Develop a program to draw a line using Bresenham's line drawing technique

```
//Header File inclusion
#include<stdio.h>
#include<math.h>
#include<glut.h>
int  X1, Y1, X2, Y2;
// Function to draw a pixel
void draw_pixel(int x, int y)
{
glBegin(GL_POINTS);
glVertex2i(x, y);
glEnd();
}
//algorithm to find next pixels
void LineBres( )
{
glClear(GL_COLOR_BUFFER_BIT);
int dx = abs(X2 - X1), dy = abs(Y2 - Y1);
int p = 2 * dy - dx;
int twoDy = 2 * dy, twoDyDx = 2 * (dy - dx);
int x, y;
if (X1 > X2)
{
x = X2;
y = Y2;
X2 = X1;
}
else
{
x = X1;
y = Y1;
X2 = X2;
}
draw_pixel(x, y);
while (x < X2)
{
x++;
if (p < 0)
p += twoDy;
else
{
y++;
p += twoDyDx;
}
draw_pixel(x, y);
}
glFlush();
```

```
}

// Init Function
void Init()
{
glClearColor(1,1,1,1);// White Background
glColor3f(0,0,0);//Black writing Color
glPointSize(2.0);//pointsize=2
glViewport(0, 0, 500, 500);
glMatrixMode(GL_PROJECTION);
glLoadIdentity( );
gluOrtho2D(0, 500, 0, 500);// min max of x and y is 0 and 500
glMatrixMode(GL_MODELVIEW);
}
void main()
{
printf("enter two points for draw line Bresenham:\n");
printf("\n enter point1(X1 Y1):");
scanf_s("%d%d", &X1, &Y1);
printf("\n enter point2(X2 Y2):");
scanf_s("%d%d", &X2, &Y2);
glutInitWindowSize(300, 400);
glutInitWindowPosition(0, 0);
glutCreateWindow("LineBresenham");
Init( );
glutDisplayFunc(LineBres);
glutMainLoop();
}
```

Develop a program to demonstrate basic geometric operations on the 2D object

```
#include<glut.h>
#include<stdio.h>

/* initial triangle */

float v[3][2] = { {0, 1},
        {-0.5, -0.5}, {0.5,-0.5} };

int n; /* number of subdivisions */
void triangle(float* a, float* b, float* c)
{
   /* display one triangle  */
   glBegin(GL_TRIANGLES);
   glVertex2fv(a);
   glVertex2fv(b);
   glVertex2fv(c);
   glEnd();
}
void divide_triangle(float* a, float* b, float* c, int m)
{
   /* triangle subdivision using vertex numbers */
   float v1[2], v2[2], v3[2];
   int j;
   if (m > 0)
   {
      for (j = 0; j < 2; j++) v1[j] = (a[j] + b[j]) / 2;
      for (j = 0; j < 2; j++) v2[j] = (a[j] + c[j]) / 2;
      for (j = 0; j < 2; j++) v3[j] = (b[j] + c[j]) / 2;
      divide_triangle(a, v1, v2, m - 1);
      divide_triangle(v1, b, v3, m - 1);
      divide_triangle(v2, v3, c, m - 1);
   }
   else
      triangle(a, b, c);
   /* draw triangle at end of recursion */
```

```
}
void display()
{
   glClear(GL_COLOR_BUFFER_BIT);
   divide_triangle(v[0], v[1], v[2], n);
   glFlush();
}

void myinit()
{
   glMatrixMode(GL_PROJECTION);
   glLoadIdentity();
   gluOrtho2D(-2, 2, -2, 2);
   glMatrixMode(GL_MODELVIEW);
   glClearColor(1, 1, 1, 0);
   glColor3f(1, 0, 0);
}
void main()
{
   printf("How many subdivisions ? : ");
   scanf_s("%d", &n);
   glutInitWindowSize(500, 500);
   glutCreateWindow("2D Gasket");
   glutDisplayFunc(display);
   myinit();
   glutMainLoop();
}
```

3. Develop a program to demonstrate basic geometric operations on the 3D object

```
#include<stdio.h>
#include<glut.h>
float v[4][3] = { {0,0,1},{0,1,0},
                {-1,-0.5, 0}, {1,-0.5, 0} };

float colors[4][3] = { {1,0,0}, {0,1,0},{0,0,1},{0,0,0} };
int n;
void triangle(float* va, float* vb, float* vc)
{
   glBegin(GL_TRIANGLES);
   glVertex3fv(va);
   glVertex3fv(vb);
   glVertex3fv(vc);
   glEnd();
}
void tetra(float* a, float* b, float* c, float* d)
{
   glColor3fv(colors[0]);
   triangle(a, b, c);
   glColor3fv(colors[1]);
   triangle(a, c, d);
   glColor3fv(colors[2]);
   triangle(a, d, b);
   glColor3fv(colors[3]);
   triangle(b, d, c);
}
void divide_tetra(float* a, float* b, float* c, float* d, int  m)
{
   float mid[6][3];
   int j;
   if (m > 0)
   {   /*compute six midpoints*/
      for (j = 0; j < 3; j++) mid[0][j] = (a[j] + b[j]) / 2;
      for (j = 0; j < 3; j++) mid[1][j] = (a[j] + c[j]) / 2;
      for (j = 0; j < 3; j++) mid[2][j] = (a[j] + d[j]) / 2;
      for (j = 0; j < 3; j++) mid[3][j] = (b[j] + c[j]) / 2;
      for (j = 0; j < 3; j++) mid[4][j] = (c[j] + d[j]) / 2;
      for (j = 0; j < 3; j++) mid[5][j] = (b[j] + d[j]) / 2;
      divide_tetra(a, mid[0], mid[1], mid[2], m - 1);
      divide_tetra(mid[0], b, mid[3], mid[5], m - 1);
      divide_tetra(mid[1], mid[3], c, mid[4], m - 1);
      divide_tetra(mid[2], mid[5], mid[4], d, m - 1);
   }
```

```
   else
      tetra(a, b, c, d);      //draw triangle at end of recursion//
}


void display(void)
{
   glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
   divide_tetra(v[0], v[1], v[2], v[3], n);
   glFlush();
}
void reshape(int w, int h)
{
   glViewport(0, 0, w, h);
   glMatrixMode(GL_PROJECTION);
   glLoadIdentity();
   if (w <= h)
      glOrtho(-2.0, 2.0, -2.0 * (float)h / (float)w, 2.0 * (float)h / (float)w, -10.0, 10.0);
   else
      glOrtho(-2.0 * (float)w / (float)h, 2.0 * (float)w / (float)h, -2.0, 2.0, -10.0, 10.0);
   glMatrixMode(GL_MODELVIEW);
}
void main()
{
   printf("No.of Divisions ?" );
   scanf_s("%d", &n);
   glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB | GLUT_DEPTH);
   glutInitWindowSize(500, 500);
   glutCreateWindow("3D Gasket");
   glutReshapeFunc(reshape);
   glutDisplayFunc(display);
   glEnable(GL_DEPTH_TEST);
   glClearColor(1.0, 1.0, 1.0, 1.0);
   glutMainLoop();
}
```

Develop a program to demonstrate 2D transformation on basic objects

```
#include<glut.h>
#include<stdio.h>
char T;
void display()
{
        glClear(GL_COLOR_BUFFER_BIT);
        glColor3f(0, 0, 0);
        glLoadIdentity();
        glBegin(GL_LINES);
        glVertex2f(-499, 0);
```

```
	glVertex2f(499, 0);
	glVertex2f(0, -499);
	glVertex2f(0, 499);
	glEnd();
	glColor3f(0, 0, 1);
	glLoadIdentity(); // Reset current matrix to identity.
	glRecti(0, 0, 100, 150); // Display blue rectangle.
	if (T == 't')
	{	printf("\n * *************\nTranslation\n");
		glLoadIdentity(); // Reset current matrix to identity.
		glColor3f(1, 0, 0);
		glTranslatef(-200.0, -50.0, 0.0); // Set translation parameters.
		glRecti(0, 0, 100, 150); // Display red, translated rectangle.
	}
	if (T == 'r')
	{	printf("\n * *************\nRotation about z-axis\n");
		glLoadIdentity(); // Reset current matrix to identity.
		glColor3f(0, 1, 0);
		glRotatef(45, 0.0, 0.0, 1.0); // Set 90-deg. rotation about z axis.
		glRecti(0, 0, 100, 150); // Display red, rotated rectangle.
	}
	if (T == 's')
	{	printf("\n * *************\nScaling\n");
		glLoadIdentity(); // Reset current matrix to identity.
		glColor3f(0, 1, 1);
		glScalef(0.5, 0.5, 0); // Set scale-reflection parameters.
		glRecti(0, 0, 100, 150); // Display red, transformed rectangle.
