

HW6 Report

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Introduction

This program computes the Yokoi connectivity number (4-connected) of an binary image. The overall process includes the following steps:

Preprocess. Binarize it with threshold=128, and then down-sample the source image using 8x8 block size with the topmost-left pixel's value

Main process. Compute the Yokoi connectivity number of the binary image.

Usage

Place the source image and main.py under the same directory. Run the following command in the terminal.

```
python3 main.py -s <source>
```

Parameters

`-s <source>` : the file path of source image, default = `lena.bmp`

Yokoi Connectivity Number

For each white pixel in the binary image, compute the *f formula*:

$$f(a_1, a_2, a_3, a_4) = \begin{cases} 5, & \text{if } a_1 = a_2 = a_3 = a_4 = r \\ n, & \text{where } n = \# \{a_k | a_k = q\}, \text{ otherwise} \end{cases}$$

where a_1, a_2, a_3, a_4 are the result of the *h formula* 4 corner neighborhood of the input pixel. The *h formula* is given as the following:

$$h(b, c, d, e) = \begin{cases} s, & \text{if } b \neq c \\ r, & \text{if } b = c = d = e \\ q, & \text{otherwise} \end{cases}$$

The result is saved as `yokoi.txt` as shown in the next page.

Screenshot of yokoi.txt

```
1 11111111000000001211111111112232222100000111111111110000000000
2 1555555100000000011555555551102011001100011555555555110000000000
3 15555551000000000102115555112002111222100001555555555110000002100
4 15555551000000000102015511202222151100000001555555555110000001000
5 1555555100000000022021120220000121000000001555555555110000000000
6 1555555100000000010000002221155555555551101151000011000000001151
7 155555510000000000120100121111000013210001555555555551100000000
8 151115510000000000132201155551111000000001555555555551100000000
9 111015510000000000010012155555551100000001555555555551100000000
10 11001551000000000000000021155555110000001551155555110000000000
11 2100155100000000000000000201555555511100001551011555511000000000
12 100015510000000000000000000020155555555110001551001155510000000001
13 0000155100000000000000001211555555555510001551000155110000000012
14 000015510000000000000000155555555555551100155100011110000000111
15 0000155100000000100000022211555555555551101151000011000000001151
16 000015510000000020000220101555555555555511015100111100000001551
17 00001551000000020000100011555555555555510151011555100000011551
18 00001551000000020000000115555555555555511151115551100000115551
19 000015510000000120000001155555555555555555555555110000001155551
20 00001551000000011000002215555555555555555555555555112000001155551
21 0000155100000001110002201555555555555555555555555510100000155551
22 0000155100000001511001012511211112111555555555511100000011555551
23 00001551000000015521001012101011555555555555511100000011555551
24 00001551000000011510013202000000000011555551110000000011555551
25 00001551000000015100003220000000001155551110012100000015555551
26 000015510000000122100020000000000155551000131000000115555551
27 00001551000000020000010000000001155555110001000000115555551
28 0000155100000002000000000000000115555551000000001015555551
29 000015510000000200000000000000011555555510000000002115555551
30 000015510000000010000000000000011555555551000000000155555551
31 00001551000000000100000000000001511115555521001000001155555551
32 000015510000000010100000000001111001155511000200001155555551
33 00001551000000013100000000001110000015111000200001555555551
34 00001551000001210000000001121000100111001000200011555555551
35 00001551000001100000000001110100221011001000200015555555551
36 000015510000120000000100000210121001101111000200015555555551
37 0000155100001000000120000220015111111551000200015555555551
38 00001551000100000000000020001555555115511000100015555555551
39 0000155100020000000000000220012555551015551000010015555555551
40 00001551000100000000000001000015555110115110000201555555551
41 000015510000000000000000210000015555101015100000201555555551
42 000015510000000000000000020000015555112015100000201555555551
43 00001551000000000100010100000115555551111100002015555555551
44 00001551000000002002200000001151111212000002115555555551
45 00001551000000001012000000000151000020100000155555511155551
46 0000155100000000000000000000011100121000000155555510155551
47 000015510000000000000000000001111110000000155555510155551
48 0000155100000000000000000000001155510000000155555510155551
49 000015510000000000000000000000115551000000015555551015551
50 00001152100000010001200000000012215551100000020000011011551100
51 100001510000000100010001000000001555551110000021110000015511000
52 22000151100000000010000000000001555555511100015511100015110000
53 022001511000000000010000000000015555555510001555100115100000
54 00200151000000000000010000000011555555555110015551100151100000
55 00200152100000000000010000000015555555555511015551012151000000
56 0020015100000000001210000000015555555555551015551101551000000
57 002001511000000000000000000001555555555555101555101511000000
58 0021015110000000000001000000015555555555551011111151000000
59 001101510000000000000000000001555555555555110000111511000000
60 0011015100000000000000000000015555555555555510000001510000000
61 00110151000000000000000000000115555555555555551000002110000000
62 00110151000000000000000000000115555555555555555110000010000000
63 00110151000000000000000000000155555555555555555100000000000000
64 0011011100000000000000000000000001211111111111111110000000000000
```

