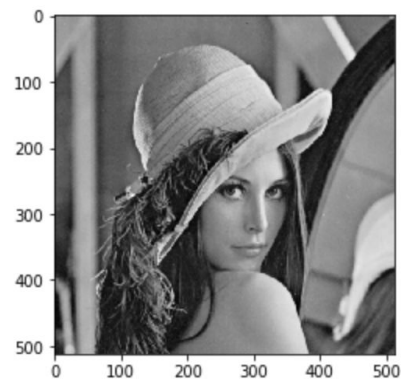
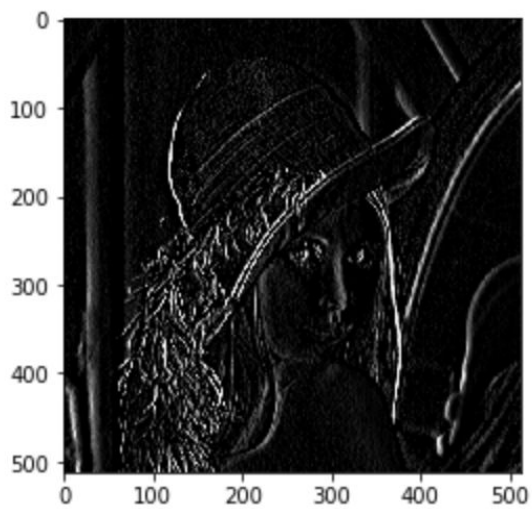


