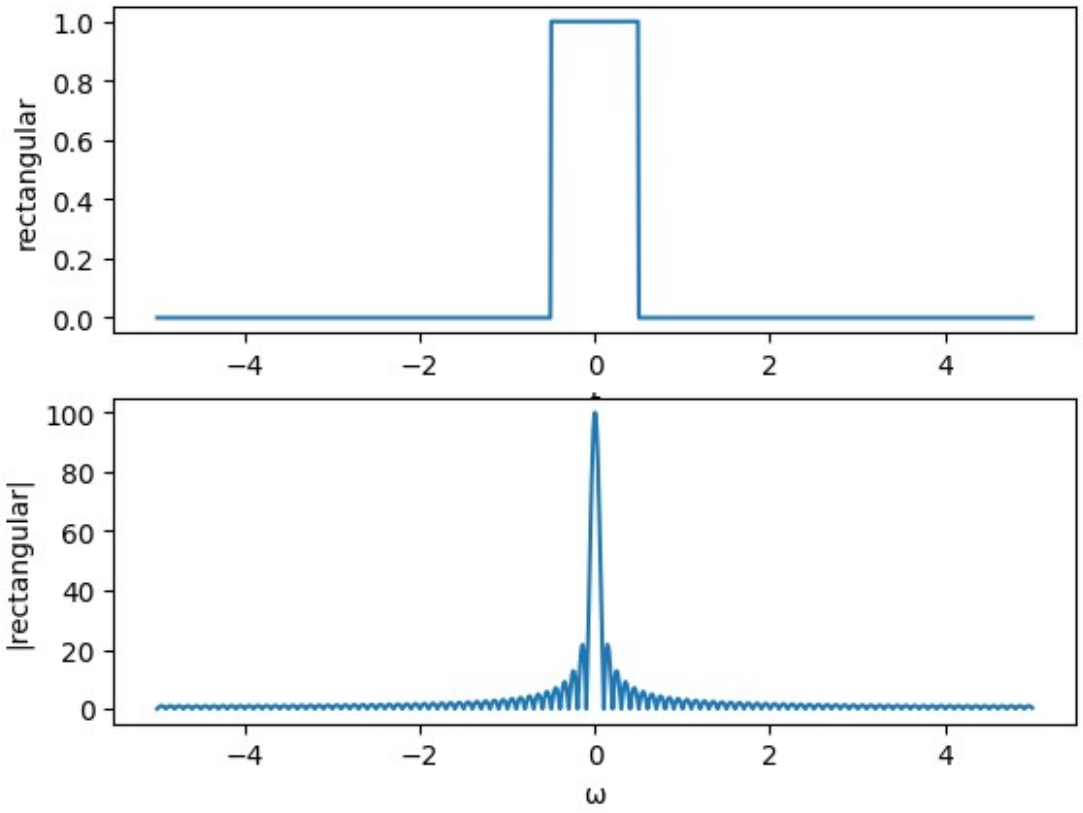
Questão 1

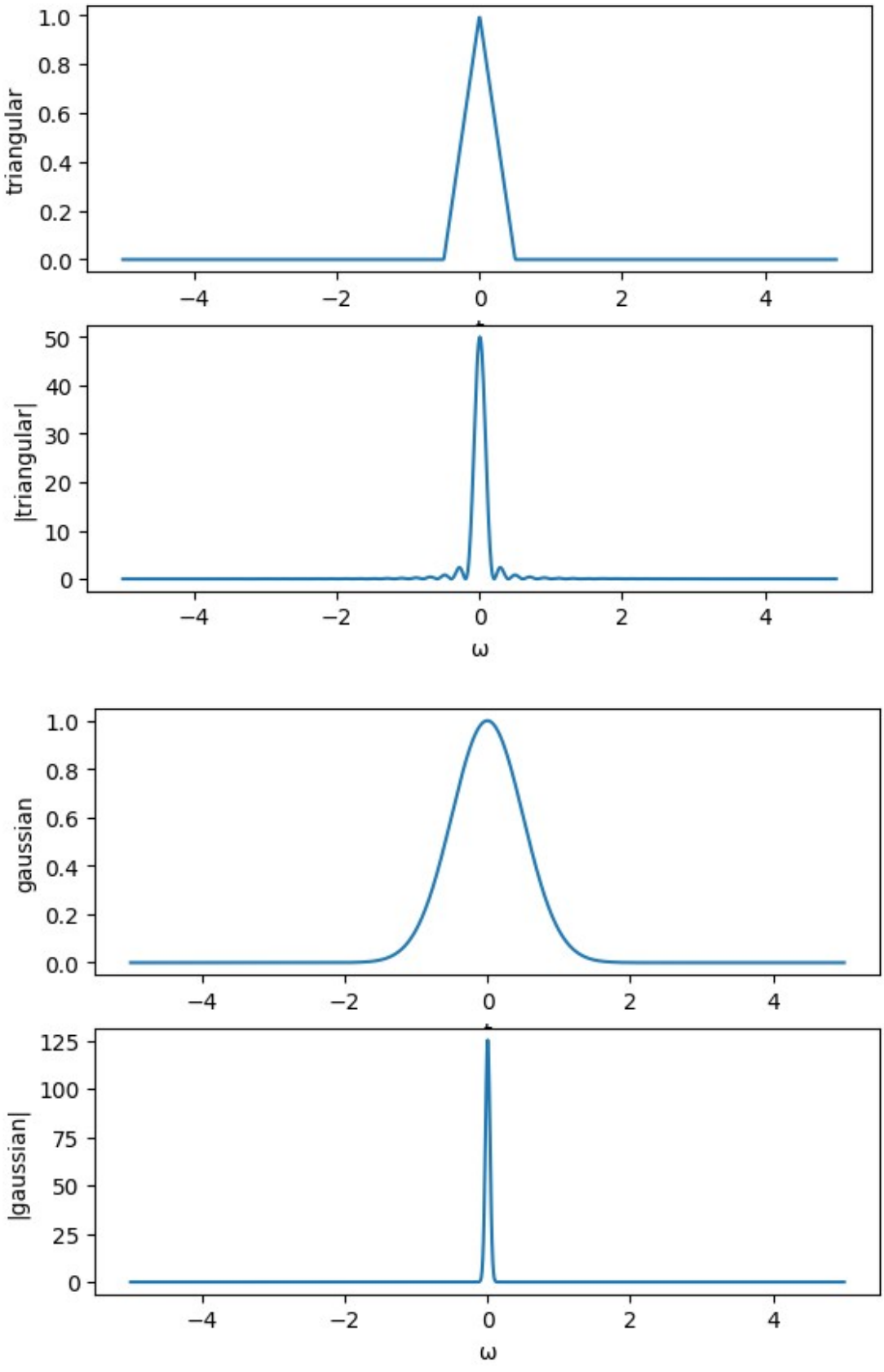
```
type(frame_list)
```

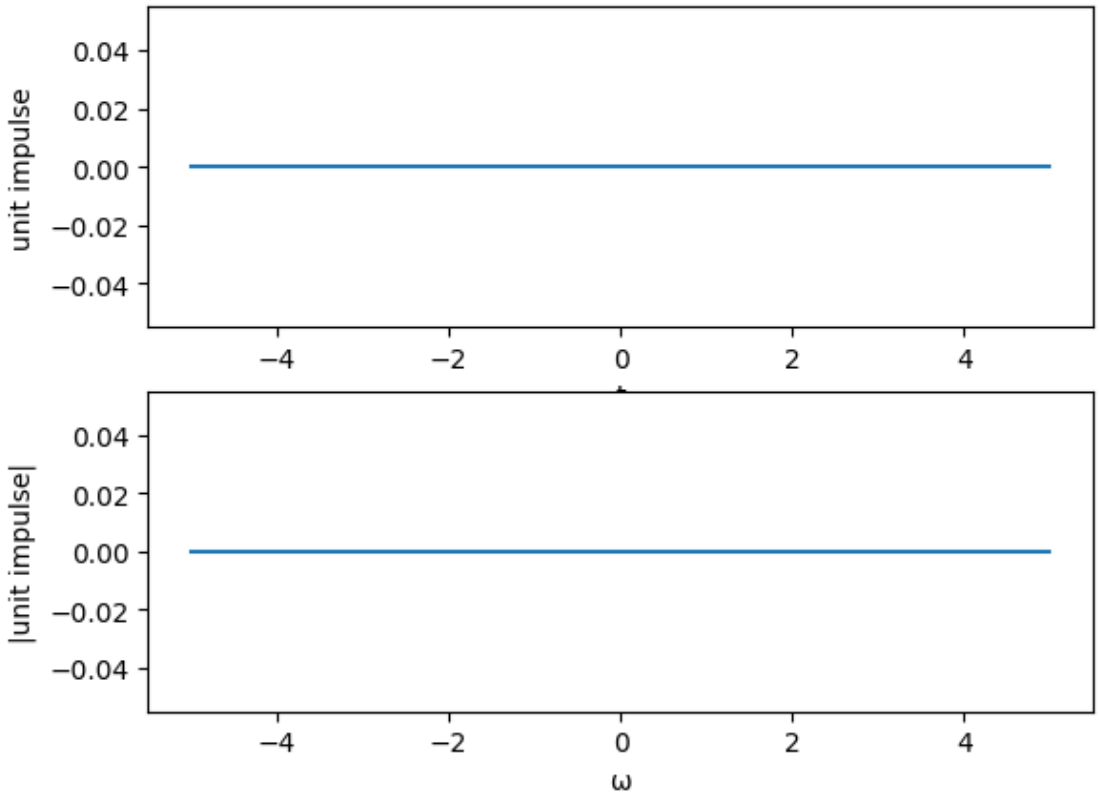
```
list
```

```
import numpy as np
import matplotlib.pyplot as plt
from scipy.fftpack import fft, fftshift

t=np.linspace(-10,10,1000)

def plot_signal_and_spectrum(signal, signal_name):
    # Calcula a transformada de Fourier da sinal
    spectrum = fftshift(fft(signal))

    # Define o eixo temporal e a frequência angular
    t = np.linspace(-5, 5, len(signal))
    w = np.linspace(-5, 5, len(spectrum))

    # Plota o sinal e a espectro de frequência
    plt.subplot(2, 1, 1)
    plt.plot(t, signal)
    plt.xlabel('t')
    plt.ylabel(signal_name)

    plt.subplot(2, 1, 2)
    plt.plot(w, abs(spectrum))
    plt.xlabel('ω')
    plt.ylabel('|' + signal_name + '|')
    plt.show()

def rectangular_signal(t):
    return np.where((t > -1) & (t < 1), 1, 0)

def triangular_signal(t):
    t = np.abs(t)
    return np.where(t < 1, 1-t, 0)

def gaussian_signal(t):
    return np.exp(-t**2 / 2)

def unit_impulse(t):
    return np.where(np.isclose(t, 0), 1, 0)

# Plota o sinal retangular e sua transformada de Fourier
plot_signal_and_spectrum(rectangular_signal(t), 'rectangular')

# Plota o sinal triangular e sua transformada de Fourier
```

```
plot_signal_and_spectrum(triangular_signal(t), 'triangular')

# Plota o sinal gaussiano e sua transformada de Fourier
plot_signal_and_spectrum(gaussian_signal(t), 'gaussian')

# Plota o impulso unitário e sua transformada de Fourier
plot_signal_and_spectrum(unit_impulse(t), 'unit impulse')
```




triangular
|triangular|
gaussian
|gaussian|
ω
ω



Questão 2

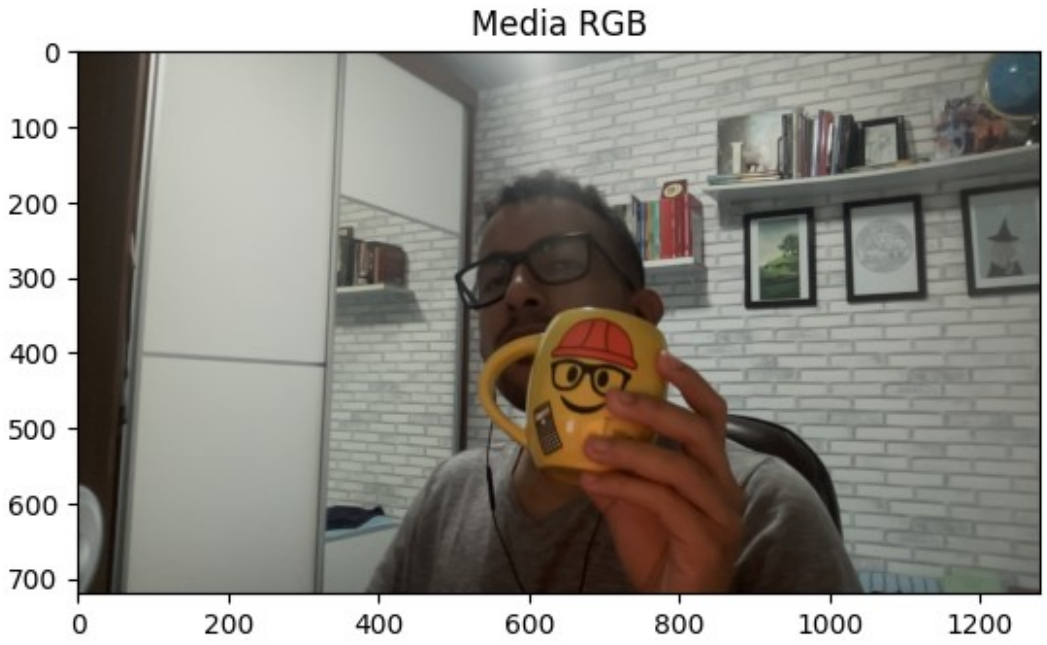
```
import cv2
import numpy as np

#capture 20 frames from camera
cap = cv2.VideoCapture(0)
frame_list = []
for i in range(20):
    ret, frame = cap.read()
    frame_list.append(frame)
cap.release()
cv2.destroyAllWindows()

#calculate mean of the 20 frames
img = frame_list[0]
img = img.astype(float)
for i in range(1,20):
    img2 = frame_list[i]
    img2 = img2.astype(float)
    img = img + img2
mean_image = img/20
mean_image = mean_image.astype(np.uint8)

#calculate variance of the 20 frames
img = frame_list[0]
```

