Exercise 03

INDEX NO - 190713X

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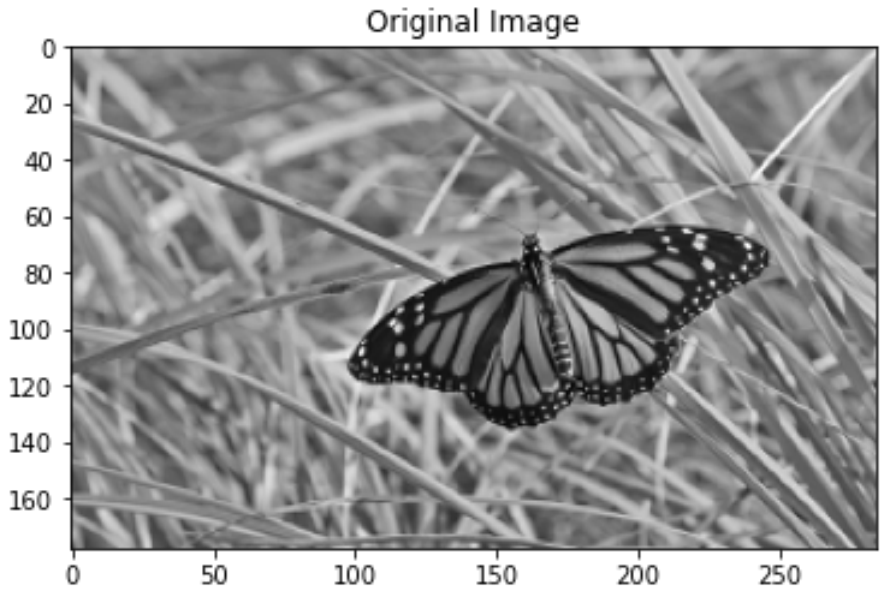
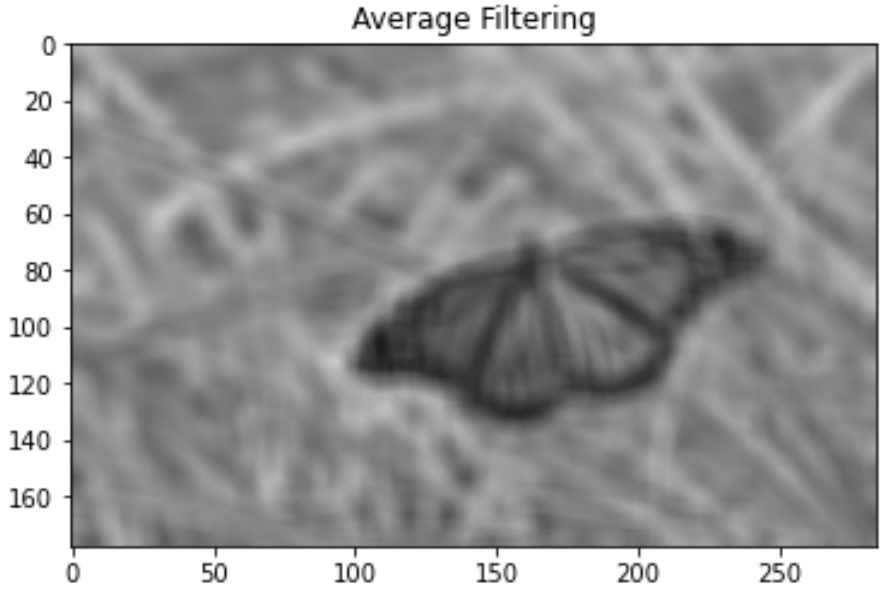
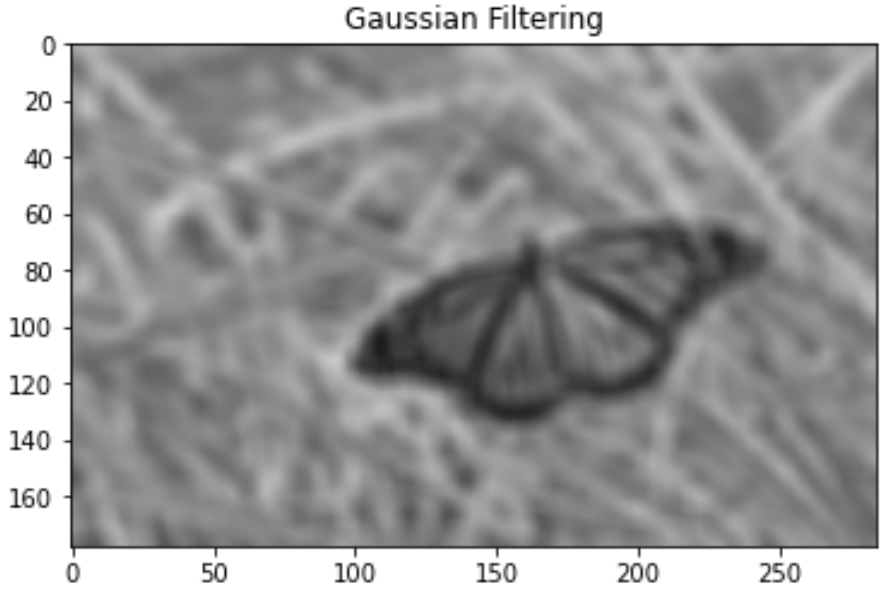
Question 1

