CV Project 8: K-curvature Edge Detector C++

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**Corner Detection Algorithm Steps:**

Step 0: Q ← 0

P ← K

R ← 2\* K

Step 1: index ← P

Step 2: curvature ← computeCurvature (Q, P, R)

Step 3: PtAry[index]->curvature ←curvature

Step 4: outFile3 ← print Q, P, R, index, x, y, curvature of PtAry[index] // for debugging to see the curvature.

Step 5: Increment Q, P, R by 1 // each need to mod with numPts

Step 6: repeat step 2 to step until P == K-1

**Algorithm for calculating the curvature:**

Step 1: Get the coordinates for p, q and r.

Step 2: Find the difference in slope (curvature) formed by line joining p and q with line joining q and r.

Step 3: Handle the possible divide by zero errors by checking if either line has the same x- coordinates or ‘r’. We can do it by increasing or decreasing the value of r by 0.1.

Step 4: Use the formula to calculate curvature.

**(c1 - c2) / (r1 - r2) - (c2 - c3) / (r2 - r3)**

**Source Code:**

#include <iostream>

#include <fstream>

#include <string>

#include <cstdarg>

using namespace std;

class BoundaryPt

{

public:

int x, y;

double curvature;

int localMax;

int corner; // 1 means it is not a corner or 9 means it is a corner

};

class Image

{

public:

int numRows;

int numCols;

int minVal;

int maxVal;

int newMin;

int newMax;

int \*\*imgAry; // a 2D array for display, initially set to 0

Image(ifstream &inFile)

{

inFile >> numRows >> numCols >> minVal >> maxVal;

imgAry = new int \*[numRows];

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

{

imgAry[i] = new int[numCols]();

}

}

void reformatPrettyPrint(ofstream &outFile)

{

outFile << numRows << " " << numCols << " " << newMin << " " << newMax << endl;

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

{

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

{

if (imgAry[i][j] > 0)

{

outFile << imgAry[i][j] << " ";

}

else

{

outFile << ". ";

}

}

outFile << endl;

}

}

~Image()

{

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

{

delete[] imgAry[i];

}

}

};

class kCurvature

{

public:

int K;

int numPts; //number of boundary Points

int Q; //an index of the array, initially set to 0

int P; //an index of the array, initially set to K

int R; //an index of the array, initially set to 2\*K

BoundaryPt \*PtAry; // an 1D array of boundaryPt class size is numPts,

// need to dynamically allocate.

// use mod function to compute the curvature for the beginning of

// the K points without extending the tail of the array,

int label;

void init(ifstream &inFile, string inputFileName)

{

countPts(inFile);

//initializing boundaryPts array

PtAry = new BoundaryPt[numPts];

inFile.close();

inFile.open(inputFileName);

int a;

//skipping image header and label

inFile >> a >> a >> a >> a >> label;

//Storing each points in the array

for (int i = 0; i < numPts; i++)

{

int x, y;

inFile >> x >> y;

storePt(x, y, i);

}

}

void cornerDetection(ofstream &debugFile)

{

Q = 0;

P = K;

R = 2 \* K;

cout << "K" << K << endl;

cout << "Number of Pts: " << numPts << endl;

for (int i = 0; i < numPts; i++)

{

double curvature = computeCurvature(Q, P, R);

PtAry[P].curvature = curvature;

P = (P + 1) % numPts;

Q = (Q + 1) % numPts;

R = (R + 1) % numPts;

}

}

void countPts(ifstream &inFile)

{

int x, y;

int count = 0;

while (inFile >> x && inFile >> y)

{

count++;

}

numPts = count;

}

void storePt(int x, int y, int index)

{

PtAry[index].x = x;

PtAry[index].y = y;

}

double computeCurvature(int q, int p, int r)

{

cout << "Q: " << Q << " P: " << P << " R: " << R << " ";

cout << "P has " << PtAry[p].x << " " << PtAry[p].y << " ";

double r1 = (double)PtAry[q].x;

double c1 = (double)PtAry[q].y;

double r2 = (double)PtAry[p].x;

double c2 = (double)PtAry[p].y;

double r3 = (double)PtAry[r].x;

double c3 = (double)PtAry[r].y;

cout << "r1 c1 r2 c2 r3 c3: " << r1 << " " << c1 << " " << r2 << " " << c2 << " " << r3 << " " << c3 << " ";

//Math error cases

if (r1 == r2)

{

r2 = r2 + 0.1;

cout << " Math Error";

}

if (r2 == r3)

{

r2 = r2 + 0.1;

cout << " Maths error";

}

double curvature = (c1 - c2) / (r1 - r2) - (c2 - c3) / (r2 - r3);

cout << " Curvature: " << curvature << endl;

return curvature;

}

void computeLocalMaxima()

{

// P(i) is a local maxima if in its 1 X 5 neighborhood if the curvature

// of p(i) is >= the curvatures of

// its linear neighbors: p(i-2), p(i-1), p(i+1), p(i+2)

// returns 1 if yes, returns 0 if not.

for (int i = 2; i < numPts + 2; i++)

{

double neighbour1 = PtAry[(i - 2) % numPts].curvature;

double neigbour2 = PtAry[(i - 1) % numPts].curvature;

double neigbour3 = PtAry[(i + 1) % numPts].curvature;

double neigbour4 = PtAry[(i + 2) % numPts].curvature;

int index = i % numPts;

double p = PtAry[index].curvature;

if (p >= neighbour1 && p >= neigbour2 && p >= neigbour3 && p >= neigbour4)

{

PtAry[index].localMax = 1;

}

else

{

PtAry[index].localMax = 0;

}

}

}

void markCorner()

{

const int t = 1; //t is threshold value of change in curvature. We ignore change in curvature that is smaller than t.

//Corner pixel has maximum change in curvature

for (int i = K; i < numPts + K; i++)

{

int pCurvature = PtAry[i % numPts].curvature;

int qCurvature = PtAry[(i - 1) % numPts].curvature;

int rCurvature = PtAry[(i + 1) % numPts].curvature;

if (abs(pCurvature - qCurvature) >= t && abs(pCurvature - rCurvature) >= t)

{

PtAry[i % numPts].corner = 9;

}

else

{

PtAry[i % numPts].corner = 1;

}

}

}

void display(Image &img)

{

img.newMax = 0;

for (int i = 0; i < numPts; i++)

{

int x = PtAry[i].x;

int y = PtAry[i].y;

img.imgAry[x][y] = PtAry[i].corner;

//Updating newMax

if (PtAry[i].corner > img.newMax)

{

img.newMax = PtAry[i].corner;

}

}

}

void printBoundary(ofstream &outFile)

{

outFile << numPts << endl;

for (int i = 0; i < numPts; i++)

{

outFile << PtAry[i].x << " " << PtAry[i].y

<< " " << PtAry[i].corner << endl;

}

}

void printPtAry(ofstream &outFile) // For debugging, print the content of the entire PtAry to outFile3

{

for (int i = 0; i < numPts; i++)

{

outFile << "r: " << PtAry[i].x << " c: " << PtAry[i].y << " "

<< " Curvature: " << PtAry[i].curvature << " Corner: " << PtAry[i].corner << endl;

}

}

~kCurvature()

{

delete[] PtAry;

}

};

int main(int argc, const char \*argv[])

{

// READ

string inputName = argv[1];

ifstream input;

input.open(inputName);

//WRITES

string outFile1Name = argv[2],

outFile2Name = argv[3], outFile3Name = argv[4];

ofstream outFile1, outFile2, outFile3;

outFile1.open(outFile1Name);

outFile2.open(outFile2Name);

outFile3.open(outFile3Name);

//Input for K

int K;

cout << "Enter the value of K: ";

cin >> K;

//Checking if IO operations succeeds

if (input.is\_open())

{

if (outFile1.is\_open() && outFile2.is\_open() && outFile3.is\_open())

{

Image img(input);

int label;

input >> label;

kCurvature k;

k.K = K;

k.init(input, inputName);

outFile3 << endl

<< "Before applying k curvature corner detection algorithm:" << endl;

k.printPtAry(outFile3);

k.cornerDetection(outFile3);

outFile3 << endl

<< "After applying k curvature corner detection algorithm:" << endl;

k.printPtAry(outFile3);

k.computeLocalMaxima();

k.markCorner();

outFile3 << endl

<< "After marking corners:" << endl;

k.printPtAry(outFile3);

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

outFile1 << k.label << endl;

k.printBoundary(outFile1);

k.display(img);

img.reformatPrettyPrint(outFile2);

}

else

{

cout << "ERROR: Some output files is missing or couldnt be opened." << endl;

}

}

else

{

cout << "ERROR: The input file with following name does not exists or there was problem reading it: " << inputName << endl;

}

input.close();

outFile1.close();

outFile2.close();

outFile3.close();

return 0;

};

**Outputs**

**Data\_A:**

Result of K-Curvature of the object boundary points

30 40 0 1

1

96

6 6 9

7 6 1

8 6 1

9 6 1

10 6 1

11 6 1

12 6 1

13 6 1

14 6 1

15 6 1

16 6 1

17 6 1

18 6 1

19 6 1

20 6 1

21 6 1

22 6 1

23 6 1

24 6 1

25 6 9

25 7 1

25 8 1

25 9 1

25 10 1

25 11 1

25 12 1

25 13 1

25 14 1

25 15 1

25 16 1

25 17 1

25 18 1

25 19 1

25 20 1

25 21 1

25 22 1

25 23 1

25 24 1

25 25 1

25 26 1

25 27 1

25 28 1

25 29 1

25 30 1

25 31 1

25 32 1

25 33 1

25 34 1

25 35 9

24 35 1

23 35 1

22 35 1

21 35 1

20 35 1

19 35 1

18 35 1

17 35 1

16 35 1

15 35 1

14 35 1

13 35 1

12 35 1

11 35 1

10 35 1

9 35 1

8 35 1

7 35 1

6 35 9

6 34 1

6 33 1

6 32 1

6 31 1

6 30 1

6 29 1

6 28 1

6 27 1

6 26 1

6 25 1

6 24 1

6 23 1

6 22 1

6 21 1

6 20 1

6 19 1

6 18 1

6 17 1

6 16 1

6 15 1

6 14 1

6 13 1

6 12 1

6 11 1

6 10 1

6 9 1

6 8 1

6 7 1

Pretty Print of the K-curvature corner detection

30 40 0 9

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Debug File

Before applying k curvature corner detection algorithm:

r: 6 c: 6 Curvature: 0 Corner: 0

r: 7 c: 6 Curvature: 0 Corner: 0

r: 8 c: 6 Curvature: 0 Corner: 0

r: 9 c: 6 Curvature: 0 Corner: 0

r: 10 c: 6 Curvature: 0 Corner: 0

r: 11 c: 6 Curvature: 0 Corner: 0

r: 12 c: 6 Curvature: 0 Corner: 0

r: 13 c: 6 Curvature: 0 Corner: 0

r: 14 c: 6 Curvature: 0 Corner: 0

r: 15 c: 6 Curvature: 0 Corner: 0

r: 16 c: 6 Curvature: 0 Corner: 0

r: 17 c: 6 Curvature: 0 Corner: 0

r: 18 c: 6 Curvature: 0 Corner: 0

r: 19 c: 6 Curvature: 0 Corner: 0

r: 20 c: 6 Curvature: 0 Corner: 0

r: 21 c: 6 Curvature: 0 Corner: 0

r: 22 c: 6 Curvature: 0 Corner: 0

r: 23 c: 6 Curvature: 0 Corner: 0

r: 24 c: 6 Curvature: 0 Corner: 0

r: 25 c: 6 Curvature: 0 Corner: 0

r: 25 c: 7 Curvature: 0 Corner: 0

r: 25 c: 8 Curvature: 0 Corner: 0

r: 25 c: 9 Curvature: 0 Corner: 0

r: 25 c: 10 Curvature: 0 Corner: 0

r: 25 c: 11 Curvature: 0 Corner: 0

r: 25 c: 12 Curvature: 0 Corner: 0

r: 25 c: 13 Curvature: 0 Corner: 0

r: 25 c: 14 Curvature: 0 Corner: 0

r: 25 c: 15 Curvature: 0 Corner: 0

r: 25 c: 16 Curvature: 0 Corner: 0

r: 25 c: 17 Curvature: 0 Corner: 0

r: 25 c: 18 Curvature: 0 Corner: 0

r: 25 c: 19 Curvature: 0 Corner: 0

r: 25 c: 20 Curvature: 0 Corner: 0

r: 25 c: 21 Curvature: 0 Corner: 0

r: 25 c: 22 Curvature: 0 Corner: 0

r: 25 c: 23 Curvature: 0 Corner: 0

r: 25 c: 24 Curvature: 0 Corner: 0

r: 25 c: 25 Curvature: 0 Corner: 0

r: 25 c: 26 Curvature: 0 Corner: 0

r: 25 c: 27 Curvature: 0 Corner: 0

r: 25 c: 28 Curvature: 0 Corner: 0

r: 25 c: 29 Curvature: 0 Corner: 0

r: 25 c: 30 Curvature: 0 Corner: 0

r: 25 c: 31 Curvature: 0 Corner: 0

r: 25 c: 32 Curvature: 0 Corner: 0

r: 25 c: 33 Curvature: 0 Corner: 0

r: 25 c: 34 Curvature: 0 Corner: 0

r: 25 c: 35 Curvature: 0 Corner: 0

r: 24 c: 35 Curvature: 0 Corner: 0

r: 23 c: 35 Curvature: 0 Corner: 0

r: 22 c: 35 Curvature: 0 Corner: 0

r: 21 c: 35 Curvature: 0 Corner: 0

r: 20 c: 35 Curvature: 0 Corner: 0

r: 19 c: 35 Curvature: 0 Corner: 0

r: 18 c: 35 Curvature: 0 Corner: 0

r: 17 c: 35 Curvature: 0 Corner: 0

r: 16 c: 35 Curvature: 0 Corner: 0

r: 15 c: 35 Curvature: 0 Corner: 0

r: 14 c: 35 Curvature: 0 Corner: 0

r: 13 c: 35 Curvature: 0 Corner: 0

r: 12 c: 35 Curvature: 0 Corner: 0

r: 11 c: 35 Curvature: 0 Corner: 0

r: 10 c: 35 Curvature: 0 Corner: 0

r: 9 c: 35 Curvature: 0 Corner: 0

r: 8 c: 35 Curvature: 0 Corner: 0

r: 7 c: 35 Curvature: 0 Corner: 0

r: 6 c: 35 Curvature: 0 Corner: 0

r: 6 c: 34 Curvature: 0 Corner: 0

r: 6 c: 33 Curvature: 0 Corner: 0

r: 6 c: 32 Curvature: 0 Corner: 0

r: 6 c: 31 Curvature: 0 Corner: 0

r: 6 c: 30 Curvature: 0 Corner: 0

r: 6 c: 29 Curvature: 0 Corner: 0

r: 6 c: 28 Curvature: 0 Corner: 0

r: 6 c: 27 Curvature: 0 Corner: 0

r: 6 c: 26 Curvature: 0 Corner: 0

r: 6 c: 25 Curvature: 0 Corner: 0

r: 6 c: 24 Curvature: 0 Corner: 0

r: 6 c: 23 Curvature: 0 Corner: 0

r: 6 c: 22 Curvature: 0 Corner: 0

r: 6 c: 21 Curvature: 0 Corner: 0

r: 6 c: 20 Curvature: 0 Corner: 0

r: 6 c: 19 Curvature: 0 Corner: 0

r: 6 c: 18 Curvature: 0 Corner: 0

r: 6 c: 17 Curvature: 0 Corner: 0

r: 6 c: 16 Curvature: 0 Corner: 0

r: 6 c: 15 Curvature: 0 Corner: 0

r: 6 c: 14 Curvature: 0 Corner: 0

r: 6 c: 13 Curvature: 0 Corner: 0

r: 6 c: 12 Curvature: 0 Corner: 0

r: 6 c: 11 Curvature: 0 Corner: 0

r: 6 c: 10 Curvature: 0 Corner: 0

r: 6 c: 9 Curvature: 0 Corner: 0

r: 6 c: 8 Curvature: 0 Corner: 0

r: 6 c: 7 Curvature: 0 Corner: 0

After applying k curvature corner detection algorithm:

r: 6 c: 6 Curvature: -10 Corner: 0

r: 7 c: 6 Curvature: 0 Corner: 0

r: 8 c: 6 Curvature: 0 Corner: 0

r: 9 c: 6 Curvature: 0 Corner: 0

r: 10 c: 6 Curvature: 0 Corner: 0

r: 11 c: 6 Curvature: 0 Corner: 0

r: 12 c: 6 Curvature: 0 Corner: 0

r: 13 c: 6 Curvature: 0 Corner: 0

r: 14 c: 6 Curvature: 0 Corner: 0

r: 15 c: 6 Curvature: 0 Corner: 0

r: 16 c: 6 Curvature: 0 Corner: 0

r: 17 c: 6 Curvature: 0 Corner: 0

r: 18 c: 6 Curvature: 0 Corner: 0

r: 19 c: 6 Curvature: 0 Corner: 0

r: 20 c: 6 Curvature: 0 Corner: 0

r: 21 c: 6 Curvature: 0 Corner: 0

r: 22 c: 6 Curvature: 0 Corner: 0

r: 23 c: 6 Curvature: 0 Corner: 0

r: 24 c: 6 Curvature: 0 Corner: 0

r: 25 c: 6 Curvature: 10 Corner: 0

r: 25 c: 7 Curvature: 20 Corner: 0

r: 25 c: 8 Curvature: 20 Corner: 0

r: 25 c: 9 Curvature: 20 Corner: 0

r: 25 c: 10 Curvature: 20 Corner: 0

r: 25 c: 11 Curvature: 20 Corner: 0

r: 25 c: 12 Curvature: 20 Corner: 0

r: 25 c: 13 Curvature: 20 Corner: 0

r: 25 c: 14 Curvature: 20 Corner: 0

r: 25 c: 15 Curvature: 20 Corner: 0

r: 25 c: 16 Curvature: 20 Corner: 0

r: 25 c: 17 Curvature: 20 Corner: 0

r: 25 c: 18 Curvature: 20 Corner: 0

r: 25 c: 19 Curvature: 20 Corner: 0

r: 25 c: 20 Curvature: 20 Corner: 0

r: 25 c: 21 Curvature: 20 Corner: 0

r: 25 c: 22 Curvature: 20 Corner: 0

r: 25 c: 23 Curvature: 20 Corner: 0

r: 25 c: 24 Curvature: 20 Corner: 0

r: 25 c: 25 Curvature: 20 Corner: 0

r: 25 c: 26 Curvature: 20 Corner: 0

r: 25 c: 27 Curvature: 20 Corner: 0

r: 25 c: 28 Curvature: 20 Corner: 0

r: 25 c: 29 Curvature: 20 Corner: 0

r: 25 c: 30 Curvature: 20 Corner: 0

r: 25 c: 31 Curvature: 20 Corner: 0

r: 25 c: 32 Curvature: 20 Corner: 0

r: 25 c: 33 Curvature: 20 Corner: 0

r: 25 c: 34 Curvature: 20 Corner: 0

r: 25 c: 35 Curvature: 10 Corner: 0

r: 24 c: 35 Curvature: 0 Corner: 0

r: 23 c: 35 Curvature: 0 Corner: 0

r: 22 c: 35 Curvature: 0 Corner: 0

r: 21 c: 35 Curvature: 0 Corner: 0

r: 20 c: 35 Curvature: 0 Corner: 0

r: 19 c: 35 Curvature: 0 Corner: 0

r: 18 c: 35 Curvature: 0 Corner: 0

r: 17 c: 35 Curvature: 0 Corner: 0

r: 16 c: 35 Curvature: 0 Corner: 0

r: 15 c: 35 Curvature: 0 Corner: 0

r: 14 c: 35 Curvature: 0 Corner: 0

r: 13 c: 35 Curvature: 0 Corner: 0

r: 12 c: 35 Curvature: 0 Corner: 0

r: 11 c: 35 Curvature: 0 Corner: 0

r: 10 c: 35 Curvature: 0 Corner: 0

r: 9 c: 35 Curvature: 0 Corner: 0

r: 8 c: 35 Curvature: 0 Corner: 0

r: 7 c: 35 Curvature: 0 Corner: 0

r: 6 c: 35 Curvature: -10 Corner: 0

r: 6 c: 34 Curvature: -20 Corner: 0

r: 6 c: 33 Curvature: -20 Corner: 0

r: 6 c: 32 Curvature: -20 Corner: 0

r: 6 c: 31 Curvature: -20 Corner: 0

r: 6 c: 30 Curvature: -20 Corner: 0

r: 6 c: 29 Curvature: -20 Corner: 0

r: 6 c: 28 Curvature: -20 Corner: 0

r: 6 c: 27 Curvature: -20 Corner: 0

r: 6 c: 26 Curvature: -20 Corner: 0

r: 6 c: 25 Curvature: -20 Corner: 0

r: 6 c: 24 Curvature: -20 Corner: 0

r: 6 c: 23 Curvature: -20 Corner: 0

r: 6 c: 22 Curvature: -20 Corner: 0

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r: 6 c: 15 Curvature: -20 Corner: 0

