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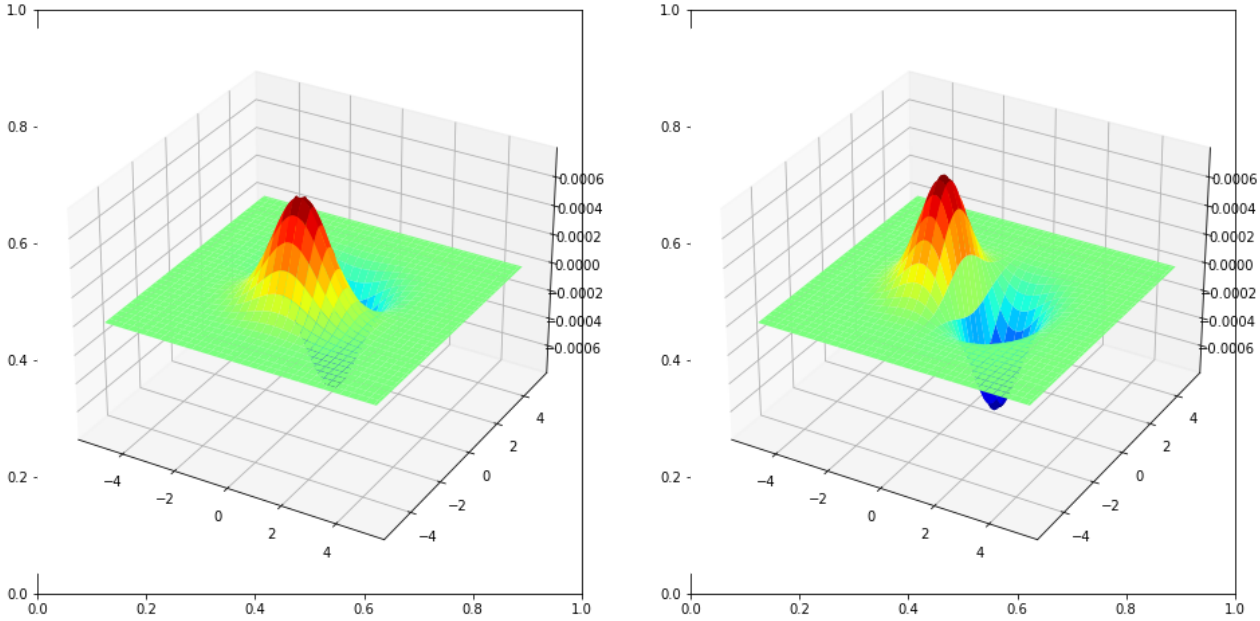
Index No.: 190172K

In [ ]:
```
import cv2
import numpy as np
import sympy
import matplotlib.pyplot as plt
import matplotlib.gridspec as gridspec
from matplotlib import cm
import math
%matplotlib inline
```

