C++

## **Project 6: Thinning**

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#### **Thin North Algorithm:**

Step 1: you will need to for loop the outer from loop let r = 1, while r < numRows + 1, and r++. Then the inner for loop would be let c = 1, while c < numCols + 1, and c++.

Step 2 if pixel is greater than zero, you check for the following cases aryOne[r-1][j] == 0 and objectNeighbor > 4 and it is not connector. If the statement is true aryTwo[r][c] = 0, and changeflag++;

Note for: South Algorithm it is same template but you just need to change aryOne[r-1][c] == 0 to aryOne[r+1][c] == 0. And for West Thinning you use same template but change aryOne[r-1][c] == 0 to aryOne[r][c-1] == 0 and change aryOne[r-1][c] == 0 to aryOne[r-1][c] == 0 to aryOne[r-1][c] == 0 to aryOne[r][c+1] == 0 and change aryOne[r-1][c] == 0 to aryOne[r][c+1] == 0 and change aryOne[r-1][c] == 0 to aryOne[r][c+1] == 0 and change aryOne[r-1][c] == 0 to aryOne[r][c+1] == 0 and change aryOne[r-1][c] == 0 to aryOne[r][c+1] == 0 and aryOne[r][c+1] == 0 and aryOne[r][c+1][c] == 0 to aryOne[r][c+1][c] == 0 to aryOne[r][c+1][c] == 0 to aryOne[r][c+1][c] == 0 to aryOne[r][c+1][c] == 0 and aryOne[r][c+1][c] == 0 to aryOne[r][c+1][c] == 0 to aryOne[r][c+1][c] == 0 to aryOne[r][c-1][c] == 0

#### **Neighbor Algorithm:**

Step 0: the method neighbor should be called neighbor (int objectNeighbor, int r, int c)

Where as objectNeighbor is how many neighbor does the pixel need to have greater, r is for current row of pixel and c = current column of pixel. That the method must return Boolean value.

Step 1: Initialize count to 0 and then have 2 for loops the outer for loop would be int i = r - 1; i <= r + 1; i++ and the inner for loop would be int i = c - 1; i <= c + 1; j++. In the inner for loop you have If i = r and c = j continue and if aryOne is not 0 you increment count by 1;

Step 2: After the two for loop is done if count > objectNeighbor then return true. If not the case on next line have return false.

#### **Connected Algorithm:**

```
Step 0: this method should have return Boolean value.
Step 1: create the variables and initialize RHS, LHS, TS and BS to false.
Step 2: if (aryOne [i - 1][j] == 0&& aryOne[i][j - 1] == 0){
                                                                  if top and left = 0
            If (aryOne [i - 1][j - 1] == 1)
                                                                       if top-left =1
             Return true;
Step 3: if (aryOne [i + 1][j] == 0\&\& aryOne[i][j - 1] == 0){
                                                                  if bottom and left = 0
            If (aryOne [i + 1][j - 1] == 1)
                                                                        if bottom-left = 1
             Return true;
Step 4: if (aryOne [i - 1][j] == 0\&\& aryOne[i][j + 1] == 0){
                                                                  if top and right = 0
            If (aryOne [i - 1][j + 1] == 1)
                                                                        if top-right = 1
             Return true;
Step 5: if (aryOne [i + 1][j] == 0\&\& aryOne[i][j + 1] == 0){
                                                                  if bottom and right = 0
            If (aryOne [i + 1][j + 1] == 1)
                                                                        if bottom-right = 1
             Return true;
Step 6: have a for loop as follow for (int c = j - 1; c < j + 1; c + +) then inside of it if aryOne [i - 1] [c] = 1 then TS = true; and if
ary[i + 1][c] == 1 \text{ then BS} = true;
Step 7: have a for loop as follow for (int r = r - 1; r < i + 1; r + +) then inside of it if aryOne [r][j - 1] = 1 then LHS is true;
aryOne[r][j + 1] == 1 then RHS = true;
Step 7: if (aryOne[i][j-1] == 0 \&\& aryOne[i][j+1] == 0){.}
                                                                  If left and right = 0
            if (TS && BS) return true;
Step 8: if (aryOne[i-1][j] == 0 \&\& aryOne[i+1][j] == 0){. If top and bottom = 0
            if (LHS && RHS) return true;
Step 9: return false;
```

