Lab Report

Week 4

Jitendra Kumar , 1401CS19

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Title

- Choose any primitive and apply all basic 2D transformations 1). OpenGL 2). MatLab

Procedure

OpenGL

1). Choose any primitive and apply all basic 2D transformations.

- Create a C file and name it as *transformations.c.*
- Following is the final code for all basic 2D transformations :

```
#include <stdio.h>
#include <math.h>
#include <GL/glut.h>
#include <stdlib.h>
#define PI 3.14159265
int flag, count; int i = 0 ; int j = 0 ; int k = 0 ;
double input_pts[10][2];
double final_pts[10][2];
double trans_matrix[3][3];

double x = 0 ;

void displayPolygon()
{

        glClear(GL_COLOR_BUFFER_BIT);
        glLineWidth(3);
        glBegin(GL_LINES);
                glColor3f(1.0f, 1.0f, 1.0f);
                glVertex2f(0.0f,400.0f);
                glVertex2f(0.0f,-400.0f);
                glVertex2f(400.0f,0.0f);
                glVertex2f(-400.0f,0.0f);
        glEnd();

        glBegin(GL_LINE_LOOP);

        glColor3f(1.0f,0.0f,0.0f);

        glVertex3f(input_pts[0][0]/100.0, input_pts[0][1]/100.0, 1.0f);
        glVertex3f(input_pts[1][0]/100.0, input_pts[1][1]/100.0, 1.0f);
        glVertex3f(input_pts[2][0]/100.0, input_pts[2][1]/100.0, 1.0f);
        glVertex3f(input_pts[3][0]/100.0, input_pts[3][1]/100.0, 1.0f);
        glEnd();

        glBegin(GL_LINE_LOOP);

        glColor3f(0.0f,1.0f,0.0f);
        glVertex3f(final_pts[0][0]/100.0, final_pts[0][1]/100.0, 1.0f);
        glVertex3f(final_pts[1][0]/100.0, final_pts[1][1]/100.0, 1.0f);
        glVertex3f(final_pts[2][0]/100.0, final_pts[2][1]/100.0, 1.0f);
        glVertex3f(final_pts[3][0]/100.0, final_pts[3][1]/100.0, 1.0f);
        glEnd();

        glFlush();
        glutSwapBuffers();
}

void matrix_multiplication()
{
        int i = 0 , j = 0 , k = 0 ;
        double a = 0 ; double b = 0 ;

        for(i = 0 ; i < 4 ; i++)
        {
                a = trans_matrix[0][0]*input_pts[i][0] + trans_matrix[0][1]*input_pts[i][1] + trans_matrix[0][2];
                b = trans_matrix[1][0]*input_pts[i][0] + trans_matrix[1][1]*input_pts[i][1] + trans_matrix[1][2];

                final_pts[i][0]=a;
                final_pts[i][1]=b;
        }
}


void translate(double x , double y)
{
        trans_matrix[0][0] = 1;
        trans_matrix[0][1] = 0;
        trans_matrix[0][2] = x;
        trans_matrix[1][0] = 0;
        trans_matrix[1][1] = 1;
        trans_matrix[1][2] = y;
        trans_matrix[2][0] = 0;
        trans_matrix[2][1] = 0;
        trans_matrix[2][2] = 1;
}

void scale_x_y(double sx, double sy)
{
        trans_matrix[0][0] = sx;
        trans_matrix[0][1] = 0;
        trans_matrix[0][2] = 0;
        trans_matrix[1][0] = 0;
        trans_matrix[1][1] = sy;
        trans_matrix[1][2] = 0;
        trans_matrix[2][0] = 0;
        trans_matrix[2][1] = 0;
        trans_matrix[2][2] = 1;
}

void reflectAroundX(void)
{
        trans_matrix[0][0] = 1;
        trans_matrix[0][1] = 0;
        trans_matrix[0][2] = 0;
        trans_matrix[1][0] = 0;
        trans_matrix[1][1] = -1;
        trans_matrix[1][2] = 0;
        trans_matrix[2][0] = 0;
        trans_matrix[2][1] = 0;
        trans_matrix[2][2] = 1;
}


