In [ ]:
```
import cv2
import numpy as np
```

1. Basics

Loading an image in the working directory. `img = cv2.imread('image.jpg' [, flags])` Flags specify the color type of a loaded image. Example: To return a grayscale image:

In [ ]:
```
img = cv2.imread('/content/sample_data/eb9931c3f39215a193826992d013a17a.jpg', 0)
```

Save Image

In [ ]:
```
img = cv2.imread('/content/sample_data/eb9931c3f39215a193826992d013a17a.jpg')
cv2.imwrite('/content/sample_data/UpdatedImage1.jpg',img)
```

Out[ ]:
```
True
```

View Image

In [ ]:
```
from google.colab.patches import cv2_imshow
img = cv2.imread('/content/sample_data/eb9931c3f39215a193826992d013a17a.jpg')
#cv2.imshow('image',img) ----> This usual comand does not work in Google Colab
cv2_imshow(img)
# cv2.waitKey(0)             # Wait indefinitely for a keystroke
# cv2.destroyAllWindows()    # Destroy all created windows upon a keystroke
```

View Image Details

In [ ]:
```
img = cv2.imread('/content/sample_data/eb9931c3f39215a193826992d013a17a.jpg')
print(img.shape) # Number of rows and columns and number of channels (if image is c
print(img.size) # Number of pixels
```

```
(700, 700, 3)
1470000
```

2. Image type conversions

In [ ]:
```
print(img.dtype)
```

```
uint8
```

Convert to grayscale

In [ ]:
```
img=cv2.cvtColor(img,cv2.COLOR_RGB2GRAY)
cv2.imwrite('/content/sample_data/UpdatedImage1.jpg',img)
cv2_imshow(img)
```

3. Basic Image **Processing** Commands

Resizing

In [ ]:
```
resized_image1 = cv2.resize(img, (100, 50)) #Reduce image to 100 cols and 50 rows
resized_image2 = cv2.resize(img, (0, 0), fx=0.5, fy=0.5) #Reduce both axes by half
resized_image3 = cv2.resize(img, (0, 0), fx=0.5, fy=0.5, interpolation=cv2.INTER_NE
cv2_imshow(resized_image1)
cv2_imshow(resized_image2)
cv2_imshow(resized_image3)
```

Rotation

In [ ]:
```
# Get dimensions of the image and calculate the center of the image
(h, w) = img.shape[:2]
center = (w / 2, h / 2)
# Computing the matrix (M) that can be used for rotating the image
# center - Point around which, the image is rotated
# 180 - Angle by which image is rotated
# 1.0 - Scaling factor (No scaling in this case)
M = cv2.getRotationMatrix2D(center, 180, 1.0)
```

```
# Perform the actual rotation
rotated = cv2.warpAffine(img, M, (w, h))
cv2_imshow(rotated)
```

Cropping

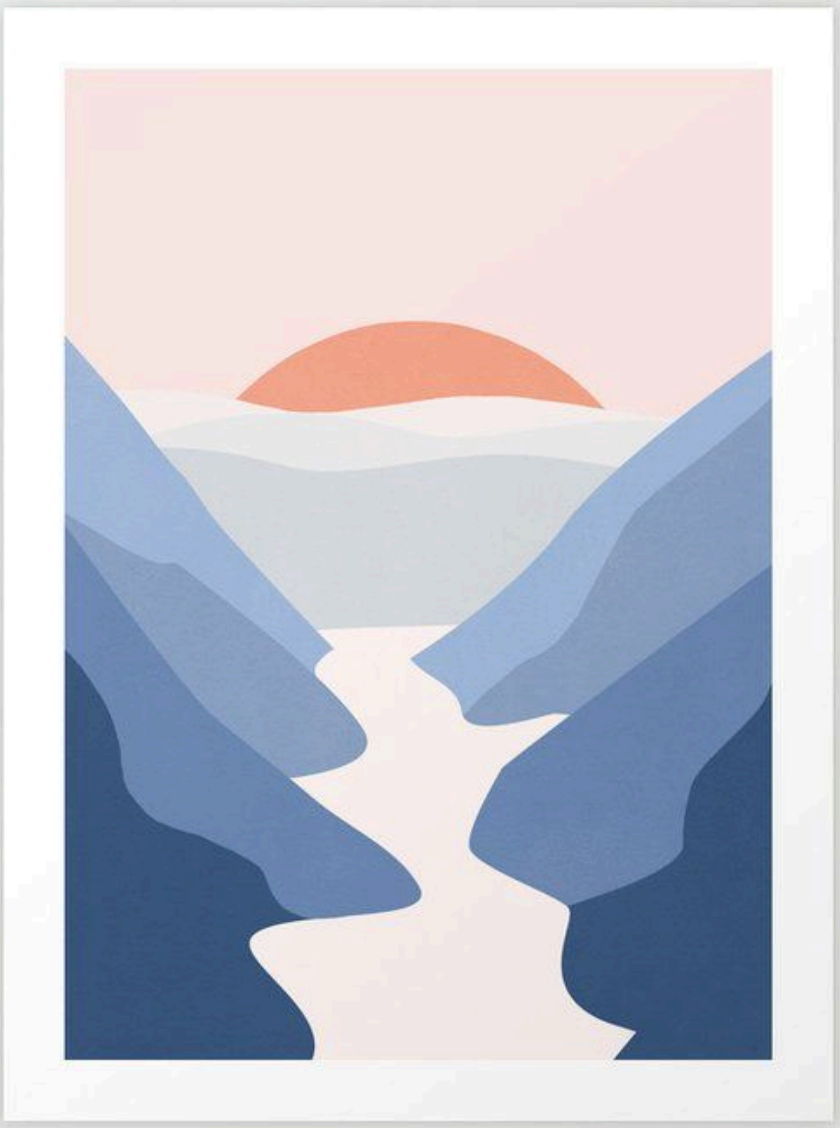
In [ ]:
```
# startY,startX - starting coordinates where cropping should begin.
# endY,endX - ending coordinates
img = cv2.imread('/content/sample_data/eb9931c3f39215a193826992d013a17a.jpg')
cropped = img[100:500, 200:300]
cv2_imshow(cropped)
```

Comlementing

In [ ]:
```
inverted = cv2.bitwise_not(img)
cv2_imshow(inverted)
```

Fliping an image

In [ ]:
```
# flipMode - If 0, flipping around x-axis
# If positive, flipping around y-axis
# If negative, flipping around both axes
cv2_imshow(img)
flipped = cv2.flip(img, 0)
cv2_imshow(flipped)
```



Section 2: CSV to Imageconversion

In [ ]:
```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
```

Read CSV file

In [ ]:
```
img_data = pd.read_csv('/content/sample_data/Digits_Lab_01.csv')
img_data.head() # Visualise data as a tabale
```

Out[ ]:

	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	pixel9	...	pixel774
0	0	0	0	0	0	0	0	0	0	0	...	0
1	0	0	0	0	0	0	0	0	0	0	...	0
2	0	0	0	0	0	0	0	0	0	0	...	0
3	0	0	0	0	0	0	0	0	0	0	...	0
4	0	0	0	0	0	0	0	0	0	0	...	0

