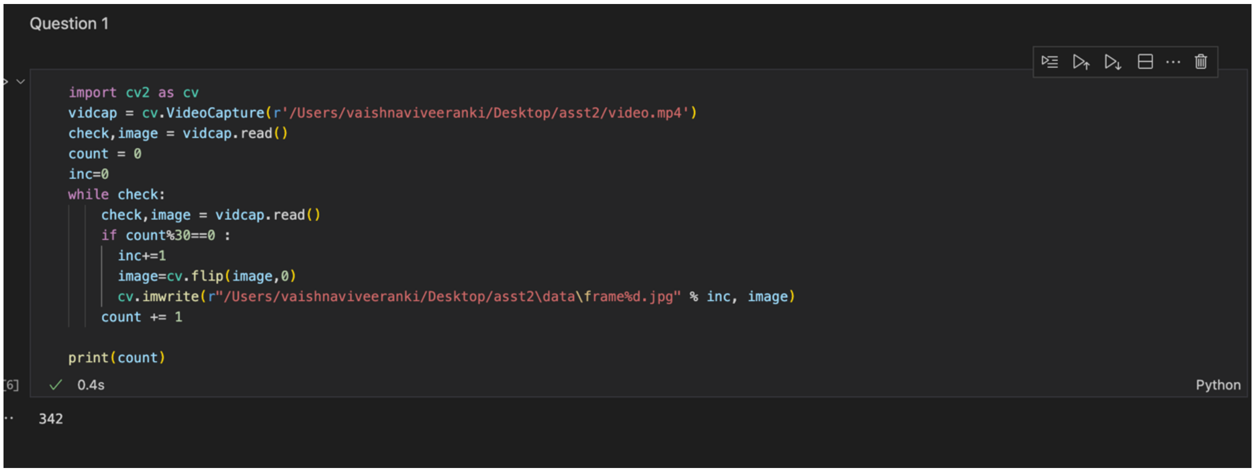
CSC4980/6980: Computer Vision
Assignment 2

1. Capture a 10 sec video footage using a camera of your choice. The footage should be taken with the camera in hand and you need to pan the camera slightly from left-right or right-left during the 10 sec duration. For all the images, operate at grayscale



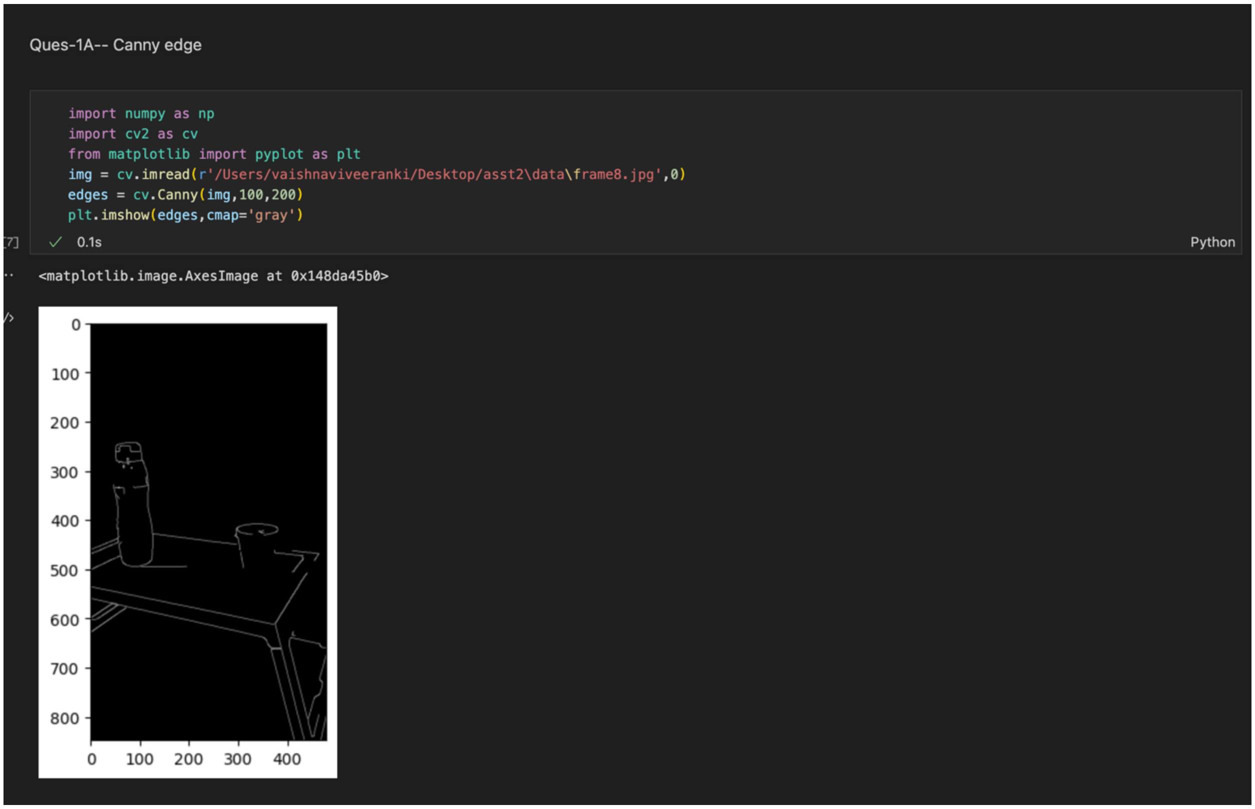
Question 1

```
import cv2 as cv
vidcap = cv.VideoCapture(r'/Users/vaishnaviveeranki/Desktop/asst2/video.mp4')
check,image = vidcap.read()
count = 0
inc=0
while check:
    check,image = vidcap.read()
    if count%30==0 :
        inc+=1
        image=cv.flip(image,0)
        cv.imwrite(r"/Users/vaishnaviveeranki/Desktop/asst2\data\frame%d.jpg" % inc, image)
    count += 1

print(count)
```

[6] ✓ 0.4s Python

```
342
```

a. Pick any image frame from the 10 sec video footage. Find the boundary of any object in the scene. You can pick regular shapes. You must show usage of Harris corner and Canny edge detection function.

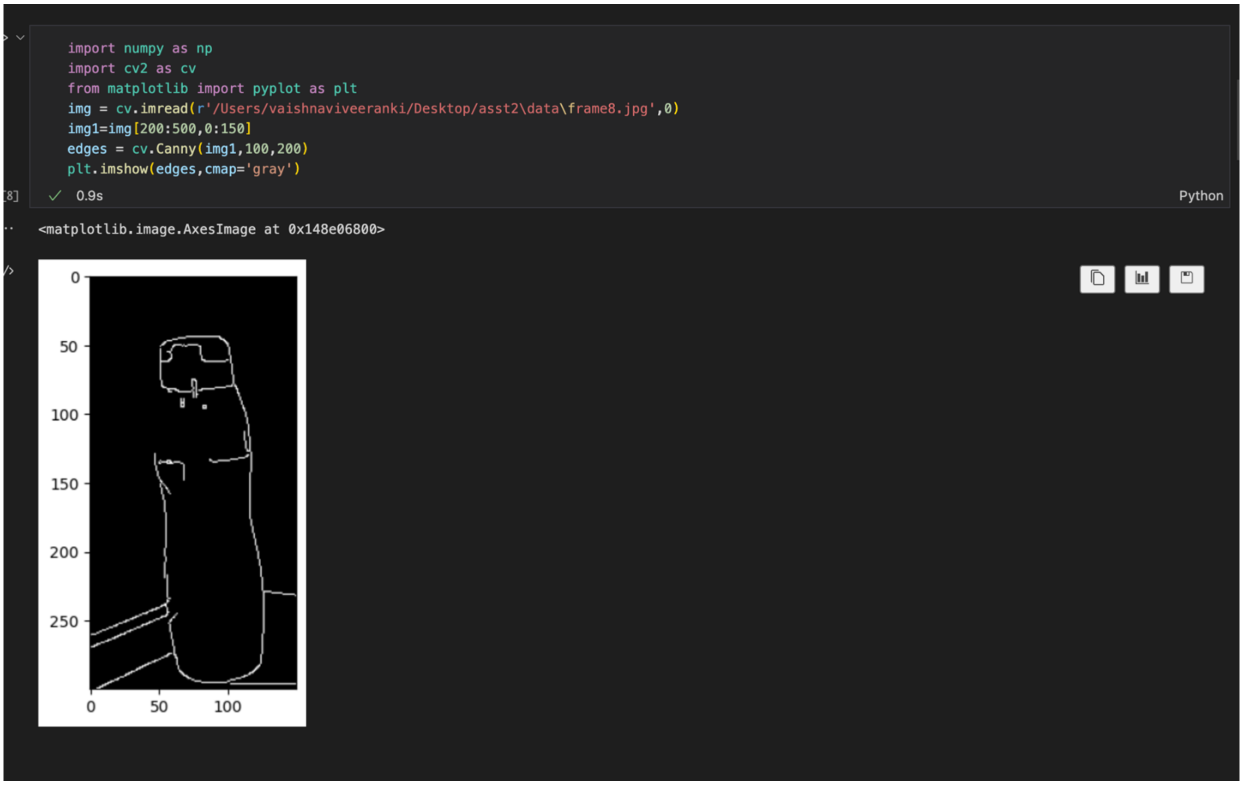


Ques-1A-- Canny edge

```
import numpy as np
import cv2 as cv
from matplotlib import pyplot as plt
img = cv.imread(r'/Users/vaishnaviveeranki/Desktop/asst2\data\frame8.jpg',0)
edges = cv.Canny(img,100,200)
plt.imshow(edges,cmap='gray')
```

