# Computer Vision hw4

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## Q: **Active Contour**

The active contour question could be divided into three part:

### 1. Set initial point:

```python
def get_fixed_initial_point(img, num_points):

    img_height, img_width = img.shape

    center = [img_height/2, img_width/2]
    radius = img_height*0.3 if img_height < img_width else img_width*0.3

    theta = np.linspace(0, 2*np.pi, num_points)

    x = center[0] + radius * np.cos(theta)
    y = center[1] + radius * np.sin(theta)
    x = [int(i) for i in x]
    y = [int(i) for i in y]
    return np.stack((x, y), axis=1)
```

This function returns a set of initial points that set a circle shape on the origin image with given numbers of points, and the radius of the circle is related to the image's height and width.

## 2. Find Contour:

```python
def find_contour(img, alpha=0.1, beta=0.4, gamma=0.5, max_iteration=2000, region=7, num_points=50, video_name=""):
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    g_img = guassian_blur(gray)
    img_gradient = get_image_gradient(g_img)

    points = get_fixed_initial_point(g_img, num_points)

    # draw initial circle
    for i in range(num_points):
        j = i+1
        if i == num_points-1:
            j = 0
        img = cv2.circle(img, (int(points[i,0]),int(points[i,1])), radius=5, color=(0,0,0), thickness=-1)
        img = cv2.line(img, (int(points[i][0]), int(points[i][1])), (int(points[j][0]), int(points[j][1])), color=(0, 0, 0), thickness=2)

    # record video
    if (video_name):
        fourcc = cv2.VideoWriter_fourcc(*'XVID')
        out = cv2.VideoWriter('./result_img/'+video_name+'.avi', fourcc, 5.0, (1000, 1000))
        out.write(img)

    min_energy_table = get_initial_energy_table(img_gradient, points, alpha, beta, gamma, num_points)

    for i in range(0, max_iteration):
        pre_points = points.copy()
        points = active_contour(img_gradient, points, min_energy_table, region, alpha, beta, gamma, num_points)
        print(i)
        if (video_name):
            frame = draw_points(img, points, num_points)
            out.write(frame)
        if (pre_points == points).all():
            break

    img = draw_points(img, points, num_points)
    if (video_name):
        out.write(frame)
        out.release()

    return img
```

find_contour() is the main function of this programming homework. After calling get_fixed_initial_points(), the next step is to draw the initial points on the origin image. Then after creating the initial energy table by calling get_initial_energy_table(), the main detection stage has come, the active_contour() function calculates each internal and external energy then moves the points to the minimum energy spots.

## 3. Save Result Videos:

```python
# record video
if (video_name):
    fourcc = cv2.VideoWriter_fourcc(*'XVID')
    out = cv2.VideoWriter('./result_img/'+video_name+'.avi', fourcc, 5.0, (1000, 1000))
    out.write(img)
```

In this homework, to save the video, cv2.VideoWriter() is used to create a video by each iteration of the points.

Result: