SSN COLLEGE OF ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
UCS1712 – GRAPHICS AND MULTIMEDIA LAB
EX NO: 5a – 2D Transformations – Translation, Rotation and Scaling

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AIM:

To draw lines as a series of points using DDA line drawing algorithm.

ALGORITHM:

```
1. Read the vertices for polygon and line to be transformed as input.
2. Read the choice of operation to be performed.
3. For Translation:
    a. Read translation factor (tx,ty).
    b. For each vertex (x,y) apply translation as follows:
        i. x = x+tx
        ii. y = y+ty
    c. For polygon, draw the translated polygon using the four new vertices.
    d. For line, draw the translated line using the two new vertices.
4. For Rotation:
    a. Read the degree of rotation Θ for polygon and line.
    b. Set the fixed point (fx,fy) as the first vertex.
    c. For each vertex (x,y) the new vertex is computed as follows:
        i. x = fx + (x-fx)cos(Θ) – (y-fy)sin(Θ)
        ii. y = fy + (x-fx)sin(Θ) + (y-fy)cos(Θ)
    d. For polygon, draw the rotated polygon using the four new vertices.
    e. For line, draw the rotated line using the two new vertices.
```

5. For Scaling:

a. Read scaling factor (sx,sy).

b. Set the fixed point (fx,fy) as the first vertex.

c. For each vertex (x,y) apply scaling as follows:

i. x = (x*sx) + fx*(1-sx)

ii. y = (y*sy) + fy*(1-sy)

d. For polygon, draw the scaled polygon using the four new vertices.

e. For line, draw the scaled line using the two new vertices.

CODE:

```
#include <stdio.h>
#include <math.h>
#include <iostream>
#include <vector>
#include <GL/glut.h>

using namespace std;
int choice;

// Polygon
vector<int> pntX;
vector<int> pntY;

int transX, transY;
double scaleX, scaleY;
double angle, angleRad;

// Line
vector<int> lpntX;
vector<int> lpntY;

int ltransX, ltransY;
double lscaleX, lscaleY;
double langle, langleRad;


double round(double d)
{
    return floor(d + 0.5);
```

