Computer Vision Labsheet 1

Geomtric Transformation

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Tasks

1. Read the given image.
2. Define separate functions to implement the following transformations
   - Translation
   - Scaling
   - Shearing
   - Rotation
   - Euclidean
   - Similarity
   - Affine
   - Projective
3. Convert the pixel coordinate to homogeneous form.
4. Apply transformations.
5. Find the new coordinates.
6. Display the transformed image.
7. Experiment with various parameters on each transition.

```
import os
import PIL
import numpy as np
import cv2
import matplotlib.pyplot as plt
```

To Do:

Tasks

1. Read the given image.
2. Define separate functions to implement the following transformations
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```
image_path = os.path.join('./Lab 1.jpg')
image = np.array(PIL.Image.open(image_path))
plt.imshow(image)
plt.axis('off')
plt.show()
```

```
print(image.shape)
```

```
(300, 400, 3)
```

```
# Defining functions for transformation
def translate(image, tx, ty):
    rows, cols = image.shape[:2]
    image_transformed = np.zeros_like(image)

    for i in range(rows):
        for j in range(cols):
            new_i = i+tx
            new_j = j+ty
            if 0 <= new_i < rows and 0 <= new_j < cols:
                image_transformed[new_i, new_j] = image[i,j]
    return image_transformed


def translate_using_matrix(image, tx, ty):
    rows, cols = image.shape[:2]
    tranformation_matrix = np.array([1,0,tx], [0,1,ty], [0,0,1])



def generate_translate_matrix(tx, ty):
    return np.array([[1,0,tx],
                     [0,1,ty],
```

```
                    [0,0,1]])

def generate_scaling_matrix(sx, sy):
    return np.array([[sx,0,0],
                     [0,sy,0],
                     [0,0,1]])

def generate_shearing_matrix(shx, shy):
    return np.array([[1,shx,0],
                     [shy,1,0],
                     [0,0,1]])

def generate_rotation_matrix(theta):
    return np.array([[np.cos(theta),-np.sin(theta),0],
                     [np.sin(theta),np.cos(theta),0],
                     [0,0,1]])

def generate_euclidean_matrix(tx, ty, theta):
    return np.array([[np.cos(theta),-np.sin(theta),tx],
                     [np.sin(theta),np.cos(theta),ty],
                     [0,0,1]])

def generate_similarity_matrix(tx, ty, theta, s):
    return np.array([[s*np.cos(theta),-s*np.sin(theta),tx],
                     [s*np.sin(theta),s*np.cos(theta),ty],
                     [0,0,1]])

def generate_affine_matrix(a11, a12, a21, a22, tx, ty):
    return np.array([[a11,a12,tx],
                     [a21,a22,ty],
                     [0,0,1]])

def generate_projective_matrix(h11, h12, h13, h21, h22, h23, h31,
h32):
    return np.array([[h11,h12,h13],
                     [h21,h22,h23],
                     [h31,h32,1]])

