2018222_Assignment_1

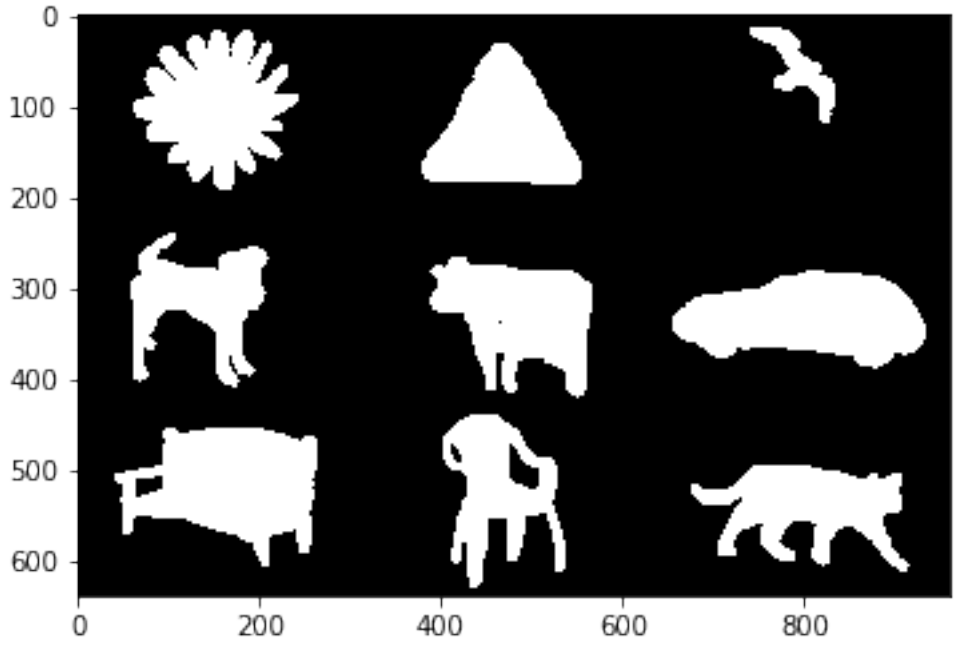
February 8, 2021

[168]:
```
import numpy as np
import cv2
import matplotlib.pyplot as plt
from skimage import filters
from collections import deque
import copy
from itertools import product
```

0.0.1 Question 1

Find tightest bounding circles for the objectspresentin the given image.[3 Marks] **Expected O/Ps**: centers & radiuses of those circles, and a visualization showing both the objects and the circles in a singleimage.0.25 marks for the center[0.15] andthe radius[0.1] for any object . [0.75] marks for thev isualization.

[63]:
```
image = cv2.imread("Project1.png")
plt.imshow(image)
plt.show()
print(image.shape)
```



```
(639, 960, 3)
```

