CV
Project 2: Average, Median and Gaussian Filtering
Java

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My Algorithms:

loadImage():
To load the input image into a 2D array
Read in from input image file

```
1. For i=1<rows+1:
2. For j=1<cols+1:
    a. inputArray[i][j] ← inputFile Read
```

mirrorFraming():
The purpose of this algorithm is to fill the empty array cells that are padding the outer walls of the input image
This can be used after having loaded the image into a 2D array(row+2, col+2) **mirrorAry** by mirroring the original input image edge pixels.

```
1. Corner Pixels:
        1.1 mirrorAry[0][0] ← mirrorAry[2][2] // top left
        1.2 mirrorAry[0][x] ←  mirrorAry[2][x-2] // top right
        1.3 mirrorAry[x][0] ←  mirrorAry[x-2][2] // bottom left
        1.4 mirrorAry[x][x] ←  mirrorAry[x-2][x-2] // bottom left
2. Edge Pixels:
    1. Horizontal
            For i=1 < columns+1
                    mirrorAry[0][i] ← mirrorAry[2][i]
                    mirrorAry[rows+1][i] ← mirrorAry[rows-1][i]
    2. Vertical
            For i =1< rows+1
                    mirrorAry[i][0] ← mirrorAry[i][2]
                    mirrorAry[i][cols+1] ← mirrorAry[i][cols-1]
```

loadMask():
Same as loadImage, read in from mask file, rows and columns are the size of the mask. 3x3

loadMask1DAry():

This method creates a 1D array from mask2DArray and calculates the total weight of the mask

```
1. Maskweight ← 0
2. For i=0 <  3:
3. For j=0 < 3:
    a. mask1D[ (i*3) + j ] ←  mask2DArray[i][j];
    b. Maskweight ←  mask2DArray[i][j];
```

loadNeighbor1DAry(r,c):

Load the target pixel in location (r,c) and 8 neighbors into 1D array

```
1. For i=0 < 3:
2. For j=0 < 3:
    a. neighborArray[i*3 +j] = mirrorAry[r-1+i][c-1+j]
```

computeAvg():

Similar to compute Median and Gaussian

```
1. newMin ← 999
2. newMax ← 0
3. For i = 1 < rows +1:
4. For j = 2 < cols +1:
    a. Avg ← 0
    b. loadNeighbor1DAry(i,j)
    c. Avg ← sumOf(neighborArray) / 9
    d. averageArray[i][j] =  Avg
    e. Check if there is newMin or newMax
```

```
/*
      Computer Vision
      Project 2
      Created by Adrian Noa

      usage:

java adrian_noa_main.java input mask 38 inputImg avgOut AvgThreshold MedianOut
MedianTreshold GaussOut GaussThreshold

      Change the value of third parameter(38) to change the Treshold Value
*/
```

```java
import java.io.*;
import java.util.Scanner;
import java.util.Arrays;

public class CVProject2 {

    public static void main(String[] args) throws IOException{
        if (args.length != 10){
            System.out.println("Not enough of arguments");
            return;
        }
        int threshold = Integer.parseInt(args[2]);
        try(
