CS 4731 Lecture 3:
Introduction to OpenGL and GLUT: Part II

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OpenGL Drawing

- OpenGL drawing usually done in display function
- Display function is called once when program starts
- Recall that first, register callback in main( ) function

```
glutDisplayFunc( display );
```

- Then, implement display function

```
void display( void )
 {  // put drawing stuff here
   …….
   glBegin( GL_LINES );
     glVertex3fv( v[0] );
     glVertex3fv( v[1] );
   ……..

   glEnd();
 }
```

Basic Drawing Primitives

- Draw points, lines, polylines, polygons
- Primitives are specified using format:

```
glBegin(primType)

    // define your primitives here

glEnd( )
```

- primType: **GL_POINTS, GL_LINES**, **GL_POLYGON….**

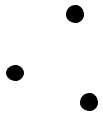
Basic Drawing Primitives: Example

- Example: to draw three dots:

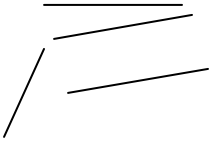
```
glBegin(GL_POINTS)
   glVertex2i(100,50)
   glVertex2i(100,130)
   glVertex2i(150, 130)
glEnd( )
```

glBegin( ) Parameters

glBegin(GL_POINTS)
– draws dots



glBegin(GL_LINES)
– draws lines



glBegin( ) Parameters

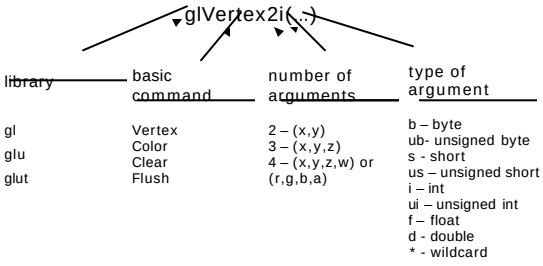
glBegin(GL_LINE_STRIP)
– polylines

glBegin(GL_POLYGON)
– convex filled polygon

glBegin( ) Parameters

- GL_POINTS - dots
- GL_LINES – lines, in pairs
- GL_LINE_STRIP – polylines
- GL_LINE_LOOP – closed loop
- GL_TRIANGLES – triangles, three vertices
- GL_QUADS – quad, four vertices
- GL_POLYGON – convex filled polygon

OpenGL Command Format



Some OpenGL Commands

- **`glVertex2i( )`** – x,y vertex position
- **`glColor3f( )`** – RGB color
- **`glRecti( )`** – aligned rectangled
- **`glClearColor`** – clear color in RGB
- **`glClear( )`** – clears screen
- **`glFlush( )`** – forces image drawing

OpenGL Data Types

C++	OpenGL
Signed char	GLByte
Short	GLShort
Int	GLInt
Float	GLFloat
Double	GLDouble
Unsigned char	GLubyte
Unsigned short	GLushort
Unsigned int	GLuint

Mouse Interaction

- Declare prototype
  - **`myMouse(int button, int state, int x, int y)`**
  - **`myMovedMouse`**
- Register callbacks:
  - **`glutMouseFunc(myMouse):`** when mouse button pressed
  - **`glutMotionFunc(myMovedMouse):`** when mouse moves
- Button returned values:
  - GLUT_LEFT_BUTTON, GLUT_MIDDLE_BUTTON, GLUT_RIGHT_BUTTON
- State returned values:
  - GLUT_UP, GLUT_DOWN
- X,Y returned values:
  - x,y coordinates of mouse location

Keyboard Interaction

- Declare prototype
  - myKeyboard(unsigned int key, int x, int y)
- Register callback:
  - glutKeyboardFunc(myKeyboard): when keyboard is pressed
- Key values:
  - ASCII value of key pressed
- X,Y values:
  - Coordinates of mouse location
- Large **`switch`** statement to check which key

Example: Keyboard Callback

- How to use keyboard to control program?
- 1. register callback in main( ) function

```
glutKeyboardFunc( myKeyboard );
```

- 2. implement keyboard function

```
void myKeyboard(char key, int x, int y )
 {    // put keyboard stuff here
   ……..;
    switch(key){   // check which key
       case 'f':
       // do stuff
       break;

    }
……..……
 }
```

OpenGL State

- OpenGL tracks states
  - Drawing color
  - Point size
- Rendered objects appearance based on current state
- State variable remains active till changed

miniGL: What?

- Object-oriented wrapper in C++
- Allows you choose to either:
  - Call pure OpenGL call or
  - Call your own OpenGL algorithm implementations
- First few projects will use pure openGL option
- Later, you will learn the algorithms and implement some OpenGL calls
- **Google note:** there exists another miniGL, OpenGL port to PDAs

miniGL: How?

- Can run executables (gears, bounce, your code) using two options:
  - **-openGL option simply calls pure OpenGL call**
  - **-cs4731GL option calls your code**
- In beginning, both options are set up to call pure OpenGL call
- Later, you will replace some parts, which are called by –cs4731GL option (*gulp!!*)
- Example:
  - In beginning: -openGL, mgl.mglRotate method calls glRotatlate
  - Later: =cs4731GL, mgl.mglRotate will call home_grown_glRotate

miniGL: How?

- miniGL advantage: debugging, can test same code using both pure calls and your code
- How? When coding your functions, can always use –openGL option to debug
- Design:
  - Encapsulate OpenGL calls in class called minigl
  - Encapsulate GLUT calls in class called miniglut
  - Use instance of minigl class called mgl
  - Use instance of miniglut class called mglut
- Examples:
  - glRotate → mgl.mglRotate
  - glutMouseFunc → mglut.mglutMouseFunc

miniGL: Who?

- miniGL written initially by Mark Stevens
- Stevens, previously CS professor, taught this class before
- miniGL extended by Emmanuel Agu
- Some students (Paul Tessier, Tony Andrade, etc) submitted bug fixes, corrections, etc
- miniGL mostly stable, been used in this course 3 or 4 previous times

Homework 1

- On class website
- Goal: to get you going, work out platform issues!!
- Get OpenGL and GLUT
- Set up your programming environment
- Compile miniGL code
- Examples:
  - Read sections of Hill book
  - Convert examples to miniGL format
  - Derive new HW1 class (from cs4731app class)
  - Modify miniGL draw function
  - Type in missing function(s)
  - Compile and run

Homework 1

- If you called OpenGL calls directly, it would work
- Don't make openGL calls directly
- Always make call to miniGL
- For example:
  - Do: mgl.mglBegin(minigl::MGL_QUADS)
  - Don't: glBegin(GL_QUADS)
- miniGL calls either call openGL calls or cs4731app (your home-grown functions).
- Due on Friday, Sept. 5, 2003

References

- Hill, chapter 2