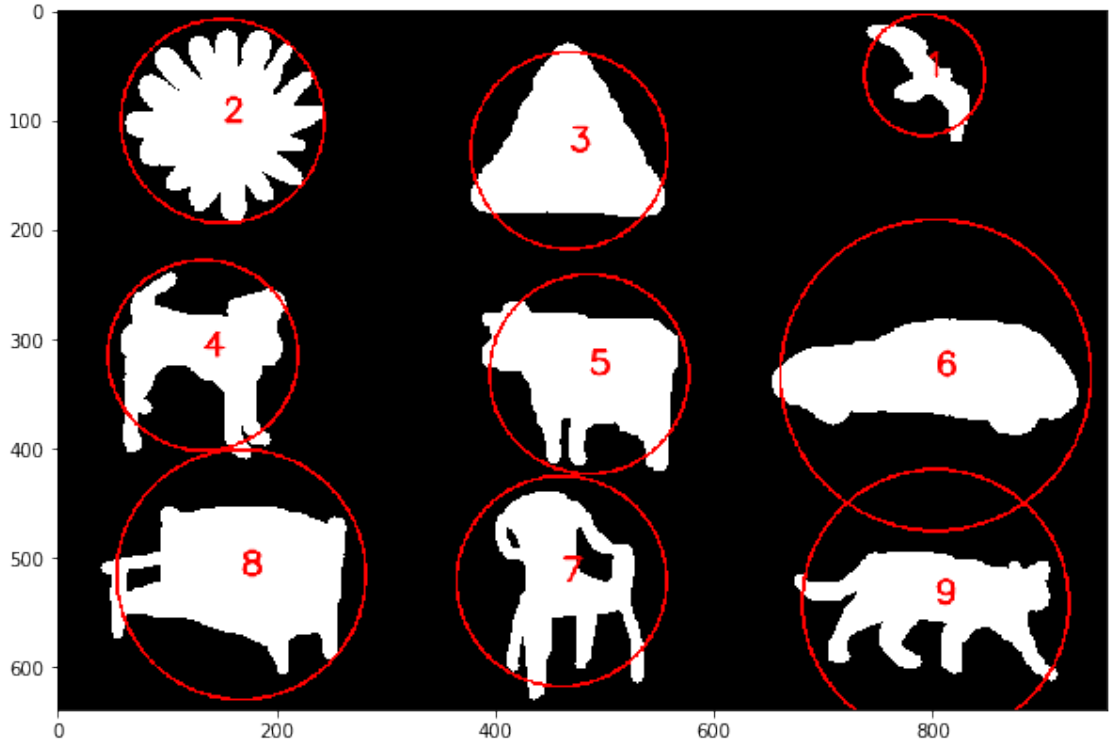
[203]:
```
def get_components(image):
    gray_img = np.mean(image,2)
    val = filters.threshold_otsu(gray_img)
    gray_img[gray_img >= val] = 1
    gray_img[gray_img < val] = 0

    rows, cols = gray_img.shape[0], gray_img.shape[1]
    visited = np.zeros((rows,cols))

    answer = np.zeros((rows,cols))
    centers = {}
    c = 1
    for i in range(rows):
        for j in range(cols):

            if(gray_img[i][j] == 0.0):
                visited[i,j] = 1
            elif(visited[i,j]):
                continue
            else:
                stack = deque()
                stack.append((i,j))

                centers[c] = []

                while(len(stack)!=0):
                    curr = stack.pop()
                    if(visited[curr[0],curr[1]] == 0):
                        visited[curr[0],curr[1]] = 1
                        m,n = curr[0],curr[1]
                        answer[m,n] = c
                        list_ = []
                        for x in range(m-1, m+2):
                            for y in range(n-1, n+2):
                                if(x == m and y == n):
                                    continue
                                else:
                                    if(x <0 or x > rows -1):
                                        continue
                                    if(y <0 or y > cols -1):
                                        continue

                                    if(gray_img[x,y] == 1.0):
```

```
                                        centers[c].append((x,y))
                                        stack.append((x,y))
                c = c + 1


#     print("Number of connected components : ", np.amax(answer))
    return np.amax(answer), centers
```

[269]:
```
def get_bounding_circles(image):

    n, centers = get_components(image)

    centers_radius = {}
    for key in list(centers.keys()):
        arr = np.array(centers[key])
        center_x, center_y = np.mean(arr,0)
        radius = max((np.max(arr[:,0]) - np.min(arr[:,0]))/2, (np.max(arr[:,1])␣
↪- np.min(arr[:,1]))/2)
        centers_radius[key] = {"center_coordinates" : (int(center_y),␣
↪int(center_x)), "radius": int(radius+2)}
        print("centre coordinates for object ",str(key),": ", "(",␣
↪int(center_y), int(center_x), ")", "radius : ",int(radius) )

    curr_image = copy.deepcopy(image)
    for key in list(centers_radius.keys()):

        color = (255, 0, 0)

        thickness = 2
        curr_image = cv2.circle(curr_image,␣
↪centers_radius[key]["center_coordinates"], centers_radius[key]["radius"],␣
↪color, thickness)
        font = cv2.FONT_HERSHEY_SIMPLEX
        fontScale = 1
        curr_image = cv2.putText(curr_image, str(key),␣
↪centers_radius[key]["center_coordinates"], font, fontScale, color,␣
↪thickness, cv2.LINE_AA)

    cv2.imwrite("bounding_image.jpg", curr_image)
    fig = plt.figure(figsize = (10,10))
    plt.imshow(curr_image)
    plt.show()

    return centers_radius
```