            Scanner inFile = readFile(args[0]);
            Scanner maskFile = readFile(args[1]);
            BufferedWriter inputImg = createFile(args[3]);
            BufferedWriter AvgOut = createFile(args[4]);
            BufferedWriter AvgThreshold = createFile(args[5]);
            BufferedWriter MedianOut = createFile(args[6]);
            BufferedWriter MedianThreshold = createFile(args[7]);
            BufferedWriter GaussOut = createFile(args[8]);
            BufferedWriter GaussThreshold = createFile(args[9]);
        ){
            ImageProcessing imgProcessing = new ImageProcessing(inFile, maskFile, threshold);
            load(imgProcessing);

            imgProcessing.imgReformat(imgProcessing.mirrorFramedAry, imgProcessing.minVal,
imgProcessing.maxVal, inputImg);

            imgProcessing.computeAvg();
            imgProcessing.imgReformat(imgProcessing.avgAry, imgProcessing.newMin, imgProcessing.newMax,
AvgOut);
            imgProcessing.threshold(imgProcessing.avgAry, imgProcessing.thrAry);
            imgProcessing.imgReformat(imgProcessing.thrAry, imgProcessing.newMin, imgProcessing.newMax,
AvgThreshold);

            imgProcessing.computeMedian();
            imgProcessing.imgReformat(imgProcessing.medianAry, imgProcessing.newMin, imgProcessing.newMax,
MedianOut);
            imgProcessing.threshold(imgProcessing.medianAry, imgProcessing.thrAry);
            imgProcessing.imgReformat(imgProcessing.thrAry, imgProcessing.newMin, imgProcessing.newMax,
MedianThreshold);

            imgProcessing.computeGauss();
            imgProcessing.imgReformat(imgProcessing.gaussAry, imgProcessing.newMin, imgProcessing.newMax,
GaussOut);
            imgProcessing.threshold(imgProcessing.gaussAry, imgProcessing.thrAry);
            imgProcessing.imgReformat(imgProcessing.thrAry, imgProcessing.newMin, imgProcessing.newMax,
GaussThreshold);
        }
    }

    public static void load(ImageProcessing imgProcessing){
        imgProcessing.allocate();
        imgProcessing.loadMask();
        imgProcessing.loadMask1DAry();
        imgProcessing.loadImage();
        imgProcessing.mirrorFraming();
    }

    public static Scanner readFile(String s) throws IOException{
        return new Scanner(new BufferedReader(new FileReader(s)));
    }

    public static BufferedWriter createFile(String s) throws IOException{
        return new BufferedWriter(new FileWriter(s));
    }
}

public class ImageProcessing {
        Scanner inFile, maskFile;
        int numRows, numCols, minVal, maxVal; // image header
        int maskRows, maskCols, maskMin, maskMax; //mask header
        int newMin, newMax, maskWeight;
        int thrVal;  // threshold value
        boolean includeZero;
        int[][] mirrorFramedAry, avgAry, medianAry, gaussAry, thrAry, mask2DAry;
        int[] neighbor1DAry, mask1DAry;

        ImageProcessing(Scanner inFile, Scanner maskFile, int threshold){
            this.inFile = inFile;
            this.maskFile = maskFile;
            this.numRows = inFile.nextInt();
            this.numCols = inFile.nextInt();
            this.minVal = inFile.nextInt();
            this.maxVal = inFile.nextInt();
            this.maskRows = maskFile.nextInt();
            this.maskCols = maskFile.nextInt();
            this.maskMin = maskFile.nextInt();
            this.maskMax = maskFile.nextInt();
            this.thrVal = threshold;
            this.includeZero = false; // change to false to Visualize treshold output files (no zeros only 1s)
        }

        public void threshold(int[][] in, int[][]out){
            newMin = 0;
            newMax = 1;
            for(int i=1; i<numRows+2; i++){
                for(int j=1; j<numCols+2; j++){
                    if (in[i][j] >= thrVal)
                        out[i][j] = 1;
                    else
                        out[i][j] = 0;
                }
            }
        }

        public void imgReformat(int[][] inAry, int newMin, int newMax, BufferedWriter outImg) throws
IOException{

            outImg.write(Integer.toString(numRows)+" ");
            outImg.write(Integer.toString(numCols)+" ");
            outImg.write(Integer.toString(newMin)+" ");
            outImg.write(Integer.toString(newMax)+"\n");

            int maxWidth = Integer.toString(newMax).length();
            String s;
            for (int i = 1; i<numRows+1; i++){
                for (int j = 1; j<numCols+1; j++){
                    s = Integer.toString(inAry[i][j]);
                    if(includeZero==true)
                        outImg.write(s);
                    else{
                        if(inAry[i][j]!=0)
                            outImg.write(s);
                        else outImg.write(" ");

                    }
                    int pixelWidth = s.length();
                    while(pixelWidth <= maxWidth){
                        outImg.write(" ");
                        pixelWidth++;
                    }
                }
                outImg.write("\n");
            }
        }

        public void mirrorFraming(){
            mirrorFramedAry[0][0] = mirrorFramedAry[2][2];
            mirrorFramedAry[0][numCols+1] = mirrorFramedAry[2][numCols-1];
            mirrorFramedAry[numRows+1][0] = mirrorFramedAry[numRows-1][2];
            mirrorFramedAry[numRows+1][numCols+1] = mirrorFramedAry[numRows-1][numCols-1];
            for(int i=1; i<numCols+1; i++){
