# AlliKhadgaJyoth_19024

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# 1 CV MIDSEM

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[1]:
```
import numpy as np
import matplotlib.pyplot as plt
import cv2
import skimage
```

### 1.3.1 Part 1

### 1.3.2 Q1

I would take the image at intensity level 8 i.e 256 bits of intensity values. Because the 8 is at the mean of lower and higher intensity levels giving us the average level feature resolution.

### 1.3.3 Q5

[2]:
```
M = np.array([
    [-2872.0,-1744.3,-138.7,77270.0],
    [-273.9,-174.8,-3287.5,94116.0],
    [-0.7380,-0.6480,-0.1883,75.633]
])

M
```

[2]:
```
array([[-2.8720e+03, -1.7443e+03, -1.3870e+02,  7.7270e+04],
       [-2.7390e+02, -1.7480e+02, -3.2875e+03,  9.4116e+04],
       [-7.3800e-01, -6.4800e-01, -1.8830e-01,  7.5633e+01]])
```

[3]:
```
H = M[:,:3]
h = M[:,3].reshape(3,1)
H_inv = np.linalg.inv(H)
H_inv
```

```
[3]: array([[-1.11863453e-03, -1.27242826e-04,  3.04548805e+00],
            [ 1.26648610e-03,  2.33839152e-04, -5.01544256e+00],
            [ 2.58592330e-05, -3.06014684e-04,  1.29399794e-02]])
```

```
[4]: R_T,K_inv = np.linalg.qr(H_inv)
     R_T
```

```
[4]: array([[-0.66192563, -0.13119877,  0.7379982 ],
            [ 0.74941331, -0.13593284,  0.64799842],
            [ 0.01530159,  0.98199244,  0.18829954]])
```

```
[5]: K_inv
```

```
[5]: array([[ 1.68997010e-03,  2.54784951e-04, -5.77432805e+00],
            [ 0.00000000e+00, -3.15596422e-04,  2.94906009e-01],
            [ 0.00000000e+00,  0.00000000e+00, -9.99997555e-01]])
```

```
[6]: K = np.linalg.inv(K_inv)
     K = K/K[2,2]
     K ,'Intrinsic Martix'
```

```
[6]: (array([[-5.91724998e+02, -4.77707014e+02,  3.27594359e+03],
             [ 0.00000000e+00,  3.16859598e+03,  9.34440281e+02],
             [ 0.00000000e+00,  0.00000000e+00,  1.00000000e+00]]),
      'Intrinsic Martix')
```

```
[7]: t = K_inv@h
     t
```

```
[7]: array([[-282.16642284],
            [  -7.39804667],
            [ -75.63281508]])
```

```
[8]: R_T.T
```

```
[8]: array([[-0.66192563,  0.74941331,  0.01530159],
            [-0.13119877, -0.13593284,  0.98199244],
            [ 0.7379982 ,  0.64799842,  0.18829954]])
```

```
[9]: Extensic_matrix = np.array([[-0.66192563,  0.74941331,  0.01530159,t[0,0]],
            [-0.13119877, -0.13593284,  0.98199244,t[1,0]],
            [ 0.7379982 ,  0.64799842,  0.18829954,t[2,0]]])
     Extensic_matrix
```

```
[9]: array([[-6.61925630e-01,  7.49413310e-01,  1.53015900e-02,
             -2.82166423e+02],
            [-1.31198770e-01, -1.35932840e-01,  9.81992440e-01,
             -7.39804667e+00],
```

```
[ 7.37998200e-01,  6.47998420e-01,  1.88299540e-01,
 -7.56328151e+01]])
```

### 1.4 Q6

[10]:
```python
u1 = np.array([4,2,2])
u2 = np.array([6,5,1])
np.cross(u1,u2)
```

[10]:
```
array([-8,  8,  8])
```

### 1.5 Q7

[11]:
```python
M = np.array([[512,-800,0,800],[512,0,-800,1600],[1,0,0,0]])
X = np.array([4,0,0,1]).T
x = M@X
x.reshape(3,-1)
```