[270]:
```
center_radius = get_bounding_circles(image)
```

```
centre coordinates for object  1 :  ( 793 59 ) radius :  53
centre coordinates for object  2 :  ( 151 101 ) radius :  91
centre coordinates for object  3 :  ( 468 128 ) radius :  88
centre coordinates for object  4 :  ( 133 315 ) radius :  85
centre coordinates for object  5 :  ( 486 332 ) radius :  89
centre coordinates for object  6 :  ( 803 333 ) radius :  140
centre coordinates for object  7 :  ( 461 521 ) radius :  94
centre coordinates for object  8 :  ( 168 515 ) radius :  112
centre coordinates for object  9 :  ( 803 541 ) radius :  120
```

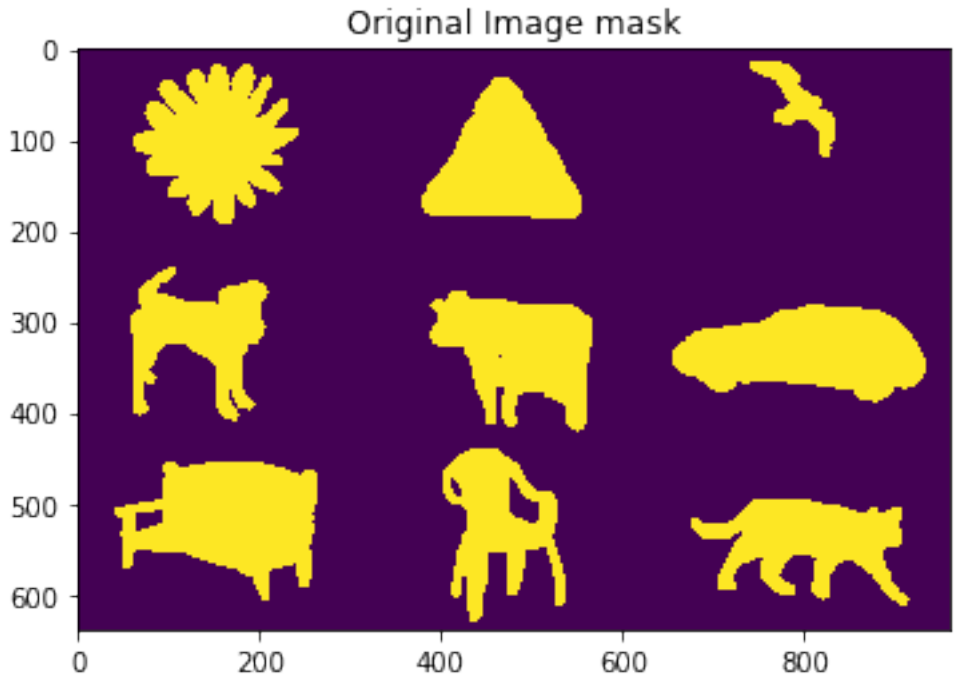


0.0.2 Question 2

Find Jaccard Similarity scores for each of the objects in the image given with respect to their corresponding circular regions obtained in Q1.[2 Marks] [0.65] marks for implementing the Jaccard Similarity module that takes two binary masks as inputs and outputs the required score.[0.15] marks for Jaccard Similarity score for any object.

[254]:
```
def jaccard_similarity(binary_mask1, binary_mask2):
    intersection = len(list(set(binary_mask1).intersection(set(binary_mask2))))
    union = len(set(binary_mask1).union(set(binary_mask2)))
    return float(intersection) / union
```

[233]:
```
gray_img = np.mean(image,2)
val = filters.threshold_otsu(gray_img)
gray_img[gray_img >= val] = 1
gray_img[gray_img < val] = 0
plt.imshow(gray_img)
plt.title("Original Image mask")
plt.show()
```



