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CSCI 381-26 Project 8: Thinning Language: C++

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**Part 1: Algorithm**

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I. main (…)

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step 0: inFile 🡨 open from argv

outFile1, outFile2🡨 open from argv

step 1: numRows, numCols, minVal, maxVal 🡨 read from inFile

outFile1 🡨 output numRows, numCols, minVal, maxVal to outFile1

dynamically allocate firstAry of size numRows + 2 by numCols + 2.

dynamically allocate secondAry of size numRows + 2 by numCols + 2.

step 2: zeroFrame(firstAry) zeroFrame(secondAry)

step 3: loadImage (inFile, firstAry)

step 4: prettyPrint (firstAry, outFile2) // This print is before thinning

step 5: changeFlag 🡨 0

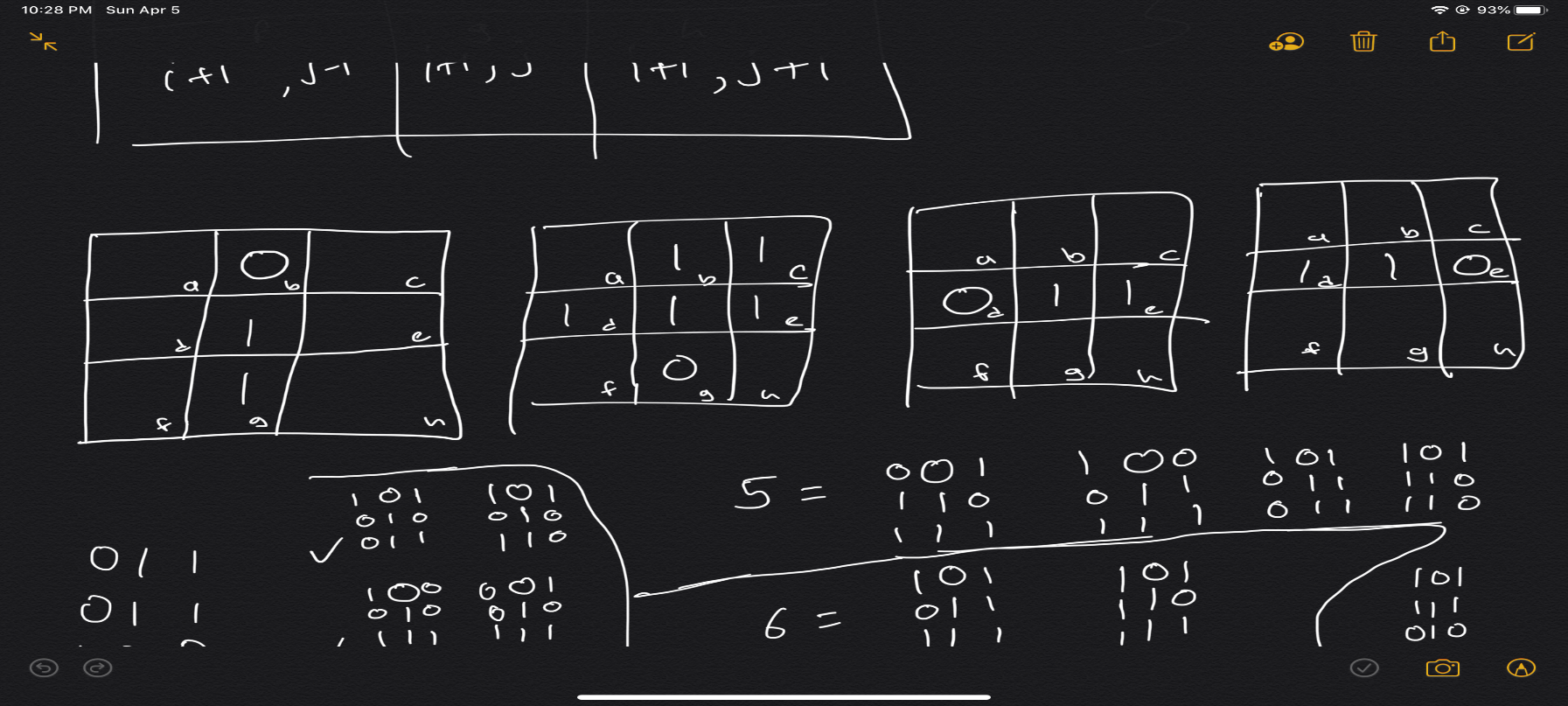
step 6: doThinning (firstAry, secondAry, changeFlag)

