

Project 8: K-curvature

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Corner Detection Algorithm:

- Step 1: initialize a variable called index type int and set value equal to zero.
- Step 2: let index = P
- Step 3: PtAry[index] -> curvature = compute Curvature (Q, P, R)
- Step 4: if P is equal to K - 1 you break the loop
- Step 5: increment Q, P and R by 1
- Step 6: repeat step 2 to 5 while true

Compute Curvature Algorithm:

Note: this method should return type double

- Step 1: I initialize variable called result which would return the curvature of the point
- Step 2: first have boundaryPt* temp = new boundaryPt() then temp = PtAry[Q];
- Step 3: get the x and y values of Q . The initialize variable r1 = x and c1 = y;
- Step 4: temp = new boundaryPt() then temp = PtAry[P] then : get the x and y values of P . The initialize variable r2 = x and c2 = y;
- Step 5 : temp = new boundaryPt() then temp = PtAry[R] then : get the x and y values of R . The initialize variable r3 = x and c3 = y;
- Step 6: create variables y1 and x1 type double. Then $y1 = c1 - c2$ and $x1 = r1 - r2$.
- Step 7: create variables y2 x= 2 type double. Then $y2 = \text{abs}(c2 - c3)$ and $x2 = \text{abs}(r2 - r3)$.
- Step 8: create variable s1 to represent slope 1 then let s1 equal to y1 divided by x1 then cast the answer as double
- Step 9: create variable s2 to represent slope 2 then let s2 equal to y2 divided by x2 then cast the answer as double.
- Step 10: result = absolute value of s1 minus s2. Then return result

Compute local Maxima Algorithm:

- Step 1: have for that start with zero. That runs till the variable is greater than or equal to numPts.
Example: for (int i = 0; i < numPts; i++)
- Step 2: In the for loop create variable n1 to represent P(i - 2).
Then PtAry[((i + numPts) - 2) % numPts] -> curvature;
- Step 3: In the for loop create variable n2 to represent P(i - 1).
Then PtAry[((i + numPts) - 1) % numPts] -> curvature;
- Step 4: In the for loop create variable n3 to represent P(i + 1).
Then PtAry[(i + 1) % numPts;] -> curvature;
- Step 5: In the for loop create variable n3 to represent P(i + 2).
Then PtAry[(i + 2) % numPts;] -> curvature;
- Step 6: In the for loop create variable n3 to represent the current point
Then PtAry[i]-> curvature;
- Step 7: if (p >= n1 && p >= n2 && p >= n3 && p >= n4 && p > 0)
PtAry[i] -> localMax = 1;
else
PtAry[i] -> localMax = 0;

Source Code:

```
#include <iostream>
#include <iostream>
#include <fstream>
#include <string>
using namespace std;

class image {
public:
    int numRows = -1;
    int numCols = -1;
    int minVal = -1;
    int maxVal = -1;
    int label = -1;
    int **imgAry;

    void constructor(ifstream & input, int k){
        input >> this->numRows >> this->numCols >> this->minVal >> this->maxVal;
        input >> this -> label;
        this -> imgAry = new int*[this -> numRows];
        for (int i = 0; i < this -> numRows; ++i){
            imgAry[i] = new int[ this -> numCols];
        }

        for (int i = 0; i < this -> numRows; ++i){
            for (int j = 0; j < this -> numCols; ++j){
                imgAry[i][j] = 0;
            }
        }
    }

    void imgReformat(ofstream & output){
        output << " " << this->numRows << " "
                << this->numCols << " "
                << this->minVal << " "
                << this->maxVal << endl;
        output << endl;

        for(int i = 0; i < numRows; i++){
            for(int j = 0; j < numCols; j++){
                if (0 != imgAry[i][j])
                    output << imgAry[i][j] << " ";
                else
                    output << ". ";
            }
            output << endl;
        }
    }

    void free_Heap (){
        for (int i = 0; i < this->numRows; ++i)
            delete[] this->imgAry[i];
        delete[] this->imgAry;
    }
};

class boundaryPt {
public:
    int x = -1;
```

```

    int y = -1;
    double curvature = 0.0;
    int localMax = -1;
    int corner = -1;
};

class kCurvature {
public:
    int K = -1;
    int numPts = -1;
    int Q = 0;
    int P = -1;
    int R = -1;
    int numRows = -1;
    int numCol = -1;
    int min = -1;
    int max = -1;
    int label = -1;
    boundaryPt** PtAry;

    void constructor(int k){
        this-> K = k;
        this-> P = K;
        this-> R = 2 * K;
    }
    void initialization(ifstream & input, string args){
        this-> numPts = countPts(input);
        input.close();
        input.open(args);
        int index = 0;

        input >> this-> numRows >> this-> numCol >> this-> min >> this-> max;
        input >> this-> label;

        this -> PtAry = new boundaryPt*[this -> numPts];
        int x = -1;
        int y = -1;
        while(input >> x){
            input >> y;
            storePT(x, y, index);
            index++;
        }
    }
    int countPts (ifstream & input){
        int count = 0;
        string x;
        string y;

        while( input >> x ){
            input >> y;
            count++;
        }
        return count;
    }

    void storePT( int a, int b, int index){
        boundaryPt* temp = new boundaryPt();
        temp -> x = a;
    }

```

```

    temp -> y = b;
    PtAry[index] = temp;
}
void printPtAry(ofstream & output){
    output << this-> numRows << " " << this-> numCol << " ";
    output << this-> min << " " << this-> max;
    output << endl;

    output << this -> label << endl;
    for(int i = 0; i < numPts; i++){
        boundaryPt* temp = new boundaryPt();
        temp = PtAry[i];
        output <<"x: " << temp -> x << " y: " << temp -> y << " curvature: ";
        output << temp -> curvature << " ";
        if (temp -> localMax >= 0)
            output << " localMax:"<< temp -> localMax;
        output << endl;
    }
    output << endl << endl;
}
void cornerDetection(ofstream & output){

    output << "Calculating Curvature debugging" << endl;
    output << endl;
    string letter = "";
    int index = 0;
    while (true){

        index = P;
        boundaryPt* temp = new boundaryPt();
        temp = PtAry[index];
        temp -> curvature = computeCurvature(Q, P, R, output);
        PtAry[index] = temp;
        output << endl;
        if (P == K - 1) break;
        Q = (Q + 1) % numPts;
        P = (P + 1) % numPts;
        R = (R + 1) % numPts;
    }
    output << endl;
}
double computeCurvature(int Q, int P, int R, ofstream & output){
    double result = 0.0;

    boundaryPt* temp = new boundaryPt();
    temp = PtAry[Q];
    int r1 = temp -> x;
    int c1 = temp -> y;
    printDebug("Q", Q , output);
    temp = new boundaryPt();
    temp = PtAry[P];
    int r2 = temp -> x;
    int c2 = temp -> y;
    temp = new boundaryPt();
    printDebug("P", P, output);
    temp = PtAry[R];
    int r3 = temp -> x;
    int c3 = temp -> y;
    printDebug("R", R , output);
    double y1 = c1 - c2;

```

```

double y2 = c2 - c3;
double x1 = abs(r1 - r2);
double x2 = abs(r2 - r3);
double s1 = 0.0;
double s2 = 0.0;

if (x1 == 0 )
    x1 = 0.5;
if(x2 == 0)
    x2 = 0.5;
s1 = (double)(y1 / x1);
s2 = (double)(y2 / x2);
result = abs(s1 - s2);

output << c1 << " - " << c2 << " = " << c1 - c2 << endl;
output << c2 << " - " << c3 << " = " << c2 - c3 << endl;
output << r1 << " - " << r2 << " = " << abs(r1 - r2) << endl;
output << r2 << " - " << r3 << " = " << abs(r2 - r3) << endl;
output << y1 << " / " << x1 << " = " << (double)(y1 / x1) << endl;
output << y2 << " / " << x2 << " = " << (double)(y1 / x1) << endl;
output << s1 << " - " << s2 << " = " << abs(s1 - s2) << endl;

return result;
}

void printDebug(string l, int i, ofstream & output){
    boundaryPt* temp = new boundaryPt();
    temp = PtAry[i];
    int r = temp -> x;
    int c = temp -> y;
    output << l << " index: " << i << " x: " << r << " y: " << c << endl;
}

void computeLocalMaxima(){
    for (int i = 0; i < numPts; i++){
        int index = ((i + numPts) - 2 ) % numPts;
        int n1 = PtAry[index] -> curvature;
        index = ((i + numPts) - 1 ) % numPts;
        int n2 = PtAry[index] -> curvature;
        index = (i + 1) % numPts;
        int n3 = PtAry[index] -> curvature;
        index = (i + 2) % numPts;
        int n4 = PtAry[index] -> curvature;
        int p = PtAry[i] -> curvature;

        if (p >= n1 && p >= n2 && p >= n3 && p >= n4 && p > 0)
            PtAry[i] -> localMax = 1;
        else
            PtAry[i] -> localMax = 0;
    }
}

void markCorner(){
    for (int i = 0; i < numPts; i++){
        int index1 = ((i + numPts) - 1 ) % numPts;

```

```

int p1 = PtAry[index1] -> localMax;
int p2 = PtAry[i] -> localMax;
int index2 = (i + 1) % numPts;
int p3 = PtAry[index2] -> localMax;
bool otherNeig = false;
bool nextNeig = false;

if (p2 == 1 ){
    if (p1 == 1 && p3 == 1)
        nextNeig = true;
    for (int j = ((i + numPts) - 2 ) % numPts; j < (i + 2) % numPts; j++){
        int x = PtAry[j] -> localMax;

        if( j == index1 || j == index2 || j == i)
            continue;
        if (x == 1){
            otherNeig = true;
            break;
        }
    }
    if( !nextNeig && !otherNeig )
        PtAry[i] -> corner = 9;

    else if(nextNeig && !otherNeig){
        PtAry[i] -> corner = 9;
    }
    else
        PtAry[i] -> corner = 1;
}
else
    PtAry[i] -> corner = 1;
}
}

void printBoundary(ofstream & output){
    output << numRows << " " << numCol << " " << min << " " << max << endl;
    output<< label;
    for (int i = 0; i < numPts; i++){
        boundaryPt* temp = new boundaryPt();
        temp = PtAry[i];
        int r = temp -> x;
        int c = temp -> y;
        int corner = temp -> corner;
        output << r << " " << c << " " << corner << endl;
    }
}

void display(int **imgAry){
    for (int i = 0; i < numPts; i++){
        boundaryPt* temp = new boundaryPt();
        temp = PtAry[i];
        int r = temp -> x;
        int c = temp -> y;
        int corner = temp -> corner;
        imgAry[r][c] = corner;
    }
}

void free_Heap (){
    delete[] this->PtAry;
}

```

```

};

int main(int argc, const char * argv[]) {
    int k = -1;

    string inputName = argv[1];
    ifstream input;
    input.open(inputName);

    string output1 = argv[2];
    ofstream outFile1;
    outFile1.open(output1);

    string output2 = argv[3];
    ofstream outFile2;
    outFile2.open(output2);

    string output3 = argv[4];
    ofstream outFile3;
    outFile3.open(output3);
    cout << "Please provide a K value: ";
    cin >> k;

    image* img = new image();
    img -> constructor(input, k);
    kCurvature* kCurv = new kCurvature();
    kCurv -> constructor(k);
    outFile3 << "K value: " << k << endl;
    kCurv -> initialization(input, inputName);
    outFile3 << "PtAry after initialization " << endl;
    kCurv -> printPtAry (outFile3);
    kCurv -> cornerDetection (outFile3);
    outFile3 << "PtAry after Corner Detection " << endl;
    kCurv -> printPtAry (outFile3);
    kCurv -> computeLocalMaxima();
    kCurv -> markCorner();
    kCurv -> printBoundary(outFile1);
    kCurv-> display(img -> imgAry);
    img -> imgReformat(outFile2);
    img -> free_Heap();
    kCurv -> free_Heap();
    input.close();
    outFile1.close();
    outFile2.close();
    outFile3.close();

    cout << "Compilation Complete"<< endl;

    return 0;
}

```

Data A Outputs:

outFile 1:

```
30 40 0 9
16 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

outFile 2:

30 40 0 9

[illegible]

outFile3(debug):

K value: 4

PtAry after initialization

30 40 0 1

1

x: 6 y: 6 curvature: 0
x: 7 y: 6 curvature: 0
x: 8 y: 6 curvature: 0
x: 9 y: 6 curvature: 0
x: 10 y: 6 curvature: 0
x: 11 y: 6 curvature: 0
x: 12 y: 6 curvature: 0
x: 13 y: 6 curvature: 0
x: 14 y: 6 curvature: 0
x: 15 y: 6 curvature: 0
x: 16 y: 6 curvature: 0
x: 17 y: 6 curvature: 0
x: 18 y: 6 curvature: 0
x: 19 y: 6 curvature: 0
x: 20 y: 6 curvature: 0
x: 21 y: 6 curvature: 0
x: 22 y: 6 curvature: 0
x: 23 y: 6 curvature: 0
x: 24 y: 6 curvature: 0
x: 25 y: 6 curvature: 0
x: 25 y: 7 curvature: 0
x: 25 y: 8 curvature: 0
x: 25 y: 9 curvature: 0
x: 25 y: 10 curvature: 0
x: 25 y: 11 curvature: 0
x: 25 y: 12 curvature: 0
x: 25 y: 13 curvature: 0
x: 25 y: 14 curvature: 0
x: 25 y: 15 curvature: 0
x: 25 y: 16 curvature: 0
x: 25 y: 17 curvature: 0
x: 25 y: 18 curvature: 0
x: 25 y: 19 curvature: 0
x: 25 y: 20 curvature: 0
x: 25 y: 21 curvature: 0
x: 25 y: 22 curvature: 0
x: 25 y: 23 curvature: 0
x: 25 y: 24 curvature: 0
x: 25 y: 25 curvature: 0
x: 25 y: 26 curvature: 0
x: 25 y: 27 curvature: 0
x: 25 y: 28 curvature: 0
x: 25 y: 29 curvature: 0
x: 25 y: 30 curvature: 0
x: 25 y: 31 curvature: 0
x: 25 y: 32 curvature: 0
x: 25 y: 33 curvature: 0
x: 25 y: 34 curvature: 0
x: 25 y: 35 curvature: 0

x: 24 y: 35 curvature: 0
x: 23 y: 35 curvature: 0
x: 22 y: 35 curvature: 0
x: 21 y: 35 curvature: 0
x: 20 y: 35 curvature: 0
x: 19 y: 35 curvature: 0
x: 18 y: 35 curvature: 0
x: 17 y: 35 curvature: 0
x: 16 y: 35 curvature: 0
x: 15 y: 35 curvature: 0
x: 14 y: 35 curvature: 0
x: 13 y: 35 curvature: 0
x: 12 y: 35 curvature: 0
x: 11 y: 35 curvature: 0
x: 10 y: 35 curvature: 0
x: 9 y: 35 curvature: 0
x: 8 y: 35 curvature: 0
x: 7 y: 35 curvature: 0
x: 6 y: 35 curvature: 0
x: 6 y: 34 curvature: 0
x: 6 y: 33 curvature: 0
x: 6 y: 32 curvature: 0
x: 6 y: 31 curvature: 0
x: 6 y: 30 curvature: 0
x: 6 y: 29 curvature: 0
x: 6 y: 28 curvature: 0
x: 6 y: 27 curvature: 0
x: 6 y: 26 curvature: 0
x: 6 y: 25 curvature: 0
x: 6 y: 24 curvature: 0
x: 6 y: 23 curvature: 0
x: 6 y: 22 curvature: 0
x: 6 y: 21 curvature: 0
x: 6 y: 20 curvature: 0
x: 6 y: 19 curvature: 0
x: 6 y: 18 curvature: 0
x: 6 y: 17 curvature: 0
x: 6 y: 16 curvature: 0
x: 6 y: 15 curvature: 0
x: 6 y: 14 curvature: 0
x: 6 y: 13 curvature: 0
x: 6 y: 12 curvature: 0
x: 6 y: 11 curvature: 0
x: 6 y: 10 curvature: 0
x: 6 y: 9 curvature: 0
x: 6 y: 8 curvature: 0
x: 6 y: 7 curvature: 0

Calculating Curvature debugging

Q index: 0 x: 6 y: 6
P index: 4 x: 10 y: 6
R index: 8 x: 14 y: 6
 $6 - 6 = 0$

$6 - 6 = 0$
 $6 - 10 = 4$
 $10 - 14 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 1 x: 7 y: 6
P index: 5 x: 11 y: 6
R index: 9 x: 15 y: 6
 $6 - 6 = 0$
 $6 - 6 = 0$
 $7 - 11 = 4$
 $11 - 15 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 2 x: 8 y: 6
P index: 6 x: 12 y: 6
R index: 10 x: 16 y: 6
 $6 - 6 = 0$
 $6 - 6 = 0$
 $8 - 12 = 4$
 $12 - 16 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 3 x: 9 y: 6
P index: 7 x: 13 y: 6
R index: 11 x: 17 y: 6
 $6 - 6 = 0$
 $6 - 6 = 0$
 $9 - 13 = 4$
 $13 - 17 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 4 x: 10 y: 6
P index: 8 x: 14 y: 6
R index: 12 x: 18 y: 6
 $6 - 6 = 0$
 $6 - 6 = 0$
 $10 - 14 = 4$
 $14 - 18 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 5 x: 11 y: 6
P index: 9 x: 15 y: 6
R index: 13 x: 19 y: 6
 $6 - 6 = 0$

$6 - 6 = 0$
 $11 - 15 = 4$
 $15 - 19 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 6 x: 12 y: 6
P index: 10 x: 16 y: 6
R index: 14 x: 20 y: 6
 $6 - 6 = 0$
 $6 - 6 = 0$
 $12 - 16 = 4$
 $16 - 20 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 7 x: 13 y: 6
P index: 11 x: 17 y: 6
R index: 15 x: 21 y: 6
 $6 - 6 = 0$
 $6 - 6 = 0$
 $13 - 17 = 4$
 $17 - 21 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 8 x: 14 y: 6
P index: 12 x: 18 y: 6
R index: 16 x: 22 y: 6
 $6 - 6 = 0$
 $6 - 6 = 0$
 $14 - 18 = 4$
 $18 - 22 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 9 x: 15 y: 6
P index: 13 x: 19 y: 6
R index: 17 x: 23 y: 6
 $6 - 6 = 0$
 $6 - 6 = 0$
 $15 - 19 = 4$
 $19 - 23 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 10 x: 16 y: 6
P index: 14 x: 20 y: 6
R index: 18 x: 24 y: 6
 $6 - 6 = 0$

$6 - 6 = 0$
 $16 - 20 = 4$
 $20 - 24 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 11 x: 17 y: 6
P index: 15 x: 21 y: 6
R index: 19 x: 25 y: 6
 $6 - 6 = 0$
 $6 - 6 = 0$
 $17 - 21 = 4$
 $21 - 25 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 12 x: 18 y: 6
P index: 16 x: 22 y: 6
R index: 20 x: 25 y: 7
 $6 - 6 = 0$
 $6 - 7 = -1$
 $18 - 22 = 4$
 $22 - 25 = 3$
 $0 / 4 = 0$
 $-1 / 3 = 0$
 $0 - -0.333333 = 0.333333$

Q index: 13 x: 19 y: 6
P index: 17 x: 23 y: 6
R index: 21 x: 25 y: 8
 $6 - 6 = 0$
 $6 - 8 = -2$
 $19 - 23 = 4$
 $23 - 25 = 2$
 $0 / 4 = 0$
 $-2 / 2 = 0$
 $0 - -1 = 1$

Q index: 14 x: 20 y: 6
P index: 18 x: 24 y: 6
R index: 22 x: 25 y: 9
 $6 - 6 = 0$
 $6 - 9 = -3$
 $20 - 24 = 4$
 $24 - 25 = 1$
 $0 / 4 = 0$
 $-3 / 1 = 0$
 $0 - -3 = 3$

Q index: 15 x: 21 y: 6
P index: 19 x: 25 y: 6
R index: 23 x: 25 y: 10
 $6 - 6 = 0$

$6 - 10 = -4$
 $21 - 25 = 4$
 $25 - 25 = 0$
 $0 / 4 = 0$
 $-4 / 0.5 = 0$
 $0 - -8 = 8$

Q index: 16 x: 22 y: 6
P index: 20 x: 25 y: 7
R index: 24 x: 25 y: 11
 $6 - 7 = -1$
 $7 - 11 = -4$
 $22 - 25 = 3$
 $25 - 25 = 0$
 $-1 / 3 = -0.333333$
 $-4 / 0.5 = -0.333333$
 $-0.333333 - -8 = 7.666667$

Q index: 17 x: 23 y: 6
P index: 21 x: 25 y: 8
R index: 25 x: 25 y: 12
 $6 - 8 = -2$
 $8 - 12 = -4$
 $23 - 25 = 2$
 $25 - 25 = 0$
 $-2 / 2 = -1$
 $-4 / 0.5 = -1$
 $-1 - -8 = 7$

Q index: 18 x: 24 y: 6
P index: 22 x: 25 y: 9
R index: 26 x: 25 y: 13
 $6 - 9 = -3$
 $9 - 13 = -4$
 $24 - 25 = 1$
 $25 - 25 = 0$
 $-3 / 1 = -3$
 $-4 / 0.5 = -3$
 $-3 - -8 = 5$

Q index: 19 x: 25 y: 6
P index: 23 x: 25 y: 10
R index: 27 x: 25 y: 14
 $6 - 10 = -4$
 $10 - 14 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 20 x: 25 y: 7
P index: 24 x: 25 y: 11
R index: 28 x: 25 y: 15
 $7 - 11 = -4$

$11 - 15 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 21 x: 25 y: 8
P index: 25 x: 25 y: 12
R index: 29 x: 25 y: 16
 $8 - 12 = -4$
 $12 - 16 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 22 x: 25 y: 9
P index: 26 x: 25 y: 13
R index: 30 x: 25 y: 17
 $9 - 13 = -4$
 $13 - 17 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 23 x: 25 y: 10
P index: 27 x: 25 y: 14
R index: 31 x: 25 y: 18
 $10 - 14 = -4$
 $14 - 18 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 24 x: 25 y: 11
P index: 28 x: 25 y: 15
R index: 32 x: 25 y: 19
 $11 - 15 = -4$
 $15 - 19 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 25 x: 25 y: 12
P index: 29 x: 25 y: 16
R index: 33 x: 25 y: 20
 $12 - 16 = -4$

$16 - 20 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 26 x: 25 y: 13
P index: 30 x: 25 y: 17
R index: 34 x: 25 y: 21
 $13 - 17 = -4$
 $17 - 21 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 27 x: 25 y: 14
P index: 31 x: 25 y: 18
R index: 35 x: 25 y: 22
 $14 - 18 = -4$
 $18 - 22 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 28 x: 25 y: 15
P index: 32 x: 25 y: 19
R index: 36 x: 25 y: 23
 $15 - 19 = -4$
 $19 - 23 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 29 x: 25 y: 16
P index: 33 x: 25 y: 20
R index: 37 x: 25 y: 24
 $16 - 20 = -4$
 $20 - 24 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 30 x: 25 y: 17
P index: 34 x: 25 y: 21
R index: 38 x: 25 y: 25
 $17 - 21 = -4$

$21 - 25 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 31 x: 25 y: 18
P index: 35 x: 25 y: 22
R index: 39 x: 25 y: 26
 $18 - 22 = -4$
 $22 - 26 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 32 x: 25 y: 19
P index: 36 x: 25 y: 23
R index: 40 x: 25 y: 27
 $19 - 23 = -4$
 $23 - 27 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 33 x: 25 y: 20
P index: 37 x: 25 y: 24
R index: 41 x: 25 y: 28
 $20 - 24 = -4$
 $24 - 28 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 34 x: 25 y: 21
P index: 38 x: 25 y: 25
R index: 42 x: 25 y: 29
 $21 - 25 = -4$
 $25 - 29 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 35 x: 25 y: 22
P index: 39 x: 25 y: 26
R index: 43 x: 25 y: 30
 $22 - 26 = -4$

$26 - 30 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 36 x: 25 y: 23
P index: 40 x: 25 y: 27
R index: 44 x: 25 y: 31
 $23 - 27 = -4$
 $27 - 31 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 37 x: 25 y: 24
P index: 41 x: 25 y: 28
R index: 45 x: 25 y: 32
 $24 - 28 = -4$
 $28 - 32 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 38 x: 25 y: 25
P index: 42 x: 25 y: 29
R index: 46 x: 25 y: 33
 $25 - 29 = -4$
 $29 - 33 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 39 x: 25 y: 26
P index: 43 x: 25 y: 30
R index: 47 x: 25 y: 34
 $26 - 30 = -4$
 $30 - 34 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 40 x: 25 y: 27
P index: 44 x: 25 y: 31
R index: 48 x: 25 y: 35
 $27 - 31 = -4$

$31 - 35 = -4$
 $25 - 25 = 0$
 $25 - 25 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 41 x: 25 y: 28
P index: 45 x: 25 y: 32
R index: 49 x: 24 y: 35
 $28 - 32 = -4$
 $32 - 35 = -3$
 $25 - 25 = 0$
 $25 - 24 = 1$
 $-4 / 0.5 = -8$
 $-3 / 1 = -3$
 $-8 - -3 = -5$

Q index: 42 x: 25 y: 29
P index: 46 x: 25 y: 33
R index: 50 x: 23 y: 35
 $29 - 33 = -4$
 $33 - 35 = -2$
 $25 - 25 = 0$
 $25 - 23 = 2$
 $-4 / 0.5 = -8$
 $-2 / 2 = -1$
 $-8 - -1 = -7$

Q index: 43 x: 25 y: 30
P index: 47 x: 25 y: 34
R index: 51 x: 22 y: 35
 $30 - 34 = -4$
 $34 - 35 = -1$
 $25 - 25 = 0$
 $25 - 22 = 3$
 $-4 / 0.5 = -8$
 $-1 / 3 = -0.333333$
 $-8 - -0.333333 = -7.666667$

Q index: 44 x: 25 y: 31
P index: 48 x: 25 y: 35
R index: 52 x: 21 y: 35
 $31 - 35 = -4$
 $35 - 35 = 0$
 $25 - 25 = 0$
 $25 - 21 = 4$
 $-4 / 0.5 = -8$
 $0 / 4 = 0$
 $-8 - 0 = -8$

Q index: 45 x: 25 y: 32
P index: 49 x: 24 y: 35
R index: 53 x: 20 y: 35
 $32 - 35 = -3$

$35 - 35 = 0$
 $25 - 24 = 1$
 $24 - 20 = 4$
 $-3 / 1 = -3$
 $0 / 4 = -3$
 $-3 - 0 = 3$

Q index: 46 x: 25 y: 33
P index: 50 x: 23 y: 35
R index: 54 x: 19 y: 35
 $33 - 35 = -2$
 $35 - 35 = 0$
 $25 - 23 = 2$
 $23 - 19 = 4$
 $-2 / 2 = -1$
 $0 / 4 = -1$
 $-1 - 0 = 1$

Q index: 47 x: 25 y: 34
P index: 51 x: 22 y: 35
R index: 55 x: 18 y: 35
 $34 - 35 = -1$
 $35 - 35 = 0$
 $25 - 22 = 3$
 $22 - 18 = 4$
 $-1 / 3 = -0.333333$
 $0 / 4 = -0.333333$
 $-0.333333 - 0 = 0.333333$

Q index: 48 x: 25 y: 35
P index: 52 x: 21 y: 35
R index: 56 x: 17 y: 35
 $35 - 35 = 0$
 $35 - 35 = 0$
 $25 - 21 = 4$
 $21 - 17 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 49 x: 24 y: 35
P index: 53 x: 20 y: 35
R index: 57 x: 16 y: 35
 $35 - 35 = 0$
 $35 - 35 = 0$
 $24 - 20 = 4$
 $20 - 16 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 50 x: 23 y: 35
P index: 54 x: 19 y: 35
R index: 58 x: 15 y: 35
 $35 - 35 = 0$

$35 - 35 = 0$
 $23 - 19 = 4$
 $19 - 15 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 51 x: 22 y: 35
P index: 55 x: 18 y: 35
R index: 59 x: 14 y: 35
 $35 - 35 = 0$
 $35 - 35 = 0$
 $22 - 18 = 4$
 $18 - 14 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 52 x: 21 y: 35
P index: 56 x: 17 y: 35
R index: 60 x: 13 y: 35
 $35 - 35 = 0$
 $35 - 35 = 0$
 $21 - 17 = 4$
 $17 - 13 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 53 x: 20 y: 35
P index: 57 x: 16 y: 35
R index: 61 x: 12 y: 35
 $35 - 35 = 0$
 $35 - 35 = 0$
 $20 - 16 = 4$
 $16 - 12 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 54 x: 19 y: 35
P index: 58 x: 15 y: 35
R index: 62 x: 11 y: 35
 $35 - 35 = 0$
 $35 - 35 = 0$
 $19 - 15 = 4$
 $15 - 11 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 55 x: 18 y: 35
P index: 59 x: 14 y: 35
R index: 63 x: 10 y: 35
 $35 - 35 = 0$

$35 - 35 = 0$
 $18 - 14 = 4$
 $14 - 10 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 56 x: 17 y: 35
P index: 60 x: 13 y: 35
R index: 64 x: 9 y: 35
 $35 - 35 = 0$
 $35 - 35 = 0$
 $17 - 13 = 4$
 $13 - 9 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 57 x: 16 y: 35
P index: 61 x: 12 y: 35
R index: 65 x: 8 y: 35
 $35 - 35 = 0$
 $35 - 35 = 0$
 $16 - 12 = 4$
 $12 - 8 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 58 x: 15 y: 35
P index: 62 x: 11 y: 35
R index: 66 x: 7 y: 35
 $35 - 35 = 0$
 $35 - 35 = 0$
 $15 - 11 = 4$
 $11 - 7 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 59 x: 14 y: 35
P index: 63 x: 10 y: 35
R index: 67 x: 6 y: 35
 $35 - 35 = 0$
 $35 - 35 = 0$
 $14 - 10 = 4$
 $10 - 6 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 60 x: 13 y: 35
P index: 64 x: 9 y: 35
R index: 68 x: 6 y: 34
 $35 - 35 = 0$

$35 - 34 = 1$
 $13 - 9 = 4$
 $9 - 6 = 3$
 $0 / 4 = 0$
 $1 / 3 = 0$
 $0 - 0.333333 = 0.333333$

Q index: 61 x: 12 y: 35
P index: 65 x: 8 y: 35
R index: 69 x: 6 y: 33
 $35 - 35 = 0$
 $35 - 33 = 2$
 $12 - 8 = 4$
 $8 - 6 = 2$
 $0 / 4 = 0$
 $2 / 2 = 0$
 $0 - 1 = 1$

Q index: 62 x: 11 y: 35
P index: 66 x: 7 y: 35
R index: 70 x: 6 y: 32
 $35 - 35 = 0$
 $35 - 32 = 3$
 $11 - 7 = 4$
 $7 - 6 = 1$
 $0 / 4 = 0$
 $3 / 1 = 0$
 $0 - 3 = 3$

Q index: 63 x: 10 y: 35
P index: 67 x: 6 y: 35
R index: 71 x: 6 y: 31
 $35 - 35 = 0$
 $35 - 31 = 4$
 $10 - 6 = 4$
 $6 - 6 = 0$
 $0 / 4 = 0$
 $4 / 0.5 = 0$
 $0 - 8 = 8$

Q index: 64 x: 9 y: 35
P index: 68 x: 6 y: 34
R index: 72 x: 6 y: 30
 $35 - 34 = 1$
 $34 - 30 = 4$
 $9 - 6 = 3$
 $6 - 6 = 0$
 $1 / 3 = 0.333333$
 $4 / 0.5 = 0.333333$
 $0.333333 - 8 = 7.66667$

Q index: 65 x: 8 y: 35
P index: 69 x: 6 y: 33
R index: 73 x: 6 y: 29
 $35 - 33 = 2$

$33 - 29 = 4$
 $8 - 6 = 2$
 $6 - 6 = 0$
 $2 / 2 = 1$
 $4 / 0.5 = 1$
 $1 - 8 = 7$

Q index: 66 x: 7 y: 35
P index: 70 x: 6 y: 32
R index: 74 x: 6 y: 28
 $35 - 32 = 3$
 $32 - 28 = 4$
 $7 - 6 = 1$
 $6 - 6 = 0$
 $3 / 1 = 3$
 $4 / 0.5 = 3$
 $3 - 8 = 5$

Q index: 67 x: 6 y: 35
P index: 71 x: 6 y: 31
R index: 75 x: 6 y: 27
 $35 - 31 = 4$
 $31 - 27 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 68 x: 6 y: 34
P index: 72 x: 6 y: 30
R index: 76 x: 6 y: 26
 $34 - 30 = 4$
 $30 - 26 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 69 x: 6 y: 33
P index: 73 x: 6 y: 29
R index: 77 x: 6 y: 25
 $33 - 29 = 4$
 $29 - 25 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 70 x: 6 y: 32
P index: 74 x: 6 y: 28
R index: 78 x: 6 y: 24
 $32 - 28 = 4$

$28 - 24 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 71 x: 6 y: 31
P index: 75 x: 6 y: 27
R index: 79 x: 6 y: 23
 $31 - 27 = 4$
 $27 - 23 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 72 x: 6 y: 30
P index: 76 x: 6 y: 26
R index: 80 x: 6 y: 22
 $30 - 26 = 4$
 $26 - 22 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 73 x: 6 y: 29
P index: 77 x: 6 y: 25
R index: 81 x: 6 y: 21
 $29 - 25 = 4$
 $25 - 21 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 74 x: 6 y: 28
P index: 78 x: 6 y: 24
R index: 82 x: 6 y: 20
 $28 - 24 = 4$
 $24 - 20 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 75 x: 6 y: 27
P index: 79 x: 6 y: 23
R index: 83 x: 6 y: 19
 $27 - 23 = 4$

$23 - 19 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 76 x: 6 y: 26
P index: 80 x: 6 y: 22
R index: 84 x: 6 y: 18
 $26 - 22 = 4$
 $22 - 18 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 77 x: 6 y: 25
P index: 81 x: 6 y: 21
R index: 85 x: 6 y: 17
 $25 - 21 = 4$
 $21 - 17 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 78 x: 6 y: 24
P index: 82 x: 6 y: 20
R index: 86 x: 6 y: 16
 $24 - 20 = 4$
 $20 - 16 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 79 x: 6 y: 23
P index: 83 x: 6 y: 19
R index: 87 x: 6 y: 15
 $23 - 19 = 4$
 $19 - 15 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 80 x: 6 y: 22
P index: 84 x: 6 y: 18
R index: 88 x: 6 y: 14
 $22 - 18 = 4$

$18 - 14 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 81 x: 6 y: 21
P index: 85 x: 6 y: 17
R index: 89 x: 6 y: 13
 $21 - 17 = 4$
 $17 - 13 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 82 x: 6 y: 20
P index: 86 x: 6 y: 16
R index: 90 x: 6 y: 12
 $20 - 16 = 4$
 $16 - 12 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 83 x: 6 y: 19
P index: 87 x: 6 y: 15
R index: 91 x: 6 y: 11
 $19 - 15 = 4$
 $15 - 11 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 84 x: 6 y: 18
P index: 88 x: 6 y: 14
R index: 92 x: 6 y: 10
 $18 - 14 = 4$
 $14 - 10 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 85 x: 6 y: 17
P index: 89 x: 6 y: 13
R index: 93 x: 6 y: 9
 $17 - 13 = 4$

$13 - 9 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 86 x: 6 y: 16
P index: 90 x: 6 y: 12
R index: 94 x: 6 y: 8
 $16 - 12 = 4$
 $12 - 8 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 87 x: 6 y: 15
P index: 91 x: 6 y: 11
R index: 95 x: 6 y: 7
 $15 - 11 = 4$
 $11 - 7 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 88 x: 6 y: 14
P index: 92 x: 6 y: 10
R index: 0 x: 6 y: 6
 $14 - 10 = 4$
 $10 - 6 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 89 x: 6 y: 13
P index: 93 x: 6 y: 9
R index: 1 x: 7 y: 6
 $13 - 9 = 4$
 $9 - 6 = 3$
 $6 - 6 = 0$
 $6 - 7 = 1$
 $4 / 0.5 = 8$
 $3 / 1 = 3$
 $8 - 3 = 5$

Q index: 90 x: 6 y: 12
P index: 94 x: 6 y: 8
R index: 2 x: 8 y: 6
 $12 - 8 = 4$

$8 - 6 = 2$
 $6 - 6 = 0$
 $6 - 8 = 2$
 $4 / 0.5 = 8$
 $2 / 2 = 8$
 $8 - 1 = 7$

Q index: 91 x: 6 y: 11
P index: 95 x: 6 y: 7
R index: 3 x: 9 y: 6
 $11 - 7 = 4$
 $7 - 6 = 1$
 $6 - 6 = 0$
 $6 - 9 = 3$
 $4 / 0.5 = 8$
 $1 / 3 = 8$
 $8 - 0.333333 = 7.66667$

Q index: 92 x: 6 y: 10
P index: 0 x: 6 y: 6
R index: 4 x: 10 y: 6
 $10 - 6 = 4$
 $6 - 6 = 0$
 $6 - 6 = 0$
 $6 - 10 = 4$
 $4 / 0.5 = 8$
 $0 / 4 = 8$
 $8 - 0 = 8$

Q index: 93 x: 6 y: 9
P index: 1 x: 7 y: 6
R index: 5 x: 11 y: 6
 $9 - 6 = 3$
 $6 - 6 = 0$
 $6 - 7 = 1$
 $7 - 11 = 4$
 $3 / 1 = 3$
 $0 / 4 = 3$
 $3 - 0 = 3$

Q index: 94 x: 6 y: 8
P index: 2 x: 8 y: 6
R index: 6 x: 12 y: 6
 $8 - 6 = 2$
 $6 - 6 = 0$
 $6 - 8 = 2$
 $8 - 12 = 4$
 $2 / 2 = 1$
 $0 / 4 = 1$
 $1 - 0 = 1$

Q index: 95 x: 6 y: 7
P index: 3 x: 9 y: 6
R index: 7 x: 13 y: 6
 $7 - 6 = 1$

$6 - 6 = 0$
 $6 - 9 = 3$
 $9 - 13 = 4$
 $1 / 3 = 0.333333$
 $0 / 4 = 0.333333$
 $0.333333 - 0 = 0.333333$

PtAry after Corner Detection:

30 40 0 1
1
x: 6 y: 6 curvature: 8
x: 7 y: 6 curvature: 3
x: 8 y: 6 curvature: 1
x: 9 y: 6 curvature: 0.333333
x: 10 y: 6 curvature: 0
x: 11 y: 6 curvature: 0
x: 12 y: 6 curvature: 0
x: 13 y: 6 curvature: 0
x: 14 y: 6 curvature: 0
x: 15 y: 6 curvature: 0
x: 16 y: 6 curvature: 0
x: 17 y: 6 curvature: 0
x: 18 y: 6 curvature: 0
x: 19 y: 6 curvature: 0
x: 20 y: 6 curvature: 0
x: 21 y: 6 curvature: 0
x: 22 y: 6 curvature: 0.333333
x: 23 y: 6 curvature: 1
x: 24 y: 6 curvature: 3
x: 25 y: 6 curvature: 8
x: 25 y: 7 curvature: 7.66667
x: 25 y: 8 curvature: 7
x: 25 y: 9 curvature: 5
x: 25 y: 10 curvature: 0
x: 25 y: 11 curvature: 0
x: 25 y: 12 curvature: 0
x: 25 y: 13 curvature: 0
x: 25 y: 14 curvature: 0
x: 25 y: 15 curvature: 0
x: 25 y: 16 curvature: 0
x: 25 y: 17 curvature: 0
x: 25 y: 18 curvature: 0
x: 25 y: 19 curvature: 0
x: 25 y: 20 curvature: 0
x: 25 y: 21 curvature: 0
x: 25 y: 22 curvature: 0
x: 25 y: 23 curvature: 0
x: 25 y: 24 curvature: 0
x: 25 y: 25 curvature: 0
x: 25 y: 26 curvature: 0
x: 25 y: 27 curvature: 0
x: 25 y: 28 curvature: 0
x: 25 y: 29 curvature: 0
x: 25 y: 30 curvature: 0

x: 25 y: 31 curvature: 0
x: 25 y: 32 curvature: 5
x: 25 y: 33 curvature: 7
x: 25 y: 34 curvature: 7.66667
x: 25 y: 35 curvature: 8
x: 24 y: 35 curvature: 3
x: 23 y: 35 curvature: 1
x: 22 y: 35 curvature: 0.333333
x: 21 y: 35 curvature: 0
x: 20 y: 35 curvature: 0
x: 19 y: 35 curvature: 0
x: 18 y: 35 curvature: 0
x: 17 y: 35 curvature: 0
x: 16 y: 35 curvature: 0
x: 15 y: 35 curvature: 0
x: 14 y: 35 curvature: 0
x: 13 y: 35 curvature: 0
x: 12 y: 35 curvature: 0
x: 11 y: 35 curvature: 0
x: 10 y: 35 curvature: 0
x: 9 y: 35 curvature: 0.333333
x: 8 y: 35 curvature: 1
x: 7 y: 35 curvature: 3
x: 6 y: 35 curvature: 8
x: 6 y: 34 curvature: 7.66667
x: 6 y: 33 curvature: 7
x: 6 y: 32 curvature: 5
x: 6 y: 31 curvature: 0
x: 6 y: 30 curvature: 0
x: 6 y: 29 curvature: 0
x: 6 y: 28 curvature: 0
x: 6 y: 27 curvature: 0
x: 6 y: 26 curvature: 0
x: 6 y: 25 curvature: 0
x: 6 y: 24 curvature: 0
x: 6 y: 23 curvature: 0
x: 6 y: 22 curvature: 0
x: 6 y: 21 curvature: 0
x: 6 y: 20 curvature: 0
x: 6 y: 19 curvature: 0
x: 6 y: 18 curvature: 0
x: 6 y: 17 curvature: 0
x: 6 y: 16 curvature: 0
x: 6 y: 15 curvature: 0
x: 6 y: 14 curvature: 0
x: 6 y: 13 curvature: 0
x: 6 y: 12 curvature: 0
x: 6 y: 11 curvature: 0
x: 6 y: 10 curvature: 0
x: 6 y: 9 curvature: 5
x: 6 y: 8 curvature: 7
x: 6 y: 7 curvature: 7.66667

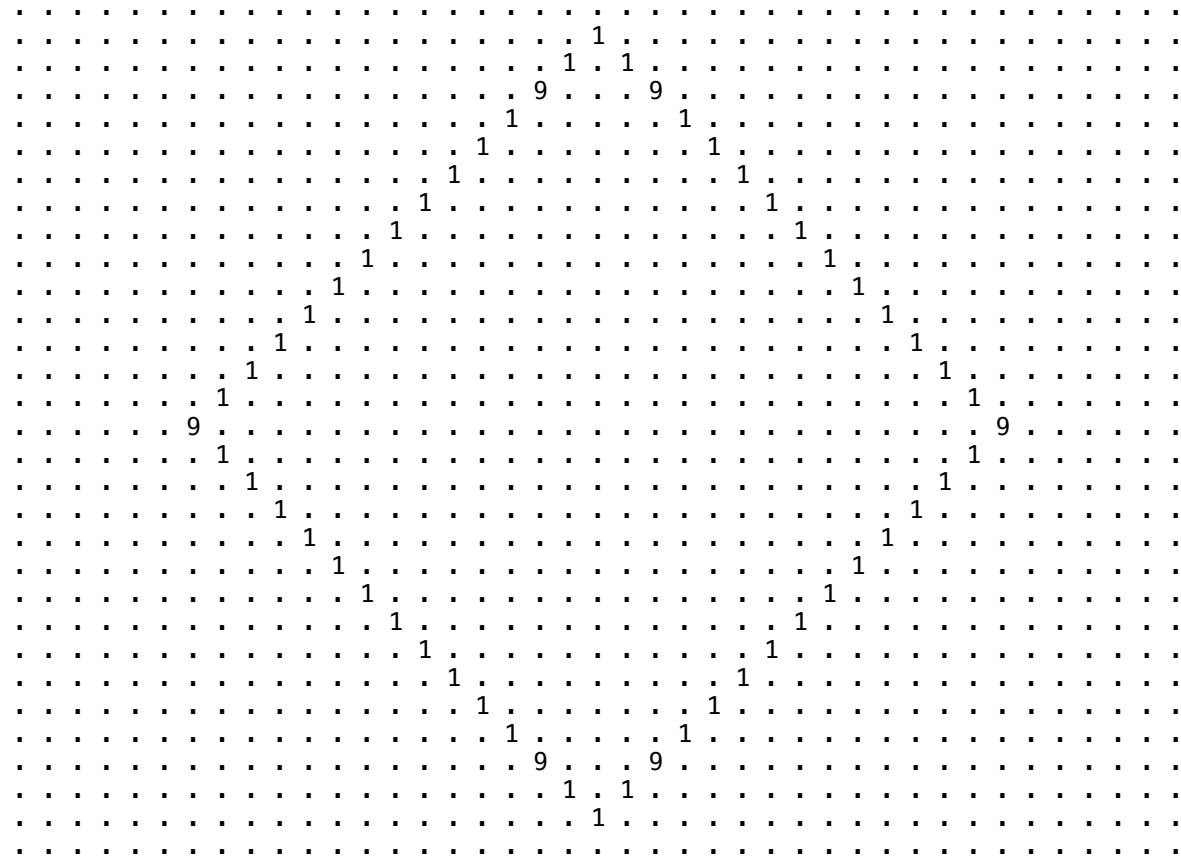
Data B Outputs:

outFile 1:

```
31 41 0 1
11 20 1
2 19 1
3 18 9
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 9
28 19 1
29 20 1
28 21 1
27 22 9
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 9
2 21 1
```

outFile 2:

31 41 0 1



outFile3(debug):

K value: 4

PtAry after initialization

40 40 0 1

1

x: 5 y: 15 curvature: 0
x: 6 y: 14 curvature: 0
x: 7 y: 13 curvature: 0
x: 8 y: 12 curvature: 0
x: 9 y: 11 curvature: 0
x: 10 y: 10 curvature: 0
x: 11 y: 9 curvature: 0
x: 12 y: 8 curvature: 0
x: 13 y: 7 curvature: 0
x: 14 y: 6 curvature: 0
x: 15 y: 5 curvature: 0
x: 16 y: 5 curvature: 0
x: 17 y: 5 curvature: 0
x: 18 y: 5 curvature: 0
x: 19 y: 5 curvature: 0
x: 20 y: 5 curvature: 0
x: 21 y: 5 curvature: 0
x: 22 y: 5 curvature: 0
x: 23 y: 5 curvature: 0
x: 24 y: 5 curvature: 0
x: 25 y: 6 curvature: 0
x: 26 y: 7 curvature: 0
x: 27 y: 8 curvature: 0
x: 28 y: 9 curvature: 0
x: 29 y: 10 curvature: 0
x: 30 y: 11 curvature: 0
x: 31 y: 12 curvature: 0
x: 32 y: 13 curvature: 0
x: 33 y: 14 curvature: 0
x: 34 y: 15 curvature: 0
x: 34 y: 16 curvature: 0
x: 34 y: 17 curvature: 0
x: 34 y: 18 curvature: 0
x: 34 y: 19 curvature: 0
x: 34 y: 20 curvature: 0
x: 34 y: 21 curvature: 0
x: 34 y: 22 curvature: 0
x: 34 y: 23 curvature: 0
x: 34 y: 24 curvature: 0
x: 33 y: 25 curvature: 0
x: 32 y: 26 curvature: 0
x: 31 y: 27 curvature: 0
x: 30 y: 28 curvature: 0
x: 29 y: 29 curvature: 0
x: 28 y: 30 curvature: 0
x: 27 y: 31 curvature: 0
x: 26 y: 32 curvature: 0
x: 25 y: 33 curvature: 0
x: 24 y: 34 curvature: 0
x: 23 y: 34 curvature: 0
x: 22 y: 34 curvature: 0
x: 21 y: 34 curvature: 0
x: 20 y: 34 curvature: 0
x: 19 y: 34 curvature: 0
x: 18 y: 34 curvature: 0

x: 17 y: 34 curvature: 0
x: 16 y: 34 curvature: 0
x: 15 y: 34 curvature: 0
x: 14 y: 33 curvature: 0
x: 13 y: 32 curvature: 0
x: 12 y: 31 curvature: 0
x: 11 y: 30 curvature: 0
x: 10 y: 29 curvature: 0
x: 9 y: 28 curvature: 0
x: 8 y: 27 curvature: 0
x: 7 y: 26 curvature: 0
x: 6 y: 25 curvature: 0
x: 5 y: 24 curvature: 0
x: 5 y: 23 curvature: 0
x: 5 y: 22 curvature: 0
x: 5 y: 21 curvature: 0
x: 5 y: 20 curvature: 0
x: 5 y: 19 curvature: 0
x: 5 y: 18 curvature: 0
x: 5 y: 17 curvature: 0
x: 5 y: 16 curvature: 0

Calculating Curvature debugging

Q index: 0 x: 5 y: 15
P index: 4 x: 9 y: 11
R index: 8 x: 13 y: 7
 $15 - 11 = 4$
 $11 - 7 = 4$
 $5 - 9 = 4$
 $9 - 13 = 4$
 $4 / 4 = 1$
 $4 / 4 = 1$
 $1 - 1 = 0$

Q index: 1 x: 6 y: 14
P index: 5 x: 10 y: 10
R index: 9 x: 14 y: 6
 $14 - 10 = 4$
 $10 - 6 = 4$
 $6 - 10 = 4$
 $10 - 14 = 4$
 $4 / 4 = 1$
 $4 / 4 = 1$
 $1 - 1 = 0$

Q index: 2 x: 7 y: 13
P index: 6 x: 11 y: 9
R index: 10 x: 15 y: 5
 $13 - 9 = 4$
 $9 - 5 = 4$
 $7 - 11 = 4$
 $11 - 15 = 4$
 $4 / 4 = 1$
 $4 / 4 = 1$
 $1 - 1 = 0$

Q index: 3 x: 8 y: 12
P index: 7 x: 12 y: 8
R index: 11 x: 16 y: 5

$12 - 8 = 4$
 $8 - 5 = 3$
 $8 - 12 = 4$
 $12 - 16 = 4$
 $4 / 4 = 1$
 $3 / 4 = 1$
 $1 - 0.75 = 0.25$

Q index: 4 x: 9 y: 11
P index: 8 x: 13 y: 7
R index: 12 x: 17 y: 5
 $11 - 7 = 4$
 $7 - 5 = 2$
 $9 - 13 = 4$
 $13 - 17 = 4$
 $4 / 4 = 1$
 $2 / 4 = 1$
 $1 - 0.5 = 0.5$

Q index: 5 x: 10 y: 10
P index: 9 x: 14 y: 6
R index: 13 x: 18 y: 5
 $10 - 6 = 4$
 $6 - 5 = 1$
 $10 - 14 = 4$
 $14 - 18 = 4$
 $4 / 4 = 1$
 $1 / 4 = 1$
 $1 - 0.25 = 0.75$

Q index: 6 x: 11 y: 9
P index: 10 x: 15 y: 5
R index: 14 x: 19 y: 5
 $9 - 5 = 4$
 $5 - 5 = 0$
 $11 - 15 = 4$
 $15 - 19 = 4$
 $4 / 4 = 1$
 $0 / 4 = 1$
 $1 - 0 = 1$

Q index: 7 x: 12 y: 8
P index: 11 x: 16 y: 5
R index: 15 x: 20 y: 5
 $8 - 5 = 3$
 $5 - 5 = 0$
 $12 - 16 = 4$
 $16 - 20 = 4$
 $3 / 4 = 0.75$
 $0 / 4 = 0.75$
 $0.75 - 0 = 0.75$

Q index: 8 x: 13 y: 7
P index: 12 x: 17 y: 5
R index: 16 x: 21 y: 5
 $7 - 5 = 2$
 $5 - 5 = 0$
 $13 - 17 = 4$
 $17 - 21 = 4$
 $2 / 4 = 0.5$
 $0 / 4 = 0.5$

$$0.5 - 0 = 0.5$$

Q index: 9 x: 14 y: 6
P index: 13 x: 18 y: 5
R index: 17 x: 22 y: 5
 $6 - 5 = 1$
 $5 - 5 = 0$
 $14 - 18 = 4$
 $18 - 22 = 4$
 $1 / 4 = 0.25$
 $0 / 4 = 0.25$
 $0.25 - 0 = 0.25$

Q index: 10 x: 15 y: 5
P index: 14 x: 19 y: 5
R index: 18 x: 23 y: 5
 $5 - 5 = 0$
 $5 - 5 = 0$
 $15 - 19 = 4$
 $19 - 23 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 11 x: 16 y: 5
P index: 15 x: 20 y: 5
R index: 19 x: 24 y: 5
 $5 - 5 = 0$
 $5 - 5 = 0$
 $16 - 20 = 4$
 $20 - 24 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 12 x: 17 y: 5
P index: 16 x: 21 y: 5
R index: 20 x: 25 y: 6
 $5 - 5 = 0$
 $5 - 6 = -1$
 $17 - 21 = 4$
 $21 - 25 = 4$
 $0 / 4 = 0$
 $-1 / 4 = 0$
 $0 - -0.25 = 0.25$

Q index: 13 x: 18 y: 5
P index: 17 x: 22 y: 5
R index: 21 x: 26 y: 7
 $5 - 5 = 0$
 $5 - 7 = -2$
 $18 - 22 = 4$
 $22 - 26 = 4$
 $0 / 4 = 0$
 $-2 / 4 = 0$
 $0 - -0.5 = 0.5$

Q index: 14 x: 19 y: 5
P index: 18 x: 23 y: 5
R index: 22 x: 27 y: 8
 $5 - 5 = 0$

$5 - 8 = -3$
 $19 - 23 = 4$
 $23 - 27 = 4$
 $0 / 4 = 0$
 $-3 / 4 = 0$
 $0 - -0.75 = 0.75$

Q index: 15 x: 20 y: 5
P index: 19 x: 24 y: 5
R index: 23 x: 28 y: 9
 $5 - 5 = 0$
 $5 - 9 = -4$
 $20 - 24 = 4$
 $24 - 28 = 4$
 $0 / 4 = 0$
 $-4 / 4 = 0$
 $0 - -1 = 1$

Q index: 16 x: 21 y: 5
P index: 20 x: 25 y: 6
R index: 24 x: 29 y: 10
 $5 - 6 = -1$
 $6 - 10 = -4$
 $21 - 25 = 4$
 $25 - 29 = 4$
 $-1 / 4 = -0.25$
 $-4 / 4 = -0.25$
 $-0.25 - -1 = 0.75$

Q index: 17 x: 22 y: 5
P index: 21 x: 26 y: 7
R index: 25 x: 30 y: 11
 $5 - 7 = -2$
 $7 - 11 = -4$
 $22 - 26 = 4$
 $26 - 30 = 4$
 $-2 / 4 = -0.5$
 $-4 / 4 = -0.5$
 $-0.5 - -1 = 0.5$

Q index: 18 x: 23 y: 5
P index: 22 x: 27 y: 8
R index: 26 x: 31 y: 12
 $5 - 8 = -3$
 $8 - 12 = -4$
 $23 - 27 = 4$
 $27 - 31 = 4$
 $-3 / 4 = -0.75$
 $-4 / 4 = -0.75$
 $-0.75 - -1 = 0.25$

Q index: 19 x: 24 y: 5
P index: 23 x: 28 y: 9
R index: 27 x: 32 y: 13
 $5 - 9 = -4$
 $9 - 13 = -4$
 $24 - 28 = 4$
 $28 - 32 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 20 x: 25 y: 6
P index: 24 x: 29 y: 10
R index: 28 x: 33 y: 14
 $6 - 10 = -4$
 $10 - 14 = -4$
 $25 - 29 = 4$
 $29 - 33 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 21 x: 26 y: 7
P index: 25 x: 30 y: 11
R index: 29 x: 34 y: 15
 $7 - 11 = -4$
 $11 - 15 = -4$
 $26 - 30 = 4$
 $30 - 34 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 22 x: 27 y: 8
P index: 26 x: 31 y: 12
R index: 30 x: 34 y: 16
 $8 - 12 = -4$
 $12 - 16 = -4$
 $27 - 31 = 4$
 $31 - 34 = 3$
 $-4 / 4 = -1$
 $-4 / 3 = -1$
 $-1 - -1.33333 = 0.333333$

Q index: 23 x: 28 y: 9
P index: 27 x: 32 y: 13
R index: 31 x: 34 y: 17
 $9 - 13 = -4$
 $13 - 17 = -4$
 $28 - 32 = 4$
 $32 - 34 = 2$
 $-4 / 4 = -1$
 $-4 / 2 = -2$
 $-1 - -2 = 1$

Q index: 24 x: 29 y: 10
P index: 28 x: 33 y: 14
R index: 32 x: 34 y: 18
 $10 - 14 = -4$
 $14 - 18 = -4$
 $29 - 33 = 4$
 $33 - 34 = 1$
 $-4 / 4 = -1$
 $-4 / 1 = -4$
 $-1 - -4 = 3$

Q index: 25 x: 30 y: 11
P index: 29 x: 34 y: 15
R index: 33 x: 34 y: 19
 $11 - 15 = -4$
 $15 - 19 = -4$

$30 - 34 = 4$
 $34 - 34 = 0$
 $-4 / 4 = -1$
 $-4 / 0.5 = -1$
 $-1 - -8 = 7$

Q index: 26 x: 31 y: 12
P index: 30 x: 34 y: 16
R index: 34 x: 34 y: 20
 $12 - 16 = -4$
 $16 - 20 = -4$
 $31 - 34 = 3$
 $34 - 34 = 0$
 $-4 / 3 = -1.33333$
 $-4 / 0.5 = -1.33333$
 $-1.33333 - -8 = 6.66667$

Q index: 27 x: 32 y: 13
P index: 31 x: 34 y: 17
R index: 35 x: 34 y: 21
 $13 - 17 = -4$
 $17 - 21 = -4$
 $32 - 34 = 2$
 $34 - 34 = 0$
 $-4 / 2 = -2$
 $-4 / 0.5 = -2$
 $-2 - -8 = 6$

Q index: 28 x: 33 y: 14
P index: 32 x: 34 y: 18
R index: 36 x: 34 y: 22
 $14 - 18 = -4$
 $18 - 22 = -4$
 $33 - 34 = 1$
 $34 - 34 = 0$
 $-4 / 1 = -4$
 $-4 / 0.5 = -4$
 $-4 - -8 = 4$

Q index: 29 x: 34 y: 15
P index: 33 x: 34 y: 19
R index: 37 x: 34 y: 23
 $15 - 19 = -4$
 $19 - 23 = -4$
 $34 - 34 = 0$
 $34 - 34 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 30 x: 34 y: 16
P index: 34 x: 34 y: 20
R index: 38 x: 34 y: 24
 $16 - 20 = -4$
 $20 - 24 = -4$
 $34 - 34 = 0$
 $34 - 34 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 31 x: 34 y: 17
P index: 35 x: 34 y: 21
R index: 39 x: 33 y: 25
 $17 - 21 = -4$
 $21 - 25 = -4$
 $34 - 34 = 0$
 $34 - 33 = 1$
 $-4 / 0.5 = -8$
 $-4 / 1 = -4$
 $-8 - -4 = -4$

Q index: 32 x: 34 y: 18
P index: 36 x: 34 y: 22
R index: 40 x: 32 y: 26
 $18 - 22 = -4$
 $22 - 26 = -4$
 $34 - 34 = 0$
 $34 - 32 = 2$
 $-4 / 0.5 = -8$
 $-4 / 2 = -2$
 $-8 - -2 = -6$

Q index: 33 x: 34 y: 19
P index: 37 x: 34 y: 23
R index: 41 x: 31 y: 27
 $19 - 23 = -4$
 $23 - 27 = -4$
 $34 - 34 = 0$
 $34 - 31 = 3$
 $-4 / 0.5 = -8$
 $-4 / 3 = -1.33333$
 $-8 - -1.33333 = -6.66667$

Q index: 34 x: 34 y: 20
P index: 38 x: 34 y: 24
R index: 42 x: 30 y: 28
 $20 - 24 = -4$
 $24 - 28 = -4$
 $34 - 34 = 0$
 $34 - 30 = 4$
 $-4 / 0.5 = -8$
 $-4 / 4 = -1$
 $-8 - -1 = -7$

Q index: 35 x: 34 y: 21
P index: 39 x: 33 y: 25
R index: 43 x: 29 y: 29
 $21 - 25 = -4$
 $25 - 29 = -4$
 $34 - 33 = 1$
 $33 - 29 = 4$
 $-4 / 1 = -4$
 $-4 / 4 = -1$
 $-4 - -1 = -3$

Q index: 36 x: 34 y: 22
P index: 40 x: 32 y: 26
R index: 44 x: 28 y: 30
 $22 - 26 = -4$
 $26 - 30 = -4$
 $34 - 32 = 2$

$32 - 28 = 4$
 $-4 / 2 = -2$
 $-4 / 4 = -2$
 $-2 - -1 = 1$

Q index: 37 x: 34 y: 23
P index: 41 x: 31 y: 27
R index: 45 x: 27 y: 31
 $23 - 27 = -4$
 $27 - 31 = -4$
 $34 - 31 = 3$
 $31 - 27 = 4$
 $-4 / 3 = -1.33333$
 $-4 / 4 = -1.33333$
 $-1.33333 - -1 = 0.33333$

Q index: 38 x: 34 y: 24
P index: 42 x: 30 y: 28
R index: 46 x: 26 y: 32
 $24 - 28 = -4$
 $28 - 32 = -4$
 $34 - 30 = 4$
 $30 - 26 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 39 x: 33 y: 25
P index: 43 x: 29 y: 29
R index: 47 x: 25 y: 33
 $25 - 29 = -4$
 $29 - 33 = -4$
 $33 - 29 = 4$
 $29 - 25 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 40 x: 32 y: 26
P index: 44 x: 28 y: 30
R index: 48 x: 24 y: 34
 $26 - 30 = -4$
 $30 - 34 = -4$
 $32 - 28 = 4$
 $28 - 24 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 41 x: 31 y: 27
P index: 45 x: 27 y: 31
R index: 49 x: 23 y: 34
 $27 - 31 = -4$
 $31 - 34 = -3$
 $31 - 27 = 4$
 $27 - 23 = 4$
 $-4 / 4 = -1$
 $-3 / 4 = -1$
 $-1 - -0.75 = 0.25$

Q index: 42 x: 30 y: 28

P index: 46 x: 26 y: 32
R index: 50 x: 22 y: 34
 $28 - 32 = -4$
 $32 - 34 = -2$
 $30 - 26 = 4$
 $26 - 22 = 4$
 $-4 / 4 = -1$
 $-2 / 4 = -1$
 $-1 - -0.5 = 0.5$

Q index: 43 x: 29 y: 29
P index: 47 x: 25 y: 33
R index: 51 x: 21 y: 34
 $29 - 33 = -4$
 $33 - 34 = -1$
 $29 - 25 = 4$
 $25 - 21 = 4$
 $-4 / 4 = -1$
 $-1 / 4 = -1$
 $-1 - -0.25 = 0.75$

Q index: 44 x: 28 y: 30
P index: 48 x: 24 y: 34
R index: 52 x: 20 y: 34
 $30 - 34 = -4$
 $34 - 34 = 0$
 $28 - 24 = 4$
 $24 - 20 = 4$
 $-4 / 4 = -1$
 $0 / 4 = -1$
 $-1 - 0 = 1$

Q index: 45 x: 27 y: 31
P index: 49 x: 23 y: 34
R index: 53 x: 19 y: 34
 $31 - 34 = -3$
 $34 - 34 = 0$
 $27 - 23 = 4$
 $23 - 19 = 4$
 $-3 / 4 = -0.75$
 $0 / 4 = -0.75$
 $-0.75 - 0 = 0.75$

Q index: 46 x: 26 y: 32
P index: 50 x: 22 y: 34
R index: 54 x: 18 y: 34
 $32 - 34 = -2$
 $34 - 34 = 0$
 $26 - 22 = 4$
 $22 - 18 = 4$
 $-2 / 4 = -0.5$
 $0 / 4 = -0.5$
 $-0.5 - 0 = 0.5$

Q index: 47 x: 25 y: 33
P index: 51 x: 21 y: 34
R index: 55 x: 17 y: 34
 $33 - 34 = -1$
 $34 - 34 = 0$
 $25 - 21 = 4$
 $21 - 17 = 4$

$-1 / 4 = -0.25$
 $0 / 4 = -0.25$
 $-0.25 - 0 = 0.25$

Q index: 48 x: 24 y: 34
P index: 52 x: 20 y: 34
R index: 56 x: 16 y: 34
 $34 - 34 = 0$
 $34 - 34 = 0$
 $24 - 20 = 4$
 $20 - 16 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 49 x: 23 y: 34
P index: 53 x: 19 y: 34
R index: 57 x: 15 y: 34
 $34 - 34 = 0$
 $34 - 34 = 0$
 $23 - 19 = 4$
 $19 - 15 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 50 x: 22 y: 34
P index: 54 x: 18 y: 34
R index: 58 x: 14 y: 33
 $34 - 34 = 0$
 $34 - 33 = 1$
 $22 - 18 = 4$
 $18 - 14 = 4$
 $0 / 4 = 0$
 $1 / 4 = 0$
 $0 - 0.25 = 0.25$

Q index: 51 x: 21 y: 34
P index: 55 x: 17 y: 34
R index: 59 x: 13 y: 32
 $34 - 34 = 0$
 $34 - 32 = 2$
 $21 - 17 = 4$
 $17 - 13 = 4$
 $0 / 4 = 0$
 $2 / 4 = 0$
 $0 - 0.5 = 0.5$

Q index: 52 x: 20 y: 34
P index: 56 x: 16 y: 34
R index: 60 x: 12 y: 31
 $34 - 34 = 0$
 $34 - 31 = 3$
 $20 - 16 = 4$
 $16 - 12 = 4$
 $0 / 4 = 0$
 $3 / 4 = 0$
 $0 - 0.75 = 0.75$

Q index: 53 x: 19 y: 34
P index: 57 x: 15 y: 34

R index: 61 x: 11 y: 30
 $34 - 34 = 0$
 $34 - 30 = 4$
 $19 - 15 = 4$
 $15 - 11 = 4$
 $0 / 4 = 0$
 $4 / 4 = 0$
 $0 - 1 = 1$

Q index: 54 x: 18 y: 34
P index: 58 x: 14 y: 33
R index: 62 x: 10 y: 29
 $34 - 33 = 1$
 $33 - 29 = 4$
 $18 - 14 = 4$
 $14 - 10 = 4$
 $1 / 4 = 0.25$
 $4 / 4 = 0.25$
 $0.25 - 1 = 0.75$

Q index: 55 x: 17 y: 34
P index: 59 x: 13 y: 32
R index: 63 x: 9 y: 28
 $34 - 32 = 2$
 $32 - 28 = 4$
 $17 - 13 = 4$
 $13 - 9 = 4$
 $2 / 4 = 0.5$
 $4 / 4 = 0.5$
 $0.5 - 1 = 0.5$

Q index: 56 x: 16 y: 34
P index: 60 x: 12 y: 31
R index: 64 x: 8 y: 27
 $34 - 31 = 3$
 $31 - 27 = 4$
 $16 - 12 = 4$
 $12 - 8 = 4$
 $3 / 4 = 0.75$
 $4 / 4 = 0.75$
 $0.75 - 1 = 0.25$

Q index: 57 x: 15 y: 34
P index: 61 x: 11 y: 30
R index: 65 x: 7 y: 26
 $34 - 30 = 4$
 $30 - 26 = 4$
 $15 - 11 = 4$
 $11 - 7 = 4$
 $4 / 4 = 1$
 $4 / 4 = 1$
 $1 - 1 = 0$

Q index: 58 x: 14 y: 33
P index: 62 x: 10 y: 29
R index: 66 x: 6 y: 25
 $33 - 29 = 4$
 $29 - 25 = 4$
 $14 - 10 = 4$
 $10 - 6 = 4$
 $4 / 4 = 1$

$$4 / 4 = 1$$

$$1 - 1 = 0$$

Q index: 59 x: 13 y: 32
P index: 63 x: 9 y: 28
R index: 67 x: 5 y: 24
 $32 - 28 = 4$
 $28 - 24 = 4$
 $13 - 9 = 4$
 $9 - 5 = 4$
 $4 / 4 = 1$
 $4 / 4 = 1$
 $1 - 1 = 0$

Q index: 60 x: 12 y: 31
P index: 64 x: 8 y: 27
R index: 68 x: 5 y: 23
 $31 - 27 = 4$
 $27 - 23 = 4$
 $12 - 8 = 4$
 $8 - 5 = 3$
 $4 / 4 = 1$
 $4 / 3 = 1$
 $1 - 1.33333 = 0.333333$

Q index: 61 x: 11 y: 30
P index: 65 x: 7 y: 26
R index: 69 x: 5 y: 22
 $30 - 26 = 4$
 $26 - 22 = 4$
 $11 - 7 = 4$
 $7 - 5 = 2$
 $4 / 4 = 1$
 $4 / 2 = 1$
 $1 - 2 = 1$

Q index: 62 x: 10 y: 29
P index: 66 x: 6 y: 25
R index: 70 x: 5 y: 21
 $29 - 25 = 4$
 $25 - 21 = 4$
 $10 - 6 = 4$
 $6 - 5 = 1$
 $4 / 4 = 1$
 $4 / 1 = 1$
 $1 - 4 = 3$

Q index: 63 x: 9 y: 28
P index: 67 x: 5 y: 24
R index: 71 x: 5 y: 20
 $28 - 24 = 4$
 $24 - 20 = 4$
 $9 - 5 = 4$
 $5 - 5 = 0$
 $4 / 4 = 1$
 $4 / 0.5 = 1$
 $1 - 8 = 7$

Q index: 64 x: 8 y: 27
P index: 68 x: 5 y: 23
R index: 72 x: 5 y: 19

$27 - 23 = 4$
 $23 - 19 = 4$
 $8 - 5 = 3$
 $5 - 5 = 0$
 $4 / 3 = 1.33333$
 $4 / 0.5 = 1.33333$
 $1.33333 - 8 = 6.66667$

Q index: 65 x: 7 y: 26
P index: 69 x: 5 y: 22
R index: 73 x: 5 y: 18
 $26 - 22 = 4$
 $22 - 18 = 4$
 $7 - 5 = 2$
 $5 - 5 = 0$
 $4 / 2 = 2$
 $4 / 0.5 = 2$
 $2 - 8 = 6$

Q index: 66 x: 6 y: 25
P index: 70 x: 5 y: 21
R index: 74 x: 5 y: 17
 $25 - 21 = 4$
 $21 - 17 = 4$
 $6 - 5 = 1$
 $5 - 5 = 0$
 $4 / 1 = 4$
 $4 / 0.5 = 4$
 $4 - 8 = 4$

Q index: 67 x: 5 y: 24
P index: 71 x: 5 y: 20
R index: 75 x: 5 y: 16
 $24 - 20 = 4$
 $20 - 16 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 68 x: 5 y: 23
P index: 72 x: 5 y: 19
R index: 0 x: 5 y: 15
 $23 - 19 = 4$
 $19 - 15 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 69 x: 5 y: 22
P index: 73 x: 5 y: 18
R index: 1 x: 6 y: 14
 $22 - 18 = 4$
 $18 - 14 = 4$
 $5 - 5 = 0$
 $5 - 6 = 1$
 $4 / 0.5 = 8$
 $4 / 1 = 8$

$$8 - 4 = 4$$

Q index: 70 x: 5 y: 21

P index: 74 x: 5 y: 17

R index: 2 x: 7 y: 13

$$21 - 17 = 4$$

$$17 - 13 = 4$$

$$5 - 5 = 0$$

$$5 - 7 = 2$$

$$4 / 0.5 = 8$$

$$4 / 2 = 8$$

$$8 - 2 = 6$$

Q index: 71 x: 5 y: 20

P index: 75 x: 5 y: 16

R index: 3 x: 8 y: 12

$$20 - 16 = 4$$

$$16 - 12 = 4$$

$$5 - 5 = 0$$

$$5 - 8 = 3$$

$$4 / 0.5 = 8$$

$$4 / 3 = 8$$

$$8 - 1.33333 = 6.66667$$

Q index: 72 x: 5 y: 19

P index: 0 x: 5 y: 15

R index: 4 x: 9 y: 11

$$19 - 15 = 4$$

$$15 - 11 = 4$$

$$5 - 5 = 0$$

$$5 - 9 = 4$$

$$4 / 0.5 = 8$$

$$4 / 4 = 8$$

$$8 - 1 = 7$$

Q index: 73 x: 5 y: 18

P index: 1 x: 6 y: 14

R index: 5 x: 10 y: 10

$$18 - 14 = 4$$

$$14 - 10 = 4$$

$$5 - 6 = 1$$

$$6 - 10 = 4$$

$$4 / 1 = 4$$

$$4 / 4 = 4$$

$$4 - 1 = 3$$

Q index: 74 x: 5 y: 17

P index: 2 x: 7 y: 13

R index: 6 x: 11 y: 9

$$17 - 13 = 4$$

$$13 - 9 = 4$$

$$5 - 7 = 2$$

$$7 - 11 = 4$$

$$4 / 2 = 2$$

$$4 / 4 = 2$$

$$2 - 1 = 1$$

Q index: 75 x: 5 y: 16

P index: 3 x: 8 y: 12

R index: 7 x: 12 y: 8

$$16 - 12 = 4$$

$12 - 8 = 4$
 $5 - 8 = 3$
 $8 - 12 = 4$
 $4 / 3 = 1.33333$
 $4 / 4 = 1.33333$
 $1.33333 - 1 = 0.333333$

PtAry after Corner Detection

40 40 0 1

1

x: 5 y: 15 curvature: 7
x: 6 y: 14 curvature: 3
x: 7 y: 13 curvature: 1
x: 8 y: 12 curvature: 0.333333
x: 9 y: 11 curvature: 0
x: 10 y: 10 curvature: 0
x: 11 y: 9 curvature: 0
x: 12 y: 8 curvature: 0.25
x: 13 y: 7 curvature: 0.5
x: 14 y: 6 curvature: 0.75
x: 15 y: 5 curvature: 1
x: 16 y: 5 curvature: 0.75
x: 17 y: 5 curvature: 0.5
x: 18 y: 5 curvature: 0.25
x: 19 y: 5 curvature: 0
x: 20 y: 5 curvature: 0
x: 21 y: 5 curvature: 0.25
x: 22 y: 5 curvature: 0.5
x: 23 y: 5 curvature: 0.75
x: 24 y: 5 curvature: 1
x: 25 y: 6 curvature: 0.75
x: 26 y: 7 curvature: 0.5
x: 27 y: 8 curvature: 0.25
x: 28 y: 9 curvature: 0
x: 29 y: 10 curvature: 0
x: 30 y: 11 curvature: 0
x: 31 y: 12 curvature: 0.333333
x: 32 y: 13 curvature: 1
x: 33 y: 14 curvature: 3
x: 34 y: 15 curvature: 7
x: 34 y: 16 curvature: 6.66667
x: 34 y: 17 curvature: 6
x: 34 y: 18 curvature: 4
x: 34 y: 19 curvature: 0
x: 34 y: 20 curvature: 0
x: 34 y: 21 curvature: 4
x: 34 y: 22 curvature: 6
x: 34 y: 23 curvature: 6.66667
x: 34 y: 24 curvature: 7
x: 33 y: 25 curvature: 3
x: 32 y: 26 curvature: 1
x: 31 y: 27 curvature: 0.333333
x: 30 y: 28 curvature: 0
x: 29 y: 29 curvature: 0
x: 28 y: 30 curvature: 0
x: 27 y: 31 curvature: 0.25
x: 26 y: 32 curvature: 0.5
x: 25 y: 33 curvature: 0.75
x: 24 y: 34 curvature: 1
x: 23 y: 34 curvature: 0.75

x: 22 y: 34 curvature: 0.5
x: 21 y: 34 curvature: 0.25
x: 20 y: 34 curvature: 0
x: 19 y: 34 curvature: 0
x: 18 y: 34 curvature: 0.25
x: 17 y: 34 curvature: 0.5
x: 16 y: 34 curvature: 0.75
x: 15 y: 34 curvature: 1
x: 14 y: 33 curvature: 0.75
x: 13 y: 32 curvature: 0.5
x: 12 y: 31 curvature: 0.25
x: 11 y: 30 curvature: 0
x: 10 y: 29 curvature: 0
x: 9 y: 28 curvature: 0
x: 8 y: 27 curvature: 0.333333
x: 7 y: 26 curvature: 1
x: 6 y: 25 curvature: 3
x: 5 y: 24 curvature: 7
x: 5 y: 23 curvature: 6.66667
x: 5 y: 22 curvature: 6
x: 5 y: 21 curvature: 4
x: 5 y: 20 curvature: 0
x: 5 y: 19 curvature: 0
x: 5 y: 18 curvature: 4
x: 5 y: 17 curvature: 6
x: 5 y: 16 curvature: 6.66667

Data C Outputs:

outFile 1:

```
40 40 0 1
15 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

40 40 0 1

[illegible]

outFile3(debug):

K value: 4

PtAry after initialization

40 40 0 1

1

x: 5 y: 5 curvature: 0
x: 6 y: 5 curvature: 0
x: 7 y: 5 curvature: 0
x: 8 y: 5 curvature: 0
x: 9 y: 5 curvature: 0
x: 10 y: 5 curvature: 0
x: 11 y: 5 curvature: 0
x: 12 y: 5 curvature: 0
x: 13 y: 5 curvature: 0
x: 14 y: 5 curvature: 0
x: 15 y: 5 curvature: 0
x: 16 y: 6 curvature: 0
x: 17 y: 7 curvature: 0
x: 18 y: 8 curvature: 0
x: 19 y: 9 curvature: 0
x: 20 y: 10 curvature: 0
x: 21 y: 9 curvature: 0
x: 22 y: 8 curvature: 0
x: 23 y: 7 curvature: 0
x: 24 y: 6 curvature: 0
x: 25 y: 5 curvature: 0
x: 26 y: 5 curvature: 0
x: 27 y: 5 curvature: 0
x: 28 y: 5 curvature: 0
x: 29 y: 5 curvature: 0
x: 30 y: 5 curvature: 0
x: 31 y: 5 curvature: 0
x: 32 y: 5 curvature: 0
x: 33 y: 5 curvature: 0
x: 34 y: 5 curvature: 0
x: 35 y: 5 curvature: 0
x: 35 y: 6 curvature: 0
x: 35 y: 7 curvature: 0
x: 35 y: 8 curvature: 0
x: 35 y: 9 curvature: 0
x: 35 y: 10 curvature: 0
x: 35 y: 11 curvature: 0
x: 35 y: 12 curvature: 0
x: 35 y: 13 curvature: 0
x: 35 y: 14 curvature: 0
x: 35 y: 15 curvature: 0
x: 35 y: 16 curvature: 0
x: 35 y: 17 curvature: 0
x: 35 y: 18 curvature: 0
x: 35 y: 19 curvature: 0
x: 35 y: 20 curvature: 0
x: 35 y: 21 curvature: 0
x: 35 y: 22 curvature: 0
x: 35 y: 23 curvature: 0

x: 35 y: 24 curvature: 0
x: 35 y: 25 curvature: 0
x: 35 y: 26 curvature: 0
x: 35 y: 27 curvature: 0
x: 35 y: 28 curvature: 0
x: 35 y: 29 curvature: 0
x: 34 y: 29 curvature: 0
x: 33 y: 29 curvature: 0
x: 32 y: 29 curvature: 0
x: 31 y: 29 curvature: 0
x: 30 y: 29 curvature: 0
x: 29 y: 29 curvature: 0
x: 28 y: 29 curvature: 0
x: 27 y: 29 curvature: 0
x: 26 y: 29 curvature: 0
x: 25 y: 29 curvature: 0
x: 24 y: 30 curvature: 0
x: 23 y: 31 curvature: 0
x: 22 y: 32 curvature: 0
x: 21 y: 33 curvature: 0
x: 20 y: 34 curvature: 0
x: 19 y: 33 curvature: 0
x: 18 y: 32 curvature: 0
x: 17 y: 31 curvature: 0
x: 16 y: 30 curvature: 0
x: 15 y: 29 curvature: 0
x: 14 y: 29 curvature: 0
x: 13 y: 29 curvature: 0
x: 12 y: 29 curvature: 0
x: 11 y: 29 curvature: 0
x: 10 y: 29 curvature: 0
x: 9 y: 29 curvature: 0
x: 8 y: 29 curvature: 0
x: 7 y: 29 curvature: 0
x: 6 y: 29 curvature: 0
x: 5 y: 29 curvature: 0
x: 5 y: 28 curvature: 0
x: 5 y: 27 curvature: 0
x: 5 y: 26 curvature: 0
x: 5 y: 25 curvature: 0
x: 5 y: 24 curvature: 0
x: 5 y: 23 curvature: 0
x: 5 y: 22 curvature: 0
x: 5 y: 21 curvature: 0
x: 5 y: 20 curvature: 0
x: 5 y: 19 curvature: 0
x: 5 y: 18 curvature: 0
x: 5 y: 17 curvature: 0
x: 5 y: 16 curvature: 0
x: 5 y: 15 curvature: 0
x: 5 y: 14 curvature: 0
x: 5 y: 13 curvature: 0
x: 5 y: 12 curvature: 0
x: 5 y: 11 curvature: 0
x: 5 y: 10 curvature: 0

x: 5 y: 9 curvature: 0
x: 5 y: 8 curvature: 0
x: 5 y: 7 curvature: 0
x: 5 y: 6 curvature: 0

Calculating Curvature debugging

Q index: 0 x: 5 y: 5
P index: 4 x: 9 y: 5
R index: 8 x: 13 y: 5
 $5 - 5 = 0$
 $5 - 5 = 0$
 $5 - 9 = 4$
 $9 - 13 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 1 x: 6 y: 5
P index: 5 x: 10 y: 5
R index: 9 x: 14 y: 5
 $5 - 5 = 0$
 $5 - 5 = 0$
 $6 - 10 = 4$
 $10 - 14 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 2 x: 7 y: 5
P index: 6 x: 11 y: 5
R index: 10 x: 15 y: 5
 $5 - 5 = 0$
 $5 - 5 = 0$
 $7 - 11 = 4$
 $11 - 15 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 3 x: 8 y: 5
P index: 7 x: 12 y: 5
R index: 11 x: 16 y: 6
 $5 - 5 = 0$
 $5 - 6 = -1$
 $8 - 12 = 4$
 $12 - 16 = 4$
 $0 / 4 = 0$
 $-1 / 4 = 0$
 $0 - -0.25 = 0.25$

Q index: 4 x: 9 y: 5
P index: 8 x: 13 y: 5
R index: 12 x: 17 y: 7

$5 - 5 = 0$
 $5 - 7 = -2$
 $9 - 13 = 4$
 $13 - 17 = 4$
 $0 / 4 = 0$
 $-2 / 4 = 0$
 $0 - -0.5 = 0.5$

Q index: 5 x: 10 y: 5
P index: 9 x: 14 y: 5
R index: 13 x: 18 y: 8
 $5 - 5 = 0$
 $5 - 8 = -3$
 $10 - 14 = 4$
 $14 - 18 = 4$
 $0 / 4 = 0$
 $-3 / 4 = 0$
 $0 - -0.75 = 0.75$

Q index: 6 x: 11 y: 5
P index: 10 x: 15 y: 5
R index: 14 x: 19 y: 9
 $5 - 5 = 0$
 $5 - 9 = -4$
 $11 - 15 = 4$
 $15 - 19 = 4$
 $0 / 4 = 0$
 $-4 / 4 = 0$
 $0 - -1 = 1$

Q index: 7 x: 12 y: 5
P index: 11 x: 16 y: 6
R index: 15 x: 20 y: 10
 $5 - 6 = -1$
 $6 - 10 = -4$
 $12 - 16 = 4$
 $16 - 20 = 4$
 $-1 / 4 = -0.25$
 $-4 / 4 = -0.25$
 $-0.25 - -1 = 0.75$

Q index: 8 x: 13 y: 5
P index: 12 x: 17 y: 7
R index: 16 x: 21 y: 9
 $5 - 7 = -2$
 $7 - 9 = -2$
 $13 - 17 = 4$
 $17 - 21 = 4$
 $-2 / 4 = -0.5$
 $-2 / 4 = -0.5$
 $-0.5 - -0.5 = 0$

Q index: 9 x: 14 y: 5
P index: 13 x: 18 y: 8
R index: 17 x: 22 y: 8

$$\begin{aligned}
5 - 8 &= -3 \\
8 - 8 &= 0 \\
14 - 18 &= -4 \\
18 - 22 &= -4 \\
-3 / 4 &= -0.75 \\
0 / 4 &= 0 \\
-0.75 - 0 &= -0.75
\end{aligned}$$

$$\begin{aligned}
Q \text{ index: } 10 \text{ x: } 15 \text{ y: } 5 \\
P \text{ index: } 14 \text{ x: } 19 \text{ y: } 9 \\
R \text{ index: } 18 \text{ x: } 23 \text{ y: } 7 \\
5 - 9 &= -4 \\
9 - 7 &= 2 \\
15 - 19 &= -4 \\
19 - 23 &= -4 \\
-4 / 4 &= -1 \\
2 / 4 &= 0.5 \\
-1 - 0.5 &= -1.5
\end{aligned}$$

$$\begin{aligned}
Q \text{ index: } 11 \text{ x: } 16 \text{ y: } 6 \\
P \text{ index: } 15 \text{ x: } 20 \text{ y: } 10 \\
R \text{ index: } 19 \text{ x: } 24 \text{ y: } 6 \\
6 - 10 &= -4 \\
10 - 6 &= 4 \\
16 - 20 &= -4 \\
20 - 24 &= -4 \\
-4 / 4 &= -1 \\
4 / 4 &= 1 \\
-1 - 1 &= -2
\end{aligned}$$

$$\begin{aligned}
Q \text{ index: } 12 \text{ x: } 17 \text{ y: } 7 \\
P \text{ index: } 16 \text{ x: } 21 \text{ y: } 9 \\
R \text{ index: } 20 \text{ x: } 25 \text{ y: } 5 \\
7 - 9 &= -2 \\
9 - 5 &= 4 \\
17 - 21 &= -4 \\
21 - 25 &= -4 \\
-2 / 4 &= -0.5 \\
4 / 4 &= 1 \\
-0.5 - 1 &= -1.5
\end{aligned}$$

$$\begin{aligned}
Q \text{ index: } 13 \text{ x: } 18 \text{ y: } 8 \\
P \text{ index: } 17 \text{ x: } 22 \text{ y: } 8 \\
R \text{ index: } 21 \text{ x: } 26 \text{ y: } 5 \\
8 - 8 &= 0 \\
8 - 5 &= 3 \\
18 - 22 &= -4 \\
22 - 26 &= -4 \\
0 / 4 &= 0 \\
3 / 4 &= 0.75 \\
0 - 0.75 &= -0.75
\end{aligned}$$

$$\begin{aligned}
Q \text{ index: } 14 \text{ x: } 19 \text{ y: } 9 \\
P \text{ index: } 18 \text{ x: } 23 \text{ y: } 7 \\
R \text{ index: } 22 \text{ x: } 27 \text{ y: } 5
\end{aligned}$$

$$\begin{aligned}
9 - 7 &= 2 \\
7 - 5 &= 2 \\
19 - 23 &= 4 \\
23 - 27 &= 4 \\
2 / 4 &= 0.5 \\
2 / 4 &= 0.5 \\
0.5 - 0.5 &= 0
\end{aligned}$$

$$\begin{aligned}
&\text{Q index: 15 x: 20 y: 10} \\
&\text{P index: 19 x: 24 y: 6} \\
&\text{R index: 23 x: 28 y: 5} \\
10 - 6 &= 4 \\
6 - 5 &= 1 \\
20 - 24 &= 4 \\
24 - 28 &= 4 \\
4 / 4 &= 1 \\
1 / 4 &= 1 \\
1 - 0.25 &= 0.75
\end{aligned}$$

$$\begin{aligned}
&\text{Q index: 16 x: 21 y: 9} \\
&\text{P index: 20 x: 25 y: 5} \\
&\text{R index: 24 x: 29 y: 5} \\
9 - 5 &= 4 \\
5 - 5 &= 0 \\
21 - 25 &= 4 \\
25 - 29 &= 4 \\
4 / 4 &= 1 \\
0 / 4 &= 1 \\
1 - 0 &= 1
\end{aligned}$$

$$\begin{aligned}
&\text{Q index: 17 x: 22 y: 8} \\
&\text{P index: 21 x: 26 y: 5} \\
&\text{R index: 25 x: 30 y: 5} \\
8 - 5 &= 3 \\
5 - 5 &= 0 \\
22 - 26 &= 4 \\
26 - 30 &= 4 \\
3 / 4 &= 0.75 \\
0 / 4 &= 0.75 \\
0.75 - 0 &= 0.75
\end{aligned}$$

$$\begin{aligned}
&\text{Q index: 18 x: 23 y: 7} \\
&\text{P index: 22 x: 27 y: 5} \\
&\text{R index: 26 x: 31 y: 5} \\
7 - 5 &= 2 \\
5 - 5 &= 0 \\
23 - 27 &= 4 \\
27 - 31 &= 4 \\
2 / 4 &= 0.5 \\
0 / 4 &= 0.5 \\
0.5 - 0 &= 0.5
\end{aligned}$$

$$\begin{aligned}
&\text{Q index: 19 x: 24 y: 6} \\
&\text{P index: 23 x: 28 y: 5} \\
&\text{R index: 27 x: 32 y: 5}
\end{aligned}$$

$6 - 5 = 1$
 $5 - 5 = 0$
 $24 - 28 = 4$
 $28 - 32 = 4$
 $1 / 4 = 0.25$
 $0 / 4 = 0.25$
 $0.25 - 0 = 0.25$

Q index: 20 x: 25 y: 5
P index: 24 x: 29 y: 5
R index: 28 x: 33 y: 5
 $5 - 5 = 0$
 $5 - 5 = 0$
 $25 - 29 = 4$
 $29 - 33 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 21 x: 26 y: 5
P index: 25 x: 30 y: 5
R index: 29 x: 34 y: 5
 $5 - 5 = 0$
 $5 - 5 = 0$
 $26 - 30 = 4$
 $30 - 34 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 22 x: 27 y: 5
P index: 26 x: 31 y: 5
R index: 30 x: 35 y: 5
 $5 - 5 = 0$
 $5 - 5 = 0$
 $27 - 31 = 4$
 $31 - 35 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 23 x: 28 y: 5
P index: 27 x: 32 y: 5
R index: 31 x: 35 y: 6
 $5 - 5 = 0$
 $5 - 6 = -1$
 $28 - 32 = 4$
 $32 - 35 = 3$
 $0 / 4 = 0$
 $-1 / 3 = 0$
 $0 - -0.333333 = 0.333333$

Q index: 24 x: 29 y: 5
P index: 28 x: 33 y: 5
R index: 32 x: 35 y: 7

$5 - 5 = 0$
 $5 - 7 = -2$
 $29 - 33 = 4$
 $33 - 35 = 2$
 $0 / 4 = 0$
 $-2 / 2 = 0$
 $0 - -1 = 1$

Q index: 25 x: 30 y: 5
P index: 29 x: 34 y: 5
R index: 33 x: 35 y: 8
 $5 - 5 = 0$
 $5 - 8 = -3$
 $30 - 34 = 4$
 $34 - 35 = 1$
 $0 / 4 = 0$
 $-3 / 1 = 0$
 $0 - -3 = 3$

Q index: 26 x: 31 y: 5
P index: 30 x: 35 y: 5
R index: 34 x: 35 y: 9
 $5 - 5 = 0$
 $5 - 9 = -4$
 $31 - 35 = 4$
 $35 - 35 = 0$
 $0 / 4 = 0$
 $-4 / 0.5 = 0$
 $0 - -8 = 8$

Q index: 27 x: 32 y: 5
P index: 31 x: 35 y: 6
R index: 35 x: 35 y: 10
 $5 - 6 = -1$
 $6 - 10 = -4$
 $32 - 35 = 3$
 $35 - 35 = 0$
 $-1 / 3 = -0.333333$
 $-4 / 0.5 = -0.333333$
 $-0.333333 - -8 = 7.66667$

Q index: 28 x: 33 y: 5
P index: 32 x: 35 y: 7
R index: 36 x: 35 y: 11
 $5 - 7 = -2$
 $7 - 11 = -4$
 $33 - 35 = 2$
 $35 - 35 = 0$
 $-2 / 2 = -1$
 $-4 / 0.5 = -1$
 $-1 - -8 = 7$

Q index: 29 x: 34 y: 5
P index: 33 x: 35 y: 8
R index: 37 x: 35 y: 12

$5 - 8 = -3$
 $8 - 12 = -4$
 $34 - 35 = 1$
 $35 - 35 = 0$
 $-3 / 1 = -3$
 $-4 / 0.5 = -8$
 $-3 - -8 = 5$

Q index: 30 x: 35 y: 5
P index: 34 x: 35 y: 9
R index: 38 x: 35 y: 13
 $5 - 9 = -4$
 $9 - 13 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 31 x: 35 y: 6
P index: 35 x: 35 y: 10
R index: 39 x: 35 y: 14
 $6 - 10 = -4$
 $10 - 14 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 32 x: 35 y: 7
P index: 36 x: 35 y: 11
R index: 40 x: 35 y: 15
 $7 - 11 = -4$
 $11 - 15 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 33 x: 35 y: 8
P index: 37 x: 35 y: 12
R index: 41 x: 35 y: 16
 $8 - 12 = -4$
 $12 - 16 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 34 x: 35 y: 9
P index: 38 x: 35 y: 13
R index: 42 x: 35 y: 17

$9 - 13 = -4$
 $13 - 17 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 35 x: 35 y: 10
P index: 39 x: 35 y: 14
R index: 43 x: 35 y: 18
 $10 - 14 = -4$
 $14 - 18 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 36 x: 35 y: 11
P index: 40 x: 35 y: 15
R index: 44 x: 35 y: 19
 $11 - 15 = -4$
 $15 - 19 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 37 x: 35 y: 12
P index: 41 x: 35 y: 16
R index: 45 x: 35 y: 20
 $12 - 16 = -4$
 $16 - 20 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 38 x: 35 y: 13
P index: 42 x: 35 y: 17
R index: 46 x: 35 y: 21
 $13 - 17 = -4$
 $17 - 21 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 39 x: 35 y: 14
P index: 43 x: 35 y: 18
R index: 47 x: 35 y: 22

$14 - 18 = -4$
 $18 - 22 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 40 x: 35 y: 15
P index: 44 x: 35 y: 19
R index: 48 x: 35 y: 23
 $15 - 19 = -4$
 $19 - 23 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 41 x: 35 y: 16
P index: 45 x: 35 y: 20
R index: 49 x: 35 y: 24
 $16 - 20 = -4$
 $20 - 24 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 42 x: 35 y: 17
P index: 46 x: 35 y: 21
R index: 50 x: 35 y: 25
 $17 - 21 = -4$
 $21 - 25 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 43 x: 35 y: 18
P index: 47 x: 35 y: 22
R index: 51 x: 35 y: 26
 $18 - 22 = -4$
 $22 - 26 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 44 x: 35 y: 19
P index: 48 x: 35 y: 23
R index: 52 x: 35 y: 27

$19 - 23 = -4$
 $23 - 27 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 45 x: 35 y: 20
P index: 49 x: 35 y: 24
R index: 53 x: 35 y: 28
 $20 - 24 = -4$
 $24 - 28 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 46 x: 35 y: 21
P index: 50 x: 35 y: 25
R index: 54 x: 35 y: 29
 $21 - 25 = -4$
 $25 - 29 = -4$
 $35 - 35 = 0$
 $35 - 35 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 47 x: 35 y: 22
P index: 51 x: 35 y: 26
R index: 55 x: 34 y: 29
 $22 - 26 = -4$
 $26 - 29 = -3$
 $35 - 35 = 0$
 $35 - 34 = 1$
 $-4 / 0.5 = -8$
 $-3 / 1 = -3$
 $-8 - -3 = -5$

Q index: 48 x: 35 y: 23
P index: 52 x: 35 y: 27
R index: 56 x: 33 y: 29
 $23 - 27 = -4$
 $27 - 29 = -2$
 $35 - 35 = 0$
 $35 - 33 = 2$
 $-4 / 0.5 = -8$
 $-2 / 2 = -1$
 $-8 - -1 = -7$

Q index: 49 x: 35 y: 24
P index: 53 x: 35 y: 28
R index: 57 x: 32 y: 29

$24 - 28 = -4$
 $28 - 29 = -1$
 $35 - 35 = 0$
 $35 - 32 = 3$
 $-4 / 0.5 = -8$
 $-1 / 3 = -8$
 $-8 - -0.333333 = 7.66667$

Q index: 50 x: 35 y: 25
P index: 54 x: 35 y: 29
R index: 58 x: 31 y: 29
 $25 - 29 = -4$
 $29 - 29 = 0$
 $35 - 35 = 0$
 $35 - 31 = 4$
 $-4 / 0.5 = -8$
 $0 / 4 = -8$
 $-8 - 0 = 8$

Q index: 51 x: 35 y: 26
P index: 55 x: 34 y: 29
R index: 59 x: 30 y: 29
 $26 - 29 = -3$
 $29 - 29 = 0$
 $35 - 34 = 1$
 $34 - 30 = 4$
 $-3 / 1 = -3$
 $0 / 4 = -3$
 $-3 - 0 = 3$

Q index: 52 x: 35 y: 27
P index: 56 x: 33 y: 29
R index: 60 x: 29 y: 29
 $27 - 29 = -2$
 $29 - 29 = 0$
 $35 - 33 = 2$
 $33 - 29 = 4$
 $-2 / 2 = -1$
 $0 / 4 = -1$
 $-1 - 0 = 1$

Q index: 53 x: 35 y: 28
P index: 57 x: 32 y: 29
R index: 61 x: 28 y: 29
 $28 - 29 = -1$
 $29 - 29 = 0$
 $35 - 32 = 3$
 $32 - 28 = 4$
 $-1 / 3 = -0.333333$
 $0 / 4 = -0.333333$
 $-0.333333 - 0 = 0.333333$

Q index: 54 x: 35 y: 29
P index: 58 x: 31 y: 29
R index: 62 x: 27 y: 29

$29 - 29 = 0$
 $29 - 29 = 0$
 $35 - 31 = 4$
 $31 - 27 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 55 x: 34 y: 29
P index: 59 x: 30 y: 29
R index: 63 x: 26 y: 29
 $29 - 29 = 0$
 $29 - 29 = 0$
 $34 - 30 = 4$
 $30 - 26 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 56 x: 33 y: 29
P index: 60 x: 29 y: 29
R index: 64 x: 25 y: 29
 $29 - 29 = 0$
 $29 - 29 = 0$
 $33 - 29 = 4$
 $29 - 25 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 57 x: 32 y: 29
P index: 61 x: 28 y: 29
R index: 65 x: 24 y: 30
 $29 - 29 = 0$
 $29 - 30 = -1$
 $32 - 28 = 4$
 $28 - 24 = 4$
 $0 / 4 = 0$
 $-1 / 4 = 0$
 $0 - -0.25 = 0.25$

Q index: 58 x: 31 y: 29
P index: 62 x: 27 y: 29
R index: 66 x: 23 y: 31
 $29 - 29 = 0$
 $29 - 31 = -2$
 $31 - 27 = 4$
 $27 - 23 = 4$
 $0 / 4 = 0$
 $-2 / 4 = 0$
 $0 - -0.5 = 0.5$

Q index: 59 x: 30 y: 29
P index: 63 x: 26 y: 29
R index: 67 x: 22 y: 32

$29 - 29 = 0$
 $29 - 32 = -3$
 $30 - 26 = 4$
 $26 - 22 = 4$
 $0 / 4 = 0$
 $-3 / 4 = 0$
 $0 - -0.75 = 0.75$

Q index: 60 x: 29 y: 29
P index: 64 x: 25 y: 29
R index: 68 x: 21 y: 33
 $29 - 29 = 0$
 $29 - 33 = -4$
 $29 - 25 = 4$
 $25 - 21 = 4$
 $0 / 4 = 0$
 $-4 / 4 = 0$
 $0 - -1 = 1$

Q index: 61 x: 28 y: 29
P index: 65 x: 24 y: 30
R index: 69 x: 20 y: 34
 $29 - 30 = -1$
 $30 - 34 = -4$
 $28 - 24 = 4$
 $24 - 20 = 4$
 $-1 / 4 = -0.25$
 $-4 / 4 = -0.25$
 $-0.25 - -1 = 0.75$

Q index: 62 x: 27 y: 29
P index: 66 x: 23 y: 31
R index: 70 x: 19 y: 33
 $29 - 31 = -2$
 $31 - 33 = -2$
 $27 - 23 = 4$
 $23 - 19 = 4$
 $-2 / 4 = -0.5$
 $-2 / 4 = -0.5$
 $-0.5 - -0.5 = 0$

Q index: 63 x: 26 y: 29
P index: 67 x: 22 y: 32
R index: 71 x: 18 y: 32
 $29 - 32 = -3$
 $32 - 32 = 0$
 $26 - 22 = 4$
 $22 - 18 = 4$
 $-3 / 4 = -0.75$
 $0 / 4 = -0.75$
 $-0.75 - 0 = -0.75$

Q index: 64 x: 25 y: 29
P index: 68 x: 21 y: 33
R index: 72 x: 17 y: 31

$29 - 33 = -4$
 $33 - 31 = 2$
 $25 - 21 = 4$
 $21 - 17 = 4$
 $-4 / 4 = -1$
 $2 / 4 = -1$
 $-1 - 0.5 = 1.5$

Q index: 65 x: 24 y: 30
P index: 69 x: 20 y: 34
R index: 73 x: 16 y: 30
 $30 - 34 = -4$
 $34 - 30 = 4$
 $24 - 20 = 4$
 $20 - 16 = 4$
 $-4 / 4 = -1$
 $4 / 4 = -1$
 $-1 - 1 = 2$

Q index: 66 x: 23 y: 31
P index: 70 x: 19 y: 33
R index: 74 x: 15 y: 29
 $31 - 33 = -2$
 $33 - 29 = 4$
 $23 - 19 = 4$
 $19 - 15 = 4$
 $-2 / 4 = -0.5$
 $4 / 4 = -0.5$
 $-0.5 - 1 = 1.5$

Q index: 67 x: 22 y: 32
P index: 71 x: 18 y: 32
R index: 75 x: 14 y: 29
 $32 - 32 = 0$
 $32 - 29 = 3$
 $22 - 18 = 4$
 $18 - 14 = 4$
 $0 / 4 = 0$
 $3 / 4 = 0$
 $0 - 0.75 = 0.75$

Q index: 68 x: 21 y: 33
P index: 72 x: 17 y: 31
R index: 76 x: 13 y: 29
 $33 - 31 = 2$
 $31 - 29 = 2$
 $21 - 17 = 4$
 $17 - 13 = 4$
 $2 / 4 = 0.5$
 $2 / 4 = 0.5$
 $0.5 - 0.5 = 0$

Q index: 69 x: 20 y: 34
P index: 73 x: 16 y: 30
R index: 77 x: 12 y: 29

$34 - 30 = 4$
 $30 - 29 = 1$
 $20 - 16 = 4$
 $16 - 12 = 4$
 $4 / 4 = 1$
 $1 / 4 = 1$
 $1 - 0.25 = 0.75$

Q index: 70 x: 19 y: 33
P index: 74 x: 15 y: 29
R index: 78 x: 11 y: 29
 $33 - 29 = 4$
 $29 - 29 = 0$
 $19 - 15 = 4$
 $15 - 11 = 4$
 $4 / 4 = 1$
 $0 / 4 = 1$
 $1 - 0 = 1$

Q index: 71 x: 18 y: 32
P index: 75 x: 14 y: 29
R index: 79 x: 10 y: 29
 $32 - 29 = 3$
 $29 - 29 = 0$
 $18 - 14 = 4$
 $14 - 10 = 4$
 $3 / 4 = 0.75$
 $0 / 4 = 0.75$
 $0.75 - 0 = 0.75$

Q index: 72 x: 17 y: 31
P index: 76 x: 13 y: 29
R index: 80 x: 9 y: 29
 $31 - 29 = 2$
 $29 - 29 = 0$
 $17 - 13 = 4$
 $13 - 9 = 4$
 $2 / 4 = 0.5$
 $0 / 4 = 0.5$
 $0.5 - 0 = 0.5$

Q index: 73 x: 16 y: 30
P index: 77 x: 12 y: 29
R index: 81 x: 8 y: 29
 $30 - 29 = 1$
 $29 - 29 = 0$
 $16 - 12 = 4$
 $12 - 8 = 4$
 $1 / 4 = 0.25$
 $0 / 4 = 0.25$
 $0.25 - 0 = 0.25$

Q index: 74 x: 15 y: 29
P index: 78 x: 11 y: 29
R index: 82 x: 7 y: 29

$29 - 29 = 0$
 $29 - 29 = 0$
 $15 - 11 = 4$
 $11 - 7 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 75 x: 14 y: 29
P index: 79 x: 10 y: 29
R index: 83 x: 6 y: 29
 $29 - 29 = 0$
 $29 - 29 = 0$
 $14 - 10 = 4$
 $10 - 6 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 76 x: 13 y: 29
P index: 80 x: 9 y: 29
R index: 84 x: 5 y: 29
 $29 - 29 = 0$
 $29 - 29 = 0$
 $13 - 9 = 4$
 $9 - 5 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 77 x: 12 y: 29
P index: 81 x: 8 y: 29
R index: 85 x: 5 y: 28
 $29 - 29 = 0$
 $29 - 28 = 1$
 $12 - 8 = 4$
 $8 - 5 = 3$
 $0 / 4 = 0$
 $1 / 3 = 0$
 $0 - 0.333333 = 0.333333$

Q index: 78 x: 11 y: 29
P index: 82 x: 7 y: 29
R index: 86 x: 5 y: 27
 $29 - 29 = 0$
 $29 - 27 = 2$
 $11 - 7 = 4$
 $7 - 5 = 2$
 $0 / 4 = 0$
 $2 / 2 = 0$
 $0 - 1 = 1$

Q index: 79 x: 10 y: 29
P index: 83 x: 6 y: 29
R index: 87 x: 5 y: 26

$29 - 29 = 0$
 $29 - 26 = 3$
 $10 - 6 = 4$
 $6 - 5 = 1$
 $0 / 4 = 0$
 $3 / 1 = 0$
 $0 - 3 = 3$

Q index: 80 x: 9 y: 29
P index: 84 x: 5 y: 29
R index: 88 x: 5 y: 25
 $29 - 29 = 0$
 $29 - 25 = 4$
 $9 - 5 = 4$
 $5 - 5 = 0$
 $0 / 4 = 0$
 $4 / 0.5 = 0$
 $0 - 8 = 8$

Q index: 81 x: 8 y: 29
P index: 85 x: 5 y: 28
R index: 89 x: 5 y: 24
 $29 - 28 = 1$
 $28 - 24 = 4$
 $8 - 5 = 3$
 $5 - 5 = 0$
 $1 / 3 = 0.333333$
 $4 / 0.5 = 0.333333$
 $0.333333 - 8 = 7.666667$

Q index: 82 x: 7 y: 29
P index: 86 x: 5 y: 27
R index: 90 x: 5 y: 23
 $29 - 27 = 2$
 $27 - 23 = 4$
 $7 - 5 = 2$
 $5 - 5 = 0$
 $2 / 2 = 1$
 $4 / 0.5 = 1$
 $1 - 8 = 7$

Q index: 83 x: 6 y: 29
P index: 87 x: 5 y: 26
R index: 91 x: 5 y: 22
 $29 - 26 = 3$
 $26 - 22 = 4$
 $6 - 5 = 1$
 $5 - 5 = 0$
 $3 / 1 = 3$
 $4 / 0.5 = 3$
 $3 - 8 = 5$

Q index: 84 x: 5 y: 29
P index: 88 x: 5 y: 25
R index: 92 x: 5 y: 21

$29 - 25 = 4$
 $25 - 21 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 85 x: 5 y: 28
P index: 89 x: 5 y: 24
R index: 93 x: 5 y: 20
 $28 - 24 = 4$
 $24 - 20 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 86 x: 5 y: 27
P index: 90 x: 5 y: 23
R index: 94 x: 5 y: 19
 $27 - 23 = 4$
 $23 - 19 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 87 x: 5 y: 26
P index: 91 x: 5 y: 22
R index: 95 x: 5 y: 18
 $26 - 22 = 4$
 $22 - 18 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 88 x: 5 y: 25
P index: 92 x: 5 y: 21
R index: 96 x: 5 y: 17
 $25 - 21 = 4$
 $21 - 17 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 89 x: 5 y: 24
P index: 93 x: 5 y: 20
R index: 97 x: 5 y: 16

$24 - 20 = 4$
 $20 - 16 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 90 x: 5 y: 23
P index: 94 x: 5 y: 19
R index: 98 x: 5 y: 15
 $23 - 19 = 4$
 $19 - 15 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 91 x: 5 y: 22
P index: 95 x: 5 y: 18
R index: 99 x: 5 y: 14
 $22 - 18 = 4$
 $18 - 14 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 92 x: 5 y: 21
P index: 96 x: 5 y: 17
R index: 100 x: 5 y: 13
 $21 - 17 = 4$
 $17 - 13 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 93 x: 5 y: 20
P index: 97 x: 5 y: 16
R index: 101 x: 5 y: 12
 $20 - 16 = 4$
 $16 - 12 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 94 x: 5 y: 19
P index: 98 x: 5 y: 15
R index: 102 x: 5 y: 11

$19 - 15 = 4$
 $15 - 11 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 95 x: 5 y: 18
P index: 99 x: 5 y: 14
R index: 103 x: 5 y: 10
 $18 - 14 = 4$
 $14 - 10 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 96 x: 5 y: 17
P index: 100 x: 5 y: 13
R index: 104 x: 5 y: 9
 $17 - 13 = 4$
 $13 - 9 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 97 x: 5 y: 16
P index: 101 x: 5 y: 12
R index: 105 x: 5 y: 8
 $16 - 12 = 4$
 $12 - 8 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 98 x: 5 y: 15
P index: 102 x: 5 y: 11
R index: 106 x: 5 y: 7
 $15 - 11 = 4$
 $11 - 7 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 99 x: 5 y: 14
P index: 103 x: 5 y: 10
R index: 107 x: 5 y: 6

$14 - 10 = 4$
 $10 - 6 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 100 x: 5 y: 13
P index: 104 x: 5 y: 9
R index: 0 x: 5 y: 5
 $13 - 9 = 4$
 $9 - 5 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 101 x: 5 y: 12
P index: 105 x: 5 y: 8
R index: 1 x: 6 y: 5
 $12 - 8 = 4$
 $8 - 5 = 3$
 $5 - 5 = 0$
 $5 - 6 = 1$
 $4 / 0.5 = 8$
 $3 / 1 = 3$
 $8 - 3 = 5$

Q index: 102 x: 5 y: 11
P index: 106 x: 5 y: 7
R index: 2 x: 7 y: 5
 $11 - 7 = 4$
 $7 - 5 = 2$
 $5 - 5 = 0$
 $5 - 7 = 2$
 $4 / 0.5 = 8$
 $2 / 2 = 1$
 $8 - 1 = 7$

Q index: 103 x: 5 y: 10
P index: 107 x: 5 y: 6
R index: 3 x: 8 y: 5
 $10 - 6 = 4$
 $6 - 5 = 1$
 $5 - 5 = 0$
 $5 - 8 = 3$
 $4 / 0.5 = 8$
 $1 / 3 = 0.333333$
 $8 - 0.333333 = 7.666667$

Q index: 104 x: 5 y: 9
P index: 0 x: 5 y: 5
R index: 4 x: 9 y: 5

$9 - 5 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $5 - 9 = 4$
 $4 / 0.5 = 8$
 $0 / 4 = 0$
 $8 - 0 = 8$

Q index: 105 x: 5 y: 8
P index: 1 x: 6 y: 5
R index: 5 x: 10 y: 5
 $8 - 5 = 3$
 $5 - 5 = 0$
 $5 - 6 = 1$
 $6 - 10 = 4$
 $3 / 1 = 3$
 $0 / 4 = 0$
 $3 - 0 = 3$

Q index: 106 x: 5 y: 7
P index: 2 x: 7 y: 5
R index: 6 x: 11 y: 5
 $7 - 5 = 2$
 $5 - 5 = 0$
 $5 - 7 = 2$
 $7 - 11 = 4$
 $2 / 2 = 1$
 $0 / 4 = 0$
 $1 - 0 = 1$

Q index: 107 x: 5 y: 6
P index: 3 x: 8 y: 5
R index: 7 x: 12 y: 5
 $6 - 5 = 1$
 $5 - 5 = 0$
 $5 - 8 = 3$
 $8 - 12 = 4$
 $1 / 3 = 0.333333$
 $0 / 4 = 0.333333$
 $0.333333 - 0 = 0.333333$