translated_image = translate(image, 3,5)
plt.imshow(translated_image)
plt.axis('off')
plt.show()
```

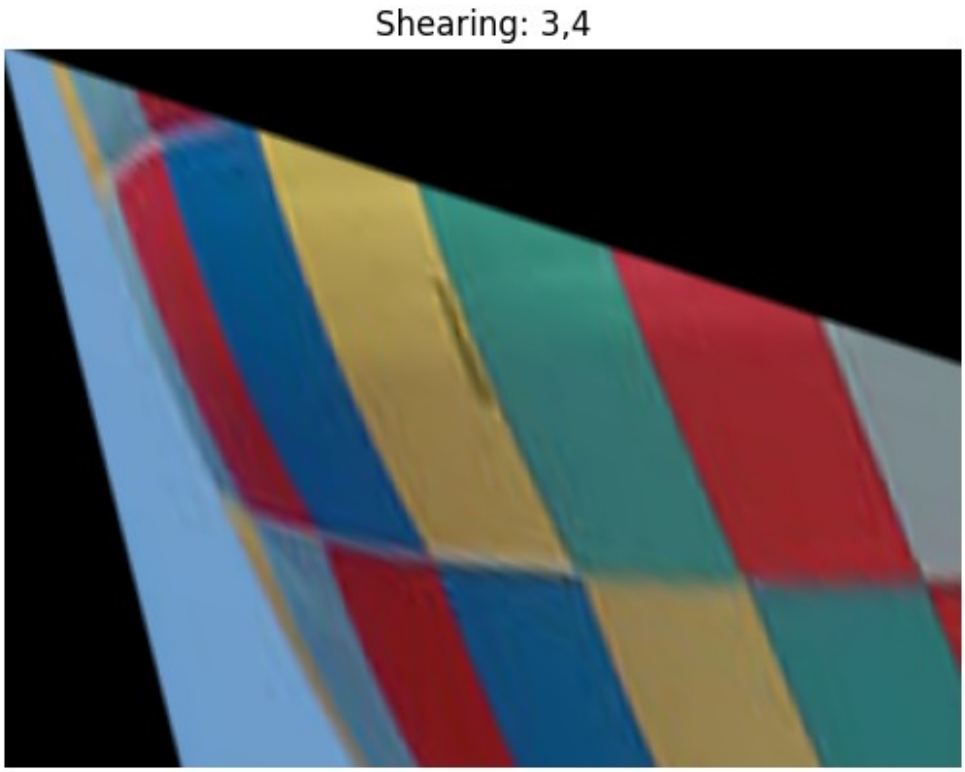
```
print(image.shape[:2])
```

```
(300, 400)
```

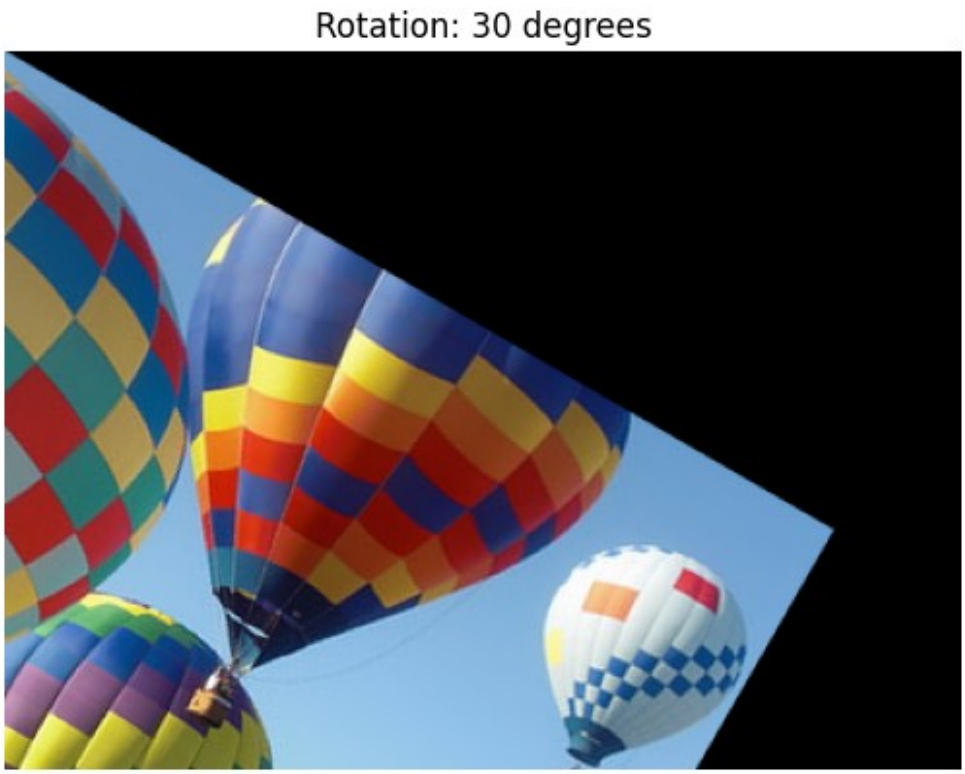
```
def transform_image_with_matrix(image_array, transformation_matrix):
    rows, cols = image_array.shape[:2]
    transformation_matrix = transformation_matrix.astype(np.float32)
    return cv2.warpPerspective(image_array, transformation_matrix,
(cols, rows))