                mirrorFramedAry[0][i] = mirrorFramedAry[2][i];
                mirrorFramedAry[numRows+1][i] = mirrorFramedAry[numRows-1][i];
            }
            for(int i=1; i<numRows+1; i++){
                mirrorFramedAry[i][0] = mirrorFramedAry[i][2];
                mirrorFramedAry[i][numCols+1] = mirrorFramedAry[i][numCols-1];
            }
        }

        public void loadImage(){
            for(int i=1; i<numRows+1; i++){
                for(int j=1; j<numCols+1; j++){
                    mirrorFramedAry[i][j] = inFile.nextInt();
                }
            }
        }

        public void loadMask(){
            for(int i=0; i<maskRows; i++){
                for(int j=0; j<maskCols; j++){
                    mask2DAry[i][j] = maskFile.nextInt();
                }
            }
        }

        public void loadMask1DAry(){
            this.maskWeight = 0;
            for(int i=0; i<maskRows; i++){
                for(int j=0; j<maskCols; j++){
                    mask1DAry[maskCols*i+j] = mask2DAry[i][j];
                    this.maskWeight += mask2DAry[i][j];
                }
            }
        }

        public void loadNeighbor1DAry(int r, int c){
            for(int i=0; i<3; i++){
                for(int j=0; j<3; j++){
                    neighbor1DAry[ (i*3) + j ] = mirrorFramedAry[r-1+i][c-1+j];
                }
            }
        }

        public void sort(int[] a){
            Arrays.sort(a);
        }

        public void computeAvg(){
            newMin = 9999;
            newMax = 0;
            for(int i=1; i<numRows+1; i++){
                for(int j=1; j<numCols+1; j++){
                    int avg = 0;
                    loadNeighbor1DAry(i,j);
                    for(int pixel:neighbor1DAry)avg+=pixel;
                    avgAry[i][j] = avg/9;
                    if (newMin > avgAry[i][j])
                        newMin = avgAry[i][j];
                    if (newMax < avgAry[i][j])
                        newMax = avgAry[i][j];
                }
            }
        }

        public void computeMedian(){
            newMin = 9999;
            newMax = 0;

            for(int i=1; i<numRows+1; i++){
                for(int j=1; j<numCols+1; j++){
                    loadNeighbor1DAry(i,j);
                    sort(neighbor1DAry);
                    medianAry[i][j] = neighbor1DAry[4];
                    if (newMin > medianAry[i][j])
                        newMin = medianAry[i][j];
                    if (newMax < medianAry[i][j])
                        newMax = medianAry[i][j];
                }
            }
        }

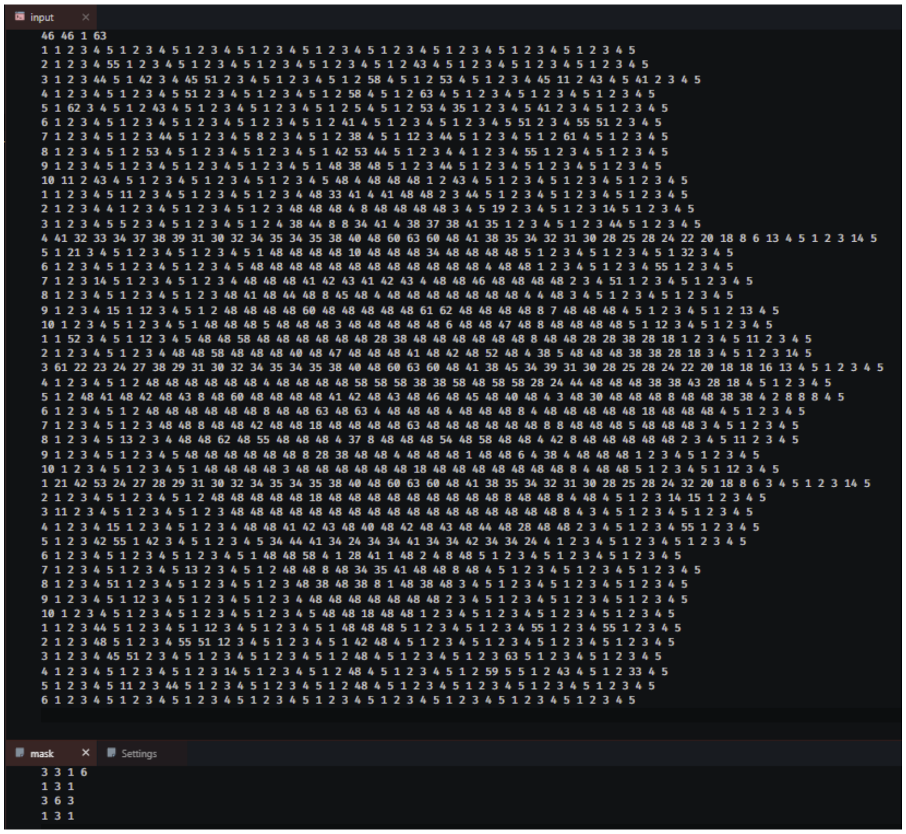
        public void computeGauss(){
            newMin = 9999;
            newMax = 0;
            for(int i=1; i<numRows+1; i++){
                for(int j=1; j<numCols+1; j++){
                    loadNeighbor1DAry(i,j);
                    gaussAry[i][j] = convolution(neighbor1DAry, mask1DAry);
                    if (newMin > gaussAry[i][j])
                        newMin = gaussAry[i][j];
                    if (newMax < gaussAry[i][j])
                        newMax = gaussAry[i][j];
                }
            }
        }

        public int convolution(int[] a, int[] mask){
            int result = 0;
            for(int i=0; i<9; i++){
                result += neighbor1DAry[i] * mask1DAry[i];
            }
            return result/maskWeight;
        }

        public void allocate(){
            mirrorFramedAry = new int[this.numRows+2][this.numCols+2];
            avgAry = new int[this.numRows+2][this.numCols+2];
            medianAry = new int[this.numRows+2][this.numCols+2];
            gaussAry = new int[this.numRows+2][this.numCols+2];
            thrAry = new int[this.numRows+2][this.numCols+2];
            mask2DAry = new int[this.maskRows][this.maskCols];
            mask1DAry = new int[this.maskRows*this.maskCols];
            neighbor1DAry = new int[9];
        }

    }
```

Input files(image and mask)



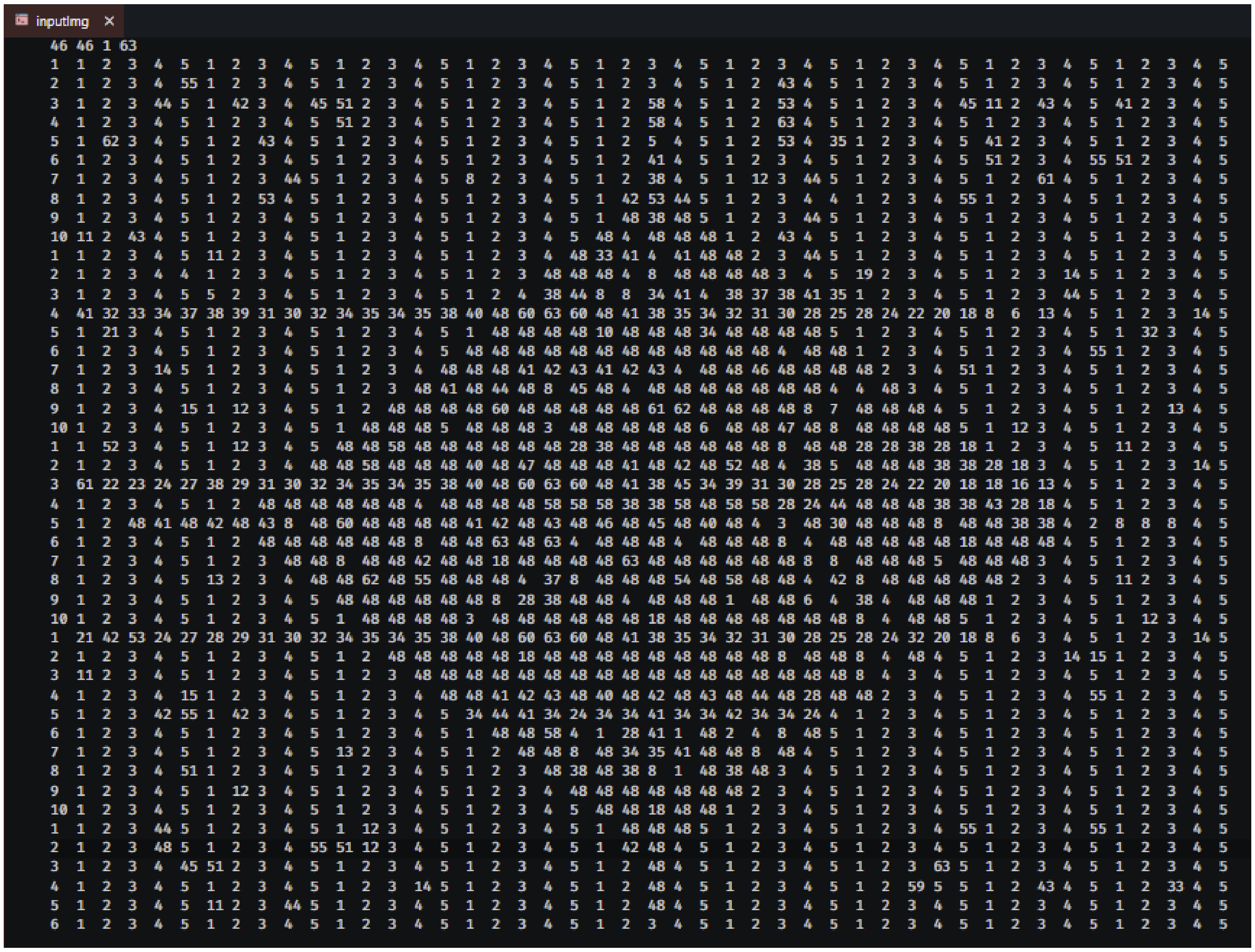
input

```
46 46 1 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
2 1 2 3 4 55 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 43 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
3 1 2 3 44 5 1 42 3 4 45 51 2 3 4 5 1 2 3 4 5 1 2 58 4 5 1 2 53 4 5 1 2 3 4 45 11 2 43 4 5 41 2 3 4 5
4 1 2 3 4 5 1 2 3 4 5 51 2 3 4 5 1 2 3 4 5 1 2 58 4 5 1 2 63 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
5 1 62 3 4 5 1 2 43 4 5 1 2 3 4 5 1 2 3 4 5 1 2 5 4 5 1 2 53 4 35 1 2 3 4 5 41 2 3 4 5 1 2 3 4 5
6 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 41 4 5 1 2 3 4 5 1 2 3 4 5 51 2 3 4 55 51 2 3 4 5
7 1 2 3 4 5 1 2 3 44 5 1 2 3 4 5 8 2 3 4 5 1 2 38 4 5 1 12 3 44 5 1 2 3 4 5 1 2 61 4 5 1 2 3 4 5
8 1 2 3 4 5 1 2 53 4 5 1 2 3 4 5 1 2 3 4 5 1 42 53 44 5 1 2 3 4 4 1 2 3 4 55 1 2 3 4 5 1 2 3 4 5
9 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 48 38 48 5 1 2 3 44 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
10 11 2 43 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 48 4 48 48 48 1 2 43 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
1 1 2 3 4 5 11 2 3 4 5 1 2 3 4 5 1 2 3 4 48 33 41 4 41 48 48 2 3 44 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
2 1 2 3 4 4 1 2 3 4 5 1 2 3 4 5 1 2 3 48 48 48 4 8 48 48 48 48 3 4 5 19 2 3 4 5 1 2 3 14 5 1 2 3 4 5
3 1 2 3 4 5 5 2 3 4 5 1 2 3 4 5 1 2 4 38 44 8 8 34 41 4 38 37 38 41 35 1 2 3 4 5 1 2 3 44 5 1 2 3 4 5
4 41 32 33 34 37 38 39 31 30 32 34 35 34 35 38 40 48 60 63 60 48 41 38 35 34 32 31 30 28 25 28 24 22 20 18 8 6 13 4 5 1 2 3 14 5
5 1 21 3 4 5 1 2 3 4 5 1 2 3 4 5 1 48 48 48 48 10 48 48 48 34 48 48 48 48 5 1 2 3 4 5 1 2 3 4 5 1 32 3 4 5
6 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 48 48 48 48 48 48 48 48 48 48 48 48 4 48 48 1 2 3 4 5 1 2 3 4 55 1 2 3 4 5
7 1 2 3 14 5 1 2 3 4 5 1 2 3 4 48 48 48 41 42 43 41 42 43 4 48 48 46 48 48 48 48 2 3 4 51 1 2 3 4 5 1 2 3 4 5
8 1 2 3 4 5 1 2 3 4 5 1 2 3 48 41 48 44 48 8 45 48 4 48 48 48 48 48 48 48 4 4 48 3 4 5 1 2 3 4 5 1 2 3 4 5
9 1 2 3 4 15 1 12 3 4 5 1 2 48 48 48 48 60 48 48 48 48 48 61 62 48 48 48 48 8 7 48 48 48 4 5 1 2 3 4 5 1 2 13 4 5
10 1 2 3 4 5 1 2 3 4 5 1 48 48 48 5 48 48 48 3 48 48 48 48 48 6 48 48 47 48 8 48 48 48 48 5 1 12 3 4 5 1 2 3 4 5
1 1 52 3 4 5 1 12 3 4 5 48 48 58 48 48 48 48 48 48 28 38 48 48 48 48 48 48 8 48 48 28 28 38 28 18 1 2 3 4 5 11 2 3 4 5
2 1 2 3 4 5 1 2 3 4 48 48 58 48 48 48 40 48 47 48 48 48 41 48 42 48 52 48 4 38 5 48 48 48 38 38 28 18 3 4 5 1 2 3 14 5
3 61 22 23 24 27 38 29 31 30 32 34 35 34 35 38 40 48 60 63 60 48 41 38 45 34 39 31 30 28 25 28 24 22 20 18 18 16 13 4 5 1 2 3 4 5
4 1 2 3 4 5 1 2 48 48 48 48 48 48 4 48 48 48 48 58 58 58 38 38 58 48 58 58 28 24 44 48 48 48 38 38 43 28 18 4 5 1 2 3 4 5
5 1 2 48 41 48 42 48 43 8 48 60 48 48 48 48 41 42 48 43 48 46 48 45 48 40 48 4 3 48 30 48 48 48 8 48 48 38 38 4 2 8 8 8 4 5
6 1 2 3 4 5 1 2 48 48 48 48 48 48 8 48 48 63 48 63 4 48 48 48 4 48 48 48 8 4 48 48 48 48 48 18 48 48 48 4 5 1 2 3 4 5
7 1 2 3 4 5 1 2 3 48 48 8 48 48 42 48 48 18 48 48 48 48 63 48 48 48 48 48 48 8 8 48 48 48 5 48 48 48 3 4 5 1 2 3 4 5
8 1 2 3 4 5 13 2 3 4 48 48 62 48 55 48 48 48 4 37 8 48 48 48 54 48 58 48 48 4 42 8 48 48 48 48 48 2 3 4 5 11 2 3 4 5
9 1 2 3 4 5 1 2 3 4 5 48 48 48 48 48 48 8 28 38 48 48 4 48 48 48 1 48 48 6 4 38 4 48 48 48 1 2 3 4 5 1 2 3 4 5
10 1 2 3 4 5 1 2 3 4 5 1 48 48 48 48 3 48 48 48 48 48 48 18 48 48 48 48 48 48 48 8 4 48 48 5 1 2 3 4 5 1 12 3 4 5
1 21 42 53 24 27 28 29 31 30 32 34 35 34 35 38 40 48 60 63 60 48 41 38 35 34 32 31 30 28 25 28 24 32 20 18 8 6 3 4 5 1 2 3 14 5
2 1 2 3 4 5 1 2 3 4 5 1 2 48 48 48 48 48 18 48 48 48 48 48 48 48 48 48 8 48 48 8 4 48 4 5 1 2 3 14 15 1 2 3 4 5
3 11 2 3 4 5 1 2 3 4 5 1 2 3 48 48 48 48 48 48 48 48 48 48 48 48 48 48 48 48 48 8 4 3 4 5 1 2 3 4 5 1 2 3 4 5
4 1 2 3 4 15 1 2 3 4 5 1 2 3 4 48 48 41 42 43 48 40 48 42 48 43 48 44 48 28 48 48 2 3 4 5 1 2 3 4 55 1 2 3 4 5
5 1 2 3 42 55 1 42 3 4 5 1 2 3 4 5 34 44 41 34 24 34 34 41 34 34 42 34 34 24 4 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
6 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 48 48 58 4 1 28 41 1 48 2 4 8 48 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
