CO543 - Image Processing

Lab 06 - Image Segmentation

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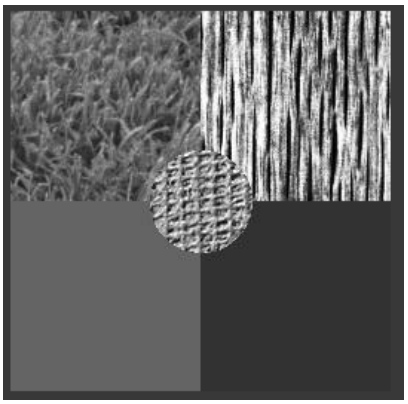
Exercise 1

1. Read the image texture.tif. Display the image. How many textures are there in the image? Describe them. Find images here (link updated): https://drive.google.com/drive/folders/1fPzXha_xapiXJhEbiatJ2pWpOyYfJ53?usp=sharing

```python
#importing libraries
from matplotlib import pyplot as plt
import numpy as np
import cv2

#importing the patch
from google.colab.patches import cv2_imshow

#load the library
img = cv2.imread('/content/texture.tif')

#display the image
cv2_imshow(img)
```

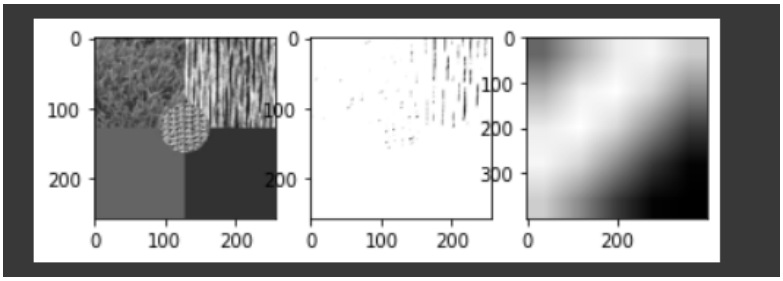


There are 5 different textures and two are plain colours.

2. Select several features and calculate them on blocks of size of 12 × 12 using Gabor filter. Display the calculated features and estimate which ones can be used to segment given structure. For the selected images apply the K-means method and comment on the results.

```
#defining parameters
ksize = 5
sigma = 5
theta = 1*np.pi/4
lamda = 1*np.pi/4
gamma=0.9
phi = 0.8

#creating the kernal
kernel = cv2.getGaborKernel((ksize, ksize), sigma, theta, lamda, gamma, phi, ktype=cv2.CV_32F)

#creating the image using the kernal
fimg = cv2.filter2D(img, cv2.CV_8UC3, kernel)
kernel_resized = cv2.resize(kernel, (400, 400))

#plotting images
plt.subplot(1,3,1), plt.imshow(img, cmap='gray')
plt.subplot(1,3,2), plt.imshow(fimg, cmap='gray')
plt.subplot(1,3,3), plt.imshow(kernel_resized, cmap='gray')

#drawing the images
plt.show()
```

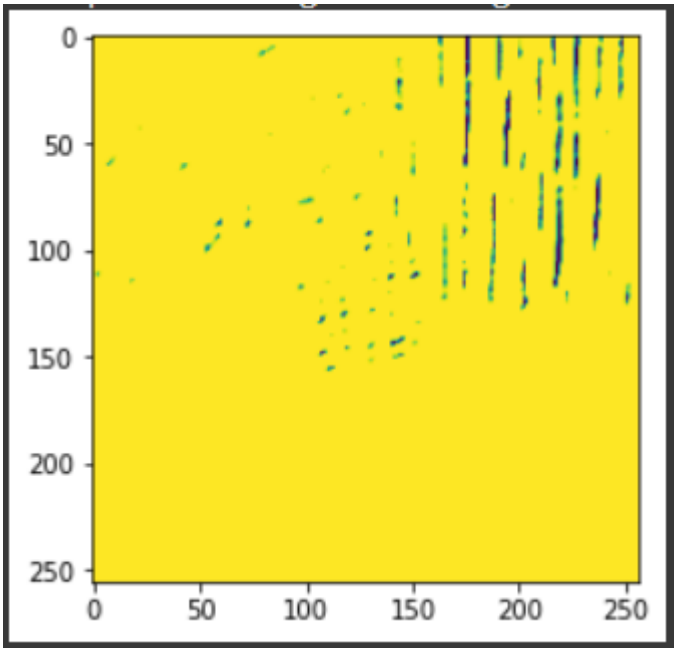
Results :



