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CSE - B

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UCS1712 – GRAPHICS AND MULTIMEDIA LAB

Lab Exercise 1 : Study of Basic Output Primitives in C++ using OpenGL

a) To create an output window using OPENGL and to draw the following basic output primitives – POINTS, LINES, LINE_STRIP, LINE_LOOP, TRIANGLES, QUADS, QUAD_STRIP, POLYGON.
b) To create an output window and draw a checkerboard using OpenGL.
c) To create an output window and draw a house using POINTS,LINES,TRAINGLES and QUADS/POLYGON.

Aim:

Study of basic output primitives in c++ using openGL.

Algorithm:

1. Include necessary header files.
2. Create an initialization function (**myInit**) to set up OpenGL settings.
3. Define a function (**drawShape**) to draw various shapes with vertices and labels.
4. Create a function (**myDisplay**) for rendering:
    - Clear the color buffer.
    - Draw points, lines, quads, triangles, and polygons using **drawShape**.
    - Label points and lines with their coordinates using **drawShape**.
5. In the **main** function:
    - Initialize GLUT and set display mode.
    - Create a window, set the display function to **myDisplay**, and initialize OpenGL settings.
    - Enter the GLUT main loop.

Code:

a.cpp:

```
// #include <GLUT/glut.h>   //in clg system
#include <GL/glut.h> //my laptop
#include <stdio.h>
#include <cstring>
#include <iostream>
using namespace std;
void myInit()
{
    glClearColor(0.0, 0.0, 0.0, 0.0); // used for glClear: sets bitplane window
    glPointSize(10);
    glMatrixMode(GL_PROJECTION); // applies the matrix operations to corresponding
stack
    /*
    GL_MODELVIEW    -   modelview matrix stack.
    GL_PROJECTION   -   projection
```

```
    GL_TEXTURE      -   texture
    GL_COLOR        -   color
    */
    glLoadIdentity();                    // replaces the current matrix with the
identity matrix
    gluOrtho2D(0.0, 640.0, 0.0, 480.0); // sets up a 2D orthographic viewing region
    // for (0,0) to be at the center of the screen, put it like (-320,320,-240,240)
}

//*************************version 1*************************:

// void myDisplay()
// {
//     glClear(GL_COLOR_BUFFER_BIT);
//     glBegin(GL_POINTS);
//     glVertex2d(150, 100);
//     glEnd();

//     glBegin(GL_LINES);
//     glVertex2d(150, 150);
//     glVertex2d(150, 200);
//     glEnd();

//     glBegin(GL_QUADS);
//     glColor3f(0.0f, 1.0f, 0.0f);
//     glVertex2d(300, 300);
//     glVertex2d(300, 350);
//     glVertex2d(350, 350);
//     glVertex2d(350, 300);
//     glVertex2d(300, 300);
//     glEnd();

//     glBegin(GL_TRIANGLES); // Each set of 3 vertices form a triangle
//     glColor3f(0.0f, 0.0f, 1.0f);
//     glVertex2d(400, 400);
//     glVertex2d(400, 450);
//     glVertex2d(450, 450);
//     glVertex2d(400, 400);
//     glEnd();

//     glBegin(GL_POLYGON);         // These vertices form a closed polygon
//     glColor3f(1.0f, 1.0f, 0.0f); // Yellow
//     glVertex2d(200, 200);
//     glVertex2d(200, 220);
//     glVertex2d(220, 240);
//     glVertex2d(240, 200);
//     glVertex2d(230, 250);
//     glVertex2d(250, 250);
//     glVertex2d(200, 200);
//     glEnd();

//     glFlush();
// }

//*************************version 2*************************:
```

```
