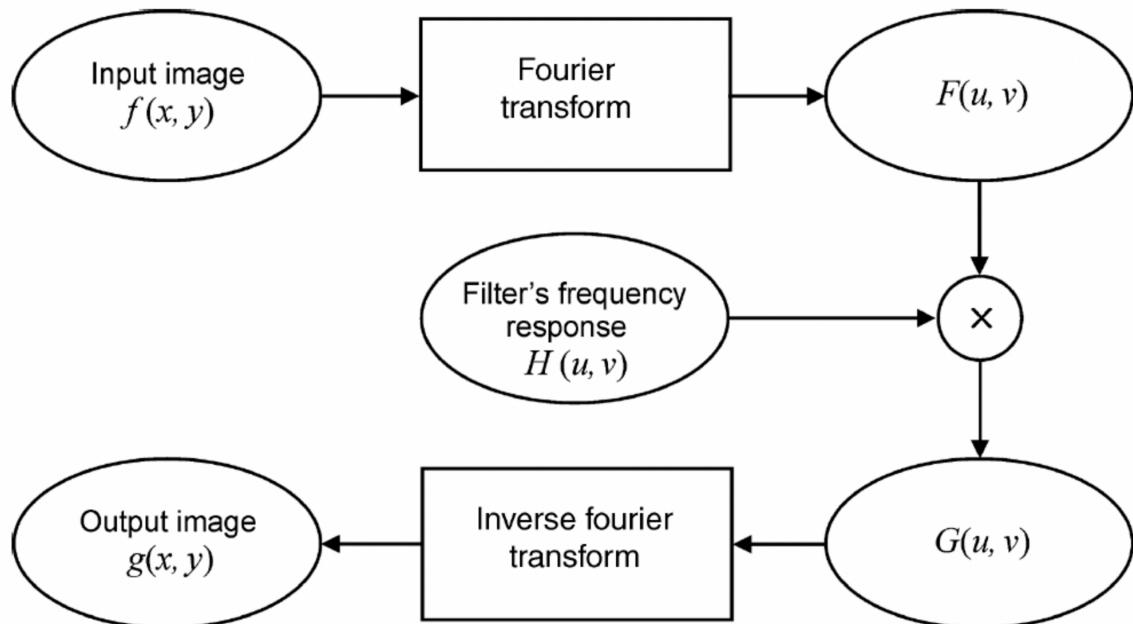


## Experiment 4

# Frequency Filtering

Frequency Filtering is the filtering of an image in the frequency domain. It is done by transforming the given image using 2D Fourier transform, multiplying the filter and then inverse 2D Fourier transforming.

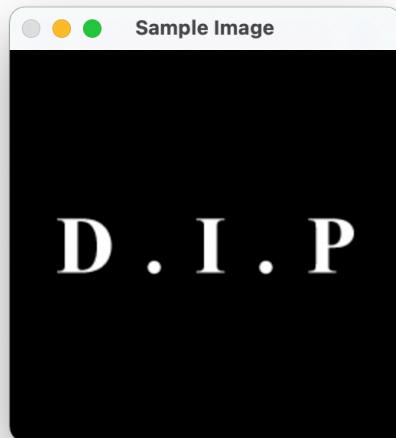


Filtering an image in the Frequency Domain

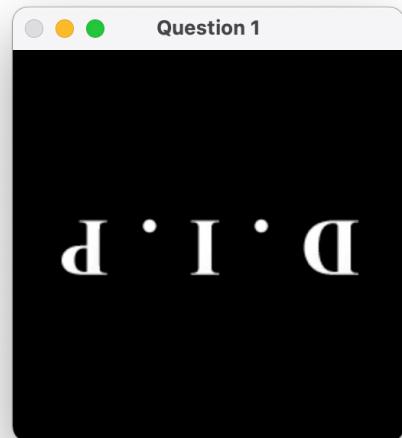
In case of an image, DFT(Discrete Fourier transform) is used because the data is not continuous but a set of discrete pixel intensity values. To implement DFT, FFT(Fast Fourier transform) is used as it is less computationally intensive than an DFT.

## Image Transformation

In this, the image was first multiplied with  $(-1)^{i+j}$  where I and j are the rows, columns of the image. Following that, the FFT of the image was done and its complex conjugate was calculated. Then, after the Inverse-FFT the image was again multiplied with  $(-1)^{i+j}$ . The pictures before show the before and after:



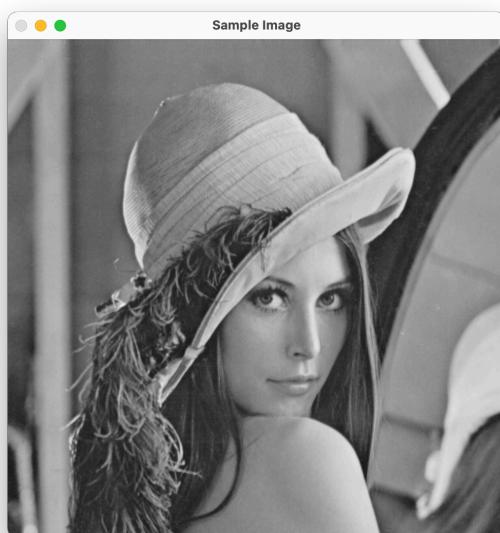
Original Image



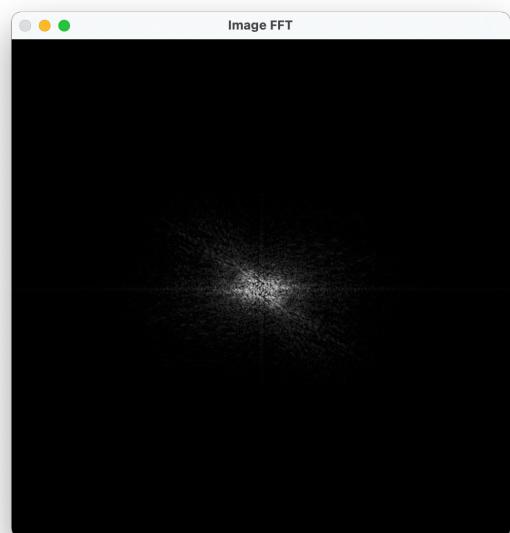
Transformed Image

## Frequency Filtering

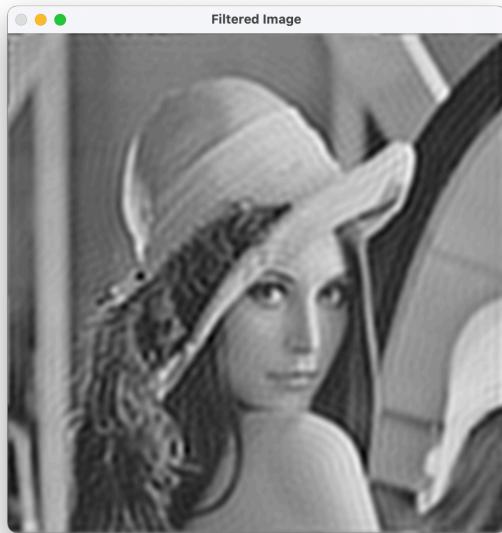
For all the following results, the image was first transformed using FFT and then after multiplying the filter, inverse Fourier Transformed.  
“Lena\_gray\_512.jpg” was used as the sample image.