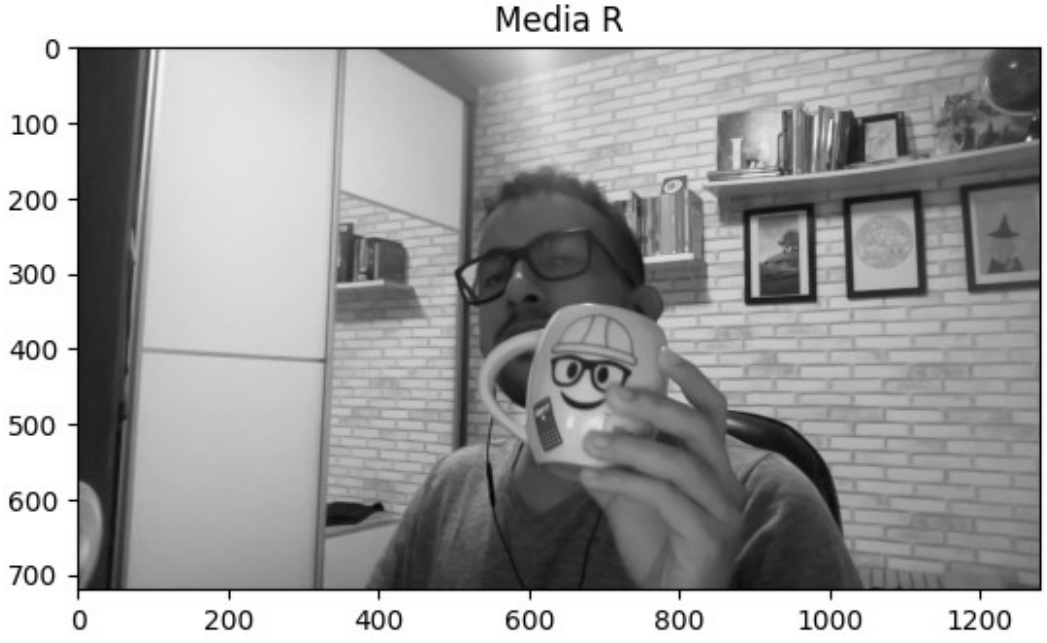
```
img = img.astype(float)
for i in range(1,20):
    img2 = frame_list[i]
    img2 = img2.astype(float)
    img = img + (img2 - mean_image)**2
variance_image = img/20
variance_image = variance_image.astype(np.uint8)

#calculate standard deviation of the 20 frames
img = frame_list[0]
img = img.astype(float)
for i in range(1,20):
    img2 = frame_list[i]
    img2 = img2.astype(float)
    img = img + (img2 - mean_image)**2
standard_deviation_image = img/20
standard_deviation_image = np.sqrt(standard_deviation_image)
standard_deviation_image = standard_deviation_image.astype(np.uint8)

print("MEDIA RGB E POR CANAL")

#plot image
import matplotlib.pyplot as plt
img = mean_image
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
plt.imshow(img)
plt.title("Media RGB")
plt.show()

#plot separe image separate channels MEAN
img = mean_image
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
plt.imshow(img[:,:,0], cmap='gray')
plt.title("Media R")
plt.show()
plt.imshow(img[:,:,1], cmap='gray')
plt.title("Media G")
plt.show()
plt.imshow(img[:,:,2], cmap='gray')
plt.title("Media B")
plt.show()

print("DESVIO PADRÃO RGB E POR CANAL")

#plot separe image separate channels STANDARD DEVIATION

img = standard_deviation_image
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
plt.imshow(img[:,:,0], cmap='gray')
```

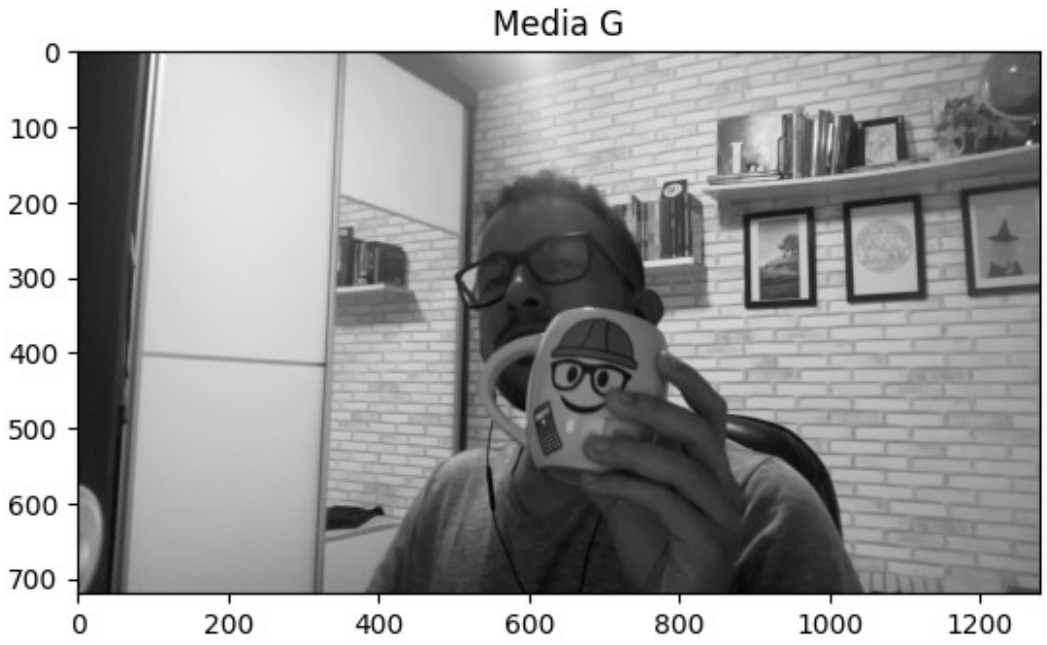
```
plt.title("Desvio Padrão R")
plt.show()
plt.imshow(img[:,:,1], cmap='gray')
plt.title("Desvio Padrão G")
plt.show()
plt.imshow(img[:,:,2], cmap='gray')
plt.title("Desvio Padrão B")
plt.show()

#plot image
import matplotlib.pyplot as plt
img = standard_deviation_image
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
plt.imshow(img)
plt.title("Desvio Padrão RGB")
plt.show()

print("VARIANCIA RGB E POR CANAL")

#plot separe image separate channels VARIANCE

img = variance_image
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
plt.imshow(img[:,:,0], cmap='gray')
plt.title("Variancia R")
plt.show()
plt.imshow(img[:,:,1], cmap='gray')
plt.title("Variancia G")
plt.show()
plt.imshow(img[:,:,2], cmap='gray')
plt.title("Variancia B")
plt.show()

#plot image
import matplotlib.pyplot as plt
img = variance_image
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
plt.imshow(img)
plt.title("Variancia RGB")
plt.show()
```

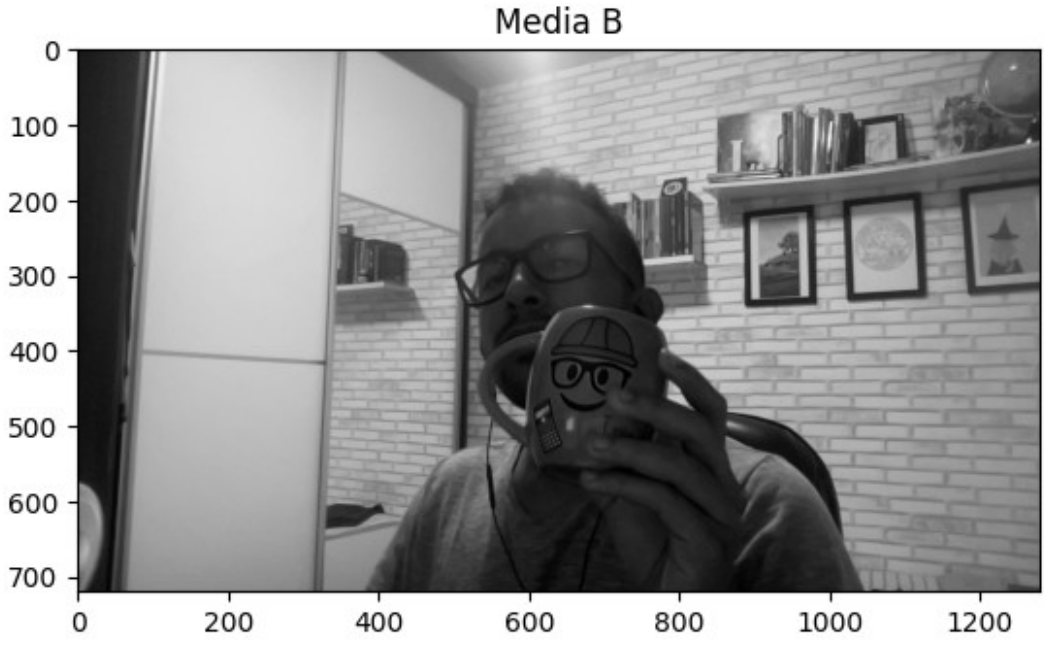
```
[ WARN:0@918.244] global
/private/var/folders/nz/j6p8yfhx1mv_0grj5xl4650h0000gp/T/abs_562_cazh1
h/croots/recipe/opencv-suite_1664548333142/work/modules/videoio/src/
cap_gstreamer.cpp (862) isPipelinePlaying OpenCV | GStreamer warning:
GStreamer: pipeline have not been created
```

```
MEDIA RGB E POR CANAL
```


