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Semester: VI

Program: B.Tech

Branch: EXTC

Date of performance: 12th March

Date of Submission: 19th March

Experiment Number: 7

Aim:

a. To write a program in PYTHON to perform morphological dilation and erosion on an image

b. To write a program in PYTHON to perform morphological opening and closing on an image

Theory:

Dilation

Dilation is defined as follows $A \bigoplus B=\{ Z|[(\hat{B}z) \cap A] \in A\}$

In the above equation, A is the image and B is the structuring element. In the above equation, $(\hat{B}z)$ means taking reflection of B about its origin and shifting it by Z. Hence dilation of A with B is set of all displacements, Z, such that $(\hat{B}z)$ and A overlap by at least one element

Erosion

$A \ominus B=\{ Z|(\hat{B}z) \in A\}$

This indicates that the erosion of A by B is set of all points that B, translated (shifted by Z), is a subset of A that is B is entirely contained within A. Erosion reduces the number of pixels from the object boundary.

Opening

Morphological opening of an image is basically erosion followed by dilation $A \circ B=OPEN(A,B)=D(E(A))$

Closing

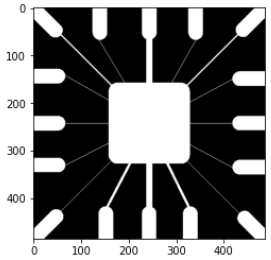
Morphological opening of an image is basically dilation followed by erosion $A \cdot B=CLOSE(A,B)=E(D(A))$

Conclusion:

We learnt about various concepts like Dilation,Erosion,Opening,Closing

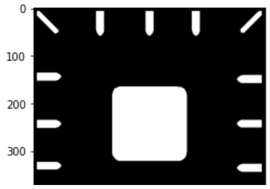
```
import cv2
import numpy as np
import matplotlib.pyplot as plt


#Read the image for erosion
img1= cv2.imread("/content/Fig0905(a)(wirebond-mask).tif",0)
m,n= img1.shape #Acquire size of the image
plt.imshow(img1, cmap="gray")
```

```
<matplotlib.image.AxesImage at 0x7f846e4c89d0>
```



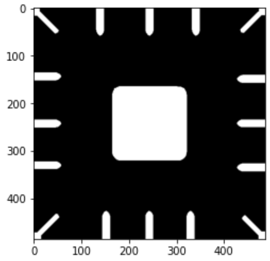
```
# Define the structuring element
# k= 11,15,45 -Different sizes of the structuring element
k=15
SE= np.ones((k,k), dtype=np.uint8)
constant= (k-1)//2


#Define new image
imgErode= np.zeros((m,n), dtype=np.uint8)


#Erosion without using inbuilt cv2 function for morphology
for i in range(constant, m-constant):
  for j in range(constant,n-constant):
    temp= img1[i-constant:i+constant+1, j-constant:j+constant+1]
    product= temp*SE
    imgErode[i,j]= np.min(product)

plt.imshow(imgErode,cmap="gray")
cv2.imwrite("Eroded3.png", imgErode)
```

```
True
```



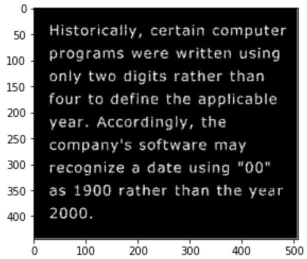
```
#Erosion using cv2 inbuilt function to obtain structuring element and perform erosion
SE1= cv2.getStructuringElement(cv2.MORPH_RECT,(15,15))
imgErodenew= cv2.erode(img1,SE1,1)
plt.imshow(imgErodenew,cmap="gray")
```

```
<matplotlib.image.AxesImage at 0x7f8462c9c790>
```



```
#Read the image for dilation
img2= cv2.imread("/content/Fig0907(a)(text_gaps_1_and_2_pixels).tif",0)
p,q= img2.shape
plt.imshow(img2, cmap="gray")
#cv2.imwrite("text.png", img2)
```

```
<matplotlib.image.AxesImage at 0x7f8462c6ee10>
```



