Name: Jingshi Liu

Section: Image Processing

Project: **Final - Hough Transform**

Due Date: Dec 13th

Source Code:

```
#include <fstream>

#include <iostream>

using namespace std;


namespace Util{

    static int** getArray(int rows, int cols){

        int** array = new int*[rows];

        for(int i = 0; i < rows; i++){

            array[i] = new int[cols];

            for(int j = 0; j < cols; j++){

                array[i][j] = 0;

            }

        }

        return array;

    }


    static int findMax(int** array, int rows, int cols){

        int max = array[0][0];

        for(int i = 0; i < rows; i++){

            for(int j = 0; j < cols; j++){

                if(array[i][j] > max){

                    max = array[i][j];

                }

            }

        }
        return max;
    }

    static int findMin(int** array, int rows, int cols){
        int min = array[0][0];
        for(int i = 0; i < rows; i++){
            for(int j = 0; j < cols; j++){
                if(array[i][j] < min){
                    min = array[i][j];
                }
            }
        }
        return min;
    }
}

class HoughTransform{
public:
    int numRows,
        numCols,
        minVal,
        maxVal,
        houghDist,
        houghAngle;
    int** imgAry;
    int** polarHoughAry;
    int angleInDegree,
        offset;
    double angleInRadian,
            PI;

    HoughTransform(ifstream& inFile){
        inFile >> numRows >> numCols >> minVal >> maxVal;
        int diagonal = sqrt(numRows * numRows + numCols * numCols);
        offset = diagonal;
        imgAry = Util::getArray(numRows, numCols);
        PI = 3.14159265;
        houghDist = 2 * diagonal;
        houghAngle = 180;
        polarHoughAry = Util::getArray(houghDist, houghAngle);
        loadImage(inFile);
    }

    void loadImage(ifstream& inFile){
        int cur = 0;
        for(int i = 0; i < numRows; i++){
            for(int j = 0; j < numCols; j++){
                inFile >> cur;
                imgAry[i][j] = cur;
            }
        }
    }

    void buildHoughSpace(){
        double angleInR;
        int dist;
        for(int i = 0; i < numRows; i++){
            for(int j = 0; j < numCols; j++){
                if(imgAry[i][j] == 0) continue;

                for(int angleInD = 0; angleInD < 180; angleInD++){
                    angleInR = (angleInD / 180.00) * PI;
                    dist = (int) polarDist(i, j, angleInR);
                    polarHoughAry[dist][angleInD]++;
                }
            }
        }
    }
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```
    double polarDist(int i, int j, double angleInR){
        return (i * cos(angleInR) + j * sin(angleInR) + offset);
    }

    void reformatPrettyPrint(ofstream& outFile){
        int houghMinVal = Util::findMin(polarHoughAry, houghDist, houghAngle),
            houghMaxVal = Util::findMax(polarHoughAry, houghDist, houghAngle);

        outFile << houghDist << " " << houghAngle << " " << houghMinVal << " " << houghMaxVal <<
'\n';
        string str;
        int curWidth,
            pixelWidth = to_string(houghMaxVal).length();

        for(int r = 0; r < houghDist; r++){
            for(int c = 0; c < houghAngle; c++){
                outFile << (polarHoughAry[r][c] == 0 ? "." : to_string(polarHoughAry[r][c]));
                str = to_string(polarHoughAry[r][c]);
                curWidth = str.length();
                while(curWidth < pixelWidth){
                    outFile<<' ';
                    curWidth++;
                }
                outFile<<' ';
            }
            outFile << '\n';
        }
    }
};

int main(int argc, const char* argv[]){
    ifstream inFile(argv[1]);
    ofstream outFile(argv[2]);
    HoughTransform houghTransform(inFile);
    houghTransform.buildHoughSpace();

    houghTransform.reformatPrettyPrint(outFile);

    inFile.close();

    outFile.close();

}
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Program Output

Data 1 Output

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Data 2 Output

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Data 3 Output

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