	}
	glFlush();
}

void keys(unsigned char k, int x, int y)
{
	T = k;
	display();
}
// Init Function
void Init()
{
	glClearColor(1, 1, 1, 1);// White Background
	glColor3f(0, 0, 0);//Black writing Color
	glPointSize(2.0);//pointsize=2
	glViewport(0, 0, 500, 500);
```

```
	glMatrixMode(GL_PROJECTION);
	glLoadIdentity();
	gluOrtho2D(-500, 500, -500, 500);// min max of x and y is -500 and 500
	glMatrixMode(GL_MODELVIEW);
}
void main()
{
	printf("Press:\n't'--> Translate\n'r'-->Rotation about z-axis\n's'-->scaling\n");
	glutInitWindowSize(500, 500);
	glutInitWindowPosition(300, 50);
	glutCreateWindow("2D Transformation");
	Init();
	glutDisplayFunc(display);
	glutKeyboardFunc(keys);
	glutMainLoop();
}
```

Develop a program to demonstrate 3D transformation on 3D objects

```
#include<glut.h>
#include<stdio.h>
char T='c';
float vertices[] = { -1,-1,-1,1,-1,-1,1,1,-1, -1,1,-1, -1,-1, 1, 1,-1,1, 1,1,1, -1,1,1 };
float colors[] = { 0,0,0,0,0,1,0,1,0,0,1,1,1,0,0,1,0,1,1,1,0,1,1,1 };
unsigned char cubeIndices[] ={ 0,3,2,1,2,3,7,6,0,4,7,3,1,2,6,5,4,5,6,7,0,1,5,4 };
void cube()
{
glScalef(0.25, 0.25, 0.25);
glRotatef(45, 1,1,1);
glDrawElements(GL_QUADS, 24, GL_UNSIGNED_BYTE, cubeIndices); //
Display cube
```

```
}

void display()
{
	glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
	glColor3f(0, 0, 0);
	glLoadIdentity();
	glBegin(GL_LINES);
	glVertex3f(-1.9, 0,0);
	glVertex3f(1.9, 0,0);
	glVertex3f(0, -1.9,0);
	glVertex3f(0, 1.9,0);
	glEnd();
	if (T == 'c')
	{	printf("\n * **********\nOriginal Position\n");
		glLoadIdentity(); // Reset current matrix to identity.
		cube();
	}
	if (T == 't')
	{	printf("\n * **********\nTranslation\n");
		glLoadIdentity(); // Reset current matrix to identity.
		glTranslatef(-0.5, -0.2, 0.0); // Set translation parameters.
		cube();
	}
	if (T == 'x')
	{	printf("\n * **********\nRotation about x-axis\n");
		glLoadIdentity(); // Reset current matrix to identity.
		glRotatef(45, 1,0,0); // Set 90-deg. rotation about z axis.
		cube();
	}
	if (T == 'y')
	{	printf("\n * **********\nRotation about y-axis\n");
		glLoadIdentity(); // Reset current matrix to identity.
		glRotatef(45,0,1,0); // Set 90-deg. rotation about z axis.
		cube();
	}
	if (T == 'z')
	{	printf("\n * **********\nRotation about z-axis\n");
```

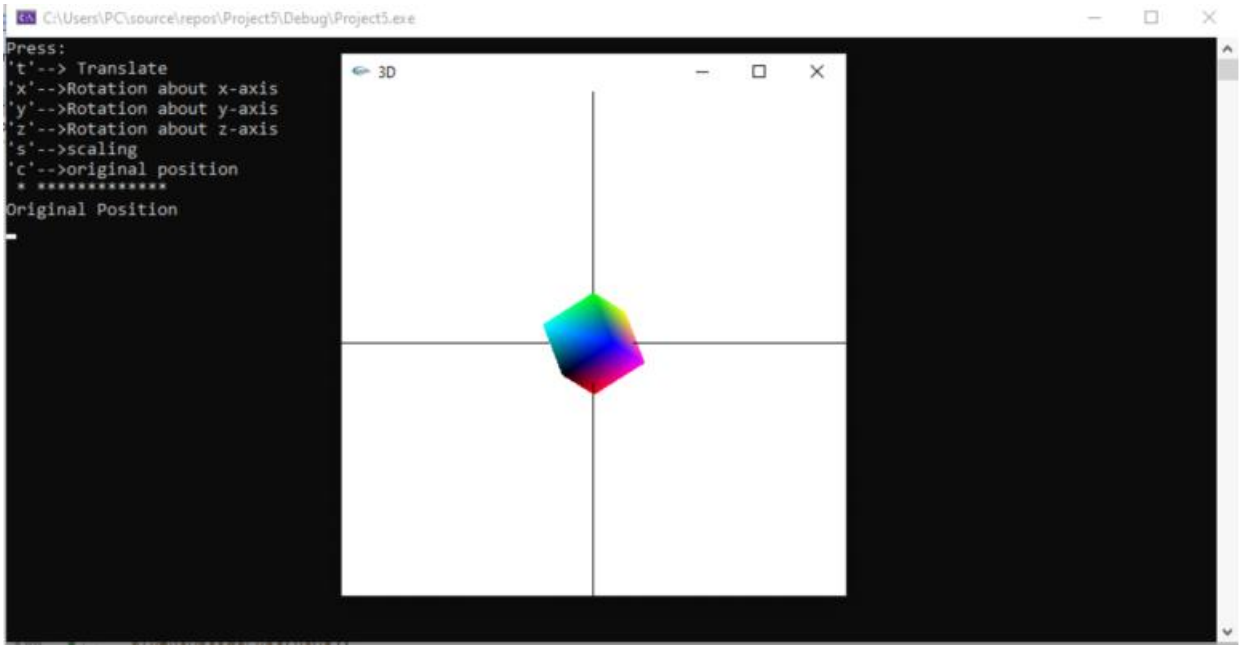
```
                glLoadIdentity(); // Reset current matrix to identity.
