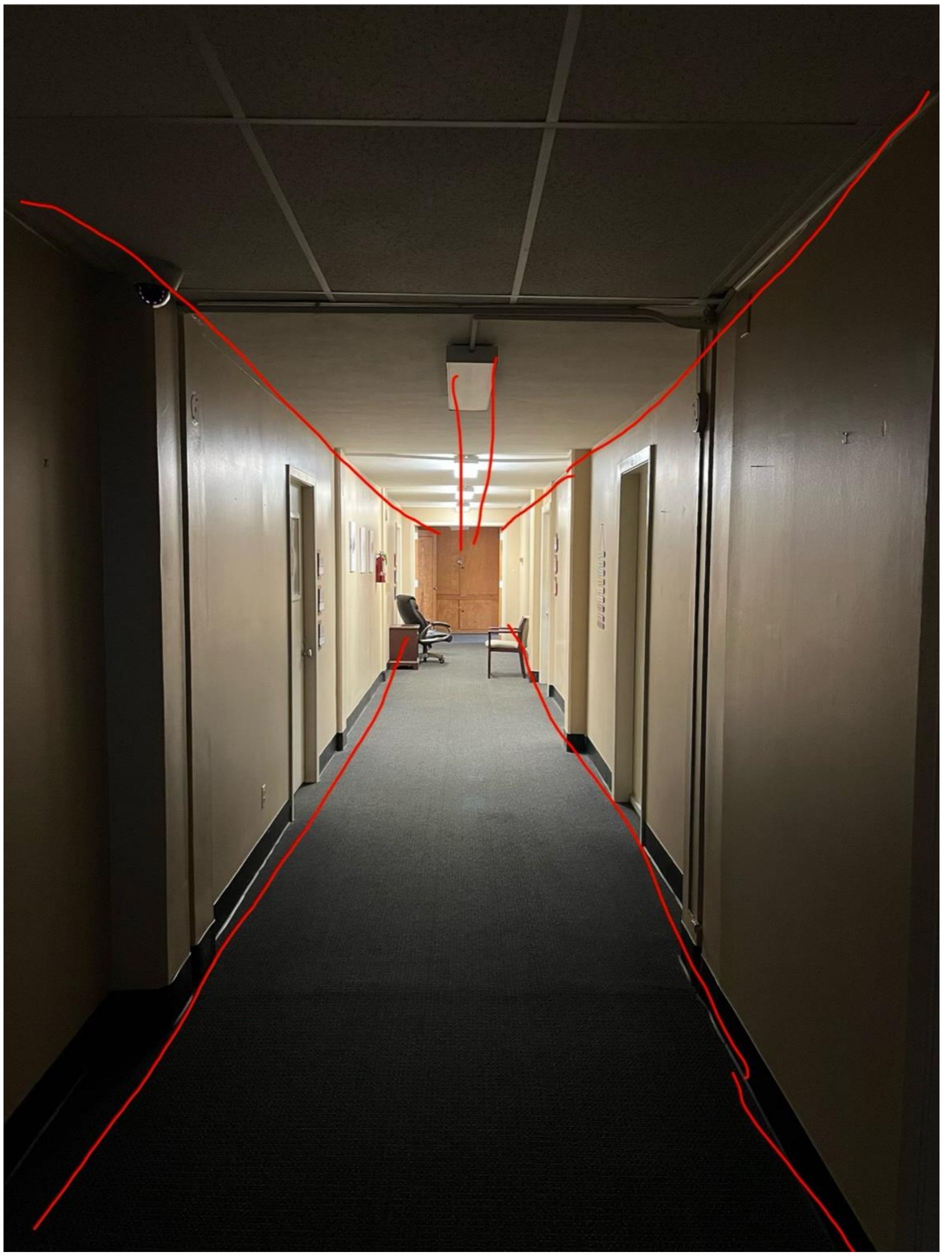
Project 1 Report

Part 1



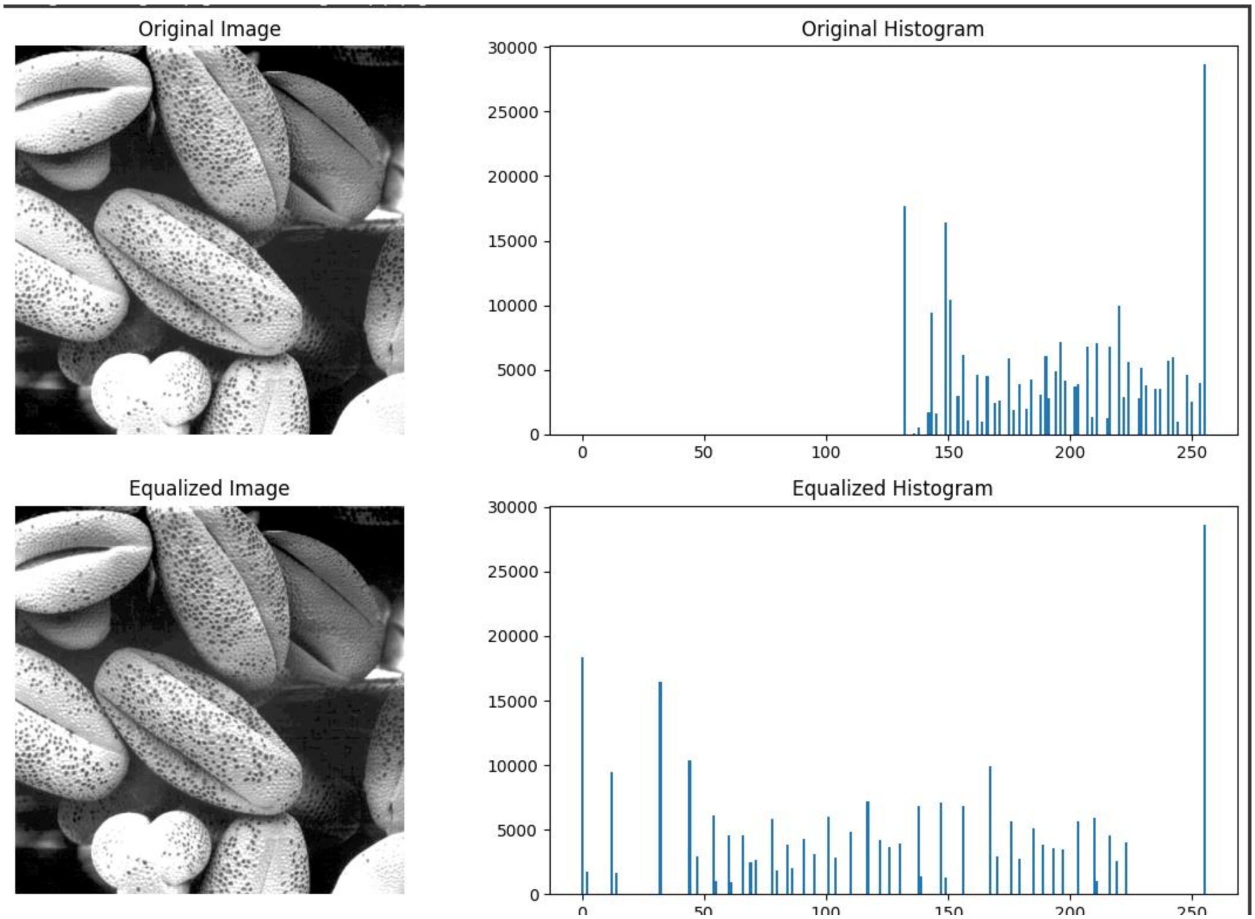
Perspective Projection

Orthographic projection

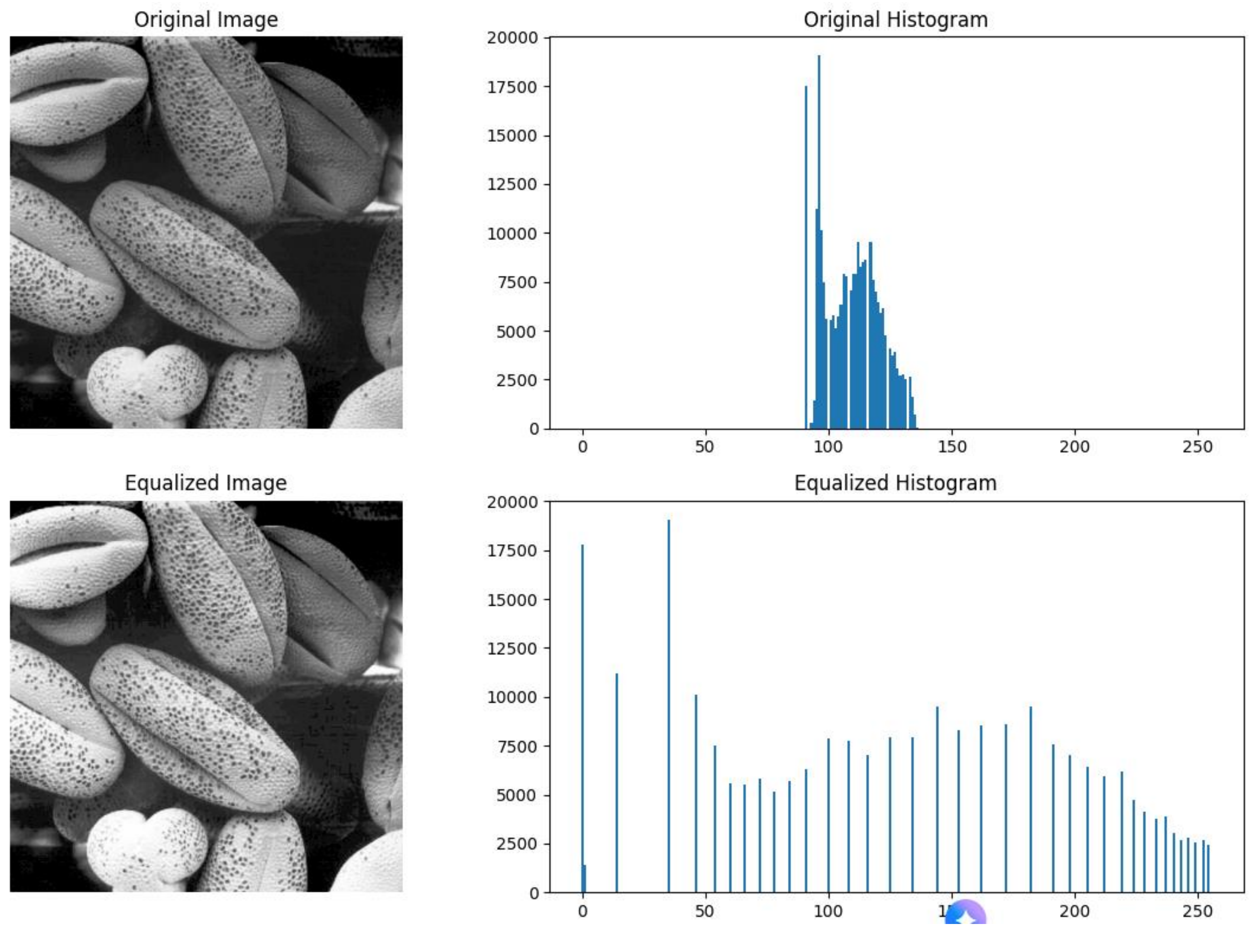
In the perspective picture, the hallway lines look like they're all coming together at a point, which makes the hallway look deeper. In the orthographic picture, the lines look straighter and more parallel, so the hallway looks flatter and less 3D. The difference shows that perspective makes things look more realistic, while orthographic makes them look more even.

