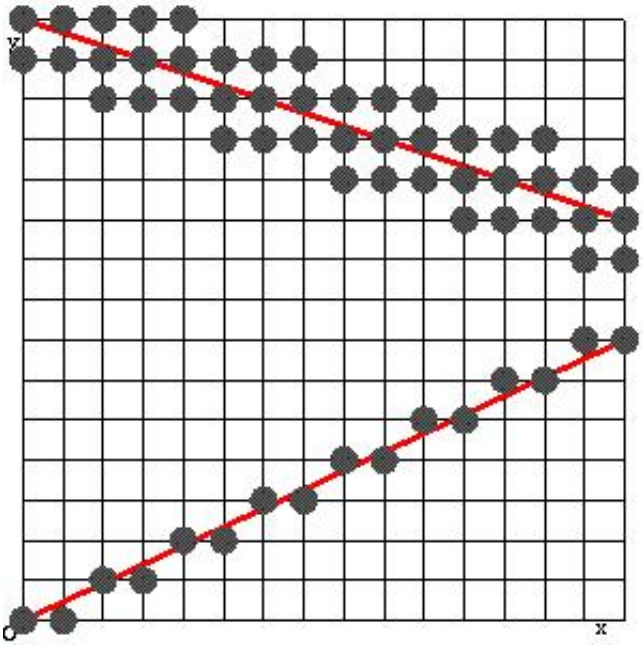
Tema 3.

Desenarea primitivelor grafice 2D pe ecrane rastru.

1. Implementati o clasa GrilaCarteziana prin intermediul careia sa puteti desena o grila carteziana patratica 2D cu urmatoarele caracteristici:
    1. Numarul de linii/coloane sunt parametri ai grilei,
    2. Liniile si coloanele grilei sunt egal spatiate,
    3. In varfurile grilei (intersectiile dintre linii si coloane) sa fie desenati pixeli avand o forma circulara (pot avea si alte forme, patratice de exemplu, dar formele circulare vor primi punctaj maxim),
    4. Pixelii sa fie disjuncti,
    5. Un pixel (i,j) sa fie aprins prin apelul unei metode writePixel avand cel putin 2 argumente de tip intreg: linia i si coloana j.
2. Implementati algoritmul prezentat la curs pentru trasarea unui segment de dreapta ale carui extremitati au coordonate intregi (vezi imaginea). **Vor primi punctaj maxim acele rezolvari care implementeaza algoritmul `AfisareSegmentDreapta3` (modificand-ul corespunzator si explicand aceste modificari).**



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```
#include <stdlib.h>
#include <stdio.h>
#include <math.h>
#include <list>
#include "glut.h"

using namespace std;

#define dimensiuneFereastra 600
#define NO_LINII_DEFAULT 15
#define NO_COLOANE_DEFAULT 15

unsigned char prevKey;

class Culoare{
private:
    float R;
    float G;
    float B;
public:
    Culoare(float R, float G, float B){
        this->R = R;
        this->G = G;
        this->B = B;
    }
    void setR(float R){
        this->R = R;
    }
    void setG(float G){
        this->G = G;
    }
    void setB(float B){
        this->B = B;
    }
    float getR(){
        return this->R;
    }
    float getG(){
        return this->G;
    }
    float getB(){
        return this->B;
    }
};
class Punct{
private:
    int X;
    int Y;
public:
    Punct(int x, int y){
        this->X = x;
        this->Y = y;
```

```
    }
    void setX(int x){
        this->X = x;
    }
    void setY(int y){
        this->Y = y;
    }
    int getX(){
        return this->X;
    }
    int getY(){
        return this->Y;
    }
};
list<Punct*> M;
class Dreapta{
private:
    int fromX;
    int fromY;
    int toX;
    int toY;
    float m;
    float n;
    int dX;
    int dY;
    int a;
    int b;
    int c;
public:
    Dreapta(int fromX, int fromY, int toX, int toY){
        this->fromX = fromX;
        this->fromY = fromY;
        this->toX = toX;
        this->toY = toY;
        dX = abs(toX - fromX);
        dY = abs(toY - fromY);
        a = dY;
        b = -dX;
        c = dX*fromY - dY*fromX;
        m = dY/(dX+0.0f);
        n = fromY - (dY*fromX)/(dX+0.0f);
    }
    float getM() const { return m; }
    void setM(float val) { m = val; }
    float getN() const { return n; }
    void setN(float val) { n = val; }
    int getDX() const { return dX; }
    void setDX(int val) { dX = val; }
    int getDY() const { return dY; }
    void setDY(int val) { dY = val; }
    int getA() const { return a; }
    void setA(int val) { a = val; }
    int getB() const { return b; }
```

```
    void setB(int val) { b = val; }
    int getC() const { return c; }
    void setC(int val) { c = val; }

};
class GrilaCarteziana{
private:
    int mLinii;
    int mColoane;
    int mDeltaPixeliPerLinie;
    int mDeltaPixeliPerColoana;
protected:
public:
    GrilaCarteziana(){
        this->mLinii = NO_LINII_DEFAULT;
        this->mColoane = NO_COLOANE_DEFAULT;
        this->initializari();
    }
    GrilaCarteziana(int pLinii, int pColoane){
        this->mLinii = pLinii;
        this->mColoane = pColoane;
        this->initializari();
    }
    void initializari(){
        mDeltaPixeliPerLinie = dimensiuneFereastra/(mLinii+1);
        mDeltaPixeliPerColoana = dimensiuneFereastra/(mColoane+1);