Media RGB
0
100
200
300
400
500
600
700
0
200
400
600
800
1000
1200


Media R
0
100
200
300
400
500
600
700
0
200
400
600
800
1000
1200

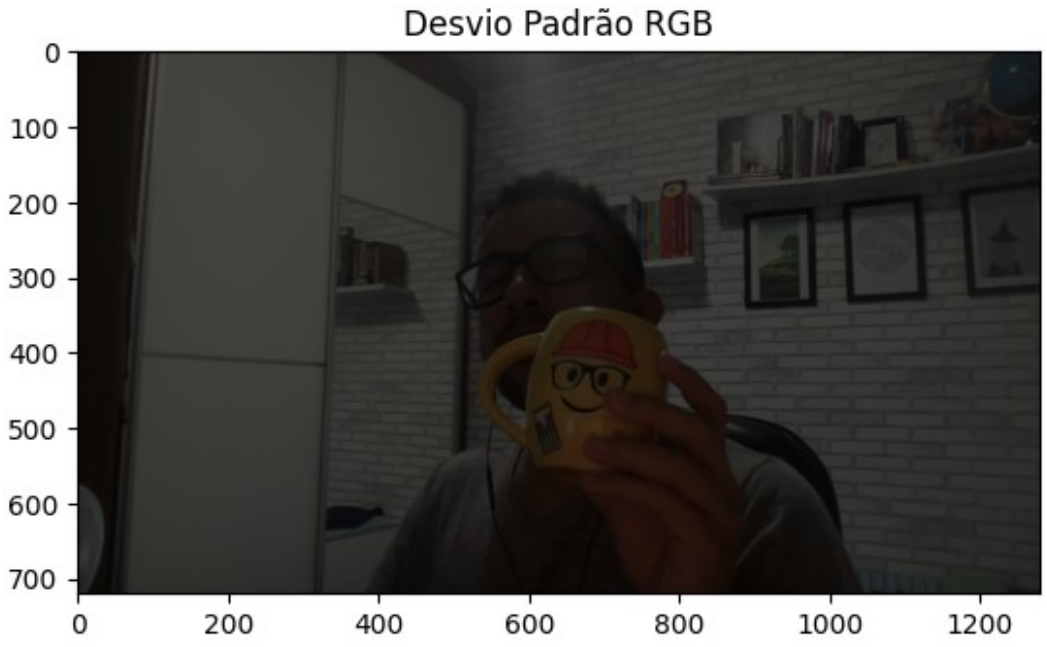




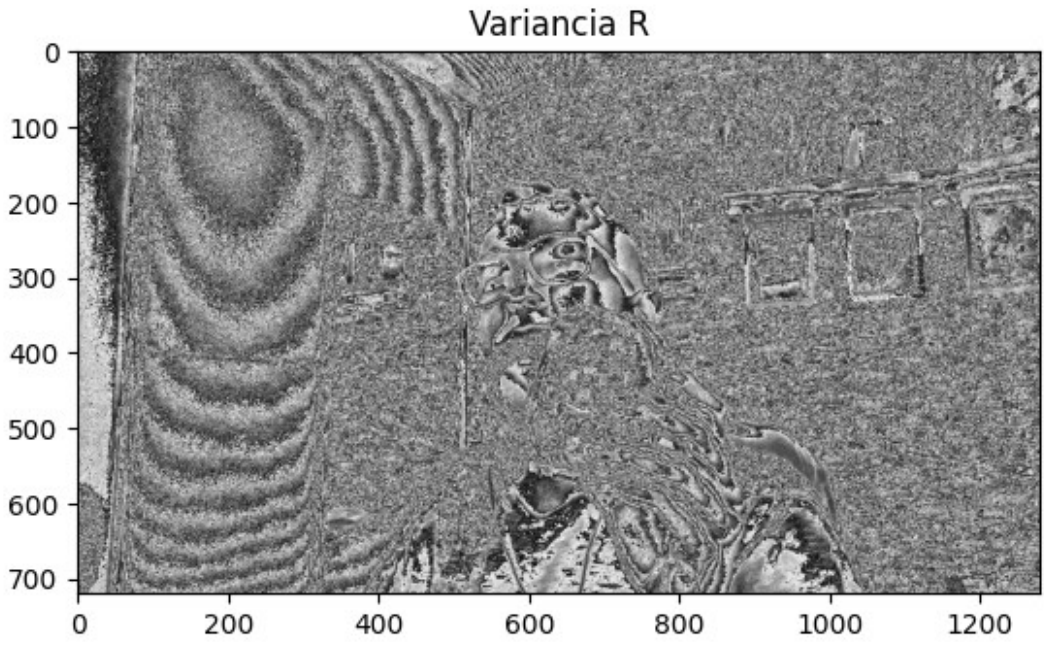
DESVIO PADRÃO RGB E POR CANAL

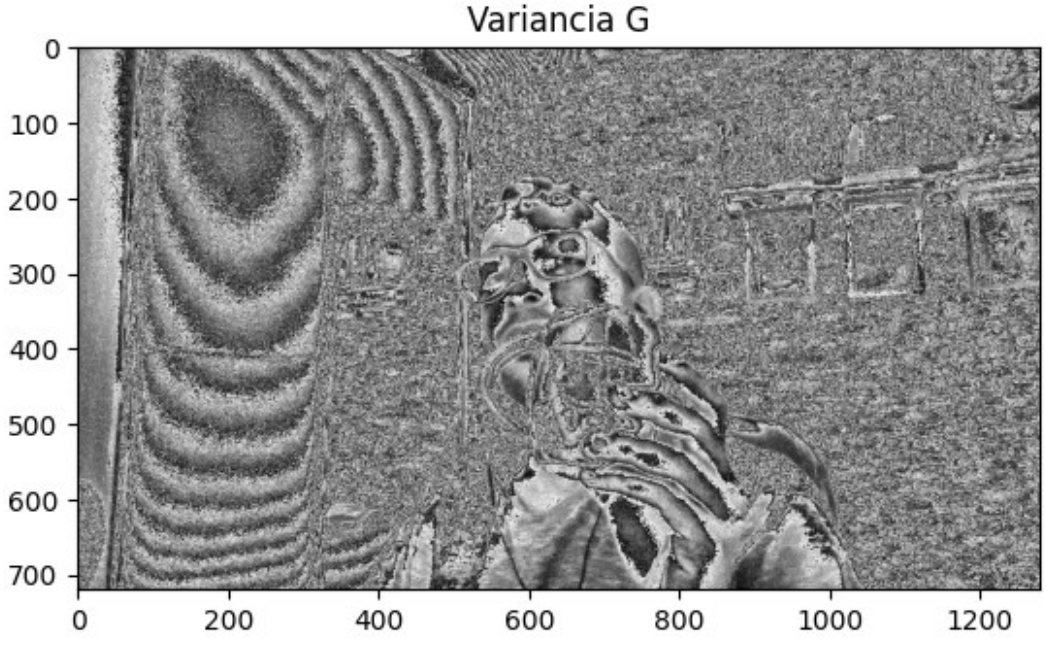

Desvio Padrão R
0
100
200
300
400
500
600
700
0
200
400
600
800
1000
1200

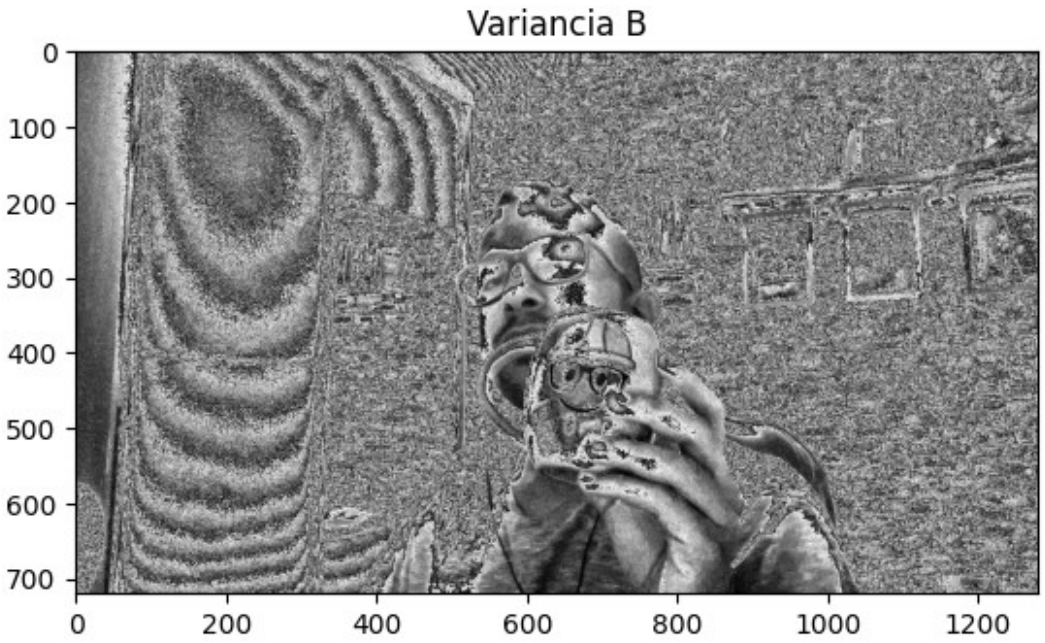

Desvio Padrão G
0
100
200
300
400
500
600
700
0
200
400
600
800
1000
1200

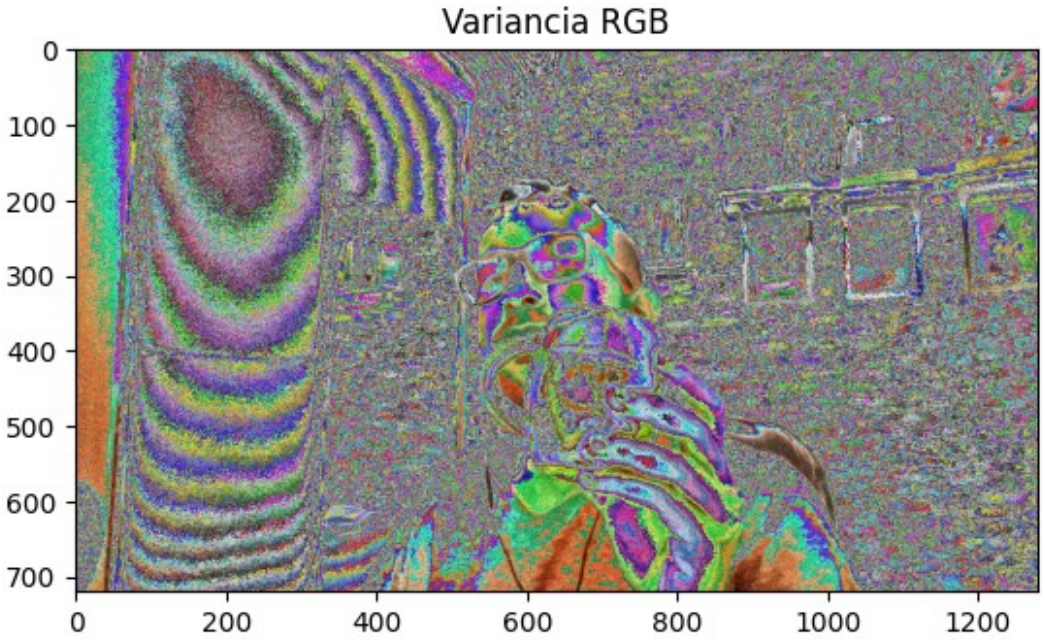


VARIANCIA RGB E POR CANAL


Variancia R
0
100
200
300
400
500
600
700
0
200
400
600
800
1000
1200


Variancia G
0
100
200
300
400
500
600
700
0
200
400
600
800
1000
1200



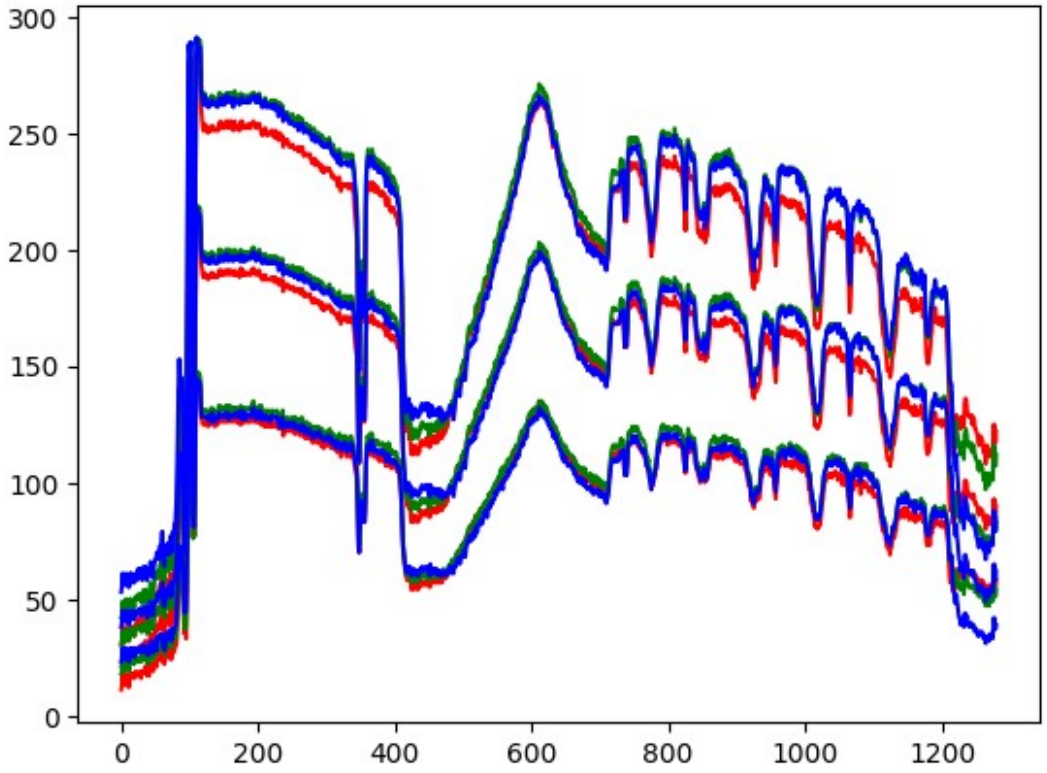


Letra b

```
#plot line 13 mean + standard deviation
img = mean_image
img2 = standard_deviation_image
img = img.astype(float)
img2 = img2.astype(float)
mean_plus_std = (img + img2)[13,:,0]
mean_minus_std = (img - img2)[13,:,0]
plt.plot(mean_plus_std, 'r', mean_minus_std, 'r', img[13,:,0], 'r')
```

```
mean_plus_std = (img + img2)[13,:,1]
mean_minus_std = (img - img2)[13,:,1]
plt.plot(mean_plus_std, 'g', mean_minus_std, 'g', img[13,:,1], 'g')
mean_plus_std = (img + img2)[13,:,2]
mean_minus_std = (img - img2)[13,:,2]
plt.plot(mean_plus_std, 'b', mean_minus_std, 'b', img[13,:,2], 'b')
```

```
[<matplotlib.lines.Line2D at 0x147a3a110>,
 <matplotlib.lines.Line2D at 0x147a39060>,
 <matplotlib.lines.Line2D at 0x147a3b010>]
```



Letra c

```
# Seleciona 5 imagens aleatórias da lista de frames
import random
random_frames = random.sample(frame_list, 5)

# Cria uma lista para armazenar os valores mínimos e máximos de cada
cor
min_max_values = []

# Percorre a lista de frames aleatórios
for frame in random_frames:
  # Lê a imagem
  img = frame

  # Converte a imagem para níveis de cinza
```

```
  gray_img = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

  # Calcula o valor mínimo e máximo de cada cor
  min_value, max_value, _, _ = cv2.minMaxLoc(gray_img)

  # Adiciona os valores mínimo e máximo à lista
  min_max_values.append((min_value, max_value))

# Imprime os valores mínimo e máximo para cada cor
for values in min_max_values:
  print(f"Valor mínimo: {values[0]}, Valor máximo: {values[1]}")
```

```
Valor mínimo: 0.0, Valor máximo: 255.0
Valor mínimo: 0.0, Valor máximo: 255.0
Valor mínimo: 0.0, Valor máximo: 255.0
Valor mínimo: 0.0, Valor máximo: 255.0
Valor mínimo: 0.0, Valor máximo: 67.0
```

