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Q1-

```
import numpy as np
import csv
#set flag to 0
flag = 0
#set arr to an empty array
arr = np.array([])
#open the file and read the data
with open('book1.csv','r') as file:
reader = csv.reader(file) #read the file
for x in reader: #loop through the file
 data = x[0].split('\t') #split the data
 if flag ==1 :
   arr = np.append(arr,int(data[1])) #append the data to the array
 flag =1 #set the flag to 1
#display the array
print(arr)
#display the max value in the array
print(max(arr))
#display the min value in the array
print(min(arr))
```

Q2-

```
import numpy as np
import csv
#set flag to 0
flag = 0
#set arr to an empty array
arr = np.array([])
#open the file and read the data
with open('book1.csv','r') as file:
reader = csv.reader(file) #read the file
for x in reader: #loop through the file
 data = x[0].split('\t') #split the data
 if flag ==1 :
   arr = np.append(arr,int(data[1])) #append the data to the array
 flag =1 #set the flag to 1
```

```
#display the array
print(arr)
#display the max value in the array
print(max(arr))
#display the min value in the array
print(min(arr))
#sort the array
new_arr = np.sort(arr)
#display the sorted array
print(new_arr)
```

Q-3

```
import numpy as np
import csv
#set flag to 0
flag = 0
#set arr to an empty array
arr = np.array([])
#open the file and read the data
with open('book1.csv','r') as file:
reader = csv.reader(file) #read the file
for x in reader: #loop through the file
 data = x[0].split('\t') #split the data
 if flag ==1 :
   arr = np.append(arr,int(data[1])) #append the data to the array
 flag =1 #set the flag to 1
#display the array
print(arr)
#display the max value in the array
print(max(arr))
#display the min value in the array
print(min(arr))
#sort the array
new_arr = np.sort(arr)
#display the sorted array
print(new_arr)
#reverse the array
reverse_arr = np.flip(new_arr)
#display the reversed array
print(reverse_arr)
```

Q4-

```
import numpy as np
import csv
#initialize the empty list
my_list = []
#set flag to 0
flag = 0
#set arr to an empty array
arr1 = np.array(my_list)
#open the file and read the data
with open('book1.csv','r') as file:
reader = csv.reader(file) #read the file
for x in reader: #loop through the file
 data = x[0].split('\t') #split the data
 if flag ==1 :
  arr1 = np.append(arr1,int(data[1])) #append the data to the array
 flag =1 #set the flag to 1
print("Array 1 is: ") #display the array
print(arr1)
flag =0
arr2 = np.array(my_list) #set arr to an empty array
#open the file and read the data
with open('book2.csv','r') as file:
reader = csv.reader(file) #read the file
for x in reader: #loop through the file
 data = x[0].split('\t') #split the data
 if flag ==1 :
  arr2 = np.append(arr2,float(data[1])) #append the data to the array
 flag =1 #set the flag to 1
print("Array 2 is: ")
print(arr2) #display the array
flag = 0
arr3 = np.array(my_list) #set arr to an empty array
#open the file and read the data
with open('book3.csv','r') as file:
reader = csv.reader(file) #read the file
for x in reader: #loop through the file
 data = x[0].split('\t') #split the data
 if flag ==1 :
  arr3 = np.append(arr3,int(data[1])) #append the data to the array
```

```
 flag =1 #set the flag to 1
print("Array 3 is: ") #display the array
print(arr3)
my_list.append(np.mean(arr1)) #append the mean of the array1 to the list
my_list.append(np.mean(arr2)) #append the mean of the array2 to the list
my_list.append(np.mean(arr3)) #append the mean of the array3 to the list
print("Mean of all arrays is: ") #display the mean of all arrays
print(my_list)
```

Q5-

```
import numpy as np
import cv2
image1 = cv2.imread('a.png',cv2.IMREAD_COLOR)
arr = np.array(image1)
print(arr)
# Display the image in a window
cv2.imshow('image', arr)
# Wait for a key press and close the window
cv2.waitKey(0)
cv2.destroyAllWindows()
```

Q6-

```
import numpy as np
import cv2
image1 = cv2.imread('a.png')
arr = np.array(image1)
# Convert the image to grayscale
gray = np.uint8(np.mean(image1,axis=2))
#Display the image in a window
cv2.imshow('gray image', gray)
# Wait for a key press and close the window
cv2.waitKey(0)
cv2.destroyAllWindows()
exit()
```