Part 2

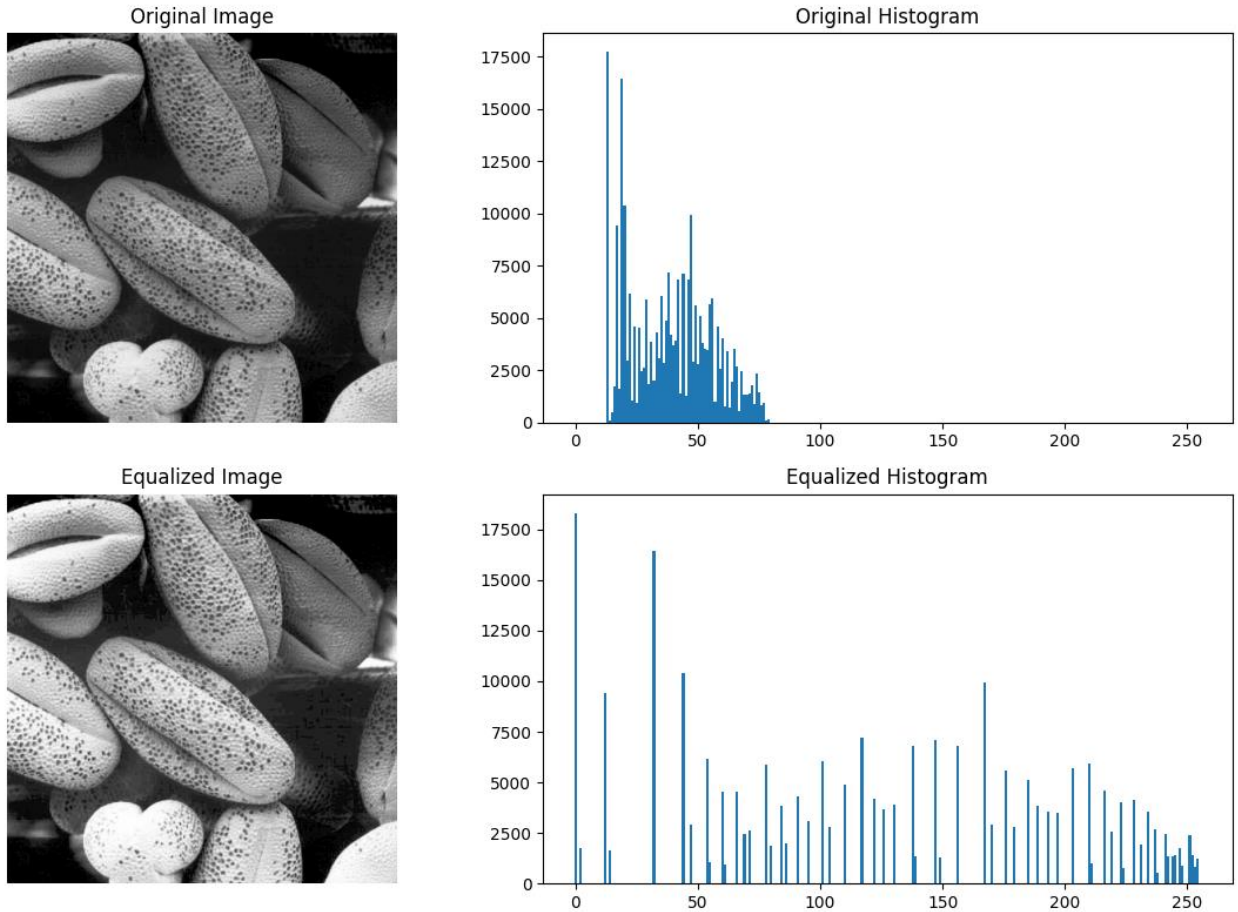
A)



The original image looked kind of faded because most of the pixels were stuck in brighter gray shades. After using histogram equalization, the pixels spread out across the whole brightness range (from dark to light), which made the picture have better contrast and look clearer.

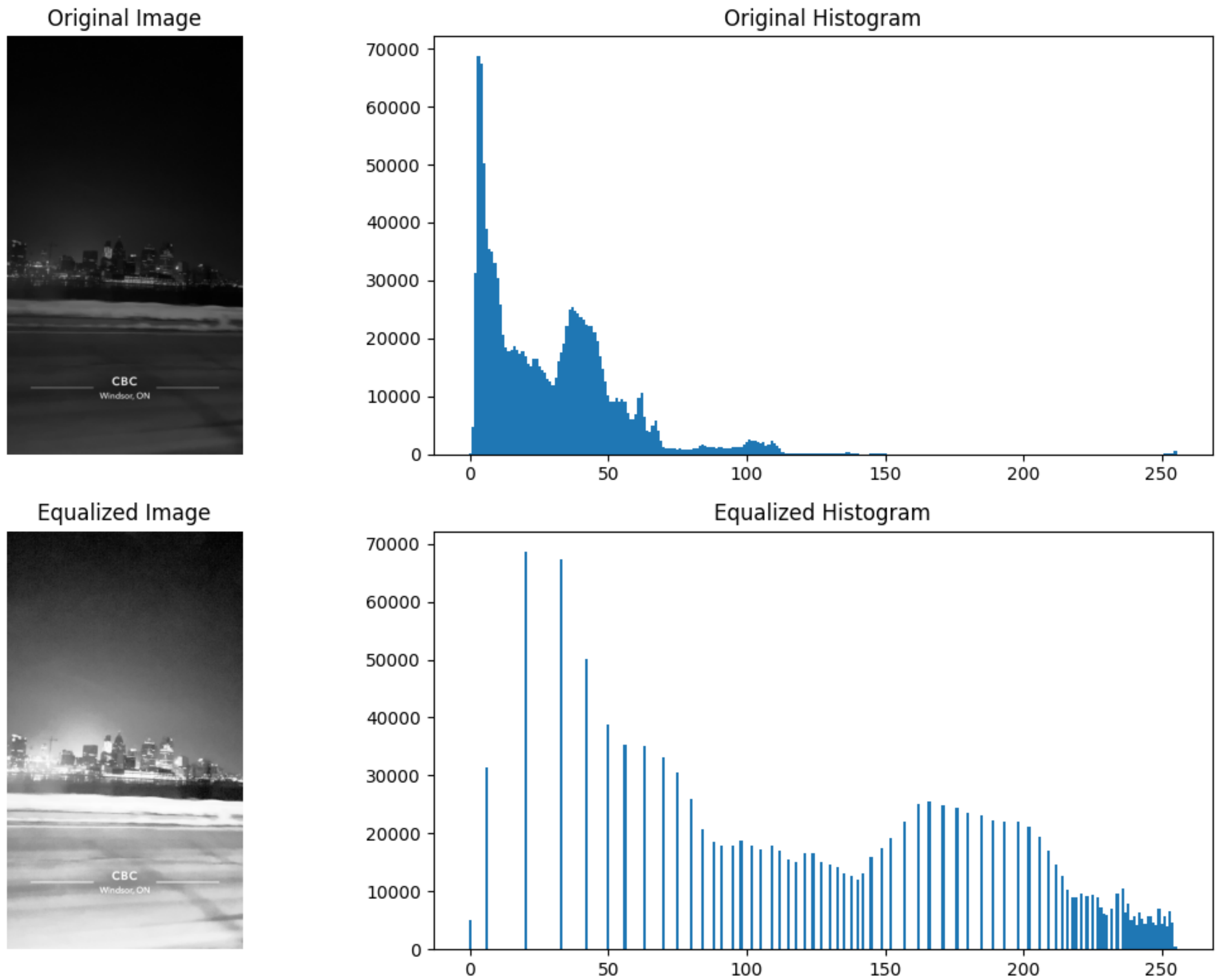


The original image looked kind of flat because most of the shades were stuck around the middle gray range. After equalization, the shades got spread out more evenly, which made the details easier to see and the picture look sharper.



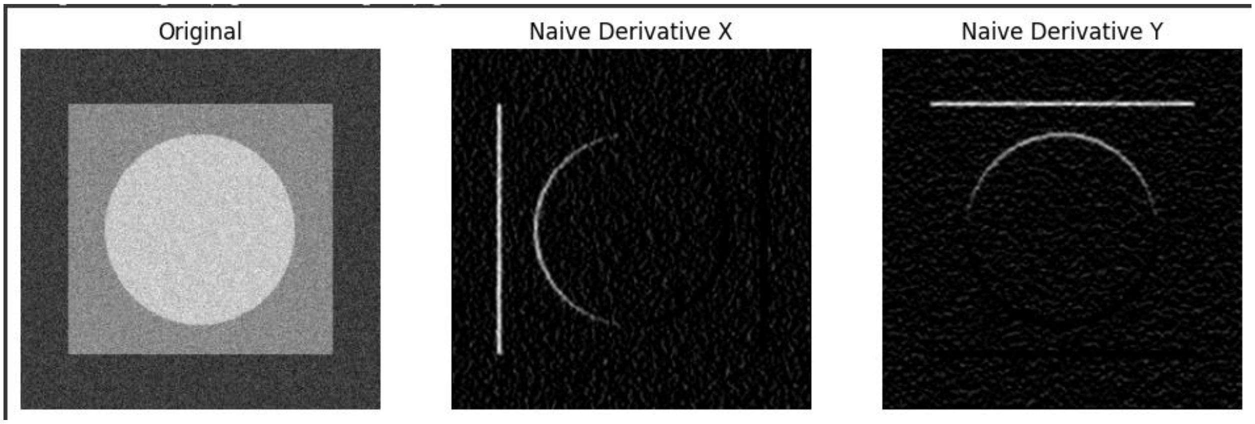
The original image was really dark because most of the shades were in the darker range. After equalization, the brightness levels were spread out, which made the picture look brighter and made it easier to tell apart the dark and light areas.

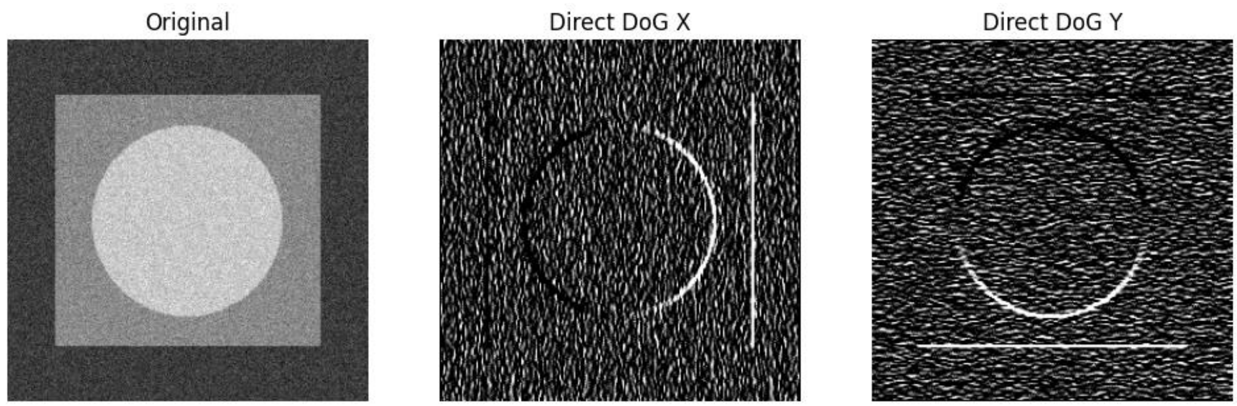
B)