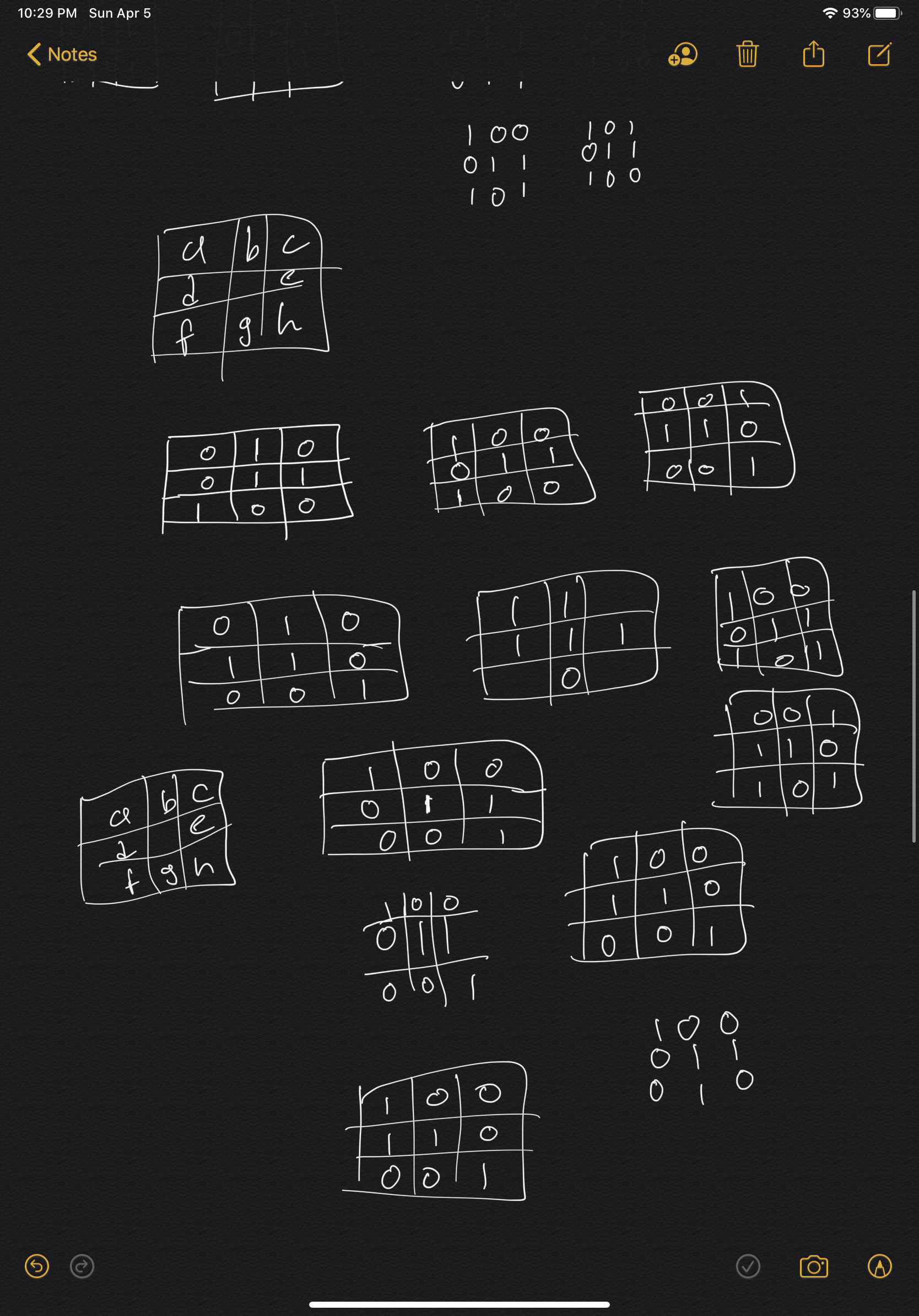
Step 7: prettyPrint (firstAry, outFile2)

Step 8: repeat step 5 to step 7 while changeFlag > 0

step 9: outFile1 🡨 output firstAry from [1][1] \*without\* extra rows and cols

step 10: close all files





**Part 2: Source code**

#include <iostream>

#include<fstream>

using namespace std;

class ThinningSkeleton{

public:

int numRows, numCols, minVal, maxVal, changeFlag , cycleCount;

int\*\* firstAry;

int\*\* secondAry;

void zeroFrame(int\*\* Ary){

for(int i = 0 ; i < numRows + 2 ; i++){

for(int j = 0 ; j < numCols + 2 ; j++){

Ary[i][j] = 0;

}

}

}

void prettyPrint(int\*\* Ary, ofstream& file){

for(int i = 0 ; i < numRows + 2 ; i++){

for(int j = 0 ; j < numCols + 2 ; j++){

if(Ary[i][j] > 0){

file<<Ary[i][j]<<" ";