[234]:
```
n, centers = get_components(image)
centers_radius = {}
for key in list(centers.keys()):
    arr = np.array(centers[key])
    center_x, center_y = np.mean(arr,0)
    radius = max((np.max(arr[:,0]) - np.min(arr[:,0]))/2, (np.max(arr[:,1]) -␣
 ↪np.min(arr[:,1]))/2)
    centers_radius[key] = {"center_coordinates" : (int(center_y),␣
 ↪int(center_x)), "radius": int(radius)}
#     print("centre coordinates : ", "(", int(center_y), int(center_x), ")",␣
 ↪"radius : ",int(radius) )

circles = {}
for key in list(centers_radius.keys()):
    curr_image = copy.deepcopy(image)
    curr_image = np.zeros(curr_image.shape)
```

```
    color = (255, 255, 255)
    thickness = -1
    y,x = center_radius[key]["center_coordinates"]
    radius = centers_radius[key]["radius"] + 5
    curr_image = cv2.circle(curr_image,␣
 ↪centers_radius[key]["center_coordinates"], centers_radius[key]["radius"],␣
 ↪color, thickness)
#     curr_image = np.mean(curr_image,2)
#     curr_image = curr_image[x - radius : x + radius , y - radius : y + radius]
    circles[key] = curr_image
    fig, (ax1, ax2) = plt.subplots(1, 2)
    fig.suptitle("Bounding circles for object " + str(key) + " Binary Mask")
    ax1.imshow(curr_image)
    ax2.imshow(image[x - radius : x + radius , y - radius : y + radius])
```

```
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers).
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floats or [0..255] for integers).
```
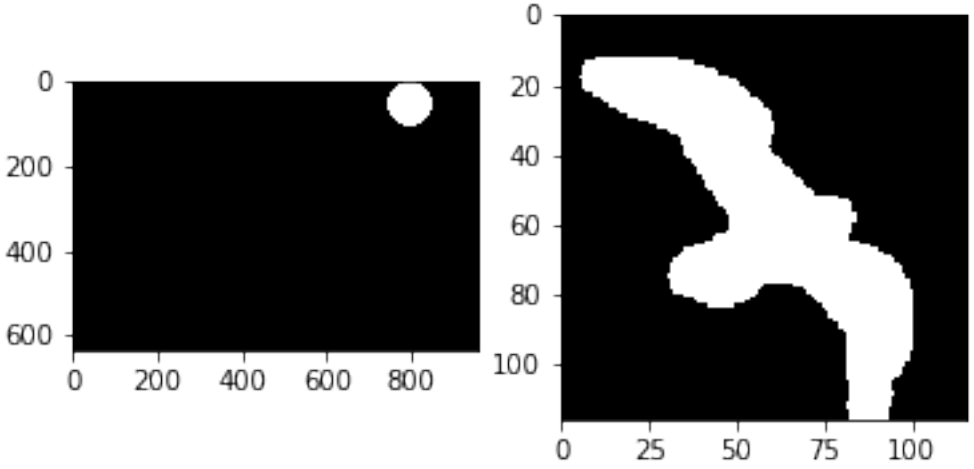
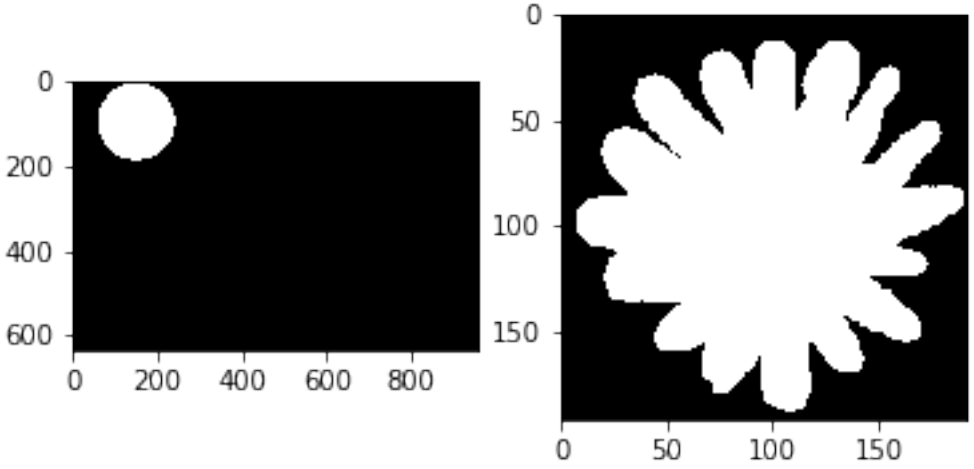
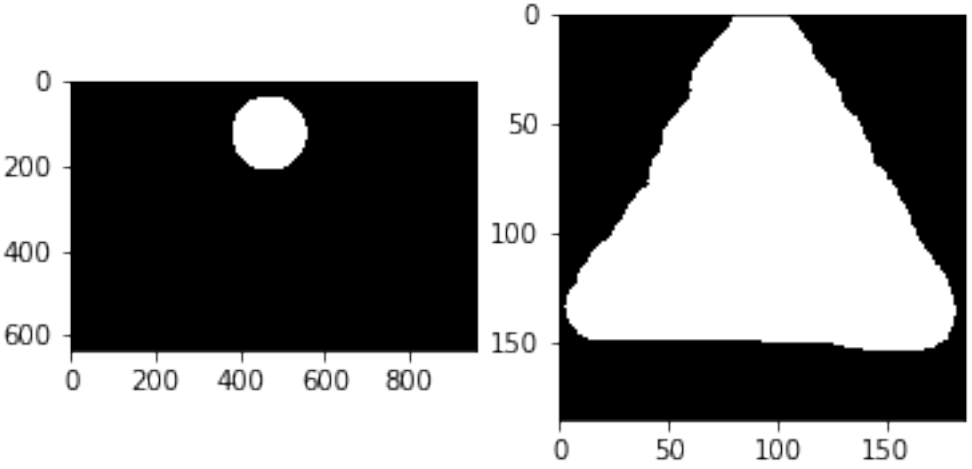

Bounding circles for object 1 Binary Mask



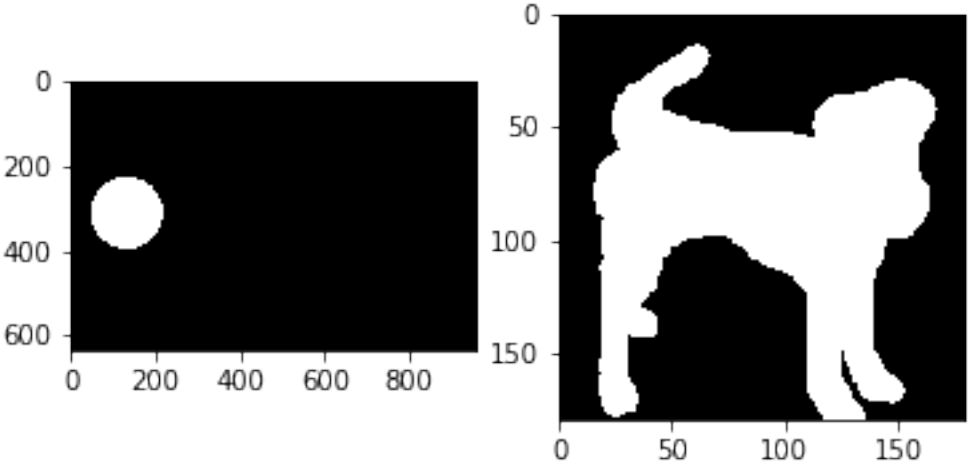
Bounding circles for object 2 Binary Mask