Historically, certain computer
programs were written using
only two digits rather than
four to define the applicable
year. Accordingly, the
company's software may
recognize a date using "00"
as 1900 rather than the year
2000.

```
img_new= cv2.imread("/content/Fig0907(a)(text_gaps_1_and_2_pixels).tif",0)
cv2.imwrite("text.png",  img_new)
```

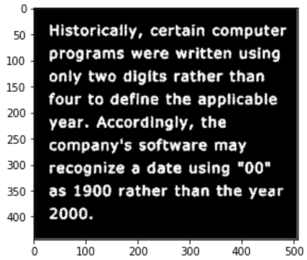
```
True
```

```
#Define new image for dilation
imgDilate= np.zeros((p,q), dtype=np.uint8)
```

```
#Define the structuring element
SED= np.array([[0,1,0], [1,1,1],[0,1,0]])
constant1=1
```

```
#Dilation
for i in range(constant1, p-constant1):
  for j in range(constant1,q-constant1):
    temp= img2[i-constant1:i+constant1+1, j-constant1:j+constant1+1]
    product= temp*SED
    imgDilate[i,j]= np.max(product)

plt.imshow(imgDilate,cmap="gray")
cv2.imwrite("Dilated.png", imgDilate)
```

```
True
```

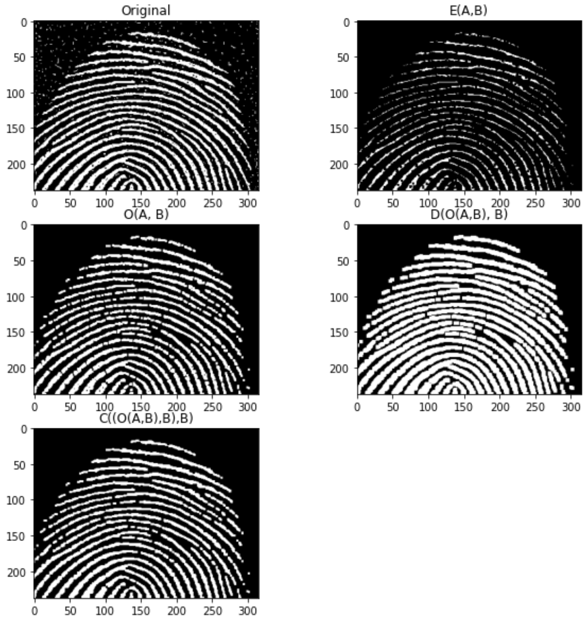


Historically, certain computer
programs were written using
only two digits rather than
four to define the applicable
year. Accordingly, the
company's software may
recognize a date using "00"
as 1900 rather than the year
2000.

```
#Use of opening and closing for morphological filtering
#Perform the following operation on the noisy fingerprint image
# [(((AoB)d B) e B)]
```

```
#AoB= (A e B) d B
#o=opening, e=erosion,d=dilation
# Here inbuilt function of erosion and dilation from cv2 module is used.
#To form the structuring element also, inbuilt function from cv2 is used


#Function for erosion
def erosion(img, SE):
  imgErode= cv2.erode(img,SE,1)
  return imgErode


#Function for dilation
def dilation(img, SE):
  imgDilate= cv2.dilate(img,SE,1)
  return imgDilate


#Read the image for dilation
img= cv2.imread("/content/Fig0911(a)(noisy_fingerprint).tif",0)
img_finger=cv2.imwrite("finger.png", img)
SE= cv2.getStructuringElement(cv2.MORPH_RECT,(3,3)) #Define the structuring element using inbuilt CV2 function
AeB= erosion(img,SE) #Erode the image
AoB= dilation(AeB, SE) #Dilate the eroded image. This gives opening oepration
AoBdB= dilation(AoB,SE) #dilate the opened image followed by ersoion. This will give closing of the openeed image
AoBdBeB= erosion(AoBdB, SE)
plt.figure(figsize=(10,10))
plt.subplot(3,2,1)
plt.imshow(img, cmap="gray")
plt.title("Original")
plt.subplot(3,2,2)
plt.title("E(A,B)")
plt.imshow(AeB, cmap="gray")
plt.subplot(3,2,3)
plt.title("O(A, B)")
plt.imshow(AoB, cmap="gray")
plt.subplot(3,2,4)
plt.title("D(O(A,B), B)")
plt.imshow(AoBdB, cmap="gray")
plt.subplot(3,2,5)
plt.title("C((O(A,B),B),B)")
plt.imshow(AoBdBeB, cmap="gray")
cv2.imwrite("finger_filtered.png", AoBdBeB)
```

