Shih-Chia Chen
50207079

CSE 573 Computer Vision
HW2 Report
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Problem (1) (Fourier Transform) :
file name: hw2_ft_ift.py

(a) Fourier Transform

1st. Shift the image using f*((-1)^(x+y))

2nd. Do Fourier transform using the formula (Reference 1.)

Use two 3-for loops in older to reduce the running time:

$$F(k,l) = \frac{1}{N}\sum_{b=0}^{N-1} P(k,b)\; e^{-\imath 2\pi \frac{lb}{N}}$$

and

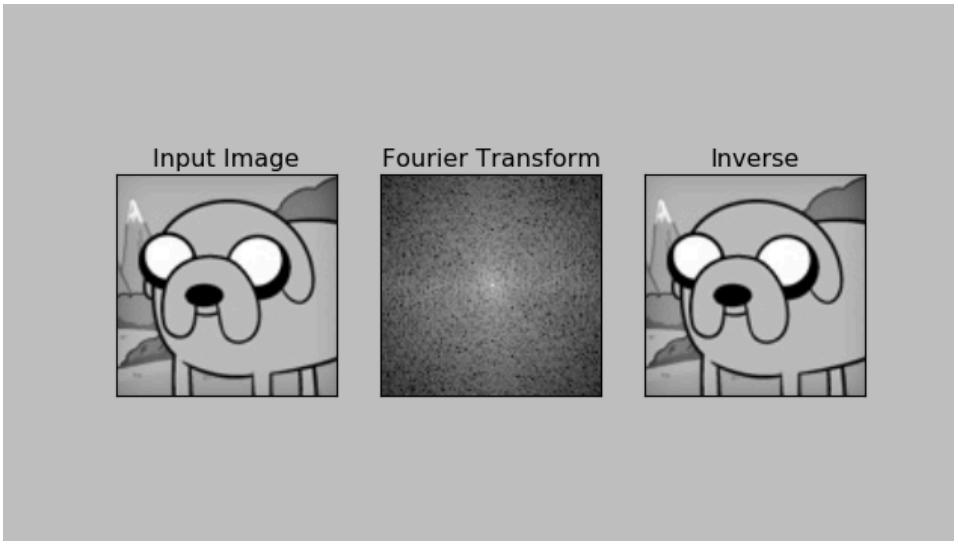
$$P(k,b) = \frac{1}{N}\sum_{a=0}^{N-1} f(a,b)\; e^{-\imath 2\pi \frac{ka}{N}}$$

(b) Inverse Fourier Transform

1st. Do the Inverse Fourier Transform by using the formula

2nd. Shift the image, then it will output the image which is almost same as the original one.

The output image of (a) and (b):



(c) MSE= 6.6650977305e-20

(d) Discuss why or why not the MSE may be non-zero

The MSE should be non-zero since the type of the value we used in the code is float, and it often ignores some value, such as 0.00000000000065.

Problem (2) (Laplacian Pyramid) :
file name: hw2_pyramid.py

(a) 5-Level Laplacian Pyramid

1st. Define the filter w=[0.05, 0.25, 0.4, 0.25, 0.05]

2nd. Convolve and reduce the size of the next image to 1/4 of the pervious one

define a function: g_convo(G)

3rd. Expand the G (Reference 2.)

define a function: expand(): expandG1(x, y)=∑∑w(m, n) G1((x-m)/2, (y-n)/2)

4th. Do Laplacian

(b) Reconstruct

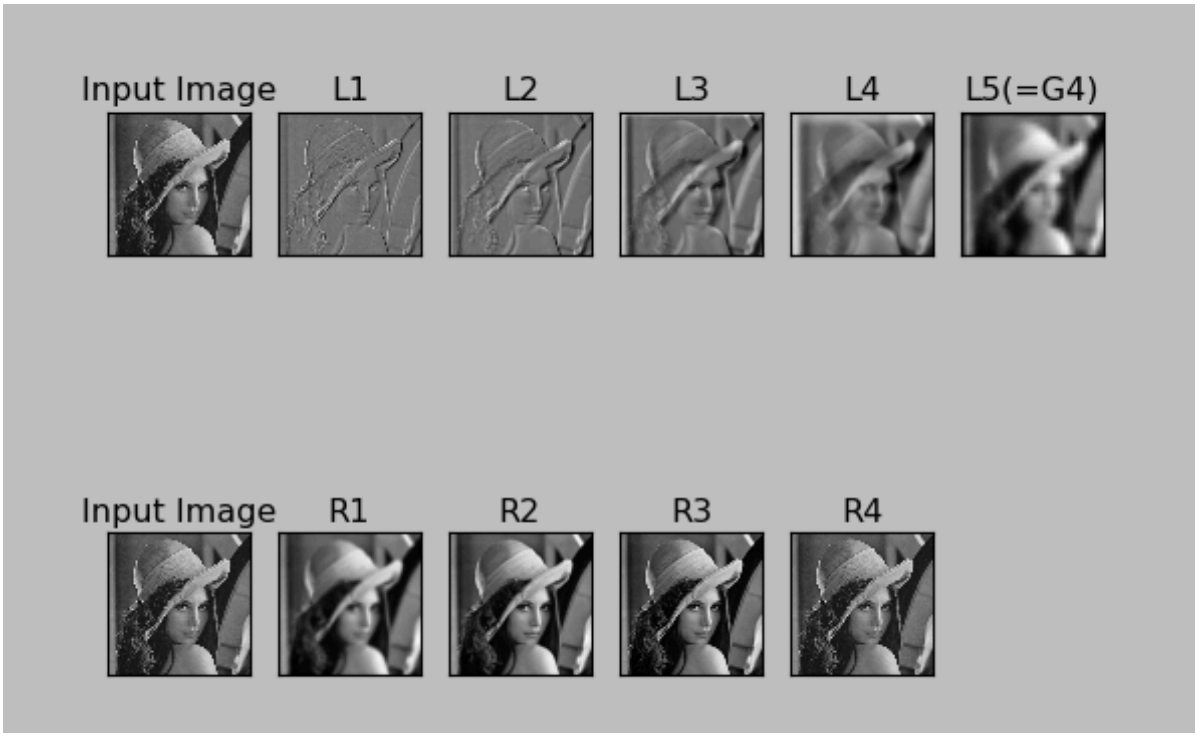
1st. R1 = L4+expand(L5)

R2 = L3+expand(R1)

R3 = L2+expand(R2)

R4 = L1+expand(R3) #original image

The output image of (a) and (b):



(c) MSE = 2.43615393662e-24

(d) Discuss why or why not the MSE may be non-zero

The MSE is non-zero. Since when we are doing the reduction, we do not consider all the element in the matrix, we eliminate the even row and even column. Moreover, even when we are expanding the matrix, we make up some value. Therefore the MSE will not be zero.

Reference:

1. http://homepages.inf.ed.ac.uk/rbf/HIPR2/fourier.htm
2. http://www.cs.utah.edu/~arul/report/node12.html