void shearaboutY(double b)
{
        trans_matrix[0][0] = 1;
        trans_matrix[0][1] = 0;
        trans_matrix[0][2] = 0;
        trans_matrix[1][0] = b;
        trans_matrix[1][1] = 1;
        trans_matrix[1][2] = 0;
        trans_matrix[2][0] = 0;
        trans_matrix[2][1] = 0;
        trans_matrix[2][2] = 1;
}

void rotate(double a)
{
        x = PI / 180 ;
        a = a*x;
        trans_matrix[0][0] = cos(a);
        trans_matrix[0][1] = -1 * sin(a);
        trans_matrix[0][2] = 0;
        trans_matrix[1][0] = sin(a);
        trans_matrix[1][1] = cos(a);
        trans_matrix[1][2] = 0;
        trans_matrix[2][0] = 0;
        trans_matrix[2][1] = 0;
        trans_matrix[2][2] = 1;
}

void transformPoints()
{
        int choice ;
        printf("\nEnter your choice:\n1. Translation\n2. Scaling\n3. Reflection\n4. Shear\n5. Rotate\n");
        printf("Your choice : ");
        scanf("%d",&choice);

        double x , y , scale_factor_x, scale_factor_y, shear_factor ,rotation_angle ;

        if(choice==1)
        {
                printf("Enter translate_x : ");
                scanf("%lf",&x);
                printf("Enter translate_y : ");
                scanf("%lf",&y);
                translate(x,y);
        }

        if(choice==2)
        {
                printf("Enter scale_factor_x : ");
                scanf("%lf",&scale_factor_x);
                printf("Enter scale_factor_y : ");
                scanf("%lf",&scale_factor_y);
                scale_x_y(scale_factor_x,scale_factor_y);
        }

        if(choice==3)
        {
                reflectAroundX();
        }

        if(choice==4)
        {
                printf("\nEnter  the shearing Factor :  ");
                scanf("%lf",&shear_factor);
                shearaboutY(shear_factor);
        }

        if(choice==5)
        {
                printf("\nEnter the rotation_angle :  ");
                scanf("%lf",&rotation_angle);
                rotate(rotation_angle);
        }
}


int main(int argc, char **argv)
{
        glutInit(&argc, argv);
        glutInitDisplayMode(GLUT_RGB);
        glutInitWindowSize(800, 800);
        for(i = 0 ; i < 10 ; i++)
        {
                for(j = 0 ; j < 3 ; j++)
                {
                        input_pts[i][j]=0;
                }
        }
        printf("**********\nWe'll be applying  transformations to a sqaure polygon\n**********\n");
        printf("Enter the polygon coordinates : ");
        count = 4 ;

        for( i = 0 ; i < count ; i++)
        {
                scanf("%lf %lf",&input_pts[i][0],&input_pts[i][1]);
        }


        for(i = 0 ; i < 10 ; i++)
        {
                for(j = 0 ; j < 2 ; j++)
                {
                        final_pts[i][j]=0;
                }
        }
        for(i = 0 ; i < 3 ; i++)
        {
                for(j = 0 ; j < 3 ; j++)
                {
                        trans_matrix[i][j]=0;
                }
        }

        transformPoints();
        matrix_multiplication();
        glClearColor(1.0, 1.0, 1.0, 1.0);
        gluOrtho2D(-400, 400, -400, 400);
        glutCreateWindow("\nPolygon transformations");
        glutDisplayFunc(displayPolygon);
        glutMainLoop();

        return 0;
}
```

- Compile and run the executable file in terminal by typing in the following commands :

  (a) *gcc transformations.c -lGL -lGLU -lglut -lm*

  (b) *./a.out*

MatLab

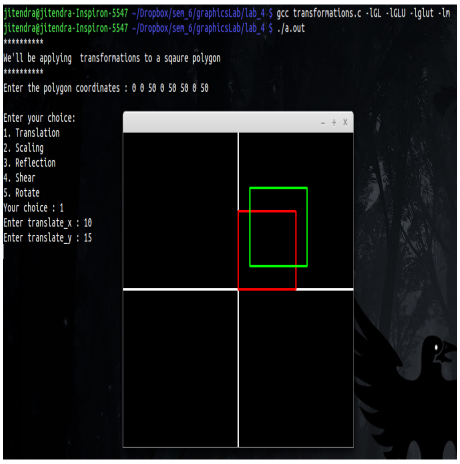
1). Choose any primitive and apply all basic 2D transformations

- Open a new Script and contruct a function transformations().
- Following is the Matlab Script Code for all basic 2D transformations.

```
function [] = transformations()
        disp("***************************************************************************")

        input_matrix = [0 0 1; 0 10 1; 10 10 1; 10 0 1 ; 0 0 1];
        disp("\nEnter your choice:\n1. Translation\n2. Scaling\n3. ReflectAroundX\n4. ShearaboutY\n5. Rotate\n");
        choice = input("Your choice : ");

        temp_matrix = [1 0 0; 0 1 0 ; 0 0 1];
        identity_matrix = [1 0 0; 0 1 0 ; 0 0 1];

        if(choice <= 5)
                if(choice==1)
                        translate_x = input(’Enter␣translate_x␣:␣’);
                        translate_y = input(’Enter␣translate_y␣:␣’);
                        temp_matrix = [1 0 translate_x ; 0 1 translate_y ; 0 0 1];
                end

                if(choice==2)
                        scale_factor_x = input(’Enter␣scale_factor_x␣:␣’);
                        scale_factor_y = input(’Enter␣scale_factor_y␣:␣’);
                        temp_matrix = [scale_factor_x 0 0 ; 0 scale_factor_y 0 ; 0 0 1];
                end

                if(choice==3)
                        temp_matrix = [1 0 0 ; 0 -1 0 ; 0 0 1];
                end

                if(choice==4)
                        shear_factor = input(’Enter␣the␣shearing␣factor␣:␣’);
                        temp_matrix = [1 0 0 ; shear_factor 1 0 ; 0 0 1];
                end

                if(choice==5)
                        theta= input(’Enter␣the␣rotation_angle␣:␣’);
                        theta = (theta*3.14159265) / 180 ;
                        %theta = theta*_x;
                        temp_matrix = [cos(theta) -sin(theta) 0;
                                        sin(theta) cos(theta) 0;
                                        0 0 1];
                end
        else
                disp("\nYou choosed an invalid choice\n")
```

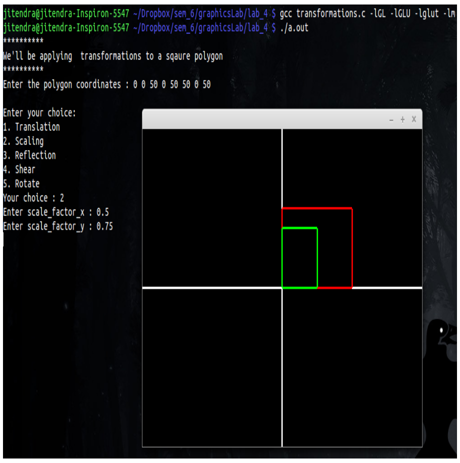
```
    end



    trans = transpose(temp_matrix);
    final = input_matrix*trans;
  plot(input_matrix(:,1),input_matrix(:,2),'--','LineWidth', 3);
  hold on
  plot(final(:,1),final(:,2),'b-','LineWidth', 3);
```

Output



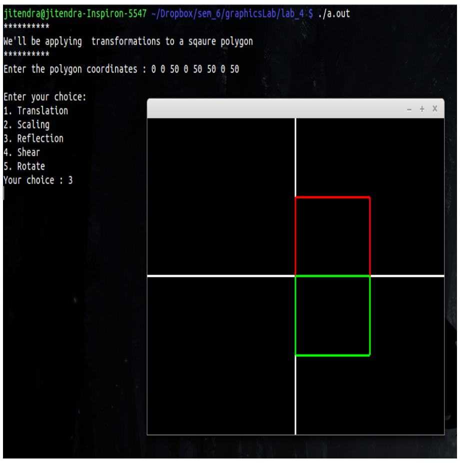
```
jitendra@jitendra-Inspiron-5547 ~/Dropbox/sem_6/graphicsLab/lab_4 $ gcc transformations.c -lGL -lGLU -lglut -lm
jitendra@jitendra-Inspiron-5547 ~/Dropbox/sem_6/graphicsLab/lab_4 $ ./a.out
**********
We'll be applying  transformations to a sqaure polygon
**********
Enter the polygon coordinates : 0 0 50 0 50 50 0 50

Enter your choice:
1. Translation
2. Scaling
3. Reflection
4. Shear
5. Rotate
Your choice : 1
Enter translate_x : 10
Enter translate_y : 15
```

Figure 1 – translation in OpenGL



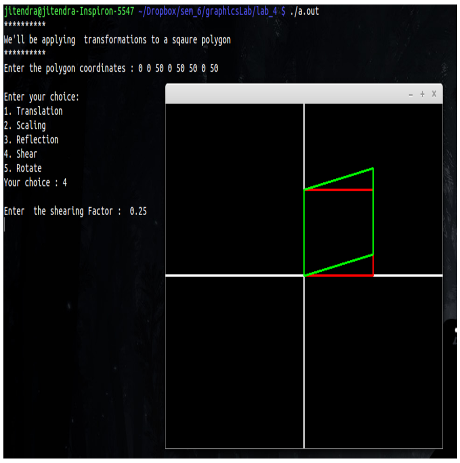
```
jitendra@jitendra-Inspiron-5547 ~/Dropbox/sem_6/graphicsLab/lab_4 $ gcc transformations.c -lGL -lGLU -lglut -lm
jitendra@jitendra-Inspiron-5547 ~/Dropbox/sem_6/graphicsLab/lab_4 $ ./a.out
**********
We'll be applying  transformations to a sqaure polygon
**********
Enter the polygon coordinates : 0 0 50 0 50 50 0 50

Enter your choice:
1. Translation
2. Scaling
3. Reflection
4. Shear
5. Rotate
Your choice : 2
Enter scale_factor_x : 0.5
Enter scale_factor_y : 0.75
```

Figure 2 – Scaling in OpenGL



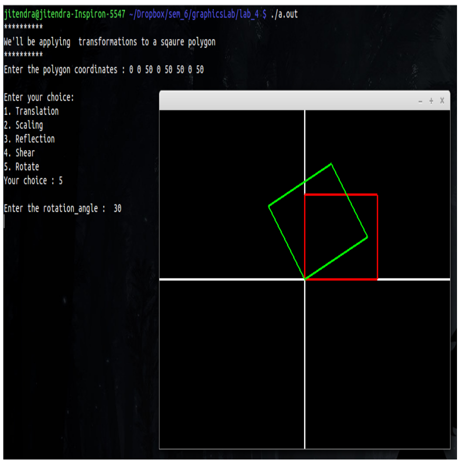
```
jitendra@jitendra-Inspiron-5547 ~/Dropbox/sem_6/graphicsLab/lab_4 $ ./a.out
**********
We'll be applying  transformations to a sqaure polygon
**********
Enter the polygon coordinates : 0 0 50 0 50 50 0 50

Enter your choice:
1. Translation
2. Scaling
3. Reflection
4. Shear
5. Rotate
Your choice : 3
```

Figure 3 – reflection in OpenGL



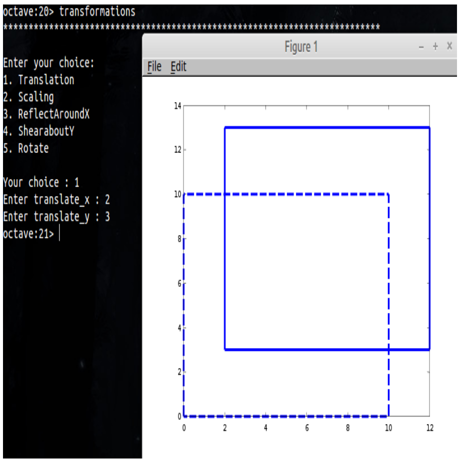
```
jitendra@jitendra-Inspiron-5547 ~/Dropbox/sem_6/graphicsLab/lab_4 $ ./a.out
**********
We'll be applying  transformations to a sqaure polygon
**********
Enter the polygon coordinates : 0 0 50 0 50 50 0 50

Enter your choice:
1. Translation
2. Scaling
3. Reflection
4. Shear
5. Rotate
Your choice : 4

Enter  the shearing Factor :  0.25
```

