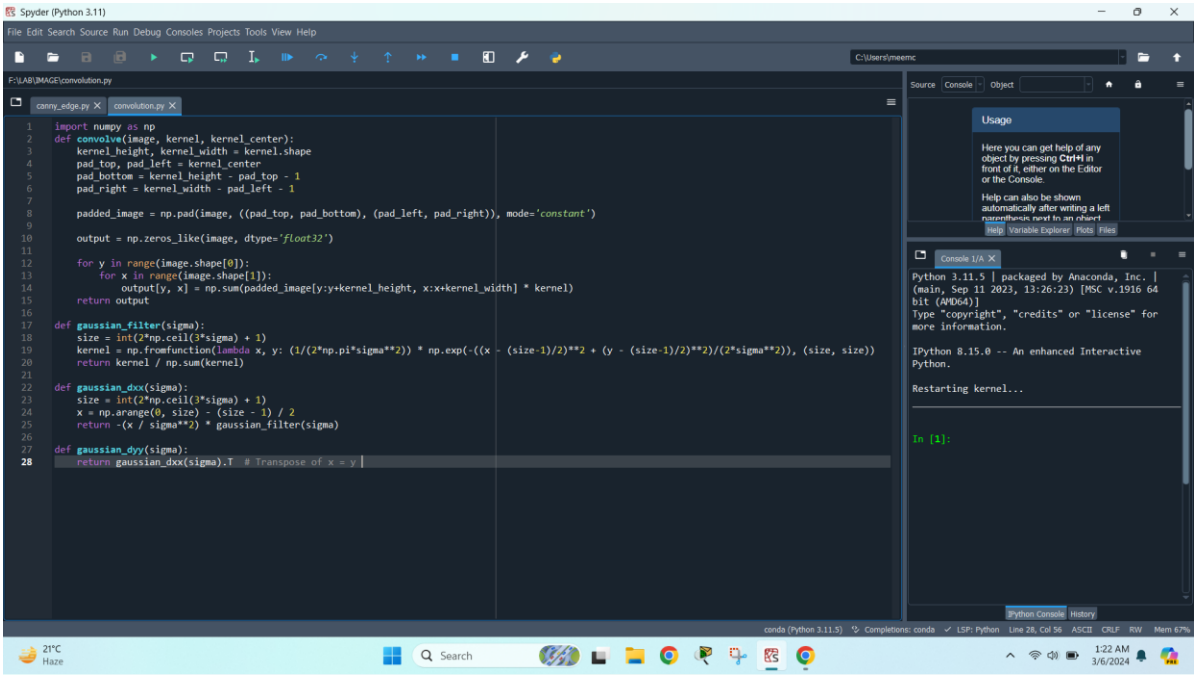
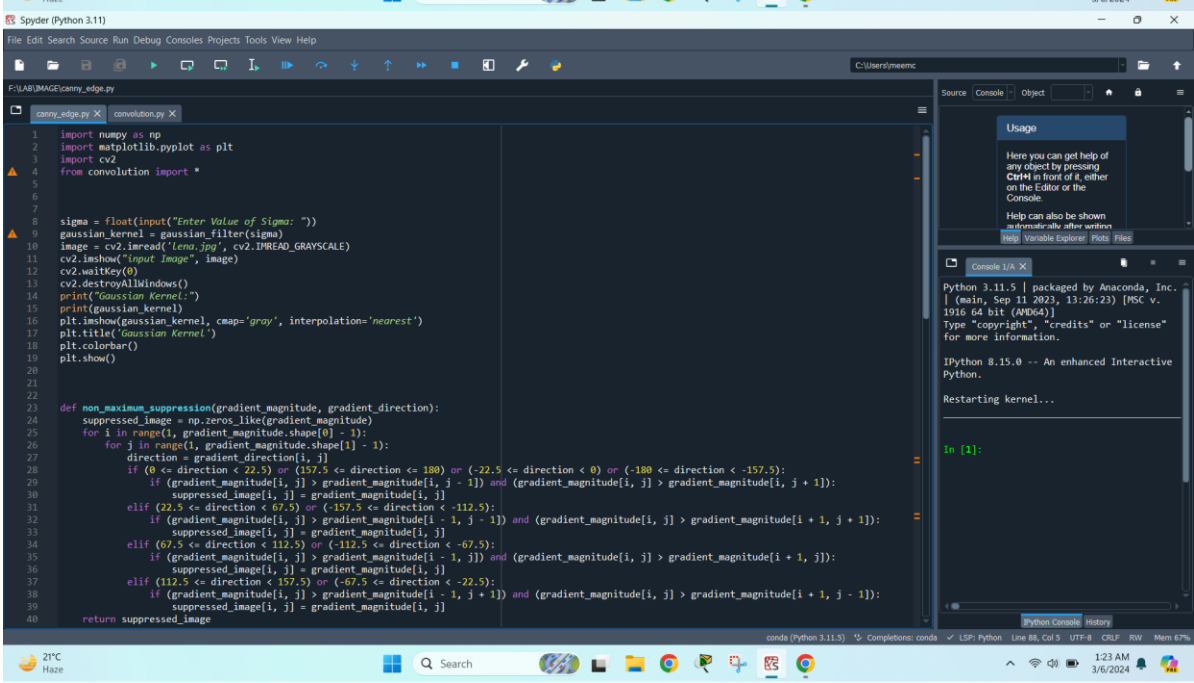

