Lab Assignment-3
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To implement a set of basic transformations on a polygon i.e. Translation, Rotation and Scaling.

Code:

```
#include <bits/stdc++.h>
#include <GL/glut.h>
using namespace std;
#define pi 3.142857

vector<vector<double>> v{{10, 20, 1}, {100, 50, 1}, {200, -200, 1}};
vector<vector<double>> z{{0, 0, 0}, {0, 0, 0}, {0, 0, 0}};
vector<vector<double>> tz{{1, 0, 0}, {0, 1, 0}, {0, 0, 1}};
vector<vector<double>> tzs{{1, 0, 0}, {0, 1, 0}, {0, 0, 1}};
vector<vector<double>> scaleu{{2, 0, 0}, {0, 2, 0}, {0, 0, 1}};
vector<vector<double>> scaled{{0.5, 0, 0}, {0, 0.5, 0}, {0, 0, 1}};
vector<vector<double>> vv{{10, 20, 1}, {100, 50, 1}, {200, -200, 1}};
vector<vector<double>> temp;
vector<vector<double>> translatexp{{1, 0, 0}, {0, 1, 0}, {50, 0, 1}};
vector<vector<double>> translatexn{{1, 0, 0}, {0, 1, 0}, {-50, 0, 1}};
vector<vector<double>> translateyp{{1, 0, 0}, {0, 1, 0}, {0, 50, 1}};
vector<vector<double>> translateyn{{1, 0, 0}, {0, 1, 0}, {0, -50, 1}};
vector<vector<double>> rotatec{{0, -1, 0}, {1, 0, 0}, {0, 0, 1}};
vector<vector<double>> rotatea{{0, 1, 0}, {-1, 0, 0}, {0, 0, 1}};

void matrix_multiply(vector<vector<double>> &vr)
{
   temp = v;
   v = z;
   for (int i = 0; i < 3; ++i)
   {
      for (int j = 0; j < 3; ++j)
      {
         for (int k = 0; k < 3; ++k)
         {
            v[i][j] += temp[i][k] * vr[k][j];
         }
      }
   }
}

void myInit(void)
{
   glClearColor(0.0, 0.0, 0.0, 1.0);
   glColor3f(1.0, 1.0, .0);

   glPointSize(3.0);
   glMatrixMode(GL_PROJECTION);
```

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```
    glLoadIdentity();
    gluOrtho2D(-500, 500, -500, 500);
}
void display(void)
{
    glClear(GL_COLOR_BUFFER_BIT);
    glBegin(GL_POINTS);
    for (double y = -500; y <= 500; y += 0.05)
    {
        glVertex2f(0, y);
        glVertex2f(y, 0);
    }
    glEnd();
    glBegin(GL_POLYGON);

    for (int i = 0; i < 3; i++)
    {
        glVertex2f(v[i][0], v[i][1]);
    }
    glEnd();
    glFlush();
}
void keyboard(unsigned char key, int x, int y)
{
    switch (key)
    {
    case 'd':
        matrix_multiply(translatexp);
        glutPostRedisplay();
        break;
    case 'a':
        matrix_multiply(translatexn);
        glutPostRedisplay();
        break;
    case 'w':
        matrix_multiply(translateyp);
        glutPostRedisplay();
        break;
    case 's':
        matrix_multiply(translateyn);
        glutPostRedisplay();

        break;
    case 'u':
        tz = tzs;
        tz[2][0] = -v[0][0];
        tz[2][1] = -v[0][1];
        matrix_multiply(tz);
```

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```
        matrix_multiply(scaleu);
        tz[2][0] = -tz[2][0];
        tz[2][1] = -tz[2][1];
        matrix_multiply(tz);
        glutPostRedisplay();

        break;
    case 'c':
        tz = tzs;
        tz[2][0] = -v[0][0];
        tz[2][1] = -v[0][1];
        matrix_multiply(tz);
        matrix_multiply(rotatec);
        tz[2][0] = -tz[2][0];
        tz[2][1] = -tz[2][1];
        matrix_multiply(tz);
        glutPostRedisplay();

        break;
    case 'z':
        tz = tzs;
        tz[2][0] = -v[0][0];
        tz[2][1] = -v[0][1];
        matrix_multiply(tz);
        matrix_multiply(rotatea);
        tz[2][0] = -tz[2][0];
        tz[2][1] = -tz[2][1];
        matrix_multiply(tz);
        glutPostRedisplay();

        break;
    case 'q':
        v = vv;
        glutPostRedisplay();

        break;
    case 'r':
        glColor3f(1, 0, 0);
        glutPostRedisplay();

        break;
    case 'b':
        glColor3f(0, 0, 1);
        glutPostRedisplay();

        break;
    case 'g':
        glColor3f(0, 1, 0);
```

