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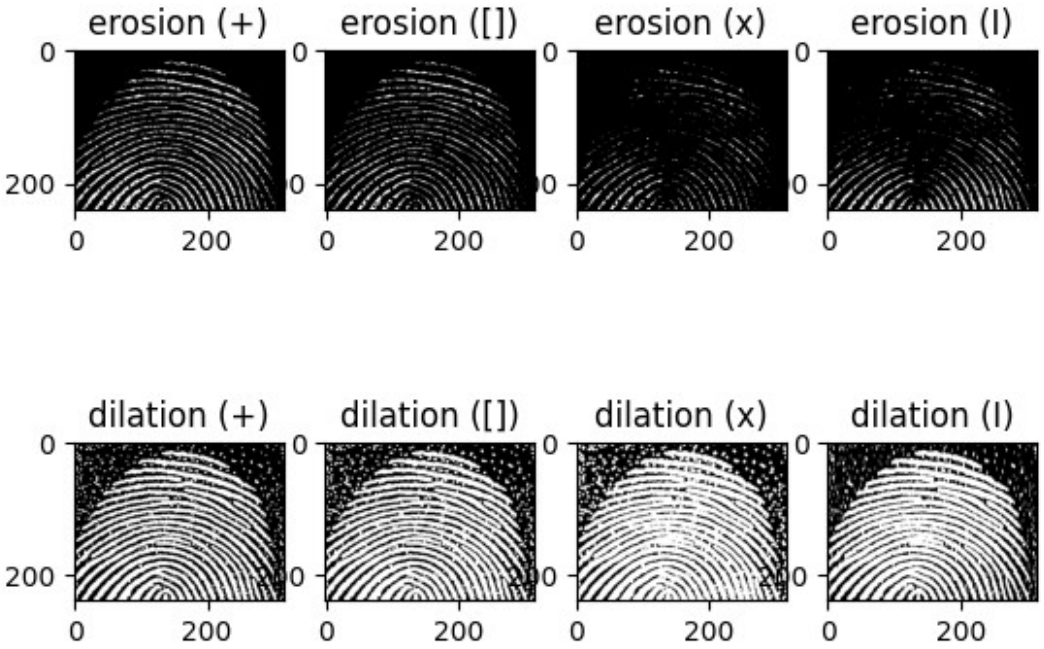
# Morfologia

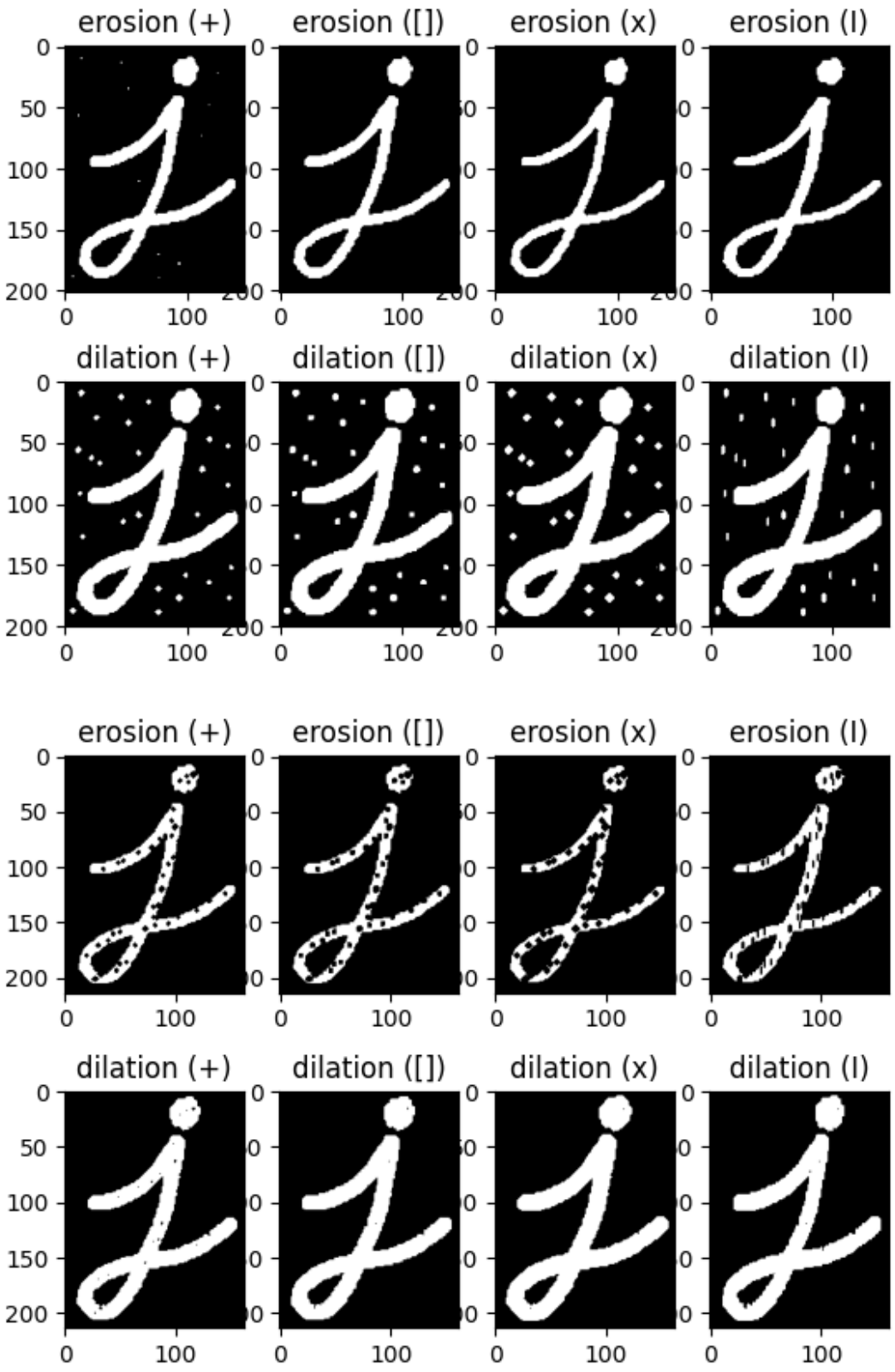
1. Implemente a erosão/dilatação utilizando os seguintes elementos estruturantes e utilize todas as imagens

