Marwadi University Marwadi Chandarana Group NAAC A+	**Marwadi University** **Faculty of Engineering & Technology** **Department of Information and Communication Technology**	
Subject: Programming With Python (01CT1309)	**Aim:** Practical based on Image Processing with Numpy	
Experiment No: 11	**Date:**	**Enrollment No:92510133011**

Aim: Practical based on Image Processing with Numpy

IDE:

NumPy for Image Processing

NumPy is a robust tool for image processing in Python.

Importing Libraries
The required libraries: PIL, NumPy, and Matplotlib. PIL is used for opening images. NumPy allows for efficient array operations and image processing. Matplotlib is used for visualizing images

```
import numpy as np
from PIL import Image
import matplotlib.pyplot as plt
```

Crop Image

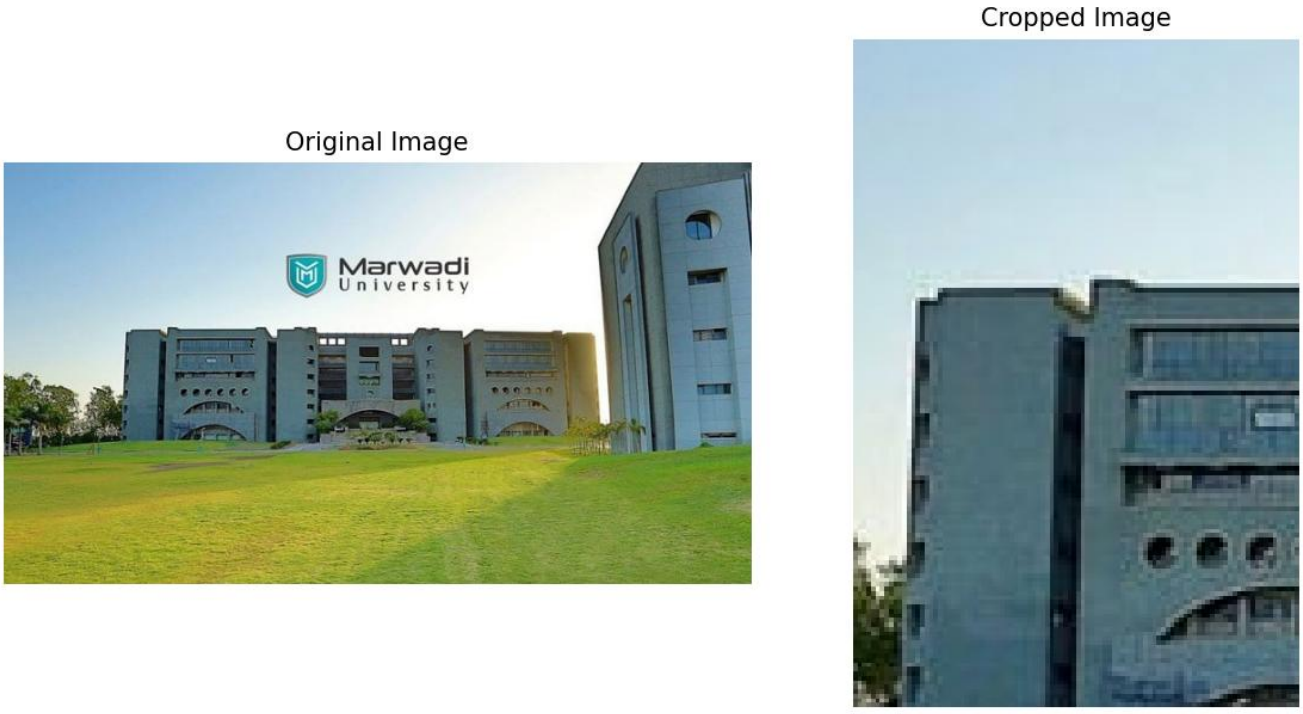
We define coordinates to mark the area we want to crop from the image. The new image contains only the selected part and discards the rest.

