Q4. Denoising Using L2-Regularisation

In [1]:
```
from matplotlib.image import imread
import matplotlib.pyplot as plt
import numpy as np
import os
plt.rcParams['figure.figsize'] = [12,6]
```

Importing and Visualizing input image

In [2]:
```
Oimg = imread('dog.jpg')
print(Oimg.shape)
img = plt.imshow(Oimg)
plt.axis('off')
img.set_cmap('gray')
plt.title("Original Image")
```

```
(2000, 1500, 3)
```

Out[2]: Text(0.5, 1.0, 'Original Image')

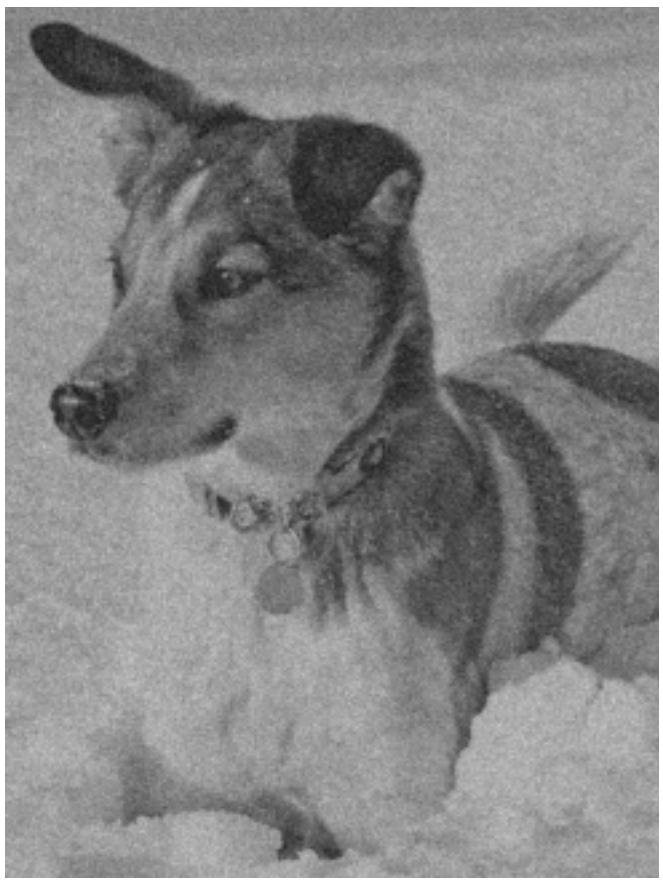
In [3]:
```
Oimg = np.mean(Oimg,-1)                    # Converting to Grayscale
```

Adding Gaussian Noise

In [4]:
```
mean = 0
sigma = 3

Noise = np.random.normal(mean, sigma, (Oimg.shape[0],Oimg.shape[1])).astype('uint8')
OimgNoisey = Oimg + Noise              # Add some noise
```

Visualizing Noise and original image

In [5]:
```
plt.figure(1)
plt.subplot(121)
img = plt.imshow(Oimg)
plt.axis('off')
img.set_cmap('gray')
plt.title("Original Image")

plt.subplot(122)
img2 = plt.imshow(OimgNoisey)
plt.axis('off')
img2.set_cmap('gray')
plt.title("Noisey Image")
plt.show()
```



