import module

In [68]:
```
import numpy as np
import cv2
import matplotlib.pyplot as plt
import math
import hashlib
import sys
import random
import os
import pandas as pd
```

Haar Transform

Forward IWT

In [2]:
```
def forwardIWT(matrix1):
    m,n=matrix1.shape
    matrix=matrix1.tolist() #matrix is a list

    #row operation
    row = list()
    for i in range(m):
        a=[]
        d=[]
        for p in range(0,m):
            if m>2*p+1: #how many time we get the a & d value
                x=matrix[i] #get the rows
                t=math.floor((x[2*p]+x[2*p+1])/2)
                a.append(t)
                t=math.floor(x[2*p]-x[2*p+1])
                d.append(t)

    combine=a+d #combine the list
    row.append(combine)
    a.clear()
    d.clear()


#column Operation
column=list() #operation w.r.t 'row' matrix
row1=[[x[i] for x in row] for i in range(len(row[0]))] #transpose of row
for i in range(n):
    a=[]
    d=[]
    for p in range(0,n):
        if n>2*p+1: #how many time we get the a & d value
            x=row1[i] #get the rows
            t=math.floor((x[2*p]+x[2*p+1])/2)
            a.append(t)
            t=math.floor(x[2*p]-x[2*p+1])
            d.append(t)

    combine=a+d #combine the list
    column.append(combine)
    a.clear()
    d.clear()

result=[[x[i] for x in column] for i in range(len(column[0]))] #again transpose of column matrix
res=np.array(result)
    final=np.reshape(res, (m,n))
    return final
```

Inverse IWT

In [3]:
```
def inverseIWT(matrix1):
    matrix=list()
    m,n=matrix1.shape
    matrix=matrix1.tolist() #matrix is a list

    #Column Operation
    trans_matrix=[[x[i] for x in matrix] for i in range(len(matrix[0]))] #transpose of matrix
    column_tr=list()
    for i in range(n):
        flag=trans_matrix[i]
        a=flag[:n//2]
        d=flag[n//2:]
        temp=list()
        for p in range(0,n):
            if n>2*p+1: #how many time we get the value
                x1=a[p]+math.floor((d[p]+1)/2)
                temp.append(x1)
                x2=x1-d[p]
                temp.append(x2)
        column_tr.append(temp)


    #row operation
    column=[[x[i] for x in column_tr] for i in range(len(column_tr[0]))] #transpose of column matrix
    row=list()
    for i in range(m):
        flag=column[i]
        a=flag[:n//2]
        d=flag[n//2:]
        temp=list()
        for p in range(0,m):
            if m>2*p+1: #how many time we get the value
                x1=a[p]+math.floor((d[p]+1)/2)
                temp.append(x1)
                x2=x1-d[p]
                temp.append(x2)
        row.append(temp)

    res=np.array(row)
    result=np.reshape(res, (m,n))
    return result
```

Histogram Shifting

Shifting

In [4]:
```
def histogram_shifting(matrix, keyword):
    row,col=matrix.shape
    img=matrix.flatten() #image in 1D
    list_img=list(set(img))
    sort_pixel=sorted(list_img)

    freq=[] #store freq of each element in sorted manner of element
    for i in sort_pixel:
        freq.append(list(img).count(i))
    key_size=len(keyword) #size of payload
```

```
print("Maximum freq in the image",max(freq))


#find base point
flag=0
x=sorted(list_img)
for i in freq:
    if i>=key_size:
        temp=freq.index(i)
        if x[temp]>0 or x[temp]<=0:
            base_point=x[temp] #get base point
            flag +=1
if flag==0:
    print("No base Point")
    sys.exit()
    # return False, False


'''cahnge value of base point+1 and no. of basepoint>len(keyword),
i.e. more no of base point the the length of keyword,
then make those extra base point increase by 2'''
flag=len(keyword)
count=0
for j in range(0, len(img)):
        if img[j]==base_point+1:
            img[j] +=1

        if img[j]==base_point:
            count +=1
            if count>flag:
                img[j] = img[j]-1 #chnage the extra bp to pixel with the previous value
                        #eg. bp=152 then extra bps will be 151

    #histogram shifting
    index=0
    key=str(keyword)
    for item in range(0, len(img)):
        if img[item]==base_point and index<len(key):
            if key[index]=='0':
                img[item]= img[item] #string is 0 then value is 0
            elif key[index]=='1':
                img[item] += 1 #string is 0 then value increase by 1
            index += 1

    result=np.resize(img, (row,col))
    return result,base_point
```

Extraction

In [5]:
```
def histogram_extract(matrix, base_point):
    img=matrix.flatten()
    payload=''
    for item in img:
        if item==base_point:
            payload += '0'
        elif item==base_point+1:
            payload +='1'
    return payload
```

SHA 256

In [6]:
```
def sha256_code(img):
    img_str = str(img)#convert to string

    # Compute the SHA-256 hash of the string representation
    sha256_hash = hashlib.sha256(img_str.encode('utf-8'))

    # Get the hexadecimal representation of the hash
    hex_digest = sha256_hash.hexdigest()

    # Convert the hexadecimal digest to binary
    binary_digest = bin(int(hex_digest, 16))[2:].zfill(256)
    return hex_digest,binary_digest
```

Break & Make image into 4parts

In [7]:
```
#extract 1/4th Components of image

def extract_quarter_components(image):
    height, width = image.shape

    # Determine the indices for slicing each quadrant
    half_height = height // 2
    half_width = width // 2

    # Extract each quadrant
    top_left = image[:half_height, :half_width]
    top_right = image[:half_height, half_width:]
    bottom_left = image[half_height:, :half_width]
    bottom_right = image[half_height:, half_width:]

    return top_left, top_right, bottom_left, bottom_right


#Make the image from 4parts
def reconstruct_image(top_left, top_right, bottom_left, bottom_right):
    height, width = top_left.shape

    # Create an empty array to hold the reconstructed image
    reconstructed_image = np.empty((height * 2, width * 2))

    # Place each component in its respective position
    reconstructed_image[:height, :width] = top_left
    reconstructed_image[:height, width:] = top_right
    reconstructed_image[height:, :width] = bottom_left
    reconstructed_image[height:, width:] = bottom_right

    return reconstructed_image
```

Convert Image to Binary

In [8]:
```
def binaryImage(img):
    x=list()
    for row in img:
        for num in row:
            y=format(num, '08b')
            x.append(y)  # '08b' ensures leading zeros for each byte
    str_bin=''
    for item in x:
        str_bin+=item
    return x, str_bin
```

Arnold's Cat Map

In [9]:
```
def arnold_cat_map(image,iteration):
    row,col=image.shape
    process_img = np.zeros_like(image)
    original_img=image.copy()

    # plt.title(f'Original Image')
    # plt.imshow(image,cmap='gray')
    # plt.axis('off')
    # plt.show()

    #calculating each pixel
    count=1
    while (count<=iteration):
        for x in range(row):
            for y in range(col):
                nx=(2*x+y)%row
                ny=(x+y)%col
                process_img[nx,ny] = image[x,y]
        image=process_img.copy()
        count +=1
    return process_img
```

Random Sequence List

In [10]:
```
def randomSequence(Size):
    random.seed(Size)
    for i in range(Size):
        if i > 2:
            HCF = math.gcd(i, Size)
            if HCF == 1:
                break
    Number = random.randint(0, Size-1)
    Temp = Number
    Result = [Temp]
    while True:
        Number = (Number + i) % Size
        if Number == Temp:
            break
        Result.append(Number)
    return Result
```

Convert Binary Image to 2D Image

In [11]:
```
def decimalImage(binary_list,size):
    decimal_list = []  # Initialize an empty list to store decimal integers

    # Iterate over each binary string in the input list
    for binary_str in binary_list:
        decimal_int = int(binary_str, 2)  # Convert the binary string to decimal integer
        decimal_list.append(decimal_int)  # Add the decimal integer to the result list

    #convert to a 2D list equal to size of secert image
    result=list()
    result = [decimal_list[i*size : (i+1)*size] for i in range(size)]
    return result
```

Convert Text to binary & Binary to text & Binary to Text

In [12]:
```
def text2binary(text):
    binary_text = ''.join(format(ord(char), '08b') for char in text)
    return binary_text

def binary2text(binary_text):
    # Split the binary string into 8-bit substrings
    binary_list = [binary_text[i:i+8] for i in range(0, len(binary_text), 8)]
    # Convert binary to text
    text = ''.join(chr(int(binary, 2)) for binary in binary_list)
    return text

def binary2number(binary_string):
    # Split the binary string into 8-bit segments
    binary_segments = [binary_string[i:i+8] for i in range(0, len(binary_string), 8)]
    # Convert each 8-bit binary segment to integer
    integer_list = [int(segment, 2) for segment in binary_segments]
    return np.array(integer_list)
```

Hamming Code

In [13]:
```
#Hamming Code
def calcRedundantBits(m):
    for i in range(m):
        if(2**i >= m + i + 1):
            return i

def posRedundantBits(data, r):
    j = 0
    k = 1
    m = len(data)
    res = ''
    for i in range(1, m + r+1):
        if(i == 2**j):
            res = res + '0'
            j += 1
        else:
            res = res + data[-1 * k]
            k += 1
    return res[::-1]

def calcParityBits(arr, r):
    n = len(arr)
    for i in range(r):
        val = 0
        for j in range(1, n + 1):
            if(j & (2**i) == (2**i)):
                val = val ^ int(arr[-1 * j])
        arr = arr[:n-(2**i)] + str(val) + arr[n-(2**i)+1:]
    return arr

def detectError(arr, nr):
    n = len(arr)
    res = 0
    for i in range(nr):
        val = 0
        for j in range(1, n + 1):
            if(j & (2**i) == (2**i)):
                val = val ^ int(arr[-1 * j])
        res = res + val*(10**i)
    return int(str(res), 2)
```

```
'''Hamming Code Insertion'''
def hammingcode(bindata): #give binary string as argument
    output=''
    for i in range(0,len(bindata),8):
        data=bindata[i:i+8]
        m=len(data)
        r=calcRedundantBits(m)
        arr=posRedundantBits(data,r)
        arr=calcParityBits(arr,r)
        output+=str(arr)
    return output,r #return binary string along with parity & return no. of redundent bits(r)

'''Hamming Code Error Correction'''
def removeerror(outdata,r): #takes argument the bit string along with parity & return no. of redundent bits(r)
    output=''
    for i in range(0,len(outdata),12):
        data=outdata[i:i+12]
        pos=detectError(data,r)
        if pos==0:
            temp=data[0:4]+data[5:8]+data[9]
        else:
            pos=len(data)-pos+1
            if data[pos-1]=='0':
                data=data[0:pos-1]+'1'+data[pos:]
            else:
                data=data[0:pos-1]+'0'+data[pos:]

            temp=data[0:4]+data[5:8]+data[9]
        output+=temp
    return output #return correct binary string
```

Image Hiding

In [14]:

```
def imageHiding(image, secret, epr):
    #1. Forward IWT
    fIWT_img=forwardIWT(image) #apply 1st time to image
    LL,HL,LH,HH = extract_quarter_components(fIWT_img)

    #2.SECRET IMAGE TO SHA256 & CONVERT IT TO BINARY
    hash_image,hash_bin=sha256_code(secret)

    #3. Histogram Shifting of secret image to LL & SHA to HH
    secret_bin, secret_str=binaryImage(secret) #convert to binary

    # '''4. Using HAMMING CODE(HC) to Secret Image, SHA, EPR'''
    # HC_secret_str, redundent_secret_str=hammingcode(secret_str) #use HC to Secret image & store the HC coded bits & r
    # HC_hash_bin, redundent_hash_bin=hammingcode(hash_bin) #HC on SHA
    # HC_epr, redundent_epr=hammingcode(epr) #HC on EPR text

    #5. Histogram Shifting of secret image to HH & SHA to HH & EPR to LH
    LL_coded, bp1=histogram_shifting(LL, hash_bin) #SHA coded to LL
    HH_coded, bp2=histogram_shifting(HH, secret_str) #Secret Image coded to HH
    LH_coded, bp3=histogram_shifting(LH, epr) #EPR coded to LH
    print(bp1,bp2,bp3)

    #4. Hiding Base Points to LH
    # row1, col1=LH.shape
    # LH[row1//2][col1//2]=bp1
    # LH[row1//4][col1//4]=bp2

    #5. Combine 4 Components
    forwardIWT_Stego=reconstruct_image(LL_coded, HL, LH_coded, HH_coded)
    Stego_Image=inverseIWT(forwardIWT_Stego) #again Inverse IWT to image


    #Return stego image & base points(bp1=LL, bp2=HH, bp3=LH) & Redundent bits
    return Stego_Image, bp1,bp2,bp3
```

Image Extraction

In [15]:

```
def imageExtraction(stego_img,bp1,bp2,bp3):
    #1. Forward IWT
    fIWT_img=forwardIWT(stego_img) #apply 1st time to image
    LL1,HL,LH1,HH1 = extract_quarter_components(fIWT_img)

    # Get base points
    # row2, col2=LH.shape
    # bp1=LH[row2//2][col2//2] #bp of SHA
    # bp2=LH[row2//4][col2//4] #bp of secret image

    #2. Histogram Extraction from LL & HH
    extract_secret_bin=histogram_extract(HH1,bp2) #extract secret image in binary,bp2=159
    extract_sha_bin=histogram_extract(LL1, bp1) #extract SHA in binary, bp1=15
    extract_epr_bin=histogram_extract(LH1, bp3) #extract EPR binary from LH, bp3


    # '''#3. Hamming Code Correction'''
    # extract_secret_bin=removeerror(HC_extract_secret_bin,redundent_secret_str) #correct code of secert image wrt redundent bits
    # extract_sha_bin=removeerror(HC_extract_sha_bin,redundent_hash_bin) #correct SHA
    # extract_epr_bin=removeerror(HC_extract_epr_bin,redundent_epr) #Correct EPR text


    #4. Convert the binary str of image to Actual Secret Image
    extract_secret_lis=list()
    for i in range(0, len(extract_secret_bin) - 1, 8):
            pair = extract_secret_bin[i:i+8]  # Extract a pair of consecutive digits
            extract_secret_lis.append(pair)

    #convert to 2d decimal array
    size=int(math.sqrt(len(extract_secret_lis)))#find size, square image so row & col value same
    extract_secret_decimal=decimalImage(extract_secret_lis,size)
    extract_secret_image=np.array(extract_secret_decimal)


    return extract_secret_image, extract_sha_bin, extract_epr_bin #return secret image & SHA in binary from stego image & epr
```

Calculate Erros

calculate normalized_cross_correlation (NCC)

In [16]:

```
def NCC(img1, img2):
    # Ensure both images have the same depth and type
    gray1 = cv2.normalize(img1, None, alpha=0, beta=1, norm_type=cv2.NORM_MINMAX, dtype=cv2.CV_32F)
    gray2 = cv2.normalize(img2, None, alpha=0, beta=1, norm_type=cv2.NORM_MINMAX, dtype=cv2.CV_32F)

    # Perform template matching
    result = cv2.matchTemplate(gray1, gray2, cv2.TM_CCORR_NORMED)
```

```
    # Extract the maximum correlation coefficient
    max_corr_coeff = cv2.minMaxLoc(result)[1]

    return max_corr_coeff
```

Salt & Peeper Code

In [17]:
```
from skimage.util import random_noise
def salt_pepper_noise(img,density):
    noise_img = random_noise(img, mode='s&p',amount=density)
    # The above function returns a floating-point image
    # on the range [0, 1], thus we changed it to 'uint8'
    # and from [0,255]
    noise_img = np.array(255*noise_img, dtype = 'uint8')
    return noise_img.astype(np.float64)
```

In [18]:
```
def saltandpepper_noise(image, density):
    # Get the image size
    height, width = image.shape

    # Create a noise mask
    # 1 represents pepper noise, 2 represents salt noise
    noise_mask = np.random.choice([0, 1, 2], size=(height, width), p=[1-density, density/2, density/2])

    # Create the noisy image
    noisy_image = image.copy()

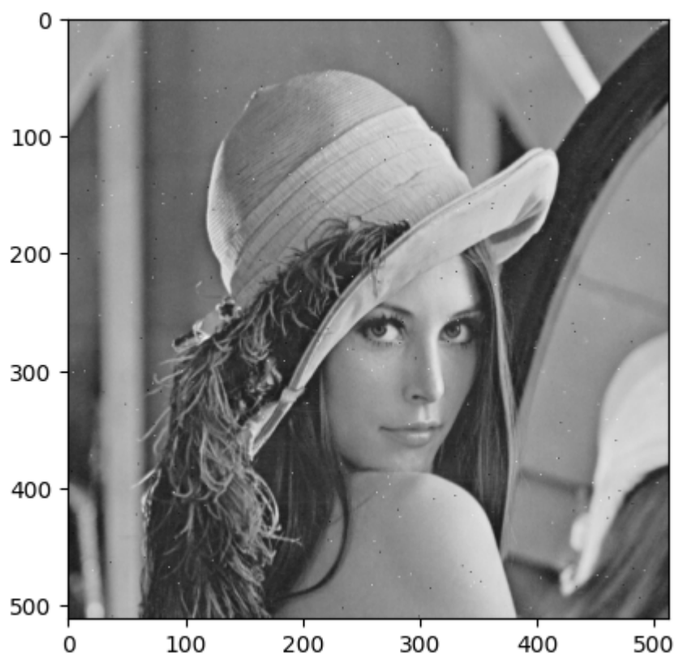
    # Apply pepper noise (set to 0)
    noisy_image[noise_mask == 1] = 0

    # Apply salt noise (set to 255)
    noisy_image[noise_mask == 2] = 255

    return noisy_image
```

In [77]:
```
cover=cv2.imread("C:\Study Meterial\Semester Project\Practical\WORK\Cover Images\lena.tiff",0)
x=salt_pepper_noise(cover,density=0.1)
y=saltandpepper_noise(cover,density=0.001)
plt.imshow(y.astype(np.uint8),cmap='gray')
plt.show
```

Out[77]: <function matplotlib.pyplot.show(close=None, block=None)>

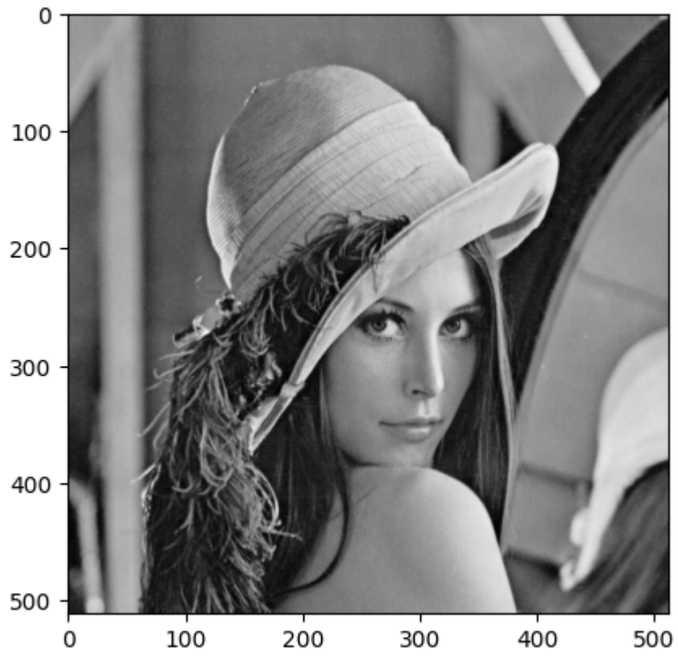


Without Attack on LENA, hiding

In [20]:
```
cover=cv2.imread("C:\Study Meterial\Semester Project\Practical\WORK\Cover Images\lena.tiff",0)
sec=cv2.imread("C:\Study Meterial\Semester Project\Practical\WORK\Stego Image.png",0)
secret=cv2.resize(sec,(16,16), interpolation=cv2.INTER_AREA)
file = open("C:\Study Meterial\Semester Project\Practical\WORK\Without Attack\sample epr - Copy.txt", 'r')
EPR_txt = file.read()
file.close()
EPR_bin=text2binary(EPR_txt) #EPR text in binary
secret_cat=arnold_cat_map(secret,iteration=7)


#STEGO IMAGE
stego_img, bp1,bp2,bp3=imageHiding(cover,secret_cat, EPR_bin)
plt.imshow(stego_img,cmap='gray')
plt.show()
```

```
Maximum freq in the image 708
Maximum freq in the image 6159
Maximum freq in the image 8740
212 5 3
```



Extraction

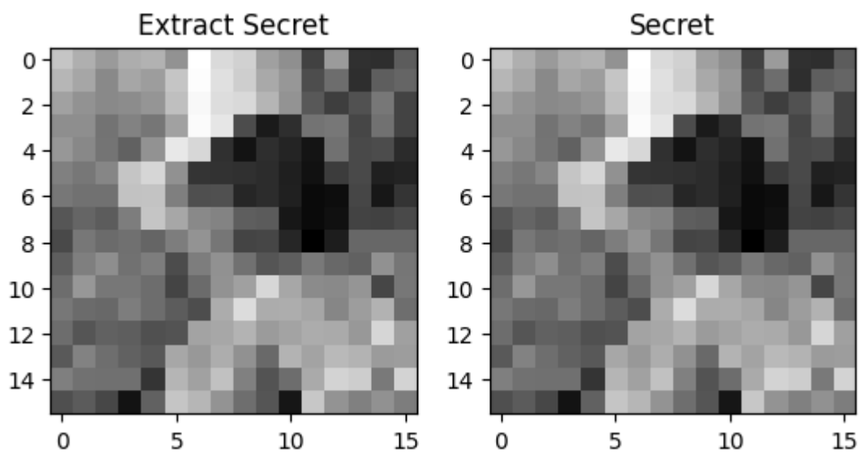
In [21]:
```
extract_secret_image, extract_sha_bin, extract_epr_bin=imageExtraction(stego_img,bp1,bp2,bp3)
secret_after_cat=arnold_cat_map(extract_secret_image,iteration=5)
print(binary2text(extract_epr_bin))
plt.subplot(1,2,1)
plt.imshow(secret_after_cat,cmap='gray')
plt.title('Extract Secret')
plt.subplot(1,2,2)
```

```
plt.imshow(secret,cmap='gray')
plt.title('Secret')
plt.show()
```

```
Patient Information:
Name: John Doe
Gender: Male
Date of Birth: January 1, 1980
Address: 123 Main Street, Anytown, USA
Phone: (555) 123-4567

Medical History
Medications: Aspirin 81mg daily, Lisinopril 10mg daily
Past Medical History: Hypertension, Type 2 Diabetes Mellitus

Machine Information:
Machine Name: HealthMaster 3000
Serial Number: HM3000-12345
```

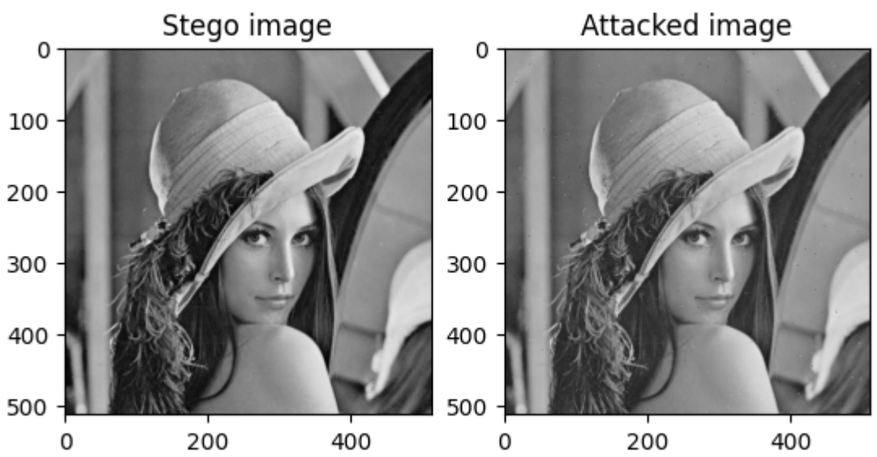


1) Salt & Peeper Noise

Attacks

In [22]:
```
attack_img_saltpeeper=saltandpepper_noise(stego_img.astype(np.uint8),density=0.001)

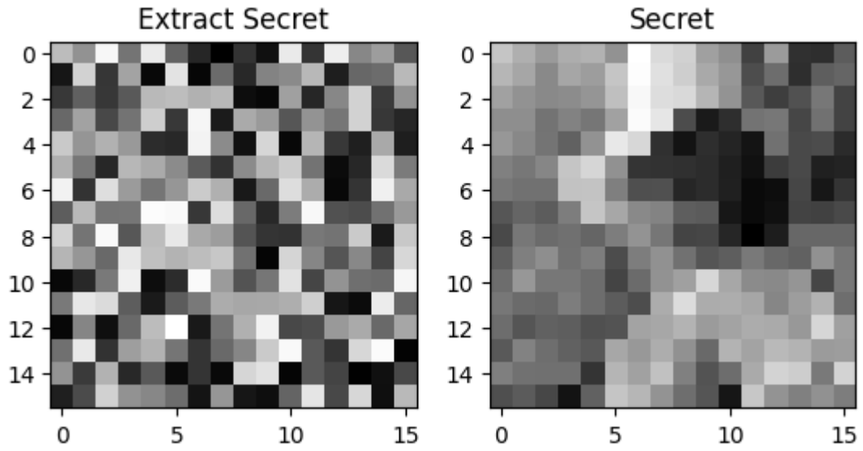
plt.subplot(1,2,1)
plt.imshow(stego_img,cmap='gray')
plt.title('Stego image')
plt.subplot(1,2,2)
plt.imshow(attack_img_saltpeeper,cmap='gray')
plt.title('Attacked image')
plt.show()
```



Extraction

In [23]:
```
extract_secret_image, extract_sha_bin, extract_epr_bin=imageExtraction(attack_img_saltpeeper.astype(np.float64),bp1,bp2,bp3)
secret_after_cat=arnold_cat_map(extract_secret_image,iteration=5)
print(binary2text(extract_epr_bin))
plt.subplot(1,2,1)
plt.imshow(secret_after_cat.astype(np.uint8),cmap='gray')
plt.title('Extract Secret')
plt.subplot(1,2,2)
plt.imshow(secret.astype(np.uint8),cmap='gray')
plt.title('Secret')
plt.show()
```

```
Patient JÜÌÞäÚÂèÒÞÜt□□ÂÚÊt□)½¡,□□½□)□□¹□□ÈÑ□k□c(R#□£)□{1□□K□£AÑ□S□s«□'□□□Â□□□□¤□□□L®ngD□&Fd      ¬--Ä
n□L¬®□-Ï.□îíÅ□
íÉN□
M□Â□□YY□q°¶□$4¹tory
Medications: Aspirin 81mg daily, LifÒÜÞàäÒØ@b`ÚÎ@ÈÂÒØä)A□ÍÐ□5□F□6□Â□□□7F÷'□¢□□□□W'FVç6□öâÂ□G□□R□"□F□□&N□®d      Y[□□]□\Â□□XXÚ□[□H□[□□Ü□XZ4··□□&°±hinJ@□ÂÚÊt@□ÊÂØèÐ□Âæè Ê ä@LÀÀÀ)M□É¥□°□9Õµ□□□Ñ□B
i□□□□Ó□#3C!□
```



In [24]:
```
NCC(extract_secret_image,secret_cat)
```

Out[24]: 0.784580409526825

In [25]:
```
epr_inserted=binary2number(EPR_bin)
epr_extracted=binary2number(extract_epr_bin)

NCC(epr_inserted,epr_extracted)
```

Out[25]: 0.8422244787216187

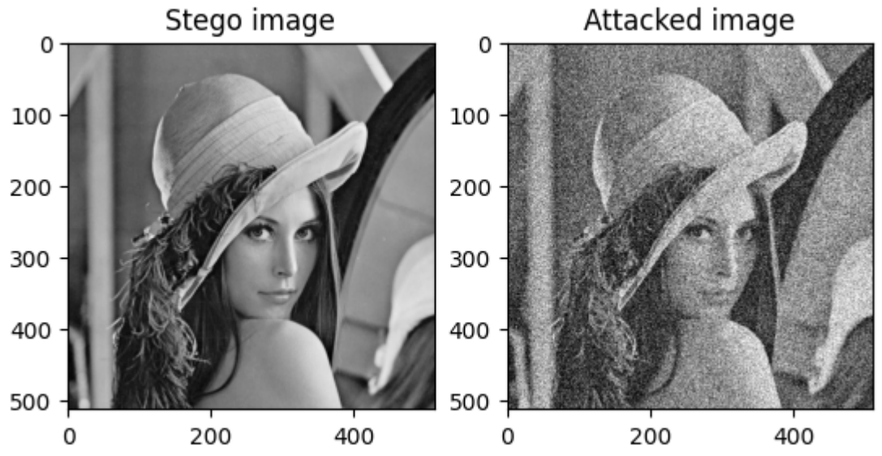
2)Gaussian Noise

code

In [26]:
```
def gaussian_noise(img,mean,var): #bg
    noise_img = random_noise(img, mode='gaussian',clip=True,mean=mean,var=var)
    #noise_img=noise_img.astype('uint8')
    noise_img = np.array(255*noise_img, dtype = 'uint8')
    return noise_img


def add_gaussian_noise(image, variance):
     # Generate Gaussian noise with zero mean and specified variance
     mean = 0
     sigma = np.sqrt(variance)
     gaussian_noise = np.random.normal(mean, sigma, image.shape)
     # Add the Gaussian noise to the image
     noisy_image = image + gaussian_noise
     return noisy_image
```

In [27]:
```
attack_img_gaussian=gaussian_noise(stego_img.astype(np.uint8),mean=0,var=0.05)
plt.subplot(1,2,1)
plt.imshow(stego_img,cmap='gray')
plt.title('Stego image')
plt.subplot(1,2,2)
plt.imshow(attack_img_gaussian,cmap='gray')
plt.title('Attacked image')
plt.show()
```



In [28]:
```
extract_secret_image, extract_sha_bin, extract_epr_bin=imageExtraction(attack_img_gaussian.astype(np.float64),bp1,bp2,bp3)
secret_after_cat=arnold_cat_map(extract_secret_image,iteration=5)
print(binary2text(extract_epr_bin))
plt.subplot(1,2,1)
plt.imshow(secret_after_cat.astype(np.uint8),cmap='gray')
plt.title('Extract Secret')
plt.subplot(1,2,2)
plt.imshow(secret.astype(np.uint8),cmap='gray')
plt.title('Secret')
plt.show()
```

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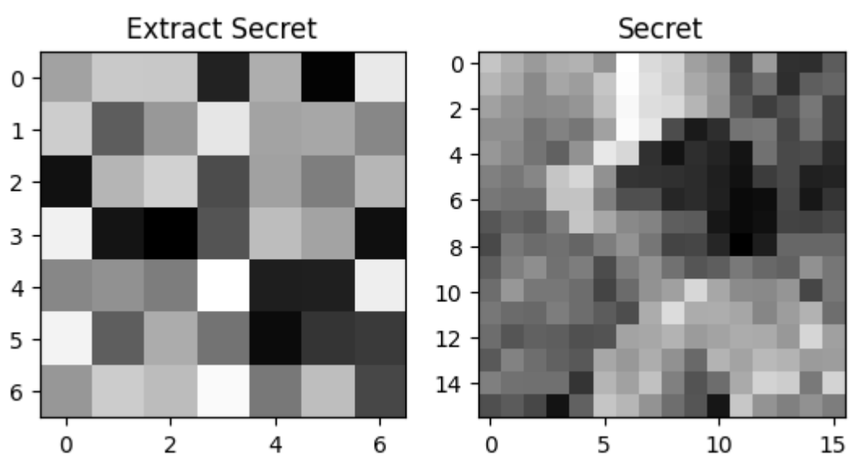

In [29]:
```
NCC(extract_secret_image,secret_cat)
```

Out[29]:
```
0.8619922399520874
```

In [30]:
```
epr_inserted=binary2number(EPR_bin)
epr_extracted=binary2number(extract_epr_bin)

NCC(epr_inserted,epr_extracted)
```

Out[30]:
```
0.8436777591705322
```

3)Median Blur

In [31]:
```
attack_img_median=cv2.medianBlur(stego_img.astype(np.uint8),3)
plt.subplot(1,2,1)
plt.imshow(stego_img,cmap='gray')
plt.title('Stego image')
plt.subplot(1,2,2)
plt.imshow(attack_img_median,cmap='gray')
plt.title('Attacked image')
plt.show()
```

In [32]:
```
extract_secret_image, extract_sha_bin, extract_epr_bin=imageExtraction(attack_img_median.astype(np.float64),bp1,bp2,bp3)
secret_after_cat=arnold_cat_map(extract_secret_image,iteration=5)
print(binary2text(extract_epr_bin))
plt.subplot(1,2,1)
plt.imshow(secret_after_cat.astype(np.uint8),cmap='gray')
plt.title('Extract Secret')
plt.subplot(1,2,2)
plt.imshow(secret.astype(np.uint8),cmap='gray')
plt.title('Secret')
plt.show()
```

```
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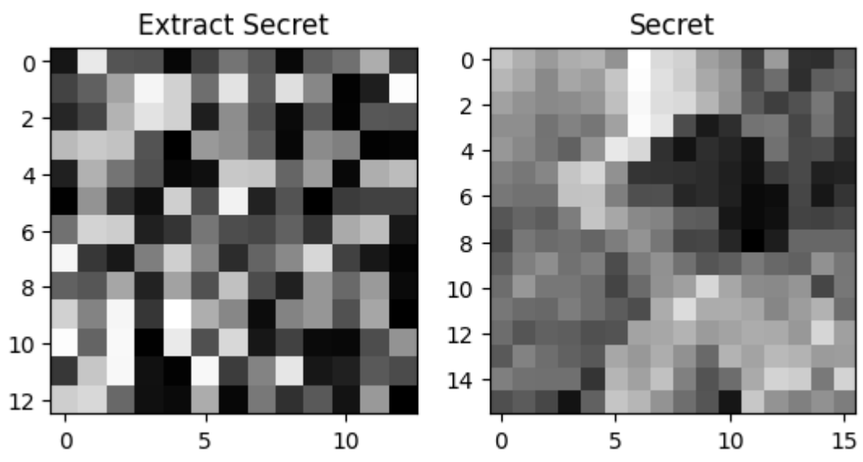
```



In [33]:
```
print(NCC(extract_secret_image,secret_cat))
epr_inserted=binary2number(EPR_bin)
epr_extracted=binary2number(extract_epr_bin)

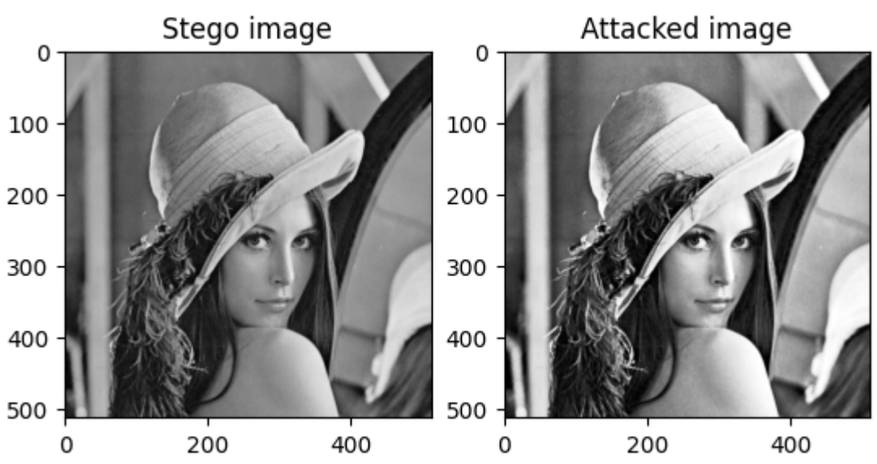
print(NCC(epr_inserted,epr_extracted))
```

```
0.7798522710800171
0.7602823972702026
```

4)Histogram Equalization

In [37]:
```
attack_img_hist= cv2.equalizeHist(stego_img.astype(np.uint8))

plt.subplot(1,2,1)
plt.imshow(stego_img,cmap='gray')
plt.title('Stego image')
plt.subplot(1,2,2)
plt.imshow(attack_img_hist,cmap='gray')
plt.title('Attacked image')
plt.show()
```



In [49]:
```
extract_secret_image, extract_sha_bin, extract_epr_bin=imageExtraction(attack_img_hist,bp1,bp2,bp3)
secret_after_cat=arnold_cat_map(extract_secret_image,iteration=5)
print(binary2text(extract_epr_bin))
plt.subplot(1,2,1)
plt.imshow(secret_after_cat.astype(np.uint8),cmap='gray')
plt.title('Extract Secret')
plt.subplot(1,2,2)
plt.imshow(secret.astype(np.uint8),cmap='gray')
plt.title('Secret')
plt.show()
```

```
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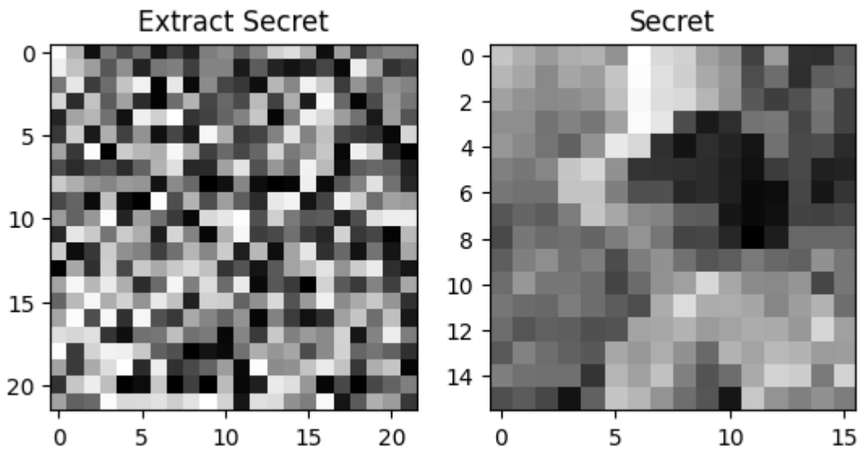
```



In [48]:
```
print(NCC(extract_secret_image,secret_cat))
epr_inserted=binary2number(EPR_bin)
epr_extracted=binary2number(extract_epr_bin)

print(NCC(epr_inserted,epr_extracted))
```

```
0.8195464611053467
0.8202852606773376
```

5)Image Sharpning

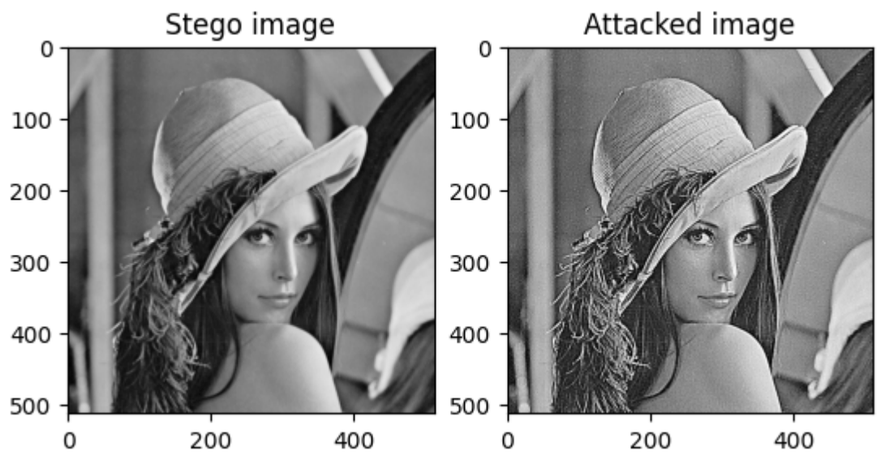
code

In [41]:
```
def sharpen_image(image):
    # Define the sharpening kernel
    kernel = np.array([[-1, -1, -1],
    [-1, 9, -1],
    [-1, -1, -1]])
    # Apply the kernel to the image
    sharpened_image = cv2.filter2D(image, -1, kernel)
    return sharpened_image
```