In [ ]:

```
import cv2 as cv
import numpy as np
from matplotlib import pyplot as plt

img = cv.imread(r"C:\Users\HIRUNI\Desktop\EN2550\3\butterfly.jpg",cv.I
assert img is not None

box_kernel = np.ones((9,9),np.float32)/81
img_avg = cv.filter2D(img , -1 , box_kernel)

sigma = 4
gkernel = cv.getGaussianKernel(9,sigma)
img_blurred = cv.sepFilter2D(img,-1,gkernel,gkernel,anchor=(-1,-1),del

fig,ax = plt.subplots()
ax.imshow(img, cmap="gray",vmin=0,vmax=255)
plt.title("Original Image")
plt.show()

fig,ax = plt.subplots()
ax.imshow(img_avg, cmap="gray",vmin=0,vmax=255)
plt.title("Average Filtering")
plt.show()

fig,ax = plt.subplots()
ax.imshow(img_blurred, cmap="gray",vmin=0,vmax=255)
plt.title("Gaussian Filtering")
plt.show()
```


Original Image
0
20
40
60
80
100
120
140
160
0
50
100
150
200
250

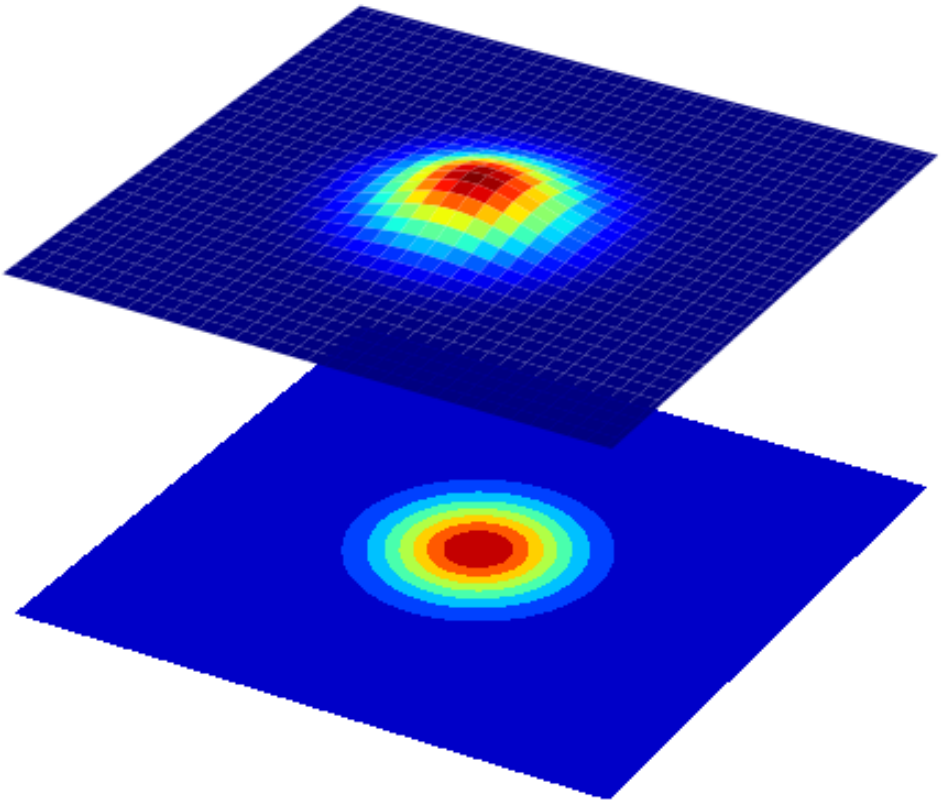

Average Filtering
0
20
40
60
80
100
120
140
160
0
50
100
150
200
250


Gaussian Filtering
0
20
40
60
80
100
120
140
160
0
50
100
150
200
250

Question 2

In [ ]:

```
import cv2 as cv
import numpy as np
from matplotlib import pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
from matplotlib import cm

sigma = 1

X_ = np.arange(-5,5.1,0.1)
Y_ = np.arange(-5,5.1,0.1)
X,Y = np.meshgrid(X_,Y_)
Z = 1/(2*np.pi*sigma**2)*np.exp(-(X**2 + Y**2)/(2*sigma**2))
fig = plt.figure(figsize=(10,10))
ax = fig.add_subplot(111,projection='3d')

surf = ax.plot_surface(X,Y,Z,cmap=cm.jet,linewidth=0,antialiased=True)

cset= ax.contourf(X,Y,Z, zdir='z', offset=np.min(Z)-1.5, cmap=cm.jet)
ax.set_zlim(np.min(Z)-2,np.max(Z))
plt.axis('off')
plt.show()
```