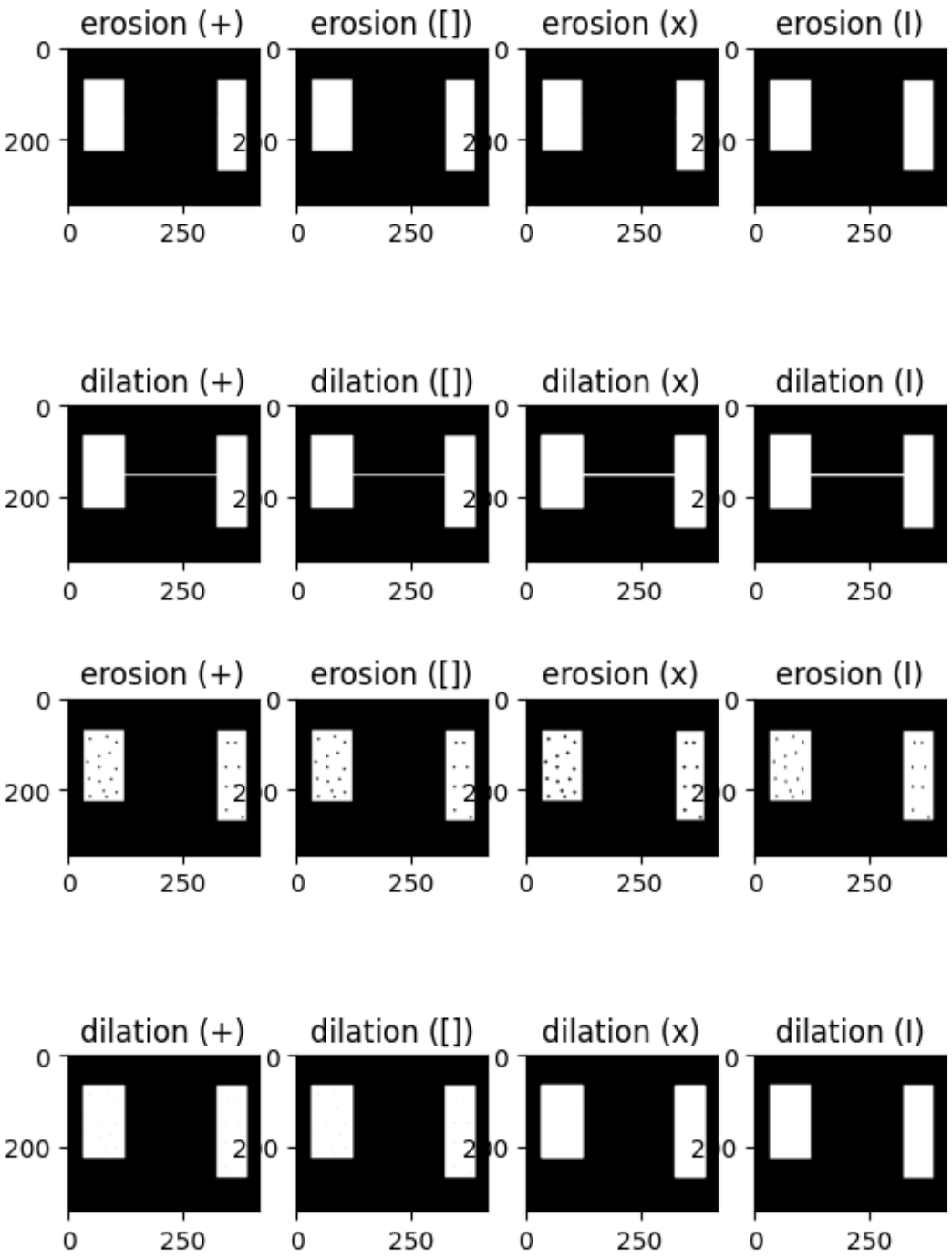
```
import os

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

def erosion(image: np.ndarray, element: np.ndarray, iterations: int =
1):
    """
    The main porpoise of this function is centralize the logic of the
erosion
    :param image:
    :param element:
    :return:
    """
    return cv2.erode(image, element, iterations=iterations)


def dilation(image: np.ndarray, element: np.ndarray, iterations: int =
1):
    """
    The main porpoise of this function is centralize the logic of the
dilation
    :param image:
    :param element:
    :return:
    """
    return cv2.dilate(image, element, iterations=iterations)


def resolve(token: str):
    """
    The main porpoise of this function is centralize the logic of the
morphological operations
    :param token:
    :return:
    """

    if token == '+':
        return np.array([
            [0, 1, 0],
            [1, 1, 1],
```

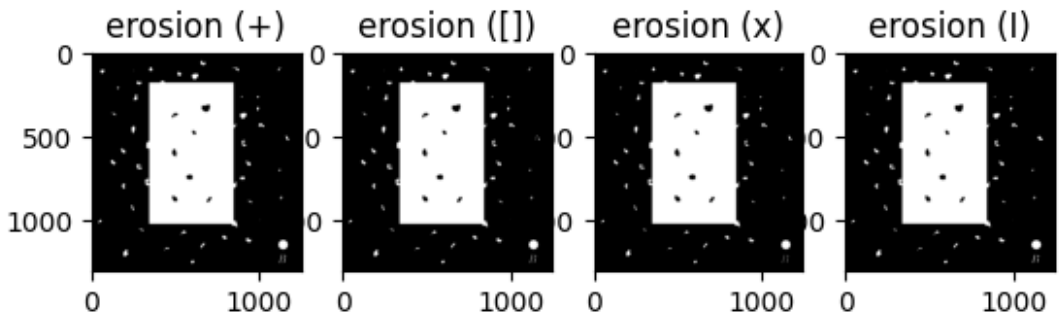
```
            [0, 1, 0]
        ], dtype=np.uint8)
    if token == '[]':
        return np.array([
            [1, 1, 1],
            [1, 1, 1],
            [1, 1, 1]
        ], dtype=np.uint8)
    if token == 'x':
        return np.array([
            [0, 0, 1, 0, 0],
            [0, 1, 1, 1, 0],
            [1, 1, 1, 1, 1],
            [0, 1, 1, 1, 0],
            [0, 0, 1, 0, 0]
        ], dtype=np.uint8)
    if token == 'I':
        return np.array([
            [0, 0, 1, 0, 0],
            [0, 0, 1, 0, 0],
            [0, 0, 1, 0, 0],
            [0, 0, 1, 0, 0],
            [0, 0, 1, 0, 0]
        ], dtype=np.uint8)
    raise Exception('Invalid token')

def operation(image: np.ndarray, token: str, op: str):
    """
    The main porpoise of this function is centralize the logic of the
morphological operations
    :param image:
    :param token:
    :param op:
    :return:
    """
    element = resolve(token)

    if op in globals():
        return globals()[op](image, element)

    raise Exception('Invalid operation')

for file in os.listdir('./images'):
    image = np.array(cv2.imread(f'images/{file}',
cv2.IMREAD_GRAYSCALE), dtype=np.uint8)
    i = 0

    for op in ['erosion', 'dilation']:
        j = 0
        for token in ['+', '[]', 'x', 'I']:
```

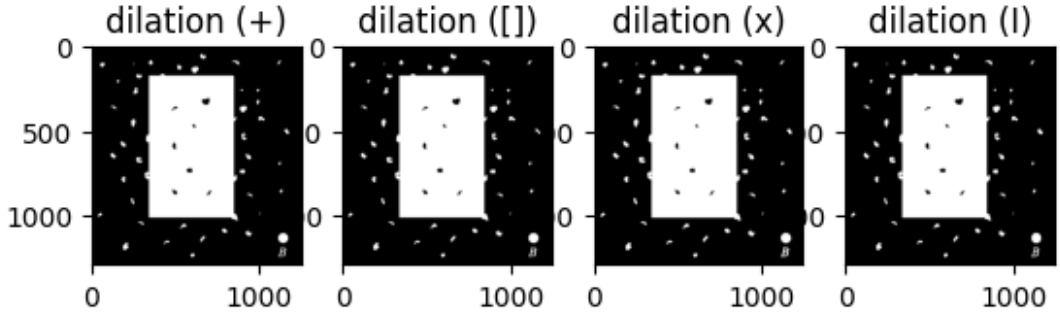
```
            result = operation(image, token, op)

            plt.subplot(2, 4, i + j + 1)
            plt.imshow(result, cmap='gray')
            plt.title(f'{op} ({token})')

            i += 1
    plt.show()
```

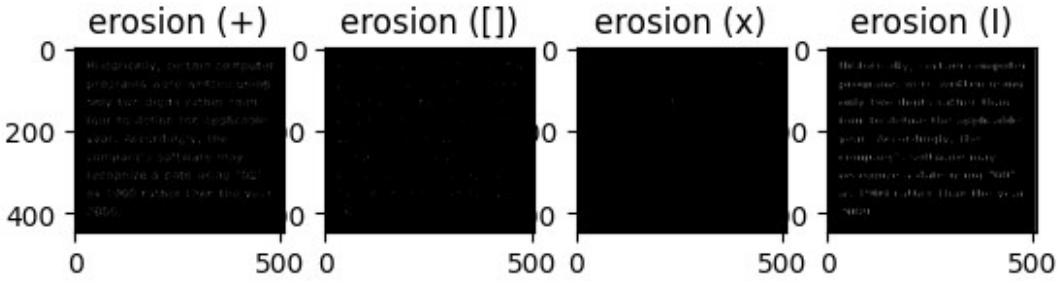


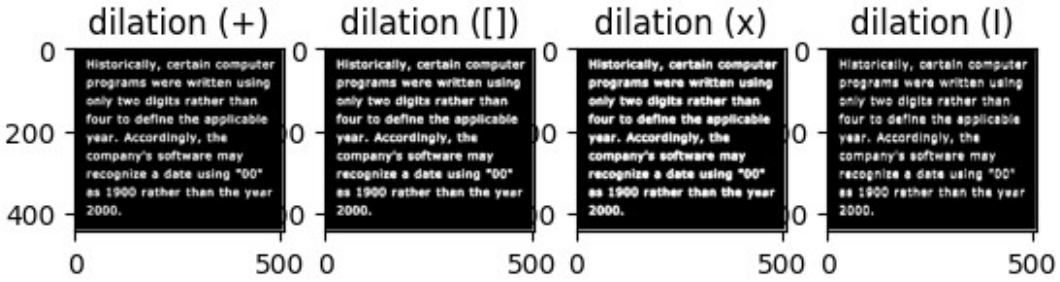

erosion (+)
erosion ([])
erosion (x)
erosion (I)
dilation (+)
dilation ([])
dilation (x)
dilation (I)
erosion (+)
erosion ([])
erosion (x)
erosion (I)
dilation (+)
dilation ([])
dilation (x)
dilation (I)

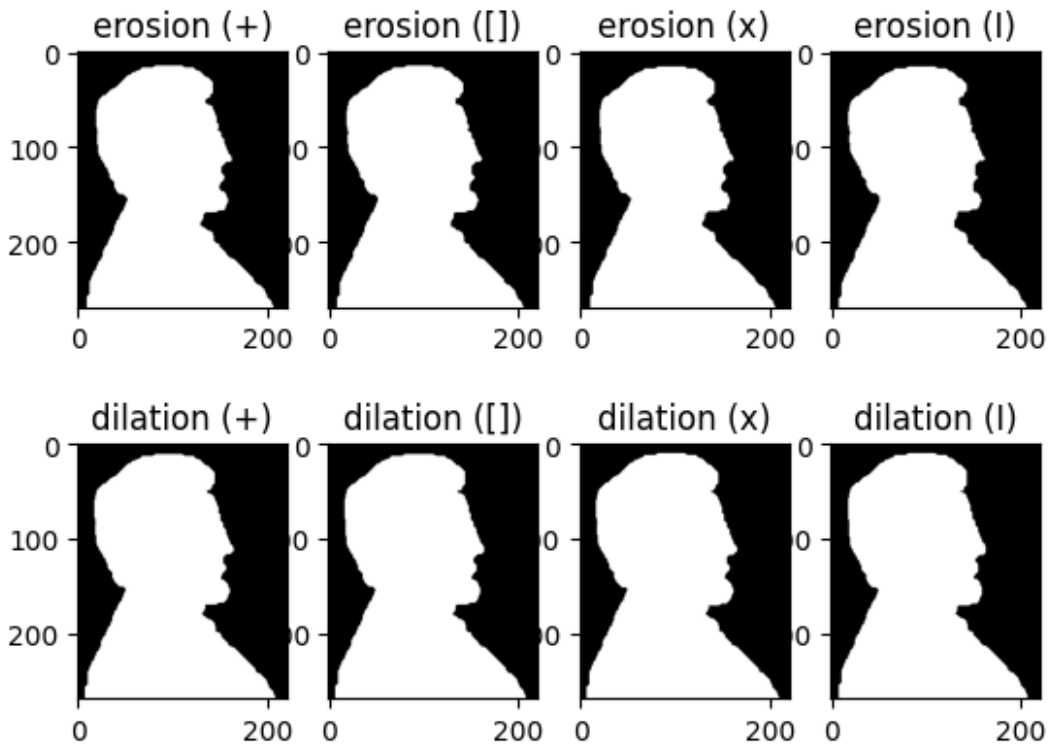

erosion (+)
erosion ([])
erosion (x)
erosion (I)
dilation (+)
dilation ([])
dilation (x)
dilation (I)
erosion (+)
erosion ([])
erosion (x)
erosion (I)
dilation (+)
dilation ([])
dilation (x)
dilation (I)
0
200
250