// Function to convert GLenum value to string
string GLenumToString(GLenum mode)
{
    switch (mode)
    {
    case GL_POINTS:
        return "GL_POINTS";
    case GL_LINES:
        return "GL_LINES";
    case GL_LINE_STRIP:
        return "GL_LINE_STRIP";
    case GL_LINE_LOOP:
        return "GL_LINE_LOOP";
    case GL_TRIANGLES:
        return "GL_TRIANGLES";
    case GL_TRIANGLE_STRIP:
        return "GL_TRIANGLE_STRIP";
    case GL_TRIANGLE_FAN:
        return "GL_TRIANGLE_FAN";
    case GL_QUADS:
        return "GL_QUADS";
    case GL_QUAD_STRIP:
        return "GL_QUAD_STRIP";
    case GL_POLYGON:
        return "GL_POLYGON";
    default:
        return "Unknown";
    }
    return "";
}

// Common function to draw shapes
void drawShape(GLenum mode, double vertices[], int numVertices)
{
    // glVertex2d-2d-d=double
    glBegin(mode);
    cout << "Drawing mode: " << GLenumToString(mode) << " (Value: " << mode <<
")\n";
    for (int i = 0; i < numVertices; i += 2)
    {
        // glVertex2d(vertices[i], vertices[i + 1]);

        double x = vertices[i];
        double y = vertices[i + 1];
        cout << "Vertex (" << x << ", " << y << ")" << endl; // Print coordinates
        glVertex2d(x, y);
    }
    glEnd();
    cout << endl;
}

// Function to draw text at a given position
void drawText(double x, double y, int a = 0, int b = 0)
{
```

```
    char text[20];
    snprintf(text, 20, "(%0.0f,%0.0f)", x, y);
    glRasterPos2d(x + a, y + b);
    for (int i = 0; text[i] != '\0'; i++)
        glutBitmapCharacter(GLUT_BITMAP_HELVETICA_10, text[i]);
    memset(text, 0, sizeof(text));
}

void myDisplay()
{
    glClear(GL_COLOR_BUFFER_BIT);

    double pointVertices[] = {150, 100};
    double lineVertices[] = {150, 150, 150, 200};
    double quadVertices[] = {300, 300, 300, 350, 350, 350, 350, 300, 300, 300};
    double triangleVertices[] = {400, 400, 400, 450, 450, 450, 400, 400};
    double polygonVertices[] = {200, 200, 200, 220, 220, 240, 240, 200, 230, 250,
250, 250, 200, 200};

    // Draw points
    drawShape(GL_POINTS,       pointVertices,       sizeof(pointVertices)       /
sizeof(pointVertices[0]));
    drawText(pointVertices[0], pointVertices[1], 10, -5);

    // Draw lines
    drawShape(GL_LINES,        lineVertices,        sizeof(lineVertices)        /
sizeof(lineVertices[0]));
    drawText(lineVertices[0], lineVertices[1], 10, -5);
    drawText(lineVertices[2], lineVertices[3], -55,-5);

    // Draw quads
    glBegin(GL_QUADS);
    glColor3f(0.0f, 1.0f, 0.0f);
    drawShape(GL_QUADS,        quadVertices,        sizeof(quadVertices)        /
sizeof(quadVertices[0]));
    glEnd();

    // Draw triangles
    glColor3f(0.0f, 0.0f, 1.0f);
    drawShape(GL_TRIANGLES,    triangleVertices,    sizeof(triangleVertices)    /
sizeof(triangleVertices[0]));

    // Draw polygon
    glBegin(GL_POLYGON);
    glColor3f(1.0f, 1.0f, 0.0f); // Yellow
    drawShape(GL_POLYGON,      polygonVertices,     sizeof(polygonVertices)     /
sizeof(polygonVertices[0]));
    glEnd();

    glFlush();
}
int main(int argc, char *argv[])
{
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
```

```
    glutInitWindowSize(640, 480);
    glutCreateWindow("1-a");
    glutDisplayFunc(myDisplay);
    myInit();
    glutMainLoop();
    return 1;
}
```