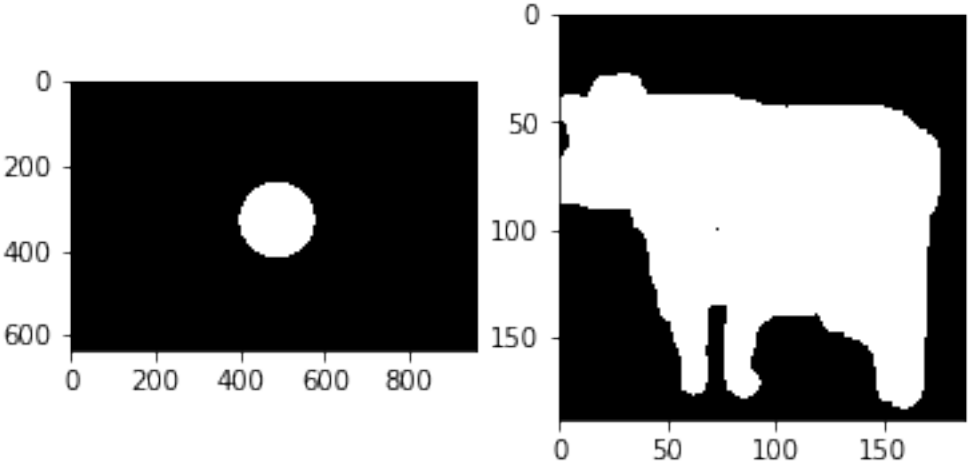
Bounding circles for object 3 Binary Mask



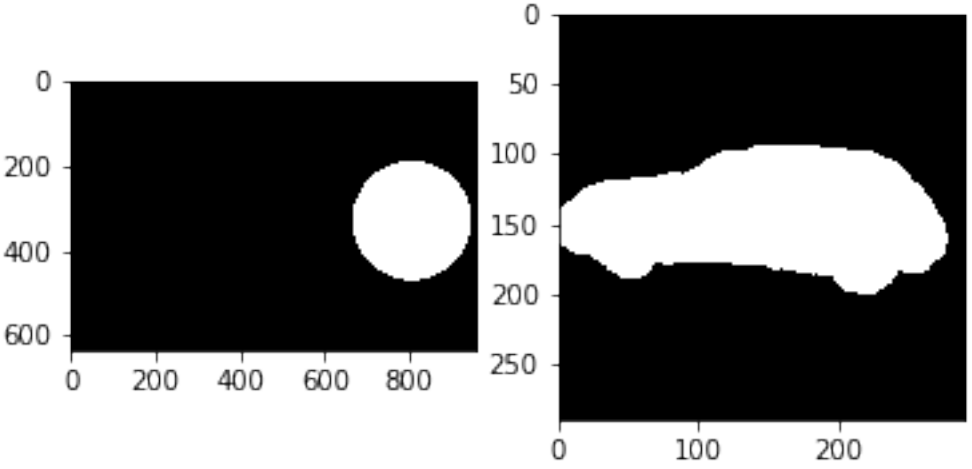
Bounding circles for object 4 Binary Mask



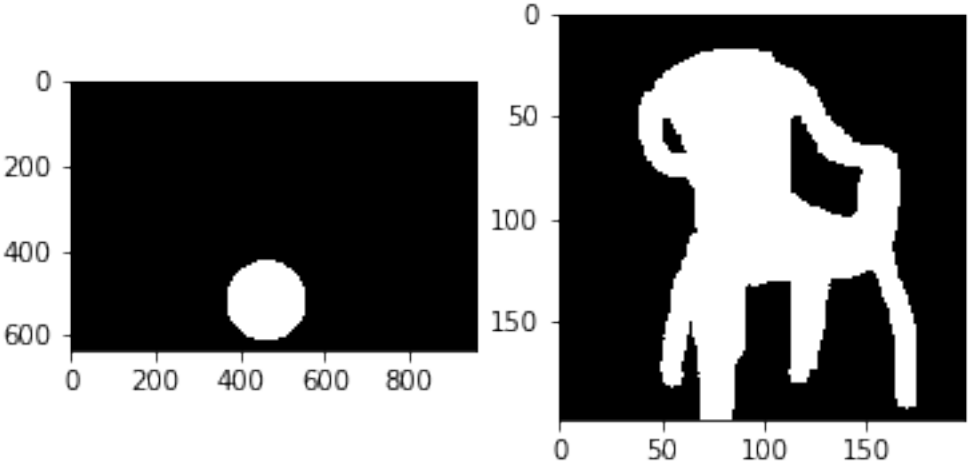
Bounding circles for object 5 Binary Mask



