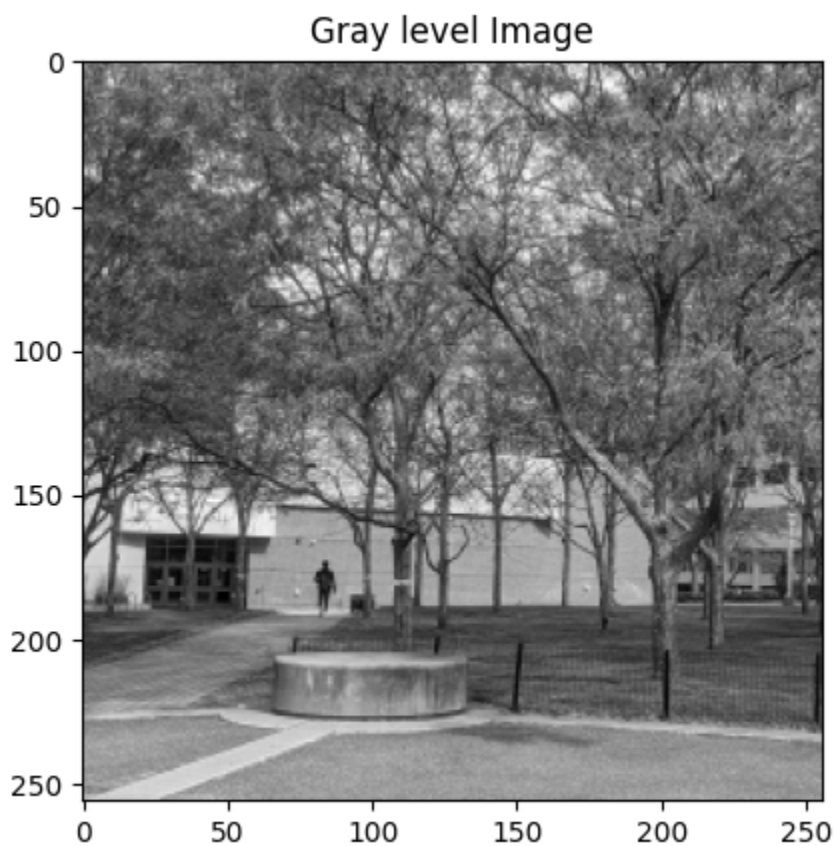


Jason Tan  
10/12/21  
Professor Subbarao  
ESE 358

**Project 3: Grey-level imaging processing, feature detection, and local feature descriptor**

**Part 1: Histogram Equalization**

Python Source Code for part 1:



**Figure 1:** Gray level image Input

Figure 1

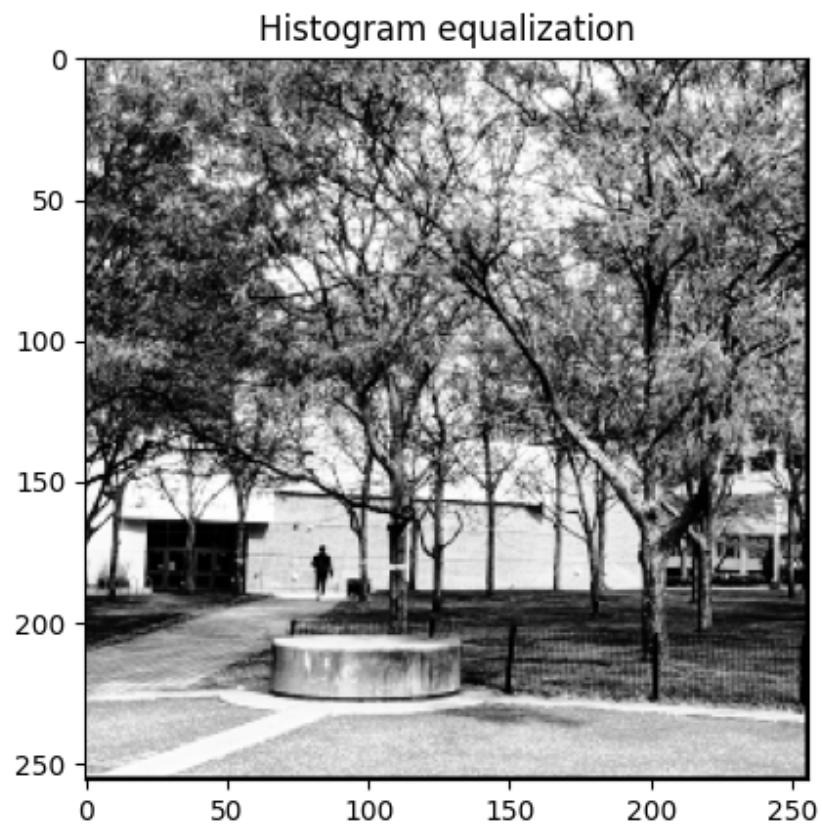
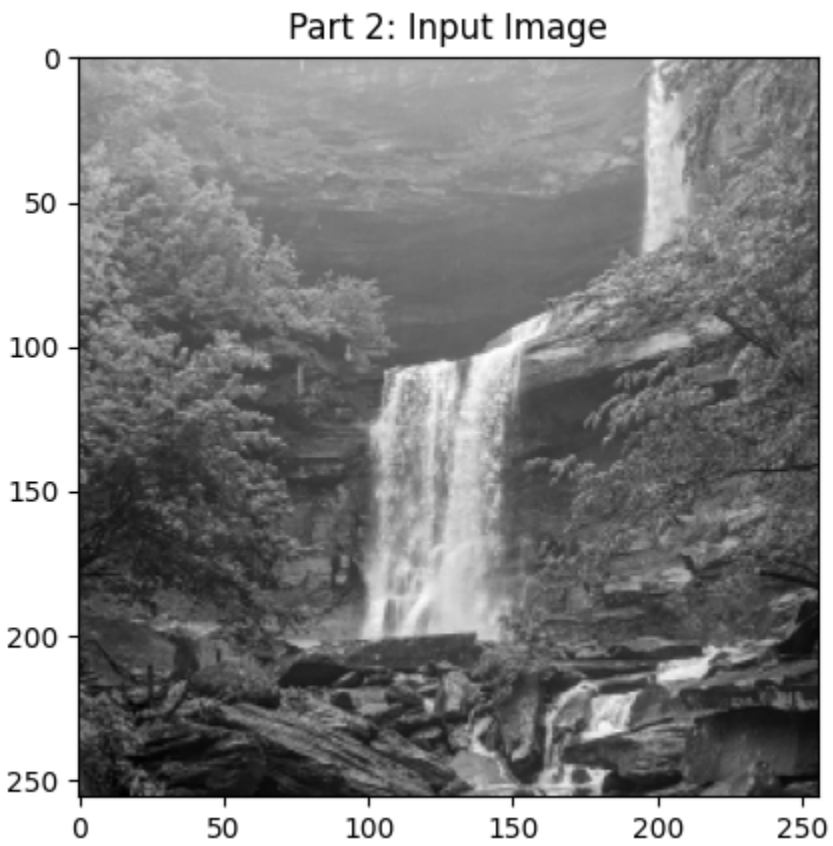


