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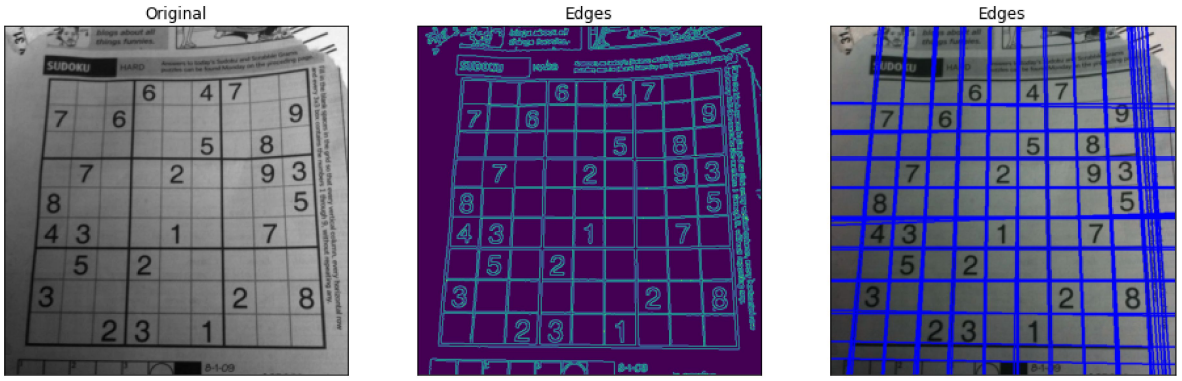
Index Number : 190107T

Github Repo: https://github.com/dulmi-19/Image-Processing-and-Machine-Vision

Question 1

In [ ]:
```
import cv2 as cv
import numpy as np
import matplotlib.pyplot as plt

sudoku = cv.imread("sudoku.png",cv.IMREAD_COLOR)
assert sudoku is not None

sudoku_gray = cv.cvtColor(sudoku,cv.COLOR_BGR2GRAY)
edges = cv.Canny(sudoku_gray,20,120,apertureSize=3)
lines = cv.HoughLines(edges,1,np.pi/180,175)

for line in lines:
    rho, theta = line[0]
    a = np.cos(theta)
    b = np.sin(theta)
    x0,y0 = a*rho,b*rho
    x1,y1 = int(x0 + 1000*(-b)), int(y0 + 1000*a)
    x2,y2 = int(x0 - 1000*(-b)), int(y0 - 1000*a)
    cv.line(sudoku,(x1,y1),(x2,y2),(0,0,255),2)

fig,ax =  plt.subplots(1,3,figsize=(16,8))

ax[0].imshow(sudoku_gray,cmap='gray')
ax[0].set_title("Original")
ax[0].set_xticks([]),ax[0].set_yticks([])

ax[1].imshow(edges)
ax[1].set_title("Edges")
ax[1].set_xticks([]),ax[1].set_yticks([])

ax[2].imshow(sudoku)
ax[2].set_title("Edges")
ax[2].set_xticks([]),ax[2].set_yticks([])
plt.show()
```

