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

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

```
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';
}
```

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

```
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;
```

步驟五:印出

```
for (int height = 0; height < lena_down.rows; height++) {</pre>
           for (int width = 0; width < lena_down.cols; width++) {</pre>
                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); <math>x1 = 0
lena_down.at<uchar>(height, width + 1);
                                x8 = 0; x4 = lena\_down.at < uchar > (height + 1, width); <math>x5 = lena\_down.at < uchar > (height + 1, width);
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); <math>x6 = 1
lena_down.at<uchar>(height - 1, width + 1);
                                  x3 = 0; x0 = lena\_down.at < uchar > (height, width); x1 = lena\_down.at < uchar > (height, width)
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); <math>x6 = 0
lena_down.at<uchar>(height - 1, width + 1);
                                 x3 = 0; x0 = lena\_down.at < uchar > (height, width); <math>x1 = 0
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)
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;
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