Example:

```
import numpy as np
from PIL import Image
import matplotlib.pyplot as plt
img = Image.open(r'C:\Users\Mitesh\OneDrive\Desktop\images.jpg')
img_array = np.array(img)
print(img_array)
y1, x1 = 100, 100  # Top-left corner of ROI
y2, x2 = 250, 200  # Bottom-right corner of ROI
cropped_img = img_array[y1:y2, x1:x2]
plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plt.imshow(img_array)
plt.title('Original Image')
plt.axis('off')
```

```
plt.subplot(1, 2, 2)
plt.imshow(cropped_img)
plt.title('Cropped Image')
plt.axis('off')
plt.tight_layout()
plt.show()
```

Output:



Rotate Image

We rotate the image array 90 degrees counterclockwise using NumPy's 'rot90' function.

Example:

```
import numpy as np
from PIL import Image
import matplotlib.pyplot as plt
img = Image.open(r'C:\Users\Mitesh\OneDrive\Desktop\images.jpg')
```

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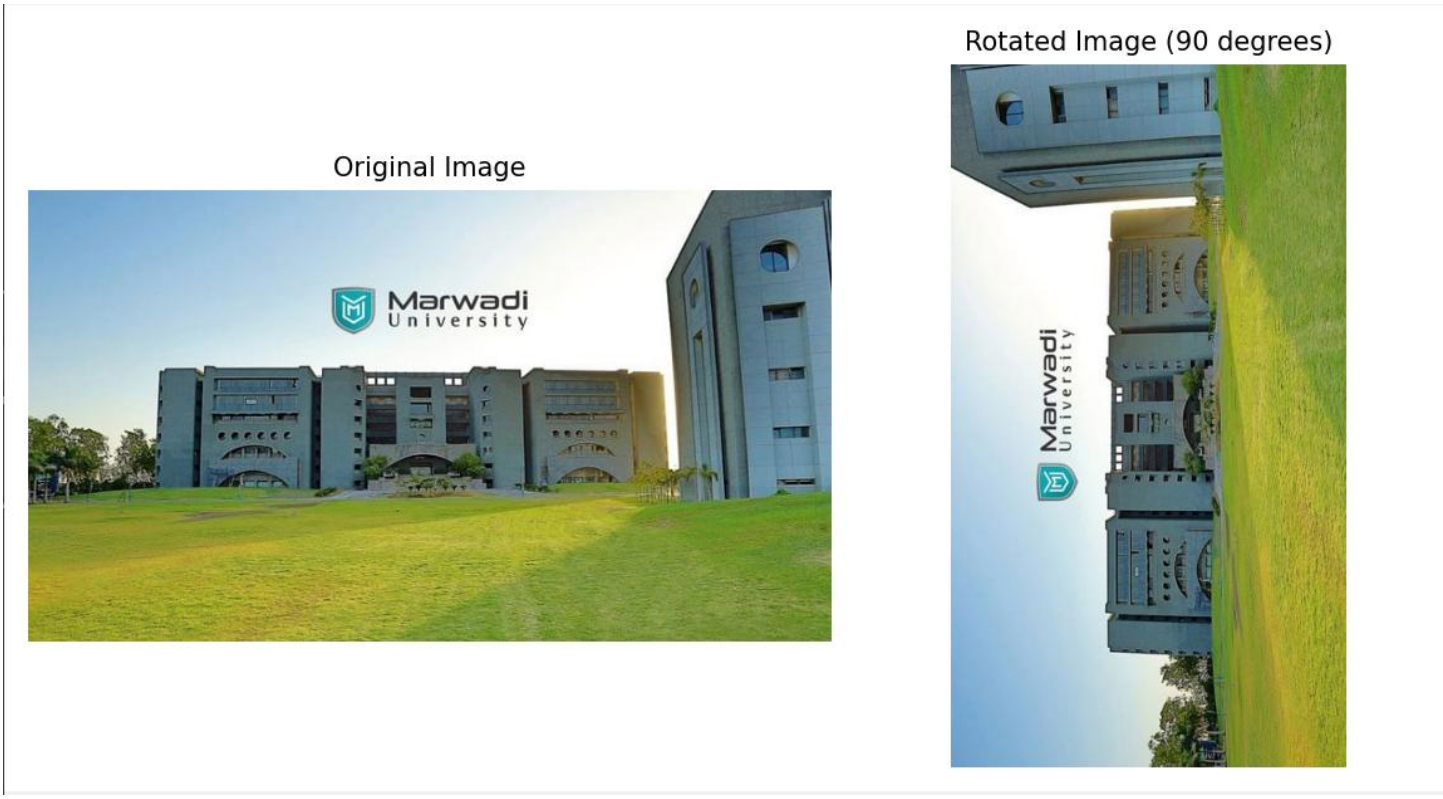
```
img_array = np.array(img)
rotated_img = np.rot90(img_array)
plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plt.imshow(img_array)
plt.title('Original Image')
plt.axis('off')

plt.subplot(1, 2, 2)
plt.imshow(rotated_img )
plt.title('Rotated Image (90 degrees)')
plt.axis('off')

plt.tight_layout()
plt.show()
```

Output:



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Flip Image

We use NumPy's 'fliplr' function to flip the image array horizontally.