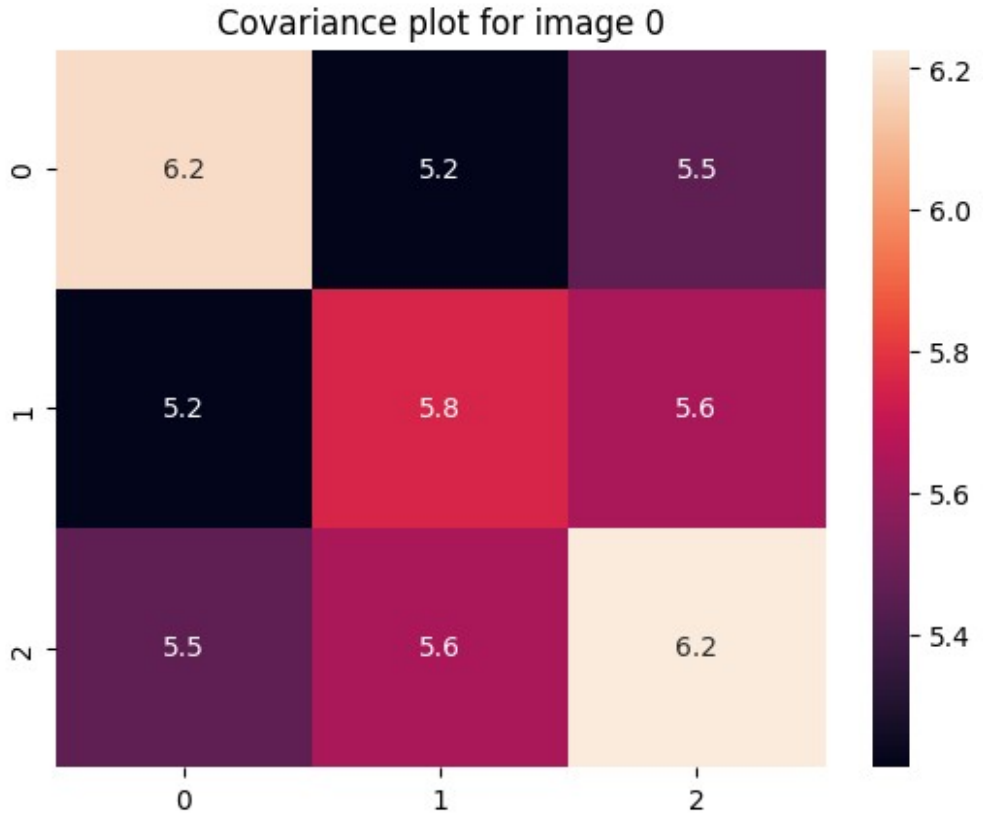
Questao 3

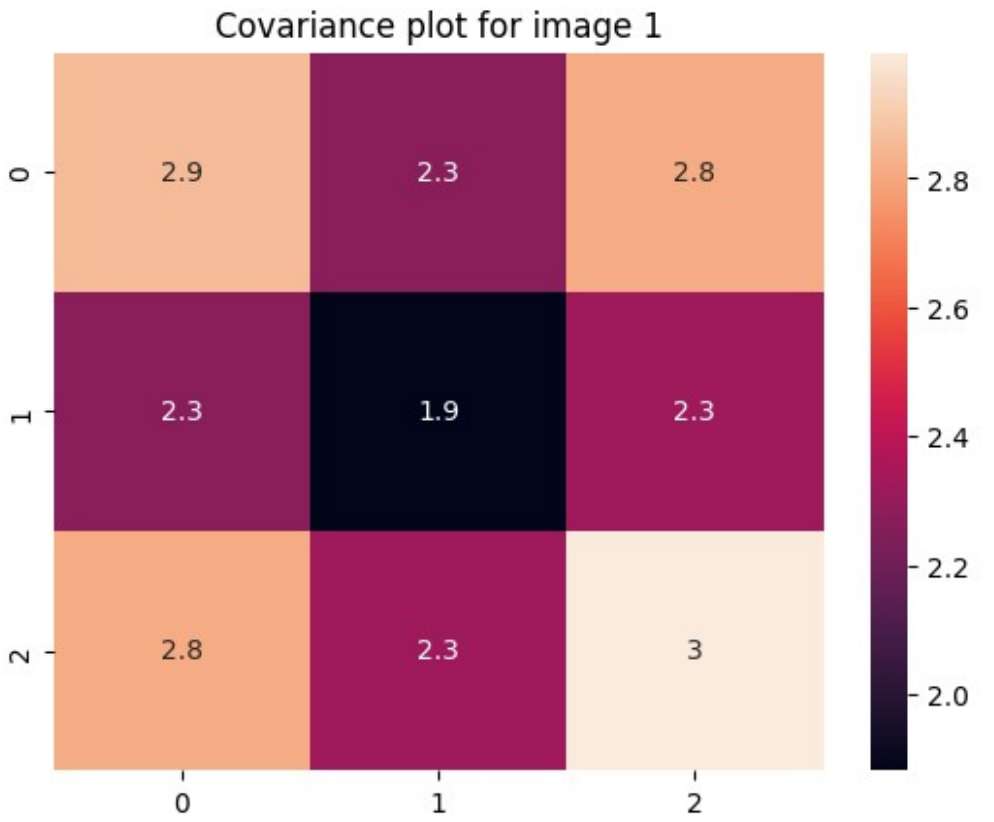
```
import cv2
import numpy as np

#capture 25 frames from camera
cap = cv2.VideoCapture(0)
frame_list = []
for i in range(25):
    ret, frame = cap.read()
    frame_list.append(frame)
cap.release()
cv2.destroyAllWindows()
```

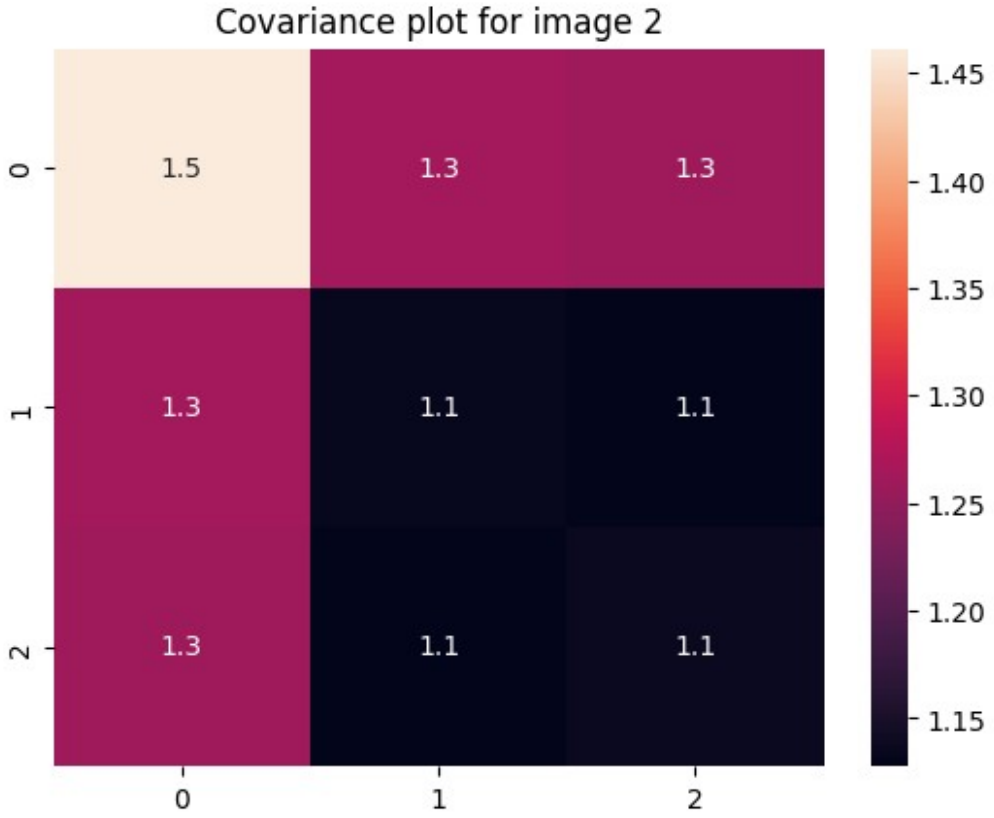
```
[ WARN:0@8207.181] global
/private/var/folders/nz/j6p8yfhx1mv_0grj5xl4650h0000gp/T/abs_562_cazh1
h/croots/recipe/opencv-suite_1664548333142/work/modules/videoio/src/
cap_gstreamer.cpp (862) isPipelinePlaying OpenCV | GStreamer warning:
GStreamer: pipeline have not been created
```

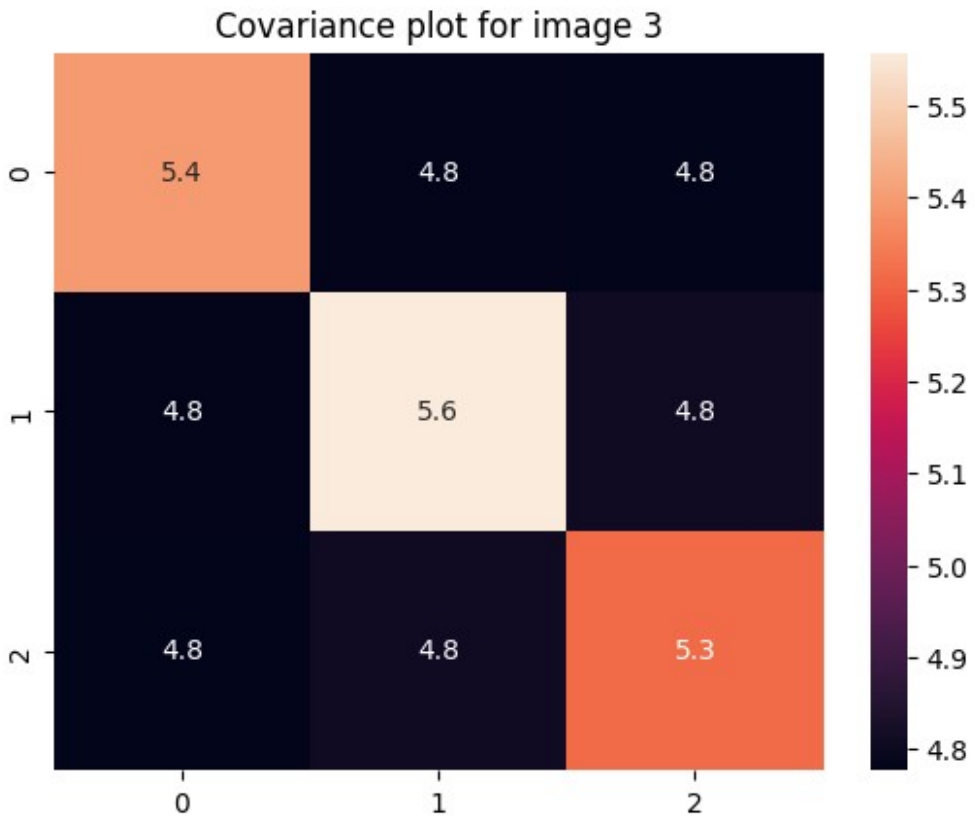
```
from statistics import covariance
import cv2
import numpy as np

def calculate_covariance(frame_list):
    covariances = []
    for img in frame_list:
        img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
        img = img[256-16:256+16, 256-16:256+16]
        img = img.astype(float)
        covarience = np.zeros((3,3))
        for i in range(3):
            for j in range(3):
```

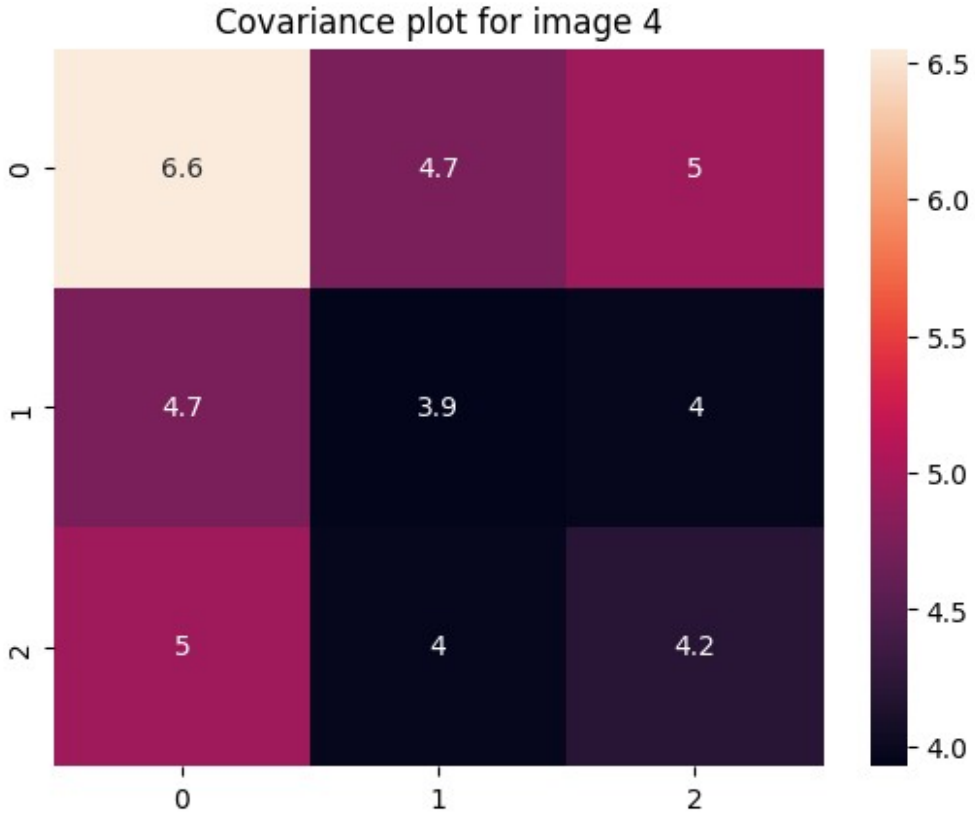
```
                covarience[i,j] = np.mean((img[:,:,i] -
np.mean(img[:,:,i])) * (img[:,:,j] - np.mean(img[:,:,j])))
        covariances.append(covarience)
    return covariances

covariances = calculate_covariance(frame_list)


import seaborn as sns
import matplotlib.pyplot as plt

def plot_covariance(covariances):
    for i, cov in enumerate(covariances):
        plt.figure()
        sns.heatmap(cov, annot=True)
        plt.title("Covariance plot for image {}".format(i))
        plt.show()

plot_covariance(covariances)
```