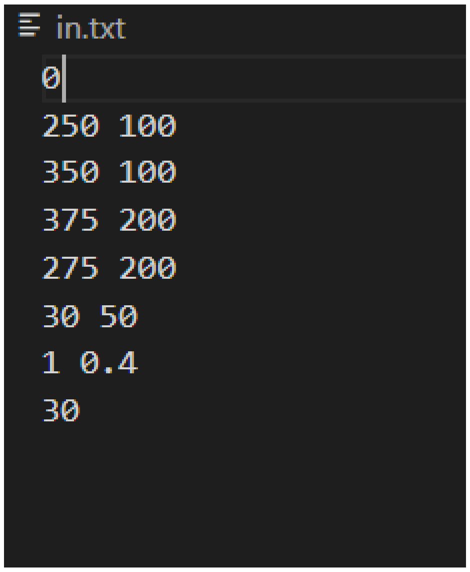
```
}

// line
void drawLine()
{
    glBegin(GL_LINES);
    glColor3f(1.0, 1.0, 1.0);
    for (int i = 0; i < 2; i++)
    {
        glVertex2i(lpntX[i], lpntY[i]);
    }
    glEnd();
}


void drawLineTrans(int x, int y)
{
    glBegin(GL_LINES);
    glColor3f(0.0, 1.0, 0.0);
    for (int i = 0; i < 2; i++)
    {
        glVertex2i(lpntX[i] + x, lpntY[i] + y);
    }
    glEnd();
}

void drawLineScale(double x, double y)
{
    glBegin(GL_LINES);
    glColor3f(1.0, 1.0, 0.0);
    for (int i = 0; i < 2; i++)
    {
        glVertex2i(round(lpntX[i] * x), round(lpntY[i] * y));
    }
    glEnd();
}

void drawLineRotation(double angleRad)
{
    glBegin(GL_LINES);
    glColor3f(0.0, 0.0, 1.0);
    for (int i = 0; i < 2; i++)
    {
        glVertex2i(round((lpntX[i] * cos(angleRad)) - (lpntY[i] *
sin(angleRad))), round((lpntX[i] * sin(angleRad)) + (lpntY[i] * cos(angleRad))));
```

```
    }
    glEnd();
}

// Polygon
void drawPolygon()
{
    glBegin(GL_QUADS);
    glColor3f(1.0, 1.0, 1.0);
    for (int i = 0; i < 4; i++)
    {
        glVertex2i(pntX[i], pntY[i]);
    }
    glEnd();
}

void drawPolygonTrans(int x, int y)
{
    glBegin(GL_QUADS);
    glColor3f(0.0, 1.0, 0.0);
    for (int i = 0; i < 4; i++)
    {
        glVertex2i(pntX[i] + x, pntY[i] + y);
    }
    glEnd();
}

void drawPolygonScale(double x, double y)
{
    glBegin(GL_QUADS);
    glColor3f(1.0, 1.0, 0.0);
    for (int i = 0; i < 4; i++)
    {
        glVertex2i(round(pntX[i] * x), round(pntY[i] * y));
    }
    glEnd();
}

void drawPolygonRotation(double angleRad)
{
    glBegin(GL_QUADS);
    glColor3f(0.0, 0.0, 1.0);
    for (int i = 0; i < 4; i++)
    {
        glVertex2i(round((pntX[i] * cos(angleRad)) - (pntY[i] * sin(angleRad))),
round((pntX[i] * sin(angleRad)) + (pntY[i] * cos(angleRad))));
    }
    glEnd();
}

void myDisplay(void)
{
    glClear(GL_COLOR_BUFFER_BIT);
    glColor3f(0.0, 0.0, 0.0);

    if(choice==0)
    {
        drawPolygon();
        drawPolygonTrans(transX, transY);
        if(scaleX > 1 || scaleY > 1)
        {
            drawPolygonScale(scaleX, scaleY);
            drawPolygon();
        }
        else
        {
            drawPolygonScale(scaleX, scaleY);
        }
        drawPolygonRotation(angleRad);
    }
    else
    {
        drawLine();
        drawLineTrans(ltransX,ltransY);
        if(lscaleX > 1 || lscaleY > 1)
        {
            drawLineScale(lscaleX, lscaleY);
            drawLine();
        }
        else
        {
            drawLineScale(lscaleX, lscaleY);
        }
        drawLineRotation(langleRad);
    }
    glFlush();
}

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

```
{
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
    glutInitWindowPosition(700, 0);
    glutInitWindowSize(750, 750);
    glutCreateWindow("5a-Geometic Transforamtion");
    glClearColor(0,0,0,1);
    glMatrixMode(GL_PROJECTION);
    gluOrtho2D(0.0, 1000, 0.0, 1000);

    int i, pntX1, pntY1;
    freopen("in.txt", "r", stdin);
    cin>>choice;
    // POLYGON
    if(choice==0)
    {
        for (i = 0; i < 4; i++)
        {
            cin >> pntX1 >> pntY1;
            pntX.push_back(pntX1);
            pntY.push_back(pntY1);
        }

        cin >> transX >> transY;
        cin >> scaleX >> scaleY;
        cin >> angle;
        angleRad = angle * 3.1416 / 180;
    }
    else
    {
        for (i = 0; i < 2; i++)
        {
            cin >> pntX1 >> pntY1;
            lpntX.push_back(pntX1);
            lpntY.push_back(pntY1);
        }

        cin >> ltransX >> ltransY;
        cin >> lscaleX >> lscaleY;
        cin >> langle;
        langleRad = langle * 3.1416 / 180;
    }

    glutDisplayFunc(myDisplay);
    glutMainLoop();
    return 0;
}
```

OUTPUT:

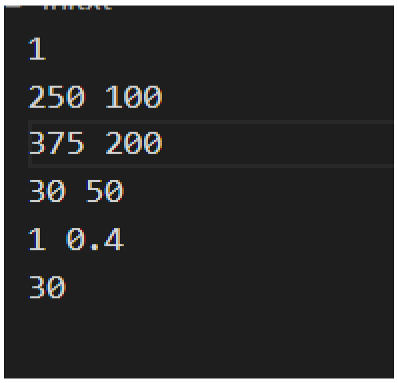
Polygon



in.txt

