

LAPORAN PCD PRAKTIKUM
KELOMPOK JEBRET



Disusun oleh :

| | |
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JURUSAN TEKNIK KOMPUTER DAN INFORMATIKA
PROGRAM STUDI D3-TEKNIK INFORMATIKA
POLITEKNIK NEGERI BANDUNG

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1. FUNCTION PIXEL KE CSV

ScreenShoot :

```
import cv2
import numpy as np
import csv

img = cv2.imread("../huruf-10-pixel.jpg")

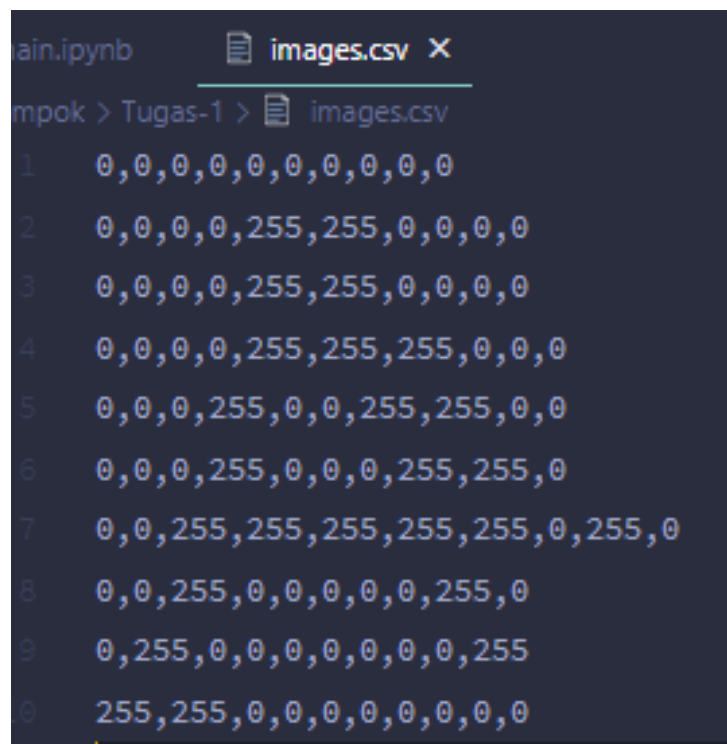
def binarize_image(image):
    # Konversi citra ke dalam citra grayscale
    gray_image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
    # Thresholding citra grayscale dengan nilai threshold 127
    _, binarized_image = cv2.threshold(gray_image, 127, 255, cv2.THRESH_BINARY)
    return binarized_image

biner = binarize_image(img)

def save_image_pixels_to_csv(pixels, filename):
    # Simpan array piksel ke dalam file CSV
    with open(filename, 'w', newline='') as f:
        writer = csv.writer(f)
        writer.writerows(pixels)

save_image_pixels_to_csv(biner, "images.csv")
```

Hasil



The screenshot shows a Jupyter Notebook interface with a file explorer at the top displaying 'main.ipynb' and 'images.csv'. The terminal output shows the command 'mpok > Tugas-1 > images.csv' followed by a list of 10 rows of pixel data. Each row contains 10 values, representing the grayscale intensity of a 10x10 pixel image. The values are either 0 or 255, indicating a binary image. The first row is all 0s. The second row has 255s in the 6th and 7th positions. The third row has 255s in the 6th and 7th positions. The fourth row has 255s in the 6th, 7th, and 8th positions. The fifth row has 255s in the 5th, 6th, 7th, and 8th positions. The sixth row has 255s in the 5th, 6th, 7th, and 8th positions. The seventh row has 255s in the 4th, 5th, 6th, 7th, and 8th positions. The eighth row has 255s in the 4th, 5th, 6th, 7th, and 8th positions. The ninth row has 255s in the 4th, 5th, 6th, 7th, and 8th positions. The tenth row is all 0s.

```
main.ipynb  images.csv X
mpok > Tugas-1 > images.csv
1 0,0,0,0,0,0,0,0,0,0
2 0,0,0,0,255,255,0,0,0,0
3 0,0,0,0,255,255,0,0,0,0
4 0,0,0,0,255,255,255,0,0,0
5 0,0,0,255,0,0,255,255,0,0
6 0,0,0,255,0,0,0,255,255,0
7 0,0,255,255,255,255,255,0,255,0
8 0,0,255,0,0,0,0,0,255,0
9 0,255,0,0,0,0,0,0,0,255
10 255,255,0,0,0,0,0,0,0,0
```