Q7-

```
import numpy as np
import cv2
import time
image1 = cv2.imread('a.png')
```

```
arr = np.array(image1)
# Convert the image to grayscale
gray = np.uint8(np.mean(image1,axis=2))
#transpose of gray
gray_transpose = gray.T
#multiplication of gray and its transpose
print("matrix X ")
print(gray)
print("matrix Y")
print(gray_transpose)
print("matrix Z")
start = time.time()
z = np.dot(np.uint8(gray), np.uint8(gray_transpose))
end = time.time()
print(z)
print(gray.shape)
print(gray_transpose.shape)
print(z.shape)
print("Time taken to multiply two matrices is ",end-start)
```

Q8-

```
import numpy as np
import cv2
import time
image1 = cv2.imread('a.png')
arr = np.array(image1)
# Convert the image to grayscale
gray = np.uint8(np.mean(image1,axis=2))
#transpose of gray
gray_transpose = gray.T
#time taken using numpy
start = time.time()
z = np.dot(np.uint8(gray), np.uint8(gray_transpose))
end = time.time()
print("Time taken to multiply two matrices using numpy ", end-start)
print(z)
#time taken without using numpy
z = [[]]
start = time.time()
#convert array to lists
```

```
x = gray.tolist()
y = gray_transpose.tolist()
#initialise it to 0
z = [[0 for _ in range(len(x))] for _ in range(len(x))]
for i in range(len(x)):
print(i)
for j in range(len(x)):
 for k in range(len(y)):
  z[i][j] = (z[i][j]+(x[i][k] * y[k][j]))
end = time.time()
z = np.uint8(np.array(z))
print(z)
print("Time taken to multiply two matrices with out numpy ", end-start)
```

Q9-

```
import numpy as np
import cv2
import matplotlib.pyplot as plt
image1 = cv2.imread('a.png')
arr = np.array(image1)
# Convert the image to grayscale
gray = np.uint8(np.mean(image1,axis=2))
# Flatten the image into 1 dimension
pixels = gray.flatten()
# Plot the histogram
plt.hist(pixels, bins=256, range=(0,256), color='gray')
#set the title
plt.title('Histogram')
#set the x-axis label
plt.xlabel('Pixel Intensity(0-255)')
#set the y-axis label
plt.ylabel('Frequency/occurence')
#show the histogram
plt.show()
```

Q10–

```
import numpy as np
import cv2
image1 = cv2.imread('a.png')
arr = np.array(image1)
```

```
# Convert the image to grayscale
gray = np.uint8(np.mean(image1,axis=2))
# cv2.rectangle(image, start_point, end_point, color, thickness)
cv2.rectangle(gray, (40,100),(70, 200), 0, -1)
#-1, fills the rectangle with black color
# Display the image
cv2.imshow('Image modified with Black Rectangle', gray)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

Q11-

```
import numpy as np
import cv2
import matplotlib.pyplot as plt
image1 = cv2.imread('a.png')
arr = np.array(image1)
# Convert the image to grayscale
gray = np.uint8(np.mean(image1,axis=2))
# Binarize the image with different thresholds
Z50 = np.where(gray < 50, 0, 255)
Z70 = np.where(gray < 70, 0, 255)
Z100 = np.where(gray< 100, 0, 255)
Z150 = np.where(gray< 150, 0, 255)
# Create a figure with 2x2 subplots
fig, axs = plt.subplots(2, 2, figsize=(10, 10))
# Display the images
axs[0, 0].imshow(Z50, cmap='gray')
axs[0, 0].set_title('Threshold 50')
axs[0, 1].imshow(Z70, cmap='gray')
axs[0, 1].set_title('Threshold 70')
axs[1, 0].imshow(Z100, cmap='gray')
axs[1, 0].set_title('Threshold 100')
axs[1, 1].imshow(Z150, cmap='gray')
axs[1, 1].set_title('Threshold 150')
# Display the figure
plt.show()
```

Q12-

```
import cv2
import numpy as np
```

```
# Load the image
imgage = cv2.imread('a.png')
# given filter
filter = np.array([[-1, -1, -1], [0, 0, 0], [1, 1, 1]])
# Apply the filter
filtered_img = cv2.filter2D(imgage, -1, filter)
# Display the filtered image
cv2.imshow('Filtered Image', filtered_img)
cv2.waitKey(0)
cv2.destroyAllWindows()
```