EN2550 Exercise 4

Name - Ekanayake E.M.S.S.N.

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

01

```python
fig, ax = plt.subplots(1,2, figsize=(16,8))
ax1 = fig.add_subplot(121, projection = '3d')
ax2 = fig.add_subplot(122, projection = '3d')

delta = 0.1
XX,YY = np.meshgrid(np.arange(-5,5+delta, delta),np.arange(-5,5+delta, delta))

sigma = 1
g = np.exp(-(XX**2 + YY**2)/(2*sigma**2))
g /= np.sum(g)
sobel_v = np.array([[-1,-2,-1],[0,0,0],[1,2,1]], dtype = np.float32)
g_x = cv.filter2D(g,-1,sobel_v)
sobel_h = np.array([[-1,0,-1],[-2,0,2],[-1,0,1]], dtype = np.float32)
g_y = cv.filter2D(g,-1,sobel_h)

surf1 = ax1.plot_surface(XX,YY,g_x, cmap = cm.jet, linewidth=0,antialiased=True)
surf2 = ax2.plot_surface(XX,YY,g_y, cmap = cm.jet, linewidth=0,antialiased=True)
ax1.axis('off')
ax2.axis('off')
plt.show()
```
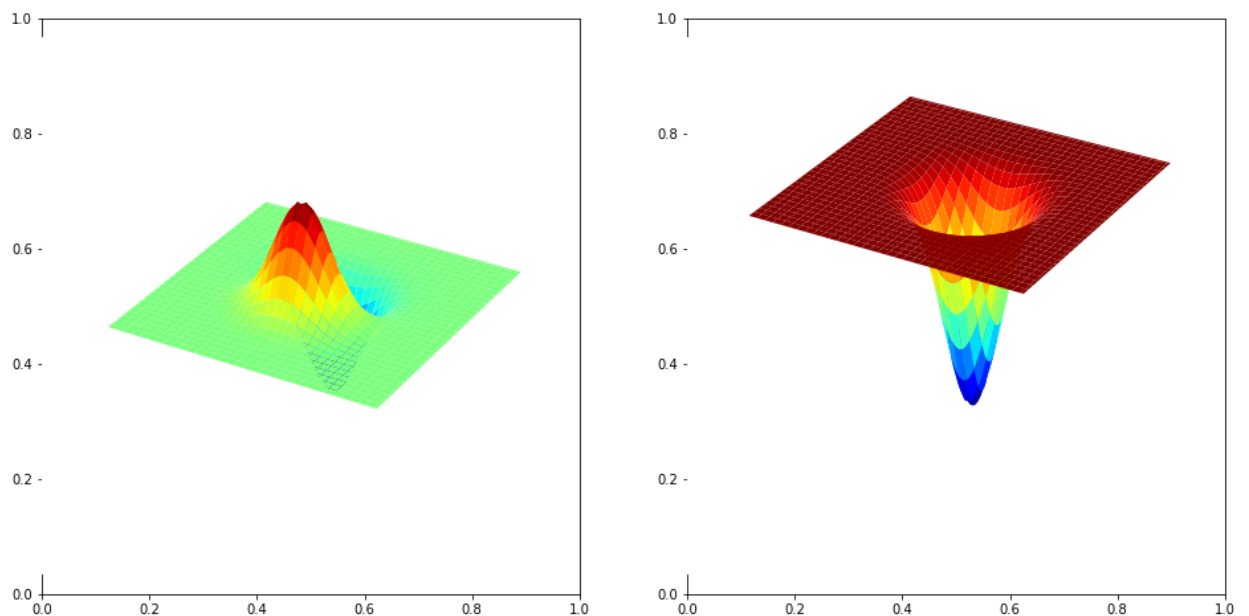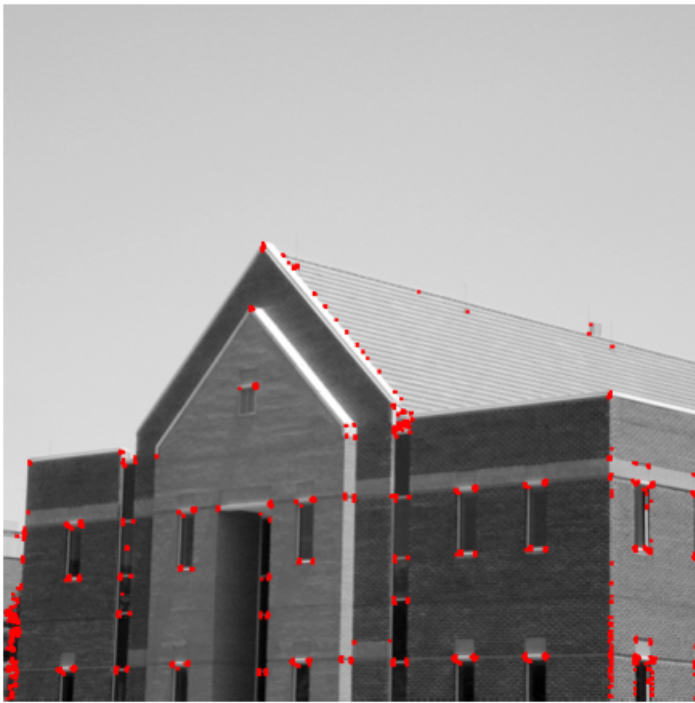