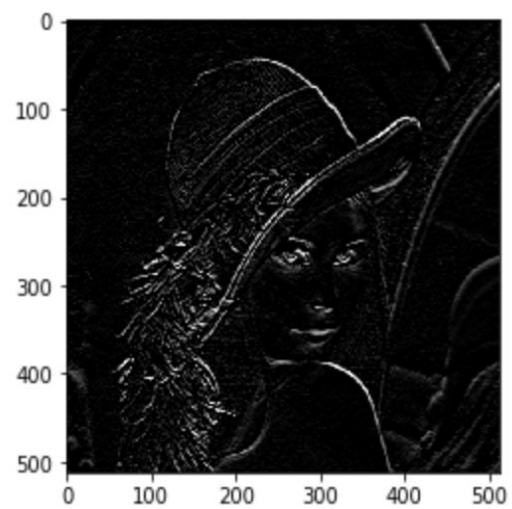
1.a



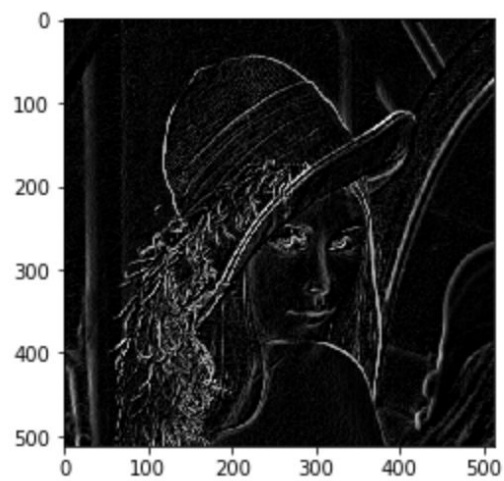
Original image



Gx



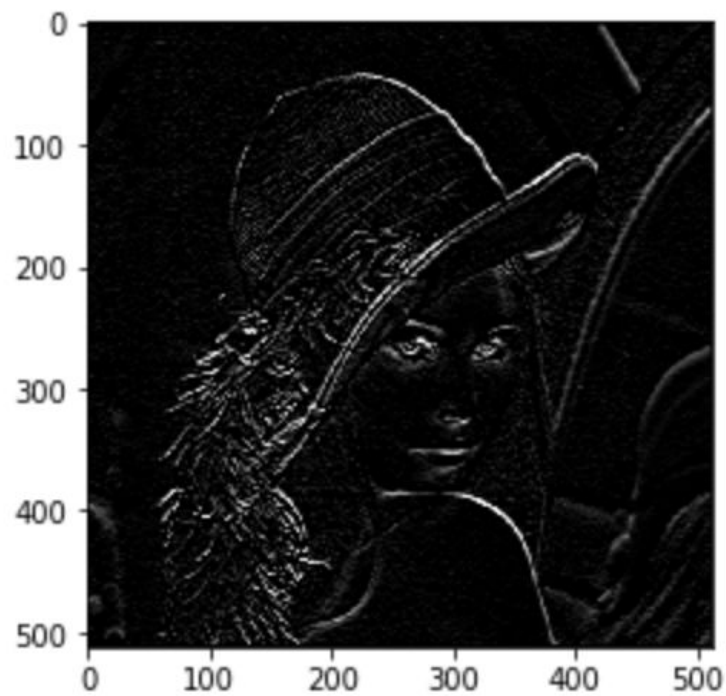
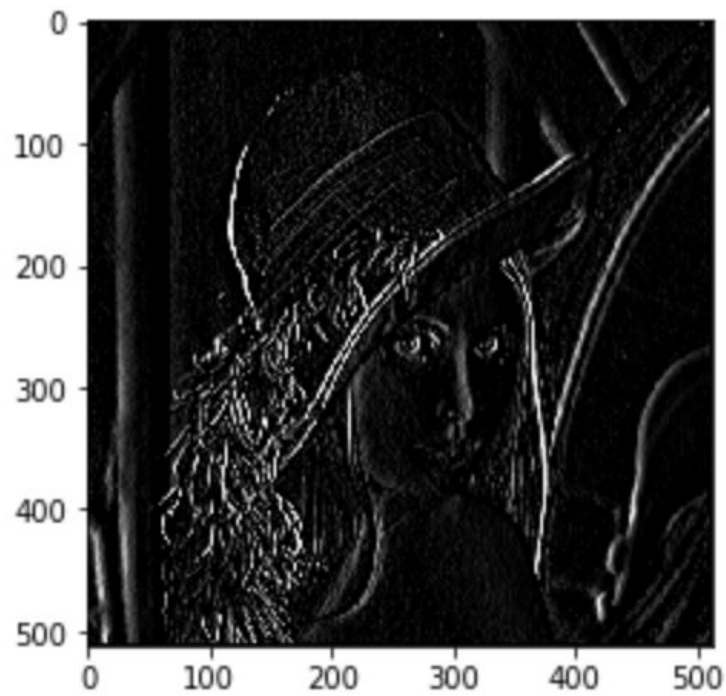
Gy



G

1.b

Gx



Gy

Verification: Image outputs are similar but image pixel matrices are different

1.C

Theoretically, we can achieve better convolution complexity through separable filters.

Image size : $M \times N$

Filter size : $P \times Q$

Computational complexity of Convolution in 2D : $O(MNPQ)$

Computational complexity of Separable convolution : $O(MN(P+Q))$

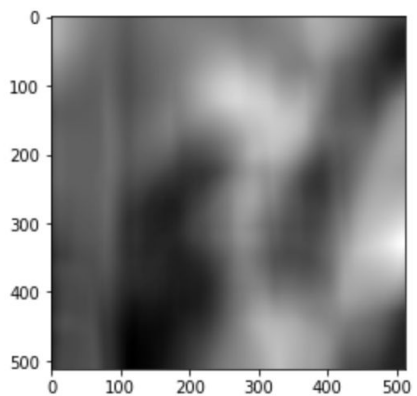
1.D

101* 101 filter

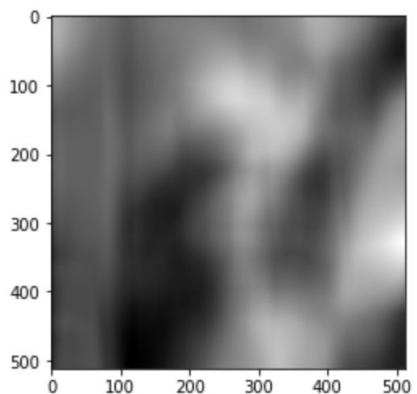
2D Convolution with Sobel Filters in x direction: 5.018904000000006

2D Convolution with Sobel Filters in y direction: 7.040755000000004

2D Convolution with Sobel Filters in x direction: 5.018904000000006



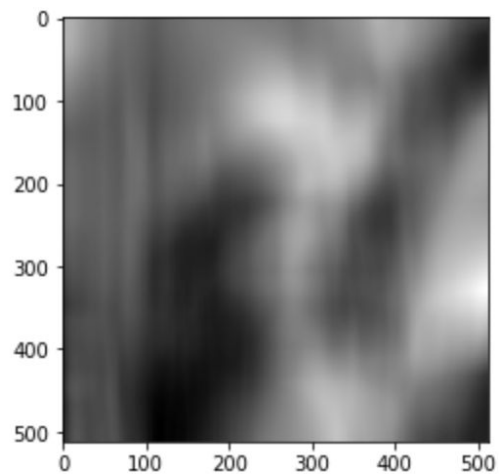
2D Convolution with Sobel Filters in y direction: 7.040755000000004