#### **Source Code:**

```
#include <iostream>
#include <fstream>
#include <string>
using namespace std;
class Thinning {
    public:
    int numRows = -1:
    int numCols= −1;
    int minVal = -1;
    int maxVal = -1:
    int changeflag = 1;
    int cycleCount = -1;
    int **aryOne;
    int **aryTwo;
    // dynamically allocate aryOne and ary2 and obtain all values of the
header
    void constructor(ifstream & input){
            input >> this->numRows >> this->numCols >> this->minVal >> this-
>maxVal:
            this -> aryOne = new int*[this -> numRows + 2];
            for (int i = 0; i < this -> numRows + 2; ++i){
                aryOne[i] = new int[ this -> numCols + 2];
            this -> aryTwo = new int*[this -> numRows + 2];
            for (int i = 0; i < this -> numRows + 2; ++i){
                aryTwo[i] = new int[ this -> numCols + 2];
        }
    // zero frame the ary
    void zeroFrame (int **Ary){
            for (int i = 0; i < this -> numRows + 2; ++i){
                for (int j = 0; j < this -> numCols + 2; ++j)
                    Ary[i][j] = 0;
            }
    }
    //adds the inFile values to aryOne
    void loadImage (ifstream & input){
        for (int i = 1; i < this -> numRows + 1; ++i){
            for (int j = 1; j < this -> numCols + 1; ++j)
                input >> aryOne[i][j];
```

```
}
    }
    // copy all the values of aryTwo to aryOne
    void copyAry(int **ary1, int **ary2){
        for (int i = 0; i < this -> numRows + 2; ++i){
            for (int j = 0; j < this -> numCols + 2; ++j)
            ary1[i][j] = ary2[i][j];
        }
    }
    void NorthThinning(){
        //copyAry(aryTwo, ary0ne);
        for (int i = 1; i < numRows + 1; i++){</pre>
            for (int j = 1; j < numCols + 1; j++){</pre>
                if (ary0ne[i][j] > 0)
                    North(i, j);
            }
        }
    void North(int i, int j){
        bool Objneighbor = false;
        bool connector = false;
        // check if there is at least 4 object neighbor
        Objneighbor = neighbor(4, i, j);
        // check if it is a connector
        connector = connectedness(i, j);
        if (aryOne[i - 1][j] == 0 && Objneighbor == true && connector ==
false){
            aryTwo[i][j] = 0;
            changeflag++;
        }
    }
    void SouthThinning(){
        for (int i = 1; i < numRows + 1; i++){</pre>
            for (int j = 1; j < numCols + 1; j++){</pre>
                if ( aryOne[i][j] > 0)
                    South(i, j);
            }
        }
    void South(int i, int j){
        bool Objneighbor = false;
        bool connect = false;
```

```
// if there are at least 4 object neighbor set pixel to zero
        Objneighbor = neighbor(4, i, j);
        //if it is not a connector then flip
        connect = connectedness(i, j);
        //North neighbor == 0 then set pixel to 0
        if (aryOne[i + 1][j] == 0 && Objneighbor == true && connect ==
false){
            aryTwo[i][j] = 0;
            changeflag++;
        }
    void WestThinning(){
        for (int i = 1; i < numRows + 1; i++){</pre>
            for (int j = 1; j < numCols + 1; j++){</pre>
                if ( aryOne[i][j] > 0)
                    West(i, j);
            }
        }
    }
    void West( int i, int j){
        bool Objneighbor = false;
        bool connect = false;
        // if there are at least 4 object neighbor set pixel to zero
        Objneighbor = neighbor(3, i, j);
        //if it is not a connector then flip
        connect = connectedness(i, j);
        //West neighbor == 0 then set pixel to 0
        if (aryOne[i][j - 1] == 0 && Objneighbor == true && connect ==
false){
            aryTwo[i][j] = 0;
            changeflag++;
        }
    }
    void EastThinning(){
        for (int i = 1; i < numRows + 1; i++){</pre>
            for (int j = 1; j < numCols + 1; j++){</pre>
                if ( ary0ne[i][j] > 0)
                    East(i, j);
            }
        }
    }
    void East( int i, int j){
        bool Objneighbor = false;
        bool connect = false;
        // if there are at least 4 object neighbor set pixel to zero
        Objneighbor = neighbor(3, i, j);
        //if it is not a connector then flip
        connect = connectedness(i, j);
        //West neighbor == 0 then set pixel to 0
```

```
if (aryOne[i][j + 1] == 0 && Objneighbor == true && connect ==
false){
            aryTwo[i][j] = 0;
            changeflag++;
        }
    }
    // North: objNeighbor = 4
    bool neighbor(int objNeighbor, int i, int j){
        bool result = false;
        int count = 0;
            for ( int row = i - 1; row <= i + 1; row++) {</pre>
                for ( int col = j - 1; col <= j + 1; col++) {
                    if ( row == i && col == j)
