7. Harris Edge & Corner Detection

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Importing Libraries

In [1]:
```
import cv2
import matplotlib.pyplot as plt
from scipy import signal as sig
import numpy as np
from scipy.ndimage.filters import convolve
```

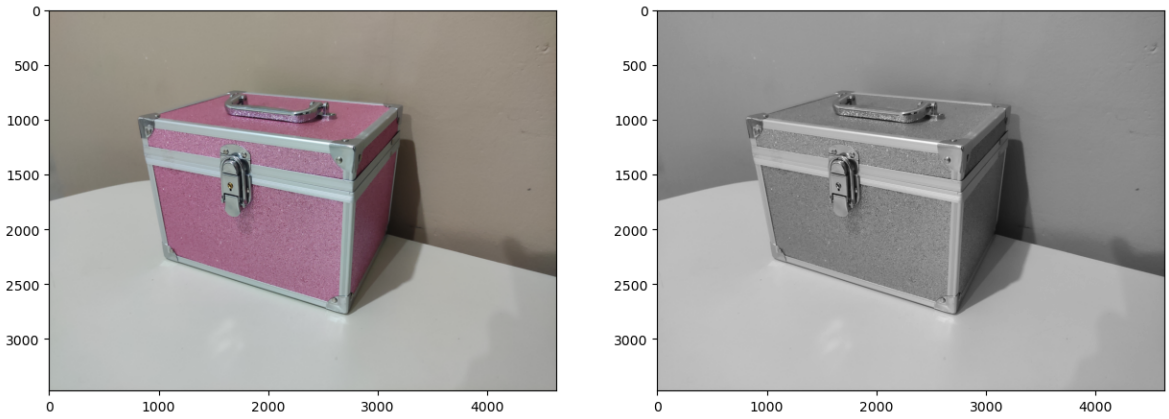
```
/tmp/ipykernel_4899/1510717638.py:5: DeprecationWarning: Please use `convo
lve` from the `scipy.ndimage` namespace, the `scipy.ndimage.filters` names
pace is deprecated.
  from scipy.ndimage.filters import convolve
```

1. Color to Grayscale

In [2]:
```
img = cv2.imread('data/elon_1.jpg')
img_color = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
img_gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

plt.figure(figsize=(15, 8))
plt.subplot(1, 2, 1)
plt.imshow(img_color)
plt.subplot(1, 2, 2)
plt.imshow(img_gray, cmap="gray")
```

Out[2]: <matplotlib.image.AxesImage at 0x7f53b2492090>



2. Spatial derivative calculation

In [3]:
```
def gradient_x(imggray):
    ##Sobel operator kernels.
    kernel_x = np.array([[-1, 0, 1],[-2, 0, 2],[-1, 0, 1]])
    return sig.convolve2d(imggray, kernel_x, mode='same')

def gradient_y(imggray):
    kernel_y = np.array([[1, 2, 1], [0, 0, 0], [-1, -2, -1]])
    return sig.convolve2d(imggray, kernel_y, mode='same')

I_x = gradient_x(img_gray)
I_y = gradient_y(img_gray)
```

3. Structure tensor setup

In [4]:
```
def gaussian_kernel(size, sigma=1):
    size = int(size) // 2
    x, y = np.mgrid[-size:size+1, -size:size+1]
    normal = 1 / (2.0 * np.pi * sigma**2)
    g =  np.exp(-((x**2 + y**2) / (2.0*sigma**2))) * normal
    return g


Ixx = convolve(I_x**2, gaussian_kernel(3, 1))
Ixy = convolve(I_y*I_x, gaussian_kernel(3, 1))
Iyy = convolve(I_y**2, gaussian_kernel(3, 1))
```

4. Harris response calculation

In [5]:
```
k = 0.05

# determinant
detA = Ixx * Iyy - Ixy ** 2

# trace
traceA = Ixx + Iyy

harris_response = detA - k * traceA ** 2
```

In [6]:
```
img_gray.shape
```

Out[6]: (3472, 4624)

In [7]:
```
window_size = 3
offset = window_size//2
width, height = img_gray.shape

for y in range(offset, height-offset):
    for x in range(offset, width-offset):
        Sxx = np.sum(Ixx[y-offset:y+1+offset, x-offset:x+1+offset])
        Syy = np.sum(Iyy[y-offset:y+1+offset, x-offset:x+1+offset])
        Sxy = np.sum(Ixy[y-offset:y+1+offset, x-offset:x+1+offset])
```

In [8]:
```
#Find determinant and trace, use to get corner response
det = (Sxx * Syy) - (Sxy**2)
trace = Sxx + Syy
r = det - k*(trace**2)
```

5. Find edges and corners using R

In [9]:
```
img_copy_for_corners = np.copy(img)
img_copy_for_edges = np.copy(img)

for rowindex, response in enumerate(harris_response):
    for colindex, r in enumerate(response):
        if r > 0:
            # this is a corner
            img_copy_for_corners[rowindex, colindex] = [255,0,0]
        elif r < 0:
            # this is an edge
            img_copy_for_edges[rowindex, colindex] = [0,255,0]
```

In [10]:
```
plt.figure(figsize=(15, 8))
plt.subplot(1, 2, 1)
plt.imshow(img_copy_for_corners, cmap="gray")
plt.subplot(1, 2, 2)
plt.imshow(img_copy_for_edges, cmap="gray")
```

Out[10]: <matplotlib.image.AxesImage at 0x7f536702ee10>