erosion (+)
erosion ([])
erosion (x)
erosion (I)
0
500
1000


dilation (+)
dilation ([])
dilation (x)
dilation (I)
0
500
1000


erosion (+)
erosion ([])
erosion (x)
erosion (I)
0
200
400
500

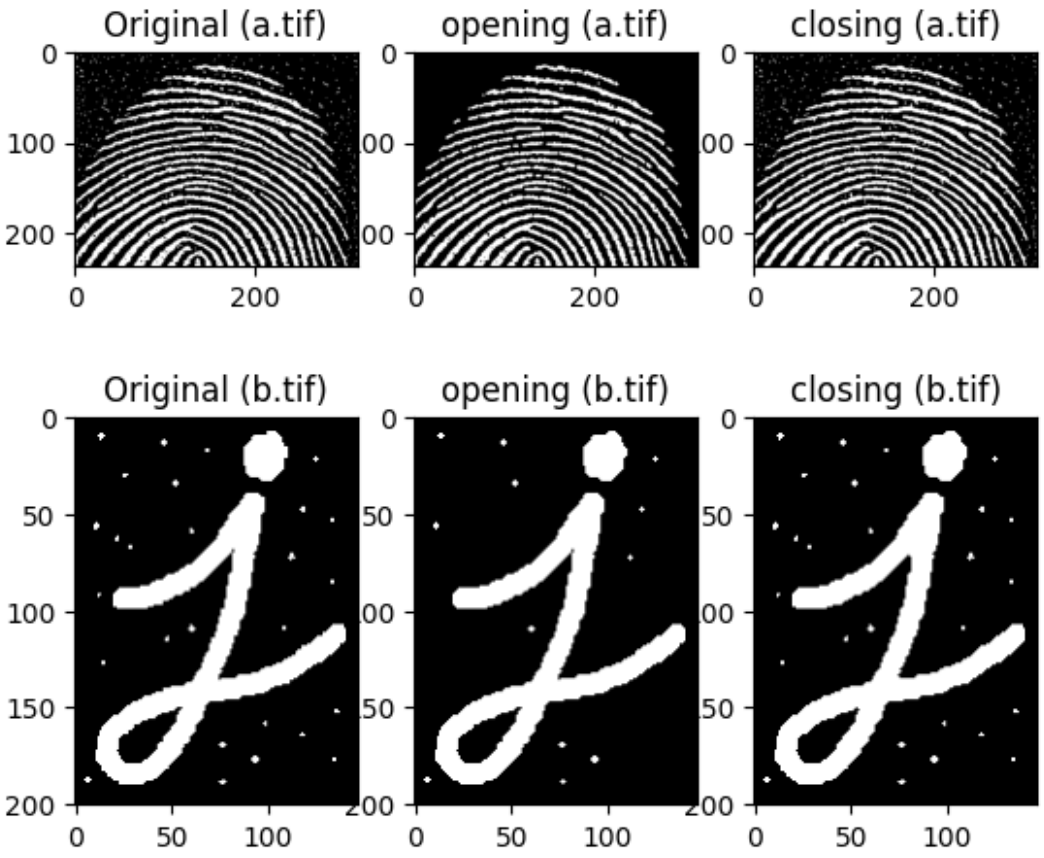

dilation (+)
dilation ([])
dilation (x)
dilation (I)
Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.
0
200
400
500