5 rows × 784 columns

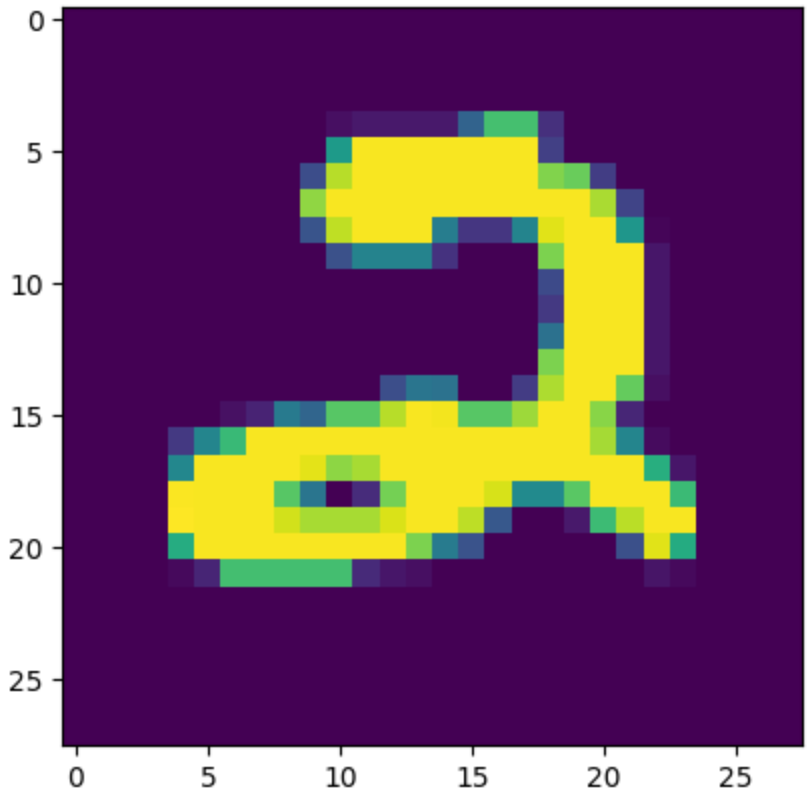
Reshape the rows of data to images (image size – 28x28x1)

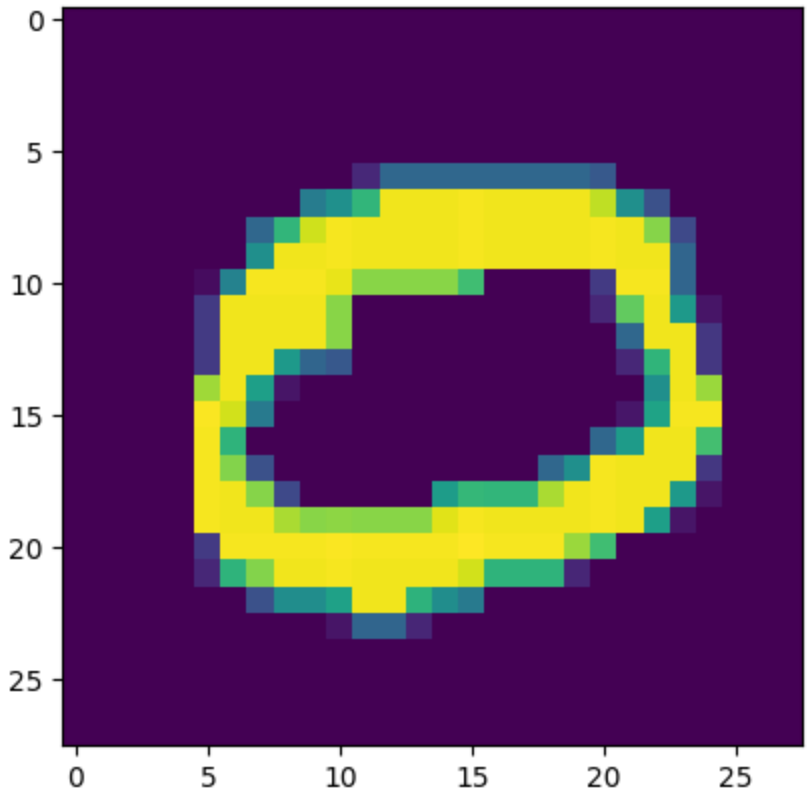
In [ ]:
```
Reshaped_images = img_data.to_numpy().reshape(-1,28,28,1)
```

Visualize

In [ ]:
```
print(len(Reshaped_images))
for image in (Reshaped_images):
  sample_img = np.array(image).reshape((28,28))
  plt.imshow(sample_img)
  plt.show()
```