transformed_image = transform_image_with_matrix(image,
generate_translate_matrix(3,4))
plt.imshow(transformed_image)
plt.title('Translation: 3,4')
plt.axis('off')
plt.show()
```


```
transformed_image = transform_image_with_matrix(image,
generate_scaling_matrix(2,3))
plt.imshow(transformed_image)
plt.title('Scaling: 2,3')
plt.axis('off')
plt.show()
```


```
transformed_image = transform_image_with_matrix(image,
generate_shearing_matrix(3,4))
plt.imshow(transformed_image)
plt.title('Shearing: 3,4')
plt.axis('off')
plt.show()
```

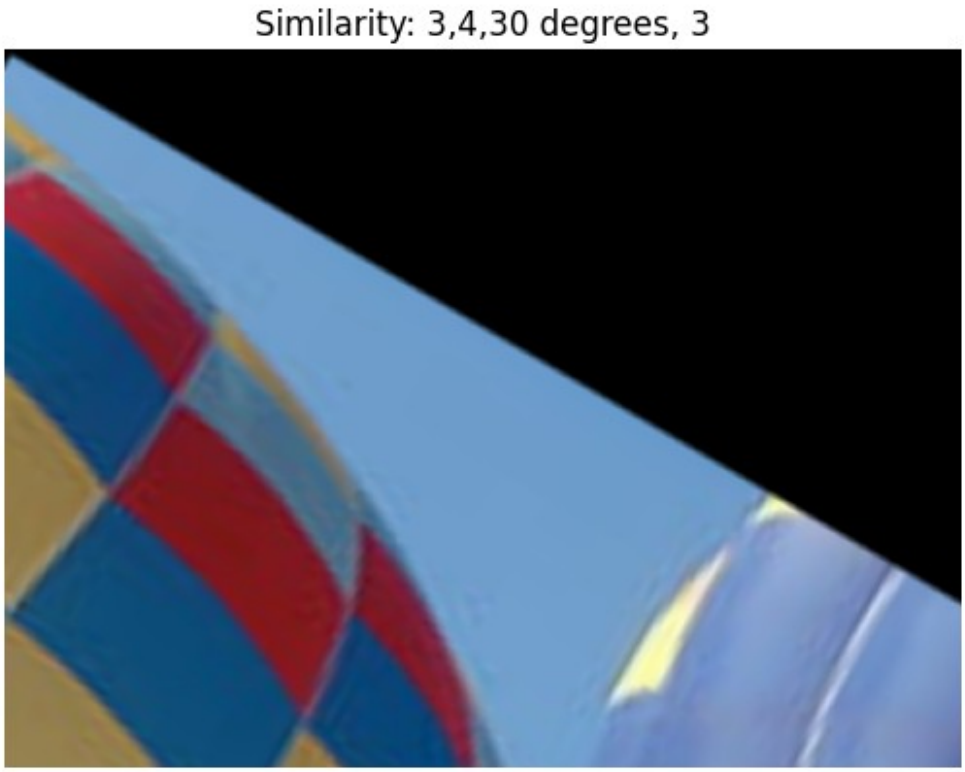