```
0
250 100
350 100
375 200
275 200
30 50
1 0.4
30
```

Line



```
1
250 100
375 200
30 50
1 0.4
30
```

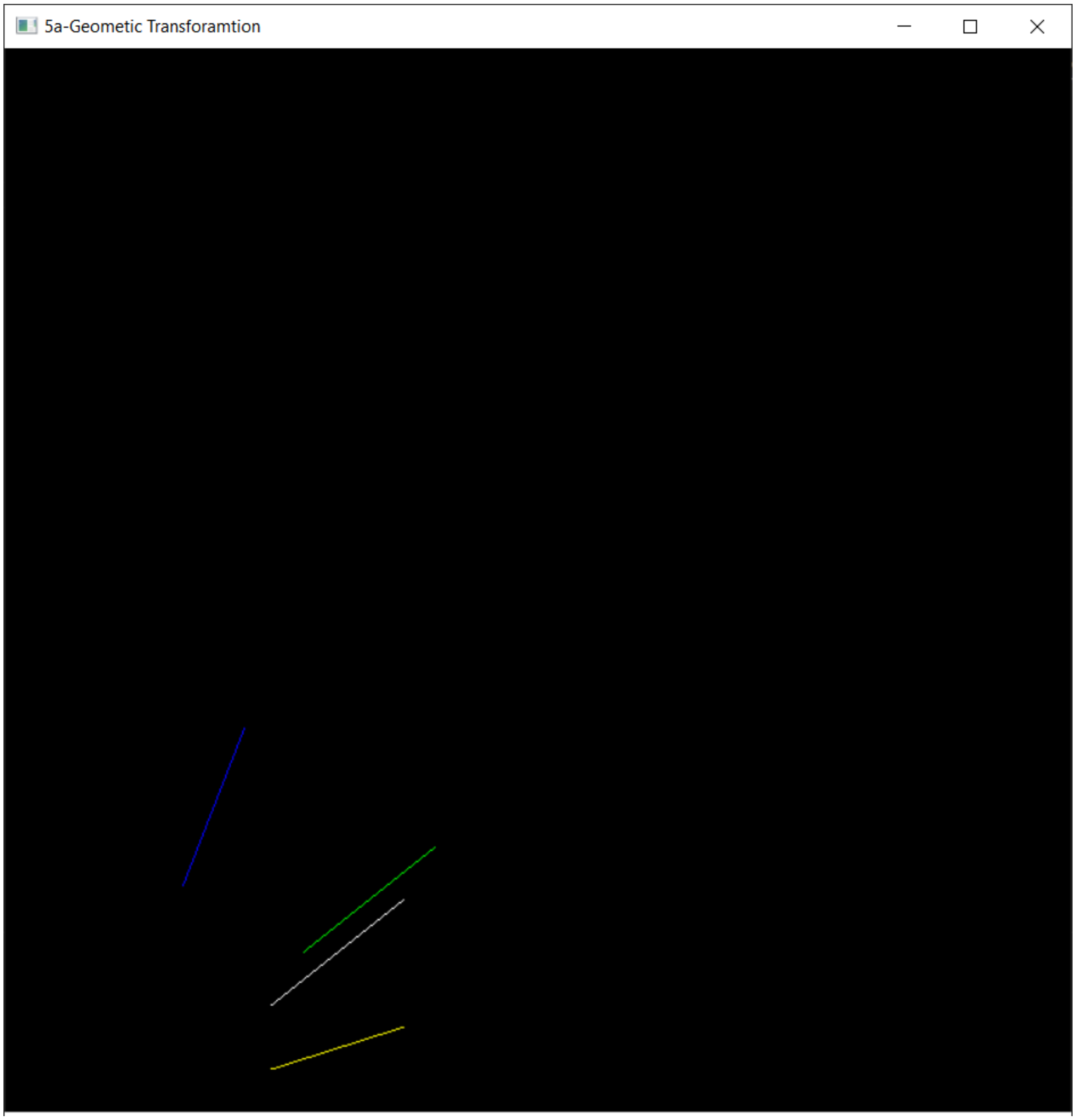
White- original line

Blue- Rotation