19

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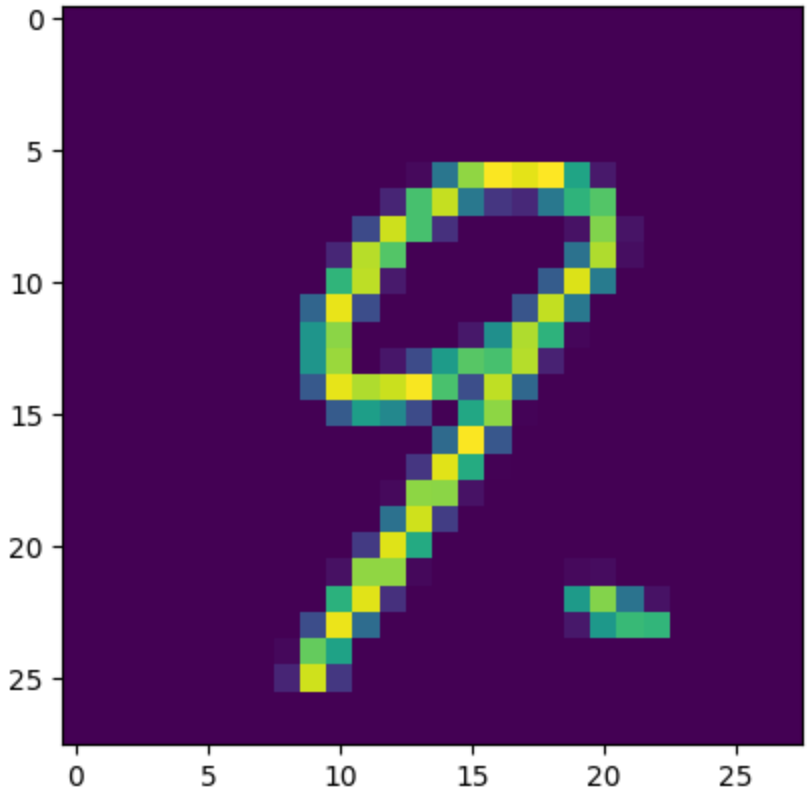
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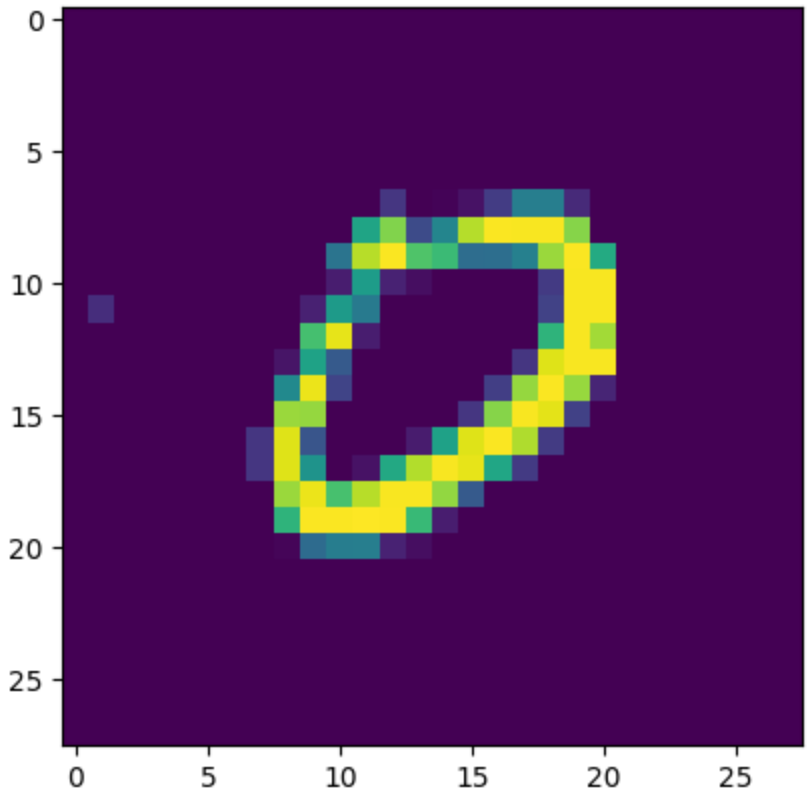
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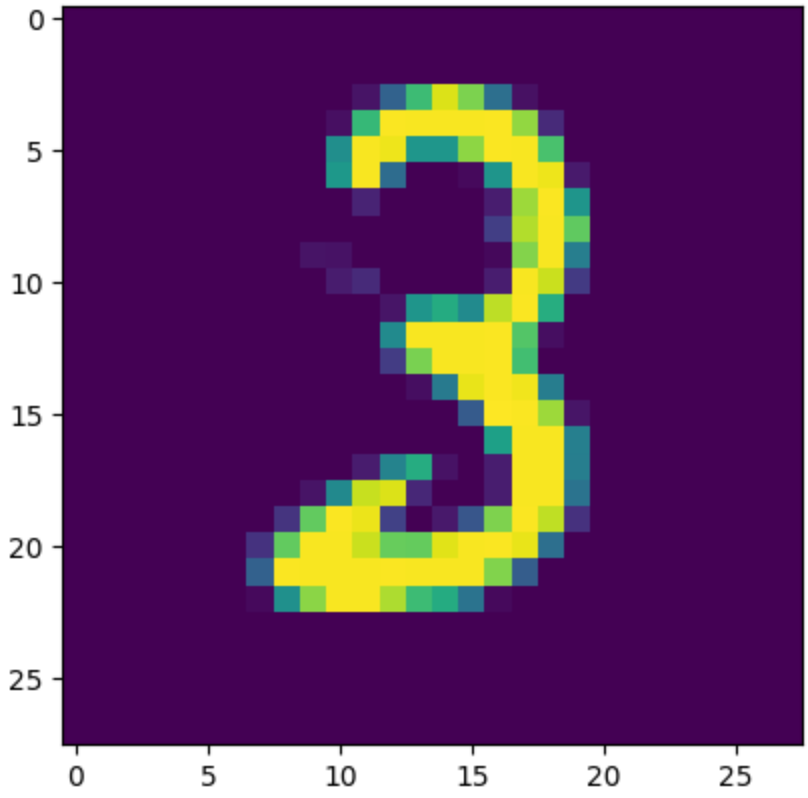
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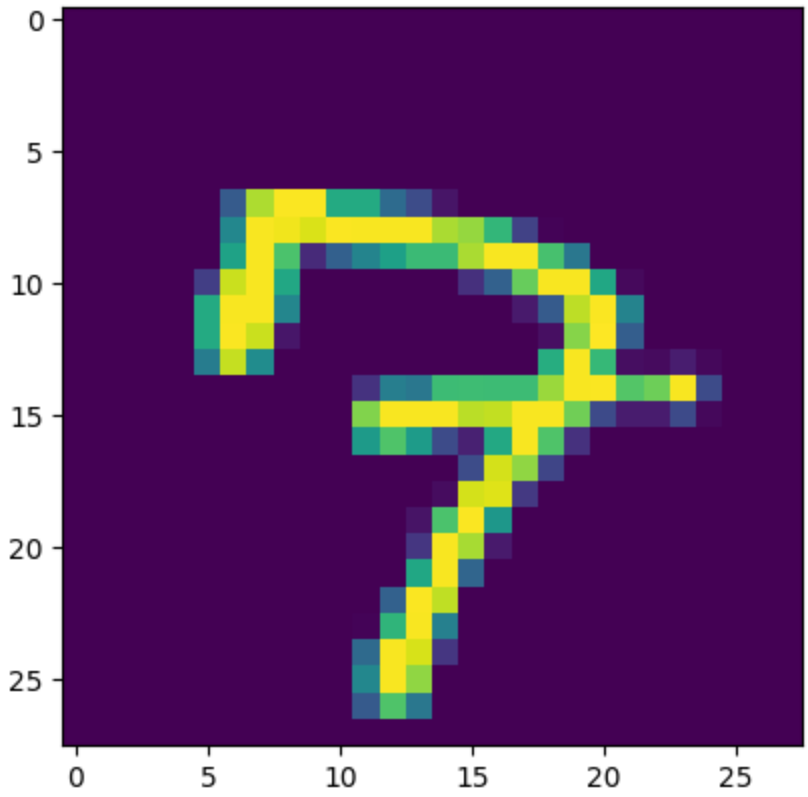
