OpenGL / GLUT

Introduction

Agenda

- OpenGL
- GLUT
- OBJ Format
- Assignment 0

Where to find more Info

- OpenGL Programming Guide (The Red Book): http://www.parallab.uib.no/SGI_bookshelves/SGI_Developer/books/OpenGL_PG/sgi_html/index.html
- OpenGL Reference Manual: http://www.parallab.uib.no/SGI_bookshelves/SGI_Developer/books/OpenGL_RM/sgi_html/bk02.html
- GLUT - The OpenGL Utility Toolkit: http://www.opengl.org/resources/libraries/glut.html
- OBJ References: http://www.royriggs.com/obj.html
- OBJ Samples: http://fastscan3d.com/download/samples/
- The history of the teapot: http://sjbaker.org/teapot/
- and many more online tutorials/faqs/code samples

OpenGL

Open Graphics Library

What is OpenGL?

- Started way back in 1989 by Kurt Akely, based on IRIS_GL by SGI
- An API to the graphics hardware.
- Designed to take advantage of hardware that is optimized for the display and manipulation of 3D graphics.
- Implemented on many different platforms
- Relatively low level

Basic Rendering

- glBegin(MODE)
  - GL_TRIANGLE, GL_POLYGON, etc.
- Add your elements
  - glAddVertex3f(-1.0, 0.0, -1.0)
  - glAddVertex3f(1.0, 0.0, -1.0)
  - glAddVertex3f(0.0, 1.0, -1.0)
- glEnd()

One time settings

- All settings remain effective until they are overwritten
  - glColor3f(1.0, 1.0, 0.0) → set color to yellow
  - glEnable(GL_DPETH_TEST)
  - glSetClearColor(0.0, 0.0, 0.2) → dark blue bg
  - glEnable(LIGHT0)

The Matrix

- Model/View Matrix
  - Where to position the camera
  - How to aim the camera
  - Where to position the model
  - How to scale/rotate the model
- gluLookAt
- glRotate
- glTranslate
- glScale
- Projection Matrix
  - How to project the 3D image on a 2D screen (Perspective/Orthogonal)
- glOrtho
- glFrustum
- gluPerspective

Code Sample

```
void display()
{
  glClearColor(0.0, 0.0, 0.0, 0.0);
  glClear(GL_COLOR_BUFFER_BIT);
  glColor3f(0.0, 1.0, 0.0);
  glBegin(GL_POLYGON);
    glVertex3f(0.25, 0.25, -0.5);
    glVertex3f(0.75, 0.25, -0.5);
    glVertex3f(0.75, 0.75, -0.5);
    glVertex3f(0.25, 0.75, -0.5);
  glEnd();
  glFlush();
}
```

GLUT

The OpenGL Utility Toolkit

What is GLUT?

- Developed by Mark Kilgard
- Simple, portable, window manager
  - Multiple OpenGL rendering windows and window management commands
  - Callback driven event processing
  - Support for input devices
  - Idle processing and timer events
- Designed for small-medium size application
- GLUT is not open source

GLUT Initialization and Windowing

- glutInit
- glutInitDisplayMode
  - GLUT_RGB
  - GLUT_DOUBLE
  - GLUT_DEPTH
- glutInitWindowSize
- glutInitWindowPossition
- glutCreateWindow
- glutMainLoop

GLUT Callbacks

- glutDisplayFunc
  - `void glutDisplayFunc (void (*func)(void));`
- glutKeyboardFunc
  - `void glutKeyboardFunc (void (*func)(unsigned char key, int x, int y));`
- glutIdleFunc
  - `void glutIdleFunc (void (*func)());`
- glutReshapeFunc
  - `void glutReshapeFunc (void (*func)(int width, int height));`

Code sample

```
int main(int argc, char *argv[])
{
  glutInit(&argc, argv);
  glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
  glutInitWindowSize(250, 250);
  glutInitWindowPosition(100, 100);
  glutCreateWindow("Demo");

  glutDisplayFunc(display);
  glutMainLoop();
  return 0;
}
```

OBJ 3D Image File format

- Created by Alias Wavefront
- Text file
- First character defines line meaning, next characters are the parameters:
  - # - is a comment line
  - v x y z – Vertex located at (x, y, z)
  - f v1 v2 v3 … - Face, Polygon of listed vertices
  - g Name – Group name of faces

OBJ sample

```
# Can anyone guess what object I am?
g Object001
v -0.500000 -0.500000 1.00000
v 0.500000 -0.500000 1.00000
v 0.500000 0.500000 1.00000
v -0.500000 0.500000 1.00000
v 0.500000 -0.500000 0.000000E+00
v -0.500000 -0.500000 0.000000E+00
v -0.500000 0.500000 0.000000E+00
v 0.500000 0.500000 0.000000E+00
f 1 2 3
f 1 3 4
f 5 6 7
f 5 7 8
f 6 1 4
f 6 4 7
f 2 5 8
f 2 8 3
f 6 5 2
f 6 2 1
f 4 3 8
f 4 8 7
```

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- GLUT - The OpenGL Utility Toolkit: http://www.opengl.org/resources/libraries/glut.html
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Assignment 0

- Learn GLUT and OpenGL basics
- Play around with the code - experiment
- Try running it at home – You will need to install GLUT
- The assignment is not graded