02

```python
im = cv.imread(r'Assignment1/building.tif', cv.IMREAD_COLOR)
assert im is not None

gray = cv.cvtColor(im, cv.COLOR_BGR2GRAY)
gray = np.float32(gray)
dst = cv.cornerHarris(gray,2,3,0.04)

dst = cv.dilate(dst,None)
im[dst>0.01*dst.max()]=[255,0,0]

fig, ax = plt.subplots(figsize = (8,8))
ax.imshow(im, cmap = 'gray')
```

```
ax.axis('off')
plt.show()
```


04

In [ ]:
```
im = cv.imread(r'Assignment1/building.tif', cv.IMREAD_GRAYSCALE)
assert im is not None

edges = cv.Canny(im,100,200)

fig, ax = plt.subplots(1,2, figsize = (16,16))
ax[0].imshow(im, cmap = 'gray')
ax[0].axis('off')
ax[1].imshow(edges, cmap = 'gray')
ax[1].axis('off')
plt.show()
```


03

In [ ]:
```
from skimage.feature import peak_local_max

im = cv.imread(r'Assignment1/building.tif', cv.IMREAD_COLOR)
assert im is not None

I = cv.cvtColor(im, cv.COLOR_BGR2GRAY)
I = np.float32(I)
sobel_v = np.array([[-1,-2,-1],[0,0,0],[1,2,1]], dtype = np.float32)
```

```python
sobel_h = np.array([[-1,0,1],[-2,0,2],[-1,0,1]], dtype = np.float32)

Ix = cv.filter2D(I, -1, sobel_v)
Iy = cv.filter2D(I, -1, sobel_h)

sigma = 3
ksize = 7
m11 = cv.GaussianBlur(Ix*Ix , (ksize, ksize), sigma)
m12 = cv.GaussianBlur(Ix*Iy , (ksize, ksize), sigma)
m21 = m12
m22 = cv.GaussianBlur(Iy*Iy , (ksize, ksize), sigma)

det = m11*m22 - m12*m21
trace = m11 + m22
alpha = 0.04
R = det - alpha*trace**2
R[ R< 1e8] = 0
coordinates = peak_local_max(R, min_distance=2)

fig, ax = plt.subplots(2,2,figsize = (20,20))
ax[0,0].imshow(im,cmap='gray')
ax[0,0].plot(coordinates[:,1],coordinates[:,0],'r.')
ax[0,1].imshow(Ix + 127 , cmap='gray')
ax[1,0].imshow(Iy + 127 , cmap='gray')
ax[1,1].imshow(R + 127, cmap=cm.jet)
for i in range(2):
    for j in range(2):
        ax[i,j].axis('off')
plt.show()
```