K-Means Algorithm

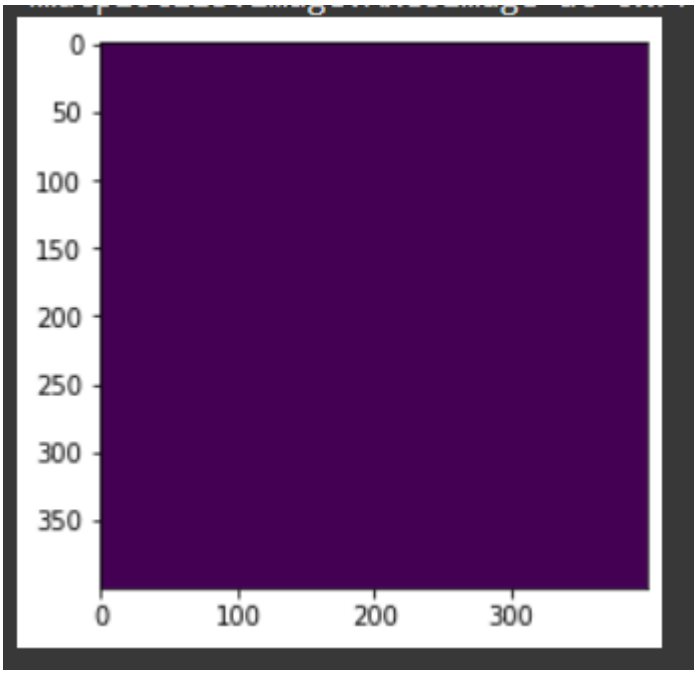
```
# creating a 2d array of floats from the image
pixel_vals = fimg.reshape((-1,1))
pixel_vals = np.float32(pixel_vals)

#setting the stop criteria as 100 iterations or 85% of the epsilon
criteria = (cv2.TERM_CRITERIA_EPS + cv2.TERM_CRITERIA_MAX_ITER, 100, 0.85)

#execute k means for number of clusters = 5
k = 5
retval, labels, centers = cv2.kmeans(pixel_vals, k, None, criteria, 10, cv2.KMEANS_RANDOM_CENTERS)

#convert the data into bytes
centers = np.uint8(centers)
segmented_data = centers[labels.flatten()]

#creating the segmented image
segmented_image = segmented_data.reshape((fimg.shape))

#plot the image
plt.imshow(segmented_image)
```

Results :



```
# creating a 2d array of floats from the image
pixel_vals = kernel_resized.reshape((-1,1))
pixel_vals = np.float32(pixel_vals)

#setting the stop criteria as 100 iterations or 85% of the epsilon
criteria = (cv2.TERM_CRITERIA_EPS + cv2.TERM_CRITERIA_MAX_ITER, 100, 0.85)

#execute k means for number of clusters = 5
k = 5
retval, labels, centers = cv2.kmeans(pixel_vals, k, None, criteria, 10, cv2.KMEANS_RANDOM_CENTERS)

#convert the data into bytes
centers = np.uint8(centers)
segmented_data = centers[labels.flatten()]

#creating the segmented image
segmented_image = segmented_data.reshape((kernel_resized.shape))

#plot the image
plt.imshow(segmented_image)
```

