Syed Ali COSC 719 Assignment 6 Due: November 5th, 2021

Problem Statement:

The goal of this assignment is two-fold:

a) Smooth the noisy image attached by using a mean (average) filter in 3x3 window iteratively until satisfactory results are obtained. Show the results for 1 5 10 iterations.

b) Do some research on median filters and advantage of median filter over mean filter. Apply median filtering in 3x3 window to smooth the noisy image given below and, iterate 1, 5, 10 times and show the results. Write your conclusions after you compare the results from average filter and median filter

Code

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Part a): Smooth the noisy image attached by using a mean (average) (Convolve)

In [1]:

```
import numpy as np
import matplotlib.pyplot as plt
```

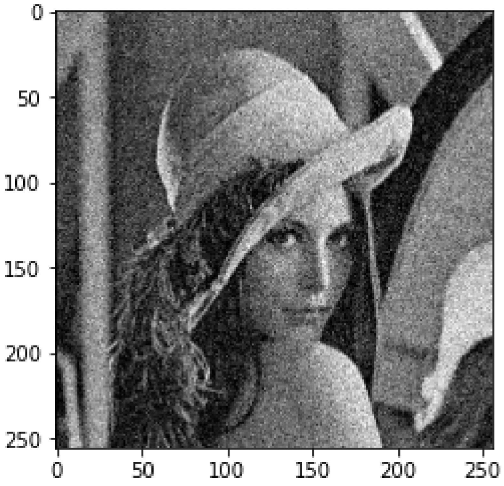
In [2]:

```
lena_noisy = plt.imread('lena_noisy.jpg')
m,n = lena_noisy.shape
print(m,n)
plt.imshow(lena_noisy, cmap = 'gray')
```

```
256 256
```

Out[2]:

```
<matplotlib.image.AxesImage at 0x230d3e4c5b0>
```



In [3]:

```
def padpixels(x):
    m,n = x.shape
    x1 = np.zeros((m,n+2),dtype = 'uint8')
    x1[:,1:n+1] = x
    x1[:,0] = x[:,0]
    x1[:,n+1] = x[:,n-1]
    x2 = np.zeros((m+2,n+2), dtype = 'uint8')
    x2[1:m+1,1:n+1] = x1[0:m,0:n]
    x2[0,:] = x1[0,:]
    x2[m+1,:] = x1[m-1,:]
    return x2
```

Padded Image

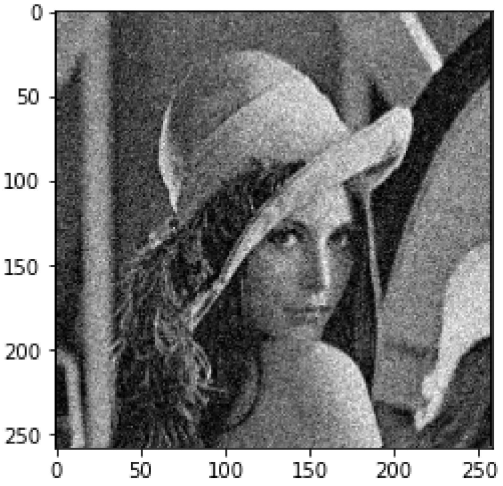
In [4]:

```
lpad = padpixels(lena_noisy)
print(lpad.shape)
plt.imshow(lpad, cmap = 'gray')
```

```
(258, 258)
```

Out[4]:

```
<matplotlib.image.AxesImage at 0x230d4145d00>
```



Implementing the mean spatial filter

In [5]:

```
def convolve(x,h):
    m,n = x.shape
    x1 = padpixels(x)
    x2 = np.zeros(x1.shape, dtype = 'float')
    for i in range(1,m):
        for j in range (1,n):
            for ii in range(-1,2):
                for jj in range(-1,2):
                    x2[i,j] += x1[i+ii, j+jj]*h[1+ii, 1+jj]
    return x2[1:m+1, 1:n+1]
```

Filter h definition

In [6]:

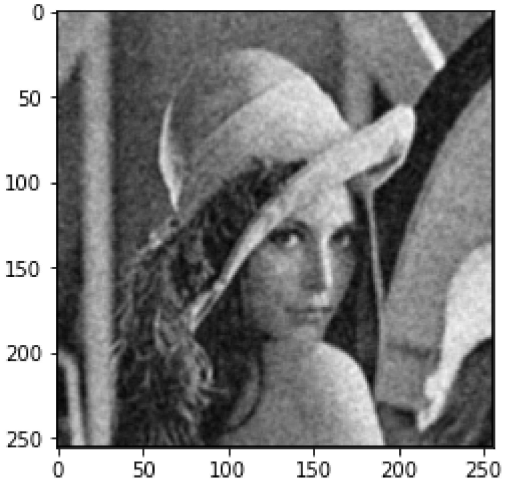
```
h = np.ones((3,3), dtype = 'float')
h = h/9
```

1 iterations

In [7]:

```
x = lena_noisy
for i in range(1):
    x = np.uint8(convolve(x,h))
plt.imshow(x, cmap = 'gray')
print(x.shape)
```

```
(256, 256)
```

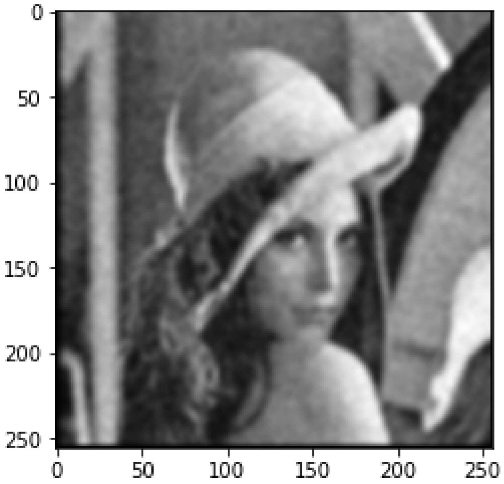


5 iterations

In [8]:

```
x = lena_noisy
for i in range(5):
    x = np.uint8(convolve(x,h))
plt.imshow(x, cmap = 'gray')
print(x.shape)
```

```
(256, 256)
```

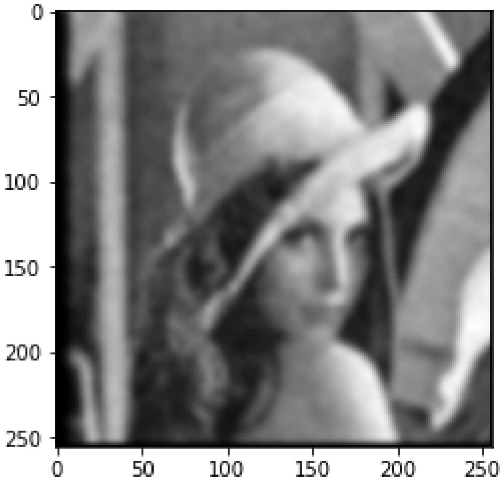


10 iterations

In [9]:

```
x = lena_noisy
for i in range(10):
    x = np.uint8(convolve(x,h))
plt.imshow(x, cmap = 'gray')
print(x.shape)
```

```
(256, 256)
```



Part b) Implementing median filtering in 3x3 window to smooth the noisy image given below and, iterate 1, 5, 10 times and show the results.

In [10]:

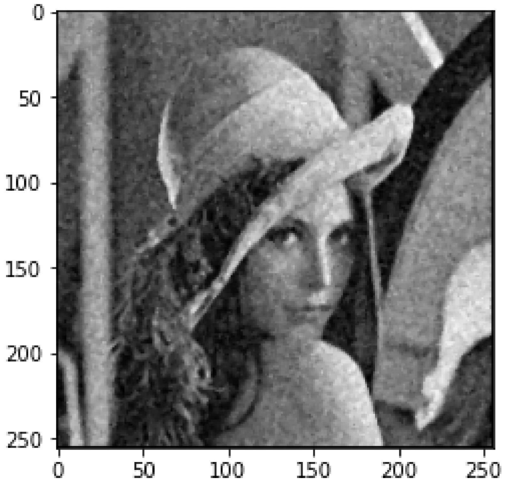
```
def convolveMedian(x):
    m,n = x.shape
    x1 = padpixels(x)
    x2 = np.zeros(x1.shape, dtype = 'float')
    for i in range(1,m):
        for j in range (1,n):
            x2[i,j] = np.median(x1[i:i+3,j:j+3])
    return x2[1:m+1, 1:n+1]
```

1 iteration

In [11]:

```
x = lena_noisy
for i in range(1):
    x = np.uint8(convolveMedian(x))
plt.imshow(x, cmap = 'gray')
print(x.shape)
```

```
(256, 256)
```

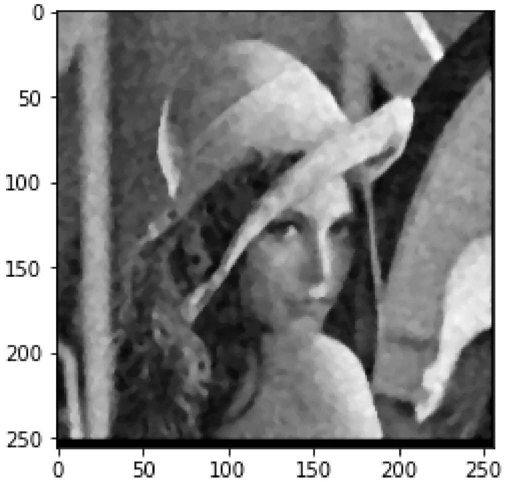


5 iterations

In [12]:

```
x = lena_noisy
for i in range(5):
    x = np.uint8(convolveMedian(x))
plt.imshow(x, cmap = 'gray')
print(x.shape)
```

```
(256, 256)
```



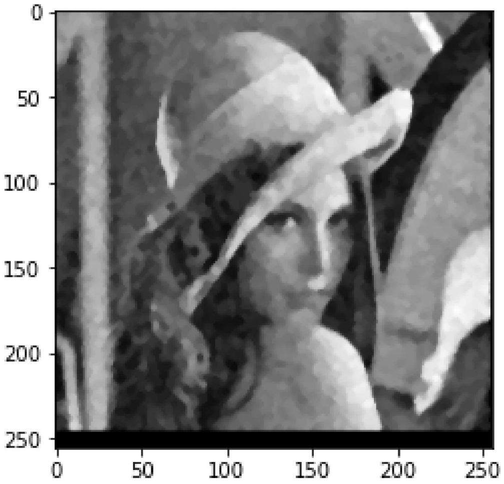
10 iterations

In [13]:

```
x = lena_noisy
for i in range(10):
    x = np.uint8(convolveMedian(x))
```

```
plt.imshow(x, cmap = 'gray')
print(x.shape)
```

```
(256, 256)
```



Conclusion:

If we compare the results obtained from the average filter (convolve function) to median filter we notice that the images are less blurry on the median filter, especially as we go at higher iterations (5 and 10 respectively), making it a better filter when compared to mean spatial filter. This is because median filters are used to remove specific noise types such as “Gaussian”, “random”, and “salt and pepper” noises. When implementing the median filter program in python, the center pixel of the M x M neighborhood is replaced by the median value of the corresponding window, thus resulting in a clearer image.