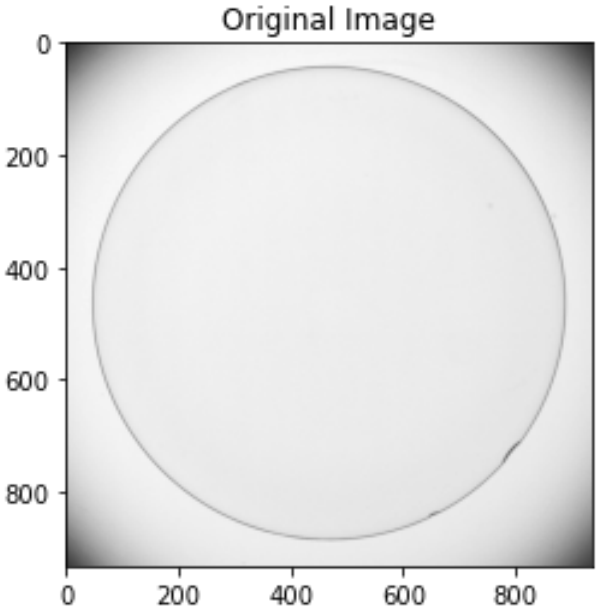


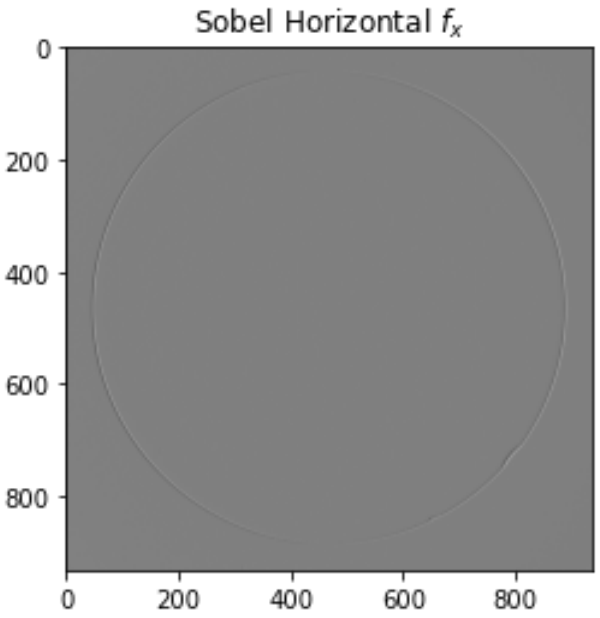
Question 3

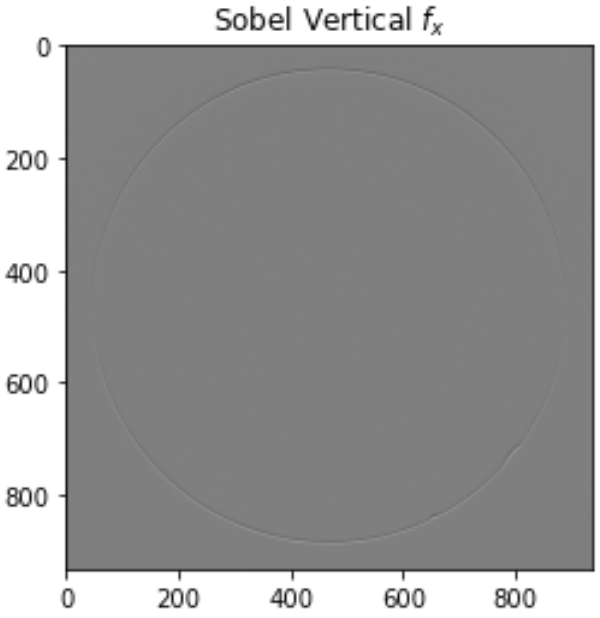
In [ ]:

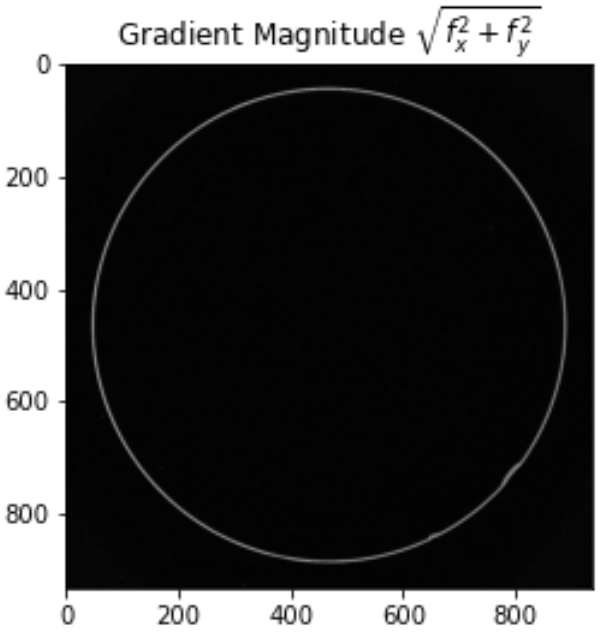
```
import cv2 as cv
import numpy as np
from matplotlib import pyplot as plt

f= cv.imread(r"C:\Users\HIRUNI\Desktop\EN2550\3\contact_lens.tif",cv.I
assert f is not None

sobel_v=  np.array([(-1,-2,-1),(0,0,0),(1,2,1)],dtype=float)
sobel_h = np.array([(-1,0,1),(-2,0,2),(-1,0,1)],dtype=float)

f_y= cv.filter2D(f , -1 , sobel_h)
f_x= cv.filter2D(f , -1 , sobel_v)
grad_mag = np.sqrt(f_x**2 + f_y**2)

fig,ax = plt.subplots()
```

```
ax.imshow(f, cmap="gray",vmin=0,vmax=255)
plt.title("Original Image")
plt.show()

fig,ax = plt.subplots()
ax.imshow(f_y, cmap="gray",vmin=-1020,vmax=1020)
plt.title("Sobel Horizontal $f_x$")
plt.show()

fig,ax = plt.subplots()
ax.imshow(f_x, cmap="gray",vmin=-1020,vmax=1020)
plt.title("Sobel Vertical $f_x$")
plt.show()

fig,ax = plt.subplots()
ax.imshow(grad_mag, cmap="gray")
plt.title("Gradient Magnitude $\sqrt{f_x^2 + f_y^2}$")
plt.show()
```