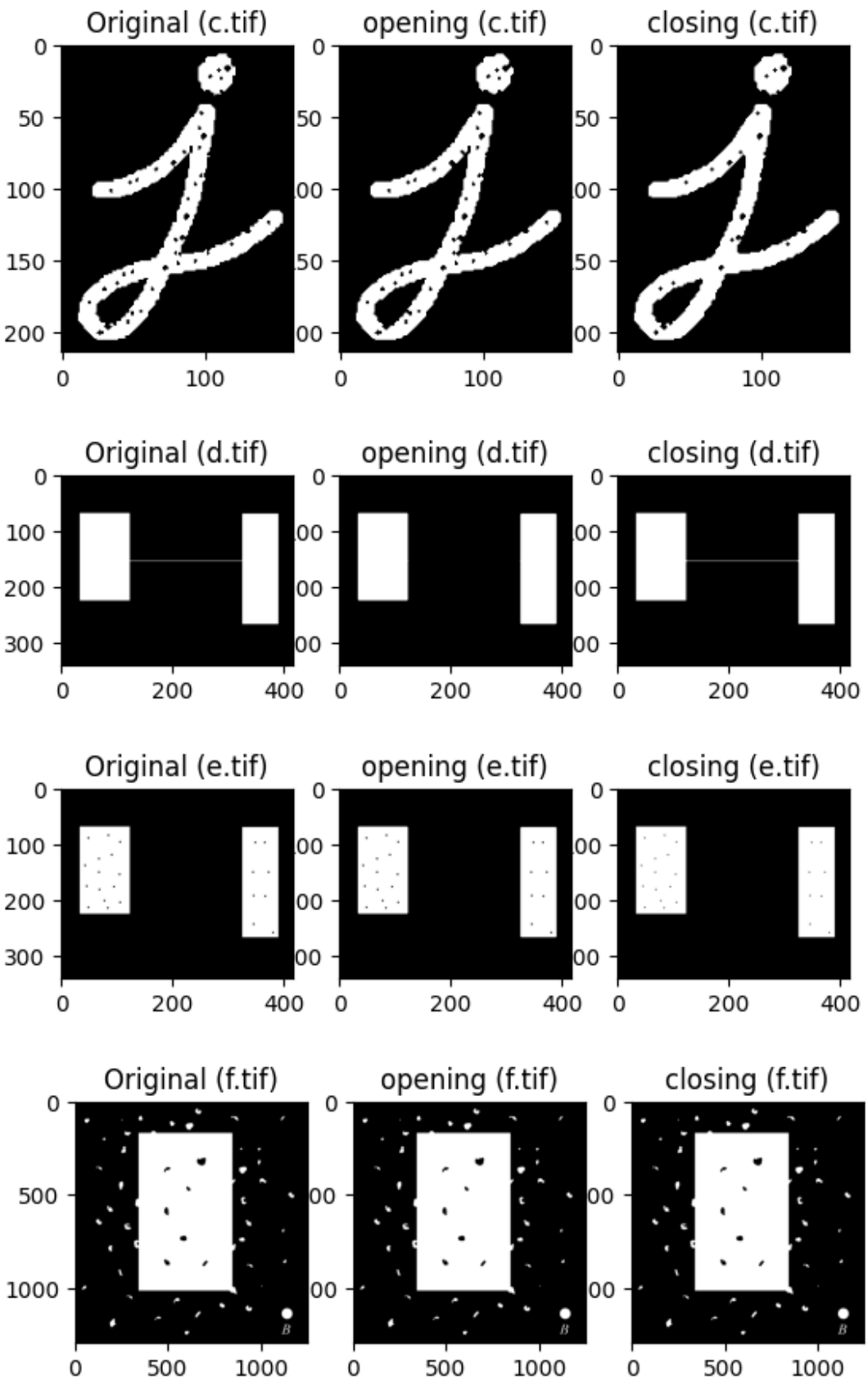


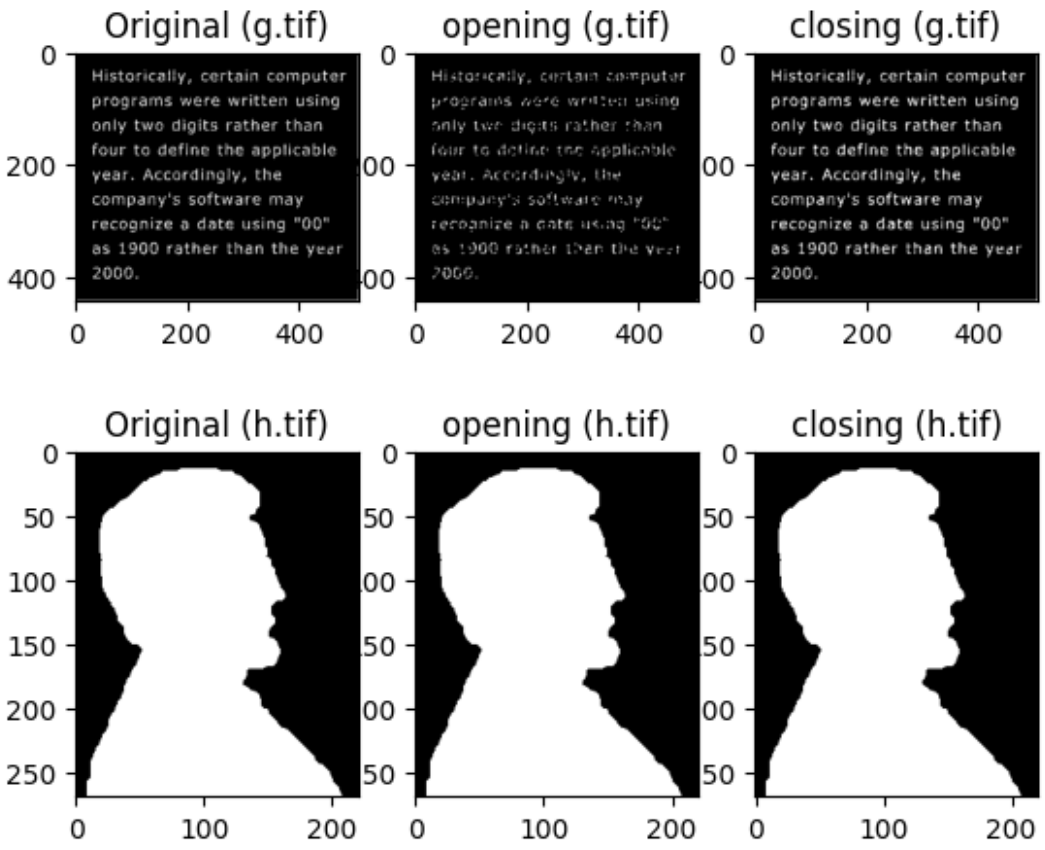

1. Implemente as operações de abertura e fechamento utilizando apenas o primeiro elemento estruturante do exercício acima. Considerando as imagens de b) a e) quais imagens seria mais interessante utilizar a abertura e quais o fechamento para remover os ruídos?

```
def opening(img: np.ndarray, element: np.ndarray, iterations: int =
1):
    """
    The main porpoise of this function is centralize the logic of the
opening
    :param img:
    :param element:
    :return:
    """
    return cv2.morphologyEx(img, cv2.MORPH_OPEN, element,
iterations=iterations)


def closing(img: np.ndarray, element: np.ndarray, iterations: int =
1):
    """
    The main porpoise of this function is centralize the logic of the
closing
    :param img:
    :param element:
    :return:
    """
```

```
    return cv2.morphologyEx(img, cv2.MORPH_CLOSE, element,
iterations=iterations)

for file in os.listdir('./images'):
    img = cv2.imread(f'./images/{file}', cv2.IMREAD_GRAYSCALE)
    i = 1

    plt.subplot(1, 3, i)
    plt.imshow(img, cmap='gray')
    plt.title(f'Original ({file})')

    for op in ['opening', 'closing']:
        result = operation(img, '+', op)