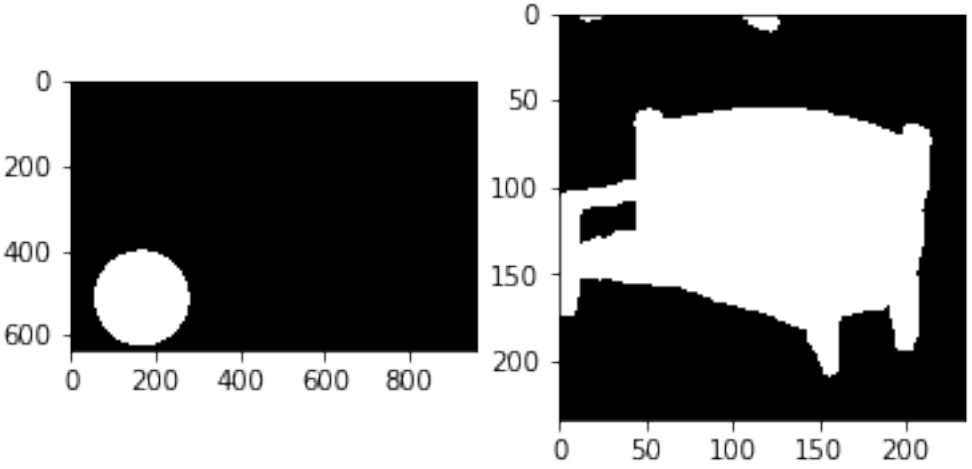
Bounding circles for object 6 Binary Mask

