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Algo steps:

Step 0: open inFile, maskFile via argv[]
open imgOutFile, AvgOutFile, MedianOutFile, GaussOutFile via argv[]
thrVal->get from argv[3] Step 1: numRows, numCols, minVal, maxVal->read from inFile
maskRows, maskCols, maskMin, maskMax->read from maskFile
Step 2: dynamically allocate all 1-D and 2-D arrays
Step 3: loadMaskAry (maskFile, maskAry) Step 4: loadImage (inFile, mirrorFramedAry) Step 5: mirrorFraming (mirrorFramedAry) Step 6: imgReformat (mirrorFramedAry, deBugFile)
Step 7: computeAvg (mirrorFramedAry, avgAry) imgReformat (avgAry, deBugFile) binaryThreshold (avgAry, thrAry) prettyPrint (thrAry, AvgOutFile)
Step 8: computeMedian (mirrorFramedAry, medianAry) imgReformat (medianAry, deBugFile) binaryThreshold (medianAry, thrAry) prettyPrint (thrAry, MedianOutFile)
Step 9: computeGauss (mirrorFramedAry, GaussAry) imgReformat (GaussAry, deBugFile) binaryThreshold (GaussAry, thrAry) prettyPrint (thrAry, GaussOutFile)
Step 10: close all files

Output1 mean

```
1
1
1   1 1 1
1   1 1 1
1   1 1 1
```

Output1 median

```
1
1
1   1 1 1
1   1 1 1
1   1 1 1
```

Output1 Gauss

```


    1 1 1
    1 1 1
    1 1 1
```

Debug.txt

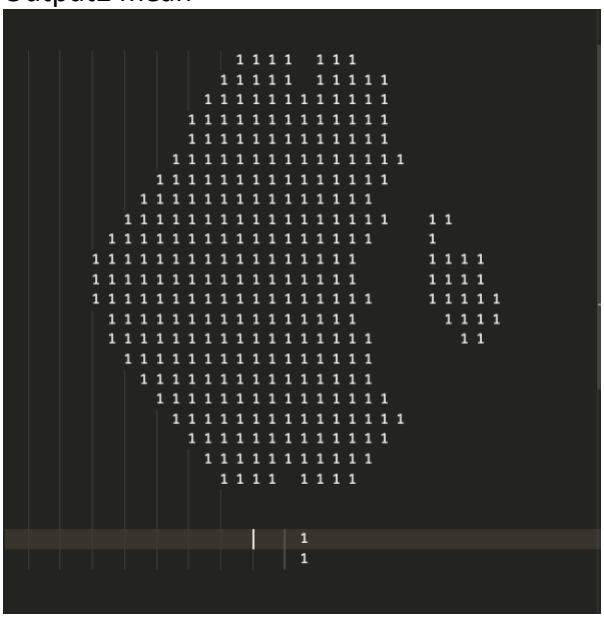
```
numRows: 5 numCols: 5 minVal: 1 maxVal: 36
5  1  22 3  4
```

numRows: 5 numCols: 5 minVal: 1 maxVal: 36
8 10 10 10 9

numRows: 5 numCols: 5 minVal: 1 maxVal: 36
8 10 10 10 9

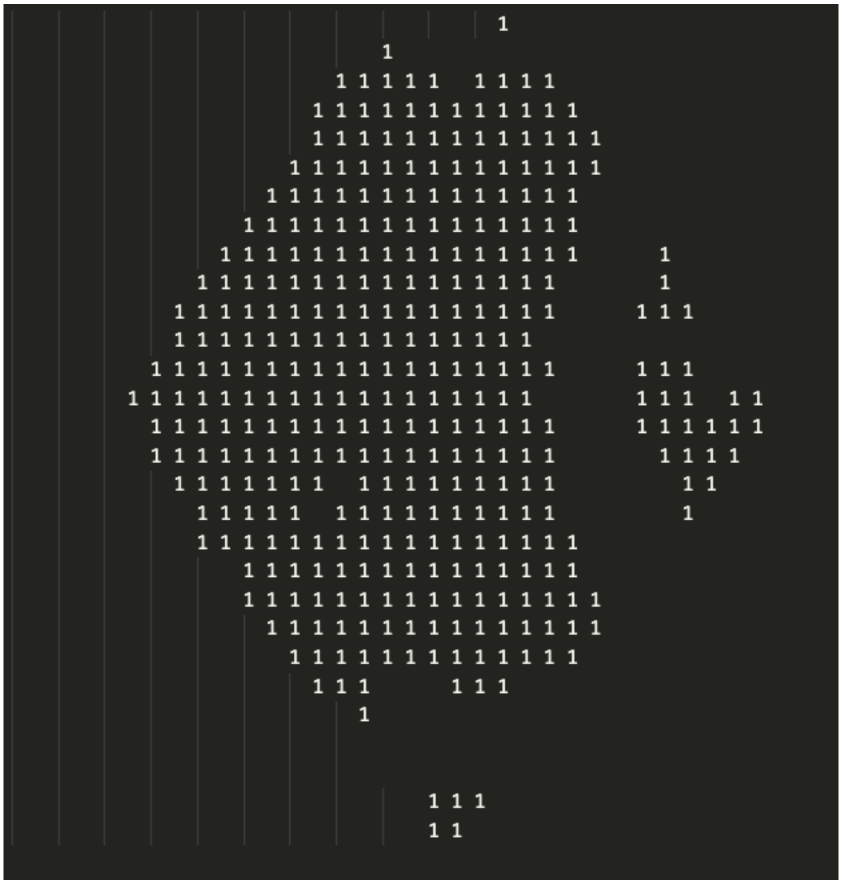
numRows: 5 numCols: 5 minVal: 1 maxVal: 36
8 10 10 10 9

Output2 mean



Output2 median

Output2 Gauss



Debug.txt

numRows: 46 numCols: 46 minVal: 1 maxVal: 63
1 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
1 2 3 4 5

numRows: 46 numCols: 46 minVal: 1 maxVal: 63
1 1 3 6 6 8 8 6 6 8 6 6 6 5 3 3 3 3 3 3 3 5 5 5 5 5 6 6 6 6 6 3 3 4 5 5 6 6 5 6 6
4 4 4 3 4

numRows: 46 numCols: 46 minVal: 1 maxVal: 63
1 1 3 6 6 8 8 6 6 8 6 6 6 5 3 3 3 3 3 3 3 5 5 5 5 5 6 6 6 6 6 3 3 4 5 5 6 6 5 6 6
4 4 4 3 4

numRows: 46 numCols: 46 minVal: 1 maxVal: 63
1 1 3 6 6 8 8 6 6 8 6 6 6 5 3 3 3 3 3 3 3 5 5 5 5 5 6 6 6 6 6 3 3 4 5 5 6 6 5 6 6
4 4 4 3 4

Main.cpp

```
#include <iostream>
#include <fstream>
#include <cmath>
#include <algorithm>
#include <sstream>

using namespace std;



class enhancement{
public:
    int numRows, numCols, minVal, maxVal, maskRows, maskCols, maskMin, maskMax, thrVal,
        **mirrorFramedAry, **avgAry, **medianAry, **gaussAry, **thrAry, neighbor[25], mask[25], maskWeight;

    enhancement(int r, int c, int min, int max, int mr, int mc, int mmin, int mmax, int thr){
        numRows = r;
        numCols = c;
        minVal = min;
        maxVal = max;
        maskRows = mr;
        maskCols = mc;
        maskMin = mmin;
        maskMax = mmax;
        thrVal = thr;
        mirrorFramedAry = new int*[numRows+4];
        avgAry = new int*[numRows+4];
        medianAry = new int*[numRows+4];
        gaussAry =  new int*[numRows+4];
        thrAry = new int*[numRows+4];

            for (int i = 0; i < numRows+4; i++){
                mirrorFramedAry[i] = new int[numCols];
                avgAry[i] = new int[numCols];
```

```
            medianAry[i] = new int[numCols];
            gaussAry[i] = new int[numCols];
            thrAry[i] = new int[numCols];
        }

}


// void printArr(int ** arr, ofstream *out){

//     for (int i = 0; i <  numRows +4; i++)
//     {
//         for (int j = 0; j  < numCols+4; j++)
//         {
//         *out << arr[i][j] << " ";
//         }
//         *out << endl;
//     }
//     *out << endl; *out << endl;



// }

void binaryThreshold(int **inAry){

    for (int i = 0; i < numRows+4; i++)
    {
        for (int  j= 0; j < numCols+4; j++)
        {
            // cout<<inAry[i][j]<<" ";
            if(inAry[i][j]>=thrVal){
                thrAry[i][j]=1;
            }else{
                thrAry[i][j]=0;
            }
        }
        // cout<<endl;
```

```
    }

    // printArr(thrAry);

}

void loadImage(ifstream *infile, ofstream *outfile){

    string line;
    int val;
    int r=0;



    while (getline(*infile, line)){
        int c=1;
        istringstream set(line);
        while (set >> val ){
            // cout << val << " ";
            mirrorFramedAry[r+1][c+1] = val;
            c++;
        }
        r++;
        // cout <<endl;
    }

}

void mirrorFraming(ofstream *out){

    //TOP ROW
    int r=2;
        for (int c = 2; c < numCols+2; c++){
            // cout << mirrorFramedAry[r][c] << " ";
            mirrorFramedAry[r-1][c] =  mirrorFramedAry[r][c];
            mirrorFramedAry[r-2][c] =  mirrorFramedAry[r][c];
        }
```

```
    //bottom row
    r = numRows+1;
    // cout <<endl << r <<endl;
        for (int c = 2; c < numCols+2; c++){
            // cout << mirrorFramedAry[r][c] << " ";
            mirrorFramedAry[r+1][c] =  mirrorFramedAry[r][c];
            mirrorFramedAry[r+2][c] =  mirrorFramedAry[r][c];
        }

    //leftmost
    int c=2;
    for (r = 0; r < numRows+4; r++){
        // cout<<mirrorFramedAry[r][c] << endl;
        mirrorFramedAry[r][c-1] =  mirrorFramedAry[r][c];
        mirrorFramedAry[r][c-2] =  mirrorFramedAry[r][c];
    }

    //rightmost
     c=numCols+1;
    for (r = 0; r < numRows+4; r++){
        mirrorFramedAry[r][c+1] =  mirrorFramedAry[r][c];
        mirrorFramedAry[r][c+2] =  mirrorFramedAry[r][c];
    }

    // printArr(mirrorFramedAry,out);
}

 void computeMedian(){
    int i =2, j=2;

    while (i < numRows+2){
        while (j < numCols+2){
            loadNeighbor(i, j);
            sort(neighbor, neighbor+25);
            medianAry[i][j] = neighbor[12];
            j++;
        }
```

```
    i++;
    }
}

void computeAvg(){
    int i =2;

    while (i < numRows+2){
        int j=2;
        while (j < numCols+2){
            int total=0;
            loadNeighbor(i,j);
            for (int i = 0; i < 25; i++){
              total += neighbor[i];
            }
            // cout<<"total is " << total<<endl <<"avg " << total/25 <<endl;
            avgAry[i][j] = total/25;
            j++;
        }
        i++;
    }


    // for (int i = 0; i < numRows+4; i++){
    //     for (int j = 0; j < numCols+4; j++)
    //     {
    //         cout << avgAry[i][j]  << " ";
    //     }
    //     cout << endl;
    // }

}
void computeGauss(){

    int i =2;
    while (i < numRows+2){
        int j=2;
```

```
        while (j < numCols+2){
            loadNeighbor(i, j);
            gaussAry[i][j] = convolution();
            j++;
        }
        i++;
    }
}

int convolution(){
    int result =0,i=0;

    while (i<25){
      result +=neighbor[i] * mask[i];
      i++;
    }

    return result/maskWeight;
}

void imgReformat(int **inAry, ofstream *output){

    *output << "numRows: " << numRows <<  " numCols: " << numCols << " minVal: " << minVal << " maxVal: " <<
maxVal<<endl;

    string str = to_string(maxVal);
    int width = str.length();

    int r =2;


//step 12
            //step 4
    int c =2;
    while (r<numRows+2){
        //step 10
        while (c<numCols+2){
```

```
            //step 5
            *output << inAry[r][c];
            //step 6
            str = to_string(inAry[r][c]);
            int WW = str.length();

            //step 8
            while (WW<width+1){
                //step 7
                *output << " ";
                WW++;
            }

            //step 9
            c++;
        }
        *output << endl;
        //step 11
        r++;
    }

}

void loadMaskAry(ifstream *infile){

    int val;
    int index =0;
    maskWeight=0;
    string line;
    while (getline(*infile, line)){
        istringstream set(line);
        while (set >> val ){
            // cout << val << " ";
            mask[index++] = val;
            maskWeight+=val;
        }
```

```
            // cout <<endl;
        }
    }

    void loadNeighbor(int i, int j){


        int count = 0;
        // cout<<mirrorFramedAry[i][j]<<endl<<endl;
        for (int r = i-2; r <i+3; r++){
            for (int c = j-2; c <j+3; c++){
                // cout<<mirrorFramedAry[r][c]<< " ";
                neighbor[count++]= mirrorFramedAry[r][c];

            }
            // cout<<endl;
        }
    }

    void prettyPrint(int **ary, ofstream *out){

        for (int i = 0; i < numRows; i++)
        {
            for (int j = 0; j < numCols; j++)
            {
                if(ary[i][j]>0){
                    *out<<ary[i][j]<<" ";
                }else{
                    *out<<"  ";
                }
            }
            *out<<endl;

        }

    }
};
```

```
int main(int argc, char *argv[]){

    ifstream input, mask;
    input.open(argv[1]);
    mask.open(argv[2]);

    int thrval = stoi(argv[3]);
    ofstream mean, median, gauss, debug;
    mean.open(argv[4]);
    median.open(argv[5]);
    gauss.open(argv[6]);
    debug.open(argv[7]);

    int numRows, numCols, minVal, maxVal;
    input >> numRows >> numCols>>minVal>>maxVal;

    // cout << numRows<< " " << numCols<< " "<<minVal<< " "<<maxVal << endl;

    int maskNumRows, maskNumCols, maskMinVal, maskMaxVal;
    mask >> maskNumRows >> maskNumCols>>maskMinVal>>maskMaxVal;

    // cout << maskNumRows<< " " << maskNumCols<< " "<<maskMinVal<< " "<<maskMaxVal << endl;

    //step 2
    enhancement *proj2 = new enhancement(numRows, numCols, minVal, maxVal, maskNumRows, maskNumCols,
maskMinVal, maskMaxVal, thrval);
    // proj2->loadImage(&input, &debug);
    // proj2->printArr(&debug);
    // proj2->mirrorFraming(&debug);
    // proj2->loadMaskAry(&mask);
    // proj2->loadNeighbor(2,2);
    // proj2->computeAvg();


    // step 3
    proj2->loadMaskAry(&mask);
```

```
//step4
proj2->loadImage(&input, &debug);

//step 5
proj2->mirrorFraming(&debug);

//step6
// cout<<"step 6";
proj2->imgReformat(proj2->mirrorFramedAry, &debug);

//step 7
// cout<<"step 7";
proj2->computeAvg();
proj2->imgReformat(proj2->avgAry, &debug);
proj2->binaryThreshold(proj2->avgAry);
proj2->prettyPrint(proj2->thrAry, &mean);


// //step 8
proj2->computeMedian();
proj2->imgReformat(proj2->avgAry, &debug);
proj2->binaryThreshold(proj2->avgAry);
proj2->prettyPrint(proj2->thrAry, &median);

//step 9
proj2->computeGauss();
proj2->imgReformat(proj2->avgAry, &debug);
proj2->binaryThreshold(proj2->gaussAry);
proj2->prettyPrint(proj2->thrAry, &gauss);

//step10
input.close();
mask.close();
mean.close();
median.close();
gauss.close();
```

```
    debug.close();
    return 0;


}
```