        plt.subplot(1, 3, i + 1)
        plt.imshow(result, cmap='gray')
        plt.title(f'{op} ({file})')

        i += 1
    plt.show()
```




Original (c.tif)
opening (c.tif)
closing (c.tif)
Original (d.tif)
opening (d.tif)
closing (d.tif)
Original (e.tif)
opening (e.tif)
closing (e.tif)
Original (f.tif)
opening (f.tif)
closing (f.tif)



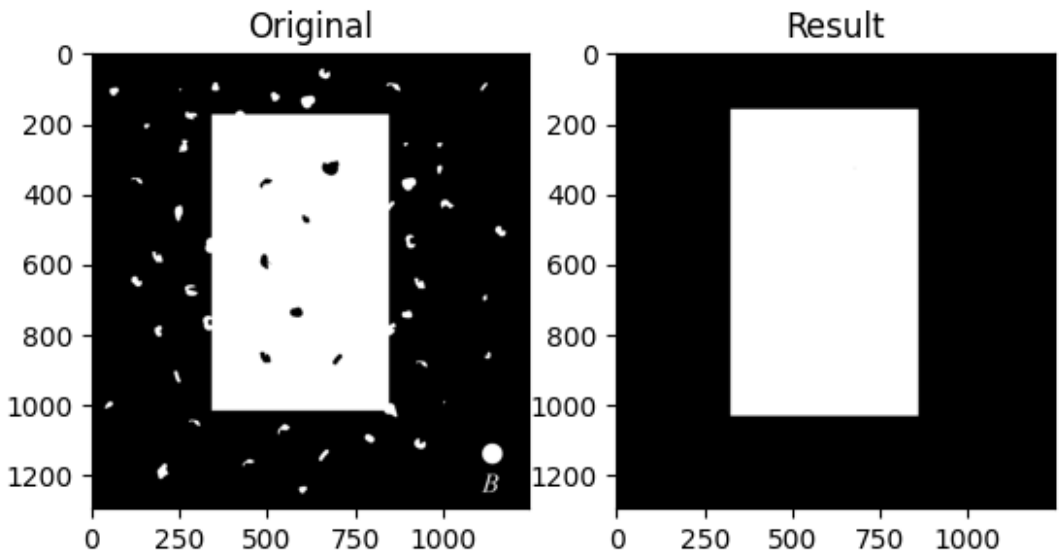

Observando o resultado obtido, podemos concluir que a abertura é mais interessante para remover os ruídos externos as bordas e o fechamento é mais interessante para remover os ruídos internos as bordas.

1. Qual sequência de operações poderia ser realizadas para que a imagem f) ficasse apenas com um retângulo branco ao centro? Implemente essas operações.

Aplicando abertura para remover os ruídos externos as bordas e depois dilatação para remover os ruídos internos as bordas.

```
img = cv2.imread('./images/f.tif',
cv2.IMREAD_GRAYSCALE).astype(np.uint8)

element = np.array([
    [1, 1, 1, 1, 1, 1, 1],
    [1, 1, 1, 1, 1, 1, 1],
    [1, 1, 1, 1, 1, 1, 1],
    [1, 1, 1, 1, 1, 1, 1],
    [1, 1, 1, 1, 1, 1, 1],
    [1, 1, 1, 1, 1, 1, 1],
    [1, 1, 1, 1, 1, 1, 1],
], dtype=np.uint8)

result = dilation(opening(img, element, 20), element, 5)
```

