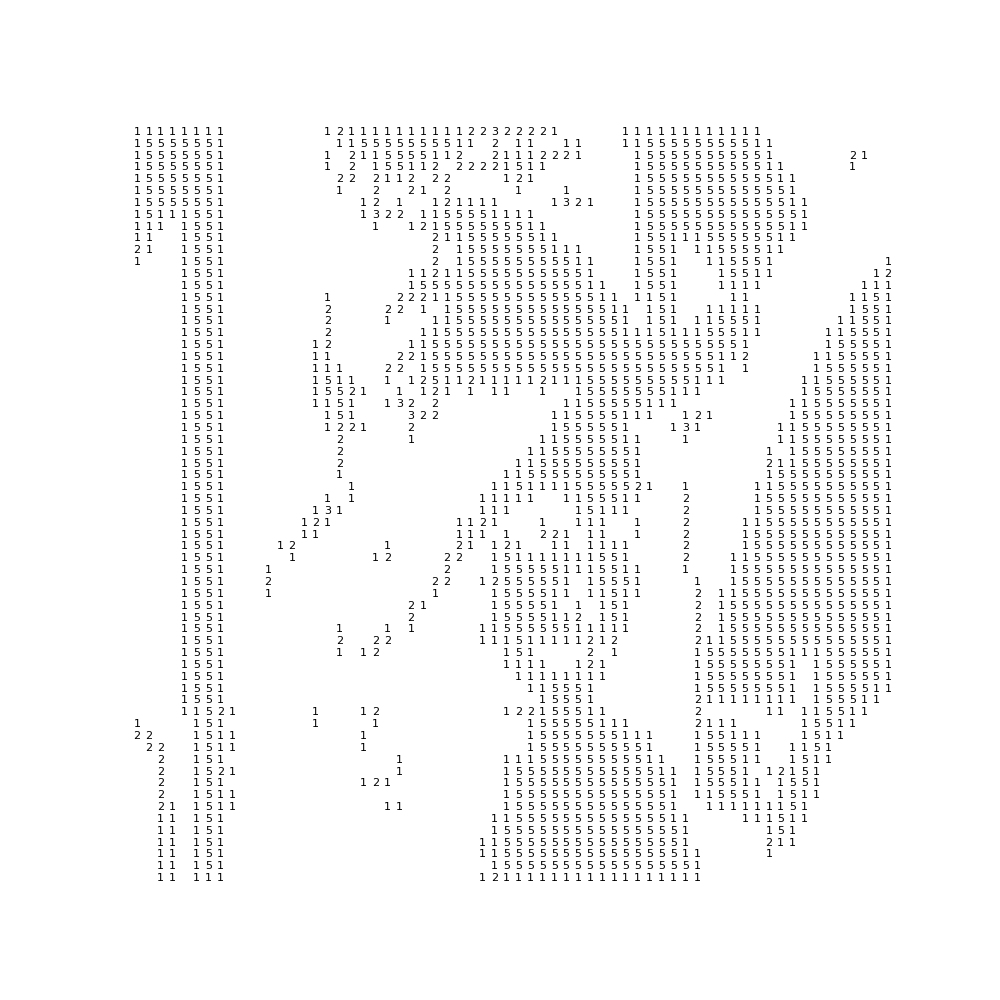
Homework 6

R13525009 羅筠笙

1. Yokoi Connectivity Number

Description: Processes a grayscale Lena image by binarizing it, then downsampling it to a 64x64 grid using the top-left pixel from each 8x8 block. It calculates the Yokoi connectivity number for each pixel in the downsampled binary image to determine its connectivity pattern. Finally, it displays the result as text on a 64x64 grid, where each number represents the connectivity value for each pixel location.



1. from PIL import Image as im
2. import numpy as np
3. import matplotlib.pyplot as plt
4. # Binarize
5. img = im.open("./lena.bmp")
6. img\_arr = np.array(img)
7. img\_arr\_binary = (img\_arr >= 128).astype(np.uint8) \* 255
8. # Downsample
9. downsample = np.zeros((64, 64), dtype=np.uint8)
10. for i in range(64):
11. for j in range(64):
12. downsample[i, j] = img\_arr\_binary[i \* 8, j \* 8]
13. # Define the h function
14. def h(b, c, d, e):
15. if b == c and (d != b or e != b):
16. return 'q'
17. elif b == c and (d == b and e == b):
18. return 'r'
19. else:
20. return 's'
21. # Yokoi connectivity
22. def yokoi\_connectivity(pixel, img, x, y):
23. if pixel == 0:
24. return 0
25. # Define the neighborhoods
26. x0 = pixel
27. x1 = img[x, y + 1] if y + 1 < 64 else 0
28. x2 = img[x - 1, y] if x - 1 >= 0 else 0
29. x3 = img[x, y - 1] if y - 1 >= 0 else 0
30. x4 = img[x + 1, y] if x + 1 < 64 else 0
31. x5 = img[x + 1, y + 1] if (x + 1 < 64 and y + 1 < 64) else 0
32. x6 = img[x - 1, y + 1] if (x - 1 >= 0 and y + 1 < 64) else 0
33. x7 = img[x - 1, y - 1] if (x - 1 >= 0 and y - 1 >= 0) else 0
34. x8 = img[x + 1, y - 1] if (x + 1 < 64 and y - 1 >= 0) else 0
35. # Calculate the output
36. a1 = h(x0, x1, x6, x2)
37. a2 = h(x0, x2, x7, x3)
38. a3 = h(x0, x3, x8, x4)
39. a4 = h(x0, x4, x5, x1)
40. # Decide the output
41. if a1 == 'r' and a2 == 'r' and a3 == 'r' and a4 == 'r':
42. return 5
43. else:
44. return sum(1 for a in [a1, a2, a3, a4] if a == 'q')
45. # Calculate Yokoi connectivity numbers
46. result = np.full((64, 64), " ", dtype=str)
47. for i in range(64):
48. for j in range(64):
49. result[i, j] = str(yokoi\_connectivity(downsample[i, j], downsample, i, j))