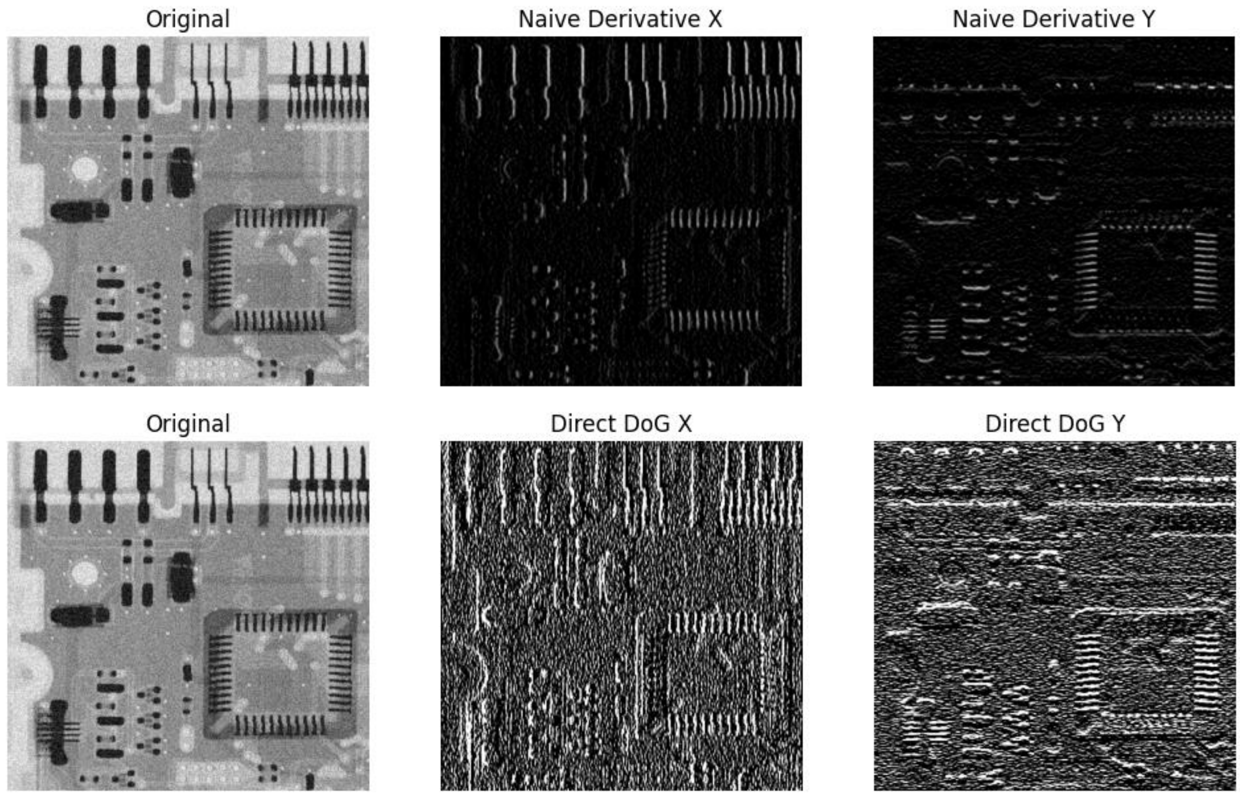
The original skyline photo was very dark, and it was hard to see the buildings. After equalization, the brightness was spread out more evenly, which made the picture brighter and the details of the skyline easier to notice. I think it improved the quality because it made the image clearer overall, but it also added some grainy spots in the darker areas.

D)