}

else{

file<<" ";

}

}

file<<endl;

}

}

void loadImage(ifstream& file, int\*\* Ary){

for(int i = 1 ; i < numRows + 1 ; i++){

for(int j = 1 ; j < numCols + 1 ; j++){

file>>Ary[i][j];

}

}

}

void doThinning(int\*\* firstAry,int\*\* secondAry,int &changeFlag){

northThinning(firstAry, secondAry, changeFlag);

copyArys(firstAry, secondAry);

southThinning(firstAry, secondAry, changeFlag);

copyArys(firstAry, secondAry);

westThinning(firstAry, secondAry, changeFlag);

copyArys(firstAry, secondAry);

EastThinning(firstAry, secondAry, changeFlag);

copyArys(firstAry, secondAry);

}

void northThinning(int\*\* firstAry, int\*\* secondAry, int &changeFlag){

for(int i = 1 ; i < numRows + 1 ; i++){

for(int j = 1 ; j < numCols + 1 ; j++){

secondAry[i][j] = firstAry[i][j];

if(firstAry[i][j] > 0 && firstAry[i-1][j] <= 0){

if(check3n4Conditions(firstAry, i, j, "north") == true){

secondAry[i][j] = 0;

changeFlag++;

}

}

}

}

}

void southThinning(int\*\* firstAry, int\*\* secondAry, int &changeFlag){

for(int i = 1 ; i < numRows + 1 ; i++){

for(int j = 1 ; j < numCols + 1 ; j++){

secondAry[i][j] = firstAry[i][j];

if(firstAry[i][j] > 0 && firstAry[i+1][j] <= 0){

if(check3n4Conditions(firstAry, i, j, "south") == true){

secondAry[i][j] = 0;

changeFlag++;

}

}

}

}

}

void westThinning(int\*\* firstAry, int\*\* secondAry, int &changeFlag){

for(int i = 1 ; i < numRows + 1 ; i++){

for(int j = 1 ; j < numCols + 1 ; j++){

secondAry[i][j] = firstAry[i][j];

if(firstAry[i][j] > 0 && firstAry[i][j-1] <= 0){

if(check3n4Conditions(firstAry, i, j, "west") == true){

secondAry[i][j] = 0;

changeFlag++;

}

}

}

}

}

void EastThinning(int\*\* firstAry,int\*\* secondAry,int &changeFlag){

for(int i = 1 ; i < numRows + 1 ; i++){

for(int j = 1 ; j < numCols + 1 ; j++){

secondAry[i][j] = firstAry[i][j];

if(firstAry[i][j] > 0 && firstAry[i][j+1] <= 0){

if(check3n4Conditions(firstAry, i, j, "east") == true){

secondAry[i][j] = 0;

changeFlag++;

}

}

}

}

}

void copyArys(int\*\* firstAry,int\*\* secondAry){

for(int i = 1 ; i < numRows + 1 ; i++){

for(int j = 1 ; j < numCols + 1 ; j++){

firstAry[i][j] = secondAry[i][j];

}

}

}

bool check3n4Conditions(int\*\* firstAry, int i, int j, string whichside){

int a = firstAry[i-1][j-1], b = firstAry[i-1][j], c = firstAry[i-1][j+1], d = firstAry[i][j-1];

int e = firstAry[i][j+1], f = firstAry[i+1][j-1], g = firstAry[i+1][j], h = firstAry[i+1][j+1];

if(whichside == "north" && g == 1 && (a + c + d + e + f + g + h) >= 4){

if((a + c + d + e + f + g + h) == 4 && ((d == 0 && f == 0 && c == 0 ) || (a == 0 && e == 0

&& h==0)) ){

return false;

}

else

{

return true;

}

}

if(whichside == "south" && b == 1 && (a + b + c + d + e + f + h) >= 4){

if((a + b + c + d + e + f + h) == 4 && ((e == 0 && f == 0 && c == 0 ) || (a == 0 && d == 0

&& h==0)) ){

return false;

}

else

{

return true;

}

}

if(whichside == "west" && e == 1 && (a + b + c + e + f + g + h) >= 3){

if(a==0 && g==0 && h==0){

return false;

}

if((a + b + c + e + f + g + h) == 4 && (b==0 && c==0 && g==0) ){

return false;

}

if(b==0 && c==0 && g==0 && h==0){

return false;

}

if(b==0 && c==0 && f==0 && h==0){

return false;

}

return true;

}

if(whichside == "east" && d == 1 && (a + b + c + d + f + g + h) >= 3){

if(b==0 && a==0 && g==0 && f==0){

return false;

}

if((a + b + c + d + f + g + h) == 4 && (b==0 && a==0 && g==0) ){

return false;

}

if(c==0 && a==0 && g==0 && f==0){

return false;

}

if(b==0 && c==0 && f==0 && g==0){

return false;

}

return true;

}

return false;

}

};

int main(int argc, char\*\* argv){

ThinningSkeleton TS;

string inputName = argv[1];

ifstream inFile;

inFile.open(inputName);

string outputName1 = argv[2];

ofstream outFile1;

outFile1.open(outputName1);

string outputName2 = argv[3];

ofstream outFile2;

outFile2.open(outputName2);

if(inFile.is\_open()){

if(outFile1.is\_open() && outFile2.is\_open()){

inFile>>TS.numRows>>TS.numCols>>TS.minVal>>TS.maxVal;

outFile1<<TS.numRows<<" "<<TS.numCols<<" "<<TS.minVal<<" "<<TS.maxVal<<endl;

TS.firstAry = new int\* [TS.numRows + 2];

TS.secondAry = new int\* [TS.numRows + 2];

for( int i = 0; i < TS.numRows + 2; i++ ){

TS.firstAry[i] = new int[TS.numCols + 2];

TS.secondAry[i] = new int[TS.numCols + 2];

}

TS.zeroFrame(TS.firstAry);

TS.zeroFrame(TS.secondAry);

TS.loadImage(inFile, TS.firstAry);

outFile2<<"----------This print is before thinning----------"<<endl;

TS.prettyPrint(TS.firstAry, outFile2);

int i = 1;

while(TS.changeFlag > 0){

TS.changeFlag = 0;

TS.doThinning(TS.firstAry, TS.secondAry, TS.changeFlag);

outFile2<<"----------This print is after pass: "<<i<<" ----------"<<endl;

TS.prettyPrint(TS.firstAry, outFile2);

i++;

}

for(int i = 1 ; i < TS.numRows + 1 ; i++){

for(int j = 1 ; j < TS.numCols + 1 ; j++){

outFile1<<TS.firstAry[i][j]<<" ";

}

outFile1<<endl;

}

inFile.close();

outFile1.close();

outFile2.close();

}else{cout<<"Error!! Could NOT create output file"<<endl ;}

}else{cout<<"Error!! Could NOT open input file"<<endl;}

}

**Part 3: Output**

* **For image1**
* **outFile2**

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| **----------This print is before thinning----------**      **1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1** | **----------This print is after pass: 1 ----------**      **1**  **1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1**  **1 1 1 1 1 1**  **1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1** |
| **----------This print is after pass: 2 ----------**      **1**  **1**  **1 1 1 1 1 1**  **1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1**  **1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1**  **1 1 1 1 1 1**  **1 1 1 1**  **1 1 1 1 1**  **1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1**  **1 1 1**  **1 1** | **----------This print is after pass: 3 ----------**      **1**  **1**  **1**  **1 1 1 1 1**  **1 1 1 1 1 1 1**  **1 1 1**  **1 1 1**  **1 1 1 1**  **1 1 1 1 1 1 1 1 1 1**  **1 1 1**  **1 1 1 1**  **1 1 1 1 1 1**  **1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1 1 1**  **1 1 1 1 1**  **1 1 1 1**  **1 1**  **1 1 1**  **1 1 1**  **1 1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1 1 1 1**  **1 1 1 1 1 1**  **1 1 1 1 1 1 1 1**  **1 1 1 1**  **1 1 1**  **1 1** |
| **----------This print is after pass: 4 ----------**      **1**  **1**  **1**  **1 1**  **1 1 1 1 1 1 1**  **1 1 1**  **1 1 1**  **1 1 1**  **1 1 1 1 1 1 1 1 1**  **1 1**  **1 1**  **1 1**  **1 1 1 1 1 1**  **1 1 1 1 1**  **1 1 1 1 1 1**  **1 1 1 1**  **1 1 1**  **1**  **1 1**  **1 1**  **1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1**  **1 1 1 1**  **1 1 1 1 1**  **1 1 1 1**  **1 1 1**  **1 1** | **----------This print is after pass: 5 ----------**      **1**  **1**  **1**  **1 1**  **1 1 1 1 1 1 1**  **1 1 1**  **1 1 1**  **1 1 1**  **1 1 1 1 1 1 1 1 1**  **1 1**  **1 1**  **1 1**  **1 1 1 1 1 1**  **1 1 1 1 1**  **1 1 1 1 1 1**  **1 1 1 1**  **1 1 1**  **1**  **1 1**  **1 1**  **1 1**  **1 1 1 1 1 1 1 1 1 1 1 1 1**  **1 1**  **1 1 1 1**  **1 1 1 1 1**  **1 1 1 1**  **1 1 1**  **1 1** |