Sobel Horizontal f_x
0
200
400
600
800
0
200
400
600
800


Sobel Vertical f_x
0
200
400
600
800
0
200
400
600
800

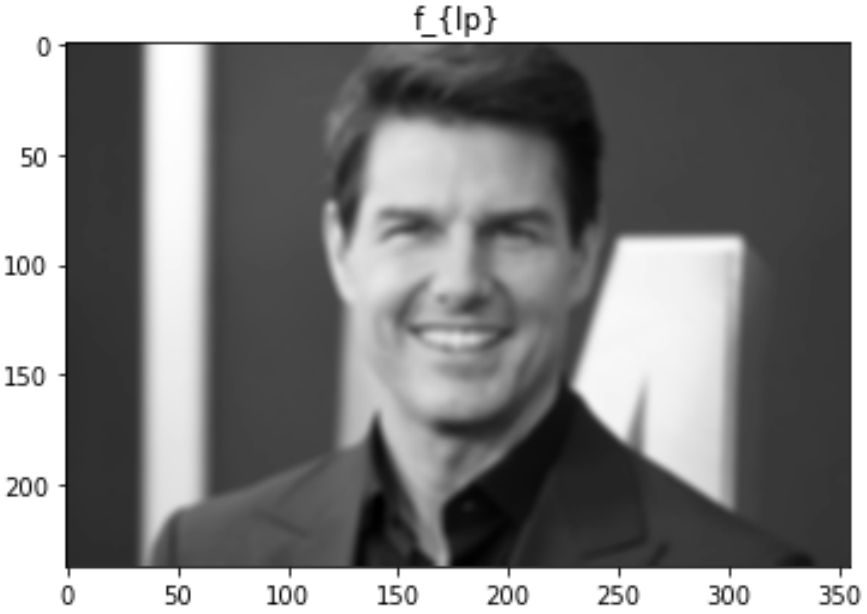


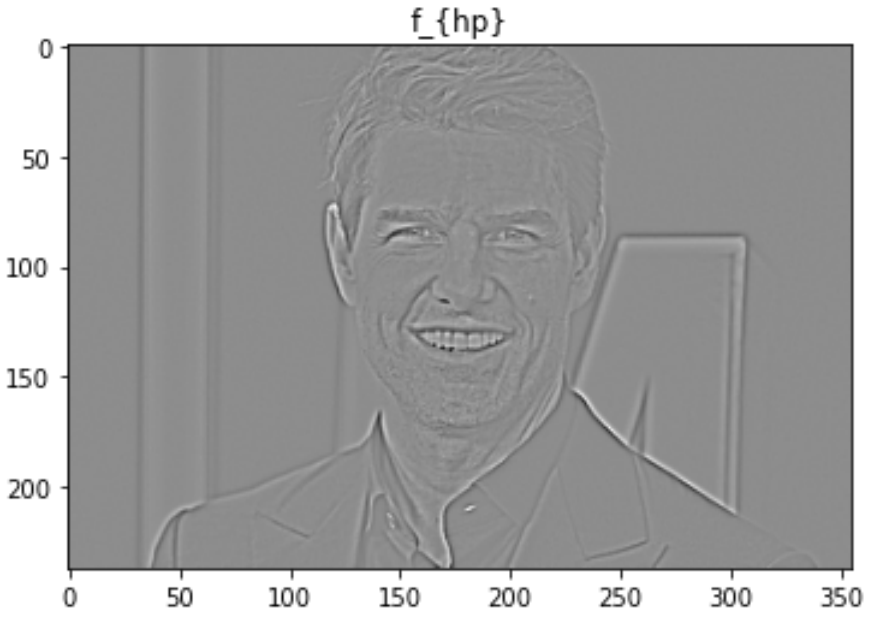
Question 4

In [ ]:

```
import cv2 as cv
import numpy as np
from matplotlib import pyplot as plt

img = cv.imread(r"C:\Users\HIRUNI\Desktop\EN2550\3\tom.jpg",cv.IMREAD_
assert img is not None

sigma = 2
gaussian_1d = cv.getGaussianKernel(5,sigma)
img_lp = cv.sepFilter2D(img,-1,gaussian_1d,gaussian_1d)
img_hp =img-img_lp
img_sharpened = cv.addWeighted(img, 1.0, img_hp, 1.5, 0)

fig,ax = plt.subplots()
ax.imshow(img, cmap="gray")
plt.title("Original")
plt.show()

fig,ax = plt.subplots()
ax.imshow(img_lp, cmap="gray")
plt.title(r'f_{lp}')
plt.show()

fig,ax = plt.subplots()
ax.imshow(img_hp, cmap="gray")
plt.title(r'f_{hp}')
plt.show()

fig,ax = plt.subplots()
```

```
ax.imshow(img_sharpened, cmap="gray")
plt.title("Sharpened")
plt.show()
```




f_{hp}
0
50
100
150
200
0
50
100
150
200
250
300
350


Sharpened
0
50
100
150
200
0
50
100
150
200
250
300
350