In [44]:
```
attack_img_sharp= sharpen_image(stego_img.astype(np.uint8))

plt.subplot(1,2,1)
plt.imshow(stego_img,cmap='gray')
plt.title('Stego image')
plt.subplot(1,2,2)
```

```
plt.imshow(attack_img_sharp,cmap='gray')
plt.title('Attacked image')
plt.show()
```



In [45]:
```
extract_secret_image, extract_sha_bin, extract_epr_bin=imageExtraction(attack_img_sharp,bp1,bp2,bp3)
secret_after_cat=arnold_cat_map(extract_secret_image,iteration=5)
print(binary2text(extract_epr_bin))
plt.subplot(1,2,1)
plt.imshow(secret_after_cat.astype(np.uint8),cmap='gray')
plt.title('Extract Secret')
plt.subplot(1,2,2)
plt.imshow(secret.astype(np.uint8),cmap='gray')
plt.title('Secret')
plt.show()
```

```
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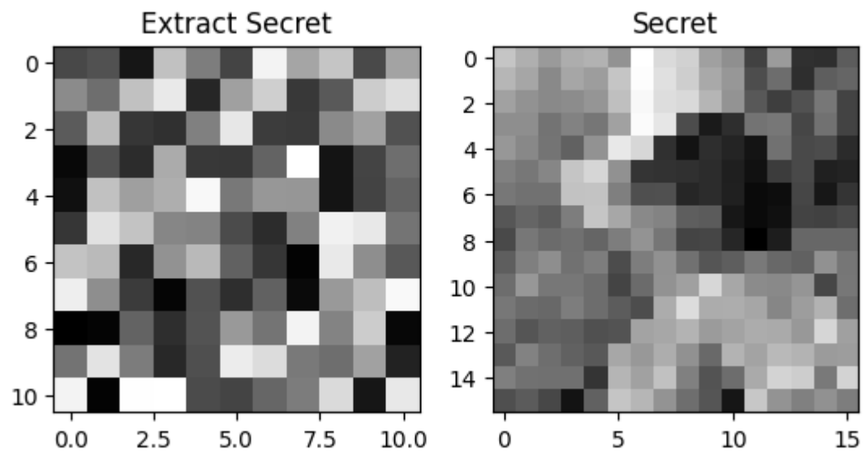
```



In [46]:
```
print(NCC(extract_secret_image,secret_cat))
epr_inserted=binary2number(EPR_bin)
epr_extracted=binary2number(extract_epr_bin)

print(NCC(epr_inserted,epr_extracted))
```

```
0.8209125399589539
0.8187617659568787
```

6)Crop

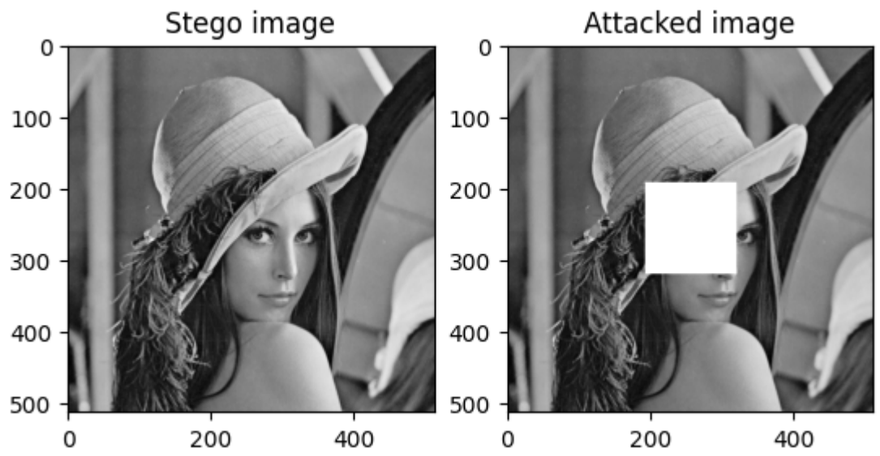
code

In [86]:
```
def crop(image, crop_percentage): #centre crop
    height, width = image.shape
    # Calculate the boundaries of the central cropped region
    crop_factor = crop_percentage / 100
    start_row = int(height * (1 - crop_factor) / 2)
    end_row = int(height * (1 + crop_factor) / 2)
    start_col = int(width * (1 - crop_factor) / 2)
    end_col = int(width * (1 + crop_factor) / 2)

    # Set the central cropped region to white
    image[start_row:end_row, start_col:end_col] = 255
    return image
```

In [90]:
```
attack_img_crop= crop(stego_img.astype(np.uint8),25)

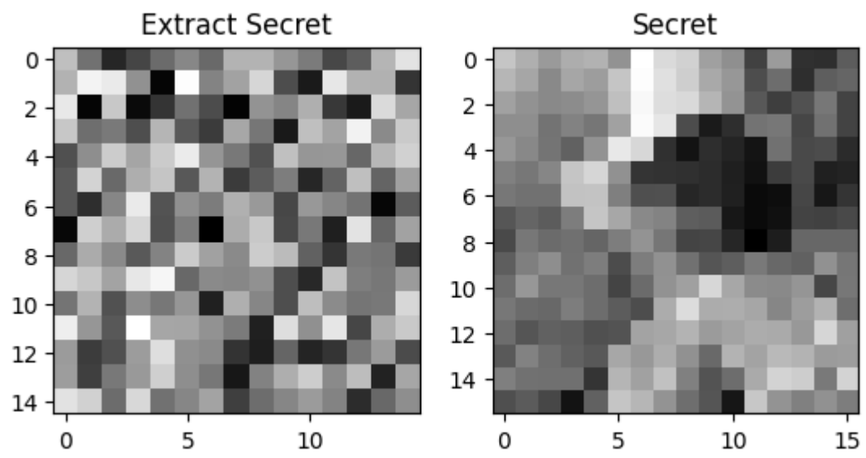
plt.subplot(1,2,1)
plt.imshow(stego_img,cmap='gray')
plt.title('Stego image')
plt.subplot(1,2,2)
plt.imshow(attack_img_crop,cmap='gray')
plt.title('Attacked image')
plt.show()
```



In [91]:
```
extract_secret_image, extract_sha_bin, extract_epr_bin=imageExtraction(attack_img_crop,bp1,bp2,bp3)
secret_after_cat=arnold_cat_map(extract_secret_image,iteration=5)
print(binary2text(extract_epr_bin))
plt.subplot(1,2,1)
plt.imshow(secret_after_cat.astype(np.uint8),cmap='gray')
plt.title('Extract Secret')
plt.subplot(1,2,2)
plt.imshow(secret.astype(np.uint8),cmap='gray')
plt.title('Secret')
plt.show()
```

```
Patient Information:
Name: John Doe
Gender: Male
Date of Birth: January 1, 1980
Address: 123 Main Street, Anytown, USA
Phone: (555) 123-4567

Medical History
Medications: Aspirin 81mg daily, Lisinopril 10k(□1hÇ□ ÆèBY#,nÂ□4»£\□td<àÅÏFVçKmÁ□yq□□□XTÊ□®@□[1¥Ñ«□ ¤ØZ□Ý($·3|□aÑíô□®Æ□□ÊA□µ:    ÂÝ□ªæ□□ □¦ÊäÒÂØ@□èÚÄÊät@□□f```Zbdfhj
```