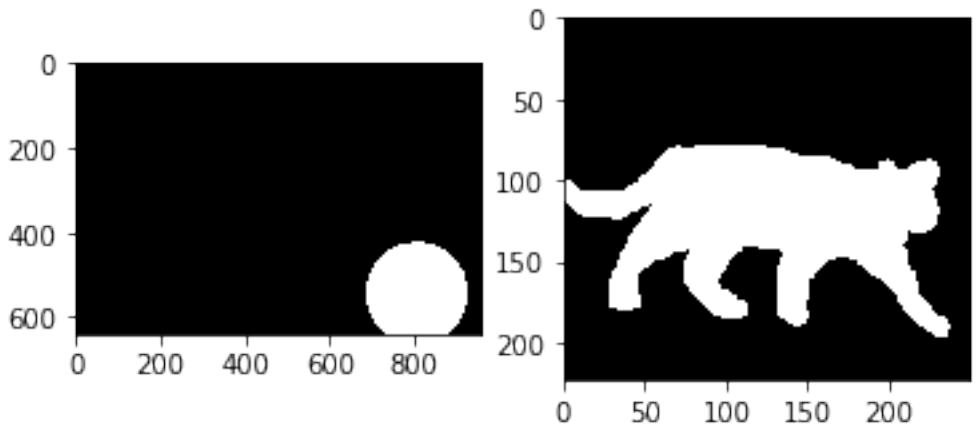


Bounding circles for object 7 Binary Mask



Bounding circles for object 8 Binary Mask





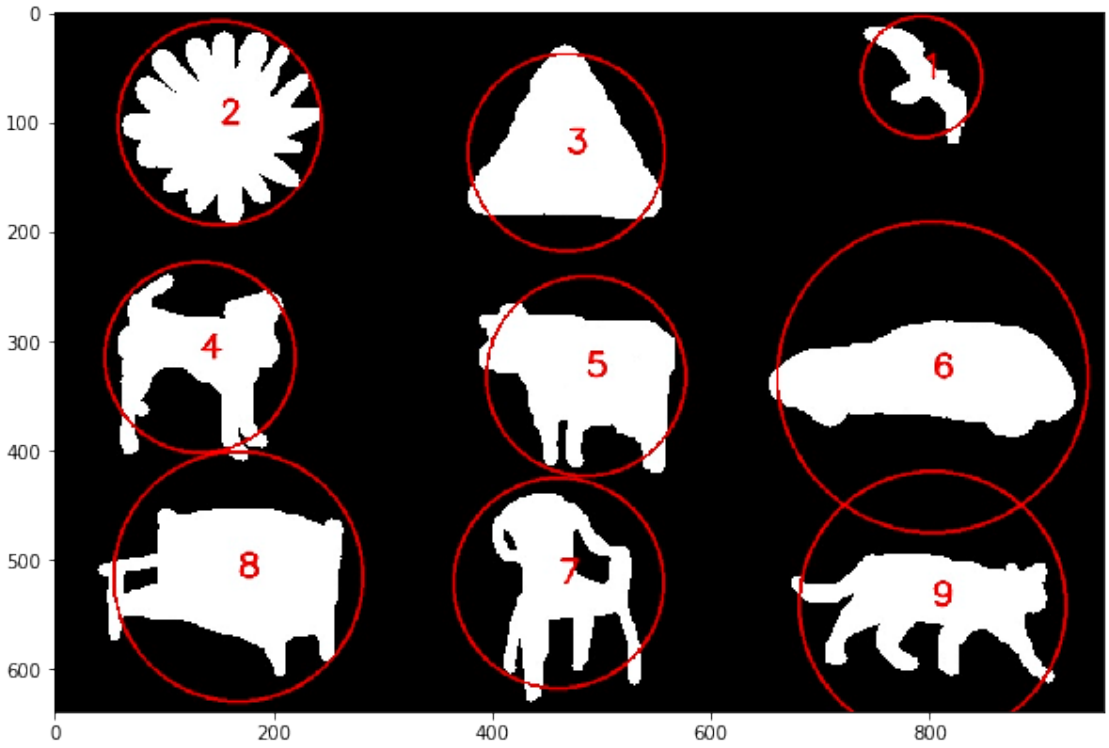
[235]:
```
def points_in_circle_np(radius, x0=0, y0=0, ):
    x_ = np.arange(x0 - radius - 1, x0 + radius + 1, dtype=int)
    y_ = np.arange(y0 - radius - 1, y0 + radius + 1, dtype=int)
    x, y = np.where((x_[:,np.newaxis] - x0)**2 + (y_ - y0)**2 <= radius**2)
    # x, y = np.where((np.hypot((x_-x0)[:,np.newaxis], y_-y0)<= radius)) #␣
↪alternative implementation
    list_ = []
    for x, y in zip(x_[x], y_[y]):
        list_.append((x,y))
    return list_
```

[257]:
```
def get_jaccard_similarity(image, circles):
    n, centers = get_components(image)
    centers_radius = {}
    for key in list(centers.keys()):
        arr = np.array(centers[key])
        center_x, center_y = np.mean(arr,0)
        radius = max((np.max(arr[:,0]) - np.min(arr[:,0]))/2, (np.max(arr[:,1])␣
↪- np.min(arr[:,1]))/2)
        centers_radius[key] = {"center_coordinates" : (int(center_y),␣
↪int(center_x)), "radius": int(radius)}

    circle_coordinates = {}
    for key in list(center_radius.keys()):
        radius = center_radius[key]["radius"]
        y,x = center_radius[key]["center_coordinates"]
```

```
#         n, centers_r = get_components(circles[key])
#         circle_coordinates[key] = centers_r[1]
        circle_coordinates[key] = points_in_circle_np(radius,x,y)
        IOU = jaccard_similarity(centers[key], circle_coordinates[key])
        print("The IOU (jaccard similarity) score for object ", str(key) ,"  is␣
 ↪: ", IOU)
    return circle_coordinates, centers
```

[273]:
```
circle_coordinates,centers = get_jaccard_similarity(image,circles)
bounding_image = cv2.imread("bounding_image.jpg")
plt.figure(figsize = (10,10))
plt.imshow(bounding_image)
plt.show()
```

```
The IOU (jaccard similarity) score for object  1   is :  0.31282416353096715
The IOU (jaccard similarity) score for object  2   is :  0.7108704460898073
The IOU (jaccard similarity) score for object  3   is :  0.6191863808903033
The IOU (jaccard similarity) score for object  4   is :  0.48961881589618816
The IOU (jaccard similarity) score for object  5   is :  0.5993872503783544
The IOU (jaccard similarity) score for object  6   is :  0.31881044639763095
The IOU (jaccard similarity) score for object  7   is :  0.42577659827838454
The IOU (jaccard similarity) score for object  8   is :  0.49704413290543636
The IOU (jaccard similarity) score for object  9   is :  0.32000085282391316
```



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