                        continue;
                    if (ary0ne[row][col] > 0)
                        count++;
                }
            }
        if (count > objNeighbor)
            result = true;
        //cout << result;</pre>
        return result;
    }
    bool connectedness(int i, int j){
        bool TS = false;
        bool BS = false;
        bool LHS = false:
        bool RHS = false;
        for(int c = j - 1; c < j + 1; c++){
            if(ary0ne[i-1][c] == 1)
                TS = true;
            if(ary0ne[i + 1][c] == 1)
                BS = true;
        }
        for(int r = i - 1; r < i + 1; r++){
            if(ary0ne[r][j-1] == 1)
                LHS = true;
            if(ary0ne[r][j + 1] == 1)
                RHS = true;
        }
        // if left and right = 0 and TS is 1
        if (ary0ne[i][j-1] == 0 \& ary0ne[i][j+1] == 0){
            if (TS && BS)
                return true;
        }
```

```
//top and bottom == 0 and LHS and RHS == 1
    if (ary0ne[i - 1][j] == 0 \& ary0ne[i + 1][j] == 0){
        if (LHS && RHS)
            return true;
    }
    // top and left = 0 and top-left = 1
    if (ary0ne[i - 1][j] == 0 \& ary0ne[i][j - 1] == 0){
        if (ary0ne[i - 1][j - 1] == 1)
            return true;
    }
    // bottom and left = 0 and bottom-left = 1
    if (ary0ne[i + 1][j] == 0 \& ary0ne[i][j - 1] == 0){
        if (ary0ne[i + 1][j - 1] == 1)
            return true;
    }
    // top and right = 0 and top-right = 1
    if (ary0ne[i - 1][j] == 0 \& ary0ne[i][j + 1] == 0){
        if (ary0ne[i - 1][j + 1] == 1)
            return true;
    }
    // bottom and right = 0 and bottom-right = 1
    if (ary0ne[i + 1][j] == 0 \& ary0ne[i][j + 1] == 0){
        if (ary0ne[i + 1][j + 1] == 1)
            return true;
    return false;
}
void imgReformat(int **inAry, ofstream & OutImg){
    OutImg << " " << this->numRows << " "</pre>
           << this->numCols << " "
           << this->minVal << " "
           << this->maxVal << endl;
    OutImg << endl;</pre>
    for (int r = 1; r < numRows + 1; r++){</pre>
        for (int c = 1; c < numCols + 1; c++){</pre>
            if (0 != inAry[r][c])
                OutImg << inAry[r][c] << " ";
            else
                OutImg << ". ";
        }
        OutImg << endl;
    OutImg << endl;
}
void free Heap (){
```

```
for (int i = 0; i < this->numRows + 2; ++i)
            delete[] this->aryOne[i];
        delete[] this->ary0ne;
        for (int i = 0; i < this->numRows + 2; ++i)
            delete[] this->aryTwo[i];
        delete[] this->aryTwo;
    }
};
int main(int argc, const char * argv[]) {
    string inputName = argv[1];
    ifstream input;
    input.open(inputName);
    string output1 = argv[2];
    ofstream outFile1;
    outFile1.open(output1);
    string output2 = argv[3];
    ofstream outFile2;
    outFile2.open(output2);
    Thinning* read_img = new Thinning();
    read_img -> constructor(input);
    read img -> zeroFrame(read img -> aryOne);
    read img -> zeroFrame(read img -> aryTwo);
    read_img -> loadImage(input);
    read_img -> cycleCount = 0;
    outFile2 << "Original Image: " << "Cycle " << read_img -> cycleCount <<
endl:
    read img -> imgReformat(read img -> aryOne, outFile2);
    read img -> copyAry(read img -> aryTwo, read img -> aryOne);
    read_img -> changeflag = 0;
    read_img -> copyAry(read_img -> aryTwo, read_img -> aryOne);
    read img -> NorthThinning();
    read_img -> copyAry(read_img -> aryOne, read_img -> aryTwo);
    read img -> SouthThinning():
    read_img -> copyAry(read_img -> aryOne, read_img -> aryTwo);
```

```
read img -> WestThinning();
    read_img -> copyAry(read_img -> aryOne, read_img -> aryTwo);
    read_img -> EastThinning();
    read_img -> copyAry(read_img -> aryOne, read_img -> aryTwo);
    read_img -> cycleCount++;
    outFile2 << "Thinning Image: " << "Cycle " << read_img -> cycleCount <<
endl:
    read img -> imgReformat(read_img -> aryOne, outFile2);
    while (read_img -> changeflag > 0){
        read_img -> changeflag = 0;
        read_img -> NorthThinning();
        read_img -> copyAry(read_img -> aryOne, read_img -> aryTwo);
        read img -> SouthThinning();
        read_img -> copyAry(read_img -> aryOne, read_img -> aryTwo);
        read img -> WestThinning();
        read_img -> copyAry(read_img -> aryOne, read_img -> aryTwo);
        read_img -> EastThinning();
        read img -> copyAry(read img -> aryOne, read img -> aryTwo);
        read_img -> cycleCount++;
        outFile1 << "Thinning Image: " << "Cycle " << read img -> cycleCount
<< endl;
        read_img -> imgReformat(read_img -> aryOne, outFile1);
    }
    read img -> free Heap();
    outFile1.close();
    outFile2.close();
    return 0;
}
```

## Image 1: (image1.txt)

#### OutFile1.txt:

Thinning Image : Cycle 2 30 40 0 1

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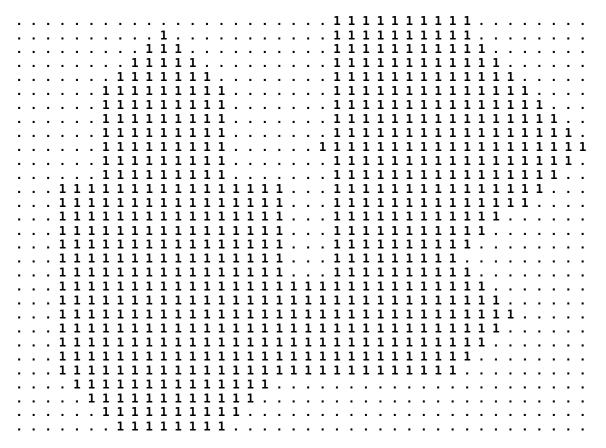
 Thinning Image : Cycle 8 30 40 0 1

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### OutFile2.txt:

Original Image: Cycle 0

30 40 0 1



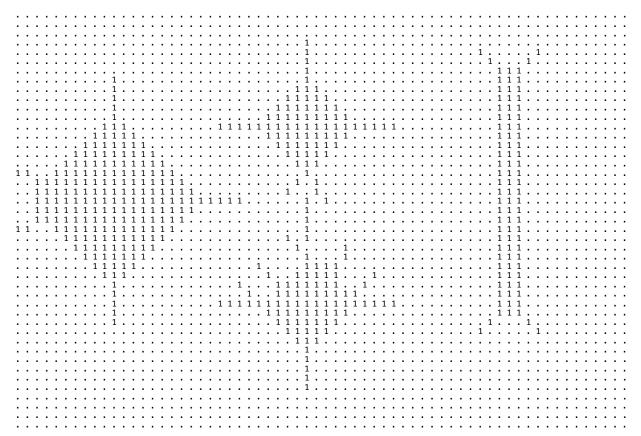
Thinning Image : Cycle 1 30 40 0 1

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# Image 2: (image2.txt)

## OutFile1.txt:

Thinning Image : Cycle 2 45 64 0 1



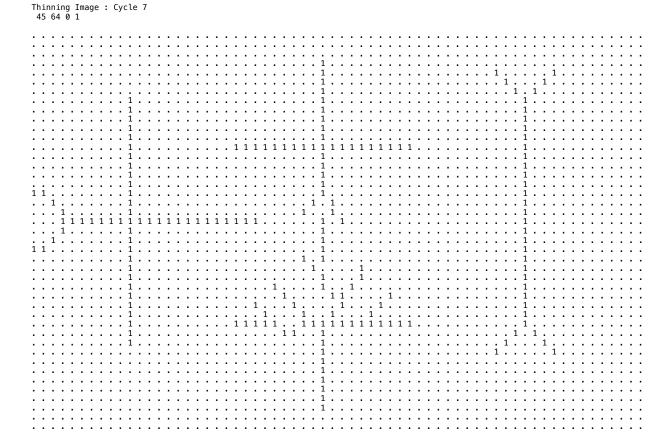
Thinning Image : Cycle 3

Thinning Image : Cycle 4

Thinning Image : Cycle 5

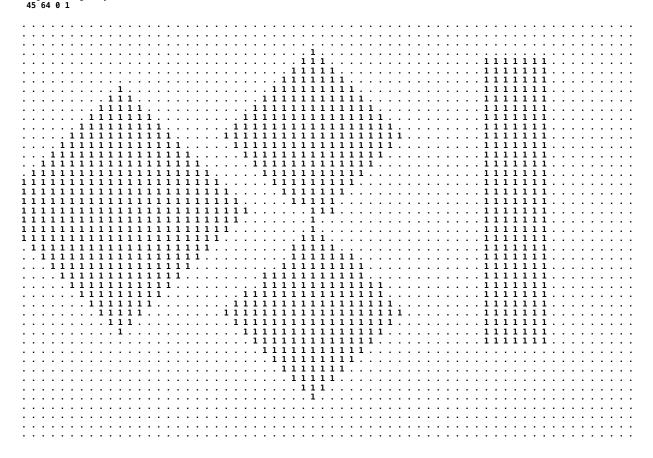
Thinning Image : Cycle 6

45 64 0 1



### OutFile2.txt:

Original Image: Cycle 0



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