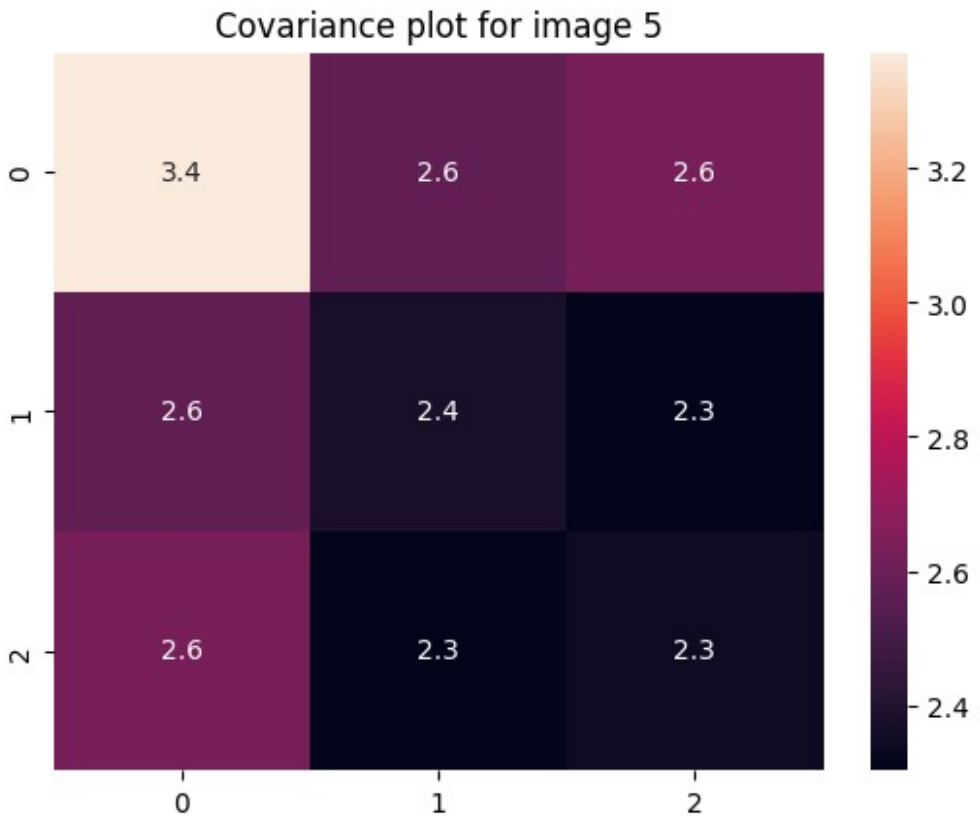



Covariance plot for image 1
2.9
2.3
2.8
2.3
1.9
2.3
2.8
2.3
3
0
1
2
2.8
2.6
2.4
2.2
2.0

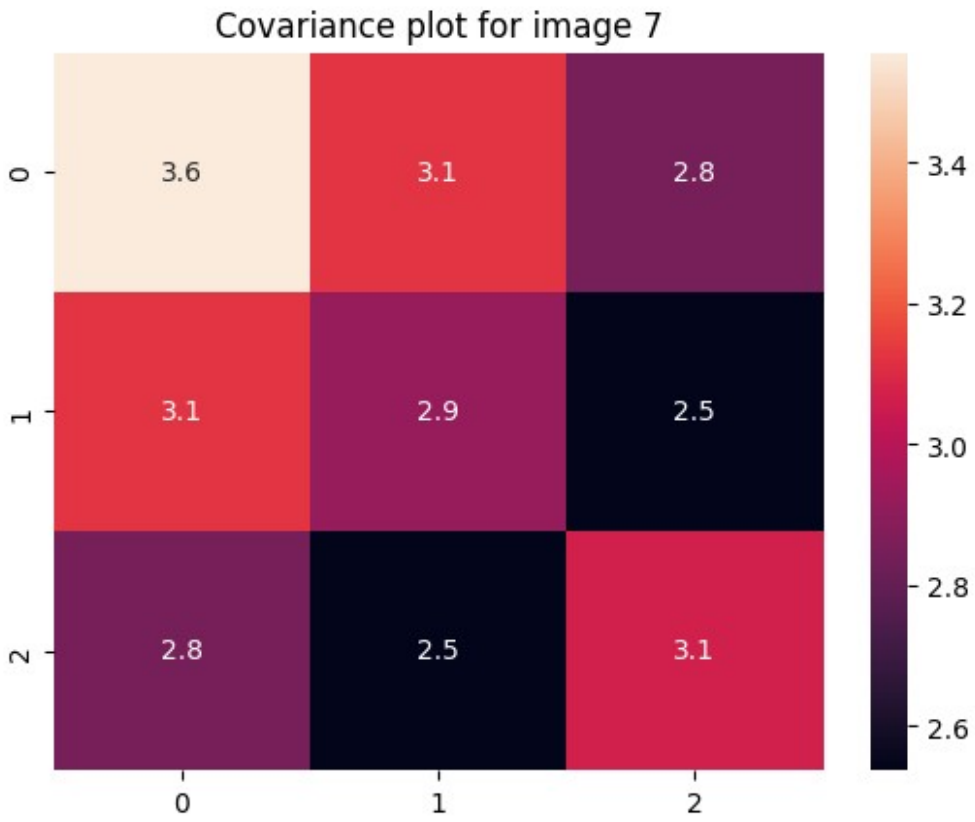

Covariance plot for image 2
1.5
1.3
1.3
1.3
1.1
1.1
1.3
1.1
1.1
0
1
2
1.45
1.40
1.35
1.30
1.25
1.20
1.15

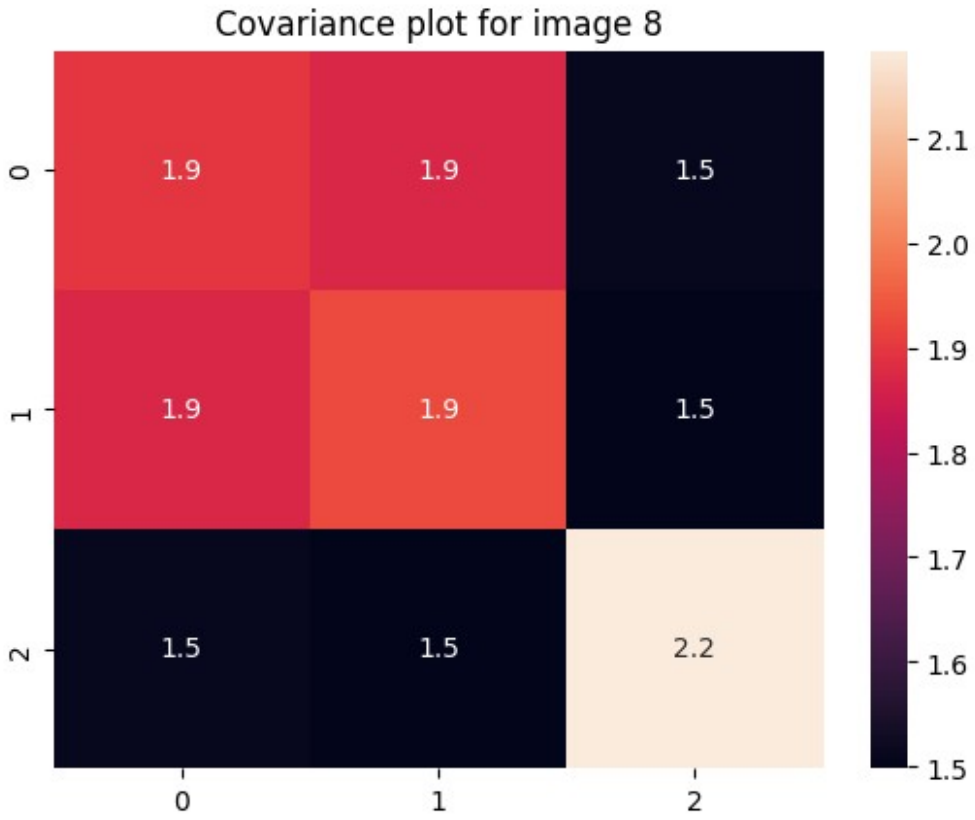

Covariance plot for image 3
5.4
4.8
4.8
4.8
5.6
4.8
4.8
4.8
5.3
0
1
2
0
1
2
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8

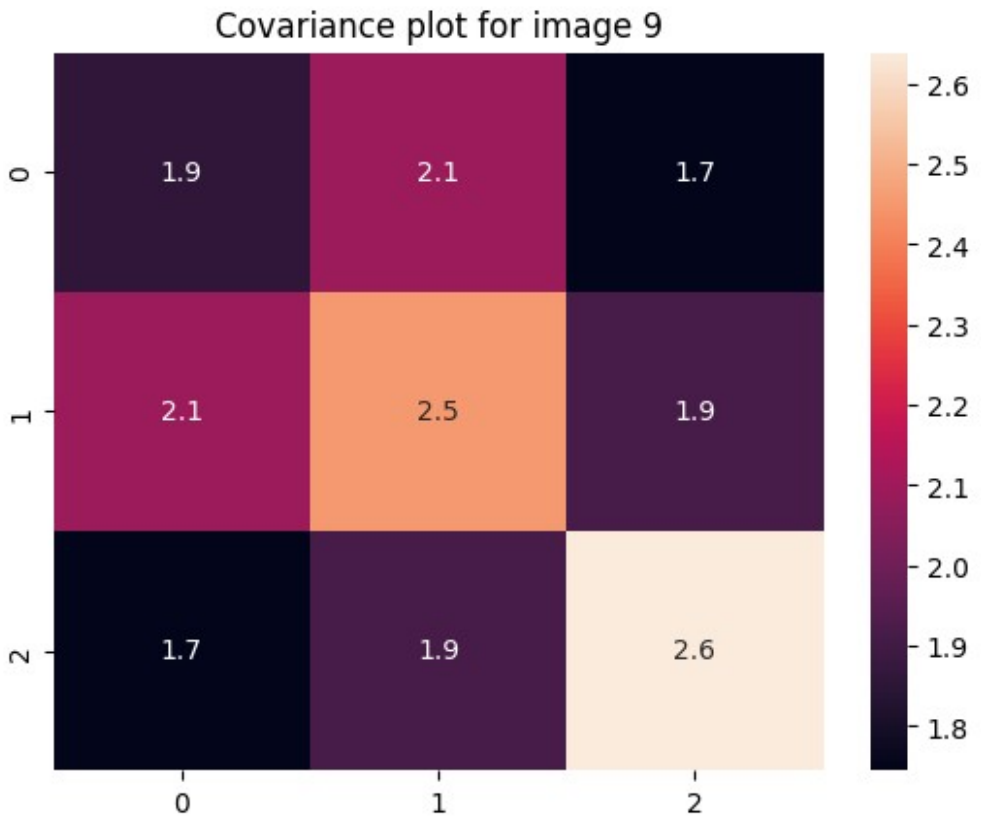

Covariance plot for image 4
6.6
4.7
5
4.7
3.9
4
5
4
4.2
0
1
2
0
1
2
6.5
6.0
5.5
5.0
4.5
4.0

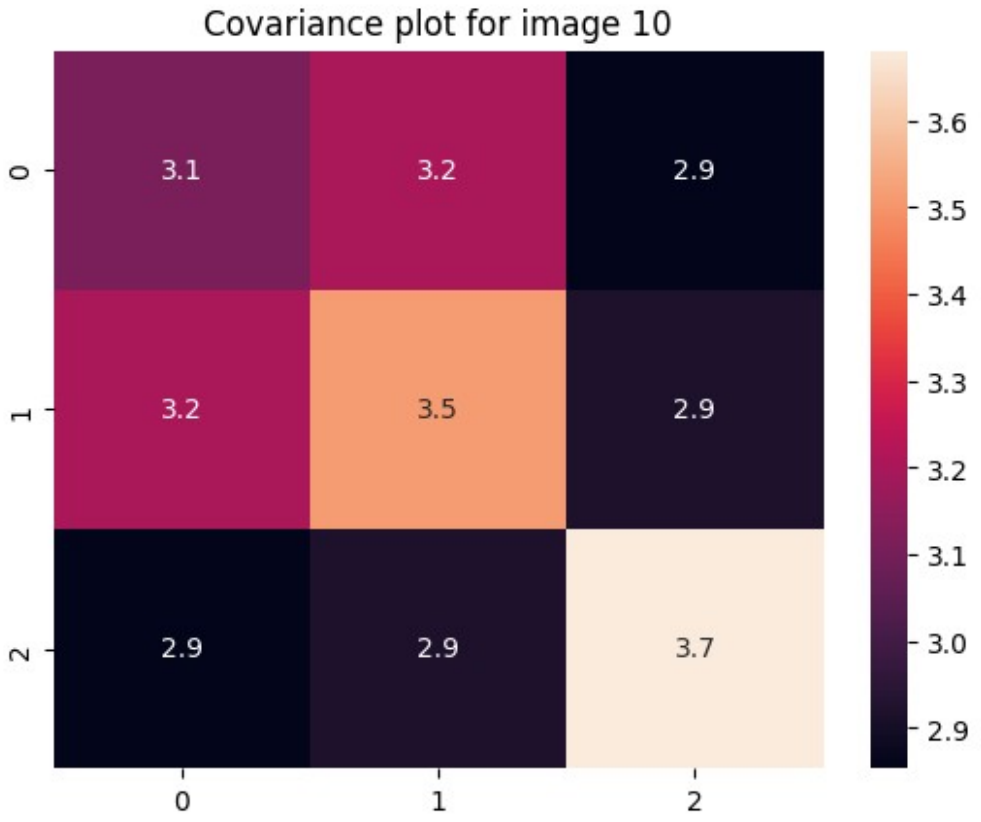

Covariance plot for image 5
3.4
2.6
2.6
2.6
2.4
2.3
2.6
2.3
2.3
0
1
2
3.2
3.0
2.8
2.6
2.4