Figure 4 – Shear in OpenGL



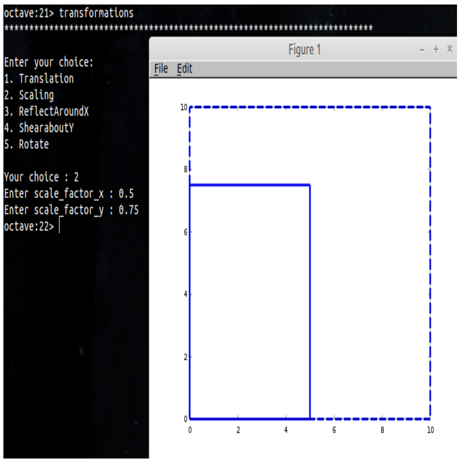
```
jitendra@jitendra-Inspiron-5547 ~/Dropbox/sem_6/graphicsLab/lab_4 $ ./a.out
**********
We'll be applying  transformations to a sqaure polygon
**********
Enter the polygon coordinates : 0 0 50 0 50 50 0 50

Enter your choice:
1. Translation
2. Scaling
3. Reflection
4. Shear
5. Rotate
Your choice : 5

Enter the rotation_angle :  30
```

Figure 5 – rotation in openGL



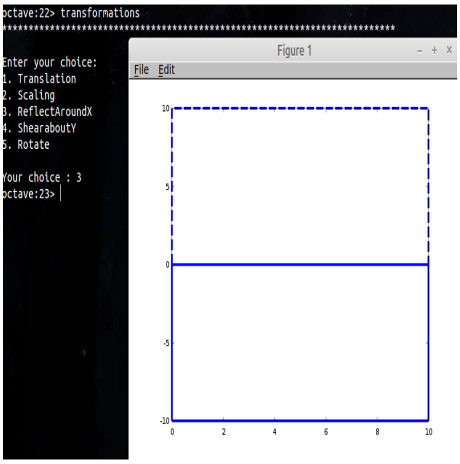
```
octave:20> transformations
**************************************************************************

Enter your choice:
1. Translation
2. Scaling
3. ReflectAroundX
4. ShearaboutY
5. Rotate

Your choice : 1
Enter translate_x : 2
Enter translate_y : 3
octave:21> 
```

Figure 6 – translation in matlab



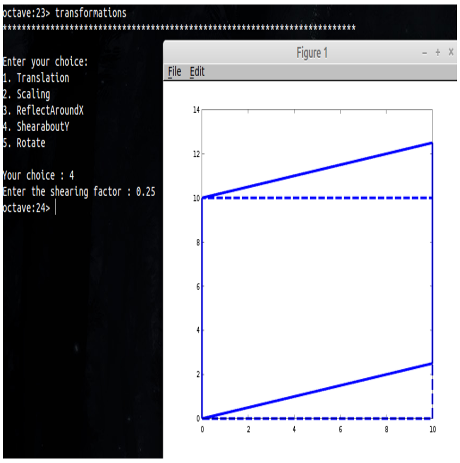
```
octave:21> transformations
**************************************************************************

Enter your choice:
1. Translation
2. Scaling
3. ReflectAroundX
4. ShearaboutY
5. Rotate

Your choice : 2
Enter scale_factor_x : 0.5
Enter scale_factor_y : 0.75
octave:22> 
```

Figure 7 – scaling in Matlab



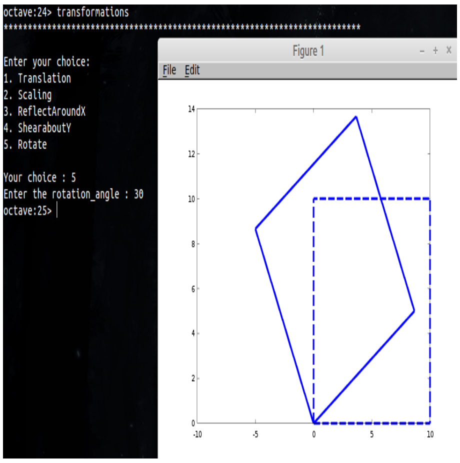
```
octave:22> transformations
**************************************************************************

Enter your choice:
1. Translation
2. Scaling
3. ReflectAroundX
4. ShearaboutY
5. Rotate

Your choice : 3
octave:23> 
```

Figure 8 – reflection in Matlab



```
octave:23> transformations
**************************************************************************

Enter your choice:
1. Translation
2. Scaling
3. ReflectAroundX
4. ShearaboutY
5. Rotate

Your choice : 4
Enter the shearing factor : 0.25
octave:24> |
```

FIGURE 9 – shear in Matlab



```
octave:24> transformations
**************************************************************************

Enter your choice:
1. Translation
2. Scaling
3. ReflectAroundX
4. ShearaboutY
5. Rotate

Your choice : 5
Enter the rotation_angle : 30
octave:25> |
```

FIGURE 10 – Rotation in Matlab