Figure 2: Gray Level Image with histogram equalization applied

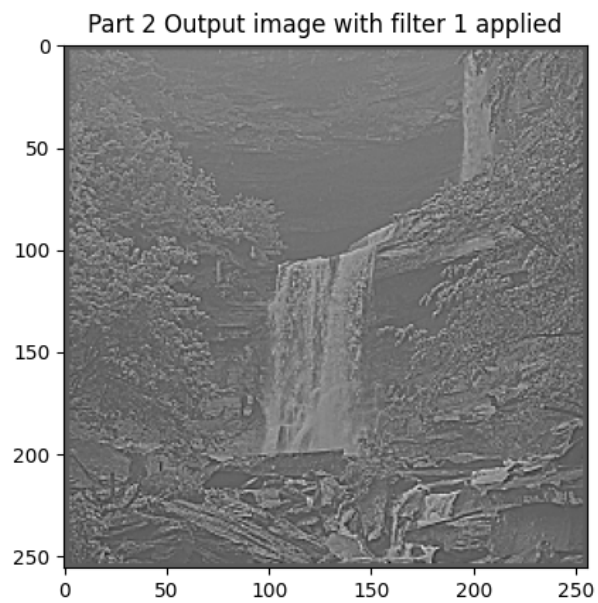
## Part 2 Image filtering and convolution:



**Figure 3:** Gray Level Image Input

Figure 1

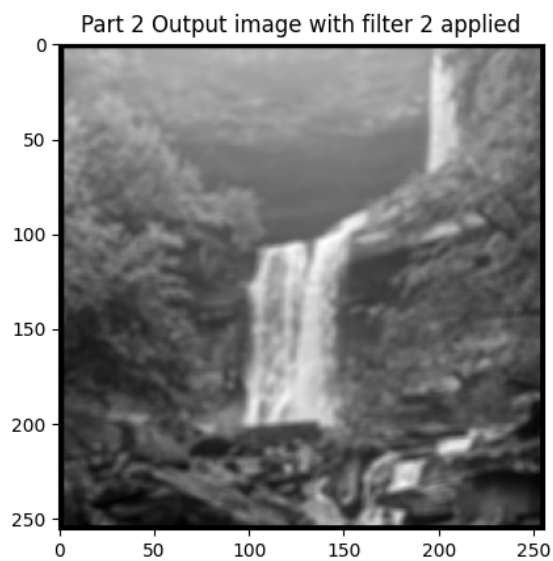
— □ ×



**Figure 4:** Gray Level Image with Filter 1 Applied Output

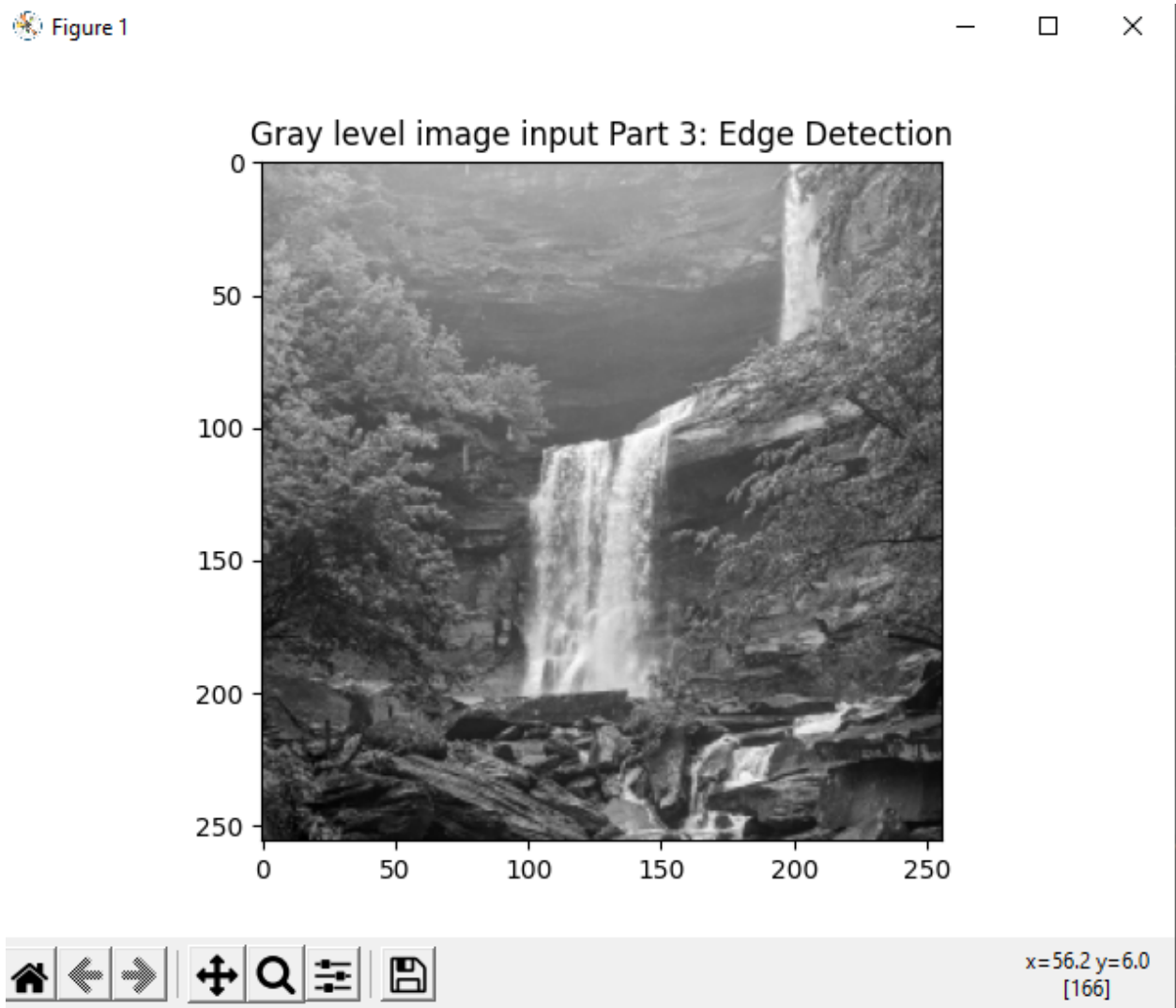
Figure 1

— □ ×