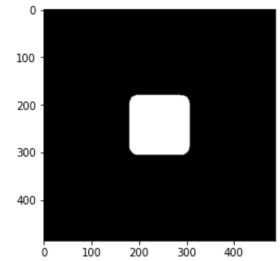
```
True
```



k=45

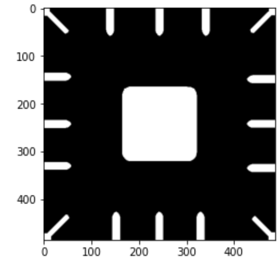
```
# Define the structuring element
# k= 11,15,45 -Different sizes of the structuring element
k=45
SE= np.ones((k,k), dtype=np.uint8)
constant1= (k-1)//2


#Define new image
imgErode1= np.zeros((m,n), dtype=np.uint8)


#Erosion without using inbuilt cv2 function for morphology
for i in range(constant1, m-constant1):
  for j in range(constant1,n-constant1):
    temp= img1[i-constant1:i+constant1+1, j-constant1:j+constant1+1]
    product= temp*SE
    imgErode1[i,j]= np.min(product)

plt.imshow(imgErode1,cmap="gray")
plt.imshow(imgErode1,cmap="gray")
cv2.imwrite("Eroded4.png", imgErode1)
```

```
True
```



```
#Erosion using cv2 inbuilt function to obtain structuring element and perform erosion
SE1= cv2.getStructuringElement(cv2.MORPH_RECT,(15,15))
imgErodenew1= cv2.erode(img1,SE1,1)
plt.imshow(imgErodenew1,cmap="gray")
```

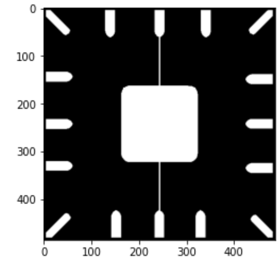
```
<matplotlib.image.AxesImage at 0x7f84610a9f50>
```



k=11

```
# Define the structuring element
# k= 11,15,45 -Different sizes of the structuring element
k=11
SE= np.ones((k,k), dtype=np.uint8)
constant2= (k-1)//2


#Define new image
imgErode2= np.zeros((m,n), dtype=np.uint8)


#Erosion without using inbuilt cv2 function for morphology
for i in range(constant2, m-constant2):
  for j in range(constant2,n-constant2):
    temp= img1[i-constant2:i+constant2+1, j-constant2:j+constant2+1]
    product= temp*SE
    imgErode2[i,j]= np.min(product)

plt.imshow(imgErode2,cmap="gray")
cv2.imwrite("Eroded5.png", imgErode1)
```

```
True
```

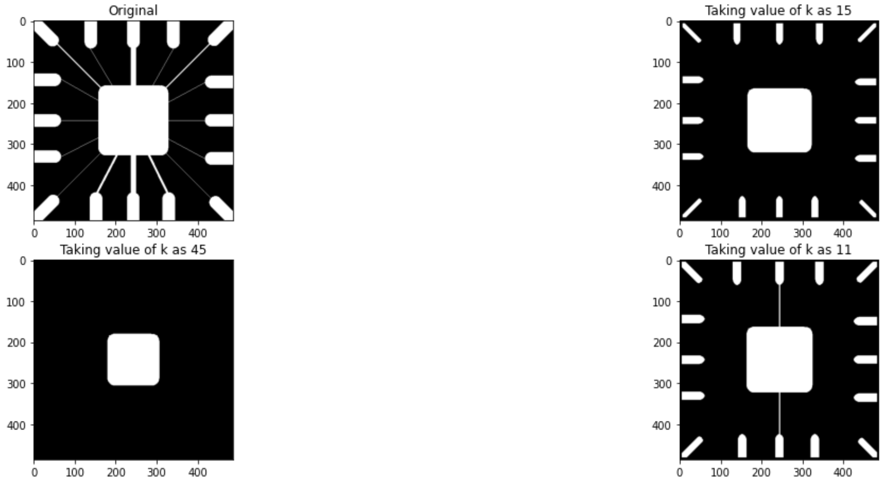


```
#Erosion using cv2 inbuilt function to obtain structuring element and perform erosion
SE1= cv2.getStructuringElement(cv2.MORPH_RECT,(15,15))
imgErodenew2= cv2.erode(img1,SE1,1)
plt.imshow(imgErodenew2,cmap="gray")
```

```
<matplotlib.image.AxesImage at 0x7f8460e5da10>
```

```
plt.figure(figsize=(20,20))
plt.subplot(5,2,1)
plt.imshow(img1, cmap="gray")
plt.title("Original")

plt.subplot(5,2,2)
plt.imshow(imgErode, cmap="gray")
plt.title("Taking value of k as 15")

plt.subplot(5,2,3)
plt.imshow(imgErode1, cmap="gray")
plt.title("Taking value of k as 45")

plt.subplot(5,2,4)
plt.title("Taking value of k as 11")
plt.imshow(imgErode2, cmap="gray")
```