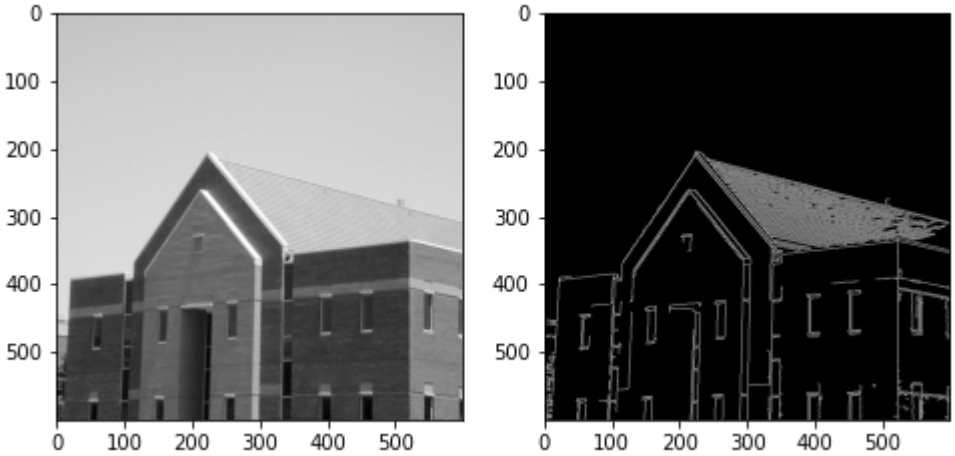
Q1

In [ ]:
```
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 = cv2.filter2D(g,-1,sobel_v)
sobel_h = np.array([[-1,0,1],[-2,0,2],[-1,0,1]],dtype = np.float32)
g_y = cv2.filter2D(g,-1,sobel_h)

surf1 = ax1.plot_surface(XX, YY, g_x, cmap = cm.jet)
surf2 = ax2.plot_surface(XX, YY, g_y, cmap = cm.jet)

plt.show()
```

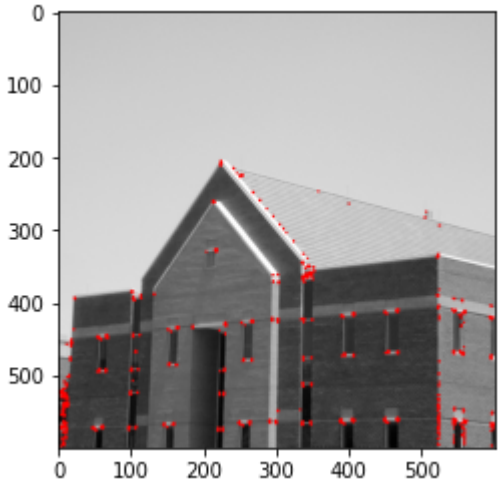


Q2

In [ ]:
```
img = cv2.imread("building.tif",cv2.IMREAD_GRAYSCALE)
edges = cv2.Canny(img,100,200)

fig,ax = plt.subplots(1,2,figsize=(8,4))
ax[0].imshow(img,cmap='gray',vmin=0,vmax=255)
ax[1].imshow(edges,cmap='gray',vmin=0,vmax=255)
plt.show()
```