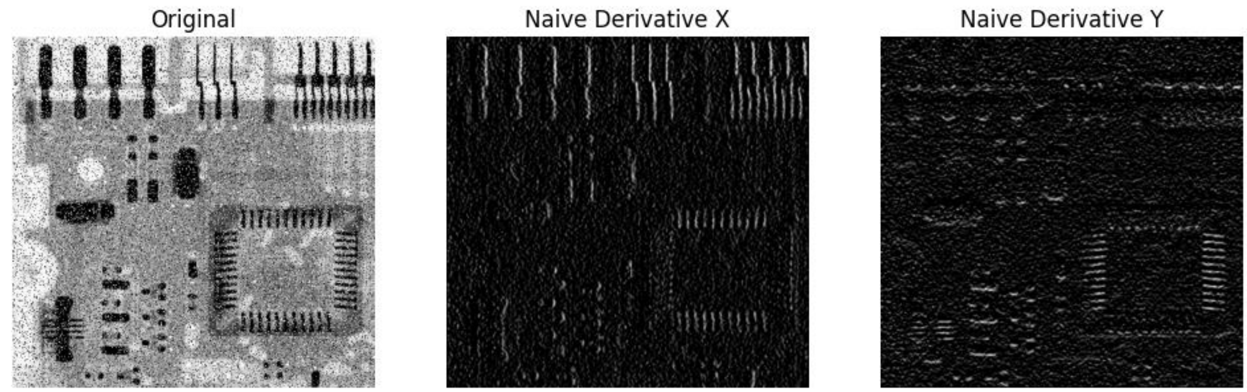


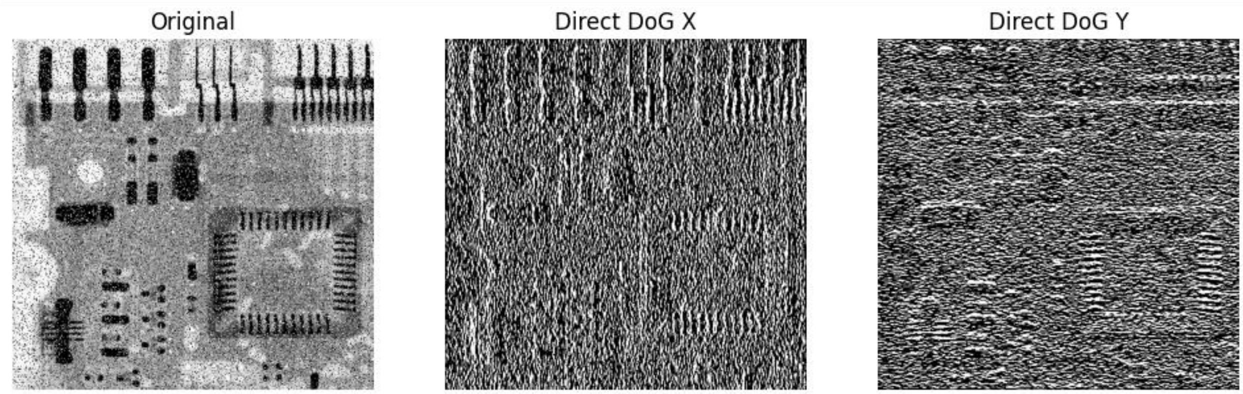


For test image 4, the naive method made the edges of the circle stand out clearly, and the smoothing step helped cut down on random noise. The direct DoG method also found the circle edges, but it looked noisier because it picked up more of the background. Both worked, but the naive method gave a cleaner result, while the direct method was more affected by noise.



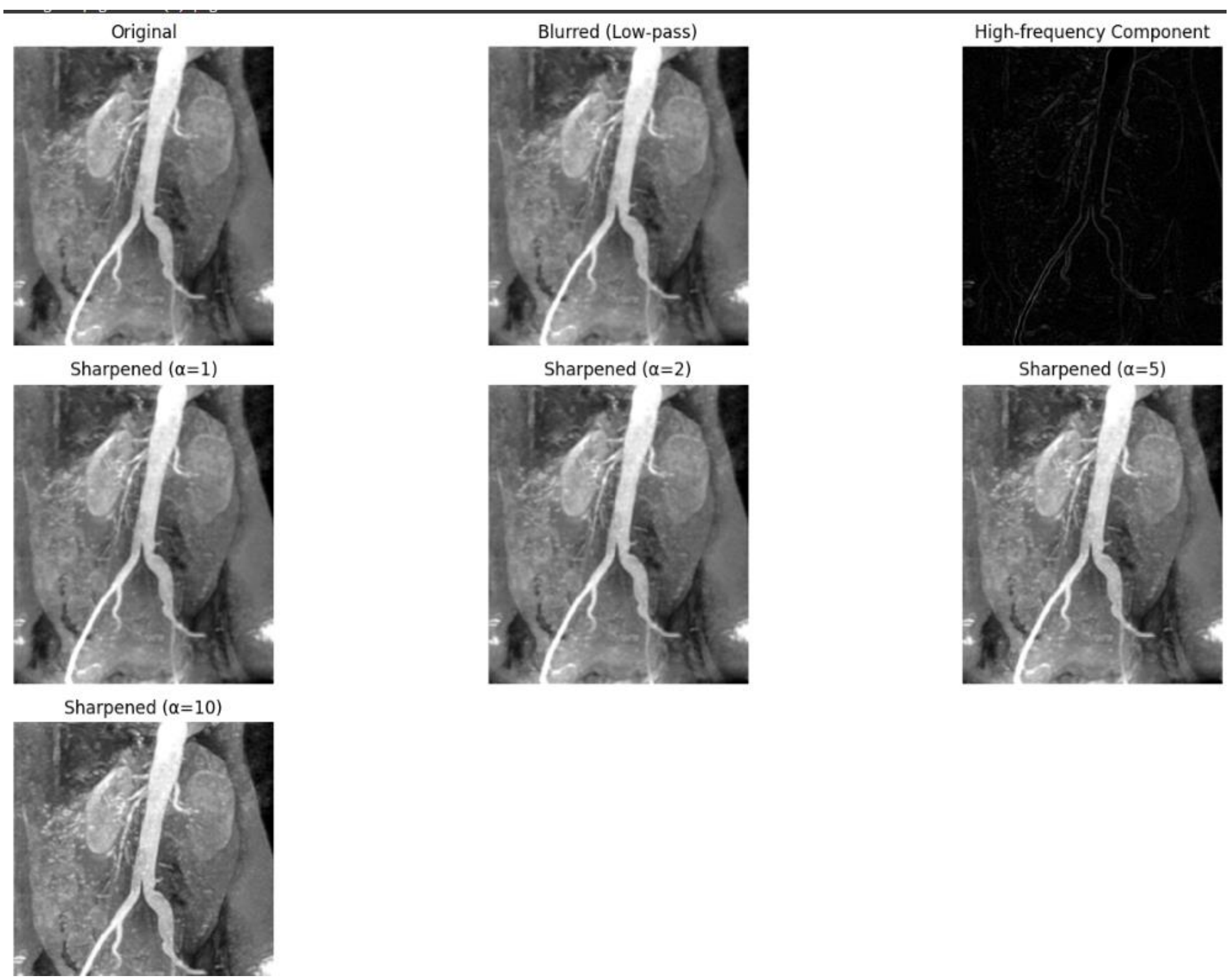
For test image 5, which is a circuit board, the naive method showed the edges of the pins and parts more clearly and reduced a lot of the noise. The direct DoG method also picked out the same edges, but it made the image look grainier and less stable because it added more noise. Both methods found the same structures, but the naive method gave smoother and easier to read results.