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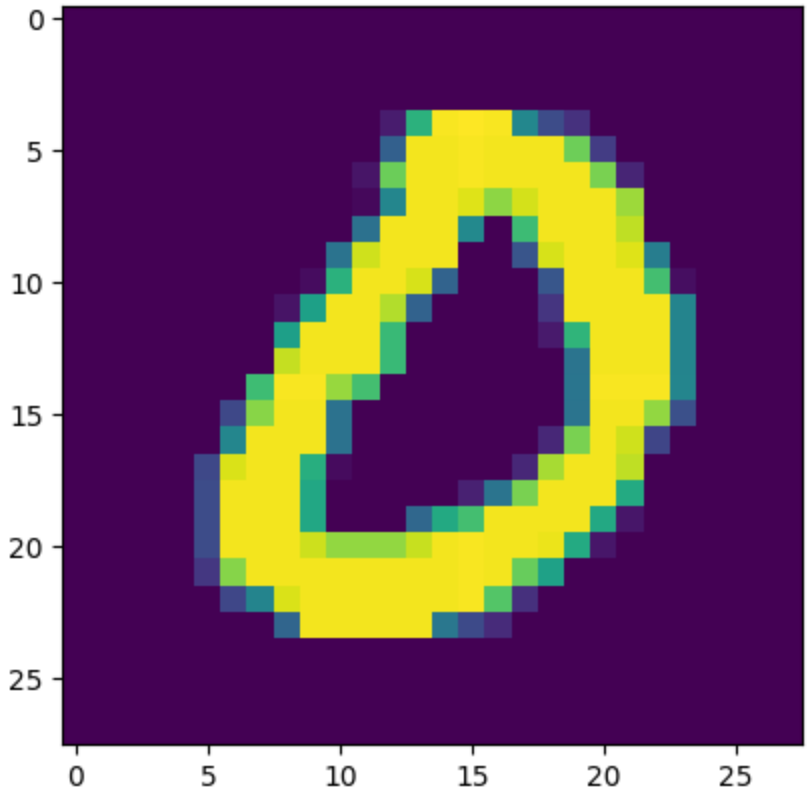
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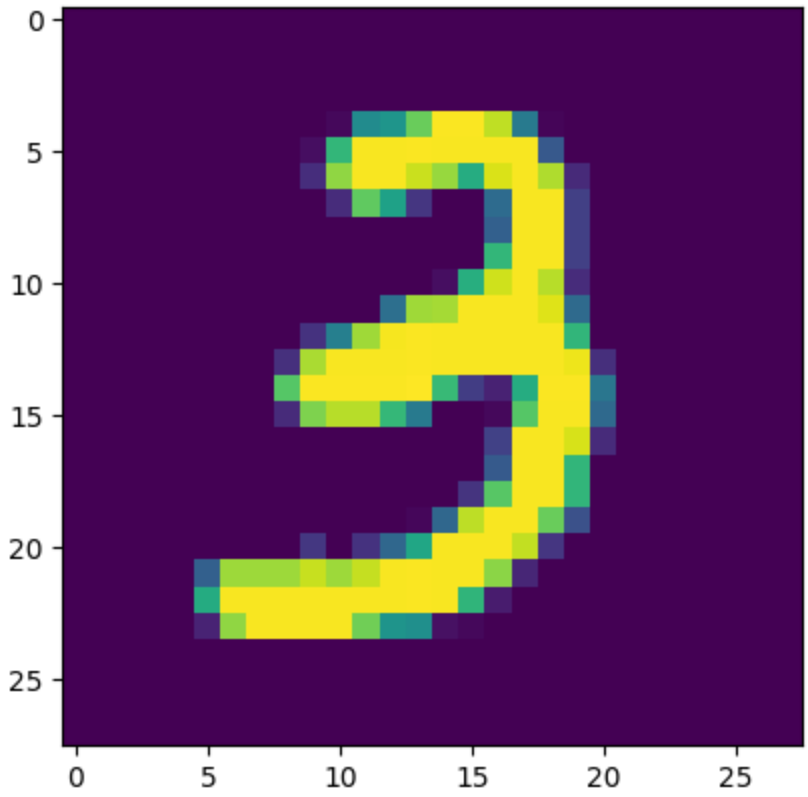
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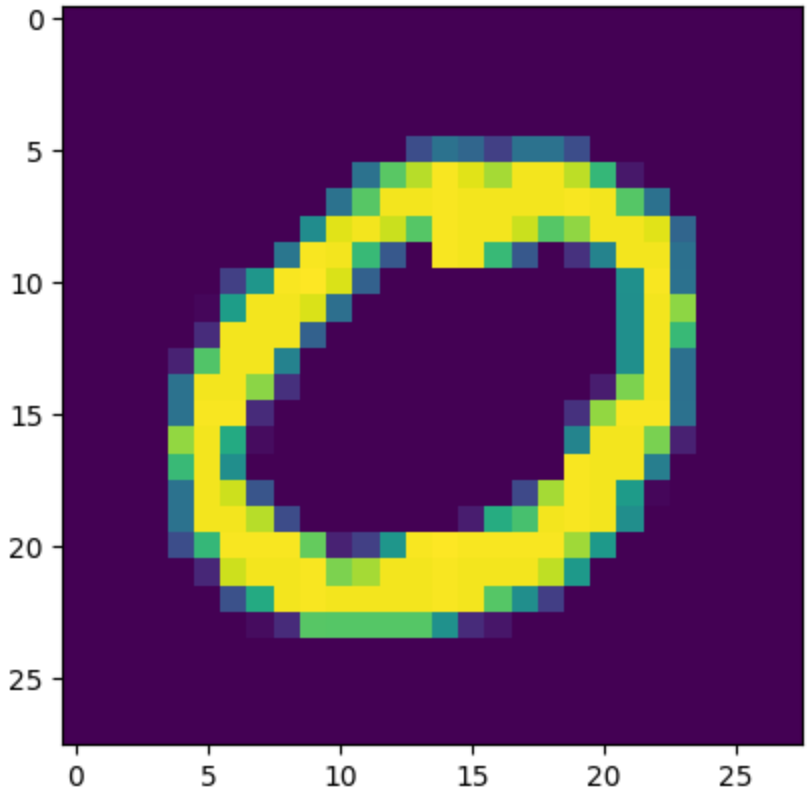
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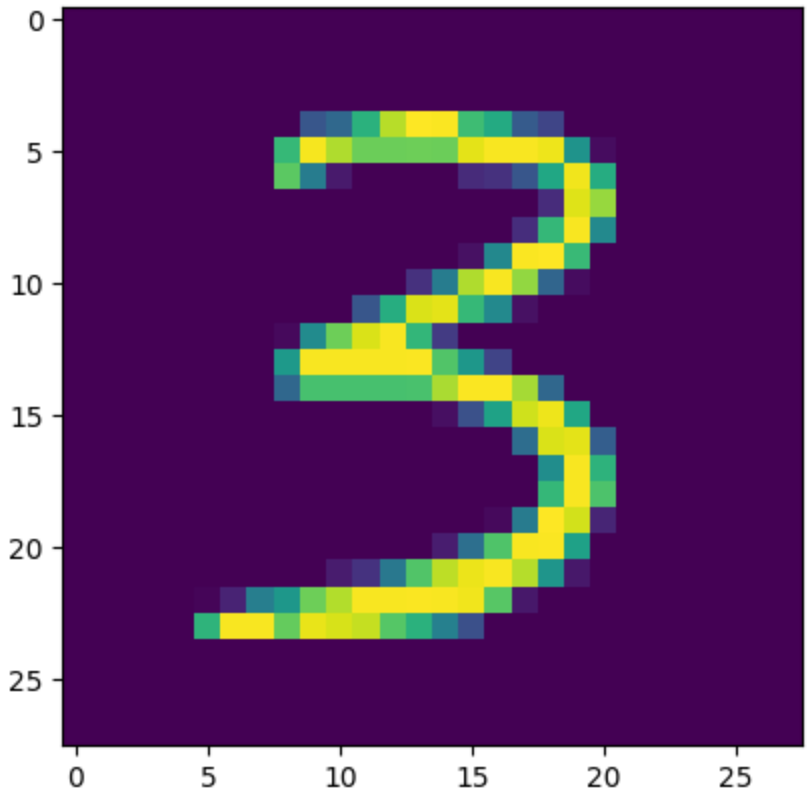