Un-Filtered Image



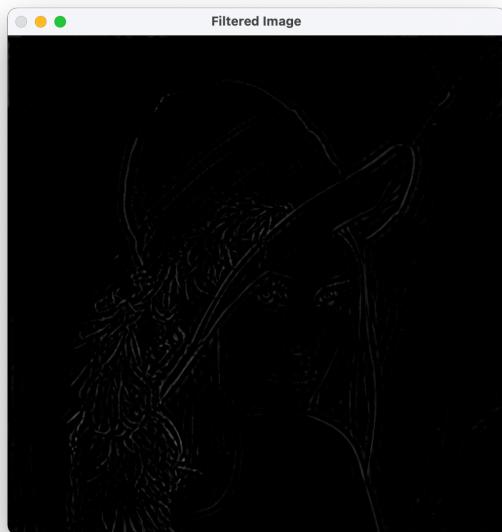
Un-Filtered Image FFT



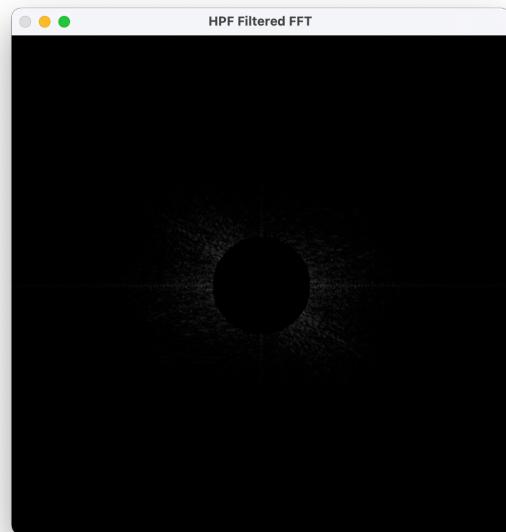
Ideal low-pass filtered image



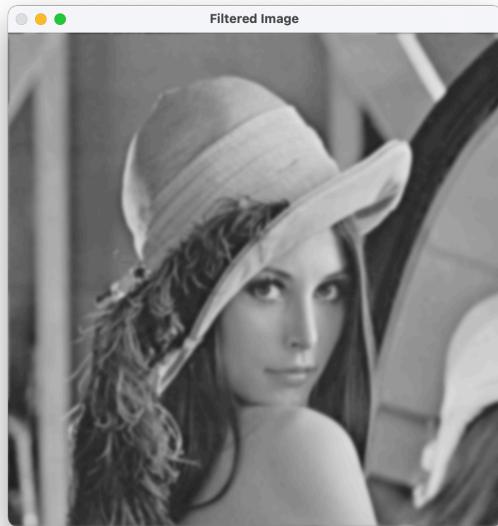
Ideal low-pass filtered image FFT



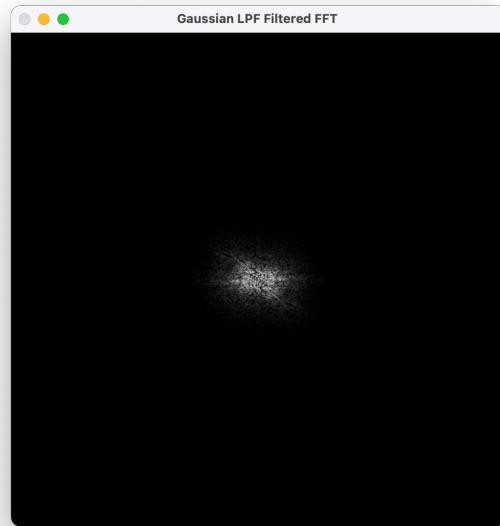
Ideal high-pass filtered image



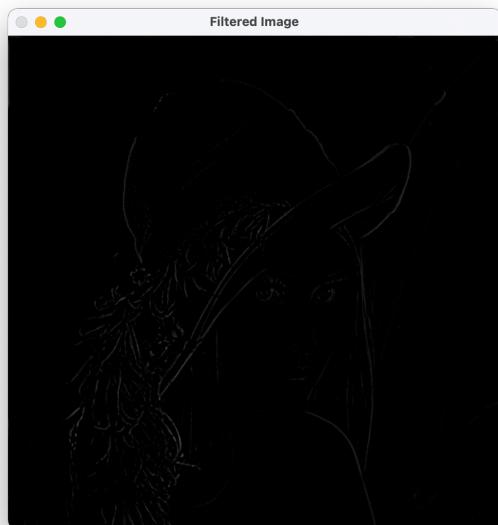
Ideal high-pass filtered image FFT



Gaussian Low-Pass filtered image



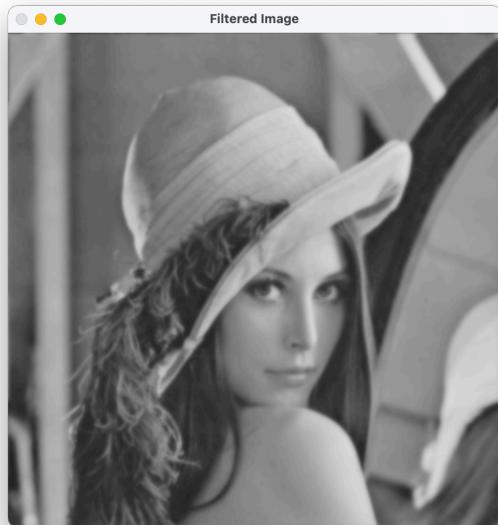
Gaussian Low-Pass filtered image FFT



