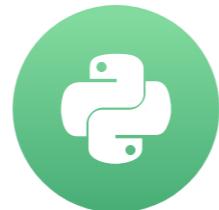


# Finding the edges with Canny

IMAGE PROCESSING IN PYTHON



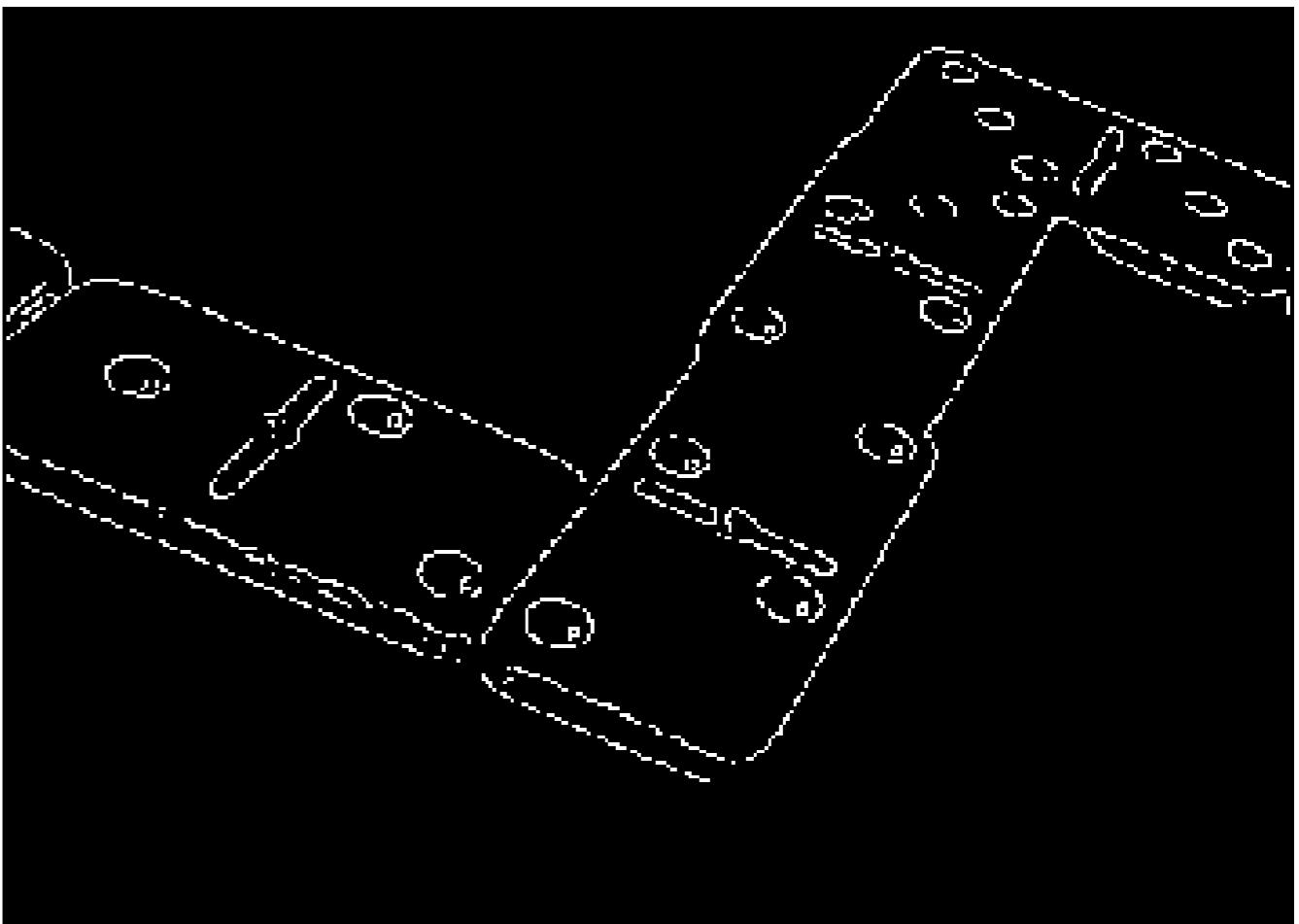
Rebeca Gonzalez  
Data Engineer

# Detecting edges

Original

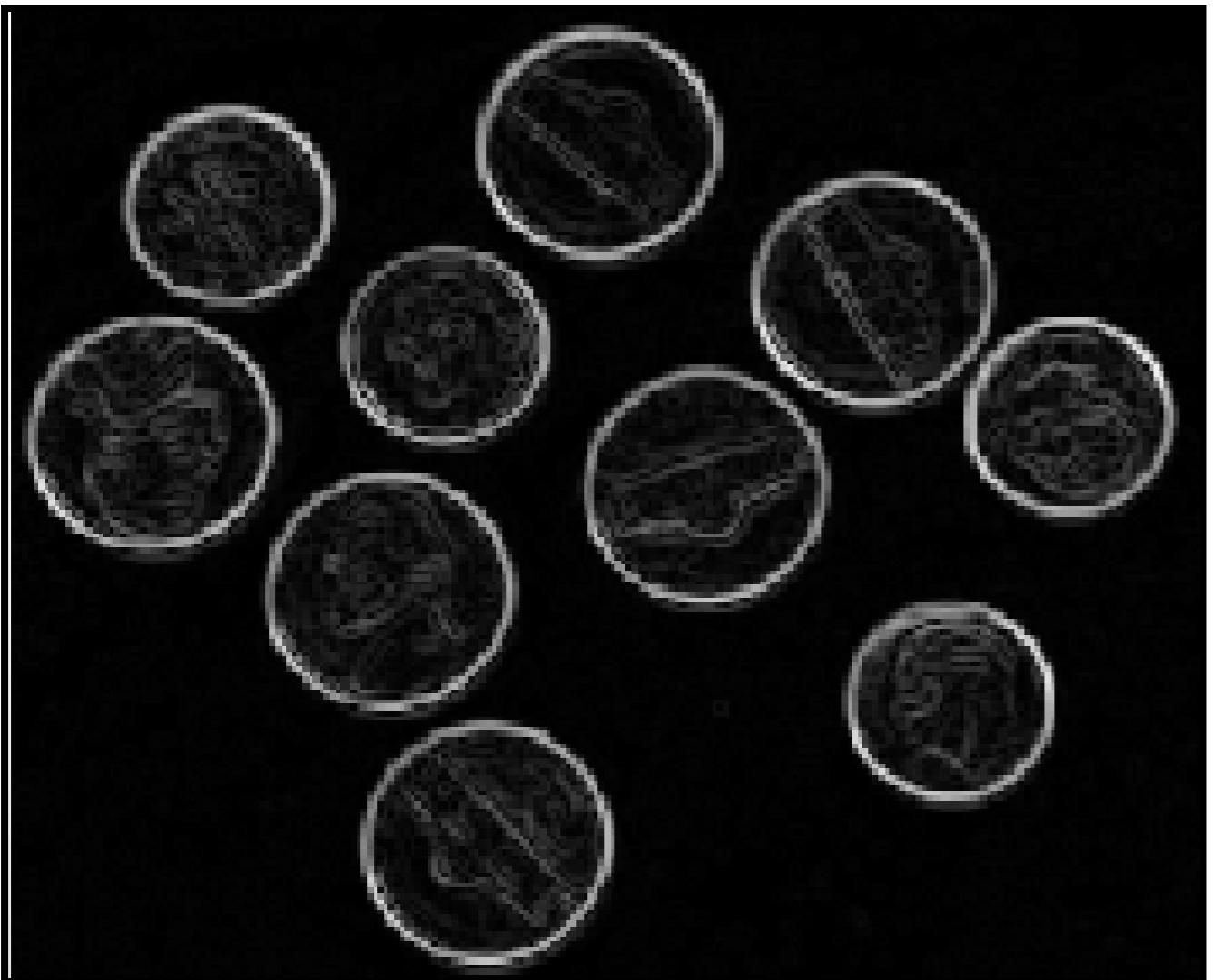


Edges with Canny

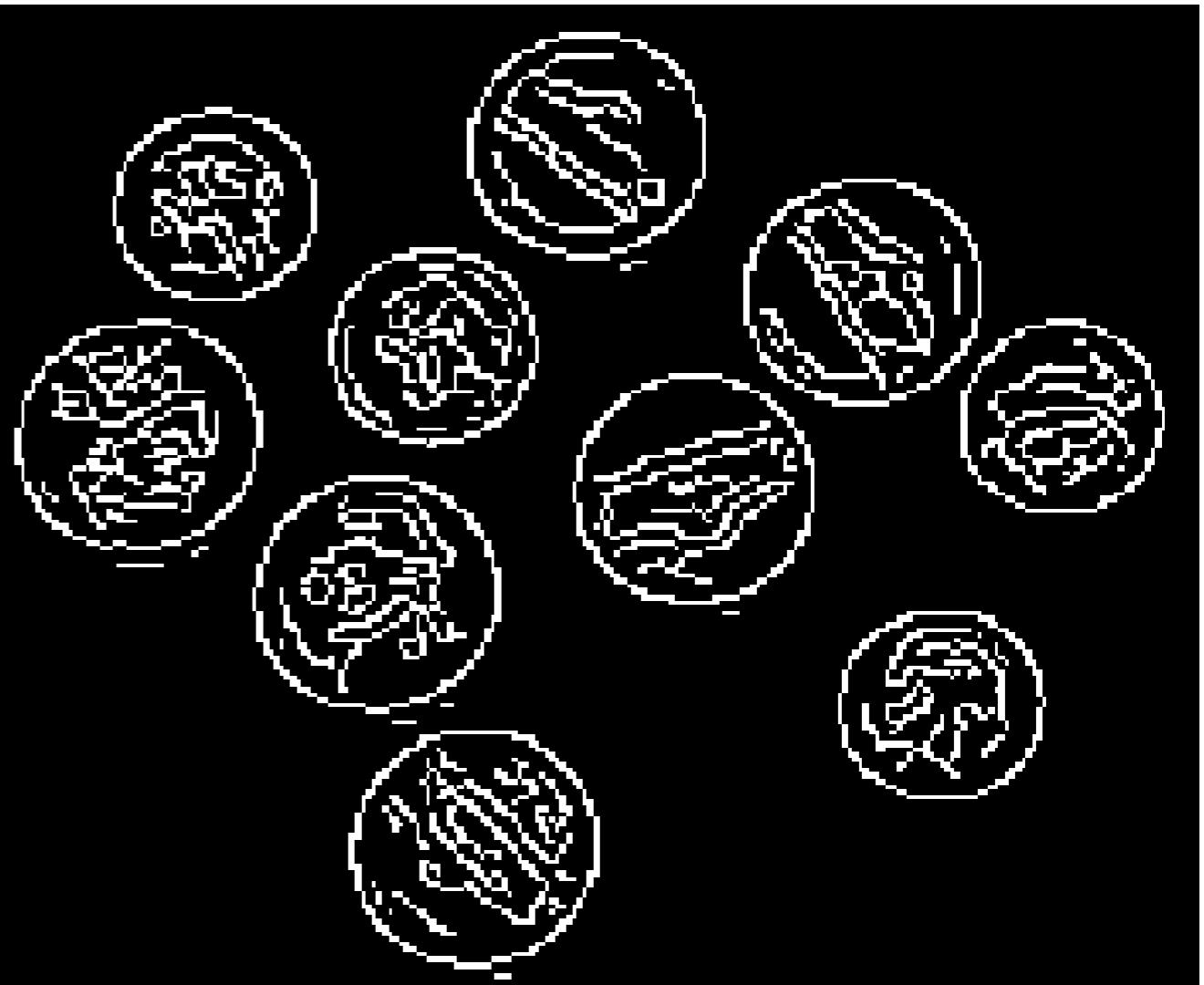


# Edge detection

Edges with Sobel



Edges with Canny



# Edge detection

```
from skimage.feature import canny

# Convert image to grayscale
coins = color.rgb2gray(coins)

# Apply Canny detector
canny_edges = canny(coins)

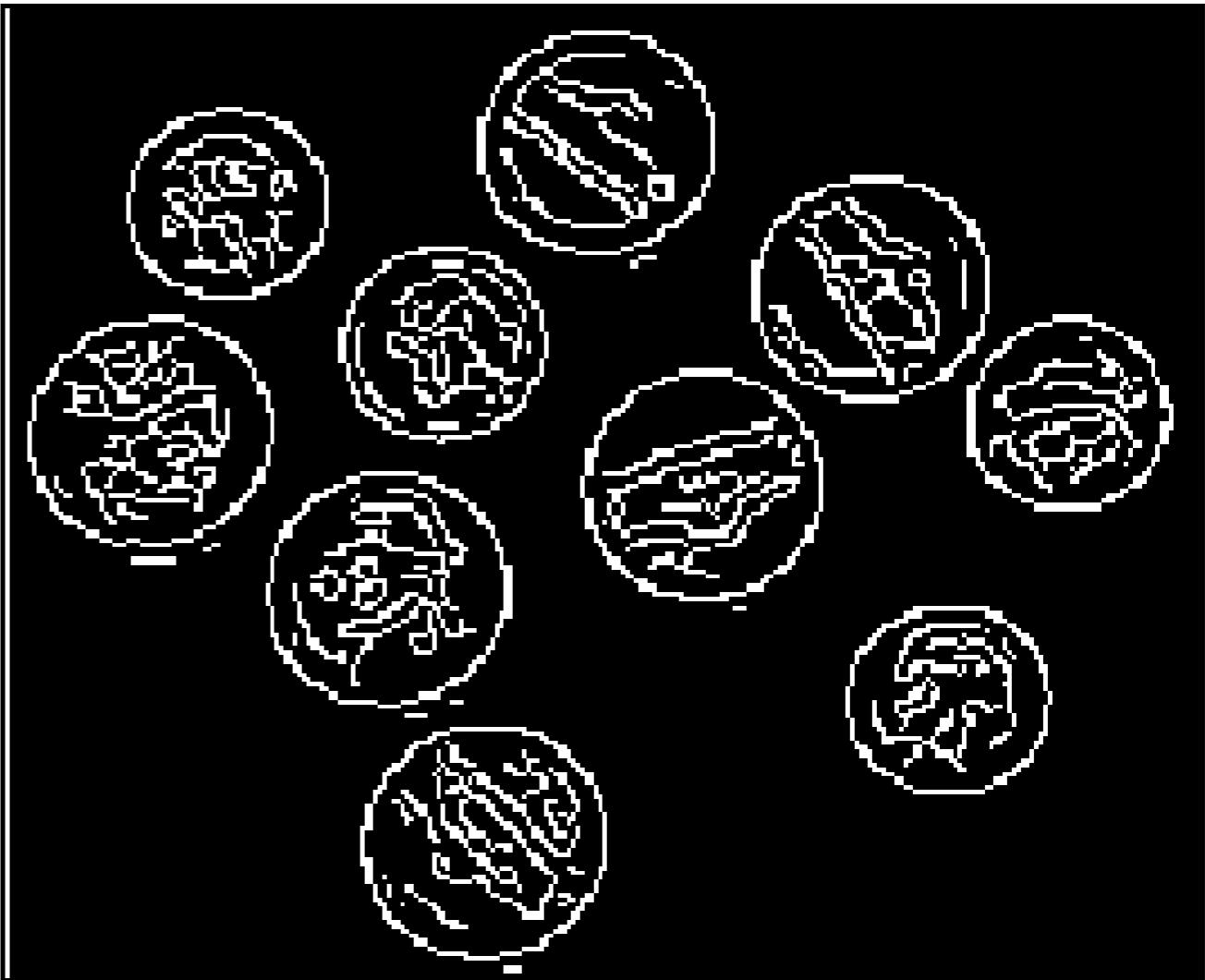
# Show resulted image with edges
show_image(canny_edges, "Edges with Canny")
```