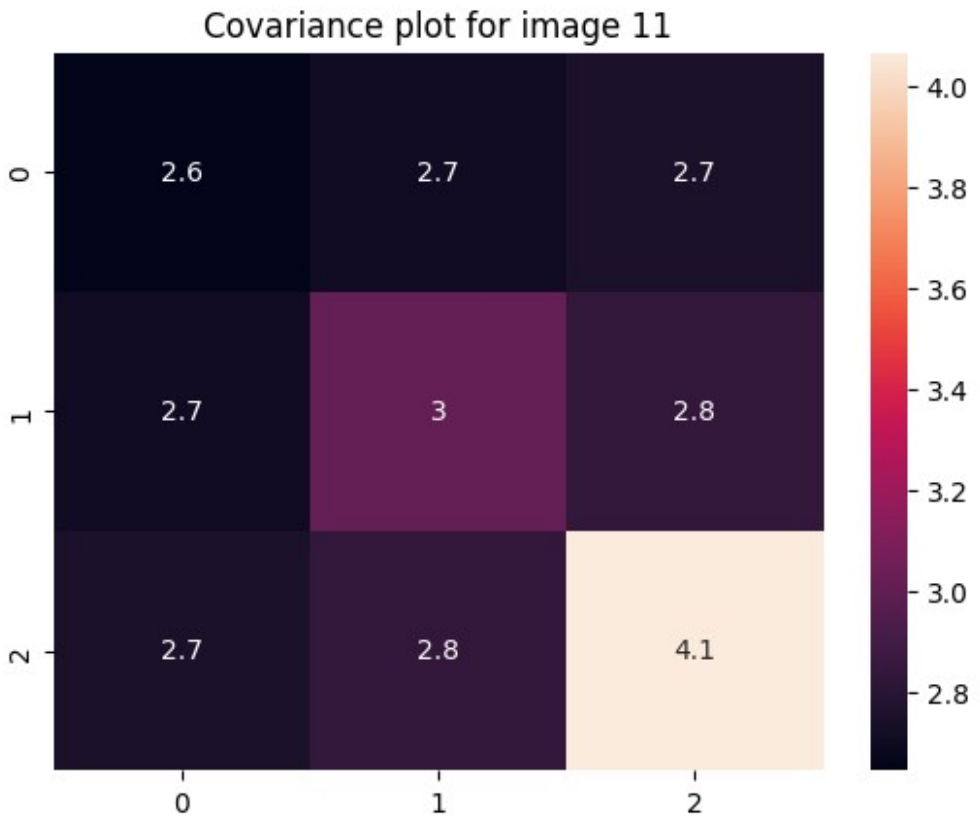

Covariance plot for image 6
2.8
2.6
2.5
2.6
3.1
2.8
2.5
2.8
2.7
0
1
2
3.1
3.0
2.9
2.8
2.7
2.6

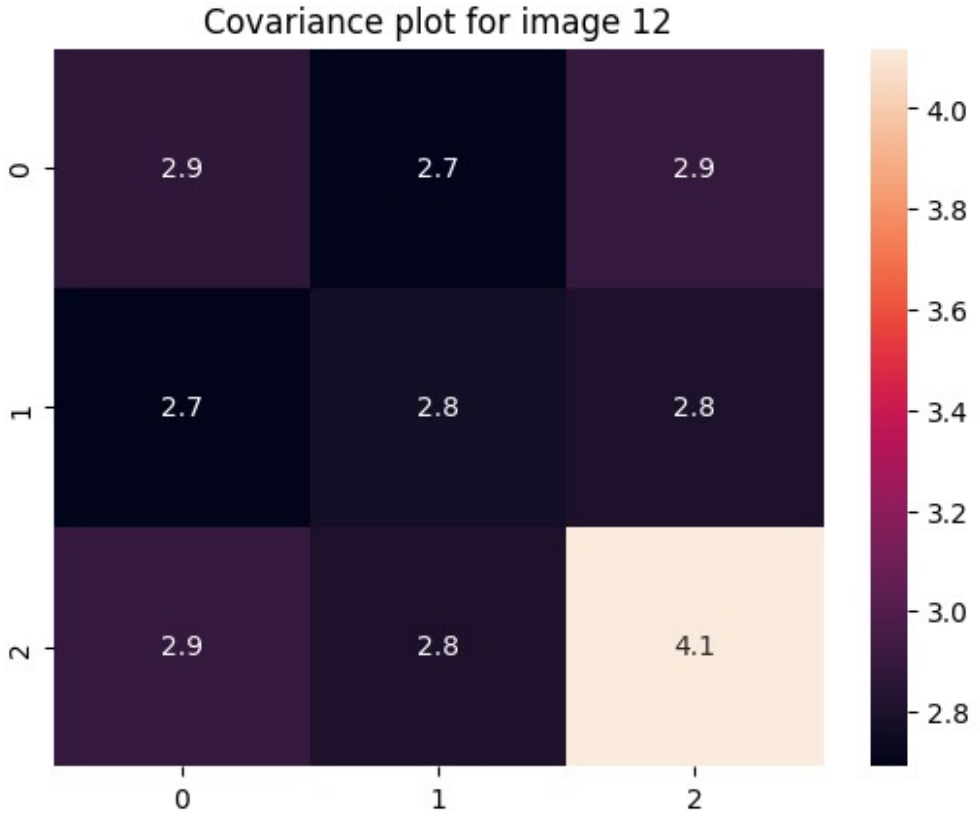

Covariance plot for image 7
3.6
3.1
2.8
3.1
2.9
2.5
2.8
2.5
3.1
0
1
2
0
1
2
3.4
3.2
3.0
2.8
2.6

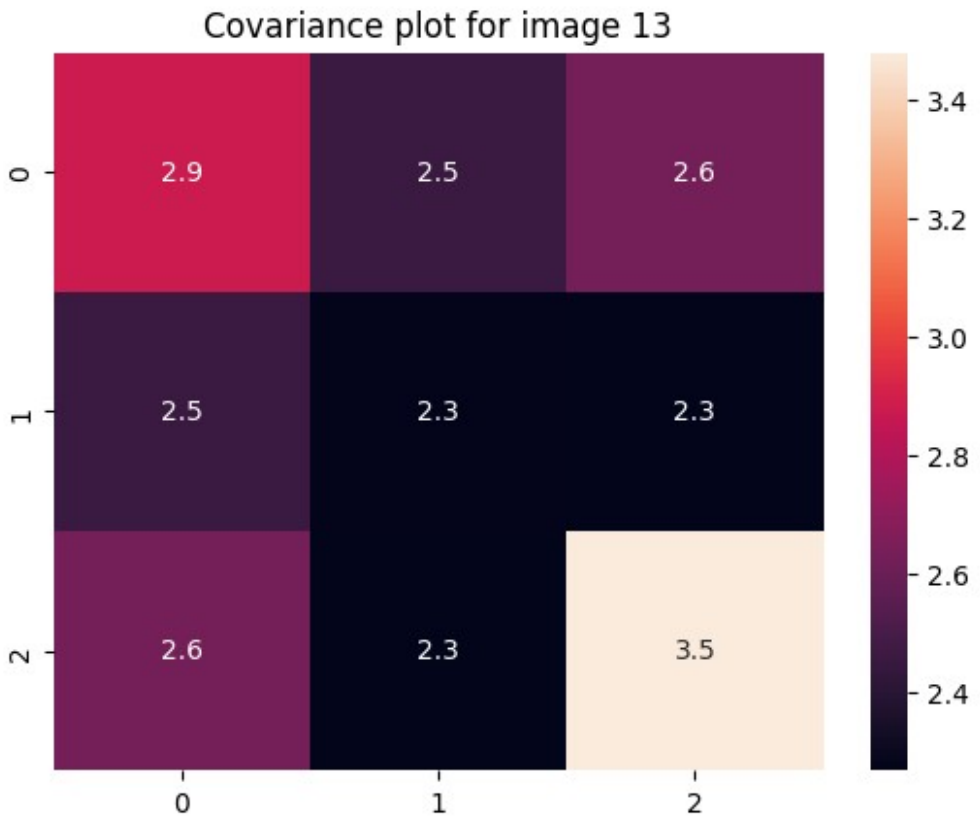

Covariance plot for image 8
1.9
1.9
1.5
1.9
1.9
1.5
1.5
1.5
2.2
0
1
2
0
1
2
2.1
2.0
1.9
1.8
1.7
1.6
1.5

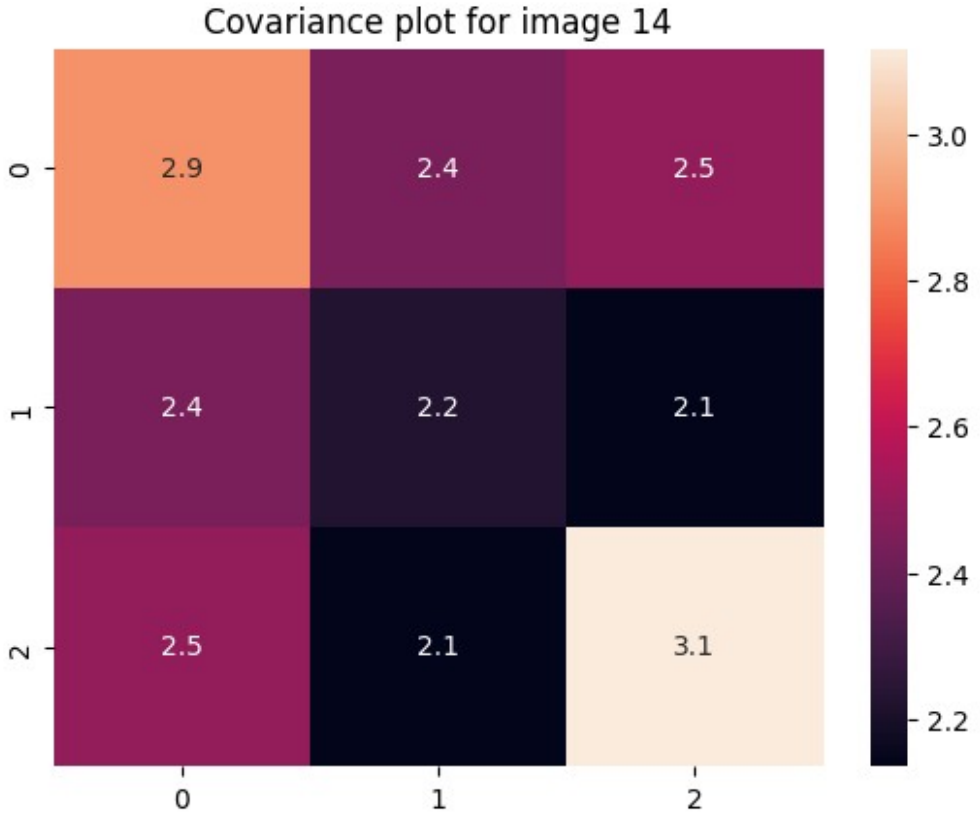

Covariance plot for image 9
1.9
2.1
1.7
2.1
2.5
1.9
1.7
1.9
2.6
0
1
2
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8

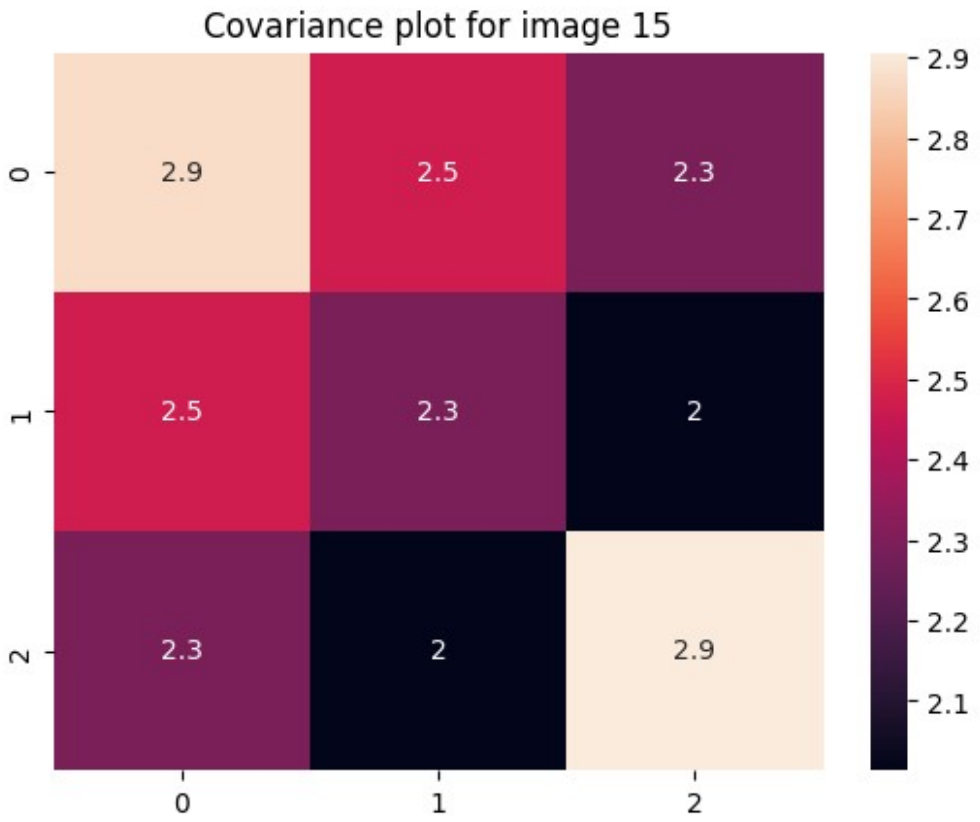

Covariance plot for image 10
3.1
3.2
2.9
3.2
3.5
2.9
2.9
2.9
3.7
0
1
2
3.6
3.5
3.4
3.3
3.2
3.1
3.0
2.9

