```
import cv2 as cv
import numpy as np
from IPython import display
# load in image
img = cv.imread("left01.jpg", 1)
kernel = np.ones((3,3),np.float32)/9
img = cv.filter2D(img, -1, kernel)
# type set
img = cv.cvtColor(img,cv.COLOR BGR2GRAY)
img = np.float32(img)
# question 1
Ix = img.copy()
Iy = imq.copy()
# find image demensions
i, j = img.shape
# Ix and Iy
for y in range(i-1):
    for x in range(j-1):
        Ix[y][x] = Ix[y][x+1]
         Iy[y][x] = Iy[y+1][x]
Ixy = cv.filter2D((Ix*Iy), -1, kernel)**2
Ix = cv.filter2D((Ix**2), -1, kernel)
Iy = cv.filter2D((Iy**2), -1, kernel)
Q1D = Ix * Iy - Ixy - 0.05 * (Ix + Iy)**2
Q3 = Q1D.copy()
# Ix and Iy
for y in range(i-1):
    for x in range(j-1):
         if (Q1D[y][x] < 100000):
             Q1D[y][x] = 0
Q1 = cv.imread("left01.jpg", 1)
# Threshold for an optimal value, it may vary depending on the image.
Q1[Q1D>0.0001*Q1D.max()]=[0,0,255]
cv.imwrite("Q1.png", Q1)
# display
print("question 1")
display.Image("q1.png")
question 1
# question 2
dst = img.copy()
dst = cv.cornerHarris(dst, 2, 3, 0.04)
# dilate for marking the corners
dst = cv.dilate(dst, None)
Q2 = cv.imread("left01.jpg", 1)
# Threshold for an optimal value, it may vary depending on the image.
Q2[dst>0.01*dst.max()]=[0,0,255]
# save
cv.imwrite("q2.png", Q2)
# display
print("question 2")
display.Image("q2.png")
 \# this method of generation is very similar to the method done manually in Q1
 # except it is a little more crude as there does not appear to be as much smoothing be
question 2
```

question print (Q3[100]) # as can be seen in the print out shown below the edges, flats and corners are all pro [-8.73620020e+03 -2.31124951e+03 -2.28979956e+03 -6.05000019e+00]-1.80000007e+00 -2.45000052e+00 -3.55555594e-01 -3.55555594e-012.41358072e-01 2.74074197e-01 4.87654507e-02 -2.22221315e-02 2.19135776e-01 1.47530884e-01 3.39506157e-02 4.38271612e-02 -2.00000048e-01 -2.00000003e-01 4.87654507e-02 7.65432119e-02 -2.00000048e-01 -5.00000007e-02 -3.02469134e-02 3.14814821e-02 6.85185194e-02 4.93827350e-02 -1.29629895e-02 -8.88888985e-02 -8.88888985e-02 1.28148150e+00 7.67901421e-01 -5.14876461e+00 $-2.90432167e + 00 \qquad 2.93826818e - 01 \qquad 6.88888907e - 01 \quad -2.44197583e + 00$ -1.25685225e+01 -1.28672867e+01 -4.15802526e+00 -4.51605034e+00 -1.31635828e+01 -1.77283916e+01 -5.56110859e+00 5.25308490e-01 1.22839525e-01 1.17901236e-01 3.39506157e-02 -2.22222246e-02 -1.38888910e-01 -2.00000003e-01 -1.38888910e-01 -2.22222246e-02 -1.38888910e-01 -2.00000003e-01 -1.38888910e-01 -5.55555616e-03 0.00000000e+00 0.0000000e+00 0.0000000e+00 0.0000000e+00

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