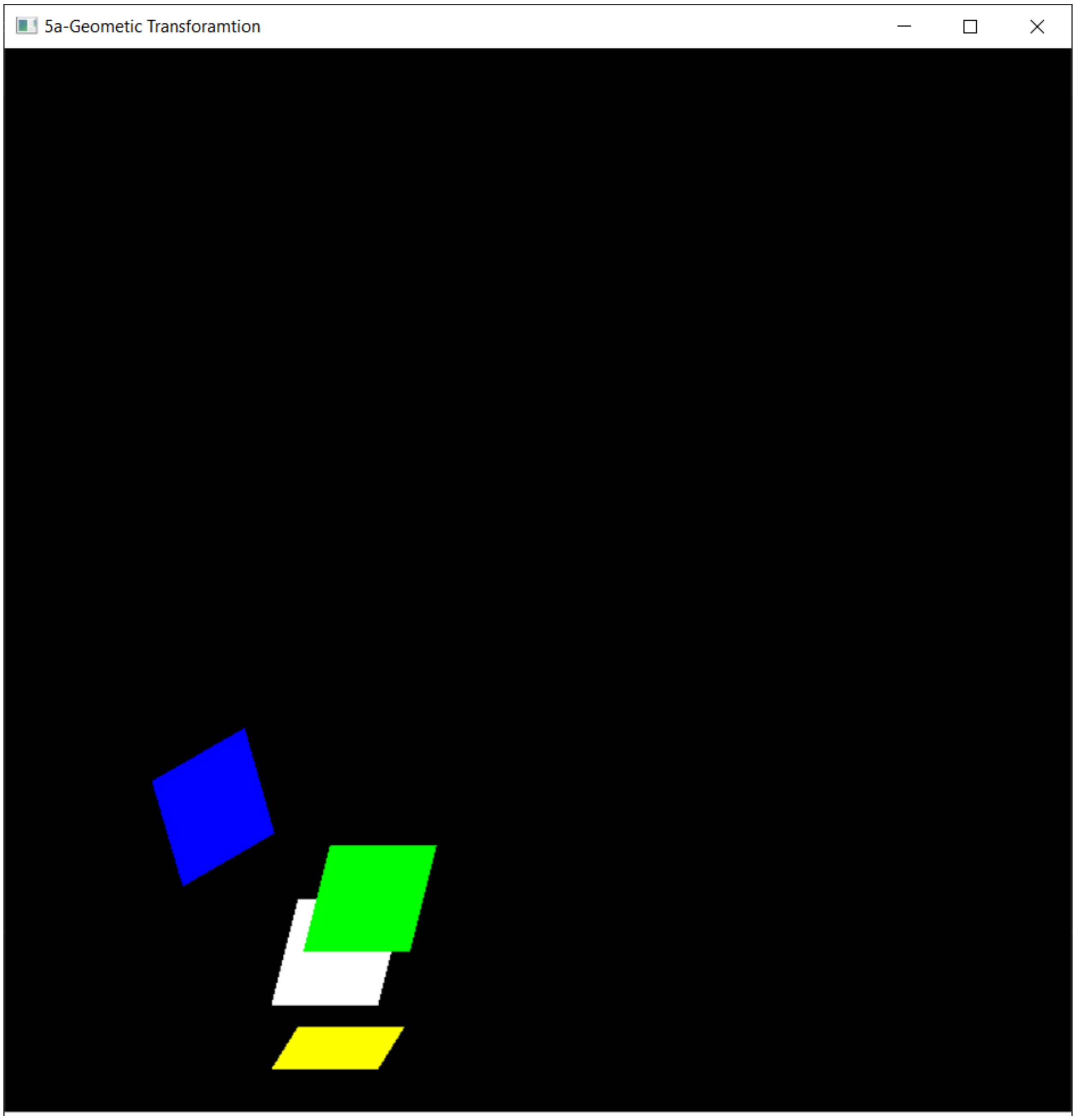
Green- Translation

Yellow- Scaling

For Line



For Polygon



RESULT:

Thus 2D Transformations like Translation, Rotation and Scaling have been performed on a polygon and a line.