



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/cgi_html/index.html
- OpenGL Reference Manual: http://www.parallab.uib.no/SGI_bookshelves/SGI_Developer/books/OpenGL_RM/cgi_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 Akeley, 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
 - glVertex3f(-1.0, 0.0, -1.0)
 - glVertex3f(1.0, 0.0, -1.0)
 - glVertex3f(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_DEPTH_TEST)
 - glClearColor(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
- glutInitWindowPosition
- 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?      f 6 1 4
g Object001                                f 6 4 7
v -0.500000 -0.500000 1.00000             f 2 5 8
v 0.500000 -0.500000 1.00000             f 2 8 3
v 0.500000 0.500000 1.00000             f 6 5 2
v -0.500000 0.500000 1.00000            f 6 2 1
v 0.500000 -0.500000 0.000000E+00       f 4 3 8
v -0.500000 -0.500000 0.000000E+00     f 4 8 7
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
```



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- GLUT - The OpenGL Utility Toolkit: <http://www.opengl.org/resources/libraries/glut.html>
- OBJ References: <http://www.royriggs.com/obj.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