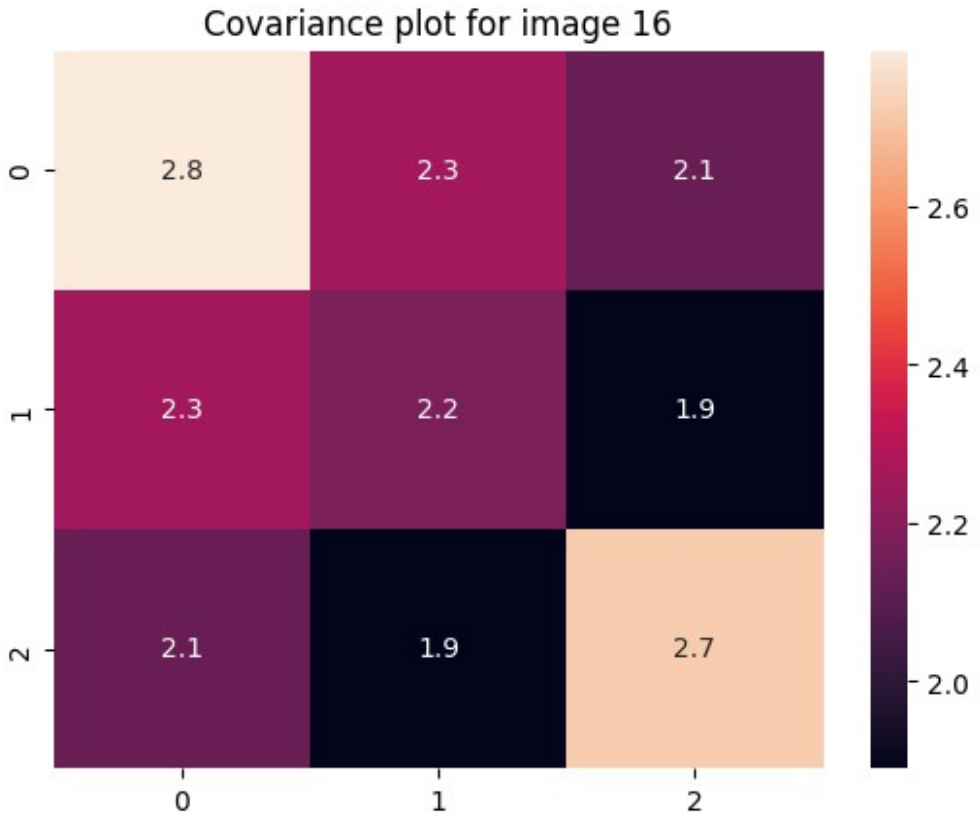

Covariance plot for image 11
2.6
2.7
2.7
2.7
3
2.8
2.7
2.8
4.1
0
1
2
0
1
2
4.0
3.8
3.6
3.4
3.2
3.0
2.8

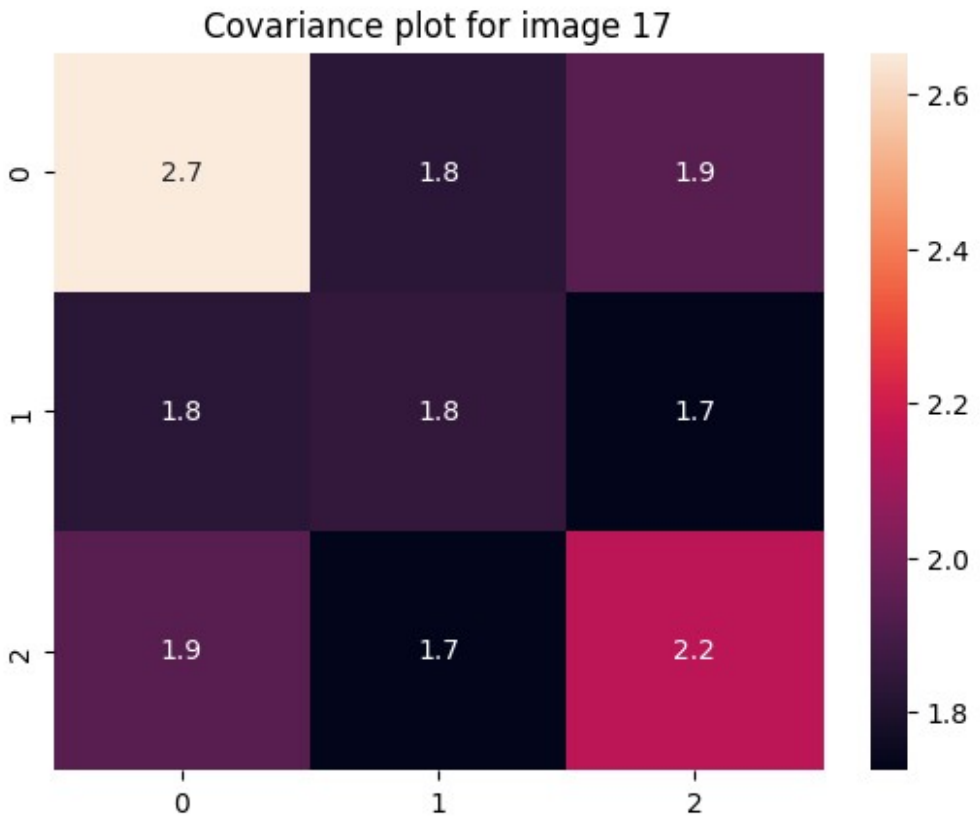

Covariance plot for image 12
2.9
2.7
2.9
2.7
2.8
2.8
2.9
2.8
4.1
0
1
2
0
1
2
4.0
3.8
3.6
3.4
3.2
3.0
2.8

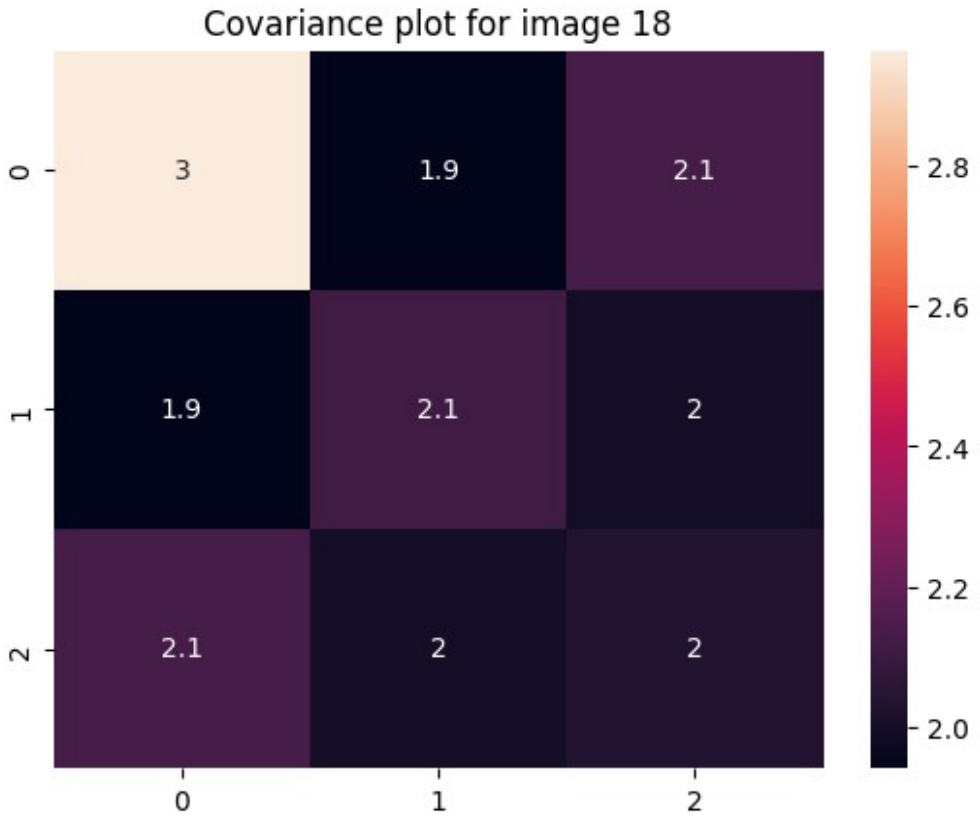

Covariance plot for image 13
2.9
2.5
2.6
2.5
2.3
2.3
2.6
2.3
3.5
0
1
2
0
1
2
3.4
3.2
3.0
2.8
2.6
2.4

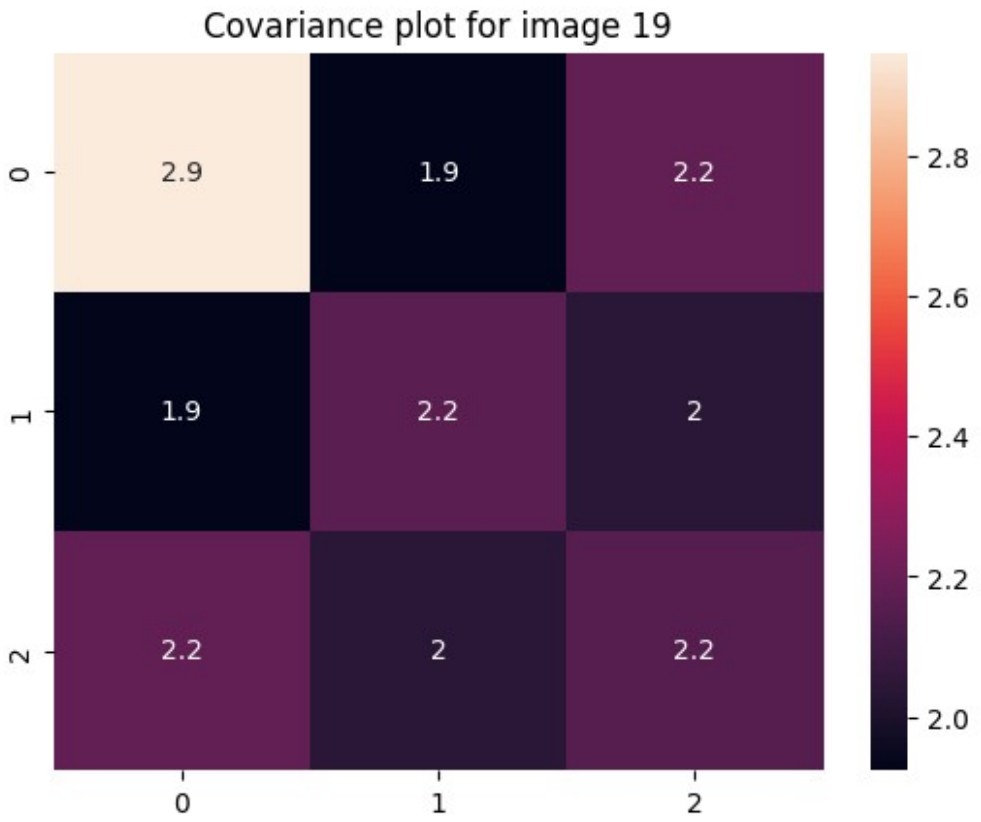

Covariance plot for image 14
2.9
2.4
2.5
2.4
2.2
2.1
2.5
2.1
3.1
0
1
2
0
1
2
3.0
2.8
2.6
2.4
2.2

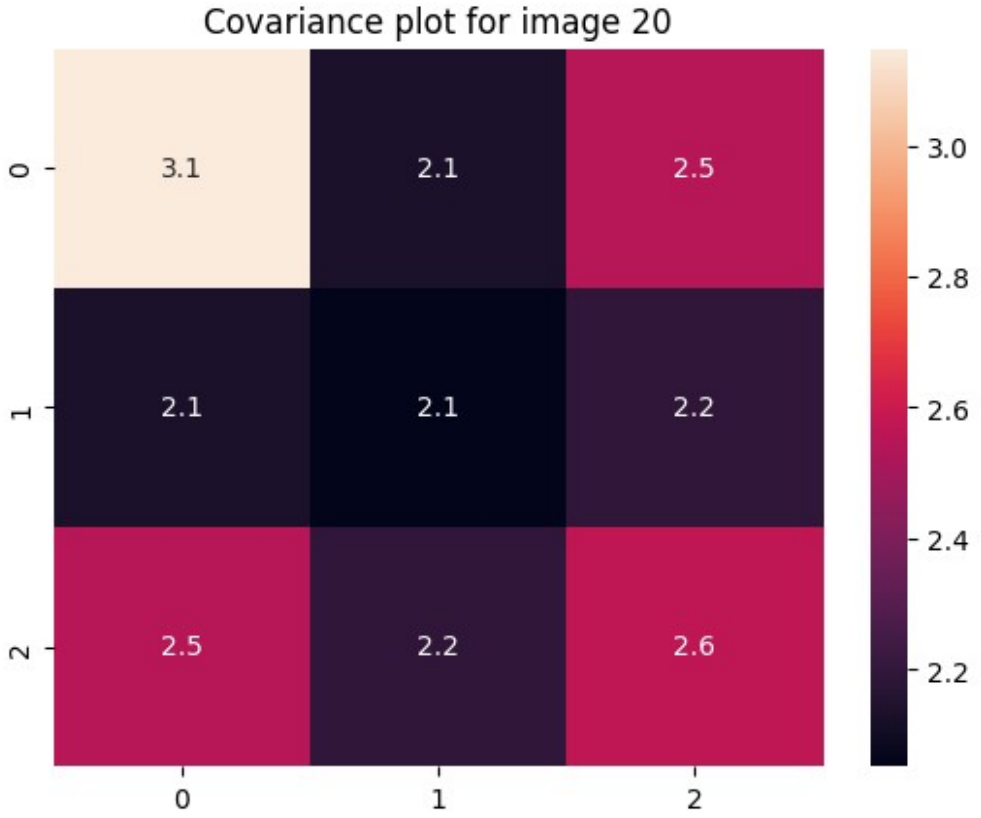

Covariance plot for image 15
2.9
2.5
2.3
2.5
2.3
2
2.3
2
2.9
0
1
2
0
1
2
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1