In [92]:
```
print(NCC(extract_secret_image,secret_cat))
epr_inserted=binary2number(EPR_bin)
epr_extracted=binary2number(extract_epr_bin)

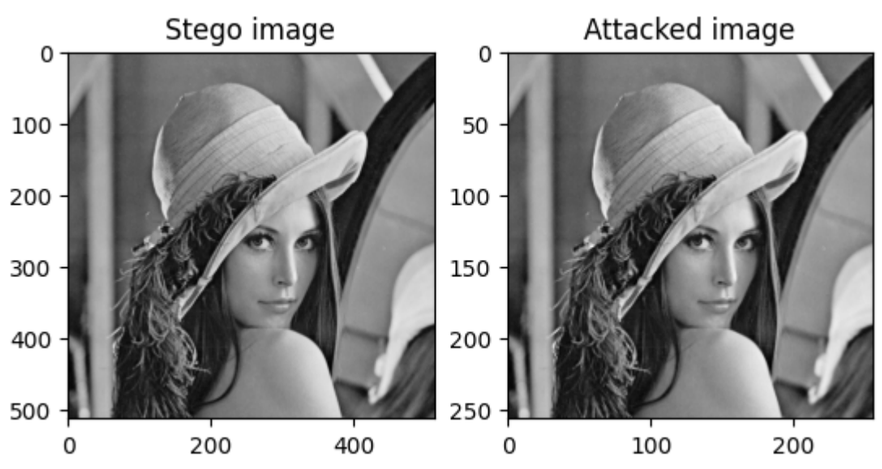
print(NCC(epr_inserted,epr_extracted))
```

```
0.8477846384048462
0.8788323998451233
```

7)Resize

In [94]:
```
attack_img_resize= cv2.resize(stego_img.astype(np.uint8),(256,256), interpolation=cv2.INTER_AREA)

plt.subplot(1,2,1)
plt.imshow(stego_img,cmap='gray')
plt.title('Stego image')
plt.subplot(1,2,2)
plt.imshow(attack_img_resize,cmap='gray')
plt.title('Attacked image')
plt.show()
```



In [95]:
```
extract_secret_image, extract_sha_bin, extract_epr_bin=imageExtraction(attack_img_resize,bp1,bp2,bp3)
secret_after_cat=arnold_cat_map(extract_secret_image,iteration=5)
print(binary2text(extract_epr_bin))
plt.subplot(1,2,1)
plt.imshow(secret_after_cat.astype(np.uint8),cmap='gray')
plt.title('Extract Secret')
plt.subplot(1,2,2)
plt.imshow(secret.astype(np.uint8),cmap='gray')
plt.title('Secret')
plt.show()
```

```
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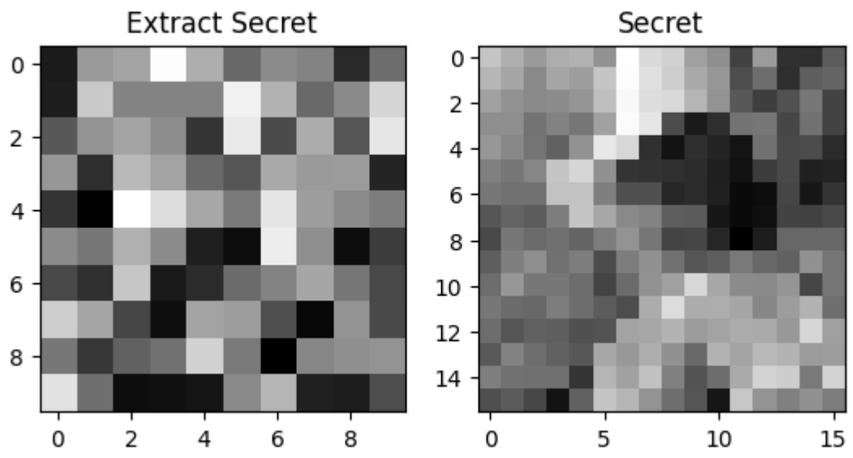
```



In [96]:
```
print(NCC(extract_secret_image,secret_cat))
epr_inserted=binary2number(EPR_bin)
epr_extracted=binary2number(extract_epr_bin)

print(NCC(epr_inserted,epr_extracted))
```

```
0.8464524745941162
0.781610369682312
```

8)Reflection

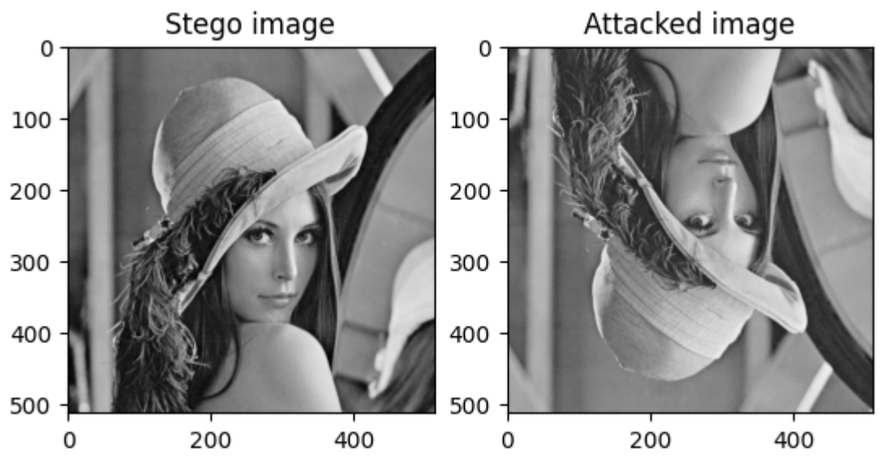
code

In [97]:
```
def reflection(img):
    rows, cols = img.shape
    M = np.float32([[1, 0, 0],
                    [0, -1, rows],
                    [0, 0, 1]])
    reflected_img = cv2.warpPerspective(img, M,(int(cols),int(rows)))
    return reflected_img
```

In [100…
```
attack_img_mirror= reflection(stego_img.astype(np.uint8))

plt.subplot(1,2,1)
plt.imshow(stego_img,cmap='gray')
plt.title('Stego image')
```

```
plt.subplot(1,2,2)
plt.imshow(attack_img_mirror,cmap='gray')
plt.title('Attacked image')
plt.show()
```



In [101…
```
extract_secret_image, extract_sha_bin, extract_epr_bin=imageExtraction(attack_img_mirror,bp1,bp2,bp3)
secret_after_cat=arnold_cat_map(extract_secret_image,iteration=5)
print(binary2text(extract_epr_bin))
plt.subplot(1,2,1)
plt.imshow(secret_after_cat.astype(np.uint8),cmap='gray')
plt.title('Extract Secret')
plt.subplot(1,2,2)
plt.imshow(secret.astype(np.uint8),cmap='gray')
plt.title('Secret')
plt.show()
```

```
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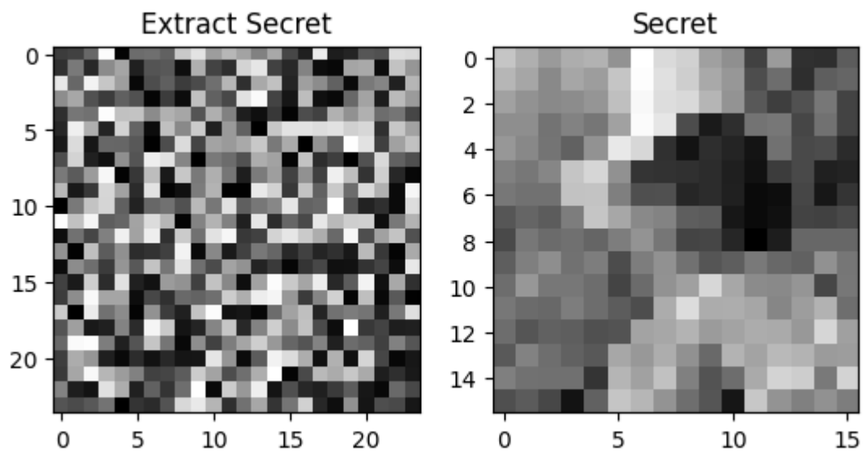


In [103…
```
print(NCC(extract_secret_image,secret_cat))
epr_inserted=binary2number(EPR_bin)
epr_extracted=binary2number(extract_epr_bin)
print(NCC(epr_inserted,epr_extracted))
```