                glRotatef(45, 0,0,1); // Set 90-deg. rotation about z axis.
                cube();
        }
        if (T == 's')
        {       printf("\n * **********\nScaling\n");
                glLoadIdentity(); // Reset current matrix to identity.
                glScalef(0.5, 0.5, 0.5); // Set scale-reflection parameters.
                cube();
        }
        glFlush();
}
void keys(unsigned char k, int x, int y)
{

        if (k == 'x' || k == 'y' || k == 'z' || k == 't' || k == 's')
                T = k;
        else
                T = 'c';
        display();
}


void myReshape(int w, int h)
{
        glViewport(0, 0, w, h);
        glMatrixMode(GL_PROJECTION);
        glLoadIdentity();
        if (w <= h)
                glOrtho(-2, 2, -2 * (float)h / (float)w, 2 * (float)h / (float)w, -2, 2);
        else
                glOrtho(-2 * (float)w / (float)h, 2 * (float)w / (float)h, -2, 2, -2, 2);
        glMatrixMode(GL_MODELVIEW);
}

void main()
{
```

```
	printf("Press:\n't'--> Translate\n'x'-->Rotation about x-axis\n'y'-->Rotation about y-axis\n'z'-->Rotation about z-axis\n's'-->scaling\n'c'-->original position");
	glutInitWindowSize(500, 500);
	glutInitWindowPosition(300, 50);
	glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB | GLUT_DEPTH);
	glutCreateWindow("3D");
	glutDisplayFunc(display);
	glutKeyboardFunc(keys);
	glEnable(GL_DEPTH_TEST);
	glEnableClientState(GL_COLOR_ARRAY);
	glEnableClientState(GL_VERTEX_ARRAY);
	glVertexPointer(3, GL_FLOAT, 0, vertices);
	glColorPointer(3, GL_FLOAT, 0, colors);
	glClearColor(1, 1, 1, 1);// White Background
	glColor3f(0, 0, 0);//Black writing Color
	glPointSize(2.0);//pointsize=2
	glutMainLoop();
}
```



6. Develop a program to demonstrate Animation effects on simple objects.

```
#include<glut.h>
#include<math.h>
float t, r = 0.5, x, y, t1 = 360, i = -0.5;
void display()
{
	glClear(GL_COLOR_BUFFER_BIT);
	glClearColor(1, 0, 0, 0);
	glColor3f(1, 1, 1);
	for (t = 0; t < 360; t +=0.1)
	{
		x = i + r * cos(t);
		y = r * sin(t);
		glBegin(GL_POINTS);
		glVertex2f(x, y);
		glEnd();
	}
	glBegin(GL_LINES);
	glVertex2f(r * cos(t1) + i, r * sin(t1));
	glVertex2f(r * -cos(t1) + i, r * -sin(t1));
	glVertex2f(r * -sin(t1) + i, r * cos(t1));
	glVertex2f(r * sin(t1) + i, r * -cos(t1));
	glEnd();
	glFlush();
}
void idle()
{
	if (i < 1)
		i = i + 0.001;
	else
		i = -0.5;
	t1 -= 0.01;
	display();
}
void mouse(int b, int s, int x, int y)
{
	if (b == GLUT_LEFT_BUTTON && s == GLUT_DOWN)
		glutIdleFunc(idle);
	if (b == GLUT_RIGHT_BUTTON && s == GLUT_DOWN)
		glutIdleFunc(NULL);
	if (b == GLUT_MIDDLE_BUTTON && s == GLUT_DOWN)
		exit(0);
```

```
}
void main()
{
	glutInitWindowSize(1200, 1200);
	glutInitWindowPosition(0, 0);
	glutCreateWindow("Rotation of wheel");
	glutDisplayFunc(display);
	glutIdleFunc(idle);
	glutMouseFunc(mouse);
	glPointSize(2);
	glutMainLoop();
}
```