2. OPERASI MORFOLOGI

a. Citra Asli

Dibawah ini merupakan citra yang dijadikan patokan untuk proses morfologi

| PIXEL CITRA ASLI | | | | | | | | | |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 255 | 255 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 255 | 255 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 255 | 255 | 255 | 0 | 0 | 0 |
| 0 | 0 | 0 | 255 | 0 | 0 | 255 | 255 | 0 | 0 |
| 0 | 0 | 0 | 255 | 0 | 0 | 0 | 255 | 255 | 0 |
| 0 | 0 | 255 | 255 | 255 | 255 | 255 | 0 | 255 | 0 |
| 0 | 0 | 255 | 0 | 0 | 0 | 0 | 0 | 255 | 0 |
| 0 | 255 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 255 |
| 255 | 255 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



b. Pixel Citra Biner

Berikut ini merupakan citra yang ubah dari citra grayscale menjadi citra biner.

| PIXEL CITRA BINER | | | | | | | | | |
|-------------------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

c. Dilasi

- Citra Asli

Dibawah ini merupakan citra asli yang akan dilakukan proses dilasi.

| DILASI | | | | | | | | | |
|--------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

- Elemen Penstruktur

Dibawah ini merupakan salah satu contoh elemen penstruktur yang digunakan untuk proses dilasi.

| | | |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 1 | 1 |
| 0 | 1 | 0 |

- Hasil dari dilasi

Dibawah ini merupakan hasil dari proses dilasi menggunakan penstruktur diatas. Apabila citra biner “1” hit dengan elemen penstruktur maka akan diberi bintang untuk ditandai.

| OPERASI DILASI | | | | | | | | | |
|----------------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | * | * | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | * | 1 | 1 | * | 0 | 0 | 0 |
| 0 | 0 | 0 | * | 1 | 1 | * | 0 | 0 | 0 |
| 0 | 0 | 0 | * | 1 | 1 | 1 | * | 0 | 0 |
| 0 | 0 | * | 1 | * | * | 1 | 1 | * | 0 |
| 0 | 0 | * | 1 | * | * | * | 1 | 1 | * |
| 0 | * | 1 | 1 | 1 | 1 | 1 | * | 1 | * |
| 0 | * | 1 | * | * | * | * | * | 1 | * |
| * | 1 | * | 0 | 0 | 0 | 0 | 0 | * | 1 |
| 1 | 1 | * | 0 | 0 | 0 | 0 | 0 | 0 | * |

d. Erosi

- Citra Asli

dibawah ini merupakan citra asli yang akan dilakukan proses dilasi dan di samping adalah elemen penstruktur nya

| EROSI | | | | | | | | | |
|-------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | |
|---|---|---|
| 0 | 1 | 0 |
| 0 | 1 | 0 |
| 0 | 1 | 0 |

- Hasil

dibawah ini adalah hasil dari erosi. Apabila terjadi fit pada elemen penstruktur makan citra tersebut akan ditandai dengan bintang untuk dilakukan proses erosi.