Example:

```
import numpy as np
from PIL import Image
import matplotlib.pyplot as plt
img = Image.open(r'C:\Users\Mitesh\OneDrive\Desktop\images.jpg')
img_array = np.array(img)
flipped_img = np.fliplr(img_array)
plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plt.imshow(img_array)
plt.title('Original Image')
plt.axis('off')
plt.subplot(1, 2, 2)
plt.imshow(flipped_img )
plt.title('Flipped Image')
plt.axis('off')
plt.tight_layout()
plt.show()
```

Output:

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Negative of an Image

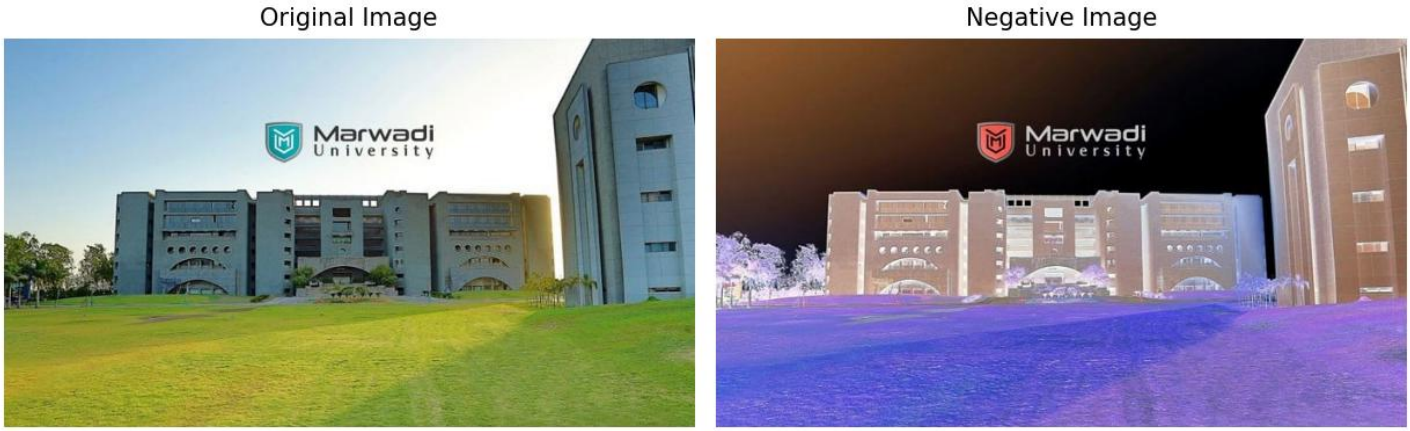
The negative of an image is made by reversing its pixel values. In grayscale images, each pixel's value is subtracted from the maximum (255 for 8-bit images). In color images, this is done separately for each color channel.

Example:

```
import numpy as np
from PIL import Image
import matplotlib.pyplot as plt
img = Image.open(r'C:\Users\Mitesh\OneDrive\Desktop\images.jpg')
img_array = np.array(img)
is_grayscale = len(img_array.shape) < 3
# Function to create negative of an image
def create_negative(image):
    if is_grayscale:
        # For grayscale images
        negative_image = 255 - image
    else:
        # For color images (RGB)
        negative_image = 255 - image
    return negative_image
# Create negative of the image
negative_img = create_negative(img_array)
# Display the original and negative images
plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plt.imshow(img_array)
plt.title('Original Image')
plt.axis('off')
plt.subplot(1, 2, 2)
plt.imshow(negative_img)
plt.title('Negative Image')
plt.axis('off')
```

```
plt.tight_layout()
plt.show()
```

Output:



Binarize Image

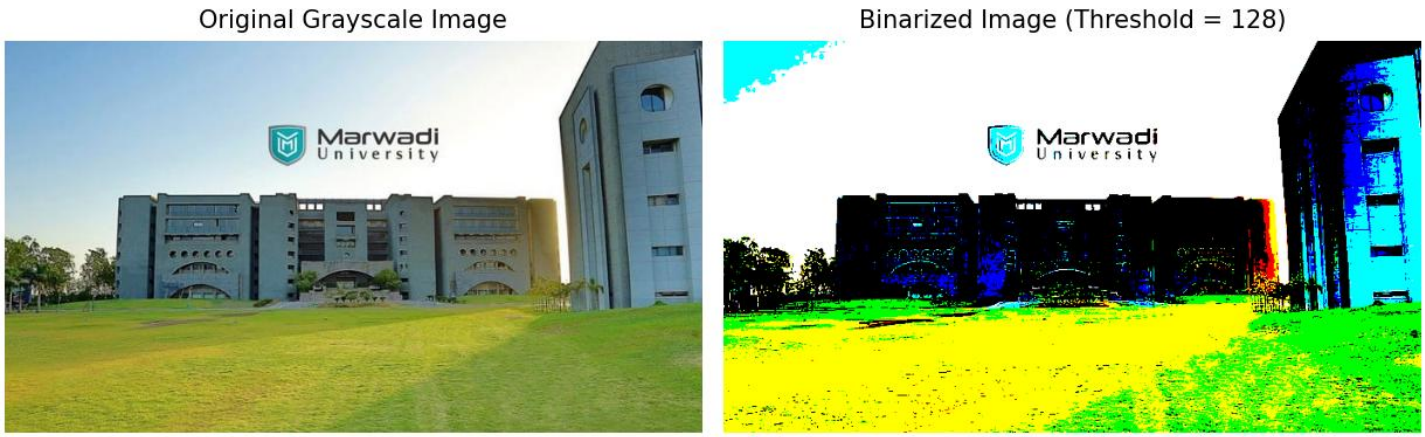
Binarizing an image converts it to black and white. Each pixel is marked black or white based on a threshold value. Pixels that are less than the threshold become 0 (black) and above those above it become 255 (white).

Example

```
import numpy as np
from PIL import Image, ImageOps
import matplotlib.pyplot as plt
img = Image.open(r'C:\Users\Mitesh\OneDrive\Desktop\images.jpg')
img_array = np.array(img)
# Binarize the image using a threshold
threshold = 128
binary_img = np.where(img_array < threshold, 0, 255).astype(np.uint8)
# Display the original and binarized images
plt.figure(figsize= (10, 5))
```

```
plt.subplot(1, 2, 1)
plt.imshow(img_array, cmap='gray')
plt.title('Original Grayscale Image')
plt.axis('off')
plt.subplot(1, 2, 2)
plt.imshow(binary_img, cmap='gray')
plt.title('Binarized Image (Threshold = 128)')
plt.axis('off')
plt.tight_layout()
plt.show()
```

Output:



Color Space Conversion

Color space conversion changes an image from one color model to another. This is done by changing the array of pixel values. We use a weighted sum of the RGB channels to convert a color image to a grayscale.

Example

```
import numpy as np
from PIL import Image, ImageOps
import matplotlib.pyplot as plt
img = Image.open(r'C:\Users\Mitesh\OneDrive\Desktop\images.jpg')
img_array = np.array(img)
# Grayscale conversion formula: Y = 0.299*R + 0.587*G + 0.114*B
gray_img = np.dot (img_array[..., :3], [0.299, 0.587, 0.114])
```

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```
# Display the original RGB image
plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plt.imshow(img_array)
plt.title('Original RGB Image')
plt.axis('off')
# Display the converted grayscale image
plt.subplot(1, 2, 2)
plt.imshow(gray_img, cmap='gray')
plt.title('Grayscale Image')
plt.axis('off')
plt.tight_layout()
plt.show()
```

Output:

Pixel Intensity Histogram

The histogram shows the distribution of pixel values in an image. The image is flattened into a one-dimensional array to compute the histogram.

Example:

```
import numpy as np
from PIL import Image, ImageOps
import matplotlib.pyplot as plt
```

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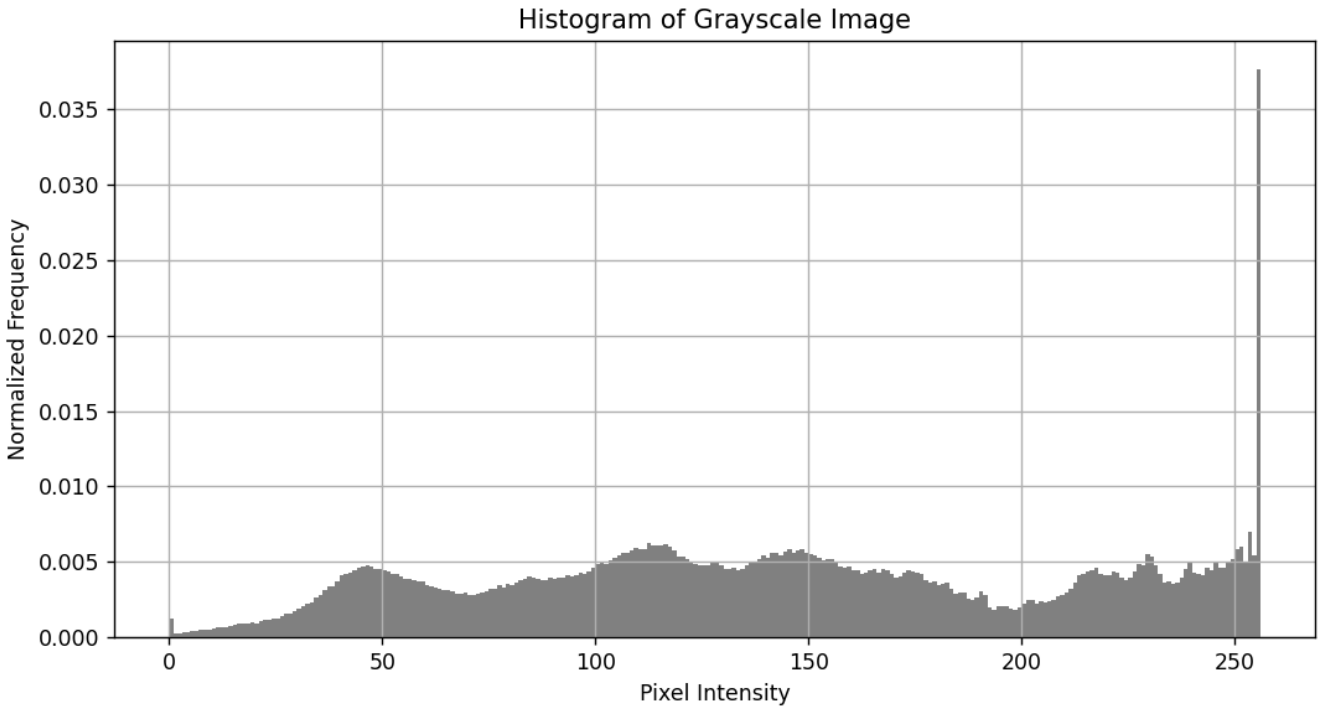
```
img = Image.open(r'C:\Users\Mitesh\OneDrive\Desktop\images.jpg')
img_array = np.array(img)
# Compute the histogram of the image
hist, bins = np.histogram(img_array.flatten(), bins=256, range= (0, 256))
# Plot the histogram
plt.figure(figsize=(10, 5))
plt.hist(img_array.flatten(), bins=256, range= (0, 256), density=True, color='gray')
plt.xlabel('Pixel Intensity')
plt.ylabel('Normalized Frequency')
plt.title('Histogram of Grayscale Image')
plt.grid(True)
plt.show()
```

Output:



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Post Lab Exercise:

a. Write a Python program to display details of an image (dimension of an image, shape of an image, min pixel value at channel B).

```
PS C:\Users\trupa\OneDrive\Documents\PWP> & C:/Users/trupa/AppData/Local/Programs/Python/Python313/python.exe "c:/Users/trupa/OneDrive/Documents/PWP/PWP EXP 11"
Dimensions (rows, cols, channels): (394, 700, 3)
Height x Width: 394 x 700
Number of Channels: 3
Min pixel value in Blue channel: 0
PS C:\Users\trupa\OneDrive\Documents\PWP>
```

b. Write a Python program to padding black spaces

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c. Write a Python program to visualize RGB channels

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More Practice
Reference : https://www.analyticsvidhya.com/blog/2021/05/image-processing-using-numpy-with-practical-implementation-and-code/