Spyder (Python 3.11)
File Edit Search Source Run Debug Consoles Projects Tools View Help
F:\LAB\IMAGE\convolution.py
canny_edge.py
convolution.py
import numpy as np
def convolve(image, kernel, kernel_center):
kernel_height, kernel_width = kernel.shape
pad_top, pad_left = kernel_center
pad_bottom = kernel_height - pad_top - 1
pad_right = kernel_width - pad_left - 1
padded_image = np.pad(image, ((pad_top, pad_bottom), (pad_left, pad_right)), mode='constant')
output = np.zeros_like(image, dtype='float32')
for y in range(image.shape[0]):
for x in range(image.shape[1]):
output[y, x] = np.sum(padded_image[y:y+kernel_height, x:x+kernel_width] * kernel)
return output
def gaussian_filter(sigma):
size = int(2*np.ceil(3*sigma) + 1)
kernel = np.fromfunction(lambda x, y: (1/(2*np.pi*sigma**2)) * np.exp(-((x - (size-1)/2)**2 + (y - (size-1)/2)**2)/(2*sigma**2)), (size, size))
return kernel / np.sum(kernel)
def gaussian_dxx(sigma):
size = int(2*np.ceil(3*sigma) + 1)
x = np.arange(0, size) - (size - 1) / 2
return -(x / sigma**2) * gaussian_filter(sigma)
def gaussian_dyy(sigma):
return gaussian_dxx(sigma).T # Transpose of x = y
Usage
Here you can get help of any object by pressing Ctrl+I in front of it, either on the Editor or the Console.
Help can also be shown automatically after writing a left
Help Variable Explorer Plots Files
Console 1/A
Python 3.11.5 | packaged by Anaconda, Inc. | (main, Sep 11 2023, 13:26:23) [MSC v.1916 64 bit (AMD64)]
Type "copyright", "credits" or "license" for more information.
IPython 8.15.0 -- An enhanced Interactive Python.
Restarting kernel...
In [1]:
Python Console History
conda (Python 3.11.5) Completions: conda LSP: Python Line 28, Col 56 ASCII CRLF RW Mem 67%
21°C Haze
Search
1:22 AM 3/6/2024