| EROSI | | | | | | | | | |
|-------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | * | * | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | * | * | * | 0 | 0 | 0 |
| 0 | 0 | 0 | * | 0 | 0 | * | * | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | * | * | 0 |
| 0 | 0 | * | * | * | * | * | 0 | 1 | 0 |
| 0 | 0 | * | 0 | 0 | 0 | 0 | 0 | * | 0 |
| 0 | * | 0 | 0 | 0 | 0 | 0 | 0 | 0 | * |
| * | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| HASIL EROSI | | | | | | | | | |
|-------------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

e. Opening

- Erosi

dibawah ini merupakan citra erosi yang akan dilakukan proses opening dan di samping adalah elemen penstruktur nya

| EROSI | | | | | | | | | |
|-------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 1 | 1 |
| 0 | 1 | 0 |

- Dilasi

dibawah ini merupakan citra dilasi yang akan dilakukan proses opening

| OPENING | | | | | | | | | |
|---------|---|---|---|---|---|---|---|---|---|
| DILASI | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | * | * | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | * | 1 | 1 | * | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | * | * | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | * | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | * | 1 | * | 0 | 0 | 0 | * | 0 |
| 0 | 0 | 0 | * | 0 | 0 | 0 | * | 1 | * |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | * | 0 |
| 0 | * | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| * | 1 | * | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

- Hasil

dibawah ini adalah hasil dari opening

| HASIL OPENING | | | | | | | | | |
|---------------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

f. Closing

- Dilasi

dibawah ini merupakan citra dilasi yang akan dilakukan proses closing dan disamping adalah elemen penstruktturnya

| DILASI | | | | | | | | | |
|--------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

| | | |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 1 | 1 |
| 0 | 1 | 0 |

- Erosi

dibawah ini merupakan citra erosi yang akan dilakukan proses closing

| CLOSING | | | | | | | | | |
|---------|---|---|---|---|---|---|---|---|---|
| EROSI | | | | | | | | | |
| 0 | 0 | 0 | 0 | * | * | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | * | 1 | 1 | * | 0 | 0 | 0 |
| 0 | 0 | 0 | * | 1 | 1 | * | 0 | 0 | 0 |
| 0 | 0 | 0 | * | 1 | 1 | 1 | * | 0 | 0 |
| 0 | 0 | * | 1 | 1 | 1 | 1 | 1 | * | 0 |
| 0 | 0 | * | 1 | 1 | 1 | 1 | 1 | 1 | * |
| 0 | * | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | * | 1 | * | * | * | * | * | 1 | 1 |
| * | 1 | * | 0 | 0 | 0 | 0 | 0 | * | 1 |
| 1 | 1 | * | 0 | 0 | 0 | 0 | 0 | 0 | * |

- Hasil

dibawah ini adalah hasil dari closing

| HASIL CLOSING | | | | | | | | | |
|---------------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

3. PERBANDINGAN HASIL MANUAL DAN PROGRAM

a. Dilasi

i. Manual

| HASIL DILASI | | | | | | | | | |
|--------------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

ii. Cv2

```
def biner_dilasi(image):
    # Struktur elemen
    # 0 1 0
    # 1 1 1
    # 0 1 0
    kernel = cv.getStructuringElement(cv.MORPH_CROSS, (3, 3))
    # Lakukan operasi dilasi
    dilasi = cv.dilate(image, kernel, iterations=1)
    return dilasi

citra_dilasi = biner_dilasi(biner)
print(citra_dilasi)
cv2_imshow(citra_dilasi)
```

```
[[ 0  0  0  0 255 255  0  0  0  0]
 [ 0  0  0 255 255 255 255  0  0  0]
 [ 0  0  0 255 255 255 255  0  0  0]
 [ 0  0  0 255 255 255 255 255  0  0]
 [ 0  0 255 255 255 255 255 255 255  0]
 [ 0  0 255 255 255 255 255 255 255 255]
 [ 0 255 255 255 255 255 255 255 255 255]
 [ 0 255 255 255 255 255 255 255 255 255]
 [255 255 255  0  0  0  0  0 255 255]
 [255 255 255  0  0  0  0  0  0 255]]
```

iii. Hasil Citra



- b. Erosi
 - i. Manual

| HASIL EROSI | | | | | | | | | |
|-------------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