[7] ✓ 0.1s Python

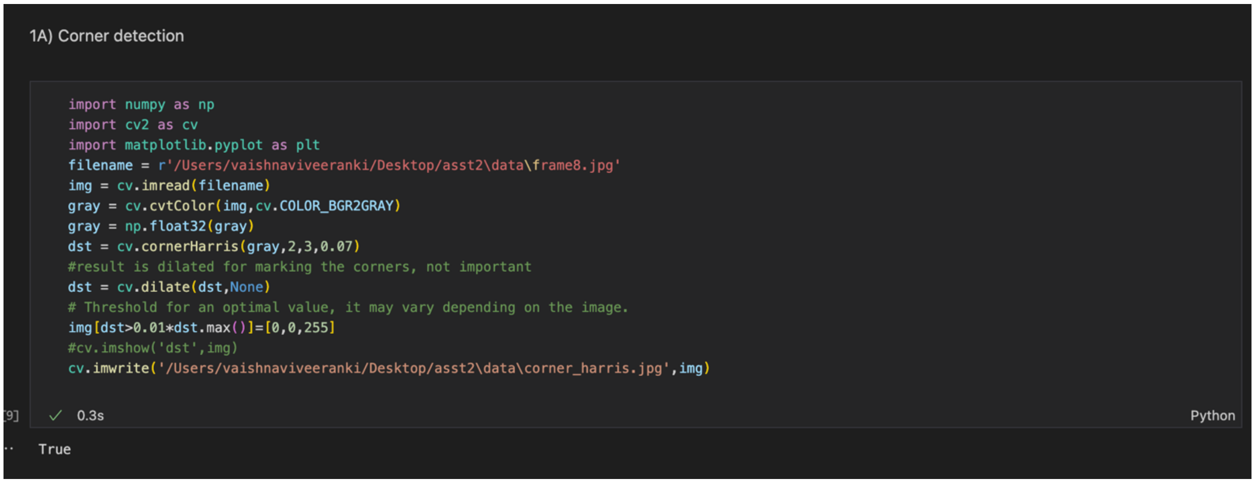
```
<matplotlib.image.AxesImage at 0x148da45b0>
```



```
import numpy as np
import cv2 as cv
from matplotlib import pyplot as plt
img = cv.imread(r'/Users/vaishnaviveeranki/Desktop/asst2\data\frame8.jpg',0)
img1=img[200:500,0:150]
edges = cv.Canny(img1,100,200)
plt.imshow(edges,cmap='gray')
```

[8] ✓ 0.9s

```
<matplotlib.image.AxesImage at 0x148e06800>
```



1A) Corner detection

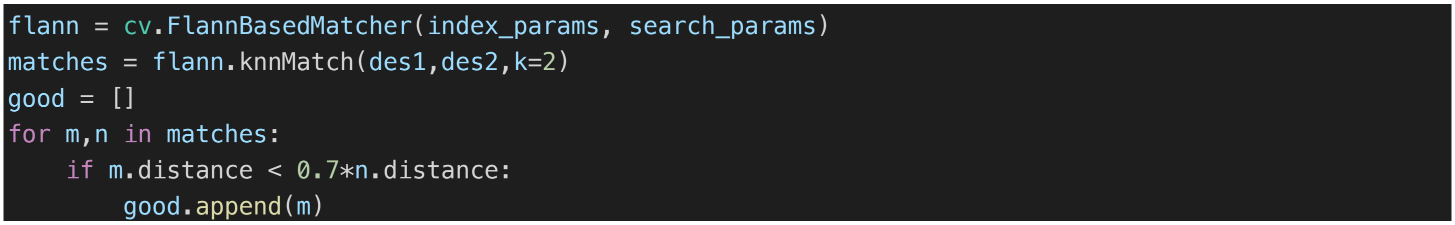
```
import numpy as np
import cv2 as cv
import matplotlib.pyplot as plt
filename = r'/Users/vaishnaviveeranki/Desktop/asst2\data\frame8.jpg'
img = cv.imread(filename)
gray = cv.cvtColor(img,cv.COLOR_BGR2GRAY)
gray = np.float32(gray)
dst = cv.cornerHarris(gray,2,3,0.07)
#result is dilated for marking the corners, not important
dst = cv.dilate(dst,None)
# Threshold for an optimal value, it may vary depending on the image.
img[dst>0.01*dst.max()]=[0,0,255]
#cv.imshow('dst',img)
cv.imwrite('/Users/vaishnaviveeranki/Desktop/asst2\data\corner_harris.jpg',img)
```

[9] ✓ 0.3s

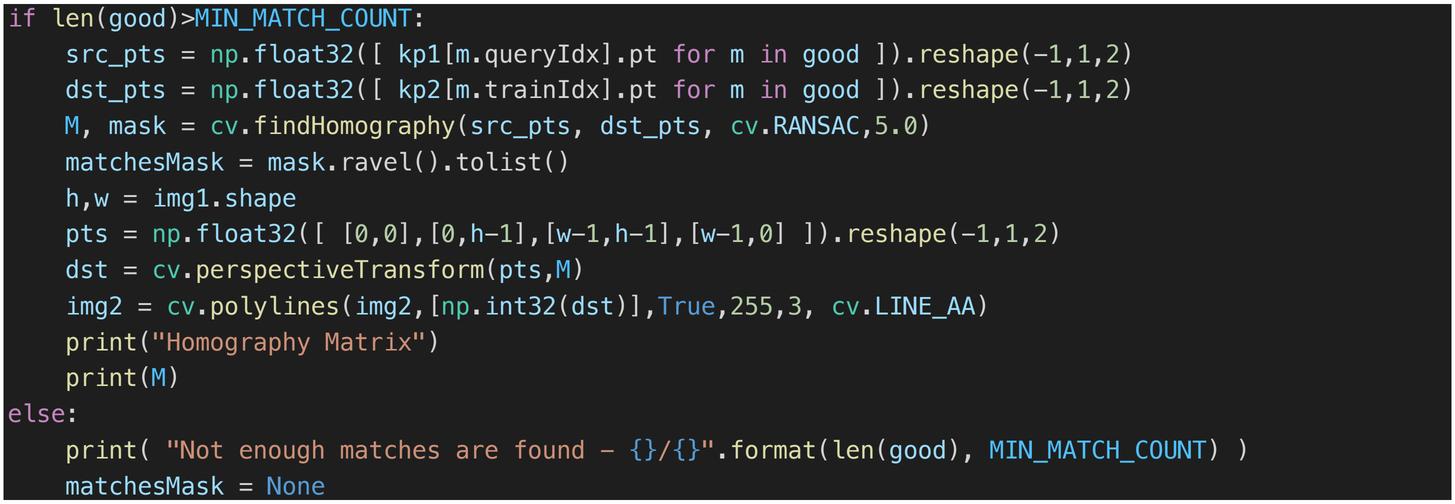
```
True
```

b. Pick another image frame from the set which also has the same object in view. Find all corresponding points of the object under consideration between these two images. Find the homography matrix between the images.

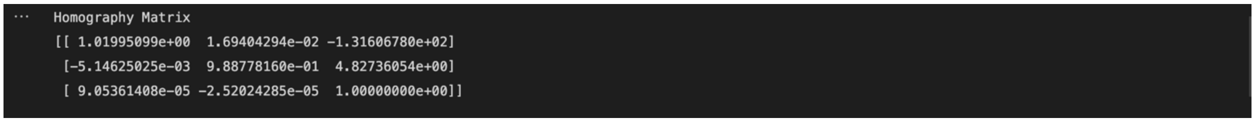
```
import numpy as np
import cv2 as cv
from matplotlib import pyplot as plt
MIN_MATCH_COUNT = 10
img1 = cv.imread(r'/Users/vaishnaviveeranki/Desktop/asst2\data\frame8.jpg',0)
img2 = cv.imread(r'/Users/vaishnaviveeranki/Desktop/asst2\data\frame6.jpg',0)
sift = cv.SIFT_create()
kp1, des1 = sift.detectAndCompute(img1,None)
kp2, des2 = sift.detectAndCompute(img2,None)
FLANN_INDEX_KDTREE = 1
index_params = dict(algorithm = FLANN_INDEX_KDTREE, trees = 5)
search_params = dict(checks = 50)
```



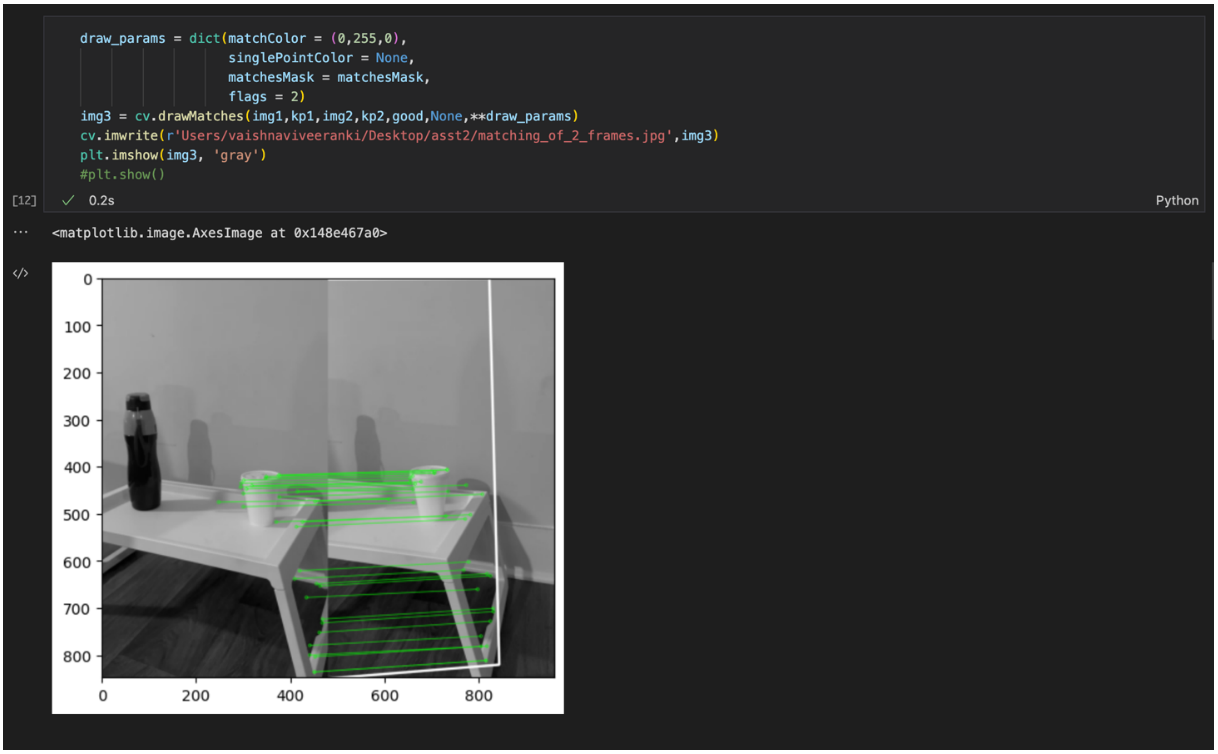
```
flann = cv.FlannBasedMatcher(index_params, search_params)
matches = flann.knnMatch(des1,des2,k=2)
good = []
for m,n in matches:
    if m.distance < 0.7*n.distance:
        good.append(m)
```



```
if len(good)>MIN_MATCH_COUNT:
    src_pts = np.float32([ kp1[m.queryIdx].pt for m in good ]).reshape(-1,1,2)
    dst_pts = np.float32([ kp2[m.trainIdx].pt for m in good ]).reshape(-1,1,2)
    M, mask = cv.findHomography(src_pts, dst_pts, cv.RANSAC,5.0)
    matchesMask = mask.ravel().tolist()
    h,w = img1.shape
    pts = np.float32([ [0,0],[0,h-1],[w-1,h-1],[w-1,0] ]).reshape(-1,1,2)
    dst = cv.perspectiveTransform(pts,M)
    img2 = cv.polylines(img2,[np.int32(dst)],True,255,3, cv.LINE_AA)
    print("Homography Matrix")
    print(M)
else:
    print( "Not enough matches are found - {}/{}".format(len(good), MIN_MATCH_COUNT) )
    matchesMask = None
```