Spyder (Python 3.11)
File Edit Search Source Run Debug Consoles Projects Tools View Help
F:\LAB\IMAGE\canny_edge.py
canny_edge.py
convolution.py
import numpy as np
import matplotlib.pyplot as plt
import cv2
from convolution import *
sigma = float(input("Enter Value of Sigma: "))
gaussian_kernel = gaussian_filter(sigma)
image = cv2.imread('lena.jpg', cv2.IMREAD_GRAYSCALE)
cv2.imshow("Input Image", image)
cv2.waitKey(0)
cv2.destroyAllWindows()
print("Gaussian Kernel:")
print(gaussian_kernel)
plt.imshow(gaussian_kernel, cmap='gray', interpolation='nearest')
plt.title('Gaussian Kernel')
plt.colorbar()
plt.show()
def non_maximum_suppression(gradient_magnitude, gradient_direction):
suppressed_image = np.zeros_like(gradient_magnitude)
for i in range(1, gradient_magnitude.shape[0] - 1):
for j in range(1, gradient_magnitude.shape[1] - 1):
direction = gradient_direction[i, j]
if (0 <= direction < 22.5) or (157.5 <= direction <= 180) or (-22.5 <= direction < 0) or (-180 <= direction < -157.5):
if (gradient_magnitude[i, j] > gradient_magnitude[i, j - 1]) and (gradient_magnitude[i, j] > gradient_magnitude[i, j + 1]):
suppressed_image[i, j] = gradient_magnitude[i, j]
elif (22.5 <= direction < 67.5) or (-157.5 <= direction < -112.5):
if (gradient_magnitude[i, j] > gradient_magnitude[i - 1, j - 1]) and (gradient_magnitude[i, j] > gradient_magnitude[i + 1, j + 1]):
suppressed_image[i, j] = gradient_magnitude[i, j]
elif (67.5 <= direction < 112.5) or (-112.5 <= direction < -67.5):
if (gradient_magnitude[i, j] > gradient_magnitude[i - 1, j]) and (gradient_magnitude[i, j] > gradient_magnitude[i + 1, j]):
suppressed_image[i, j] = gradient_magnitude[i, j]
elif (112.5 <= direction < 157.5) or (-67.5 <= direction < -22.5):
if (gradient_magnitude[i, j] > gradient_magnitude[i - 1, j + 1]) and (gradient_magnitude[i, j] > gradient_magnitude[i + 1, j - 1]):
suppressed_image[i, j] = gradient_magnitude[i, j]
return suppressed_image
Usage
Here you can get help of any object by pressing Ctrl+I in front of it, either on the Editor or the Console.
Help can also be shown
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Console 1/A
Python 3.11.5 | packaged by Anaconda, Inc. | (main, Sep 11 2023, 13:26:23) [MSC v.1916 64 bit (AMD64)]
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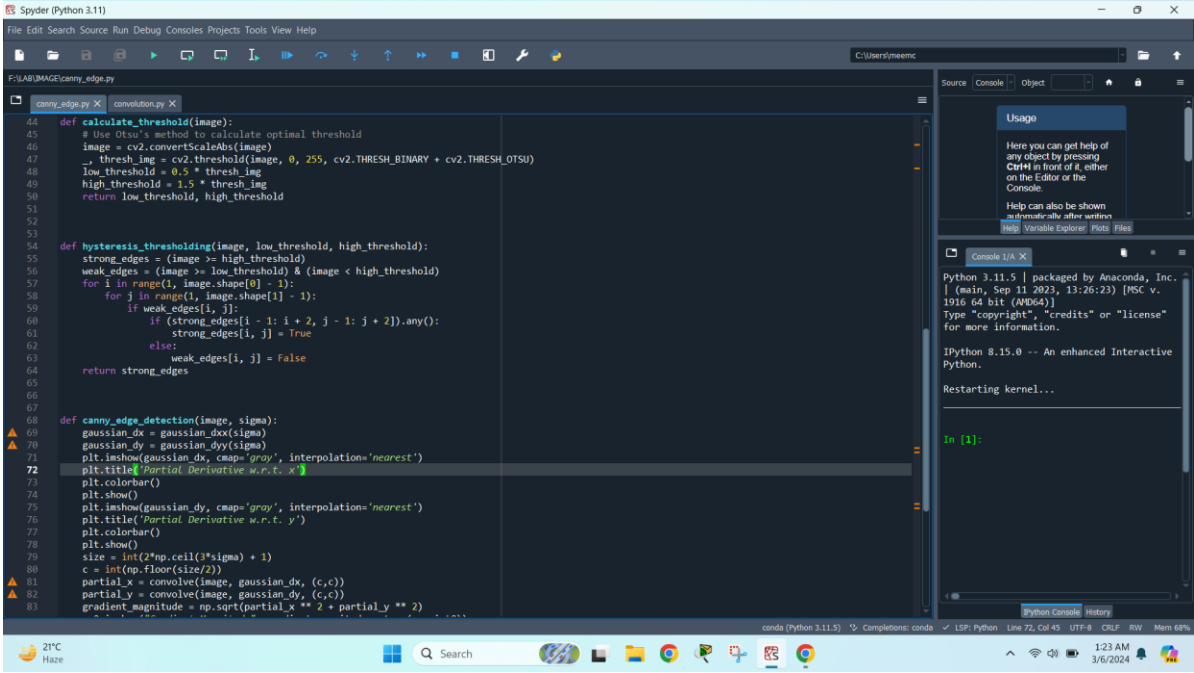
IPython 8.15.0 -- An enhanced Interactive Python.
Restarting kernel...
In [1]:
Python Console History
conda (Python 3.11.5) Completions: conda LSP: Python Line 88, Col 5 UTF-8 CRLF RW Mem 67%
21°C Haze
Search
1:23 AM 3/6/2024