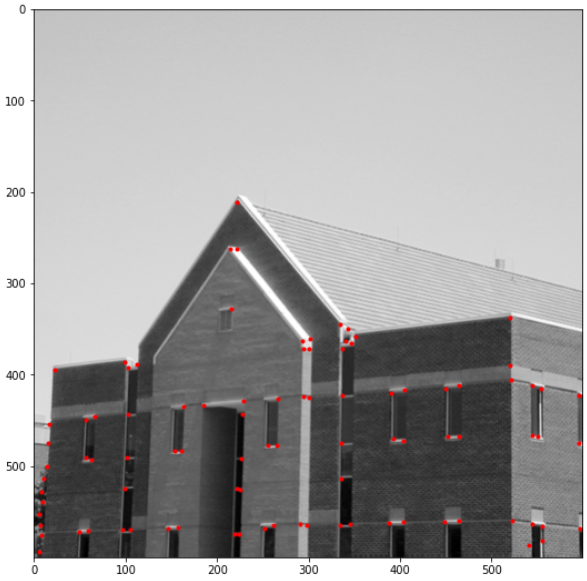
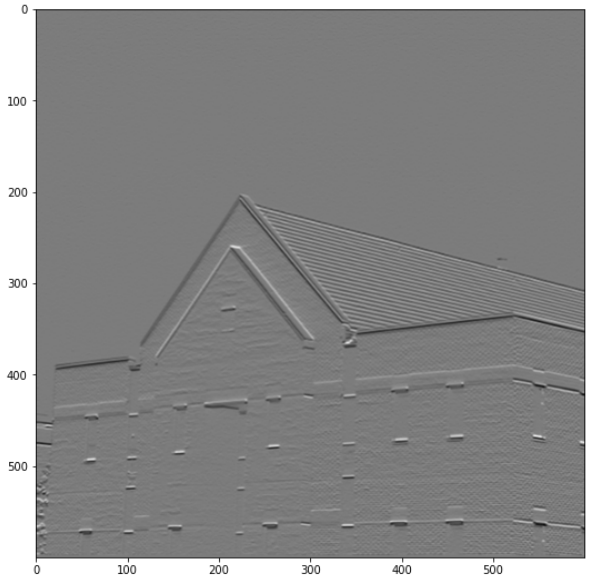
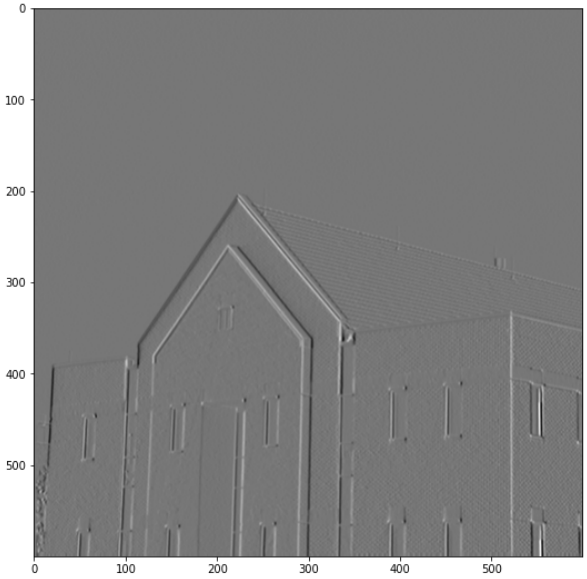
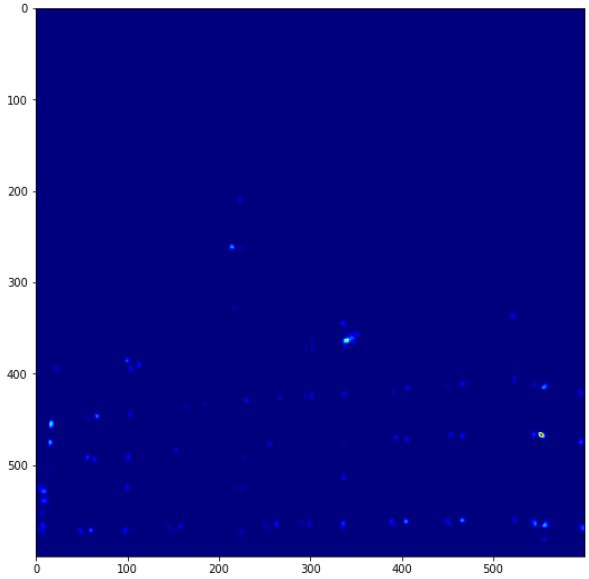


In [ ]:
```
img = cv2.imread("building.tif",cv2.IMREAD_COLOR)

gray = cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
gray = np.float32(gray)
dst = cv2.cornerHarris(gray,2,3,0.04)

dst = cv2.dilate(dst,None)
img[dst>0.01*dst.max()]=[0,0,255]
plt.imshow(cv2.cvtColor(img,cv2.COLOR_BGR2RGB))
plt.show()
```



In [ ]:

```
from skimage.feature import peak_local_max
img = cv2.imread("building.tif",cv2.IMREAD_COLOR)
I = cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
I = np.float32(I)
sobel_v = np.array([[-1,-2,-1],[0,0,0],[1,2,1]],dtype = np.float32)
sobel_h = np.array([[-1,0,1],[-2,0,2],[-1,0,1]],dtype = np.float32)

Ix = cv2.filter2D(I,-1,sobel_v)
Iy = cv2.filter2D(I,-1,sobel_h)

ksize = 7
sigma = 3
m11 = cv2.GaussianBlur(Ix*Ix,(ksize,ksize),sigma)
m12 = cv2.GaussianBlur(Ix*Iy,(ksize,ksize),sigma)
m21 = m12
m22 = cv2.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(img, 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)

plt.show()
```

In [ ]: