Image Acquisition Assignment 1

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1.1 Camera Properties

a. Small IDS UEye XS camera:

Property	Description
Interface	USB 2
Frame rate	15.0 fps
Resolution	5.04 MP
Shutter	Rolling Shutter
Pixel size	1.40 µm

b. IDS UI-3140CP-C-HQ R2 camera:

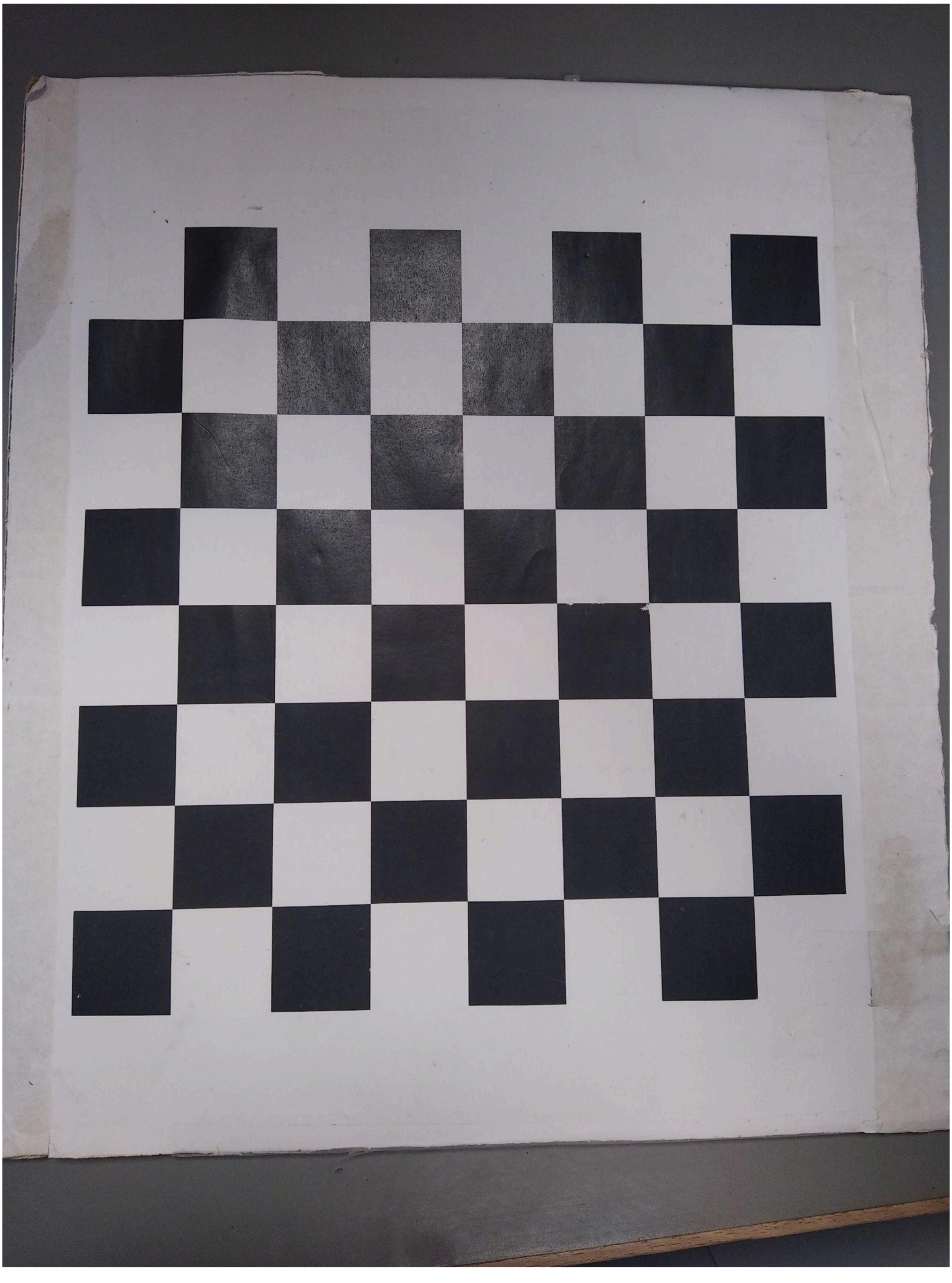
Property	Description
Shutter	Global Shutter
Pixel Class	1.3 MP
Resolution	1.31 Mpx
Optical sensor class	½ “
Pixel size	4.8 µm

c. My cell phone camera (Redmi Note 8 pro):

Property	Description
Resolution	64 MP Ultra high-resolution
Optical sensor class	1/1.7 “
Pixel size	0.8 µm
Photo resolution	3840x2160 pixels

Zoom	10x digital zoom

1.2 Capture a test image



<table>
<tr><td>FileDateTime</td><td>1736756983 (2025-01-13 09:29:43)</td></tr>
<tr><td>FileSize</td><td>4303577</td></tr>
<tr><td>FileType</td><td>2</td></tr>
<tr><td>MimeType</td><td>image/jpeg</td></tr>
<tr><td>SectionsFound</td><td>ANY_TAG, IFD0, THUMBNAIL, EXIF, GPS, INTEROP</td></tr>
<tr><td>Model</td><td>Core-X4</td></tr>
<tr><td>Software</td><td>L762-user 10 QKQ1.200407.002 L762.20.27 release-keys</td></tr>
<tr><td>DateTime</td><td>2025:01:13 09:15:17</td></tr>
<tr><td>YCbCrPositioning</td><td>1</td></tr>
<tr><td>Exif_IFD_Pointer</td><td>241</td></tr>
<tr><td>ResolutionUnit</td><td>2</td></tr>
<tr><td>GPS_IFD_Pointer</td><td>722</td></tr>
<tr><td>XResolution</td><td>72/1</td></tr>
<tr><td>YResolution</td><td>72/1</td></tr>
<tr><td>Make</td><td>Crosscall</td></tr>
<tr><td>THUMBNAIL</td><td><table>
<tr><td>JPEGInterchangeFormat</td><td>1036</td></tr>
<tr><td>JPEGInterchangeFormatLength</td><td>9923</td></tr>
<tr><td>Compression</td><td>6</td></tr>
<tr><td>ResolutionUnit</td><td>2</td></tr>
<tr><td>XResolution</td><td>72/1</td></tr>
<tr><td>YResolution</td><td>72/1</td></tr>
</table></td></tr>
<tr><td>ISOSpeedRatings</td><td>115</td></tr>
</table>

ExposureProgram	0
FNumber	179/100
ExposureTime	1/100
SensingMethod	0
SubSecTimeDigitized	943918
SubSecTimeOriginal	943918
SubSecTime	943918
FocalLength	4710/1000
Flash	16
MeteringMode	2
SceneCaptureType	0
InteroperabilityOffset	692
FocalLengthIn35mmFilm	0
DateTimeDigitized	2025:01:13 09:15:17
ExifImageLength	4000
WhiteBalance	0
DateTimeOriginal	2025:01:13 09:15:17
BrightnessValue	328/100
ExifImageWidth	3000
ExposureMode	0
ApertureValue	167/100
ComponentsConfiguration	
ColorSpace	1
SceneType	
ShutterSpeedValue	6644/1000
ExifVersion	0220
FlashPixVersion	0100

GPSLatitudeRef	N
GPSLatitude	58/1 56/1 154967/10000
GPSLongitudeRef	E
GPSLongitude	5/1 41/1 309659/10000
GPSAltitudeRef	
GPSAltitude	119500/1000
GPSTimeStamp	2/1 25/1 56/1
GPSProcessingMode	ASCIICELLID
GPSDateStamp	1970:01:21
InterOperabilityIndex	R98
InterOperabilityVersion	0100
APP1	

c.
d2=(p2*d1)/p1
d2=(406*400)/285=570mm

1.3 Install and check Python

a. What kind of computer do you use?

Personal laptop (HP Victus 16)

b. What kind of OS do you use?

Windows 11

c. Which version of Python (sys version) do you use?

Python 3.11.0

d. Which editor, or IDE, do you use?

Visual Studio Code

e. Which version of numpy do you use?

Numpy 1.26.1

f. Which version of OpenCV do you use?

OpenCV 4.10.0.84

g. Which version of Qt do you use?

PyQt 6.8.0

h. Have you installed and checked pyueye?

Yes, I have version 4.96.952

i. Have you installed and checked qimage2ndarray?

Yes, I have version 1.10.0

######################################

j. What kind of computer do you use?

Personal laptop (MSI Thin GF63 12VE)

k. What kind of OS do you use?

Windows 11

l. Which version of Python (sys version) do you use?

Python 3.12.8

m. Which editor, or IDE, do you use?

SublimeText

n. Which version of numpy do you use?

Numpy 2.2.1

o. Which version of OpenCV do you use?

OpenCV 4.10.0.84

p. Which version of Qt do you use?

PyQt 6.8.

q. Have you installed and checked pyueye?

Yes, I have version 4.96.952

r. Have you installed and checked qimage2ndarray?

Yes, I have version 1.10.0

1.4.1 Test image in OpenCV

Code used:

```
try:
    import cv2
except ImportError:
    print("Error importing cv2, functions from myImageTools have cv2 options disabled.")

img = cv2.imread('C:/Users/jesus/ELE610/py/IA 1.4/table.jpg')
print(f"{img.dtype=}, {img.size=}, {img.ndim=}, {img.shape=}")


height, width = img.shape[:2]

startX = (height) // 3
stratY = (width) // 3

endX = height - startX
endY = width - stratY

cropped_img = img[startX:endX, stratY:endY]
print(f"{cropped_img.dtype=}, {cropped_img.size=}, {cropped_img.ndim=}, {cropped_img.shape=}")
```

```python
original_img_bytes = img.nbytes
cropped_img_bytes = cropped_img.nbytes

print(f"Original Image Size: {original_img_bytes} bytes")
print(f"Cropped Image Size: {cropped_img_bytes} bytes")

cv2.imwrite("C:/Users/jesus/ELE610/py/IA 1.4/cropped_table.jpg", cropped_img)

cv2.imshow("Cropped Image", cropped_img)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

a. Result of print-statement:

img.dtype=dtype('uint8'), img.size=5760000, img.ndim=3, img.shape=(1600, 1200, 3)

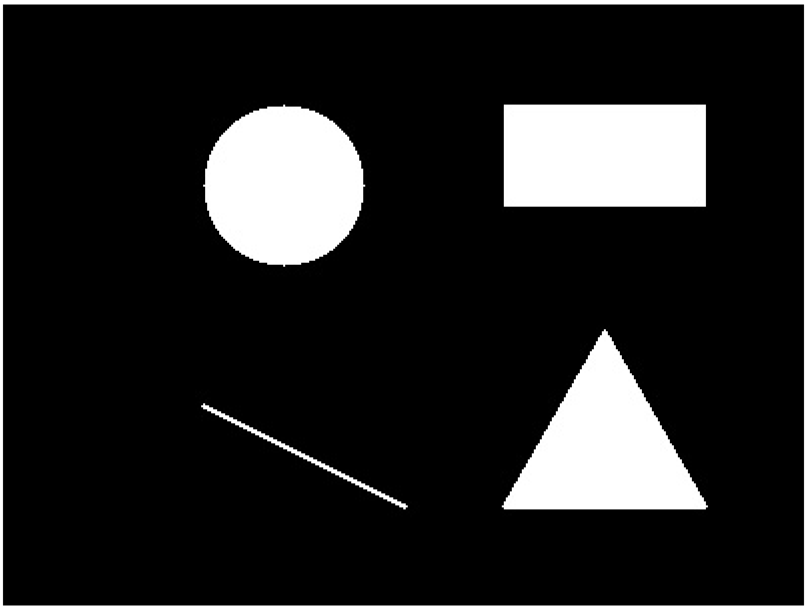
b. Print statement for the cropped image:

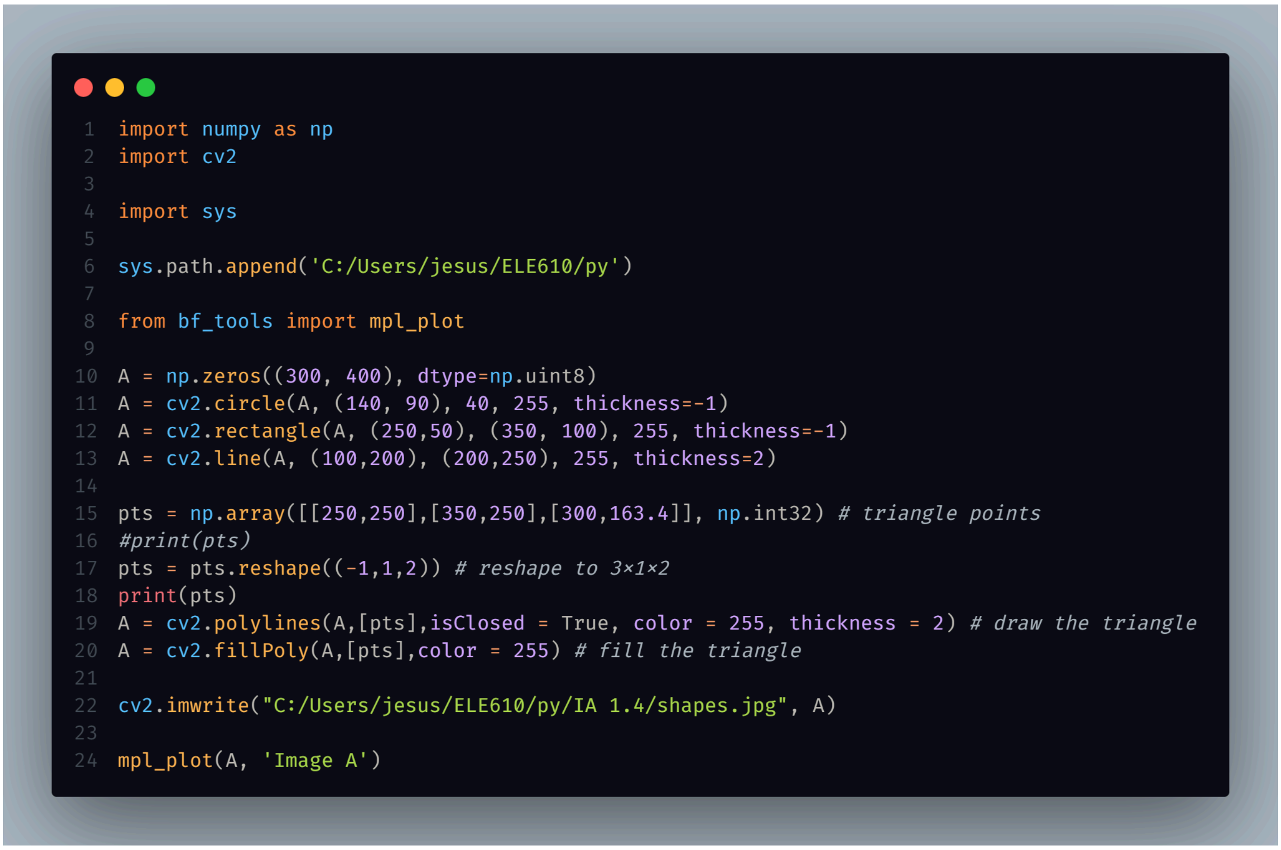
cropped_img.dtype=dtype('uint8'), cropped_img.size=640800, cropped_img.ndim=3, cropped_img.shape=(534, 400, 3)

c. Sizes of the original and cropped images:

Original Image Size: 5760000 bytes
Cropped Image Size: 640800 bytes

1.4.3 Make an image with some simple shapes

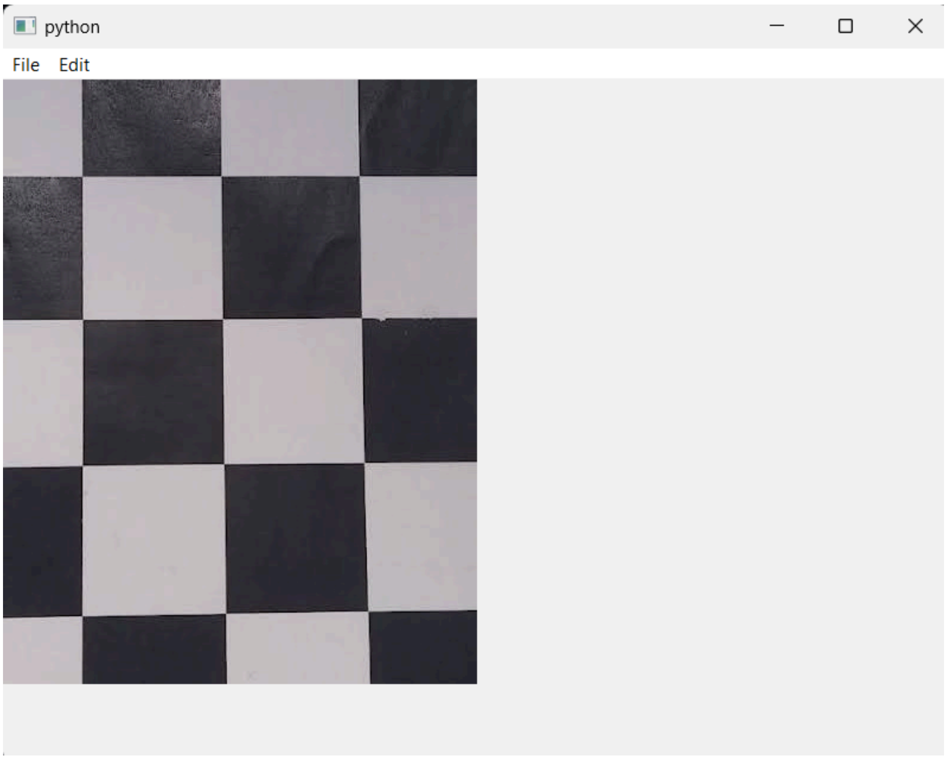




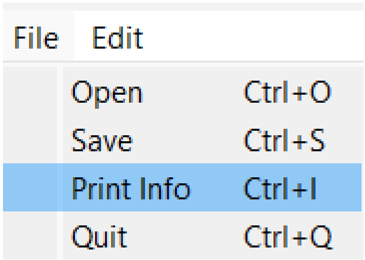
```python
import numpy as np
import cv2

import sys

sys.path.append('C:/Users/jesus/ELE610/py')

from bf_tools import mpl_plot

A = np.zeros((300, 400), dtype=np.uint8)
A = cv2.circle(A, (140, 90), 40, 255, thickness=-1)
A = cv2.rectangle(A, (250,50), (350, 100), 255, thickness=-1)
A = cv2.line(A, (100,200), (200,250), 255, thickness=2)

pts = np.array([[250,250],[350,250],[300,163.4]], np.int32) # triangle points
#print(pts)
pts = pts.reshape((-1,1,2)) # reshape to 3×1×2
print(pts)
A = cv2.polylines(A,[pts],isClosed = True, color = 255, thickness = 2) # draw the triangle
A = cv2.fillPoly(A,[pts],color = 255) # fill the triangle

cv2.imwrite("C:/Users/jesus/ELE610/py/IA 1.4/shapes.jpg", A)

mpl_plot(A, 'Image A')
```

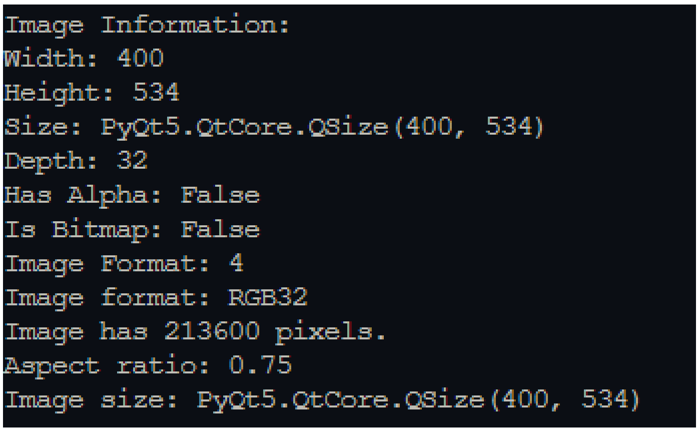
1.4.4 Image edges and image lines

Display an image on screen:



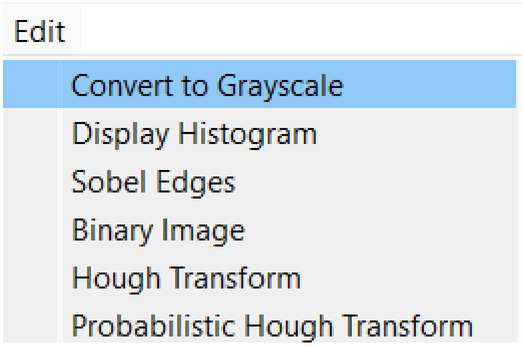
Print image information:

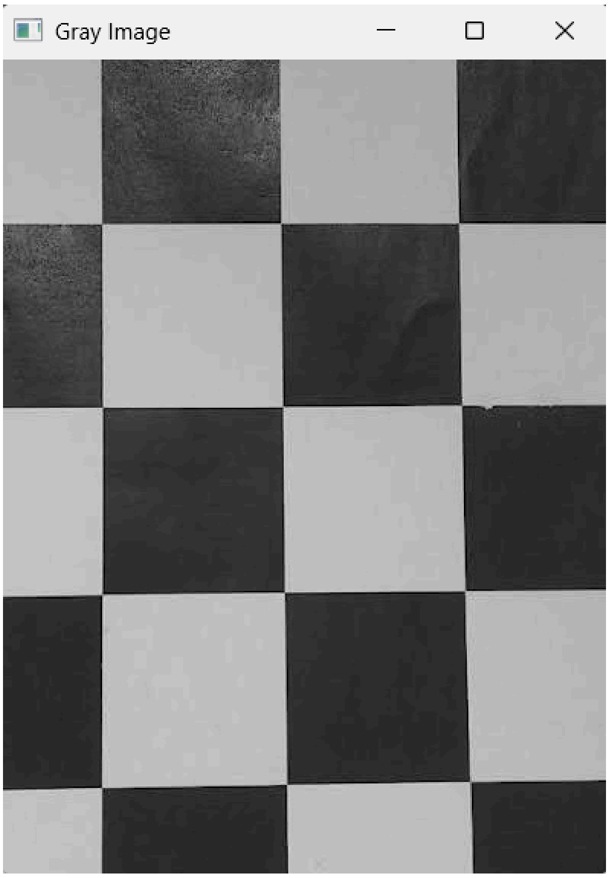




```
Image Information:
Width: 400
Height: 534
Size: PyQt5.QtCore.QSize(400, 534)
Depth: 32
Has Alpha: False
Is Bitmap: False
Image Format: 4
Image format: RGB32
Image has 213600 pixels.
Aspect ratio: 0.75
Image size: PyQt5.QtCore.QSize(400, 534)
```

Convert the image into a grayscale image:





Display a histogram of the pixel values in the grayscale image:

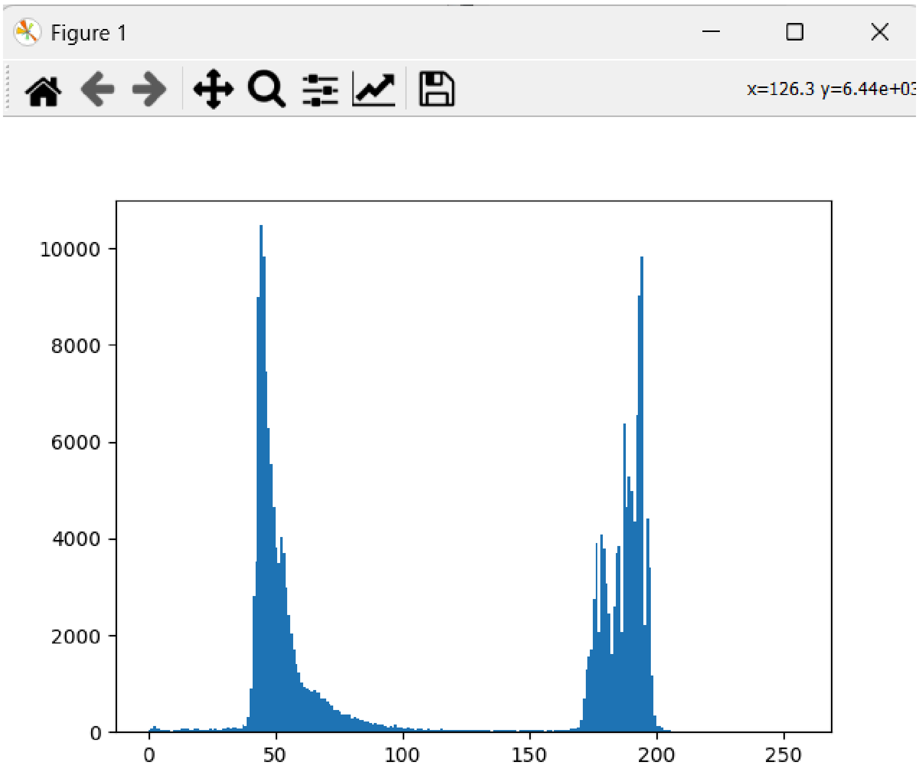
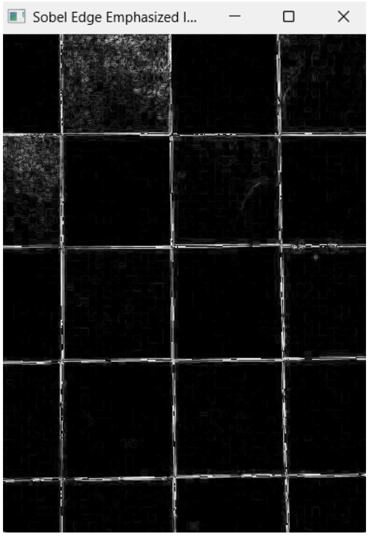


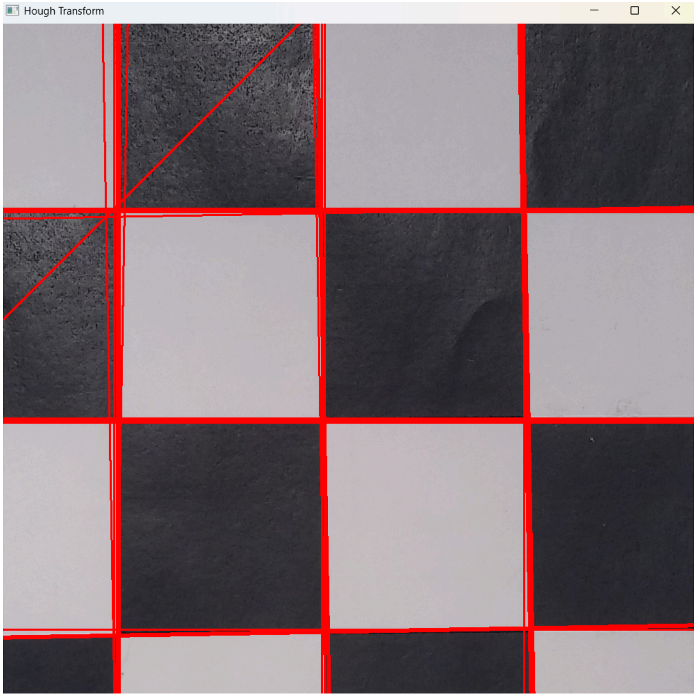
Image edges vs Image lines:

- Image edges: refer to the boundaries or transitions between different regions or objects in an image. They are typically characterized by a significant change in intensity color.
- Lines: refer to straight or curved sequences of pixels thought of as the boundaries of objects or regions. Lines are specific types of edges that have a particular orientation and length.

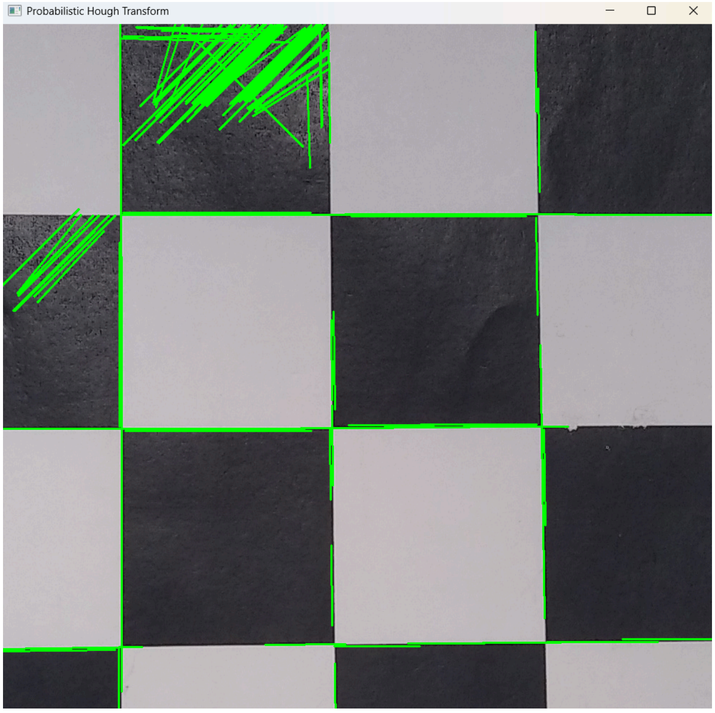
Emphasize image edges using the sobel filter:



Hough Transform:



Probabilistic Hough Transform:


Probabilistic Hough Transform