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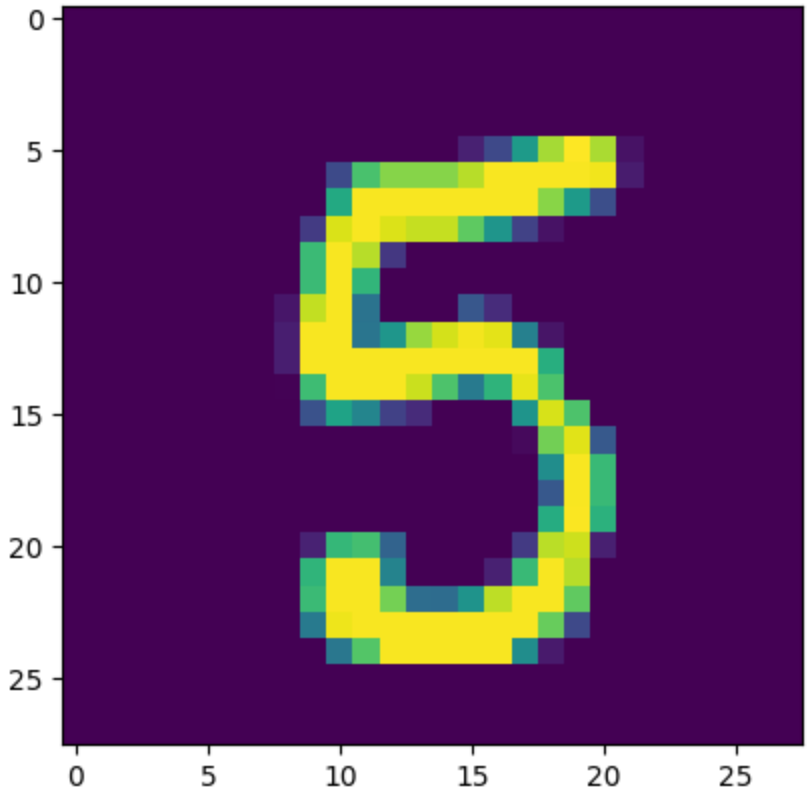
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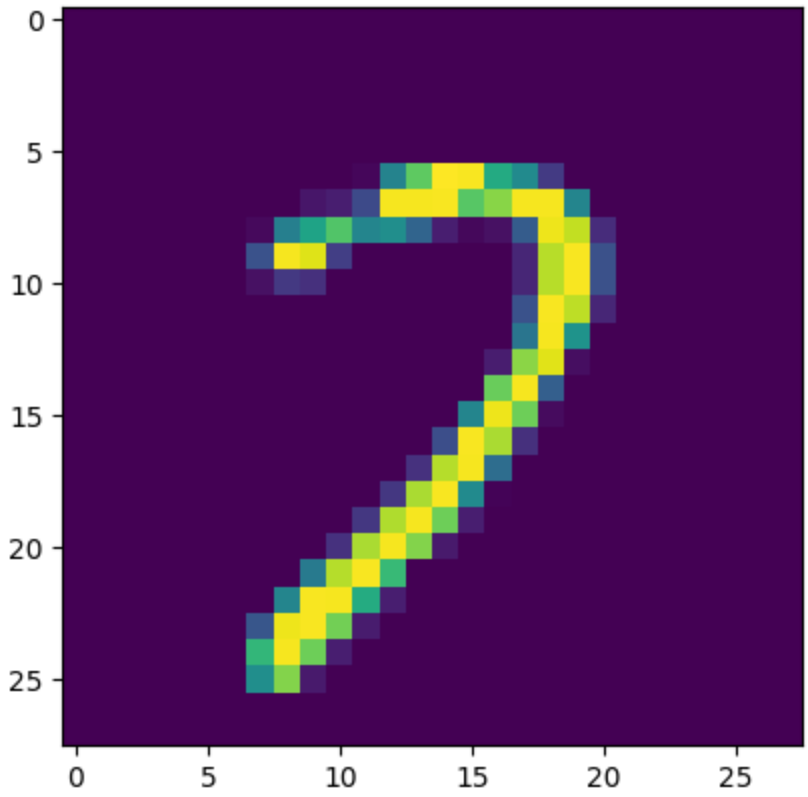
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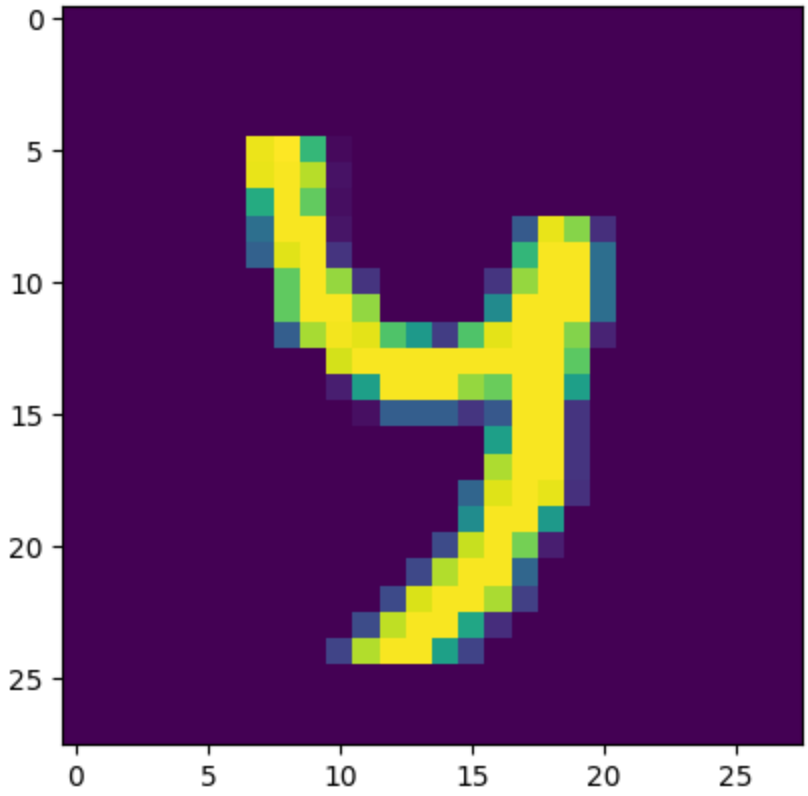
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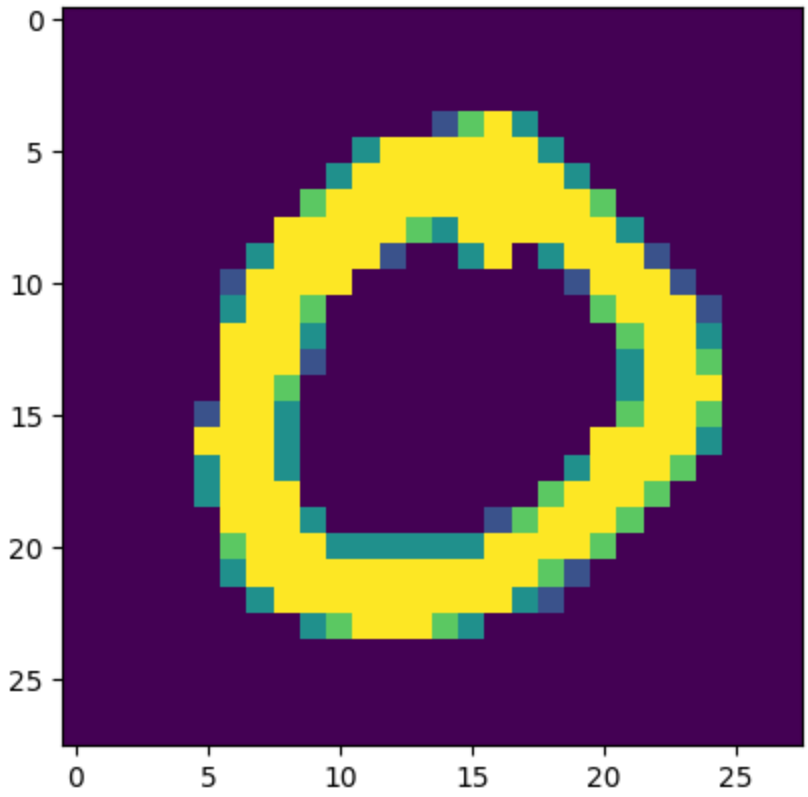