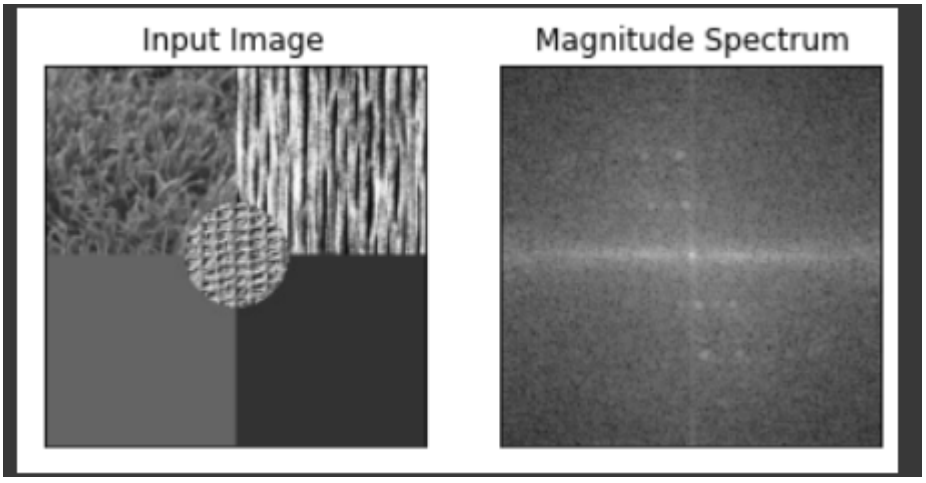
Results :



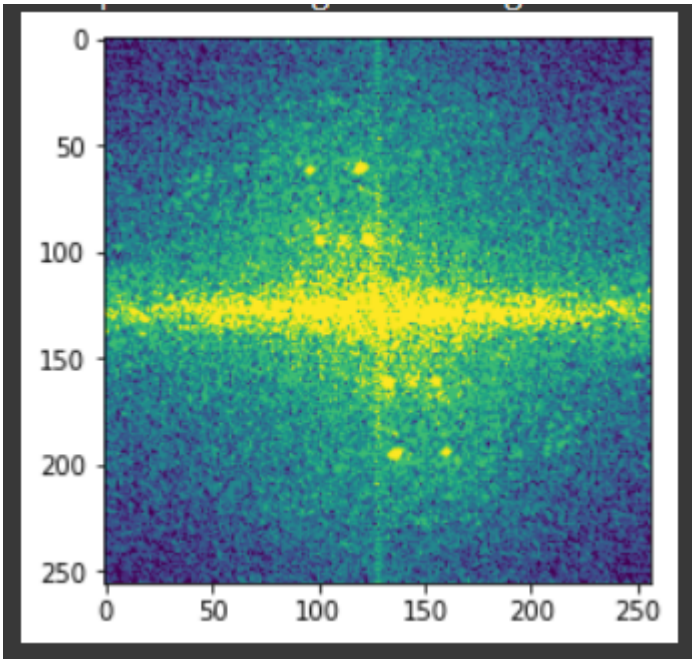
3. Calculate the spectra energy (without the DC component) feature on the texture.tif image, on the blocks of size 12×12. Is this feature good for segmentation of the textures on this image? Segment the energy image using the K-means method and comment on the results.

```
#loading the image
img = cv2.imread('/content/texture.tif',0)

#turn the image into floats
img_float32 = np.float32(img)

#get the dft of the image
dft = cv2.dft(img_float32, flags = cv2.DFT_COMPLEX_OUTPUT)

#apply shifting
dft_shift = np.fft.fftshift(dft)

#get the magnitude spectrum
magnitude_spectrum = 20*np.log(cv2.magnitude(dft_shift[:,:,0],dft_shift[:,:,1]))

#plot the images
plt.subplot(121),plt.imshow(img, cmap = 'gray')
plt.title('Input Image'), plt.xticks([]), plt.yticks([])
plt.subplot(122),plt.imshow(magnitude_spectrum, cmap = 'gray')
plt.title('Magnitude Spectrum'), plt.xticks([]), plt.yticks([])

#display images
plt.show()
```