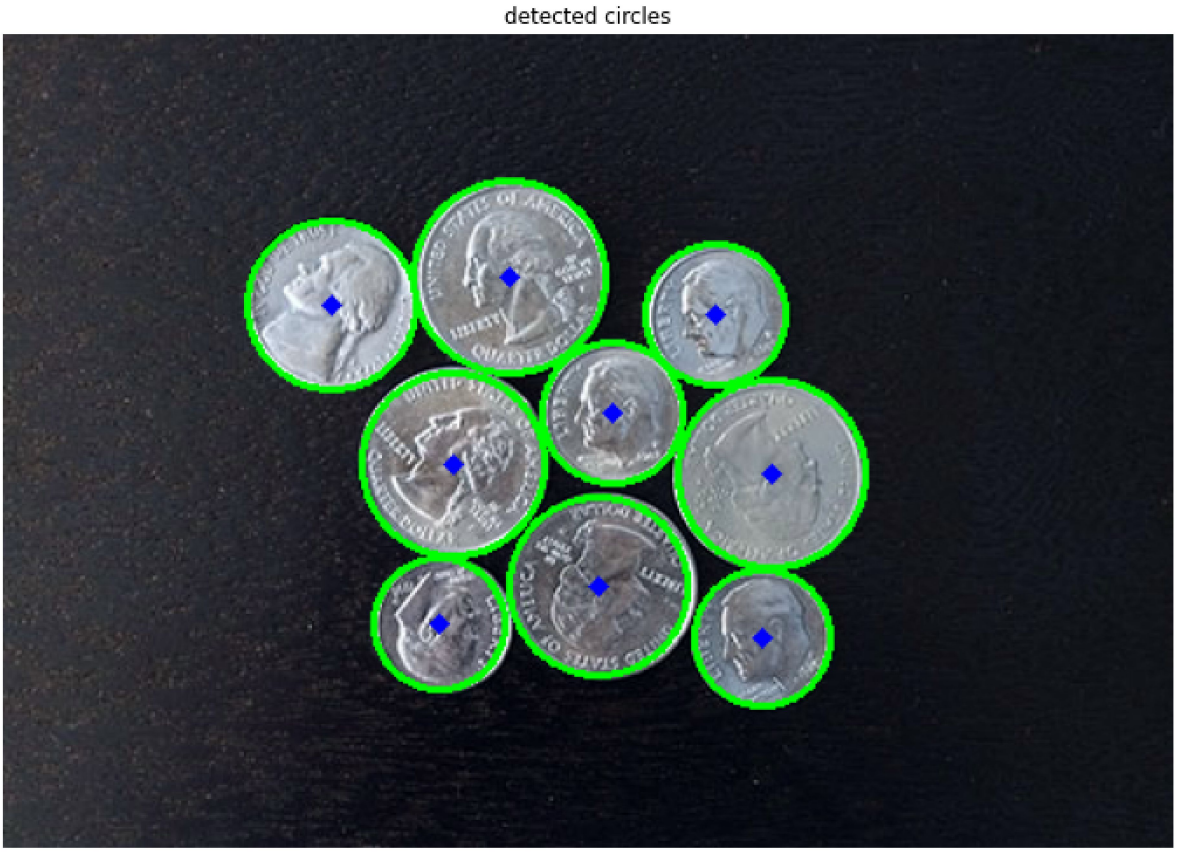


Question 2

In [ ]:
```
import cv2 as cv
import matplotlib.pyplot as plt
```

```
import numpy as np
%matplotlib inline

img=cv.imread(r'coins.jpg',cv.IMREAD_COLOR)
assert img is not None

gray=cv.cvtColor(img,cv.COLOR_BGR2GRAY)
circles = cv.HoughCircles(gray,cv.HOUGH_GRADIENT,1,50,
                          param1=190,param2=70,minRadius=15,maxRadius=70)
circles = np.uint16(np.around(circles))
for i in circles[0,:]:
    # draw the outer circle
    cv.circle(img,(i[0],i[1]),i[2],(0,255,0),2)
    # draw the center of the circle
    cv.circle(img,(i[0],i[1]),2,(0,0,255),3)

fig,ax=plt.subplots(1,1,figsize=(12,12))
ax.imshow(img)
ax.set_title("detected circles")
ax.axis(False)
```

Out[ ]:
```
(-0.5, 499.5, 347.5, -0.5)
```



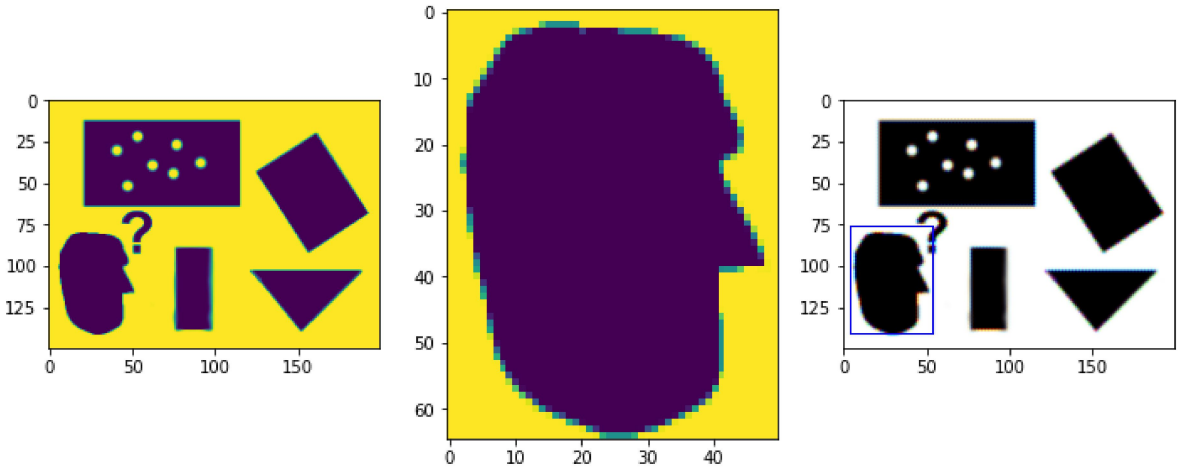
Question 3

In [ ]:
```
import cv2 as cv
import matplotlib.pyplot as plt
import numpy as np
%matplotlib inline

img=cv.imread(r'pic1.png',cv.IMREAD_REDUCED_GRAYSCALE_2)
assert img is not None
temp=cv.imread(r'templ.png',cv.IMREAD_REDUCED_GRAYSCALE_2)
assert temp is not None

im_edges=cv.Canny(img,50,250)
```

```
temp_edges=cv.Canny(temp,50,250)
alg=cv.createGeneralizedHoughGuil()
alg.setTemplate(temp_edges)
alg.setAngleThresh(100000)
alg.setScaleThresh(40000)
alg.setPosThresh(1000)
alg.setAngleStep(1)
alg.setScaleStep(0.1)
alg.setMinScale(0.9)
alg.setMaxScale(1.1)

positions,votes=alg.detect(im_edges)

out=cv.cvtColor(img,cv.COLOR_BAYER_BG2BGR)
for x,y,scale,orientation in positions[0]:
    halfHeight=temp.shape[0]/2.0*scale
    halfWidth=temp.shape[1]/2.0*scale
    p1=(int(x-halfWidth),int(y-halfHeight))
    p2=(int(x+halfWidth),int(y+halfHeight))
    print('x = {}, y= {}, scale = {},orientation = {},p1={},p2={}'.format(x,y,scale
    cv.rectangle(out,p1,p2,(0,0,255))

fig,ax=plt.subplots(1,3,figsize=(12,20))
ax[0].imshow(img)
ax[1].imshow(temp)
ax[2].imshow(out)
```

Out[ ]:

```
x = 29.0, y= 109.0, scale = 1.0,orientation = 0.0,p1=(4, 76),p2=(54, 141)
<matplotlib.image.AxesImage at 0x1e1a9d79d20>
```

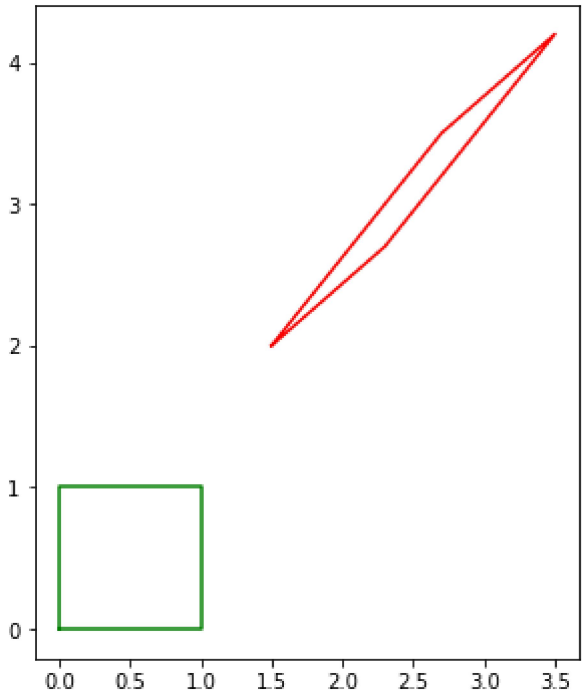


Question 4

In [ ]:

```
a, b, c, d = [0, 0, 1], [0, 1, 1], [1,1,1], [1,0,1]
X = np.array([a,b,c,d]).T

theta = np.pi*30/180
s = 2
tx, ty = 1.5, 2
# H = np.array([[s*np.cos(theta), -s*np.sin(theta), tx], [s*np.sin(theta), s*np.cos
# Y = H @ X

a11, a12, a21, a22 = 0.8, 1.2, 0.7, 1.5 #Should be a non-singular matrix here
A = np.array([[a11,a12,tx], [a21, a22, ty], [0,0,1]])
Y = A @ X

x = np.append(X[0, :], X[0, 0])
y = np.append(X[1, :], X[1, 0])
fig, ax = plt.subplots(1,1,figsize =(6,6))
```

```
ax.plot(x, y, color='g')
ax.set_aspect('equal')

x = np.append(Y[0, :], Y[0, 0])
y = np.append(Y[1, :], Y[1, 0])
ax.plot(x, y, color='r')
ax.set_aspect('equal')
plt.show()
```



Question 5

In [ ]:

```
#warphing using the given homography

im1 = cv.imread(r'./graf/img1.ppm',cv.IMREAD_ANYCOLOR)
assert im1 is not None
im4 = cv.imread(r'./graf/img4.ppm',cv.IMREAD_ANYCOLOR)
assert im4 is not None

H = []
with open(r'graf/H1to4p') as f:
    H = np.array([[float(h) for h in line.split()] for line in f])
im4to1=cv.warpPerspective(im4,np.linalg.inv(H),(1000,1000))

fig,ax=plt.subplots(1,3,figsize=(20,20))

ax[0].imshow(im1)
ax[0].axis(False)
ax[1].imshow(im4)
ax[1].axis(False)
ax[2].imshow(im4to1)
ax[2].axis(False)
plt.show()
```