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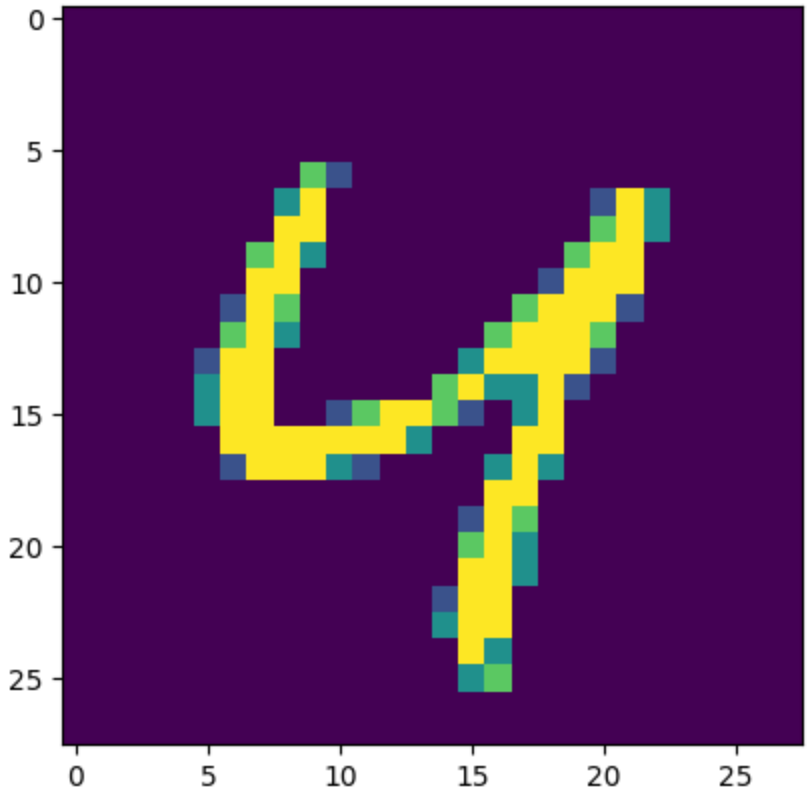
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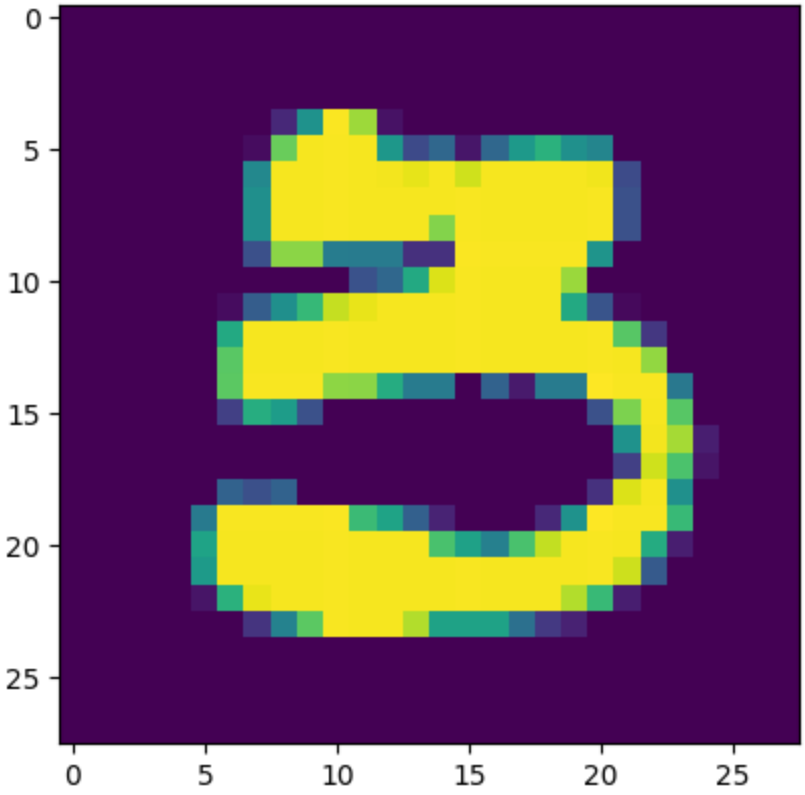
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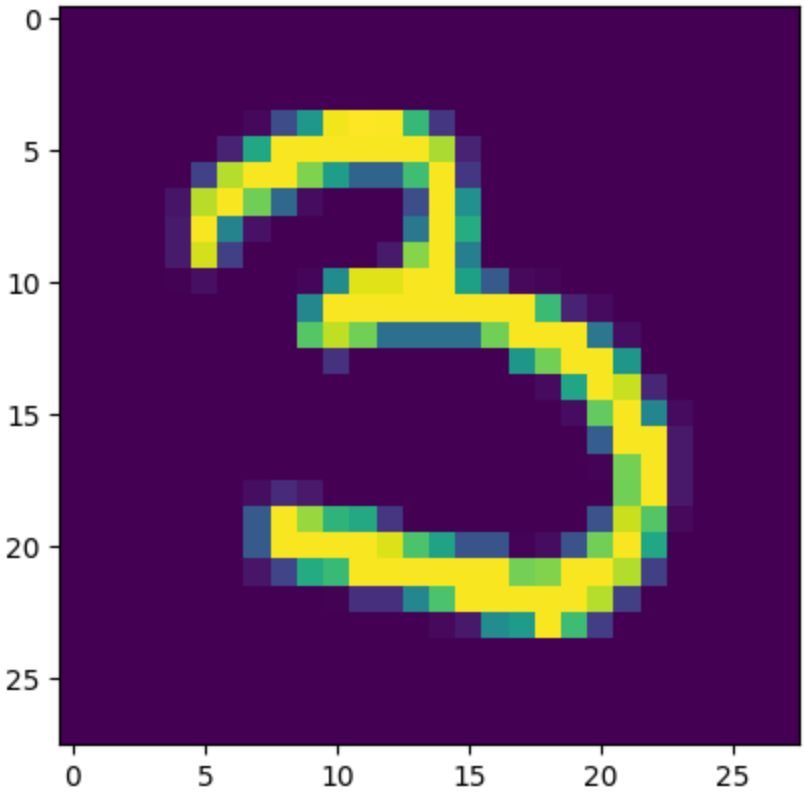
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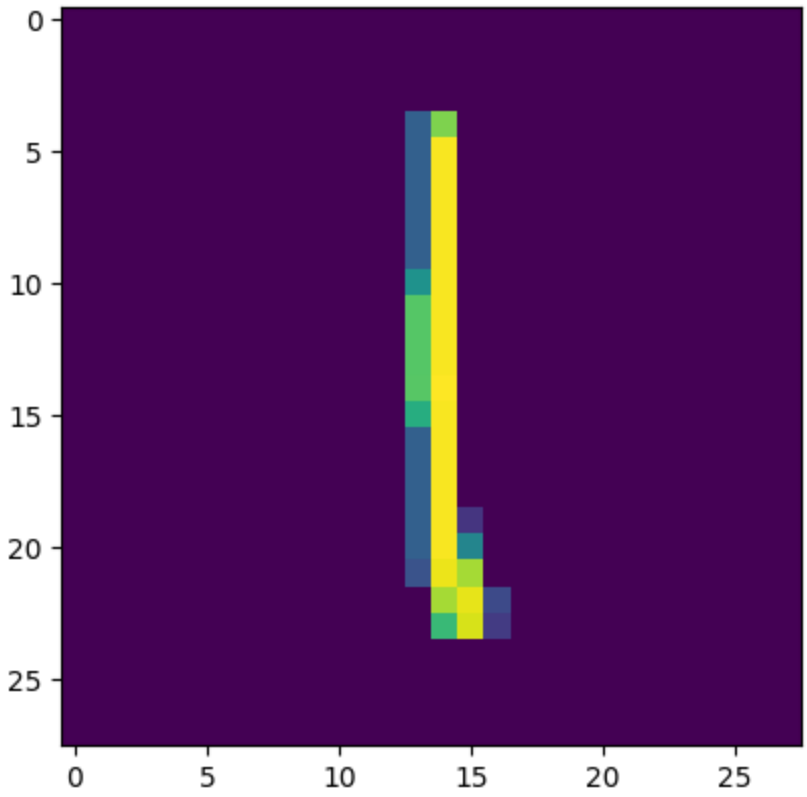
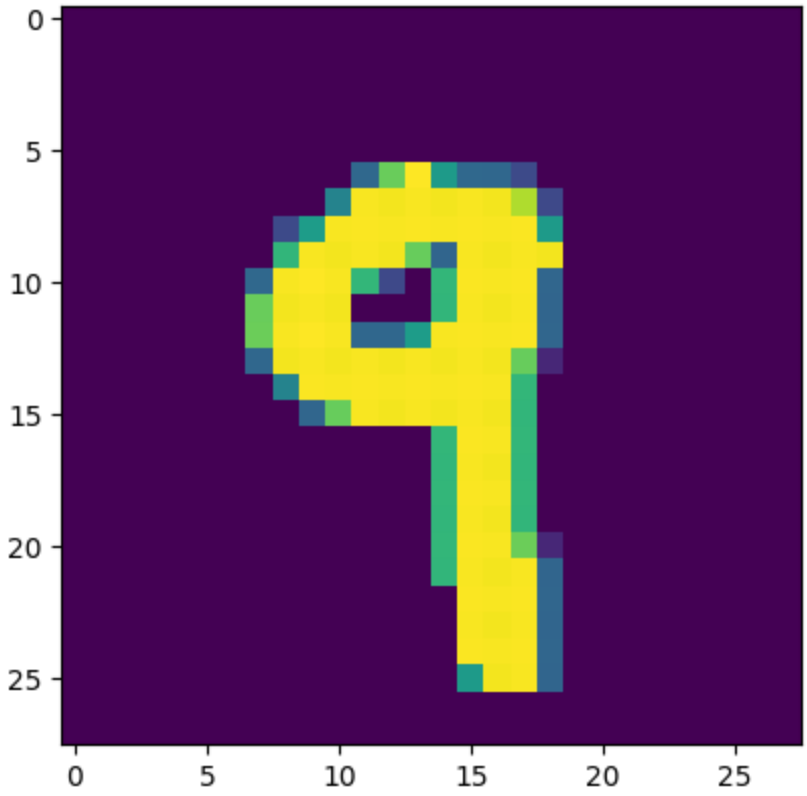