# Edge detection

Original



Edges with Canny

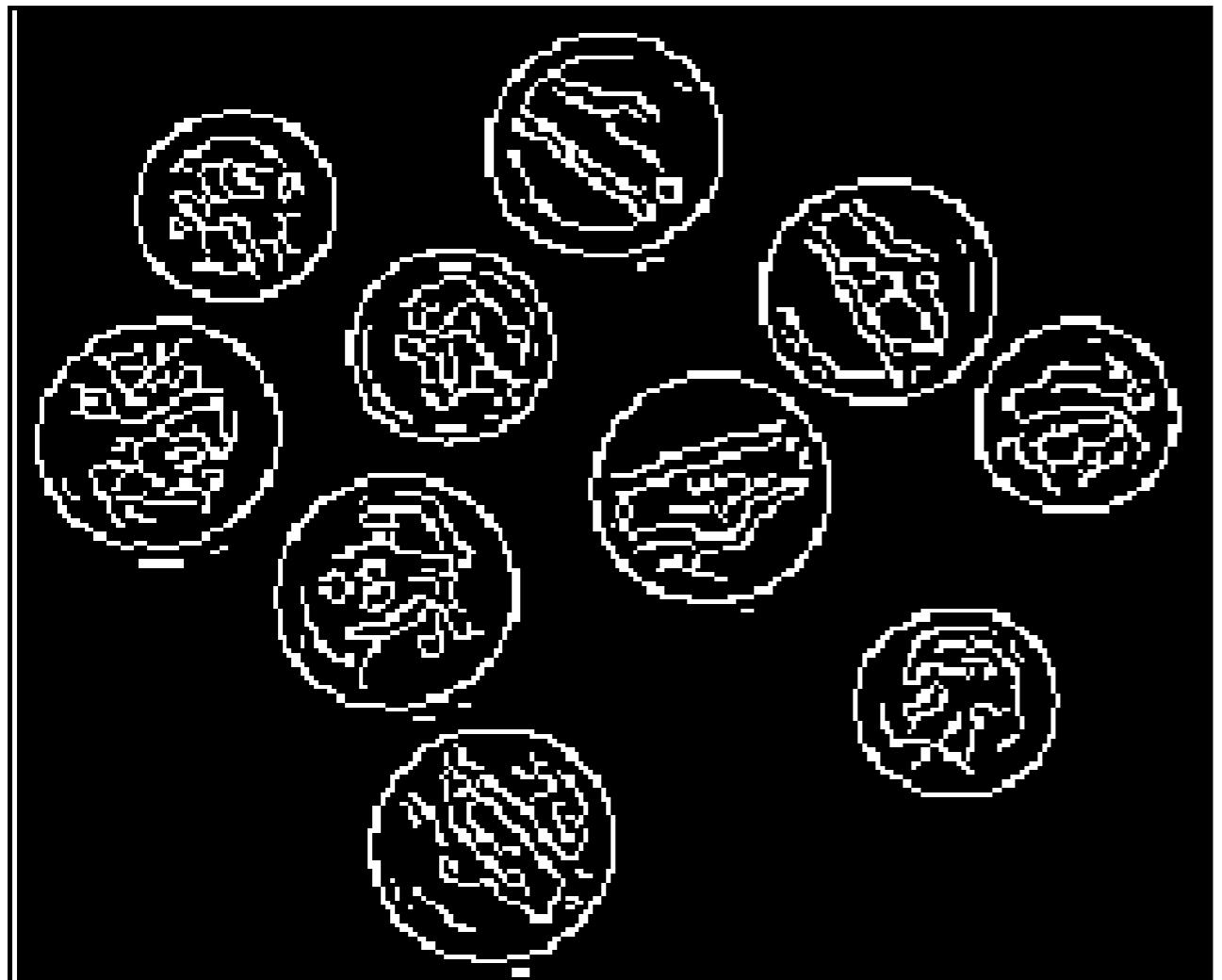


# Canny edge detector

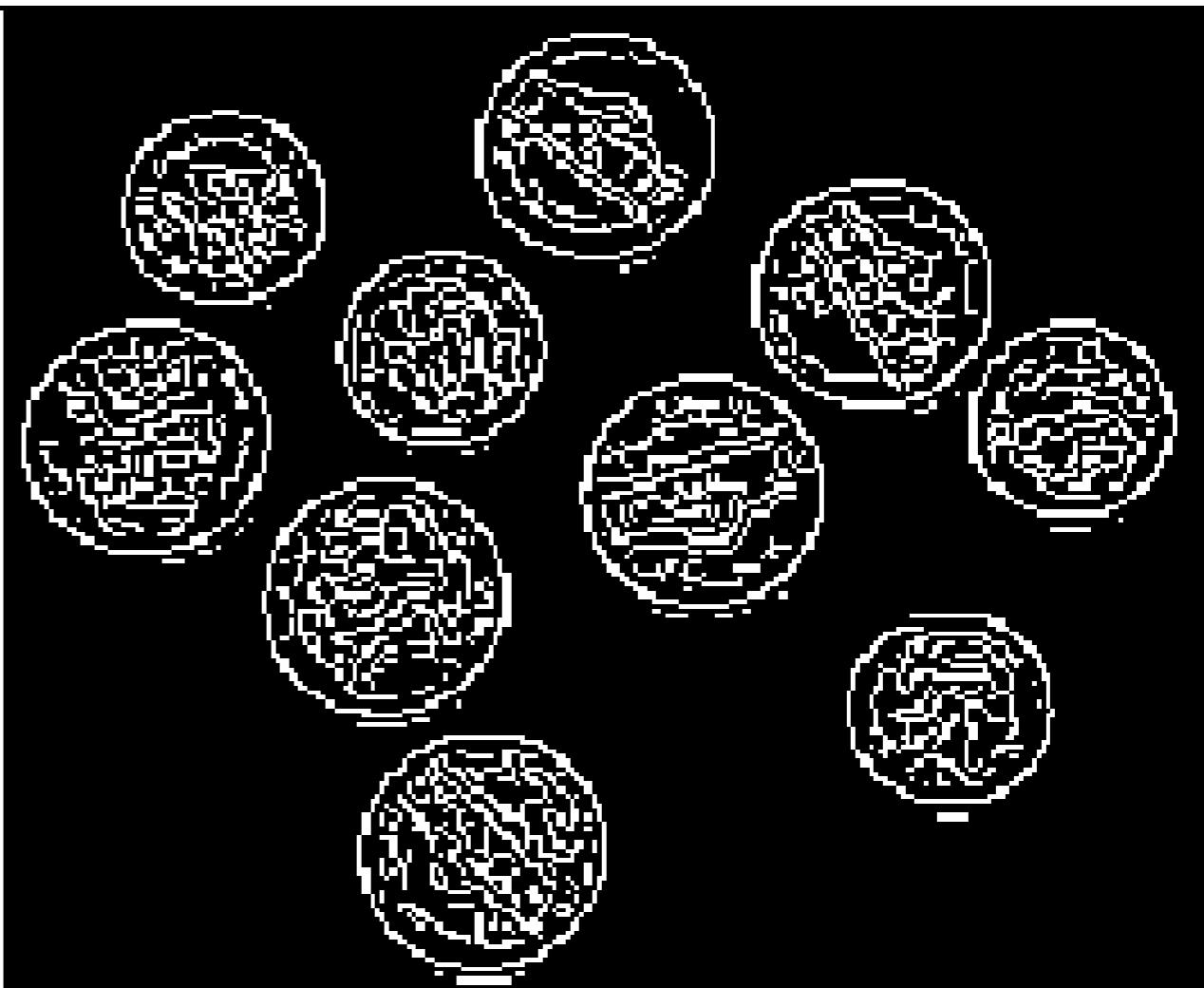
```
# Apply Canny detector with a sigma of 0.5  
canny_edges_0_5 = canny(coins, sigma=0.5)  
  
# Show resulted images with edges  
show_image(canny_edges, "Sigma of 1")  
show_image(canny_edges_0_5, "Sigma of 0.5")
```