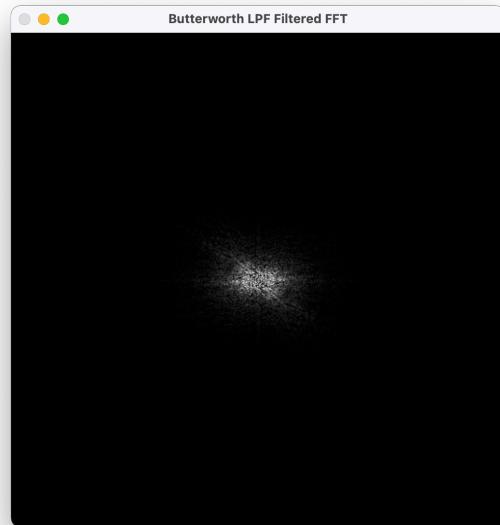
Gaussian High-Pass filtered image



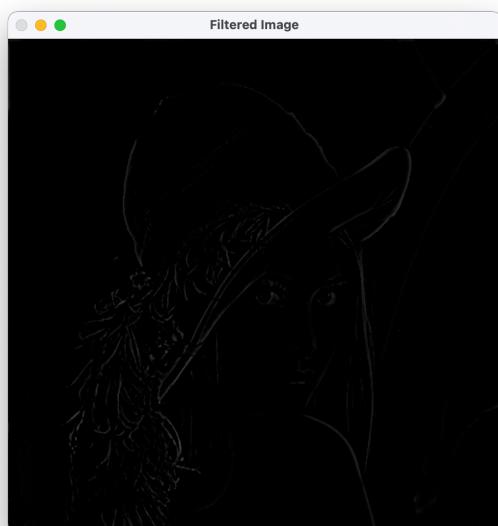
Gaussian High-Pass filtered image FFT



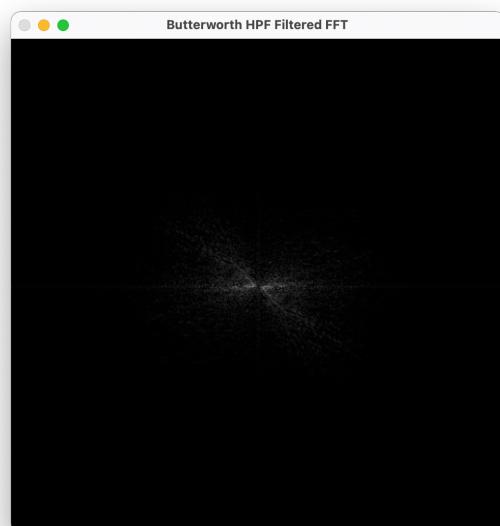
Butterworth Low-Pass Filtered Image



Butterworth Low-Pass Filtered Image FFT



Butterworth High-Pass Filtered Image



Butterworth High-Pass Filtered Image FFT

The code can be found at [https://github.com/jaybee-117/Image\\_Processing/tree/main/Frequency\\_Filtering](https://github.com/jaybee-117/Image_Processing/tree/main/Frequency_Filtering)