7 1 2 3 4 5 1 2 3 4 5 13 2 3 4 5 1 2 48 48 8 48 34 35 41 48 48 8 48 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
8 1 2 3 4 51 1 2 3 4 5 1 2 3 4 5 1 2 3 48 38 48 38 8 1 48 38 48 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
9 1 2 3 4 5 1 12 3 4 5 1 2 3 4 5 1 2 3 4 48 48 48 48 48 48 48 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
10 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 48 48 18 48 48 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
1 1 2 3 44 5 1 2 3 4 5 1 12 3 4 5 1 2 3 4 5 1 48 48 48 5 1 2 3 4 5 1 2 3 4 55 1 2 3 4 55 1 2 3 4 5
2 1 2 3 48 5 1 2 3 4 55 51 12 3 4 5 1 2 3 4 5 1 42 48 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
3 1 2 3 4 45 51 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 48 4 5 1 2 3 4 5 1 2 3 63 5 1 2 3 4 5 1 2 3 4 5
4 1 2 3 4 5 1 2 3 4 5 1 2 3 14 5 1 2 3 4 5 1 2 48 4 5 1 2 3 4 5 1 2 59 5 5 1 2 43 4 5 1 2 33 4 5
5 1 2 3 4 5 11 2 3 44 5 1 2 3 4 5 1 2 3 4 5 1 2 48 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
6 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
```

mask Settings

```
3 3 1 6
1 3 1
3 6 3
1 3 1
```

Reformatted Input Image



```
46 46 1 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
2 1 2 3 4 55 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 43 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
3 1 2 3 44 5 1 42 3 4 45 51 2 3 4 5 1 2 3 4 5 1 2 58 4 5 1 2 53 4 5 1 2 3 4 45 11 2 43 4 5 41 2 3 4 5
4 1 2 3 4 5 1 2 3 4 5 51 2 3 4 5 1 2 3 4 5 1 2 58 4 5 1 2 63 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
5 1 62 3 4 5 1 2 43 4 5 1 2 3 4 5 1 2 3 4 5 1 2 5 4 5 1 2 53 4 35 1 2 3 4 5 41 2 3 4 5 1 2 3 4 5
6 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 41 4 5 1 2 3 4 5 1 2 3 4 5 51 2 3 4 55 51 2 3 4 5
7 1 2 3 4 5 1 2 3 44 5 1 2 3 4 5 8 2 3 4 5 1 2 38 4 5 1 12 3 44 5 1 2 3 4 5 1 2 61 4 5 1 2 3 4 5
8 1 2 3 4 5 1 2 53 4 5 1 2 3 4 5 1 2 3 4 5 1 42 53 44 5 1 2 3 4 4 1 2 3 4 55 1 2 3 4 5 1 2 3 4 5
9 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 48 38 48 5 1 2 3 44 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
10 11 2 43 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 48 4 48 48 48 1 2 43 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
1 1 2 3 4 5 11 2 3 4 5 1 2 3 4 5 1 2 3 4 48 33 41 4 41 48 48 2 3 44 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
2 1 2 3 4 4 1 2 3 4 5 1 2 3 4 5 1 2 3 48 48 48 4 8 48 48 48 48 3 4 5 19 2 3 4 5 1 2 3 14 5 1 2 3 4 5
3 1 2 3 4 5 5 2 3 4 5 1 2 3 4 5 1 2 4 38 44 8 8 34 41 4 38 37 38 41 35 1 2 3 4 5 1 2 3 44 5 1 2 3 4 5
4 41 32 33 34 37 38 39 31 30 32 34 35 34 35 38 40 48 60 63 60 48 41 38 35 34 32 31 30 28 25 28 24 22 20 18 8 6 13 4 5 1 2 3 14 5
5 1 21 3 4 5 1 2 3 4 5 1 2 3 4 5 1 48 48 48 48 10 48 48 48 34 48 48 48 48 5 1 2 3 4 5 1 2 3 4 5 1 32 3 4 5
6 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 48 48 48 48 48 48 48 48 48 48 48 48 4 48 48 1 2 3 4 5 1 2 3 4 55 1 2 3 4 5
7 1 2 3 14 5 1 2 3 4 5 1 2 3 4 48 48 48 41 42 43 41 42 43 4 48 48 46 48 48 48 48 2 3 4 51 1 2 3 4 5 1 2 3 4 5
8 1 2 3 4 5 1 2 3 4 5 1 2 3 48 41 48 44 48 8 45 48 4 48 48 48 48 48 48 48 4 4 48 3 4 5 1 2 3 4 5 1 2 3 4 5
9 1 2 3 4 15 1 12 3 4 5 1 2 48 48 48 48 60 48 48 48 48 48 61 62 48 48 48 48 8 7 48 48 48 4 5 1 2 3 4 5 1 2 13 4 5
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1 1 52 3 4 5 1 12 3 4 5 48 48 58 48 48 48 48 48 48 28 38 48 48 48 48 48 48 8 48 48 28 28 38 28 18 1 2 3 4 5 11 2 3 4 5
2 1 2 3 4 5 1 2 3 4 48 48 58 48 48 48 40 48 47 48 48 48 41 48 42 48 52 48 4 38 5 48 48 48 38 38 28 18 3 4 5 1 2 3 14 5
3 61 22 23 24 27 38 29 31 30 32 34 35 34 35 38 40 48 60 63 60 48 41 38 45 34 39 31 30 28 25 28 24 22 20 18 18 16 13 4 5 1 2 3 4 5
4 1 2 3 4 5 1 2 48 48 48 48 48 48 4 48 48 48 48 58 58 58 38 38 58 48 58 58 28 24 44 48 48 48 38 38 43 28 18 4 5 1 2 3 4 5
5 1 2 48 41 48 42 48 43 8 48 60 48 48 48 48 41 42 48 43 48 46 48 45 48 40 48 4 3 48 30 48 48 48 8 48 48 38 38 4 2 8 8 8 4 5
6 1 2 3 4 5 1 2 48 48 48 48 48 48 8 48 48 63 48 63 4 48 48 48 4 48 48 48 8 4 48 48 48 48 48 18 48 48 48 4 5 1 2 3 4 5
7 1 2 3 4 5 1 2 3 48 48 8 48 48 42 48 48 18 48 48 48 48 63 48 48 48 48 48 48 8 8 48 48 48 5 48 48 48 3 4 5 1 2 3 4 5
8 1 2 3 4 5 13 2 3 4 48 48 62 48 55 48 48 48 4 37 8 48 48 48 54 48 58 48 48 4 42 8 48 48 48 48 48 2 3 4 5 11 2 3 4 5
9 1 2 3 4 5 1 2 3 4 5 48 48 48 48 48 48 8 28 38 48 48 4 48 48 48 1 48 48 6 4 38 4 48 48 48 1 2 3 4 5 1 2 3 4 5
10 1 2 3 4 5 1 2 3 4 5 1 48 48 48 48 3 48 48 48 48 48 48 18 48 48 48 48 48 48 48 8 4 48 48 5 1 2 3 4 5 1 12 3 4 5
1 21 42 53 24 27 28 29 31 30 32 34 35 34 35 38 40 48 60 63 60 48 41 38 35 34 32 31 30 28 25 28 24 32 20 18 8 6 3 4 5 1 2 3 14 5
2 1 2 3 4 5 1 2 3 4 5 1 2 48 48 48 48 48 18 48 48 48 48 48 48 48 48 48 8 48 48 8 4 48 4 5 1 2 3 14 15 1 2 3 4 5
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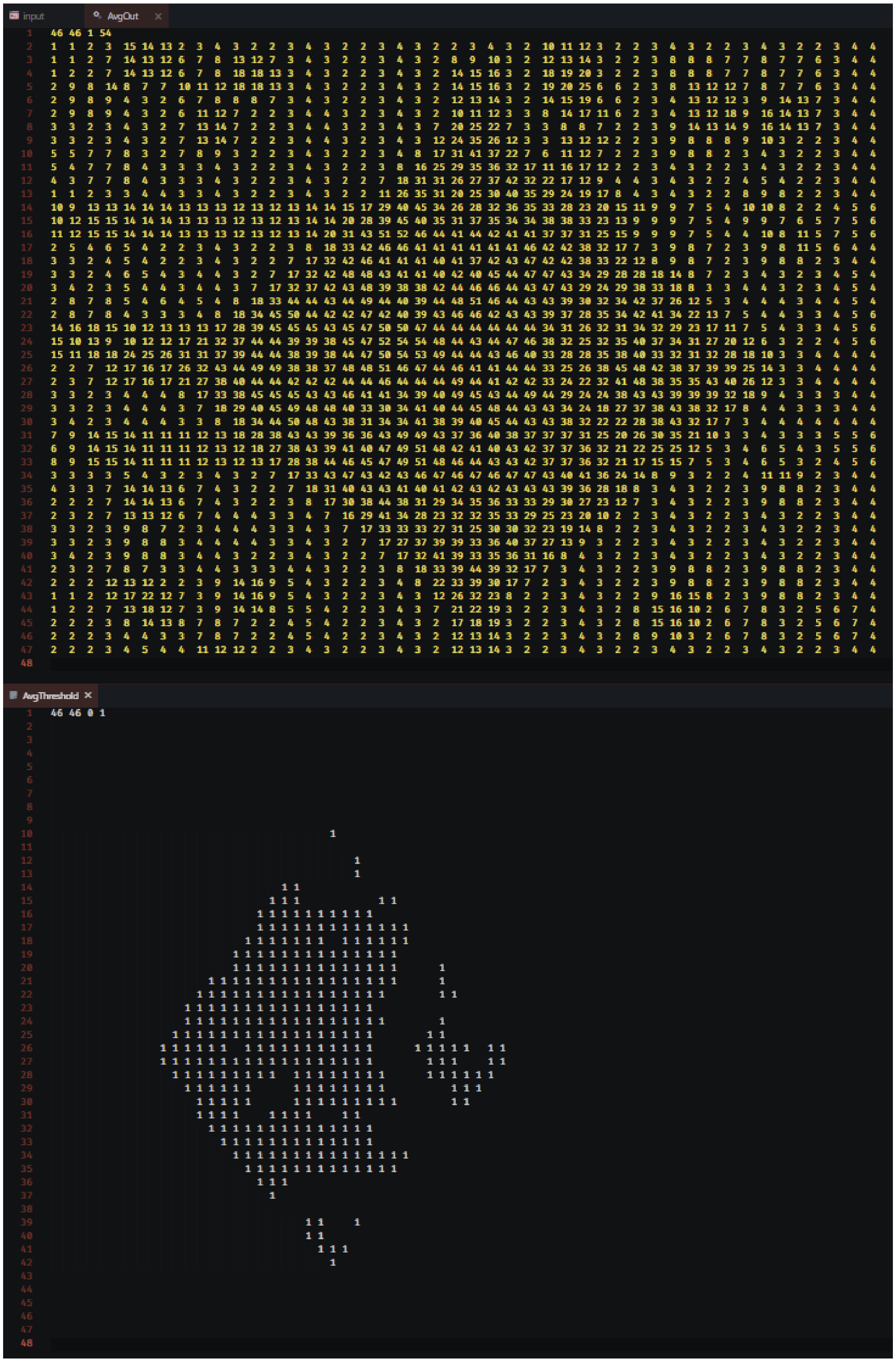

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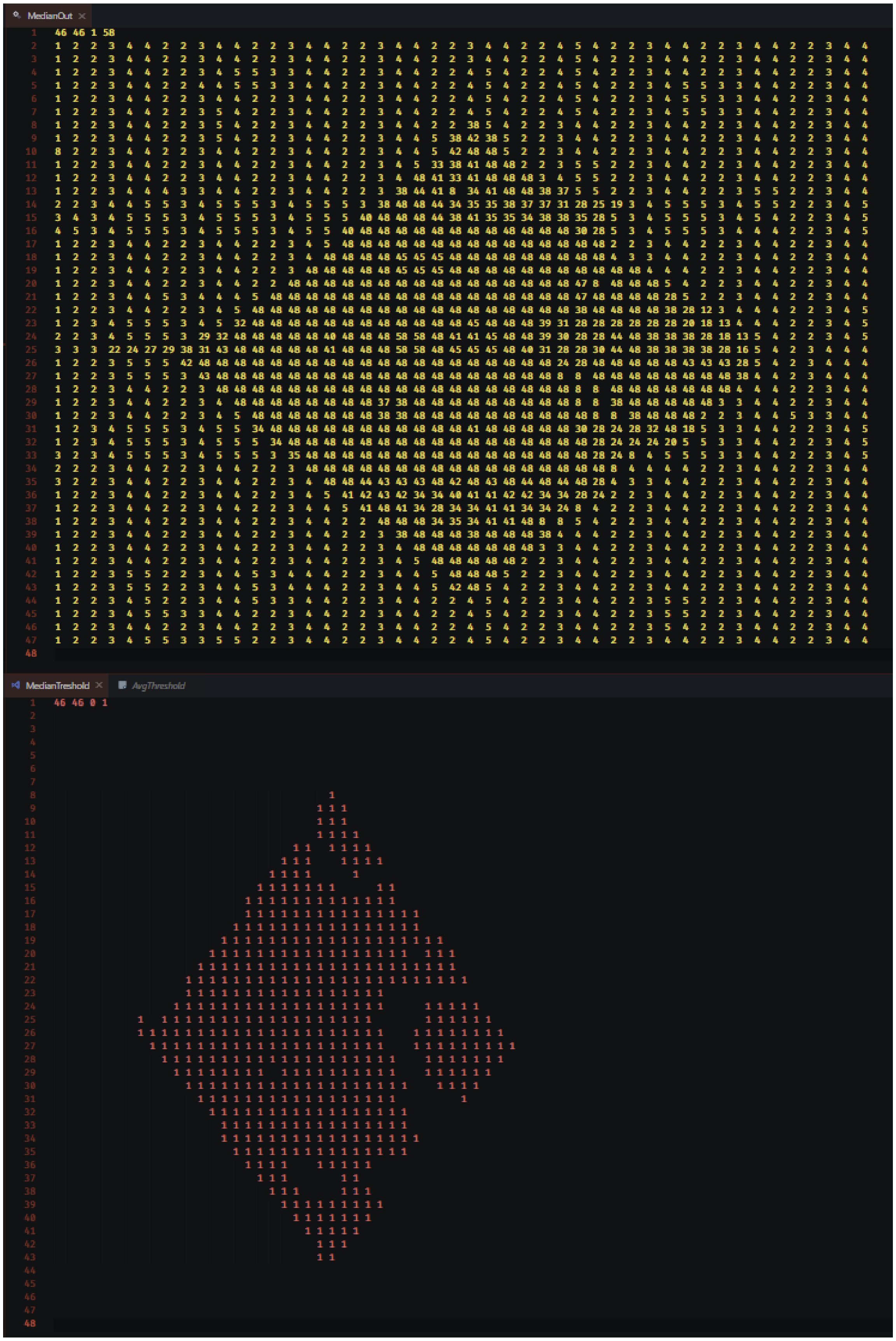
Reformatted Median and Binary Median Treshold



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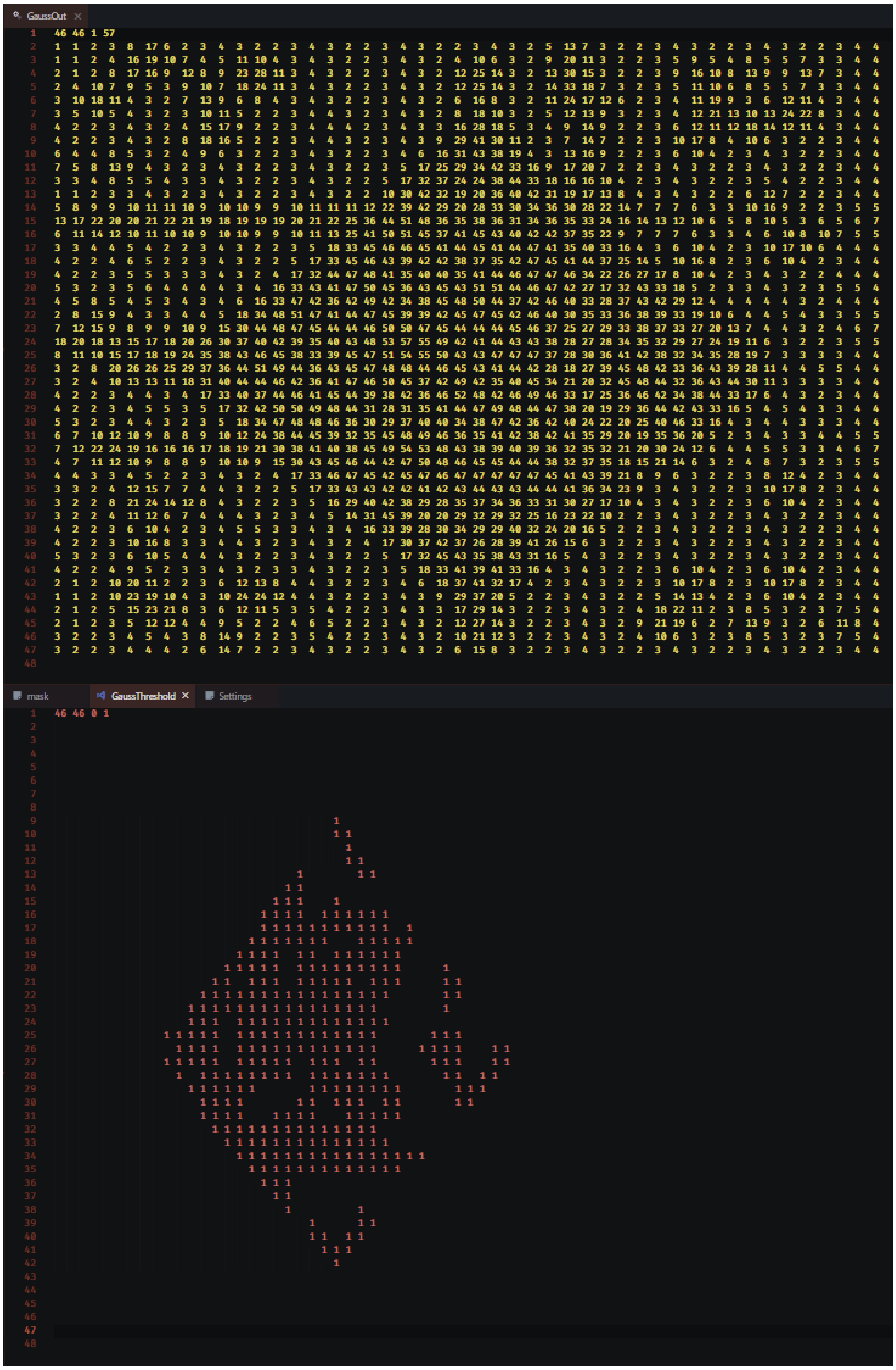
Reformatted Gaussian and Binary Gaussian Treshold



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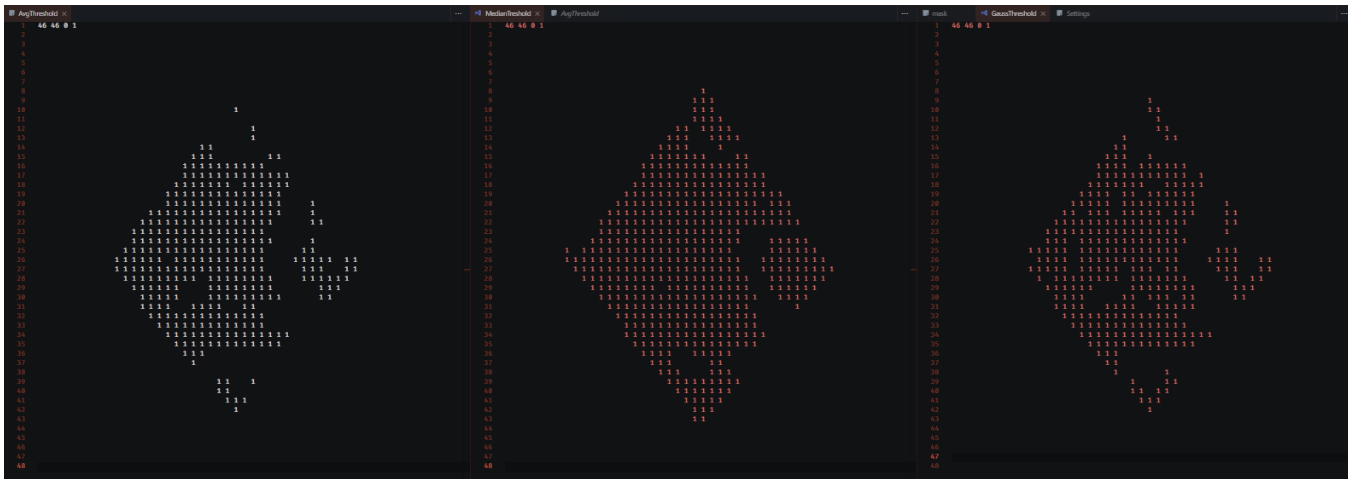

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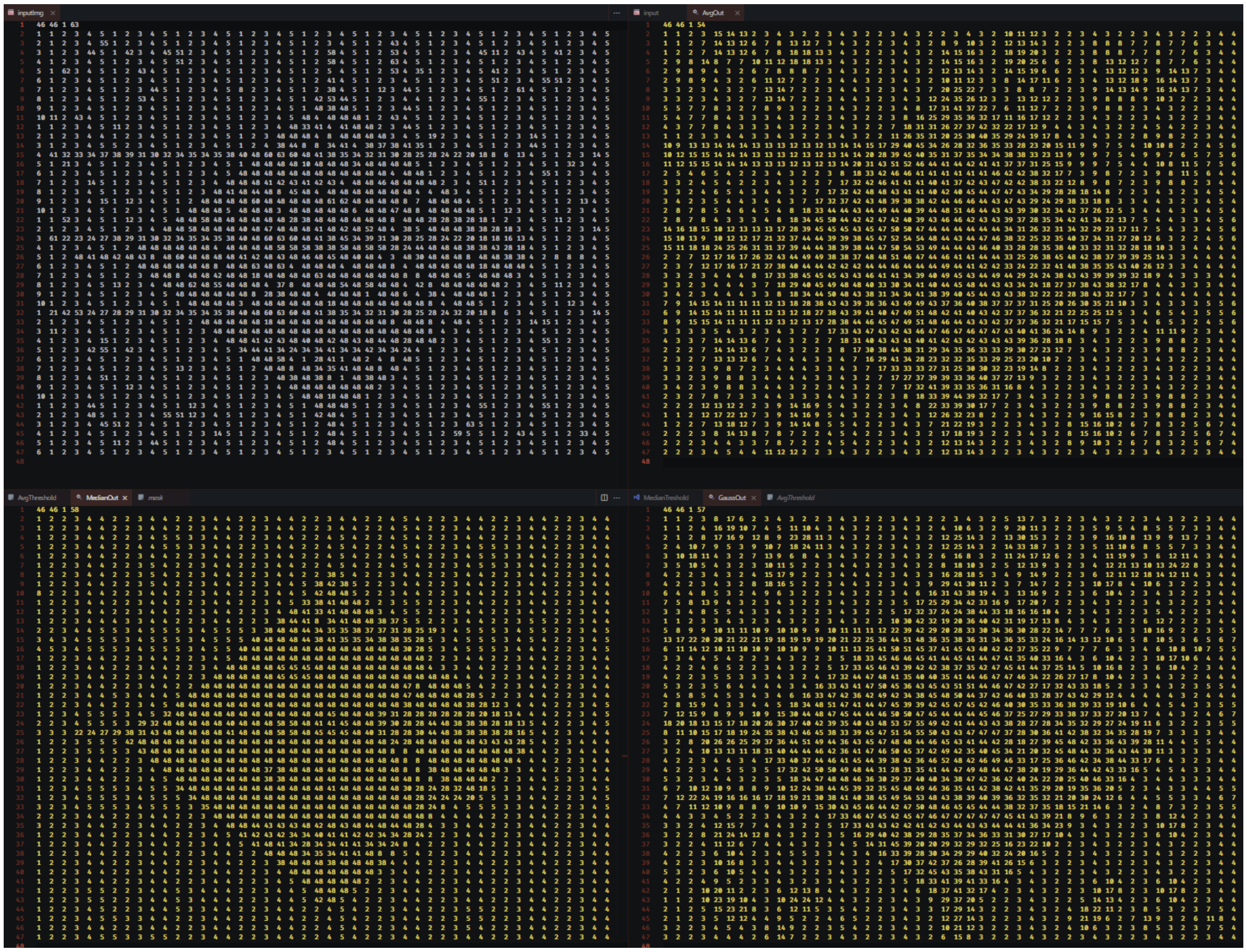

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