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```
        glutPostRedisplay();

        break;
    case 'i':
        tz = tzs;
        tz[2][0] = -v[0][0];
        tz[2][1] = -v[0][1];
        matrix_multiply(tz);
        matrix_multiply(scaled);
        tz[2][0] = -tz[2][0];
        tz[2][1] = -tz[2][1];
        matrix_multiply(tz);
        glutPostRedisplay();

        break;
    case 27:
        exit(0);
        break;
    }
}

int main(int argc, char **argv)
{
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
    glutInitWindowSize(1000, 1000);
    glutInitWindowPosition(0, 0);
    glutCreateWindow("Original ViewPort");
    myInit();
    glutKeyboardFunc(keyboard);
    glutDisplayFunc(display);
    glutMainLoop();
    return 0;
}
```

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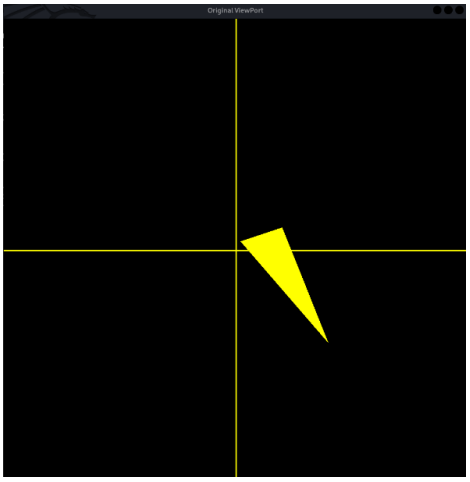
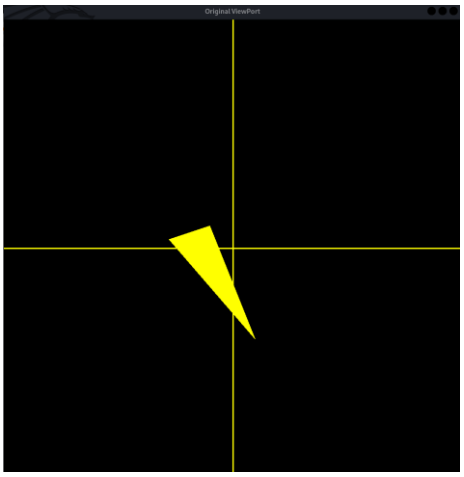
Output:

Translation:

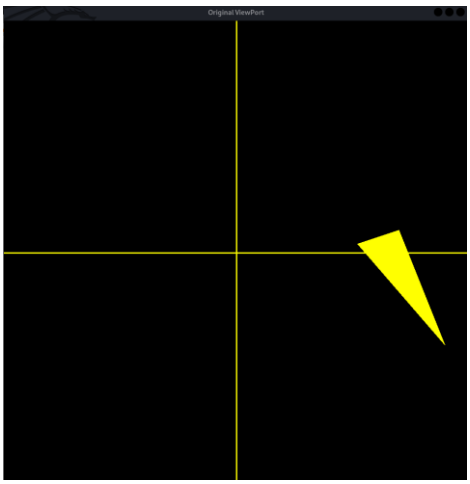
- Original image



- After applying translation and moving image to -ve x-axis **(using key 'a')**