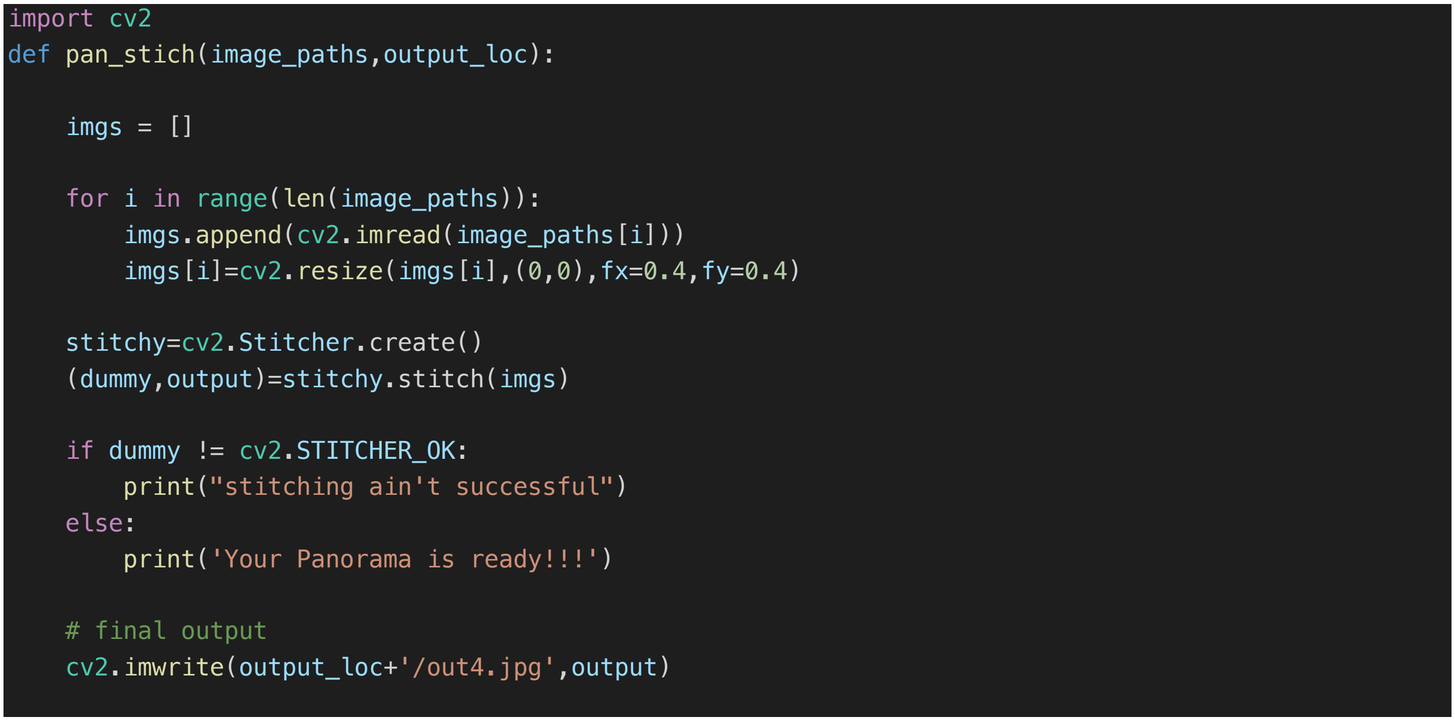
```
Homography Matrix
[[ 1.01995099e+00  1.69404294e-02 -1.31606780e+02]
 [-5.14625025e-03  9.88778160e-01  4.82736054e+00]
 [ 9.05361408e-05 -2.52024285e-05  1.00000000e+00]]
```



