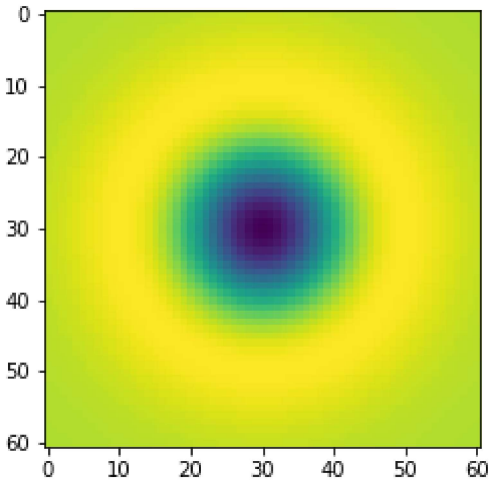
Index:190098M Name: Chamara RPO EX05

Question 01

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

sigma = 10
hw = 3*sigma
X,Y = np.meshgrid(np.arange(-hw,hw+1,1),np.arange(-hw,hw+1,1))
log = 1/(2*np.pi*sigma**2)*(X**2/(sigma**2)+Y**2/(sigma**2)-2)*np.exp(-(X**2+Y**2)/(2*
plt.imshow(log)
```

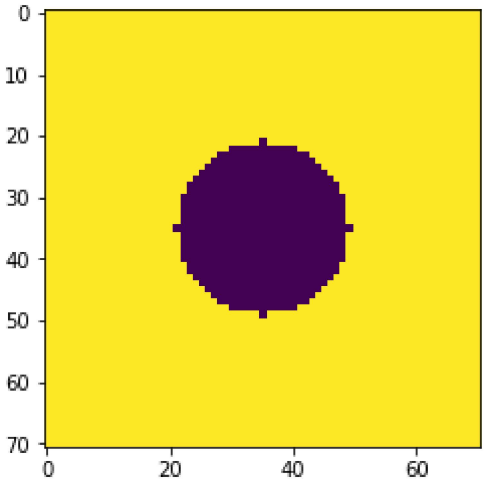
Out[ ]:
```
<matplotlib.image.AxesImage at 0x1cfefd58490>
```



Question 02

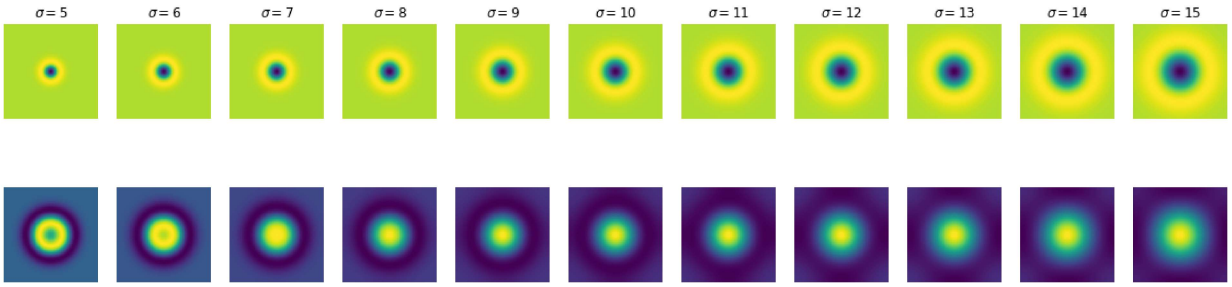
In [ ]:
```
import numpy as np
import matplotlib.pyplot as plt
import cv2 as cv

w,h =71,71
hw =w//2
hh =h//2

f = np.ones((h,w),dtype=np.float32)*255
X,Y = np.meshgrid(np.arange(-hw,hw+1,1),np.arange(-hw,hw+1,1))
r = w//5 #14
f*=X**2+Y**2>r**2
plt.imshow(f)
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x1cfeff896c0>
```



In [ ]:
```
s = 11
fig,ax = plt.subplots(2,s,figsize = (20,5))
scale_space = np.empty((h,w,s),dtype = np.float32)
sigmas = np.arange(5,16,1)
for i,sigma in enumerate(sigmas):
    log_hw = 3*np.max(sigmas)
    X,Y = np.meshgrid(np.arange(-log_hw,log_hw+1,1),np.arange(-log_hw,log_hw+1,1))
    log = 1/(2*np.pi*sigma**2)*(X**2/(sigma**2)+Y**2/(sigma**2)-2)*np.exp(-(X**2+Y**2)
    f_log =cv.filter2D(f,-1,log)
    scale_space[:,:,i] = f_log
    ax[0,i].imshow(log)
    ax[0,i].axis('off')
    ax[0,i].set_title(r'$\sigma = {}$'.format(sigma))
    ax[1,i].imshow(f_log)
    ax[1,i].axis('off')
indices = np.unravel_index(np.argmax(scale_space,axis=None),scale_space.shape)
print(indices)
print(sigmas[indices[2]])
```

```
(35, 35, 5)
10
```



Question 03

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

# read images
img1 = cv2.imread('img1.ppm')
img2 = cv2.imread('img2.ppm')
```

```
img1 = cv2.cvtColor(img1, cv2.COLOR_BGR2GRAY)
img2 = cv2.cvtColor(img2, cv2.COLOR_BGR2GRAY)

#sift
sift = cv.SIFT_create()

keypoints_1, descriptors_1 = sift.detectAndCompute(img1,None)
keypoints_2, descriptors_2 = sift.detectAndCompute(img2,None)

#feature matching
bf = cv2.BFMatcher(cv2.NORM_L1, crossCheck=True)

matches = bf.match(descriptors_1,descriptors_2)
matches = sorted(matches, key = lambda x:x.distance)

img3 = cv2.drawMatches(img1, keypoints_1, img2, keypoints_2, matches[:50], img2, flags
plt.figure(figsize=(20,10))
plt.imshow(img3),plt.show()
```

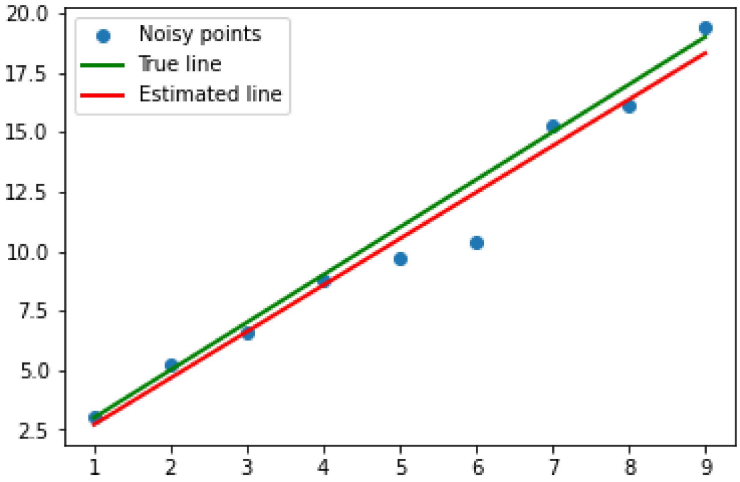
Out[ ]: (<matplotlib.image.AxesImage at 0x1cff21bf640>, None)

Question 04

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


m = 2 # Line equa t ion : y = m*x + c . m i s the s l o p e . c i s the i n t e r c e
c = 1
x = np.arange (1 ,10 , 1)
sigma = 1
np.random.seed(45)
noise = sigma*np.random.randn(len(x))
o = np.zeros ( x.shape )
# o [=1] = 20
y = m*x + c + noise + o
n = len(x)
X = np.concatenate([x.reshape((n,1)),np.ones((n,1))],axis=1)
B = np.linalg.pinv(X.T@X)@X.T@y
mstar = B[0]
cstar = B[1]
plt.plot(x,y,'o',label = "Noisy points")
plt.plot([x[0],x[-1]],[m*x[0]+c,m*x[-1]+c],color = 'g',linewidth=2,label = 'True line'
```

```
plt.plot([x[0],x[-1]],[mstar*x[0]+cstar,mstar*x[-1]+cstar],color = 'r',linewidth=2,lab
plt.legend()
```

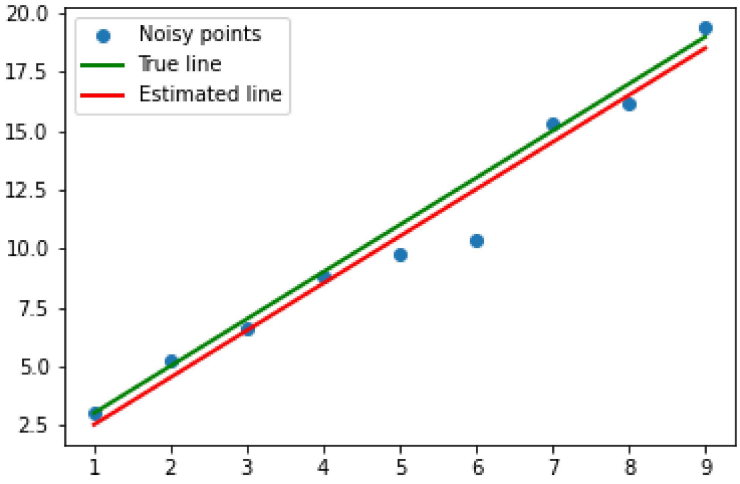
Out[ ]:
```
<matplotlib.legend.Legend at 0x1cff08472e0>
```



Question 05

In [ ]:
```
m = 2
c = 1
x = np.arange (1 ,10 , 1)
sigma = 1
np.random.seed(45)
noise = sigma*np.random.randn(len(x))
o = np.zeros ( x.shape )
# o [=1] = 20
y = m*x + c + noise + o
n = len(x)
u11 = np.sum((x-np.mean(x))**2)
u12 = np.sum((x-np.mean(x))*(y-np.mean(y)))
u21=u12
u22 = np.sum((y-np.mean(y))**2)
U = np.array([[u11,u12],[u21,u22]])
W,V  =np.linalg.eig(U)
ev_corresponding_to_smallest_ev = V[:,np.argmin(W)]
a = ev_corresponding_to_smallest_ev[0]
b = ev_corresponding_to_smallest_ev[1]
d = a*np.mean(x)+b*np.mean(y)
mstar =-a/b
cstar = d/b

plt.plot(x,y,'o',label = "Noisy points")
plt.plot([x[0],x[-1]],[m*x[0]+c,m*x[-1]+c],color = 'g',linewidth=2,label = 'True line'
plt.plot([x[0],x[-1]],[mstar*x[0]+cstar,mstar*x[-1]+cstar],color = 'r',linewidth=2,lab
plt.legend()
```

Out[ ]:
```
<matplotlib.legend.Legend at 0x1cff29343d0>
```


Noisy points
True line
Estimated line
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
1
2
3
4
5
6
7
8
9