**Figure 5:** Gray Level Image with Filter 2 Applied Output

### Part 3 Edge Detection:

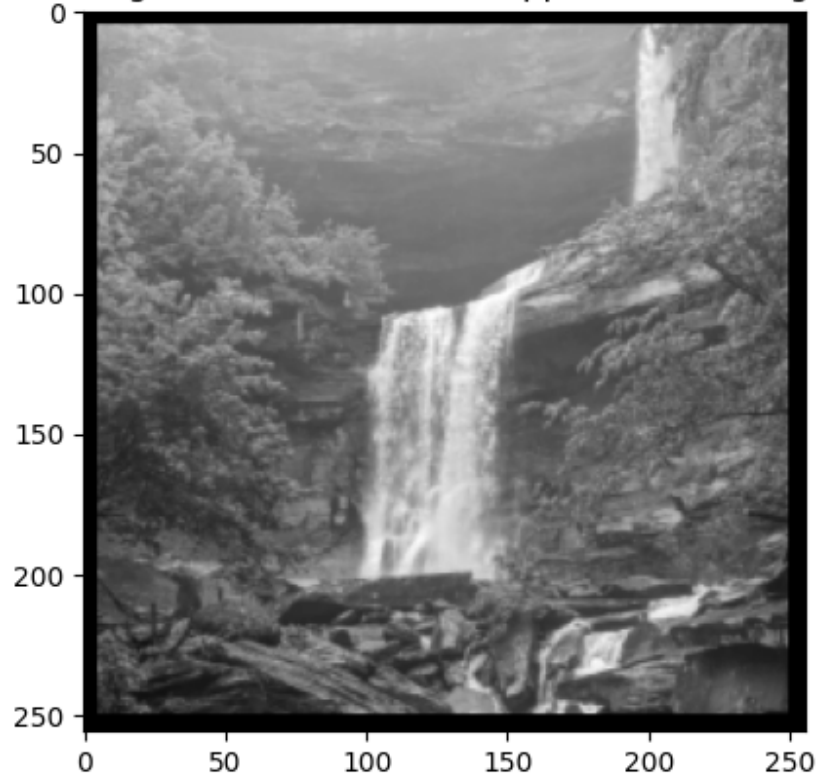


**Figure 6:** Gray Level Image Input

Figure 1



Gray level image with Gaussian filter applied Part 3: Edge Detection