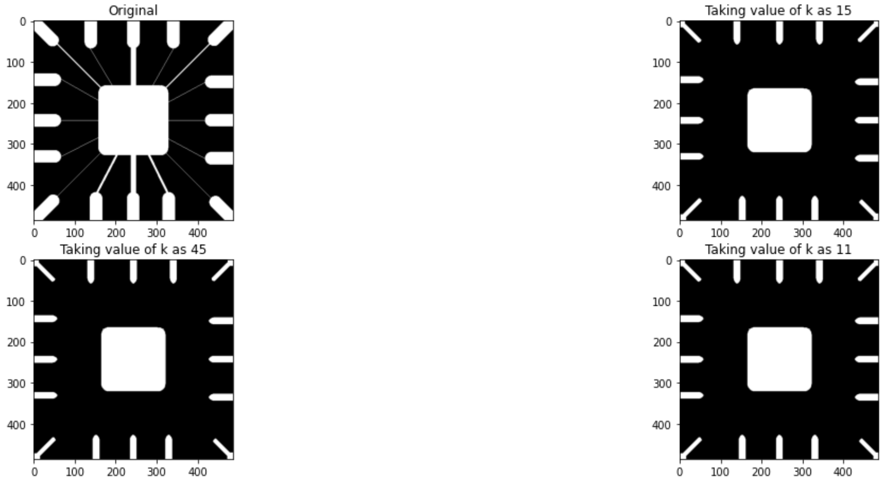
```
<matplotlib.image.AxesImage at 0x7f8462b92450>
```



As you increase the value of k the image is getting more and more eroded.

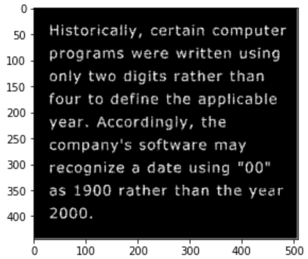
```
plt.figure(figsize=(20,20))
plt.subplot(5,2,1)
plt.imshow(img1, cmap="gray")
plt.title("Original")

plt.subplot(5,2,2)
plt.imshow(imgErodenew, cmap="gray")
plt.title("Taking value of k as 15")

plt.subplot(5,2,3)
plt.imshow(imgErodenew1, cmap="gray")
plt.title("Taking value of k as 45")

plt.subplot(5,2,4)
plt.title("Taking value of k as 11")
plt.imshow(imgErodenew2, cmap="gray")
```

```
<matplotlib.image.AxesImage at 0x7f8460a16b10>
```



```
#Read the image for dilation
img2= cv2.imread("/content/Fig0907(a)(text_gaps_1_and_2_pixels).tif",0)
p,q= img2.shape
plt.imshow(img2, cmap="gray")
#cv2.imwrite("text.png", img2)
```

```
<matplotlib.image.AxesImage at 0x7f8461011650>
```



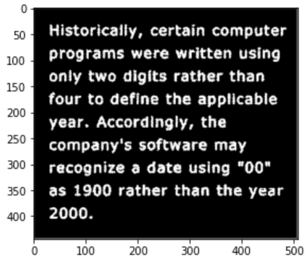
Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.

```
img_new1= cv2.imread("/content/Fig0907(a)(text_gaps_1_and_2_pixels).tif",0)
cv2.imwrite("text.png",  img_new1)
```

```
True
```

```
#Define new image for dilation
imgDilate1= np.zeros((p,q), dtype=np.uint8)


#Define the structuring element
SED= np.array([[0,1,0], [1,1,1],[0,1,0]])
constant1=1


#Dilation
for i in range(constant1, p-constant1):
  for j in range(constant1,q-constant1):
    temp= img2[i-constant1:i+constant1+1, j-constant1:j+constant1+1]
    product= temp*SED
    imgDilate1[i,j]= np.max(product)

plt.imshow(imgDilate1,cmap="gray")
cv2.imwrite("Dilated1.png", imgDilate1)
```

```
True
```



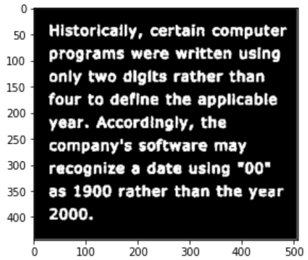
Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.

```
img_new2= cv2.imread("/content/Fig0907(a)(text_gaps_1_and_2_pixels).tif",0)
cv2.imwrite("text.png",  img_new2)
```

```
True
```

```
#Define new image for dilation
imgDilate2= np.zeros((p,q), dtype=np.uint8)


#Define the structuring element
SED= np.array([[1,1,1], [1,1,1],[1,1,1]])
constant2=1


#Dilation
for i in range(constant2, p-constant2):
  for j in range(constant2,q-constant2):
    temp= img2[i-constant2:i+constant2+1, j-constant2:j+constant2+1]
    product= temp*SED
    imgDilate2[i,j]= np.max(product)

plt.imshow(imgDilate2,cmap="gray")
cv2.imwrite("Dilated2.png", imgDilate2)
```

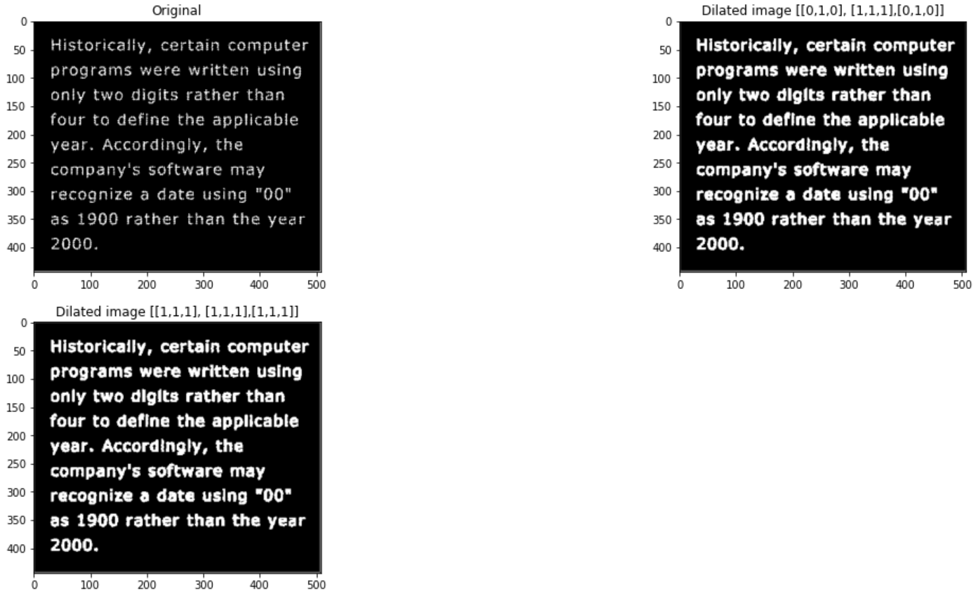
```
True
```



Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.

```
plt.figure(figsize=(20,20))
plt.subplot(4,2,1)
plt.imshow(img2, cmap="gray")
plt.title("Original")
plt.subplot(4,2,2)
plt.title("Dilated image [[0,1,0], [1,1,1],[0,1,0]]")
plt.imshow(imgDilate1, cmap="gray")
plt.subplot(4,2,3)
plt.title("Dilated image [[1,1,1], [1,1,1],[1,1,1]]")
plt.imshow(imgDilate2, cmap="gray")
```

```
<matplotlib.image.AxesImage at 0x7f84606b2f10>
```



Original
Dilated image [[0,1,0], [1,1,1],[0,1,0]]
Dilated image [[1,1,1], [1,1,1],[1,1,1]]
0
50
100
150
200
250
300
350
400
0
100
200
300
400
500

Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.