Results :



```
#geeting the matrix of the rgb representation of the image in floats
pixel_vals = magnitude_spectrum.reshape((-1,1))
pixel_vals = np.float32(pixel_vals)

#setting the stop criteria as 100 iterations or 85% of the epsilon
criteria = (cv2.TERM_CRITERIA_EPS + cv2.TERM_CRITERIA_MAX_ITER, 100, 0.85)

#execute k means for number of clusters = 5 and centroids are initialized randomly
k = 5
retval, labels, centers = cv2.kmeans(pixel_vals, k, None, criteria, 10, cv2.KMEANS_RANDOM_CENTERS)

#convert the data into bytes
centers = np.uint8(centers)
segmented_data = centers[labels.flatten()]

#creating the segmented image
segmented_image = segmented_data.reshape((magnitude_spectrum.shape))

#plot the image
plt.imshow(segmented_image)
```



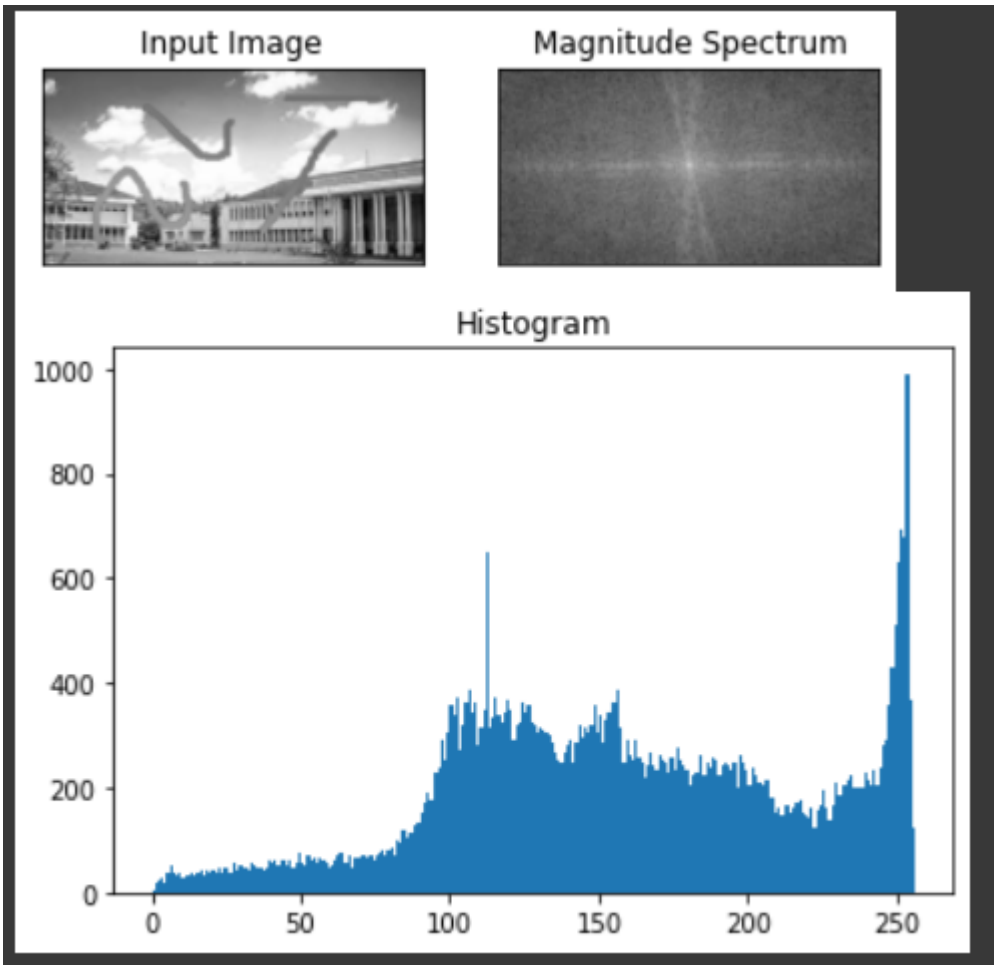
It can be seen a separation of colors in the image.