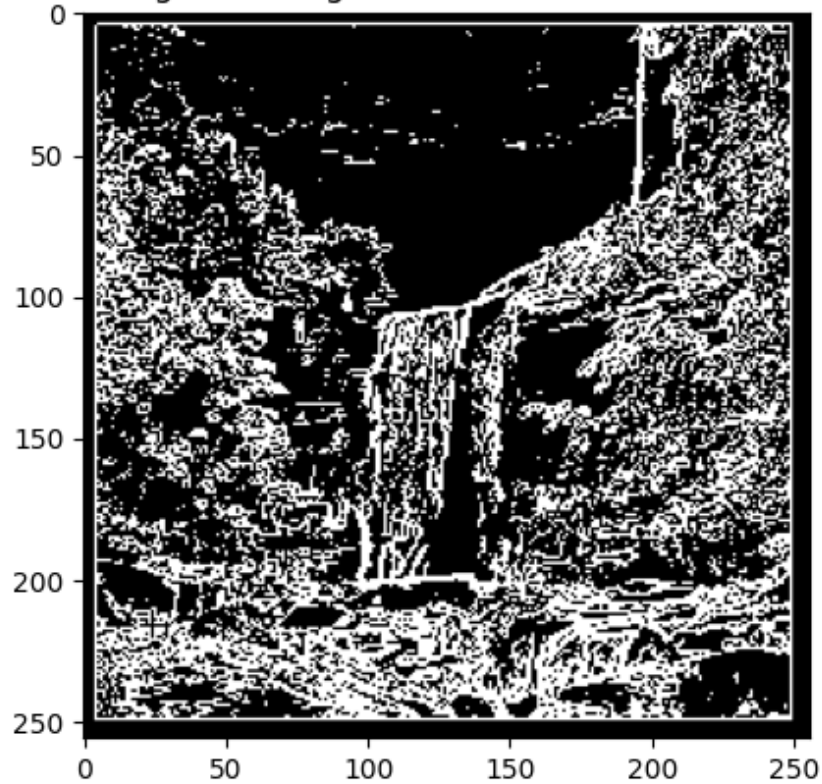


**Figure 7:** Gray Level Image with 9x9 Gaussian Filter Applied

Figure 1



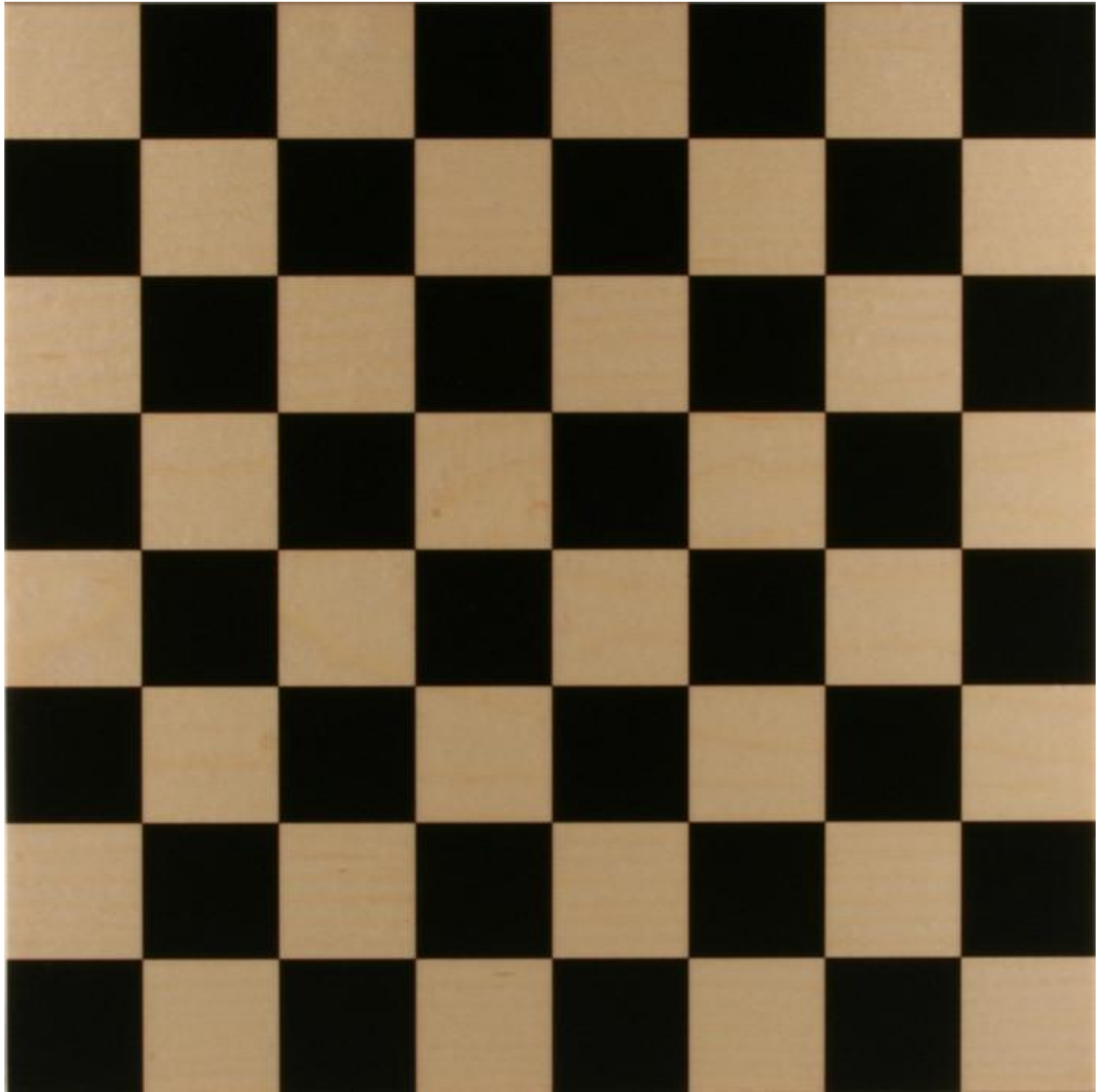
Gray level image with edge detection and Gaussian filter applied



**Figure 8:** Gray Level Image with 9x9 Gaussian Filter and the Edge Detection Applied

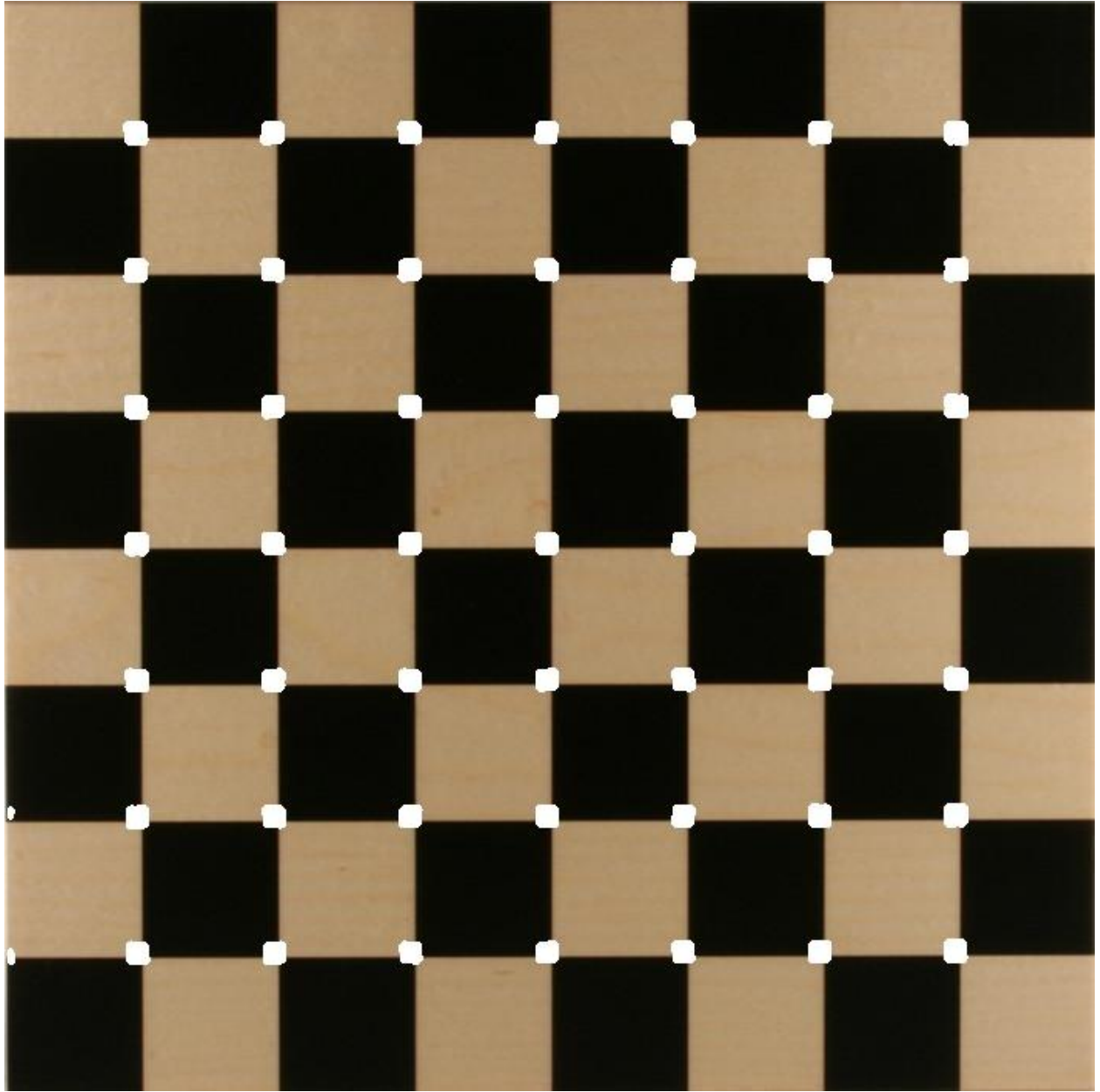
#### **Part 4 Corner detection and local feature descriptor:**