[11]:
```
array([[2848],
       [3648],
       [   4]])
```

[ ]:
```python

```

[ ]:
```python

```

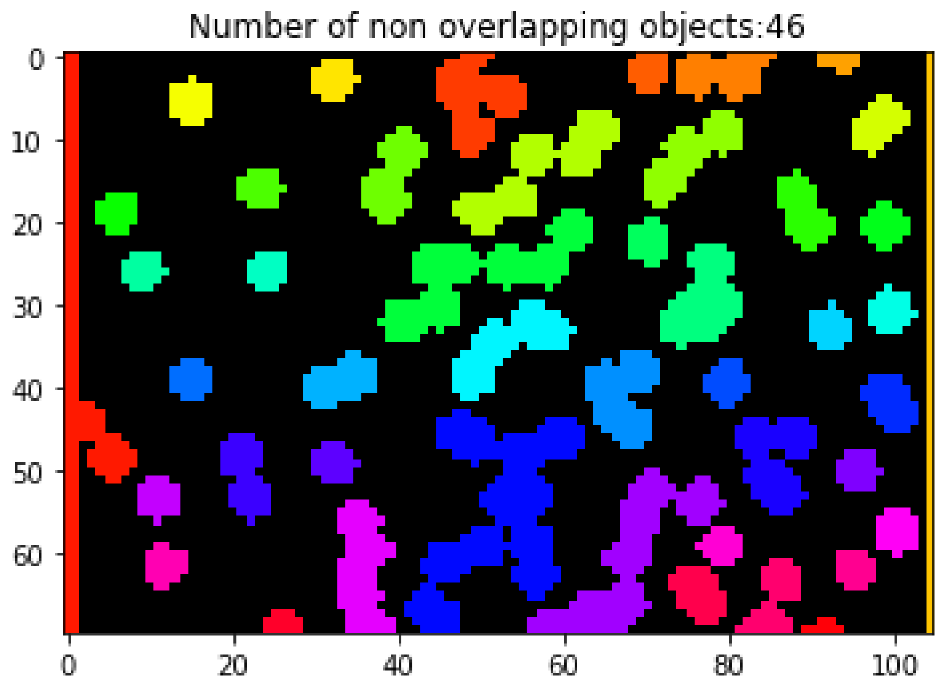
### 1.6 Part 2

[31]:
```python
import cv2 as cv
input_image = cv2.imread('Fig2.png')
input_image= cv.cvtColor(input_image,cv2.COLOR_RGB2GRAY)
input_image = cv.threshold(input_image,127,1,cv.THRESH_BINARY)[1]
num_labels, labels = cv2.connectedComponents(input_image,connectivity = 4)
# plt.imshow(labels,'gray'),num_labels

# Map component labels to hue val, 0-179 is the hue range in OpenCV
label_hue = np.uint8(179*labels/np.max(labels))
blank_ch = 255*np.ones_like(label_hue)
labeled_img = cv2.merge([label_hue, blank_ch, blank_ch])

# Converting cvt to BGR
labeled_img = cv2.cvtColor(labeled_img, cv2.COLOR_HSV2BGR)

# set bg label to black
labeled_img[label_hue==0] = 0
plt.imshow(cv2.cvtColor(labeled_img, cv2.COLOR_BGR2RGB)),plt.title(f'Number of␣
↪non overlapping objects:{num_labels}')
```

```
##########################
# THe color is just to show distinction
##########################
```

[31]:

```
(<matplotlib.image.AxesImage at 0x249b1b59430>,
 Text(0.5, 1.0, 'Number of non overlapping objects:46'))
```




[13]:

```python
import scipy.ndimage as spi
```

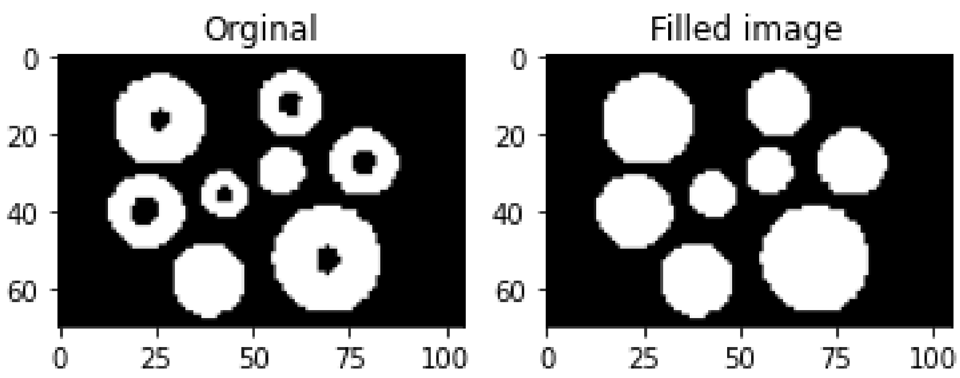
### 1.7 Q2

[14]:

```python
input_image = cv2.imread('Fig1.png')
input_image= cv.cvtColor(input_image,cv2.COLOR_RGB2GRAY)
input_image = cv.threshold(input_image,127,255,cv.THRESH_BINARY)[1]
out = spi.binary_fill_holes(input_image)
plt.subplot(121),plt.imshow(input_image,'gray'),plt.title('Orginal')
plt.subplot(122),plt.imshow(out,'gray'),plt.title('Filled image')
```

[14]:

```
(<AxesSubplot:title={'center':'Filled image'}>,
 <matplotlib.image.AxesImage at 0x249b0321430>,
 Text(0.5, 1.0, 'Filled image'))
```




[15]:
```
out = out.astype(int)
# out= cv.cvtColor(out,cv2.COLOR_RGB2GRAY)
out = np.array(out)
# out = cv.threshold(out,127,256,cv.THRESH_BINARY)
kernal = np.ones((5,5))
# kernal = kernal/kernal.sum() We dont do that here
erosion = cv.erode(out,kernal,1)
plt.imshow(input_image-erosion,'gray')
plt.subplot(121),plt.imshow(labels,'gray'),plt.title('Orginal')
```

```
---------------------------------------------------------------------------
error                                     Traceback (most recent call last)
C:\Users\KHADGA~1\AppData\Local\Temp/ipykernel_13028/1086848512.py in <module>
      5 kernal = np.ones((5,5))
      6 # kernal = kernal/kernal.sum() We dont do that here
----> 7 erosion = cv.erode(out,kernal,1)
      8 plt.imshow(input_image-erosion,'gray')
      9 plt.subplot(121),plt.imshow(labels,'gray'),plt.title('Orginal')

error: OpenCV(4.5.3) C:/Users/runneradmin/AppData/Local/Temp/
↪pip-req-build-q3d_8t8e/opencv/modules/imgproc/src/morph.simd.hpp:756: error:
↪(-213:The function/feature is not implemented) Unsupported data type (=4) in
↪function 'cv::opt_AVX2::getMorphologyRowFilter'
```

[ ]:
```
```

### 1.8 Q1

[26]:
```
import math
```

[30]:

```
N = 501;
x2 = (N-1)/2;
x1 = -x2
x1 = np.linspace(x2, x1, 501)
x2 = np.linspace(x2, x1, 501)
x,y= np.meshgrid(x1,x2,sparse=True)
# plt.plot(x,y)
# x,y
r = math.hypot(x[0],y[0])
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
C:\Users\KHADGA~1\AppData\Local\Temp/ipykernel_13028/512419636.py in <module>
      7 # plt.plot(x,y)
      8 # x,y
----> 9 r = math.hypot(x[0],y[0])

TypeError: only size-1 arrays can be converted to Python scalars
```

[22]:

```
x1 = np.linspace(x2, x1, 501)
x2 = np.linspace(x2, x1, 501)
x, x = np.meshgrid(x1, x2, sparse=True)
z = np.sin(xa**2 + xb**2) / (xa**2 + xb**2)
h = plt.contourf(a,b,z)
plt.show()
```

[23]:

```
km = 0.7*np.pi;
rm = x2;
w = rm/10;
term1 = math.sin( (km * r**2) / (2 * rm) );
term2 = 0.5*math.tanh((rm - r)/w) + 0.5;
g = term1 * term2;
I = (g + 1)/2;
```