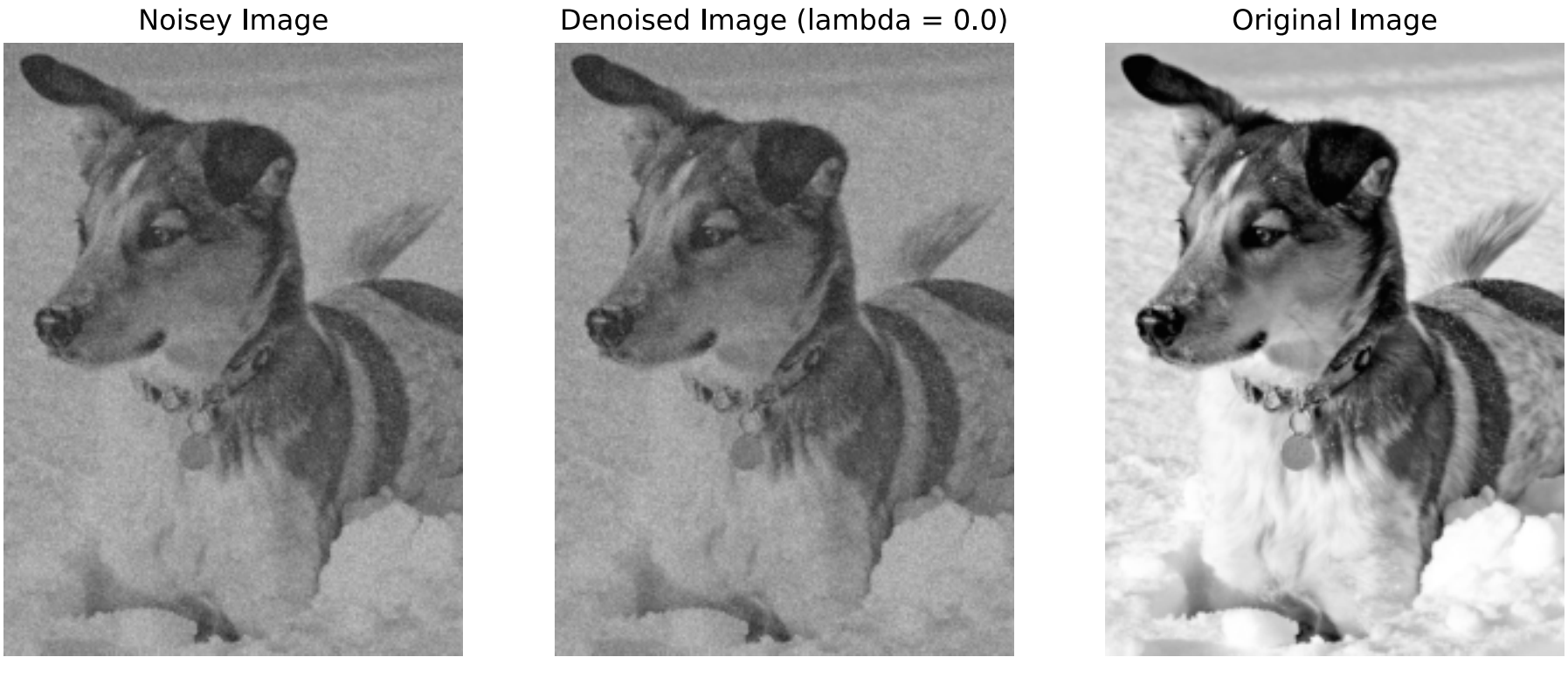
L2-regularisation Function

In [6]:

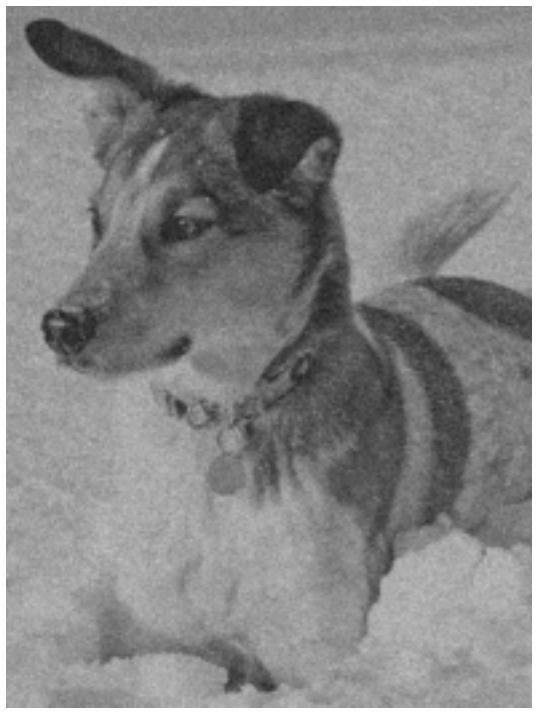
```
def L2Regularisation(NoiseyInput, ExpectedOutput,factor):

    n = len(ExpectedOutput)
    I = np.identity(n)
    A = I
    At = A.T
    AtA = np.matmul(At,A)
    M = (AtA - factor*I)

    T = np.matmul(np.linalg.inv(M),At)
    pred = np.matmul(T,NoiseyInput)

    plt.figure()
    plt.subplot(131)
    img1 = plt.imshow(NoiseyInput)
    img1.set_cmap('gray')
    plt.axis('off')
    plt.title(f'Noisey Image')

    plt.subplot(132)
    img2 = plt.imshow(pred)
    img2.set_cmap('gray')
    plt.axis('off')
    plt.title(f'Denoised Image (lambda = {factor})')

    plt.subplot(133)
    img3 = plt.imshow(ExpectedOutput)
    img3.set_cmap('gray')
    plt.axis('off')
    plt.title('Original Image')
    plt.show()
```

In [7]:

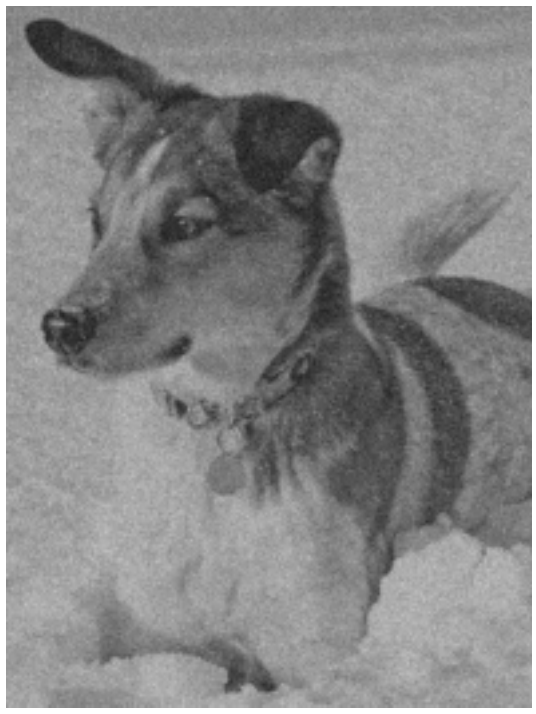
```
fact = np.arange(0,1,0.2)
for i in fact:
    L2Regularisation(OimgNoisey,Oimg,i)
```



Noisey Image

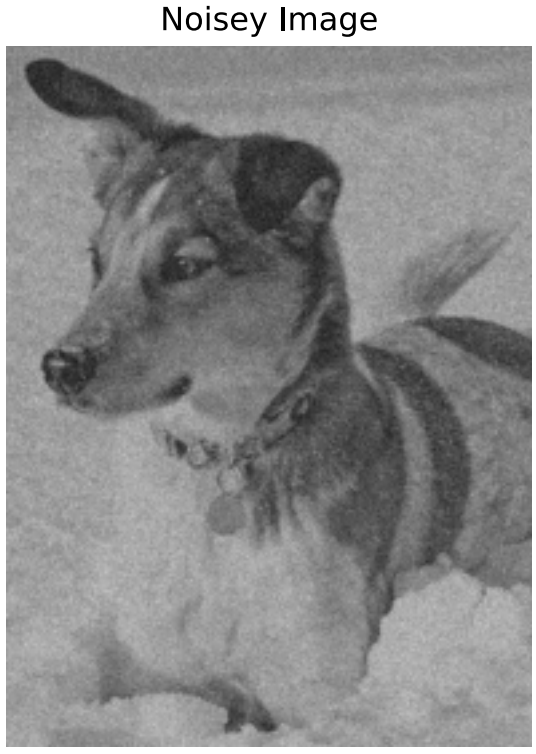


Denoised Image (lambda = 0.2)

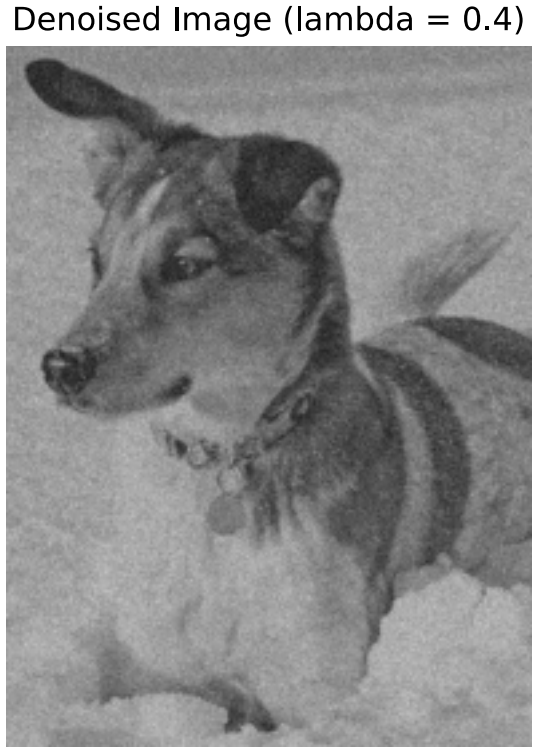


Original Image

Noisey Image

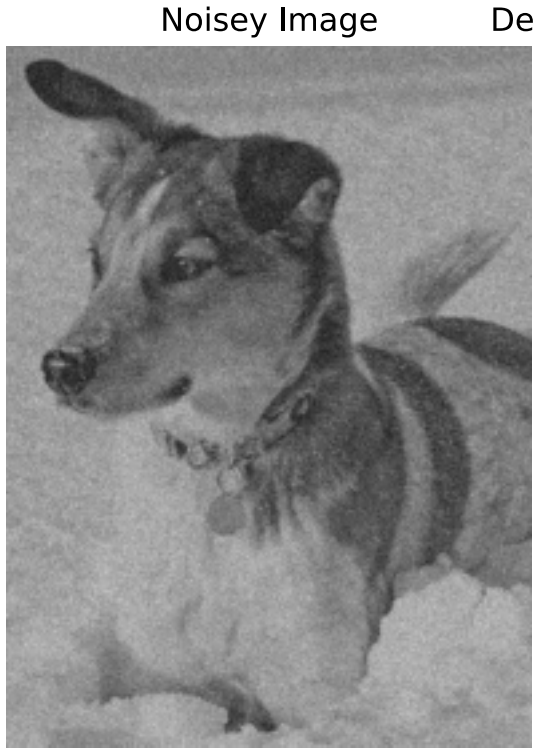


Denoised Image (lambda = 0.4)

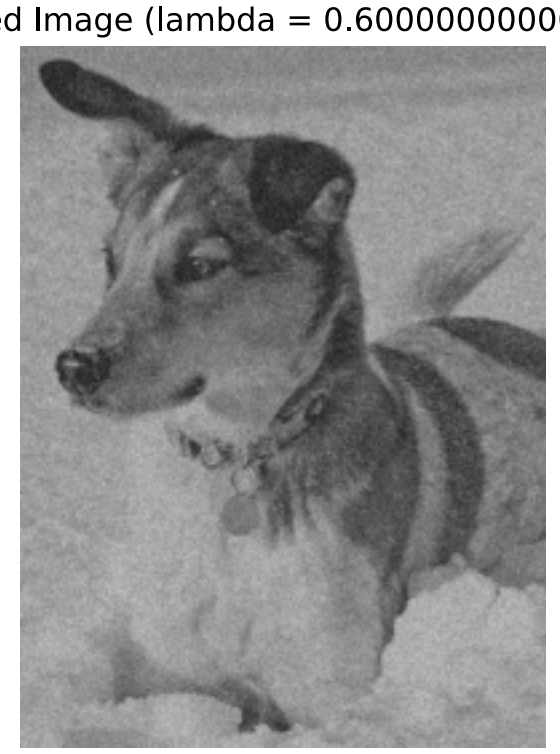


Original Image

Noisey Image



Denoised Image (lambda = 0.6000000000000001)



Original Image