4. By using segmentation and cv2.inpaint restore the “Efac.jpg” image. In your report explain the steps you used to achieve it.

Creating the mask of four curves

```
#importing the library with aliasing
import cv2 as cv

#load the image of the efac
img = cv.imread('/content/Efac.jpg',0)

#get the magnitude spectrum of the image
f = np.fft.fft2(img)
fshift = np.fft.fftshift(f)
magnitude_spectrum =20*np.log(np.abs(fshift))

#plotting the image
plt.subplot(121), plt.imshow(img,cmap = 'gray')
plt.title('Input Image'), plt.xticks([]),
plt.yticks([])

#plotting the magnitude specturm of the image
plt.subplot(122),plt.imshow(magnitude_spectrum,cmap = 'gray')
plt.title('Magnitude Spectrum'),
plt.xticks([]),
plt.yticks([])
plt.show()

#plotting the histogram of the image
plt.hist(img.ravel(),256,[0,256])
plt.title('Histogram')
plt.show()
```

Results :


Input Image
Magnitude Spectrum
Histogram
1000
800
600
400
200
0
0
50
100
150
200
250

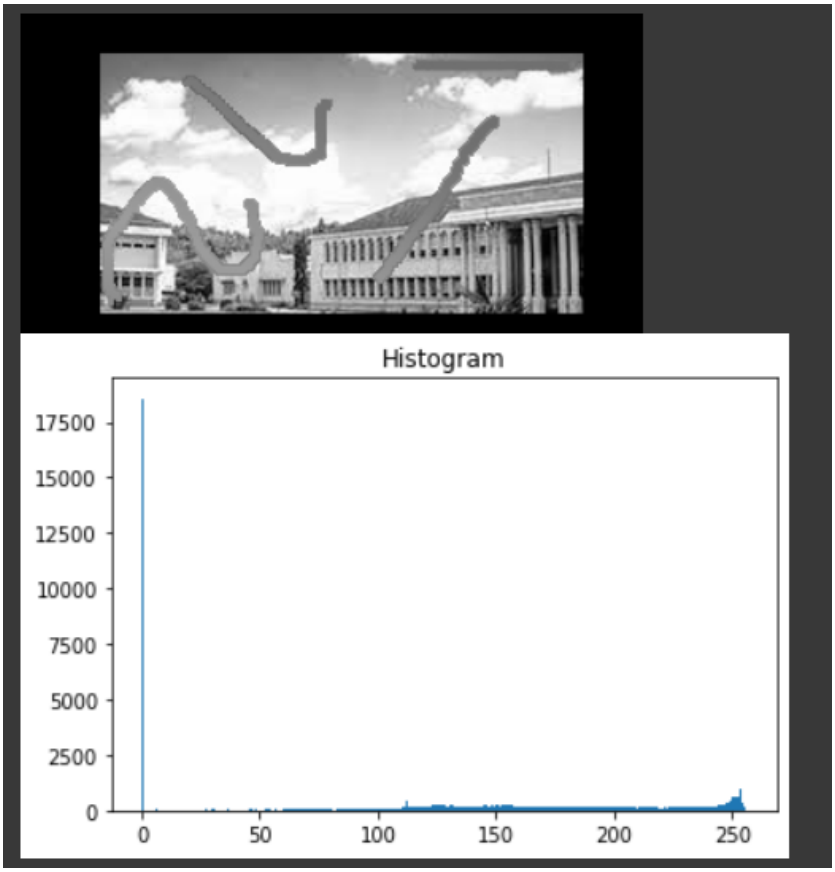
Identifying manually the area where actually need to be painted with visual observations.

```
#creating the mask as zeros initially
mask = np.zeros((img.shape[0],img.shape[1]), np.uint8)

#setting the mask to 255 to a certain region
mask[20:-10, 40:-30] = 255

#applying the mask elementwise
masked_img = cv.bitwise_and(img,img,mask = mask)

#saving the image
cv.imwrite('masked1.jpg',masked_img)

#plotting the image and the masked image
set_of_images = np.hstack((img, masked_img))
cv2_imshow(set_of_images)
```

Applying median blur to make the image smooth

```
#applying the median blur to the image
img2 = cv.medianBlur(masked_img, 15)

#display the image
cv2_imshow(masked_img)

#plot the histogram of the image
plt.hist(masked_img.ravel(),256,[0,256])

#set the title
plt.title('Histogram')

#show the histogram
plt.show()
```

Results :




```
 #setting white and blacks to the background and foreground
_ , thresholded = cv.threshold(masked_img, 130, 255, cv.THRESH_BINARY_INV)

#get the amount and labels, here label 0 is the background
amount, labels = cv.connectedComponents(thresholded)

#preview for observation
preview = np.zeros((masked_img.shape[0], masked_img.shape[1], 3), dtype=np.uint8)

#draw blue and green labels
preview[labels == 1] = (255, 0, 0)
preview[labels == 2] = (0, 255, 0)

#displaying the image
cv2_imshow(preview)
```

Blue coloured region is the unwanted curves.

Make the blue colour region to white for easy processing

```
[19] #setting the white labels for drawing
     preview[labels == 1] = (255, 255, 255)
     preview[labels == 2] = (0, 255, 0)
```

```
#creating a new mask, initialize with zeros
mask2 = np.zeros((preview.shape[0],preview.shape[1]), np.uint8)

#set some regions to 255
mask2[20:-10, 40:-30] = 255

#created the masked image using the bitwise anding
masked_img2 = cv.bitwise_and(preview,preview,mask = mask2)

#plot the image
cv2_imshow(masked_img2)
```

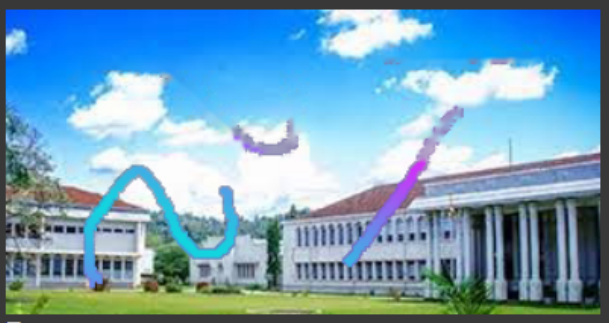
The whole image is masked step by step.

```
#create another mask
mask3 = np.zeros((preview.shape[0],preview.shape[1]), np.uint8)

#set the corresponding region to 255
mask3[23:-80, 70:-30] = 255

#creating the masked image
masked_img3 = cv.bitwise_and(masked_img2,masked_img2,mask = mask3)

#plot the image
cv2_imshow(masked_img3)
```

```
#creating another mask
mask4 = np.zeros((preview.shape[0],preview.shape[1]), np.uint8)

#set corresponding region to 255
mask4[:, :] = 255
mask4[23:-130, 70:-120] = 0

#creating the masked image
masked_img4 = cv.bitwise_and(masked_img3,masked_img3,mask = mask4)

#preview the image and save it
cv2_imshow(masked_img4)
cv.imwrite('upper_mask.jpg',masked_img4)
```

```
True
```

```
import numpy as np
import cv2

#load the image and the masked imaged
img = cv2.imread('/content/Efac.jpg')
mask = cv2.imread('/content/upper_mask.jpg', 0)

#making it inpaint
dst = cv2.inpaint(img, mask, 3, cv2.INPAINT_NS)

#preview the dst and save it
cv2_imshow(dst)
cv2.imwrite('efac_inpainted.png', dst)
```



```
True
```

```
[51] #load the image
     img = cv.imread('/content/Efac.jpg',0)

     #masking the curve
     mask_lower = np.zeros((img.shape[0],img.shape[1]), np.uint8)
     mask_lower[-80:-20, 170:-80] = 255
     masked_img_lower = cv.bitwise_and(img,img,mask = mask_lower)

     #plotting the images
     set_of_images = np.hstack((img, masked_img_lower))
     cv2_imshow(set_of_images)
```

```
 #setting white and blacks to the background and foreground
_ , thresholded = cv.threshold(masked_img_lower, 125, 255, cv.THRESH_BINARY_INV)

#get the amount and labels, here label 0 is the background
amount, labels = cv.connectedComponents(thresholded)

#preview for observation
preview2 = np.zeros((masked_img_lower.shape[0], masked_img_lower.shape[1], 3), dtype=np.uint8)

#making the background white
preview2[labels == 1] = (255, 255, 255)
preview2[labels == 2] = (0, 255, 0)

#display the image
cv2_imshow(preview2)
```

```
[53]  #setting white and blacks to the background and foreground
      _ , thresholded = cv.threshold(masked_img_lower, 145, 255, cv.THRESH_BINARY_INV)

      #get the amount and labels, here label 0 is the background
      amount, labels = cv.connectedComponents(thresholded)

      #preview for observation
      preview3 = np.zeros((masked_img_lower.shape[0], masked_img_lower.shape[1], 3), dtype=np.uint8)

      # draw label 1 blue and label 2 green
      preview3[labels == 1] = (255, 255, 255)
      preview3[labels == 2] = (0, 255, 0)

      #preview the image
      cv2_imshow(preview3)
```

