

CMSC 435
Introductory Computer Graphics
A Bit of OpenGL

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OpenGL

- Software interface to graphics hardware
 - Interactive, 3D
 - Platform independent
- Primitives: points, lines, polygons
- Additional libraries
 - GLU: higher-level primitives
 - GLUT: windowing
- Persistent state

Draw a Square

```
main(){
    InitializeAWindowPlease();
    glClearColor(0.0,0.0,0.0,0.0);
    glClear(GL_COLOR_BUFFER_BIT);
    glColor3f(1.0, 1.0, 1.0);
    glOrtho(0.0, 1.0, 0.0, -1.0, 1.0);
    glBegin(GL_POLYGON);
        glVertex3f(0.25, 0.25, 0.0);
        glVertex3f(0.75, 0.25, 0.0);
        glVertex3f(0.75, 0.75, 0.0);
        glVertex3f(0.25, 0.75, 0.0);
    glEnd();
    glFlush();
    UpdateTheWindowAndCheckForEvents();
}
```

GLUT (OpenGL Utility Toolkit)

- Initializing a window
 - glutInit(int *argc, char **argv)
 - Init system, pass args to window system
 - glutInitDisplayMode (unsigned int mode)
 - Color and buffering mode
 - glutInitWindowPosition (int x, int y)
 - Specifies position of upper-left corner
 - glutInitWindowSize (int width, int height)
 - Specifies window size in pixels
 - glutCreateWindow (char *string)
 - Creates window, returns id

GLUT (cont)

- Display Callback
 - glutDisplayFunc(void (*func))
 - Draw window contents
 - Can trigger with glutPostRedisplay(void)
- Run the Program
 - glutMainLoop(void)
 - Begin event processing

GLUT (cont)

- Handling input events
 - glutReshapeFunc(void (*func)(int w, int h))
 - Action on resize window
 - glutKeyboardFunc (void (*func)(unsigned char key, int x, int y))
 - Action on key press
 - glutMouseFunc (void (*func)(unsigned char button, int x, int y))
 - Action on mouse button click
 - glutMotionFunc (void (*func)(int x, int y))
 - Action on mouse drag

Main Driver

```
int main(int argc, char *argv[]) {
    /* initialize GLUT */
    glutInit(&argc, argv);
    glutInitWindowPosition(0, 0);
    glutInitWindowSize(winWidth, winHeight);
    glutInitDisplayMode(GLUT_RGB | GLUT_DOUBLE);
    glutCreateWindow("Viewing: P3");

    /* set callback functions */
    glutDisplayFunc(draw);
    glutReshapeFunc(reshape);
    glutKeyboardFunc(key);
    glutMouseFunc(mouse);

    /* let glut take over */
    glutMainLoop();
    return 0;}

```

Rendering Modes

- Immediate Mode
 - Primitives displayed as soon as called
- Display Lists
 - List compiled to store model (save work)
 - Basic structure

```
glNewList (id, GL_COMPILE);
... Commands ...
glEndList ();
... later ...
glCallList (id);
```

Coordinate System Transforms

- Two matrices control viewing
 - `glMatrixMode (GL_MODELVIEW)`
 - `glMatrixMode (GL_PROJECTION)`
- Basic steps to set matrix
 - Identify matrix -- `glMatrixMode (mode)`
 - Set to identity -- `glLoadIdentity()`
 - Alter to desired matrix
 - `glFrustum(l,r,b,t,n,f)`
 - `glTranslate (x,y,z)`
 - `glRotate (degrees, axis_x, axis_y, axis_z)`
 - `glMultMatrix (matrix)`
 - `glLoadMatrix (matrix)`
 - `glPushMatrix(), glPopMatrix()`