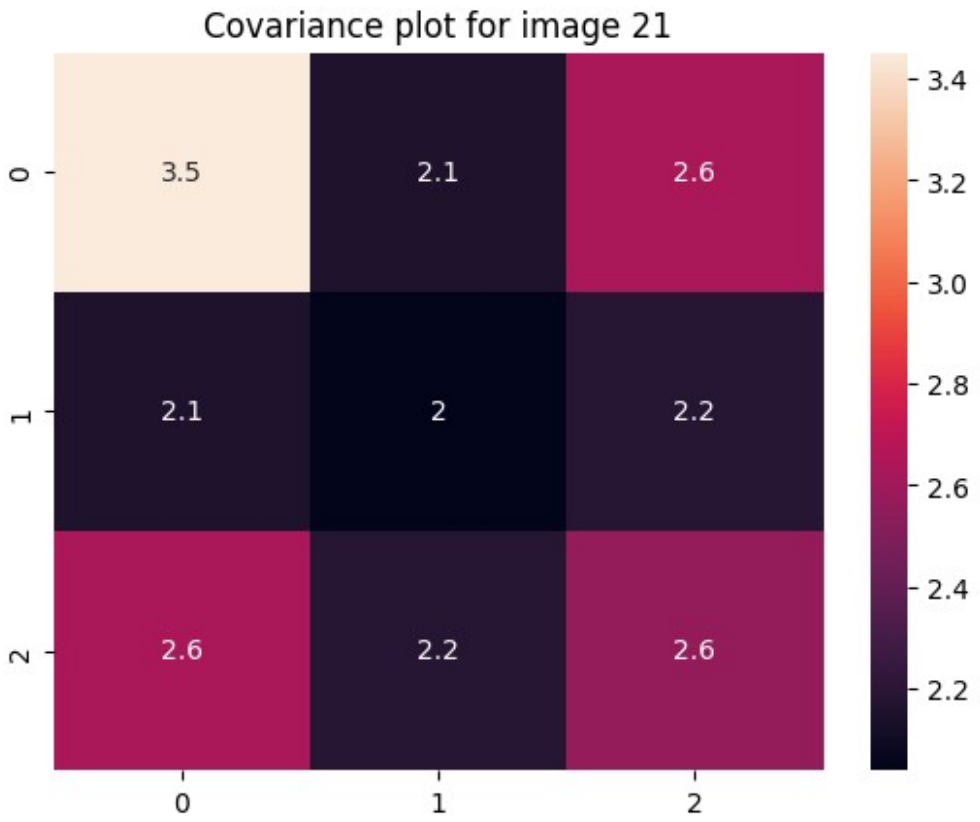

Covariance plot for image 16
2.8
2.3
2.1
2.3
2.2
1.9
2.1
1.9
2.7
0
1
2
0
1
2
2.6
2.4
2.2
2.0

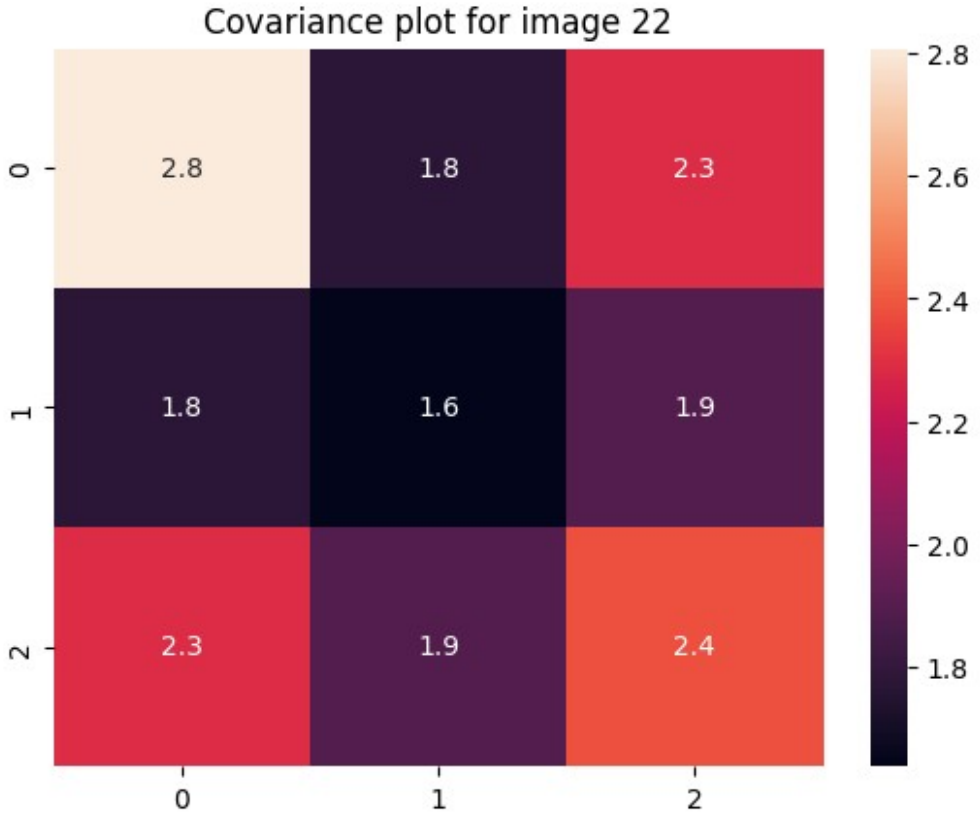

Covariance plot for image 17
2.7
1.8
1.9
1.8
1.8
1.7
1.9
1.7
2.2
0
1
2
0
1
2
2.6
2.4
2.2
2.0
1.8

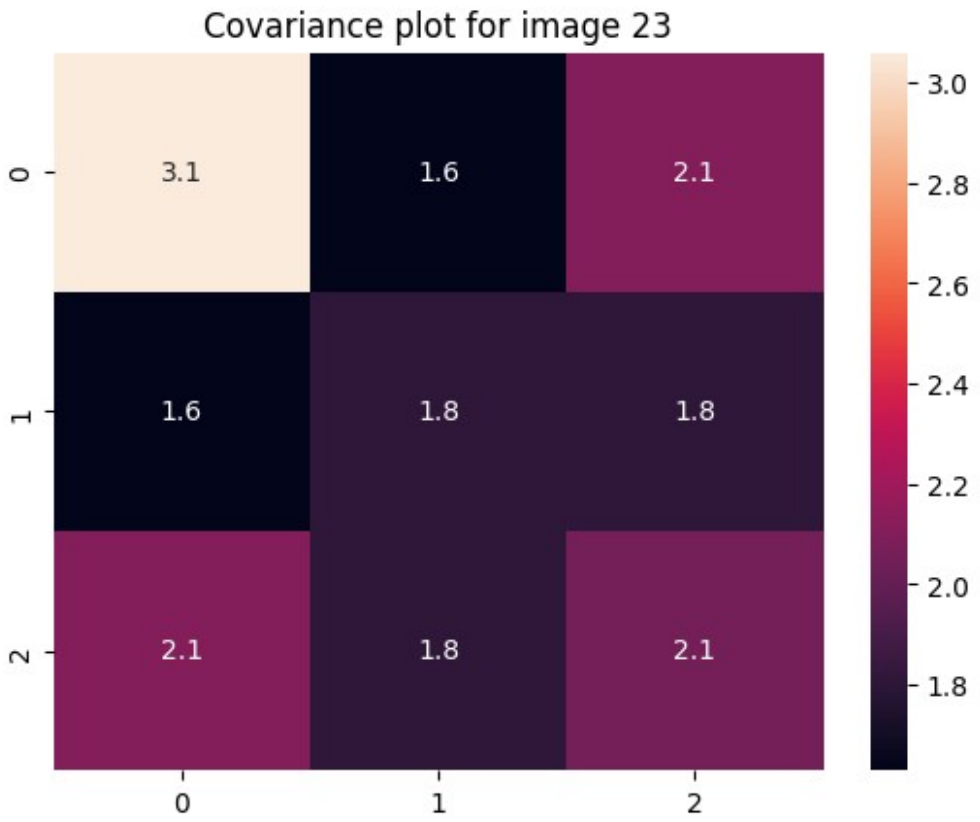

Covariance plot for image 18
3
1.9
2.1
1.9
2.1
2
2.1
2
2
0
1
2
0
1
2
2.8
2.6
2.4
2.2
2.0

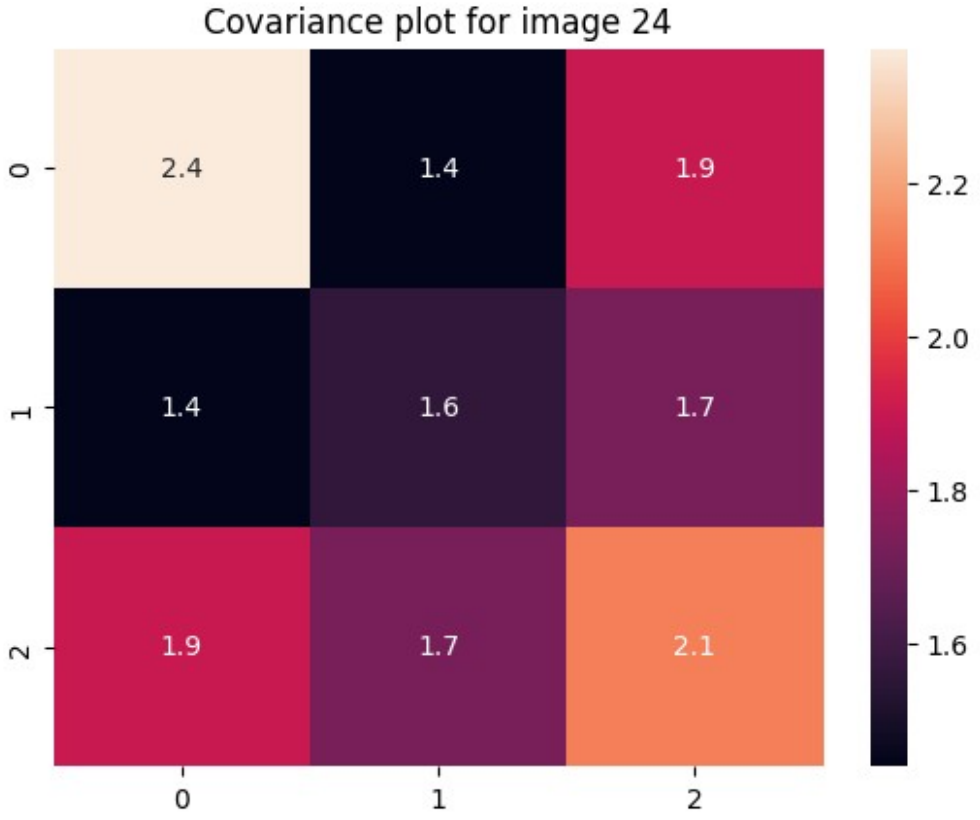

Covariance plot for image 19
2.9
1.9
2.2
1.9
2.2
2
2.2
2
2.2
0
1
2
0
1
2
2.8
2.6
2.4
2.2
2.0


Covariance plot for image 20
3.1
2.1
2.5
2.1
2.1
2.2
2.5
2.2
2.6
0
1
2
0
1
2
3.0
2.8
2.6
2.4
2.2


Covariance plot for image 21
3.5
2.1
2.6
2.1
2
2.2
2.6
2.2
2.6
0
1
2
0
1
2
3.4
3.2
3.0
2.8
2.6
2.4
2.2

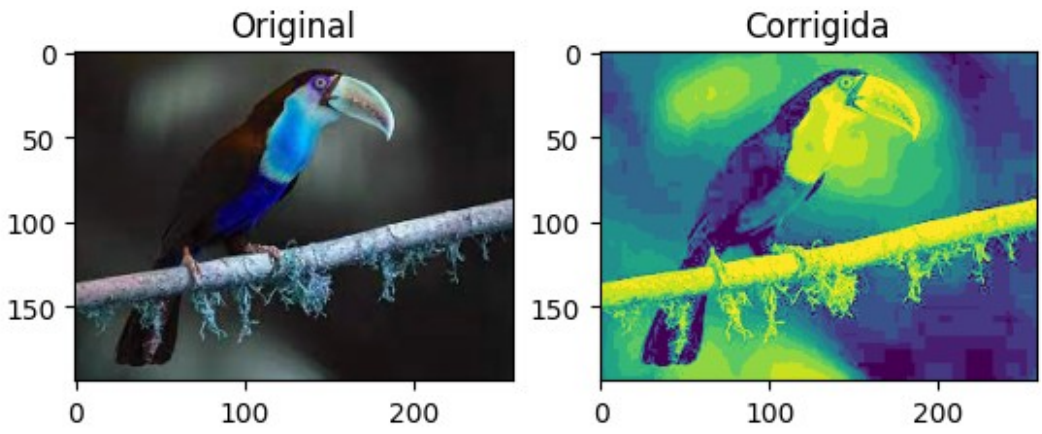

Covariance plot for image 22
2.8
1.8
2.3
1.8
1.6
1.9
2.3
1.9
2.4
0
1
2
0
1
2
2.8
2.6
2.4
2.2
2.0
1.8


Covariance plot for image 23
3.1
1.6
2.1
1.6
1.8
1.8
2.1
1.8
2.1
0
1
2
0
1
2
3.0
2.8
2.6
2.4
2.2
2.0
1.8


Covariance plot for image 24
2.4
1.4
1.9
1.4
1.6
1.7
1.9
1.7
2.1
0
1
2
0
1
2
2.2
2.0
1.8
1.6

Questão 4

```
import cv2
import numpy as np
import matplotlib.pyplot as plt

# Carrega a imagem original
img = cv2.imread('imagem.jpg')

# Converte para tons de cinza
gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

# Calcula o histograma da imagem
hist = cv2.calcHist([gray], [0], None, [256], [0, 256])

# Calcula a função de distribuição acumulada (CDF) a partir do
histograma
cdf = hist.cumsum()

# Normaliza a CDF
cdf_normalized = cdf * hist.max() / cdf.max()

# Aplica a transformação à imagem
img_equalized = np.empty(gray.shape, dtype=np.uint8)
for i in range(gray.shape[0]):
    for j in range(gray.shape[1]):
        img_equalized[i, j] = 255 * cdf_normalized[gray[i, j]] /
cdf.max()

# Exibe as imagens original e corrigida usando o matplotlib
plt.subplot(121)
plt.imshow(img)
plt.title('Original')

plt.subplot(122)
plt.imshow(img_equalized)
plt.title('Corrigida')

plt.show()
```


Original
Corrigida
0
50
100
150
0
100
200