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Code

```cpp
#include <fstream>
#include <iostream>

using namespace std;

class EdgeDetector{
    public:
    int numRows, numCols, minVal, maxVal;
    int** MFAry;
    int** tempAry;
    int** edgeAry;
    int** maskAry;

    void run(ifstream& inp, ifstream& mask, ofstream& outp1, ofstream& outp2);
    int convolve(int** inp, int r, int c, int** m);
    void binaryEdge(int** fromAry, int** toAry);


};

int main(int argv, char** args){
    string input_filename = args[1];
    string mask_filename = args[2];
    string output_filename1 = args[3];
    string output_filename2 = args[4];

    ifstream inp(input_filename);
    ifstream mask(mask_filename);

    ofstream outp1(output_filename1);
    ofstream outp2(output_filename2);


    EdgeDetector ed;
    ed.run(inp, mask, outp1, outp2);

    inp.close();
    mask.close();
    outp1.close();
    outp2.close();
```

```
}

void EdgeDetector::run(ifstream& inp, ifstream& mask, ofstream& outp1, ofstream&
outp2){
    inp >> numRows; inp >> numCols; inp >> minVal; inp >> maxVal;


    //dynamically allocate
    MFAry = new int*[numRows+2];
    tempAry = new int*[numRows+2];
    edgeAry = new int*[numRows+2];
    for(int i = 0; i < numRows + 2; ++i){
        MFAry[i] = new int[numCols+2]{0};
        tempAry[i] = new int[numCols+2]{0};
        edgeAry[i] = new int[numCols+2]{0};
    }
    maskAry = new int*[3];
    for(int i = 0; i < 3; ++i){
        maskAry[i] = new int[3]{0};
    }



    //load image into MFAry
    for(int row = 1; row <= numRows; ++row){
        for(int col = 1; col <= numCols; ++col){
            inp >> MFAry[row][col];
        }
    }

    //mirror frame top and bottom
    for(int col = 1; col <= numCols; ++col){
        MFAry[0][col] = MFAry[1][col];
        MFAry[numRows+1][col] = MFAry[numRows][col];
    }

    //mirror frame left and right
    for(int row = 1; row <= numRows; ++row){
        MFAry[row][0] = MFAry[row][1];
        MFAry[row][numCols+1] = MFAry[row][numCols];
    }

    //mirror corners -- over axis
    MFAry[0][0] = MFAry[1][1];
```

```
    MFAry[0][numCols+1] = MFAry[1][numCols];
    MFAry[numRows+1][0] = MFAry[numRows][1];
    MFAry[numRows+1][numCols+1] = MFAry[numRows][numCols];

    //load 3x3 Mask
    for(int i = 0; i < 3; ++i){
        for(int j = 0; j < 3; ++j){
            mask >> maskAry[i][j];
            //cout << maskAry[i][j] << " ";
        }
    }

    //loading convolutions into tempAry
    for(int row = 1; row <= numRows; ++row){
        for(int col = 1; col <= numCols; ++col){
            tempAry[row][col] = convolve(MFAry, row, col, maskAry);
        }
    }


    //thresholding tempAry
    for(int row = 1; row <= numRows; ++row){
        for(int col = 1; col <= numCols; ++col){
            if(tempAry[row][col] > 0) tempAry[row][col] = 1;
            else tempAry[row][col] = 0;
        }
    }

    //output thresholded tempAry
    for(int row = 1; row <= numRows; ++row){
        for(int col = 1; col <= numCols; ++col){
            if (tempAry[row][col] > 0){
             outp1 << tempAry[row][col];
            }
            else outp1 << ".";
            outp1 << " ";
        }
        outp1 << "\n";
    }

    //zero-crossing edge detection
    binaryEdge(tempAry, edgeAry);

    //output edgeAry
    for(int row = 1; row <= numRows; ++row){
```

```
        for(int col = 1; col <= numCols; ++col){
            if(edgeAry[row][col] > 0){
                outp2 << edgeAry[row][col];
            }
            else outp2 << ".";
            outp2 << " ";
        }
        outp2 << "\n";
    }

}

int EdgeDetector::convolve(int** inp, int r, int c, int** m){
    int retVal = 0;
    for(int row = r-1; row <= r+1; ++row){
        for(int col = c-1; col <= c+1; col++){
            retVal += inp[row][col] * m[row-r+1][col-c+1];
        }
    }

    return retVal;
}

void EdgeDetector::binaryEdge(int** fromAry, int** toAry){
    for(int row = 1; row <= numRows; ++row){
        for(int col = 1; col <= numCols; ++col){
            if(fromAry[row][col] == 1 && (fromAry[row][col-1] == 0 ||
fromAry[row][col+1] == 0)){
                toAry[row][col] = 1;
            }
            else toAry[row][col] = 0;
        }
    }
}
```

OUTPUTS (next page)


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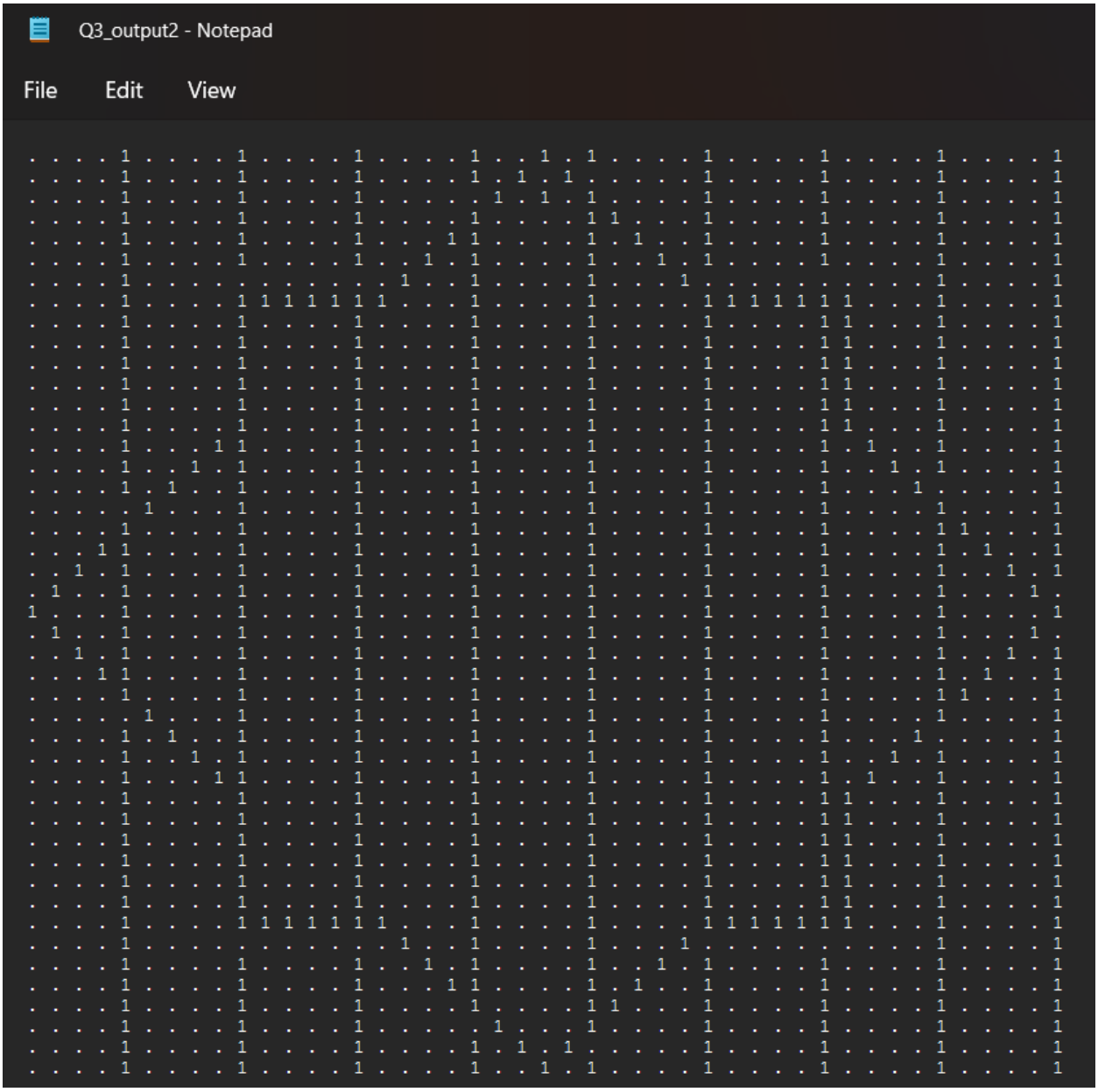
Q3_output2 - Notepad
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