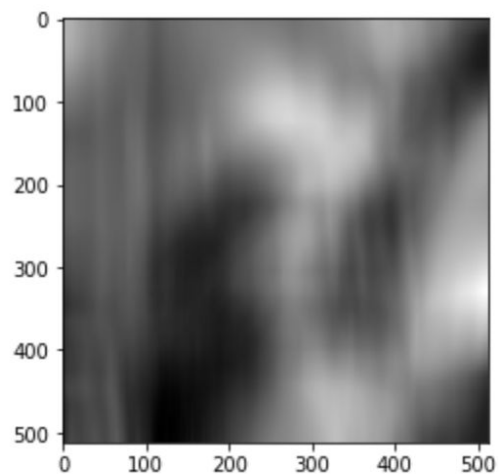
1D Convolution with Sobel Separable Filters in x direction: 9.591318000000001

1D Convolution with Sobel Separable Filters in y direction: 9.864364999999992

1D Convolution with Sobel Separable Filters in x direction: 9.591318000000001



1D Convolution with Sobel Separable Filters in y direction: 9.864364999999992



Problem (2) Histogram Equalization

Original Image

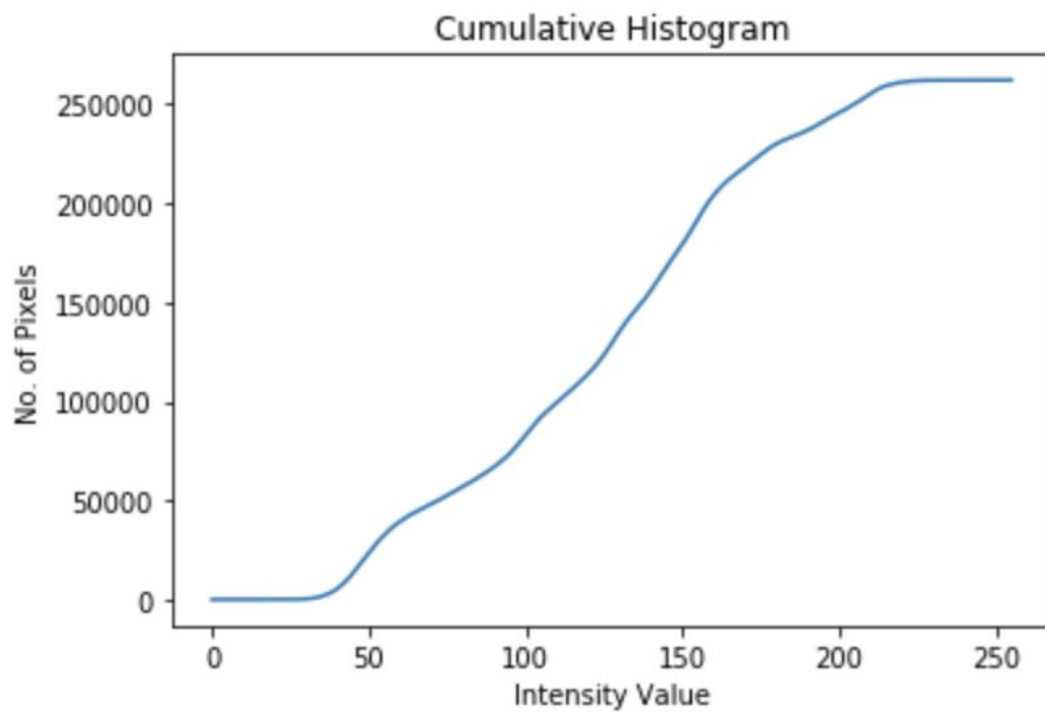
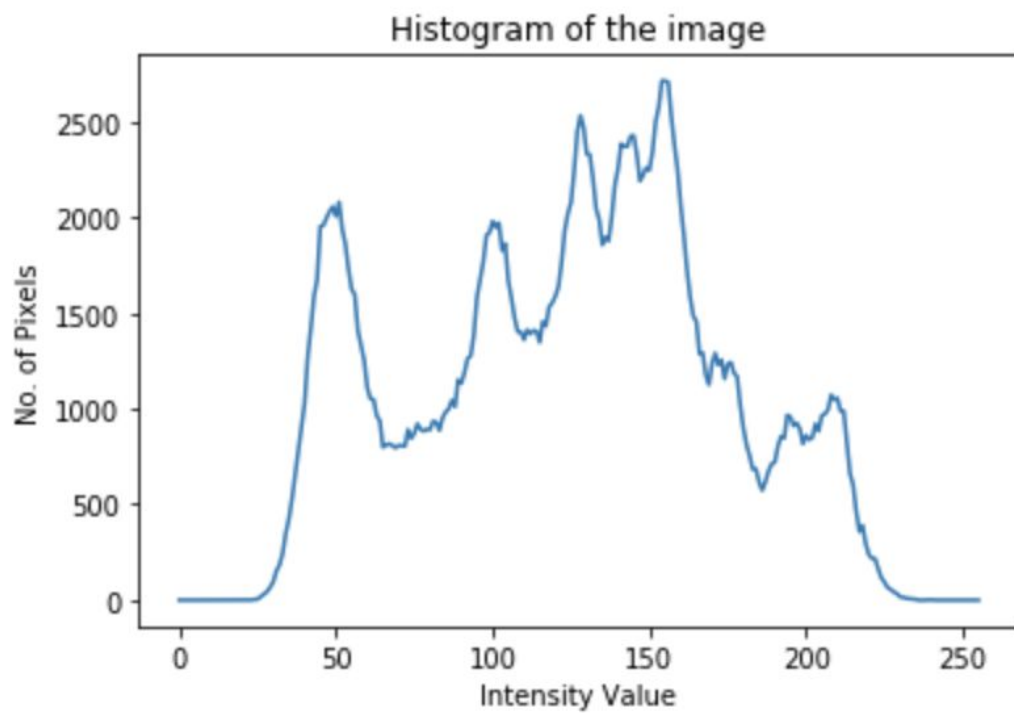