# Canny edge detector

Sigma of 1



Sigma of 0.5



# Let's practice!

IMAGE PROCESSING IN PYTHON

# Right around the corner

IMAGE PROCESSING IN PYTHON



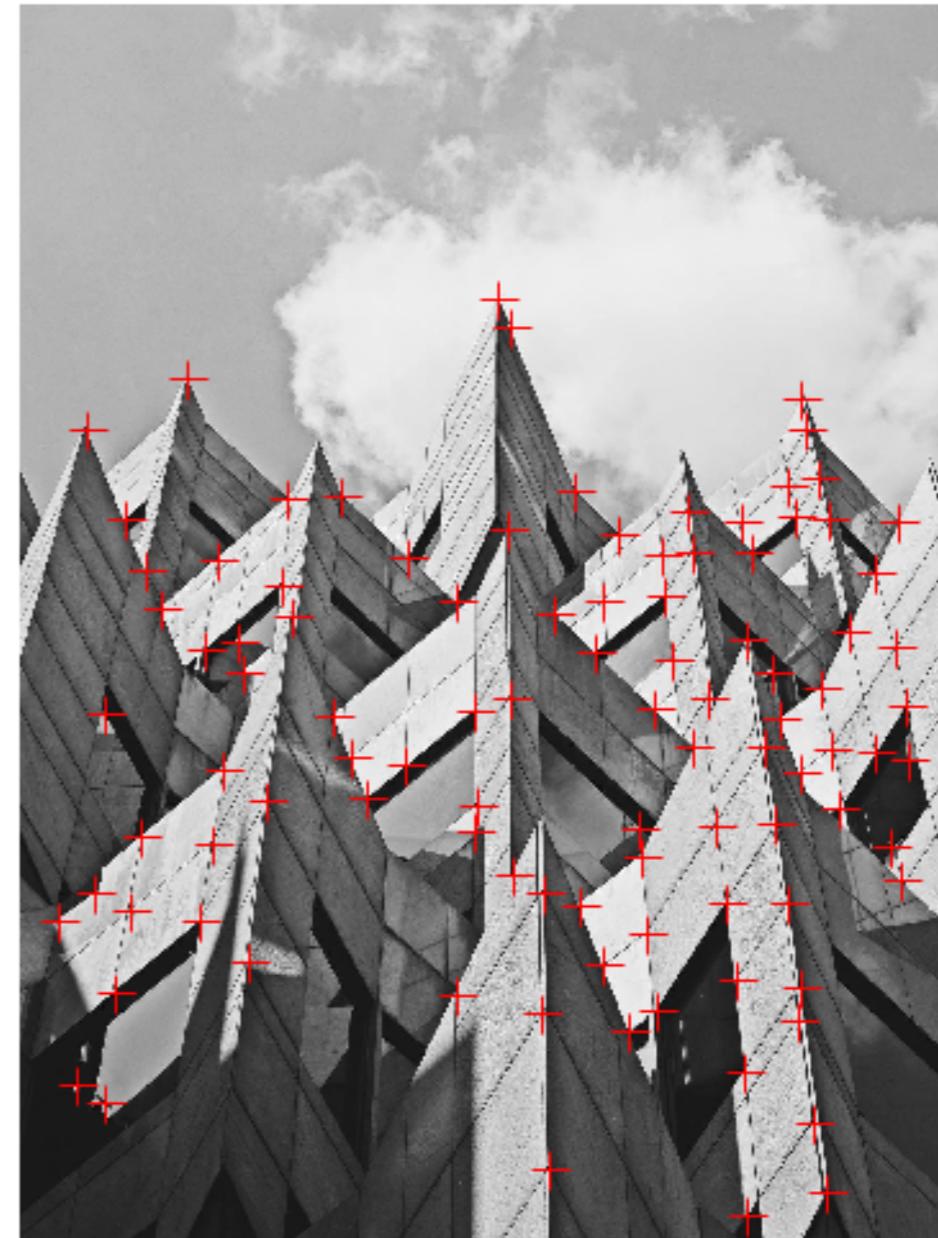
Rebeca Gonzalez  
Data Engineer

# Corner detection

Original image

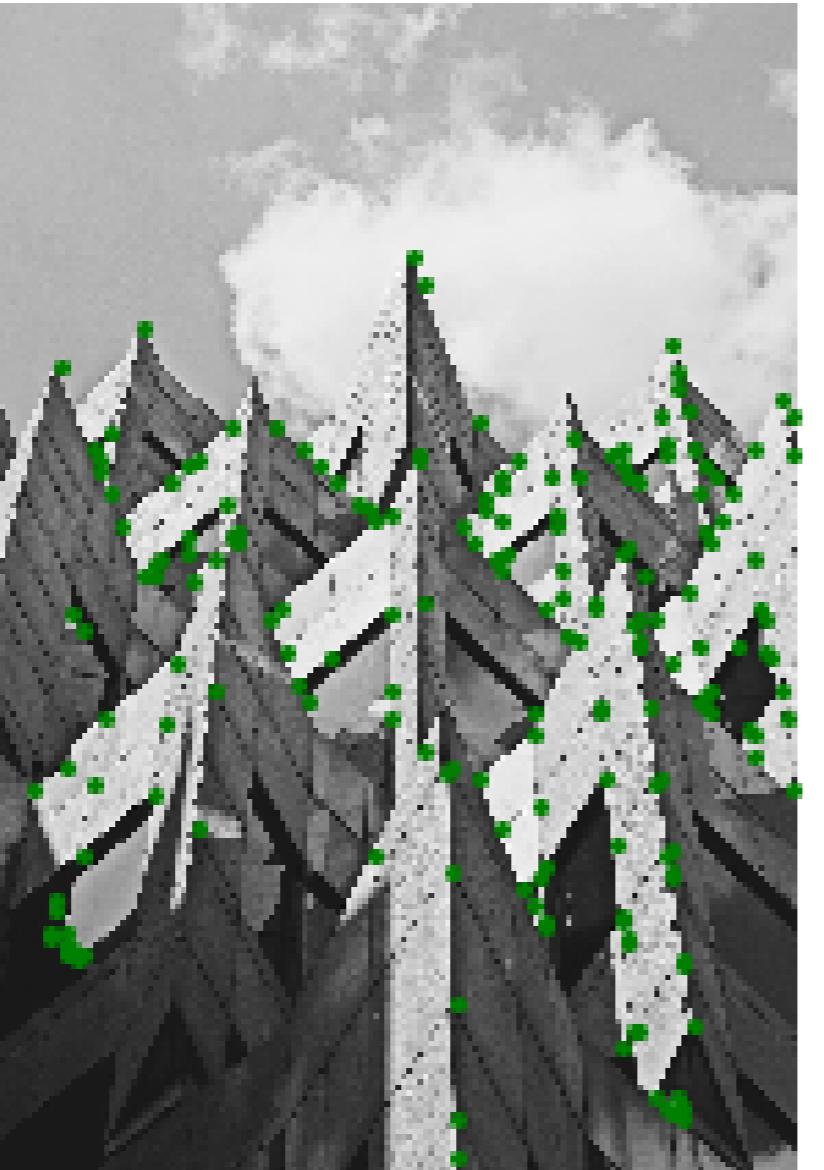


Corners detected



# Points of interest

Points of interest

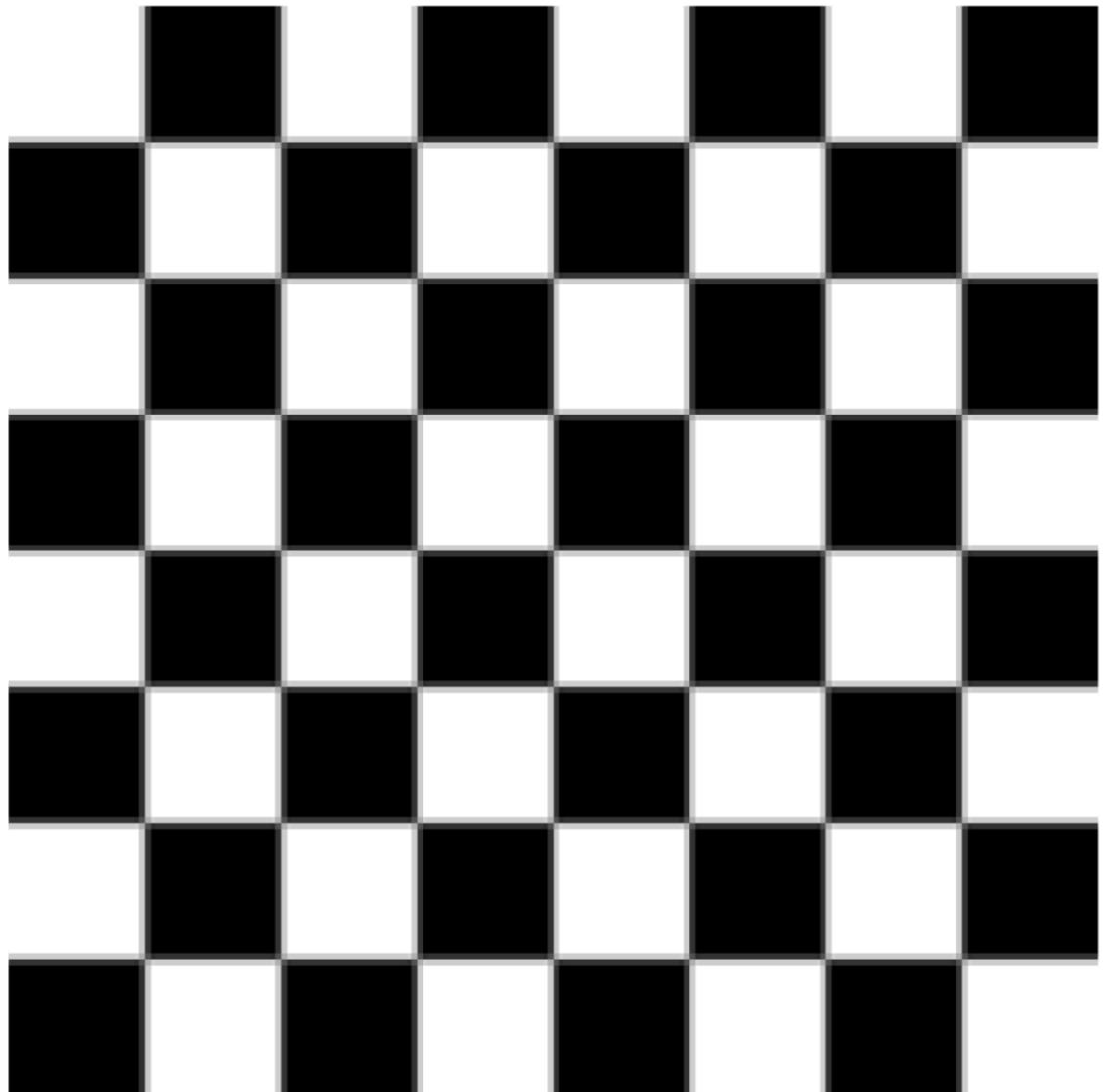


Edges with Sobel

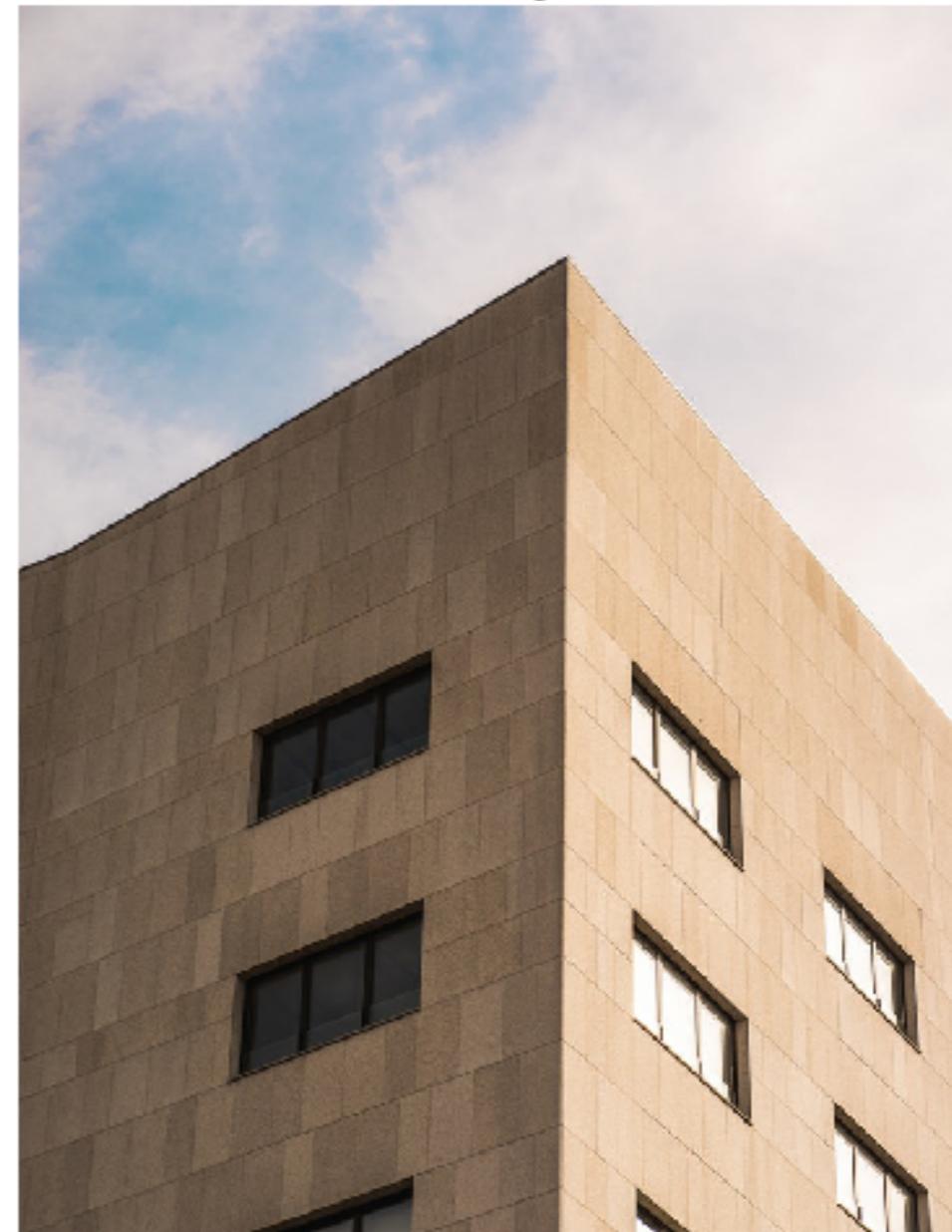


# Corners

Checkerboard

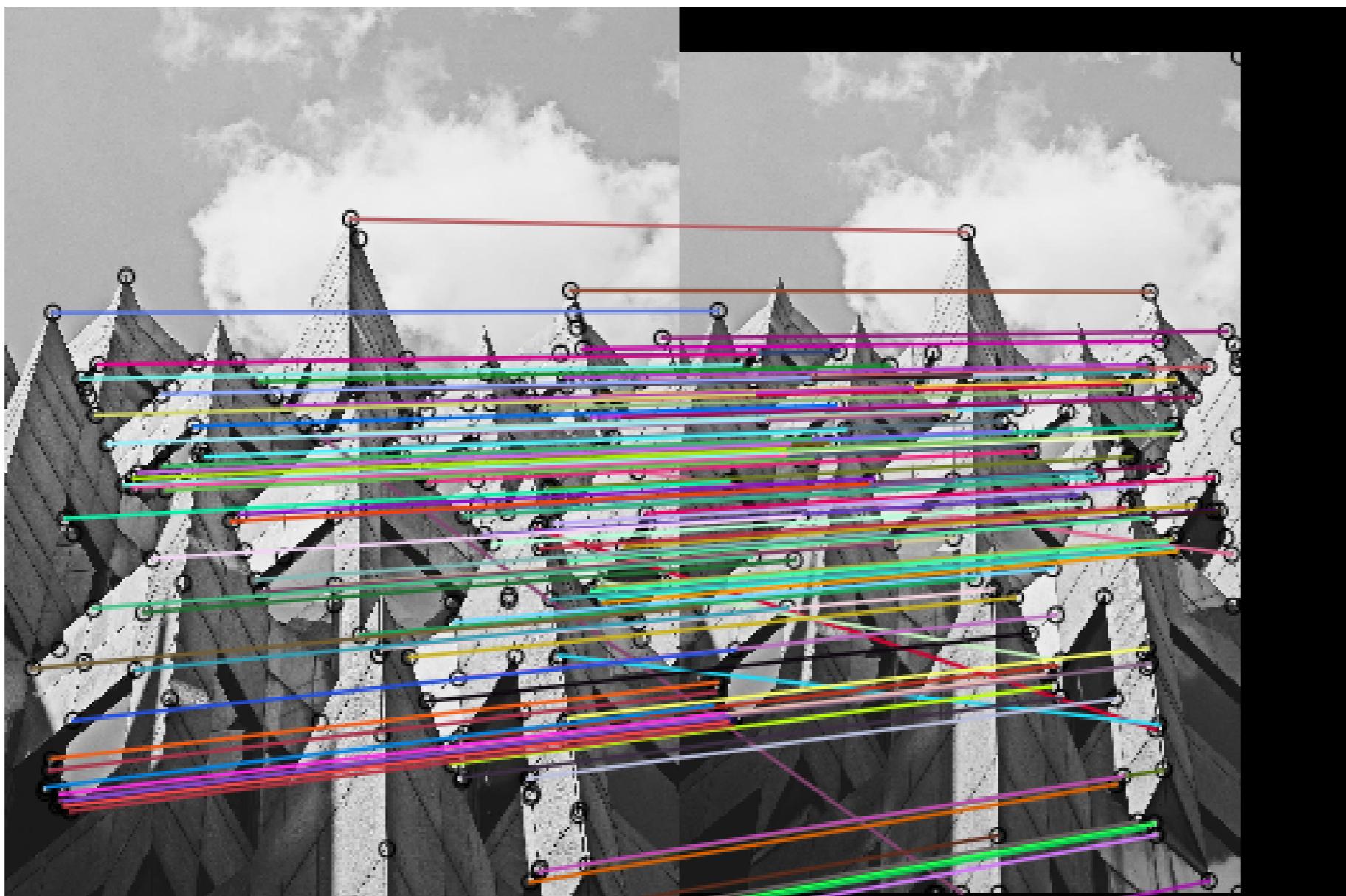


Building



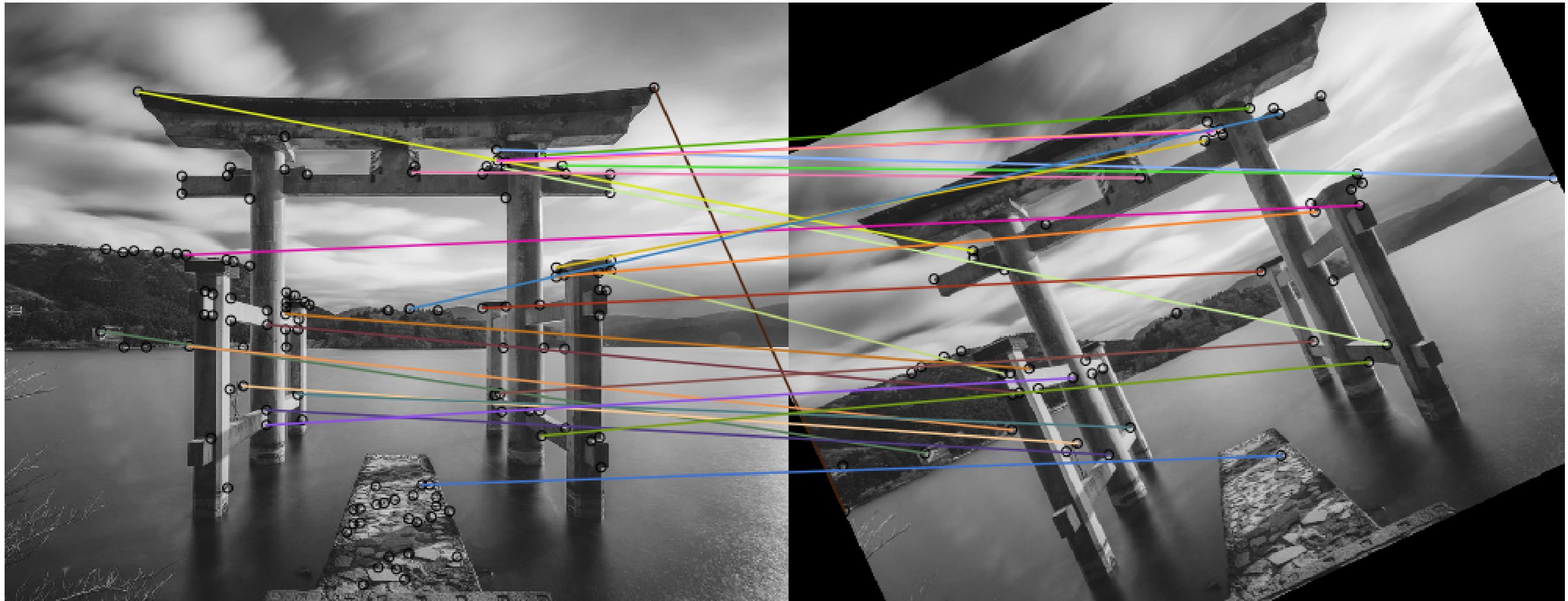
# Matching corners

Original Image vs. Transformed Image



# Matching corners

Original Image vs. Transformed Image



# Harris corner detector

Original image



Corners detected



# Harris corner detector



# Harris corner detector

```
from skimage.feature import corner_harris

# Convert image to grayscale
image = rgb2gray(image)

# Apply the Harris corner detector on the image
measure_image = corner_harris(image)

# Show the Harris response image
show_image(measure_image)
```

