ASSIGNMENT 2

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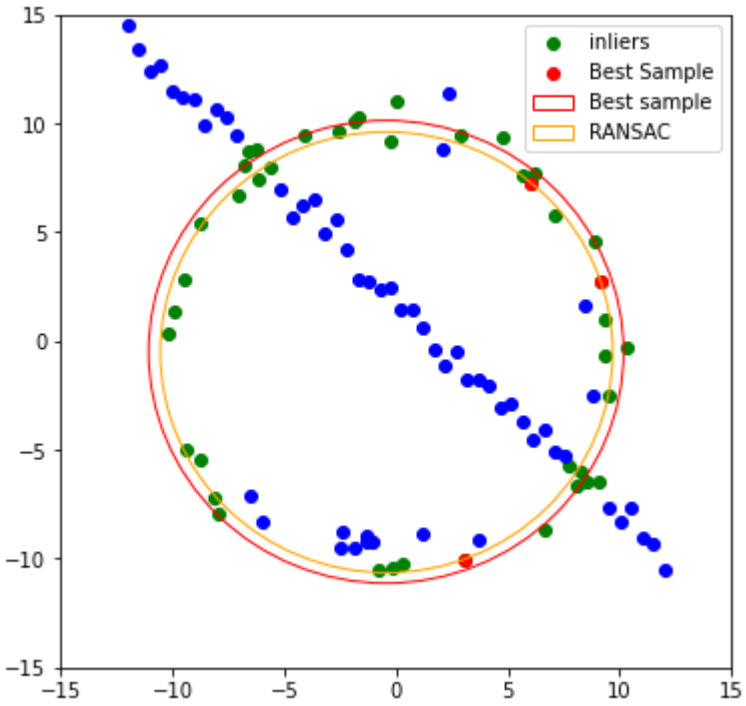
Question 1

In [ ]:
```
X_new = np.concatenate((X_circ, X_line),axis=0)
candidates = [] # circles after ransac and MAE

#RANSAC
maximum_iterations = 30
for iter in range(maximum_iterations):
  # 1.Select any 3 points
  one,two,three=np.random.choice(50),np.random.choice(50),np.random.choice(50)
  first,second,third= X_circ[one],X_circ[two],X_circ[three]
  best_circles = [] # from ransac
  # 2.Finding the circle that passes through these three points
  center , radius = circleRadius(first,second, third)
  # Define threshold distance to find inliers
  threshold_distance = 1
  # 3.Finding inliers
  inliers = []
  sq_distance = 0
  for i in range(100):
      sq_distance = (X_new[i][0] - center[0])**2 + (X_new[i][1] - center[1])**2
      sq_distance = np.sqrt(sq_distance)
      if sq_distance > radius - threshold_distance and sq_distance < radius + threshold
        inliers.append(X_new[i])
  # 4. define a threshold for inlier count to distinguish circles(best)
  inlier_threshold = 40
  if len(inliers) > inlier_threshold:
      best_circles.append([center, radius])
      # 5. determine a new candidate circle using all the inlier points
      # Least Square Circle Fit
      x_bar = sum(inliers[i][0] for i in range(len(inliers))) /len(inliers)
      y_bar = sum(inliers[i][1] for i in range(len(inliers))) /len(inliers)

      u_i = X_circ[:,0] - x_bar
      v_i = X_circ[:,1] - y_bar
      s_u = sum(u_i)
      s_uu = sum(u_i ** 2)
      s_uuu = sum(u_i ** 3)
      s_v = sum(v_i)
      s_vv = sum(v_i ** 2)
      s_vvv = sum(v_i ** 3)
      s_uv = sum(u_i * v_i)
      s_uvv = sum(u_i * v_i * v_i)
      s_vuu = sum(v_i * u_i * u_i)
      u_c = 0.5 * ((s_uuu + s_uvv) * s_vv - (s_vvv + s_vuu) * s_uv) / (s_uu * s_vv - s_
      v_c = 0.5 * ((s_uuu + s_uvv) * s_uv - (s_vvv + s_vuu) * s_uu) / (s_uv ** 2 - s_uu
      x_c = u_c + x_bar # center
      y_c = v_c + y_bar # center
      Radius = np.sqrt(u_c**2 + v_c**2 + (s_uu + s_vv)/len(inliers))
      # 6.Find all new inliner points and new  outlier points for new candidate circle
      new_inliers=[]
      new_outliers=[]
```

```
    for i in range(100):
      sq_distance2 = (X_new[i][0] - x_c)**2 + (X_new[i][1] - y_c)**2
      sq_distance2 = np.sqrt(sq_distance2)

      if sq_distance2 > Radius - threshold_distance and sq_distance2 < Radius + thres
        new_inliers.append(list(X_new[i]))
      else: new_outliers.append(list(X_new[i]))
  #7.If the count of inlier points is less than threshold inlier count then skip this n
  # If the count exceeds threshold inlier count then move on to next step
    if len(new_inliers) > inlier_threshold:
    # 8. Calculate the mean absolute error for the new candidate circle using the new i
      MAE = sum(np.sqrt((np.array(new_inliers)[:,0]-x_c)**2 + (np.array(new_inliers
    # 9. Add this candidate circle to the shortlist along with count of inlier points a
      candidates.append([(x_c,y_c), Radius, len(new_inliers), MAE, new_inliers, new
    # 10. Go back to the first step and repeat for max iterations number of times
#11.When max iterations is completed, examine the shortlist of candidate circles and pi
# If more than candidate circles with same inliner count then pick the candidate circle
```

