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本次作業採用 C++配合 OpenCV 完成

Yokoi Connectivity Number

步驟一：二值化，利用先前 HW2 的 function

```
//先進行二值化
Mat b_img = binary(img, THREASHOLD, widthLimit, heightLimit);
```

步驟二：用8 × 8的 blocks 進行 downsample

```
Mat lena_down(64, 64, CV_8U, Scalar(0));
for (int height = 0; height < 64; height++) {
    for (int width = 0; width < 64; width++) {
        lena_down.at<uchar>(height, width) = b_img.at<uchar>(8 * height, 8 * width);
    }
}
```

步驟三：定義 x0～x8

步驟四：定義兩函數

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

```
char h(bool b, bool c, bool d, bool e) {
    if (b == c && (d != b || e != b))
        return 'q';

    if (b == c && (d == b && e == b))
        return 'r';

    return 's';
}
```

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

```
char a[5];
a[1] = h(x0, x1, x6, x2);
a[2] = h(x0, x2, x7, x3);
a[3] = h(x0, x3, x8, x4);
a[4] = h(x0, x4, x5, x1);

int yokoi;
```

```
if (a[1] == 'r' && a[2] == 'r' && a[3] == 'r' && a[4] == 'r')
    yokoi = 5;
    else {
        yokoi = 0;
        for (int i = 1; i < 5; i++) {
            if (a[i] == 'q')
              yokoi++;
            }
     }
```

步驟五：印出

```
for (int height = 0; height < lena_down.rows; height++) {
          for (int width = 0; width < lena_down.cols; width++) {
               if (lena_down.at<uchar>(height, width) > 0) {//代表是foreground的像素

                    if (height == 0) {

                         if (width == 0) {
                              //top-left
                              x7 = x2 = x6 = 0;
                              x3 = 0; x0 = lena_down.at<uchar>(height, width); x1 =
lena_down.at<uchar>(height, width + 1);
                              x8 = 0; x4 = lena_down.at<uchar>(height + 1, width); x5 =
lena_down.at<uchar>(height + 1, width + 1);
                         }
                         else if (width == lena_down.cols - 1) {
                              //top-right
                              x7 = x2 = x6 = 0;
                              x3 = lena_down.at<uchar>(height, width - 1); x0 = lena_down.at<uchar>(height,
width); x1 = 0;
                              x8 = lena_down.at<uchar>(height + 1, width - 1); x4 =
lena_down.at<uchar>(height + 1, width); x5 = 0;
                         }

                         else {
                              //第一列其他元素
                              x7 = x2 = x6 = 0;
                              x3 = lena_down.at<uchar>(height, width - 1); x0 = lena_down.at<uchar>(height,
width); x1 = lena_down.at<uchar>(height, width + 1);
                              x8 = lena_down.at<uchar>(height + 1, width - 1); x4 =
lena_down.at<uchar>(height + 1, width); x5 = lena_down.at<uchar>(height + 1, width + 1);
                         }
```

```
                    }

                    else if (height == lena_down.rows - 1) {

                        if (width == 0) {
                            //bottom-left
                            x7 = 0; x2 = lena_down.at<uchar>(height - 1, width); x6 =
lena_down.at<uchar>(height - 1, width + 1);
                            x3 = 0; x0 = lena_down.at<uchar>(height, width); x1 =
lena_down.at<uchar>(height, width + 1);
                            x8 = x4 = x5 = 0;
                        }
                        else if (width == lena_down.cols - 1) {
                            //bottom-right
                            x7 = lena_down.at<uchar>(height - 1, width - 1); x2 =
lena_down.at<uchar>(height - 1, width); x6 = 0;
                            x3 = lena_down.at<uchar>(height, width - 1); x0 = lena_down.at<uchar>(height,
width); x1 = 0;
                            x8 = x4 = x5 = 0;
                        }

                        else {
                            //最後一列其他元素
                            x7 = lena_down.at<uchar>(height - 1, width - 1); x2 =
lena_down.at<uchar>(height - 1, width); x6 = lena_down.at<uchar>(height - 1, width + 1);
                            x3 = lena_down.at<uchar>(height, width - 1); x0 = lena_down.at<uchar>(height,
width); x1 = lena_down.at<uchar>(height, width + 1);
                            x8 = x4 = x5 = 0;
                        }
                    }

                    else {

                        if (width == 0) {
                            //中間最左
                            x7 = 0; x2 = lena_down.at<uchar>(height - 1, width); x6 =
lena_down.at<uchar>(height - 1, width + 1);
                            x3 = 0; x0 = lena_down.at<uchar>(height, width); x1 =
lena_down.at<uchar>(height, width + 1);
                            x8 = 0; x4 = lena_down.at<uchar>(height + 1, width); x5 =
lena_down.at<uchar>(height + 1, width + 1);
                        }
```

```
                    else if (width == lena_down.cols - 1) {
                        //中間最右，臣又來了
                        x7 = lena_down.at<uchar>(height - 1, width - 1); x2 =
lena_down.at<uchar>(height - 1, width); x6 = 0;
                        x3 = lena_down.at<uchar>(height, width - 1); x0 = lena_down.at<uchar>(height,
width); x1 = 0;
                        x8 = lena_down.at<uchar>(height + 1, width - 1); x4 =
lena_down.at<uchar>(height + 1, width); x5 = 0;
                    }

                    else {
                        //都有在範圍內
                        x7 = lena_down.at<uchar>(height - 1, width - 1); x2 =
lena_down.at<uchar>(height - 1, width); x6 = lena_down.at<uchar>(height - 1, width + 1);
                        x3 = lena_down.at<uchar>(height, width - 1); x0 = lena_down.at<uchar>(height,
width); x1 = lena_down.at<uchar>(height, width + 1);
                        x8 = lena_down.at<uchar>(height + 1, width - 1); x4 =
lena_down.at<uchar>(height + 1, width); x5 = lena_down.at<uchar>(height + 1, width + 1);
                    }
                }

                char a[5];
                a[1] = h(x0, x1, x6, x2);
                a[2] = h(x0, x2, x7, x3);
                a[3] = h(x0, x3, x8, x4);
                a[4] = h(x0, x4, x5, x1);

                int yokoi;

                if (a[1] == 'r' && a[2] == 'r' && a[3] == 'r' && a[4] == 'r')
                    yokoi = 5;
                else {
                    yokoi = 0;
                    for (int i = 1; i < 5; i++) {
                        if (a[i] == 'q')
                            yokoi++;
                    }
                }
                cout << yokoi << ' ';
            }
            else
                cout << "  ";
```

```
                if (width == lena_down.cols - 1)
                    cout << endl;
            }
        }
```