Section 3: Geometric Transformations

Read the image and check for the shape

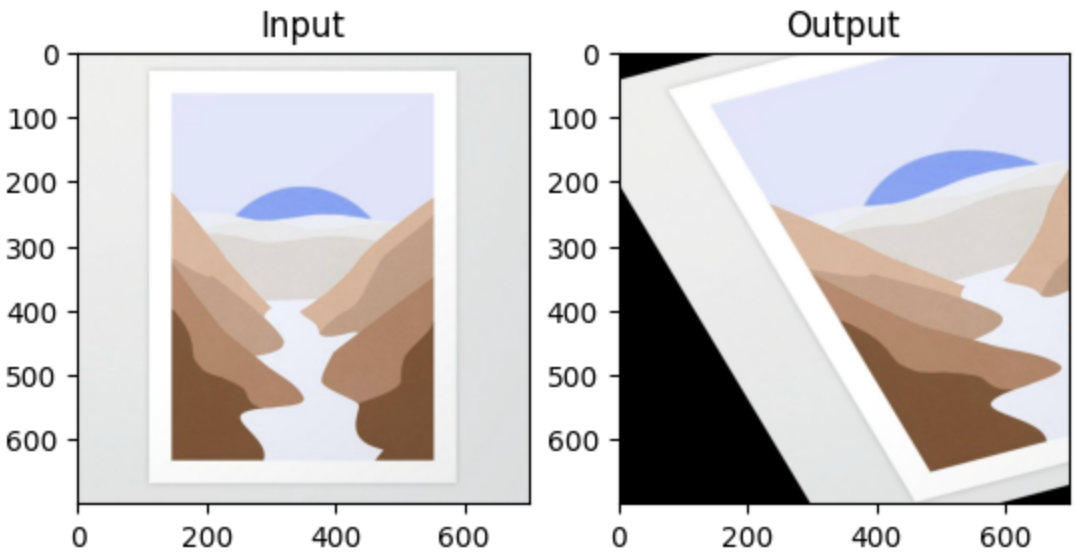
In [ ]:
```
img =cv2.imread('/content/sample_data/eb9931c3f39215a193826992d013a17a.jpg')
rows,cols,ch = img.shape
```

