Digital Image Processing
Assignment-2 Report

1 Question 1: Spatial Filtering and Binarisation

We applied the Gaussian filter with the given σ_g values and observed the following within-class variances:

Table 1: Within-class variances for different σ_g values

σ_g	σ_w^{2*}
0	705.8781310985962
0.1	705.8781310985962
0.5	368.66952130963585
1	181.56220180694106
2.5	170.7453490786044
5	211.94966749852912
10	278.6786045392623
20	319.9827964009445

We get the minimum within-class variance 170.7453490786044 at $\sigma_g = 2.5$.

1.1 Gaussian Filter Implementation

The Gaussian filter was implemented using the following kernel:

$$G_f(x, y) = \frac{1}{K} \exp\left(-\frac{x^2 + y^2}{2\sigma_g^2}\right), \tag{1}$$

where $x, y \in \{-20, -19, \ldots, 19, 20\}$ and σ_g is the standard deviation of the Gaussian kernel. K normalizes the filter such that $\sum_x \sum_y G_f(x, y) = 1$.

2 Question 2: Bilinear Interpolation

We implemented the bilinear interpolation function and obtained the given two results.

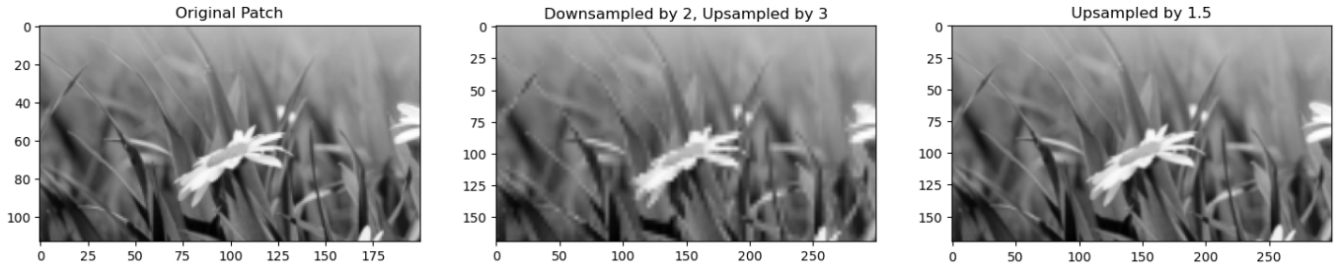

Figure 1: Comparison of the 3 patches

2.1 Observations

1. The 'Downsampled by 2, Upsampled by 3' image shows more artifacts and loss of detail compared to the 'Upsampled by 1.5' image.
2. The 'Upsampled by 1.5' image retains more details and appears smoother.
3. Downsampling followed by upsampling introduces more interpolation artifacts due to the initial loss of information during downsampling.

3 Question 3: Brightness/Contrast Adjustment

We implemented the functions for contrast and brightness adjustments and got the following results.

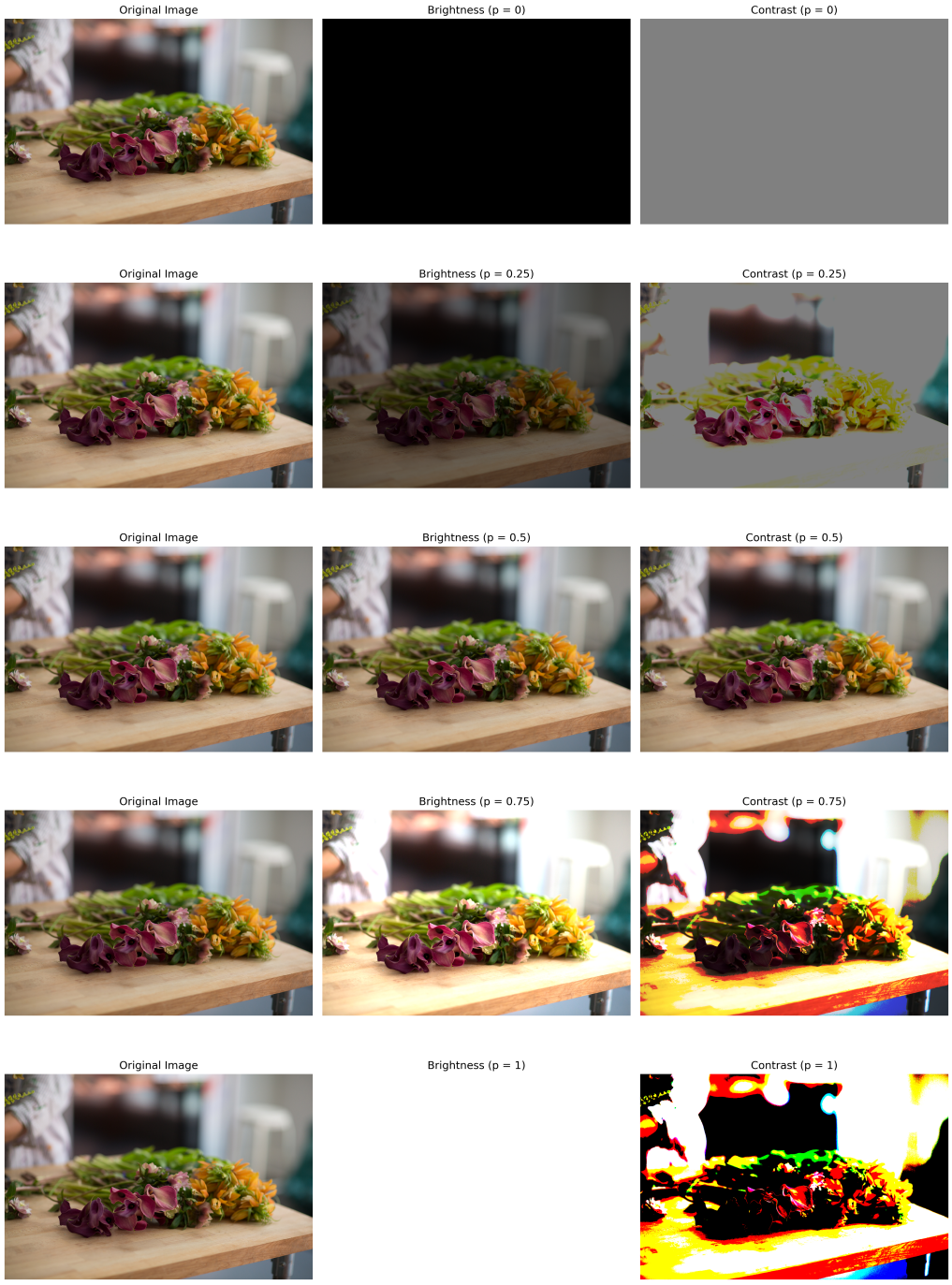

Figure 2: Results of Brightness and Contrast Adjustments