- ii. Cv2

```
def biner_erosi(image):
    # struktur elemen
    # 0 1 0
    # 0 1 0
    # 0 1 0
    kernel = cv.getStructuringElement(cv.MORPH_RECT, (1, 3))
    erosi = cv.erode(image, kernel, iterations = 1)
    return erosi

citra_erosi = biner_erosi(biner)
print(citra_erosi)
cv2_imshow(citra_erosi)
```

```
[[ 0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0 255 255  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0 255  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0 255  0]
 [ 0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0]
 [ 0 255  0  0  0  0  0  0  0  0]]
```

- iii. Hasil Citra



- c. Opening
 - i. Manual

| HASIL OPENING | | | | | | | | | |
|---------------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

ii. Cv2

```
def biner_opening(image):
    # jadi untuk opening itu sendiri kita akan melakukan erosi terlebih dahulu
    # erosi ini kita menggunakan struktur elemen
    # 0 1 0
    # 0 1 0
    # 0 1 0
    kernel = cv.getStructuringElement(cv.MORPH_RECT, (1,3))
    erosi = cv.erode(image, kernel, iterations=1)

    # lalu setelah mendapatkan hasil erosi, kita akan lakukan proses dilasi
    # proses dilasi ini kita menggunakan struktur elemen
    # 0 1 0
    # 1 1 1
    # 0 1 0
    kernel = cv.getStructuringElement(cv.MORPH_CROSS, (3,3))
    opening = cv.dilate(erosi, kernel, iterations=1)
    return opening

citra_opening = biner_opening(biner)
print(citra_opening)
cv2_imshow(citra_opening)
```

```
[[ 0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0 255 255  0  0  0  0]
 [ 0  0  0 255 255 255 255  0  0  0]
 [ 0  0  0  0 255 255  0  0  0  0]
 [ 0  0  0 255  0  0  0  0  0  0]
 [ 0  0 255 255 255  0  0  0 255  0]
 [ 0  0  0 255  0  0  0 255 255 255]
 [ 0  0  0  0  0  0  0  0 255  0]
 [ 0 255  0  0  0  0  0  0  0  0]
 [255 255 255  0  0  0  0  0  0  0]]
```

iii. Hasil Citra



- d. Closing
- i. Manual

| HASIL CLOSING | | | | | | | | | |
|---------------|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

- ii. Cv2

```
def biner_closing(image):
    # jadi untuk closing itu sendiri kita akan melakukan dilasi terlebih dahulu
    # dilasi ini kita menggunakan struktur elemen
    # 0 1 0
    # 1 1 1
    # 0 1 0
    kernel = cv.getStructuringElement(cv.MORPH_CROSS, (3,3))
    dilasi = cv.dilate(image, kernel, iterations=1)

    # lalu setelah mendapatkan hasil dilasi, kita akan lakukan proses erosi
    # proses erosi ini kita menggunakan struktur elemen
    # 0 1 0
    # 1 1 1
    # 0 1 0
    kernel = cv.getStructuringElement(cv.MORPH_CROSS, (3,3))
    closing = cv.erode(dilasi, kernel, iterations=1)

    return closing

citra_closing = biner_closing(biner)
print(citra_closing)
cv2_imshow(citra_closing)
```

```
[[ 0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0 255 255  0  0  0  0]
 [ 0  0  0  0 255 255  0  0  0  0]
 [ 0  0  0  0 255 255 255  0  0  0]
 [ 0  0  0 255 255 255 255 255  0  0]
 [ 0  0  0 255 255 255 255 255 255  0]
 [ 0  0 255 255 255 255 255 255 255 255]
 [ 0  0 255  0  0  0  0  0 255 255]
 [ 0 255  0  0  0  0  0  0  0 255]
 [255 255  0  0  0  0  0  0  0  0]]
```

- iii. Hasil Citra