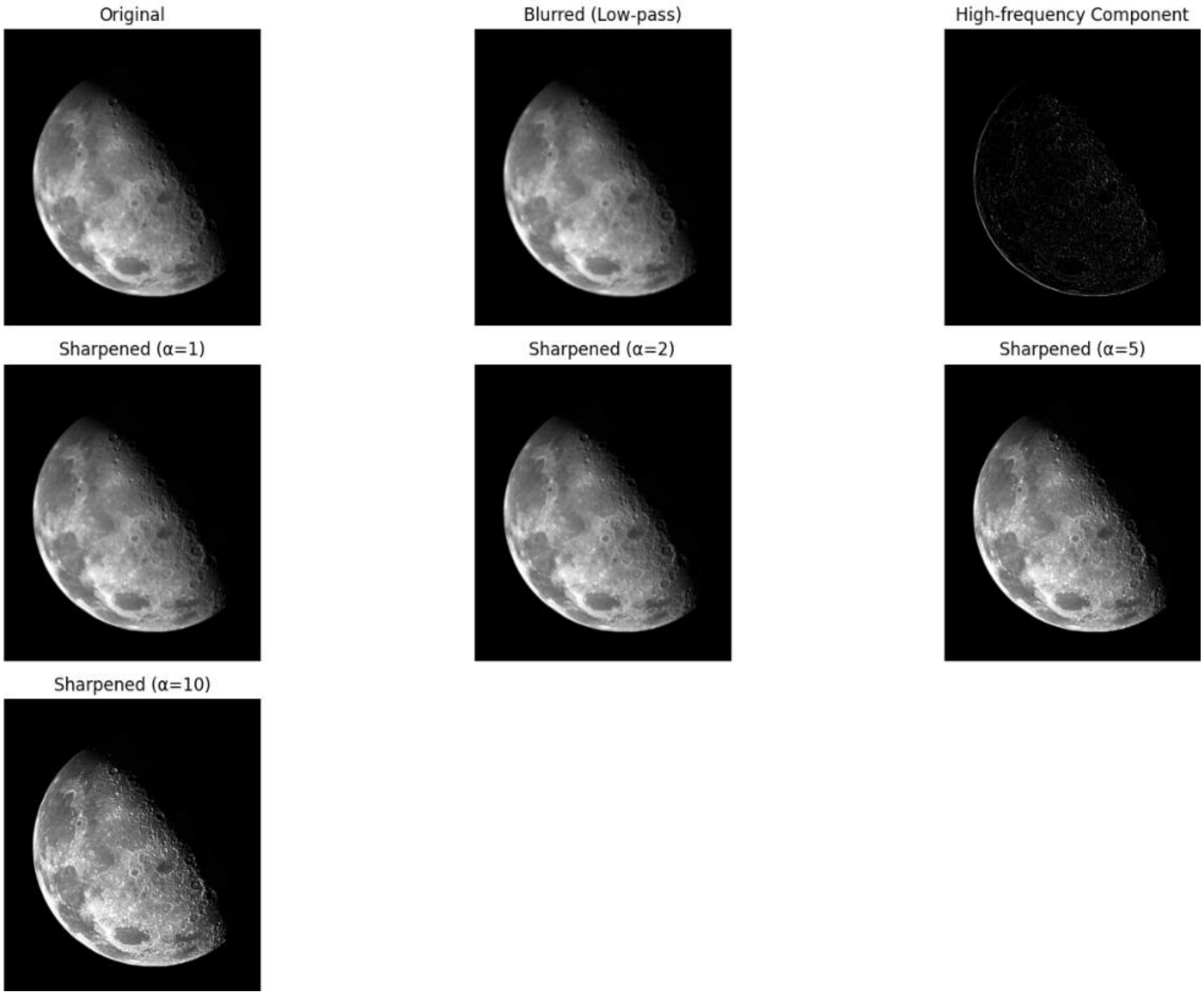


For test image 6, which is very noisy, the naive method gave clearer edges after smoothing, and the outlines of the parts could still be seen even with the noise. The direct DoG method made the noise much worse, creating messy edge maps that were harder to read. Both methods found the main edges, but the naive method handled the noise better and gave cleaner results.