Define the Transformation

In [ ]:
```
pts1 = np.float32([[50,50],[200,50],[50,200]])
pts2 = np.float32([[10,100],[200,50],[100,250]])
M = cv2.getAffineTransform(pts1,pts2)
```

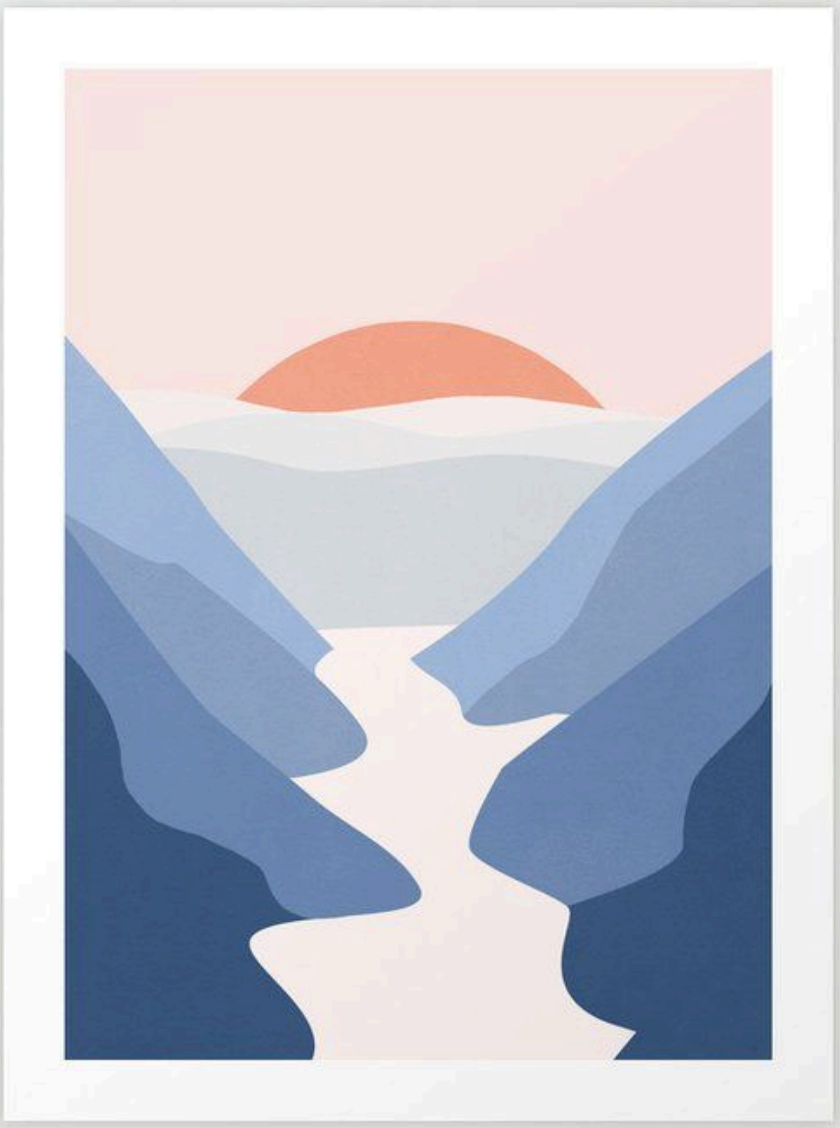
Do the Transformation

In [ ]:
```
dst = cv2.warpAffine(img,M,(cols,rows))
plt.subplot(121),plt.imshow(img),plt.title('Input')
plt.subplot(122),plt.imshow(dst),plt.title('Output')
plt.show()
```



In [60]:
```
import cv2
import numpy as np

# 1(a) Invert an image
def imcomplement(I):
    return 255 - I

# 1(b) flip image along x-axis (0)
def flipud(I):
    return cv2.flip(I, 0)

# 1(c) flip image along y-axis (1)
def fliplr(I):
    return cv2.flip(I, 1)

# 1(d) Resize image with nearest-neighbour interpolation
def imresize(I, size):
    return cv2.resize(I, tuple(size), interpolation=cv2.INTER_NEAREST)

# Example for geometric transformations
```

```python
def rotate_image(I, angle):
    rows, cols = I.shape[:2]
    center = (cols // 2, rows // 2)
    M = cv2.getRotationMatrix2D(center, angle, 1)
    return cv2.warpAffine(I, M, (cols, rows))

def translate_image(I, tx, ty):
    rows, cols = I.shape[:2]
    M = np.float32([[1, 0, tx], [0, 1, ty]])
    return cv2.warpAffine(I, M, (cols, rows))

def scale_image(I, sx, sy):
    rows, cols = I.shape[:2]
    M = np.float32([[sx, 0, 0], [0, sy, 0]])
    return cv2.warpAffine(I, M, (int(cols * sx), int(rows * sy)))

def shear_image(I, shx, shy):
    rows, cols = I.shape[:2]
    M = np.float32([[1, shx, 0], [shy, 1, 0]])
    return cv2.warpAffine(I, M, (cols, rows))


# Load image
image = cv2.imread('/content/sample_data/eb9931c3f39215a193826992d013a17a.jpg')
grayscale_image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)

# Apply transformations
inverted = imcomplement(grayscale_image)
flipped_ud = flipud(grayscale_image)
flipped_lr = fliplr(grayscale_image)
resized = imresize(grayscale_image, [100, 100])

# geometric transformations
rotated = rotate_image(image, 45)
translated = translate_image(image, 50, 30)
scaled = scale_image(image, 1.5, 1.5)
sheared = shear_image(image, 0.2, 0.2)

# Display results
cv2_imshow(image)
cv2_imshow(inverted)
cv2_imshow(flipped_ud)
cv2_imshow(flipped_lr)
cv2_imshow(resized)
cv2_imshow(rotated)
cv2_imshow(translated)
cv2_imshow(scaled)
cv2_imshow(sheared)
```



In [58]:
```
!jupyter nbconvert --to html /content/Image_Processing_Lab_01.ipynb
```

```
[NbConvertApp] Converting notebook /content/Image_Processing_Lab_01.ipynb to html
[NbConvertApp] WARNING | Alternative text is missing on 39 image(s).
[NbConvertApp] Writing 4708367 bytes to /content/Image_Processing_Lab_01.html
```