    }
    void writePixel(int atX, int atY){
        float x,y;
        float PI = 4*atan(1.0);
        float radius = 10;
        float delta_theta = 0.01;
        glColor3f(0.76,0.76,0.76);
        glBegin( GL_POLYGON );{
            for( float angle = 0; angle < 2*PI; angle += delta_theta )
                glVertex2f( atX+radius*cos(angle),atY+radius*sin(angle));
        }glEnd();
    }
    void writePixels(list<Punct*> m){
        list<Punct*>::const_iterator iterator;
        for(iterator = m.begin(); iterator!=m.end(); iterator++){
            this->writePixel((*iterator)->getX()*mDeltaPixeliPerLinie, (*iterator)->getY()*
            mDeltaPixeliPerColoana);
        }
    }
    void writeRedLine(int fromX, int fromY, int toX, int toY){
        glColor3f(1,0,0);
        glBegin(GL_LINES);{
            glVertex2i(fromX*mDeltaPixeliPerLinie, fromY*mDeltaPixeliPerColoana);
            glVertex2i(toX*mDeltaPixeliPerLinie, toY*mDeltaPixeliPerColoana);
        }glEnd();
    }
```

```
    void draw(){
        glColor3f(0,0,0);
        for(int i = -mLinii-1 ; i<=mLinii; i++){
            glBegin(GL_LINES);{
                glVertex2i(-dimensiuneFereastra*mDeltaPixeliPerLinie,i*mDeltaPixeliPerLinie);
                glVertex2i(dimensiuneFereastra+mDeltaPixeliPerLinie,i*mDeltaPixeliPerLinie);
            }glEnd();
        }
        for(int i = -mLinii-1 ; i<=mLinii; i++){
            glBegin(GL_LINES);{
                glVertex2i(i*mDeltaPixeliPerColoana,-dimensiuneFereastra+mDeltaPixeliPerColoana
                );
                glVertex2i(i*mDeltaPixeliPerColoana, dimensiuneFereastra+mDeltaPixeliPerColoana);
            }glEnd();
        }
    }

};

void AfisareSegmentDreapta3 (int fromX, int fromY, int toX, int toY, bool bolded) {
    GrilaCarteziana* grila = new GrilaCarteziana();
    grila->draw();
    Dreapta* dreapta = new Dreapta(fromX, fromY, toX, toY);
    int d = 2*dreapta->getDY()-dreapta->getDX();
    int dE = 2*dreapta->getDY();
    int dNE = 2*(dreapta->getDY()-dreapta->getDX());
    int x = fromX, y = fromY;
    M.push_back(new Punct(x,y));
    if(bolded){
        M.push_back(new Punct(x,y+1));
        M.push_back(new Punct(x,y-1));
    }
    while(x<toX){
        if(dreapta->getM()>=0){
            if(d<=0){
                //alegem E
                M.push_back(new Punct(x+1, y));
                if(bolded){
                    M.push_back(new Punct(x+1,y+1));
                    M.push_back(new Punct(x+1,y-1));
                }
                d+=dE;
                x++;
            } else {
                //alegem NE
                    M.push_back(new Punct(x+1,y+1));
                    if(bolded){
                        M.push_back(new Punct(x+1,y));
                        M.push_back(new Punct(x+1,y+2));
                    }
                d+=dNE;
                x++;
                y++;
```

```
            }
        } else {

        }
    }
    grila->writeRedLine(fromX, fromY, toX, toY);
    grila->writePixels(M);
    //free memory
    while(M.size()>0){
        Punct* p = M.back();
        M.pop_back();
        delete(p);

    }
    delete(dreapta);
    delete(grila);
}

void Init(void) {

   glClearColor(1.0,1.0,1.0,1.0);

   glLineWidth(1);

//   glPointSize(4);

   glPolygonMode(GL_FRONT, GL_FILL);
   glMatrixMode(GL_PROJECTION);
   gluOrtho2D(-dimensiuneFereastra*0.9f, dimensiuneFereastra*0.9f,
        -dimensiuneFereastra*0.9f, dimensiuneFereastra*0.9f);
}
void Display(void) {
   glClear(GL_COLOR_BUFFER_BIT);

   switch(prevKey) {
   case '1':
      AfisareSegmentDreapta3(-16,-16,16,16, true);
      break;
   default:
      break;
   }

   glFlush();
}

void Reshape(int w, int h) {
   glViewport(0, 0, (GLsizei) w, (GLsizei) h);
}

void KeyboardFunc(unsigned char key, int x, int y) {
   prevKey = key;
   if (key == 27) // escape
      exit(0);
```

```
   glutPostRedisplay();
}

void MouseFunc(int button, int state, int x, int y) {
}

int main(int argc, char** argv) {

   glutInit(&argc, argv);

   glutInitWindowSize(dimensiuneFereastra, dimensiuneFereastra);

   glutInitWindowPosition(100, 100);

   glutInitDisplayMode (GLUT_SINGLE | GLUT_RGB);

   glutCreateWindow (argv[0]);

   Init();

   glutReshapeFunc(Reshape);

   glutKeyboardFunc(KeyboardFunc);

   glutMouseFunc(MouseFunc);

   glutDisplayFunc(Display);

   glutMainLoop();

   return 0;
}
```