

ECE 558

Digital Imaging Systems

Project #1

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For Question 1 (a), please refer to the python file "Q1.py" inside "hshukla_codes" folder

Q1>

(b)

In the given image of 1024×1024 , where we have zeros everywhere and 1 at $[512, 512]$.

When we apply Convolution with box filter

$$K = \frac{1}{9} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}, \text{ we get}$$

	510	511	512	513	514
510	0	0	0	0	0
511	0	0	0	0	0
512	0	0	255	0	0
513	0	0	0	0	0
514	0	0	0	0	0

So, when kernel reaches as shown in the above figure, we get convoluted value at the position $[511, 511]$ as shown by a circle in the above figure. Similarly, we get the convoluted images as below.

	510	511	512	513	514
510	0	0	0	0	0
511	0	28	28	28	0
512	0	28	28	28	0
513	0	28	28	28	0
514	0	0	0	0	0

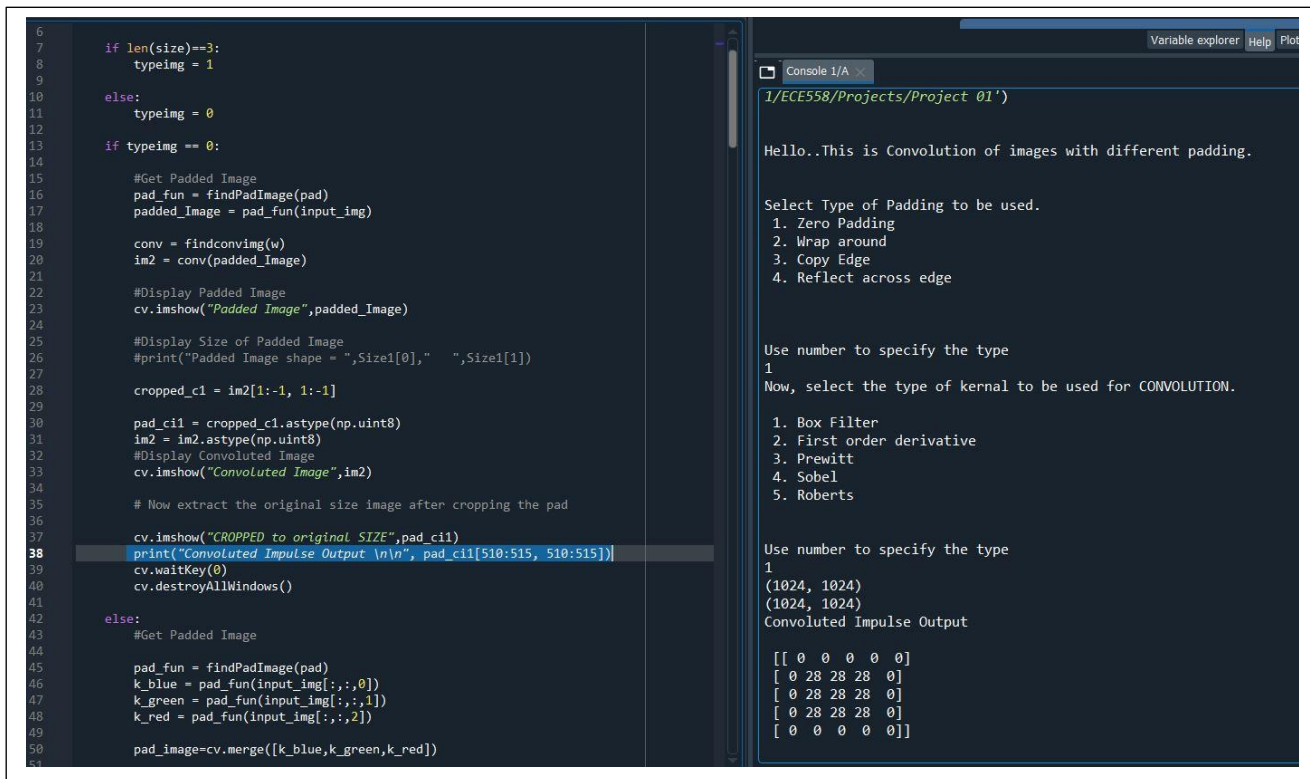
figure (2)

Average Value =

$$\begin{aligned} & \frac{1}{9} \times 0 + \frac{1}{9} \times 0 + \frac{1}{9} \times 0 + \frac{1}{9} \times 0 + \frac{1}{9} \times 0 + \frac{1}{9} \times 0 + \\ & \frac{1}{9} \times 0 + \frac{1}{9} \times 0 + \frac{1}{9} \times 255 \\ & = 28.3 \approx \underline{\underline{28}} \end{aligned}$$

In the next figure (2), we can see the position of the last cell $(513, 513)$ which will be convoluted by this kernel.

All the result images are attached inside “Q1_images” folder in the zipped file.



```
6
7     if len(size)==3:
8         typeimg = 1
9
10    else:
11        typeimg = 0
12
13    if typeimg == 0:
14
15        #Get Padded Image
16        pad_fun = findPadImage(pad)
17        padded_image = pad_fun(input_img)
18
19        conv = findconvimg(w)
20        im2 = conv(padded_image)
21
22        #Display Padded Image
23        cv.imshow("Padded Image",padded_image)
24
25        #Display Size of Padded Image
26        #print("Padded Image shape = ",Size1[0]," ",Size1[1])
27
28        cropped_c1 = im2[1:-1, 1:-1]
29
30        pad_c11 = cropped_c1.astype(np.uint8)
31        im2 = im2.astype(np.uint8)
32        #Display Convolved Image
33        cv.imshow("Convolved Image",im2)
34
35        # Now extract the original size image after cropping the pad
36
37        cv.imshow("CROPPED to original SIZE",pad_c11)
38        print("Convolved Impulse Output \n\n", pad_c11[510:515, 510:515])
39        cv.waitKey(0)
40        cv.destroyAllWindows()
41
42    else:
43        #Get Padded Image
44
45        pad_fun = findPadImage(pad)
46        k_blue = pad_fun(input_img[:, :, 0])
47        k_green = pad_fun(input_img[:, :, 1])
48        k_red = pad_fun(input_img[:, :, 2])
49
50        pad_image=cv.merge([k_blue,k_green,k_red])
```

```
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Hello..This is Convolution of images with different padding.

Select Type of Padding to be used.
1. Zero Padding
2. Wrap around
3. Copy Edge
4. Reflect across edge

Use number to specify the type
1
Now, select the type of kernal to be used for CONVOLUTION.

1. Box Filter
2. First order derivative
3. Prewitt
4. Sobel
5. Roberts

Use number to specify the type
1
(1024, 1024)
(1024, 1024)
Convolved Impulse Output

[[ 0  0  0  0  0]
 [ 0 28 28 28  0]
 [ 0 28 28 28  0]
 [ 0 28 28 28  0]
 [ 0  0  0  0  0]]
```

In the output window, we can see that pixel values are changed to 28. This proves that the algorithm is performing convolution.

Question 2

Python code “Q2.py” inside “hshukla_codes” folder which is attached in the zip folder.

Results are attached inside “Q2_images” folder in the zipped file.