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PROBLEM STATEMENT

Homework 2

(A) Given a grayscale image I,

Step 1: Use the dithering matrix D_2 to generate an array D of image size by repeating D_2

$$D_2 = \begin{bmatrix} 0 & 128 & 32 & 160 \\ 192 & 64 & 224 & 96 \\ 48 & 176 & 16 & 144 \\ 240 & 112 & 208 & 80 \end{bmatrix}$$

D

D_2	D_2	D_2	D_2
D_2	D_2	D_2	D_2
D_2	D_2	D_2	D_2
D_2	D_2	D_2	D_2

Step 2: Threshold image I by

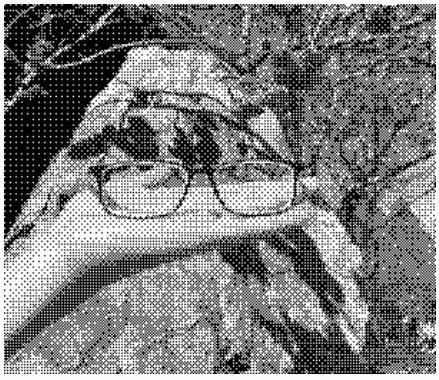
$$I'(i,j) = \begin{cases} 255 & \text{if } I(i,j) > D(i,j) \\ 0 & \text{if } I(i,j) \le D(i,j) \end{cases}$$

Step 3: Show images I and I'

(B) Extend to $n = 4$ gray values

1. $255 / 3 = 85$
2. $Q(i,j) = [I(i,j)/85]$
3. $D_1 = \begin{bmatrix} 0 & 56 \\ 84 & 28 \end{bmatrix} \underset{\text{extend}}{\Rightarrow} D$
4. $I'(i,j) = Q(i,j) + \begin{cases} 1 & \text{if } I(i,j) - 85Q(i,j) > D(i,j) \\ 0 & \text{if } I(i,j) - 85Q(i,j) \le D(i,j) \end{cases}$
5. Scale values of I' so that its values are in [0, 255] for displaying

EXPERIMENTAL RESULTS

Input grayscale image	Output image (A)	Output image (B)
		

SOURCE CODE

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

d_2 = np.array([
    [0, 128, 32, 160],
    [192, 64, 224, 96],
    [48, 176, 16, 144],
    [240, 112, 208, 80],
])
d_1 = np.array([
    [0, 56],
    [84, 28],
])

# (A)

image = np.array(cv2.imread("input.jpeg", cv2.IMREAD_GRAYSCALE))

D = d_2
while D.shape[0] < image.shape[0]:
    D = np.vstack((D, D))
while D.shape[1] < image.shape[1]:
    D = np.hstack((D, D))

for i in range(image.shape[0]):
    for j in range(image.shape[1]):
        image[i][j] = 255 if image[i][j] > D[i][j] else 0

cv2.imwrite('output-a.jpeg', image)

# (B)

image = np.array(cv2.imread("input.jpeg", cv2.IMREAD_GRAYSCALE))

D = d_1
while D.shape[0] < image.shape[0]:
    D = np.vstack((D, D))
while D.shape[1] < image.shape[1]:
    D = np.hstack((D, D))

arr = []
```

```
for i in range(image.shape[0]):
    for j in range(image.shape[1]):
        q = int(image[i][j] / (255 / 3))
        image[i][j] = q + (1 if image[i][j] - 85*q > D[i][j] else 0)
        image[i][j] = image[i][j]/4 * 255

cv2.imwrite('output-b.jpeg', image)
```

COMMENTS

來不及寫完，所以沒交，不過後來補完了我好棒