In [ ]:
```
import matplotlib.patches as mpatches
plt.show()
```



Question 2

In [ ]:
```
import cv2 as cv
def mouse_handler(event, x, y, flags, data) :

    if event == cv.EVENT_LBUTTONDOWN :
        cv.circle(data['im'], (x,y),3, (0,0,255), 5, 16)
        cv.imshow("Image", data['im'])
        if len(data['points']) < 4 :
            data['points'].append([x,y])

def get_four_points(im):
    # Set up data to send to mouse handler
    data = {}
    data['im'] = im.copy()
```

```
    data['points'] = []

    #Set the callback function for any mouse event
    cv.imshow("Image",im)
    cv.setMouseCallback("Image", mouse_handler, data)
    cv.waitKey(0)
    cv.destroyAllWindows()

    # Convert array to np.array
    points = np.vstack(data['points']).astype(float)
    return points

image = [('Images/Go_Home_Gota.jpg',"Images/Galle_Fort.jpg"),("Images/I_lv_u2.jpg","Ima
iter=0
f,ax=plt.subplots(1,3,figsize=(18,6))
for (src, dst) in image:
    # Read source image.
    im_src = cv.imread(src)
    cv.rotate(im_src,cv.cv2.ROTATE_90_COUNTERCLOCKWISE)
    size = im_src.shape
    # Create a vector of source points.
    pts_src = np.array([[0,0],[size[1] - 1, 0],[size[1] - 1, size[0] -1],[0, size[0] -
    # Read destination image
    im_dst = cv.imread(dst)
    # Get four corners of the billboard
    pts_dst = get_four_points(im_dst)
    # Calculate Homography between source and destination points
    h, status = cv.findHomography(pts_src, pts_dst)
    # Warp source image
    im_temp = cv.warpPerspective(im_src, h, (im_dst.shape[1],im_dst.shape[0]))
    # Black out polygonal area in destination image.
    if iter == 0:
        cv.fillConvexPoly(im_dst, pts_dst.astype(int), 0, 16)
    # Add warped source image to destination image.
    im_dst = im_dst + im_temp
    ax[iter].imshow(cv.cvtColor(im_dst,cv.COLOR_BGR2RGB))
    ax[iter].axis('off')
    iter += 1
plt.show()
```

There are three pairs of images and here is the non-technical rationale of them :D,

1) For the country and respect the people who are fighting for #GoHomeGota

2) For my love

3) Just for fun we took over the civil department under our custedy.

Question 3

In [ ]:

```
import numpy as np
import cv2 as cv
import matplotlib.pyplot as plt
# Load the images in gray scale
img1 = cv.imread('Images/img1.ppm', cv.IMREAD_ANYCOLOR)
img2 = cv.imread('Images/img5.ppm', cv.IMREAD_ANYCOLOR)
# Detect the SIFT key points and compute the descriptors for the two images
sift = cv.xfeatures2d.SIFT_create()
keyPoints1, descriptors1 = sift.detectAndCompute(img1, None)
keyPoints2, descriptors2 = sift.detectAndCompute(img2, None)
# Create brute-force matcher object
bf = cv.BFMatcher()
# Match the descriptors
matches = bf.knnMatch(descriptors1, descriptors2, k=2)
# Select the good matches using the ratio test
goodMatches = []
for m, n in matches:
    if m.distance < 0.65 * n.distance:
        goodMatches.append(m)
# Apply the homography transformation if we have enough good matches
MIN_MATCH_COUNT = 10
if len(goodMatches) > MIN_MATCH_COUNT:
    # Get the good key points positions
    sourcePoints = np.float32([keyPoints1[m.queryIdx].pt for m in goodMatches]).reshape
    destinationPoints = np.float32([keyPoints2[m.trainIdx].pt for m in goodMatches]).re
    # obtain the homography matrix
    M, mask = cv.findHomography(sourcePoints, destinationPoints, method=cv.RANSAC, rans
    matchesMask = mask.ravel().tolist()
    # Apply the perspective transformation to the source image corners
    h = img1.shape[0]
    w = img1.shape[1]
    corners = np.float32([[0, 0], [0, h - 1], [w - 1, h - 1], [w - 1, 0]]).reshape(-1,
    transformedCorners = cv.perspectiveTransform(corners, M)
    # Draw a polygon on the second image joining the transformed corners
    img2 = cv.polylines(img2, [np.int32(transformedCorners)], True, (255, 255, 255), 2,
else:
    #print("Not enough matches are found - %d/%d" % (len(goodMatches), MIN_MATCH_COUNT)
    matchesMask = None
# Draw the matches
drawParameters = dict(matchColor=(0, 255, 0), singlePointColor=None, matchesMask=matche
result = cv.drawMatches(img1, keyPoints1, img2, keyPoints2, goodMatches, None, **drawPa
```

GitHub link: github.com/nifla2000/EN2550-Codings.git