Spyder (Python 3.11)
File Edit Search Source Run Debug Consoles Projects Tools View Help
F:\LAB\IMAGE\canny_edge.py
canny_edge.py
convolution.py
def calculate_threshold(image):
# Use Otsu's method to calculate optimal threshold
image = cv2.convertScaleAbs(image)
_, thresh_img = cv2.threshold(image, 0, 255, cv2.THRESH_BINARY + cv2.THRESH_OTSU)
low_threshold = 0.5 * thresh_img
high_threshold = 1.5 * thresh_img
return low_threshold, high_threshold
def hysteresis_thresholding(image, low_threshold, high_threshold):
strong_edges = (image >= high_threshold)
weak_edges = (image >= low_threshold) & (image < high_threshold)
for i in range(1, image.shape[0] - 1):
for j in range(1, image.shape[1] - 1):
if weak_edges[i, j]:
if (strong_edges[i - 1: i + 2, j - 1: j + 2]).any():
strong_edges[i, j] = True
else:
weak_edges[i, j] = False
return strong_edges
def canny_edge_detection(image, sigma):
gaussian_dx = gaussian_dxx(sigma)
gaussian_dy = gaussian_dyy(sigma)
plt.imshow(gaussian_dx, cmap='gray', interpolation='nearest')
plt.title('Partial Derivative w.r.t. x')
plt.colorbar()
plt.show()
plt.imshow(gaussian_dy, cmap='gray', interpolation='nearest')
plt.title('Partial Derivative w.r.t. y')
plt.colorbar()
plt.show()
size = int(2*np.ceil(3*sigma) + 1)
c = int(np.floor(size/2))
partial_x = convolve(image, gaussian_dx, (c,c))
partial_y = convolve(image, gaussian_dy, (c,c))
gradient_magnitude = np.sqrt(partial_x ** 2 + partial_y ** 2)
Usage
Here you can get help of any object by pressing Ctrl+I in front of it, either on the Editor or the Console.
Help can also be shown
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Console 1/A
Python 3.11.5 | packaged by Anaconda, Inc. | (main, Sep 11 2023, 13:26:23) [MSC v.1916 64 bit (AMD64)]
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IPython 8.15.0 -- An enhanced Interactive Python.
Restarting kernel...
In [1]:
Python Console History
conda (Python 3.11.5) Completions: conda LSP: Python Line 72, Col 45 UTF-8 CRLF RW Mem 68%
21°C Haze
Search
1:23 AM 3/6/2024

Spyder (Python 3.11)

File Edit Search Source Run Debug Consoles Projects Tools View Help

F:\LAB\IMAGE\canny_edge.py

canny_edge.py | convolution.py

```
    return strong_edges


def canny_edge_detection(image, sigma):
    gaussian_dx = gaussian_dxx(sigma)
    gaussian_dy = gaussian_dyy(sigma)
    plt.imshow(gaussian_dx, cmap='gray', interpolation='nearest')
    plt.title('Partial Derivative w.r.t. x')
    plt.colorbar()
    plt.show()
    plt.imshow(gaussian_dy, cmap='gray', interpolation='nearest')
    plt.title('Partial Derivative w.r.t. y')
    plt.colorbar()
    plt.show()
    size = int(2*np.ceil(3*sigma) + 1)
    c = int(np.floor(size/2))
    partial_x = convolve(image, gaussian_dx, (c,c))
    partial_y = convolve(image, gaussian_dy, (c,c))
    gradient_magnitude = np.sqrt(partial_x ** 2 + partial_y ** 2)
    cv2.imshow("Gradient Magnitude", gradient_magnitude.astype(np.uint8))
    cv2.waitKey(0)
    cv2.destroyAllWindows()



    gradient_direction = np.arctan2(partial_y, partial_x) * (180 / np.pi)
    suppressed_image = non_maximum_suppression(gradient_magnitude, gradient_direction)
    low_threshold, high_threshold = calculate_threshold(suppressed_image)
    edges = hysteresis_thresholding(suppressed_image, low_threshold, high_threshold)
    return edges



edges = canny_edge_detection(image, sigma)
cv2.imshow('Canny Edges Detected', np.uint8(edges * 255))
cv2.waitKey(0)
cv2.destroyAllWindows()
```