* **outFile1**

**30 40 0 1**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1**

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**0 0 0 0 0 1 1 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0**

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**0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

* **For image2**
  + **outFile2**

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**0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

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**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

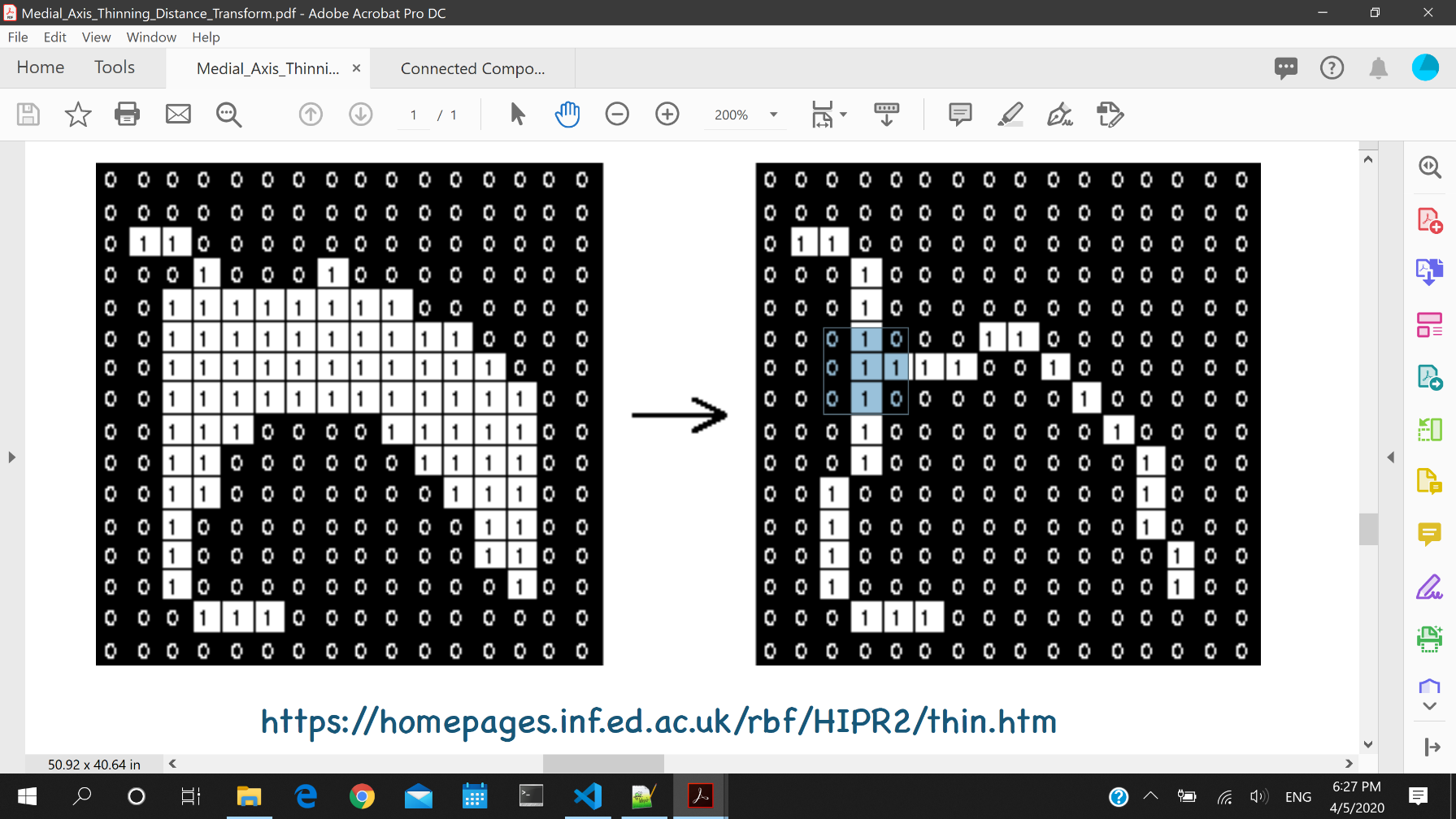
**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0**

**Note:-**



Since we check for all 8-neighbor’s, if we do west-thinning algorithm shouldn’t be middle pixel be 0 in above (selected part on second image.) since, it satisfied all conditions (sum of neighbors is 3 and still stays in one object), if not could you please explain I was bit confuse doing check3n4Conditions method.