##### **Part a) Corner Detection**



**Figure 9:** Image Input For Part 4





**Figure 10:** Image Output with the Marked Corner Points

**Part b Local feature descriptor:**

**Normalized Histogram for Corner pixels (part4b): (433, 437)**

**0 degrees: 128060.83584411947**

**45 degrees: 17388.09905262821**

**90 degrees: 112871.97522103693**

**135 degrees: 20827.594977192784**

**180 degrees: 129063.94887130038**

**225 degrees: 17571.548679595522**

**270 degrees: 65964.00146988682**

**315 degrees: 18047.857432256857**

**Pixel Coordinates of Corner pixels: (434, 437)**

**Normalized Histogram for Corner pixels (part4b): (434, 437)**

**0 degrees: 128060.83584411947**

**45 degrees: 17388.09905262821**

**90 degrees: 113017.96837156119**

**135 degrees: 20827.594977192784**

**180 degrees: 129063.94887130038**

**225 degrees: 17571.548679595522**

**270 degrees: 65964.00146988682**

**315 degrees: 18047.857432256857**

**Pixel Coordinates of Corner pixels: (435, 437)**

**Normalized Histogram for Corner pixels (part4b): (435, 437)**

**0 degrees: 128060.83584411947**

**45 degrees: 17388.09905262821**

**90 degrees: 113156.56851586126**

**135 degrees: 20827.594977192784**

**180 degrees: 129063.94887130038**

**225 degrees: 17571.548679595522**

**270 degrees: 65964.00146988682**

**315 degrees: 18047.857432256857**

**Pixel Coordinates of Corner pixels: (436, 437)**

**Normalized Histogram for Corner pixels (part4b): (436, 437)**

**0 degrees: 128060.83584411947**

**45 degrees: 17388.09905262821**

**90 degrees: 113156.56851586126**

**135 degrees: 20954.504393707084**

**180 degrees: 129063.94887130038**

**225 degrees: 17571.548679595522**

270 degrees: 65964.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (437, 437)

Normalized Histogram for Corner pixels (part4b): (437, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129063.94887130038  
225 degrees: 17571.548679595522  
270 degrees: 65964.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (438, 437)

Normalized Histogram for Corner pixels (part4b): (438, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129161.69343636668  
225 degrees: 17571.548679595522  
270 degrees: 65964.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (439, 437)

Normalized Histogram for Corner pixels (part4b): (439, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17571.548679595522  
270 degrees: 65964.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (440, 437)

Normalized Histogram for Corner pixels (part4b): (440, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646

270 degrees: 65964.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (441, 437)

Normalized Histogram for Corner pixels (part4b): (441, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646  
270 degrees: 65964.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (442, 437)

Normalized Histogram for Corner pixels (part4b): (442, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646  
270 degrees: 65964.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (517, 437)

Normalized Histogram for Corner pixels (part4b): (517, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646  
270 degrees: 66108.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (518, 437)

Normalized Histogram for Corner pixels (part4b): (518, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646

270 degrees: 66252.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (519, 437)

Normalized Histogram for Corner pixels (part4b): (519, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646  
270 degrees: 66252.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (520, 437)

Normalized Histogram for Corner pixels (part4b): (520, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646  
270 degrees: 66252.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (521, 437)

Normalized Histogram for Corner pixels (part4b): (521, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646  
270 degrees: 66388.00146988682  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (522, 437)

Normalized Histogram for Corner pixels (part4b): (522, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646

270 degrees: 66517.4696126865  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (523, 437)

Normalized Histogram for Corner pixels (part4b): (523, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646  
270 degrees: 66633.95137091499  
315 degrees: 18047.857432256857  
Pixel Coordinates of Corner pixels: (524, 437)

Normalized Histogram for Corner pixels (part4b): (524, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646  
270 degrees: 66633.95137091499  
315 degrees: 18146.902876372173  
Pixel Coordinates of Corner pixels: (525, 437)

Normalized Histogram for Corner pixels (part4b): (525, 437)  
0 degrees: 128060.83584411947  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646  
270 degrees: 66633.95137091499  
315 degrees: 18235.953423815747  
Pixel Coordinates of Corner pixels: (526, 437)

Normalized Histogram for Corner pixels (part4b): (526, 437)  
0 degrees: 128155.03775492811  
45 degrees: 17388.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646

270 degrees: 66633.95137091499  
315 degrees: 18235.953423815747  
Pixel Coordinates of Corner pixels: (527, 437)

Normalized Histogram for Corner pixels (part4b): (527, 437)  
0 degrees: 128155.03775492811  
45 degrees: 17498.09905262821  
90 degrees: 113156.56851586126  
135 degrees: 21068.2057569355  
180 degrees: 129251.50434884396  
225 degrees: 17669.3852780646  
270 degrees: 66633.95137091499  
315 degrees: 18235.953423815747  
Pixel Coordinates of Corner pixels: (528, 437)

**Figure 12:** Displayed Output of the histograms displayed above with some sample corner points shown here