r: 6 c: 14 Curvature: -20 Corner: 0

r: 6 c: 13 Curvature: -20 Corner: 0

r: 6 c: 12 Curvature: -20 Corner: 0

r: 6 c: 11 Curvature: -20 Corner: 0

r: 6 c: 10 Curvature: -20 Corner: 0

r: 6 c: 9 Curvature: -20 Corner: 0

r: 6 c: 8 Curvature: -20 Corner: 0

r: 6 c: 7 Curvature: -20 Corner: 0

After marking corners:

r: 6 c: 6 Curvature: -10 Corner: 9

r: 7 c: 6 Curvature: 0 Corner: 1

r: 8 c: 6 Curvature: 0 Corner: 1

r: 9 c: 6 Curvature: 0 Corner: 1

r: 10 c: 6 Curvature: 0 Corner: 1

r: 11 c: 6 Curvature: 0 Corner: 1

r: 12 c: 6 Curvature: 0 Corner: 1

r: 13 c: 6 Curvature: 0 Corner: 1

r: 14 c: 6 Curvature: 0 Corner: 1

r: 15 c: 6 Curvature: 0 Corner: 1

r: 16 c: 6 Curvature: 0 Corner: 1

r: 17 c: 6 Curvature: 0 Corner: 1

r: 18 c: 6 Curvature: 0 Corner: 1

r: 19 c: 6 Curvature: 0 Corner: 1

r: 20 c: 6 Curvature: 0 Corner: 1

r: 21 c: 6 Curvature: 0 Corner: 1

r: 22 c: 6 Curvature: 0 Corner: 1

r: 23 c: 6 Curvature: 0 Corner: 1

r: 24 c: 6 Curvature: 0 Corner: 1

r: 25 c: 6 Curvature: 10 Corner: 9

r: 25 c: 7 Curvature: 20 Corner: 1

r: 25 c: 8 Curvature: 20 Corner: 1

r: 25 c: 9 Curvature: 20 Corner: 1

r: 25 c: 10 Curvature: 20 Corner: 1

r: 25 c: 11 Curvature: 20 Corner: 1

r: 25 c: 12 Curvature: 20 Corner: 1

r: 25 c: 13 Curvature: 20 Corner: 1

r: 25 c: 14 Curvature: 20 Corner: 1

r: 25 c: 15 Curvature: 20 Corner: 1

r: 25 c: 16 Curvature: 20 Corner: 1

r: 25 c: 17 Curvature: 20 Corner: 1

r: 25 c: 18 Curvature: 20 Corner: 1

r: 25 c: 19 Curvature: 20 Corner: 1

r: 25 c: 20 Curvature: 20 Corner: 1

r: 25 c: 21 Curvature: 20 Corner: 1

r: 25 c: 22 Curvature: 20 Corner: 1

r: 25 c: 23 Curvature: 20 Corner: 1

r: 25 c: 24 Curvature: 20 Corner: 1

r: 25 c: 25 Curvature: 20 Corner: 1

r: 25 c: 26 Curvature: 20 Corner: 1

r: 25 c: 27 Curvature: 20 Corner: 1

r: 25 c: 28 Curvature: 20 Corner: 1

r: 25 c: 29 Curvature: 20 Corner: 1

r: 25 c: 30 Curvature: 20 Corner: 1

r: 25 c: 31 Curvature: 20 Corner: 1

r: 25 c: 32 Curvature: 20 Corner: 1

r: 25 c: 33 Curvature: 20 Corner: 1

r: 25 c: 34 Curvature: 20 Corner: 1

r: 25 c: 35 Curvature: 10 Corner: 9

r: 24 c: 35 Curvature: 0 Corner: 1

r: 23 c: 35 Curvature: 0 Corner: 1

r: 22 c: 35 Curvature: 0 Corner: 1

r: 21 c: 35 Curvature: 0 Corner: 1

r: 20 c: 35 Curvature: 0 Corner: 1

r: 19 c: 35 Curvature: 0 Corner: 1

r: 18 c: 35 Curvature: 0 Corner: 1

r: 17 c: 35 Curvature: 0 Corner: 1

r: 16 c: 35 Curvature: 0 Corner: 1

r: 15 c: 35 Curvature: 0 Corner: 1

r: 14 c: 35 Curvature: 0 Corner: 1

r: 13 c: 35 Curvature: 0 Corner: 1

r: 12 c: 35 Curvature: 0 Corner: 1

r: 11 c: 35 Curvature: 0 Corner: 1

r: 10 c: 35 Curvature: 0 Corner: 1

r: 9 c: 35 Curvature: 0 Corner: 1

r: 8 c: 35 Curvature: 0 Corner: 1

r: 7 c: 35 Curvature: 0 Corner: 1

r: 6 c: 35 Curvature: -10 Corner: 9

r: 6 c: 34 Curvature: -20 Corner: 1

r: 6 c: 33 Curvature: -20 Corner: 1

r: 6 c: 32 Curvature: -20 Corner: 1

r: 6 c: 31 Curvature: -20 Corner: 1

r: 6 c: 30 Curvature: -20 Corner: 1

r: 6 c: 29 Curvature: -20 Corner: 1

r: 6 c: 28 Curvature: -20 Corner: 1

r: 6 c: 27 Curvature: -20 Corner: 1

r: 6 c: 26 Curvature: -20 Corner: 1

r: 6 c: 25 Curvature: -20 Corner: 1

r: 6 c: 24 Curvature: -20 Corner: 1

r: 6 c: 23 Curvature: -20 Corner: 1

r: 6 c: 22 Curvature: -20 Corner: 1

r: 6 c: 21 Curvature: -20 Corner: 1

r: 6 c: 20 Curvature: -20 Corner: 1

r: 6 c: 19 Curvature: -20 Corner: 1

r: 6 c: 18 Curvature: -20 Corner: 1

r: 6 c: 17 Curvature: -20 Corner: 1

r: 6 c: 16 Curvature: -20 Corner: 1

r: 6 c: 15 Curvature: -20 Corner: 1

r: 6 c: 14 Curvature: -20 Corner: 1

r: 6 c: 13 Curvature: -20 Corner: 1

r: 6 c: 12 Curvature: -20 Corner: 1

r: 6 c: 11 Curvature: -20 Corner: 1

r: 6 c: 10 Curvature: -20 Corner: 1

r: 6 c: 9 Curvature: -20 Corner: 1

r: 6 c: 8 Curvature: -20 Corner: 1

r: 6 c: 7 Curvature: -20 Corner: 1

**Data\_B:**

Result of K-Curvature of the object boundary points

31 41 0 1

1

56

1 20 9

2 19 1

3 18 1

4 17 1

5 16 1

6 15 1

7 14 1

8 13 1

9 12 1

10 11 1

11 10 1

12 9 1

13 8 1

14 7 1

15 6 9

16 7 1

17 8 1

18 9 1

19 10 1

20 11 1

21 12 1

22 13 1

23 14 1

24 15 1

25 16 1

26 17 1

27 18 1

28 19 1

29 20 9

28 21 1

27 22 1

26 23 1

25 24 1

24 25 1

23 26 1

22 27 1

21 28 1

20 29 1

19 30 1

18 31 1

17 32 1

16 33 1

15 34 9

14 33 1

13 32 1

12 31 1

11 30 1

10 29 1

9 28 1

8 27 1

7 26 1

6 25 1

5 24 1

4 23 1

3 22 1

2 21 1

Pretty Print of the K-curvature corner detection

31 41 0 9

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. . . . . . . . . . . . . . . . . . . . 9 . . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . 1 . 1 . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . 1 . . . 1 . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . 1 . . . . . 1 . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . 1 . . . . . . . 1 . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . 1 . . . . . . . . . 1 . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . 1 . . . . . . . . . . . 1 . . . . . . . . . . . . . .

. . . . . . . . . . . . . 1 . . . . . . . . . . . . . 1 . . . . . . . . . . . . .

. . . . . . . . . . . . 1 . . . . . . . . . . . . . . . 1 . . . . . . . . . . . .

. . . . . . . . . . . 1 . . . . . . . . . . . . . . . . . 1 . . . . . . . . . . .

. . . . . . . . . . 1 . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . .

. . . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . .

. . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . .

. . . . . . 9 . . . . . . . . . . . . . . . . . . . . . . . . . . . 9 . . . . . .

. . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . .

. . . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . .

. . . . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . .

. . . . . . . . . . 1 . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . . . . . . . 1 . . . . . . . . . . . . . . . . . 1 . . . . . . . . . . .

. . . . . . . . . . . . 1 . . . . . . . . . . . . . . . 1 . . . . . . . . . . . .

. . . . . . . . . . . . . 1 . . . . . . . . . . . . . 1 . . . . . . . . . . . . .

. . . . . . . . . . . . . . 1 . . . . . . . . . . . 1 . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . 1 . . . . . . . . . 1 . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . 1 . . . . . . . 1 . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . 1 . . . . . 1 . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . 1 . . . 1 . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . 1 . 1 . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . . 9 . . . . . . . . . . . . . . . . . . . .

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Debug File

Before applying k curvature corner detection algorithm:

r: 1 c: 20 Curvature: 0 Corner: 0

r: 2 c: 19 Curvature: 0 Corner: 0

r: 3 c: 18 Curvature: 0 Corner: 0

r: 4 c: 17 Curvature: 0 Corner: 0

r: 5 c: 16 Curvature: 0 Corner: 0

r: 6 c: 15 Curvature: 0 Corner: 0

r: 7 c: 14 Curvature: 0 Corner: 0

r: 8 c: 13 Curvature: 0 Corner: 0

r: 9 c: 12 Curvature: 0 Corner: 0

r: 10 c: 11 Curvature: 0 Corner: 0

r: 11 c: 10 Curvature: 0 Corner: 0

r: 12 c: 9 Curvature: 0 Corner: 0

r: 13 c: 8 Curvature: 0 Corner: 0

r: 14 c: 7 Curvature: 0 Corner: 0

r: 15 c: 6 Curvature: 0 Corner: 0

r: 16 c: 7 Curvature: 0 Corner: 0

r: 17 c: 8 Curvature: 0 Corner: 0

r: 18 c: 9 Curvature: 0 Corner: 0

r: 19 c: 10 Curvature: 0 Corner: 0

r: 20 c: 11 Curvature: 0 Corner: 0

r: 21 c: 12 Curvature: 0 Corner: 0

r: 22 c: 13 Curvature: 0 Corner: 0

r: 23 c: 14 Curvature: 0 Corner: 0

r: 24 c: 15 Curvature: 0 Corner: 0

r: 25 c: 16 Curvature: 0 Corner: 0

r: 26 c: 17 Curvature: 0 Corner: 0

r: 27 c: 18 Curvature: 0 Corner: 0

r: 28 c: 19 Curvature: 0 Corner: 0

r: 29 c: 20 Curvature: 0 Corner: 0

r: 28 c: 21 Curvature: 0 Corner: 0

r: 27 c: 22 Curvature: 0 Corner: 0

r: 26 c: 23 Curvature: 0 Corner: 0

r: 25 c: 24 Curvature: 0 Corner: 0

r: 24 c: 25 Curvature: 0 Corner: 0

r: 23 c: 26 Curvature: 0 Corner: 0

r: 22 c: 27 Curvature: 0 Corner: 0

r: 21 c: 28 Curvature: 0 Corner: 0

r: 20 c: 29 Curvature: 0 Corner: 0

r: 19 c: 30 Curvature: 0 Corner: 0

r: 18 c: 31 Curvature: 0 Corner: 0

r: 17 c: 32 Curvature: 0 Corner: 0

r: 16 c: 33 Curvature: 0 Corner: 0

r: 15 c: 34 Curvature: 0 Corner: 0

r: 14 c: 33 Curvature: 0 Corner: 0

r: 13 c: 32 Curvature: 0 Corner: 0

r: 12 c: 31 Curvature: 0 Corner: 0

r: 11 c: 30 Curvature: 0 Corner: 0

r: 10 c: 29 Curvature: 0 Corner: 0

r: 9 c: 28 Curvature: 0 Corner: 0

r: 8 c: 27 Curvature: 0 Corner: 0

r: 7 c: 26 Curvature: 0 Corner: 0

r: 6 c: 25 Curvature: 0 Corner: 0

r: 5 c: 24 Curvature: 0 Corner: 0

r: 4 c: 23 Curvature: 0 Corner: 0

r: 3 c: 22 Curvature: 0 Corner: 0

r: 2 c: 21 Curvature: 0 Corner: 0

After applying k curvature corner detection algorithm:

r: 1 c: 20 Curvature: 2 Corner: 0

r: 2 c: 19 Curvature: 0 Corner: 0

r: 3 c: 18 Curvature: 0 Corner: 0

r: 4 c: 17 Curvature: 0 Corner: 0

r: 5 c: 16 Curvature: 0 Corner: 0

r: 6 c: 15 Curvature: 0 Corner: 0

r: 7 c: 14 Curvature: 0 Corner: 0

r: 8 c: 13 Curvature: 0 Corner: 0

r: 9 c: 12 Curvature: 0 Corner: 0

r: 10 c: 11 Curvature: 0 Corner: 0

r: 11 c: 10 Curvature: 0 Corner: 0

r: 12 c: 9 Curvature: 0 Corner: 0

r: 13 c: 8 Curvature: 0 Corner: 0

r: 14 c: 7 Curvature: 0 Corner: 0

r: 15 c: 6 Curvature: -2 Corner: 0

r: 16 c: 7 Curvature: 0 Corner: 0

r: 17 c: 8 Curvature: 0 Corner: 0

r: 18 c: 9 Curvature: 0 Corner: 0

r: 19 c: 10 Curvature: 0 Corner: 0

r: 20 c: 11 Curvature: 0 Corner: 0

r: 21 c: 12 Curvature: 0 Corner: 0

r: 22 c: 13 Curvature: 0 Corner: 0

r: 23 c: 14 Curvature: 0 Corner: 0

r: 24 c: 15 Curvature: 0 Corner: 0

r: 25 c: 16 Curvature: 0 Corner: 0

r: 26 c: 17 Curvature: 0 Corner: 0

r: 27 c: 18 Curvature: 0 Corner: 0

r: 28 c: 19 Curvature: 0 Corner: 0

r: 29 c: 20 Curvature: 2 Corner: 0

r: 28 c: 21 Curvature: 0 Corner: 0

r: 27 c: 22 Curvature: 0 Corner: 0

r: 26 c: 23 Curvature: 0 Corner: 0

r: 25 c: 24 Curvature: 0 Corner: 0

r: 24 c: 25 Curvature: 0 Corner: 0

r: 23 c: 26 Curvature: 0 Corner: 0

r: 22 c: 27 Curvature: 0 Corner: 0

r: 21 c: 28 Curvature: 0 Corner: 0

r: 20 c: 29 Curvature: 0 Corner: 0

r: 19 c: 30 Curvature: 0 Corner: 0

r: 18 c: 31 Curvature: 0 Corner: 0

r: 17 c: 32 Curvature: 0 Corner: 0

r: 16 c: 33 Curvature: 0 Corner: 0

r: 15 c: 34 Curvature: -2 Corner: 0

r: 14 c: 33 Curvature: 0 Corner: 0

r: 13 c: 32 Curvature: 0 Corner: 0

r: 12 c: 31 Curvature: 0 Corner: 0

r: 11 c: 30 Curvature: 0 Corner: 0

r: 10 c: 29 Curvature: 0 Corner: 0

r: 9 c: 28 Curvature: 0 Corner: 0

r: 8 c: 27 Curvature: 0 Corner: 0

r: 7 c: 26 Curvature: 0 Corner: 0

r: 6 c: 25 Curvature: 0 Corner: 0

r: 5 c: 24 Curvature: 0 Corner: 0

r: 4 c: 23 Curvature: 0 Corner: 0

r: 3 c: 22 Curvature: 0 Corner: 0

r: 2 c: 21 Curvature: 0 Corner: 0

After marking corners:

r: 1 c: 20 Curvature: 2 Corner: 9

r: 2 c: 19 Curvature: 0 Corner: 1

r: 3 c: 18 Curvature: 0 Corner: 1

r: 4 c: 17 Curvature: 0 Corner: 1

r: 5 c: 16 Curvature: 0 Corner: 1

r: 6 c: 15 Curvature: 0 Corner: 1

r: 7 c: 14 Curvature: 0 Corner: 1

r: 8 c: 13 Curvature: 0 Corner: 1

r: 9 c: 12 Curvature: 0 Corner: 1

r: 10 c: 11 Curvature: 0 Corner: 1

r: 11 c: 10 Curvature: 0 Corner: 1

r: 12 c: 9 Curvature: 0 Corner: 1

r: 13 c: 8 Curvature: 0 Corner: 1

r: 14 c: 7 Curvature: 0 Corner: 1

r: 15 c: 6 Curvature: -2 Corner: 9

r: 16 c: 7 Curvature: 0 Corner: 1

r: 17 c: 8 Curvature: 0 Corner: 1

r: 18 c: 9 Curvature: 0 Corner: 1

r: 19 c: 10 Curvature: 0 Corner: 1

r: 20 c: 11 Curvature: 0 Corner: 1

r: 21 c: 12 Curvature: 0 Corner: 1

r: 22 c: 13 Curvature: 0 Corner: 1

r: 23 c: 14 Curvature: 0 Corner: 1

r: 24 c: 15 Curvature: 0 Corner: 1

r: 25 c: 16 Curvature: 0 Corner: 1

r: 26 c: 17 Curvature: 0 Corner: 1

r: 27 c: 18 Curvature: 0 Corner: 1

r: 28 c: 19 Curvature: 0 Corner: 1

r: 29 c: 20 Curvature: 2 Corner: 9

r: 28 c: 21 Curvature: 0 Corner: 1

r: 27 c: 22 Curvature: 0 Corner: 1

r: 26 c: 23 Curvature: 0 Corner: 1

r: 25 c: 24 Curvature: 0 Corner: 1

r: 24 c: 25 Curvature: 0 Corner: 1

r: 23 c: 26 Curvature: 0 Corner: 1

r: 22 c: 27 Curvature: 0 Corner: 1

r: 21 c: 28 Curvature: 0 Corner: 1

r: 20 c: 29 Curvature: 0 Corner: 1

r: 19 c: 30 Curvature: 0 Corner: 1

r: 18 c: 31 Curvature: 0 Corner: 1

r: 17 c: 32 Curvature: 0 Corner: 1

r: 16 c: 33 Curvature: 0 Corner: 1

r: 15 c: 34 Curvature: -2 Corner: 9

r: 14 c: 33 Curvature: 0 Corner: 1

r: 13 c: 32 Curvature: 0 Corner: 1

r: 12 c: 31 Curvature: 0 Corner: 1

r: 11 c: 30 Curvature: 0 Corner: 1

r: 10 c: 29 Curvature: 0 Corner: 1

r: 9 c: 28 Curvature: 0 Corner: 1

r: 8 c: 27 Curvature: 0 Corner: 1

r: 7 c: 26 Curvature: 0 Corner: 1

r: 6 c: 25 Curvature: 0 Corner: 1

r: 5 c: 24 Curvature: 0 Corner: 1

r: 4 c: 23 Curvature: 0 Corner: 1

r: 3 c: 22 Curvature: 0 Corner: 1

r: 2 c: 21 Curvature: 0 Corner: 1

**Data\_C:**

Result of K-Curvature of the object boundary points

40 40 0 1

1

108

5 5 9

6 5 1

7 5 1

8 5 1

9 5 1

10 5 1

11 5 1

12 5 1

13 5 1

14 5 1

15 5 9

16 6 1

17 7 1

18 8 1

19 9 1

20 10 9

21 9 1

22 8 1

23 7 1

24 6 1

25 5 9

26 5 1

27 5 1

28 5 1

29 5 1

30 5 1

31 5 1

32 5 1

33 5 1

34 5 1

35 5 9

35 6 1

35 7 1

35 8 1

35 9 1

35 10 1

35 11 1

35 12 1

35 13 1

35 14 1

35 15 1

35 16 1

35 17 1

35 18 1

35 19 1

35 20 1

35 21 1

35 22 1

35 23 1

35 24 1

35 25 1

35 26 1

35 27 1

35 28 1

35 29 9

34 29 1

33 29 1

32 29 1

31 29 1

30 29 1

29 29 1

28 29 1

27 29 1

26 29 1

25 29 9

24 30 1

23 31 1

22 32 1

21 33 1

20 34 9

19 33 1

18 32 1

17 31 1

16 30 1

15 29 9

14 29 1

13 29 1

12 29 1

11 29 1

10 29 1

9 29 1

8 29 1

7 29 1

6 29 1

5 29 9

5 28 1

5 27 1

5 26 1

5 25 1

5 24 1

5 23 1

5 22 1

5 21 1

5 20 1

5 19 1

5 18 1

5 17 1

5 16 1

5 15 1

5 14 1

5 13 1

5 12 1

5 11 1

5 10 1

5 9 1

5 8 1

5 7 1

5 6 1

Pretty Print of the K-curvature corner detection

40 40 0 9

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

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. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

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. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . 9 . . . . . . . . . . . . . . . . . . . . . . . 9 . . . . . . . . . .

. . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . .

. . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . .

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. . . . . . . . . . 9 . . . . . . . . . . . . . . . . . . . . . . . 9 . . . . .

. . . . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . .

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. . . . . 9 . . . . . . . . . . . . . . . . . . . . . . . 9 . . . . . . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

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. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

Debug File

Before applying k curvature corner detection algorithm:

r: 5 c: 5 Curvature: 0 Corner: 0

r: 6 c: 5 Curvature: 0 Corner: 0

r: 7 c: 5 Curvature: 0 Corner: 0

r: 8 c: 5 Curvature: 0 Corner: 0

r: 9 c: 5 Curvature: 0 Corner: 0

r: 10 c: 5 Curvature: 0 Corner: 0

r: 11 c: 5 Curvature: 0 Corner: 0

r: 12 c: 5 Curvature: 0 Corner: 0

r: 13 c: 5 Curvature: 0 Corner: 0

r: 14 c: 5 Curvature: 0 Corner: 0

r: 15 c: 5 Curvature: 0 Corner: 0

r: 16 c: 6 Curvature: 0 Corner: 0

r: 17 c: 7 Curvature: 0 Corner: 0

r: 18 c: 8 Curvature: 0 Corner: 0

r: 19 c: 9 Curvature: 0 Corner: 0

r: 20 c: 10 Curvature: 0 Corner: 0

r: 21 c: 9 Curvature: 0 Corner: 0

r: 22 c: 8 Curvature: 0 Corner: 0

r: 23 c: 7 Curvature: 0 Corner: 0

r: 24 c: 6 Curvature: 0 Corner: 0

r: 25 c: 5 Curvature: 0 Corner: 0

r: 26 c: 5 Curvature: 0 Corner: 0

r: 27 c: 5 Curvature: 0 Corner: 0

r: 28 c: 5 Curvature: 0 Corner: 0

r: 29 c: 5 Curvature: 0 Corner: 0

r: 30 c: 5 Curvature: 0 Corner: 0

r: 31 c: 5 Curvature: 0 Corner: 0

r: 32 c: 5 Curvature: 0 Corner: 0

r: 33 c: 5 Curvature: 0 Corner: 0

r: 34 c: 5 Curvature: 0 Corner: 0

r: 35 c: 5 Curvature: 0 Corner: 0

r: 35 c: 6 Curvature: 0 Corner: 0

r: 35 c: 7 Curvature: 0 Corner: 0

r: 35 c: 8 Curvature: 0 Corner: 0

r: 35 c: 9 Curvature: 0 Corner: 0

r: 35 c: 10 Curvature: 0 Corner: 0

r: 35 c: 11 Curvature: 0 Corner: 0

r: 35 c: 12 Curvature: 0 Corner: 0

r: 35 c: 13 Curvature: 0 Corner: 0

r: 35 c: 14 Curvature: 0 Corner: 0

r: 35 c: 15 Curvature: 0 Corner: 0

r: 35 c: 16 Curvature: 0 Corner: 0

r: 35 c: 17 Curvature: 0 Corner: 0

r: 35 c: 18 Curvature: 0 Corner: 0

r: 35 c: 19 Curvature: 0 Corner: 0

r: 35 c: 20 Curvature: 0 Corner: 0

r: 35 c: 21 Curvature: 0 Corner: 0

r: 35 c: 22 Curvature: 0 Corner: 0

r: 35 c: 23 Curvature: 0 Corner: 0

r: 35 c: 24 Curvature: 0 Corner: 0

r: 35 c: 25 Curvature: 0 Corner: 0

r: 35 c: 26 Curvature: 0 Corner: 0

r: 35 c: 27 Curvature: 0 Corner: 0

r: 35 c: 28 Curvature: 0 Corner: 0

r: 35 c: 29 Curvature: 0 Corner: 0

r: 34 c: 29 Curvature: 0 Corner: 0

r: 33 c: 29 Curvature: 0 Corner: 0

r: 32 c: 29 Curvature: 0 Corner: 0

r: 31 c: 29 Curvature: 0 Corner: 0

r: 30 c: 29 Curvature: 0 Corner: 0

r: 29 c: 29 Curvature: 0 Corner: 0

r: 28 c: 29 Curvature: 0 Corner: 0

r: 27 c: 29 Curvature: 0 Corner: 0

r: 26 c: 29 Curvature: 0 Corner: 0

r: 25 c: 29 Curvature: 0 Corner: 0

r: 24 c: 30 Curvature: 0 Corner: 0

r: 23 c: 31 Curvature: 0 Corner: 0

r: 22 c: 32 Curvature: 0 Corner: 0

r: 21 c: 33 Curvature: 0 Corner: 0

r: 20 c: 34 Curvature: 0 Corner: 0

r: 19 c: 33 Curvature: 0 Corner: 0

r: 18 c: 32 Curvature: 0 Corner: 0

r: 17 c: 31 Curvature: 0 Corner: 0

r: 16 c: 30 Curvature: 0 Corner: 0

r: 15 c: 29 Curvature: 0 Corner: 0

r: 14 c: 29 Curvature: 0 Corner: 0

r: 13 c: 29 Curvature: 0 Corner: 0

r: 12 c: 29 Curvature: 0 Corner: 0

r: 11 c: 29 Curvature: 0 Corner: 0

r: 10 c: 29 Curvature: 0 Corner: 0

r: 9 c: 29 Curvature: 0 Corner: 0

r: 8 c: 29 Curvature: 0 Corner: 0

r: 7 c: 29 Curvature: 0 Corner: 0

r: 6 c: 29 Curvature: 0 Corner: 0

r: 5 c: 29 Curvature: 0 Corner: 0

r: 5 c: 28 Curvature: 0 Corner: 0

r: 5 c: 27 Curvature: 0 Corner: 0

r: 5 c: 26 Curvature: 0 Corner: 0

r: 5 c: 25 Curvature: 0 Corner: 0

r: 5 c: 24 Curvature: 0 Corner: 0

r: 5 c: 23 Curvature: 0 Corner: 0

r: 5 c: 22 Curvature: 0 Corner: 0

r: 5 c: 21 Curvature: 0 Corner: 0

r: 5 c: 20 Curvature: 0 Corner: 0

r: 5 c: 19 Curvature: 0 Corner: 0

r: 5 c: 18 Curvature: 0 Corner: 0

r: 5 c: 17 Curvature: 0 Corner: 0

r: 5 c: 16 Curvature: 0 Corner: 0

r: 5 c: 15 Curvature: 0 Corner: 0

r: 5 c: 14 Curvature: 0 Corner: 0

r: 5 c: 13 Curvature: 0 Corner: 0

r: 5 c: 12 Curvature: 0 Corner: 0

r: 5 c: 11 Curvature: 0 Corner: 0

r: 5 c: 10 Curvature: 0 Corner: 0

r: 5 c: 9 Curvature: 0 Corner: 0

r: 5 c: 8 Curvature: 0 Corner: 0

r: 5 c: 7 Curvature: 0 Corner: 0

r: 5 c: 6 Curvature: 0 Corner: 0

After applying k curvature corner detection algorithm:

r: 5 c: 5 Curvature: -10 Corner: 0

r: 6 c: 5 Curvature: 0 Corner: 0

r: 7 c: 5 Curvature: 0 Corner: 0

r: 8 c: 5 Curvature: 0 Corner: 0

r: 9 c: 5 Curvature: 0 Corner: 0

r: 10 c: 5 Curvature: 0 Corner: 0

r: 11 c: 5 Curvature: 0 Corner: 0

r: 12 c: 5 Curvature: 0 Corner: 0

r: 13 c: 5 Curvature: 0 Corner: 0

r: 14 c: 5 Curvature: 0 Corner: 0

r: 15 c: 5 Curvature: -1 Corner: 0

r: 16 c: 6 Curvature: 0 Corner: 0

r: 17 c: 7 Curvature: 0 Corner: 0

r: 18 c: 8 Curvature: 0 Corner: 0

r: 19 c: 9 Curvature: 0 Corner: 0

r: 20 c: 10 Curvature: 2 Corner: 0

r: 21 c: 9 Curvature: 0 Corner: 0

r: 22 c: 8 Curvature: 0 Corner: 0

r: 23 c: 7 Curvature: 0 Corner: 0

r: 24 c: 6 Curvature: 0 Corner: 0

r: 25 c: 5 Curvature: -1 Corner: 0

r: 26 c: 5 Curvature: 0 Corner: 0

r: 27 c: 5 Curvature: 0 Corner: 0

r: 28 c: 5 Curvature: 0 Corner: 0

r: 29 c: 5 Curvature: 0 Corner: 0

r: 30 c: 5 Curvature: 0 Corner: 0

r: 31 c: 5 Curvature: 0 Corner: 0

r: 32 c: 5 Curvature: 0 Corner: 0

r: 33 c: 5 Curvature: 0 Corner: 0

r: 34 c: 5 Curvature: 0 Corner: 0

r: 35 c: 5 Curvature: 10 Corner: 0

r: 35 c: 6 Curvature: 20 Corner: 0

r: 35 c: 7 Curvature: 20 Corner: 0

r: 35 c: 8 Curvature: 20 Corner: 0

r: 35 c: 9 Curvature: 20 Corner: 0

r: 35 c: 10 Curvature: 20 Corner: 0

r: 35 c: 11 Curvature: 20 Corner: 0

r: 35 c: 12 Curvature: 20 Corner: 0

r: 35 c: 13 Curvature: 20 Corner: 0

r: 35 c: 14 Curvature: 20 Corner: 0

r: 35 c: 15 Curvature: 20 Corner: 0

r: 35 c: 16 Curvature: 20 Corner: 0

r: 35 c: 17 Curvature: 20 Corner: 0

r: 35 c: 18 Curvature: 20 Corner: 0

r: 35 c: 19 Curvature: 20 Corner: 0

r: 35 c: 20 Curvature: 20 Corner: 0

r: 35 c: 21 Curvature: 20 Corner: 0

r: 35 c: 22 Curvature: 20 Corner: 0

r: 35 c: 23 Curvature: 20 Corner: 0

r: 35 c: 24 Curvature: 20 Corner: 0

r: 35 c: 25 Curvature: 20 Corner: 0

r: 35 c: 26 Curvature: 20 Corner: 0

r: 35 c: 27 Curvature: 20 Corner: 0

r: 35 c: 28 Curvature: 20 Corner: 0

r: 35 c: 29 Curvature: 10 Corner: 0

r: 34 c: 29 Curvature: 0 Corner: 0

r: 33 c: 29 Curvature: 0 Corner: 0

r: 32 c: 29 Curvature: 0 Corner: 0

r: 31 c: 29 Curvature: 0 Corner: 0

r: 30 c: 29 Curvature: 0 Corner: 0

r: 29 c: 29 Curvature: 0 Corner: 0

r: 28 c: 29 Curvature: 0 Corner: 0

r: 27 c: 29 Curvature: 0 Corner: 0

r: 26 c: 29 Curvature: 0 Corner: 0

r: 25 c: 29 Curvature: 1 Corner: 0

r: 24 c: 30 Curvature: 0 Corner: 0

r: 23 c: 31 Curvature: 0 Corner: 0

r: 22 c: 32 Curvature: 0 Corner: 0

r: 21 c: 33 Curvature: 0 Corner: 0

r: 20 c: 34 Curvature: -2 Corner: 0

r: 19 c: 33 Curvature: 0 Corner: 0

r: 18 c: 32 Curvature: 0 Corner: 0

r: 17 c: 31 Curvature: 0 Corner: 0

r: 16 c: 30 Curvature: 0 Corner: 0

r: 15 c: 29 Curvature: 1 Corner: 0

r: 14 c: 29 Curvature: 0 Corner: 0

r: 13 c: 29 Curvature: 0 Corner: 0

r: 12 c: 29 Curvature: 0 Corner: 0

r: 11 c: 29 Curvature: 0 Corner: 0

r: 10 c: 29 Curvature: 0 Corner: 0

r: 9 c: 29 Curvature: 0 Corner: 0

r: 8 c: 29 Curvature: 0 Corner: 0

r: 7 c: 29 Curvature: 0 Corner: 0

r: 6 c: 29 Curvature: 0 Corner: 0

r: 5 c: 29 Curvature: -10 Corner: 0

r: 5 c: 28 Curvature: -20 Corner: 0

r: 5 c: 27 Curvature: -20 Corner: 0

r: 5 c: 26 Curvature: -20 Corner: 0

r: 5 c: 25 Curvature: -20 Corner: 0

r: 5 c: 24 Curvature: -20 Corner: 0

r: 5 c: 23 Curvature: -20 Corner: 0

r: 5 c: 22 Curvature: -20 Corner: 0

r: 5 c: 21 Curvature: -20 Corner: 0

r: 5 c: 20 Curvature: -20 Corner: 0

r: 5 c: 19 Curvature: -20 Corner: 0

r: 5 c: 18 Curvature: -20 Corner: 0

r: 5 c: 17 Curvature: -20 Corner: 0

r: 5 c: 16 Curvature: -20 Corner: 0

r: 5 c: 15 Curvature: -20 Corner: 0

r: 5 c: 14 Curvature: -20 Corner: 0

r: 5 c: 13 Curvature: -20 Corner: 0

r: 5 c: 12 Curvature: -20 Corner: 0

r: 5 c: 11 Curvature: -20 Corner: 0

r: 5 c: 10 Curvature: -20 Corner: 0

r: 5 c: 9 Curvature: -20 Corner: 0

r: 5 c: 8 Curvature: -20 Corner: 0

r: 5 c: 7 Curvature: -20 Corner: 0

r: 5 c: 6 Curvature: -20 Corner: 0

After marking corners:

r: 5 c: 5 Curvature: -10 Corner: 9

r: 6 c: 5 Curvature: 0 Corner: 1

r: 7 c: 5 Curvature: 0 Corner: 1

r: 8 c: 5 Curvature: 0 Corner: 1

r: 9 c: 5 Curvature: 0 Corner: 1

r: 10 c: 5 Curvature: 0 Corner: 1

r: 11 c: 5 Curvature: 0 Corner: 1

r: 12 c: 5 Curvature: 0 Corner: 1

r: 13 c: 5 Curvature: 0 Corner: 1

r: 14 c: 5 Curvature: 0 Corner: 1

r: 15 c: 5 Curvature: -1 Corner: 9

r: 16 c: 6 Curvature: 0 Corner: 1

r: 17 c: 7 Curvature: 0 Corner: 1

r: 18 c: 8 Curvature: 0 Corner: 1

r: 19 c: 9 Curvature: 0 Corner: 1

r: 20 c: 10 Curvature: 2 Corner: 9

r: 21 c: 9 Curvature: 0 Corner: 1

r: 22 c: 8 Curvature: 0 Corner: 1

r: 23 c: 7 Curvature: 0 Corner: 1

r: 24 c: 6 Curvature: 0 Corner: 1

r: 25 c: 5 Curvature: -1 Corner: 9

r: 26 c: 5 Curvature: 0 Corner: 1

r: 27 c: 5 Curvature: 0 Corner: 1

r: 28 c: 5 Curvature: 0 Corner: 1

r: 29 c: 5 Curvature: 0 Corner: 1

r: 30 c: 5 Curvature: 0 Corner: 1

r: 31 c: 5 Curvature: 0 Corner: 1

r: 32 c: 5 Curvature: 0 Corner: 1

r: 33 c: 5 Curvature: 0 Corner: 1

r: 34 c: 5 Curvature: 0 Corner: 1

r: 35 c: 5 Curvature: 10 Corner: 9

r: 35 c: 6 Curvature: 20 Corner: 1

r: 35 c: 7 Curvature: 20 Corner: 1

r: 35 c: 8 Curvature: 20 Corner: 1

r: 35 c: 9 Curvature: 20 Corner: 1

r: 35 c: 10 Curvature: 20 Corner: 1

r: 35 c: 11 Curvature: 20 Corner: 1

r: 35 c: 12 Curvature: 20 Corner: 1

r: 35 c: 13 Curvature: 20 Corner: 1

r: 35 c: 14 Curvature: 20 Corner: 1

r: 35 c: 15 Curvature: 20 Corner: 1

r: 35 c: 16 Curvature: 20 Corner: 1

r: 35 c: 17 Curvature: 20 Corner: 1

r: 35 c: 18 Curvature: 20 Corner: 1

r: 35 c: 19 Curvature: 20 Corner: 1

r: 35 c: 20 Curvature: 20 Corner: 1

r: 35 c: 21 Curvature: 20 Corner: 1

r: 35 c: 22 Curvature: 20 Corner: 1

r: 35 c: 23 Curvature: 20 Corner: 1

r: 35 c: 24 Curvature: 20 Corner: 1

r: 35 c: 25 Curvature: 20 Corner: 1

r: 35 c: 26 Curvature: 20 Corner: 1

r: 35 c: 27 Curvature: 20 Corner: 1

r: 35 c: 28 Curvature: 20 Corner: 1

r: 35 c: 29 Curvature: 10 Corner: 9

r: 34 c: 29 Curvature: 0 Corner: 1

r: 33 c: 29 Curvature: 0 Corner: 1

r: 32 c: 29 Curvature: 0 Corner: 1

r: 31 c: 29 Curvature: 0 Corner: 1

r: 30 c: 29 Curvature: 0 Corner: 1

r: 29 c: 29 Curvature: 0 Corner: 1

r: 28 c: 29 Curvature: 0 Corner: 1

r: 27 c: 29 Curvature: 0 Corner: 1

r: 26 c: 29 Curvature: 0 Corner: 1

r: 25 c: 29 Curvature: 1 Corner: 9

r: 24 c: 30 Curvature: 0 Corner: 1

r: 23 c: 31 Curvature: 0 Corner: 1

r: 22 c: 32 Curvature: 0 Corner: 1

r: 21 c: 33 Curvature: 0 Corner: 1

r: 20 c: 34 Curvature: -2 Corner: 9

r: 19 c: 33 Curvature: 0 Corner: 1

r: 18 c: 32 Curvature: 0 Corner: 1

r: 17 c: 31 Curvature: 0 Corner: 1

r: 16 c: 30 Curvature: 0 Corner: 1

r: 15 c: 29 Curvature: 1 Corner: 9

r: 14 c: 29 Curvature: 0 Corner: 1

r: 13 c: 29 Curvature: 0 Corner: 1

r: 12 c: 29 Curvature: 0 Corner: 1

r: 11 c: 29 Curvature: 0 Corner: 1

r: 10 c: 29 Curvature: 0 Corner: 1

r: 9 c: 29 Curvature: 0 Corner: 1

r: 8 c: 29 Curvature: 0 Corner: 1

r: 7 c: 29 Curvature: 0 Corner: 1

r: 6 c: 29 Curvature: 0 Corner: 1

r: 5 c: 29 Curvature: -10 Corner: 9

r: 5 c: 28 Curvature: -20 Corner: 1

r: 5 c: 27 Curvature: -20 Corner: 1

r: 5 c: 26 Curvature: -20 Corner: 1

r: 5 c: 25 Curvature: -20 Corner: 1

r: 5 c: 24 Curvature: -20 Corner: 1

r: 5 c: 23 Curvature: -20 Corner: 1

r: 5 c: 22 Curvature: -20 Corner: 1

r: 5 c: 21 Curvature: -20 Corner: 1

r: 5 c: 20 Curvature: -20 Corner: 1

r: 5 c: 19 Curvature: -20 Corner: 1

r: 5 c: 18 Curvature: -20 Corner: 1

r: 5 c: 17 Curvature: -20 Corner: 1

r: 5 c: 16 Curvature: -20 Corner: 1

r: 5 c: 15 Curvature: -20 Corner: 1

r: 5 c: 14 Curvature: -20 Corner: 1

r: 5 c: 13 Curvature: -20 Corner: 1

r: 5 c: 12 Curvature: -20 Corner: 1

r: 5 c: 11 Curvature: -20 Corner: 1

r: 5 c: 10 Curvature: -20 Corner: 1

r: 5 c: 9 Curvature: -20 Corner: 1

r: 5 c: 8 Curvature: -20 Corner: 1

r: 5 c: 7 Curvature: -20 Corner: 1

r: 5 c: 6 Curvature: -20 Corner: 1

**Data\_D:**

Result of K-Curvature of the object boundary points

40 40 0 1

1

76

5 15 9

6 14 1

7 13 1

8 12 1

9 11 1

10 10 1

11 9 1

12 8 1

13 7 1

14 6 1

15 5 9

16 5 1

17 5 1

18 5 1

19 5 1

20 5 1

21 5 1

22 5 1

23 5 1

24 5 9

25 6 1

26 7 1

27 8 1

28 9 1

29 10 1

30 11 1

31 12 1

32 13 1

33 14 1

34 15 9

34 16 1

34 17 1

34 18 1

34 19 1

34 20 1

34 21 1

34 22 1

34 23 1

34 24 9

33 25 1

32 26 1

31 27 1

30 28 1

29 29 1

28 30 1

27 31 1

26 32 1

25 33 1

24 34 9

23 34 1

22 34 1

21 34 1

20 34 1

19 34 1

18 34 1

17 34 1

16 34 1

15 34 9

14 33 1

13 32 1

12 31 1

11 30 1

10 29 1

9 28 1

8 27 1

7 26 1

6 25 1

5 24 9

5 23 1

5 22 1

5 21 1

5 20 1

5 19 1

5 18 1

5 17 1

5 16 1

Pretty Print of the K-curvature corner detection

40 40 0 9

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. . . . . . . . . . . . . . . 9 1 1 1 1 1 1 1 1 9 . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . 1 . . . . . . . . . . 1 . . . . . . . . . . . . . .

. . . . . . . . . . . . . 1 . . . . . . . . . . . . 1 . . . . . . . . . . . . .

. . . . . . . . . . . . 1 . . . . . . . . . . . . . . 1 . . . . . . . . . . . .

. . . . . . . . . . . 1 . . . . . . . . . . . . . . . . 1 . . . . . . . . . . .

. . . . . . . . . . 1 . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . . . . . 1 . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . .

. . . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . .

. . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . .

. . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . .

. . . . . 9 . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9 . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . .

. . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . .

. . . . . 9 . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9 . . . . .

. . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . .

. . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . .

. . . . . . . . 1 . . . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . .

. . . . . . . . . 1 . . . . . . . . . . . . . . . . . . . . 1 . . . . . . . . .

. . . . . . . . . . 1 . . . . . . . . . . . . . . . . . . 1 . . . . . . . . . .

. . . . . . . . . . . 1 . . . . . . . . . . . . . . . . 1 . . . . . . . . . . .

. . . . . . . . . . . . 1 . . . . . . . . . . . . . . 1 . . . . . . . . . . . .

. . . . . . . . . . . . . 1 . . . . . . . . . . . . 1 . . . . . . . . . . . . .

. . . . . . . . . . . . . . 1 . . . . . . . . . . 1 . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . 9 1 1 1 1 1 1 1 1 9 . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

Debug File

Before applying k curvature corner detection algorithm:

r: 5 c: 15 Curvature: 0 Corner: 0

r: 6 c: 14 Curvature: 0 Corner: 0

r: 7 c: 13 Curvature: 0 Corner: 0

r: 8 c: 12 Curvature: 0 Corner: 0

r: 9 c: 11 Curvature: 0 Corner: 0

r: 10 c: 10 Curvature: 0 Corner: 0

r: 11 c: 9 Curvature: 0 Corner: 0

r: 12 c: 8 Curvature: 0 Corner: 0

r: 13 c: 7 Curvature: 0 Corner: 0

r: 14 c: 6 Curvature: 0 Corner: 0

r: 15 c: 5 Curvature: 0 Corner: 0

r: 16 c: 5 Curvature: 0 Corner: 0

r: 17 c: 5 Curvature: 0 Corner: 0

r: 18 c: 5 Curvature: 0 Corner: 0

r: 19 c: 5 Curvature: 0 Corner: 0

r: 20 c: 5 Curvature: 0 Corner: 0

r: 21 c: 5 Curvature: 0 Corner: 0

r: 22 c: 5 Curvature: 0 Corner: 0

r: 23 c: 5 Curvature: 0 Corner: 0

r: 24 c: 5 Curvature: 0 Corner: 0

r: 25 c: 6 Curvature: 0 Corner: 0

r: 26 c: 7 Curvature: 0 Corner: 0

r: 27 c: 8 Curvature: 0 Corner: 0

r: 28 c: 9 Curvature: 0 Corner: 0

r: 29 c: 10 Curvature: 0 Corner: 0

r: 30 c: 11 Curvature: 0 Corner: 0

r: 31 c: 12 Curvature: 0 Corner: 0

r: 32 c: 13 Curvature: 0 Corner: 0

r: 33 c: 14 Curvature: 0 Corner: 0

r: 34 c: 15 Curvature: 0 Corner: 0

r: 34 c: 16 Curvature: 0 Corner: 0

r: 34 c: 17 Curvature: 0 Corner: 0

r: 34 c: 18 Curvature: 0 Corner: 0

r: 34 c: 19 Curvature: 0 Corner: 0

r: 34 c: 20 Curvature: 0 Corner: 0

r: 34 c: 21 Curvature: 0 Corner: 0

r: 34 c: 22 Curvature: 0 Corner: 0

r: 34 c: 23 Curvature: 0 Corner: 0

r: 34 c: 24 Curvature: 0 Corner: 0

r: 33 c: 25 Curvature: 0 Corner: 0

r: 32 c: 26 Curvature: 0 Corner: 0

r: 31 c: 27 Curvature: 0 Corner: 0

r: 30 c: 28 Curvature: 0 Corner: 0

r: 29 c: 29 Curvature: 0 Corner: 0

r: 28 c: 30 Curvature: 0 Corner: 0

r: 27 c: 31 Curvature: 0 Corner: 0

r: 26 c: 32 Curvature: 0 Corner: 0

r: 25 c: 33 Curvature: 0 Corner: 0

r: 24 c: 34 Curvature: 0 Corner: 0

r: 23 c: 34 Curvature: 0 Corner: 0

r: 22 c: 34 Curvature: 0 Corner: 0

r: 21 c: 34 Curvature: 0 Corner: 0

r: 20 c: 34 Curvature: 0 Corner: 0

r: 19 c: 34 Curvature: 0 Corner: 0

r: 18 c: 34 Curvature: 0 Corner: 0

r: 17 c: 34 Curvature: 0 Corner: 0

r: 16 c: 34 Curvature: 0 Corner: 0

r: 15 c: 34 Curvature: 0 Corner: 0

r: 14 c: 33 Curvature: 0 Corner: 0

r: 13 c: 32 Curvature: 0 Corner: 0

r: 12 c: 31 Curvature: 0 Corner: 0

r: 11 c: 30 Curvature: 0 Corner: 0

r: 10 c: 29 Curvature: 0 Corner: 0

r: 9 c: 28 Curvature: 0 Corner: 0

r: 8 c: 27 Curvature: 0 Corner: 0

r: 7 c: 26 Curvature: 0 Corner: 0

r: 6 c: 25 Curvature: 0 Corner: 0

r: 5 c: 24 Curvature: 0 Corner: 0

r: 5 c: 23 Curvature: 0 Corner: 0

r: 5 c: 22 Curvature: 0 Corner: 0

r: 5 c: 21 Curvature: 0 Corner: 0

r: 5 c: 20 Curvature: 0 Corner: 0

r: 5 c: 19 Curvature: 0 Corner: 0

r: 5 c: 18 Curvature: 0 Corner: 0

r: 5 c: 17 Curvature: 0 Corner: 0

r: 5 c: 16 Curvature: 0 Corner: 0

After applying k curvature corner detection algorithm:

r: 5 c: 15 Curvature: -8.88889 Corner: 0

r: 6 c: 14 Curvature: 0 Corner: 0

r: 7 c: 13 Curvature: 0 Corner: 0

r: 8 c: 12 Curvature: 0 Corner: 0

r: 9 c: 11 Curvature: 0 Corner: 0

r: 10 c: 10 Curvature: 0 Corner: 0

r: 11 c: 9 Curvature: 0 Corner: 0

r: 12 c: 8 Curvature: 0 Corner: 0

r: 13 c: 7 Curvature: 0 Corner: 0

r: 14 c: 6 Curvature: 0 Corner: 0

r: 15 c: 5 Curvature: -1 Corner: 0

r: 16 c: 5 Curvature: 0 Corner: 0

r: 17 c: 5 Curvature: 0 Corner: 0

r: 18 c: 5 Curvature: 0 Corner: 0

r: 19 c: 5 Curvature: 0 Corner: 0

r: 20 c: 5 Curvature: 0 Corner: 0

r: 21 c: 5 Curvature: 0 Corner: 0

r: 22 c: 5 Curvature: 0 Corner: 0

r: 23 c: 5 Curvature: 0 Corner: 0

r: 24 c: 5 Curvature: -1 Corner: 0

r: 25 c: 6 Curvature: 0 Corner: 0

r: 26 c: 7 Curvature: 0 Corner: 0

r: 27 c: 8 Curvature: 0 Corner: 0

r: 28 c: 9 Curvature: 0 Corner: 0

r: 29 c: 10 Curvature: 0 Corner: 0

r: 30 c: 11 Curvature: 0 Corner: 0

r: 31 c: 12 Curvature: 0 Corner: 0

r: 32 c: 13 Curvature: 0 Corner: 0

r: 33 c: 14 Curvature: 0 Corner: 0

r: 34 c: 15 Curvature: 10.9091 Corner: 0

r: 34 c: 16 Curvature: 20 Corner: 0

r: 34 c: 17 Curvature: 20 Corner: 0

r: 34 c: 18 Curvature: 20 Corner: 0

r: 34 c: 19 Curvature: 20 Corner: 0

r: 34 c: 20 Curvature: 20 Corner: 0

r: 34 c: 21 Curvature: 20 Corner: 0

r: 34 c: 22 Curvature: 20 Corner: 0

r: 34 c: 23 Curvature: 20 Corner: 0

r: 34 c: 24 Curvature: 10.9091 Corner: 0

r: 33 c: 25 Curvature: 0 Corner: 0

r: 32 c: 26 Curvature: 0 Corner: 0

r: 31 c: 27 Curvature: 0 Corner: 0

r: 30 c: 28 Curvature: 0 Corner: 0

r: 29 c: 29 Curvature: 0 Corner: 0

r: 28 c: 30 Curvature: 0 Corner: 0

r: 27 c: 31 Curvature: 0 Corner: 0

r: 26 c: 32 Curvature: 0 Corner: 0

r: 25 c: 33 Curvature: 0 Corner: 0

r: 24 c: 34 Curvature: -1 Corner: 0

r: 23 c: 34 Curvature: 0 Corner: 0

r: 22 c: 34 Curvature: 0 Corner: 0

r: 21 c: 34 Curvature: 0 Corner: 0

r: 20 c: 34 Curvature: 0 Corner: 0

r: 19 c: 34 Curvature: 0 Corner: 0

r: 18 c: 34 Curvature: 0 Corner: 0

r: 17 c: 34 Curvature: 0 Corner: 0

r: 16 c: 34 Curvature: 0 Corner: 0

r: 15 c: 34 Curvature: -1 Corner: 0

r: 14 c: 33 Curvature: 0 Corner: 0

r: 13 c: 32 Curvature: 0 Corner: 0

r: 12 c: 31 Curvature: 0 Corner: 0

r: 11 c: 30 Curvature: 0 Corner: 0

r: 10 c: 29 Curvature: 0 Corner: 0

r: 9 c: 28 Curvature: 0 Corner: 0

r: 8 c: 27 Curvature: 0 Corner: 0

r: 7 c: 26 Curvature: 0 Corner: 0

r: 6 c: 25 Curvature: 0 Corner: 0

r: 5 c: 24 Curvature: -8.88889 Corner: 0

r: 5 c: 23 Curvature: -20 Corner: 0

r: 5 c: 22 Curvature: -20 Corner: 0

r: 5 c: 21 Curvature: -20 Corner: 0

r: 5 c: 20 Curvature: -20 Corner: 0

r: 5 c: 19 Curvature: -20 Corner: 0

r: 5 c: 18 Curvature: -20 Corner: 0

r: 5 c: 17 Curvature: -20 Corner: 0

r: 5 c: 16 Curvature: -20 Corner: 0

After marking corners:

r: 5 c: 15 Curvature: -8.88889 Corner: 9

r: 6 c: 14 Curvature: 0 Corner: 1

r: 7 c: 13 Curvature: 0 Corner: 1

r: 8 c: 12 Curvature: 0 Corner: 1

r: 9 c: 11 Curvature: 0 Corner: 1

r: 10 c: 10 Curvature: 0 Corner: 1

r: 11 c: 9 Curvature: 0 Corner: 1

r: 12 c: 8 Curvature: 0 Corner: 1

r: 13 c: 7 Curvature: 0 Corner: 1

r: 14 c: 6 Curvature: 0 Corner: 1

r: 15 c: 5 Curvature: -1 Corner: 9

r: 16 c: 5 Curvature: 0 Corner: 1

r: 17 c: 5 Curvature: 0 Corner: 1

r: 18 c: 5 Curvature: 0 Corner: 1

r: 19 c: 5 Curvature: 0 Corner: 1

r: 20 c: 5 Curvature: 0 Corner: 1

r: 21 c: 5 Curvature: 0 Corner: 1

r: 22 c: 5 Curvature: 0 Corner: 1

r: 23 c: 5 Curvature: 0 Corner: 1

r: 24 c: 5 Curvature: -1 Corner: 9

r: 25 c: 6 Curvature: 0 Corner: 1

r: 26 c: 7 Curvature: 0 Corner: 1

r: 27 c: 8 Curvature: 0 Corner: 1

r: 28 c: 9 Curvature: 0 Corner: 1

r: 29 c: 10 Curvature: 0 Corner: 1

r: 30 c: 11 Curvature: 0 Corner: 1

r: 31 c: 12 Curvature: 0 Corner: 1

r: 32 c: 13 Curvature: 0 Corner: 1

r: 33 c: 14 Curvature: 0 Corner: 1

r: 34 c: 15 Curvature: 10.9091 Corner: 9

r: 34 c: 16 Curvature: 20 Corner: 1

r: 34 c: 17 Curvature: 20 Corner: 1

r: 34 c: 18 Curvature: 20 Corner: 1

r: 34 c: 19 Curvature: 20 Corner: 1

r: 34 c: 20 Curvature: 20 Corner: 1

r: 34 c: 21 Curvature: 20 Corner: 1

r: 34 c: 22 Curvature: 20 Corner: 1

r: 34 c: 23 Curvature: 20 Corner: 1

r: 34 c: 24 Curvature: 10.9091 Corner: 9

r: 33 c: 25 Curvature: 0 Corner: 1

r: 32 c: 26 Curvature: 0 Corner: 1

r: 31 c: 27 Curvature: 0 Corner: 1

r: 30 c: 28 Curvature: 0 Corner: 1

r: 29 c: 29 Curvature: 0 Corner: 1

r: 28 c: 30 Curvature: 0 Corner: 1

r: 27 c: 31 Curvature: 0 Corner: 1

r: 26 c: 32 Curvature: 0 Corner: 1

r: 25 c: 33 Curvature: 0 Corner: 1

r: 24 c: 34 Curvature: -1 Corner: 9

r: 23 c: 34 Curvature: 0 Corner: 1

r: 22 c: 34 Curvature: 0 Corner: 1

r: 21 c: 34 Curvature: 0 Corner: 1

r: 20 c: 34 Curvature: 0 Corner: 1

r: 19 c: 34 Curvature: 0 Corner: 1

r: 18 c: 34 Curvature: 0 Corner: 1

r: 17 c: 34 Curvature: 0 Corner: 1

r: 16 c: 34 Curvature: 0 Corner: 1

r: 15 c: 34 Curvature: -1 Corner: 9

r: 14 c: 33 Curvature: 0 Corner: 1

r: 13 c: 32 Curvature: 0 Corner: 1

r: 12 c: 31 Curvature: 0 Corner: 1

r: 11 c: 30 Curvature: 0 Corner: 1

r: 10 c: 29 Curvature: 0 Corner: 1

r: 9 c: 28 Curvature: 0 Corner: 1

r: 8 c: 27 Curvature: 0 Corner: 1

r: 7 c: 26 Curvature: 0 Corner: 1

r: 6 c: 25 Curvature: 0 Corner: 1

r: 5 c: 24 Curvature: -8.88889 Corner: 9

r: 5 c: 23 Curvature: -20 Corner: 1

r: 5 c: 22 Curvature: -20 Corner: 1

r: 5 c: 21 Curvature: -20 Corner: 1

r: 5 c: 20 Curvature: -20 Corner: 1

r: 5 c: 19 Curvature: -20 Corner: 1

r: 5 c: 18 Curvature: -20 Corner: 1

r: 5 c: 17 Curvature: -20 Corner: 1

r: 5 c: 16 Curvature: -20 Corner: 1