OpenGL API

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1 Administrivia

Announcements

Project 0 due now.

Assignment

Read over Project 1 handout.

From Last Time

Introduction to OpenGL lab.

Outline

1. Sierpinski gasket program.
2. Coordinate systems.
3. OpenGL API.

Coming Up

Project 1 and discussion.

2 Sierpinski Gasket

Let's take apart an OpenGL program.

The algorithm:

```
// Define the vertices of some 2-D convex geometric shape.

old = a random initial point within the shape;

for some number of points
   randomly choose one of the vertices of your shape;
   new = the point halfway between this vertex and old;
   plot new;
   old = new;
```

The program:

```
#include <GL/gl.h>
#include <GL/glu.h>
#include <GL/glx.h>
#include <GL/glut.h>

typedef struct { float x,y;} point;

/* A pentagon */
point vertices[5]={{50,0},{0,250},{250,500},{500,250},{450,0}};

int j;
point new, old={75,50}; /* A random point */

void clear(void)
{
glClear(GL_COLOR_BUFFER_BIT);
```

```
}

void display(void)

/* computes and plots a single new point */

{
long random();
int i;
j=random()%5; /* pick a vertex at random */


/* Compute point halfway between vertex and old point */

new.x = (old.x+vertices[j].x)/2;
new.y = (old.y+vertices[j].y)/2;

/* plot point */

glBegin(GL_POINTS);
glVertex2f(new.x, new.y);
glEnd();


/* replace old point by new */

old.x=new.x;
old.y=new.y;


glFlush();
}


void mouse(int btn, int state, int x, int y)
{
if(btn==GLUT_LEFT_BUTTON&state==GLUT_DOWN)  glutIdleFunc(display);
if(btn==GLUT_MIDDLE_BUTTON&state==GLUT_DOWN)   glutIdleFunc(NULL);
if(btn==GLUT_RIGHT_BUTTON&state==GLUT_DOWN)   exit();
}

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

```
glutInit(&argc,argv);
glutInitDisplayMode (GLUT_SINGLE | GLUT_RGB);
glutInitWindowSize(500,500);
glutInitWindowPosition(0,0);
glutCreateWindow("Sierpinski Gasket");

glutIdleFunc (display);
glutMouseFunc (mouse);
glClearColor(1.0, 1.0, 1.0, 0.0); /* white background */
glColor3f(1.0, 0.0, 0.0);
glMatrixMode(GL_PROJECTION);
glLoadIdentity();
glOrtho(0.0, 500.0, 0.0, 500.0, -1.0, 1.0);
glMatrixMode(GL_MODELVIEW);
glutDisplayFunc(clear);


glutMainLoop();

}
```

3 Coordinate Systems

1. What units are we drawing in?
2. World coordinates.
   (a) Virtual.
   (b) Where is the origin?
3. Window (raster) coordinates.
   (a) Physical.
   (b) Where is the origin?
4. Device independence via abstraction.

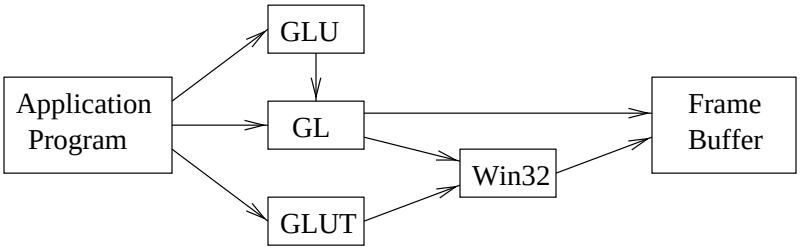
4 OpenGL API

Function classes within the OpenGL API:

1. Control: window system interactions.
2. Primitives: rendering.
3. Attribute: current color.
4. Viewing: camera settings.
5. Transformation: translation, rotation, scale.
6. Input: interaction.

Three-layered libraries: GL, GLU, GLUT.

Library organization:



5 OpenGL Primitive Types

1. Basic rendering code:

```
glBegin(primitiveType);
   glVertex*(...);
   // ...
   glVertex*(...);
glEnd();
```

2. 0-D primitives: `GL_POINTS`.

   Color.

3. 1-D primitives: `GL_LINES` (pairs of points), `GL_LINE_STRIP` (continuous), `GL_LINE_LOOP` (unfilled poly).

   Color. Width?

4. 2-D primitives: `GL_POLYGON`, `GL_TRIANGLES` (three-at-a-time) `GL_QUADS` (etc.), strips and fans for "intricate" surfaces.

   Filled. Fill types: color, pattern.

   Simple, convex polygons.

5. Text:

   (a) Font, face, point size.

   (b) Stroke text vs. raster text.

   Stroke text: specified by vertices of the characters.

   Raster text: bit maps.

   Quality (or lack) of scaled text.

6. Curved objects: tessellate.