- After applying translation and moving image to +ve x-axis **(using key 'd')**



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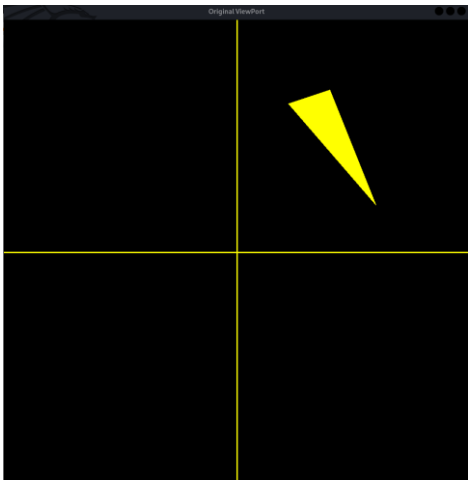
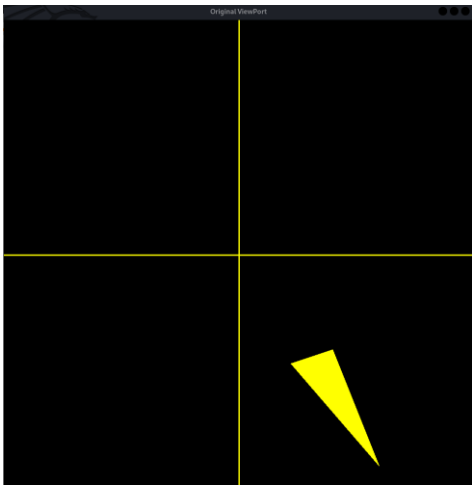
- After applying translation and moving image to +ve y-axis **(using key 'w')**



- After applying translation and moving image to -ve y-axis **(using key 's')**



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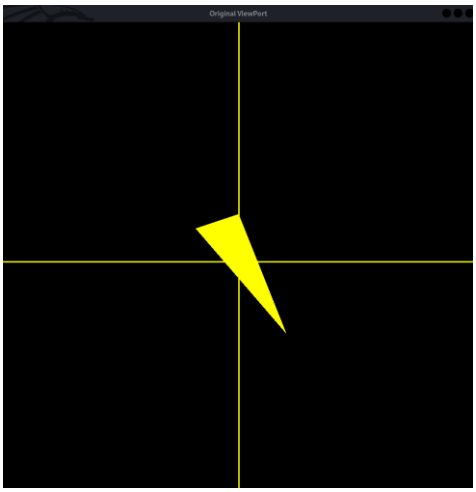
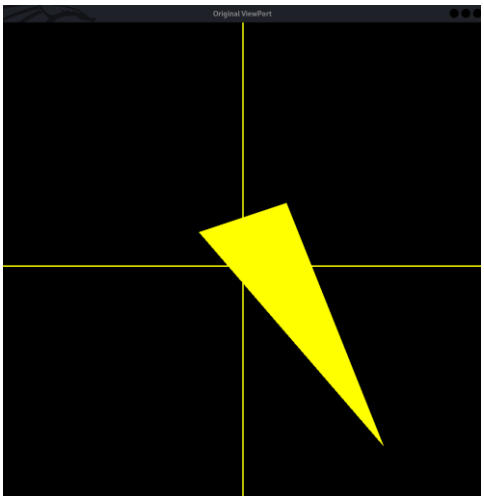
Scaling:

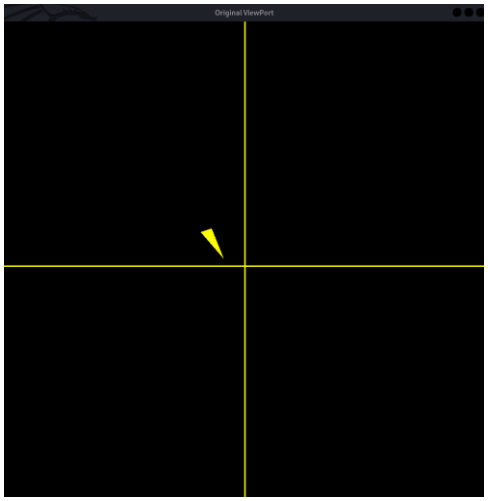
- Original image



- After increasing the size of object(expansion) **(using key 'u')**



- After decreasing the size of object(shrinkage) **(using key 'i')**



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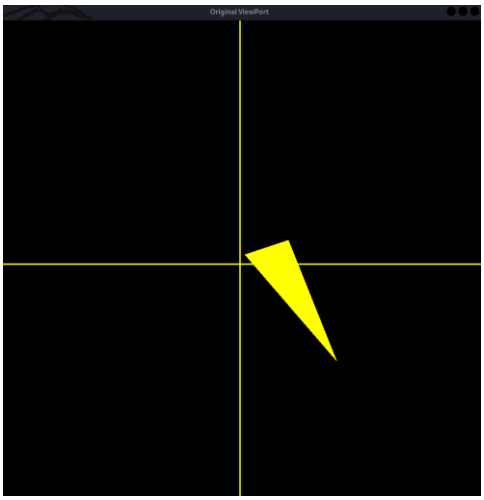
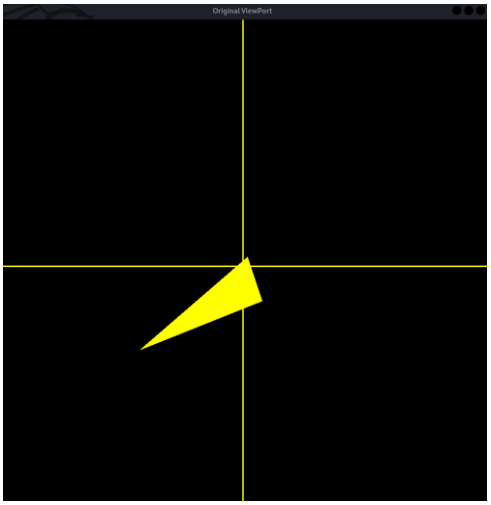
Scaling:

- Original image



- After rotating image in clockwise direction by 90deg **(using key 'c')**



- After rotating image in anticlockwise direction by 90deg **(using key 'z')**