E)



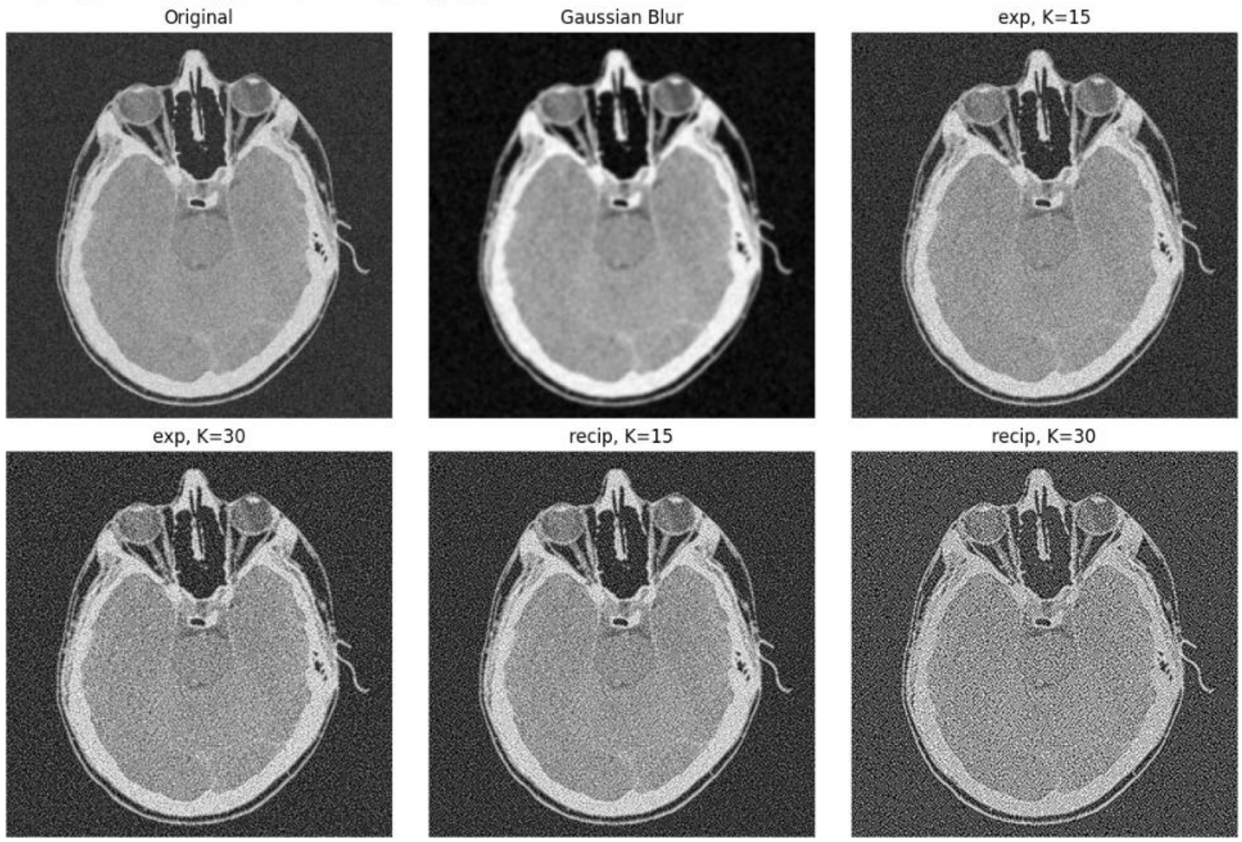
For the CT image, the sharpening process enhanced the visibility of blood vessels and organ structures. At lower blending weights (alpha = 1 and alpha = 2), the sharpening improved the clarity of edges and fine details without introducing much noise. With alpha = 5, the structures became even more pronounced, but some areas of the image also started to look slightly grainy. At alpha = 10, the sharpening effect was very strong, which amplified noise and made the image appear less natural. Moderate sharpening (alpha = 2–5) provided the best balance between improved detail and image quality, while very high alpha values led to unwanted artifacts.



For the moon image, sharpening effectively enhanced the surface details and crater edges. At lower blending weights (alpha = 1 and alpha = 2), the image gained noticeable clarity, and the boundaries between illuminated and shadowed regions became sharper. With alpha = 5, the craters and textures stood out even more, giving the surface a highly detailed appearance, though some areas began to look slightly harsh. At alpha = 10, the sharpening was excessive, introducing an unnatural look and amplifying noise, especially along the edges. Moderate sharpening values (alpha = 2–5) provided the best results by improving contrast and detail without making the image look artificial.

For my own image, I used the skyline photo. With a smaller alpha value (alpha=2), sharpening made the buildings and lights stand out more clearly and improved the overall detail. When I increased alpha to 10, the image became too sharp and grainy, especially in the dark sky, which hurt the quality. This shows that moderate sharpening can improve visibility, but too much sharpening brings out unwanted noise and artifacts.

Part 3


Original
Gaussian Blur
exp, K=15
exp, K=30
recip, K=15
recip, K=30


Original
Gaussian Blur
exp, K=15
exp, K=30
recip, K=15
recip, K=30

Question 1

For both the Lena image and the CT scan, anisotropic diffusion was applied using two different diffusion functions (exponential and reciprocal) with parameter K values of 15 and 30. Compared to Gaussian blur, which reduced noise but also smoothed out important edges and fine details, anisotropic diffusion was much better at preserving structures while still reducing noise in flat regions. With K set to 15, the exponential function produced strong edge preservation but left a bit more noise, while increasing K to 30 gave smoother results but softened some finer details. The reciprocal function generally produced a softer look overall, with weaker edge preservation compared to the exponential case. Anisotropic diffusion outperformed Gaussian blur because it removed noise without destroying edges, and the choice of K allowed us to control the balance between smoothing and detail preservation.

Question 2

When comparing anisotropic diffusion to Gaussian smoothing, the main difference is in how edges are preserved. Gaussian smoothing reduces noise by blurring the entire image evenly, which causes edges and fine structures to become less sharp. In contrast, anisotropic diffusion smooths mostly within regions of similar intensity while limiting smoothing across edges, which keeps important boundaries intact. This is especially clear in the CT scan, where Gaussian blur softens vessel edges, while anisotropic diffusion reduces background noise but still maintains the vessel outlines. Similarly, in the Lena image, Gaussian blur makes the hat and face edges look fuzzy, but anisotropic diffusion preserves those details while still lowering the random noise.