# Harris corner detector

Harris response image



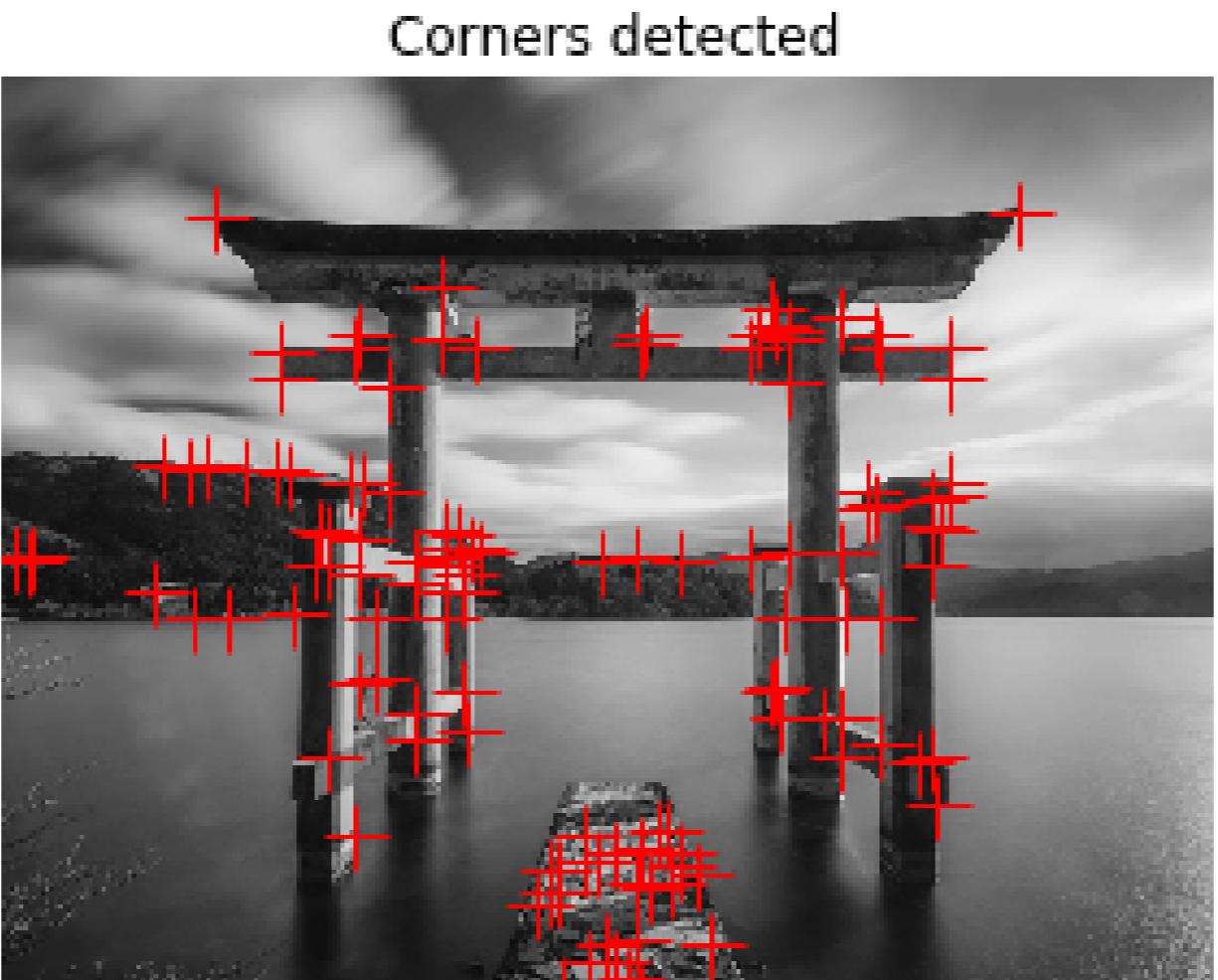
# Harris corner detector

```
# Finds the coordinates of the corners  
coords = corner_peaks(corner_harris(image), min_distance=5)  
  
print("A total of", len(coords), "corners were detected.")
```

A total of 122 corners were found from measure response image.

# Corners detected

```
# Show image with marks in detected corners  
show_image_with_detected_corners(image, coords)
```



# Show image with contours

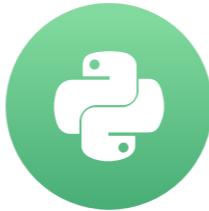
```
def show_image_with_corners(image, coords, title="Corners detected"):  
    plt.imshow(image, interpolation='nearest', cmap='gray')  
    plt.title(title)  
    plt.plot(coords[:, 1], coords[:, 0], '+r', markersize=15)  
    plt.axis('off')  
    plt.show()
```

# Let's practice!

IMAGE PROCESSING IN PYTHON

# Face detection

IMAGE PROCESSING IN PYTHON



**Rebeca Gonzalez**  
Data Engineer

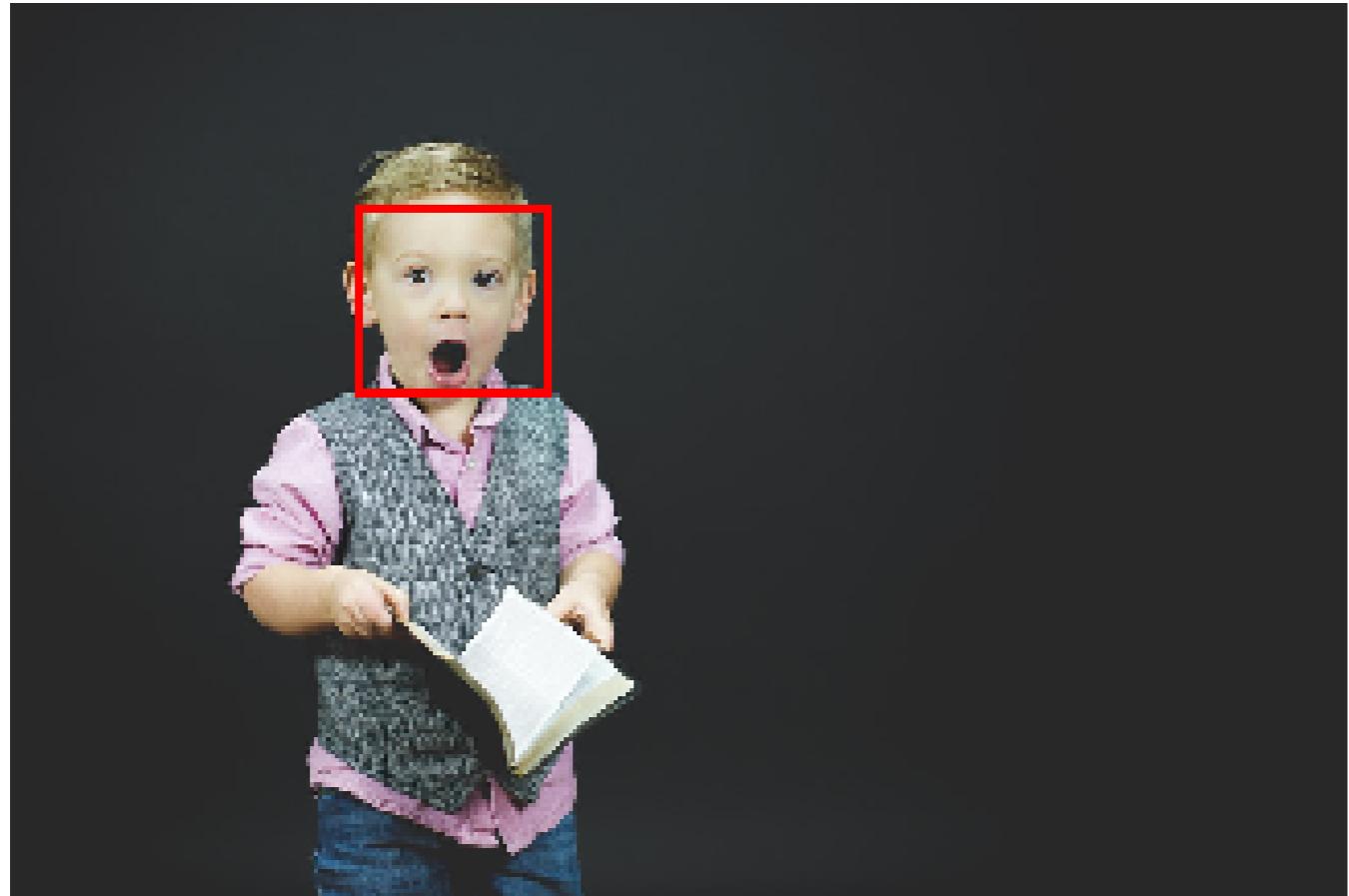
# Face detection use cases

- Filters
- Auto focus
- Recommendations
- Blur for privacy protection
- To recognize emotions later on