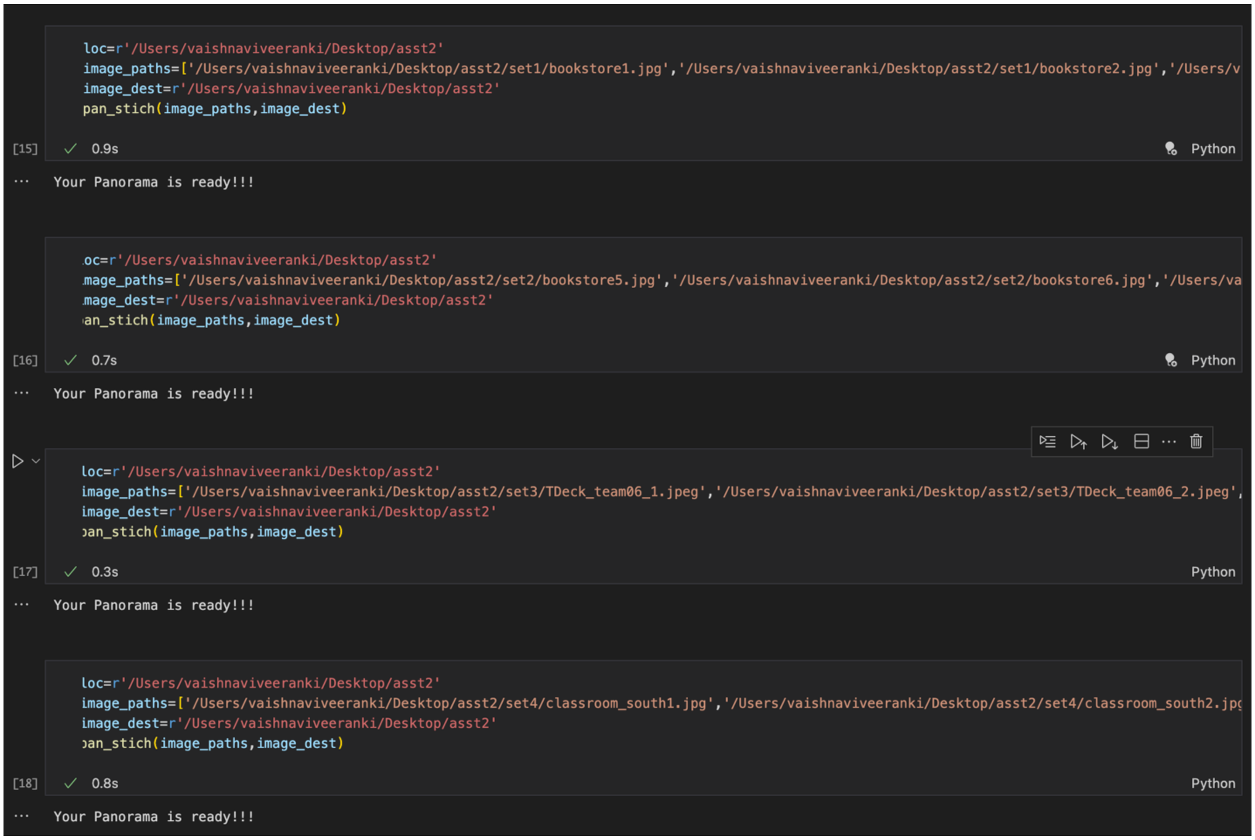
```
draw_params = dict(matchColor = (0,255,0),
                   singlePointColor = None,
                   matchesMask = matchesMask,
                   flags = 2)
img3 = cv.drawMatches(img1,kp1,img2,kp2,good,None,**draw_params)
cv.imwrite(r'Users/vaishnaviveeranki/Desktop/asst2/matching_of_2_frames.jpg',img3)
plt.imshow(img3, 'gray')
#plt.show()
```

```
<matplotlib.image.AxesImage at 0x148e467a0>
```

2. Implement the image stitching application in MATLAB (not necessary to be real-time). Test your application for any FIVE of a set of 3 image-set available in the gsu_building_database. That is, your stitching application should stitch 3 images. You must test the performance of your application for FIVE such sets.



```python
import cv2
def pan_stich(image_paths,output_loc):

    imgs = []

    for i in range(len(image_paths)):
        imgs.append(cv2.imread(image_paths[i]))
        imgs[i]=cv2.resize(imgs[i],(0,0),fx=0.4,fy=0.4)

    stitchy=cv2.Stitcher.create()
    (dummy,output)=stitchy.stitch(imgs)

    if dummy != cv2.STITCHER_OK:
        print("stitching ain't successful")
    else:
        print('Your Panorama is ready!!!')

    # final output
    cv2.imwrite(output_loc+'/out4.jpg',output)
```



```
loc=r'/Users/vaishnaviveeranki/Desktop/asst2'
image_paths=['/Users/vaishnaviveeranki/Desktop/asst2/set1/bookstore1.jpg','/Users/vaishnaviveeranki/Desktop/asst2/set1/bookstore2.jpg','/Users/v
image_dest=r'/Users/vaishnaviveeranki/Desktop/asst2'
pan_stich(image_paths,image_dest)
```

```
Your Panorama is ready!!!
```

```
oc=r'/Users/vaishnaviveeranki/Desktop/asst2'
mage_paths=['/Users/vaishnaviveeranki/Desktop/asst2/set2/bookstore5.jpg','/Users/vaishnaviveeranki/Desktop/asst2/set2/bookstore6.jpg','/Users/va
mage_dest=r'/Users/vaishnaviveeranki/Desktop/asst2'
an_stich(image_paths,image_dest)
```

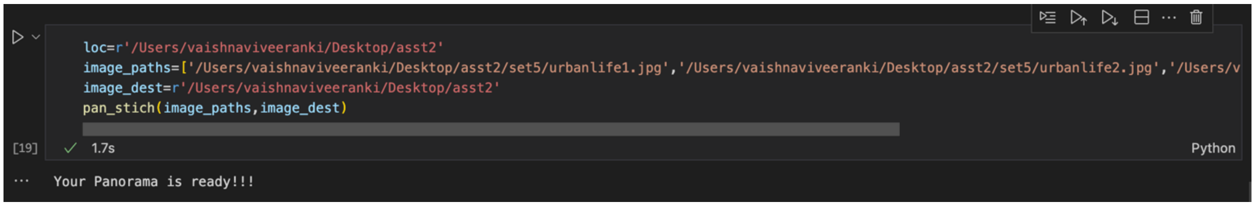
```
Your Panorama is ready!!!
```

```
loc=r'/Users/vaishnaviveeranki/Desktop/asst2'
image_paths=['/Users/vaishnaviveeranki/Desktop/asst2/set3/TDeck_team06_1.jpeg','/Users/vaishnaviveeranki/Desktop/asst2/set3/TDeck_team06_2.jpeg',
image_dest=r'/Users/vaishnaviveeranki/Desktop/asst2'
pan_stich(image_paths,image_dest)
```

```
Your Panorama is ready!!!
```

```
loc=r'/Users/vaishnaviveeranki/Desktop/asst2'
image_paths=['/Users/vaishnaviveeranki/Desktop/asst2/set4/classroom_south1.jpg','/Users/vaishnaviveeranki/Desktop/asst2/set4/classroom_south2.jpg
image_dest=r'/Users/vaishnaviveeranki/Desktop/asst2'
pan_stich(image_paths,image_dest)
```

```
Your Panorama is ready!!!
```



```
loc=r'/Users/vaishnaviveeranki/Desktop/asst2'
image_paths=['/Users/vaishnaviveeranki/Desktop/asst2/set5/urbanlife1.jpg','/Users/vaishnaviveeranki/Desktop/asst2/set5/urbanlife2.jpg','/Users/v
image_dest=r'/Users/vaishnaviveeranki/Desktop/asst2'
pan_stich(image_paths,image_dest)
```

```
Your Panorama is ready!!!
```