b.cpp:

```
// #include <GLUT/glut.h>   //in clg system
#include <GL/glut.h> //my laptop

int windowWidth = 800;
int windowHeight = 800;
void myInit()
{
    glClearColor(0.0f, 0.0f, 0.0f, 0.0f);
    // glPointSize(10);
    glMatrixMode(GL_PROJECTION);
    glLoadIdentity();
    gluOrtho2D(0.0, windowWidth, 0.0, windowHeight);

    // why?
    // glMatrixMode(GL_MODELVIEW);
}
void drawCheckerboard()
{
    // glVertex2i-2i-i=int

    int rows = 8;
    int cols = 8;
    int squareSize = windowWidth / cols;

    glColor3f(1.0f, 1.0f, 1.0f);
    glBegin(GL_QUADS);

    for (int i = 0; i < rows; i++)
    {
        for (int j = 0; j < cols; j++)
        {
            ((i + j) & 1) ? glColor3f(0.0f, 0.0f, 0.0f) : glColor3f(1.0f, 1.0f,
1.0f);
            glVertex2i(j * squareSize, i * squareSize);
            glVertex2i((j + 1) * squareSize, i * squareSize);
            glVertex2i((j + 1) * squareSize, (i + 1) * squareSize);
            glVertex2i(j * squareSize, (i + 1) * squareSize);
        }
    }

    glEnd();
    glFlush();
}
```

```
void display()
{
    glClear(GL_COLOR_BUFFER_BIT);
    drawCheckerboard();
}
int main(int argc, char **argv)
{