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Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.

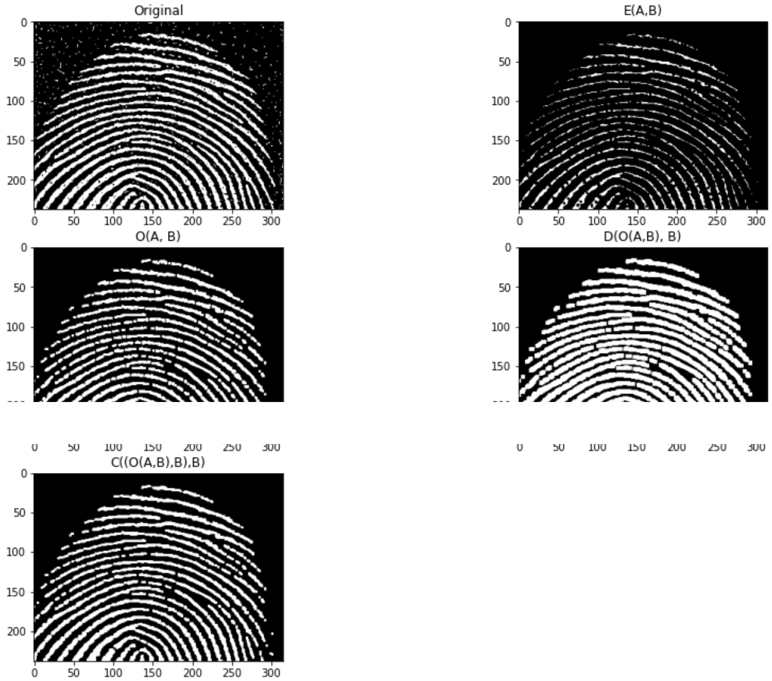
Thus by changing different values of the dilated image we get from not so clear text to a more and more clear text

```
#Function for erosion
def erosion(img, SE):
  imgErode1= cv2.erode(img,SE,1)
  return imgErode1


#Function for dilation
def dilation(img, SE):
  imgDilate1= cv2.dilate(img,SE,1)
  return imgDilate1


#Read the image for dilation
img= cv2.imread("/content/Fig0911(a)(noisy_fingerprint).tif",0)
img_finger=cv2.imwrite("finger.png", img)
SE= cv2.getStructuringElement(cv2.MORPH_RECT,(3,3)) #Define the structuring element using inbuilt CV2 function
AeB= erosion(img,SE) #Erode the image
AoB= dilation(AeB, SE) #Dilate the eroded image. This gives opening oepration
AoBdB= dilation(AoB,SE) #dilate the opened image followed by ersoion. This will give closing of the openeed image
AoBdBeB= erosion(AoBdB, SE)
plt.figure(figsize=(15,15))
plt.subplot(4,2,1)
plt.imshow(img, cmap="gray")
plt.title("Original")
plt.subplot(4,2,2)
plt.title("E(A,B)")
plt.imshow(AeB, cmap="gray")
plt.subplot(4,2,3)
plt.title("O(A, B)")
plt.imshow(AoB, cmap="gray")
plt.subplot(4,2,4)
plt.title("D(O(A,B), B)")
plt.imshow(AoBdB, cmap="gray")
plt.subplot(4,2,5)
plt.title("C((O(A,B),B),B)")
plt.imshow(AoBdBeB, cmap="gray")
cv2.imwrite("finger_filtered.png", AoBdBeB)
```

```
True
```


Original
E(A,B)
O(A, B)
D(O(A,B), B)
C((O(A,B),B),B)
0
50
100
150
200
250
300