(↓ 0s removed)

```
1 111111111 121111111111122322221 1111111111111
2 155555511 115555555511 2 11 11 1155555555511
3 155555511 1 2115555112 21112221 15555555551 21
4 155555511 1 2 155112 22221511 15555555551 1
5 155555511 2 2 2112 2 155555555511
6 155555511 1 2 21 2 1 155555555551
7 155555511 12 1 121111 1321 1555555555511
8 15111551 1322 1155551111 1555555555551
9 111 1551 1 12155555511 1555555555511
10 11 1551 2115555511 1551115555511
11 21 1551 2 15555555111 1551 11555511
12 1 1551 2 15555555511 1551 115551 1
13 1551 1121155555551 1551 15511 1551 12
14 1551 155555555555511 1551 1111 111
15 1551 1 222115555555555511 1151 11 1151
16 1551 2 22 1 1555555555555551 151 11111 1551
17 1551 2 1 11555555555555551 151 115551 11551
18 1551 2 11555555555555555111511155511 115551
19 1551 12 115555555555555555555555555551 15551
20 1551 11 2215555555555555555555555555112 115551
21 1551 111 22 15555555555555555555555551 1 155551
22 1551 1511 1 125112111112111555555111 115551
23 1551 15521 1 121 1 11 1 1555555511 1555551
24 1551 1151 132 2 1155555111 11555551
25 1551 151 322 115555111 121 15555551
26 1551 1221 2 155551 131 11555551
27 1551 2 1 115555511 1 115555551
28 1551 2 115555551 1 15555551
29 1551 2 1155555551 2115555551
30 1551 1 1155555551 1555555551
31 1551 1 115111555521 1 1155555551
32 1551 1 1 11111 1155511 2 15555555551
33 1551 131 11 15111 2 15555555551
34 1551 121 1121 1 111 1 2 115555555551
35 1551 11 111 1 221 11 1 2 155555555551
36 1551 12 21 121 11 1111 2 155555555551
37 1551 1 12 22 151111111551 2 115555555551
38 1551 1 2 1555551115511 1 155555555551
39 1551 2 22 1255551 15551 1 15555555551
40 1551 1 1 1555511115511 2 115555555551
41 1551 21 155551 1 151 2 1555555555551
42 1551 2 15555112 151 2 1555555555551
43 1551 1 1 1 1155555511111 2 1555555555551
44 1551 2 22 11511111212 211555555555551
45 1551 1 12 151 2 1 155555511155551
46 1551 1111 121 15555551 155551
47 1551 11111111 15555551 1555551
48 1551 11551 155551 1555511
49 1551 15551 21111111 155511
50 11521 1 12 122155511 2 11 115511
51 1 151 1 155555111 211 15511
52 22 1511 1 1555555511 155111 1511
53 22 1511 1 1555555551 155551 1151
54 2 151 1 11155555555511 155511 1511
55 2 1521 1 155555555555511 15551 12151
56 2 151 121 15555555555551 155511 1551
57 2 1511 11555555555551 11551 1511
58 21 1511 11 15555555555551 111111151
59 11 151 11555555555555511 111511
60 11 151 15555555555555551 151
61 11 151 11555555555555551 211
62 11 151 11555555555555551 1
63 11 151 15555555555555551
64 11 111 121111111111111111
```