```
transformed_image = transform_image_with_matrix(image,
generate_rotation_matrix(np.pi/6))
plt.imshow(transformed_image)
plt.title('Rotation: 30 degrees')
plt.axis('off')
plt.show()
```

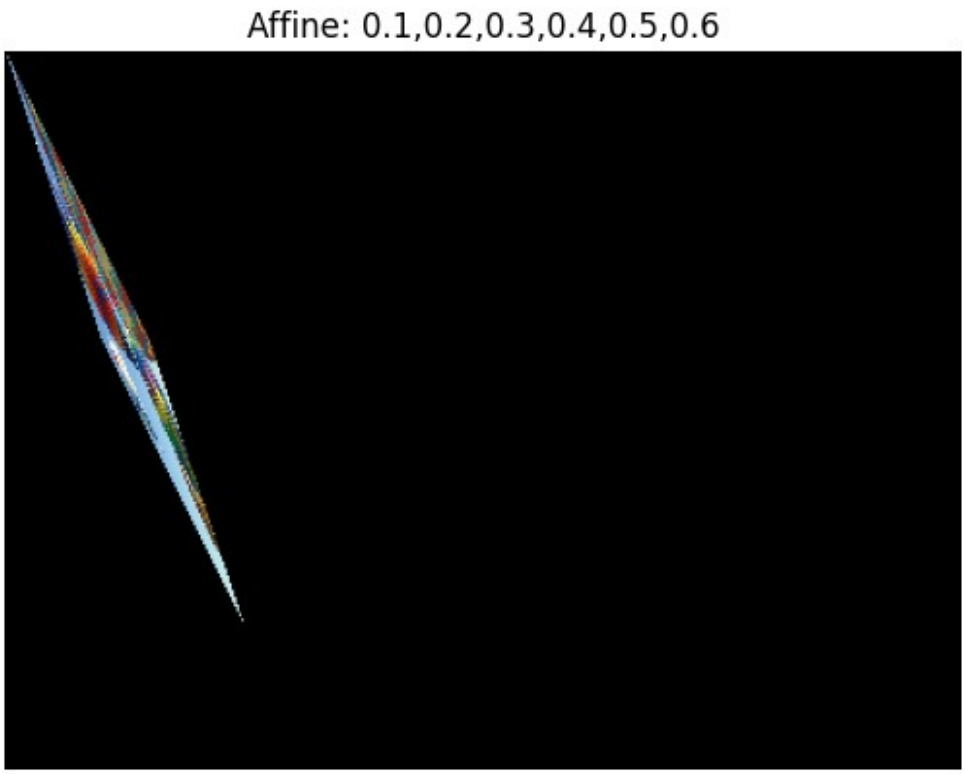



```
transformed_image = transform_image_with_matrix(image,
generate_euclidean_matrix(3,4,np.pi/6))
plt.imshow(transformed_image)
plt.title('Euclidean: 3,4,30 degrees')
plt.axis('off')
plt.show()
```


```
transformed_image = transform_image_with_matrix(image,
generate_similarity_matrix(3,4,np.pi/6, 3))
plt.imshow(transformed_image)
plt.title('Similarity: 3,4,30 degrees, 3')
plt.axis('off')
plt.show()
```




```
transformed_image = transform_image_with_matrix(image,
generate_affine_matrix(0.1,0.2,0.3,0.4,0.5,0.6))
plt.imshow(transformed_image)
plt.title('Affine: 0.1,0.2,0.3,0.4,0.5,0.6')
plt.axis('off')
plt.show()
```




```
transformed_image = transform_image_with_matrix(image,
generate_projective_matrix(0.5, 0,0, 0,0.5, 0, 0,0))
plt.imshow(transformed_image)
plt.title('Projective: 0.5,0,0,0,0.5,0,0,0')
plt.axis('off')
plt.show()


# h11,h12,h13       Scaling in X, shearing in X, translation in X
# h21,h22,h23   ==> Shearing in Y, Scaling in Y, translation in Y
# h31,h32,1         Projective warping in X, Projective Warping in Y,
1
```

Projective: 0.5,0,0,0,0.5,0,0,0