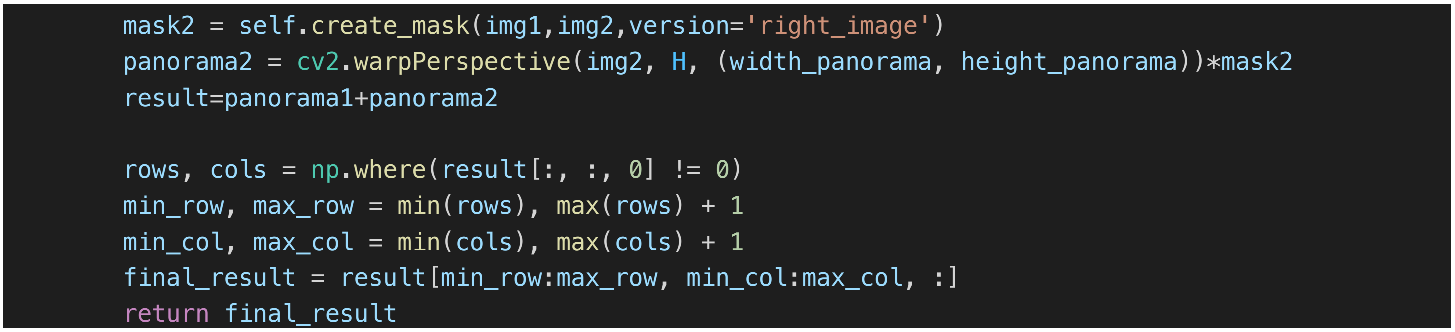
3. Implement an application that will compute and display the INTEGRAL image feed along with the stereo and RGB feed. You cannot use a built-in function such as “output = integral_image(input)”

```
img = cv2.imread(r'/Users/vaishnaviveeranki/Desktop/asst2\data\frame8.jpg')
img_bw = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

# initialising to 0
intergal_img = [[0 for j in range(len(img_bw[0]))] for i in range(len(img_bw))]

# compying values form img array
for i in range(len(img_bw)):
    for j in range(len(img_bw[0])):
        intergal_img[i][j] = int(img_bw[i][j])

# calculating the integral img
for i in range(1, len(img_bw[0])):
    intergal_img[0][i] += intergal_img[0][i-1]

for j in range(1, len(img_bw)):
    intergal_img[j][0] += intergal_img[j-1][0]

for i in range(1, len(img_bw)):
    for j in range(1, len(img_bw[0])):
        intergal_img[i][j] = intergal_img[i-1][j] + intergal_img[i][j-1] - intergal_img[i-1][j-1] + img_bw[i][j]
```

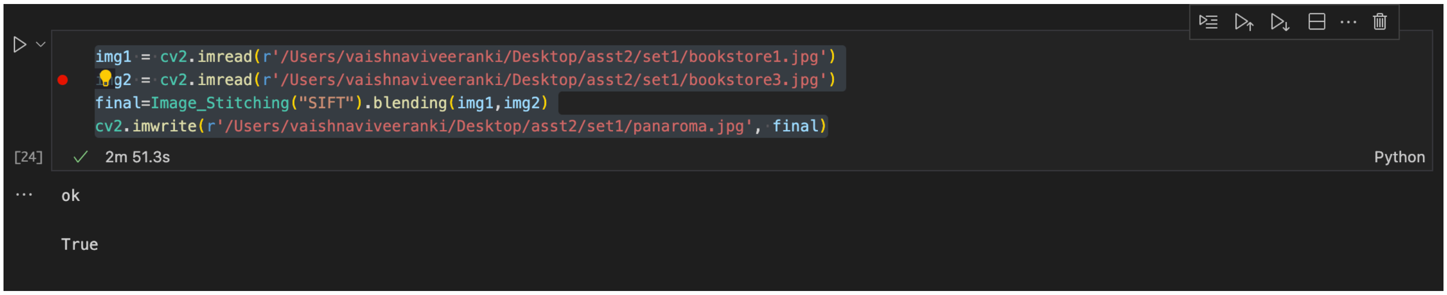
```
a = np.array(intergal_img)
mat = np.matrix(a)

with open('integral_matrix.txt','wb') as f:
    for line in mat:
        np.savetxt(f, line, fmt="%d")
```

4. Implement the image stitching, for at least 1 pair of images. Use SIFT features. If using Depth AI API this should function in real-time. You can use built-in libraries/tools provided by the DepthAI API.

```
import cv2
import numpy as np
import sys

class Image_Stitching():
    def __init__(self,soro) :
        self.ratio=0.85
        self.min_match=10
        if soro=="SIFT":
          self.soro=cv2.SIFT_create()
        else:
          self.soro=cv2.ORB_create()
        self.smoothing_window_size=800
    def registration(self,img1,img2):
        kp1, des1 = self.soro.detectAndCompute(img1, None)
        kp2, des2 = self.soro.detectAndCompute(img2, None)
        matcher = cv2.BFMatcher()
        raw_matches = matcher.knnMatch(des1, des2, k=2)
        good_points = []
        good_matches=[]
        for m1, m2 in raw_matches:
            if m1.distance < self.ratio * m2.distance:
                good_points.append((m1.trainIdx, m1.queryIdx))
                good_matches.append([m1])
        img3 = cv2.drawMatchesKnn(img1, kp1, img2, kp2, good_matches, None, flags=2)
        cv2.imwrite('matching.jpg', img3)
        if len(good_points) > self.min_match:
            image1_kp = np.float32(
                [kp1[i].pt for (_, i) in good_points])
            image2_kp = np.float32(
                [kp2[i].pt for (i, _) in good_points])
            H, status = cv2.findHomography(image2_kp, image1_kp, cv2.RANSAC,5.0)
        return H

    def create_mask(self,img1,img2,version):
        height_img1 = img1.shape[0]
        width_img1 = img1.shape[1]
        width_img2 = img2.shape[1]
        height_panorama = height_img1
        width_panorama = width_img1 +width_img2
        offset = int(self.smoothing_window_size / 2)
        barrier = img1.shape[1] - int(self.smoothing_window_size / 2)
        mask = np.zeros((height_panorama, width_panorama))
        if version== 'left_image':
            mask[:, barrier - offset:barrier + offset ] = np.tile(np.linspace(1, 0, 2 * offset ).T,
(height_panorama, 1))
            mask[:, :barrier - offset] = 1
        else:
            mask[:, barrier - offset :barrier + offset ] = np.tile(np.linspace(0, 1, 2 * offset
).T, (height_panorama, 1))
            mask[:, barrier + offset:] = 1
        return cv2.merge([mask, mask, mask])

    def blending(self,img1,img2):
        H = self.registration(img1,img2)
        height_img1 = img1.shape[0]
        width_img1 = img1.shape[1]
        width_img2 = img2.shape[1]
        height_panorama = height_img1
        width_panorama = width_img1 +width_img2

        panorama1 = np.zeros((height_panorama, width_panorama, 3))
        mask1 = self.create_mask(img1,img2,version='left_image')
        panorama1[0:img1.shape[0], 0:img1.shape[1], :] = img1
        panorama1 *= mask1
```



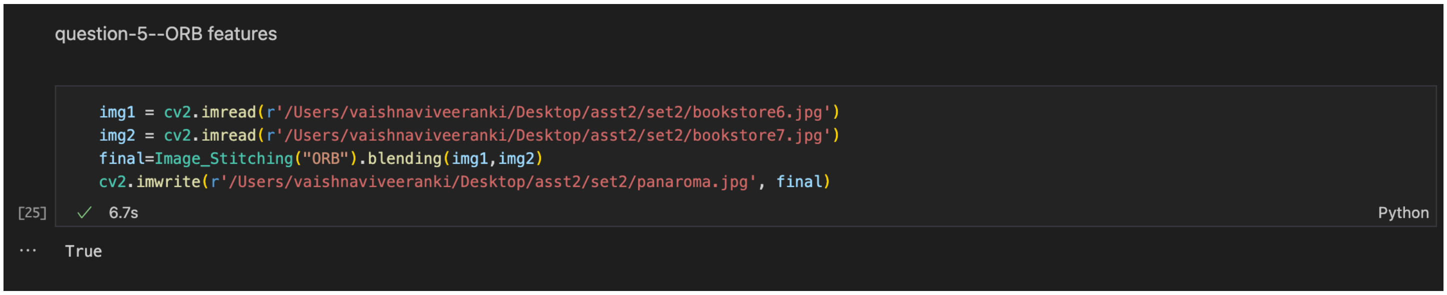
```
        mask2 = self.create_mask(img1,img2,version='right_image')
        panorama2 = cv2.warpPerspective(img2, H, (width_panorama, height_panorama))*mask2
        result=panorama1+panorama2

        rows, cols = np.where(result[:, :, 0] != 0)
        min_row, max_row = min(rows), max(rows) + 1
        min_col, max_col = min(cols), max(cols) + 1
        final_result = result[min_row:max_row, min_col:max_col, :]
        return final_result
```



```
img1 = cv2.imread(r'/Users/vaishnaviveeranki/Desktop/asst2/set1/bookstore1.jpg')
img2 = cv2.imread(r'/Users/vaishnaviveeranki/Desktop/asst2/set1/bookstore3.jpg')
final=Image_Stitching("SIFT").blending(img1,img2)
cv2.imwrite(r'/Users/vaishnaviveeranki/Desktop/asst2/set1/panaroma.jpg', final)
```

```
ok

True
```

5. Repeat (4) using ORB features.



question-5--ORB features

```
img1 = cv2.imread(r'/Users/vaishnaviveeranki/Desktop/asst2/set2/bookstore6.jpg')
img2 = cv2.imread(r'/Users/vaishnaviveeranki/Desktop/asst2/set2/bookstore7.jpg')
final=Image_Stitching("ORB").blending(img1,img2)
cv2.imwrite(r'/Users/vaishnaviveeranki/Desktop/asst2/set2/panaroma.jpg', final)
```

```
True
```