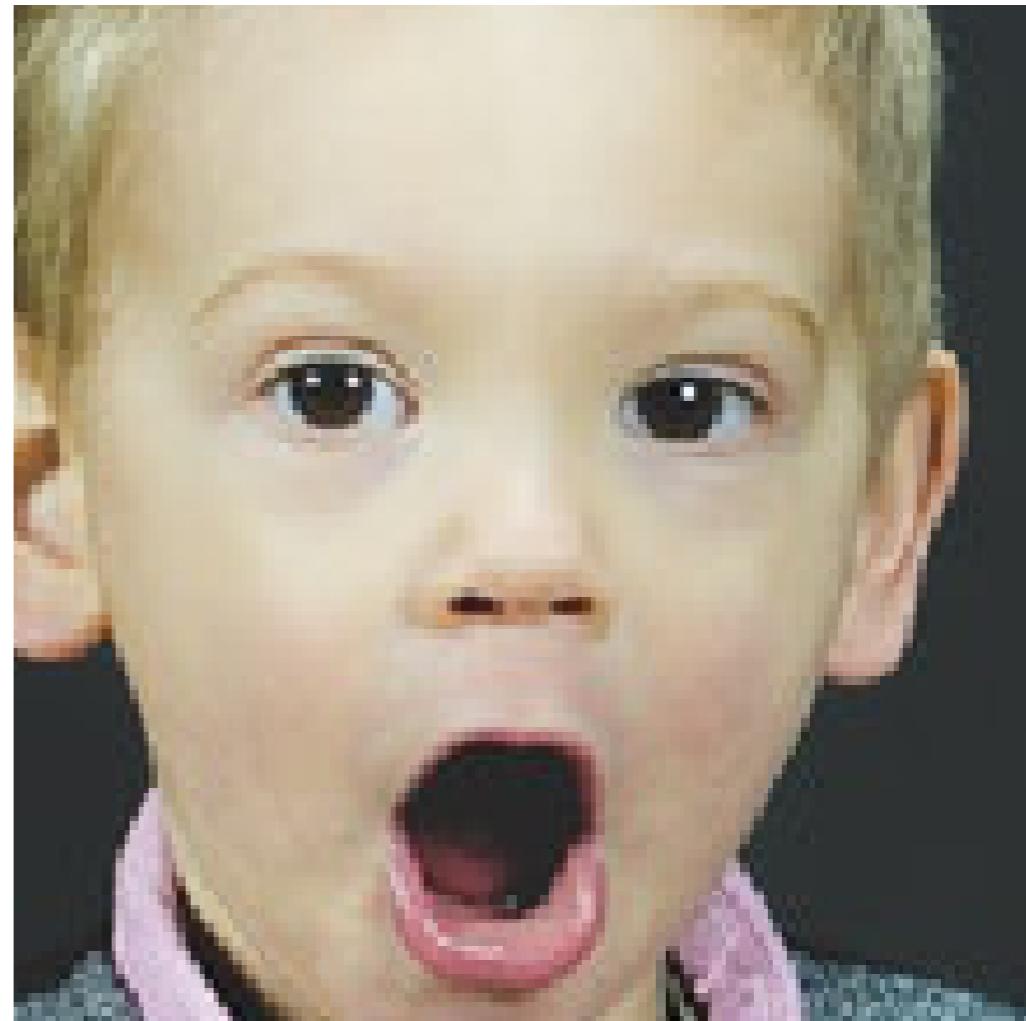


# Detecting faces with scikit-image

Face image



Face detected



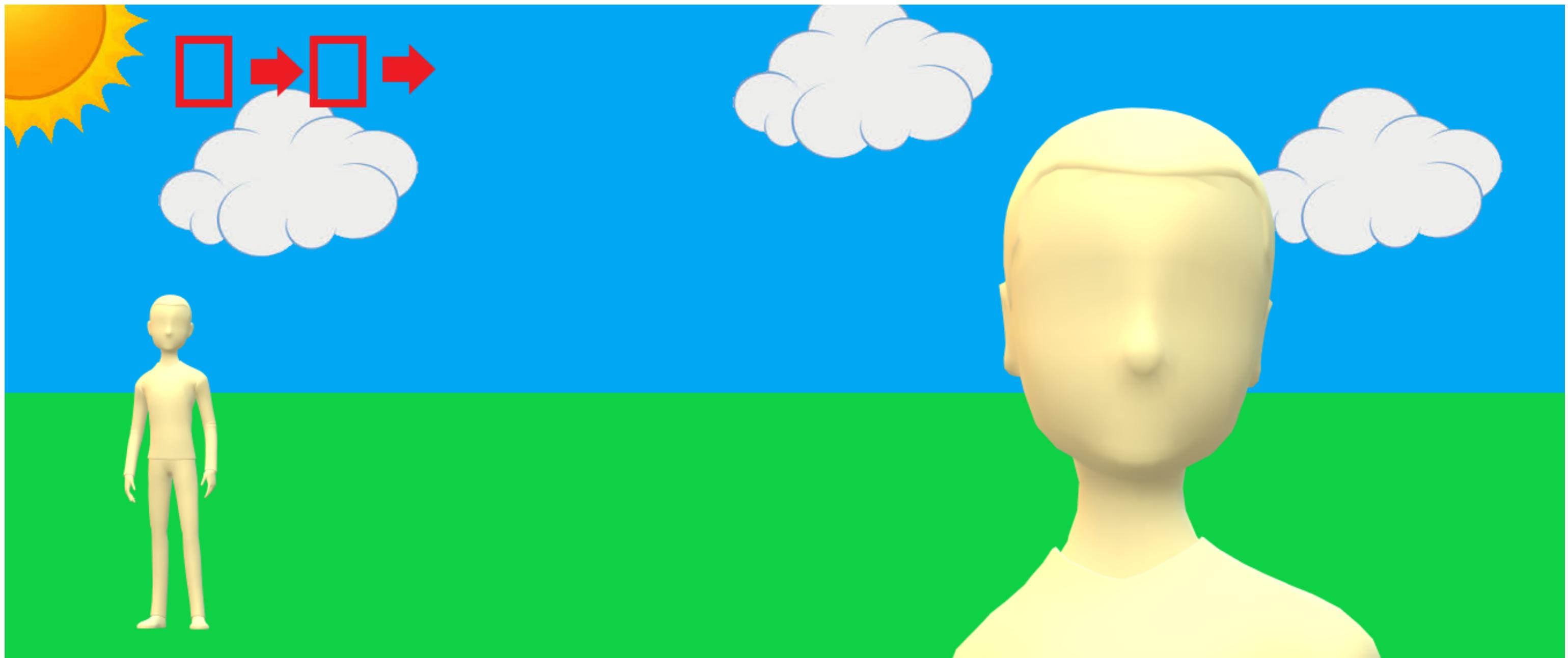
# Detecting faces with scikit-image

```
# Import the classifier class  
from skimage.feature import Cascade  
  
# Load the trained file from the module root.  
trained_file = data.lbp_frontal_face_cascade_filename()  
  
# Initialize the detector cascade.  
detector = Cascade(trained_file)
```

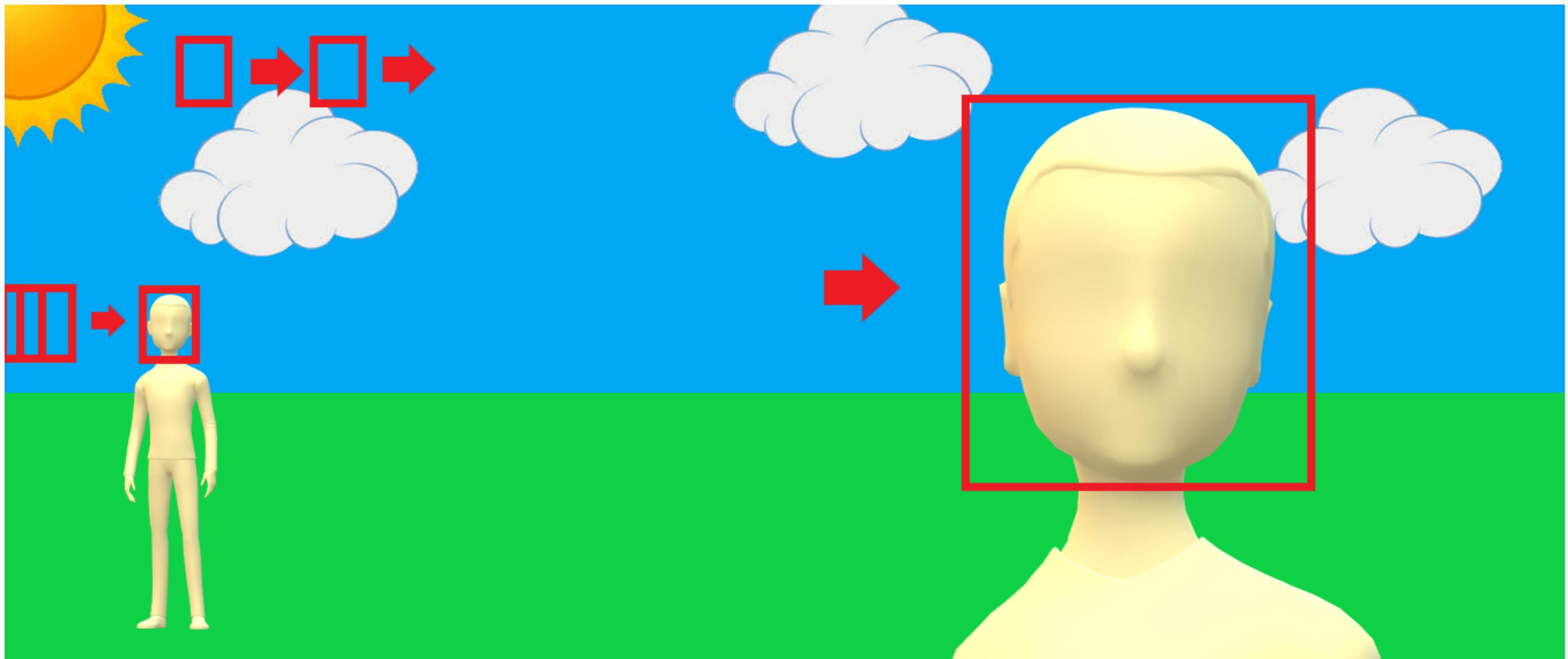
# Let's try it



# Detecting faces



# Detecting faces



# Detecting faces

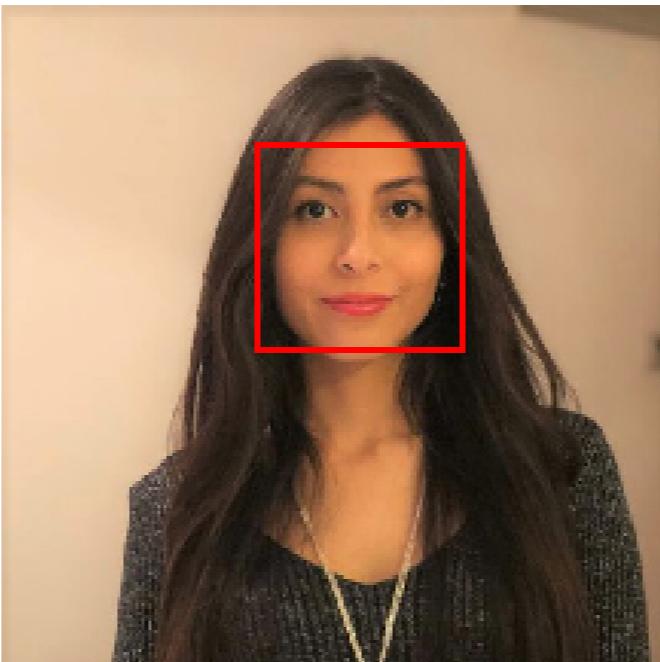
```
# Apply detector on the image  
detected = detector.detect_multi_scale(img=image,  
                                         scale_factor=1.2,  
                                         step_ratio=1,  
                                         min_size=(10, 10),  
                                         max_size=(200, 200))
```