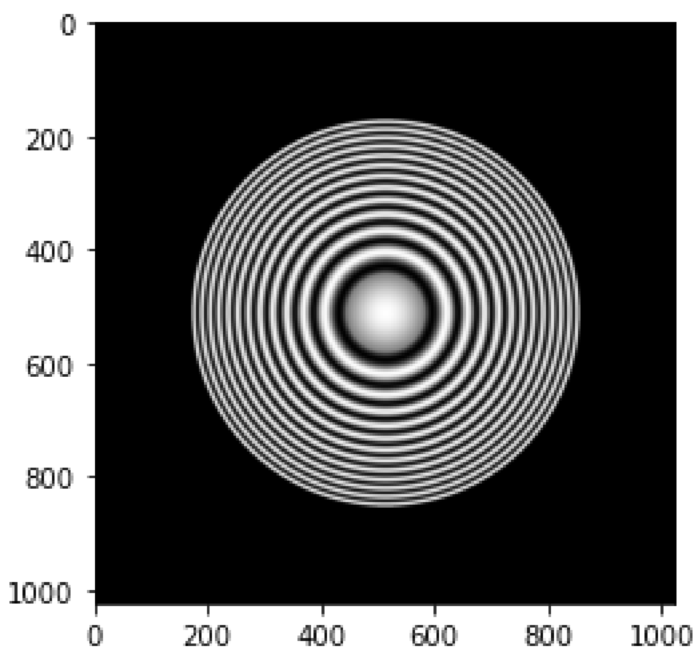
```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
C:\Users\KHADGA~1\AppData\Local\Temp/ipykernel_13028/2630066175.py in <module>
      2 rm = x2;
      3 w = rm/10;
----> 4 term1 = math.sin( (km * r**2) / (2 * rm) );
      5 term2 = 0.5*math.tanh((rm - r)/w) + 0.5;
      6 g = term1 * term2;

NameError: name 'r' is not defined
```

[32]:
```
import math
r = math.hypot(x,y)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
C:\Users\KHADGA~1\AppData\Local\Temp/ipykernel_13028/1469078048.py in <module>
      1 import math
----> 2 r = math.hypot(x,y)

TypeError: only size-1 arrays can be converted to Python scalars
```

[40]:
```
# Using a downloaded zone plate
img = cv.imread('download.dib')
plt.imshow(img)
```

[40]: <matplotlib.image.AxesImage at 0x249b2349130>



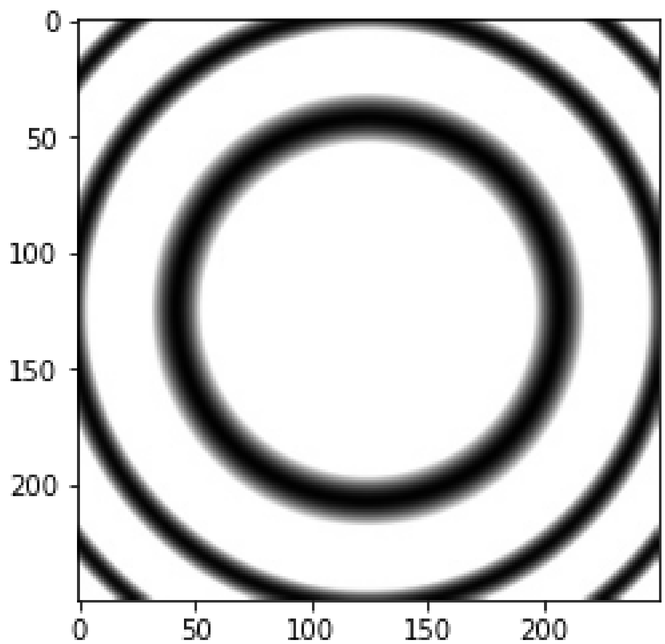

[47]:
```
center = np.array(img.shape[0:2]) / 2
x = center[1] - 250/2
y = center[0] - 250/2

I_cropped = img[int(y):int(y+250), int(x):int(x+250)]
```

[48]:
```
kernal = np.array([[1,1,1],[1,1,1],[1,1,1]])
kernal = kernal/sum(kernal)
img_lpf = cv2.filter2D(I_cropped,-1,kernal)
cv2.imwrite('lpf.jpg',img_lpf)
# plt.imshow()
```

[48]: True

[49]:
```
plt.imshow(cv2.imread('lpf.jpg'))
```

[49]: <matplotlib.image.AxesImage at 0x249b2b3f490>



Q2. A set 'A' is called Connected Set if there doesn't exist two disjoint sets such that

$$A \not\subset B \cup C \;\&\; B \cap C = \phi$$

Q3.

a, It is a second derivative box filter used to find edges.

b, It is second derivative with smoothing.

c,

d, It's a structural element detecting horizontal boundary edge.

e, It's a SE detecting vertical boundary.

Teacher's Signature ____________

Q 4. If the sd. of gaussian is more, then the values inside the ~~box~~ filter fall-off more compared to when sd. is less. It means, the pixels around the center pixel ~~is~~ are given less importance when compared to when sd. was less.

Q 8. If Gaussian smoothing is performed several times, all the pixel values will eventually converge to the mean pixel intensity value. And then the filter will have no effect on the image.

10. b

11. b

12. b

13. There are black & white spots on the image, so, its salt & pepper noise. It can be removed by using median filter.