```
0.7972204685211182
0.7743988037109375
```

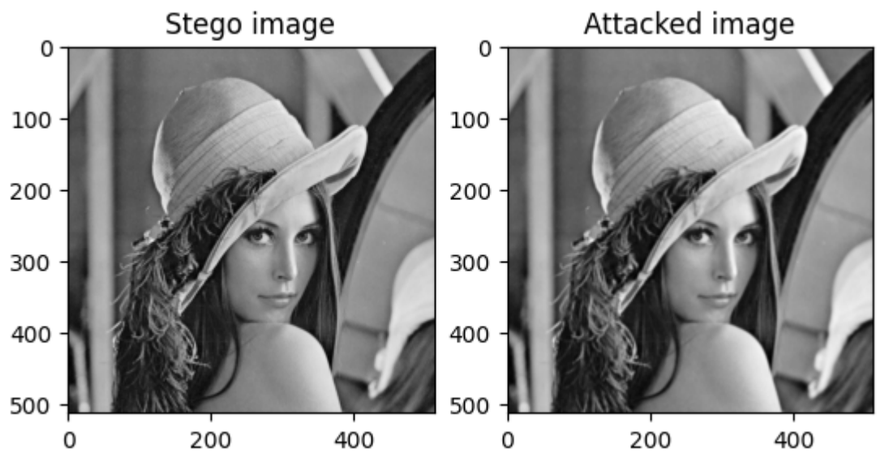
9)Average Filtering

code

In [104…
```
def average_filter(image, kernel_size):
 # Apply average filtering
 blurred_image = cv2.blur(image, kernel_size)
 return blurred_image
```

In [107…
```
attack_img_avg= average_filter(stego_img.astype(np.uint8),kernel_size=(3,3))

plt.subplot(1,2,1)
plt.imshow(stego_img,cmap='gray')
plt.title('Stego image')
plt.subplot(1,2,2)
plt.imshow(attack_img_avg,cmap='gray')
plt.title('Attacked image')
plt.show()
```



In [108…
```
extract_secret_image, extract_sha_bin, extract_epr_bin=imageExtraction(attack_img_avg,bp1,bp2,bp3)
secret_after_cat=arnold_cat_map(extract_secret_image,iteration=5)
print(binary2text(extract_epr_bin))
plt.subplot(1,2,1)
plt.imshow(secret_after_cat.astype(np.uint8),cmap='gray')
plt.title('Extract Secret')
plt.subplot(1,2,2)
plt.imshow(secret.astype(np.uint8),cmap='gray')
plt.title('Secret')
plt.show()
```

```
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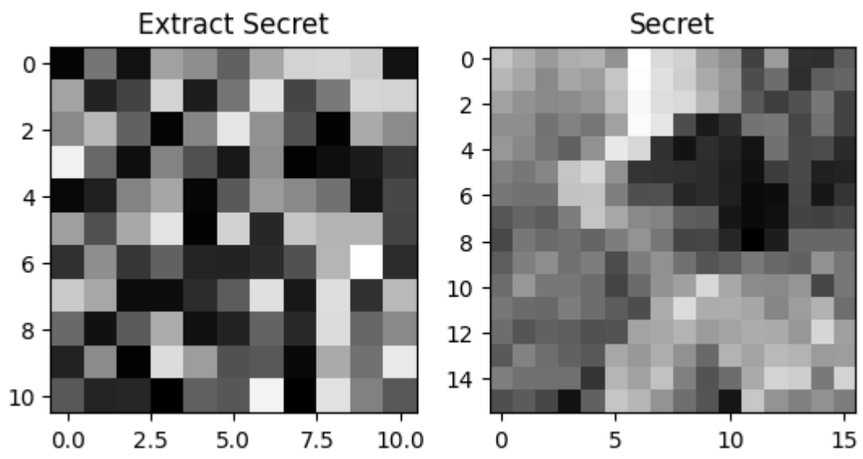
```



In [109…
```
print(NCC(extract_secret_image,secret_cat))
epr_inserted=binary2number(EPR_bin)
epr_extracted=binary2number(extract_epr_bin)

print(NCC(epr_inserted,epr_extracted))
```

```
0.7974084615707397
0.768646776676178
```

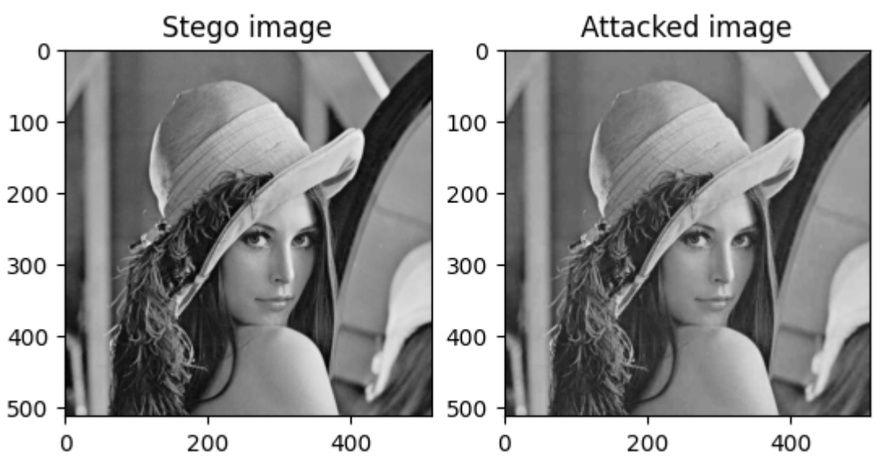
10)JPEG Compression

code

In [110…
```
def jpeg_compress(image, quality):
    cv2.imwrite('compress.jpg', image, [cv2.IMWRITE_JPEG_QUALITY, quality])
    x=cv2.imread('compress.jpg',0)
    os.remove('compress.jpg')
    return x
```

In [123…
```
attack_img_jpeg= jpeg_compress(stego_img.astype(np.uint8),30)

plt.subplot(1,2,1)
plt.imshow(stego_img,cmap='gray')
plt.title('Stego image')
plt.subplot(1,2,2)
plt.imshow(attack_img_jpeg,cmap='gray')
plt.title('Attacked image')
plt.show()
```



In [124…
```
extract_secret_image, extract_sha_bin, extract_epr_bin=imageExtraction(attack_img_jpeg,bp1,bp2,bp3)
secret_after_cat=arnold_cat_map(extract_secret_image,iteration=5)
print(binary2text(extract_epr_bin))
plt.subplot(1,2,1)
plt.imshow(secret_after_cat.astype(np.uint8),cmap='gray')
plt.title('Extract Secret')
plt.subplot(1,2,2)
plt.imshow(secret.astype(np.uint8),cmap='gray')
plt.title('Secret')
plt.show()
```

```
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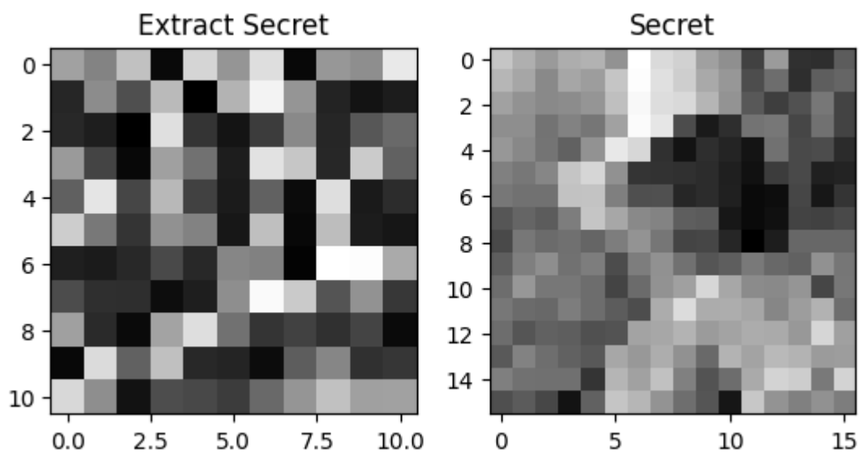
```



In [125…
```
print(NCC(extract_secret_image,secret_cat))
epr_inserted=binary2number(EPR_bin)
epr_extracted=binary2number(extract_epr_bin)

print(NCC(epr_inserted,epr_extracted))
```

```
0.7798099517822266
0.7570669054985046
```

In [ ]: