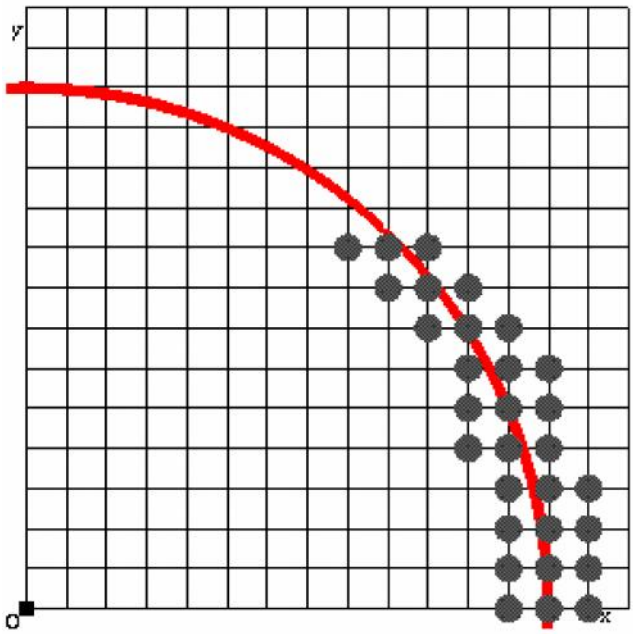
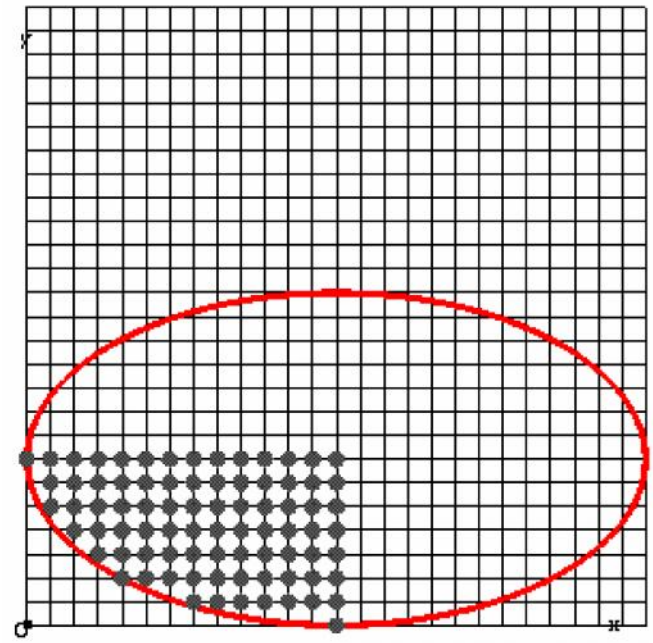
Tema 4

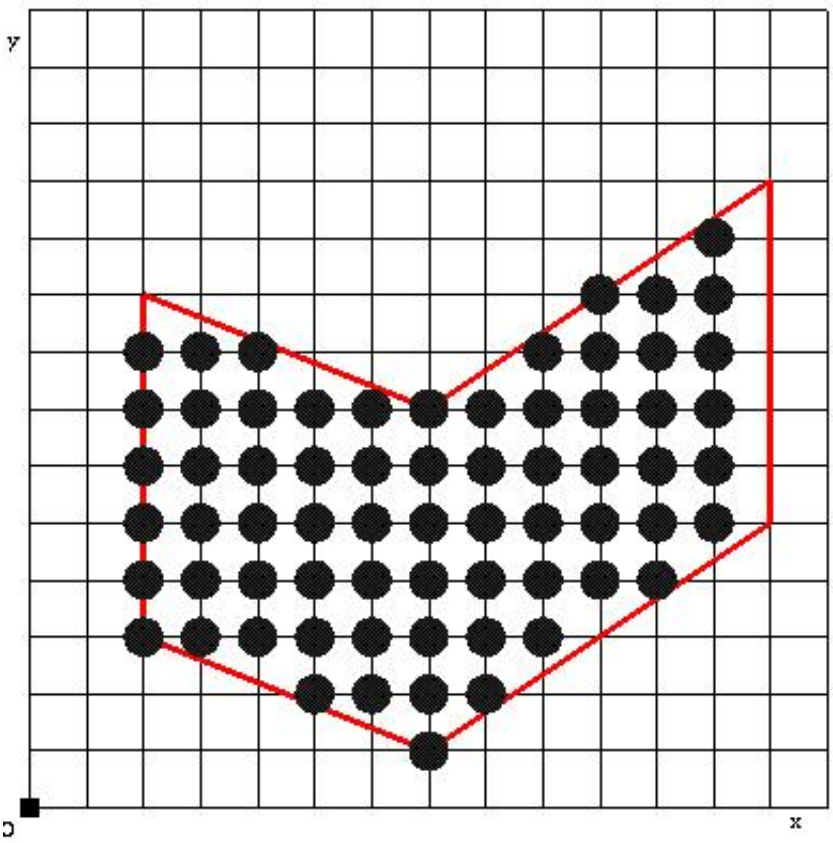
Desenarea primitivelor grafice 2D pe ecrane rastru.