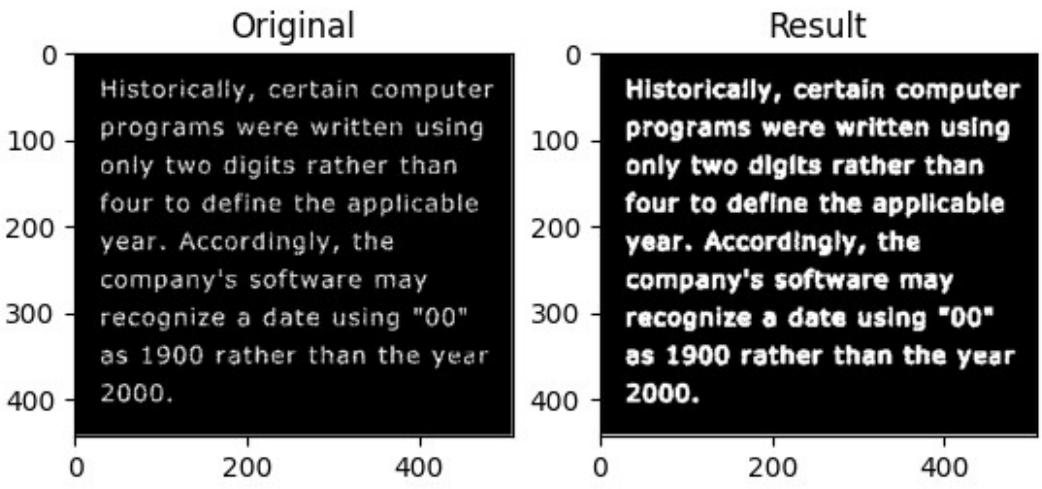
```
plt.subplot(1, 2, 1)
plt.imshow(img, cmap='gray')
plt.title('Original')

plt.subplot(1, 2, 2)
plt.imshow(result, cmap='gray')
plt.title('Result')

plt.show()
```




1. Qual(is) operações seriam necessárias para melhorar a imagem g)? Implemente essa(s) operação(ões)

A imagem (g) é constituída de textos, então a operação mais interessante seria a dilatação para engrossar os traços.

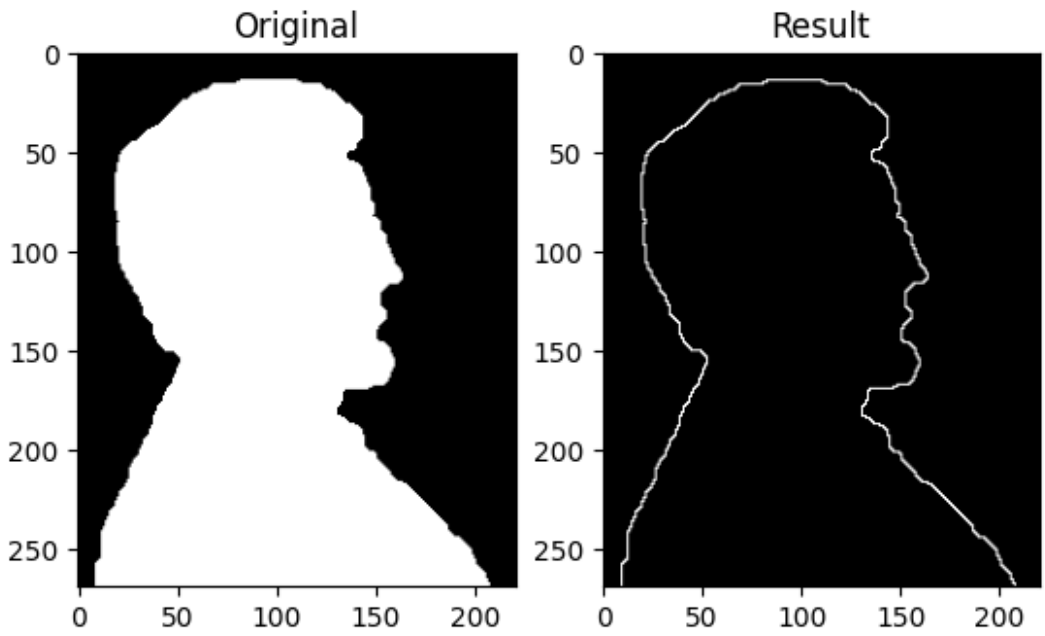
```
img = cv2.imread('./images/g.tif',
cv2.IMREAD_GRAYSCALE).astype(np.uint8)

result = dilation(img, resolve('[]'), 1)

plt.subplot(1, 2, 1)
plt.imshow(img, cmap='gray')
plt.title('Original')

plt.subplot(1, 2, 2)
plt.imshow(result, cmap='gray')
plt.title('Result')

plt.show()
```




1. Quais operações seriam necessárias para extrair apenas a borda da imagem h)? Implemente essas operações

Utilizando a erosão para remover os traços internos e depois subtraindo da imagem original.

```
img = cv2.imread('./images/h.tif',
cv2.IMREAD_GRAYSCALE).astype(np.uint8)

result = img - erosion(img, resolve('[]'), 1)

plt.subplot(1, 2, 1)
plt.imshow(img, cmap='gray')
plt.title('Original')

plt.subplot(1, 2, 2)
plt.imshow(result, cmap='gray')
plt.title('Result')

plt.show()
```


Original
Result
0
50
100
150
200
250
0
50
100
150
200