40 40 0 1
1
x: 5 y: 5 curvature: 8
x: 6 y: 5 curvature: 3
x: 7 y: 5 curvature: 1
x: 8 y: 5 curvature: 0.333333
x: 9 y: 5 curvature: 0
x: 10 y: 5 curvature: 0
x: 11 y: 5 curvature: 0
x: 12 y: 5 curvature: 0.25
x: 13 y: 5 curvature: 0.5
x: 14 y: 5 curvature: 0.75
x: 15 y: 5 curvature: 1

x: 16 y: 6 curvature: 0.75
x: 17 y: 7 curvature: 0
x: 18 y: 8 curvature: 0.75
x: 19 y: 9 curvature: 1.5
x: 20 y: 10 curvature: 2
x: 21 y: 9 curvature: 1.5
x: 22 y: 8 curvature: 0.75
x: 23 y: 7 curvature: 0
x: 24 y: 6 curvature: 0.75
x: 25 y: 5 curvature: 1
x: 26 y: 5 curvature: 0.75
x: 27 y: 5 curvature: 0.5
x: 28 y: 5 curvature: 0.25
x: 29 y: 5 curvature: 0
x: 30 y: 5 curvature: 0
x: 31 y: 5 curvature: 0
x: 32 y: 5 curvature: 0.333333
x: 33 y: 5 curvature: 1
x: 34 y: 5 curvature: 3
x: 35 y: 5 curvature: 8
x: 35 y: 6 curvature: 7.66667
x: 35 y: 7 curvature: 7
x: 35 y: 8 curvature: 5
x: 35 y: 9 curvature: 0
x: 35 y: 10 curvature: 0
x: 35 y: 11 curvature: 0
x: 35 y: 12 curvature: 0
x: 35 y: 13 curvature: 0
x: 35 y: 14 curvature: 0
x: 35 y: 15 curvature: 0
x: 35 y: 16 curvature: 0
x: 35 y: 17 curvature: 0
x: 35 y: 18 curvature: 0
x: 35 y: 19 curvature: 0
x: 35 y: 20 curvature: 0
x: 35 y: 21 curvature: 0
x: 35 y: 22 curvature: 0
x: 35 y: 23 curvature: 0
x: 35 y: 24 curvature: 0
x: 35 y: 25 curvature: 0
x: 35 y: 26 curvature: 5
x: 35 y: 27 curvature: 7
x: 35 y: 28 curvature: 7.66667
x: 35 y: 29 curvature: 8
x: 34 y: 29 curvature: 3
x: 33 y: 29 curvature: 1
x: 32 y: 29 curvature: 0.333333
x: 31 y: 29 curvature: 0
x: 30 y: 29 curvature: 0
x: 29 y: 29 curvature: 0
x: 28 y: 29 curvature: 0.25
x: 27 y: 29 curvature: 0.5
x: 26 y: 29 curvature: 0.75
x: 25 y: 29 curvature: 1
x: 24 y: 30 curvature: 0.75

x: 23 y: 31 curvature: 0
x: 22 y: 32 curvature: 0.75
x: 21 y: 33 curvature: 1.5
x: 20 y: 34 curvature: 2
x: 19 y: 33 curvature: 1.5
x: 18 y: 32 curvature: 0.75
x: 17 y: 31 curvature: 0
x: 16 y: 30 curvature: 0.75
x: 15 y: 29 curvature: 1
x: 14 y: 29 curvature: 0.75
x: 13 y: 29 curvature: 0.5
x: 12 y: 29 curvature: 0.25
x: 11 y: 29 curvature: 0
x: 10 y: 29 curvature: 0
x: 9 y: 29 curvature: 0
x: 8 y: 29 curvature: 0.333333
x: 7 y: 29 curvature: 1
x: 6 y: 29 curvature: 3
x: 5 y: 29 curvature: 8
x: 5 y: 28 curvature: 7.66667
x: 5 y: 27 curvature: 7
x: 5 y: 26 curvature: 5
x: 5 y: 25 curvature: 0
x: 5 y: 24 curvature: 0
x: 5 y: 23 curvature: 0
x: 5 y: 22 curvature: 0
x: 5 y: 21 curvature: 0
x: 5 y: 20 curvature: 0
x: 5 y: 19 curvature: 0
x: 5 y: 18 curvature: 0
x: 5 y: 17 curvature: 0
x: 5 y: 16 curvature: 0
x: 5 y: 15 curvature: 0
x: 5 y: 14 curvature: 0
x: 5 y: 13 curvature: 0
x: 5 y: 12 curvature: 0
x: 5 y: 11 curvature: 0
x: 5 y: 10 curvature: 0
x: 5 y: 9 curvature: 0
x: 5 y: 8 curvature: 5
x: 5 y: 7 curvature: 7
x: 5 y: 6 curvature: 7.66667

Data D Outputs:

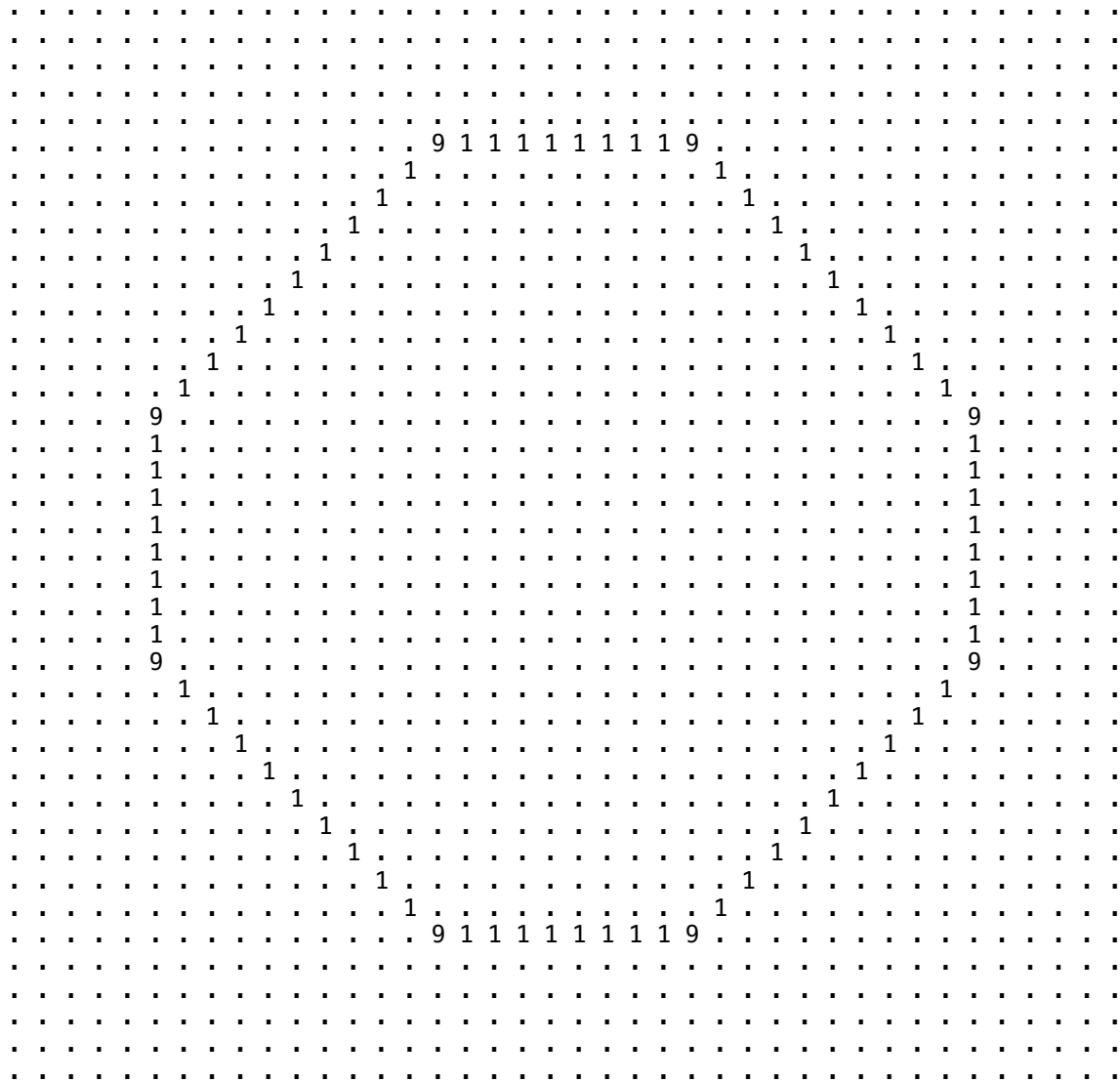
outFile 1:

```
40 40 0 1
15 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

outFile 2:

40 40 0 1



outFile3(debug):

K value: 4PtAry after initialization

40 40 0 1

1

x: 5 y: 15 curvature: 0
x: 6 y: 14 curvature: 0
x: 7 y: 13 curvature: 0
x: 8 y: 12 curvature: 0
x: 9 y: 11 curvature: 0
x: 10 y: 10 curvature: 0
x: 11 y: 9 curvature: 0
x: 12 y: 8 curvature: 0
x: 13 y: 7 curvature: 0
x: 14 y: 6 curvature: 0
x: 15 y: 5 curvature: 0
x: 16 y: 5 curvature: 0
x: 17 y: 5 curvature: 0
x: 18 y: 5 curvature: 0
x: 19 y: 5 curvature: 0
x: 20 y: 5 curvature: 0
x: 21 y: 5 curvature: 0
x: 22 y: 5 curvature: 0
x: 23 y: 5 curvature: 0
x: 24 y: 5 curvature: 0
x: 25 y: 6 curvature: 0
x: 26 y: 7 curvature: 0
x: 27 y: 8 curvature: 0
x: 28 y: 9 curvature: 0
x: 29 y: 10 curvature: 0
x: 30 y: 11 curvature: 0
x: 31 y: 12 curvature: 0
x: 32 y: 13 curvature: 0
x: 33 y: 14 curvature: 0
x: 34 y: 15 curvature: 0
x: 34 y: 16 curvature: 0
x: 34 y: 17 curvature: 0
x: 34 y: 18 curvature: 0
x: 34 y: 19 curvature: 0
x: 34 y: 20 curvature: 0
x: 34 y: 21 curvature: 0
x: 34 y: 22 curvature: 0
x: 34 y: 23 curvature: 0
x: 34 y: 24 curvature: 0
x: 33 y: 25 curvature: 0
x: 32 y: 26 curvature: 0
x: 31 y: 27 curvature: 0
x: 30 y: 28 curvature: 0
x: 29 y: 29 curvature: 0
x: 28 y: 30 curvature: 0
x: 27 y: 31 curvature: 0
x: 26 y: 32 curvature: 0
x: 25 y: 33 curvature: 0
x: 24 y: 34 curvature: 0
x: 23 y: 34 curvature: 0
x: 22 y: 34 curvature: 0
x: 21 y: 34 curvature: 0
x: 20 y: 34 curvature: 0
x: 19 y: 34 curvature: 0
x: 18 y: 34 curvature: 0

x: 17 y: 34 curvature: 0
x: 16 y: 34 curvature: 0
x: 15 y: 34 curvature: 0
x: 14 y: 33 curvature: 0
x: 13 y: 32 curvature: 0
x: 12 y: 31 curvature: 0
x: 11 y: 30 curvature: 0
x: 10 y: 29 curvature: 0
x: 9 y: 28 curvature: 0
x: 8 y: 27 curvature: 0
x: 7 y: 26 curvature: 0
x: 6 y: 25 curvature: 0
x: 5 y: 24 curvature: 0
x: 5 y: 23 curvature: 0
x: 5 y: 22 curvature: 0
x: 5 y: 21 curvature: 0
x: 5 y: 20 curvature: 0
x: 5 y: 19 curvature: 0
x: 5 y: 18 curvature: 0
x: 5 y: 17 curvature: 0
x: 5 y: 16 curvature: 0

Calculating Curvature debugging

Q index: 0 x: 5 y: 15
P index: 4 x: 9 y: 11
R index: 8 x: 13 y: 7
 $15 - 11 = 4$
 $11 - 7 = 4$
 $5 - 9 = 4$
 $9 - 13 = 4$
 $4 / 4 = 1$
 $4 / 4 = 1$
 $1 - 1 = 0$

Q index: 1 x: 6 y: 14
P index: 5 x: 10 y: 10
R index: 9 x: 14 y: 6
 $14 - 10 = 4$
 $10 - 6 = 4$
 $6 - 10 = 4$
 $10 - 14 = 4$
 $4 / 4 = 1$
 $4 / 4 = 1$
 $1 - 1 = 0$

Q index: 2 x: 7 y: 13
P index: 6 x: 11 y: 9
R index: 10 x: 15 y: 5
 $13 - 9 = 4$
 $9 - 5 = 4$
 $7 - 11 = 4$
 $11 - 15 = 4$
 $4 / 4 = 1$
 $4 / 4 = 1$
 $1 - 1 = 0$

Q index: 3 x: 8 y: 12
P index: 7 x: 12 y: 8
R index: 11 x: 16 y: 5

$12 - 8 = 4$
 $8 - 5 = 3$
 $8 - 12 = 4$
 $12 - 16 = 4$
 $4 / 4 = 1$
 $3 / 4 = 1$
 $1 - 0.75 = 0.25$

Q index: 4 x: 9 y: 11
P index: 8 x: 13 y: 7
R index: 12 x: 17 y: 5
 $11 - 7 = 4$
 $7 - 5 = 2$
 $9 - 13 = 4$
 $13 - 17 = 4$
 $4 / 4 = 1$
 $2 / 4 = 1$
 $1 - 0.5 = 0.5$

Q index: 5 x: 10 y: 10
P index: 9 x: 14 y: 6
R index: 13 x: 18 y: 5
 $10 - 6 = 4$
 $6 - 5 = 1$
 $10 - 14 = 4$
 $14 - 18 = 4$
 $4 / 4 = 1$
 $1 / 4 = 1$
 $1 - 0.25 = 0.75$

Q index: 6 x: 11 y: 9
P index: 10 x: 15 y: 5
R index: 14 x: 19 y: 5
 $9 - 5 = 4$
 $5 - 5 = 0$
 $11 - 15 = 4$
 $15 - 19 = 4$
 $4 / 4 = 1$
 $0 / 4 = 1$
 $1 - 0 = 1$

Q index: 7 x: 12 y: 8
P index: 11 x: 16 y: 5
R index: 15 x: 20 y: 5
 $8 - 5 = 3$
 $5 - 5 = 0$
 $12 - 16 = 4$
 $16 - 20 = 4$
 $3 / 4 = 0.75$
 $0 / 4 = 0.75$
 $0.75 - 0 = 0.75$

Q index: 8 x: 13 y: 7
P index: 12 x: 17 y: 5
R index: 16 x: 21 y: 5
 $7 - 5 = 2$
 $5 - 5 = 0$
 $13 - 17 = 4$
 $17 - 21 = 4$
 $2 / 4 = 0.5$
 $0 / 4 = 0.5$

$$0.5 - 0 = 0.5$$

Q index: 9 x: 14 y: 6
P index: 13 x: 18 y: 5
R index: 17 x: 22 y: 5
 $6 - 5 = 1$
 $5 - 5 = 0$
 $14 - 18 = 4$
 $18 - 22 = 4$
 $1 / 4 = 0.25$
 $0 / 4 = 0.25$
 $0.25 - 0 = 0.25$

Q index: 10 x: 15 y: 5
P index: 14 x: 19 y: 5
R index: 18 x: 23 y: 5
 $5 - 5 = 0$
 $5 - 5 = 0$
 $15 - 19 = 4$
 $19 - 23 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 11 x: 16 y: 5
P index: 15 x: 20 y: 5
R index: 19 x: 24 y: 5
 $5 - 5 = 0$
 $5 - 5 = 0$
 $16 - 20 = 4$
 $20 - 24 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 12 x: 17 y: 5
P index: 16 x: 21 y: 5
R index: 20 x: 25 y: 6
 $5 - 5 = 0$
 $5 - 6 = -1$
 $17 - 21 = 4$
 $21 - 25 = 4$
 $0 / 4 = 0$
 $-1 / 4 = 0$
 $0 - -0.25 = 0.25$

Q index: 13 x: 18 y: 5
P index: 17 x: 22 y: 5
R index: 21 x: 26 y: 7
 $5 - 5 = 0$
 $5 - 7 = -2$
 $18 - 22 = 4$
 $22 - 26 = 4$
 $0 / 4 = 0$
 $-2 / 4 = 0$
 $0 - -0.5 = 0.5$

Q index: 14 x: 19 y: 5
P index: 18 x: 23 y: 5
R index: 22 x: 27 y: 8
 $5 - 5 = 0$

$5 - 8 = -3$
 $19 - 23 = 4$
 $23 - 27 = 4$
 $0 / 4 = 0$
 $-3 / 4 = 0$
 $0 - -0.75 = 0.75$

Q index: 15 x: 20 y: 5
P index: 19 x: 24 y: 5
R index: 23 x: 28 y: 9
 $5 - 5 = 0$
 $5 - 9 = -4$
 $20 - 24 = 4$
 $24 - 28 = 4$
 $0 / 4 = 0$
 $-4 / 4 = 0$
 $0 - -1 = 1$

Q index: 16 x: 21 y: 5
P index: 20 x: 25 y: 6
R index: 24 x: 29 y: 10
 $5 - 6 = -1$
 $6 - 10 = -4$
 $21 - 25 = 4$
 $25 - 29 = 4$
 $-1 / 4 = -0.25$
 $-4 / 4 = -0.25$
 $-0.25 - -1 = 0.75$

Q index: 17 x: 22 y: 5
P index: 21 x: 26 y: 7
R index: 25 x: 30 y: 11
 $5 - 7 = -2$
 $7 - 11 = -4$
 $22 - 26 = 4$
 $26 - 30 = 4$
 $-2 / 4 = -0.5$
 $-4 / 4 = -0.5$
 $-0.5 - -1 = 0.5$

Q index: 18 x: 23 y: 5
P index: 22 x: 27 y: 8
R index: 26 x: 31 y: 12
 $5 - 8 = -3$
 $8 - 12 = -4$
 $23 - 27 = 4$
 $27 - 31 = 4$
 $-3 / 4 = -0.75$
 $-4 / 4 = -0.75$
 $-0.75 - -1 = 0.25$

Q index: 19 x: 24 y: 5
P index: 23 x: 28 y: 9
R index: 27 x: 32 y: 13
 $5 - 9 = -4$
 $9 - 13 = -4$
 $24 - 28 = 4$
 $28 - 32 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 20 x: 25 y: 6
P index: 24 x: 29 y: 10
R index: 28 x: 33 y: 14
 $6 - 10 = -4$
 $10 - 14 = -4$
 $25 - 29 = 4$
 $29 - 33 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 21 x: 26 y: 7
P index: 25 x: 30 y: 11
R index: 29 x: 34 y: 15
 $7 - 11 = -4$
 $11 - 15 = -4$
 $26 - 30 = 4$
 $30 - 34 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 22 x: 27 y: 8
P index: 26 x: 31 y: 12
R index: 30 x: 34 y: 16
 $8 - 12 = -4$
 $12 - 16 = -4$
 $27 - 31 = 4$
 $31 - 34 = 3$
 $-4 / 4 = -1$
 $-4 / 3 = -1$
 $-1 - -1.33333 = 0.333333$

Q index: 23 x: 28 y: 9
P index: 27 x: 32 y: 13
R index: 31 x: 34 y: 17
 $9 - 13 = -4$
 $13 - 17 = -4$
 $28 - 32 = 4$
 $32 - 34 = 2$
 $-4 / 4 = -1$
 $-4 / 2 = -2$
 $-1 - -2 = 1$

Q index: 24 x: 29 y: 10
P index: 28 x: 33 y: 14
R index: 32 x: 34 y: 18
 $10 - 14 = -4$
 $14 - 18 = -4$
 $29 - 33 = 4$
 $33 - 34 = 1$
 $-4 / 4 = -1$
 $-4 / 1 = -4$
 $-1 - -4 = 3$

Q index: 25 x: 30 y: 11
P index: 29 x: 34 y: 15
R index: 33 x: 34 y: 19
 $11 - 15 = -4$
 $15 - 19 = -4$

$30 - 34 = 4$
 $34 - 34 = 0$
 $-4 / 4 = -1$
 $-4 / 0.5 = -1$
 $-1 - -8 = 7$

Q index: 26 x: 31 y: 12
P index: 30 x: 34 y: 16
R index: 34 x: 34 y: 20
 $12 - 16 = -4$
 $16 - 20 = -4$
 $31 - 34 = 3$
 $34 - 34 = 0$
 $-4 / 3 = -1.33333$
 $-4 / 0.5 = -1.33333$
 $-1.33333 - -8 = 6.66667$

Q index: 27 x: 32 y: 13
P index: 31 x: 34 y: 17
R index: 35 x: 34 y: 21
 $13 - 17 = -4$
 $17 - 21 = -4$
 $32 - 34 = 2$
 $34 - 34 = 0$
 $-4 / 2 = -2$
 $-4 / 0.5 = -2$
 $-2 - -8 = 6$

Q index: 28 x: 33 y: 14
P index: 32 x: 34 y: 18
R index: 36 x: 34 y: 22
 $14 - 18 = -4$
 $18 - 22 = -4$
 $33 - 34 = 1$
 $34 - 34 = 0$
 $-4 / 1 = -4$
 $-4 / 0.5 = -4$
 $-4 - -8 = 4$

Q index: 29 x: 34 y: 15
P index: 33 x: 34 y: 19
R index: 37 x: 34 y: 23
 $15 - 19 = -4$
 $19 - 23 = -4$
 $34 - 34 = 0$
 $34 - 34 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 30 x: 34 y: 16
P index: 34 x: 34 y: 20
R index: 38 x: 34 y: 24
 $16 - 20 = -4$
 $20 - 24 = -4$
 $34 - 34 = 0$
 $34 - 34 = 0$
 $-4 / 0.5 = -8$
 $-4 / 0.5 = -8$
 $-8 - -8 = 0$

Q index: 31 x: 34 y: 17
P index: 35 x: 34 y: 21
R index: 39 x: 33 y: 25
 $17 - 21 = -4$
 $21 - 25 = -4$
 $34 - 34 = 0$
 $34 - 33 = 1$
 $-4 / 0.5 = -8$
 $-4 / 1 = -4$
 $-8 - -4 = -4$

Q index: 32 x: 34 y: 18
P index: 36 x: 34 y: 22
R index: 40 x: 32 y: 26
 $18 - 22 = -4$
 $22 - 26 = -4$
 $34 - 34 = 0$
 $34 - 32 = 2$
 $-4 / 0.5 = -8$
 $-4 / 2 = -2$
 $-8 - -2 = -6$

Q index: 33 x: 34 y: 19
P index: 37 x: 34 y: 23
R index: 41 x: 31 y: 27
 $19 - 23 = -4$
 $23 - 27 = -4$
 $34 - 34 = 0$
 $34 - 31 = 3$
 $-4 / 0.5 = -8$
 $-4 / 3 = -1.33333$
 $-8 - -1.33333 = -6.66667$

Q index: 34 x: 34 y: 20
P index: 38 x: 34 y: 24
R index: 42 x: 30 y: 28
 $20 - 24 = -4$
 $24 - 28 = -4$
 $34 - 34 = 0$
 $34 - 30 = 4$
 $-4 / 0.5 = -8$
 $-4 / 4 = -1$
 $-8 - -1 = -7$

Q index: 35 x: 34 y: 21
P index: 39 x: 33 y: 25
R index: 43 x: 29 y: 29
 $21 - 25 = -4$
 $25 - 29 = -4$
 $34 - 33 = 1$
 $33 - 29 = 4$
 $-4 / 1 = -4$
 $-4 / 4 = -1$
 $-4 - -1 = -3$

Q index: 36 x: 34 y: 22
P index: 40 x: 32 y: 26
R index: 44 x: 28 y: 30
 $22 - 26 = -4$
 $26 - 30 = -4$
 $34 - 32 = 2$

$32 - 28 = 4$
 $-4 / 2 = -2$
 $-4 / 4 = -2$
 $-2 - -1 = 1$

Q index: 37 x: 34 y: 23
P index: 41 x: 31 y: 27
R index: 45 x: 27 y: 31
 $23 - 27 = -4$
 $27 - 31 = -4$
 $34 - 31 = 3$
 $31 - 27 = 4$
 $-4 / 3 = -1.33333$
 $-4 / 4 = -1.33333$
 $-1.33333 - -1 = 0.33333$

Q index: 38 x: 34 y: 24
P index: 42 x: 30 y: 28
R index: 46 x: 26 y: 32
 $24 - 28 = -4$
 $28 - 32 = -4$
 $34 - 30 = 4$
 $30 - 26 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 39 x: 33 y: 25
P index: 43 x: 29 y: 29
R index: 47 x: 25 y: 33
 $25 - 29 = -4$
 $29 - 33 = -4$
 $33 - 29 = 4$
 $29 - 25 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 40 x: 32 y: 26
P index: 44 x: 28 y: 30
R index: 48 x: 24 y: 34
 $26 - 30 = -4$
 $30 - 34 = -4$
 $32 - 28 = 4$
 $28 - 24 = 4$
 $-4 / 4 = -1$
 $-4 / 4 = -1$
 $-1 - -1 = 0$

Q index: 41 x: 31 y: 27
P index: 45 x: 27 y: 31
R index: 49 x: 23 y: 34
 $27 - 31 = -4$
 $31 - 34 = -3$
 $31 - 27 = 4$
 $27 - 23 = 4$
 $-4 / 4 = -1$
 $-3 / 4 = -1$
 $-1 - -0.75 = 0.25$

Q index: 42 x: 30 y: 28

P index: 46 x: 26 y: 32
R index: 50 x: 22 y: 34
 $28 - 32 = -4$
 $32 - 34 = -2$
 $30 - 26 = 4$
 $26 - 22 = 4$
 $-4 / 4 = -1$
 $-2 / 4 = -1$
 $-1 - -0.5 = 0.5$

Q index: 43 x: 29 y: 29
P index: 47 x: 25 y: 33
R index: 51 x: 21 y: 34
 $29 - 33 = -4$
 $33 - 34 = -1$
 $29 - 25 = 4$
 $25 - 21 = 4$
 $-4 / 4 = -1$
 $-1 / 4 = -1$
 $-1 - -0.25 = 0.75$

Q index: 44 x: 28 y: 30
P index: 48 x: 24 y: 34
R index: 52 x: 20 y: 34
 $30 - 34 = -4$
 $34 - 34 = 0$
 $28 - 24 = 4$
 $24 - 20 = 4$
 $-4 / 4 = -1$
 $0 / 4 = -1$
 $-1 - 0 = 1$

Q index: 45 x: 27 y: 31
P index: 49 x: 23 y: 34
R index: 53 x: 19 y: 34
 $31 - 34 = -3$
 $34 - 34 = 0$
 $27 - 23 = 4$
 $23 - 19 = 4$
 $-3 / 4 = -0.75$
 $0 / 4 = -0.75$
 $-0.75 - 0 = 0.75$

Q index: 46 x: 26 y: 32
P index: 50 x: 22 y: 34
R index: 54 x: 18 y: 34
 $32 - 34 = -2$
 $34 - 34 = 0$
 $26 - 22 = 4$
 $22 - 18 = 4$
 $-2 / 4 = -0.5$
 $0 / 4 = -0.5$
 $-0.5 - 0 = 0.5$

Q index: 47 x: 25 y: 33
P index: 51 x: 21 y: 34
R index: 55 x: 17 y: 34
 $33 - 34 = -1$
 $34 - 34 = 0$
 $25 - 21 = 4$
 $21 - 17 = 4$

$-1 / 4 = -0.25$
 $0 / 4 = -0.25$
 $-0.25 - 0 = 0.25$

Q index: 48 x: 24 y: 34
P index: 52 x: 20 y: 34
R index: 56 x: 16 y: 34
 $34 - 34 = 0$
 $34 - 34 = 0$
 $24 - 20 = 4$
 $20 - 16 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 49 x: 23 y: 34
P index: 53 x: 19 y: 34
R index: 57 x: 15 y: 34
 $34 - 34 = 0$
 $34 - 34 = 0$
 $23 - 19 = 4$
 $19 - 15 = 4$
 $0 / 4 = 0$
 $0 / 4 = 0$
 $0 - 0 = 0$

Q index: 50 x: 22 y: 34
P index: 54 x: 18 y: 34
R index: 58 x: 14 y: 33
 $34 - 34 = 0$
 $34 - 33 = 1$
 $22 - 18 = 4$
 $18 - 14 = 4$
 $0 / 4 = 0$
 $1 / 4 = 0$
 $0 - 0.25 = 0.25$

Q index: 51 x: 21 y: 34
P index: 55 x: 17 y: 34
R index: 59 x: 13 y: 32
 $34 - 34 = 0$
 $34 - 32 = 2$
 $21 - 17 = 4$
 $17 - 13 = 4$
 $0 / 4 = 0$
 $2 / 4 = 0$
 $0 - 0.5 = 0.5$

Q index: 52 x: 20 y: 34
P index: 56 x: 16 y: 34
R index: 60 x: 12 y: 31
 $34 - 34 = 0$
 $34 - 31 = 3$
 $20 - 16 = 4$
 $16 - 12 = 4$
 $0 / 4 = 0$
 $3 / 4 = 0$
 $0 - 0.75 = 0.75$

Q index: 53 x: 19 y: 34
P index: 57 x: 15 y: 34

R index: 61 x: 11 y: 30
 $34 - 34 = 0$
 $34 - 30 = 4$
 $19 - 15 = 4$
 $15 - 11 = 4$
 $0 / 4 = 0$
 $4 / 4 = 0$
 $0 - 1 = 1$

Q index: 54 x: 18 y: 34
P index: 58 x: 14 y: 33
R index: 62 x: 10 y: 29
 $34 - 33 = 1$
 $33 - 29 = 4$
 $18 - 14 = 4$
 $14 - 10 = 4$
 $1 / 4 = 0.25$
 $4 / 4 = 0.25$
 $0.25 - 1 = 0.75$

Q index: 55 x: 17 y: 34
P index: 59 x: 13 y: 32
R index: 63 x: 9 y: 28
 $34 - 32 = 2$
 $32 - 28 = 4$
 $17 - 13 = 4$
 $13 - 9 = 4$
 $2 / 4 = 0.5$
 $4 / 4 = 0.5$
 $0.5 - 1 = 0.5$

Q index: 56 x: 16 y: 34
P index: 60 x: 12 y: 31
R index: 64 x: 8 y: 27
 $34 - 31 = 3$
 $31 - 27 = 4$
 $16 - 12 = 4$
 $12 - 8 = 4$
 $3 / 4 = 0.75$
 $4 / 4 = 0.75$
 $0.75 - 1 = 0.25$

Q index: 57 x: 15 y: 34
P index: 61 x: 11 y: 30
R index: 65 x: 7 y: 26
 $34 - 30 = 4$
 $30 - 26 = 4$
 $15 - 11 = 4$
 $11 - 7 = 4$
 $4 / 4 = 1$
 $4 / 4 = 1$
 $1 - 1 = 0$

Q index: 58 x: 14 y: 33
P index: 62 x: 10 y: 29
R index: 66 x: 6 y: 25
 $33 - 29 = 4$
 $29 - 25 = 4$
 $14 - 10 = 4$
 $10 - 6 = 4$
 $4 / 4 = 1$

$4 / 4 = 1$
 $1 - 1 = 0$

Q index: 59 x: 13 y: 32
P index: 63 x: 9 y: 28
R index: 67 x: 5 y: 24
 $32 - 28 = 4$
 $28 - 24 = 4$
 $13 - 9 = 4$
 $9 - 5 = 4$
 $4 / 4 = 1$
 $4 / 4 = 1$
 $1 - 1 = 0$

Q index: 60 x: 12 y: 31
P index: 64 x: 8 y: 27
R index: 68 x: 5 y: 23
 $31 - 27 = 4$
 $27 - 23 = 4$
 $12 - 8 = 4$
 $8 - 5 = 3$
 $4 / 4 = 1$
 $4 / 3 = 1$
 $1 - 1.33333 = 0.333333$

Q index: 61 x: 11 y: 30
P index: 65 x: 7 y: 26
R index: 69 x: 5 y: 22
 $30 - 26 = 4$
 $26 - 22 = 4$
 $11 - 7 = 4$
 $7 - 5 = 2$
 $4 / 4 = 1$
 $4 / 2 = 1$
 $1 - 2 = 1$

Q index: 62 x: 10 y: 29
P index: 66 x: 6 y: 25
R index: 70 x: 5 y: 21
 $29 - 25 = 4$
 $25 - 21 = 4$
 $10 - 6 = 4$
 $6 - 5 = 1$
 $4 / 4 = 1$
 $4 / 1 = 1$
 $1 - 4 = 3$

Q index: 63 x: 9 y: 28
P index: 67 x: 5 y: 24
R index: 71 x: 5 y: 20
 $28 - 24 = 4$
 $24 - 20 = 4$
 $9 - 5 = 4$
 $5 - 5 = 0$
 $4 / 4 = 1$
 $4 / 0.5 = 1$
 $1 - 8 = 7$

Q index: 64 x: 8 y: 27
P index: 68 x: 5 y: 23
R index: 72 x: 5 y: 19

$27 - 23 = 4$
 $23 - 19 = 4$
 $8 - 5 = 3$
 $5 - 5 = 0$
 $4 / 3 = 1.33333$
 $4 / 0.5 = 1.33333$
 $1.33333 - 8 = 6.66667$

Q index: 65 x: 7 y: 26
P index: 69 x: 5 y: 22
R index: 73 x: 5 y: 18
 $26 - 22 = 4$
 $22 - 18 = 4$
 $7 - 5 = 2$
 $5 - 5 = 0$
 $4 / 2 = 2$
 $4 / 0.5 = 2$
 $2 - 8 = 6$

Q index: 66 x: 6 y: 25
P index: 70 x: 5 y: 21
R index: 74 x: 5 y: 17
 $25 - 21 = 4$
 $21 - 17 = 4$
 $6 - 5 = 1$
 $5 - 5 = 0$
 $4 / 1 = 4$
 $4 / 0.5 = 4$
 $4 - 8 = 4$

Q index: 67 x: 5 y: 24
P index: 71 x: 5 y: 20
R index: 75 x: 5 y: 16
 $24 - 20 = 4$
 $20 - 16 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 68 x: 5 y: 23
P index: 72 x: 5 y: 19
R index: 0 x: 5 y: 15
 $23 - 19 = 4$
 $19 - 15 = 4$
 $5 - 5 = 0$
 $5 - 5 = 0$
 $4 / 0.5 = 8$
 $4 / 0.5 = 8$
 $8 - 8 = 0$

Q index: 69 x: 5 y: 22
P index: 73 x: 5 y: 18
R index: 1 x: 6 y: 14
 $22 - 18 = 4$
 $18 - 14 = 4$
 $5 - 5 = 0$
 $5 - 6 = 1$
 $4 / 0.5 = 8$
 $4 / 1 = 8$

$$8 - 4 = 4$$

Q index: 70 x: 5 y: 21

P index: 74 x: 5 y: 17

R index: 2 x: 7 y: 13

$$21 - 17 = 4$$

$$17 - 13 = 4$$

$$5 - 5 = 0$$

$$5 - 7 = 2$$

$$4 / 0.5 = 8$$

$$4 / 2 = 8$$

$$8 - 2 = 6$$

Q index: 71 x: 5 y: 20

P index: 75 x: 5 y: 16

R index: 3 x: 8 y: 12

$$20 - 16 = 4$$

$$16 - 12 = 4$$

$$5 - 5 = 0$$

$$5 - 8 = 3$$

$$4 / 0.5 = 8$$

$$4 / 3 = 8$$

$$8 - 1.33333 = 6.66667$$

Q index: 72 x: 5 y: 19

P index: 0 x: 5 y: 15

R index: 4 x: 9 y: 11

$$19 - 15 = 4$$

$$15 - 11 = 4$$

$$5 - 5 = 0$$

$$5 - 9 = 4$$

$$4 / 0.5 = 8$$

$$4 / 4 = 8$$

$$8 - 1 = 7$$

Q index: 73 x: 5 y: 18

P index: 1 x: 6 y: 14

R index: 5 x: 10 y: 10

$$18 - 14 = 4$$

$$14 - 10 = 4$$

$$5 - 6 = 1$$

$$6 - 10 = 4$$

$$4 / 1 = 4$$

$$4 / 4 = 4$$

$$4 - 1 = 3$$

Q index: 74 x: 5 y: 17

P index: 2 x: 7 y: 13

R index: 6 x: 11 y: 9

$$17 - 13 = 4$$

$$13 - 9 = 4$$

$$5 - 7 = 2$$

$$7 - 11 = 4$$

$$4 / 2 = 2$$

$$4 / 4 = 2$$

$$2 - 1 = 1$$

Q index: 75 x: 5 y: 16

P index: 3 x: 8 y: 12

R index: 7 x: 12 y: 8

$$16 - 12 = 4$$

$12 - 8 = 4$
 $5 - 8 = 3$
 $8 - 12 = 4$
 $4 / 3 = 1.33333$
 $4 / 4 = 1.33333$
 $1.33333 - 1 = 0.333333$

PtAry after Corner Detection

40 40 0 1

1

x: 5 y: 15 curvature: 7
x: 6 y: 14 curvature: 3
x: 7 y: 13 curvature: 1
x: 8 y: 12 curvature: 0.333333
x: 9 y: 11 curvature: 0
x: 10 y: 10 curvature: 0
x: 11 y: 9 curvature: 0
x: 12 y: 8 curvature: 0.25
x: 13 y: 7 curvature: 0.5
x: 14 y: 6 curvature: 0.75
x: 15 y: 5 curvature: 1
x: 16 y: 5 curvature: 0.75
x: 17 y: 5 curvature: 0.5
x: 18 y: 5 curvature: 0.25
x: 19 y: 5 curvature: 0
x: 20 y: 5 curvature: 0
x: 21 y: 5 curvature: 0.25
x: 22 y: 5 curvature: 0.5
x: 23 y: 5 curvature: 0.75
x: 24 y: 5 curvature: 1
x: 25 y: 6 curvature: 0.75
x: 26 y: 7 curvature: 0.5
x: 27 y: 8 curvature: 0.25
x: 28 y: 9 curvature: 0
x: 29 y: 10 curvature: 0
x: 30 y: 11 curvature: 0
x: 31 y: 12 curvature: 0.333333
x: 32 y: 13 curvature: 1
x: 33 y: 14 curvature: 3
x: 34 y: 15 curvature: 7
x: 34 y: 16 curvature: 6.66667
x: 34 y: 17 curvature: 6
x: 34 y: 18 curvature: 4
x: 34 y: 19 curvature: 0
x: 34 y: 20 curvature: 0
x: 34 y: 21 curvature: 4
x: 34 y: 22 curvature: 6
x: 34 y: 23 curvature: 6.66667
x: 34 y: 24 curvature: 7
x: 33 y: 25 curvature: 3
x: 32 y: 26 curvature: 1
x: 31 y: 27 curvature: 0.333333
x: 30 y: 28 curvature: 0
x: 29 y: 29 curvature: 0
x: 28 y: 30 curvature: 0
x: 27 y: 31 curvature: 0.25
x: 26 y: 32 curvature: 0.5
x: 25 y: 33 curvature: 0.75
x: 24 y: 34 curvature: 1
x: 23 y: 34 curvature: 0.75

x: 22 y: 34 curvature: 0.5
x: 21 y: 34 curvature: 0.25
x: 20 y: 34 curvature: 0
x: 19 y: 34 curvature: 0
x: 18 y: 34 curvature: 0.25
x: 17 y: 34 curvature: 0.5
x: 16 y: 34 curvature: 0.75
x: 15 y: 34 curvature: 1
x: 14 y: 33 curvature: 0.75
x: 13 y: 32 curvature: 0.5
x: 12 y: 31 curvature: 0.25
x: 11 y: 30 curvature: 0
x: 10 y: 29 curvature: 0
x: 9 y: 28 curvature: 0
x: 8 y: 27 curvature: 0.333333
x: 7 y: 26 curvature: 1
x: 6 y: 25 curvature: 3
x: 5 y: 24 curvature: 7
x: 5 y: 23 curvature: 6.66667
x: 5 y: 22 curvature: 6
x: 5 y: 21 curvature: 4
x: 5 y: 20 curvature: 0
x: 5 y: 19 curvature: 0
x: 5 y: 18 curvature: 4
x: 5 y: 17 curvature: 6
x: 5 y: 16 curvature: 6.66667