145 and 125 are the threshold values and the required part is taken using the following logical operation.

```
[54] #create the mask using above 2 images
     masked_img_lower_right = (cv.bitwise_and(~preview2,preview3))

     #display it
     cv2_imshow(masked_img_lower_right)
```

```
[55] #load the image
     img = cv.imread('/content/Efac.jpg',0)

     #masking
     mask_lower1 = np.zeros((img.shape[0],img.shape[1]), np.uint8)
     mask_lower1[-80:-20, 40:122] = 255
     masked_img_lower_left = cv.bitwise_and(img ,img ,mask = mask_lower1)

     #display the image and the  masked image
     set_of_images = np.hstack((img, masked_img_lower_left))
     cv2_imshow(set_of_images)
```

```
#setting white and blacks to the background and foreground
_ , thresholded = cv.threshold(masked_img_lower_left, 160, 255, cv.THRESH_BINARY_INV)

#get the amount and labels, here label 0 is the background
amount, labels = cv.connectedComponents(thresholded)

#preview for observation
preview4 = np.zeros((masked_img_lower_left.shape[0], masked_img_lower_left.shape[1], 3), dty

#setting label parameteres
preview4[labels == 1] = (255, 255, 255)
preview4[labels == 2] = (0, 255, 0)

#display the image
cv2_imshow(preview4)
```

```
[57] #setting white and blacks to the background and foreground
     _ , thresholded = cv.threshold(masked_img_lower_left, 140, 255, cv.THRESH_BINARY_INV)

     #get the amount and labels, here label 0 is the background
     amount, labels = cv.connectedComponents(thresholded)

     #preview for observation
     preview5 = np.zeros((masked_img_lower_left.shape[0], masked_img_lower_left.shape[1], 3), dtype

     #setting the labels
     preview5[labels == 1] = (255, 255, 255)
     preview5[labels == 2] = (0, 255, 0)

     #display the image
     cv2_imshow(preview5)
```

The two masks need to be logically combined.

```
[58] #masking the lower left and display it
     masked_img_lower_left = (cv.bitwise_and(~preview5,preview4))
     cv2_imshow(masked_img_lower_left)
```

```
[59] #masking the lower part of the image and dispaly it
     masked_img_low = cv.bitwise_or(masked_img_lower_right,masked_img_lower_left)
     cv2_imshow(masked_img_low)
```

Now inpainting should be applied.

```
import numpy as np
import cv2

#load the image and the masked imaged
img = cv2.imread('/content/Efac.jpg')
mask = cv2.imread('/content/lower_mask.jpg', 0)

#making it inpaint
dst = cv2.inpaint(img, mask, 3, cv2.INPAINT_NS)

#preview the dst and save it
cv2_imshow(dst)
cv2.imwrite('efac_inpainted.png', dst)
```