# Detected faces

```
print(detected)  
# Show image with detected face marked  
show_detected_face(image, detected)
```

```
Detected face: [ {'r': 115, 'c': 210, 'width': 167, 'height': 167}]
```

Face image



# Show detected faces

```
def show_detected_face(result, detected, title="Face image"):  
    plt.imshow(result)  
    img_desc = plt.gca()  
    plt.set_cmap('gray')  
    plt.title(title)  
    plt.axis('off')  
  
    for patch in detected:  
        img_desc.add_patch(  
            patches.Rectangle(  
                (patch['c'], patch['r']),  
                patch['width'],  
                patch['height'],  
                fill=False, color='r', linewidth=2)  
        )  
    plt.show()
```

# Let's practice!

IMAGE PROCESSING IN PYTHON

# Real-world applications

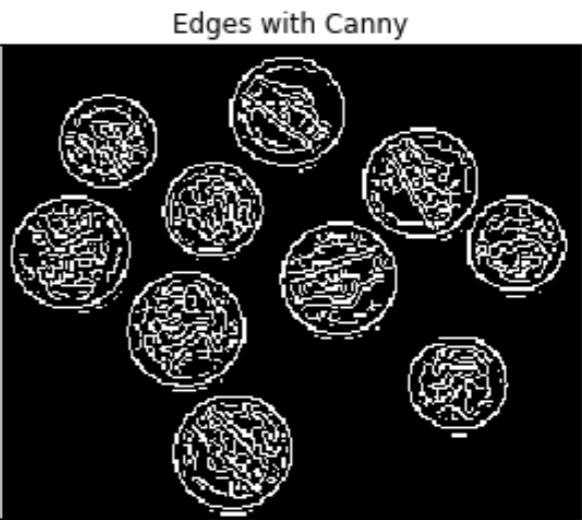
IMAGE PROCESSING IN PYTHON



**Rebeca Gonzalez**  
Data engineer

# Applications

- Turning to grayscale before detecting edges/corners
- Reducing noise and restoring images
- Blurring faces detected
- Approximation of objects' sizes



# Privacy protection



# Privacy protection

```
# Import Cascade of classifiers and gaussian filter
from skimage.feature import Cascade
from skimage.filters import gaussian
```

# Privacy protection

```
# Detect the faces
detected = detector.detect_multi_scale(img=image,
                                         scale_factor=1.2, step_ratio=1,
                                         min_size=(50, 50), max_size=(100, 100))

# For each detected face
for d in detected:
    # Obtain the face cropped from detected coordinates
    face = getFace(d)
```

# Privacy protection

```
def getFace(d):
    ''' Extracts the face rectangle from the image using the
    coordinates of the detected.'''
    # X and Y starting points of the face rectangle
    x, y = d['r'], d['c']

    # The width and height of the face rectangle
    width, height = d['r'] + d['width'], d['c'] + d['height']

    # Extract the detected face
    face= image[x:width, y:height]
    return face
```

# Privacy protection

```
# Detect the faces
detected = detector.detect_multi_scale(img=image,
                                         scale_factor=1.2, step_ratio=1,
                                         min_size=(50, 50), max_size=(100, 100))

# For each detected face
for d in detected:
    # Obtain the face cropped from detected coordinates
    face = getFace(d)

    # Apply gaussian filter to extracted face
    gaussian_face = gaussian(face, multichannel=True, sigma = 10)

    # Merge this blurry face to our final image and show it
    resulting_image = mergeBlurryFace(image, gaussian_face)
```

# Privacy protection

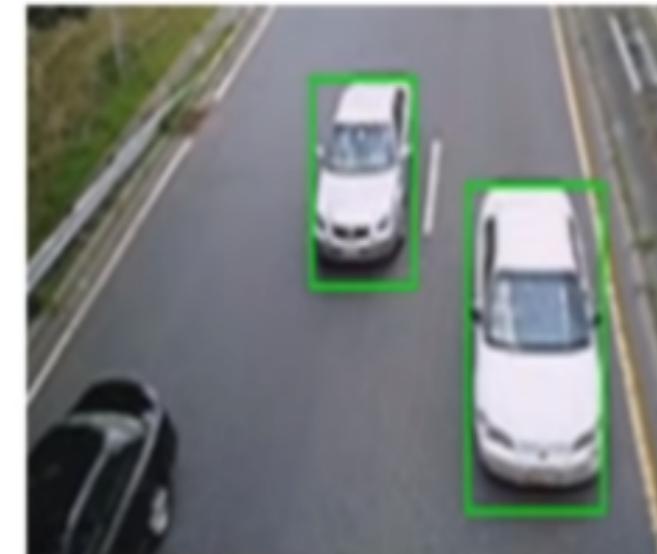
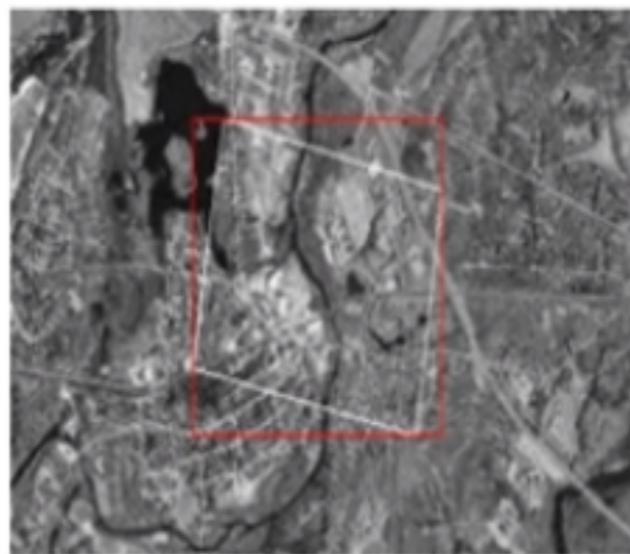
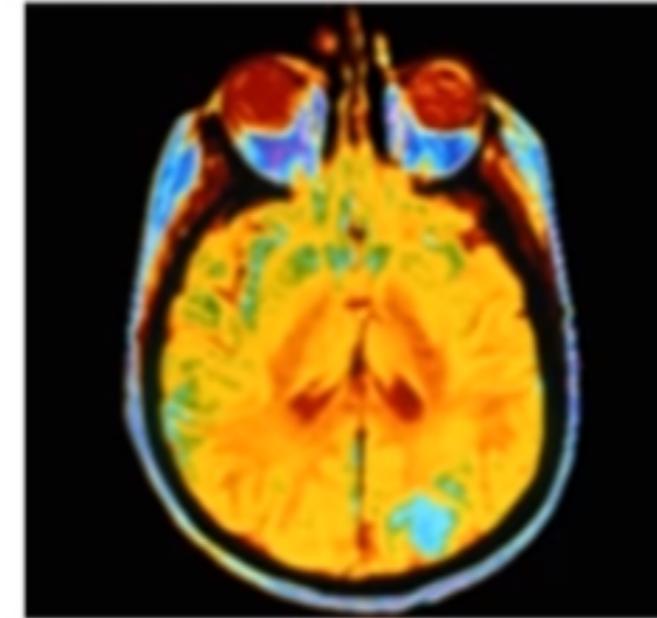
```
def mergeBlurryFace(original, gaussian_image):  
    # X and Y starting points of the face rectangle  
    x, y = d['r'], d['c']  
    # The width and height of the face rectangle  
    width, height = d['r'] + d['width'], d['c'] + d['height']  
  
    original[ x:width, y:height] = gaussian_image  
    return original
```

# Privacy protection

Blurred faces



# More cases



# Let's practice!

IMAGE PROCESSING IN PYTHON

# Amazing work!

IMAGE PROCESSING IN PYTHON



**Rebeca Gonzalez**  
Data Engineer

# Recap: What you have learned

- Improved contrast
- Restored images
- Applied filters
- Rotated, flipped and resized!
- Segmented: supervised and unsupervised
- Applied morphological operators
- Created and reduced noise
- Detected edges, corners and faces
- And mixed them up to solve problems!

# What's next?

- Tinting gray scale images
- Matching
- Approximation
- Many others!



# Congrats!

IMAGE PROCESSING IN PYTHON