1. La curs a fost prezentat un algoritm pentru trasarea unui cerc cu centrul in origine si de raza din Z. Mai intai se generau pixelii din octantul al 2-lea si ulterior prin simetrie fata de O, Ox, Oy si bisectoare toti pixelii cercului. Modificati algoritmul astfel incat sa fie generati doar pixelii din primul octant si utilizati o tehnica de ingrosare a primitivelor pentru a obtine imaginea.
   Vor primi punctaj maxim acele rezolvari care implementeaza algoritmul `AfisareCerc4` (modificand-ul corespunzator si explicand aceste modificari).
2. La curs a fost prezentat un algoritm pentru colorarea uniforma a unei elipse (avand centrul in origine si semiaxe din Z): se genereaza mai intai pixelii din cadranul 1 si apoi, prin simetrie fata de O, Ox si Oy pixelii din celelalte cadrane. Modificati algoritmul prezentat astfel incat sa fie generati mai intai pixelii din cadranul al 3-lea (vezi imaginea).
   Vor primi punctaj maxim acele rezolvari care modifica algoritmul 11 `UmplereElipsa` dar pastreaza aceleasi principii de obtinere ale extremitatilor segmentelor de scanare maximale.
3. Implementati algoritmul prezentat la curs pentru colorarea pixelilor care sunt interiori unui poligon (vezi imaginea). Varfurile poligonului se vor citi dintr-un fisier. Fisierul va avea urmatorul format: pe prima linie va fi numarul de varfuri si apoi, pe linii consecutive, coordonatele x si y ale varfurilor. Ordinea varfurilor V1, V2, ..., Vn are urmatoarea semnificatie: muchiile poligonului sunt V1V2, V2V3, ..., VnV1.
   De exemplu, pentru poligonul din imagine, fisierul de intrare ar putea fi:

```
6
2 3
7 1
13 5
13 11
7 7
2 9
```


y
O
x


y
O
x



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

using namespace std;

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

unsigned char prevKey;

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*> MPixeliDreapta;
list<Punct*> MPixeliCerc;
list<Punct*> MPixeliElipsa;
class Cerc{
private:
    Punct* centru;
    int raza;
public:
    Cerc(Punct* pCentru, int pRaza){
        this->centru = pCentru;
        this->raza = pRaza;
    }
    Punct* getCentru() const { return centru; }
    void setCentru(Punct* val) { centru = val; }
    int getRaza() const { return raza; }
```

```
    void setRaza(int val) { raza = val; }
};
class Elipsa{
private:
    Punct* centru;
    int raza1;
    int raza2;
public:
    Elipsa(Punct* pCentru, int pRaza1, int pRaza2){
        this->centru = pCentru;
        this->raza1 = pRaza1;
        this->raza2 = pRaza2;
    }
    Punct* getCentru() const { return centru; }
    void setCentru(Punct* val) { centru = val; }
    int getRaza1() const { return raza1; }
    void setRaza1(int val) { raza1 = val; }
    int getRaza2() const { return raza2; }
    void setRaza2(int val) { raza2 = val; }
};
class SegmentOrizontal{
public:
    int xMin;
    int xMax;
    int y;
    SegmentOrizontal(int y,int xmin, int xmax){
        this->xMax = xmax;
        this->xMin = xmin;
        this->y = y;
    }
};
list<SegmentOrizontal*> MSegmente;
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(0,0,0);
    glPolygonMode(GL_FRONT, GL_FILL);
    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 writeLinePixels(list<SegmentOrizontal*> segments){

    list<SegmentOrizontal*>::const_iterator iterator;
    for(iterator = segments.begin(); iterator!=segments.end(); iterator++){
        int xMax, xMin, aux;
        if( (*iterator)->xMin < (*iterator)->xMax){
            xMin = (*iterator)->xMin;
            xMax = (*iterator)->xMax;
        } else {
            xMin = (*iterator)->xMax;
            xMax = (*iterator)->xMin;
        }
        for(int j =xMin; j<=xMax; j++){
            this->writePixel(j*mDeltaPixeliPerLinie,(*iterator)->y*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 writeCircle(Cerc* pCerc){
    float PI = 4*atan(1.0);
    float radius = pCerc->getRaza()*mDeltaPixeliPerColoana;
    float delta_theta = 0.01;
    glColor3f(1,0,0);
    glPolygonMode(GL_FRONT, GL_LINE);
    glBegin( GL_POLYGON );{
```

```
            for( float angle = 0; angle < 2*PI; angle += delta_theta )
                glVertex2f( pCerc->getCentru()->getX()*mDeltaPixeliPerLinie+radius*cos(angle),
                            pCerc->getCentru()->getY()*mDeltaPixeliPerColoana+radius*sin(angle));
        }glEnd();
    }
    void writeElipse(Elipsa* pElipsa){
        float PI = 4*atan(1.0);
        float radius1 = pElipsa->getRaza1()*mDeltaPixeliPerLinie;
        float radius2 = pElipsa->getRaza2()*mDeltaPixeliPerColoana;
        float delta_theta = 0.01;
        glColor3f(1,0,0);
        glPolygonMode(GL_FRONT, GL_LINE);
        glBegin( GL_POLYGON );{
            for( float angle = 0; angle < 2*PI; angle += delta_theta )
                glVertex2f( pElipsa->getCentru()->getX()*mDeltaPixeliPerLinie+radius1*cos(angle),
                            pElipsa->getCentru()->getY()*mDeltaPixeliPerColoana+radius2*sin(
                            angle));
        }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 AfisarePuncteCerc3(int x, int y){
    MPixeliCerc.push_back(new Punct(x,y));
    MPixeliCerc.push_back(new Punct(x+1,y));
    MPixeliCerc.push_back(new Punct(x-1,y));
    /*
    MPixeliCerc.push_back(new Punct(-x,-y));
    MPixeliCerc.push_back(new Punct(-x,y));
    MPixeliCerc.push_back(new Punct(x,-y));;
    if(x != y){
        MPixeliCerc.push_back(new Punct(y,x));
        MPixeliCerc.push_back(new Punct(-y,-x));
        MPixeliCerc.push_back(new Punct(-y,x));
        MPixeliCerc.push_back(new Punct(y,-x));
    }*/
}
void AfisareCerc4(Cerc* cerc, bool showGrid){
```

```
    GrilaCarteziana* grila = new GrilaCarteziana();
    if(showGrid){
        grila->draw();
    }
    grila->writeCircle(cerc);
    int raza = cerc->getRaza();
    int x = raza, y = 0;
    int d = 1- raza;
    int dN = 3, dNE = -2*raza+5;
    AfisarePuncteCerc3(x+cerc->getCentru()->getX(),y+cerc->getCentru()->getY());
    while(y!=x){
        if(d<0){
            d+=dN;
            dN+=2;
            dNE+=2;
        } else {
            d+=dNE;
            dN+=2;
            dNE += 4;
            x--;
        }
        y++;
        AfisarePuncteCerc3(x+cerc->getCentru()->getX(),y+cerc->getCentru()->getY());
    }
    grila->writePixels(MPixeliCerc);
    //free
    delete(cerc);
    delete(grila);

}
void UmplereElipsa(int x0, int y0, int a, int b){
    int newA = a-1;
    int newB = b-1;
    int xi = 0, x = 0, y = -newB;
    double fxpyp =0.0;
    double deltaV, deltaNV, deltaN;
    GrilaCarteziana* grila = new GrilaCarteziana();
    grila->draw();
    grila->writeElipse(new Elipsa(new Punct(x0, y0), a-1, b-1));
    MSegmente.push_back(new SegmentOrizontal(y-y0, x-x0, x0));
    while((double)newA*newA*((double)y-0.5)<(double)newB*newB*(x+1)){
        deltaV = (double)newB*newB*(-2*x+1);
        deltaNV = (double)newB*newB*(-2*x+1)+(double)newA*newA*(2*y+1);
        if(fxpyp+deltaV <=0.0){
            fxpyp +=deltaV;
            --x;
            list<SegmentOrizontal*>::const_iterator iterator;
            for(iterator = MSegmente.begin(); iterator!=MSegmente.end(); iterator++){
                if((*iterator)->y == y-y0){
                    (*iterator)->y = y-y0;
                    (*iterator)->xMin = x-x0;
                    (*iterator)->xMax = x0;
                }
```

```
            }
        } else if(fxpyp+deltaNV<=0.0){
            fxpyp += deltaNV;
            --x; ++y;
            MSegmente.push_back(new SegmentOrizontal(y-y0, x-x0, x0));
        }
    }
    while (y<0){
        deltaNV = (double)newB*newB*(-2*x+1)+(double)newA*newA*(2*y+1);
        deltaN = (double)newA*newA*(2*y+1);
        if(fxpyp+deltaNV<=0){
            fxpyp+=deltaNV;
            --x; ++y;
            MSegmente.push_back(new SegmentOrizontal(y-y0, x-x0, x0));
        } else {
            fxpyp += deltaN;
            ++y;
        }
        MSegmente.push_back(new SegmentOrizontal(y-y0, x-x0, x0));
    }
    grila->writeLinePixels(MSegmente);
}
void Init(void) {

   glClearColor(1.0,1.0,1.0,1.0);

   glLineWidth(1);

//   glPointSize(4);

   glPolygonMode(GL_FRONT, GL_LINE);
   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':
        AfisareCerc4(new Cerc(new Punct(0,0),10), true);
        break;
    case '2':
        UmplereElipsa(0,0,10,7);
        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;
}
```