Usage

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Console 1/A

```
Python 3.11.5 | packaged by Anaconda, Inc.
| (main, Sep 11 2023, 13:26:23) [MSC v.
1916 64 bit (AMD64)]
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IPython 8.15.0 -- An enhanced Interactive
Python.

Restarting kernel...

In [1]:
```

IPython Console | History

conda (Python 3.11.5) | Completions: conda | LSP: Python | Line 72, Col 45 | UTF-8 | CRLF | RW | Mem 67%

21°C Haze | Search | 1:23 AM 3/6/2024

Spyder (Python 3.11)

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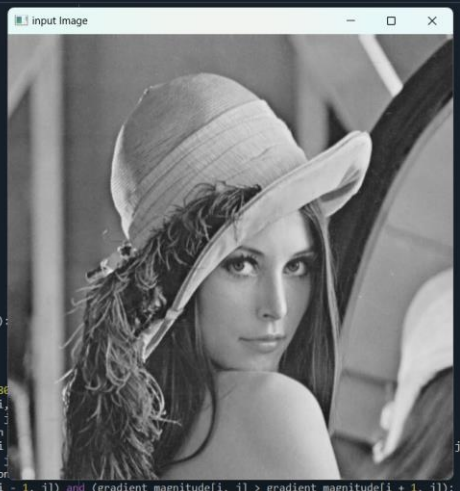
F:\LAB\IMAGE\canny_edge.py

canny_edge.py | convolution.py

```
import numpy as np
import matplotlib.pyplot as plt
import cv2
from convolution import *



sigma = float(input("Enter Value of Sigma: "))
gaussian_kernel = gaussian_filter(sigma)
image = cv2.imread('Lena.jpg', cv2.IMREAD_GRAYSCALE)
cv2.imshow("input Image", image)
cv2.waitKey(0)
cv2.destroyAllWindows()
print("Gaussian Kernel:")
print(gaussian_kernel)
plt.imshow(gaussian_kernel, cmap='gray', interpolation='nearest')
plt.title('Gaussian Kernel')
plt.colorbar()
plt.show()



def non_maximum_suppression(gradient_magnitude, gradient_direction):
    suppressed_image = np.zeros_like(gradient_magnitude)
    for i in range(1, gradient_magnitude.shape[0] - 1):
        for j in range(1, gradient_magnitude.shape[1] - 1):
            direction = gradient_direction[i, j]
            if (0 <= direction < 22.5) or (157.5 <= direction <= 180
                if (gradient_magnitude[i, j] > gradient_magnitude[i,
                    suppressed_image[i, j] = gradient_magnitude[i, j
            elif (22.5 <= direction < 67.5) or (-157.5 <= direction
                if (gradient_magnitude[i, j] > gradient_magnitude[i
                    suppressed_image[i, j] = gradient_magnitude[i, j
            elif (67.5 <= direction < 112.5) or (-112.5 <= direction
                if (gradient_magnitude[i, j] > gradient_magnitude[i - 1, j]) and (gradient_magnitude[i, j] > gradient_magnitude[i + 1, j]):
                    suppressed_image[i, j] = gradient_magnitude[i, j]
            elif (112.5 <= direction < 157.5) or (-67.5 <= direction < -22.5):
                if (gradient_magnitude[i, j] > gradient_magnitude[i - 1, j + 1]) and (gradient_magnitude[i, j] > gradient_magnitude[i + 1, j - 1]):
                    suppressed_image[i, j] = gradient_magnitude[i, j]
    return suppressed_image
```

input Image



Usage

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Help | Variable Explorer | Plots | Files