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
    glutInitWindowSize(windowWidth, windowHeight);
    glutCreateWindow("1-b");
    glutDisplayFunc(display);
    myInit(); // glClearColor(0.0f, 0.0f, 0.0f, 0.0f);
    glutMainLoop();
    return 1;
}
```

c.cpp:

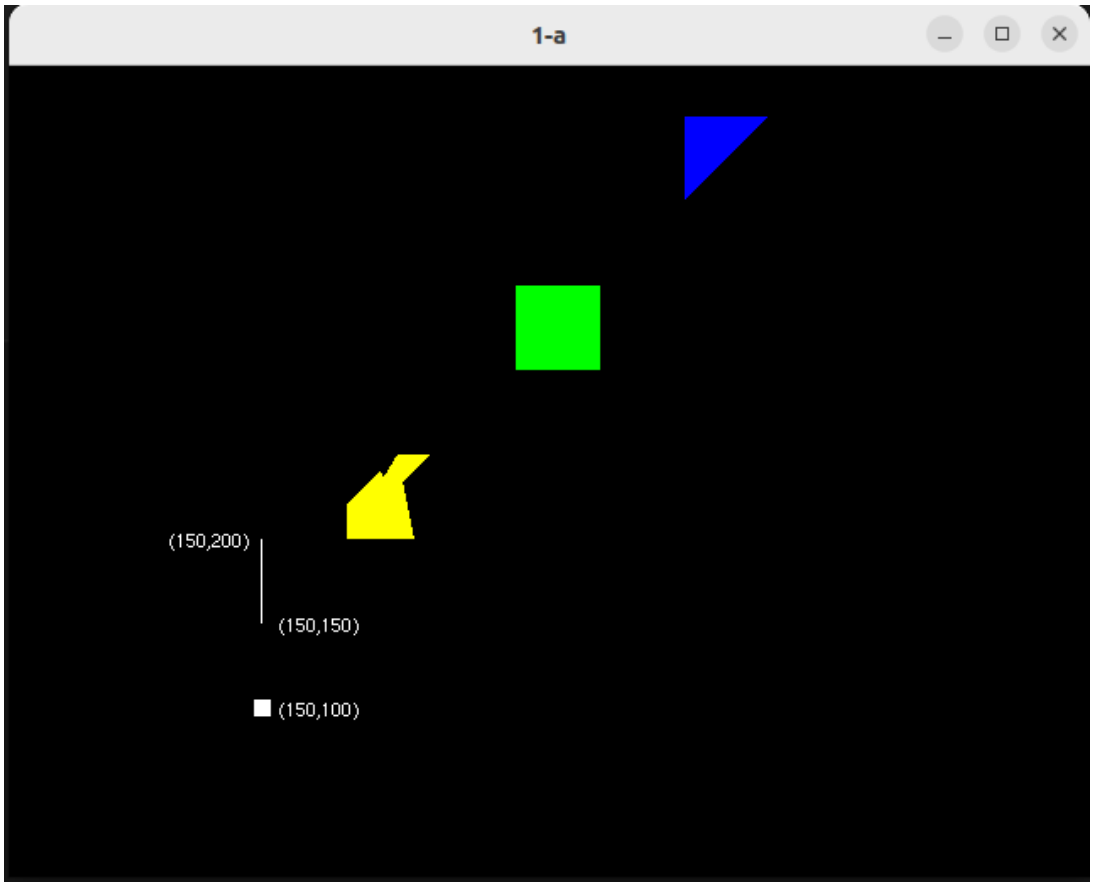
```
// #include <GLUT/glut.h>   //in clg system
#include <GL/glut.h> //my laptop

int windowWidth = 800;
int windowHeight = 600;

void myInit()
{
    glClearColor(1.0f, 1.0f, 1.0f, 0.0f); //White BG
    // glPointSize(10);
    glMatrixMode(GL_PROJECTION);
    glLoadIdentity();
    gluOrtho2D(0.0, windowWidth, 0.0, windowHeight);

    // why?
    // glMatrixMode(GL_MODELVIEW);
}
void drawHouse()
{
    // Clear the screen
    // Draw the house using different primitive shapes
    // Draw the base of the house using a quad
    glColor3f(0.59f, 0.85f, 0.71f); // Gray color
    glBegin(GL_QUADS);
    glVertex2i(100, 100);
    glVertex2i(500, 100);
    glVertex2i(500, 400);
    glVertex2i(100, 400);
    glEnd();

    // Draw the roof using triangles
    glColor3f(1.0f, 0.0f, 0.0f); // Red color
    glBegin(GL_TRIANGLES);
    glVertex2i(100, 400);
```

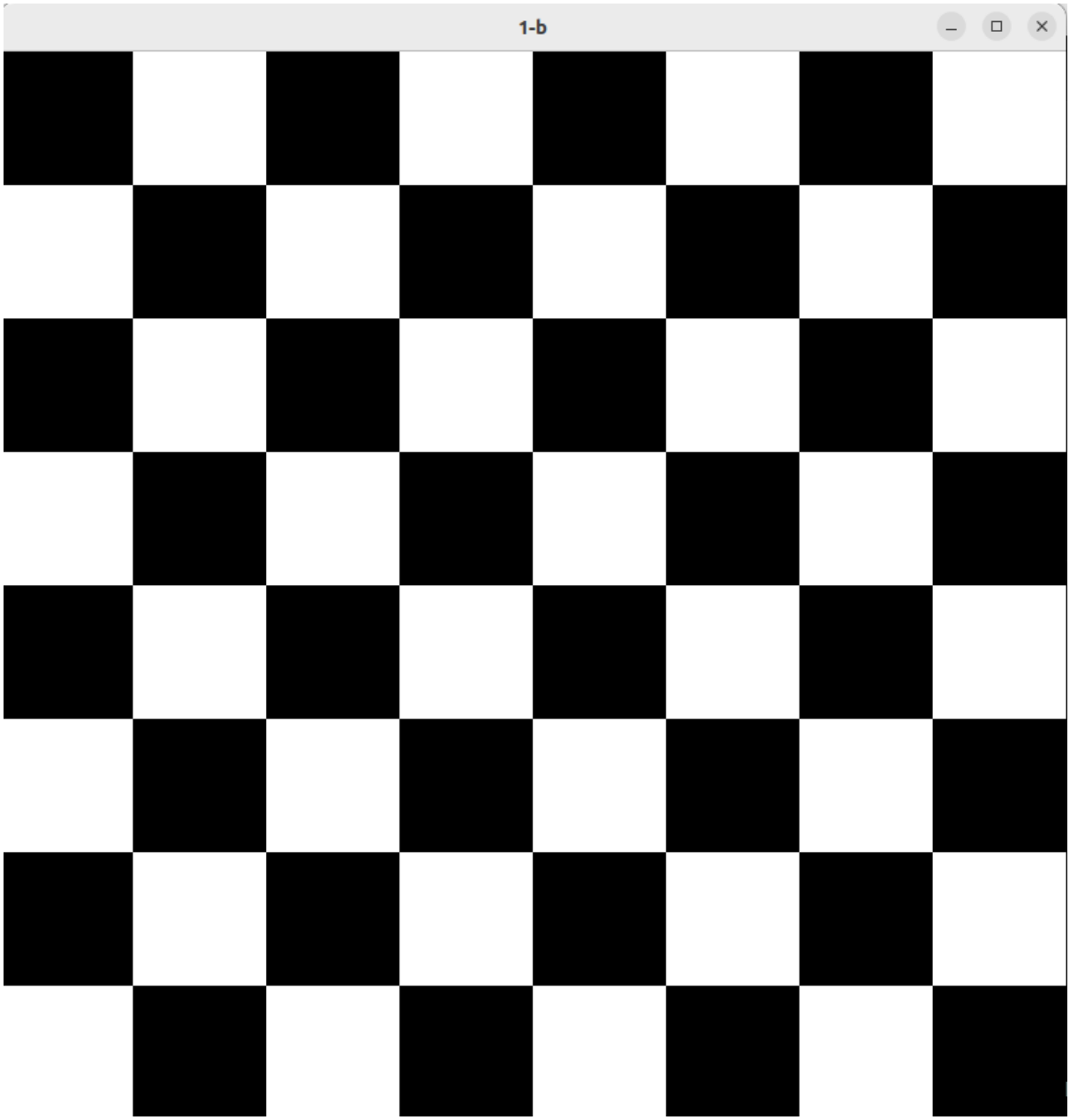
```
    glVertex2i(300, 600);
    glVertex2i(500, 400);
    glEnd();

    // Draw the door using quads
    glColor3f(1.0f, 1.0f, 1.0f); // Blue color
    glBegin(GL_QUADS);
    glVertex2i(250, 100);
    glVertex2i(350, 100);
    glVertex2i(350, 300);
    glVertex2i(250, 300);
    // glEnd();

    glColor3f(0.36f, 0.05f, 0.05f);
    // glBegin(GL_QUADS);
    glVertex2i(250, 100);
    glVertex2i(330, 130);
    glVertex2i(330, 300);
    glVertex2i(250, 300);
    // glEnd();

    // Draw the windows using quads
    glColor3f(0.06f, 0.22f, 0.45f); // Green color
    // glBegin(GL_QUADS);
    glVertex2i(150, 200);
    glVertex2i(200, 200);
    glVertex2i(200, 250);
    glVertex2i(150, 250);
    glVertex2i(400, 200);
    glVertex2i(450, 200);
    glVertex2i(450, 250);
    glVertex2i(400, 250);

    glEnd();
    glFlush();
}
void display()
{
    glClear(GL_COLOR_BUFFER_BIT);
    drawHouse();
}
int main(int argc, char **argv)
{
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
    glutInitWindowSize(windowWidth, windowHeight);
    glutCreateWindow("Drawing a House using OpenGL");
    glutDisplayFunc(display);
    myInit(); // glClearColor(1.0f, 1.0f, 1.0f, 0.0f); // White background
    glutMainLoop();
    return 0;
}
```

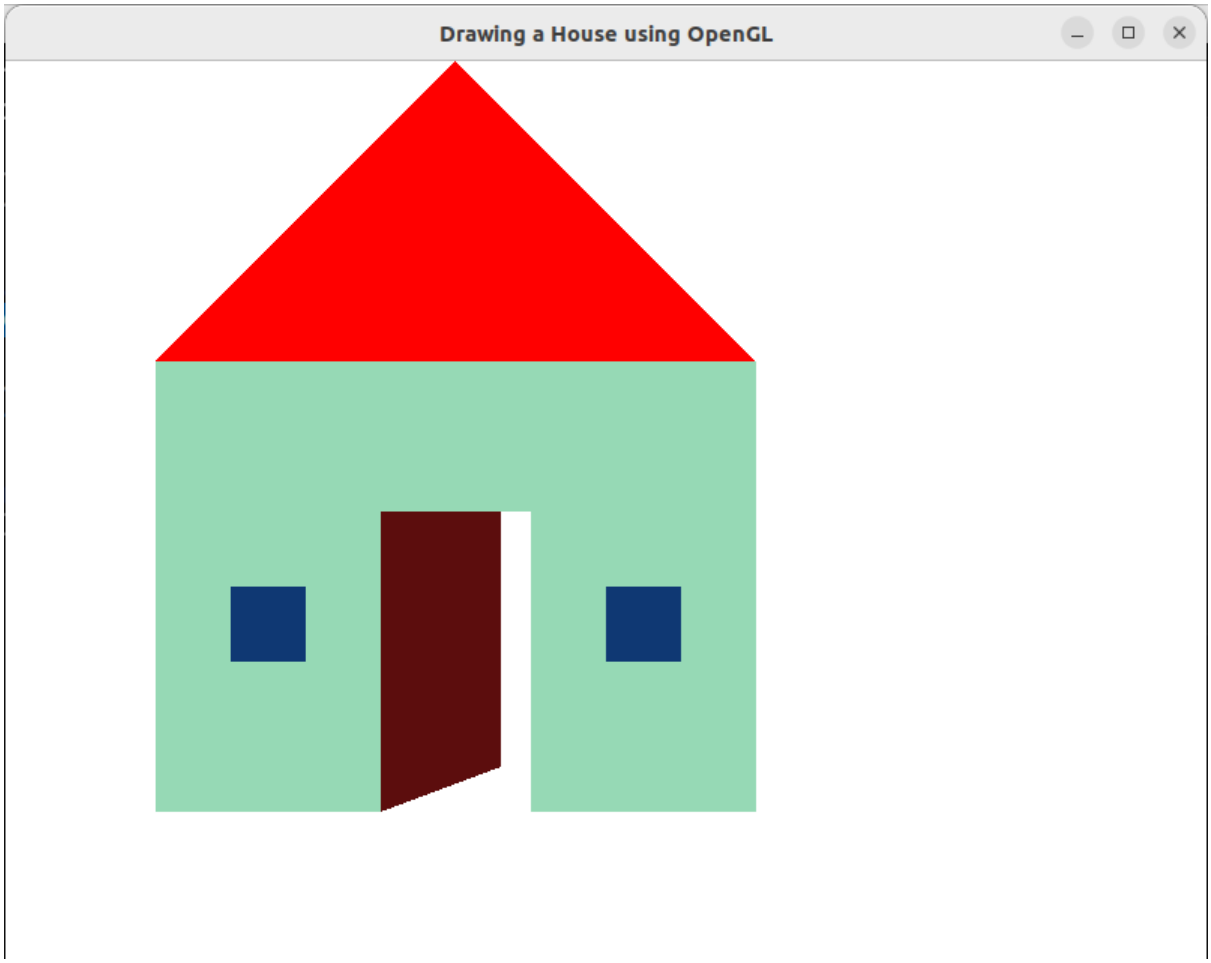
run.sh:

```
g++ a.cpp -lGL -lglut -lGLU
./a.out
```

Sample I/O:




1-b



Learning Outcomes:

Thus, the following shapes/objects have been created using OpenGL primitive