1. Image Sampling
Write a program to change the spatial resolution from 256 x 256 to 128 x 128, 64 x 64, and 32 x 32 pixels using sub-sampling by a factor of 2, 4, and 8 correspondingly. For comparison purposes, resize the sub-sampled images back to the original size 256 x 256 (as shown in the lecture). Show your results using the “lenna” and “peppers” images from the image gallery. The example below shows how to sub-sample and resize an image assuming a factor of 2. Use the same idea for factors 4 and 8.

2. Image Quantization
Write a program to reduce the number of gray levels L in a PGM image from L=256 to: (i) L=128, (ii) L=32, (iii) L=8, and (iv) L=2. Show your results using the “lenna” and “peppers” images. For comparison purposes, subsample the gray levels to visualize the quantized images (e.g., if L=128, you can use 0, 2, 4, ..., 254 with Q=255 in the PGM file instead of 0, 1, 2, ..., 127 with Q=127; similarly, if L=2, you can use 0, 127 with Q=255 instead of 0, 1 with Q=1).

3. Histogram Equalization
(a) Implement the histogram equalization technique. Debug your algorithm using a “test” image (e.g., 5 x 5) to make sure that it works correctly.
(b) Perform histogram equalization on the “boat” and “f_16” images
(c) Show all histograms before and after equalization and analyze your results.
4. **Histogram Specification**

(a) Implement the histogram specification technique. Debug your algorithm using a “test” image (e.g., 5 x 5) to make sure that it works correctly.

(b) Perform histogram specification on “boat” and “f_16” images. Assume that the specified histogram for the “boat” image is the histogram of the “sf” image and that the specified histogram for the “f_16” image is the histogram of the “peppers” image.

(c) Show all histograms before and after specification and analyze your results.

**Laboratory Write-up**

For each programming assignment, you are to turn in a report by closely following the instructions posted on the course’s website. The report is very important in determining your grade for the programming assignment. Be well organized, type your reports, and include figure captions with a brief description for all the figures included in your report. Motivation and initiative are greatly encouraged and will earn extra credit.