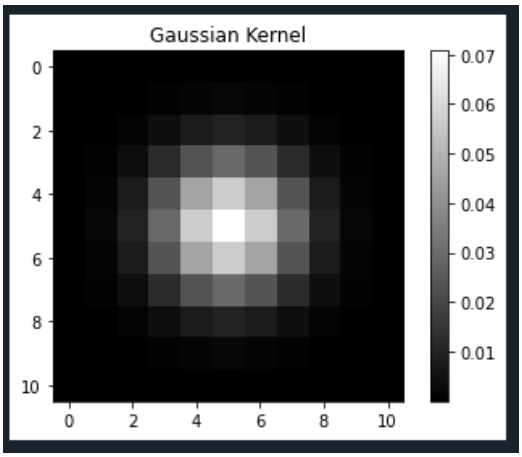
Console 1/A

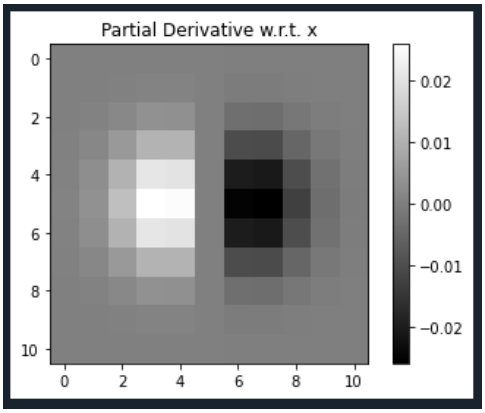
```
Python 3.11.5 | packaged by Anaconda, Inc.
| (main, Sep 11 2023, 13:26:23) [MSC v.
1916 64 bit (AMD64)]
Type "copyright", "credits" or "license"
for more information.

IPython 8.15.0 -- An enhanced Interactive
Python.

Restarting kernel...

In [1]: runfile('F:/LAB/IMAGE/
canny_edge.py', wdir='F:/LAB/IMAGE')
Enter Value of Sigma: 1.5
```

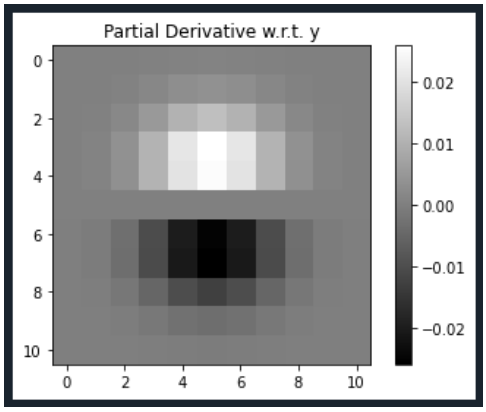
IPython Console | History

conda (Python 3.11.5) | Completions: conda | LSP: Python | Line 80, Col 30 | UTF-8 | CRLF | RW | Mem 68%

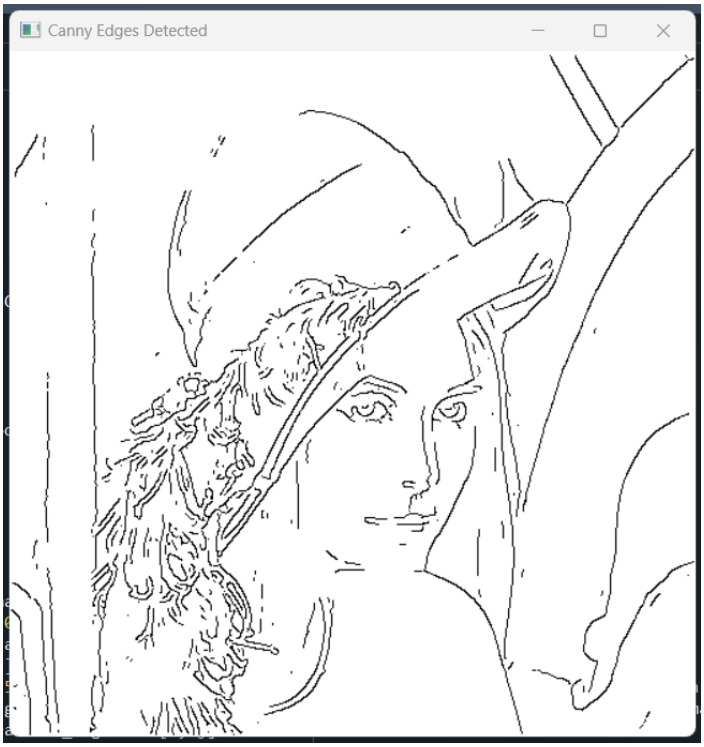
21°C Haze | Search | 1:24 AM 3/6/2024




Partial Derivative w.r.t. x
0
2
4
6
8
10
0.02
0.01
0.00
−0.01
−0.02


Partial Derivative w.r.t. y
0
2
4
6
8
10
0.02
0.01
0.00
−0.01
−0.02


Gradient Magnitude


Canny Edges Detected