Grayscale Image

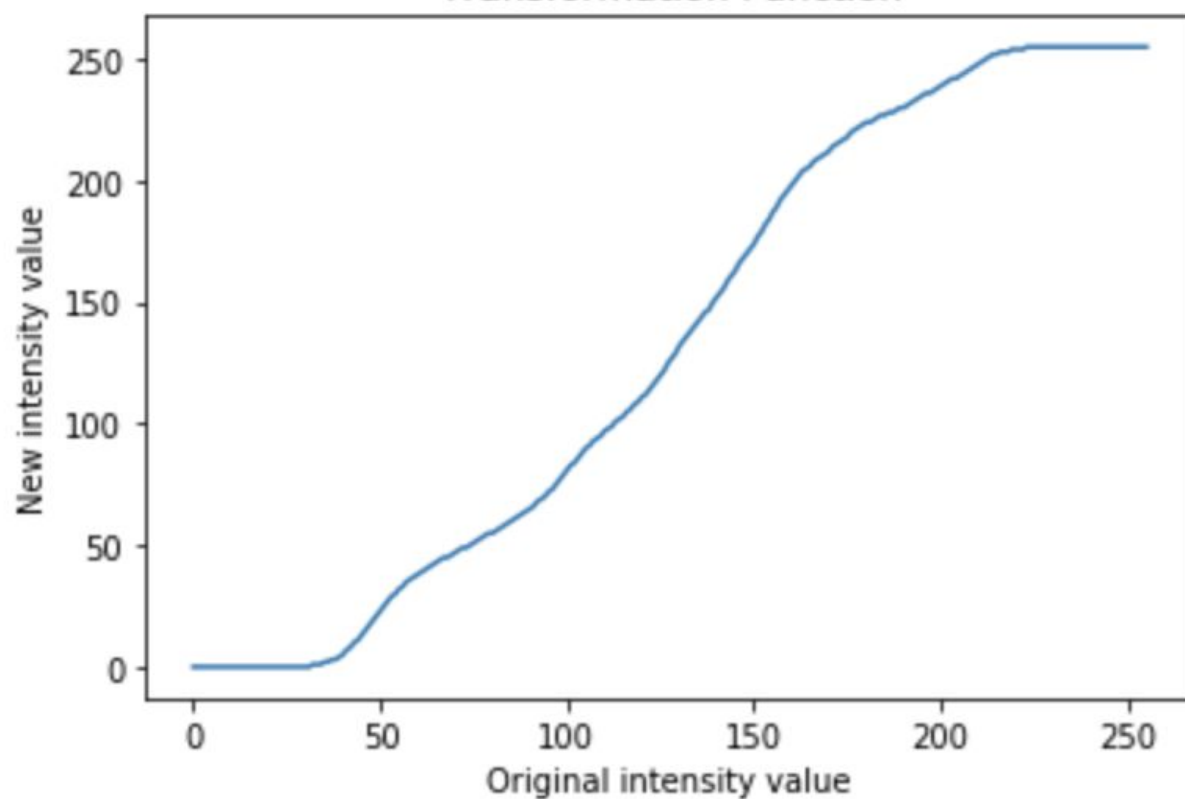


Enhanced Image





Transformation Function



Equalized Histogram

