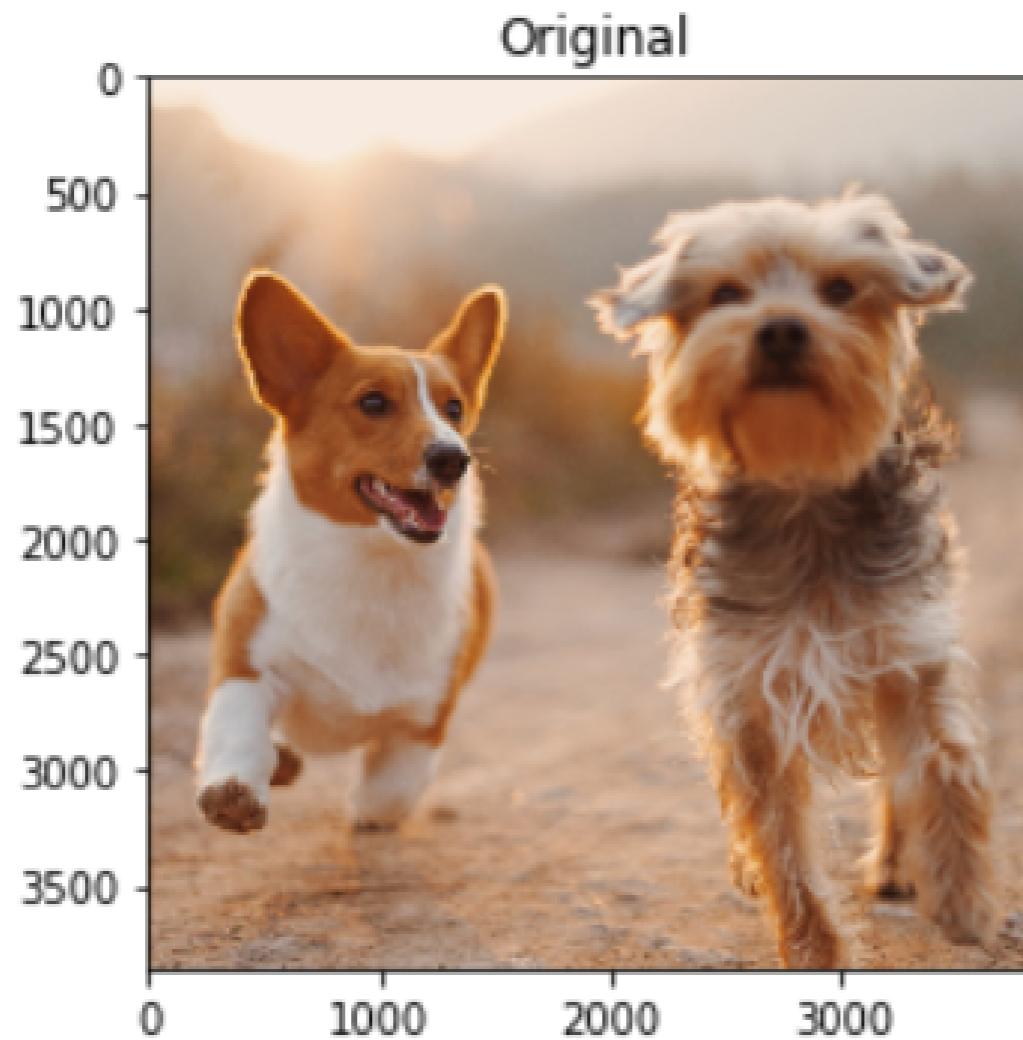
## Downgrading

```
from skimage.transform import rescale

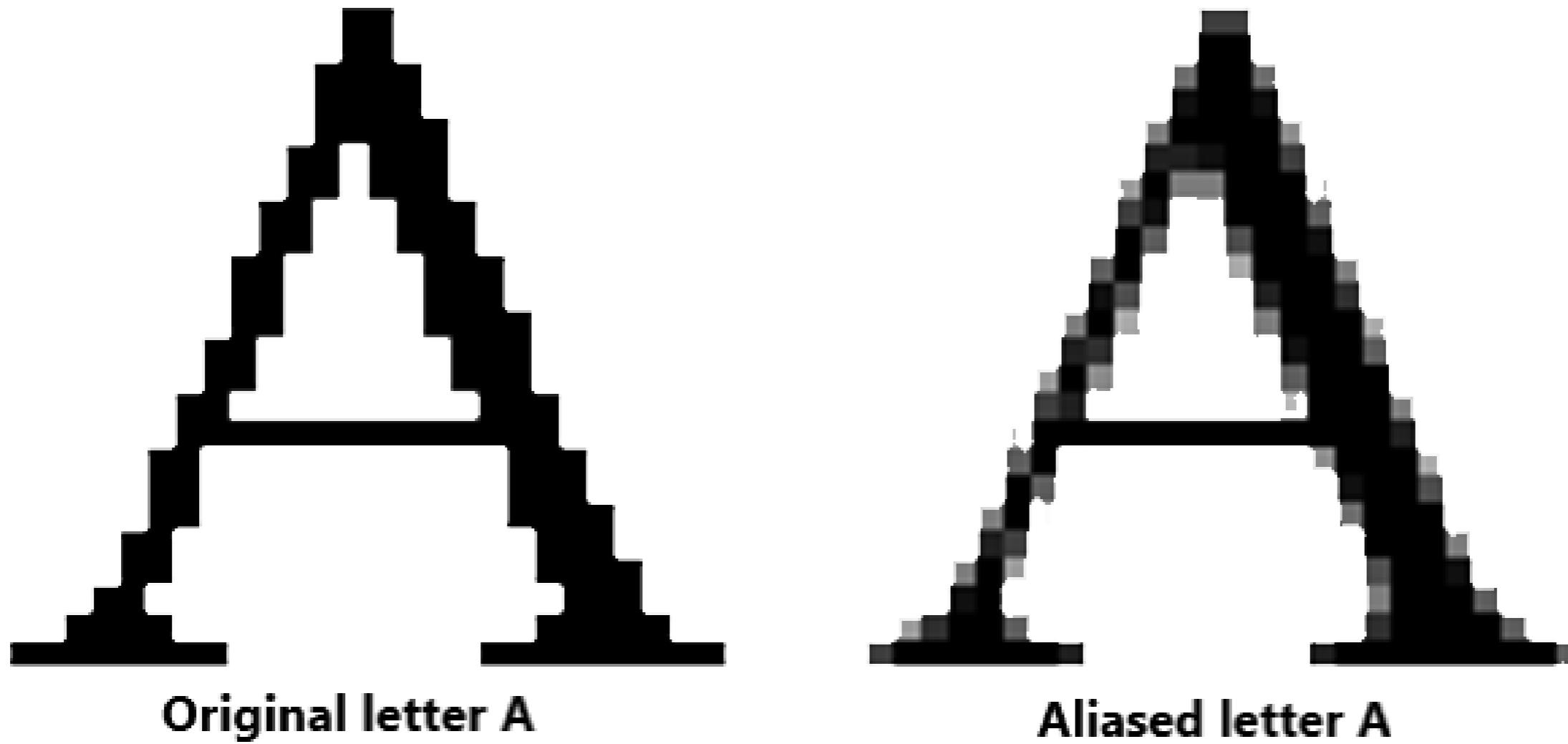
# Rescale the image to be 4 times smaller
image_rescaled = rescale(image, 1/4, anti_aliasing=True, multichannel=True)

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

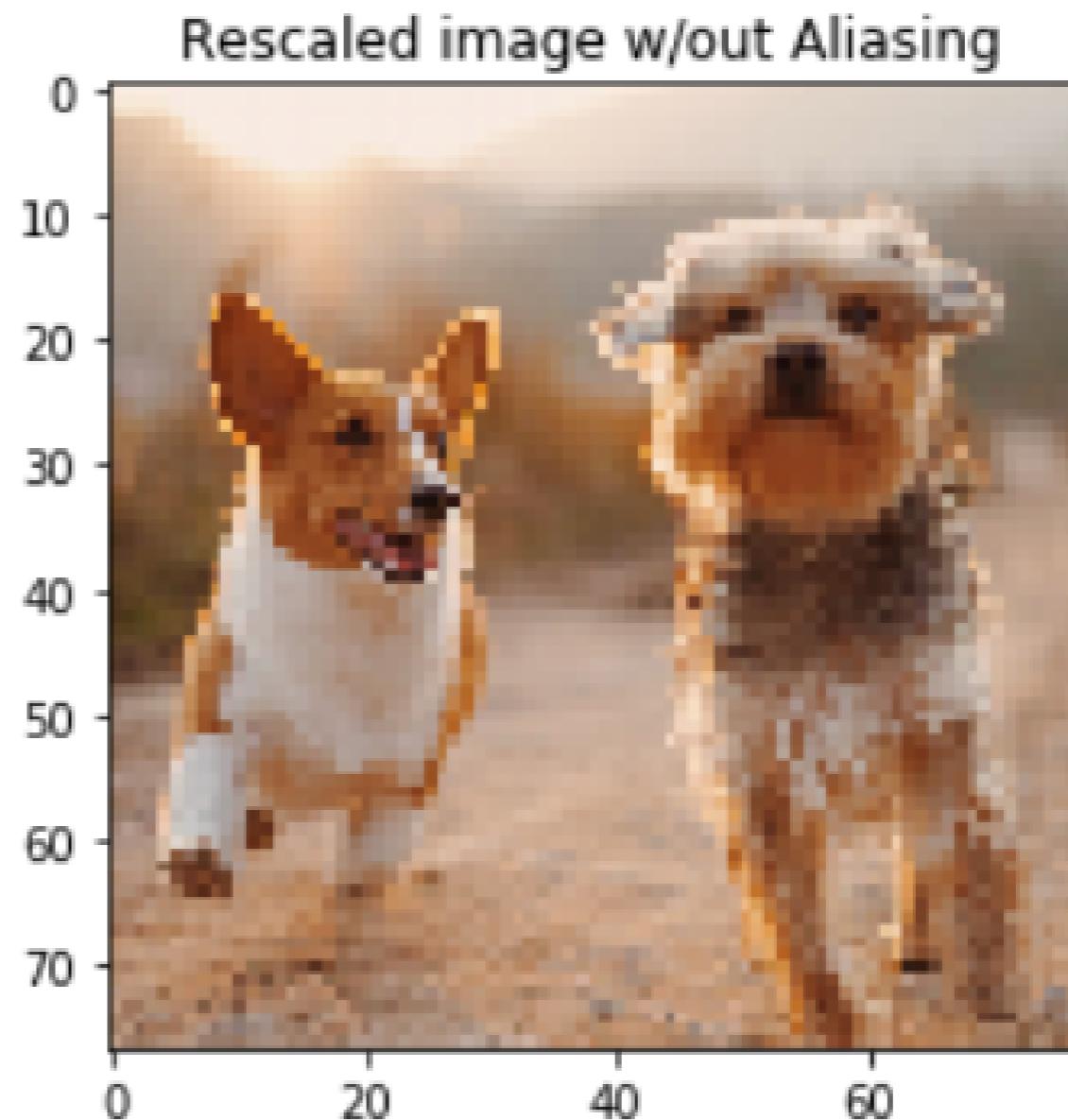
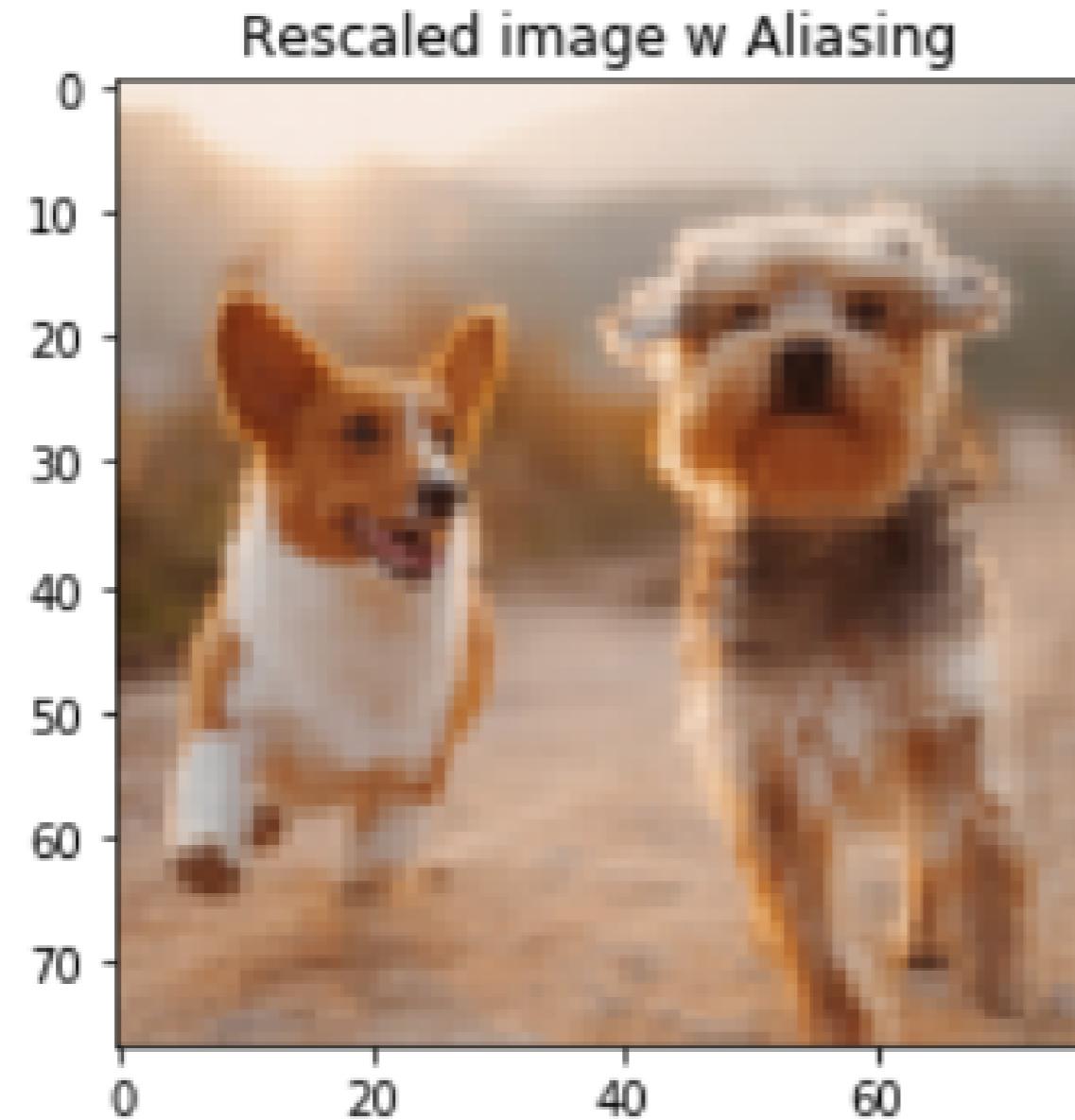
# Rescaling



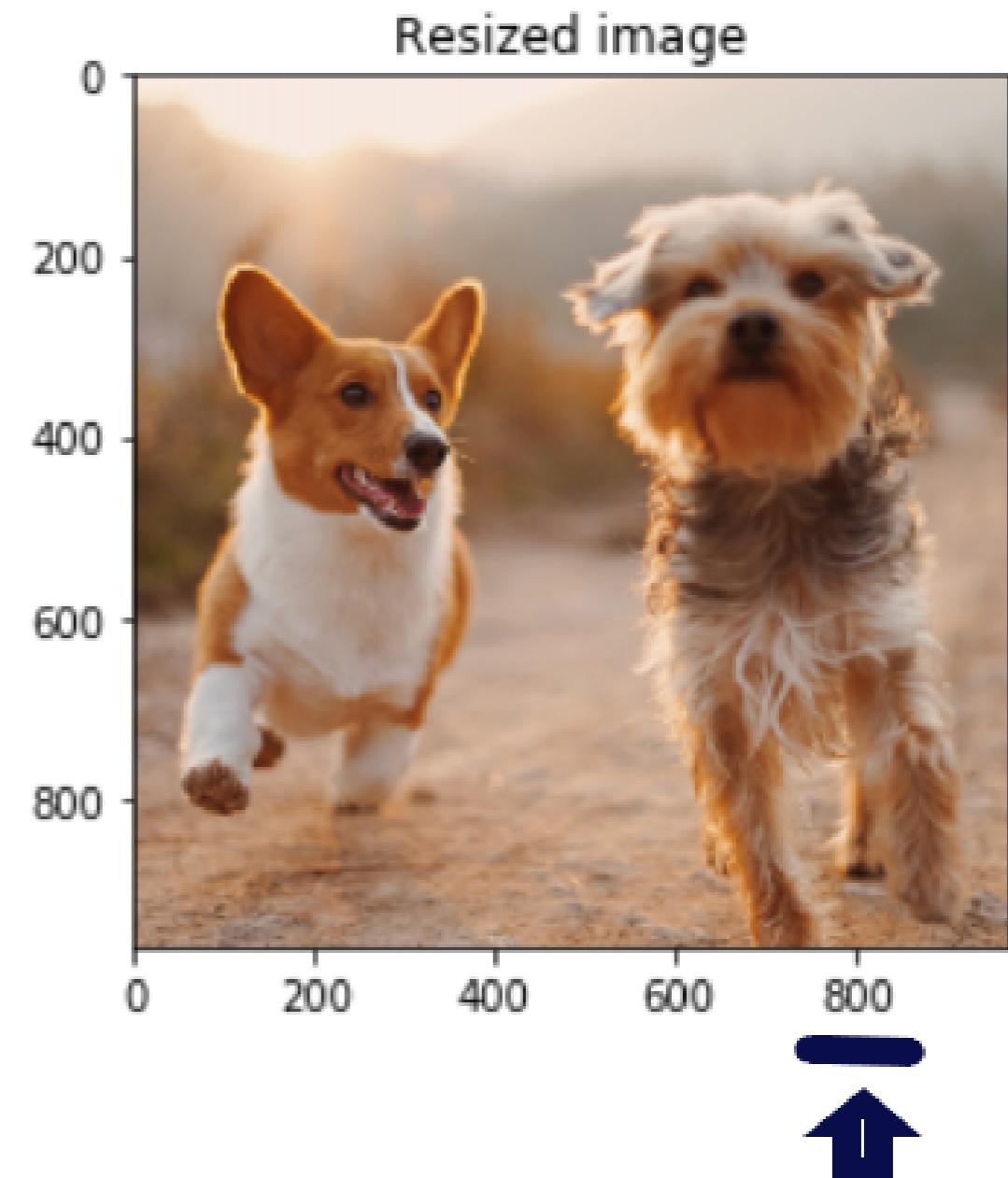
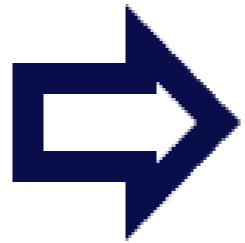
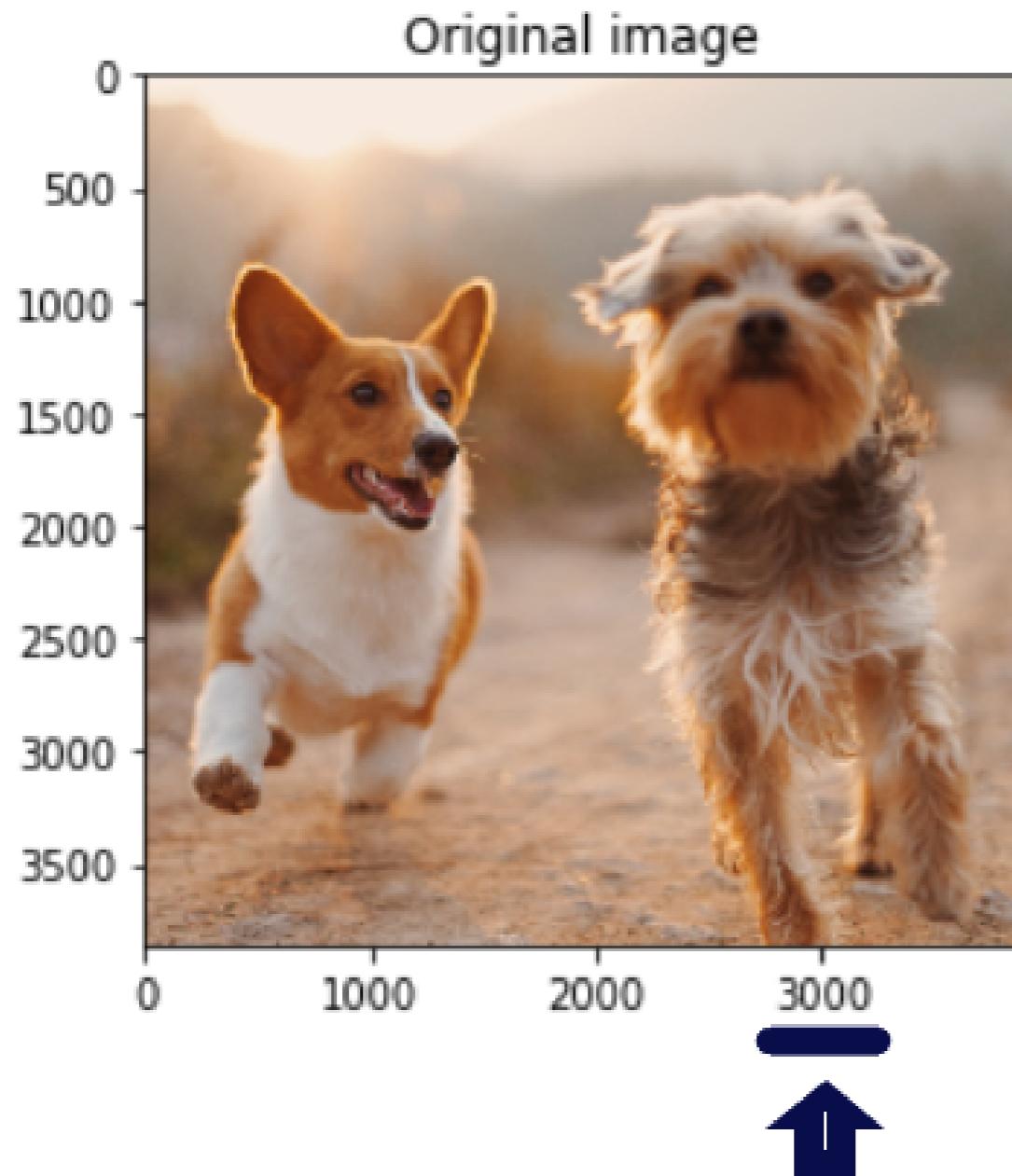
# Aliasing in digital images



# Aliasing in digital images



# Resizing



# Resizing

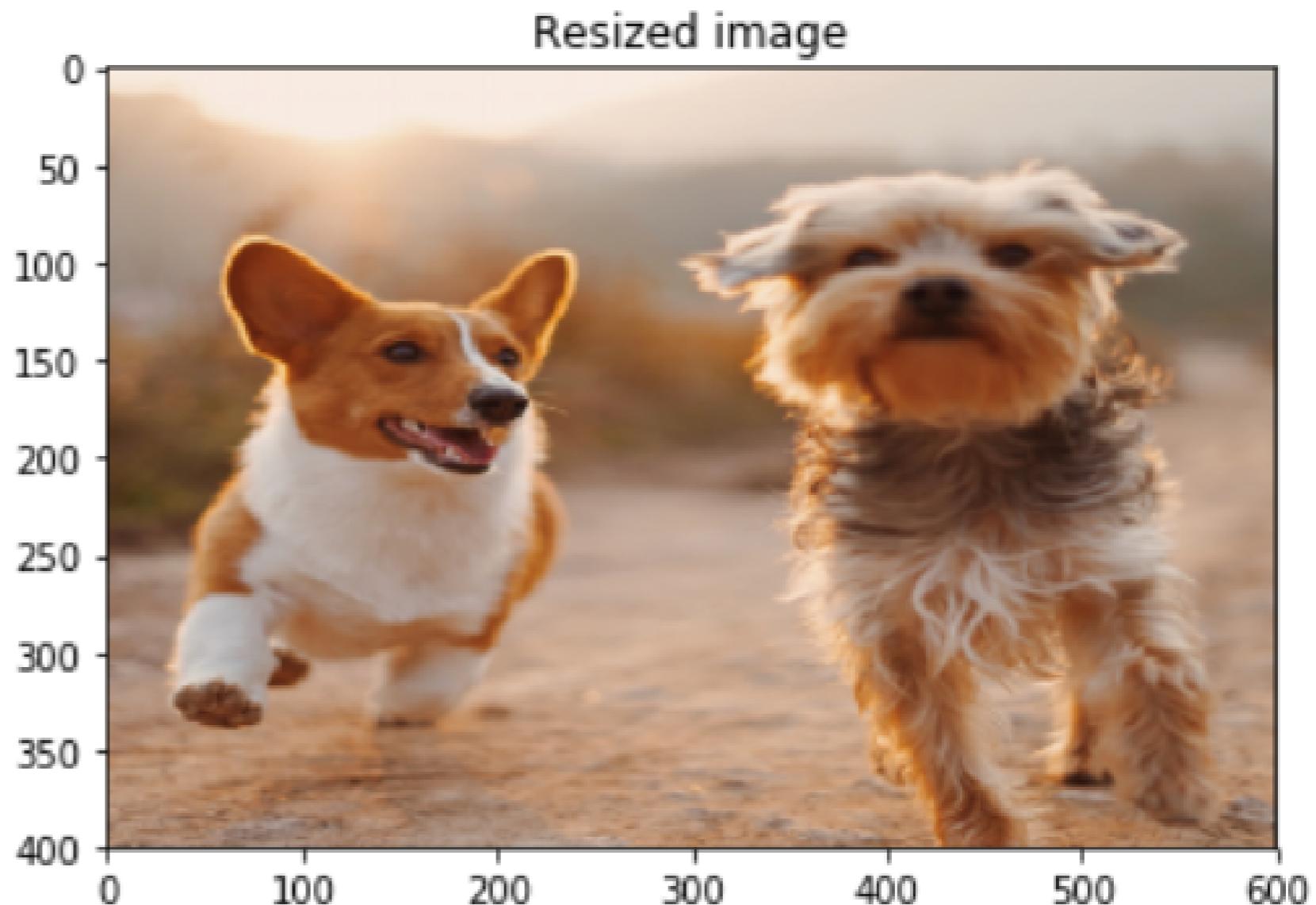
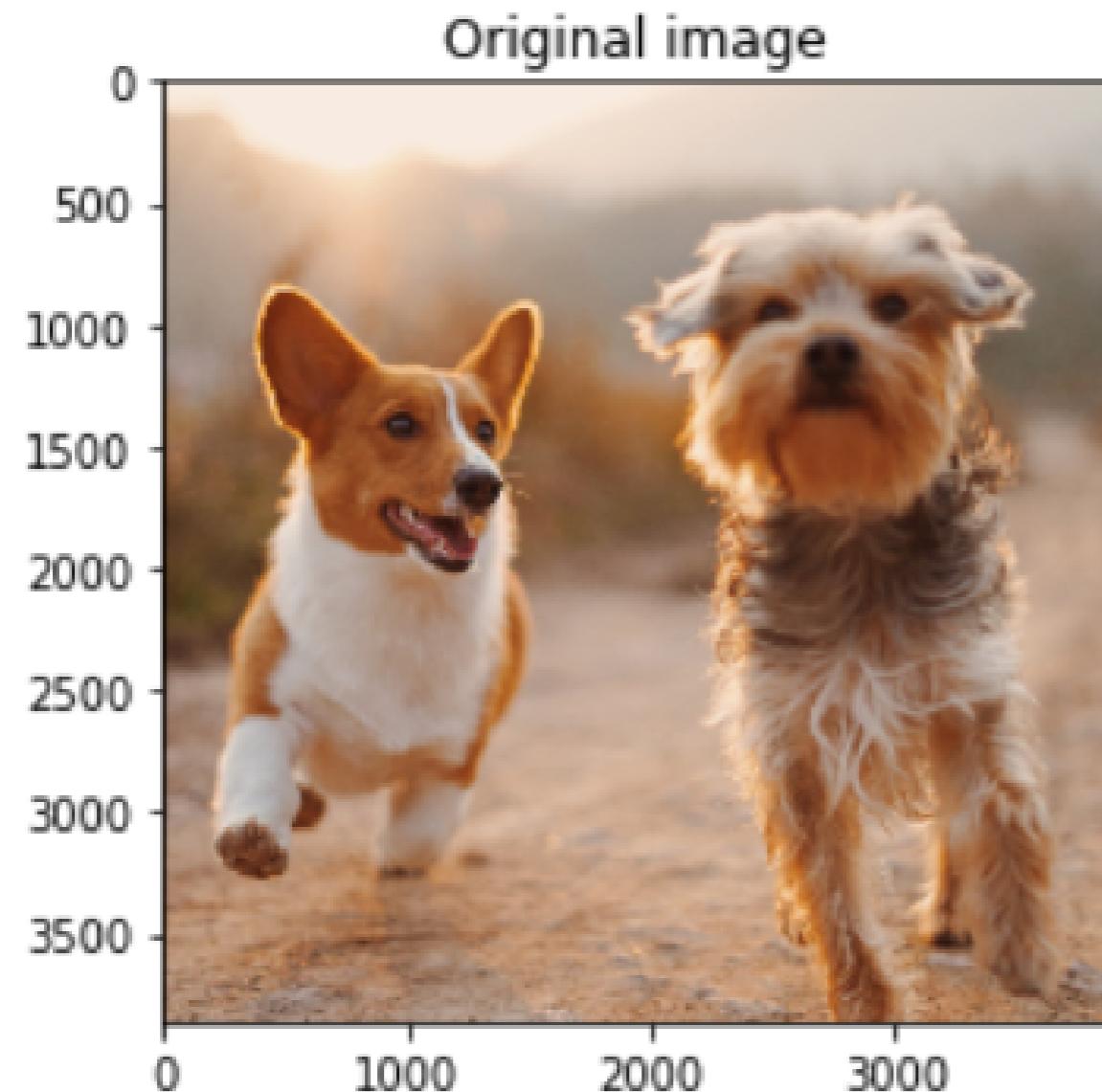
```
from skimage.transform import resize

# 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

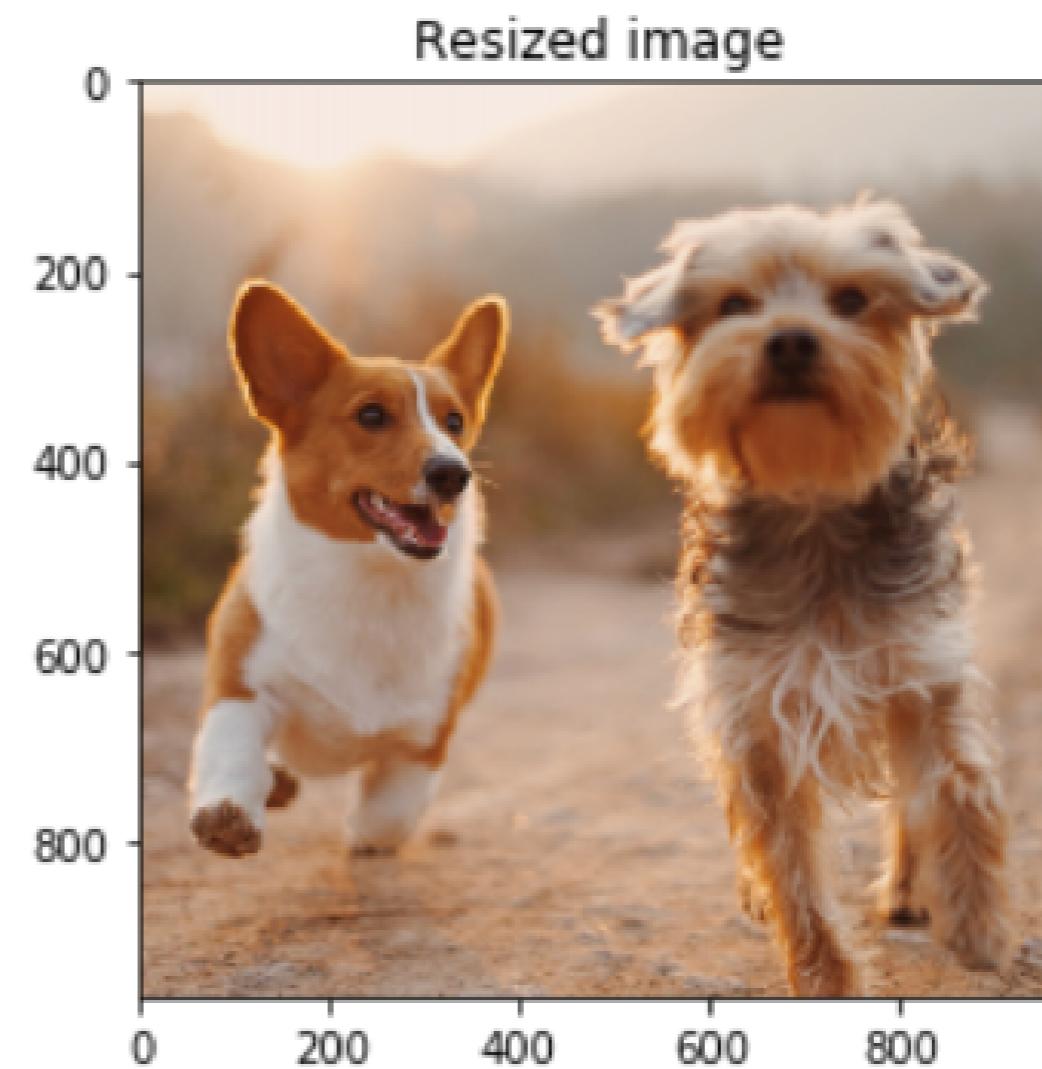
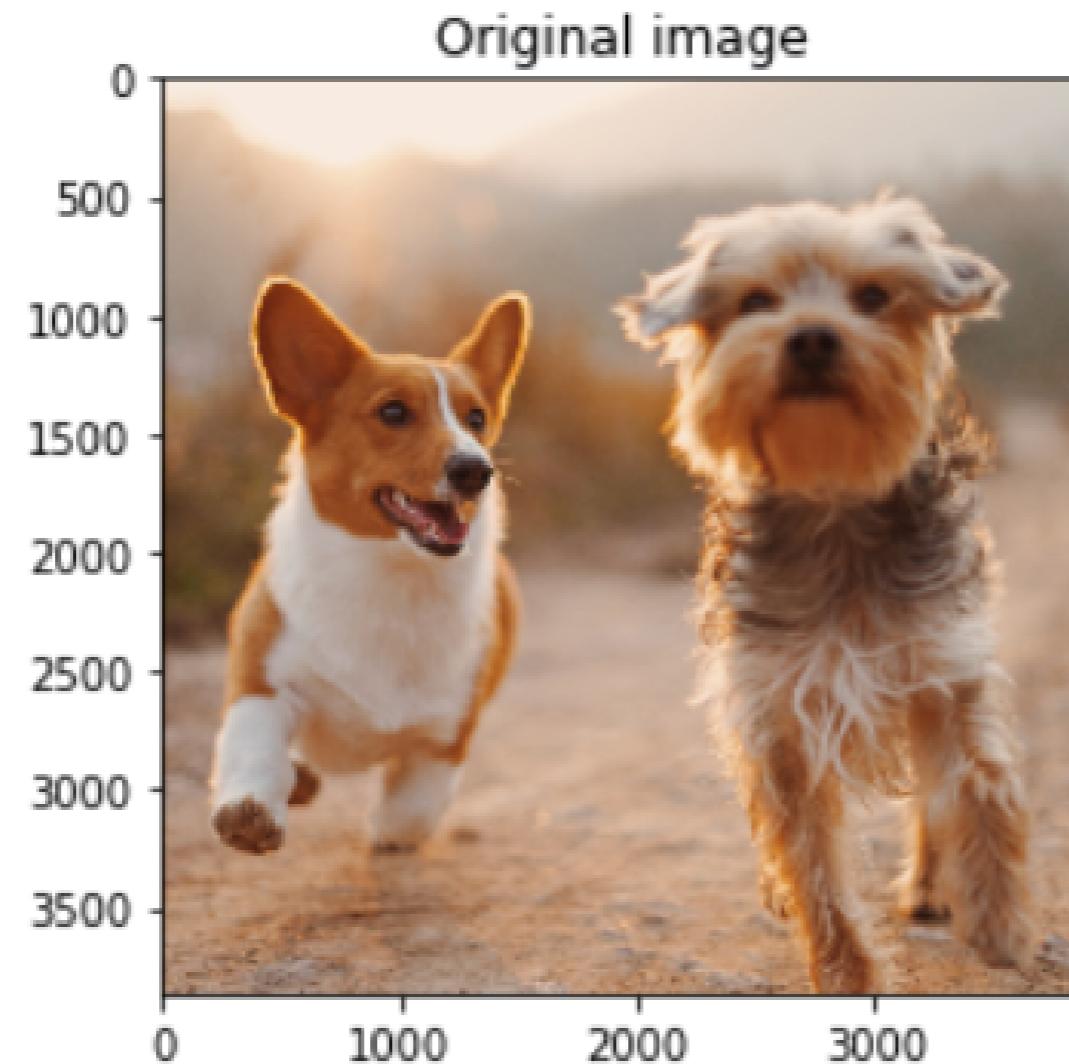
```
from skimage.transform import resize

# 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

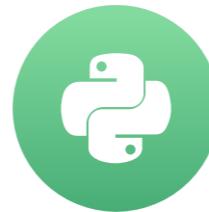


# Let's practice!

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



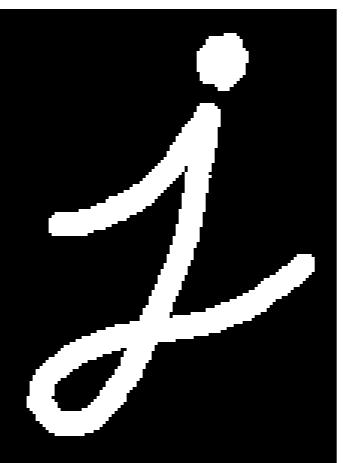
Grayscale



# Morphological operations

- Dilation
- Erosion

Original



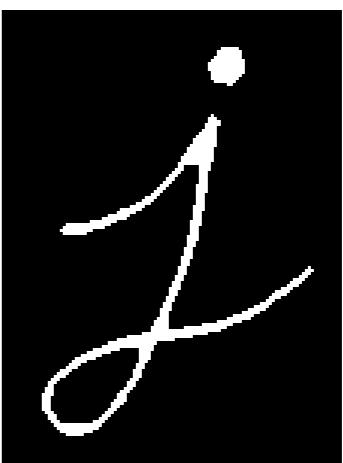
Dilated



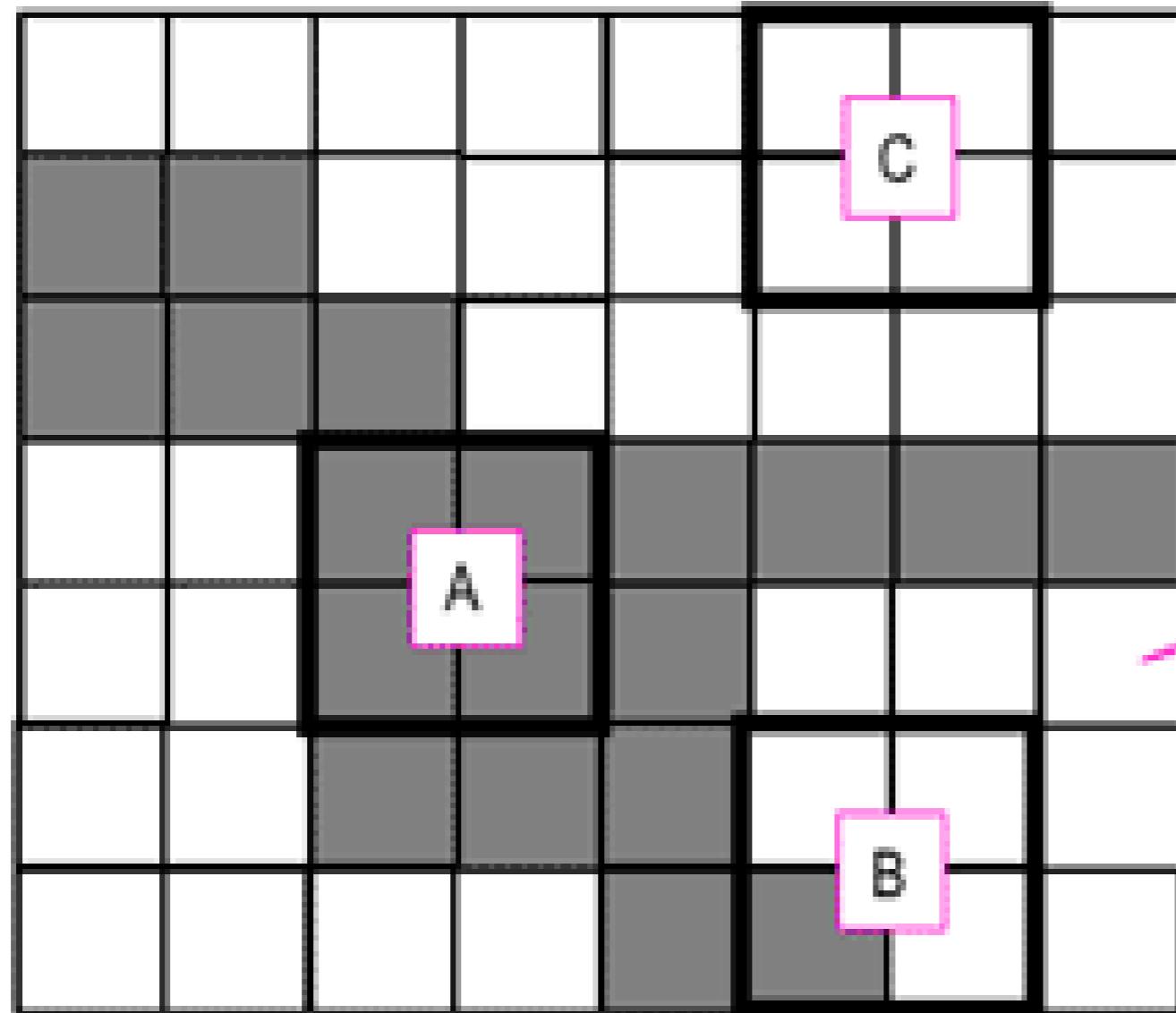
Original



Eroded

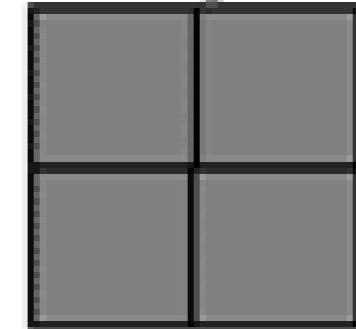


# Structuring element



- 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)
```

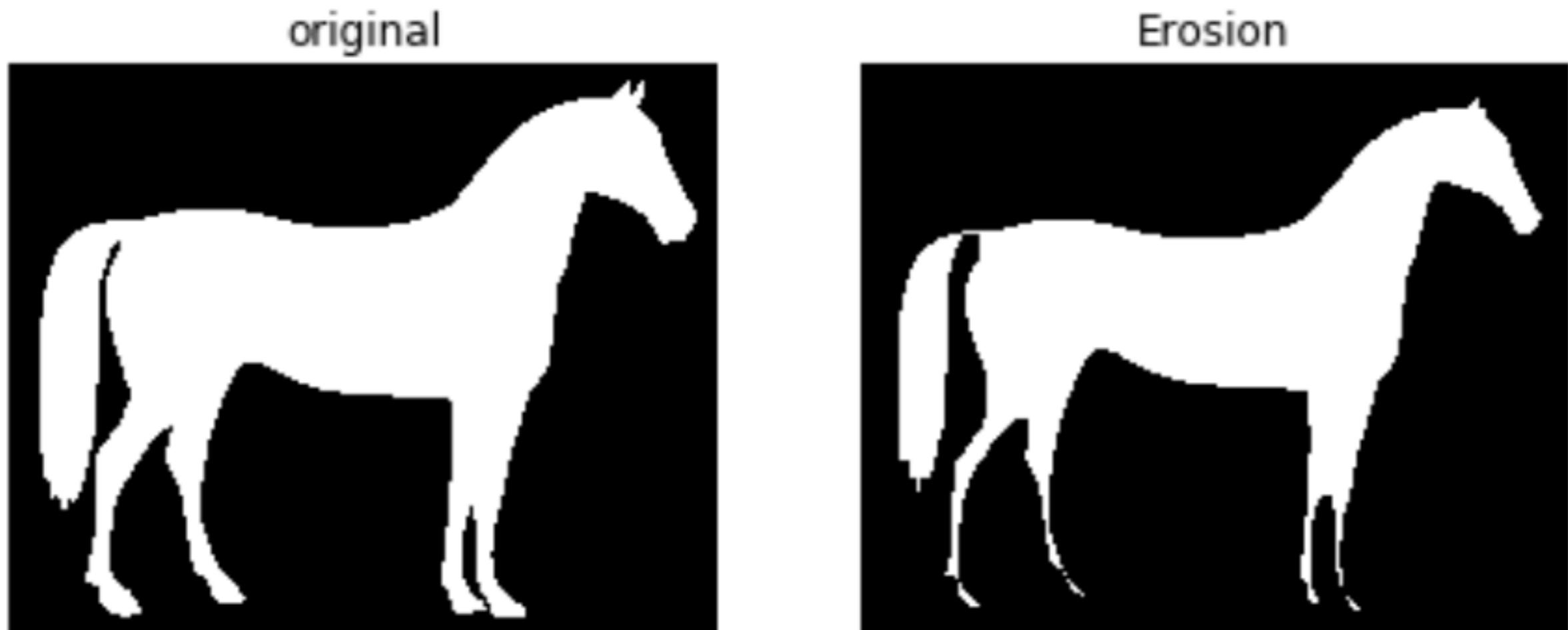
```
[[1 1]
 [1 1]
 [1 1]
 [1 1]]
```

# 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

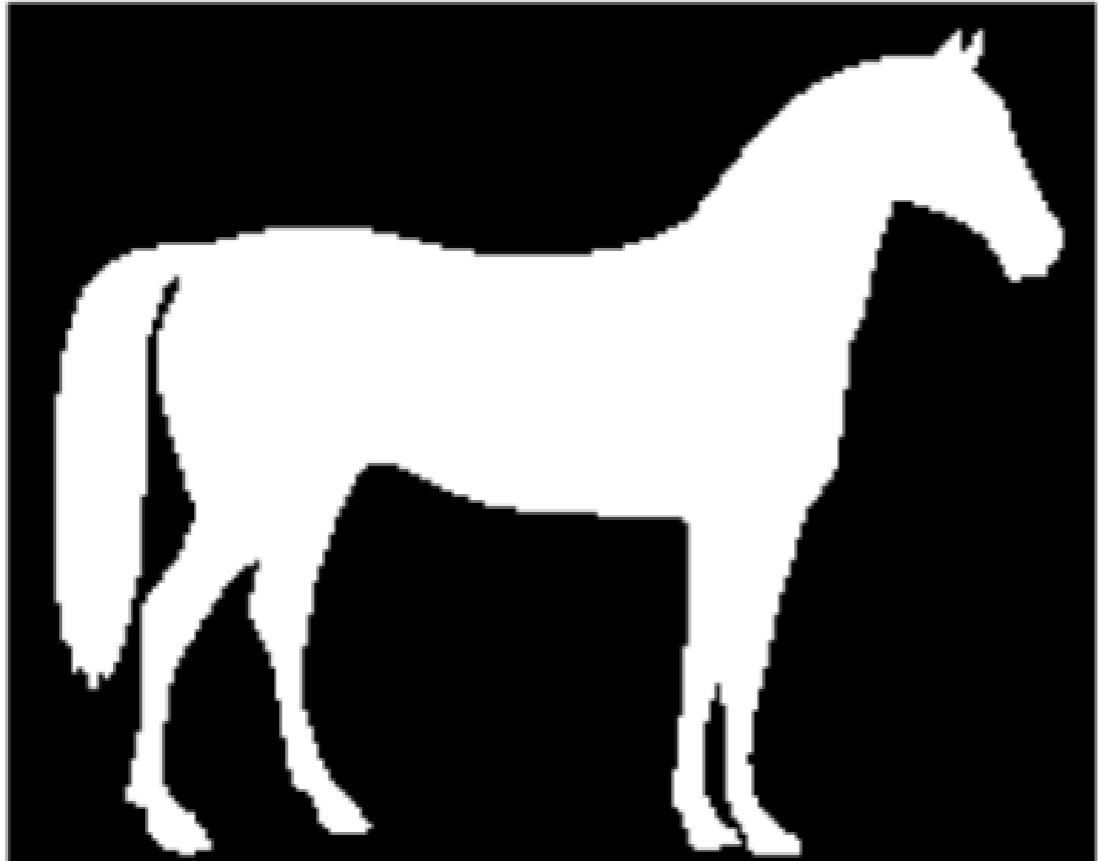
```
# Show result  
plot_comparison(image_horse, eroded_image, 'Erosion')
```



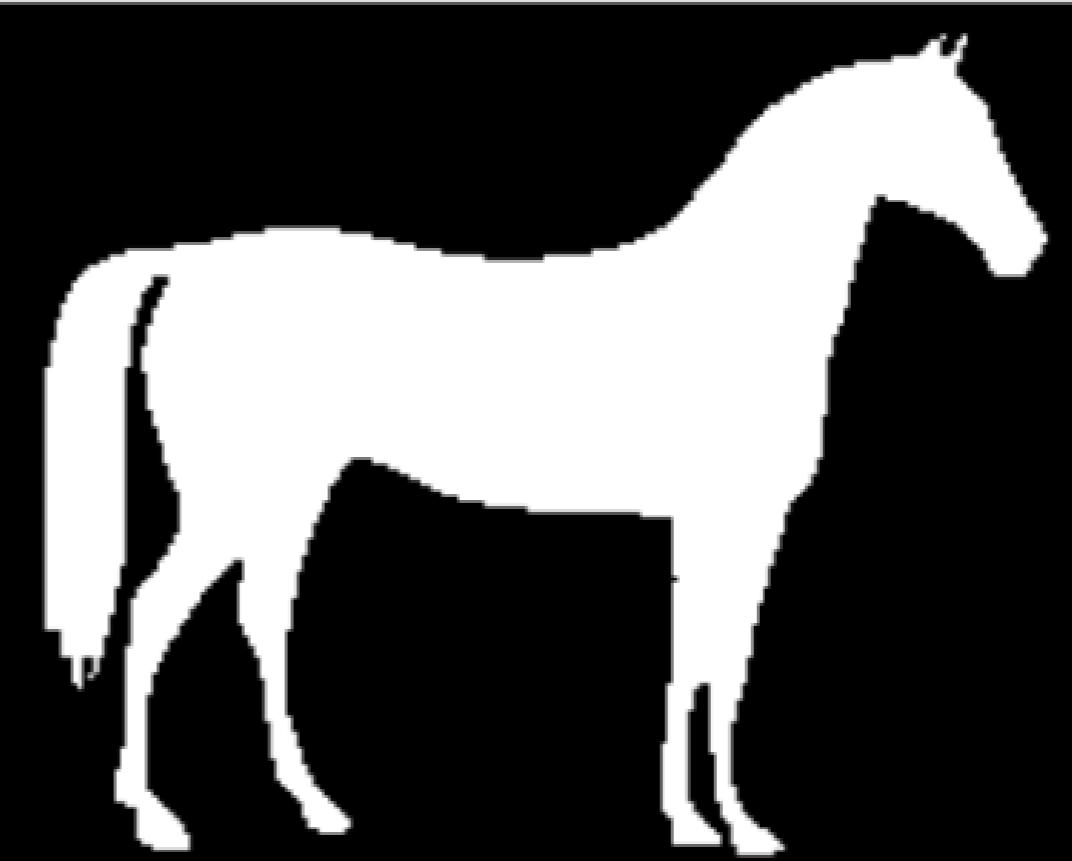
# Binary erosion with default selem

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

original



Erosion

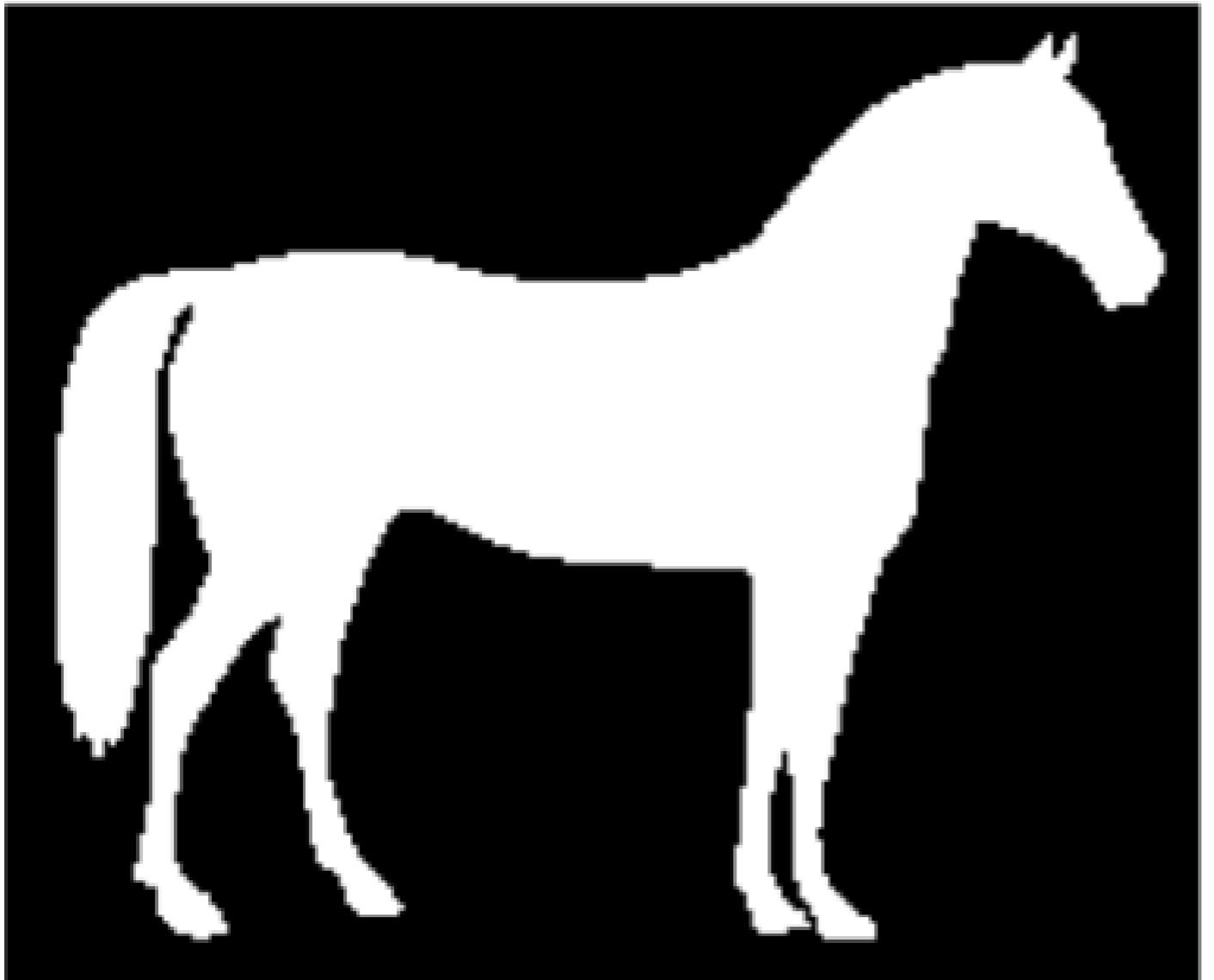


# Dilation in scikit-image

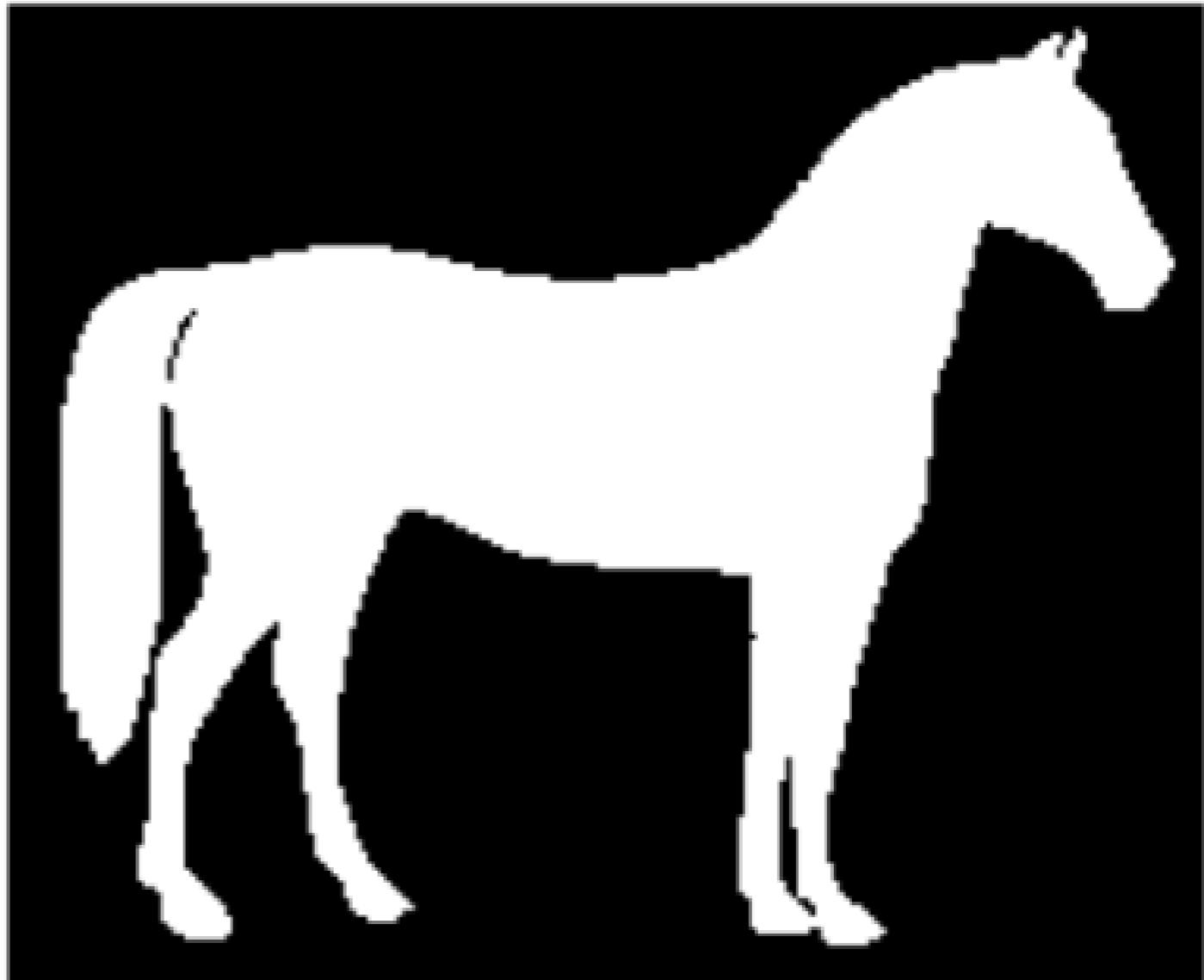
```
from skimage import morphology  
  
# Obtain dilated image, using binary dilation  
dilated_image = morphology.binary_dilation(image_horse)  
  
# See results  
plot_comparison(image_horse, dilated_image, 'Erosion')
```

# Dilation in scikit-image

original



Dilation



# Let's practice!

IMAGE PROCESSING IN PYTHON